Selection and Implementation of Alternatives Report

Combined Sewer Management Permit Compliance

City of Elizabeth
Union County, NJ

50 Winfield Scott Plaza
Elizabeth, NJ 07201

NJPDES Permit No. NJ0108782

Joint Meeting of Essex and Union Counties
Union County, NJ

500 South First Street
Elizabeth, NJ 07202

NJPDES Permit No. NJ0024741

Combined Sewer Overflow Long Term Control Program

October 2020

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Combined Sewer Overflow Long Term Control Program
Selection and Implementation of Alternatives Report

Submitted by the following participating Permittee

City of Elizabeth
NJPDES Permit No. NJ0108782

Certification:

"Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted; or (b) as part of a cooperative effort by members of a hydraulically connected system, as is required under the NJPDES Permit, to provide the information requested. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information."

Permittee: ______________________________ 9/25/2020
Daniel J. Loomis, P.E. Date
City Engineer, City of Elizabeth

Combined Sewer Overflow Long Term Control Program
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Joint Meeting of Essex and Union Counties
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Permittee: ______________________________ 9/25/20

Hanifa Z. Johnson — Date
Executive Director, Joint Meeting of Essex and Union Counties

Executive Summary

Introduction

The City of Elizabeth (City) and the Joint Meeting of Essex and Union Counties (JMEUC or Joint Meeting) are submitting this document to meet certain conditions of the New Jersey Pollutant Discharge Elimination System (NJPDES) individual permit for Combined Sewer Overflow (CSO) control. In the current NJPDES individual permits, the New Jersey Department of Environmental Protection (NJDEP) has mandated that permittees prepare a CSO Long Term Control Plan (LTCP). The permit conditions closely reflect the requirements of the National CSO Control Policy established by the United States Environmental Protection Agency (EPA).

This Selection and Implementation of Alternatives Report (SIAR) has been prepared by the City and JMEUC in fulfillment of the requirements under Part IV, Combined Sewer Management, Section D.3, G.2 and G.5 through G.9 of the City's NJPDES Permit No. NJ0108782 and JMEUC's NJPDES Permit No. NJ0024741. This submission fulfills the permit requirements for the selection of a practical and technically feasible Long Term Control Plan, documenting the process used to select a control program to cost-effectively meet the water quality-based requirements of the Clean Water Act. The proposed control program has been developed by the City and JMEUC, in consultation with NJDEP and the public, to meet the regulatory requirements with a reasonable and sustainable expenditure of public funds. This report presents the selected LTCP alternatives, and the corresponding implementation schedule and financial capability analysis. (See Section 1 for additional information on the regulatory background and reports completed by the City and JMEUC under the LTCP process.)

System Description

The JMEUC owns and operates a wastewater treatment facility which treats wastewater collected in a 65 square mile service area in northern New Jersey, which includes the City of Elizabeth as a customer community. The JMEUC service area is primarily comprised of separately sewered areas, with the only confirmed combined sewer area in the system being located within the City of Elizabeth. The City of Elizabeth provides wastewater and stormwater collection and conveyance services to about 128,600 people within its municipal boundaries, which encompasses approximately 12.3 square miles in Union County, NJ. This collection and conveyance system consists of an extensive network of intercepting sewers, sewer mains, manholes, catch basins, pump stations, overflow control facilities, and drainage channels. The City of Elizabeth does not own or operate any wastewater treatment plant facilities; wastewater flows are conveyed to the JMEUC wastewater treatment facility (WWTF).

The hydraulically connected system under this permit is defined as including the JMEUC WWTF and all the municipal separate sanitary and combined sewers that discharge to the JMEUC intercepting sewers. The connected system also includes the combined sewer outfalls, netting facilities and other structures on the outfalls downstream of the regulators. All dry weather sewage from the City owned sewer system is conveyed to and treated at the JMEUC WWTF. During wet weather conditions, a certain amount of combined sewage is conveyed through the City interceptors to the Trenton Avenue Pump Station and pumped to the JMEUC WWTF for treatment. Excess flows are discharged at the City's 29 CSO discharge points (outfalls), with the following number of outfalls by receiving waterbody:

- 4 CSO outfalls discharge to Newark Bay (2 via the Great Ditch, 1 via the Peripheral Ditch, and 1 directly to the bay);
- 4 CSO outfalls discharge to the Arthur Kill; and
- 21 CSO outfalls discharge to the Elizabeth River.

(See Section 2 for additional information on the sewer system description.)

Baseline System Performance

A hydrologic and hydraulic (H&H) computer model of the sewer system was created collaboratively by the City and JMEUC. This model serves as the basic tool for evaluating alternatives and demonstrating compliance with certain regulatory criteria for combined sewer overflow control. The H&H model was used to simulate the hydraulic performance, including overflow statistics, under the existing sewer system configuration and to evaluate the predicted performance under a range of CSO control alternatives. The 2004 precipitation data set available for the Newark Liberty International Airport weather station was selected by a regional consortium of CSO permittees (known as the NJ CSO Group, which includes both the City and JMEUC) as representative of typical annual conditions and was utilized in this LTCP as the Typical Year (see Section 3.3).

Since the previous permit-required report submission in June 2019, evaluation and updates have been made to the original LTCP model (the System Characterization Model) to reflect the latest data available as well as current system understanding. All data and updates were carefully examined to determine the effect on total CSO volume. Special attention was given to stormwater systems and their connections to combined sewer conduits. The Updated Model estimates the total overflow volume discharged annually from the existing combined sewer regulators on a system-wide basis as 866 million gallons (MG), which is a reduction of 202 MG from the value in the previous report. However, the volume flowing into the regulators during wet weather conditions also decreased, which results in a lower baseline percent capture performance level. (Percent capture refers to the percentage of wet weather combined sewer flow captured for treatment during the Typical Year; see Section 3.4.)

The regulations have established a minimum percent capture of wet weather inflow volume as a target CSO control that may be evaluated and selected by permittees. Percent capture can be calculated based on either (1) the total flow in the full JMEUC system (i.e. JMEUC's entire service area), or (2) the flow in only the Elizabeth sewer system. Calculations have been made and reported in this LTCP using both methods. The percent capture changes in the baseline condition resulting from updating of the model are presented in the following table.

Table 1: Updates to Existing System-Wide Percent Capture Calculation

Percent Capture: System Characterization Model		Percent Capture: Updated Model	
Elizabeth system only	**Full JMEUC system**	**Elizabeth system only**	**Full JMEUC system**
66.5%	83.1%	58.3%	81.0%

When evaluating the combined sewer system performance under future baseline conditions, population projections through Year 2050 were evaluated and base sanitary flows to the system were increased accordingly (see Section 3.6). Under the future baseline conditions, a total overflow volume of 898 MG annually system-wide is estimated. The maximum number of overflow events increases under the 2050 condition from 54 to 55 events per year. The performance of proposed CSO control alternatives were modeled with the future base sanitary flow conditions as an input. (See Section 3 for additional information on baseline sewer system performance.)

Water Quality Objectives

In order to improve the water quality of the receiving waters, the primary objectives of this CSO LTCP are the reduction of pathogens and CSO volume. Under the New Jersey Surface Water Quality Standards (SWQS), the Arthur Kill and Newark Bay are classified by NJDEP as saline estuary waters designated use class 3 (SE3). The Elizabeth River is divided into two reaches for SWQS classification, based on salinity content. The lower reach, from the Broad Street bridge to the mouth, is classified as saline estuary SE3 and the upper reach of the Elizabeth River, from the source to the Broad Street bridge, is classified as freshwater category 2, non-trout supporting (FW2-NT).

Because many of the waterbodies impacted by CSO discharges from the NJ CSO Group sewer systems are common, water quality objectives and analysis of CSO impacts have been coordinated by this consortium. A pathogen water quality model was developed collaboratively, led by the Passaic Valley Sewerage Commission (PVSC), to characterize the impact of CSO discharges on existing water quality impairment and the corresponding level of CSO control necessary for the attainment of current water quality standards. The overall findings from this model relevant to the City of Elizabeth and JMEUC are that FW2 waters (upper Elizabeth River) currently have poor attainment of the pathogen water quality criteria, and complete elimination of the combined sewer overflow discharges will not improve attainment of the criteria because of the high pathogen levels from the incoming river flow and from other dry weather sources. On the other hand, the SE3 waters (Newark Bay, Arthur Kill, and the Lower Elizabeth River) are noted as fully attaining the pathogen water quality criteria under the current baseline conditions (i.e. with no CSO control). It was further determined that there are no sensitive areas or exceptional water quality elements or uses for the subject receiving waters that would distinguish any CSO outfall discharge area as being more critical or sensitive than other discharge areas.

In selecting the CSO control approach for the City of Elizabeth and JMEUC, the aim is to provide the greatest water quality benefits to the receiving waters for a reasonable expenditure of publicly available funds. The City and JMEUC have selected the Presumption Approach with the criterion of eliminating or capturing for treatment no less than 85% by volume of the wet weather combined sewer flow during the Typical Year as the basis for permit compliance and the selection of LTCP alternatives. This CSO control objective results in a cost effective LTCP that best balances protection of the local water quality conditions with financial and other impacts on the community. (See Section 4 for details on the water quality objectives.)

Development and Evaluation of Alternatives

A two-tiered approach was applied to the development of CSO control alternatives for the City of Elizabeth and JMEUC, starting with a screening analysis of a wide range of alternatives, followed by an evaluation of the remaining CSO control alternatives. The intent was to give adequate consideration to the full breadth of alternatives available, but to limit the list of alternatives evaluated in detail to only those most promising approaches. The long-list of CSO control alternatives screened was based on the CSO control alternatives listed in Part IV.G.4.e of the NJPDES CSO Permit. The detailed evaluation is provided in the previously submitted and approved Development and Evaluation of Alternatives Report, revision date October 2019.

The CSO control technologies screened as potentially viable were formulated into control programs and evaluated. The control programs include strategies for each CSO basin as well as alternatives for system-wide improvements. The seven (7) CSO control programs evaluated were:

1. Complete sewer separation
2. Satellite CSO treatment facilities
3. Pump station and sewage treatment plant (STP) expansion
4. Satellite storage facilities
5. Tunnel storage and secondary controls
6. Green infrastructure
7. Infiltration/Inflow (I/I) reduction

The CSO control alternatives were analyzed for their practical and technical feasibility, community and environmental justice impacts, and performance capabilities under future conditions. They were each evaluated for a range of control levels, including number of annual overflows ranging from zero to 20, phased pumping upgrades, and percent impervious area managed by green infrastructure. Costs were determined both as present worth and cost per annual gallon of CSO volume abated (during the Typical Year). The majority of the alternatives evaluated were found to be well beyond the financial capacity of the community for the overflow frequency metrics considered. However, it was determined that increased conveyance and treatment is an appropriate and cost-effective primary control measure for reasonably attainable water quality pollution reduction benefits. (See Section 5 for additional information on the evaluation of alternatives.)

Public Participation

Public participation is an important component of the LTCP development process, and the City and JMEUC have endeavored to provide opportunities for public education and awareness, as well as to gain feedback on the CSO control alternatives.

Since the submission of the Development and Evaluation of Alternatives Report in June 2019, the following public outreach activities have been completed:

- Public Meeting #1 / Supplemental CSO Team Meeting #9: This meeting, convened on January 23, 2020 presented an overview of the LTCP process, a recap of the public participation process, a summary of the alternatives evaluation, and discussion on program affordability. Comments from attendees were regarding cost per household and a discussion of how to increase attendance at meetings and increase community engagement.
- Outreach During COVID-19: Due to limitations on gatherings related to the ongoing COVID-19 pandemic, an email update was sent to the Supplemental CSO Team in early May 2020 to provide information on recent developments for the LTCP. Two presentation packages on “CSO Basics” and “CSO Solutions” were also provided for circulation to the Supplemental CSO Team members’ constituents. These presentations were also posted on the City’s website.
- Public Meeting #2 / Supplemental CSO Team Meeting #10: This meeting, held on August 26, 2020, was convened to present and obtain feedback from the public on the tentatively selected CSO control program. The meeting presented an overview of the LTCP process, as well as a recap of the public participation process, a summary of the alternatives evaluation, the recommended CSO control program, program affordability, and CSO program implementation schedule. Due to the COVID-19 pandemic, this meeting was conducted online using the Zoom platform. Comments were on whether the CSO LTCP was related to the JMEUC storm surge construction project, and further clarification of the blending application at the WWTF.
- A presentation was made to City Council on November 6, 2019 to review the alternatives evaluated and the plan selection process.
- Community Events: Continued collaboration with local community groups, such as Future City Inc. and Groundwork Elizabeth, and participated in public education events, both in person, and online during COVID-19.
- Regional Partnerships: Ongoing participation in the regional NJ CSO Group, coordination with NJDEP, and partnership with Hudson River Foundation and EPA on a case study using the Climate Resilience Evaluation and Awareness Tool (CREAT) to assess the City’s combined sewer system vulnerability to climate change.
- Continuation of other public outreach efforts such as maintenance of educational signage on green infrastructure installations, online CSO notification system, information on website and public notices.

Throughout the development of the LTCP, the City and JMEUC have communicated key CSO control program information to the Supplemental CSO team and the general public, enabled stakeholders to provide feedback and input on the program, and fulfilled the public information and notification requirements of the NJPDES CSO permit. The feedback received from the stakeholders has mostly involved the extensive costs for the CSO control measures, the financial burden associated with the potential program costs, federal and State grant funding needs, incorporating street flooding mitigation projects, and simplifying the technical content of presentations. This public participation feedback has been considered by the permittees and addressed in the plan selection process to the extent possible. (See Section 6 and Appendix A for additional information.)

Selected CSO Control Plan

The selected plan involves a combination of different CSO control strategies, including sewer separation, off-line storage tanks, and green infrastructure, however maximizing conveyance to the existing wastewater treatment facilities and providing additional conveyance and treatment capacity is the primary strategy for CSO volume reduction. The recommended plan is technically feasible, effective in meeting the control goals, cost-effective, and suitable to the community by mitigating difficult siting challenges and disruptive construction work. The components of the selected plan are outlined as follows:

a. Current and planned stormwater control projects
b. Increased conveyance from existing Trenton Avenue Pumping Station
c. New wet weather pumping station and force main to JMEUC
d. Regulator modifications and interceptor improvements for additional wet weather conveyance
e. New combined sewer flow treatment facility at the JMEUC WWTF
f. Selected sewer separation projects
g. Green infrastructure pilot program

The list of projects for the CSO LTCP is provided in the table below.

Table 2: CSO LTCP Project List

Project No.	Project Name	Project Type
-	Progress Street Stormwater Control Project	Completed stormwater control
-	Trumbull Street Stormwater Control Project	Completed stormwater control
-	South Street Flood Control Project	Ongoing stormwater control
1	South Second Street Stormwater Control	Current/planned stormwater control
2	Lincoln Avenue Stormwater Drainage Improvements	Current/planned stormwater control
3	Trenton Avenue Pumping Station - Phase 1 Upgrade	Increased conveyance from TAPS
4	Basin 012 Sewer Separation	Select sewer separation
5	Atlantic Street CSO Storage Facility	Current/planned stormwater control
6	Park Avenue Stormwater Control	Current/planned stormwater control
7	Green Infrastructure Pilot Program	Green infrastructure pilot program
8	Trenton Avenue Pumping Station - Phase 2 Upgrade	Increased conveyance from TAPS
9	Basin 037 Sewer Separation	Select sewer separation

Project No.	Project Name	Project Type
10	Easterly Interceptor Improvements	Regulator modifications and interceptor improvements for additional conveyance
11	New Wet Weather Pump Station Force Main to JMEUC	New wet weather pump station and force main
12	New Wet Weather Pump Station	New wet weather pump station and force main
13	New CSO WWTF	New combined sewer flow treatment facility
14	Bridge Street Siphon Upgrade	Regulator modifications and interceptor improvements for additional conveyance
15	Palmer Street Branch Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
16	Palmer Street Siphon Upgrade	Regulator modifications and interceptor improvements for additional conveyance
17	Lower Westerly Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
18	Pearl Street Branch Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
19	R027/028 Regulator Modifications	Regulator modifications and interceptor improvements for additional conveyance
20	R040 Regulator Modifications	Regulator modifications and interceptor improvements for additional conveyance
21	Upper Westerly Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
22	Morris Avenue Siphon Upgrade	Regulator modifications and interceptor improvements for additional conveyance

The hydraulic model was updated to include the CSO LTCP component projects described above, and the corresponding percent capture is presented in the table below. The Presumption Approach requirement for a minimum of 85% by volume of the combined sewage collected in the sewer system during wet weather events is achieved with the proposed CSO Control Program. The greatest reduction in CSO overflow volumes is in the upper Elizabeth River.

Table 3: System-Wide Percent Capture After Plan Implementation

Item	Elizabeth system only, TAPS	Full JMEUC system
Total Wet Weather Flow (MG)	2,154	4,550
Wet Weather Flow Captured (MG)	1,832	4,228
CSO Volume (MG)	322	322
Percent Capture	85.1 %	92.9 %

Capital and operation and maintenance (O&M) cost estimates were prepared, accounting for the proposed control plan components except the already completed local stormwater projects. The estimated capital costs in current (2020) dollars are presented in Table 4.

Table 4: CSO Control Plan Capital Cost Estimate

Project Name	Capital Cost (2020 $)
South Second Street Stormwater Control	$ 2,810,000
Atlantic Street CSO Storage Facility	$ 8,210,000
Lincoln Avenue Stormwater Drainage Improvements	$ 2,820,000
Park Avenue Stormwater Control	$ 8,580,000
Basin 012 Sewer Separation	$ 270,000
Basin 037 Sewer Separation	$ 4,590,000
Green Infrastructure Pilot Program	$ 1,280,000
Trenton Avenue Pumping Station - Phase 1 Upgrade	$ 610,000
Trenton Avenue Pumping Station - Phase 2 Upgrade	$ 9,250,000
New Wet Weather Pump Station	$ 41,370,000
New Wet Weather Pump Station Force Main to JMEUC	$ 11,930,000
New CSO WWTF	$ 20,890,000
Easterly Interceptor Upgrade	$ 2,530,000
Bridge Street Siphon Upgrade	$ 2,630,000
Lower Westerly Interceptor Improvements	$ 36,210,000
Palmer Street Branch Interceptor Upgrade	$ 4,280,000
Palmer Street Siphon Upgrade	$ 2,530,000
Pearl Street Branch Interceptor Upgrade	$ 5,480,000
R027/028 Regulator Modifications	$ 500,000
R040 Regulator Modifications	$ 500,000
Upper Westerly Interceptor Improvements	$ 21,510,000
Morris Avenue Siphon Upgrade	$ 2,140,000
Total	**$ 190,920,000**

(Section 7 presents additional information about the evaluation and selection of the projects shown in Table 4 above, and Appendix B provides additional detail on the cost estimates.)

Financial Capability

A financial capability assessment was prepared to evaluate the ability of the City of Elizabeth and its sewer system ratepayers to support the future investments required for the proposed CSO control program. The objective was to balance the schedule for the LTCP implementation with the financial and economic capability of the permittees and ratepayers.

The methodology for this analysis was based primarily on EPA guidance which recommends a two-phase approach to develop: (1) a Residential Indicator; and (2) Financial Capability Indicators. These indicators are then entered into a financial capability matrix to obtain an overall financial burden assessment. A total sewer system residential cost share exceeding 2% of median household income (MHI) is considered to be a high financial burden on a community. Permittees are also encouraged to provide any additional information that would provide insight into any unique or atypical circumstances, to ensure that a full understanding of the financial capability guides the development of the implementation schedule.

A dynamic financial model was developed in order to account for time-variable factors and provide a more accurate representation of the City's sewer cost affordability. In order to determine the percentage of MHI resulting from the proposed CSO control program, the factors considered included: current annual sewer system costs and debt service, median household income, population, residential share of total flows, escalation of existing sewer system costs, income growth rates, construction cost inflation, bond rating, unemployment rate, and property tax revenues. Additional economic factors such as poverty rate, income distribution and disproportionate impact on lower income households, community distress score and cost of living were also evaluated.

The cost of the proposed CSO LTCP projects as well as the consideration of the affordability factors listed above indicated that the LTCP represents a High Burden on the City of Elizabeth residential sewer users, exceeding the threshold of 2% of MHI. The City and JMEUC recognize the financing program for the LTCP must be planned so as to maintain reasonable sewer charges and rates and a supportable total debt amount. As such, an implementation schedule of 40 years is proposed. (Section 8 and Appendix C present additional information about the financial capability assessment used to establish this schedule.)

Implementation Schedule

The project costs associated with the Long Term Control Plan present a high financial burden to the local residential sewer users. With the recommended 40-year implementation schedule, the sewer charges and total sewer utility debts for the City of Elizabeth are controlled so that the program is more affordable and the annual cost burden on rate payers is reduced.

The City and JMEUC have prioritized the selected projects identified to be highly effective in reducing combined sewer overflows and have scheduled them for early implementation. The sequence and phasing of the recommended CSO control projects was developed based on the time required to complete each project, water quality goals, regulatory considerations, typical construction sequencing practices, and the findings of the affordability analysis. The duration for each project was estimated based on factors including the time to complete the design, bidding and construction phases, acquisition of property or easements where required, regulatory/permit requirements, traffic and neighborhood impacts, and maintenance of sewer service throughout construction. The proposed project sequencing is as follows:

Table 5: CSO LTCP Project Sequencing Plan

Project Name	Start Year (after approval)	Estimated Project Duration
Progress Street Stormwater Control Project	Completed	Completed
Trumbull Street Stormwater Control Project	Completed	Completed
South Street Flood Control Project	Ongoing	Ongoing
South Second Street Stormwater Control	1	4
Lincoln Avenue Stormwater Drainage Improvements	1	3
Trenton Avenue Pumping Station - Phase 1 Upgrade	1	2
Atlantic Street CSO Storage Facility	1	5
Park Avenue Stormwater Control	1	5
CSO Basin 012 Sewer Separation	2	2
Green Infrastructure Pilot Program	2	7
Trenton Avenue Pumping Station - Phase 2 Upgrade	4	7
CSO Basin 037 Sewer Separation	5	6
Easterly Interceptor Upgrade	6	5

Project Name	Start Year (after approval)	Estimated Project Duration
New Wet Weather Pumping Station Force Main to JMEUC	9	9
New Wet Weather Pumping Station	11	10
New Combined Sewer Flow Treatment Facility at JMEUC	12	9
Bridge Street Siphon Upgrade	16	7
Palmer Street Branch Interceptor Upgrade	16	7
Palmer Street Siphon Upgrade	16	7
Lower Westerly Interceptor Improvements	21	10
Pearl Street Branch Interceptor Upgrade	23	7
R027/028 Regulator Modifications	27	4
R040 Regulator Modifications	27	4
Upper Westerly Interceptor Improvements	31	10
Morris Avenue Siphon Upgrade	31	7

This corresponds to an annual capital spending plan indicated in Figure 1, in which the total cumulative capital outlay is $191 million over the 40-year implementation schedule.

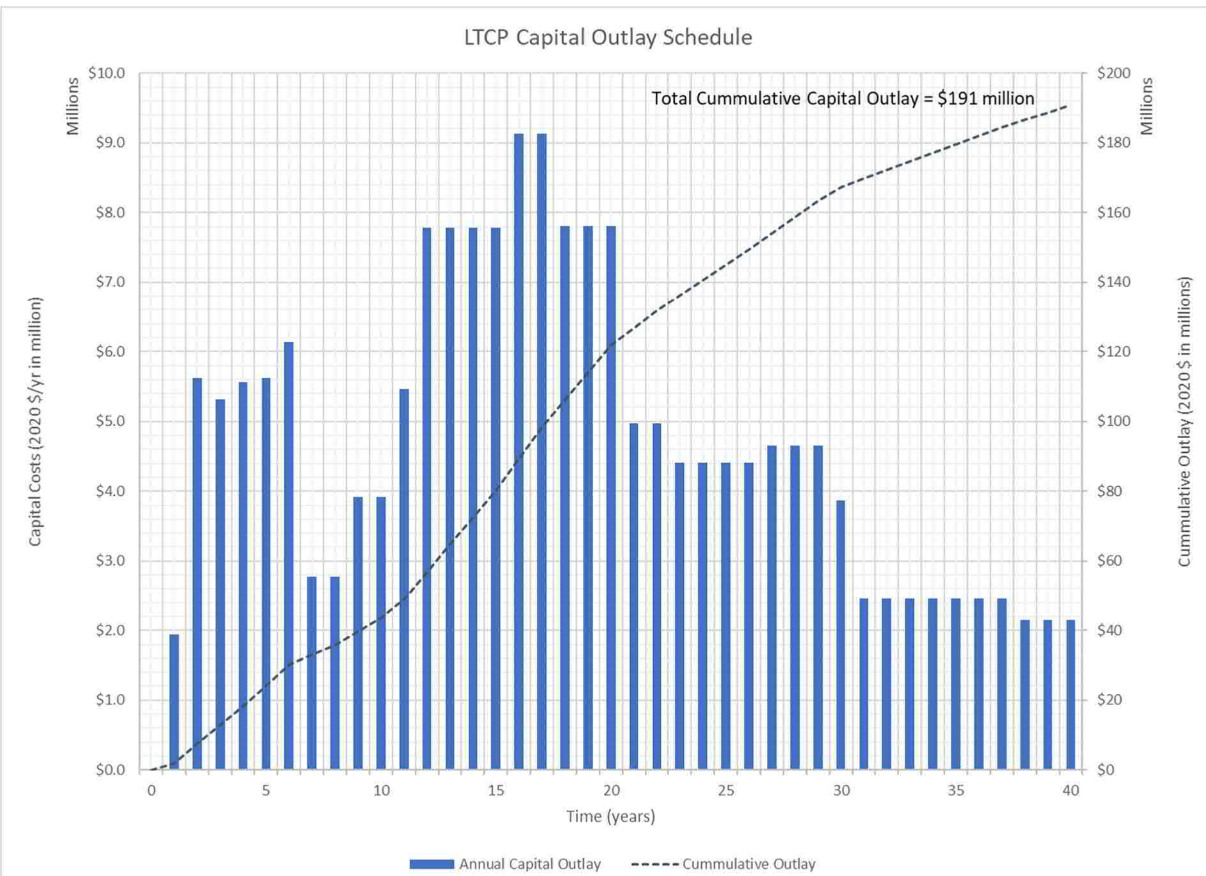


Figure 1: CSO LTCP Capital Outlay Schedule

An analysis was completed to assess the potential year-by-year sewer rate impacts associated with the implementation of the LTCP, based on the proposed project implementation schedule. The projected average monthly residential sewer bill, both with the existing sewer program and with proposed LTCP costs included, is presented in Figure 2.

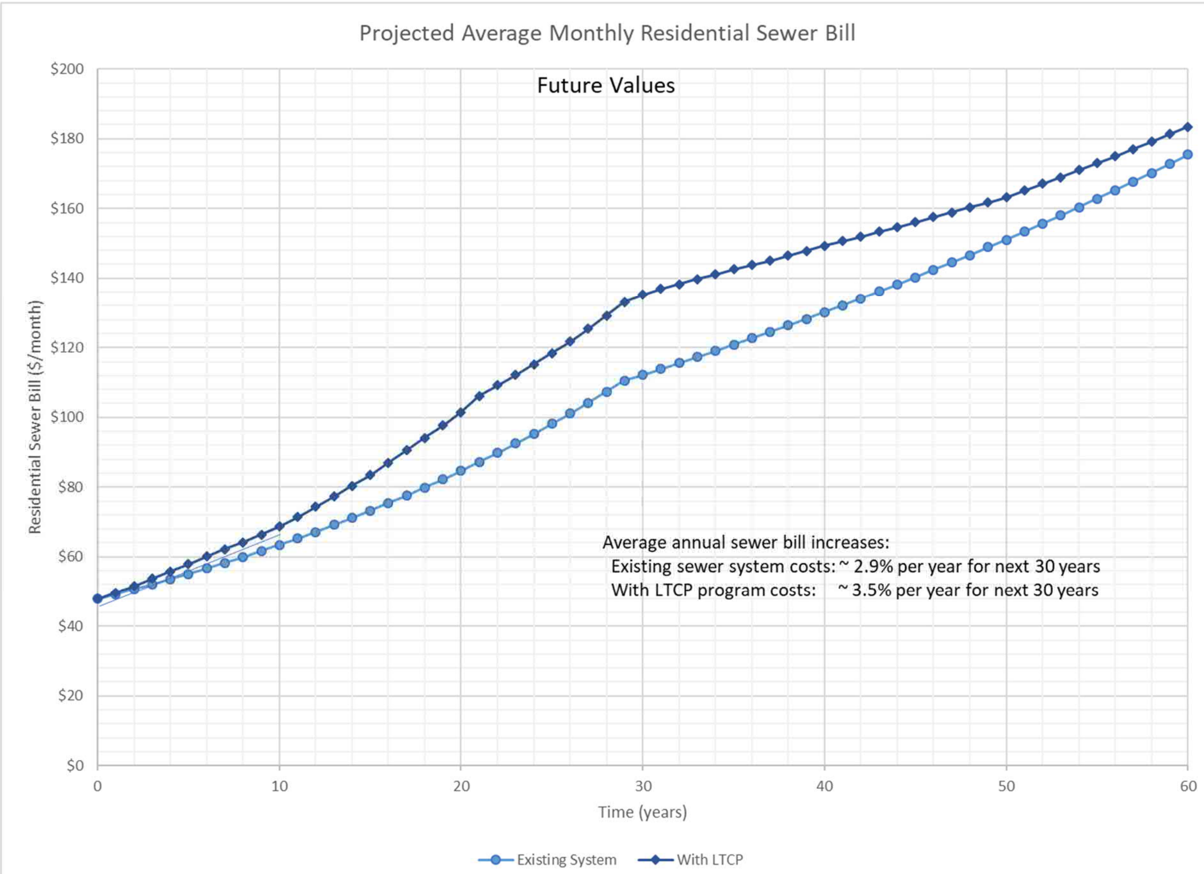


Figure 2: Projected Average Monthly Residential Sewer Bill

The City of Elizabeth and JMEUC anticipate that the capital costs for the Long Term Control Plan projects would be financed primarily through low interest loans from the New Jersey Water Bank (formerly the New Jersey Environmental Infrastructure Financing Program). These loans would be serviced by revenues generated from sewer user charges. It is noted that the proposed 40-year implementation schedule is predicated on sufficient funding being available through the New Jersey Water Bank at the time required so that the funding required to design and construct the projects can be obtained.

Furthermore, the City and JMEUC intend to implement the components of the CSO LTCP using an adaptive management approach to ensure that the decision-making process and investments are in line with changes in the financial environment, control technologies, water quality conditions and local support that may evolve over time. As additional data is obtained through activities such as flow monitoring, water quality monitoring, asset management analyses, and technology evaluations, this information will be used to refine future project planning, design, and implementation steps. Factors that could influence the implementation schedule include easements and land acquisition, permitting, public acceptance, environment and climate change, and financial conditions.

For example, the COVID-19 pandemic may have impacts on the affordability of the CSO LTCP, including potentially reduced sewer utility revenues, cost increases, unplanned expenses, reduced household incomes, and other factors. The projections and conclusions concerning the affordability of the CSO control program proposed in this Selection and Implementation of Alternatives Report are premised on the baseline financial conditions of the City as well as the economic conditions in New Jersey and the United States generally at the time that work on the report commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues and household incomes.

Given the current and likely continuing uncertainties in New Jersey and national economic conditions, the City and JMEUC will be reluctant to commit to long term capital expenditures for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this report based on emergent economic conditions beyond the permittees' control. Considering the adaptive management practices noted above, a suitable approach to address likely financial challenges would be to develop a schedule for incremental improvements, and then revisit these improvements as financial conditions change or as new control technologies emerge.

Moreover, in September 2020, the United States Environmental Protection Agency (EPA) announced its proposed 2020 Financial Capability Assessment guidance document, describing changes to the existing assessment to include additional considerations for economically disadvantaged communities. This new EPA guidance is still under review and not yet final, however it is recognized that these updates may impact the affordability analysis, and in turn the LTCP implementation schedule presented. As such, elements of the LTCP may be revised in the future to incorporate the EPA's proposed approach and resubmitted to NJDEP for review and approval.

Although a complete implementation schedule is being proposed as part of this LTCP, based on the factors noted above, a revised affordability assessment should be performed during review of the next NJPDES permit to re-evaluate and validate financial capability and to identify any revisions to the proposed controls that may or may not be financially feasible during that next permit period.

Section 9 presents additional information about the proposed LTCP implementation schedule.

Operational Plan

As the proposed CSO control facilities are implemented, the City and JMEUC will expand and update their corresponding Operations and Maintenance Program and Manual accordingly as part of the LTCP operational plan. The City and JMEUC will continue to review the O&M Program and Manual on an annual basis and make updates to reflect any additional operations and maintenance requirements for new system assets. Training will be provided where necessary, to ensure that staff are able to operate any new CSO control assets.

Post Construction Compliance Monitoring

The objective of the Post Construction Compliance Monitoring Program (PCCMP) is to compare findings from the baseline monitoring program to system performance during and after LTCP implementation. The key elements of the proposed PCCMP are:

- Ambient water quality monitoring and modeling to measure and assess the water quality impacts of CSOs on receiving streams. The City of Elizabeth and JMEUC will continue to participate in regional collaboration as part of the NJ CSO Group to monitor ambient water quality during implementation of the LTCP.

- Combined sewer overflow performance, including discharge frequency, duration, and volume statistics, will be evaluated using the approved hydrologic and hydraulic model for the Typical Year. Additional sewer flow monitoring and precipitation data will be collected in the future, after the implementation of major CSO control projects to update the hydraulic model so that a properly calibrated and validated model representing the actual sewer system configuration is available for compliance evaluations and reporting. The data collection and modeling updates will be performed following a Quality Assurance Project Plan (QAPP), which will be submitted to NJDEP for approval if and as required under NJPDES permit renewal conditions.
- Reporting of progress to regulatory agencies and the public, including the anticipated submission of periodic progress reports and monthly discharge monitoring reports to the New Jersey Department of Environmental Protection. Compliance monitoring data and analysis will be documented in reports prepared in compliance with approved QAPPs, with periodic updates included in progress reports as required under the NJPDES permit renewals.

Adaptive management will be a key element in the successful implementation of the selected CSO control projects. A flexible approach to implementation will be employed that involves testing, monitoring, public feedback, and open communication channels with stakeholders. Based on the information gathered, the implementation plan will be regularly re-evaluated as part of each permit cycle, and components will be adapted and updated as necessary. It is anticipated that this adaptive management approach will allow the City and JMEUC to achieve the required CSO control volume reductions under an affordable and sustainable program with broad stakeholder support.

Section 1
Introduction

1.1 Background

The City of Elizabeth (City) and the Joint Meeting of Essex and Union Counties (JMEUC or Joint Meeting) are submitting this document to meet certain conditions of the New Jersey Pollutant Discharge Elimination System (NJPDES) individual permit actions issued by the New Jersey Department of Environmental Protection (NJDEP) for Combined Sewer Overflow (CSO) control, referred herein as the NJPDES CSO Permits. As permittees of a hydraulically connected system, the City and JMEUC have cooperated and collaborated on the development of this Long Term Control Plan (LTCP) for CSO control per the permit conditions and are jointly submitting this report for permit compliance. The City and JMEUC are collectively referred herein as the Permittees.

In 2015, the New Jersey Department of Environmental Protection revoked prior authorizations related to combined sewer overflows under NJPDES Master General Permit No. NJ0105023 and issued individual permits to municipalities, authorities, and other entities that own or operate facilities controlling, transporting, or treating wastewater flows from combined sewer systems. Discharges from the City of Elizabeth's 29 designated CSO outfalls are authorized and regulated under NJPDES Permit No. NJ0108782. While the Joint Meeting does not own or operate CSO control facilities or outfalls, the downstream portion of the JMEUC trunk sewer system receives and conveys combined sewage from the City and the systems are hydraulically connected. As such, the NJDEP revoked and reissued the JMEUC individual Category "A" Permit No. NJ0024741 to incorporate the NJPDES CSO Permit requirements as part of the recent permit actions.

This Selection and Implementation of Alternatives Report (SIAR) has been compiled by the City and JMEUC in fulfillment of the requirements under Part IV Section D.3, G.2 and G.5 through G.9 of the City's NJPDES Permit No. NJ0108782 and JMEUC's NJPDES Permit No. NJ0024741. This submission fulfills the permit requirements for selection of a practical and technically feasible Long Term Control Plan. This report documents the process used to select a control program to cost-effectively meet the water quality-based requirements of the Clean Water Act. The proposed control program has been developed by the Permittees, in consultation with NJDEP and the public, to balance conforming with the various regulatory requirements and the reasonable expenditure of public funds.

There are numerous control methods that could be utilized to reduce or eliminate discharges from the combined sewer system and this report represents the process used to identify specific control alternatives for the subject combined sewer system and develop an implementation plan that is practical and technically feasible, as well as considers the potential water quality benefits to meet the requirements of the CWA.

This SIAR presents the selected CSO control program, implementation schedule and financial capability analysis. The selection of the preferred control program incorporates a comprehensive review and analysis of applicable CSO control strategies based on the information gathered and presented in the previously NJDEP-approved System Characterization Report and the Development and Evaluation of Alternatives Report. JMEUC and the City have developed a thorough understanding of their wastewater collection and treatment systems, including the systems' responses to precipitation events of varying duration and intensity, and the capacity of these systems to capture and treat flows from the combined sewer system (CSS).The hydrologic and hydraulic models approved by the NJDEP have been used to simulate the system performance under the baseline conditions as well as the system response with CSO control alternatives included.

The program objectives addressed herein are:

- Summarize the evaluation process presented leading up to the selection of the CSO control program
- Present a selected CSO control program that is consistent with the NJPDES CSO permits and National CSO Control Policy;
- Present water quality benefit, technical merit, implementation schedule for CSO control program
- Present cost/performance considerations; and,
- Provide an update on the public participation process.

The program goal is to select and develop an implementation plan for a CSO control program that is capable of cost-effectively improving water quality within the impacted receiving waters. The contents of this report collectively relate to each of these goals and objectives and provides the information necessary for the City and JMEUC to advance the implementation of the selected alternative.

1.2 Regulatory Context

In the current NJPDES CSO Permits, the NJDEP has mandated that the permittees prepare a CSO Long Term Control Plan and the NJDEP has incorporated permit conditions that closely reflect the requirements of the National CSO Control Policy established by the United States Environmental Protection Agency (EPA). A CSO LTCP involves a comprehensive study of the hydraulically connected sewer system and the evaluation of alternatives for reducing CSO impacts to receiving waters. It investigates the hydrologic and hydraulic relationships between precipitation, conveyance, treatment capacity, and overflows and evaluates the scope, costs, and performance of possible control alternatives for treating or reducing the frequency and volume of CSO discharges.

The EPA CSO Control Policy and the individual NJPDES CSO Permits describe nine elements or requirements for the development of a CSO Long Term Control Plan:

1. Characterization, monitoring, and modeling of the combined sewer systems to provide a thorough understanding of the hydraulically connected system, its response to various precipitation events, the characteristics of the overflows, and the water quality impacts that result from the CSOs;
2. A public participation process that actively involves the affected public in the decision-making to select long term CSO controls;
3. Consideration of sensitive areas in identifying the highest priority for controlling overflows;
4. Evaluation of alternatives that considers a reasonable range of CSO control options that provide a level of control presumed (per the criteria given in the Policy and Permit) or demonstrated to meet the water quality-based requirements of the Clean Water Act (CWA);
5. Cost/performance considerations to demonstrate the relationships among a comprehensive set of reasonable control alternatives;
6. An operational plan that incorporates revisions to the operation and maintenance program necessary after approval of the LTCP to incorporate its associated CSO controls;
7. Maximizing treatment at the existing publicly owned treatment works (POTW) treatment plant during and after each precipitation event so that such flows receive treatment to the greatest extent practicable utilizing existing tankage for storage, while still meeting permit limits;
8. An implementation schedule addressing the construction and financing of proposed CSO controls; and
9. A post-construction compliance monitoring program adequate to verify compliance with water quality-based CWA requirements and designated uses as well as to ascertain the effectiveness of implemented CSO controls.

The NJPDES CSO Permits divided the above requirements into three sequential steps, providing an orderly progression for the development of the LTCP. The tasks undertaken and the documents submitted under each step, per the specified schedule, are:

- Step 1 incorporates the characterization, monitoring, and modeling element and components of the public participation process, consideration of sensitive areas, and compliance monitoring program. It is further divided into the following submittal requirements and schedule:
    - Permittees were required to submit a System Characterization Work Plan within 6 months from the effective date of the permit (EDP), which corresponded to a due date of January 1, 2016. Separate Work Plans were submitted by the Permittees; both were submitted on time and approved by NJDEP.
    - Permittees were required to submit a System Characterization Report within 36 months of the EDP, or a due date of July 1, 2018. Separate System Characterization Reports were submitted on time by the Permittees and approved by NJDEP. These documents serve as the basis for the subsequent development and evaluation of alternatives efforts (documented in this report).
    - Permittees were required to submit a Public Participation Process Report and a Consideration of Sensitive Areas Information document within 36 months from the EDP (i.e., July 1, 2018). The Public Participation Process Report was prepared jointly by the Permittees and submitted on time. The Consideration of Sensitive Areas report was prepared as a cooperative effort of the NJ CSO Group and submitted on time by the Group. Both reports were approved by NJDEP and contributed to the development and evaluation of alternatives efforts.
    - Although listed separately from the steps in the permit under the LTCP Submittal Requirements, permittees were also required to submit a Baseline Compliance Monitoring Program (CMP) Work Plan by January 1, 2016 and then a Baseline CMP Report by July 1, 2018. The Permittees collaborated with the NJ CSO Group to satisfy these permit conditions through a regional ambient water quality sampling and testing program and pathogen water quality modeling. Both the Work Plan and Report were submitted on time by the Group and were approved by NJDEP.
- Under Step 2, permittees were required to submit a Development and Evaluation of Alternatives Report (DEAR) within 48 months from the EDP, or a due date of July 1, 2019. This step involved evaluating a broad range of control alternatives to meet CWA requirements and water quality standards (WQS) per the corresponding conditions prescribed in the permit. Maximizing treatment at the existing POTW treatment plant and cost and performance considerations were also addressed in Step 2. The Development and Evaluation of Alternatives Report was submitted on time by the Group and was approved by NJDEP.
    - Section G.4.a stipulates that permittees are to evaluate a reasonable range of CSO control alternatives that will meet the water quality-based requirements of the CWA using either the Presumption Approach or the Demonstration Approach.
    - Section G.4.b. states the DEAR is to enable the permittees, in consultation with NJDEP, the public, owners and operators of the entire collection system that conveys flows to the treatment works, to select the alternatives to ensure the CSO controls meet the water quality-based requirements of the CWA, are protective of the existing and designated uses, give the highest priority to controlling CSOs to sensitive areas, and address minimizing impacts from significant indirect user (SIU) discharges.
    - Section G.4.c. indicates that permittees are to select either the Demonstration or Presumption Approach for each group of hydraulically connected CSOs and identify each CSO group and its individual discharge locations.
    - Section G.4.d. notes that the DEAR is to include a list of control alternative(s) evaluated for each CSO outfall.

  - Section G.4.e requires that the permittees evaluate a range of CSO control alternatives predicted to accomplish the requirements of the CWA and use hydrologic, hydraulic and water quality models approved by NJDEP in the evaluation. The models are to simulate the existing conditions and conditions as they are expected to exist after construction and operation of the chosen alternative(s).
  - Section G.4.e further notes that the evaluation is to consider the practical and technical feasibility of the proposed CSO control alternative(s), and water quality benefits of constructing and implementing various remedial controls and combination of such controls and activities. It also includes a list of seven (7) control alternatives that, at a minimum, are to be evaluated.
  - Section G.4.f describes the criteria of the Presumption Approach, while Section G.4.g lists the criteria of the Demonstration Approach, with each section referring to N.J.A.C. 7:14A-11 Appendix C. These criteria are described in further detail in Section 3 of this report.
  - Section G.5.a indicates that the DEAR is to include cost/performance considerations to relate and compare proposed control alternatives evaluated per Section G.4 and help guide selection of controls. The analysis is to consider the diminishing incremental pollution reduction achieved in the receiving water compared to the increased costs as the level of control increases.

Section 1.3 below provides additional detail on the documents prepared and submitted under Steps 1 and 2 of the NJPDES CSO permit process.

Under Step 3, permittees are required to submit a Selection and Implementation of Alternatives Report that evaluates a sufficient number of control alternatives to guide the selection of a suitable and cost-effective long term control plan, and incorporates the final plan selection and implementation schedule for the construction and financing of proposed CSO controls. A proposed operational plan revision schedule and a post-construction compliance monitoring program also should be addressed. This submittal was originally due within 59 months from the EDP, which corresponds to a due date of June 1, 2020. This deadline was extended to October 1, 2020 in the NJDEP permit stay letters of April 15, 2020 issued to both the City and JMEUC.

- Section G.2. outlines the requirements for a Public Participation Process Report, which was submitted as part of Step 1 on July 1, 2018. Updates to the public participation process are provided in this report.
- Section G.6. requires updates to the O&M Program and Manual following the NJDEP approval of the final LTCP and throughout implementation of the LTCP.
- Section G.7. requires the LTCP to include maximizing flow and treatment at the STP during and after each precipitation event, ensuring that such flows receive treatment to the greatest extent practicable utilizing existing tankage for storage, while still meeting all permit limits.
- Section G.8. requires an implementation schedule including a construction and financing schedule for implementation of the LTCP CSO controls. The schedule is to account for the relative importance of water quality and the permittee's financial capability.
- Section G.9. requires a compliance monitoring program

NJDEP has issued similar NJPDES CSO permits to New Jersey entities who own combined sewer systems or who treat combined sewage from these systems with the intent to address combined sewer overflow impacts on the State’s waters. The JMEUC and the City are members of the NJ CSO Group and have coordinated with the Group during the preparation of this SIA, including work related to water quality modeling, CSO control technology descriptions, basis of cost estimates, and reporting on sensitive area assessments. The NJ CSO Group was originally formed to bring together utilities and municipalities that own combined sewers in Northern New Jersey, who all have the common interest of coordinating their activities and responses to local regulatory issues like the pathogen Total Maximum Daily Load (TMDL) program. The group was expanded to facilitate compliance with the NJPDES requirements established in the 2015 CSO permits and the JMEUC and the City are actively participating in the permit compliance efforts of the Group.

1.3 Related Permit Submissions and Reports

This report builds on the System Characterization Reports prepared by the Permittees and approved by NJDEP under the first part of the NJPDES CSO Permits. Other prior work plans and reports submitted by the Permittees and through the NJ CSO Group are also referenced. These recent permit submissions and reports include:

- Development and Evaluation of Alternatives Report, prepared jointly by Mott MacDonald and CDM Smith for the City of Elizabeth and the Joint Meeting of Essex and Union Counties, dated June 2019, revised October 2019.
- System Characterization Report, prepared by CDM Smith for the Joint Meeting of Essex and Union Counties, dated June 2018, revised December 2018.
- System Characterization Report, prepared by Mott MacDonald for the City of Elizabeth, dated June 2018, revised January 2019.
- System Characterization Work Plan, prepared by CDM Smith for the Joint Meeting of Essex and Union Counties, dated December 2015, revised June 2016.
- System Characterization Work Plan: Quality Assurance Project Plan, prepared by Hatch Mott MacDonald on behalf of the City of Elizabeth, dated December 2015, revised May 2016.
- Public Participation Process Report, completed for the City of Elizabeth and Joint Meeting of Essex and Union Counties, dated June 2018, revised November 2018.
- Identification of Sensitive Areas Report, prepared by the Passaic Valley Sewerage Commission on behalf of participating permittees of the NJ CSO Group, dated June 2018, revised March 2019.
- NJ CSO Group Compliance Monitoring Program Report, prepared by the Passaic Valley Sewerage Commission on behalf of participating permittees of the NJ CSO Group, dated June 2018, revised October 2018.
- Pathogen Water Quality Model (PWQM) Quality Assurance Project Plan (QAPP), prepared by the Passaic Valley Sewerage Commission on behalf of participating permittees of the NJ CSO Group, dated May 2016, revised January 2017.
- Typical Hydrologic Year Report, prepared by the Passaic Valley Sewerage Commission on behalf of participating permittees of the NJ CSO Group, dated May 2018.
- Calibration and Validation of the Pathogen Water Quality Modeling Report, prepared by the Passaic Valley Sewerage Commission on behalf of participating permittees of the NJ CSO Group, dated June 2020.

Reports from previous permit cycle submissions that were consulted for the cost and performance of CSO control strategies are:

- Long Term Control Plan, Cost and Performance Analysis Report, completed by CDM for JMEUC in March 2007.
- CSO Long Term Control Plan, Cost & Performance Analysis Report, Volume 1, prepared by Hatch Mott MacDonald for the City of Elizabeth, dated March 2007.
- CSO Long Term Control Plan, Cost & Performance Analysis Report, Volume 2 - Technical Guidance Manual, prepared by Hatch Mott MacDonald for the City of Elizabeth, dated March 2007.

1.4 Responses to Previous Comments Provided by NJDEP

In their approval letter for the Development and Evaluation of Alternatives Report dated December 13, 2019, the NJDEP requested the following item be addressed in the SIAR, with the City and JMEUC's response noted below.

Comment 1: The Department reserved the right to comment on the percent capture and resultant calculations. The Department also reserved the right to require a breakdown of percent capture results by subcatchment in order to approve any percent capture calculation, as well as a clear definition of the hydraulically connected system.

Response 1: The City of Elizabeth and JMEUC have coordinated with the NJ CSO Group members to use a regionally consistent definition of % capture. The details of this calculation are included in Section 4.7 and Section 8 of this report. The hydraulic model does not facilitate an analysis of percent capture on a subcatchment basis. The hydraulically connected system is described in Section 2 of this report.

1.5 Report Organization

The report sections are organized as follows:

- This section (Section 1) introduces the overall project background, regulatory requirements, and the purpose and general contents of the report.
- Section 2 presents general information on the sewer system and treatment facilities, including the collection system components and treatment technologies.
- Section 3 presents the development of the hydraulic model, and existing and future flow projections to develop an understanding of baseline system performance.
- Section 4 discusses the water quality objectives, including the applicable water quality standards, and baseline compliance monitoring program for the receiving waterbodies. It presents the percent attainment from the water quality model under current conditions as well as the selection of the CSO control approach.
- Section 5 presents a summary of the development and evaluation of CSO control alternatives, including the water quality benefits of these controls based on the level of control.
- Section 6 presents the range of public participation strategies that have been employed by the City to obtain feedback throughout the LTCP process.
- Section 7 presents the selected CSO control program.
- Section 8 provides the financial capability assessment, presenting the various factors that the City has considered in developing a reasonable affordability scale.
- Section 9 presents the implementation schedule for this program, including milestones for completion and possible funding strategy
- Section 10 covers the procedures that will be implemented as part of the operational plan upon approval of this selected LTCP and through implementation of the approved LTCP.
- Section 11 describes the post-construction compliance monitoring program that will be employed following implementation of the selected program to compare the performance of the implemented CSO control measures to the baseline sewer system and receiving water quality characterization

Section 2
Sewer System and Treatment Facilities Description

This section summarizes the key elements of the Joint Meeting of Essex and Union Counties (JMEUC) and City of Elizabeth sewer service areas and systems. Detailed descriptions are provided in the following previously approved reports:

- System Characterization Report, prepared by CDM Smith for the Joint Meeting of Essex and Union Counties, dated June 2018, revised December 2018.
- System Characterization Report, prepared by Mott MacDonald for the City of Elizabeth, dated June 2018, revised January 2019.
- Development and Evaluation of Alternatives, prepared jointly by Mott MacDonald for the City of Elizabeth and CDM Smith for the Joint Meeting of Essex and Union Counties, dated June 2019, revised October 2019.

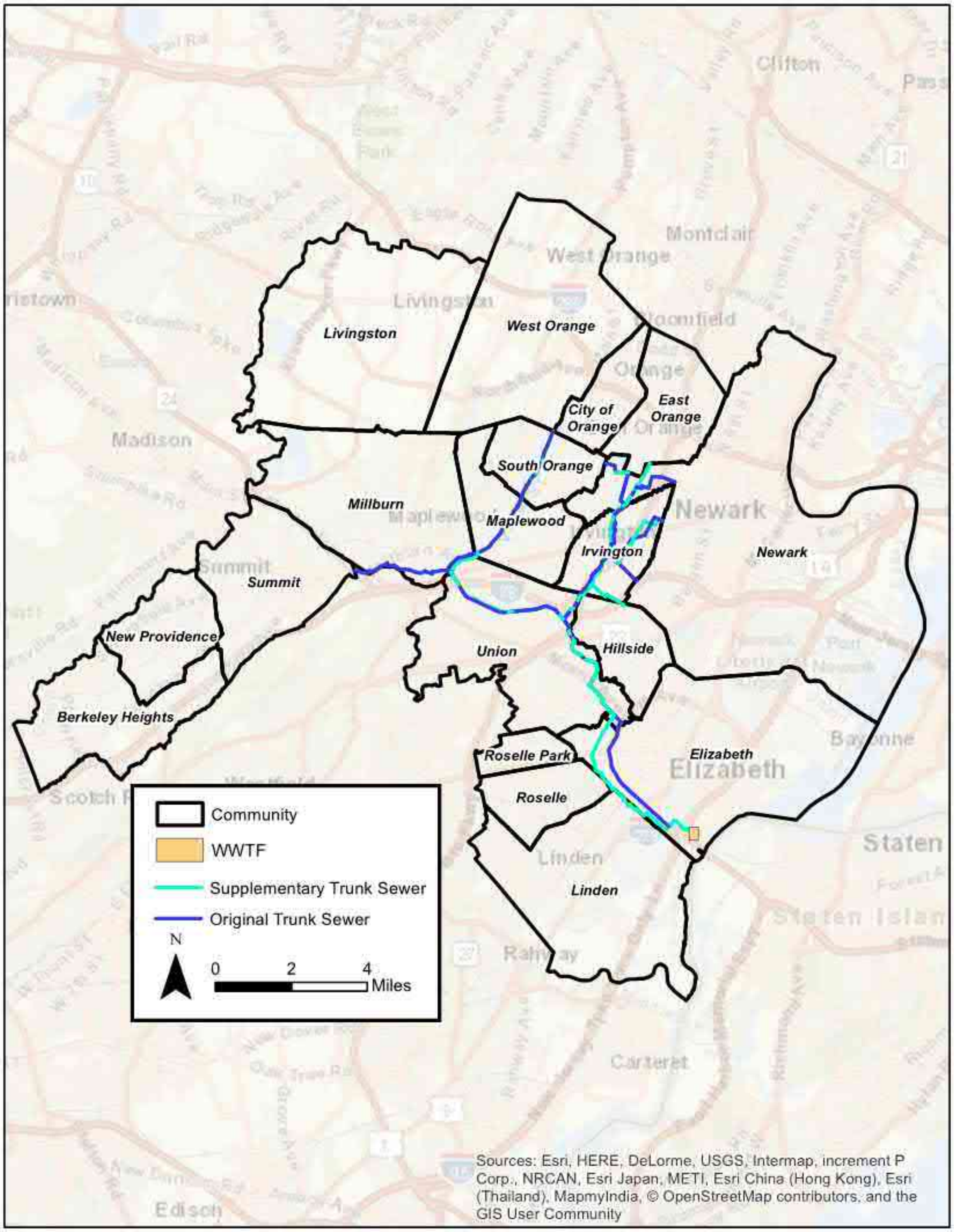
2.1 Hydraulically Connected Sewer System

The JMEUC owns and operates a wastewater treatment facility which treats wastewater collected in a 65 square mile service area in northern New Jersey. The JMEUC trunk sewer system collects wastewater from a service area which includes eleven member (owner) communities and four customer communities. Owner communities include all or some parts of East Orange, Hillside, Irvington, Maplewood, Millburn, Newark, Roselle Park, South Orange, Summit, Union, and West Orange. The City of Elizabeth and portions of Livingston, Orange, and New Providence are currently served as customers by the JMEUC. Small portions of two neighboring communities, Berkeley Heights and Linden are also served. As such, only portions of Newark, Berkeley Heights, Linden, Roselle, and Livingston are within the service area of JMEUC. Figure 2-1 depicts the locations of trunk sewer system, communities served, and the wastewater treatment facility.

Part IV B.1.c of the New Jersey Pollutant Discharge Elimination System (NJPDES) CSO Permit provides the following definition: *"Hydraulically connected system" means the entire collection system that conveys flows to one Sewage Treatment Plant (STP)."* Accordingly, the hydraulically connected system under this permit is defined as including the JMEUC interceptor sewers and all the municipal separate sanitary and combined sewers that discharge to the interceptor and also include the combined sewer outfalls, netting facilities and other structures on the outfalls downstream of the regulators. Part IV G.4.f of the Permit further requires that, for the presumption approach, compliance with the permit requirements be met on the basis of the hydraulically connected system. The definition continues to allow segmentation of the hydraulically connected system on a case by case basis if justified by the nature of the system.

> "On a case-by-case basis, the permittee, in consultation with the Department, may segment a larger hydraulically connected system into a series of smaller inter-connected systems, based upon the specific nature of the sewer system layout, pump stations, gradients, locations of CSOs and other physical features which support such a sub area. A hydraulically connected system could include multiple municipalities, comprised of both combined and separate sewers."

The City and JMEUC each developed their own system characterization reports, while closely coordinating and sharing information during the characterization phase. Given that the City of Elizabeth is one of the many municipalities served by JMEUC and is part of the JMEUC hydraulically connected system, the City and JMEUC jointly submitted the Development and Evaluation of Alternatives Report and have jointly prepared this Selection and Implementation of Alternatives Report for permit compliance.



Note: Only portions of Newark, Berkeley Heights, Linden, Roselle and Livingston are within the service area of JMEUC.

Figure 2-1: Municipalities Served by JMEUC

In drafting the current NJPDES CSO Permits, the NJDEP recognized the complexity of the hydraulic interrelationships between a combined sewer system (CSS) and its associated domestic treatment works and the connections from other municipal sewer systems. This complexity is further compounded by the fractured ownership of these interrelated systems and the different positions and interests each owner will have. These hydraulically connected systems have been evaluated concurrently so that an effective and equitable CSO Long Term Control Plan (LTCP) has been developed.

Part IV D.1.c of the permit, entitled "Submittals", requires that: *"Since multiple municipalities/permittees own separate portions of the hydraulically connected sewer system, the permittee shall work cooperatively with all other appropriate municipalities/permittees in the hydraulically connected sewer system to ensure that the Nine Minimum Controls [and] Long Term Control Plans activities are being developed and implemented consistently."* As permittees of a hydraulically connected system, the City and Joint Meeting have cooperated and collaborated on the development and selection of the LTCP for CSO control. The City and Joint Meeting have met regularly, sharing information, exchanging hydraulic models, and jointly worked towards a single LTCP to address the permit requirements.

2.1.1 Separate Sanitary Sewer Service Area Description

The eleven member communities of the JMEUC along with the customer communities of Livingston, Orange, and New Providence (along with small portions of Berkeley Heights and Linden) are serviced by separate sanitary sewer systems which are owned and operated by each individual community. These systems are tributary to the Original and Supplementary Trunk Sewers owned and operated by the JMEUC, which collect and convey flows from these communities to the WWTF. The total population of the separated sewer service area is estimated to be 327,313 based on American Community Survey 2011-2015 5-year estimates, while the total sewered area of these communities (excluding large parks and other significant open spaces) is estimated to be 29,780 acres or 46.5 square miles.

Over two-thirds of the JMEUC separate sanitary sewer service area is made up of residential property, of which most is either medium or high-density housing. Commercially developed land makes up the next highest land use percentage (15%), while the remaining areas are evenly distributed among wooded, recreational, industrial, and transportation land uses. Population estimates and sewered areas are broken down by community in Table 2-1.

Table 2-1: Separated Sewer Communities Served by JMEUC

Member Community (see footnotes below)	Estimated Population Serviced by the JMEUC	Sewered Area (acres)
East Orange [1]	17,247	570
Hillside	20,415	1,570
Irvington	55,774	1,870
Maplewood	23,156	1,890
Millburn and Livingston	17,322	3,840
Newark[1]	44,284	1,210
Roselle Park [2]	11,735	680
South Orange	16,257	1,670
Summit [3]	31,978	5,700
Union	53,871	5,140
West Orange [4]	40,743	5,440

[1] Population and area values include only the portion of the community serviced by JMEUC. Remainder of community is serviced by Passaic Valley Sewerage Commission.
[2] Population and area values include only the portion of the community serviced by JMEUC. Remainder of community is serviced by Rahway Valley Sewerage Commission.

[3] Population and area values include the customer community of New Providence and portion of Berkeley Heights serviced by the JMEUC.
[4] Population and area values include Customer Community of City of Orange.

2.1.2 Combined Sewer Service Area Description

The JMEUC service area is primarily separately sewered areas, with the only confirmed combined sewer area in the system located within the City of Elizabeth. The JMEUC has coordinated with Elizabeth to identify portions of Roselle Park and possibly other adjoining towns that flow into Elizabeth that may also be combined, or have their storm sewers connected into Elizabeth's combined or separate sanitary sewers. Similarly, the JMEUC has identified New Jersey Department of Transportation (NJDOT) catch basin connections into the sanitary and/or combined sewer systems in JMEUC's service area.

The City of Elizabeth provides wastewater and stormwater collection and conveyance services to about 128,600 people within its municipal boundaries, which encompasses approximately 12.3 square miles in Union County, NJ. This collection and conveyance system consists of an extensive network of intercepting sewers, sewer mains, manholes, catch basins, pump stations, overflow control facilities, and drainage channels. The City of Elizabeth does not own or operate any wastewater treatment plant facilities; wastewater flows are conveyed to the JMEUC WWTF. The City owned sewer system assets are operated and maintained through a multi-year service contract with a utility contract operator.

Much of the City is served by a CSS that collects and conveys sanitary and stormwater flows in the same conduit. The combined sewers are prevalent throughout the northern, western, and southern sections of the City, coinciding with its historical residential, industrial, and commercial development. In other areas of the City, sanitary flows are conveyed in a separate (sanitary) sewer system connected to interceptors, with stormwater runoff conveyed by a separate storm sewer system.

All dry weather sewage from the City owned sewer system is conveyed to and treated at the JMEUC WWTF. Except for flows from sewers directly connected to the Joint Meeting trunk sewers, wastewater is collected and conveyed by two City-owned intercepting sewers serving the easterly and westerly portions of the City, respectively. These intercepting sewers flow to the Trenton Avenue Pumping Station (TAPS), which is the City's main pumping station, and its force main discharges flows to the JMEUC incoming trunk sewer approximately 1,300 feet upstream of the wastewater treatment facilities. The City is a customer of JMEUC, not a member municipality, and is currently contractually limited to an 18 mgd maximum average daily flow and a 36 mgd maximum instantaneous peak discharge from its main wastewater pumping station to the JMEUC treatment works.

2.1.3 Flow from Neighboring Communities

As part of the system characterization process, the City reviewed record documents and corresponded with adjacent municipalities to identify the location and flow contribution of inter-municipal sewer connections. Except of the City of Newark, the neighboring communities are reported to have separate sanitary and stormwater collection systems. From this investigation, the major external connection to the City's combined sewer system consists of a 42" diameter storm sewer from the Borough of Roselle Park connecting to the City's combined sewer system in Park Avenue along the municipal boundary at Galloping Hill Road. The other identified inter-municipal connections were found to be associated with small sewers of short lengths, following local topography, and of limited tributary flow.

The 42" Roselle Park storm sewer connection contributes significant wet weather flow to the upstream end of the large combined sewer drainage basin of the northwestern section of the City of Elizabeth. Furthermore, its impact on localized street flooding at the intersection of Park Avenue and Glenwood Road was recognized in a prior study by the City. Roselle Park has delineated a 120-acre drainage area as being tributary to the 42” storm sewer connection to the City combined sewer system. The City has been monitoring the flow from the connection on a continuous basis since December 2017 and has provided a draft inter-municipal agreement to the Borough of Roselle Park for the connection at Park Avenue, including a cost structure for a user charges and future construction and capital expenditures. The contributing drainage area to the 42” Roselle Park storm sewer connection has been incorporated into the hydraulic computer model for the Elizabeth CSS.

2.2 JMEUC Trunk Sewer System

The JMEUC does not own or operate any portion of member or customer community collection systems upstream of the two trunk sewers. The JMEUC trunk sewer system includes the Original Trunk Sewer constructed in the early 1900’s and the Supplementary Trunk Sewer constructed in the 1930’s. They generally run parallel to one another throughout the service area. In the downstream portion of the collection system, the Original and Supplementary Trunk Sewers come together at Junction J16 at the intersection of Bayway Avenue and Pulaski Street. A twin barrel trunk sewer (the North Barrel and South Barrel) exit J16 with flow being split relatively evenly between the two barrels. Together, the total length of the trunk sewers owned and operated by the JMEUC is approximately 43 miles.

There are approximately 900 manholes which serve as access points to the trunk sewers from the tributary collection systems. The diameters of the trunk sewers range in size from 10” in the most upstream portions of the system in Newark and Irvington, to 81” in the downstream portion of the Supplementary Trunk Sewer. Figure 2-2 through Figure 2-5 show the trunk sewer network and associated pipe shapes and sizes. All pipes within the trunk sewer network are circular except the twin barrel trunk sewer in the downstream portion of the system and a short stretch of rectangular pipe making up the Original Trunk Sewer, as indicated in Figure 2-4.

All flow within the JMEUC trunk sewers is conveyed downstream via gravity, although four pump stations are present immediately upstream of the trunk sewer network. Three of the pump stations convey separated wastewater flows to the trunk sewer system, while the Trenton Avenue Pumping Station (Trenton Avenue PS or TAPS) conveys combined flows from the City of Elizabeth to the North Barrel of the twin barrel trunk sewer. There are no constructed relief points to the receiving waters within the trunk sewer system. There are a total of 18 cross connections (relief sewers) and 16 junctions throughout the trunk sewer network which divert and distribute flow among the two trunk sewers to maximize conveyance capacity of the system during wet weather flow (WWF) conditions. These connections and junctions balance flow and head in the system, thereby avoiding the overloading of one trunk while capacity may be available in the other.

The trunk sewer network also includes two inoperable venturi meters and four areas of depressed pipe segments below stream/river crossings. The venturi meters are not currently used to measure flows, but they are still able to convey flows via inverted siphons. Additionally, both venturi meters have bypass structures which add additional localized capacity and allow for some flow to bypass the inverted siphons. There are also four areas of depressed pipe segments under stream/river crossings that can impact the hydraulic conditions in the trunk sewers. At the depressed pipe locations, the pipe maintains its slope and transitions in cross-sectional shape from circular to rectangular and then back to circular.

Historically, the JMEUC has not observed issues with sewer system overflows or flooding and the hydraulic modeling results have indicated no measurable flooding in the JMEUC system during the Typical Year rainfall, as described in the City of Elizabeth and JMEUC System Characterization Reports.

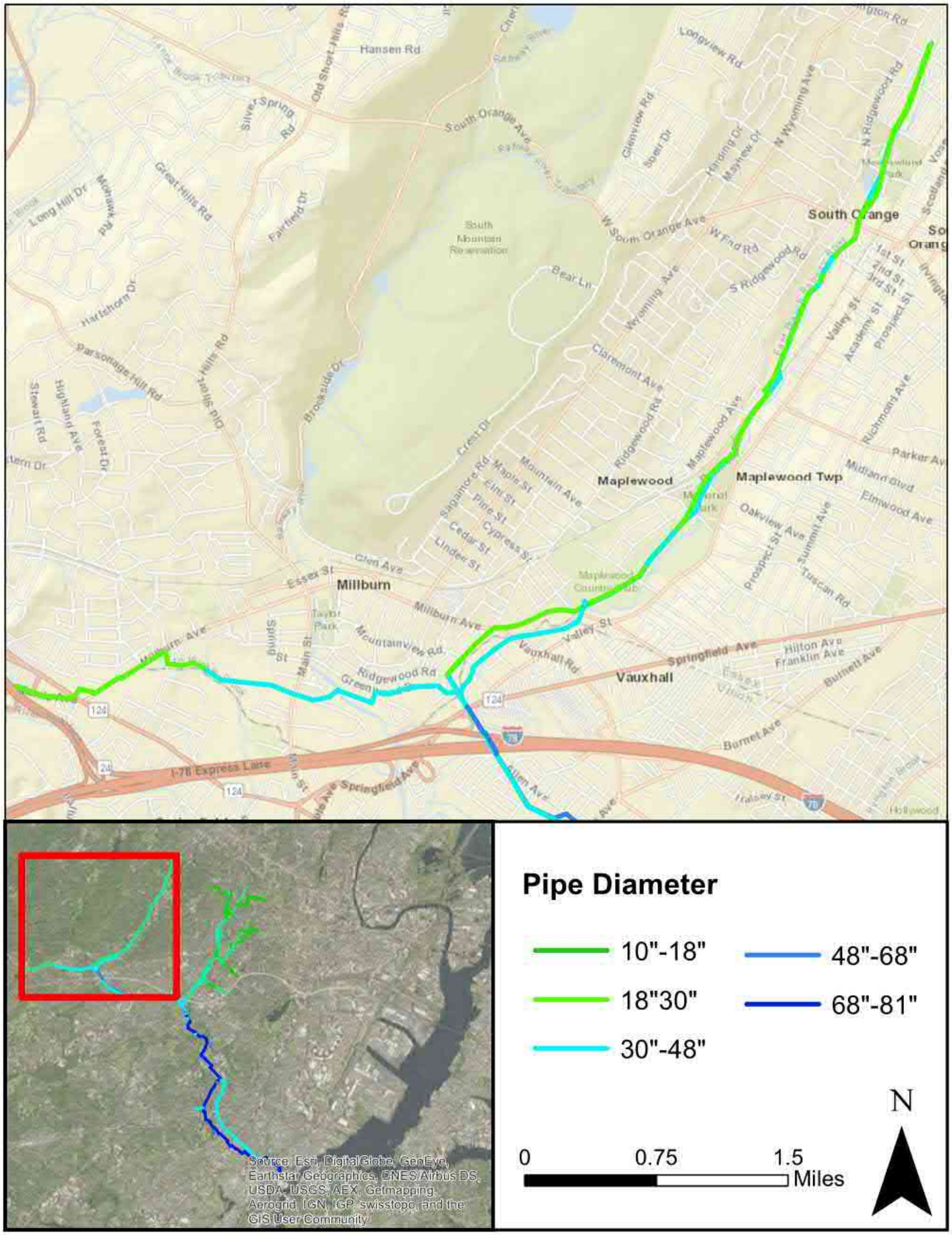


Figure 2-2: JMEUC Trunk Sewer Pipe Sizes and Shapes – Northwest Portion of Service Area

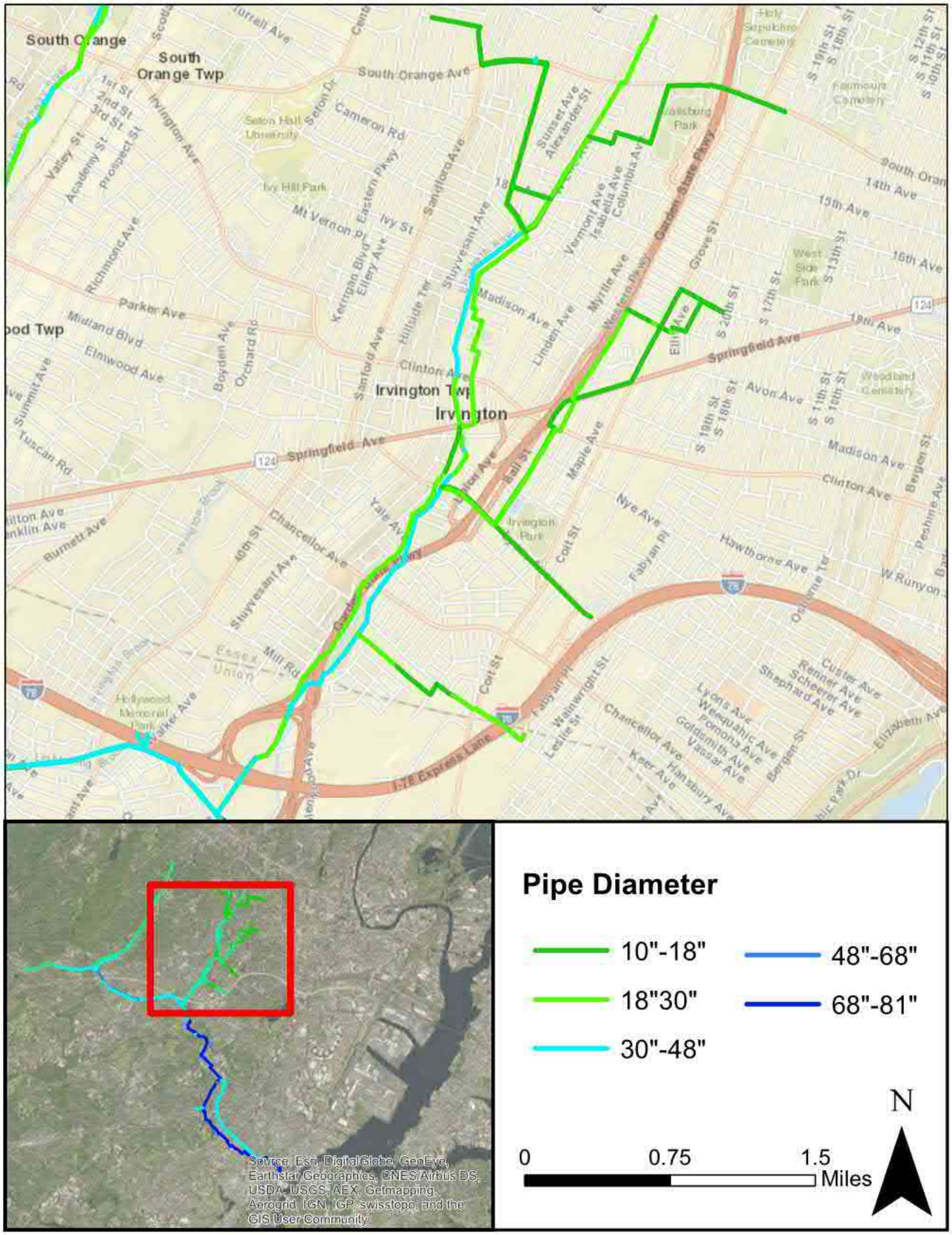


Figure 2-3: JMEUC Trunk Sewer Pipe Sizes and Shapes – Northern Portion of Service Area

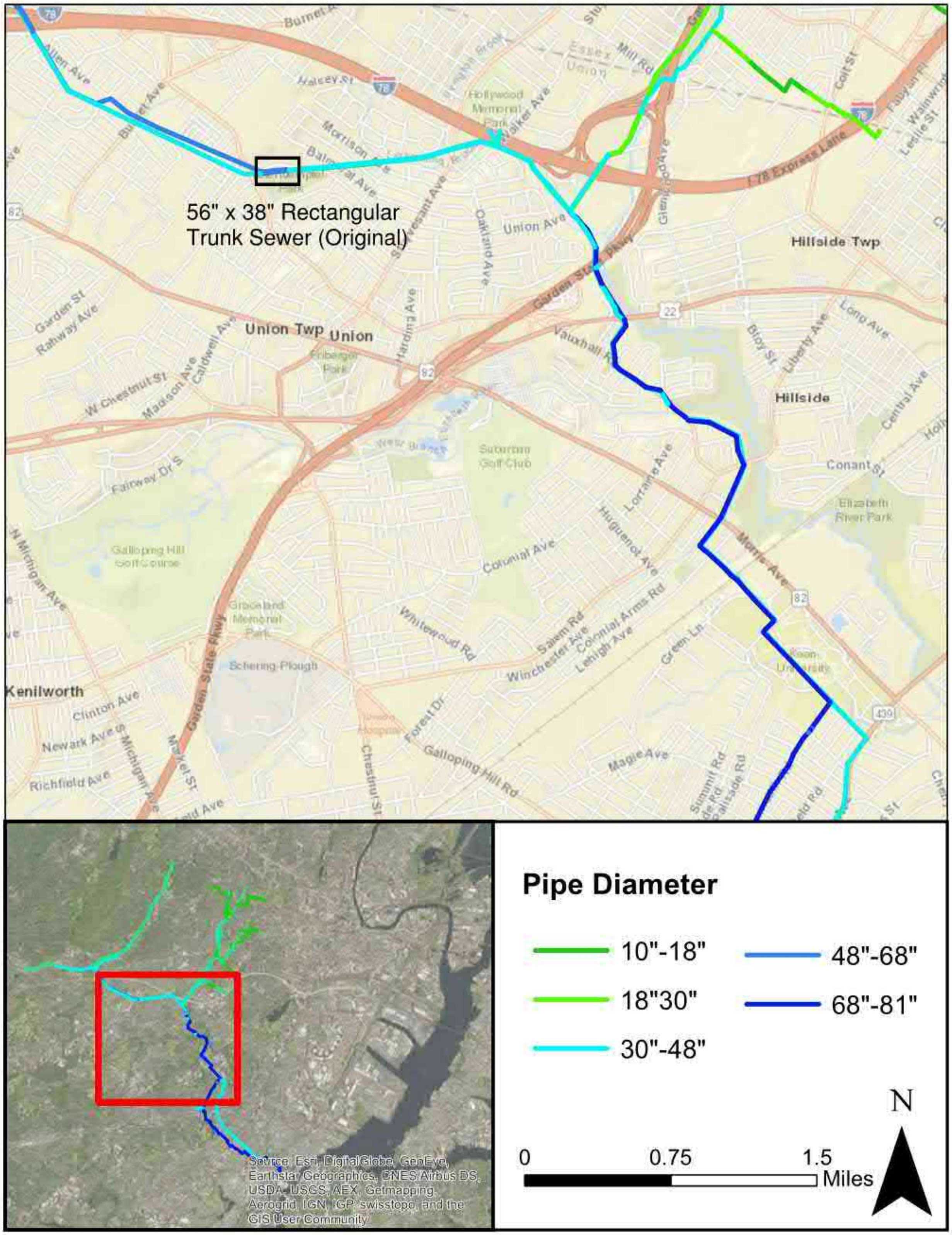


Figure 2-4: JMEUC Trunk Sewer Pipe Sizes and Shapes – Central Portion of Service Area

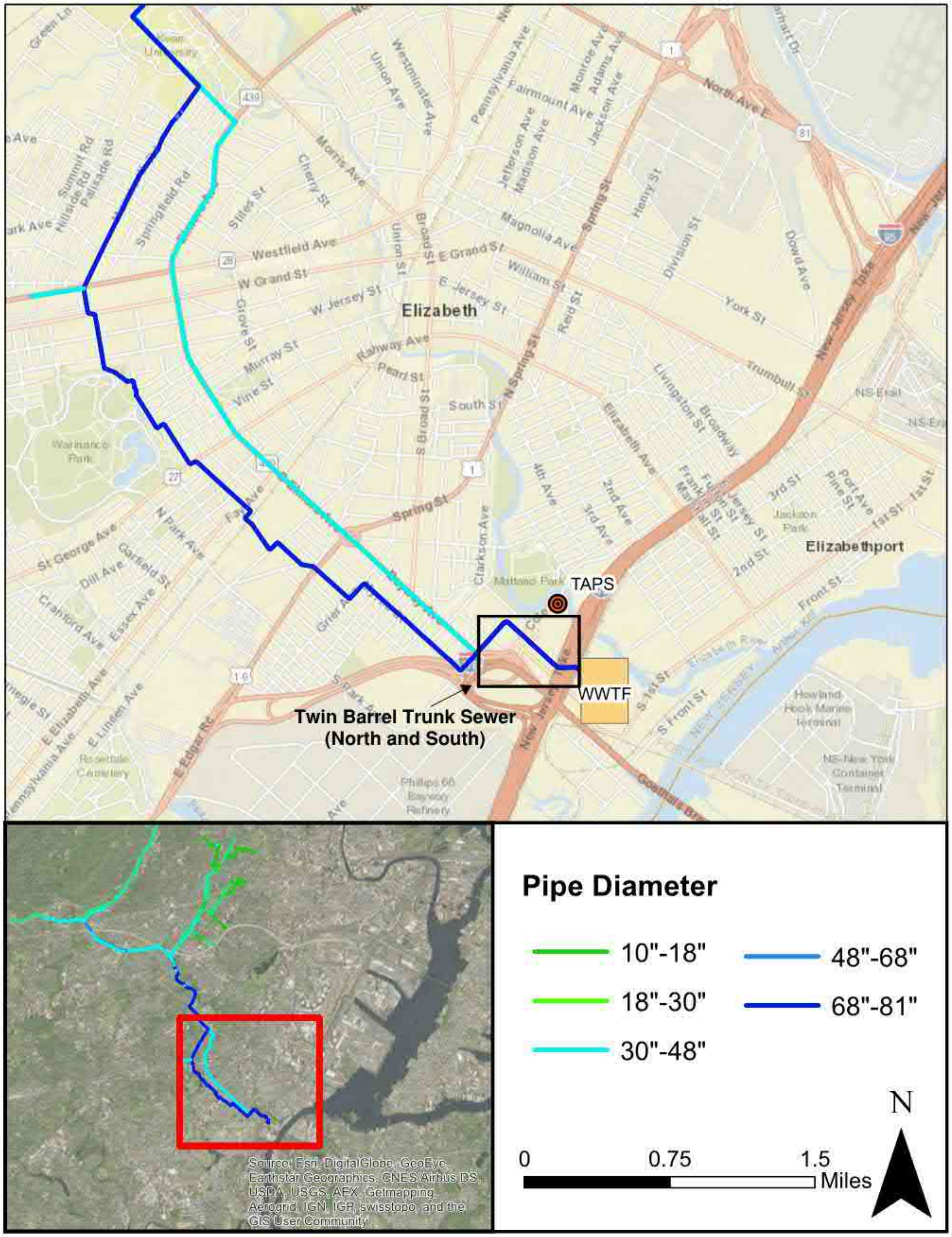


Figure 2-5: JMEUC Trunk Sewer Pipe Sizes and Shapes – Southeast Portion of Service Area

2.3 Edward P. Decher Secondary Wastewater Treatment Facility

The Edward P. Decher Secondary Wastewater Treatment Facility has a rated peak hydraulic capacity of 180 million gallons per day (mgd), although flows reaching 220 mgd may be processed during significant wet weather events. Peak discharge from the WWTF is limited by mean sea level (MSL), with rated capacity of the WWTF dropping to 120 mgd when tides exceed eight feet above MSL (corresponding to 13-year recurrence interval). The plant is rated for average daily influent flows of 85 mgd.

2.3.1 Preliminary Treatment

Flows from the Original and Supplementary Trunk Sewers enter the headworks of the WWTF and are diverted to one of two paired sets of coarse and fine screens. No pumping of the influent is required at the headworks of the WWTF. Flow passes by gravity first through the coarse screens and then through the fine screens. The coarse screens have 3.5-inch clear openings while the fine screens have 0.75 inch clear openings. When both sets of screens are on-line flow is typically split evenly between the paired sets of screens. Effluent flow from the fine screen enters four grit channels, each measuring 9.5 feet wide by seven feet deep by 57 feet long.

2.3.2 Primary Treatment

Flow exiting the individual grit channels is combined at a downstream flume which routes flow to a collection channel immediately upstream of four primary settling tanks (PSTs). The four PSTs have identical geometries (200 feet long by 75 feet wide by 13.8 feet deep). During dry weather flow (DWF) conditions, only two of the four PSTs are on-line. A third PST is brought on-line during WWF events when flows measured directly upstream of secondary treatment exceed 100 mgd. The fourth PST is only brought on-line in emergency situations such as power failure.

The four PSTs have effluent weir lengths of 75 feet each, with effluent flow entering a collection channel before flowing to the primary effluent chamber. Under normal operating conditions, flow exits the primary effluent chamber and enters a six foot by 10 foot box-shaped conduit which conveys flow to the Main Sewage Pumps wet well. The wet well feeds five low lift pumps, all equipped with variable frequency drives. Two pumps are normally in operation at all times, and their pumping rate controlled by the water level of the wet well. When flows discharging from the wet well exceed 100 mgd, a third and occasionally fourth pump are turned on manually to maintain the water level in the wet well. Collectively the five wet well pumps have a capacity of over 200 mgd, enough to maintain proper water levels in the plant during extreme wet weather events.

The primary effluent chamber also has two emergency overflows (one discharging to the Arthur Kill and the other discharging to the Elizabeth River). Activation of these overflows is controlled by the primary effluent chamber water level and by gates in the chamber which are normally closed. These emergency overflows have not activated in many years and any activation of these overflows would most likely be due to downstream mechanical issues as opposed to insufficient downstream capacity.

2.3.3 Secondary Treatment and Disinfection

The WWTF has four aeration tanks, each with a volume of 3.97 million gallons (15.89 million gallons total). Each aeration tank has eight surface aerators rated at 100 horsepower and two-speed operation capable of providing a maximum of 2,360 lb/hour of oxygen per tank. Effluent flows from the aeration tanks enter four final settling tanks (FSTs), each having a diameter of 180 feet and a depth of 15 feet. FST effluent flows are disinfected with sodium hypochlorite in a chlorine contact tank capable of treating a peak hour flow of 73 mgd at the required contact time of 20 minutes. The disinfected effluent is then dechlorinated with sodium bisulfate before being discharged to the Arthur Kill through two outfall conduits.

2.4 City of Elizabeth Combined Sewer System

The City of Elizabeth is located at the downstream end of the JMEUC service area. Data on the various components of the City of Elizabeth sewer system, particularly the features integral to the combined sewer system and its responses to wet weather events, are highlighted below. Emphasis has been placed on summarizing pertinent information as compiled from the existing combined sewer system characterization.

Figure 2-6, Figure 2-7, and Figure 2-8 depict the location of the major sewer system components in the northwestern, northeastern, and southern sections of the City, respectively. The location of Significant Indirect Users (SIU) within the City are also noted on these figures. In general, these major sewer system facilities include:

- Approximately 159 miles of combined gravity sewer mains and trunks, with an estimated 6,400 manholes and 3,300 inlets and catch basins associated with these lines.
- Approximately 9.5 miles of separate sanitary sewers, with about 310 manholes associated with these lines.
- Approximately 38 miles of separate storm sewers, with an estimated 700 manholes and 1,700 inlets and catch basins associated with these lines.
- Twenty-nine (29) permitted combined sewer overflow (CSO) outfall discharge points, 38 regulator and diversion structures, and associated solids/floatables control facilities and tide gate chambers.
- Two (2) intercepting sewer lines, totaling 6.6 miles: 4.3 miles for the Easterly Interceptor and 2.3 miles for the Westerly Interceptor.
- A total of 9 pumping stations: 3 sewage pumping stations and 6 stormwater pumping stations.
- Stormwater drainage ditches and channels that convey stormwater as well as combined sewer overflows in certain locations to receiving waters.

Statistics on the major components of the Elizabeth sewer system are summarized in Table 2-2. As with many other combined sewer systems, the City’s combined sewers are predominately vitrified clay pipe (VCP) ranging from 6” to 24” diameter, and larger pipe is constructed of brick or reinforced concrete pipe (RCP). Brick combined sewers are either circular ranging in size between 15” and 84” diameter or egg-shaped ranging in size between 16” wide by 24” high and 60” wide by 90” high, inside dimensions. About 75% of the combined sewer are reported as less than 24” diameter (or minimum internal dimension) and over 10% is greater than 42”. Approximately 67% of the combined sewer system is constructed of VCP, 14% of RCP, 9% of brick masonry, and the balance of various other materials.

During wet weather conditions, a certain amount of combined sewage is conveyed through the interceptors to the Trenton Avenue PS and pumped to the JMEUC WWTF for treatment. The daily average flow rate from the TAPS is approximately 15.5 mgd based on records for the last five years. This value fluctuates from year to year based on wet weather conditions as the flow in the City’s CSS is comprised of both sewage and stormwater runoff. The City’s sewage is predominantly domestic, with some commercial and industrial wastewater contribution.

Legend

- Significant Industrial Users
- JMEUC Treatment Plant
- Pumping Station
- CSO Discharge
- Regulator
- Elizabeth City Hall
- Force Main
- Siphon Main
- Trunk Sewer
- CSO Outfall

Interceptor Alignment

- Easterly Interceptor
- Westerly Interceptor
- JMEUC Trunk Sewer
- Municipal Boundary
- Regulator Basin

Sewer System Drainage Types

- Combined Sewer System
- Seperated Sewer System
- No Contributing Flow

0 1,200 2,400 Feet

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FIGURE 2-6

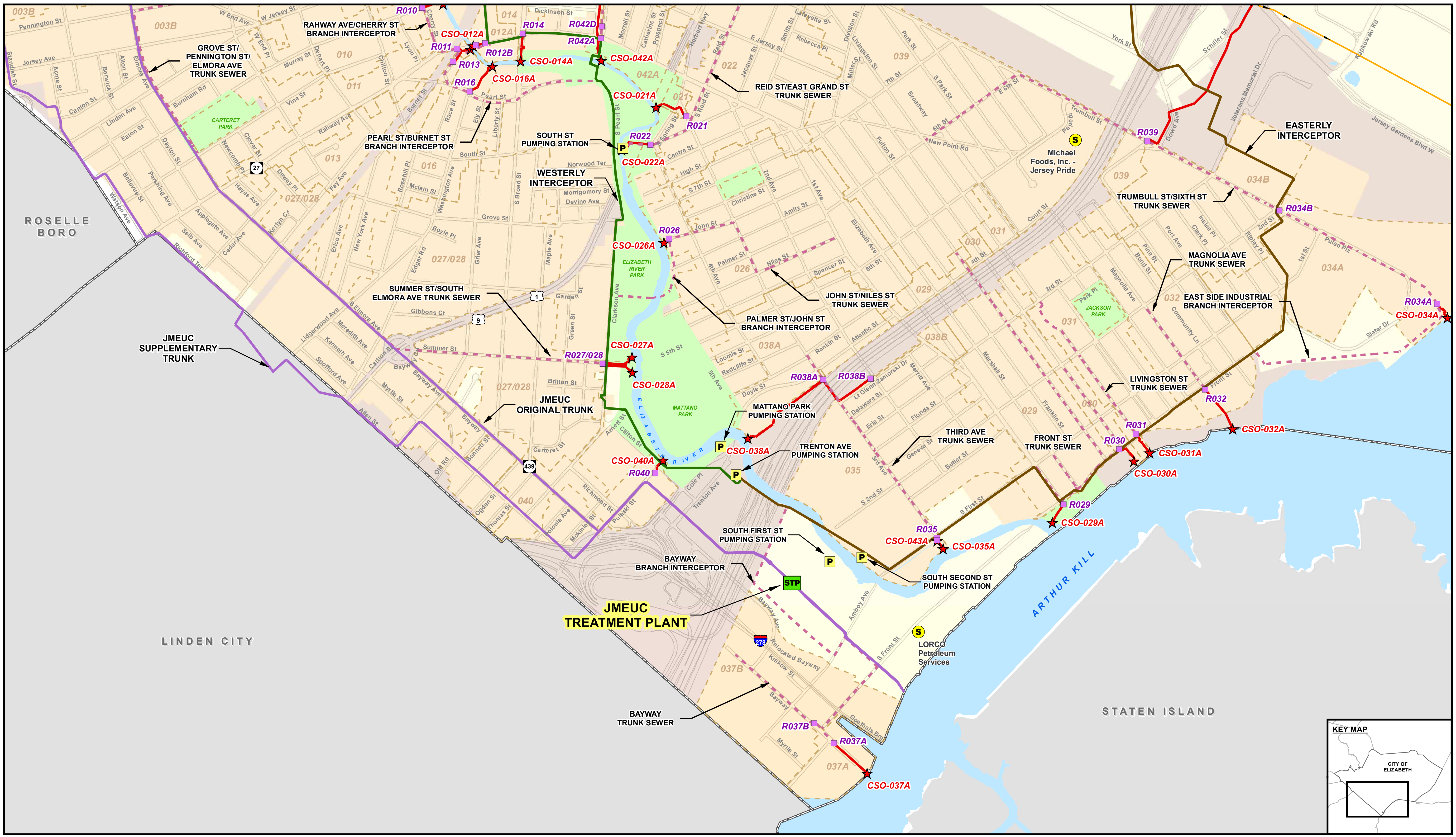
MOTT MACDONALD
111 Wood Avenue South
Iselin, New Jersey 08830-4112

CITY OF ELIZABETH
UNION COUNTY, NEW JERSEY
CSO LONG TERM CONTROL PROGRAM
SELECTION AND IMPLEMENTATION
OF ALTERNATIVE REPORT

SEWER SYSTEM COMPONENTS NORTHEAST ELIZABETH

Designed	Drawn	Checked	Approved	Date
AG	MM	SM	AG	9/2/2020


NEWARK CITY
HILLSIDE TWP
UNION TWP
ROSELLE PARK BORO
VERONA GEBHARDT PUMPING STATION
ALINA ST/VAN BURAN ST/ NORTH AVE TRUNK SEWER
UNION AVE/ NEWARK AVE TRUNK SEWER
EASTERLY INTERCEPTOR
DIVISION ST BRANCH INTERCEPTOR
FAIRMOUNT AVE TRUNK SEWER
BRIDGE ST/ JEFFERSON AVE TRUNK SEWER
JMEUC ORIGINAL TRUNK
JMEUC SUPPLEMENTARY TRUNK
ORCHARD ST/MORRIS AVE TRUNK SEWER
MAGIE AVE TRUNK SEWER
ARCH PUMPING STATION
REID ST/EAST GRAND ST TRUNK SEWER
42" STORM FROM ROSELLE PARK
WESTFIELD AVE/ PARK AVE TRUNK SEWER
WEST JERSEY/ WEST GRAND BRANCH INTERCEPTOR
WESTERLY INTERCEPTOR
WEST JERSEY AVE LIFT STATION
RAHWAY AVE/CHERRY ST BRANCH INTERCEPTOR
GROVE ST/ PENNINGTON ST/ ELMORA AVE TRUNK SEWER
CITY HALL
KELLOGG PARK
ELIZABETH RIVER PARK
Michael Foods, Inc. - North Ave
Duro Bag Manufacturing Company
Superior Powder Coating,Inc.
Wakefern Food Corporation
Mastercraft Metal Finishing
Actavis Elizabeth L.L.C.
CSO-001A
CSO-002A
CSO-036A
CSO-041A
CSO-003A
CSO-005A
CSO-008A
CSO-010A
R001
R002
R036A
R036B
R041
R005
R042C
R003A
R003B
R008
R042B
R010
R011
R012B
R014
R042D
R042A
KEY MAP
CITY OF ELIZABETH
Legend
Significant Industrial Users
JMEUC Treatment Plant
Pumping Station
CSO Discharge
Regulator
Elizabeth City Hall
Trunk Sewer
CSO Outfall
Force Main Alignment
Edge Of Pavement
Interceptor Alignment
Easterly Interceptor
Westerly Interceptor
JMEUC Trunk Sewer
Municipal Boundary
Regulator Basin
Sewer System Drainage Types
Combined Sewer System
Seperated Sewer System
No Contributing Flow
0
1,200
2,400
Feet
FIGURE 2-7
MOTT MACDONALD
111 Wood Avenue South
Iselin, New Jersey 08830-4112
CITY OF ELIZABETH
UNION COUNTY, NEW JERSEY
CSO LONG TERM CONTROL PROGRAM
SELECTION AND IMPLEMENTATION
OF ALTERNATIVES REPORT
SEWER SYSTEM COMPONENTS
NORTHWEST ELIZABETH
Designed AG
Drawn MM
Checked SM
Approved AG
Date 9/2/2020



Legend

- S Significant Industrial Users
- STP JMEUC Treatment Plant
- P Pumping Station
- CSO Discharge
- Regulator
- Elizabeth City Hall
- Trunk Sewer
- CSO Outfall
- Force Main
- Edge Of Pavement

Interceptor Alignment

- Easterly Interceptor
- Westerly Interceptor
- JMEUC Trunk Sewer
- Municipal Boundary
- Regulator Basin

Sewer System Drainage Types

- Combined Sewer System
- Seperated Sewer System
- No Contributing Flow

0 1,200 2,400 Feet

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FIGURE 2-8

MOTT MACDONALD
111 Wood Avenue South
Iselin, New Jersey 08830-4112

CITY OF ELIZABETH
UNION COUNTY, NEW JERSEY
CSO LONG TERM CONTROL PROGRAM
SELECTION AND IMPLEMENTATION
OF ALTERNATIVES REPORT

SEWER SYSTEM COMPONENTS SOUTH ELIZABETH

Designed	Drawn	Checked	Approved	Date
AG	MM	SM	AG	9/2/2020

Table 2-2: Major Components of Sewer System

Component	Length/Number (approx.)
Gravity sewer mains (miles)	206.5 total 159.0 combined sewer 9.5 separate sanitary 38.0 separate storm
Manholes (estimated number)	7,410 total 6,400 combined sewer 310 separate sanitary 700 separate storm
Inlets and catch basins (estimated number)	5,000 total 3,300 combined sewer 1,700 separate storm
Interceptor sewers (miles)	6.6 total 4.3 Easterly Interceptor 2.3 Westerly Interceptor
Pump Stations – Sanitary/Combined Sewer	3 Trenton Avenue Pump Station (TAPS) Kapkowski Road Pump Station West Jersey Street Pump Station
Pump Stations – Stormwater System	6 Arch Pump Station Verona-Gebhardt Pump Station South Street Pump Station Mattano Park Pump Station South Second Street Pump Station South First Street Pump Station (operated and maintained by JMEUC)
Siphons	8
Permitted CSO Outfall Discharge Outlets	29
CSO Regulators	39
Solids/Floatable Control Facilities	35

Under the current agreement with the JMEUC, the maximum average daily flow that can be discharged from the Trenton Avenue PS to the JMEUC WWTF is 18 million gallons per day (mgd) and the maximum peak flow is limited to 36 mgd. Modifications to the service agreement between JMEUC and the City are developed as of the date of this report to address several combined sewer overflow control measures described elsewhere in the report.

The existing ultimate pumping capacity (all pumps running) of Trenton Avenue PS is estimated to be about 55 mgd. Combined sewage flows in excess of the allowable pumping rate and the conveyance and storage capacities are diverted at regulator structures to the permitted CSO outfalls to the Elizabeth River, Arthur Kill and Newark Bay. Each CSO outfall is equipped with an overflow control facility to collect solids and floatables that would otherwise be discharged to the receiving waters.

Based on population estimates and hydraulic model results, the estimated average dry weather flow from the Elmora sewer area is around two mgd, a significant majority of which drains directly to the Original JMEUC Trunk Sewer. Along with the combined sewer area in the City of Elizabeth, there are also NJDOT catch basin connections to the Original Trunk Sewer which collect storm water along Elmora Avenue and Bayway between Westfield Avenue and Brunswick Avenue.

2.4.1 Permitted Combined Sewer Overflow Discharge Locations

The City's NJPDES CSO Permit currently includes 29 CSO discharge points:

- 4 CSO outfalls discharge to Newark Bay (2 via the Great Ditch, 1 via the Peripheral Ditch, and 1 directly to the bay);
- 4 CSO outfalls discharge to the Arthur Kill; and
- 21 CSO outfalls discharge to the Elizabeth River.

Several CSO outfalls have been eliminated over the years through outfall consolidation and sewer separation work. Accordingly, the remaining number of CSO outfalls is significantly less than the highest outfall discharge serial number assigned by the CSO Permit. The permitted CSO outfall discharge points are listed in Table 2-3 and shown in Figure 2-6, Figure 2-7, and Figure 2-8.

Table 2-3: List of CSO Outfall Discharges and Locations

Outfall No.	Outfall Name	Discharge Coordinates		Receiving Stream
		Latitude (degree)	Longitude (degree)	
001A	Airport South Area	40.680754	-74.191792	Peripheral Ditch to Newark Bay
002A	Dowd Avenue	40.671438	-74.188015	Great Ditch to Newark Bay
003A *	Westfield Avenue & Magie Avenue	40.667910	-74.219405	Elizabeth River
005A	Westfield Avenue	40.667885	-74.219236	Elizabeth River
008A	West Grand Street/Price Street	40.666300	-74.218607	Elizabeth River
010A	Murray Street/Cherry Street	40.663122	-74.218836	Elizabeth River
012A	Rahway Avenue	40.661474	-74.217542	Elizabeth River
013A	Rahway Avenue/Burnet Street	40.661598	-74.217420	Elizabeth River
014A	Broad Street Rahway Avenue	40.661050	-74.215169	Elizabeth River
016A	Edgar Road/Pearl Street	40.660860	-74.216519	Elizabeth River
021A *	Spring Street/Third Avenue	40.659355	-74.208766	Elizabeth River
022A	South Street	40.657827	-74.210393	Elizabeth River
026A	John Street	40.654472	-74.208411	Elizabeth River
027A	Summer Street/Arnett Street	40.650336	-74.209934	Elizabeth River
028A	Summer Street/Arnett Street	40.649784	-74.209929	Elizabeth River
029A	South Front Street	40.644317	-74.190050	Elizabeth River
030A *	Front Street/East Jersey Street	40.646520	-74.186165	Arthur Kill
031A	Front Street/Livingston Street	40.646811	-74.185418	Arthur Kill
032A	Front Street/Magnolia Avenue	40.647672	-74.181477	Arthur Kill
034A	Atalanta Place	40.651665	-74.171288	Newark Bay
035A	South Front Street/Third Avenue	40.643376	-74.195218	Elizabeth River
036A *	Orchard Street/Dod Court	40.671036	-74.219232	Elizabeth River
037A	Bayway/South Front Street	40.635265	-74.198874	Arthur Kill
038A *	Third Avenue	40.647386	-74.204464	Elizabeth River

Outfall No.	Outfall Name	Discharge Coordinates		Receiving Stream
		Latitude (degree)	Longitude (degree)	
039A *	Trumbull Street, Fourth Street	40.663314	-74.180887	Great Ditch to Newark Bay
040A	Pulaski Street/Clifton Street	40.646607	-74.208485	Elizabeth River
041A *	Morris Avenue/Sayre Street	40.669631	-74.219365	Elizabeth River
042A	Bridge Street/Elizabeth River	40.661052	-74.211343	Elizabeth River
043A *	Army Corps Flood Control Structure	40.643666	-74.195516	Elizabeth River via ditch

The permitted CSO outfalls are classified as either primary or relief outfalls, with relief outfalls being designated where the sewershed has an interconnection to another downstream sewershed with a subsequent regulator and outfall network. The relief outfalls (annotated with an asterisk in Table 2-3) and the associated sewersheds are as follows:

- Relief Outfall 003A, Westfield Avenue and Magie Avenue, relieving Relief Outfall 041A and Primary Outfall 005A. (Westerly Interceptor.)
- Relief Outfall 021A, Spring Street / Third Avenue, relieving Primary Outfall 022A. (Westerly Interceptor.)
- Relief Outfall 030A, Front Street/East Jersey Street, relieving Primary Outfall 029A. (Easterly Interceptor.)
- Relief Outfall 036A, Orchard Street / Dod Court, relieving Primary Outfall 005A. (Westerly Interceptor.)
- Relief Outfall 038A, Third Avenue, relieving Primary Outfall 035A. (Easterly Interceptor.)
- Relief Outfall 039A, Trumbull Street / Fourth Street, relieving Primary Outfall 034A. (Easterly Interceptor.)
- Relief Outfall 041A, Morris Avenue / Sayre Street, relieving Primary Outfall 005A (Westerly Interceptor.)
- Relief Outfall 043A, Army Corps Flood Control Structure, relieves Primary Outfall 035A (Easterly Interceptor.)

2.4.2 Overflow Regulators and Diversion Structures

The intended purpose of combined sewer regulators and diversion structures is to route dry weather flows downstream for treatment, typically through a pipe to an interceptor sewer, and to divert excess wet weather flows to an outfall. The City's larger combined sewers have several times the capacity of its interceptor sewers. At each point of combined sewage interception, it is necessary to limit the rate of flow entering the interceptor through the dry weather flow pipe (also known as an underflow or foul sewer pipe). If not limited by the hydraulic capacity of the interconnection, the rate is limited by the capacity of the downstream interceptor or pumping rates.

There are currently 38 overflow regulators and diversion structures in the existing system that discharge through the 29 CSO outfalls, as indicated in Table 2-4. Each regulator is associated with a CSO outfall and either the Easterly or Westerly Interceptor sewer service areas. The size of the tributary area to the CSO regulators are also noted in the table and the boundaries of the CSO basins are presented in Figure 2-6, Figure 2-7, and Figure 2-8.

Table 2-4: List of Overflow Regulators

Outfall No.	Interceptor Service Area	Regulator ID	Location / Street Name	Coordinates Latitude (degree)	Longitude (degree)	Area (acres)
001A	Easterly	R001	Route 1&9 N Ramp from Route 81 West	40.680809	-74.192651	438.9
002A	Easterly	R002	Division St at Fairmount Ave	40.670950	-74.193386	222.9
003A *	Westerly	R003A *	Westfield Ave at Magie Ave and Orchard St	40.666448	-74.228955	220.4
		R003B *	Grove St at W. Grand St	40.664905	-74.229390	118.8
005A	Westerly	R005	Westfield Ave at Union St	40.668616	-74.217710	189.2
008A	Westerly	R008	W. Grand St, west of Elizabeth R	40.666282	-74.218750	23.1
010A	Westerly	R010	Murray St at Cherry St	40.662981	-74.219820	76.3
012A	Westerly	R012A	Rahway Ave, east of Elizabeth River	40.661619	-74.217280	See R012B
		R012B	Rahway Ave, east of Elizabeth River	40.661681	-74.216842	9.2
013A	Westerly	R011	Rahway Ave at Burnet St	40.661488	-74.218185	34.1
		R013	Burnet St, south of Rahway Ave	40.661025	-74.218373	23.8
014A	Westerly	R014	South Broad Street at Rahway Ave	40.662033	-74.215064	12.4
016A	Westerly	R016	Pearl St at Washington Ave	40.659955	-74.217582	38.1
021A *	Westerly	R021 *	Third Ave, north of South Reid St	40.659022	-74.207321	2.8
022A	Westerly	R022	South St at Fourth Ave	40.658011	-74.209023	168.3
026A	Westerly	R026	John St at Elizabeth River	40.654604	-74.208163	110.7
027A & 028A	Westerly	R027/028	Summer St, west of Clarkson Ave	40.650097	-74.211322	216.2
029A	Easterly	R029	S. Front St at Elizabeth Ave, Veterans Memorial Waterfront Park	40.644955	-74.189513	76.3
030A *	Easterly	R030 *	Front St, west of E. Jersey Ave	40.646941	-74.186849	19.2
031A	Easterly	R031	Front St at Livingston St	40.647499	-74.186058	59.5
032A	Easterly	R032	Front St at Magnolia Ave	40.649095	-74.182773	65.0
034A	Easterly	R034A	Esmt on 1 Atlanta Plz, east of Puleo Pl	40.652154	-74.171752	102.9
		R034B *	Trumbull St at Second St	40.655549	-74.179215	75.5
035A	Easterly	R035	S. First St at Third Ave	40.643767	-74.195509	120.0
036A *	Westerly	R036A *	N. Broad St at Salem Ave and Pingry Pl	40.675879	-74.213348	See R036B
		R036B *	N. Broad St, north of Pingry Pl	40.676359	-74.213390	209.5

Outfall No.	Interceptor Service Area	Regulator ID	Location / Street Name	Coordinates Latitude (degree)	Longitude (degree)	Area (acres)
037A	Easterly	R037A	Bayway, south of S. Front St	40.636352	-74.200433	16.2
		R037B	Bayway, north of S. Front St	40.637085	-74.201346	70.2
038A *	Easterly	R038A *	Third Ave, south of Atlantic St	40.649505	-74.200874	58.0
		R038B *	LT Glenn Zamorski Dr at Second St	40.649533	-74.198624	5.8
039A *	Easterly	R039 *	Trumbull St at Fourth Ave	40.658062	-74.185464	244.9
040A	Westerly	R040	Pulaski St, west of Clifton St	40.646155	-74.208854	34.9
041A *	Westerly	R041 *	Morris Ave, north of Elizabeth R	40.670003	-74.219117	238.1
042A	Westerly	R042A	Elizabeth Ave at Bridge St	40.661856	-74.211366	23.7
		R042B	E. Jersey St at Winfield Scott Plz	40.664057	-74.211256	25.1
		R042C *	Jefferson Ave at Chestnut St	40.668196	-74.210906	109.9
		R042D *	Winfield Scott Park, north of Elizabeth Ave	40.662288	-74.211381	32.8
043A *	Easterly	R043 *	S. First St at Third Ave	40.643684	-74.195507	See R035

Some regulators serve as relief diversion structures and are connected to sewersheds for other regulators. These relief regulators are indicated with an asterisk in Table 2-4. Key observations associated with the overflow regulators are summarized below:

- Regulators R003A, R003B, and R041 are connected, with the DWF pipe from R003B flowing to R003A, which then in turn connects to the trunk sewer to Regulator R041. Regulators R036A and R036B contribute flow to a separate trunk sewer collecting flow from the Regulator R005 sewershed, which then merges with the trunk sewer from R041 before connecting to R005 and subsequently to the Westerly Interceptor.
- Dry weather flow from Regulator R021 is tributary to the Regulator R022 sewershed.
- Outfalls 027A and 028A have a common tributary area and regulator structure. Regulator R027/028 has two (2) overflow outlets, one that leads to each outfall pipe. The outfall pipes are also interconnected downstream of the regulator.
- Dry weather flow from Regulator R030 connects downstream to the Regulator R029 sewershed.
- Regulators R035, R038A, R038B, and R043 are interconnected, with Regulator R035 having the downstream DWF pipe connection to the Easterly Interceptor. The DWF pipes from Regulators R038A and R038B connect to the trunk sewer within Third Avenue leading to R035, while the R038A and R038B overflow pipes merge prior to discharging through CSO Outfall 038A. Regulator R043 is an emergency relief overflow located on the CSO 035A Outfall.
- Regulator R039 is a relief overflow diversion situated on a trunk sewer within Trumbull Street connecting Regulator R034B. Regulator R034B has a DWF pipe connection to the Easterly Interceptor, while the wet weather flow pipe continues as the trunk sewer and the incoming pipe to Regulator R034A, collecting flow from the R034A drainage basin. As such, R034B is an internal diversion to the interceptor and does not have a designated outfall.

- Regulator R042D provides a relief overflow diversion for the sewershed associated with Regulator R042A, with the DWF pipe continuing through R042D to R042A and then connecting downstream to the Westerly Interceptor. The sewersheds for Regulators R042B and R042C are also interconnected, with the DWF pipe from R042C continuing as a trunk sewer to R042B, from which a dry weather branch sewer extends southerly to the Westerly Interceptor, collecting sanitary flow from lateral connections along the run.

2.4.3 City Interceptors and Trunk Sewers

The City's sewer system tributary to the Trenton Avenue Pumping Station, its main sewage pumping station, is served by Easterly and Westerly Interceptors. Each interceptor enters the Trenton Avenue PS through a 60" diameter reinforced concrete pipe (RCP). The City interceptors intercept various local trunk and branch sewers. Table 2-5 summarizes certain data for the City interceptors, interceptor branches, and major trunk sewers. The location of the interceptor and main trunk sewers are also noted on Figure 2-6 through Figure 2-8.

Table 2-5: City Interceptors and Major Trunk Sewers

Interceptor Name Branch Interceptor Name Trunk Sewer Name	Sewer Length (miles)	Downstream Pipe Size (inches)	Downstream Pipe Material (-)	Total Tributary System Length (miles)
Easterly Interceptor	4.30	60	RCP	58.7
Division Street Branch	0.27	24	RCP	
East Side Industrial Branch	0.56	18	PCCP	1.43
Bayway Branch	0.93	30	VCP	1.56
Alina St / Van Buren St / North Ave Trunk	1.50	48	RCP	14.1
Fairmount Ave Trunk	0.40	48	RCP	5.56
Trumbull St / Sixth St Trunk	1.48	48 x 72	Brick Egg	12.7
Magnolia Ave Trunk	0.26	30 x 45	Brick Egg	3.00
Livingston St Trunk	0.43	36 x 54	Brick Egg	2.75
Front St Trunk	1.32	44 x 63	Brick Egg	3.41
Third Ave Trunk	0.57	48	RCP	5.09
Bayway Trunk	0.26	72	Brick	1.07
Westerly Interceptor	2.30	60	RCP	78.9
W Jersey St / W Grand St Branch	0.16	12	VCP	1.04
Rahway Ave / Cherry St Branch	0.25	12	VCP	3.68
Pearl St / Burnet St Branch	0.50	12	VCP	1.97
South St Branch	0.08	15	VCP	6.76
Palmer St / John St Branch	0.26	20	VCP	4.54
Westfield Ave / Park Ave Trunk	1.23	54	CCFRPM	8.00
Grove St / Pennington St / Elmora Ave Trunk	0.86	48 x 72	Brick	4.97
Magie Ave Trunk	0.26	18	VCP	0.392
Orchard St / Morris Ave Trunk	0.78	72	RCP	23.4
Union Ave / Newark Ave Trunk	1.24	48 x 72	Brick Egg	15.4
Bridge St / Jefferson Ave Trunk	0.79	42 x 63	Brick Egg	5.22
Reid St / East Grand St Trunk	0.86	48 x 72	Brick Egg	6.64

Interceptor Name Branch Interceptor Name Trunk Sewer Name	Sewer Length (miles)	Downstream Pipe Size (inches)	Downstream Pipe Material (-)	Total Tributary System Length (miles)
John St / Niles St Trunk	0.52	36 x 54	Brick Egg	4.28
Summer St / South Elmora Ave Trunk	0.68	60	RCP	7.34

Abbreviations: Brick Egg = Egg-shaped brick masonry sewer; CCFRPM = centrifugally cast fiberglass reinforced polymer mortar; PCCP = pre-stressed concrete cylinder pipe; RCP = reinforced concrete pipe; VCP = vitrified clay pipe.

Easterly Interceptor

The Easterly Interceptor is approximately 23,400 feet long, ranges in size from 33” to 60” diameter, and is constructed of reinforced concrete pipe. It starts in the northern portion of the City at Regulator R001 and then flows southeasterly along NJ Route 81 and Dowd Avenue, across the New Jersey Turnpike and Conrail lines, and through easements to Trumbull Street at Second Street and to Front Street at Port Avenue. The interceptor continues southwesterly along Front Street, northerly along Elizabeth Avenue, and southwesterly again along South First Street. The interceptor then heads northwesterly along the Elizabeth River to the Trenton Avenue Pumping Station. The 60” RCP interceptor reduces to twin 36” ductile iron pipes where it crosses beneath the Elizabeth River near the end of South Second Street.

The Easterly Interceptor receives flows from a sewage service area of 3,690 acres, including 1,570 acres of combined sewers associated with Regulators R001, R002, R029, R030, R031, R032, R034A and B, R035, R037A and B, R038A and B, and R039. It also receives flow from the largest separate sewer areas of the City associated with the Kapkowski Road Pumping Station and along Dowd Avenue. The system tributary to the Easterly Interceptor includes approximately 58.7 miles of sewer main, 2,350 manholes, and 1,070 storm inlets and catch basins.

The Division Street branch of the Easterly Interceptor is comprised of 24” RCP, approximately 1,400 feet in length, and runs from Regulator R002 at Fairmount Avenue to the interceptor at Dowd Avenue. In the late 1960s, the Bayway branch of the Easterly Interceptor was constructed, running northeasterly from Regulator R037A along Bayway, South Front Street, Clifton Street, and through easements to its interceptor connection adjacent to the Elizabeth River, east of the New Jersey Turnpike and Conrail lines. The Bayway branch is about 4,800 feet long, 24” and 30” diameter VCP. A 2,900-foot long, 18” diameter pre-stressed concrete cylinder pipe (PCCP), referred to on the record plans as the East Side Industrial Waste Sewer, conveys flows from Regulator R034A through easements south of Slater Drive to the interceptor at Front Street and Port Avenue.

Westerly Interceptor

The Westerly Interceptor serves the northern, central, and western parts of the City, with the main branch beginning at the Union Street, Morris Avenue, and Westfield Avenue intersection, connecting to Regulator R005. The Westerly Interceptor flows southerly along Union Street to West Jersey Street, easterly across the Amtrak railroad lines to Elizabethtown Plaza, and then southerly to Rahway Avenue. The interceptor continues easterly along Rahway Avenue and Elizabeth Avenue to Bridge Street, and then runs southerly across the Elizabeth River to Pearl Street. It then flows southerly along South Pearl Street, through Grove Street to Clarkson Avenue. From Clarkson Avenue at Britton Street, the Westerly Interceptor is mostly routed along the western bank of the Elizabeth River to the Trenton Avenue Pumping Station.

The Westerly Interceptor main branch is approximately 11,900 feet long, with the section from Regulator R005 to Clarkson Avenue at Britton Street being of brick masonry construction ranging from 28” to 40” in diameter. The siphon across the river at Bridge Street is associated with this section, consisting of 2 ductile iron pipe (DIP) barrels, one 16” and the other 24” diameter, each approximately 130 feet long. The section from Clarkson Avenue at Britton Street to the Trenton Avenue Pumping Station is comprised of

48" and 60" diameter RCP installed in the late 1950s, extending the interceptor to the then constructed Trenton Avenue PS. In the late 1980s, the brick masonry interceptor pipe sections were internally lined, reducing the internal diameter of the original brick sewers by about 1.5 inches.

The Westerly Interceptor receives flows from a sewer service area of 2,140 acres, including 1,890 acres of combined sewer system areas associated with Regulators R003A, R003B, R005, R008, R010, R012A, R011, R013, R014, R016, R021, R022, R026, R027/028, R027/028, R036A, R040, R041, and R042A, B, C and D. Approximately 78.9 miles of sewer main, 3,330 manholes, and 1,270 storm inlets and catch basins are estimated to contribute flow to the Westerly Interceptor.

Branch Interceptors and City Trunk Sewers
Three (3) branch interceptors, varying in length from 1,400 feet to 4,800 feet, are associated with the Easterly Interceptor and five (5) branch interceptors, varying from 600 feet to 2,600 feet, connect the Westerly Interceptor to various upstream regulators. Seventeen (17) trunk sewers with a total length of about 13.3 miles are listed in Table 2-5 for the City's combined sewer system. Each trunk sewer receives and conveys flows from a relatively large area and has substantial branch sewer connections. Eight (8) trunk sewers contribute flow to the Easterly Interceptor and 9 trunk sewers flow to the Westerly Interceptor. Many trunk sewers are egg-shaped or circular brick sewers, ranging in size from 30" wide by 45" high to 60" wide by 90" high.

Regulator / diversion structures R001, R002, R003A and B, R005, R022, R027/028, R029, R030, R031, R032, R034B, R035, R036A and B, R037A and B, R038A, R039, R041, and R042A, B, C and D are situated along these major trunk sewers. Some regulators, including R003A and B, R036A and B, R034B, R039, R041, and R042B and C, are positioned a good distance upstream of a corresponding interceptor or branch interceptor, with dry weather flows continuing to downstream sewersheds and excess wet weather flows diverted to CSO outfalls.

Combined Sewer System Siphons
The Elizabeth sewer system contains eight siphons. Seven siphons are in the Westerly Interceptor drainage basin and one siphon is in the Easterly Interceptor drainage basin. Six siphons cross the Elizabeth River, one siphon was constructed in 1971 to facilitate the installation of a large combined sewer outfall and storm sewer on Union Avenue, and one siphon was constructed circa 1982 to facilitate the installation of a storm sewer on Division Street. The siphons are located at:

- Union Avenue at Oakwood Place (Westerly Interceptor)
- Morris Avenue at the Elizabeth River (Westerly Interceptor)
- West Grand Street at Price Street (Westerly Interceptor)
- Rahway Avenue at the Elizabeth River (Westerly Interceptor)
- Bridge Street at the Elizabeth River (Westerly Interceptor)
- South Street at the Elizabeth River (Westerly Interceptor)
- Palmer Street at the Elizabeth River (Westerly Interceptor)
- Dowd Avenue at Division Street (Easterly Interceptor)

The siphons represent potential restrictions for wet weather flow conveyance and have been evaluated so as to maximize the combined sewer flow captured for wastewater treatment.

2.4.4 Pumping Stations

There are 3 pumping stations within the City that handle dry weather sanitary sewage: the Trenton Avenue Pumping Station (TAPS) located at Trenton Avenue and the Elizabeth River; the Kapkowski Road Pumping Station located at the intersection of Kapkowski Road and North Avenue East; and the West Jersey Street Pumping Station located on West Jersey Street between Cherry Street and Price

Street. The Kapkowski Road and West Jersey Street pumping stations receive flow from separate sewer systems, but discharge into the combined sewer system for treatment. As previously noted, TAPS is the main pumping station situated at the downstream point of the sewer system and conveys the majority of flows from the City to the JMEUC WWTP, including the tributary flows from the Kapkowski Road and West Jersey Street pumping stations. These stations are further described below.

Additionally, there are 6 stormwater pumping stations (SWPS) within the City: Arch Stormwater Pumping Station, Verona-Gebhardt Stormwater Pumping Station, and four stations constructed by the United States Army Corps of Engineers as part of the Elizabeth River Flood Control Project. Due to connections with CSO outfalls, certain stormwater pumping stations can influence the combined sewer system hydraulics, as noted below. These stations are therefore incorporated in the characterization and the collection system model.

2.5 Significant Indirect Users

The NJPDES CSO Permit requires that impacts from significant indirect users (SIUs) contributing to the CSOs are minimized. Based on the loading and toxicity of SIU contributions, each SIU is required to incorporate a level of pretreatment prior to discharge to the sewer system. JMEUC monitors SIUs for compliance with pretreatment requirements.

A facility is classified as a SIU if the permitted discharge is greater than 25,000 gallons per day (gpd) or the equivalent loading for a specific pollutant, or if the facility falls under a federal categorical group. This additional information indicates that eight (8) facilities located in Elizabeth are classified as Significant Indirect Users. These facilities are listed in Table 2-6.

Table 2-6: Significant Indirect Users

ID	Name	CSO Basin	Street Address	Flow (mgd)	SIC Code	Pre-treatment
1	Actavis Elizabeth LLC.	None	200 Elmora Avenue	0.054	Manufacturer of Generic Pharmaceuticals - 2834	Yes
2	Duro Bag Manufacturing Company	None	750 Dowd Avenue	0.018	Manufacturing of Paper Bags - 2674	No
3	LORCO Petroleum Services	None	450 S. Front Street	0.063	CWT, Oil Treatment & Recovery - 2992	Yes
4	Mastercraft Metal Finishing	039	801 Magnolia Avenue	0.00008	Manufacturing of Phonographic Masters - 3471	Yes
5	Michael Foods, Inc. - North Ave	None	877 North Avenue	0.109	Egg Processing - 2015	Yes
6	Michael Foods, Inc. - Jersey Pride	039	1 Papetti Plaza	0.110	Egg Processing - 2015	Yes
7	Superior Powder Coating, Inc.	None	600 Progress Street	0.014	Powder Coating of Metal Parts - 3399	Yes
8	Wakefern Food Corporation	002	600 York Street	0.013	Food Warehousing & Distribution - 5140	Yes

The NJPDES CSO Permit requires that impacts from significant indirect users (SIUs) contributing to the CSOs are minimized. Under the current rules and regulations, each SIU is required to incorporate a level of pretreatment prior to discharge to the sewer system based on the loading and toxicity of the SIU contributions. JMEUC monitors SIUs for compliance with the pretreatment requirements. Of the eight (8) SIUs located in the City of Elizabeth, only three of these facilities contribute flow to a sewer that is tributary to a CSO regulator / diversion structure, as noted in Table 2-6. An analysis of the discharge from these three SIUs for the average wet weather overflow volumes to evaluate the potential impacts on water quality is provided in Section 4.7.

Section 3
Baseline Sewer System Performance

3.1 Background

The hydrologic and hydraulic (H&H) computer model developed, calibrated and approved as part of the System Characterization phase serves as the basis for demonstrating compliance with the regulatory requirements for combined sewer overflow (CSO) control. The model is the main tool used to simulate existing conditions and to evaluate the range of CSO control alternatives.

The System Characterization Reports for the City and JMEUC provide complete details on the development of the H&H computer model representing the hydraulically connected sewer system and its response to wet weather events. The modelling of the CSO control alternatives is consistent with the approach to modeling performed under the system characterization.

3.2 Hydraulic Model Development

Using a detailed delineation of the existing collection system pipe network conditions from geographic information system (GIS) data, record drawings and field surveys as well as precipitation and sewer flow monitoring data, an existing conditions collection system H&H model was developed for the City and JMEUC's combined sewer system during the System Characterization phase. The model has been calibrated and validated to reflect the combined sewer system's predicted response to precipitation events, so that the location, frequency, volume, and duration of overflows can be characterized. By predicting the potential performance under various system modifications and configurations, the model also provides the basis for making decisions on long term CSO controls.

3.2.1 Rainfall and Sewer Flow Monitoring

To generate data on actual physical conditions, the City performed a precipitation and sewer flow monitoring program reflecting the extent and complexity of the combined sewer system. 40 continuous flow meters, 3 rain gauges, 2 tide gauges, 14 tide gate contact switches, and 2 groundwater level monitors were installed throughout the system for the monitoring period of August 22, 2015 through December 21, 2015. The 40 flow meter locations were distributed as follows: 14 meters on incoming combined sewers upstream of overflow control structures; 10 meters on overflow outfall lines; 6 meters along the Easterly Interceptor; 6 meters along the Westerly Interceptor; and 4 meters on storm sewer lines.

The monitoring data collection and processing activities followed the quality assurance procedures identified in the QAPP. The flow meters recorded the flow depth, velocity, and flow data in 5-minute intervals throughout the 4-month monitoring period. The rain gauge network provided precipitation monitoring coverage to capture and characterize intense and spatially variable storm events across the overall sewershed. During the monitoring period, a total of 10 precipitation events occurred, varying in duration from 2.8 to 46 hours and in peak intensity from 0.07 to 0.76 inches per hour (in/hr). Various periods of dry weather conditions, defined as a minimum of 3 days of no precipitation following a rainfall exceeding 0.25 inches, or two days of no precipitation following a rainfall 0.25 inches or less, were captured within the monitoring period.

One tide gauge was installed at the Elizabeth Municipal Marina on the Arthur Kill and the other was located on the Elizabeth River at Bridge Street. Readings at the marina were taken as being representative of tides for Newark Bay as well. The observed tidal data for the monitoring period was found to be consistent with National Oceanic and Atmospheric Administration (NOAA) data for the Sandy Hook, NJ station.

The 14 tide gate limit switches were strategically located to assist with the determination of CSO volumes with high tide tailwater conditions using scattergraph techniques. The on/off state of the limit switches monitored the open/closed status of the tide gate position and the time and duration of the limit switch on status were used in CSO quantification at certain locations where backwater conditions were experienced prior to an overflow event.

The 2 groundwater monitors were installed in manholes along Front Street, near the Arthur Kill waterfront, to identify the potential for groundwater infiltration in this low-lying area which has older vitrified clay pipe sewers that may be susceptible to infiltration from leaking manhole and pipe defects. However, the gauges did not record any measurable groundwater levels during the monitoring period.

3.2.2 Network Definition and Refinement

The collection system model was developed using the Innovyze InfoWorks® ICM computer program. The existing conditions model incorporates all sewers 24" and larger in diameter, and a substantial number of smaller sewers. All interceptor, trunk, overflow control structures, and outfall pipes have been included in the model, along with various sewage and stormwater pumping facilities. This broad model geometry facilitates simulating and routing of dry weather and wet weather flow components throughout the combined sewer collection system.

A dry weather flow (DWF) analysis was conducted on the data from the current collection system monitoring period for each meter with such flows. Dry weather weekday and weekend flows were segregated from the datasets and diurnal peak factors were calculated. The metersheds were analyzed for population estimates and correlated to the sanitary flow component in the recorded data for that meter. The groundwater infiltration component in the meter data was also translated to unit factors on a metershed basis. The DWF characteristics from the metersheds were then assigned to the broader sewersheds according to the location and physical characteristics of the sewersheds.

Similarly, a wet weather flow (WWF) analysis was performed on the tributary area to each meter, whereby runoff generation characteristics, such as impervious area, initial abstraction, and runoff coefficients, were calculated. These parameters were entered in the modeling program and peak WWF were generated. Adjustments in the WWF generation coefficients were then made as part of the calibration process.

3.2.3 Calibration and Validation

The 10 rainfall events captured during the monitoring period were classified based on duration and intensity into 4 categories and 4 events were selected for model calibration and 2 events were selected for model validation to cover a range of wet weather conditions. For the selected rainfall events, the simulated model results were compared with the measured data against criteria for peak flow rate, volume, timing of peak, and hydrograph shape. The overall model results match the metered data closely, with the majority of the goodness-of-fit values falling on the 45-degree line, indicating an excellent correlation between the simulated and measured flows. Where the simulated values differ from the measured values, the goodness-of-fit points are predominantly above the direct correlation line, signifying that the model is able to conservatively overestimate the indicated property.

3.3 Typical Year Selection

The selection of a typical hydrologic record serves to provide a representative and unbiased prediction of average design rainfall conditions that incorporates the variability observed in the historical records. In conjunction with the NJ CSO Group, local historical rainfall data and storm patterns were analyzed and calendar year 2004 was selected as the Typical Year hydrologic dataset for the LTCP efforts by the NJ CSO Group permittees. Precipitation data from the Newark Liberty International Airport rain gauge as well as the more recent period of 2004 was used in order to consider local climate change and reflect more recent climate conditions. With the submission of the Typical Hydrologic Year Report by PVSC on behalf of the NJ CSO Group, the NJDEP responded in May 2018 that the submitted report addressed all its questions and comments to its satisfaction. The 2004 precipitation data set was utilized as the Typical Year condition for the analysis of the CSO control alternatives.

3.4 Model Adjustments

The characterization of the City's combined sewer system presented in the previously submitted System Characterization report centered on generating, calibrating, and validating a detailed computer model of the collection system to serve as the key tool in assessing the existing system's response to wet weather events. Calibration and validation procedures confirmed that the baseline H&H model presented in the System Characterization accurately reflected the combined sewer system's response to conveying flows and provide a solid basis for making future system improvements and modifications.

Since the previous submission, evaluation and updates have been made to the model to reflect the latest data available as well as current system understanding. All data and updates were carefully examined to determine the effect on total combined sewer overflow (CSO) volume. Special attention was given to stormwater systems and their connections to combined sewer conduits.

Following the completion of the baseline model for the system characterization, additional model review was conducted as were additional investigations under the City's Municipal Separate Storm Sewer System (MS4) program. It was determined that the model had accounted for runoff from some separately sewered areas in the City as part of the CSO volume calculation, such that the separate storm sewer flow was connected into the system upstream of CSO regulators rather than downstream. This impacted the flow at regulator basins R001, R003, R027/R028, R032, R036 and R042. The model was updated to improve the locations where runoff from the affected sub-catchments is discharged to the model. Analysis points for CSO discharge statistics were relocated from outfalls to regulator weirs to omit these separately sewered contributions from the CSO overflow volume calculation. This resulted in a reduction of approximately 485 acres of separately sewered area which had previously contributed to CSO volumes.

In addition, the system characterization model also had several sanitary sub-catchments with a total area of 790 acres that were producing runoff. However, these sub-catchments were located in separated sewer areas, thus the model was corrected to exclude the runoff flow component from these areas. The majority of the affected areas are located in the vicinity of the Jersey Garden complex which drains to the Kapkowski Road Pumping Station. The modeled capacity of the pumping station limited the impact on the overall model and prevented detection of the issue during the calibration of the Easterly Interceptor.

The updated model has been used as the base model for the evaluation and selection of the CSO control program, using the same precipitation data, flow metering data, and calibration periods. An important metric for evaluation of system performance is percent capture. This metric is defined as the percentage of wet weather combined sewer flow captured for treatment during the Typical Year, consistent with the EPA CSO Control Policy. Percent capture can be calculated based on either (1) the total flow in the full JMEUC system (i.e. JMEUC's entire service area), or (2) the flow in only the Elizabeth sewer system. Calculations have been made and reported in this LTCP using both methods. The percent capture changes in the baseline condition resulting from updating of the model are presented in the following table. While the overflow volumes were reduced by about 20%, the wet weather inflow volumes decreased as well, resulting in a lower percent capture when using output from the updated model. The change in percent capture for both the Elizabeth system only, as well as the full JMEUC system are provided below:

Table 3-1: Updates to System-Wide Percent Capture Calculation

Percent Capture: System Characterization Model		Percent Capture: Updated Model	
Elizabeth system only	**Full JMEUC system**	**Elizabeth system only**	**Full JMEUC system**
66.5%	83.1%	58.3%	81.0%

Since the interceptor system frequently runs at capacity, the isolated changes made did impact the overflow statistic systemwide. In general, the prior calibration statistics were maintained or improved following the model updates. The comparison of results between the System Characterization model and the Updated model are presented in Table 3-2. The updated model reduces total overflow volume by 202 million gallons (MG), and results in a reduction of the number of overflow events at most locations except for Outfall 027A. Overflow durations and peak flows are reduced at all locations.

3.5 Future Wastewater Flow Projections

The year 2050 was selected as the future condition, representing a 30-year planning period. Flows to the system were developed based on population projections and estimates of planned projects to the year 2050.

The City is fully developed with limited available space for additional residential development, which corresponds to a relatively low future population growth rate. Average per capita sanitary flow rates have also been trending downward over the past decade due to the adoption of water conservation measures and low-flow plumbing fixtures. The population for the future baseline condition was increased at annual rate of 0.36% per year, or 15.4% total, from the 2010 population of 124,969 persons to an extrapolated 2050 population of 144,240 persons for the City overall, based on US Census Bureau projection.

3.6 Future Baseline Typical Year System Performance

The estimated CSO performance by outfall associated with 2050 future conditions for the representative hydrologic year is provided in Table 3-3. Compared to the 2015 updated model results producing a total overflow volume of 866 MG, the 2050 condition produces a total of 898 MG. The maximum number of overflow events increases from 54 to 55 per year.

Table 3-2: Model Update Comparison of Results

	Characterization Model (2015 Baseline)				Updated Model (2015 Baseline)				Change			
Outfall No.	No. Overflow Events	Overflow Volume (MG)	Duration (hours)	Peak Flow (MGD)	No. Overflow Events	Overflow Volume (MG)	Duration (hours)	Peak Flow (MGD)	No. Overflow Events	Overflow Volume (MG)	Duration (hours)	Peak Flow (MGD)
001A	42	86.3	432	73.4	41	48.5	338	61.2	-1	-37.8	-94.3	-12.2
002A	35	32.3	224	62.0	31	24.5	239	51.7	-4	-7.8	15.3	-10.4
003A	43	60.7	285	188	43	57.7	291	175	0	-3.1	6.0	-12.4
005A	54	96.6	593	61.3	53	85.4	588	45.6	-1	-11.2	-4.6	-15.6
008A	36	9.62	302	11.8	36	8.65	303	10.2	0	-1.0	1.8	-1.6
010A	42	17.2	271	31.8	37	12.8	264	31.5	-5	-4.4	-7.6	-0.3
012A	44	5.84	355	3.14	38	4.47	318	1.09	-6	-1.4	-36.8	-2.1
013A	42	16.8	313	20.9	36	14.6	288	20.0	-6	-2.3	-24.8	-0.9
014A	13	1.05	16.3	6.57	8	0.396	9.83	4.11	-5	-0.7	-6.5	-2.5
016A	46	16.7	367	28.1	42	14.6	332	26.6	-4	-2.1	-34.7	-1.5
021A	19	1.44	32.0	6.36	12	0.877	25.2	4.39	-7	-0.6	-6.9	-2.0
022A	46	71.3	591	62.0	44	53.5	456	58.4	-2	-17.8	-135	-3.5
026A	53	53.2	613	54.3	54	50.3	575	53.5	1	-2.8	-37.7	-0.8
027A	25	27.7	378	42.9	35	21.5	350	34.2	10	-6.2	-28.1	-8.7
028A	35	35.4	514	57.0	34	22.2	334	46.0	-1	-13.2	-179	-11.0
029A	39	44.6	474	60.4	36	32.7	336	55.4	-3	-12.0	-138	-5.0
030A	11	2.18	18.7	38.1	11	1.98	16.9	38.0	0	-0.2	-1.8	-0.0
031A	35	15.4	266	35.7	32	12.3	256	35.8	-3	-3.1	-9.8	0.1
032A	26	7.37	82.9	40.7	19	2.41	34.2	20.2	-7	-5.0	-48.7	-20.5
034A	44	77.7	404	70.3	38	66.6	297	65.1	-6	-11.1	-106	-5.2
035A	35	42.6	307	51.8	31	34.6	267	45.6	-4	-8.0	-39.4	-6.1
036A	30	43.6	240	61.4	29	33.8	162	86.0	-1	-9.7	-77.5	24.6
037A	44	64.6	463	46.5	38	47.7	350	33.0	-6	-16.9	-112	-13.6
038A	30	8.58	224	40.0	30	8.27	202	38.1	0	-0.3	-22.0	-1.9
039A	27	9.87	88.4	18.1	27	9.48	109	17.9	0	-0.4	20.6	-0.2
040A	42	16.3	262	20.0	37	11.8	242	17.7	-5	-4.5	-19.5	-2.3
041A	53	192	591	146	53	176	585	132	0	-16.0	-6.6	-14.3
042A	19	11.5	54.3	58.9	16	8.68	40.9	44.3	-3	-2.8	-13.4	-14.6
043A	3	0.157	1.47	6.16	3	0.048	0.500	3.35	0	-0.1	-1.0	-2.8
Total		**1,068**				**866**				**-202**		

Table 3-3: 2050 Baseline Typical Year CSO Performance

Outfall No.	Outfall Name	Annual Total			Maximum
		No. Overflow Events	Overflow Volume (MG)	Duration (hours)	Peak Flow (mgd)
001A	Airport South Area	49	50.2	428	61.2
002A	Dowd Avenue	31	24.8	239	51.7
003A	Westfield Avenue & Magie Avenue	43	57.9	304	175
005A	Westfield Avenue	54	90.1	658	45.5
008A	West Grand Street/Price Street	36	9.04	325	10.2
010A	Murray Street/Cherry Street	38	12.9	265	31.5
012A	Rahway Avenue	40	4.75	338	1.09
013A	Rahway Avenue/Burnet Street	39	14.7	290	20.0
014A	Broad Street Rahway Avenue	8	0.409	9.92	4.13
016A	Edgar Road/Pearl Street	42	15.0	345	26.5
021A	Spring Street/Third Avenue	13	0.894	25.3	4.39
022A	South Street	45	57.5	696	58.4
026A	John Street	55	52.3	644	53.5
027A	Summer Street/Arnett Street	40	22.5	534	34.4
028A	Summer Street/Arnett Street	35	23.4	498	46.1
029A	South Front Street	37	34.1	488	55.5
030A	Front Street/East Jersey Street	11	2.00	16.9	38.0
031A	Front Street/Livingston Street	33	12.6	267	35.8
032A	Front Street/Magnolia Avenue	19	2.42	34.2	20.2
034A	Atalanta Place	41	68.9	368	65.2
035A	South Front Street/Third Avenue	37	36.1	307	46.6
036A	Orchard Street/Dod Court	29	34.3	164	85.9
037A	Bayway/South Front Street	40	50.8	386	33.0
038A	Third Avenue	30	8.34	203	38.3

Outfall No.	Outfall Name	Annual Total			Maximum
		No. Overflow Events	Overflow Volume (MG)	Duration (hours)	Peak Flow (mgd)
039A	Trumbull Street, Fourth Street	27	9.56	109	17.9
040A	Pulaski Street/Clifton Street	39	12.3	264	17.7
041A	Morris Avenue/Sayre Street	54	182	624	132
042A	Bridge Street/Elizabeth River	18	8.78	43.7	44.4
043A	Army Corps Flood Control Structure	3	0.050	0.500	3.41
System-wide Total		**not appl.**	**898**	**not appl.**	**not appl.**
System-wide Maximum		**55**	**182**	**696**	**175**

Section 4
Water Quality Objectives

4.1 Background

In order to improve the water quality of the receiving waters, the primary objectives of the CSO long term control program are the reduction of pathogens and CSO volume. The overall goal is to select and implement a CSO control program to cost-effectively improve water quality of the receiving waters so as to advance the water-quality based requirements of the Clean Water Act (CWA) consistent with NJPDES CSO Permit and the National CSO Control Policy. The CSO control program costs and water quality benefits achieved through combined sewer overflow reduction must be fair and equitable to the community and take into consideration the benefits reasonably attainable given other pollution sources impacting the receiving waters.

4.2 CSO Control Approach Alternatives

Per the National CSO Control Policy, a Long Term Control Plan can adopt either the Presumption Approach or the Demonstration Approach to achieve the objectives of the policy. The NJPDES CSO Permit Section G.4.a stipulates that permittees are to evaluate a reasonable range of CSO control alternatives that will meet the water quality-based requirements of the CWA using either the Presumption Approach or the Demonstration Approach.

The Presumption Approach refers to a program that is presumed to achieve attainment of water quality standards (WQS). The Presumption Approach requires that the CSO control program meets any of the following three (3) criteria, provided that the permitting authority determines that the approach is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and in consideration of sensitive areas:

1. No more than an average of four overflow events per year occurs from a hydraulically connected system as the result of a precipitation event. The Department may allow up to two additional overflow events per year.
2. Elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system (CSS) during precipitation events on a hydraulically connected system-wide annual average basis.
3. Elimination or removal of no less than the mass of the pollutants, identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort, for the volumes that would be eliminated or captured for treatment under paragraph 2 above.

The Demonstration Approach refers to a program that uses a receiving water model to demonstrate compliance with each of the following criteria from the National CSO Control Policy:

1. The planned control program is adequate to meet WQS and protect designated uses, unless WQS or uses cannot be met as a result of natural background conditions or pollution sources other than CSOs.
2. The CSO discharges remaining after implementation of the planned control program will not preclude the attainment of WQS or the receiving waters' designated uses or contribute to their impairment.
3. The planned control program will provide the maximum pollution reduction benefits reasonably attainable.

4. The planned control program is designed to allow cost effective expansion or cost-effective retrofitting if additional controls are subsequently determined to be necessary to meet WQS or designated uses.

4.3 Receiving Waters Description

The City of Elizabeth CSO outfall receiving waters are the Elizabeth River, the Arthur Kill and Newark Bay. The Peripheral Ditch and Great Ditch are manmade stormwater conveyance ditches tributary to Newark Bay and are noted in NJPDES CSO Permit No. NJ0108782 as receiving streams.

These receiving waters are located within Watershed Management Area (WMA) 7 – Arthur Kill as designated by NJDEP. According to the State of New Jersey "2014 Hazard Mitigation Plan: Appendix P Watersheds" document, water quality in WMA 7 is reported as being reflective of urbanized streams and past industrial uses. Key issues in this watershed are indicated as including point and nonpoint source pollution, habitat destruction, and flood control. Sources of nonpoint pollution can involve construction activities, storm sewers, and urban surface and road runoff and these conditions are noted as having contributed to high stream temperatures, sediment and nutrient loadings, periodic low dissolved oxygen levels and fish kills.

Under the New Jersey Surface Water Quality Standards (SWQS), the Arthur Kill and Newark Bay are classified by NJDEP as saline estuary waters designated use class 3 (SE3), with four CSO outfalls discharging to each. The Peripheral Ditch and Great Ditch, which are manmade and mainly convey stormwater, drain to Newark Bay, and thus have been grouped as such. The Elizabeth River is divided into two reaches for SWQS classification, based on salinity content. The lower reach, from the Broad Street bridge to the mouth, is classified as saline estuary SE3 and eleven CSO outfalls discharge to this section. The upper reach of the Elizabeth River, from the source to the Broad Street bridge, is classified as freshwater category 2, non-trout supporting (FW2-NT) and ten outfalls discharge to this section. The outfalls can be grouped according to the receiving waters and water quality requirements as listed in Table 4-1 and outfall locations are shown in Figure 4-1.

Table 4-1: City of Elizabeth Receiving Waters

Waterbody	Reach	Water Quality Classification	Outfalls Discharging in this Reach
Elizabeth River	North of Broad St. bridge	FW2-NT	003A, 005A, 008A, 010A, 012A, 013A, 014A, 016A, 036A, 041A
	Broad St. bridge to mouth	SE3	021A, 022A, 026A, 027A, 028A, 029A, 035A, 038A, 040A, 042A, 043A
Arthur Kill	n/a	SE3	030A, 031A, 032A, 037A
Newark Bay and ditches	n/a	SE3	001A, 002A, 034A, 039A

The 2014 New Jersey Integrated Water Quality Monitoring and Assessment Report 303(d) list is a catalog of the impaired waters throughout the state of New Jersey. The Elizabeth River below the Elizabeth City corporate boundary appears on the 303(d) list as being impaired for the following pollutants: arsenic, benzo(a)pyrene (PAHs), chlordane in fish tissue, DDT and its metabolites in fish tissue, dieldrin, dioxin, heptachlor epoxide, hexachlorobenzene, lead, mercury in fish tissue, PCB in fish tissue, pH, phosphorus (total), total dissolved solids (TDS). These contaminants primarily impact the designated use of fish consumption for SE3 and FW2 classified waters. However, combined sewer overflows are not associated as a source of these chemical pollutants and the historical water quality impairments. The primary water quality concerns related to combined sewer overflows are as a source of pathogen loads.

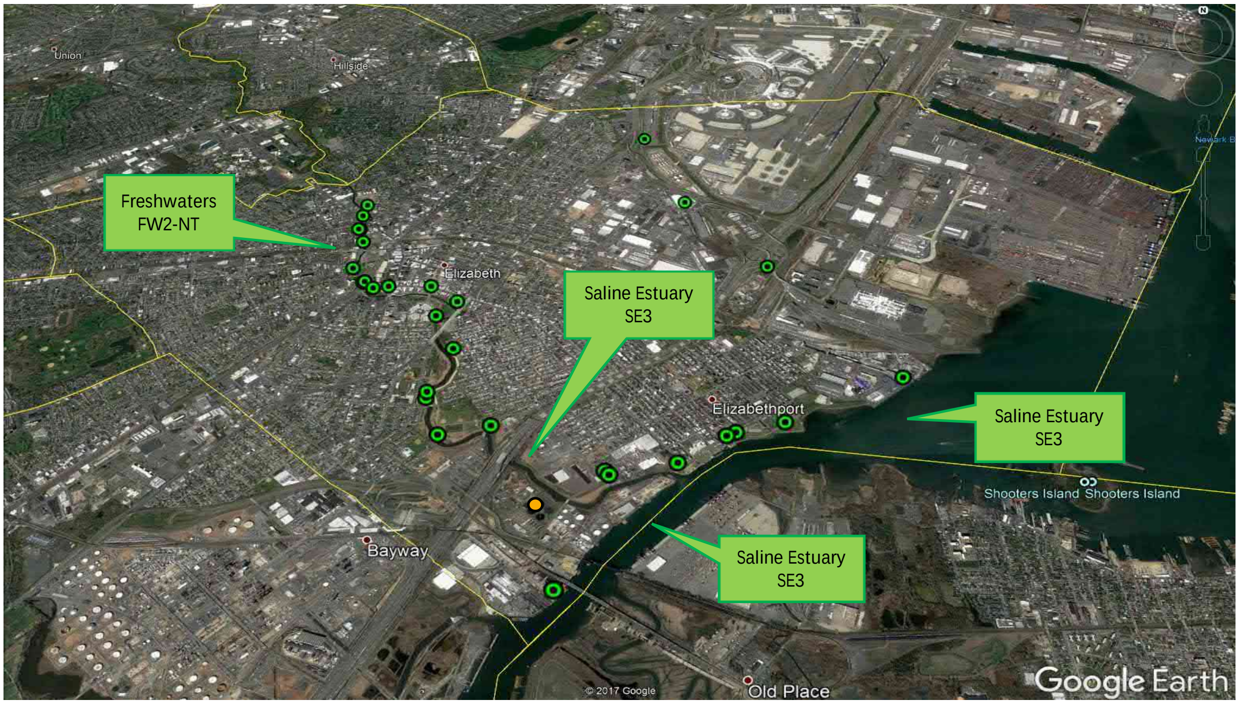


Figure 4-1: City of Elizabeth Receiving Waters

4.4 Water Quality Parameters and Applicable Standards

NJDEP has established the Surface Water Quality Standards, which outline designated uses for the state's surface waters, classify those waters based on their designated uses, and establish water quality criteria for each waterbody classification. The standards are based on both bacterial and physical/chemical standards such as levels of dissolved oxygen, turbidity, nutrients, and pH. Discharges from combined sewer overflows contribute pathogens, and thus the parameter of interest for CSOs is the bacterial standards. Bacterial standards are typically set with monthly mean and single sample maximums set at levels to protect the watercourse's primary or intended use. The receiving waters relevant to the City of Elizabeth are FW2-NT (freshwaters category 2, non-trout supporting) and SE3 (saline estuarine). The NJDEP surface water bacterial quality criteria and designated uses for these waters are shown in Table 4-2.

Table 4-2: Surface Water Quality Standards

Classification	Designated Use(s)	Indicator Bacteria	Criteria (per 100 mL)
FW2-NT (Fresh Water Non Trout)	1. Maintenance, migration and propagation of the natural and established biota; 2. Primary contact recreation; 3. Industrial and agricultural water supply; 4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate)	E. Coli	126 cfu geometric mean, 235 cfu single sample maximum

Classification	Designated Use(s)	Indicator Bacteria	Criteria (per 100 mL)
SE3 (Saline Estuarine Water)	1. Secondary contact recreation; 2. Maintenance and migration of fish populations; 3. Migration of diadromous fish; 4. Maintenance of wildlife; 5. Any other reasonable uses.	Fecal Coliform	1500 cfu geometric mean

4.5 Water Quality Data Analysis

The City of Elizabeth and JMEUC are participating members of the NJ CSO Group, which is a collaboration of various CSO permit holders to coordinate CSO programs that impact common receiving waterbodies and share resources and services on a regional basis. Members of the NJ CSO Group cooperatively conducted a regional Compliance Monitoring Program to satisfy various permit conditions, with the Passaic Valley Sewerage Commission (PVSC) serving as the program manager. The program included ambient in-stream monitoring and other work necessary to define the baseline conditions of the CSO receiving waters and the preparation of a receiving water quality model. Extensive investigations have been conducted on the current water quality conditions in the subject waterbodies on behalf of the NJ CSO Group and the reader is directed to the PVSC Baseline Compliance Monitoring Report (October 2018) for further information. A brief summary description of the program and data is provided in Section 4.5.1.

In order to evaluate the suitability of the Demonstration Approach should a permittee choose it as the LTCP approach, the development of a Pathogen Water Quality Model was also undertaken through the NJ CSO Group to understand the pollutant sources and their relative contributions for the affected study area. The results of this modeling are summarized in Section 4.5.2. The NJ CSO Group water quality model was used to provide insight into what level of control for the CSO outfalls maybe needed to demonstrate attainment of WQS and designated uses of the corresponding receiving waters. The Pathogen Water Quality Model was used to calculate bacteria water quality data for the Baseline Conditions and to assess the attainment of pathogen water quality standards under potential future CSO control levels.

4.5.1 Baseline Compliance Monitoring Program

The NJPDES CSO Permits direct permittees to implement a Compliance Monitoring Program (CMP) adequate to verify existing ambient water quality conditions for pathogens and evaluate the effectiveness of future CSO controls related to compliance with water quality standards and the protection of designated uses. A Baseline Compliance Monitoring Program (BCMP) Report, revision date October 2019, was submitted by PVSC on behalf of the NJ CSO Group to document the ambient in-stream sampling work and data collected under the Baseline Compliance Monitoring Program. The purpose of the BCMP is to generate sufficient data to establish existing ambient water quality conditions for pathogens in the CSO receiving waters and to update, calibrate and validate a pathogen water quality model of the receiving waterbodies. The report was approved by NJDEP in March 2019.

The CMP report describes the full Baseline Compliance Monitoring Program implemented through the NJ CSO Group, including the program description; the field sampling and the field and laboratory analytical methods used; the data quality objectives; an evaluation of data completeness, precision, and representativeness; and presentations and discussion of data results. The three pollutants of concern (POCs) identified for the receiving waters are fecal coliform, E. coli, and Enterococcus. The concentrations of these identified POCs are parameters typically associated with CSO discharges. The impact of CSO discharges on the receiving waters for the POCs were further investigated through the receiving water quality monitoring and modeling program with the NJ CSO Group.

The BCMP involved 3 categories of data generation and collection, based on sampling location and sampling for routine or wet weather events:

1. Baseline Sampling was modeled after and intended to supplement the approved routine sampling program of the New Jersey Harbor Dischargers Group (NJHDG), of which PVSC is a member.
2. Source Sampling targeted the major influent streams within the study area to establish non-CSO loadings and coincided with the NJHDG and Baseline Sampling. Baseline Sampling and Source Sampling stations were sampled under the same field activities.
3. Event Sampling was timed to coincide with rainfall to capture three discrete wet-weather events over the course of the year on each segment of the NY-NJ Harbor complex impacted by CSOs.

The CMP Report organizes the baseline, source, and event sampling locations by waterbody grouping, station number, and specific waterbody. A total of 35 baseline sampling locations (including select NJHDG stations), 7 source sampling locations, and 25 event sampling locations (which overlap with certain baseline sampling locations) were incorporated in the BCMP. Figure 4-2 provides the BCMP ambient water sampling locations in and surrounding the City of Elizabeth and Table 4-3 tabulates certain information from the CMP Report for the 11 corresponding sampling stations.

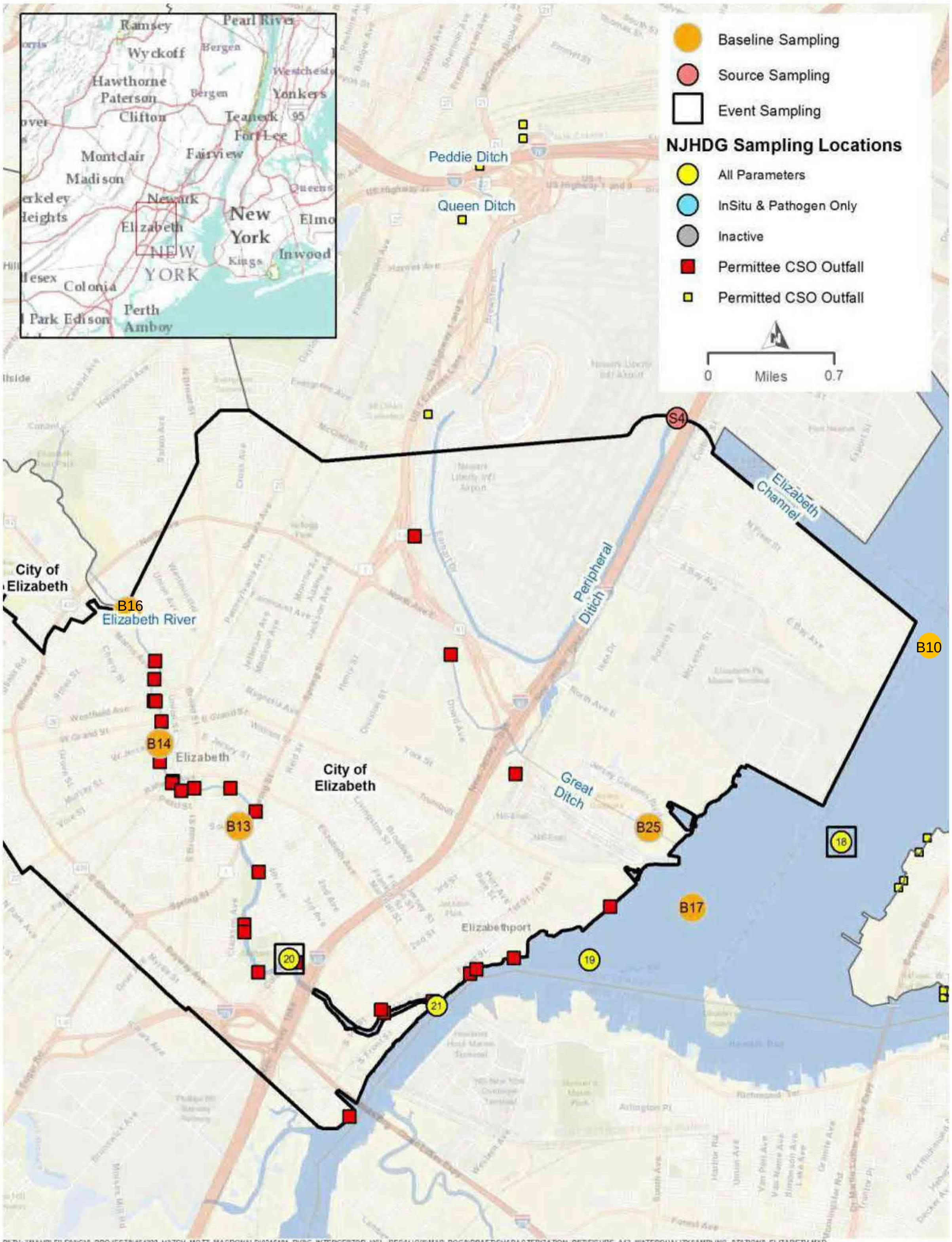
Table 4-3: Compliance Monitoring Program Sampling Locations, City of Elizabeth

Waterbody Grouping	Station No.	Waterbody	Sampling Category	Surface WQS Classification
Newark Bay & Tributaries	B10	Newark Bay	Baseline	SE3
	18	Newark Bay	NJHDG & Event	SE3
	B17	Newark Bay	Baseline	SE3
	19	Newark Bay	NJHDG	SE3
	21	Arthur Kill	NJHDG	SE3
	B16	Elizabeth River	Baseline	FW2-NT
	B14	Elizabeth River	Baseline	FW2-NT
	B13	Elizabeth River	Baseline	SE3
	20	Elizabeth River	NJHDG & Event	SE3
	S4	Peripheral Ditch	Source	SE3
	B25	Great Ditch Outlet	Baseline	SE3

Source: *NJ CSO Group Compliance Monitoring Program Report*, Passaic Valley Sewerage Commission, June 2018.

A total of 23 baseline and source (i.e., routine) sampling events were completed from April 2016 through March 2017 and the information presented for the baseline CMP Report includes the NJHDG data collected between March 2016 and December 2016. The event sampling goal of capturing 3 significant wet weather events, consisting of greater than 0.5 inches of precipitation within 24 hours, at each targeted station was completed across 4 sampling dates.

All samples collected were analyzed for fecal coliform and enterococcus and samples from freshwater locations were also analyzed for E. coli. During field sampling, field measurements were also made for: temperature, salinity, dissolved oxygen, light penetration (secchi depth), and turbidity. Depending on the sampling location, samples were collected at either 1 or 2 depths. For event sampling, locations were sampled twice per day for 3 days, except for 3 locations that were sampled 4 times per day for 3 days.



Source: *NJ CSO Group Compliance Monitoring Program Report*, Passaic Valley Sewerage Commission, June 2018.

Figure 4-2: Compliance Monitoring Program Sampling Locations

As stated in the NJ CSO Group CMP Report, the baseline ambient monitoring data collected met the goals of the corresponding Quality Assurance Project Plan and the data was sufficient for calibrating the pathogen water quality model.

In viewing the BCMP Report graphs for the baseline sampling results, the data indicated that the Elizabeth River waters entering the City do not meet WQS for pathogens. Furthermore, no changes in the pathogen data ranges were discernable between sampling locations situated along the stretch of the Elizabeth River studied. Values for sampling stations located along the upstream sections of the river were generally similar to values for stations along the downstream sections. As the number of CSO outfalls tributary to the river increase further downstream, the ambient in-stream monitoring data did not demonstrate a direct relationship between baseline pathogen concentrations and the presence of tributary CSO outfalls.

In comparing baseline and wet weather event sampling results for a given location, the wet weather pathogen concentrations fell within the upper range of the observed baseline ambient water quality results. However, it is noted that combined sewer overflows are only one of many wet weather pollution sources that may be influencing the higher in-stream pathogen concentrations coincident with the wet weather event sampling data and the contribution of the other pollution sources must be evaluated.

4.5.2 Pathogen Water Quality Modeling

The goal of pathogen water quality modeling is to assist in characterizing the impact of CSO discharges on water quality impairment and the corresponding level of CSO control necessary to meet water quality compliance requirements. The model can be used to demonstrate the CSO controls that will provide for the attainment of WQS, including designated uses in the receiving water, and is typically used with the Demonstration Approach. While the Presumption Approach does not explicitly call for analysis of receiving water impacts, it usually involves at least screening-level models of receiving water impacts. The reader is directed to the Calibration and Validation of the Pathogen Water Quality Model (PWQM) Report, dated June 2020, as prepared by PVSC on behalf of the NJ CSO Group, for further information about pathogen water quality modeling in the subject waterbodies. The following provides a brief discussion of the PWQM Report.

In further coordination with the NJ CSO Group, the pathogen water quality modeling was undertaken for the regional receiving waters of the member municipalities, including the Passaic, Hackensack, lower Hudson, Raritan and Elizabeth Rivers, Raritan Bay, the Upper and Lower Bays of NY-NJ Harbor System, connecting waterways Kill van Kull and Arthur Kill, and Newark Bay. The model was used to calculate bacteria concentrations in the waters of the NY/NJ Harbor complex under existing and potential future conditions to demonstrate attainment of applicable water quality standards.

The mass balance model developed for this effort considers upstream pollutant loadings and other pollution sources in addition to CSOs. The previously developed NY-NJ Harbor Estuary Program (HEP) pathogen model was the basis for the updated model. The model consists of two major components: a hydrodynamic module that defines the transport of the estuarine water throughout the Harbor-Bight-Sound complex, and a water quality module that tracks the fate of bacteria in the water column. The model projects pollutant concentrations spatially, vertically, and temporally. The model updates incorporated additional water quality sampling data to present performance against current water quality modeling standards. Hourly data was utilized to develop the baseline existing conditions model. The baseline conditions model was developed using the following:

- 2004 Newark International Airport meteorological conditions
- 2004 river flows
- 2015 infrastructure and development conditions

- Existing background pathogen loads

The sampling locations for available water elevations, current meter, temperature, and salinity data were the same as those presented in the Baseline CMP report. The monthly or weekly temperature and salinity monitoring data collected at more than 30 locations in NY-NJ Harbor by NJ Dischargers Group and NYC DEP were available for the Passaic and Hackensack Rivers, Hudson River, Upper and Lower Bays, as well as the Kills. These data sets provided long-term spatial and temporal variations of temperature and salinity conditions at most of the waterbodies within NY-NJ Harbor system. A field survey team also performed water quality surveys during wet weather events in 2016 and 2017 period.

The model was calibrated for each of the sampling locations over the course of time using 2016 data, as well as at various depths below the surface of the receiving waterbodies. It was determined that the model is able to adequately capture variations in water elevations, velocities varying with depth, as well as reproducing magnitude and temporal variations of water quality data.

The model comparison results at various depths for Station B17 in Newark Bay, extracted from the PWQM Report are presented in Figure 4-3. Newark Bay is classified as an SE3 waterbody, and fecal coliform are used for the bacteria criterion. The model reproduces the fecal coliform distribution very well. It is clear from both the model and data that the geometric mean of the fecal coliform concentrations is well below the criterion and this area of Newark Bay is in attainment of the criterion. The model overestimates the enterococci concentrations.

Figure 4-4 and Figure 4-5 present model versus data probability distributions for the freshwater (FW2) (Station B16), and saltwater (SE3) (Station 20) portions of the Elizabeth River, respectively. The Elizabeth River was one of the more difficult areas of the model to calibrate because, as can be seen in the data, the bacteria concentrations are elevated most of the time, which indicate there are high upstream pathogen loads and dry-weather sources. This makes it difficult to assess the model's response to wet-weather events because the bacteria concentrations are always high. The model underpredicts the E. coli data at Station B16, but still indicates the geometric mean concentration is well above the criterion. This area is upstream of any CSO and not impacted by the tides. The fecal coliform data at Station 20 is reproduced very well. The model is also able to show non-attainment at Station B16 and attainment at Station 20 as indicated by the data.

The model versus data comparison for Station 21 in the Arthur Kill is presented in Figure 4-6. This area is designated as SE3. The model distribution line compares favorably to both the fecal coliform and enterococci data. In many portions of the study area data are either collected at mid-depth, or the data do not show much difference between the surface and bottom concentrations. At this location in the Arthur Kill, there is some stratification between the surface and bottom concentrations in the upper end of the fecal coliform distribution, and the model is able to reproduce this feature.

As described in the PWQM Report, in order to calculate attainment of the criteria using the model, results from the surface layer of the model were used, such that the surface layer represents the top 10 percent of the water column. It was determined that this approach would be conservative since freshwater tends to stay on the surface because it is less dense than saline water, and most bacteria sources are associated with freshwater. In addition, attainment was based on spatial averaging over areas defined by NJDEP 14-digit Assessment Units (AU). Model surface cells within an AU were averaged, and the attainment was based on the average concentrations, allowing for all locations within the project area to be assessed. Furthermore, the model utilized thirty-day rolling periods, shifted on an hourly basis, to calculate the geometric mean.

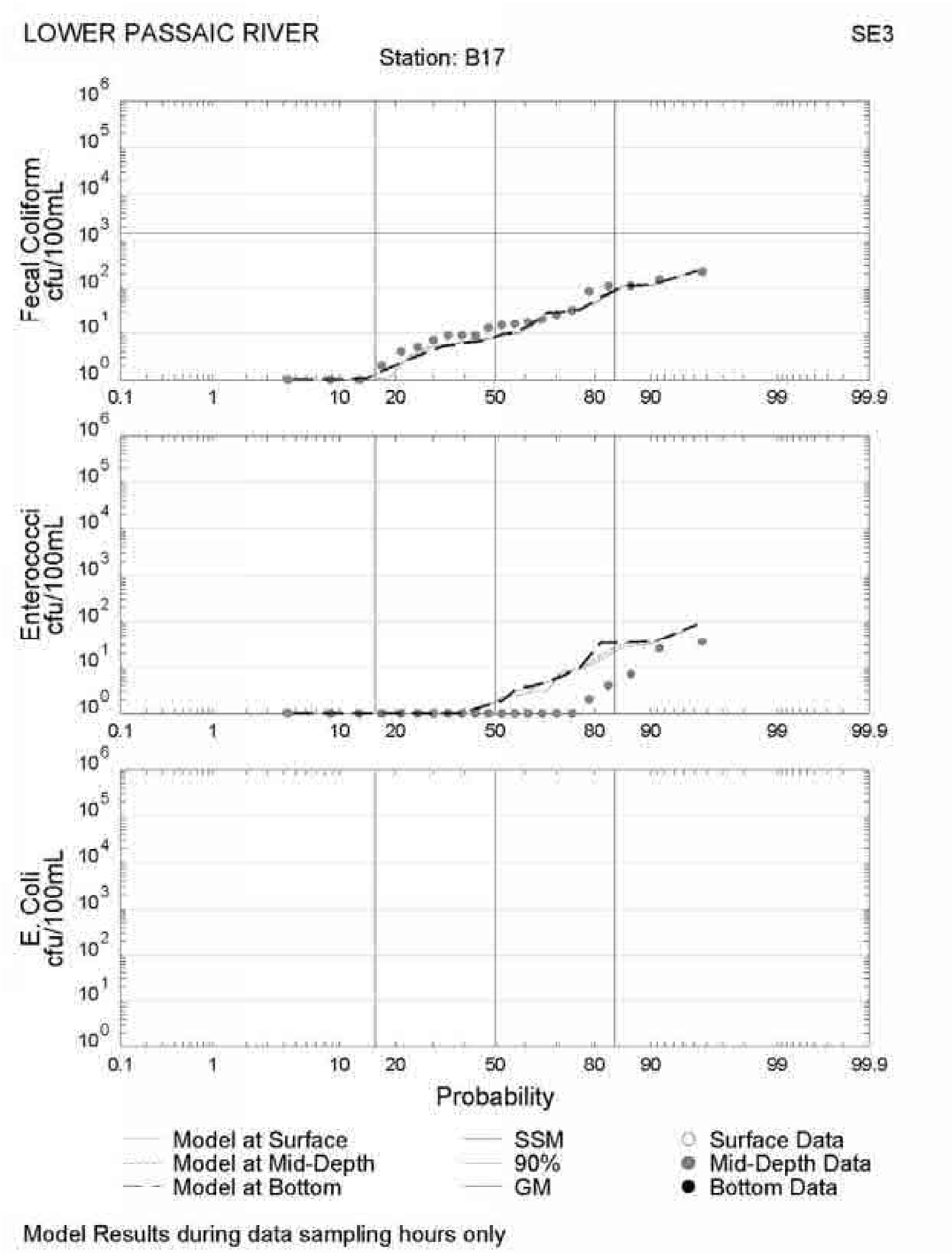


Figure 4-3: 2016 Annual Model versus Data Probability Distribution Comparison at Station B17, Newark Bay

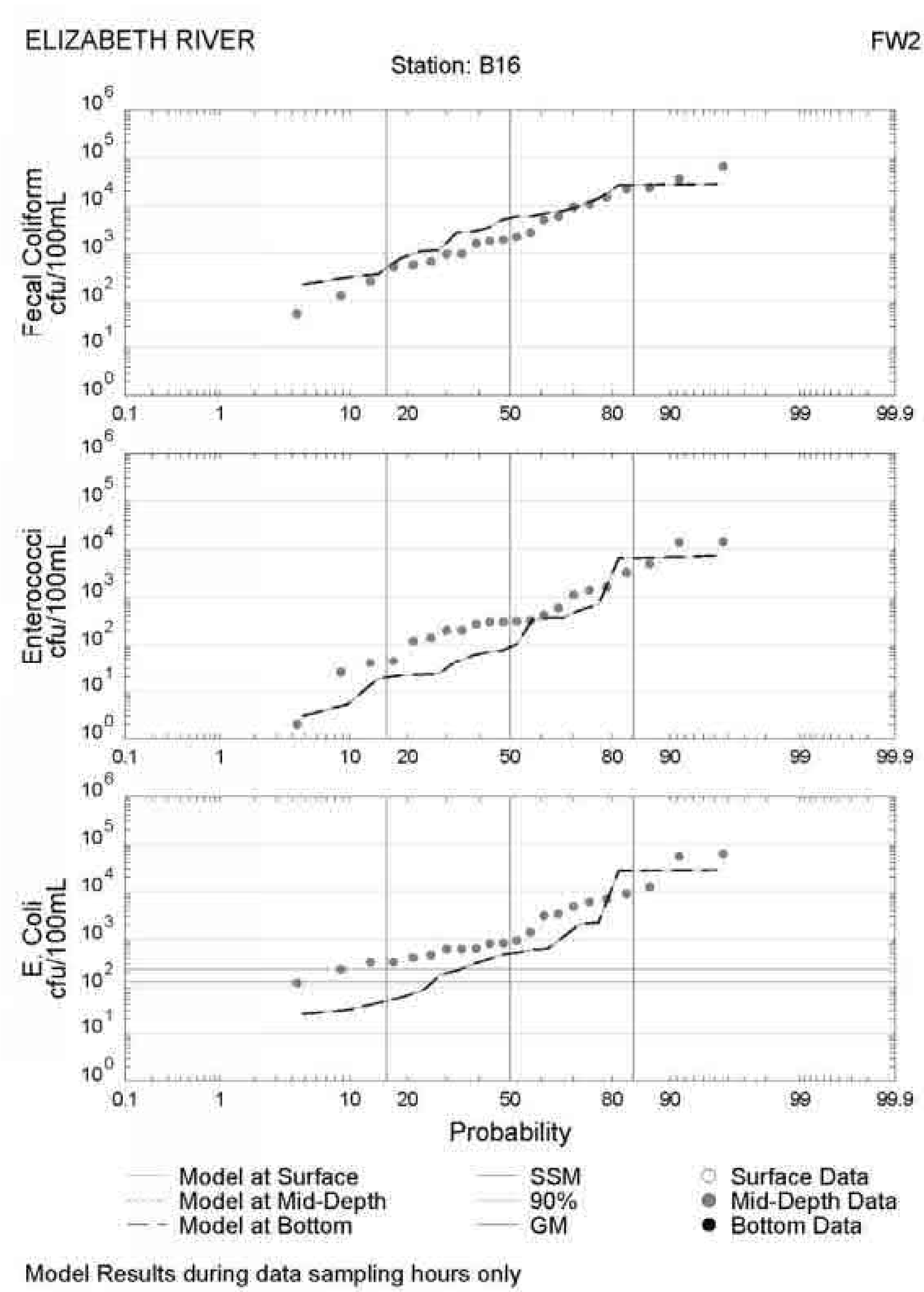


Figure 4-4: 2016 Annual Model versus Data Probability Distribution Comparison at Station B16, Elizabeth River

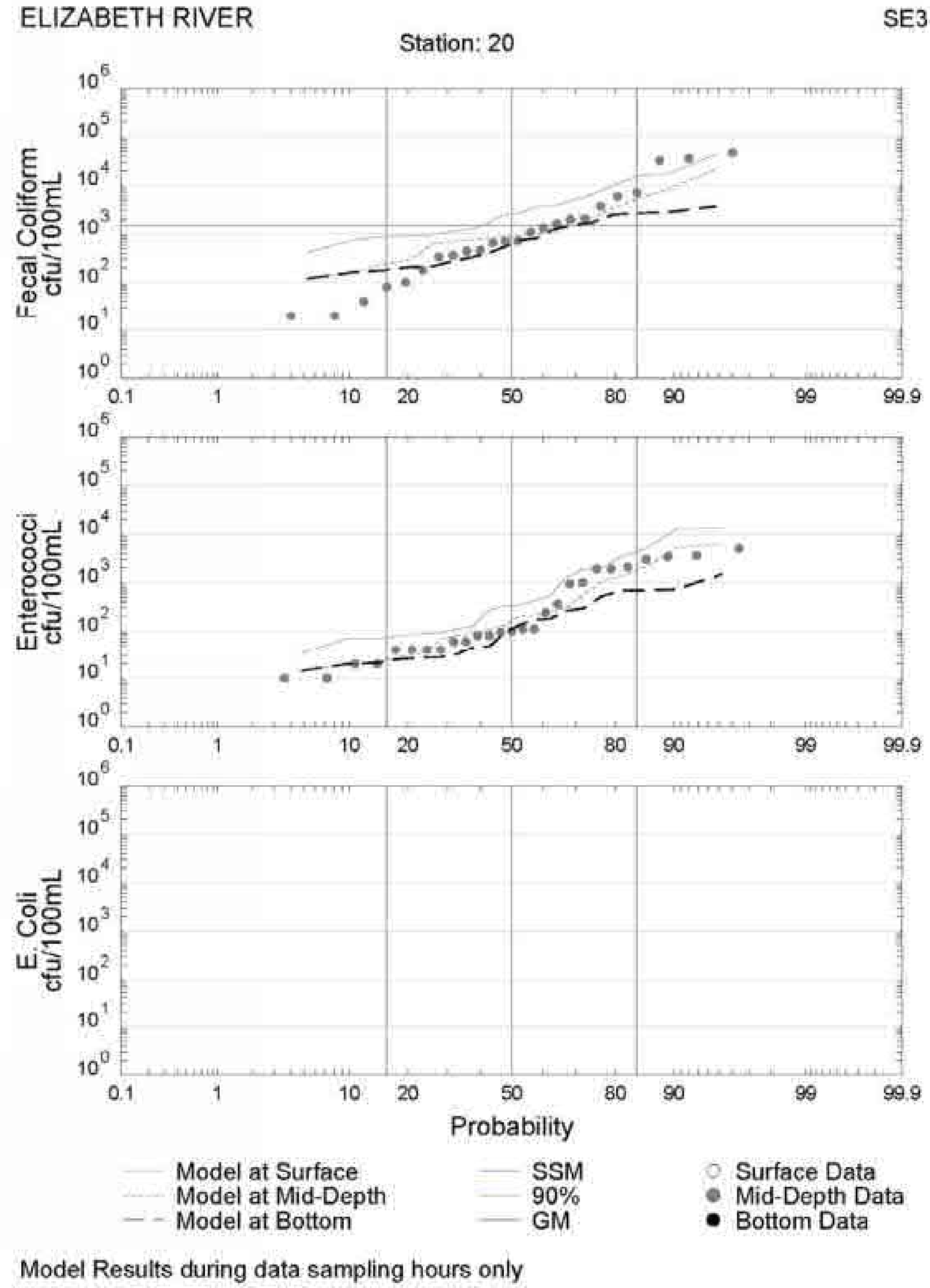


Figure 4-5: 2016 Annual Model versus Data Probability Distribution Comparison at Station 20, Elizabeth River

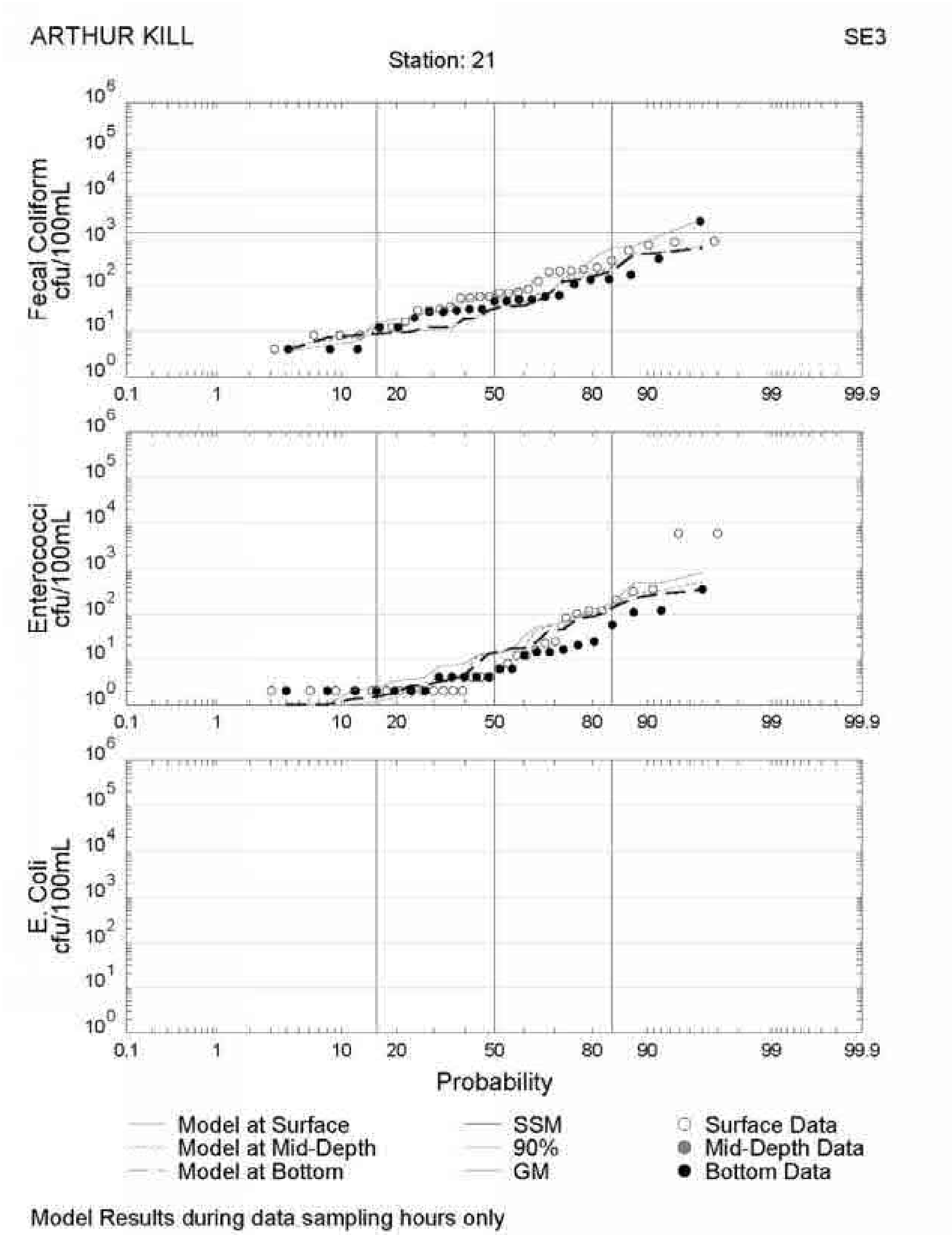


Figure 4-6: 2016 Annual Model versus Data Probability Distribution Comparison at Station 21, Arthur Kill

The water quality component analysis was completed in order to develop an understanding of the three pathogens of interest in the receiving waterbodies: E. coli, Fecal coliform, and Enterococci. The objective of the component analysis was to determine the concentrations of these pathogens based on relative contributions of other pollutant components, and to determine whether the concentrations of these pathogens as a result of CSO contributions would preclude attainment of water quality standards. The components analyzed were as follows:

- CSO contributions from New Jersey sources
- Stormwater runoff from New Jersey sources
- New Jersey sewage treatment plant contributions
- New York and Connecticut sewage treatment plant contributions
- New Jersey, New York and Connecticut rivers
- Hudson River
- Dry weather conditions
- New York City CSO and stormwater contributions

The PWQM also provides data to how CSO controls affect water quality and attainment with the water quality criteria. The PWQM Report presents a gap analysis of the model calculated attainment under the Baseline and a 100% CSO control conditions. The 100% CSO control condition represents the maximum level of control that can be attained for CSOs and results in the maximum improvement that can be achieved by CSO control only. Selected findings from the PWQM analysis as they relate to the City of Elizabeth's receiving waterbodies are presented below.

The component analysis for fecal coliform concentrations in Newark Bay demonstrates that concentrations rarely exceed 1,500 cfu/100 mL and do not approach the water quality standard which is a 30-day geometric mean of 1,500 cfu/100mL. In the Arthur Kill, like Newark Bay, fecal coliform concentrations are below the water quality standard which is a geometric mean of 1,500 cfu/100 mL for an SE3 waterbody. The lower Elizabeth River, which is an SE waterbody, has results similar to the Arthur Kill and Newark Bay. The main contributors to the fecal coliform concentrations modeled for these waterbodies are CSO contributions from New Jersey and New York City sources and stormwater runoff from New Jersey sources. In the upper Elizabeth River, which is FW2, E. coli concentrations exceed the water quality standard, which is 126 cfu/100 mL geometric mean, and 235 cfu/100 mL single sample maximum under the baseline conditions. The findings indicate that the Elizabeth River is heavily impacted by upstream sources, dry-weather discharge, and CSOs.

Table 4-4 summarizes the gap analysis results for the model calculated percent attainment of the pathogen water quality standards by receiving water under the Baseline and 100% CSO control simulations. The model results indicate that regardless of the level of CSO control, there is 100% attainment of the water quality standard for the Newark Bay, Arthur Kill, and lower Elizabeth River waters. However, for the upper Elizabeth River, regardless of the level of CSO control, there is 0% attainment of the water quality standard. Based on these PWQM results, the relative water quality benefits of different levels of CSO control are unclear because the attainment of the bacteria water quality standards does not vary with the CSO control.

Table 4-4: Attainment under Baseline and 100% Control Conditions

Receiving Water	Baseline % Attainment	100% CSO Control % Attainment
Newark Bay (SE3)	100.0	100.0
Arthur Kill (SE3)	100.0	100.0
Lower Elizabeth River (SE3)	100.0	100.0
Upper Elizabeth River (FW2)	0.0	0.0

4.5.3 Analysis and Discussion

The overall findings from the PWQM Report relevant to the City of Elizabeth and JMEUC are that:

- FW2 waters have poor attainment of the pathogen water quality criteria, and CSO control will not improve attainment of the criteria.
- SE3 waters generally fully attain the pathogen water quality criteria.

The modeling results from the gap analysis that compares the existing pathogen water quality conditions as a baseline to a situation where all combined sewer overflows are eliminated indicate that for the upper Elizabeth River, no matter what amount of overflow reduction is provided, the water quality standards cannot be achieved because of existing upstream pollutant loads and other sources of pathogens. For the Lower Elizabeth River, Arthur Kill, and Newark Bay, the gap analysis results indicate the opposite situation where the pathogen water quality standards are being attained under the existing conditions and of course would be attained under any reduction of CSO discharges.

With the existing and projected water quality conditions for the receiving waters, including the high upstream pathogen sources to the upper Elizabeth River, the water quality modeling does not provide a clear picture of the CSO controls necessary to protect water quality standards and the water quality benefits reasonably attainable. In such situations, the United States Environmental Protection Agency guidance documents note that the selection of the Presumption Approach is appropriate and acceptable (Combined Sewer Overflows: Guidance for Long-Term Control Plan, EPA, 1995). This will enable the City and JMEUC to move forward in addressing CSO impacts to the upper Elizabeth River with the CSO LTCP, while the upstream pathogen sources are potentially investigated by others, and these separate efforts may ultimately be merged into a comprehensive watershed approach for this waterbody.

4.6 Consideration of Sensitive Areas

Consistent with the requirements of the National CSO Control Policy, the NJPDES CSO Permits stipulate that the highest priority must be given to controlling overflows to sensitive areas. The permits define sensitive areas as designated Outstanding National Resource Waters; National Marine Sanctuaries; waters with threatened or endangered species and their habitat; waters used for primary contact recreation (including but not limited to bathing beaches); public drinking water intakes or their designated protection areas; and shellfish beds. If a CSO outfall discharges to a sensitive area, the CSO outfall is to be eliminated or relocated wherever physically possible and economically achievable, and where elimination or relocation is not feasible, treatment of the overflow deemed necessary to meet water quality standards must be provided. The implementation schedule for the LTCP must also place the highest priority to controlling CSOs to sensitive areas.

A thorough assessment of the potential need for a higher prioritization of any specific CSO discharge location in the City due to the presence of sensitive areas has been conducted. This work includes a detailed investigation of the subject waterbodies performed by the NJ CSO Group on behalf of the participating permittees, as described in the Identification of Sensitive Areas Report. PVSC prepared a Sensitive Areas Report on behalf of the permittees of the NJ CSO Group to identify all sensitive areas that are impacted by CSOs within the NJ CSO Group study area, which includes the receiving surface waters as well as the adjacent waters. A comprehensive review to identify sensitive areas within the project area was completed. Results from this review can be found in the Identification of Sensitive Areas Report issued last revised and submitted on March 29, 2019, and approved by NJDEP on April 8, 2019.

The City and JMEUC also solicited input on sensitive area considerations through its public participation process. Information on the sensitive areas assessment was compiled and presented at multiple public participation and supplemental team meetings. The City and JMEUC sought input from the team on sensitive locations, particularly related to primary contact recreational and public use activities. No wading, swimming, or other primary contact recreation activities in the receiving waters was reported. It was noted that the waters surrounding the CSO discharge points are generally restricted to public access for contact recreational use due to the earthen berm and concrete channel construction and low water depth of the Elizabeth River and heavy container ship and barge traffic on the Arthur Kill and Newark Bay.

The major findings and conclusions from these sensitive area evaluations are summarized below:

- No Outstanding Natural Resource Waters, National Marine Sanctuaries, bathing beaches, public drinking water intakes, or shellfish beds exist in the City of Elizabeth and JMEUC study area.
- No primary contact recreation has been observed or reported within the study area and no sensitive areas related to primary contact recreation were identified.
- The waterway configurations and site development in the vicinity of the CSO discharge points are not conducive to primary contact recreation uses. The channel depths, flows, construction, and current prevailing uses deter full or partial body contact recreation in the receiving waters.
- The Identification of Sensitive Areas Report noted that the Newark Bay and Arthur Kill waters are considered a potential migration corridor for the endangered Atlantic sturgeon and Shortnose sturgeon. As presented in the report, the populations of these species in the study area waters have been recovering and their recovery is not affected by exposure to human pathogens. The research indicates that the current level of habitat protection is adequate toward growing and maintaining healthy sturgeon population.
- Given the broad sturgeon habitat range across the saline waterbodies and the high water quality standards for the non-saline portion of the Elizabeth River, CSO impacts should be controlled broadly across the CSO impacted waterbodies.
- Overall, there are no exceptional water quality elements or uses for the City and JMEUC receiving waters that would distinguish any CSO outfall discharge area as being more critical or of greater concern than other discharge areas.

4.7 Consideration of Significant Indirect Users

The NJPDES CSO Permit requires that impacts from significant indirect users (SIUs) contributing to the CSOs be minimized. Under the current rules and regulations, each SIU is required to incorporate a level of pretreatment prior to discharge to the sewer system based on the loading and toxicity of the SIU contributions. JMEUC monitors SIUs for compliance with the pretreatment requirements. There are only three SIU located in the combined sewer area of the City of Elizabeth, as tabulated in Table 4-5.

Table 4-5: Significant Indirect Users Discharging to Combined Sewer System

SIU Name Address Standard Industrial Class.	CSO Basin	Contributing Flow	Description
Mastercraft Metal Finishing 801 Magnolia Avenue 3471 Manufacturing of phonographic masters	039A	Process wastewater flow rate is approximately **80 gallons per day (gpd)**. Pre-treatment consists of chemical precipitation, filtration, neutralization and pH correction.	The facility electroplates vinyl record masters. The vinyl record masters are silver and nickel plated to form record stampers to make the production vinyl records.
Michael Foods, Inc. - Jersey Pride 1 Papetti Plaza 2015 - Egg processing	039A	Process wastewater flow rate is approximately **110,000 gpd**. Pre-treatment includes flow equalization, settled solids	The egg processing performed at the site includes liquid-egg pasteurization, homogenization, storage, and distribution and hard

		removal, neutralization and pH correction.	cook eggs washing, boiling, peeling, and packaging.
Wakefern Food Corporation 600 York Street 5140 - Food Warehousing and distribution	002A	Reported average daily process wastewater flow rate is approximately **13,300 gpd**. Pre-treatment includes flow equalization, sedimentation, grease/sludge removal and pH neutralization.	The facility warehouses and distributes various food items to supermarkets and seafood cleaning/packaging.

The discharge from these SIUs were analyzed to assess whether, during overflow events, the discharge would negatively affect water quality, focusing on toxic metals and organics. Based on the concentration and the discharge flow rate from each SIU, the annual mass load was calculated for each measured contaminant over the annual duration of overflow events for the representative hydrologic year. To estimate the average concentration of each contaminant in the overflow attributable to SIUs, the mass load was divided by the annual volume of overflow. Because the objective is to assess the effect of the SIUs, concentrations in the combined sewer flow without SIUs was not considered. All concentrations were found to be very low, less than 0.011 mg/L, most less than 0.001 mg/L. This is attributable to dilution, as the average flow rate at the CSO is approximately 27 times larger than the flow from the SIUs.

The concentrations were then compared with EPA's aquatic life criteria (*National Recommended Water Quality Criteria - Aquatic Life Criteria Table, EPA, Undated*), where criteria were available. It was found that none of the estimated concentrations exceeded the EPA criteria. Given that the concentrations are low and do not exceed EPA criteria, further measures to prevent or limit discharges from SIUs during wet weather do not appear necessary. Further information on the SIU analysis is available in the Development and Evaluation of Alternatives Report.

4.8 Selection of CSO Control Approach

In selecting the CSO control approach for the City of Elizabeth and JMEUC, the objective is to provide water quality benefits to the receiving waters within reasonable expenditure of publicly available funds. As described in Section 4.5, the water quality modeling does not provide a clear picture of the CSO controls necessary to protect water quality for the local conditions. Based on the information available and after reviewing both approaches, the City and JMEUC have selected the Presumption Approach for permit compliance and the selection of LTCP alternatives. Selection of the Presumption Approach provides an appropriate balance between water quality benefit and expenditure of public funds given the local water quality conditions and the need for cost-effective controls.

Section 4.2 notes that the permittees must satisfy one of three criteria as outlined in the National CSO Policy under the Presumption Approach. The second criterion listed for the Presumption Approach stipulates the "elimination or capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide annual average basis." The City and JMEUC have assessed alternatives under the different criteria and have determined that a CSO control program satisfying the second criterion of the Presumption Approach is the more economically attainable approach for permit compliance. The analysis during the alternatives evaluation phase showed that the estimated costs to reach the identified control level will be an extraordinary financial burden to the community. A CSO control objective which targets 85% capture of the average annual combined sewage produced system-wide results in a cost effective LTCP that best balances protection of local water quality conditions with financial and other impacts on the community.

4.9 Baseline Percent Capture

The hydraulic model was used to estimate the percent capture from the CSS under the future (2050) baseline conditions for the Typical Year. Wet weather periods for the 2004 Typical Year precipitation record were identified using a 12-hour inter-event time period and rainfall threshold of 0.1" depth in the preceding 12 hours. Approximately 1,500 hours of wet weather flow (74 discrete events) are defined with these conditions.

Percent capture was calculated using the following equation, where wet weather inflow is represented as the sum of base groundwater inflow, sanitary diurnal flow, and wet weather runoff from the contributing area:

$$Percent\ Capture = \frac{(Total\ System\ Wet\ Weather\ Inflow - \ Total\ CSO\ Volume)}{(Total\ System\ Wet\ Weather\ Inflow)}$$

The percent capture was calculated using two different approaches to defining the Total System Wet Weather Inflow: the first is percent capture at the inflow of the Trenton Avenue Pump Station (TAPS), and the second is percent capture at the inflow of the Joint Meeting WWTF. Table 4-6 summarizes the results from the hydraulic model at the two locations under the Typical Year condition. The results were used to estimate the percent capture, as well as the estimated additional capture volume required to meet the CSO objectives for each calculation method. Because the Total System Wet Weather Inflow is so much greater at the WWTF than at the TAPS (which includes only the City of Elizabeth service area), the percent capture measured at the WWTF is much higher. Both approaches are considered appropriate and useful, however, for the plan selection alternatives, achieving an 85% capture using the wet weather inflow limited to the City of Elizabeth service area was targeted.

Table 4-6: Baseline System-Wide Percent Capture Performance

Item	Elizabeth system only, TAPS	Full JMEUC system
Total Wet Weather Inflow (MG)	2,150	6,650
Wet Weather Inflow Captured (MG)	1,250	5,750
CSO Volume (MG)	898	898
% Capture	58.2%	86.5%

Section 5
Development and Evaluation of Alternatives

5.1 Introduction

This section summarizes the key elements of the development and evaluation of CSO control alternatives process. The detailed evaluation is provided in the previously approved Development and Evaluation of Alternatives Report, prepared jointly by Mott MacDonald for the City of Elizabeth and CDM Smith for the Joint Meeting of Essex and Union Counties, dated June 2019, revised October 2019.

The Development and Evaluation of Alternatives Report addressed the requirements of Part IV.G.4 of the NJPDES CSO Permit. This step involved evaluation of a reasonable range of CSO control alternatives that would meet the water quality-based requirements of the Clean Water Act (CWA) using hydrologic, hydraulic and water quality modelling to simulate existing conditions as well as conditions incorporating CSO controls.

The evaluation of seven (7) CSO control alternatives is mandated in Part IV.G.4.e of NJPDES CSO Permit. This list is not intended to be limiting, and is broad enough that all of the control alternatives explored as part of the LTCP fall within the list. The control alternatives listed in the Permit are:

1. Green infrastructure.
2. Increased storage capacity in the collection system.
3. Sewage Treatment Plant (STP) expansion and/or storage at the plant.
4. Inflow/Infiltration (I/I) reduction in the entire collection system that conveys flow to the treatment works.
5. Sewer separation.
6. Treatment of the CSO discharge.
7. CSO related bypass of the secondary treatment portion of the STP.

A two-tiered approach was applied to the development of alternatives for the City of Elizabeth and JMEUC, starting with a screening analysis and followed by an evaluation of the remaining CSO control alternatives. The intent was to give adequate attention to the breadth of alternatives available, but to limit the list of alternatives evaluated to a reasonable amount.

The first step of the screening process was to identify the breadth of alternatives which could then narrowed down to alternatives appropriate for the evaluation process. The screening was based on the requirements to “evaluate the practical and technical feasibility of the proposed CSO control alternative(s)” (Part IV.G.4.e) to determine if the alternative will proceed to a more detailed evaluation. The results of the CSO control screening process are presented in Table 5-1 to Table 5-3 below.

5.1.1 Siting Analysis

The EPA document “Combined Sewer Overflows: Guidance for Long-Term Control Plan” (EPA 832-B-95-002 September 1995) lists preliminary siting considerations as a screening mechanism for evaluating CSO control alternatives and recommends evaluation of the following:

- Availability of sufficient space for the facility on the site
- Distance of the site from CSO regulator(s) or outfall(s) that will be controlled
- Environmental, political, or institutional issues related to locating the facility on the site.

Table 5-1: Source Control Technology Screening Summary

Technology Group	Practice	Primary Goals		Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction					
Stormwater Management	Street/Parking Lot Storage (Catch Basin Control)	Low	Low	Flow restrictions to the CSS can cause flooding in lots, yards and buildings; potential for freezing in lots; low operational cost. Effective at reducing peak flows during wet weather events but can cause dangerous conditions for the public if pedestrian areas freeze during flooding.	No	No	No	Not suitable.
	Catch Basin Modification (for Floatables Control)	Low	None	Requires periodic catch basin cleaning; requires suitable catch basin configuration; potential for street flooding and increased maintenance efforts. Reduces debris and floatables that can cause operational problems with the mechanical regulators.	No	Yes	No	Continue current practice.
	Catch Basin Modification (Leaching)	Low	Low	Can be installed in new developments or used as replacements for existing catch basins. Require similar maintenance as traditional catch basins. Leaching catch basins have minor effects on the primary CSO control goals.	No	No	No	Not suitable for soils or groundwater conditions.
Public Education and Outreach	Water Conservation	None	Low	Water purveyor is responsible for the water system and all related programs in the respective City. However, water conservation is a common topic for public education programs. Water conservation can reduce CSO discharge volume, but would have little impact on peak flows.	Yes	Yes	No	Minimal benefits, already being implemented.
	Catch Basin Stenciling	None	None	Inexpensive; easy to implement; public education. Is only as effective as the public's acceptance and understanding of the message. Public outreach programs would have a more effective result.	Yes	Yes	No	Already being implemented.
	Community Cleanup Programs	None	None	Inexpensive; sense of community ownership; educational BMP; aesthetic enhancement. Community cleanups are inexpensive and build ownership in the city.	Yes	Yes	No	Already being implemented.
	Public Outreach Programs	Low	None	Public education program is ongoing. Permittee should continue its public education program as control measures demonstrate implementation of the NMC.	Yes	Yes	No	Already being implemented.
	FOG Program	Low	None	Requires communication with business owners; Permittee may not have enforcement authority. Reduces buildup and maintains flow capacity. Only as effective as business owner cooperation.	Yes	Yes	No	Already being implemented.
	Garbage Disposal Restriction	Low	None	Permittee may not be responsible for Garbage Disposal. This requires an increased allocation of resources for enforcement while providing very little reduction to wet weather CSO events.	Yes	No	No	Minimal benefit and unenforceable.
	Pet Waste Management	Medium	None	Low cost of implementation and little to no maintenance. This is a low-cost technology that can significantly reduce bacteria loading in wet weather CSO's.	Yes	Yes	No	Already being implemented.
	Lawn and Garden Maintenance	Low	Low	Requires communication with business and homeowners. Guidelines are already established per EPA. Educating the public on proper lawn and garden treatment protocols developed by EPA will reduce waterway contamination. Since this information is already available to the public it is unlikely to have a significant effect on improving water quality.	Yes	No	No	Minimal benefit and unenforceable.
	Hazardous Waste Collection	Low	None	The N.J.A.C prohibits the discharge of hazardous waste to the collection system.	Yes	Yes	No	Already being implemented.
Ordinance Enforcement	Construction Site Erosion & Sediment Control	None	None	In building code; reduces sediment and silt loads to waterways; reduces clogging of catch basins; little O&M required; contractor or owner pays for erosion control. A Soil Erosion & Sediment Control Plan Application or 14-day notification (if Permittee covered under permit-by-rule) will be required by NJDEP per the N.J.A.C.	Yes	Yes	No	Already being implemented.
	Illegal Dumping Control	Low	None	Enforcement of current law requires large number of code enforcement personnel; recycling sites maintained. Local ordinances already in place can be used as needed to address illegal dumping complaints.	Yes	Yes	No	Already being implemented.
	Pet Waste Control	Medium	None	Requires resources to enforce pet waste ordinances. Public education and outreach is a more efficient use of resources, but this may also provide an alternative to reducing bacterial loads.	Yes	Yes	No	Already being implemented.
	Litter Control	None	None	Aesthetic enhancement; labor intensive; City function. Litter control provides an aesthetic and water quality enhancement. It will require city resources to enforce. Public education and outreach is a more efficient use of resources.	Yes	Yes	No	Already being implemented.
	Illicit Connection Control	Low	Low	Site specific; more applicable to separate sanitary system; new storm sewers may be required; interaction with homeowners required. The primary goal of the LTCP is to meet the NJPDES Permit requirements relative to POCs. Illicit connection control is not particularly effective at any of these goals and is not recommended for further evaluation unless separate sewers are in place.	Yes	Yes	No	Already being implemented.

Technology Group	Practice	Primary Goals		Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction					
Good Housekeeping	Street Sweeping/Flushing	Low	None	Labor intensive; specialized equipment; doesn't address flow or bacteria; City function. Street sweeping and flushing primarily addresses floatables entering the CSS while offering an aesthetic improvement.	Yes	Yes	No	Already being implemented.
	Leaf Collection	Low	None	Requires additional seasonal labor. Leaf collection maximizes flow capacity and removes nutrients from the collection system.	Yes	Yes	No	Already being implemented.
	Recycling Programs	None	None	Most Cities have an ongoing recycling program.	Yes	Yes	No	Already being implemented.
	Storage/Loading/Unloading Areas	None	None	Requires industrial & commercial facilities designate and use specific areas for loading/unloading operations. There may be few major commercial or industrial users upstream of CSO regulators.	Yes	No	No	Minimal benefits.
	Industrial Spill Control	Low	None	JMEUC has established a pretreatment program for industrial users subject to the Federal Categorical Pretreatment Standards 40 CFR 403.1.	Yes	Yes	No	Already being implemented.
Green Infrastructure Buildings	Green Roofs	None	Medium	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permittee or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof vegetation. Portions of Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	No	No	Not practical
	Blue Roofs	None	Medium	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permittees or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof debris. Portions of the Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	No	No	Not practical
Green Infrastructure Buildings	Rainwater Harvesting	None	Medium	Simple to install and operate; low operational resource demand; will require the Permittees or private owners to implement; requires regular cleaning of gutters & pipes. Portions of the Cities have densely populated areas, but this technology is limited to capturing rooftop drainage. Capture is limited to available storage, which can vary on rainwater use. Can be difficult to require on private properties.	Yes	No	No	Not feasible
Green Infrastructure Impervious Areas	Permeable Pavement	Low	Medium	Not durable and clogs in winter; oil and grease will clog; significant O&M requirements with vacuuming and replacing deteriorated surfaces; can be very effective in parking lots, lanes and sidewalks. Maintenance requirements could be reduced if located in low-traffic areas, and can utilize underground infiltration beds or detention tanks to increase storage.	Yes	No	Yes	Advance to evaluation
	Planter Boxes	Low	Medium	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltrating and evapotranspirating runoff in developed areas. Flexible and can be implemented even on a small-scale to any high-priority drainage areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	No	No	Incorporated into evaluation as bioswales
Green Infrastructure Pervious Areas	Bioswales	Low	Low	Site specific; good BMP; minimal vegetation & mulch O&M requirements; not as flexible or infiltrate as much stormwater as planter boxes. Technology requires open space and is primarily a surface conveyance technology with additional storage & infiltration benefits. Can be modified with check dams to slow water flow. Limited open space in most Cities means land can be utilized in more effective ways with the existing infrastructure.	Yes	No	Yes	Advance to evaluation; representative technology
	Free-Form Rain Gardens	Low	Medium	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltrating and evapotranspirating diverted runoff. Rain Gardens are flexible and can be modified to fit into the previous areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	No	No	Incorporated into evaluation as bioswales

Table 5-2: Collection System Technology Screening Summary

Technology Group	Practice	Primary Goals		Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction					
Operation and Maintenance	I/I Reduction	Low	Medium	Requires labor intensive work; changes to the conveyance system require temporary pumping measures; repairs on private property required by homeowners. Reduces the volume of flow and frequency; Provides additional capacity for future growth; House laterals account for 1/2 the sewer system length and significant sources of I/I in the sanitary sewer.	Yes	No	Yes	Further analysis for feasibility.
Operation and Maintenance	Advanced System Inspection & Maintenance	Low	Low	Requires additional resources towards regular inspection and maintenance work. Inspection and maintenance programs can provide detailed information about the condition and future performance of infrastructure. Offers relatively small advances towards goals of the LTCP.	Yes	No	No	Minimal benefits
Operation and Maintenance	Combined Sewer Flushing	Low	Low	Requires inspection after every flush; no changes to the existing conveyance system needed; requires flushing water source. Ongoing: CSO Operational Plan; maximizes existing collection system; reduces first flush effect.	Yes	No	No	Already being implemented.
Operation and Maintenance	Catch Basin Cleaning	Low	None	Labor intensive; requires specialized equipment. Catch Basin Cleaning reduces litter and floatables but will have no effect on flow and little effect on bacteria and BOD levels.	Yes	Yes	No	Already being implemented.
Combined Sewer Separation	Roof Leader Disconnection	Low	Low	Site specific; Includes area drains and roof leaders; new storm sewers may be required; requires home and business owner participation. The Cities are densely populated and disconnected roof leaders have limited options for discharge to pervious space. Disconnection may be coupled with other GI technologies but is not considered an effective standalone option.	Yes	No	No	Not likely to be effective
Combined Sewer Separation	Sump Pump Disconnection	Low	Low	Site specific; more applicable to separate sanitary system; new storm sewers may be required; interaction with homeowners required. The Cities are densely populated and disconnected sump pumps have limited options for discharge to pervious space. Disconnection may be coupled with other GI technologies but is not considered an effective standalone option.	Yes	Yes	No	Not likely to be effective
Combined Sewer Separation	Combined Sewer Separation	High	High	Very disruptive to affected areas; requires homeowner participation; sewer asset renewal achieved at the same time; labor intensive.	No	Yes	Yes	Advance to evaluation
Combined Sewer Optimization	Additional Conveyance	High	High	Additional conveyance can be costly and would require additional maintenance to keep new structures and pipelines operating.	No	No	Yes	Pump station focus
Combined Sewer Optimization	Regulator Modifications	Medium	Medium	Relatively easy to implement with existing regulators; mechanical controls require O&M. May increase risk of upstream flooding. Permittees have an ongoing O&M program and system wide replacement program for CSO regulators and tide gates.	Yes	No	Yes	As part of other alternatives
Combined Sewer Optimization	Outfall Consolidation/Relocation	High	High	Lower operational requirements; may reduce permitting/monitoring; can be used in conjunction with storage & treatment technologies. Combining and relocating outfalls may lower operating costs and CSO flows. It can also direct flow away from specific areas.	Yes	No	Yes	As part of other alternatives
Combined Sewer Optimization	Real Time Control	High	High	Requires periodic inspection of flow elements; highly automated system; increased potential for sewer backups. RTC is only effective if additional storage capacity is present in the system.	Yes	No	Yes	As part of other alternatives

Table 5-3: Storage and Treatment Technology Screening Summary

Technology Group	Practice	Primary Goals		Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction					
Linear Storage	Pipeline	High	High	Can only be implemented if in-line storage potential exists in the system; increased potential for basement flooding if not properly designed; maximizes use of existing facilities. Pipe storage for a CSS typically requires large diameter pipes to have a significant effect on reducing CSOs. This typically requires large open trenches and temporary closure of streets to install.	No	Yes	No	Not cost effective
	Tunnel	High	High	Requires small area at ground level relative to storage basins; disruptive at shaft locations; increased O&M burden.	No	No	Yes	Advance to evaluation
Point Storage	Tank (Above or Below Ground)	High	High	Storage tanks typically require pumps to return wet weather flow to the system which will require additional O&M; disruptive to affected areas during construction. Several CSO outfalls have space available for tank storage. There may be existing tanks in abandoned commercial and industrial areas to be converted to hold stormwater. Tanks are an effective technology to reduce wet weather CSO's.	No	No	Yes	Advance to evaluation
	Industrial Discharge Detention	Low	Low	Requires cooperation with industrial users; more resources devoted to enforcement; depends on IUs to maintain storage basins. IUs hold stormwater or combined sewage until wet weather flows subside; there may be commercial or industrial users upstream of CSO regulators.	Yes	Yes	No	Review impacts from SIUs
Treatment-CSO Facility	Vortex Separators	None	None	Space required; challenging controls for intermittent and highly variable wet weather flows. Vortex separators would remove floatables and suspended solids when installed. It does not address volume, bacteria or BOD.	Yes	No	No	Not effective alone
	Screens and Trash Racks	None	None	Prone to clogging; requires manual maintenance; requires suitable physical configuration; increased O&M burden. Screens and trash racks will only address floatables.	Yes	No	No	Not effective alone, include as part of other alternatives
	Netting	None	None	Easy to implement; labor intensive; potential negative aesthetic impact; requires additional resources for inspection and maintenance. Netting will only address floatables.	Yes	Yes	No	Already being implemented.
	Contaminant Booms	None	None	Difficult to maintain requiring additional resources. Contaminant booms will only address floatables.	Yes	No	No	Not effective
	Baffles	None	None	Very low maintenance; easy to install; requires proper hydraulic configuration; long lifespan. Baffles will only address floatables.	Yes	No	No	Not effective
	Disinfection & Satellite Treatment	High	None	Requires additional flow stabilizing measures; requires additional resources for maintenance; requires additional system analysis. Disinfection is an effective control to reduce bacteria and BOD in CSO's.	Yes	No	Yes	Advance to evaluation
	High Rate Physical/Chemical Treatment (High Rate Clarification Process - ActiFlo)	None	None	Challenging controls for intermittent and highly variable wet weather flows; smaller footprint than conventional methods. This technology primarily focuses on TSS & BOD removal, but does not help reduce the bacteria or CSO discharge volume.	Yes	No	Yes	Advance to evaluation
	High Rate Physical (Fuzzy Filters)	None	None	Relatively low O&M requirements; smaller footprint than traditional filtration methods. This technology primarily focuses on TSS removal, but does not help reduce the bacteria or CSO discharge volume.	Yes	No	No	Consider alternate technology
Treatment-WWTP	Additional Treatment Capacity	High	High	May require additional space; increased O&M burden.	No	No	Yes	Advance to evaluation
	Wet Weather Blending	Low	High	Requires upgrading the capacity of influent pumping, primary treatment and disinfection processes; increased O&M burden. Wet weather blending does not address bacteria reduction, as it is a secondary treatment bypass for the POTW. Permittee must demonstrate there are no feasible alternatives to the diversion for this to be implemented.	Yes	No	Yes	Advance to evaluation
Treatment-Industrial	Industrial Pretreatment Program	Low	Low	Requires cooperation with Industrial User's; more resources devoted to enforcement; depends on IU's to maintain treatment standards. May require Permits.	Yes	Yes	No	Review impacts from SIUs

In order to identify potential sites in the vicinity of combined sewer system (CSS) regulators and outfalls where CSO control measures might be installed based on the criteria above, a GIS analysis was completed. Sites were prioritized based on proximity to outfalls, public ownership or vacant land, and under-utilized locations such as parking areas or abandoned sites. Over 80 sites were identified by the project team as potential locations for control facilities near CSO outfalls, including possible under-utilized locations. Based on the initial evaluation by City representatives, only 11 of the 85 potential sites, or 12.9%, were considered well suited for a relatively smooth easement acquisition and facility siting. Another 23.5% of the sites were rated with a fair probability for potential siting, while 52.9% and 10.6% were identified with low and very low ratings as suitable locations.

Many of the low and very low-ranking locations were noted as having major redevelopment projects currently underway, with plans for construction approved or under review with the City Planning Board. Given the wide spatial distribution of the CSO outfalls, there are significant competing interests for potential sites given that the City has several ongoing redevelopment programs focusing on economic initiatives. Other sites are indicated as likely to be highly disruptive to the existing business operations.

This analysis showed that a very limited amount of under-utilized space is available within the City. The outfall by outfall investigation noted that the type and amount of real estate surrounding each outfall is nearly fully occupied and highly constrained. Significant acquisition of occupied commercial, residential, and other urban land will likely be required to implement CSO control facilities sited within the City. Extensive business and resident displacement, lost property taxes, and neighborhood disruptions would likely be associated with the procurement of such land for CSO facility siting. These considerations and the estimated costs for obtaining land rights to construct the CSO facilities impact the assessment of the control strategies.

5.2 Description of Alternatives

The CSO control technologies screened as potentially viable were formulated into control programs and evaluated. The control programs include strategies for each CSO basin as well as alternatives for system-wide improvements. The discussion herein describes the alternative CSO control programs evaluated in the Development and Evaluation of Alternatives Report.

The seven (7) CSO control programs evaluated were:

8. Complete sewer separation
9. Satellite CSO treatment facilities
10. Pump station and sewage treatment plant (STP) expansion
11. Satellite storage facilities
12. Tunnel storage and secondary controls
13. Green infrastructure
14. Infiltration/Inflow (I/I) reduction

Each of the control programs evaluations are summarized below.

5.2.1 Control Program 1: Sewer Separation

Sewer separation is the conversion of a CSS into a system of separate storm sewers and sanitary sewers. This control program constitutes constructing a new sanitary sewer system and converting the existing combined sewer into a storm sewer. This would effectively remove the City of Elizabeth from being a CSO community.

The benefits of this alternative include:

- 100% CSO elimination, although the discharge of urban storm runoff through the existing outfalls would remain.

- The majority of the work remains in public right-of-way and minimal additional easement and land acquisition would be required.
- Opportunity for renewal of other municipal utilities and road reconstruction.

The challenges include:

- Highly disruptive to roads and traffic, broadly affecting residents and businesses particularly in downtown areas.
- Scale of construction (i.e., over 100 miles of roads would be affected).
- Reconnection of every building sewer sanitary sewer lateral on each street would be required.
- Private property infiltration and inflow sources would have to be separated from the existing building sewers connected to the new sanitary sewer main. Coordination with private property owners and site access would be necessary to identify these I/I sources, and extensive private property disruption could be required to separate drainage from sewage on the property.
- Typically has a very high cost if implemented outside of large-scale redevelopment.
- Additional maintenance costs for new sanitary sewer collection system.
- Treatment of the separated stormwater discharge from the outfalls likely will be required in the future.

The City has completed several sewer separation projects, often associated with flood relief and property redevelopment programs, which has resulted in the elimination of some CSO outfalls. However, these projects in most cases have only partially separated the storm runoff from the larger CSO basin and many CSO outfalls also have storm drain connections downstream of the regulator. The sewer separation alternative was evaluated on a sewershed-by-sewershed basis, however the overall objective under this control program was a full sewer separation system-wide.

In addition to standard permitting requirements, it was noted that separating stormwater flow from sanitary flow may not be an effective long-term solution. This is because stormwater contributes to pollution of the receiving waters, and as such will eventually need to be treated or controlled. Under current NJDEP permit approval practices, total suspended solids (TSS) removal requirements have been applied to sewer separation projects where modifications to the stormwater outfalls are proposed. Recently proposed stormwater regulations include increased treatment requirements for creating separately sewered areas, which would greatly increase the costs and impacts of performing separation.

5.2.2 Control Program 2: Satellite CSO Treatment Facilities

Treatment technologies are intended to reduce the pollutant loads to receiving waters by treating wet weather flows prior to discharging to the environment. This control program consisted of siting a treatment facility near the point of discharge for each CSO outfall or group of nearby outfalls. According to the National CSO Control Policy, overflows that meet the minimum required treatment are no longer considered untreated overflows. Thus, by providing a treatment train capable of providing the minimum required treatment, which is the equivalent of primary treatment and disinfection, a CSO event is considered as a wet-weather event during which peak flow exceeds the design maximum for full treatment at the satellite facility.

The following proposed treatment train was considered for this control program evaluation:

1. Divert flows downstream of the regulator, and if possible downstream of the existing netting facility.
2. Fine screening (removal of solids greater than 0.5 inches) of the flows to remove additional floatables and coarse particles.
3. Interim pumping to offset the head losses associated with the treatment processes.

4. High-rate primary treatment of the flows to remove solids in advance of disinfection. For evaluation purposes, the ActiFlo® clarification process by Veolia Water Technologies was used as a representative and applicable technology for such treatment.
5. Disinfection by peracetic acid, by providing a six-minute contact time.
6. Discharge flow through the existing outfall or possibly a modified outfall.

The size of the treatment units would reflect the peak flow rates corresponding to the specific outfall. The treatment systems for this control program were considered for each CSO outfall. The evaluation consisted of diverting the flows from the CSO outfall to the treatment facility and once the outfall discharge has exceeded the treatment rate, the remaining flows were tracked as untreated overflow volume. Outfall flows were checked to make sure that overflows only occur for the number of events allowable for that level of control.

The preliminary siting analysis demonstrated that given the dense existing development, ongoing and future redevelopment plans, and other land use constraints, there is a general lack of suitable available space for CSO control facilities along the outfall alignments. Accordingly, no specific sites were proposed for use and the evaluation assumes that extensive land acquisition for the control program would have to be implemented, with the corresponding costs considered.

End of pipe treatment is often operator intensive, with the permittee operating several small-scale wastewater treatment facilities. In addition to standard permitting requirements, the level of treatment proposed may need to be increased over time in response to more stringent water quality standards. Future regulations could include increased treatment requirements that could greatly increase the costs and impacts of this alternative. Installation of satellite treatment facilities in the City would be challenging due to space and access limitations. Satellite treatment facilities generally extend partially above grade level and have the potential to produce odors and noise, making them more difficult to site in residential and commercial areas. Following construction, satellite treatment facilities may be less preferable to the public due to the permanent visibility of the above grade structures. It also uses land area that could otherwise be utilized by the community for other purposes.

5.2.3 Control Program 3: Additional Conveyance and Treatment

CSOs can potentially be reduced by increasing the capture and conveyance of wet weather combined sewer flow that is directed to the existing wastewater treatment plant, instead of flowing to CSO outfalls. Increased treatment capacity may be needed to handle the increased flow to the plant. This control program evaluated CSO control that can be achieved by expansion of the City of Elizabeth combined sewage pumping and conveyance capacity to deliver flow to the Joint Meeting of Essex and Union Counties (JMEUC) Wastewater Treatment Facility (WWTF) for treatment of additional wet weather combined sewage flow from the City of Elizabeth. Two components of expanded treatment of combined sewer flows at the WWTF that were evaluated in the Development and Evaluation of Alternatives Report:

Control Program 3A: Interim Plan for Increased CSO Treatment with Real Time Control
An interim plan based on changing the operation of the existing Trenton Avenue Pumping Station (TAPS) to pump at the estimated peak hydraulic capacity of the existing facility (approximately 55 million gallons per day (mgd)) was developed and evaluated. This represents an increase of 19 mgd over the current peak pumping rate of 36 mgd as defined by the flow limit in the contractual agreement between the City of Elizabeth and JMEUC. In addition to a change in the contractual agreement, this change would also require upgrades to TAPS to improve the reliability of the facility to pump at the higher rate. In order to avoid stressing the plant during large wet weather events, the use of real time controls (RTC) will enable higher flows to be pumped from TAPS without increasing peak flow rates for these large events above current levels. This will enable increased capture of combined sewer flows with no changes to the TAPS force main, JMEUC

trunk sewers or WWTF required, as the existing force main, trunk sewers and WWTF can accept and treat flow at the increased TAPS pumping rate with RTC.

Control Program 3B: Expanded Wet-Weather Treatment for Combined Sewer Flows and CSO-Related Bypass
A long-term plan to increase the capture and pumping of wet weather combined sewer flow at TAPS beyond the 55 mgd flow rate described above was also developed and evaluated. This alternative assumed at rates above roughly 55 mgd, additional pumping capacity would need to be provided, along with additional treatment capacity at the WWTF. TAPS pumping rates up to 140 mgd were considered, which would increase flow by as much as 104 mgd above the current pumping rate of 36 mgd. The potential use of a new CSO treatment process train was considered to treat the combined sewer system flow that exceeds the existing treatment plant capacity. This alterative evaluation included blending the new CSO treatment train effluent with the normal plant effluent for discharge through the existing outfall to the Arthur Kill.

With the Interim control program, the system-wide average annual overflow volume was estimated to be reduced by approximately 175 million gallons, using the 2018 hydraulic model setup. The modeling showed that with the control rules implemented, the total volume of flow conveyed to the JMEUC WWTF could be increased without impacting the peak flow. For the Expanded Wet-Weather Treatment control program, an estimated overflow reduction of up to 370 million on a system-wide average annual was calculated. Overall, this strategy of increased conveyance and treatment of the wet-weather flow was found to provide relatively large reductions in overflow volumes at lower costs than other programs.

5.2.4 Control Program 4: Satellite Storage Facilities

The objective of storage is to reduce overflows by capturing and storing wet weather flows, greater than CSS conveyance/treatment plant capacity, for controlled release back into the system once treatment and conveyance capacity have been restored. A storage facility can attenuate peak flows in the CSS and provide a relatively constant flow into the treatment plant after peak events. This control alternative considered the construction of storage tanks near CSO outfalls. Each facility consists of:

- A diversion structure;
- An offline below grade tank equipped with a flushing system and odor control;
- Tank overflow to an outfall;
- Dewatering pumping station; and
- Discharge connection back towards the JMEUC treatment plant.
- Increased pumping capacity at the Trenton Avenue Pump Station (TAPS)

The required sizing of storage tanks for various control levels was determined, and the storage tanks were input into the model to identify any impacts to CSO reduction. The sizing of these satellite storage facilities was based on increased CSO conveyance and treatment, with the pumping capacity at the TAPS upgraded to 65 mgd. The stored flow would be dewatered to the JMEUC WWTF as capacity in the interceptor sewers and WWTF is restored post-event. This represents a significant volume of additional flow to be treated annually at the WWTF and the associated operation and maintenance costs were estimated.

The Development and Evaluation of Alternatives Report presents the tank volume and corresponding tank area required for a facility to control 0, 4, 8, 12 or 20 overflows at each outfall location, assuming that a satellite storage tank would have a depth of 15 feet. The facilities would also include dewatering pumps, screens, and connecting pipes. The storage volume required system-wide varied from about 125 million gallons (MG) for 0 overflows per year to 21 MG for 20 overflows per year, with the corresponding land area to be acquired estimated to be 25 acres and 4.3 acres, respectively.

Significant siting challenges are associated with the Satellite Storage Facilities control program. Off-line storage tanks require large land area for installation and very limited open or under-utilized sites are available within the City. Extensive land acquisition would be required to implement the control program on a system-wide basis. If the existing sewers are deep, then the storage tank must also be deep, which results in additional construction costs. Operation and maintenance costs can also be high, especially if the application includes provisions for partial treatment and discharge, rather than simple storage and bleed-back to the sewer. Depending on the application, odor problems may also be an issue. Furthermore, adequate interceptor sewer conveyance capacity and treatment process capacities must be available for pumping out of the stored CSO volumes.

The construction required for storage tanks is considerable and invasive making public acceptance of the project a concern. Once construction is completed, some area of the site may be available for public amenities to assist with public acceptance since the majority of the CSO storage facility would be underground. Aboveground features would still be required such as electrical facilities, odor control, access points to pumps, flushing systems, and access ways to the tanks for periodic maintenance.

5.2.5 Control Program 5: Tunnel Storage and Secondary Controls

Under this control program, a tunnel approximately 19,800 feet in length, with one segment extending along the southern waterfront of the City and the second segment along the west side of the Elizabeth River was evaluated. This deep tunnel storage would service 26 CSO outfalls. The tunnel would be constructed in rock at a depth of the approximately 120 feet, with 8 vertical shafts (7 consolidation drop shafts and 1 work shaft/dewatering pump station shaft). The tunnel would be dewatered and discharge to the JMEUC WWTF and would include an overflow to the river. This alternative also incorporated satellite storage for CSO Basins 001 and 002 and sewer separation for CSO Basin 037.

Tunnels are often used in congested urban areas where available land is scarce and connections to most of the CSO regulators can be made. In this alternative, the majority of tunnel infrastructure would be located below grade, however land acquisition would be required for siting of launch and drop shafts during construction. Land would also be required for siting the dewatering pump station and a tunnel overflow relief. This alternative would require less land acquisition than other programs such as satellite storage and satellite treatment. A centralized storage tunnel would also serve to store overflows from outfalls throughout the City during wet weather events, which provides more effective use of the storage volume than storage tanks dedicated to an outfall or group of outfalls.

Implementing a tunnel within the confines of a dense urban area is challenging. Mining and recovery shaft areas are required for this alternative to be feasible, and available area in Elizabeth for this purpose is minimal. The layout and feasibility of tunnels would be highly dependent on geotechnical conditions. For the purpose of the analysis, it was assumed that the tunnel would be constructed in rock, which is a favorable condition for tunnel boring machine excavation.

The construction required for tunnels is capital intensive and invasive making public acceptance of the project a concern. The proposed tunnel shaft sites would have to be located throughout the City and there may be concerns related to heavy mechanical facilities in areas that are in close proximity to residential development. Shaft sites located in industrial areas may raise fewer concerns from the public. Following construction, tunnels may receive higher public acceptance because of the fewer site locations and the majority of the facilities are underground.

5.2.6 Control Program 6: Green Infrastructure

This control program evaluated the installation of green infrastructure to provide storage or detention to contribute to meeting the overflow requirements. Green infrastructure (GI) refers to practices which reduce stormwater volume or flow rate by allowing the stormwater to infiltrate, be stored, or be treated by vegetation or soils. Bioswales were selected as the representative type of GI to evaluate for the purposes of model calculations. If selected for system-wide implementation, further refinement of types and specific locations of GI would need to be determined in future planning stages.

The available data on soils and groundwater levels indicate that the majority of the City is classified as "urban land" as such the infiltration potential of the soil is not defined. Field studies have also found limited infiltration potential in most areas of the City. As such, bioswales were conservatively assumed to be non-infiltrating and equipped with a sub-drain to drain back into the collection system.

For purposes of evaluation, directing 2.5%, 5%, 7.5%, 10%, and 15% of the impervious area within the combined sewer area to green stormwater infrastructure was evaluated. It was observed that GI has a very minimal impact on both peak flow and volume mitigation. As such, it is understood that a high level of proliferation of GI would be required to provide an improvement in CSO reduction.

From a land acquisition standpoint, green infrastructure would rate highly for implementability. The intent is to site the green stormwater infrastructure in the public right-of-way which is owned by the City. Accordingly, no land acquisition would be required. However, there are other implementation challenges associated with green stormwater infrastructure to be considered. There are numerous field conditions that can prevent construction of green stormwater infrastructure on a site identified through a desktop study, including soil conditions, utility locations, and proximity to trees, building entrances, or bus stops.

It is generally assumed that public acceptance of green stormwater infrastructure would be high since it can serve as an amenity to the community. This is likely true for implementation of bioswales as they provide additional green space and the construction footprint is relatively small. The implementation of permeable pavement as a green infrastructure alternative may be less accepted by the public as the construction is more invasive. However, upon completion of the project the area will closely resemble the existing condition.

5.2.7 Control Program 7: Inflow/Infiltration Reduction

Excessive infiltration and inflow can consume the hydraulic capacity of a collection system and increase overall operations and maintenance costs. Inflow comes from sources such as roof drains, manhole covers, cross connections from storm sewers, catch basins, and surface runoff. Within a CSS, surface drainage is the primary source of inflow, and the system is designed to capture inflow. Sanitary sewer systems are not designed to capture inflow, although design standards often recognize that completely excluding inflow is extremely difficult and allowances for modest rates of inflow are made. Infiltration comes from groundwater that seeps in through leaking pipe joints, cracked pipes, manholes, and other similar sources. The flow from infiltration tends to be constant, but at a lower rate and volume than that of inflow. Identifying I/I sources is labor intensive and requires specialized equipment. Significant I/I reductions can also be difficult and expensive to achieve. However, the benefit of a good I/I control program is that it can save money by extending the life of the system, reducing the need for expansion, and lowering treatment costs.

I/I originating from upstream member municipalities, while of sufficient magnitude to cause surcharging in some reaches of the JMEUC trunk sewer system, does not cause measurable flooding in the system, and does not restrict the capture of combined sewage from Elizabeth. However, I/I reduction has the potential to effectively increase the conveyance capacity downstream of the Trenton Avenue Pump Station (TAPS) and through the JMEUC WWTF available for capture and treatment of additional combined sewage flow from Elizabeth during wet weather. Because the existing JMEUC trunk sewers and WWTF can handle current and future TAPS flows (at 55 mgd) during wet weather, the primary benefit to reducing I/I rates would be to reduce the capacity of additional facilities that would be constructed to provide treatment of additional flows from an expanded pump station and new force main. Additional wet weather combined sewage from Elizabeth could be directed to the existing JMEUC trunk sewers and WWTF at rates equal to the reduction in I/I rates, which would reduce by the same amount the flow rates used in sizing of a new force main and CSO treatment facilities.

JMEUC encourages member municipalities to reduce I/I and provides significant resources to them in support of their I/I reduction program. An estimated 40% of infiltration and 34% of inflow have been removed from upstream member municipalities since 1983. A comprehensive I/I reduction program can expect to achieve up to 50% I/I reduction from a system-wide standpoint, indicating significant I/I reduction has already been achieved by JMEUC member municipalities.

A planning-level cost and performance analysis was completed to estimate the potential costs associated with a maximum attainable reduction in I/I volume of 50% from baseline conditions (no previous I/I removal). This analysis was based on the I/I reduction method of CIPP lining of sewer mains and laterals. To assess the impact that I/I reduction would have on JMEUC system performance, the InfoWorks ICM model was used. The complete model results including the predicted reduction in peak inflow (peak hourly rates) to the WWTF during the largest rainfall events in the Typical Year can be found in the Development and Evaluation of Alternatives Report.

5.3 Alternatives Evaluation

In the Development and Evaluation of Alternatives Report, the CSO control programs were analyzed for their practical and technical feasibility and performance capabilities under future conditions. The alternatives evaluation considered several factors, including:

- Performance capabilities and effectiveness relative to CSO volume reduction, pollutant of concern (i.e., pathogen) removal, and CSO event frequency reduction.
- Estimates of the total capital costs, O&M costs, and total present worth value associated with implementing and operating the control facilities for the level noted. Where applicable, cost estimates for land acquisition have been included due to the absence of available City-owned sites and under-utilized properties within the combined sewer area.
- Public acceptance considerations that reflect the degree to which communities may be impacted, public amenities can be incorporated, and political matters may impact the approval of a control alternative by elected officials, non-governmental organizations, and the general public.
- Institutional issues concerning permitting requirements and associated approval processes and schedule impacts.
- Implementation constraints related to likely environmental issues, subsurface conditions, construction complexity, facility reliability, and scale of operations and maintenance.
- Adaptability for multiple-use facilities to provide other beneficial services in addition to CSO control; grouped outfall applications and facility consolidation; and phased construction.
- Regulatory requirements and any potential compliance risks.

5.3.1 Alternatives Cost and Performance Summary

The costs for each of the alternatives as presented in the Development and Evaluation of Alternatives Report are summarized in Table 5-4 below. These are Class 5 (+100%, -50%) cost estimates representing total capital costs, 20-year operation and maintenance (O&M) costs, and total present worth (TPW) as present values, in 2019 dollars.

For comparison, the total present worth costs normalized by the gallon of CSO abated or controlled in the Typical Year are tabulated in Table 5-5, based on 2018 hydraulic model development. Where applicable, the alternative program is qualified by the level of CSO control or the extent of implementation considered. For example, the control programs for satellite treatment facilities, satellite storage facilities, and deep tunnel storage have subcategories using the frequency of CSO events for the Typical Year as a performance metric, while the additional conveyance and treatment alternative considers the discharge from the Trenton Avenue Pump Station (TAPS) as the extent of implementation measure.

Table 5-4: Control Alternatives Cost Summary

Control Alternative	Control Level or Extent of Implementation	Estimated Costs (2019 $ in Million) Total Capital Cost	20-Year O&M Cost as Present Value	20-Year Total Present Worth
1) Sewer Separation	0 events/yr	$1,244	$151.3	$1,396
2) Satellite Treatment Facilities	0 events/yr	$865.2	$98.0	$963.2
	4 events/yr	$803.0	$93.0	$896.0
	8 events/yr	$714.2	$87.0	$801.2
	12 events/yr	$714.2	$87.0	$801.2
	20 events/yr	$488.8	$70.0	$558.8
3) Additional Conveyance & Treatment	55 mgd-Real Time Control	$9.06	$1.10	$10.16
	140 mgd	$85.69	$15.4	$101.12
4) Satellite Storage Facilities	0 events/yr	$1,175	$130.7	$1,306
	4 events/yr	$638.1	$71.4	$709.5
	8 events/yr	$485.0	$56.2	$541.3
	12 events/yr	$439.9	$50.2	$490.0
	20 events/yr	$297.2	$35.0	$332.2
5) Deep Tunnel Storage	0 events/yr	$901.9	$61.0	$962.9
	4 events/yr	$684.6	$46.0	$730.6
	8 events/yr	$576.2	$37.0	$613.2
	12 events/yr	$524.1	$34.0	$558.1
	20 events/yr	$459.8	$29.0	$488.8
6) Green Stormwater Infrastructure (by percent impervious area managed)	2.5%	$104.6	$1.00	$105.6
	5.0%	$204.2	$2.00	$206.2
	7.5%	$306.4	$3.00	$309.4
	10.0%	$408.4	$4.00	$412.4
	15.0%	$611.6	$7.00	$618.6
7) Inflow/Infiltration Reduction	50% I/I volume reduction[1]	$594.0	Not appl.	$594.0

[1] Reduction in JMEUC separate sanitary sewer area I/I rates/volumes with maximum attainable I/I reduction at the sewershed level at 50% of initial condition (1983 SSES results).

Table 5-5: Summary of CSO control program CSO volume reductions

Control Alternative	Control Level/Extent	CSO Volume Abated (MG/yr)	CSO Volume Reduction (%)	Cost (TPW) per Volume Abated ($/gal)
1) Sewer Separation	0 events/yr	1068.5	100.0%	$1.31
2) Satellite Treatment Facilities	0 events/yr	1068.5	100.0%	$0.90
	4 events/yr	1063.6	99.5%	$0.84
	8 events/yr	1055.6	98.8%	$0.76
	12 events/yr	1055.6	98.8%	$0.76
	20 events/yr	956.4	89.5%	$0.58
3) Additional Conveyance & Treatment	55 mgd-Real Time Control	175.8	16.5%	$0.06
	140 mgd	370.3	34.7%	$0.27
4) Satellite Storage Facilities	0 events/yr	1068.5	100.0%	$1.22
	4 events/yr	960.3	89.9%	$0.74
	8 events/yr	867.5	81.2%	$0.62
	12 events/yr	822.9	77.0%	$0.60
	20 events/yr	661.1	61.9%	$0.50
5) Deep Tunnel Storage	0 events/yr	1068.5	100.0%	$0.90
	4 events/yr	1005.0	94.1%	$0.73
	8 events/yr	905.3	84.7%	$0.68
	12 events/yr	844.8	79.1%	$0.66
	20 events/yr	735.1	68.8%	$0.66
6) Green Stormwater Infrastructure (by percent impervious area managed)	2.5%	16.2	1.5%	$6.52
	5.0%	22.6	2.1%	$9.13
	7.5%	26.6	2.5%	$11.63
	10.0%	31.3	2.9%	$13.18
	15.0%	36.0	3.4%	$17.18
7) Inflow/Infiltration Reduction	50% I/I volume reduction[1]	See Note [2]	See Note [2]	See Note [2]

[1] Reduction in JMEUC separate sanitary sewer area I/I rates/volumes with maximum attainable I/I reduction at the sewershed level at 50% of initial condition (1983 SSES results).
[2] Specific value not calculated. See Development and Evaluation of Alternatives Report text for further discussion.

5.3.2 Alternatives Comparison Discussion

The CSO control alternatives were analyzed for their practical and technical feasibility and performance capabilities under future conditions, as discussed in detail in the Development and Evaluation of Alternatives Report. Extensive data has been compiled and analyzed for the CSO control programs by determining the size of facilities or scale of implementation associated with a range of performance criteria. The evaluation documented that implementation of the control programs to a performance measure of 0 overflows per year (based on the Typical Year) would have 20-year present value cost of over $950 million. Even at the less restrictive performance measure of 20 overflows per year, the implementation costs are still over $330 million. As such, the majority of the alternatives evaluated were found to be well beyond financial capacity of the community for the overflow frequency metrics considered.

Based on the evaluation findings, it can be seen that increased conveyance is an appropriate direction for improvements to the Elizabeth CSS. Additional conveyance from the Trenton Avenue Pump Station up to 55 or 65 mgd with real time controls provides a significant reduction in total system-wide CSO volume. Although major pump station improvements programs would be required, this control alternative option has a low cost per gallon for CSO volume reduction and is expected to have minimal public impact and permitting constraints. Additional conveyance from the Elizabeth combined sewer system above this flow rate would necessitate construction of a new CSO treatment train at the JMEUC WWTF and new pumping and conveyance facilities for higher wet weather flows.

While sewer separation offers an approach for complete elimination of CSO discharges, cost estimates for full sewer separation indicate that this control alternative is extremely costly and the extensive construction work in road rights-of-way would be highly disruptive to City residents. It would also increase untreated stormwater discharges, which will likely be subject to additional treatment requirements in the future. While sewer separation may not be the most practical alternative for the entire City, some smaller basins or more isolated areas may be suitable candidates for basin-level sewer separation, and partial separation could also be additive to other control programs. Overall, sewer separation as a widely implemented alternative would be too disruptive and costly, but separation of certain smaller and more isolated CSO basins may be considered as selected alternatives.

The preliminary siting analysis conducted to identify potential open or under-utilized sites for CSO control facilities demonstrated that insufficient City-owned or unoccupied land is available in the areas surrounding the CSO outfalls. As such, the identification of appropriate sites would be a challenge in selecting Long Term Control Plan alternatives, particularly in relation to satellite storage and satellite treatment facilities.

Satellite treatment was determined to be an undesirable alternative due to the cost of land acquisition and challenges of permitting and obtaining easements, as well as access to and maintenance of these facilities. Furthermore, the type and scale of operations for satellite treatment facilities would require staffing resources that the City does not have. Satellite storage facilities would also require extensive land acquisition, with associated costs that are excessive for the lower CSO frequency metrics. Constraints on finding sufficient suitable sites for the satellite storage facilities have the greatest impact on the ability to implement this control program and maintenance of these facilities would also add significant complexity and resource demands on the City. Nonetheless, limited implementation of CSO storage facilities may be suitable if an appropriate site can be identified and if the project is required to address other system issues, such as localized street flooding.

A deep tunnel storage control program was one of the lower-cost programs evaluated on a cost per gallon basis that achieves a full range of CSO control levels. In terms of cost per gallon treated, the value is relatively constant for 8 through 20 overflow events per year, then escalates for the more restrictive performance measures. However, tunnel storage as CSO control alternative is not easily implemented in phases or flexibility in cost effective expansion or retrofitting if different control levels are required. A tunnel storage program also would have a narrow time period of intense capital expenditures during construction, which causes financing difficulties.

Results from the modeling analyses indicate that green infrastructure achieves relatively small reductions in CSO volumes. An important factor related to the GI performance is the generally poor infiltration rates associated with the soil conditions within the City. GI does not achieve the desired level of control in terms of volume reduction or reduction in CSO frequency. As such, GI can only provide limited support toward meeting the CSO control objectives. GI also has a notably higher cost per gallon relative to other alternatives due to significant operational and maintenance requirements. As such, it is anticipated that it would only be additive to other control programs due to its aesthetic and public value.

The I/I reduction evaluation indicates that the existing JMEUC trunk sewers and WWTF can capture and treat all flow from the JMEUC service area during the Typical Year, including proposed additional conveyance (up to 55 mgd TAPS discharge) with real time controls. A 30-40% reduction in I/I levels in the JMEUC sanitary sewer service area has already been achieved, and the additional cost to pursue 50% I/I reduction is not cost effective for the marginal reduction in peak hourly flow rate at the WWTF. I/I reduction was therefore eliminated from further consideration as a specific CSO control alternative.

Section 6
Public Participation Process Update

6.1 Background

Public outreach and input are an important component of the Long Term Control Plan (LTCP) development process, and the project team has endeavored to provide opportunities for public education and awareness, as well as to gain feedback on the combined sewer overflow (CSO) control alternatives. Public outreach is one of nine elements of the LTCP.

Part IV.D.3.b.iii of the New Jersey Pollutant Discharge Elimination System (NJPDES) CSO permits requires the submission of a Public Participation Process Report. Part IV.G.2 indicates that the public participation process should include:

- Outreach to inform the affected/interested public through avenues including: public meetings, direct mailers, billing inserts, newsletters, press releases to the media, postings of information on the permittee's website, hotline, development of advisory committees, etc.
- Development of a Supplemental CSO Team to work with the permittee team to share and review information, provide input to the evaluation and selection of CSO controls.

The Public Participation Process report was submitted to New Jersey Department of Environmental Protection (NJDEP) in June 2018, revised in November 2018, and approved in February 2019. Public participation activities up to June 2018 are documented in that report. Public participation activities between June 2018 and June 2019 are summarized in the Development and Evaluation of Alternatives Report which was submitted in June 2019 and approved by NJDEP in December 2019. Below is a summary of the City of Elizabeth's activities since June 2019.

6.2 Supplemental CSO Team and Public Meetings

A Supplemental CSO Team was formed early in the NJPDES CSO Permit compliance cycle to provide input on the planning process and to serve as points of connection to the larger community. The City of Elizabeth and JMEUC have continued to encourage members of the affected public to participate in the Supplemental CSO Team and to attend public meetings as the primary mechanisms to share information and solicit input information on the LTCP alternatives selection process. The meeting proceedings since the last report submission are summarized below.

6.2.1 Supplemental CSO Team Meetings

Ten meetings of the Supplemental CSO Team, including two open public meetings, were convened throughout the development of the CSO LTCP, to obtain community input through the System Characterization, Development and Evaluation of Alternatives, and Selection and Implementation of Alternatives phases of the process. While the initial meetings were primarily informative and educational in nature, the latter meetings involved more participation and feedback from the team members on the evaluation and selection of CSO LTCP. These meetings were held on the following dates:

- Supplemental CSO Team Meeting #1 – June 9, 2017
- Supplemental CSO Team Meeting #2 – October 11, 2017
- Supplemental CSO Team Meeting #3 – January 29, 2018
- Supplemental CSO Team Meeting #4 – June 5 ,2018
- Supplemental CSO Team Meeting #5 – October 26, 2018

- Supplemental CSO Team Meeting #6 – January 30, 2019
- Supplemental CSO Team Meeting #7 – April 11, 2019
- Supplemental CSO Team Meeting #8 – June 7, 2019
- Supplemental CSO Team Meeting #9 – January 23, 2020
- Supplemental CSO Team Meeting #10 – August 26, 2020

A complete set of the presentation materials presented at the Supplemental CSO Team meetings is included in Appendix A, along with other public outreach and education materials.

6.2.2 Public Meeting #1

An open public meeting, held jointly as Supplemental CSO Team Meeting #9, was convened on January 23, 2020, and was attended by 19 individuals, of which ten were from the permittee team including Elizabeth, JMEUC and consultants, three were from NJDEP, and six were stakeholder representatives from the other invited groups. The meeting was held at 7:00 p.m. at Elizabeth City Hall in order to provide a time and location that would be convenient for community members to attend. At this meeting, an overview of the LTCP process, a recap of the public participation process, a summary of the alternatives evaluation, and discussion on program affordability was presented. Input on the CSO control alternatives was requested and the questions and comments from this meeting were as follows:

1. In presenting the financial capability assessment and the current sewer system cost, a representative asked what the most expensive portion of the per household sewer cost was. The project team indicated that the treatment plant, existing debt service, and sewer system repair costs are the major cost components and the team would review the relative proportions.
2. An attendee asked whether the future estimated cost per household was in current dollars or 2040 dollars. The project team indicated that the future cost was presented in 2040 dollars to account for inflation.
3. An attendee observed that the City and JMEUC are doing a great job working with NJDEP and the Supplemental CSO Team, however there are not many members of the public represented at the meeting. The attendee asked how the team can reach out to community members to keep them involved because these are big projects that will be implemented for the next several decades. The project team responded that this meeting was advertised twice in the local newspapers in both English and Spanish, as well as on the City's website. The project team has also been requesting assistance from the Supplemental CSO Team and regional organizations to distribute information and increase public participation. The City has also been trying to get students involved through participation in environmental days, with the intent that they will share the CSO information with the adults at home.
4. The group acknowledged that getting the public involved is difficult. A project team member suggested that the most effective way is through word of mouth, and that those who are present should tell the members of their community. The project team indicated that they are open to ideas for engaging the community, noting that the team has been participating in community events, with other regional groups, etc. but typically it is the same faces that always attend. An attendee added that most other municipalities have trouble getting the general public to participate and provide input on this issue.
5. An attendee suggested that public outreach materials and presentations be made available in other languages such as Spanish and Portuguese, and that information could be shared on social networks such as Instagram and Twitter. The project team indicated that handouts and notices have been made available in English and Spanish and that the team does not want language to be a barrier for public input, however it may not be an efficient use of City resources to translate every presentation. The project team noted that the team is open to any ideas for additional community engagement.

Feedback from the attendees was also solicited electronically through an interactive web-based survey application. Participants anonymously answered survey questions on a website using their mobile devices during the meeting and the poll results were presented in real-time. Incorporating these live polls was also an effective communication strategy as it encouraged participants to provide instant feedback and remain engaged throughout the meeting. The survey questions and responses are noted in Table 6-1.

Table 6-1: Public Meeting #1 Poll Questions and Responses

Question Possible Selections	Response Count
Which best describes you?	
Resident	0
Business Owner/Industry Advocate	0
Community/Environmental Advocate	6
Government	7
Other	1
Total	**14**
What is your primary concern related to the sewer system?	
Polluted waterways	7
Deteriorating sewer pipes	4
Street flooding	1
Rising sewer bills	0
Other	1
Total	**13**
Do you think the water quality in the local waterways is:	
Getting better	7
Staying the same	2
Getting worse	1
Total	**10**
What would you like to see as the primary future use of local waterbodies?	
Swimming	0
Fishing	0
Kayaking/boating	0
Improved urban drainage	5
Public waterfront access (e.g. Riverwalk)	7
Total	**12**
Which is your greatest concern in siting of CSO control facilities?	
Size of required property	1
Private property acquisition/resident displacement	3
Traffic impacts	0
Odor/environmental impacts	5
Losing green space	3
Total	**12**
How do you feel about the acquisition of private property for siting CSO facilities?	
Acceptable	1
Maybe, if considered the best CSO management strategy	2
Maybe, if well-screened or incorporated into existing landscape/architecture	4
Not in favor – disruptive to community, displace residents, etc.	4
Total	**11**
What is your primary consideration in selecting a preferred alternative?	
Water quality improvements	5
Cost	5
Improved street drainage	1
Integrated green community spaces	1

Job creation potential	0
Total	**12**

Keeping cost in mind, please select your preferred CSO control alternative:

Pump station and treatment plant expansion	7
Complete sewer separation	3
Satellite storage facilities	2
Tunnel storage and secondary controls	0
Satellite CSO treatment facilities	0
Green infrastructure	0
Inflow/infiltration	0
Total	**12**

Based on water quality benefit, please select your preferred CSO control alternative:

Pump station and treatment plant expansion	4
Complete sewer separation	4
Satellite storage facilities	0
Tunnel storage and secondary controls	3
Satellite CSO treatment facilities	0
Green infrastructure	0
Inflow/infiltration	0
Total	**11**

What is a reasonable maximum monthly sewer bill?

$10-$30	0
$31-$50	4
$51-$70	3
$71-$90	1
Over $90	0
Total	**8**

How difficult would it be on your household if your sewer bill increased by $50 per month?

Very difficult	1
Difficult	7
Manageable	1
Not an issue	1
Total	**10**

6.2.3 Outreach During COVID-19

Due to limitations on gatherings related to the ongoing COVID-19 pandemic, the Supplemental CSO Team was not able to hold a meeting during Spring 2020. An email update was sent to the team in early May 2020 to provide information on recent developments for the LTCP, including notification of the NJDEP deadline extension for submission of the Selection and Implementation of Alternatives report to October 1, 2020. It was indicated that the next Public Meeting/Supplemental CSO Team Meeting would be planned for late Summer 2020 to present the recommended CSO control projects and receive feedback on the proposed program. The meeting would be held in-person if possible or as a virtual meeting otherwise. Two PDF presentation packages were also provided for circulation to the Supplemental CSO Team members' constituents. The first package provided information on "CSO Basics" including general background information on CSOs and water quality management in the City of Elizabeth. The second package provided information on "CSO Solutions" including the range of CSO control alternatives evaluated as part of the LTCP process, and the current status for selection of a preferred CSO control plan. Both presentation packages included a set of question prompts to encourage input from the team and their constituents. These presentations were also posted on the City's website.

6.2.4 Public Meeting #2 / Supplemental CSO Team Meeting #10

The second open public meeting, held jointly as Supplemental CSO Team Meeting #10, was convened on August 26, 2020 at 6:30 p.m. to present and obtain feedback from the public on the tentatively selected CSO control program. The meeting was advertised in the local newspaper, as well as on the City's website, and circulated to the members of the Supplemental CSO Team. Due to limitations on public gatherings related to the ongoing COVID-19 pandemic, this meeting was conducted remotely using the Zoom platform. Several virtual meeting platforms were investigated, and Zoom was selected due to its accessibility and ease of use for the public, as well as functionality for asking questions of the presenters, polling for feedback, and the ability to participate via online videoconference or telephone. The meeting was attended by 17 individuals, of which eight were from the permittee team including Elizabeth, JMEUC and consultants, two were from NJDEP, and seven were members of the public and stakeholder representatives from the other invited groups. At this meeting, an overview of the LTCP process was presented, as well as a recap of the public participation process, a summary of the alternatives evaluation, the recommended CSO control program, program affordability, and CSO program implementation schedule. Following the meeting, the presentation slides were posted to the City's website. Input on the tentatively selected CSO control program was requested and the questions and comments from this meeting were as follows:

1. An attendee asked whether this project would be part of the JMEUC storm surge construction project, and whether water quantity, flow and capacity would be incorporated. The project team indicated that JMEUC is undertaking a project to protect the plant from high storm surge conditions which is being conducted in parallel with the CSO LTCP, but it is a separate and distinct project. JMEUC is coordinating between the projects for certain parameters, including the plant effluent pumping facilities handling of flows from a CSO treatment train. A participant added that JMEUC will receive approximately 90% reimbursement from FEMA for the storm surge project, for which the City of Elizabeth will be a direct beneficiary.
2. A question was asked whether the Detroit CSO treatment train fine screen facility is a blending application in which the screened water is blended with the effluent. The project team responded that it is not, it is a satellite treatment facility located on the bank of the Detroit River that captures CSO flow and provides treatment prior to discharge to the river. This facility is outside the property boundary of the treatment plant.

Feedback from the attendees was also solicited electronically through an interactive web-based survey application. Participants anonymously answered survey questions on a website using their connected devices during the meeting and the poll results were presented in real-time. Incorporating these live polls was also an effective communication strategy as it encouraged participants to provide instant feedback and remain engaged throughout the meeting. The survey questions and responses are summarized in Table 6-2.

Table 6-2: Public Meeting #2 Poll Questions and Responses

Question Possible Selections	Response Count
Which best describes you?	
Resident	0
Business Owner/Industry Advocate	0
Community/Environmental Advocate	1
Government	7
Other	2
Total	**10**
How concerned are you about the water quality in local watercourses?	
Very concerned	4
Concerned	6

Slightly concerned	0
Not concerned	0
Total	**10**

What is your primary concern related to the sewer system?

Polluted waterways	1
Deteriorating sewer pipes	6
Street flooding	3
Rising sewer bills	0
Other	0
Total	**10**

What is your primary consideration in selecting a CSO control solution?

Water quality improvements	2
Cost	5
Reduced street flooding	0
More green public spaces	0
Minimizing disturbance to the community	1
Total	**8**

What would be an acceptable increase in your annual sewer bill?

$300-$400	0
$200-$300	0
$100-$200	2
Up to $100	6
None	0
Total	**8**

What is the most effective way to communicate information about CSOs to you and your families?

Mail	0
Community events / school presentations	3
Website / social media	5
Other (Include your response in chat)	0
Total	**8**

6.3 Presentations and Updates to Council and Board Officials

Presentations and updates have been given to City Council and JMEUC board officials to review the options for controlling CSOs and to obtain input on constituent outreach. A presentation was made to the Elizabeth City Council on November 6, 2019 to review the alternatives evaluated and the plan selection process. Updates on the progress of the LTCP development have also been provided through informal discussions with City and JMEUC administrators and executives. Through these discussions, the general feedback received has involved concerns about the extensive costs for the CSO control measures and the severe financial burden associated with costs. Other concerns and comments raised included the need for federal and State grant funding, simplifying the technical content for public presentations, and identifying opportunities to address street flooding where possible.

6.4 Regional and Watershed Based Partnerships

The permittees continue to recognize the value in collaboration with regional groups focused on CSO issues and they have and will continue to actively participate in events hosted by the local community and regional groups such as Jersey Water Works and the NJ CSO Group. Through these meetings, permittees are sharing resources, obtaining feedback from peers on challenges with CSO mitigation and the LTCP process, and reviewing techniques on public messaging.

Comments on the Development and Evaluation of Alternatives Reports were published by Sewage Free Streets and Rivers in August 2019, in which it was noted that the City of Elizabeth and JMEUC section on the public participation process update, which summarized the CSO Supplemental Team coordination and meetings, community outreach activities and educational events, and public information signage and notification systems, was a good example of including community input in the report.

The City has been meeting with NJDEP on a quarterly basis to provide status updates on LTCP progress, and to obtain regular feedback on project direction and developments. The City also hosted the NJDEP's CSO Public Participation Workshop on March 6, 2019 at the local Peterstown Community Center. This workshop was organized by NJDEP in order to gather Supplemental Team members and CSO Permittees from across the State and discussed methods of identifying and effectively engaging with stakeholders.

The City provided assistance to the EPA in the pilot testing of their "CSO Model for Small Communities". The City provided spatial and monitoring data that was gathering during the LTCP System Characterization phase including flow metering, precipitation and tidal time series data, and GIS databases of outfalls, sewer networks, manholes and drainage basins. The City also offered additional support in answering any questions about the data, in order to help the EPA to refine and calibrate the model for application in communities that do not have the resources to develop their own CSO model.

The City has also partnered with the Hudson River Foundation New York-New Jersey Harbor Estuary Program to work with the EPA in using the Climate Resilience Evaluation and Awareness Tool (CREAT) to assess the City's combined sewer system vulnerability to the impacts of climate change. Between October 2019 and July 2020, the City participated in three training webinars, a two-day site visit and workshop, and a concluding workshop over two days to present the results of this assessment. A memorandum to the City Director of Public Works was prepared on the case study results and on how the CREAT tool may be utilized.

The CREAT tool was used to assess the potential impact of sea level rise on the CSO Outfall 035A regulator basin, to evaluate the resilience of selected CSO control alternatives, and to identify potential additional analyses and data that would be useful for future climate change impact assessments. It was found that the tool provides a valuable sensitivity analysis for investigating different extreme weather and sea level rise scenarios and identifying and quantifying their potential impacts. The City found that CREAT could be used to supplement the analysis of LTCP projects in terms of their vulnerability to future climate conditions, and the output products may be useful for public engagement related to integration of climate change considerations into the planning and design process.

On January 28, 2020, the City hosted a "Climate-Ready Combined Sewer Overflow Solutions Forum" at the Elizabeth Public Library, which was organized by New Jersey Future. The Mayor of the City of Elizabeth was a speaker at this event which was meant to provide an opportunity for members of the public learn what state and local officials and wastewater utilities are doing to upgrade wastewater infrastructure to be resilient and mitigate climate change. The event was co-sponsored by Groundwork Elizabeth and Future City Inc. who are both members of the Supplemental CSO Team.

6.5 Community Organization and School Events

The City of Elizabeth has continued to collaborate with Future City Inc., which is a member of the Supplemental CSO Team, on its Environmental Day and Estuary Day activities, attending biannual events since 2017. These annual Estuary Day and Environmental Day student outreach events have been an excellent way to reach many students from various parts of the City. As an update since the Development and Evaluation of Alternatives Report, the City presented at the Estuary Day event on October 4, 2019. At this event, the City made about 8 presentations to over 250 students from different City schools on topics such as combined sewers, rainfall infiltration on different types of land surfaces, and the structure and function of rain gardens.

Future City also conducted a “Remote Environmental Day” on May 1, 2020. Due to the COVID-19 pandemic, an in-person event was not possible. However, the project team provided two presentations to engage the students remotely. The first presentation was on “CSO Basics” including general background information on CSOs and water quality management in the City of Elizabeth, and the second presentation was on “CSO Solutions” and included the range of CSO control alternatives evaluated as part of the LTCP process, and the current status for selection of a preferred CSO control plan. Both presentation packages included a set of question prompts to encourage input and feedback from the students. The presentations were given to over 450 students, and responses were received as indicated in Table 6-3.

In January 2020, Future City implemented an educational outreach program for 88 local students to provide information about Combined Sewer Systems and inform them about the Sewage Free Streets and Rivers campaign. During this event, Future City Inc. distributed one dictionary to each student, which they used to complete a crossword puzzle with vocabulary related to Combined Sewage Systems and Overflows. The students were presented with a bilingual Combined Sewage Systems flyer and encouraged to discuss the flyer as a group and talk about their personal experience with keeping the streets of their town clean.

Table 6-3: Environmental Day Survey Responses

Part 1: CSO Basics	Percentage (%)
1. How clean do you think the Elizabeth River is?	
A. Very clean	18%
B. Somewhat clean	21%
C. Slightly polluted	30%
D. Very polluted	31%
2. What do you think is the main source of pollution in Elizabeth’s waterways?	
A. Street and ground runoff	39%
B. Sewer overflows	39%
C. Sources outside the City	17%
D. Other? (Name other sources)	6%
3. What is the best way the public can help protect local waterways from pollution?	
A. Support construction of new stormwater storage and treatment tanks	26%
B. Organize and participate in local waterway cleanups	47%
C. Install rain barrels and store rainwater at their homes	16%
D. Plant more trees and vegetation at their homes to absorb more rainwater	11%
4. What is the most effective way to communicate information about CSOs to you and your families?	
A. Mail	19%
B. Community events / school presentations	30%
C. Website / social media	36%
D. Other (Name other methods of communication)	15%
Part 2: CSO Control Solutions	**Percentage (%)**
1. What should be the primary consideration in selecting a CSO control solution?	
A. Water quality improvements	46%
B. Cost	21%

C. Reduced flooding	17%
D. More green community spaces	16%
2. What would be your preference in selecting locations for CSO control facilities?	
A. CSO controls that you can see (treatment plant, green infrastructure, etc.)	50%
B. CSO controls that are hidden (tunnel, underground storage tank, etc.)	50%
3. What would be your preference in selecting locations for CSO control facilities?	
A. Centralized solution – longer-term disruption to streets, but fewer locations around the City	36%
B. Satellite sites – smaller, shorter-term disruption, but several locations around the City	64%
4. What would be your greatest concern in selecting sites for CSO control facilities?	
A. Size of required property / change in community/Acquiring private property / requiring residents to move	22%
B. Traffic impacts	22%
C. Odor / Environmental issues	25%
D. Losing green space	31%
5. What do you consider the primary benefit of green infrastructure?	
A. Water quality improvements	34%
B. Reduced flooding	21%
C. Aesthetic, green community spaces	23%
D. Job creation for green infrastructure operations and maintenance	22%

6.6 Posters, Flyers, Brochures and Handouts

The City of Elizabeth has developed and circulated several informational posters and flyers during the Long Term Control Plan development, as included in Appendix A. These items provide educational information about CSOs, the LTCP process, and some of the projects that the City is currently working on. The flyers have been distributed at Elizabeth City Hall and emailed to the 35 members of the Supplemental CSO Team for distribution through their organizational networks. The flyers were made available in both English and Spanish.

Informational handouts describing CSOs, rain gardens, and projects in Elizabeth have been made available to students at the Future City E-Day events, with an estimated 50 handouts distributed to students at each event.

At the National Night Out event held in the City of Elizabeth on August 6, 2019, the City distributed about 290 flyers on the combined sewer overflow control program to residents and visitors.

In 2019, the City has initiated a city-wide tree planting program, with a goal to plant up to 2,500 trees on private property upon request by the owners. Over 15,000 copies of an informational brochure on this tree planting program were mailed to City residents to provide information on the initiative as well as describe the value of trees to a community in improving water quality, managing stormwater and reducing flooding.

6.7 News Releases and Media Coverage

Media advisory notices indicating the City of Elizabeth’s participation in public education events, such as those organized through Future City, Inc. and Elizabeth River/ Arthur Kill Watershed Association, have been issued.

Public notices to notify the community about Public Meeting #1 were published in English and Spanish in the local newspaper on January 8, 2020, as well as on the City webpage. A copy of this notice is provided as Figure 6-1.

Public notices to notify the community about Public Meeting #2 were published in the local newspaper on August 14, 2020 as well as on the City webpage. A copy of this notice is provided as Figure 6-2.

6.8 Social Media and Websites

The City of Elizabeth's new website was launched on June 19, 2019 to provide residents and visitors with new features, upgrades and enhanced, user-friendly experience. Information on the CSO control plan, the municipal stormwater management plan, the stormwater pollution prevention plan, sewer system mapping, informational flyers, and a link to the CSO notification webpage are posted on this website. Copies of the presentations made at the Supplemental CSO Team meetings and the City’s current stormwater management ordinances are available through the webpage. Public notices for each of the open public meetings have also been posted on the City webpage, with the first meeting notice also translated into Spanish. As a result of the COVID-19 pandemic, the Supplemental CSO Team was not able to meet in-person during Spring 2020. As such, two PDF informational presentation packages were posted on the City’s website. The first package provided information on “CSO Basics” including general background information on CSOs and water quality management in the City of Elizabeth. The second package provided information on “CSO Solutions” including the range of CSO control alternatives evaluated as part of the LTCP process, and the current status for selection of a preferred CSO control plan. Both presentation packages included a set of question prompts to encourage input from the public.

The JMEUC website continues to include a public outreach section, which has information about water infrastructure, sewer rates, F.R.O.G. (fats, roots, oil, and grease), scheduling of plant tours, and the CSO LTCP Program.

A CSO control program announcement was shared on social media via City of Elizabeth’s Twitter and Facebook in mid-December 2018 (see Figure 6-3). The City of Elizabeth continues to maintain a Twitter page followed by over 2,200 users and a Facebook page followed by over 9,700 users. With such a large following, the permittees may use these two social media platforms to post educational information about CSOs as well as to advertise any education events or opportunities to provide input on the LTCP process and CSO alternatives. The Facebook post linking to the informational flyer reached 988 people, was clicked on 73 times, “liked” 11 times and shared 5 times.

The City of Elizabeth also arranged with the police department to take drone footage of the construction site at the Trumbull Street Stormwater Control Project, with the intention to use this footage in future public awareness videos.

6.9 CSO Identification Signs

The City of Elizabeth has continued to maintain signs at each CSO outfall to educate the public of the potential hazards associated with water contact during and following wet weather.

PUBLIC NOTICE
THE CITY OF ELIZABETH TO HOLD PUBIC MEETING TO PRESENT INFORMATION ON ITS COMBINED SEWER OVERFLOW (CSO) LONG TERM CONTROL PLAN

The City of Elizabeth (City) will hold a public meeting on Thursday, January 23, 2020 at which time consultants hired by the City will present a progress update on the Combined Sewer Overflow Long Term Control Plan (CSO LTCP) being prepared as required by the City's NJPDES Permit for its combined sewer system. This meeting is for informational purposes only and no formal action will be taken. The CSO LTCP is a feasibility study to evaluate the means, costs and effectiveness of control alternatives for reducing the frequency and volume of CSO discharges, as well as different levels of pretreatment and disinfection of CSO discharges. The public will have the opportunity to comment on the consultant's recommendations. The meeting will be held from 7:00 pm to 8:30 pm at City Council Chambers, 3rd Floor, Elizabeth City Hall, 50 Winfield Scott Plaza, Elizabeth, NJ. Comments from the public will be included in the public participation section of the report that will be submitted to the NJ Department of Environmental Protection. The meeting is the public's opportunity to voice opinions so that the City can consider this input and the economic impacts of CSO controls when selecting the final control program for review and approval by the New Jersey Department of Environmental Protection.

John F. Papetti, Jr.
Director Public Works

NOTICIA PÚBLICA
LA CIUDAD DE ELIZABETH REALIZARÁ UNA REUNIÓN PÚBLICA PARA PRESENTAR INFORMACIÓN SOBRE SU PLAN COMBINADO DE CONTROL DE LARGO PLAZO DE ALCANCE DE ALCANTARILLADO (CSO)

La Ciudad de Elizabeth (Ciudad) llevará a cabo una reunión pública el jueves 23 de enero de 2020, donde los consultores contratados por la Ciudad presentarán una actualización del progreso sobre el Combined Sewer Overflow Long Term Control Plan (CSO LTCP) que se prepara según lo requerido Permiso NJPDES de la Ciudad para su sistema de alcantarillado combinado. Esta reunión es solo para fines informativos y no se tomarán medidas formales. El CSO LTCP es un estudio de viabilidad para evaluar los medios, los costos y la efectividad de las alternativas de control para reducir la frecuencia y el volumen de las descargas de OSC, así como los diferentes niveles de pretratamiento y desinfección de las descargas de OSC. El público tendrá la oportunidad de comentar las recomendaciones del consultor. La reunión se llevará a cabo de 7:00 pm a 8:30 pm en las Cámaras del Consejo de la Ciudad, 3er piso, Elizabeth City Hall, 50 Winfield Scott Plaza, Elizabeth, NJ. Los comentarios del público se incluirán en la sección de participación pública del informe que se presentará al Departamento de Protección Ambiental de NJ. La reunión es la oportunidad del público para expresar opiniones para que la Ciudad pueda considerar esta aportación y los impactos económicos de los controles de las OSC al seleccionar el programa de control final para su revisión y aprobación por el Departamento de Protección Ambiental de Nueva Jersey.

Figure 6-1: Public Meeting #1 Notice Advertisement

PUBLIC NOTICE

THE CITY OF ELIZABETH TO HOLD VIRTUAL PUBLIC MEETING TO PRESENT INFORMATION ON COMBINED SEWER OVERFLOW (CSO) LONG TERM CONTROL PLAN

The City of Elizabeth (City), in conjunction with the Joint Meeting of Essex and Union Counties (JMEUC), will be conducting a virtual public meeting on Wednesday, August 26, 2020 at 6:30 pm, at which time consultants hired by the City and JMEUC will present information on proposed projects for the Combined Sewer Overflow Long Term Control Plan (CSO LTCP), which is being prepared pursuant to regulatory permits for the combined sewer system issued by the NJ Department of Environmental Protection (NJDEP). This meeting is for informational purposes only and no formal action will be taken. The CSO LTCP is a feasibility study to evaluate the means, effectiveness, costs and economic impacts of control alternatives for reducing the frequency and volume of combined sewer overflow discharges. The City and JMEUC are soliciting comments from the public on the proposed plan and input from the public will be included in the report that will be submitted to the NJDEP. This meeting is an opportunity for the public to obtain information, ask questions, and provide comments so that the City can consider this input when finalizing the selection of the recommended control program, for review and approval by the NJDEP.

Due to limitations on public gatherings related to the ongoing COVID-19 public health crisis, this meeting will be conducted remotely using the Zoom.com platform and there will be no meeting held in person. The public will be able to participate by online videoconference or telephone only. To participate via the online meeting system, please go to: https://us02web.zoom.us/j/84669285538; or enter the following link into your web browser: https://us02web.zoom.us/join; and enter Meeting ID: 846 6928 5538 where prompted.

To participate via telephone, please call 1-646-558-8656, and enter Meeting ID: 846 6928 5538 when prompted. Interested persons may also contact the Office of the City Engineer at 908-820-4271, Monday through Friday, between the hours of 9 a.m. and 4 p.m., regarding meeting connection details. For more information on the CSO LTCP program, including details on the meeting schedule and login, please visit https://www.elizabethnj.org/182/CSO.

John F. Papetti, Jr.
Director Public Works

Figure 6-2: Public Meeting #2 Notice Advertisement

6.10CSO Notification System

One of the Nine Minimum Control Requirements is “Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts”. As part of NJ CSO Group, the City of Elizabeth has continued to utilize the online CSO notification system (https://njcso.hdrgateway.com/) as a public information tool advising on the status of CSO occurrences in the City of Elizabeth and certain other communities participating in the NJ CSO Group.

6.11 Green Infrastructure Signage

The City is committed to continuing to install signage for rain gardens explaining the function and purpose of green infrastructure as a strategy in stormwater management. The locations include at Trumbull Street, Kenah Field, and Green Acres Park.

6.12 Combined Sewer Infrastructure and Treatment Plant Tours

JMEUC continues to host several tours each year of its wastewater treatment facilities upon request by interested parties. Additional tours for community, environmental, and media groups of the combined sewer outfall and control facilities, receiving waterways, JMEUC wastewater treatment plant, and green infrastructure installations may be hosted by the permittees to foster understanding of the sewer system, water quality, and CSO issues and control alternatives.

6.13 Future Public Participation

The CSO LTCP provides planning level recommendations for the selection of a suitable and feasible CSO control program. The City and JMEUC will continue to conduct public outreach through the detailed design and implementation phases for the selected CSO control program, in order to provide information on construction schedules, anticipated traffic or community impacts, and to gain public input on items such as the selection of specific sites around the city. This outreach may be in the form of periodic meetings open to the public or selected representative community members to provide project updates, the circulation of informational flyers in the mail or on social media, or public notices posted on the City website or local newspaper. The City and JMEUC are committed to ensuring that members of the public are provided with information as well as an opportunity to comment throughout the duration of planning and implementation of the selected CSO control program.

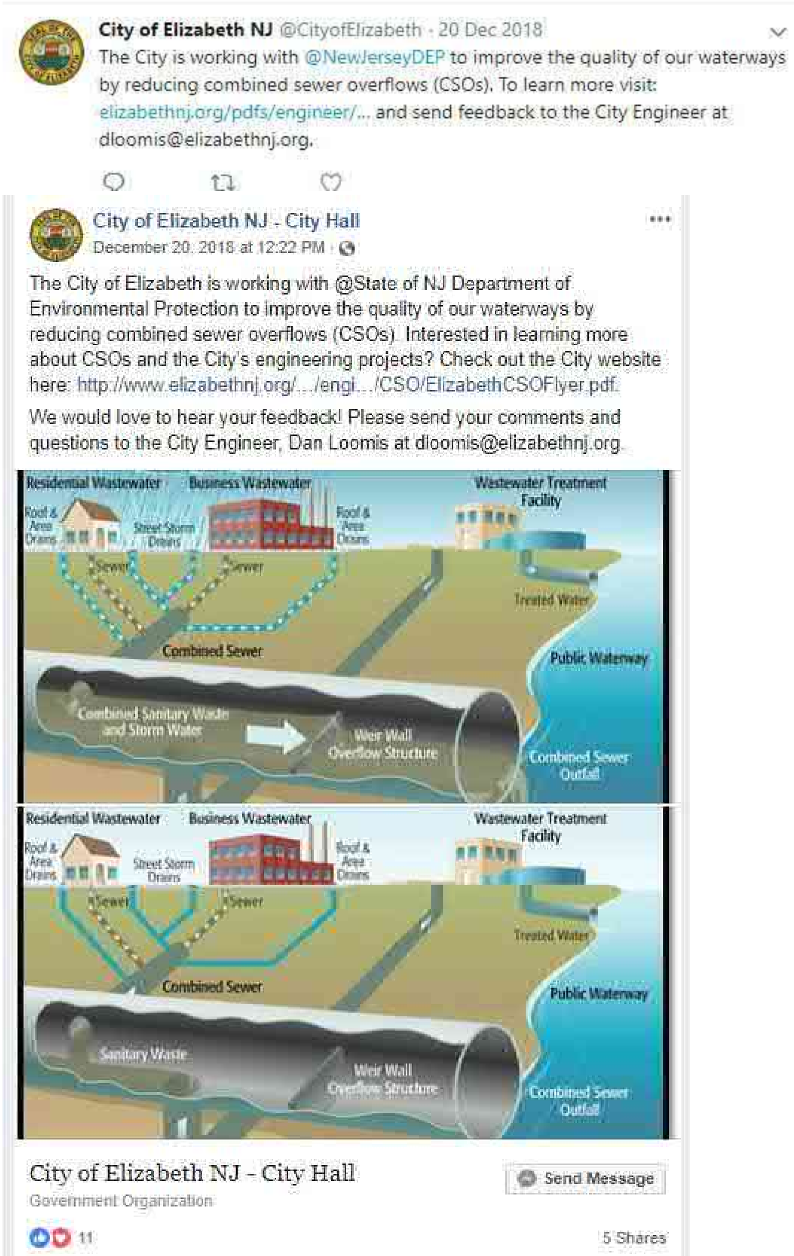


Figure 6-3: Social Media Posts

Section 7
Plan Selection

This section describes the proposed combined sewer overflow (CSO) control projects selected for the Long Term Control Plan (LTCP) based on the evaluation of alternatives, water quality performance, financial capability analysis, and public outreach program. The selection of the recommended CSO Long Term Control Plan meets the requirements of the New Jersey Pollutant Discharge Elimination System (NJPDES) CSO Permit Sections G.2. and G.6. through G.9.

As noted in Section 4, the Presumption Approach with the criterion of capturing 85% by volume of the average annual combined sewage produced system-wide was selected by the City of Elizabeth and the Joint Meeting of Essex and Union Counties (JMEUC) as the control approach for the selection of the LTCP alternatives.

Based on the findings of the alternatives analysis, affordability analysis, and input from the local community, it was determined that the most practical approach to cost-effective CSO control would be a focus on increased conveyance and treatment. While the selected plan involves a combination of different controls strategies, including sewer separation, off-line storage tanks, and green infrastructure, maximizing conveyance to the existing wastewater treatment facilities and providing additional conveyance and treatment capacity as the primary strategy is consistent with the public input and fiscal situation. By selecting alternatives that are most applicable for the City and JMEUC, the recommended plan is technically feasible, effective in meeting the control goals, cost-effective, and suitable by mitigating difficult siting challenges and disruptive construction of multiple satellite facilities.

The components of the selected plan are outlined as follows:

h. Current and planned stormwater control projects
i. Increased conveyance from existing Trenton Avenue Pumping Station
j. New wet weather pumping station and force main to JMEUC
k. Regulator modifications and interceptor improvements for additional wet weather conveyance
l. New combined sewer flow facility at JMEUC Wastewater Treatment Facility (WWTF)
m. Select sewer separation projects
n. Green infrastructure pilot program

The complete list of recommended projects for the CSO LTCP is provided in Table 7-1, while Figure 7-1 indicates the general location of the recommended projects.

Table 7-1: CSO LTCP Recommended Project List

Project No.	Project Name	Project Type
1	South Second Street Stormwater Control	Current/planned stormwater control
2	Lincoln Avenue Stormwater Drainage Improvements	Current/planned stormwater control
3	Trenton Avenue Pumping Station - Phase 1 Upgrade	Increased conveyance from TAPS
4	Basin 012 Sewer Separation	Select sewer separation
5	Atlantic Street CSO Storage Facility	Current/planned stormwater control
6	Park Avenue Stormwater Control	Current/planned stormwater control
7	Green Infrastructure Pilot Program	Green infrastructure pilot program

Project No.	Project Name	Project Type
8	Trenton Avenue Pumping Station - Phase 2 Upgrade	Increased conveyance from TAPS
9	Basin 037 Sewer Separation	Select sewer separation
10	Easterly Interceptor Improvements	Regulator modifications and interceptor improvements for additional conveyance
11	New Wet Weather Pump Station Force Main to JMEUC	New wet weather pump station and force main
12	New Wet Weather Pump Station	New wet weather pump station and force main
13	New CSO WWTF	New combined sewer flow facility
14	Bridge Street Siphon Upgrade	Regulator modifications and interceptor improvements for additional conveyance
15	Palmer Street Branch Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
16	Palmer Street Siphon Upgrade	Regulator modifications and interceptor improvements for additional conveyance
17	Lower Westerly Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
18	Pearl Street Branch Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
19	R027/028 Regulator Modifications	Regulator modifications and interceptor improvements for additional conveyance
20	R040 Regulator Modifications	Regulator modifications and interceptor improvements for additional conveyance
21	Upper Westerly Interceptor Upgrade	Regulator modifications and interceptor improvements for additional conveyance
22	Morris Avenue Siphon Upgrade	Regulator modifications and interceptor improvements for additional conveyance

Descriptions for each component of the CSO control program are provided in the following sections.

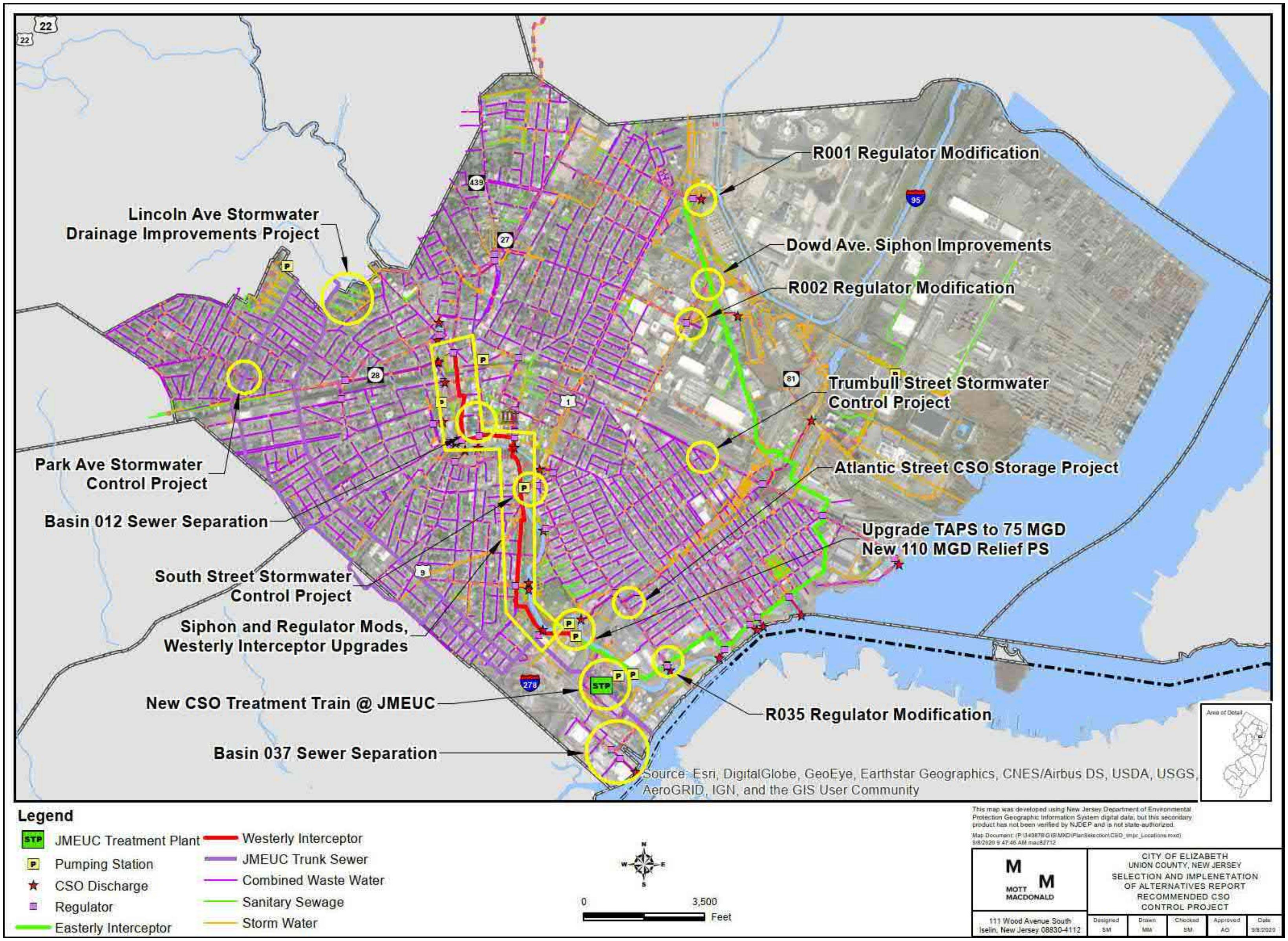


Figure 7-1: General Location of Recommended CSO Control Projects

7.1 Current and Planned Stormwater Control Projects

There are several ongoing and recently completed stormwater control projects that have been undertaken by the City of Elizabeth which, when completed, will contribute to the reduction of combined sewer overflows discharging to the local receiving waters. These projects are itemized below, and have been accounted for in the future conditions model simulation. It is also noted that these projects have already been included in the existing sewer system budget.

7.1.1 Completed and Current Construction Projects

7.1.1.1 Progress Street Stormwater Control Project

The Progress Street Stormwater Control Project was substantially completed in 2018 to address flooding in a low-lying industrial area. The flooding was caused by excessive flows in the CSO outfall line, coupled with high water levels at the outlet to the Great Ditch, which then conveyed wet weather flows to Newark Bay. Under the project, the low area was isolated from the CSO outfall line by re-routing 850 linear feet of 48-inch outfall line and connecting the local drainage to an existing storm sewer. Approximately 1,500 linear feet of 4-foot x 8-foot box culvert was also installed in the Progress Street right-of-way to provide storage for excess runoff when the tail water in the Great Ditch is elevated. Customized control structures allow runoff to drain until the tail water is elevated, then water is directed into the box culverts. The project is being financed through New Jersey Water Bank (formerly New Jersey Environmental Infrastructure Financing Program), with a final construction cost of about $5.7 million.

7.1.1.2 Trumbull Street Stormwater Control Project

The Trumbull Street Stormwater Control Project was substantially completed in August 2020, and was implemented to address localized street flooding at Trumbull Street and Sixth Street that disrupts trucking transportation traffic from the area to nearby highways and impacts the passage of emergency response vehicles. Based on field surveying, flow monitoring, and hydraulic modeling, insufficient wet weather flow capacity in the stormwater drainage system was identified as a contributor to the localized flooding. Under the project, the City acquired an under-utilized triangular land parcel and installed a 1.0-million-gallon subsurface concrete tank to store excess runoff, which, with a dewatering pump station and remote level sensing system, would be pumped to the combined sewer following wet weather events. The newly purchased property also serves as an opportunity to implement green infrastructure controls with a network of rain gardens that capture street runoff and provides a pedestrian plaza for the beautification and enhancement of the neighborhood. Runoff that exceeds the capacity of the rain gardens overflows to subsurface storage tank. The project is being financed through New Jersey Water Bank), with a construction contract bid price of about $5.42 million.

7.1.1.3 South Street Flood Control Project

The South Street Flood Control Project was implemented to address inadequate capacity within the existing combined sewer and the inability to reliably operate the South Street Pump Station. The project includes rehabilitation and upgrades to the South Street Pump Station, including new pumps, electrical systems and controls, and a backup generator. It also involves repairs and lining of the existing combined sewer on Fourth Avenue and connecting streets, installation of separate storm sewers and inlets at various locations including South Spring Street and the dead-end streets of Fourth Avenue between South Street and John Street, and restoration of the Elizabeth River Flood Control ponding areas and outlet structures. Construction of this project began in 2019 and is anticipated to be completed in 2020. The total cost of this project is $5,320,000, with financing through New Jersey Water Bank.

7.1.2 Current Design Projects

The City of Elizabeth currently has plans to implement the following capital projects to address the multiple goals of combined sewer overflow reduction, street flooding mitigation, stormwater management compliance, and sewer system renewal. The scope of the projects involve stormwater drainage improvements, partial sewer separation, and off-line combined sewer flow storage facilities.

7.1.2.1 South Second Street Stormwater Control Project

The South Second Street Stormwater Control Project consists of drainage upgrades to provide a new storm system that drains into the existing ditch at the end of South Second Street, control improvements to the existing South Second Street Stormwater Pump Station, and cleaning and enhancement of the existing drainage ditch and headwall to allow unimpeded flow of runoff from the Geneva Street and South Second Street area to the pump station. The estimated construction cost is approximately $2.8 million and construction is anticipated for 2021 to 2022.

7.1.2.2 Atlantic Street CSO Storage Facility Project

During moderate rainfall events with a high tide condition in the Elizabeth River, due to inadequate hydraulic gradient in the existing combined sewer, runoff generated in the Atlantic Street drainage area cannot enter the subsurface conveyance system. This results in flooding of localized low points along Third Avenue and the intersections of Doyle Street and Atlantic Street.

The Atlantic Street CSO Storage Facility Project proposes to address this flooding while significantly reducing the overflow volume for Outfall 038A through the installation of an underground wet weather storage system in excess of 1 million gallons at Atlantic Street and Third Avenue. This storage facility will provide combined sewer overflow control for CSO Basin 038 and mitigate street flooding on Third Avenue. The project also includes installation of connection piping from existing combined sewer lines, and construction of a new pump station, emergency generator, and recycling center building on the property. After each wet weather event, the dewatering pump station will convey the combined sewage through a force main back to the existing trunk sewer. The use of a storage facility will effectively limit the quantity and frequency of CSOs. The estimated construction cost for this project is approximately $8.2 million and construction is anticipated for 2021 to 2022.

The City has purchased the property parcels for the proposed storage tank site, which is located adjacent to the Interstate 95 (New Jersey Turnpike) roadway to the southeast and the City Department of Public Works maintenance facility and salt dome to the southwest. Figure 7-2 shows a location plan of the project site and Figure 7-3 indicates the preliminary site plan for the facilities. The existing building on the site has been demolished and cleared and design development for the storage tank is ongoing.

7.1.2.3 Lincoln Avenue Stormwater Control Project

The Lincoln Avenue Stormwater Control Project addresses capacity limitations in a separate storm sewer drainage system that relates to surface flooding along Lincoln Avenue at the intersections with Melrose Terrace, Decker Avenue, and Wilson Terrace. This Lincoln Avenue drainage area is a partially separated sewer area of CSO Basin 041. The project involves construction of approximately 3,000 feet of new storm sewers to replace and augment the existing drainage system on Lincoln Avenue, Melrose Terrace, Decker Avenue and Wilson Terrace. The existing storm sewers on these streets will be upsized and the stormwater runoff directed east along Lincoln Avenue, north on Cherry Street, and across Morris Avenue to an existing large diameter storm sewer on Trotters Lane for discharge to the Elizabeth River. The estimated construction cost is about $2.8 million and construction is anticipated for 2021 to 2022.

Figure 7-2: Atlantic Street Storage Facility Project Location

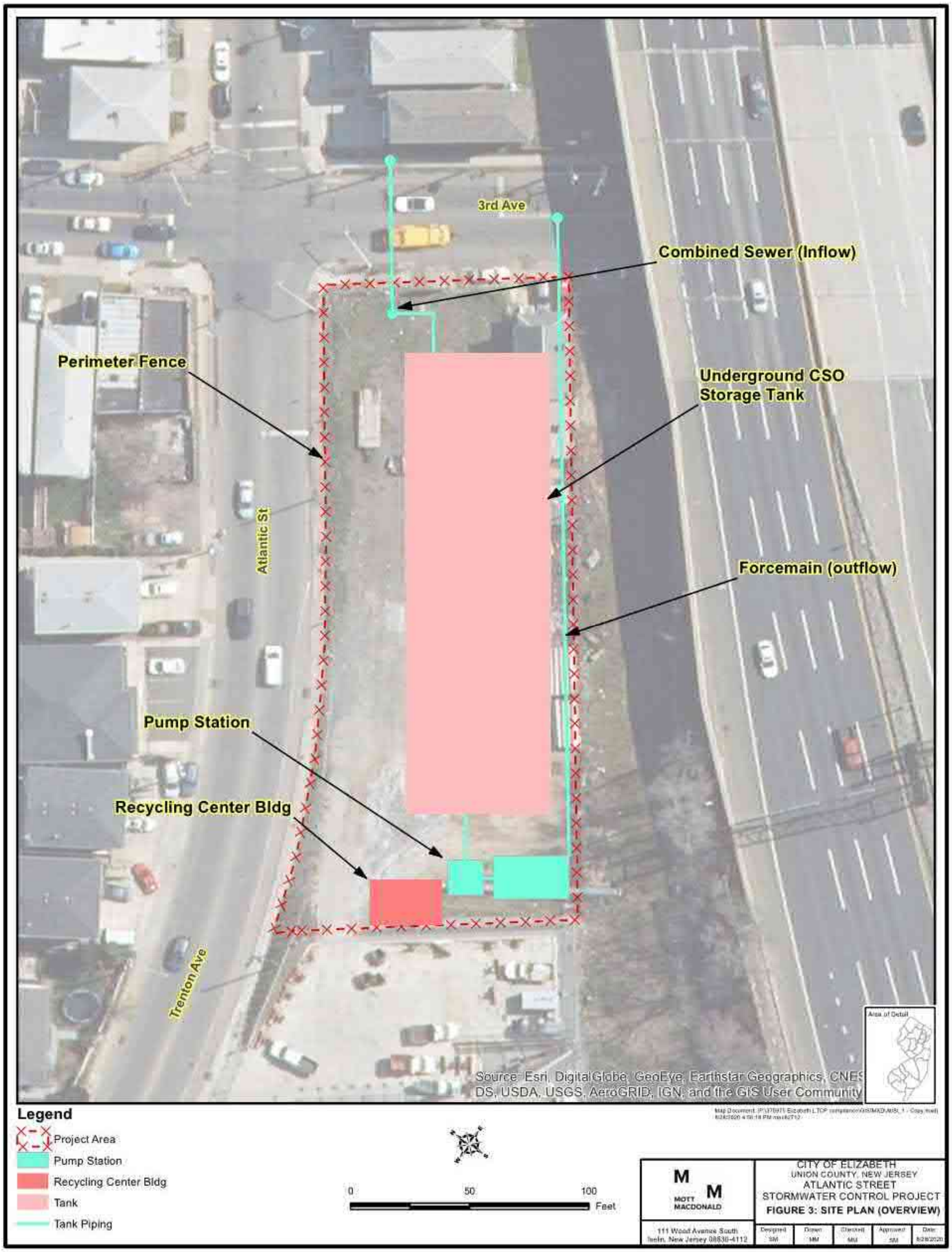


Figure 7-3: Atlantic Street Storage Facility Proposed Site Plan

7.1.2.4 Park Avenue Stormwater Control Project

The Park Avenue Stormwater Control Project provides additional drainage capacity to address periodic localized street flooding on Park Avenue between Coolidge Road and Springfield Road during significant wet weather events. The project involves the Westfield Avenue / Park Avenue trunk sewer located in CSO Basin 003, which receives flow from the Borough of Roselle Park via a 42” diameter storm sewer connection. The project includes replacement of the combined sewer, maintaining the existing pipe alignment but using smoother pipe material, and increasing the diameter and slope to the maximum extent possible for improved hydraulic performance. The options being studied for mitigating the roadway flooding may also require modifications to the downstream regulator to assist with the flood relief. The current estimated construction cost is $8.6 million and construction is anticipated for 2021 to 2022.

7.2 Increased Conveyance from Existing Trenton Avenue Pumping Station

The existing Trenton Avenue Pumping Station (TAPS) and force main can convey greater flow to the JMEUC WWTF than allowed under current operating conditions. This selected plan component is consistent with the Control Program 3A alternative described and evaluated in Section 5. Increased pumping at TAPS will take advantage of peak wet weather flow timing differences between the JMEUC and Elizabeth service areas, and this is described further below. However, in order to increase conveyance of flows to the JMEUC WWTF for treatment, it is necessary to upgrade the TAPS. Upgrades will include (1) the implementation of real time control (RTC) to ensure that the increased pumping rates at TAPS do not cause hydraulic problems in the JMEUC trunk sewer system, and (2) pump replacement and station improvements to increase pumping capacity and reliability.

The TAPS upgrades will be completed in a phased approach, to ensure that additional conveyance from the TAPS can be properly received downstream at the JMEUC WWTF. The advantage of a phased approach is primarily the ability to increase flow capture and treatment as quickly as possible. These phases are described below.

7.2.1 Phase 1 Upgrade: Increase Pumping with Real Time Controls and Existing Pumps

The first phase of upgrades to the TAPS will allow the station to pump at the peak hydraulic capacity of the facility (estimated to be up to 55 million gallons per day (mgd)). Previous analysis completed as part of the Development and Evaluations of Alternatives Report show that implementation of RTC would allow the Trenton Avenue Pumping Station to safely discharge to the JMEUC’s trunk sewer system at rates greater than the current contractual limit of 36 mgd. The increased flow requires a revision to the existing contractual agreement between the City of Elizabeth and the JMEUC to allow the increase in pumping, and contractual modifications are being developed at the time of this report.

The proposed RTC would take advantage of the peak timing difference in wet weather flows from the separate sewer municipalities serviced by the JMEUC, and flows from Elizabeth’s combined system, which reach peak much more quickly. This timing difference is illustrated in Figure 7-4 which shows model simulation results for the 9/18/2004 Typical Year rainfall event.

Since its original development, the modeled control rule representing the RTC has been modified to more closely simulate how it will physically perform during wet weather flow once implemented. Previous iterations of the modeled control rule throttled flow through the TAPS by controlling the opening height of two upstream sluice gates, whose opening heights were a function of flow through the JMEUC’s North Barrel. The present modeled control rule throttles flow through the TAPS by directly controlling pumping rate as a function of depth in the North Barrel. A proposed “Control Point” has been identified approximately 1,600 feet upstream of the TAPS force main discharge point. Flow depth will be monitored at this location which will enable over-ride of the control of the TAPS pumping rate during high flow conditions that risk trunk sewer flooding.

As capacity becomes limited in JMEUC's system during wet weather flow (measured via flow depth at the Control Point), TAPS discharge will be throttled so that the depth at the "Critical Node" will be maintained at, or kept below, the existing peak typical year flow depth at the Critical Node's location. The Critical Node was identified as the first manhole that would flood due to increased TAPS discharges to the JMEUC North Barrel. Model results show that approximately 1.5' of freeboard exists at this location during peak existing Typical Year conditions. The control rule has been developed so that this freeboard is not exceeded during the Typical Year. Figure 7-5 shows the location of both the proposed Control Point and Critical Node in relation to the TAPS discharge point, while Figure 7-6 presents a schematic of the modeled control rule representing the proposed RTC.

As seen in Figure 7-6, the control rule will work by allowing combined flow from Elizabeth to discharge to the JMEUC's system at 55 mgd during the onset of a wet weather event, prior to JMEUC's separate sewer system rainfall response reaching the downstream end of their system. As the separate sewer system's wet weather response nears the TAPS discharge point, TAPS flow will be maintained at 55 mgd until hydraulic conditions require that TAPS flow be throttled back to current levels. Figure 7-7 shows the TAPS discharge under the proposed Phase 1 RTC for the 9/28/2004 Typical Year event, along with the flow depth at the Control Point and Critical Node. Figure 7-7 illustrates how the RTC will maintain flow depth at the Critical Node during large wet weather events. Model results indicate that over the course of the Typical Year under Phase 1 conditions, the TAPS RTC can be expected to activate 3-4 times, depending on the magnitude of throttling of the TAPS influent gates, as discussed in Section 7.2.2.

Installation and start-up of RTC hardware is expected to be complete by the Summer of 2021. Hardware will consist of three radar-type level sensors installed within the JMEUC's North Barrel along Pulaski Street. These level sensors are currently expected to be installed at the Control Point, Critical Node, and at point between the Control Point and Critical Node. In addition to the level sensors, two NEMA 4X control panels with radio/cellular communication capabilities will be installed at the TAPS and the JMEUC's WWTF to allow for monitoring and manual override of the RTC if necessary. Communication between hardware will occur over a secure VPN tunnel. Once hardware is installed, system-wide testing of communications and level measurement will occur to ensure proper RTC performance.

Model results indicate that implementation of the RTC described above will result in an immediate improvement in typical year CSO capture volume. A CSO volumetric reduction of between 165 and 197 million gallons (MG) during the Typical Year is predicted (dependent on throttling of upstream sluice gates which limit debris reaching TAPS wet well screens).

7.2.2 Phase 2 Upgrade: Pump Replacement and Station Improvements

Phase 2 upgrades to the TAPS involve increasing the TAPS peak pumping capacity up to approximately 75 MGD in order to maximize flow through the existing force main and JMEUC trunk sewers. This includes replacement of the existing wastewater pumps and other process, structural, and electrical improvements to the existing station.

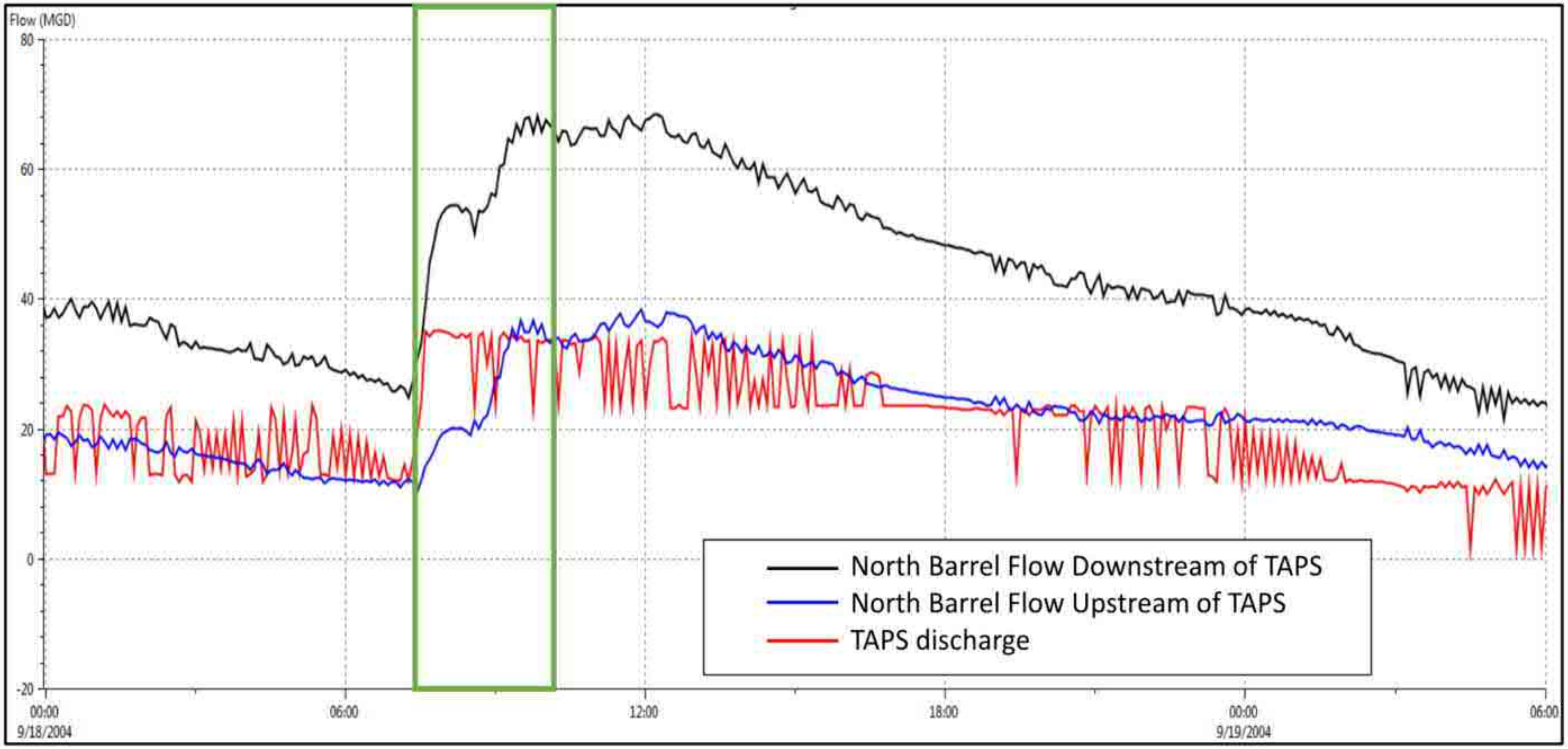


Figure 7-4: Peak Timing Difference in Flows Through TAPS and From JMEUC's Upstream Municipalities for 9/18/2004 Event

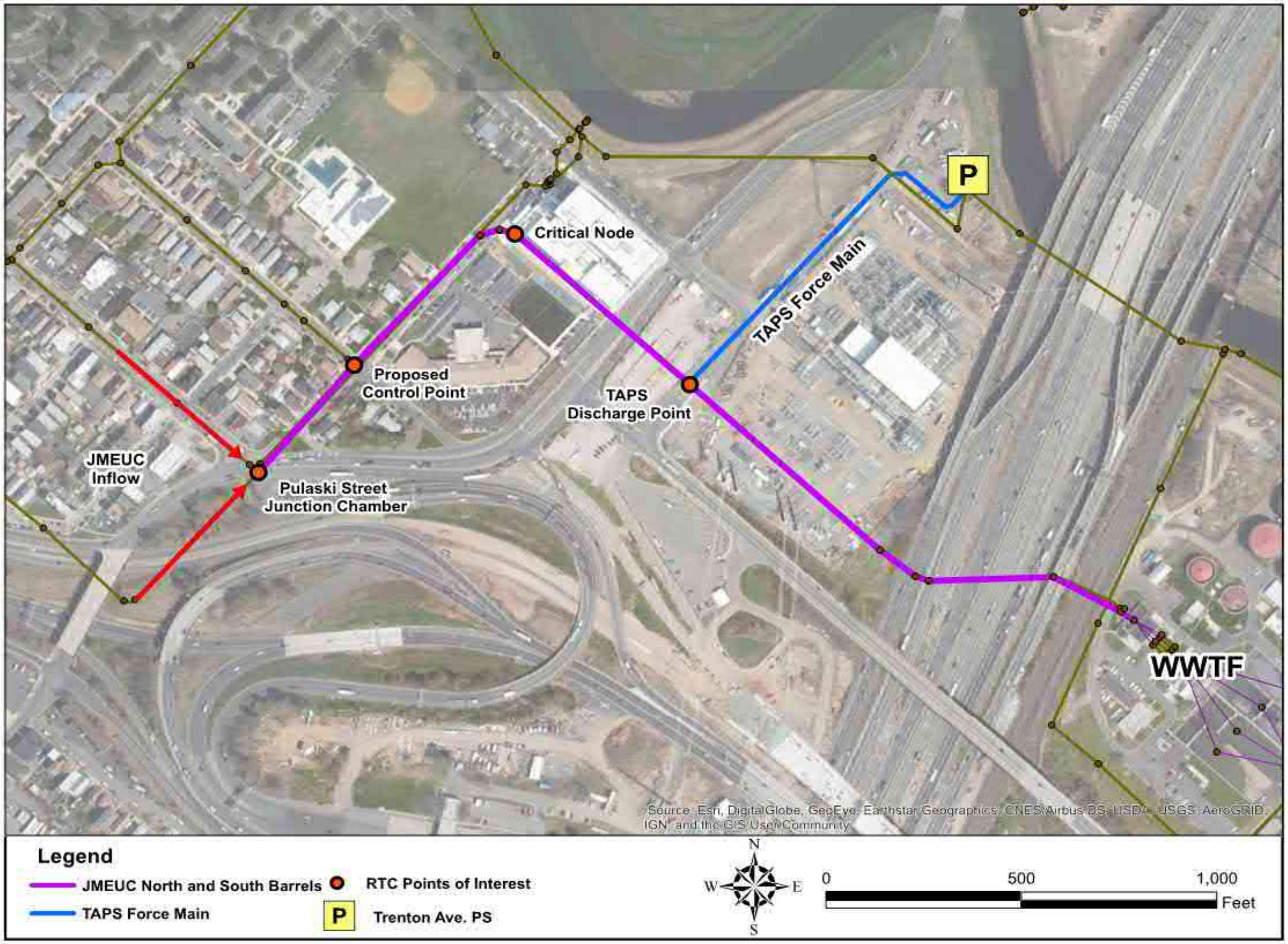


Figure 7-5: Proposed Control Point and Critical Node Locations in Relation to the TAPS

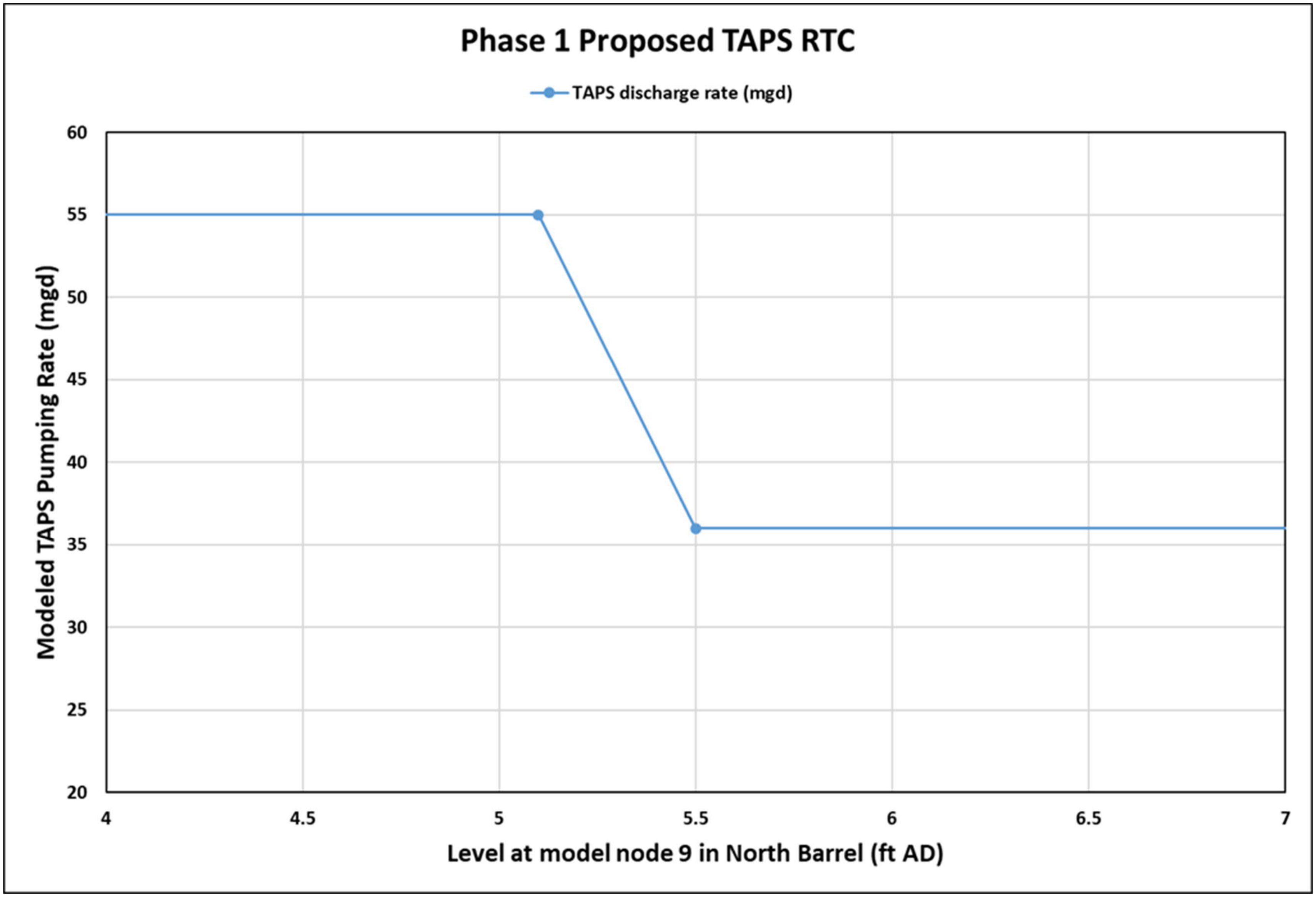


Figure 7-6: Modeled Control Rule Representing Proposed Phase 1 RTC

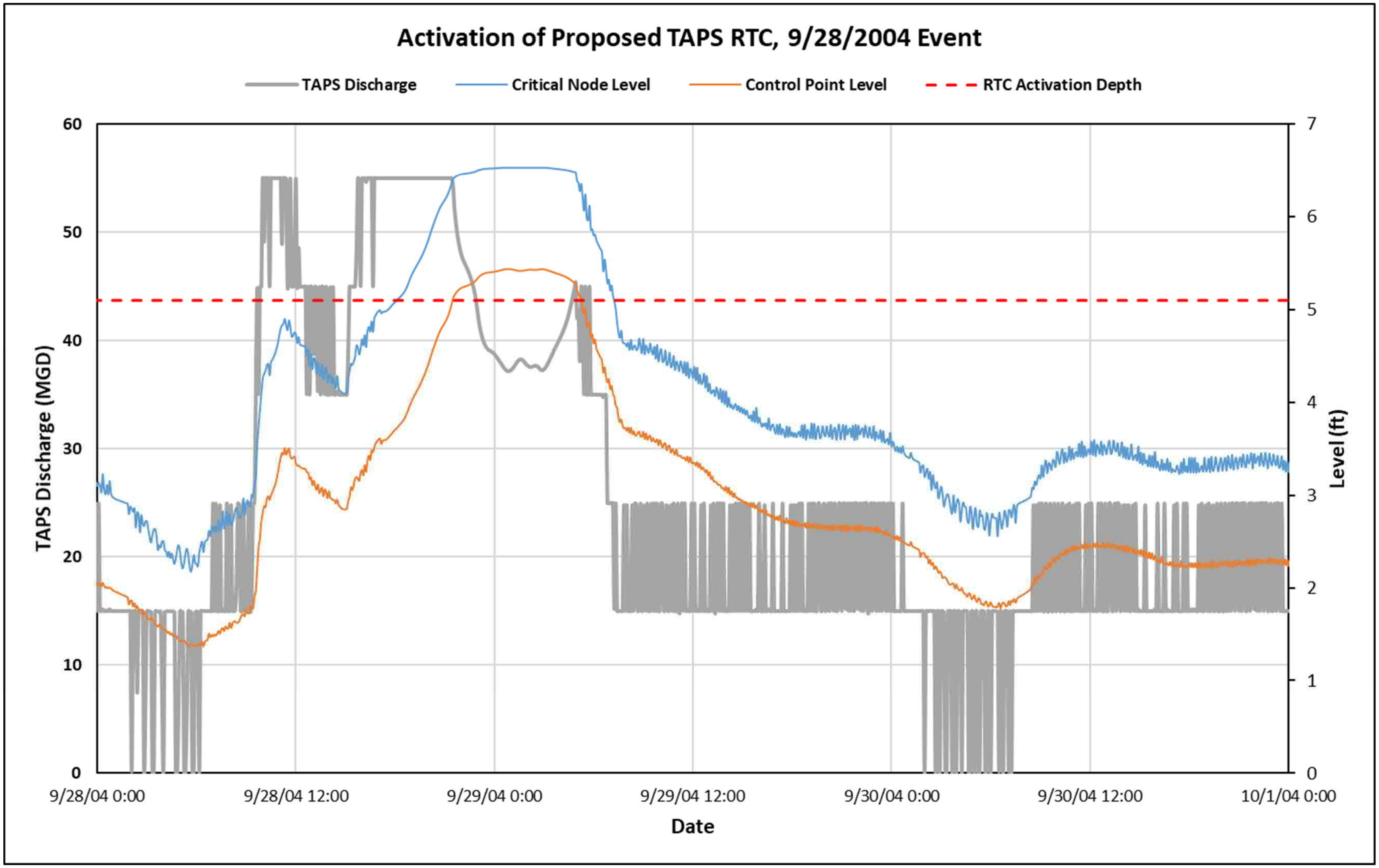


Figure 7-7: Activation of Proposed TAPS RTC for 9/28/2004 Event

Under the Phase 2 TAPS upgrade, the existing force main will continue to be used to deliver flow to JMEUC trunk sewer system and to the WWTF, and the rehabilitated TAPS facility will maximize the capacity of this conduit. The level sensors in the North Barrel installed in Phase 1 and linked to pump controls will continue to be used to limit pumping during high flow periods as necessary to prevent upstream flooding in the trunk sewers. In addition, as part of this phase, an inter-connection 3-feet high by 6-feet wide would be created between JMEUC's North and South Barrels in order to improve the balance of hydraulic gradients between the two conduits. Trunk sewer modeling has demonstrated that increasing the peak pumping rate at TAPS with this inter-connection implemented does not increase the hydraulic grade line (HGL) in the North Barrel. The inter-connection enables higher pumping rates to be implemented at TAPS before the critical HGL is reached.

The Trenton Avenue Pumping Station was constructed in 1955 and certain pieces of equipment are original. Given the stress placed on the equipment if operated at 55 mgd consistently during wet weather, a number of upgrades are required to reliably provide the desired future performance. The following list summarizes the major components that would require upgrades:

- Mechanical bar screens – During dry weather TAPS receives debris consisting of rags, "flushable" wipes and other materials. During wet weather the debris load increases sharply as the first flush of litter, leaves, etc. is washed off the streets and into the combined sewer system. In response, during wet weather events, the TAPS influent gates are throttled to reduce the amount of debris reaching the screens. Throttling the gates holds the debris in the system to be released after the storm when the flow rate is lower, thus reducing the amount of debris entering the pumping station. To operate the pumping station at 55 mgd, the gates would need to remain open during wet weather, which would result in the debris reaching the screens at a rate higher than they can handle. Accordingly, the screens would need to be upgraded to prevent blinding of the screens and allow proper operation of the pumping station.
- Screenings handling system – Currently, the screenings are raked from the screen and passed through a grinder and discharged downstream of the screens. From time to time, the ground screenings reconstitute and cause pump clogging, which is addressed through regular maintenance. With the increased rate of the flow and upgraded screens, the amount of screenings will increase, creating the potential for more frequent pump clogging. To prevent this, the existing grinder would be replaced with a screenings washer-compactor system, which would discharge screenings to a dumpster. This would also reduce the solids and organic loads delivered to the WWTF.
- Wastewater pumps – The pump casings are original from construction in 1955. To improve operational reliability, the pumps including casings, impellers and motors, would be replaced. This would allow TAPS to achieve a firm capacity of up to 75 mgd, which assumes the largest pump is out of operation.
- Structural repairs – Given the age and condition of TAPS, it is likely that to accommodate the required improvements, structural repairs and modifications will be required. This includes modifications to allow installation of the new screens, repairs that may be needed to protect new equipment from exposure to harsh conditions within the pumping station and improvements to accommodate additional loads from new pumps and pumping rates.
- Electrical upgrade – The Phase 2 electrical improvements are expected to include:
    - Replacement of the Motor Control Center, including replacement of associated starters for sluice gates and mechanical equipment.
    - Replacement of all five variable speed drives.
    - Replacement of existing automatic transfer switch.
    - Replacement of existing emergency generator with two generators capable of running all pumps simultaneously.

- o Replacement and upgrade of existing lighting and power panelboards for compliance with codes and standards (e.g. Panel LP, Panel LPA, and PP-1).
- o Replacement of the main control panel / pump sequence control center.
- o Installation of a new fire alarm system.

The 3-feet high by 6-feet wide inter-connection is proposed to be located in the immediate vicinity of the TAPS discharge point (see Figure 7-5). As can be seen in the figure, the JMEUC North and South barrels begin at the Pulaski Street Junction Chamber, approximately 2,000 ft upstream of the TAPS force main discharge point (see Figure 7-5). From this point, the two barrels are hydraulically separated until they come together at the WWTF, approximately 1,300 ft downstream of the TAPS force main discharge point. Adding the proposed inter-connection will improve the HGL balance between the two barrels by compensating for the potential imbalance caused by the TAPS discharges to only the North Barrel. The peak typical year discrepancy in the HGLs between the North and South Barrels is illustrated schematically in Figure 7-8.

Model results indicate that under existing conditions, the imbalance of flows caused by TAPS discharge to the North Barrel results in a peak HGL difference between the North and South Barrels of 0.7’ at the discharge point. This peak difference increases to 1.3’ when TAPS discharge is increased to the proposed Phase 2 discharge of 75 mgd. The difference in HGLs diminishes in a linear fashion in both upstream and downstream directions until either the Pulaski Street Junction Chamber or WWTF are reached. The peak HGL difference between North and South Barrels at the Critical Node referenced in Section 7.2.1 is 0.5’ under existing conditions, and 0.9’ when TAPS discharge increases to 75 mgd.

Model results indicate that a 3-feet high by 6-feet wide inter-connection installed near the North Barrel’s invert near the TAPS discharge point is sufficiently sized to balance the North and South Barrel HGLs to within 0.1’ during peak Typical Year flows. The lowering of the HGL in the North Barrel due to the inter-connection results in fewer RTC activation events over the course of the Typical Year. In addition to fewer activation events, the inter-connection is predicted to reduce CSO volume by an additional 7-8 MG during the Typical Year. Table 7-2 summarizes predicted RTC activation events and CSO volumetric reduction over the course of the Typical Year with TAPS Phase 2 improvements in place.

Table 7-2: Phase 2 Typical Year RTC Activation and CSO Volumetric Reduction Statistics

	TAPS 65 mgd Capacity		TAPS 75 mgd Capacity	
	Activation Events	CSO Volumetric Reduction (MG)	Activation Events	CSO Volumetric Reduction (MG)
With Inter-connection	4	244	8	269
Without Inter-Connection	7	237	10	261
Difference	-3	7	-2	8

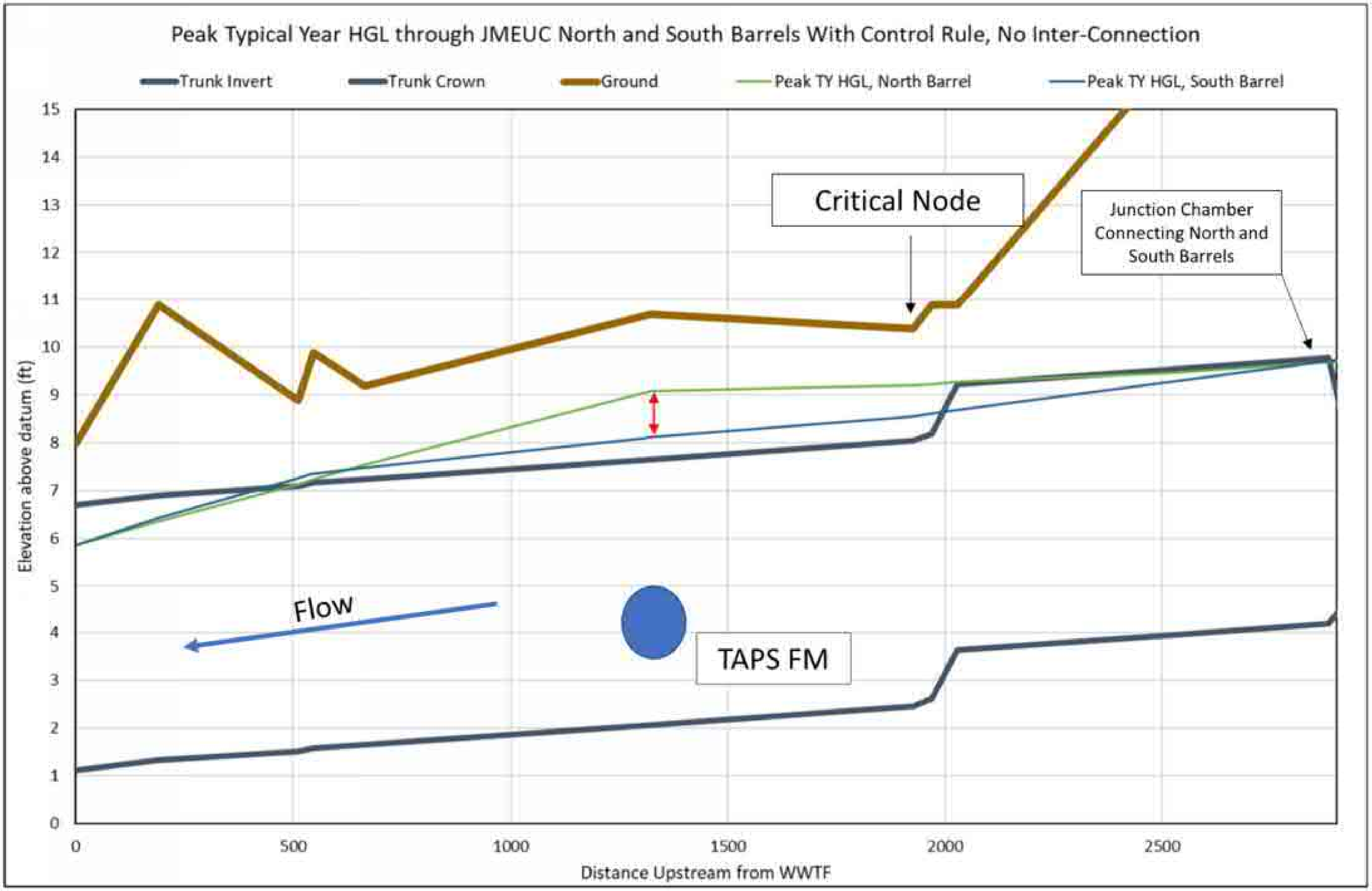


Figure 7-8: Peak Typical Year HGL Imbalance Resulting from TAPS Discharge to North Barrel

7.3 New Wet Weather Pumping Station and Force Main to JMEUC

Under this selected alternative for the Long Term Control Plan, a new wet weather pumping station will be constructed at or near the existing TAPS site to provide up to 110 mgd additional pumping capacity, for a total pumping capacity of up to 185 MGD from the Elizabeth combined sewer system. With this new pumping station, it will be necessary to install a new force main with the capacity to convey the increased flow to the JMEUC WWTF.

The timing of the new wet weather pumping station construction will be coordinated with certain upstream conveyance improvements, including the Easterly Interceptor improvements related to the Dowd Avenue siphon and regulator modifications. The completion of the new wet weather pumping station and force main construction must also be coordinated with the completion of the new wet weather treatment facility at the JMEUC plant for the combined sewer flow from Elizabeth. At startup, the new pumping facilities will maximize the conveyance that can be carried through the existing interceptor sewers. However, the full capacity of the new wet weather pumping station will not be utilized until improvements to the Westerly Interceptor lower reach are completed. The sequencing of the recommended plan provides the downstream conveyance and treatment capacity before major investments are made to modify the upstream sewer system to convey the additional relief flow.

The proposed expansion is anticipated to be completed on the property of the existing Trenton Avenue Pumping Station, which is owned by the City of Elizabeth. Figure 7-9 provides a schematic site plan of the proposed wet weather pumping station for the combined sewer system. It is likely that the existing animal shelter on the property will need to be relocated in order to facilitate the construction of the new pump station and maintain the existing Trenton Avenue Pumping Station in service. This relocation of the City of Elizabeth animal shelter is the main property acquisition requirement that would need to be resolved in the future under the recommended plan.

Figure 7-10 presents a potential routing of the new 60-inch diameter force main from the new pump station to the new combined sewer flow treatment facility at the JMEUC WWTF site. It is anticipated that the force main would be routed along Trenton Avenue and south along the Bayway and then underneath the New Jersey Turnpike to the JMEUC WWTF. The total estimated length for the new force main is approximately 2,800 feet, with an estimated 2,100 feet proposed for open cut installation and 700 feet of microtunnel installation within a casing pipe for the New Jersey Turnpike crossing. Air release, blowoff, and transition chambers will be required along the new force main alignment. Plan approvals and a license to cross agreement will need to be obtained from the New Jersey Turnpike Authority, and given the size of this utility crossing, an extensive planning and review period should be anticipated.

The new facilities and improvements proposed under this project include:

1. Demolition and removal of the existing animal shelter building and other site demolition work to allow construction of the new wet weather pump station.
2. Construction of a new diversion chamber, channel, and conduits to convey flow from the existing interceptors to the proposed new wet weather pump station. Provisions will also be provided at the new diversion chamber for future incoming relief sewer connections.
3. Construction of a new screening facility with mechanically cleaned bar screens incorporating 1-1/2 inch openings to protect the new wet weather pumps.
4. Construction of a new wet weather pump station with a capacity of up to 110 mgd. The new pump station would be of the submersible deign with up to five pumps (four duty units and one standby) for the peak hydraulic condition. At this concept stage, it is estimated that the pumps would have 250 horsepower motors rated for approximately 35 feet of head.
5. Construction of a new valve chamber, meter chamber, and discharge piping system.

Figure 7-9: Potential New Wet Weather Pump Station Site Layout

Figure 7-10: Preliminary New Wet Weather Pumping Station Force Main Alignment

6. Installation of a new 60-inch diameter force main to connect to the new wet weather treatment facility at the JMEUC plant site.
7. Implementation of power system upgrades and new standby power system.
8. Construction of above-grade monorail structure and hoisting equipment for pumping equipment servicing and building encloser or canopy structure for screenings removal area.

The new wet weather pump station and force main projects provide the additional pumping facilities necessary to reach the target 85% capture CSO control objective upon completion of upstream improvements described in the next section. A facilities plan and a preliminary engineering report will further develop the concept presented here for the Long Term Control Plan. Nonetheless, the concept illustrates that the approach mitigates expensive land acquisition and construction challenges compared to satellite treatment and storage alternatives. The new pump station would be constructed on property owned by the City, thereby posing minimal impacts to residents, businesses, and transportation systems. The new force main will require work within roadways and disruption to traffic areas, but these temporary impacts can be controlled.

The new pump station and force main will add to the operating and maintenance expenses for the combined sewer system, but these expenses are limited to a centralized facility compared to numerous facilities dispersed across the City. Furthermore, the new pumping facilities would be operated only when the incoming flows exceed the Phase 2 Trenton Avenue Pumping Station Upgrade capacity, which for the future baseline Typical Year conditions is estimated to correspond to 27 storm events, where a particular storm event may span multiple days. The proposed facilities involve conventional pumping and screening equipment with normal maintenance requirements, so the systems does not represent a significant change from existing operations.

7.4 Regulator Modifications and Interceptor Upgrades for Additional Conveyance

With additional pumping and treatment systems available downstream, regulator modifications and interceptor upgrades will be required to increase the combined sewer flows transported from the various CSO basins so as to effectively reduce the overflow volumes system-wide. Certain existing regulator structures will be modified to direct more flow to the existing and upgraded interceptor sewers to fully utilize the downstream conveyance. Many of the proposed regulator modifications also involve raising the overflow weir height where negative impacts on upstream conditions can be avoided.

The interceptor upgrades for increased conveyance will be accomplished by providing additional conveyance pipes or replacing the existing conveyance pipes with a larger size pipe for a greater capacity. The proposed interceptor upgrade projects are mainly associated with the Westerly Interceptor because the majority of the combined sewer basins are served by the Westerly Interceptor and are situated along the Elizabeth River, where reduced overflow volumes may be expected to have a greater water quality benefit. Furthermore, the Easterly Interceptor is not as old as most of the Westerly Interceptor and is considered to be in better structural and hydraulic condition. Hydraulic calculations for the Westerly Interceptor have indicated that there is limited existing wet weather flow capacity along much of the system and a previous project was planned for the replacement of these interceptor sewers in the Mid-Town area.

Several siphons within the combined sewer system limit the wet weather flow conveyance capacity. Four siphon upgrade projects are recommended with the selected plan to provide the required conveyance capacity. Under these projects, an additional pipe barrel will be constructed at the siphon crossing, with the associated flow diversion connections, piping, transitions, and inlet and outlet chambers. Three of these siphons are for crossings under the Elizabeth River, which will be regulated by the United States

Army Corps of Engineers. A lengthy planning and permitting process can be expected for these river crossing projects. The variable flow conditions must be considered for proper design and operations, including the need for adequate scour velocities and the impacts of intermittent use of the high flow barrels, such as potential settling and odor generation during idle conditions. The additional siphon barrels will need to be maintained on a regular basis and likely more frequently than the existing siphons.

The large conveyance projects proposed for the Westerly Interceptor will be expensive and disruptive to residents, businesses, and roadway traffic along the alignment of the interceptor upgrades. The greater excavation depths, extensive bypass pumping for maintaining existing sewer flows, and numerous utility relocations required increase the complexity, costs, and temporary disruptions for large diameter conveyance piping projects. However, the proposed construction work remains within the existing public right-of-way and the acquisition of additional property or easements rights is not anticipated. Impacts to the local neighborhood would mostly be temporary during the construction period, as the permanent facilities consist of below grade sewer piping and manholes with gravity flow. There will be little change in the operation and maintenance conditions associated with the interceptor upgrades and any additional conveyance piping would be managed alongside the existing interceptor sewers.

The projects provide the opportunity to replace and renew the existing interceptor sewers and offer the flexibility to convey higher flows in the future if required due to development or climate change. The basis for the proposed additional conveyance concept plans and project costs is the replacement of the existing piping with the required equivalent upsized pipe. However, the variable flow conditions will need to be further considered in subsequent planning and design phases to determine if adding a relief conveyance pipe better serves the project objectives.

7.4.1 Easterly Interceptor Improvements

Improvements to certain components along the Easterly Interceptor, such as undersized regulator openings and siphons, are needed to fully utilize the available capacity and balance the inflows along the alignment. Regulators 001, 002 and 035 will be modified to provide a larger discharge through their dry weather flow orifices, while the Dowd Avenue siphon will be upgraded with a third barrel.

7.4.1.1 CSO Basin 001, 002, and 035 Regulator Modifications

Regulator R001 is located at the upstream end of the Easterly Interceptor and has an overflow outfall to the Peripheral Ditch. Regulator R002 discharges dry weather flows to the Division Street branch interceptor and then to the Easterly Interceptor at Dowd Avenue. Regulator R035 discharges dry weather flows to the Easterly Interceptor at Third Avenue and South First Street. Each of these regulators will be improved to increase the dry weather flow orifice size and lower the orifice invert elevation. The overflow weir elevation for R001 will be raised, and the existing dry weather flow pipe connecting Regulator R035 to the Easterly Interceptor will be replaced with a new 30” diameter pipe.

7.4.1.2 Dowd Avenue Siphon Upgrade

The existing pipe at Dowd Avenue is a siphon due to a utility crossing and will be upgraded to add an additional barrel to provide increased conveyance. It was constructed circa 1982 to convey the Easterly Interceptor beneath a 98” wide by 63” high horizontal elliptical reinforced concrete pipe storm sewer in Division Street as it crosses Dowd Avenue. Flows from CSO Basin 001 are tributary to this siphon, while flow from Regulator R002 discharges to the Easterly Interceptor a short distance downstream of the siphon. The existing siphon consists of 2 pipe barrels: a 10” diameter cast-iron pipe primary barrel (situated at the incoming sewer invert elevation) and a 24” diameter cast-iron pipe secondary barrel (situated at a higher elevation).

The Dowd Avenue Siphon will be upgraded to increase the siphon capacity by adding a third barrel that is 18" diameter and approximately 100 feet long. New inlet and outlet chambers and connections to existing chambers will also be added. The proposed improvements are shown in Figure 7-11 below.

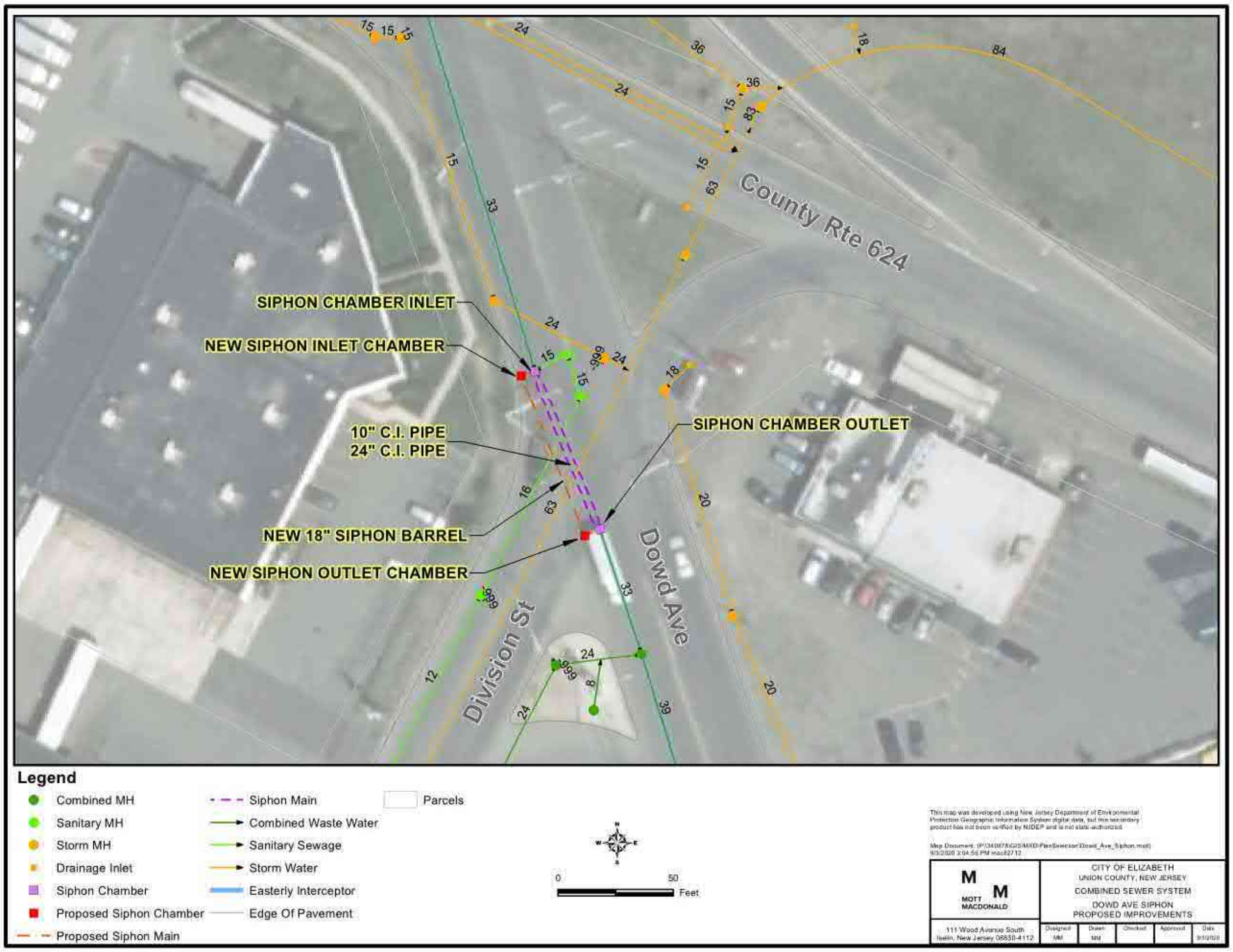


Figure 7-11: Proposed Dowd Avenue Siphon Upgrade

7.4.2 Westerly Interceptor Improvements

The Westerly Interceptor serves the northern, central, and western parts of the City, with the main branch beginning at the Union Street, Morris Avenue, and Westfield Avenue intersection, connecting to Regulator R005. The Westerly Interceptor flows southerly along Union Street to West Jersey Street, easterly across the Amtrak railroad lines to Elizabethtown Plaza, and then southerly to Rahway Avenue. The interceptor continues easterly along Rahway Avenue and Elizabeth Avenue to Bridge Street, and then runs southerly across the Elizabeth River to Pearl Street. It then flows southerly along South Pearl Street, through Grove Street to Clarkson Avenue. From Clarkson Avenue at Britton Street, the Westerly Interceptor is mostly routed along the western bank of the Elizabeth River to the Trenton Avenue Pumping Station.

The Westerly Interceptor services most CSO basins along the Elizabeth River, receiving flows from a sewer service area of 2,140 acres, including 1,890 acres of combined sewer system areas. Upgrades to portions of the Westerly Interceptor will allow for increased capacity for conveyance of flows from the contributing CSO basins to the Trenton Avenue Pumping Station, and eventually to the JMEUC WWTF for treatment.

It is necessary to complete upgrades to the downstream portion of the Westerly Interceptor before the upstream portion, so that the downstream portion has the capacity to convey flows as these upgrades as completed. The proposed improvements are summarized as follows:

7.4.2.1 Palmer Street Branch Interceptor and Siphon Upgrades

In order to increase the dry weather flow capacity of the CSO Basin 026 regulator and branch interceptor, upgrades to the existing infrastructure are proposed. The Palmer Street branch interceptor is approximately 1,600 feet long, predominantly of 15" and 20" diameter vitrified clay pipe (VCP), and includes the Palmer Street siphon. The branch receives flow from Regulator R026 and conveys it to the Westerly Interceptor on the west side of the Elizabeth River at Clarkson Avenue south of Fillmore Street. The Palmer Street siphon is a double barrel (two 10" diameter) siphon that conveys flow from Drainage basin 026 on the east side of the Elizabeth River to the Westerly Interceptor in Clarkson Avenue on the west side of the Elizabeth River. At this location, the river is confined by the levee system and stormwater ponding areas are located between the levees and adjacent streets. The siphon outlet manhole located at the toe of slope of the levee embankment has made access for maintenance difficult.

For additional conveyance from this CSO basin, the Regulator R026 dry weather flow orifice will be upsized from a 9.75" high by 7.5" wide opening to a 30" diameter opening and the regulator overflow weir raised to reduce the frequency of overflows. The existing 15" branch interceptor will be replaced with 720 feet of new 30" diameter pipe and 650 feet of the existing 20" branch interceptor will be replaced with new 36" diameter pipe. A third 30" barrel approximately 170 feet long will be added to the Palmer Street Siphon, with new chambers for the new barrel and connections to the existing siphon inlet and outlet chambers. The proposed siphon improvements are shown in Figure 7-12 below.

7.4.2.2 Lower Westerly Interceptor Improvements

Interceptor improvements for increased conveyance will be initiated starting from the downstream end of the system, so that adequate capacity is available when the upstream upgrades have been completed. The lower interceptor improvements include upsizing of the interceptor itself, as well as upgrades to the Bridge Street Siphon, modifications to Regulators R027/028 and R040 and the Pearl Street branch interceptor improvements which also includes Regulator R016. The proposed upgraded Westerly Interceptor assumes increasing the existing sewer pipe (i.e., removing the existing and providing a new larger pipe) or providing a new additional pipe along the existing Westerly Interceptor sewer alignment, with a depth and profile similar to the existing sewer.

Improvements along the Lower Westerly Interceptor include the following components, described in more detail below:

- Bridge Street siphon upgrade
- Lower Westerly Interceptor sewer upgrade
- Pearl Street branch interceptor upgrade
- Regulator 016 modifications
- Regulator 027/028 modifications
- Regulator 040 modifications

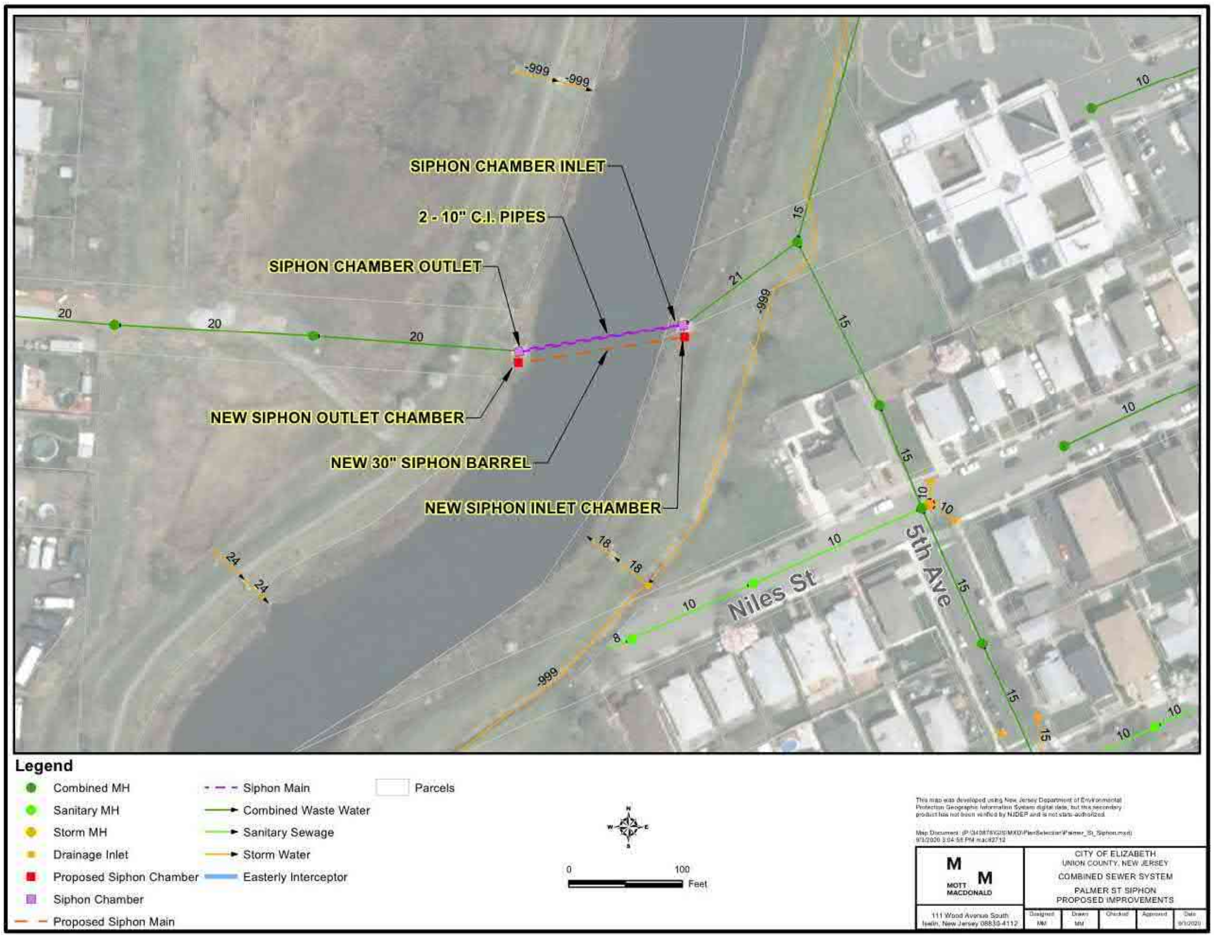


Figure 7-12: Proposed Palmer Street Siphon Upgrade

The objective of the Bridge Street Siphon upgrade is to increase the conveyance capacity from the upper interceptor system to the lower interceptor system. The existing siphon is a double barrel (16" and 24" diameter) siphon approximately 130 feet long that conveys the Westerly Interceptor beneath the Elizabeth River. This siphon and the associated interceptor connection have tended to accumulate significant sediment in the past, substantially reducing its conveyance capacity. In 2009, the Bridge Street siphon was thoroughly cleaned, which re-established the flow capacity and since then the siphon is regularly inspected. It is proposed that the existing siphon chambers and barrels be maintained, with a new 42" third barrel approximately 130 feet in length being added for additional conveyance. The upgrade will also include new chambers for the new barrel and connections to the existing siphon inlet and outlet chambers. The proposed siphon improvements are shown in Figure 7-13 below.

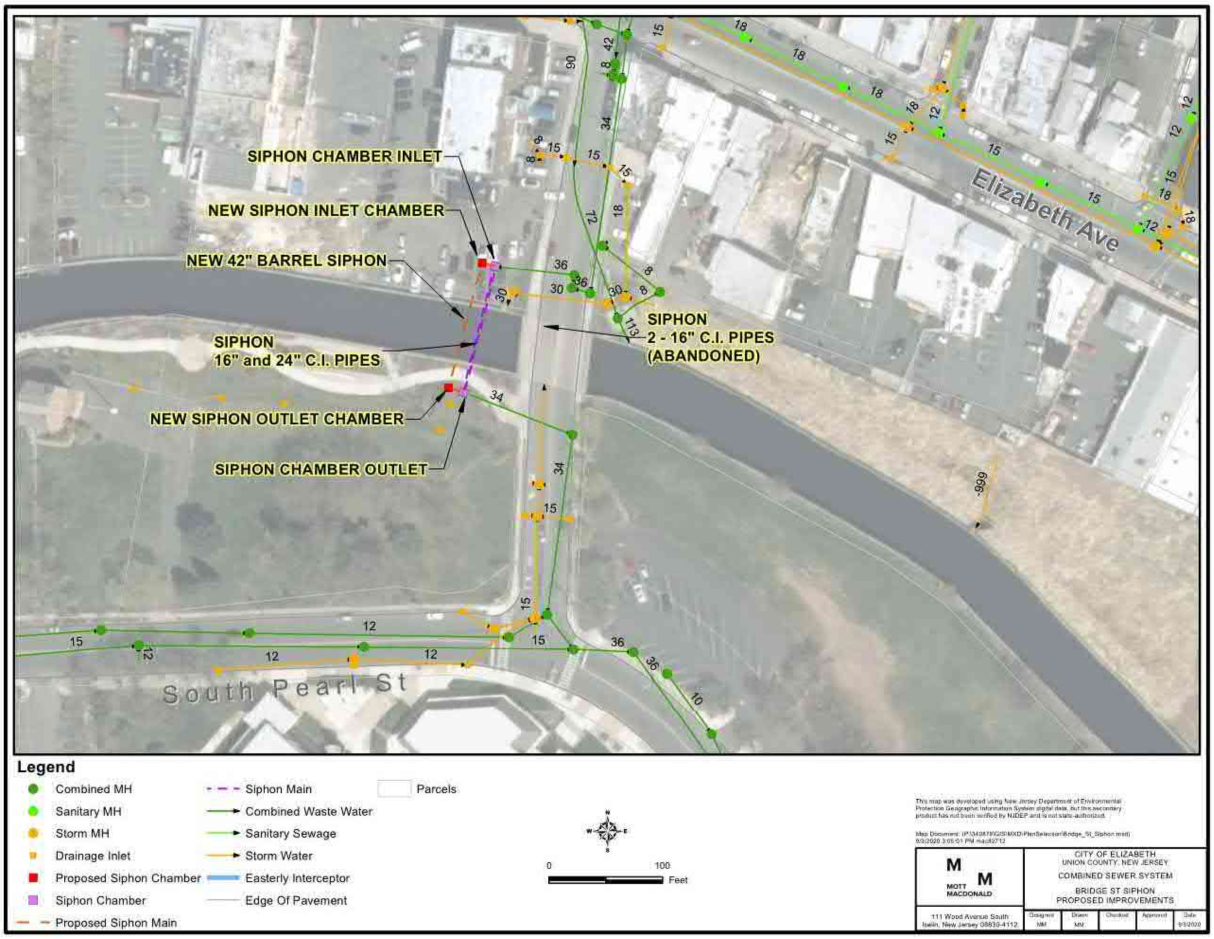


Figure 7-13: Proposed Bridge Street Siphon Upgrade

The proposed concept for the Lower Interceptor upgrade is to provide additional interceptor conveyance capacity for the section downstream of Bridge Street. The upgrade includes replacing the existing 34", 36", and 38" interceptor sewer segments, which are predominantly circular gunited brick sewers, with new 60" diameter pipe, from the Bridge Street siphon outlet chamber to the Regulator R027/R028 connection chamber, an approximate length of 4,200 feet. In addition, the existing 40" gunited brick and 48" and 60" RCP interceptor sewer segments would be replaced with new 72" diameter pipe, from the Regulator R027/R028 connection chamber to the Trenton Avenue Pumping Station diversion chamber, an approximate length of 3,000 feet.

The Pearl Street Branch interceptor upgrade will provide additional dry and wet weather capacity for the branch interceptor from Regulator R016 to the Westerly Interceptor at South Pearl Street and Bridge Street. The existing Pearl Street / Burnet Street branch is approximately 2,600 feet long, predominantly of 12" diameter VCP. It receives flows from Regulator R016 and conveys it to the Westerly Interceptor on the west side of the Elizabeth River at South Pearl Street and Bridge Street. This branch can also convey flow from a relief interconnection from the Rahway Avenue / Cherry Street branch.

The proposed upgrades will replace the existing 12" diameter VCP branch interceptor segments with new 30" diameter pipe for a length of about 1,800 feet from Regulator R016 at Pearl Street and Washington Street to the Westerly Interceptor at South Pearl Street and Bridge Street. Regulator R016 will also be upgraded. The existing branch interceptor section upstream of Regulator R016 to Burnet Street and

Rahway Avenue is not proposed for replacement. This may need to be reconsidered in the future if determined to be necessary to improve the performance of the Rahway Avenue siphon.

Regulator R027/028 is located on Summer Street, west of Clarkson Avenue, and 2 incoming sewer lines converge at the regulator. Regulator R040 is located on the south side of Pulaski Street, west of Clifton Street, and incorporates the netting facility for solids and floatables control. The regulator improvements at these two locations include upsizing the dry weather flow orifice and lowering the orifice invert, replacing the connecting pipe to the interceptor, and raising the overflow weir elevation.

The extents of the proposed upgrades to the Westerly interceptor are shown in Figure 7-14 and Figure 7-15 below.

7.4.2.3 Upper Westerly Interceptor Improvements

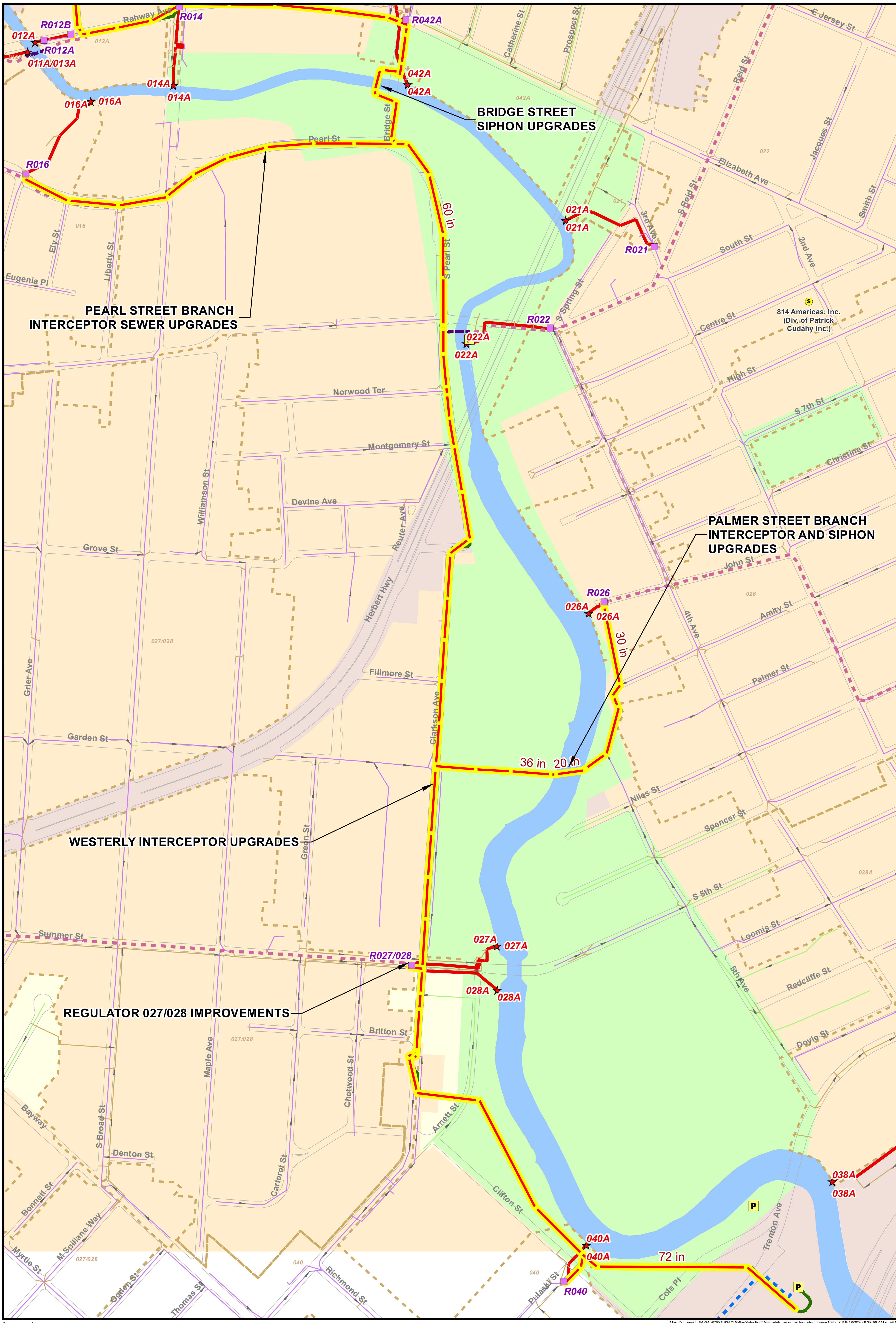
The proposed Upper Westerly Interceptor improvements include the following projects:

- Upper Westerly Interceptor sewer upgrade
- Regulator R005
- Morris Avenue siphon upgrade
- Regulator R041 modifications

These Upper Westerly Interceptor improvements will provide additional interceptor conveyance capacity for the section upstream of the Bridge Street siphon. Starting at the upstream end, this section of the Westerly Interceptor runs southerly along Union Street from Regulator R005 to West Jersey Street (with an underpass at the Amtrak railroad lines), easterly to Elizabethtown Plaza, southerly to Rahway Avenue, and then easterly along Rahway Avenue and Elizabeth Avenue to Bridge Street.

Based on the replacement of the existing piping with the required equivalent upsized pipe, the proposed upgrades include replacing the existing 28”, 30”, and 32” gunited circular brick interceptor sewer segments with new 54” diameter pipe, from Regulator R005 at Westfield Avenue and Union Street to the Regulator R042A connection at Elizabeth Avenue and Bridge Street. It also includes replacing the existing 34” gunited circular brick interceptor sewer segments from the Regulator R042A connection at Elizabeth Avenue and Bridge Street to the Bridge Street siphon inlet chamber with new 60” diameter pipe. The total length of these upgrades is approximately 4,700 feet. Regulator R005 will be upgraded as part of this undertaking, to increase the weir elevation, branch interceptor sewer size and orifice size and lower the orifice elevation.

The Morris Avenue Siphon upgrade is intended to increase the conveyance capacity from CSO Basins 003 and 041 to the upgraded Westerly Interceptor. The Morris Avenue siphon is a triple barrel (8” and two 14” diameter) siphon that conveys the Morris Avenue trunk sewer flows beneath the Elizabeth River to Westerly Interceptor at Regulator R005. Flows from the Regulator R003A, R003B and R041 sewersheds are tributary to this siphon. Regulator R041 is located immediately upstream of the siphon and will be upgraded as part of this undertaking to raise the weir elevation. The siphon is approximately 80 feet long. The existing siphon barrels from the regulator will be maintained, with a new (fourth) 30” barrel approximately 80 feet in length added for additional conveyance. The upgrades will also include new chambers for new barrel and diversion connections to the existing siphon inlet and outlet chambers. The proposed siphon improvements are shown in Figure 7-16 below.



Legend

- JMEUC Treatment Plant
- Pumping Station
- CSO Discharge
- Regulator
- Significant Industrial Users
- Conduits For Upgrade
- Westerly Interceptor
- Combined Sewer Main
- Seperated Sanitary Sewer Main
- Storm Water Sewer Main (CSS)
- CSO Outfall
- Force Main Alignment
- Siphon Main
- Trunk Sewer Alignments
- Regulator Basin

Sewer System Drainage Types

- Combined Sewer System
- Seperated Sewer System
- No Contributing Flow

0 400 800 Feet

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FIGURE 7-14

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

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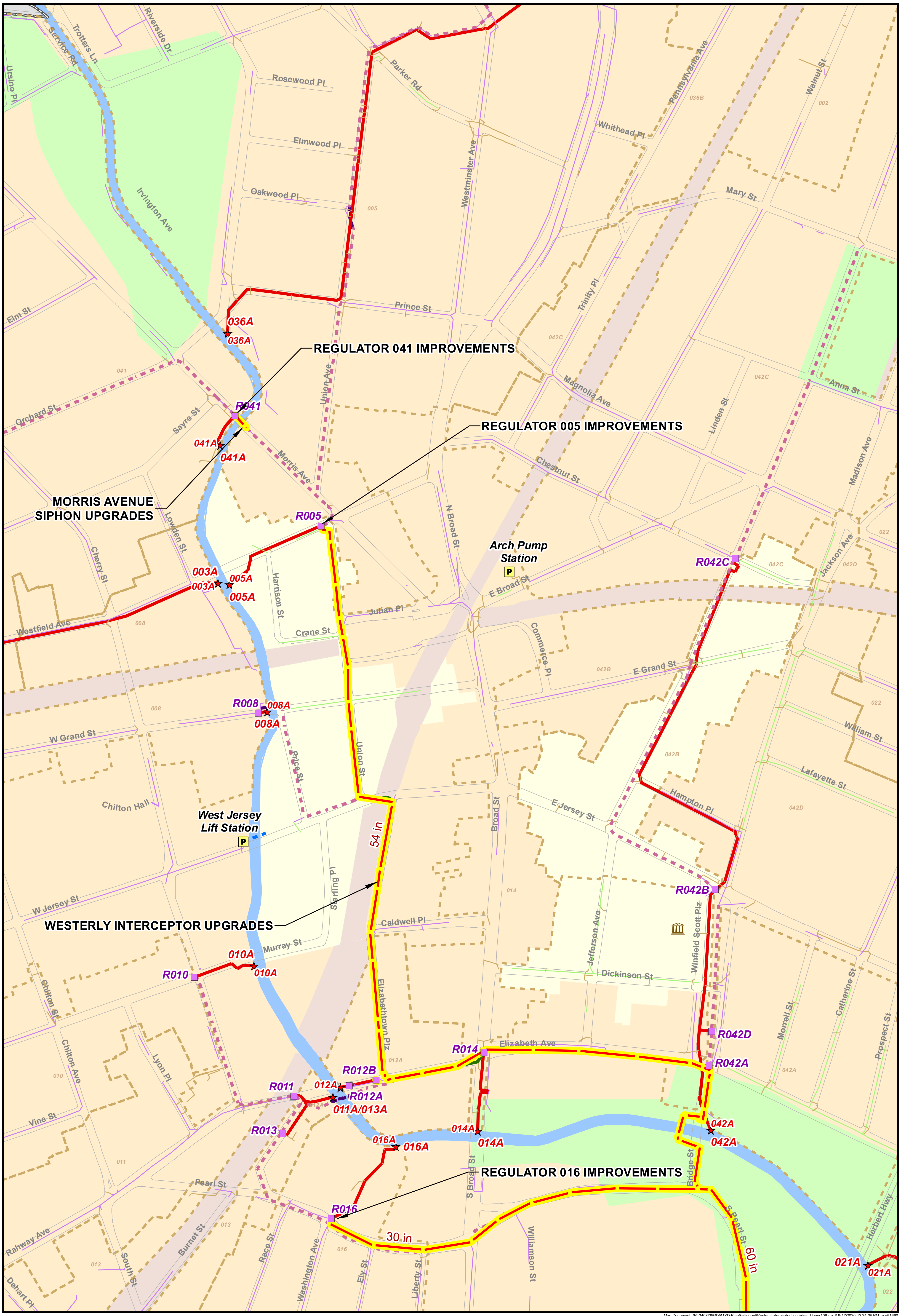
CITY OF ELIZABETH
UNION COUNTY, NEW JERSEY
SELECTION AND IMPLEMENTATION OF ALTERNATIVES REPORT
LOWER WESTERLY INTERCEPTOR UPGRADES

Designed	Drawn	Checked	Approved	Date
MM	MM	SM	AG	9/18/2020



Map Document: (P:\340878\GIS\MXD\PlanSelection\WesterlyInterceptorUpgrades_Upper106.mxd) 9/17/2020 12:24:35 PM mar51660

Legend

- STP JMEUC Treatment Plant
- P Pumping Station
- CSO Discharge
- Regulator
- S Significant Industrial Users
- Conduits For Upgrade
- Westerly Interceptor
- Combined Sewer Main
- Seperated Sanitary Sewer Main
- Storm Water Sewer Main (CSS)
- CSO Outfall
- Force Main Alignment
- Siphon Main
- Trunk Sewer Alignments
- Regulator Basin

Sewer System Drainage Types

- Combined Sewer System
- Seperated Sewer System
- No Contributing Flow

0 400 800 Feet

FIGURE 7-15

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

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CITY OF ELIZABETH
UNION COUNTY, NEW JERSEY

SELECTION AND IMPLEMENTATION OF ALTERNATIVES REPORT

UPPER WESTERLY INTERCEPTOR UPGRADES

Designed	Drawn	Checked	Approved	Date
MM	MM	SM	AG	9/17/2020

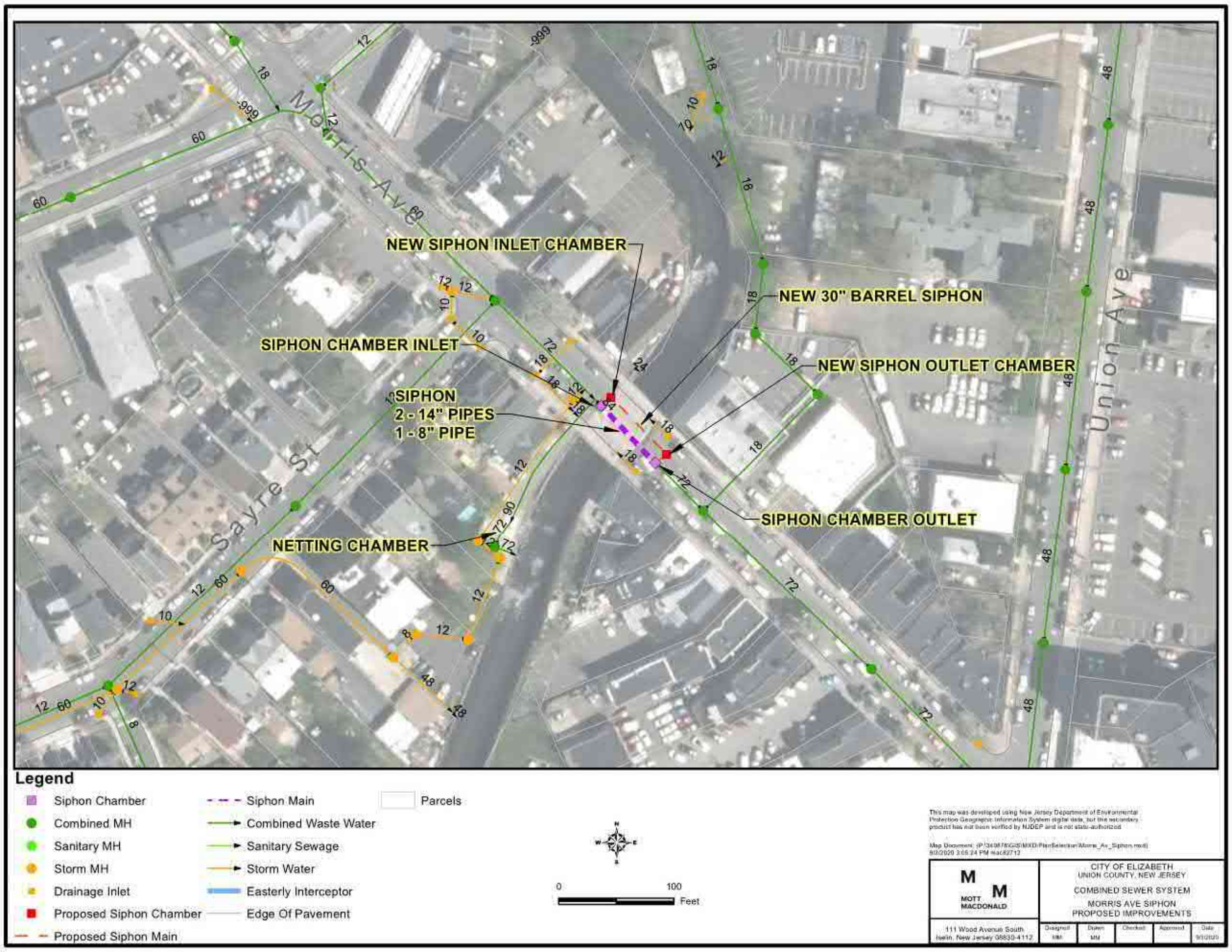


Figure 7-16: Proposed Morris Avenue Siphon Upgrade

7.5 New Combined Sewer Flow Treatment Facility at JMEUC WWTF

Per Section 7.3, up to 110 mgd of combined sewer flow will be captured in the Elizabeth CSO control facilities during the Typical Year and pumped via a segregated force main to the WWTF and treated on site in a new dedicated combined sewer flow treatment facility. The combined sewer flow treatment process will parallel the existing primary and secondary treatment processes and deliver the treated combined flow to the WWTF outfall conduit upstream of the dechlorination point. This approach was selected so as not to hydraulically overload the existing headworks and primary treatment facilities during wet weather events and to simplify control of flow directed to secondary treatment.

The proposed treatment process consists of flow metering, coarse mechanical multi-rake screens followed by fine mechanical multi-rake screens, followed by high rate disinfection using sodium hypochlorite in a conventional plug flow contact basin. A conservatively low assumption of percent TSS removal has been assumed, which results in blended effluent permit compliance from both mass and concentration weekly average perspectives. It is noted that 85% mass removal requirements are not applicable during wet weather event analysis, pursuant to the final major permit modification issued by NJDEP on May 1, 2020. Sodium hypochlorite disinfection with high energy chemical distribution, at a high dose and short detention time is proposed to provide a weekly effluent fecal coliform count of less than

400 counts per 100 ml geometric mean prior to reintroduction to the disinfected secondary effluent stream.

7.5.1 Updated Evaluation of Alternative Treatment Processes

In the Development and Evaluation of Alternatives Report (DEAR; revised 10/23/2019 and approved by NJDEP 12/13/2019), treatment at the WWTF was presented with several potential flow paths and an overview of three processes: fine screens, vortex separators, and ballasted flocculation, all followed by disinfection. It was shown that fine screen solids removal followed by high rate disinfection performance meets the criteria for effluent quality that complies with the existing NJPDES permit.

For this Selection and Implementation of Alternatives Report**,** vortex separation was analyzed more closely because disinfection (chlorination) can occur within the vortex vessels and it appeared the consolidated footprint (eliminating a separate contact vessel) might make for a less expensive installation.

The fine screening alternative (Alternative 1) consists of two conventional, rectangular structures and uses standard treatment type equipment, while the vortex alternative (Alternative 2) requires multiple approach channels and multiple circular units which complicates the construction cost. Also, the vortex units pricing for the equipment is high due to the specialized and proprietary nature of the units.

The fine screening process is expected to remove fewer solids and little to no CBOD, however the blended effluent meets NJPDES criteria. Table 7-3 summarizes the blended effluent TSS and cBOD under the largest modeled flows that would be pumped to the WWTF under the 110 MGD TAPS expansion and force main improvements. The calculations use average wet weather flow influent concentrations obtained from analysis of plant data; methodology presented in Section 7.5.2.

Table 7-3: Blended Effluent Summary for "Typical Year" Storm Event Volumes

Fine Screen CS Flow Treatment Process Assuming 5% TSS removal

Event Name	TSS out, mg/L	cBOD out, mg/L	TSS meet permit (weekly avg mg/L)?	cBOD meet permit (weekly avg mg/L)?	TSS out 24 hr total, kg/day	cBOD out 24 hr total, kg/day	TSS meet permit (weekly avg kg/d)?	cBOD meet permit (weekly avg kg/d)?
"2/6"	25.1	17.7	yes	yes	8296	5843	yes	yes
"9/28"	26.9	19.0	yes	yes	9124	6509	yes	yes
"9/8"	25.6	18.1	yes	yes	6723	4774	yes	yes
"July"	26.2	18.5	yes	yes	7721	5488	yes	yes
"4/12"	25.2	17.8	yes	yes	8584	6070	yes	yes

TSS Permit Limit, mg/L weekly avg	cBOD Permit Limit, mg/L weekly avg
45	40

TSS Permit Limit, mg/L weekly avg	cBOD Permit Limit, mg/L weekly avg
12779	11355

The fine screening facility includes a flow meter chamber, a screen building with two parallel channels containing coarse and fine screens in series, a conventional plug flow contact basin with high rate chlorination and a gravity flow pipeline to the existing outfall conduit. The fine screening facility only has a solids waste stream in the form of compacted screenings.

The vortex treatment facility includes a flow meter chamber, a screen building with parallel channels, three parallel vortex treatment units with chlorine application at the influent header to the vortex units and a gravity flow pipeline to the existing outfall conduit. The Vortex treatment facility has both a solids waste stream of compacted screenings and a liquid waste stream of dilute sludge that must be pumped to the gravity thickeners.

Alternative layouts for fine screens and vortex separators are shown on Figure 7-17Figure 7-10 and Figure 7-18 respectively.

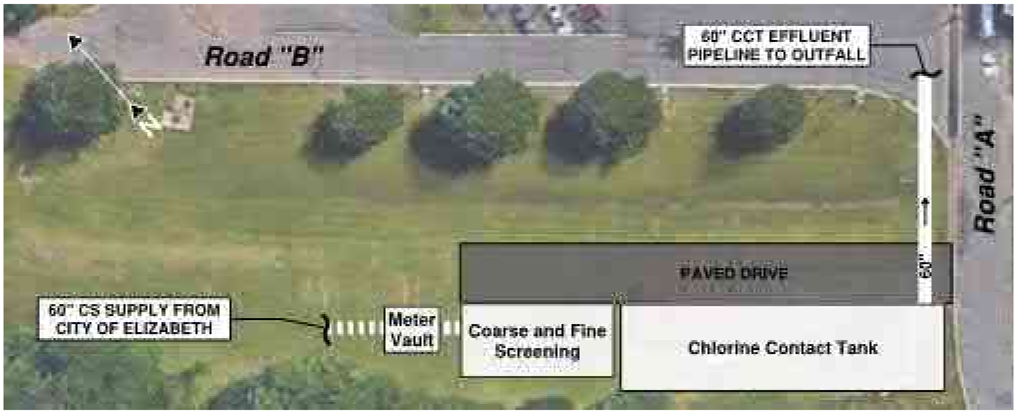


Figure 7-17: Fine Screen Facility Layout

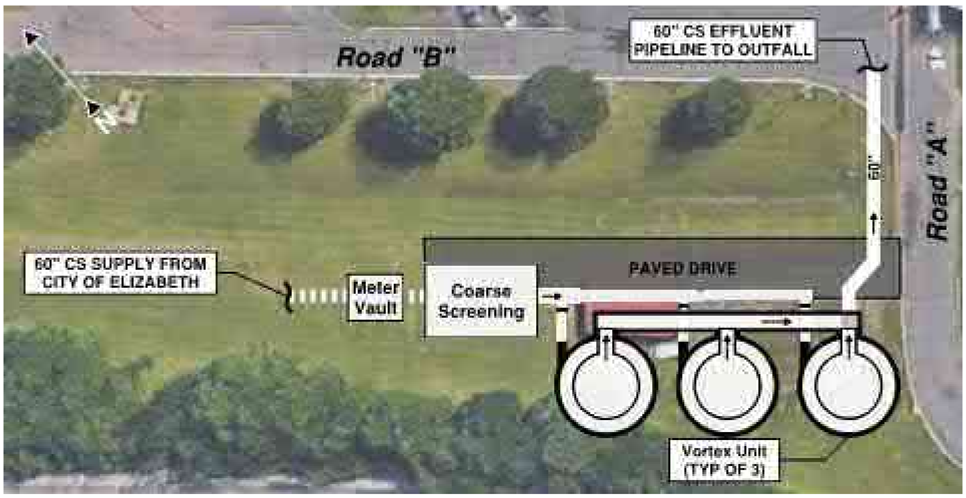


Figure 7-18: Alternative 2, Vortex Facility Layout

7.5.1.1 Preliminary Construction Cost Estimates

Preliminary construction cost estimates were prepared for both alternatives. The cost workup includes the following assumptions and values:

- Civil Work includes clearing, excavation, backfill, sheeting- pulled and salvaged, and assumes all structures are pile supported. Civil utility work includes road removal, excavation, backfill, utility relocations, tunneling for the effluent pipeline and new yard piping installation. A dewatering allowance is included, proportional to the volume of excavation.
- Mechanical costs include equipment costs for large valves, gates, storage tanks, pumps, screens and equipment obtained from vendors in 2019. Piping costs are estimated using installed linear foot costs. Allowances are included for hatches, stairs, supports and ancillaries. Installation of mechanical equipment is included as 25% of equipment cost.
- Structural costs include pile supports and reinforced concrete costs for walls, base slabs and floors using estimated unit volumes of concrete for preliminary structure sizes. Superstructure

costs assume brick and block construction with flat membrane roofing, the costs are estimated on a $ per square foot basis using current northeast construction values. These costs include building mechanical and plumbing costs.

- Electrical costs include allowances for lighting and MCCs and estimates for buried power feeders on $ per linear foot basis. Wiring of mechanical equipment is included as 10% of the mechanical equipment cost.
- Instrumentation costs include vendor quotes for flow meters and analyzers and an allowance for miscellaneous requirements. Programming is included as 7% of mechanical equipment and instrument equipment costs.

For operation and maintenance costs, chemical costs were estimated on the basis of treating 38 events per year at an average flow volume of 42 million gallons per event as obtained from the current modeling. Sodium hypochlorite dose is estimated at 21 mg/L for Alternative 1 and 13 mg/L for Alternative 2 at a cost of $0.87 per gallon. Sodium bisulfite dose is based on quenching 12 mg/L chlorine residual at a cost of $1.12 per gallon.

Equipment operation costs include electrical power consumption, estimated parts replacement costs, man-hour estimates for operation and maintenance of mechanical equipment. Electrical power is estimated at $0.14/kWh and O&M labor estimated at $85/hr. Periodic major component replacement costs are included using equipment manufacturers recommendations.

The operations and maintenance costs are normalized via present worth analysis using a lifecycle period of 20 years and a discount rate of 2.75%.

The total lifecycle cost workup for both alternatives is shown below on Table 7-4.

Table 7-4: Comparison of Alternatives - Lifecycle Cost

JMEUC Wet Weather Flow Treatment Project Cost Estimate
Conceptual Cost Summary

		Alternative	
Item		**Screens and CCT**	**Screens and Vortex Units**
Construction Cost w/o Markup		$11,008,700	$15,355,500
General Requirements	10%	$12,109,600	$16,891,100
Contractor O&P	20%	$14,531,500	$20,269,300
Construction Contingency	25%	$18,164,400	$25,336,600
Total Opinion of Probable Construction Cost		**$18,164,400**	**$25,336,600**
Engineering and Implementation	15%	$20,889,100	$29,137,100
Total Opinion of Probable Project Cost		**$20,890,000**	**$29,140,000**
Operating Cost- Present Worth		**$5,943,000**	**$4,306,000**
Total Present Worth Cost		**$26,833,000**	**$33,446,000**

The fine screening facility meets process demands using more basic equipment and common structural shapes. Although the present worth of the operating costs are higher due to a higher estimated chlorine dose Alternative 1 has a lower lifecycle cost, therefore the fine screening option is recommended for implementation.

7.5.2 Treatment Design Criteria

The combined flow treatment train will process a very dilute flow stream as determined by analysis of historic wet weather influent characteristics obtained from JMEUC plant data from 2013 to 2018 for influent flows greater than 100 mgd. These data are summarized in Table 7-5 below:

Table 7-5: Wet Weather Influent Characteristics

Parameter	Wet Weather Average Influent	Wet Weather Average Primary Effluent	Wet Weather Average Effluent
Flow, mgd	116	116	116
Temperature, degrees Celsius	13.7	not measured	14.1
Total Suspended Solids (TSS), mg/L	121	95.0	24.4
Volatile Suspended Solids (VSS), mg/L	82.1	not measured	NA
Biochemical Oxygen Demand (BOD), mg/L	109	95	27.9
Carbonaceous Biochemical Oxygen Demand (cBOD), mg/L	84.1	76.1	17.2
Chemical Oxygen Demand (COD), mg/L	268	not measured	70.5
Ammonia (NH_3), mg/L	8.5	not measured	10.5
Nitrate (NO_3), mg/L	5.2	not measured	2.6
Total Phosphorus (TP), mg/L	2.0	not measured	1.9

Flow modeling has been performed as referenced in Section 7.5.1 for six major storm events. The maximum flow to be treated is 238 mgd (reference Section 2.2.6) of which a maximum of 110 mgd is directed to the combined flow treatment process. From the modeling, the actual peak volume of flow is 42.3 million gallons processed which defines the mass loading associated with combined flow pumped to the WWTF.

The evaluation assumes no greater than 5% TSS removal through the screening facility, where the PVSC LTCP reference document uses 15% TSS removal. Even using the conservative 5% removal the calculated blended effluent concentration and weekly mass values are well below permit limits. This is because the flow volume treated is relatively low compared to the volume treated through the WWTF secondary treatment process during a storm event.

While fine screens do not remove a significant amount of TSS, they remove a significant majority of floatables and particulates which allow the disinfection process to function efficiently.

7.5.3 Disinfection Design Criteria

Combined sewer flow treatment designs are unique in that the influent water quality varies across storm events and the system operates intermittently. To establish the effective chlorine dose range to treat the CSO influent, a disinfection pilot study is recommended to be conducted during preliminary facilities design. The objectives in a pilot study would include gathering the influent water quality characteristics by collecting water during various storm events, performing oxidant demand testing across a range of chlorine doses, performing a residual chlorine analysis over the designed contact time and measuring effluent water quality parameters of interest for meeting specific regulatory permit requirements.

The initial chlorine demand is dependent on the influent water quality, where sufficient chlorine should be dosed to maintain a desired chlorine residual over the contact time. Experience has shown that long contact times required for conventual wastewater treatment are not necessary for the treatment of CSOs and disinfection can be accomplished using high dose with initial high-intensity mixing to accomplish disinfection within a short contact time.

Per the PVSC TGM, a chlorine dose between 18-24 mg/L is appropriate for high rate disinfection. Application via a chemical flash mixer, followed by a plug flow detention basin sized for 5 minutes of contact time is anticipated to reduce fecal coliform concentrations to the levels required in the LTCP treatment objectives. This method of disinfection treatment was selected for the combined sewer treatment process at JMEUC WWTF. For the purpose of estimating operational costs, a chlorine dose of 21 mg/L was selected by averaging the reported range of 18-24 mg/L.

Disinfection performance can be assessed using mathematical equations, such as the Sellick-Collins model (EPA 1999), where bacterial concentrations are a function of chlorine residual concentrations and system contact time.

$Y_t = Y_o(1 + 0.23CT)^{-3}$, where:

Y_t = bacterial concentrations after time T (MPN/100mL)
Y_o= original bacterial concentrations (MPN/100mL)
C=Chlorine residual concentration after time T (mg/L)
T= Contact time (min)

A limited sewer system (CSO discharge) wet weather sampling program was performed by the City of Elizabeth, which included fecal coliform data for three wet weather events in 2016 and 2017. The average fecal coliform concentration from this program was 4,138,119 cfu/100mL. This concentration is assumed as the influent concentration into the combined sewer flow treatment train. In order to meet the JMEUC effluent limit of 400 cfu/100 mL, 4 log removal of fecal coliform must be obtained. The above equation predicts an average chlorine residual of 12 mg/L using 6-minute contact time.

Conceptual operational costs for chemical consumption were calculated using an assumed sodium hypochlorite dose as chlorine of 21 mg/L and a quenching a chlorine residual of 12 mg/L using sodium bisulfite. As noted above, in order to determine the optimum chlorine dose and residual for required log removal and regulated CT requirements, a pilot testing study will need to be performed.

The chlorination contact tank is sized for 5 minutes of contact time at 110 mgd. The effluent pipe from the chlorination contact tank provides roughly another 1 minute of contact time at 110 mgd.

The sodium hypochlorite feed pumps would need to deliver an applied dose of 21 mg/L of hypochlorite as chlorine at a peak flow of 110 mgd. For the largest modeled flow volume of 42.3 million gallons, 7100 gallons of 12.5% strength sodium hypochlorite would be consumed.

The existing sodium bisulfite dechlorination system will have supplemental pumps to deliver enough chemical to quench an expected residual of 12 mg/L at 110 mgd. For the largest modeled CSO flow volume of 42.3 million gallons, 710 gallons of 38% sodium bisulfite solution would be consumed.

7.5.4 Implementation Evaluation at WWTF

7.5.4.1 Siting of Treatment Units

The selected alternative consists of three structures arranged in series followed by a 60-inch diameter effluent pipe to deliver the treated flow to the existing outfall conduits. The north and east side of the site are congested with existing solids handling process units, further constrained by the construction of the new FEMA flood wall. There is open space southwest of the existing primary settling tanks on which a drainage swale and limited buried utilities exist. The space can accommodate the proposed structures as well as a receiving pit for a tunneled combined flow force main from the collection system. Figure 7-17 shows the proposed treatment train in plan view.

Routing of the proposed effluent pipe to the outfall conduits poses the largest challenge in that the available corridor is dense with existing utilities. The route does appear feasible and the utility crossings are further discussed in Section 7.5.5.6.

7.5.4.2 Capacity of WWTF to Support Treatment Process

The new combined sewer flow treatment processes at the WWTF must be supported by existing WWTF infrastructure where capacity exists, and new infrastructure must be constructed if existing capacity is not available. The WWTF facilities that are necessary to support the combined sewer flow treatment train were evaluated to identify capital costs for implementation.

The driving head for the combined sewer flow treatment process will be provided from new wet weather pumping facilities to be constructed by the City of Elizabeth as discussed in Section 7.3.The treatment process will operate under gravity flow regime to the existing outfall conduits. The new Effluent Pumping Station currently under design will have a capacity of 360 mgd, sufficient to carry the combined treated combined sewer flow and secondary effluent flow to the Arthur Kill under all tide conditions.

The screens can be expected to generate a maximum of approximately 23.5 wet yards and 11.7 dewatered yards of screenings per storm event. These screenings may be handled separately or be combined with the main screenings container at the headworks facility.

The connected power for the screenings and disinfection processes is less than 40 hp. Power source will be determined during preliminary design.

The process structures will have provisions for drainage via pumps. The pump discharge will be routed to a new drainage pipe to be installed to the headworks of the facility.

Service water for washdown and screening processes can be obtained from the 8-inch service water line immediately north of the proposed treatment facility site.

Disinfection and dechlorination of the combined flow will require additional chemical feed pumps which can be located in the existing Chlorination Dechlorination Building. New chemical feed piping will be required for sodium hypochlorite delivery to the chlorine contact basins. The existing sodium bisulfite feed lines are large enough to carry additional sodium bisulfite to quench the residual chlorine from the combined flow treatment process.

The WWTF currently has approximately 7.2 days of sodium hypochlorite chemical storage based on an average chemical usage of 125,000 gal/month and 30,000 gal of storage available (via six 5,000 gal tanks). The largest modeled storm event would result in 7000 gallons of chlorine consumption. If back to back large storm events occurred, the WWTF would have to increase their delivery frequency on a temporary basis. However, it is not anticipated that additional storage will be required.

The WWTF currently has approximately 31 days of sodium bisulfite chemical storage based on an average chemical usage of 13,500 gal/month and 14,000 gal of storage available (via two 7,000 gal tanks). The largest modeled storm event would result in 710 gallons of sodium bisulfite consumption. It is not anticipated that additional storage will be required.

A 60-inch effluent pipe from the proposed disinfection basin is proposed to discharge to the existing outfall conduit and must be routed between the existing primary settling tanks and the aeration tanks. The primary settling tank emergency overflow chamber structure is large enough to facilitate connection of the new effluent pipe.

7.5.5 Selected Treatment Alternative Description

The proposed treatment process consists of flow metering, coarse mechanical multi-rake screens followed by fine mechanical multi-rake screens, followed by high rate disinfection using sodium hypochlorite in a conventional plug flow contact basin. Effluent from the treatment process will be delivered to the existing Emergency Overflow Structure via a 60-inch pipe. The flow will combine with the existing chlorine contact tank effluent where dechlorination will be performed using existing bisulfite delivery equipment.

7.5.5.1 Hydraulic Profile

Flow through the new treatment process will be entirely by gravity. The driving hydraulic gradient will be supplied by a new off-site combined sewage pumping station, and effluent flow will be delivered to the Arthur Kill via gravity under low tide conditions, and via the new Effluent Pumping Station during high tide / storm surge conditions.

Water surface elevations (WSE) at the Emergency Overflow Structure were obtained from the Alden CFD Model Study (Alden Report No. 1175ELIZ -01), dated June 2018. The Alden report identified WSE at the Emergency Overflow Structure under several Effluent Pumping Station operating scenarios. The highest WSE was utilized to construct the preliminary hydraulic profile for the proposed combined sewer flow treatment train.

The resultant hydraulic flow regime requires that the new treatment facilities be constructed with working water surface elevations above existing grade. Construction of the new facilities at approximate elevations shown will allow drainage of the proposed Disinfection Basin by gravity when flow subsides and the water level in the Outfall Conduit lowers to normal levels. The differential WSE is estimated to be approximately 9.4 ft under maximum process flows and maximum WSE at the Emergency Overflow Structure. A preliminary hydraulic profile is shown in Figure 7-19.

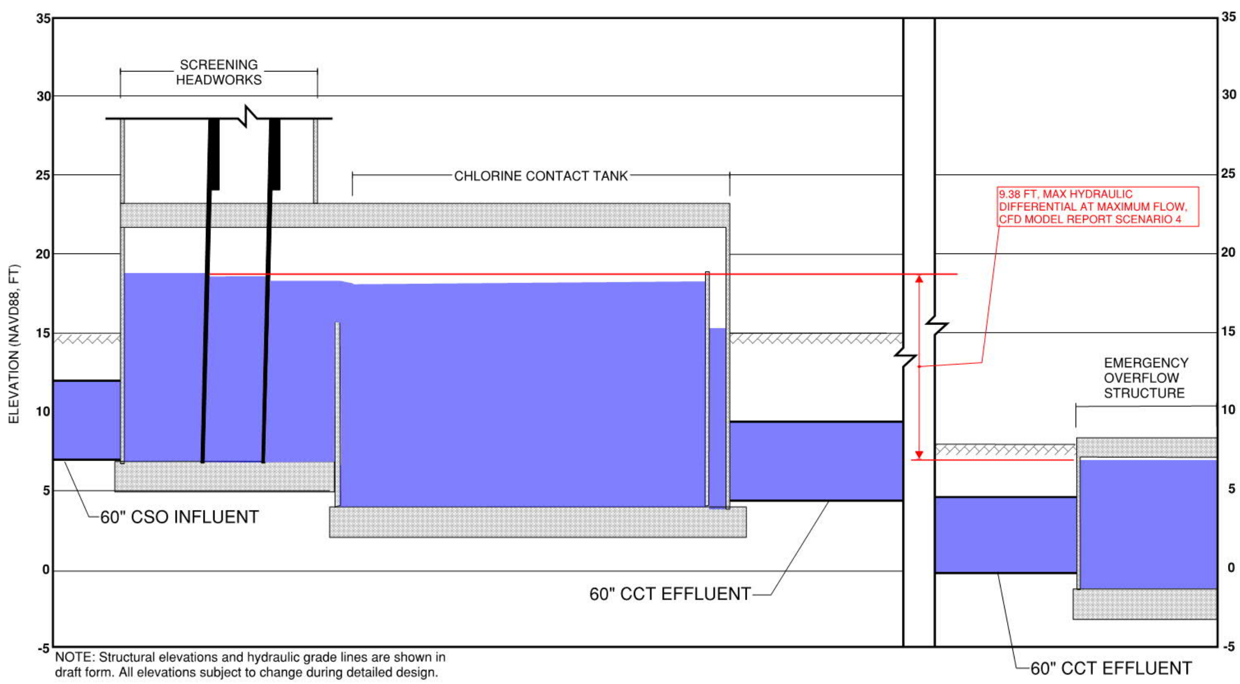


Figure 7-19: Preliminary Hydraulic Profile

7.5.5.2 Influent Flow Meter Vault

Combined sewage influent, delivered to the combined flow treatment facilities via a 60-inch transmission main, will be metered in a buried precast concrete meter vault. The meter vault will include a 60-inch electromagnetic flowmeter for transmitting on-line combined sewage influent flow data to JMEUC's SCADA system. A 60-inch electrically actuated butterfly control valve with an interlock to the wet weather pump station will also be included for isolating flow to the combined flow treatment train. Ancillary components will include operator access through a double-leaf top hatch and ladder, passive venting through a steel gooseneck pipe, sump pump, pit and piping to the exterior. A conceptual meter vault graphic is shown in Figure 7-20.

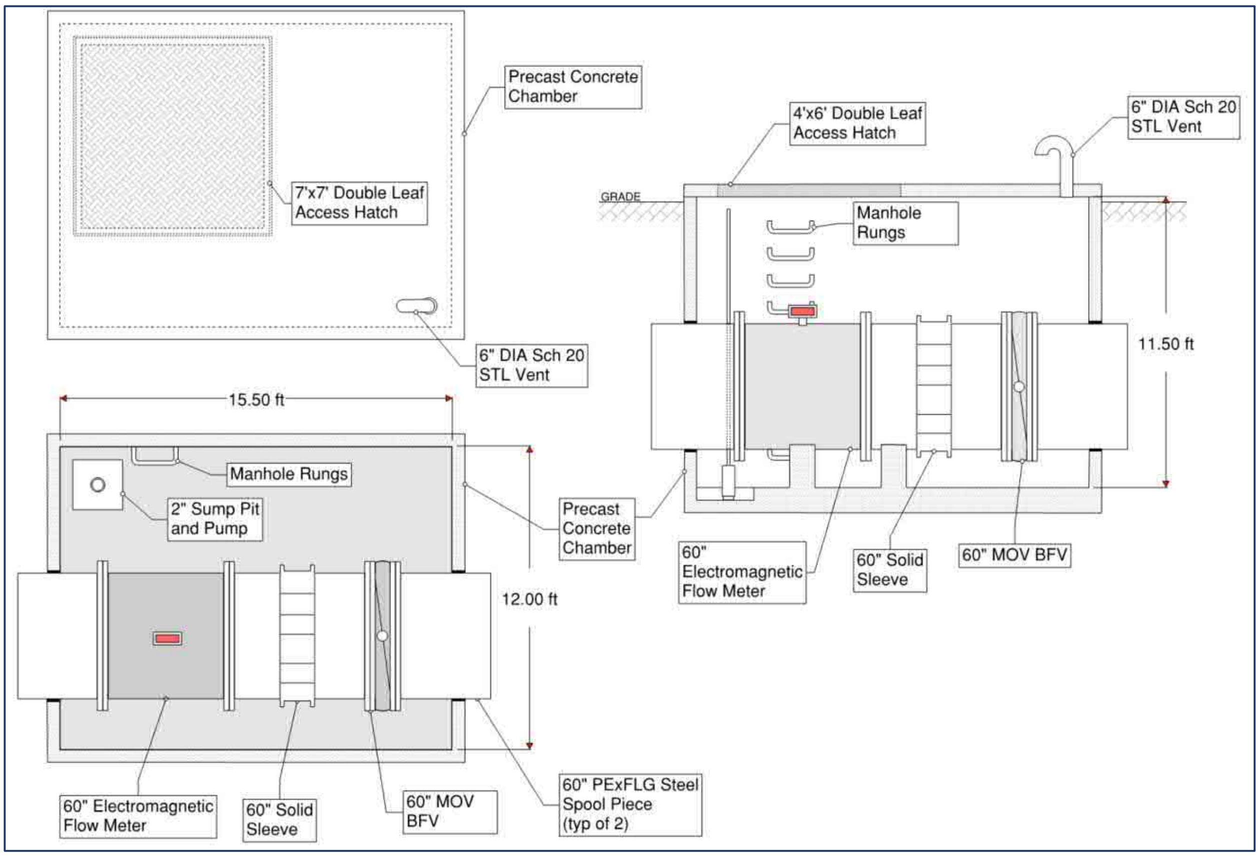


Figure 7-20: Influent Flow Meter Vault

7.5.5.3 Screening Facility

Combined flow is conveyed from the flow meter vault to a screening facility to be treated for removal of large debris and floatables. The screening building consists of a reinforced concrete hydraulic basement structure and a single-story masonry superstructure. The hydraulic structure includes two (2) screening channels, a bypass channel, an effluent weir and a connecting channel to the Disinfection Basin. The superstructure houses the mechanical systems and electrical room. Mechanical systems include 5/8" coarse screens, 1/8" fine screens, slide gates for channel isolation, screenings conveyors, and screening washer-compactors. Screenings bin storage is exterior to the building covered by a roof extension. A conceptual overview of the screening facility is shown in Figure 7-21 and Figure 7-22.

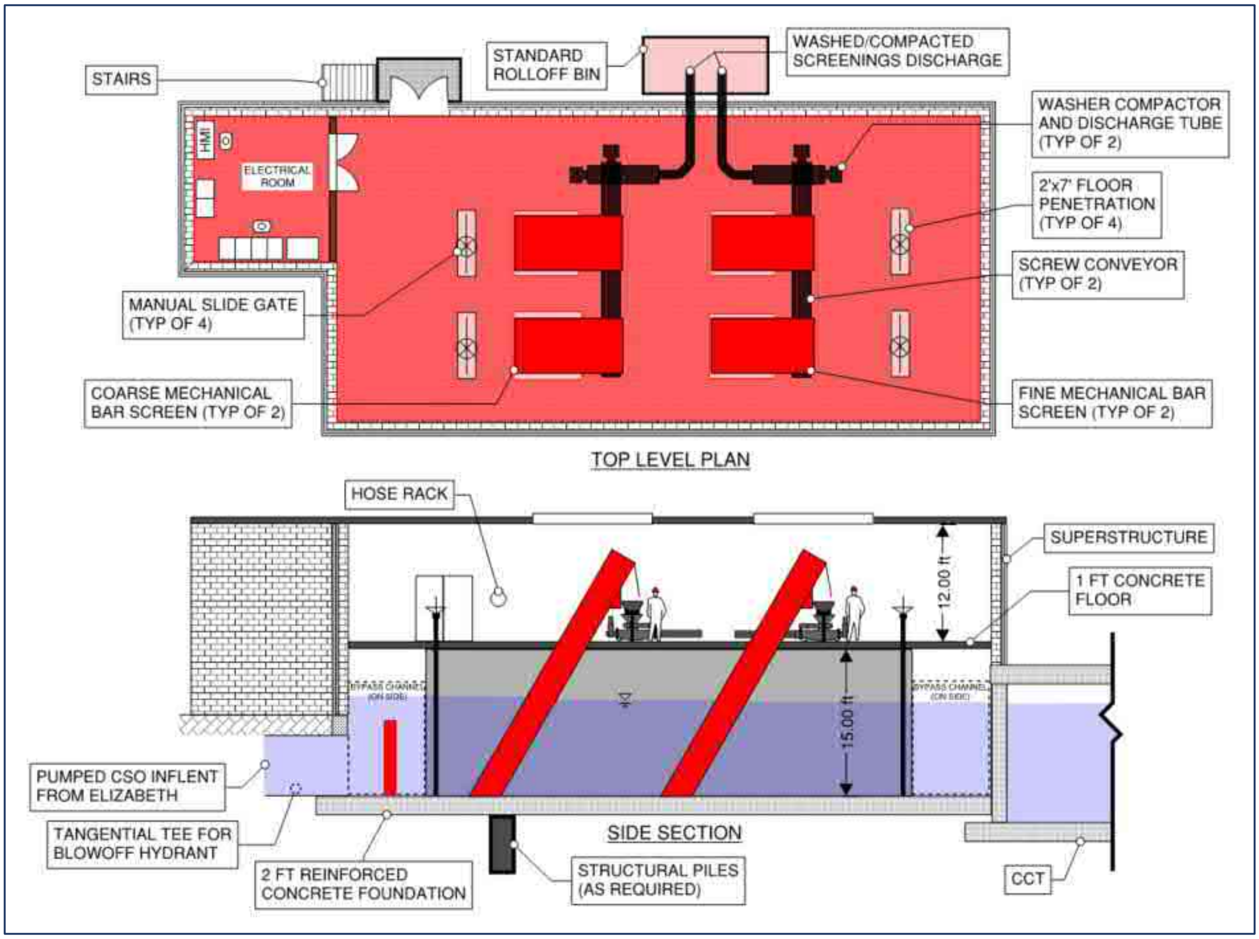


Figure 7-21: Screening Facility Conceptual Top-Level Plan and Section

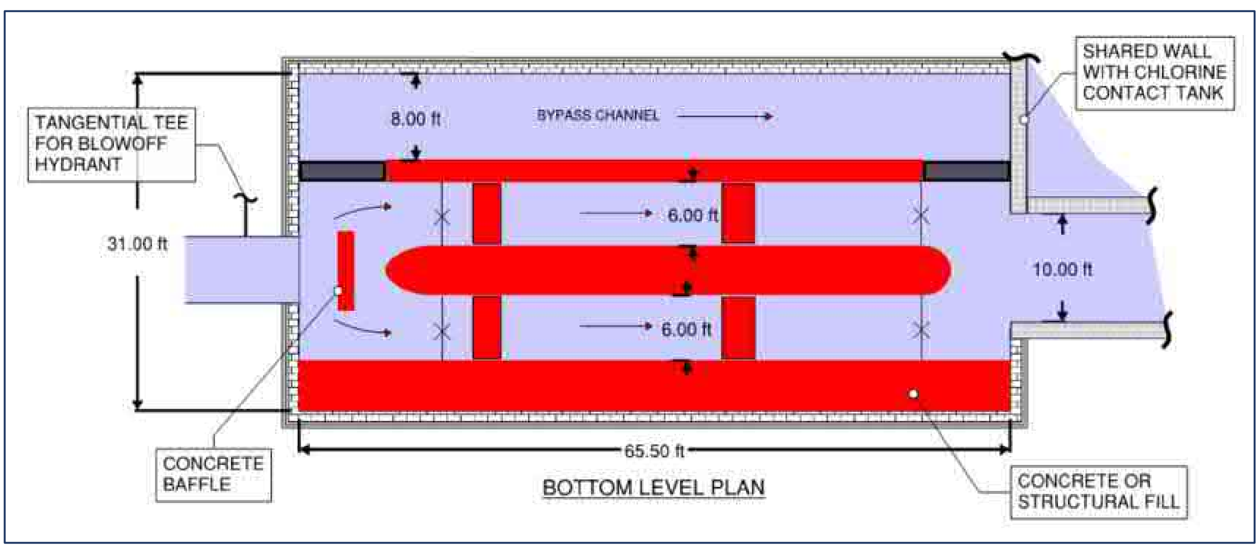


Figure 7-22: Screening Facility Conceptual Bottom-Level Plan

Combined flow is baffled upon entering the facility to reduce approach velocity and turbulence in the screening channels. Maximum channel velocity is 1.4 feet per second through each of two (2) 6-foot wide channels. Upon entering the channel, combined flow is first screened by 5/8" mechanical coarse screens, then by 1/8" mechanical fine screens. The operating water profile through the facility is set by a downstream weir upstream of the Disinfection Basin. Four (4) self-contained gates with electric operators (2 per channel) are located at the entrance point and exit point of each screenings channel to allow either channel to be isolated. In the event of power failure or screen blinding, lateral concrete overflow weirs are included adjacent to the screening channel's influent and effluent zone to allow flow to be bypassed.

Screenings handling will be performed on the upper operating level of the facility. Two (2) separate screening handling trains will process screenings discharged from the coarse screens and fine screens, respectively. Each treatment train will convey discharged screenings to its respective washer-compactor. Washed and compacted screenings will be conveyed outside of the building into an exterior roll off bin. WEF Manual of Practice 8 estimate 5 cubic feet of debris removed per million gallons of inflow for 5/8" coarse screens and 15 cubic feet of debris removed per million gallons of inflow for 1/8" fine screens.

Preliminary estimates show as much 23.5 yards of wet screenings could be removed in a max daily combined flow volume of 42.3 million gallons. Wet screenings processed by the washer compactors and discharged into the roll off bin are estimated to receive a 40% - 70% reduction in moisture and a 60% - 70% reduction in weight. The washer compactor manufacturers claim volume reductions as high as 84%, which would theoretically reduce maximum daily dewatered screenings volumes to 3.8 yards. In practice, daily screening volume totals will likely be less when treating dilute combined flow influent. Dewatered screenings will be combined with JMEUC's existing headworks screenings.

Means to drain the screenings facility will be provided. Since remaining wastewater will have solids, this water must be returned to the main headworks.

7.5.5.4 Disinfection Basin and Effluent Pipe

The disinfection basin receives flow from the screening facility via a channel. The disinfection basin is a rectangular structure with two internal channel walls to provide a three-pass plug flow regime. The disinfection basin will have effluent finger weirs to control water level variation within the basin. The weirs discharge to an effluent pipe connection chamber. A 60-inch effluent pipe will carry disinfected flow to the existing Emergency Overflow Structure at the PSTs, which flows into the existing Outfall Conduits. The volume of the effluent pipe from the disinfection basin to the Emergency Overflow Structure is included in the computation of contact time.

Disinfection Basin:

- Length: 135 feet
- Number of channels: 3
- Channel width: 10 feet
- Channel depth: 12.5 feet
- Length to width ratio: 40.5:1
- Volume: 50,625 cubic feet
- Contact time at 110 mgd: 4.96 minutes

Effluent pipe geometry:

- Length: 445 feet
- Diameter: 5 feet
- Volume: 8689 cubic feet
- Contact time at 110 mgd: 0.85 minutes

Sodium hypochlorite will be fed at the entry to the basin using a high energy induction mixer to disperse chlorine effectively. The basin will have an access platform for mixer maintenance.

The disinfection basin includes a pump out chamber to facilitate drainage between storm events. Submersible pumps will be provided in the chamber to pump the basin down. The contents can be pumped to sanitary sewer or to the effluent pipe chamber. The effluent pipe will remain full between events. A conceptual overview of the disinfection basin is shown in Figure 7-23.

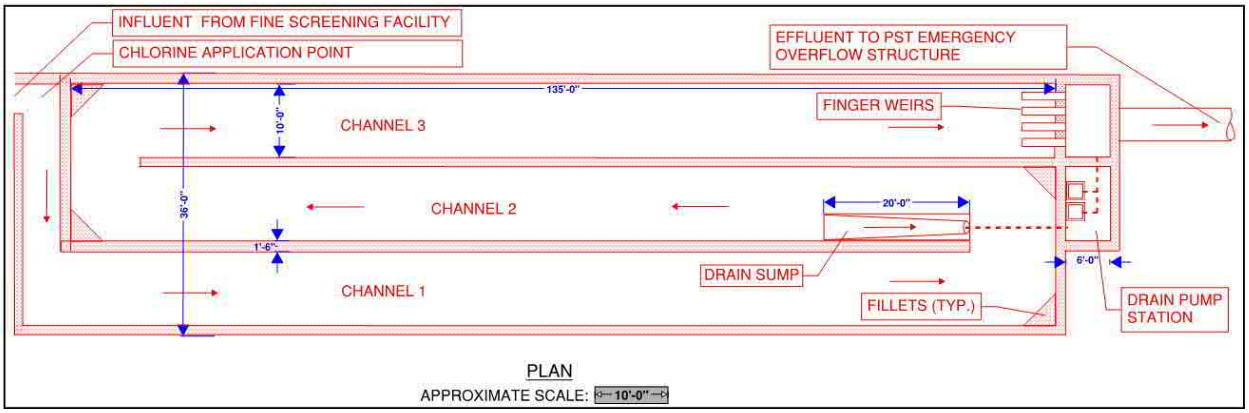


Figure 7-23: Disinfection Basin Plan

It is anticipated that the basin will behave as a settling basin because the velocity thru the basin will be low. Provisions for cleaning sediment will be required. This may be accomplished by providing depressions in each pass with pipes to the pump out chamber and using water cannons to push solids the depressions. Or provisions for rigging a Bobcat style loader into the basin could be furnished, and solids removed periodically. It is difficult to predict the rate of accumulation or volume of sediment that may be deposited. Means for cleaning the disinfection basin will be further explored during preliminary design.

7.5.5.5 Modifications to Hypochlorite and Bisulfite Feed Systems

The existing Chlorination/Dechlorination Building (CDB) has space for new sodium hypochlorite and sodium bisulfite metering pumps. A new, double contained sodium hypochlorite feed line will be installed parallel to the new effluent pipe from the CDB. For the sodium bisulfite, preliminary calculations indicate the existing bisulfite feed lines can carry the additional flow to dechlorinate the effluent from the new disinfection basin. The dechlorination application point is downstream of the confluence of the treated combined flow effluent and the secondary effluent and is not proposed to change.

As discussed in Section 7.5.4.2 additional chemical storage is sufficient and additional storage is not proposed.

Sodium Hypochlorite design criteria:

- Min/Max flow: 1-100 mgd
- Number of pumps: 3, two duty one backup
- Design sodium hypochlorite strength: 12.5 wt %
- Disinfectant dose as chlorine: 21 mg/L
- Minimum pump capacity: 7 gph using 1 pump
- Max pump capacity: 770 gph, using two pumps

Sodium bisulfite design criteria:

- Min/Max flow: 1-100 mgd
- Number of pumps: 2, one duty one backup
- Design sodium bisulfite strength: 38 wt %
- Stoichiometric excess: 10%
- Chlorine concentration to reduce: 5 mg/L
- Minimum pump capacity: 0,7 gph using 1 pump
- Max pump capacity: 77 gph, using 1 pump

7.5.5.6 Effluent Pipe to Existing Outfall Conduits

Screened and disinfected combined flows will be conveyed to JMEUC's existing outfall control chamber (also referred to as Emergency Overflow Structure) via a 60-inch cement-lined steel effluent pipe. It is proposed that the effluent pipe be routed northeast from the combined sewage treatment zone through the Road "A" corridor between the primary settling tanks and the aeration tanks. Figure 7-24 shows an aerial site plan of the proposed effluent pipe routing. Buried utilities are superimposed onto this figure based on survey data from the CME Underground Utilities Site Plans, dated January 2018. As shown, several utilities must be traversed to install the new effluent pipe including:

- 6-ft x 10-ft box culvert primary effluent conduit
- Various storm sewers - diameters ranging from 6-inch to 36-inch
- Various water force mains, fire and service lines
- Gas main (diameter unknown)
- Various electrical conduits

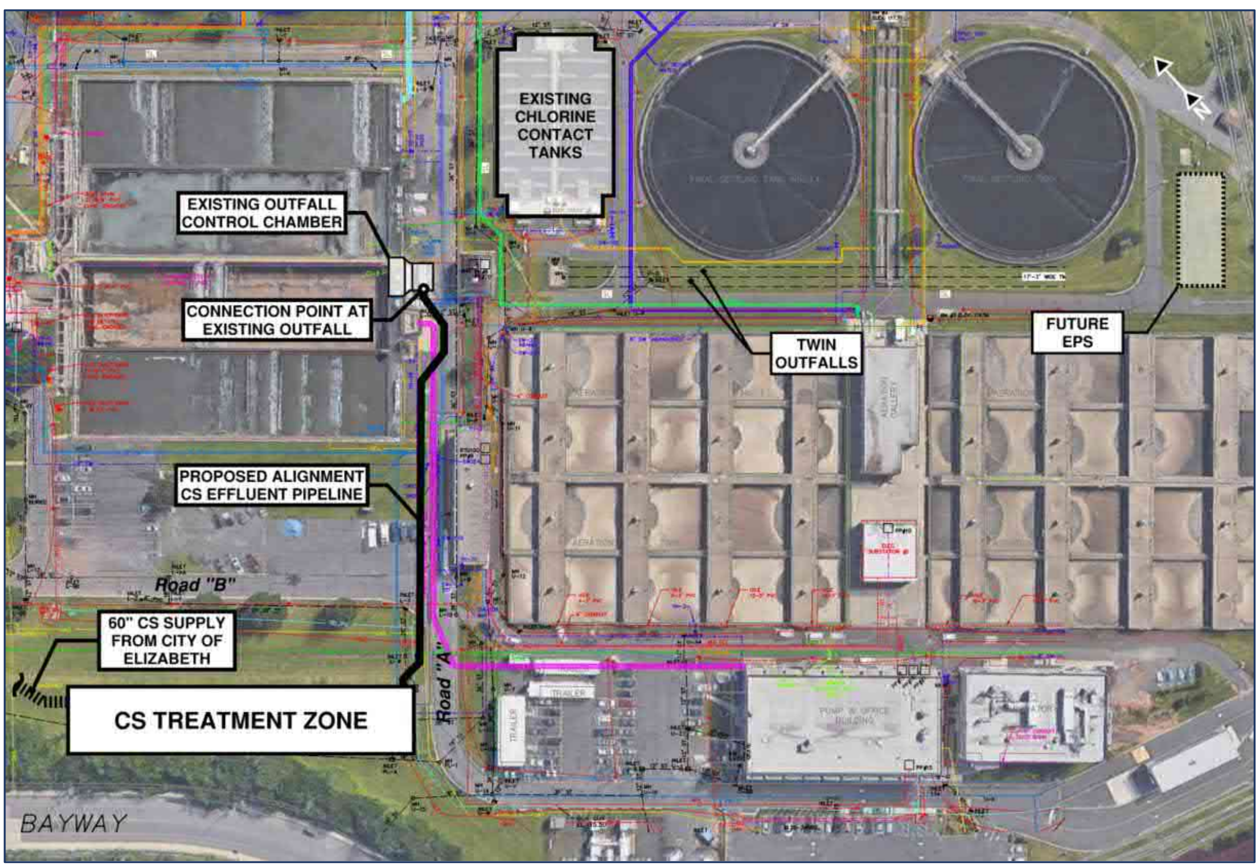


Figure 7-24: Combined Flow Treated Effluent Pipeline Routing

At minimum, tunneling via jack and bore methods will be required for the 6-ft x 10-ft box culvert primary effluent conduit crossing. Relocation of existing sanitary, storm, water, gas and electrical utilities will likely be required as well. Final horizontal and vertical alignments and full scope of required utility relocations will be determined during preliminary design.

It is currently proposed that the effluent pipe will discharge treated combined flow at the existing Emergency Overflow Structure. Figure 7-25 shows a plan and section view of the structure illustrating the effluent pipe penetration. Sufficient space is available on the wall of the structure for a 60-inch diameter pipe penetration. During preliminary design additional evaluation of effluent conduit hydraulics should be performed to confirm, or perhaps modify, the location of the point of connection into the existing effluent conduit.

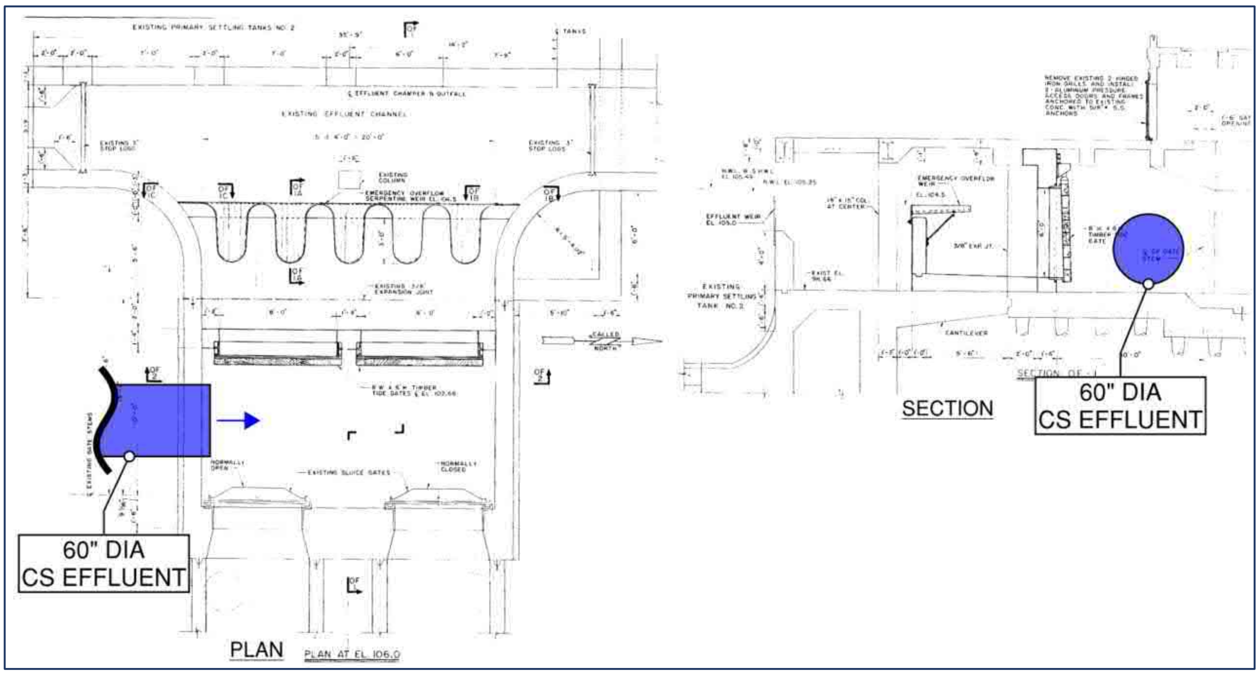


Figure 7-25: 60-inch Combined Flow Effluent Pipe Penetration of Existing Emergency Overflow Structure

7.5.6 Conclusions

The proposed combined sewer flow treatment facility will apply proven technology to cost-effectively treat the additional combined sewer flow proposed to be captured in the new Wet Weather Pumping Station and Force Main to JMEUC. This conclusion is of course based on the current state of technology and the current conditions and objectives of the LTCP. Given the proposed implementation schedule, under which the proposed combined sewer flow treatment facility will be designed more than 10 years after submittal of the LTCP, it is reasonable to expect that changes may occur over that period that could in turn change the proposed facility planning in the LTCP. Therefore, it is also expected that during detailed facility planning and implementation the selected approach will be re-evaluated to incorporate new technology and other information that may be available at that future time (i.e. adaptive management).

It should also be noted that the DEAR selected chlorination with dechlorination as the disinfection approach, and that approach has been carried forward into this report. However, JMEUC has recently decided to consider peracetic acid as an alternative to chlorination for disinfection of the current WWTF effluent. If JMEUC conducts an evaluation of disinfection practices and selects peracetic acid as the disinfection approach for the current (normal) plant effluent, the disinfection approach for the combined sewer flow treatment train will be re-evaluated to consider the change in practice at the plant.

7.6 Select Sewer Separation Projects

The Development and Evaluation of Alternatives Report found that sewer separation was not viable for implementation on a City-wide basis, due to the extremely high cost, extensive construction requirements, and the corresponding disruption to City residents. However, sewer separation was determined to be appropriate for certain areas that are relatively small in area or in tributary sewer lengths, and where a CSO outfall is isolated from other outfall locations.

7.6.1 CSO Basin 012

CSO Basin 012 covers approximately 9 acres and extends north and south of Rahway Avenue between the Elizabeth River and Broad Street. Regulator R012A and R012B are located along the sewer in Rahway Avenue, with R012A positioned approximately 110’ downstream of R012B. Dry weather flows are first diverted at R012B and combined flows from R012B continue downstream to R012A. This basin was selected for sewer separation because of its small size and relatively short tributary sewer lengths.

In order to provide sewer separation for CSO Basin 012, it is necessary to isolate the existing outfall from sanitary flows by plugging the overflow outlet at Regulator R012B and the dry weather flow outlet at Regulator R012A. The existing storm inlets at the Rahway Avenue and Elizabethtown Plaza intersection will then redirected to an existing separate storm sewer outfall. The existing 8-inch dry weather flow pipe from Regulator R012B to the Westerly Interceptor will be replaced with a new 15-inch diameter pipe. The existing dry weather flow line from Regulator R012A to the Westerly Interceptor will be abandoned. It will be necessary to field verify that parking lots and roof drains from the Union County Administration, Building, Court House, and Prosecutors Office are not connected to the small collector sewers on Rahway Avenue and Elizabethtown Plaza. Based on the hydraulic modeling performed to date, removing the connection to CSO Outfall 012 will not surcharge the Rahway Avenue siphon or the Westerly Interceptor.

The proposed extents of the sewer separation in CSO Basin 012 are presented in Figure 7-26.

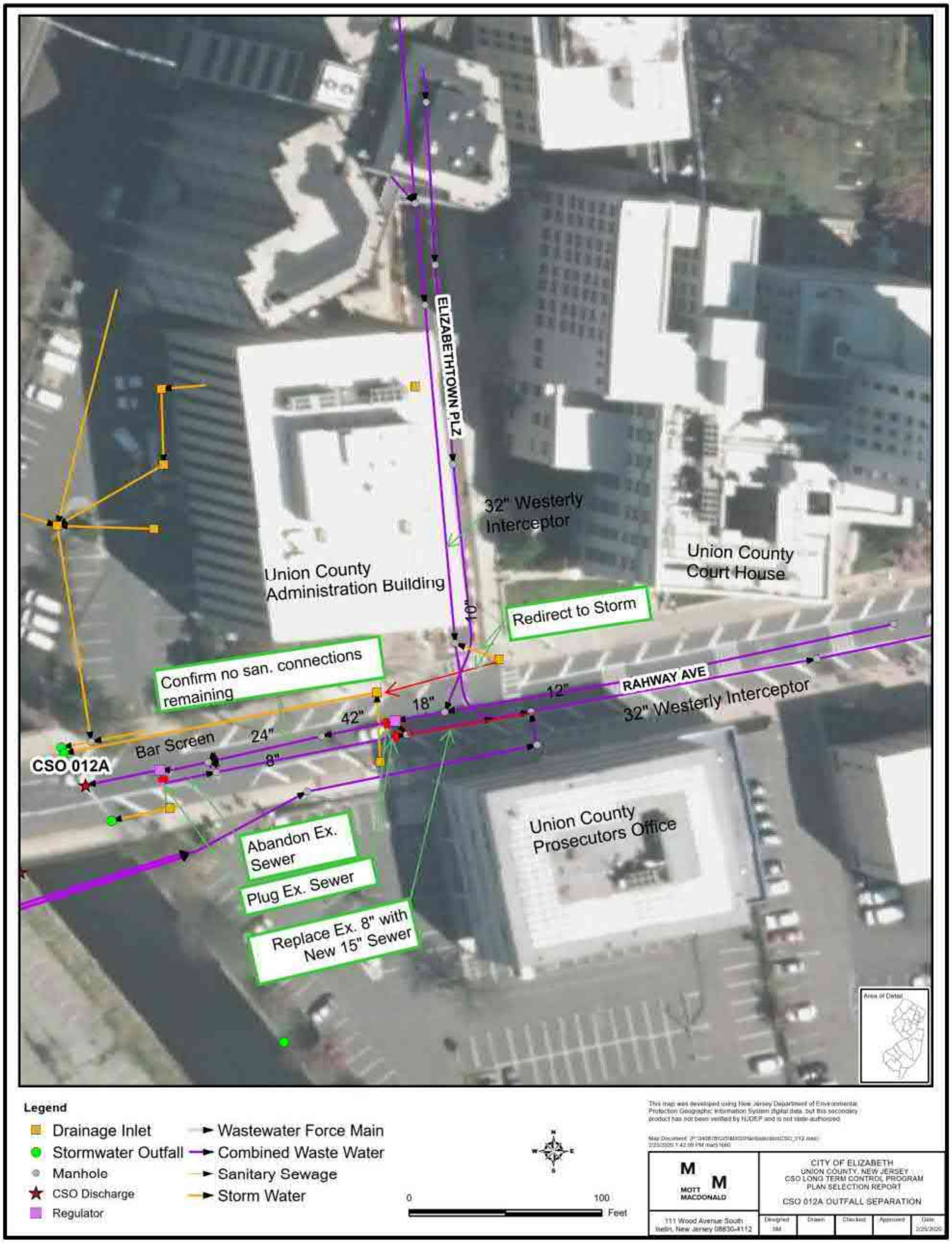


Figure 7-26: Basin 012 Sewer Separation

7.6.2 CSO Basin 037

CSO Basin 037 has a total area of approximately 86 acres. The basin is divided into 2 sub-basins corresponding to its 2 regulators. The Regulator R037A sewershed is about 16 acres and the Regulator R037B sewershed, is about 70 acres. Branch sewers in the area connect to the Bayway trunk sewer. Regulators R037A and B are located on this trunk sewer and divert dry weather flows to the Bayway Branch Interceptor that then connects to the Easterly Interceptor. Wet weather flows from Regulator R037B connect back into the Bayway trunk sewer, which continues as the incoming sewer to Regulator R037A. An area of properties along the Bayway Branch Interceptor are connected to the branch interceptor, creating a separate sewer area adjacent to Basin 037.

CSO Basin 037 was selected for sewer separation because of its existing industrial land use, resulting in only a few building that would need to be connected to a new separate sanitary sewer system. Given the land development in this basin, full sewer separation can be more readily accomplished compared to the dense residential development of other neighborhoods.

The proposed sewer separation of CSO Basin 037 is presented in Figure 7-27 and consists of the installation of approximately 3,200 linear feet of new 12-inch and 15-inch sanitary sewers parallel to existing combined sewers. These sewers will be installed with estimated invert depth of up to 12 feet. Due to the low density development there are only a few existing sanitary service laterals that would need to be redirected to the new sanitary sewer system. The existing combined sewer will be converted to a dedicated storm sewer and modifications to the existing regulator structures will be made to plug the existing connections to the Bayway Branch Interceptor. Treatment of the separated stormwater discharge from the existing CSO outfall 037A may be required and will need to be resolved with the New Jersey Department of Environmental Protection Water Pollution Management Element.

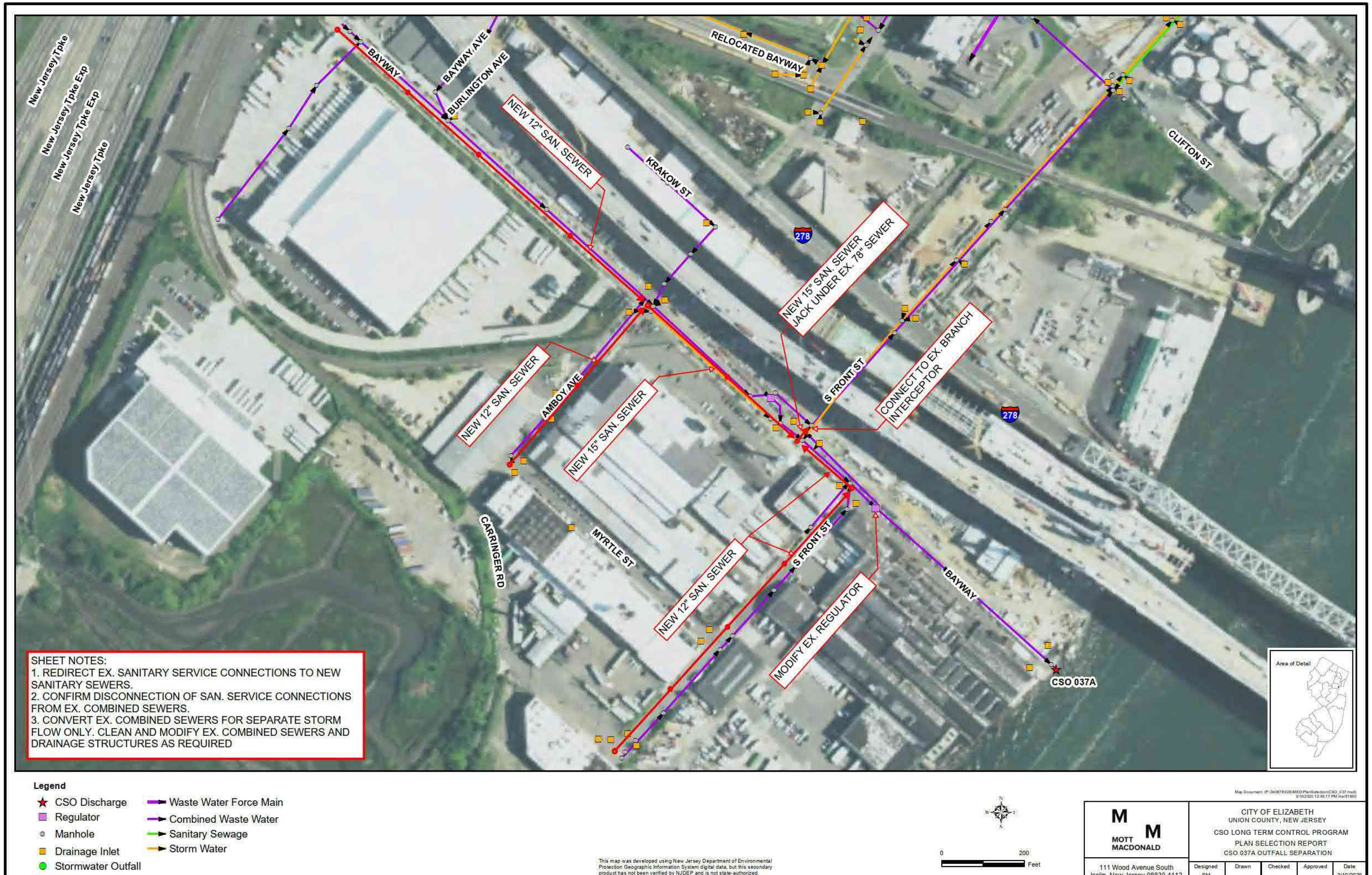
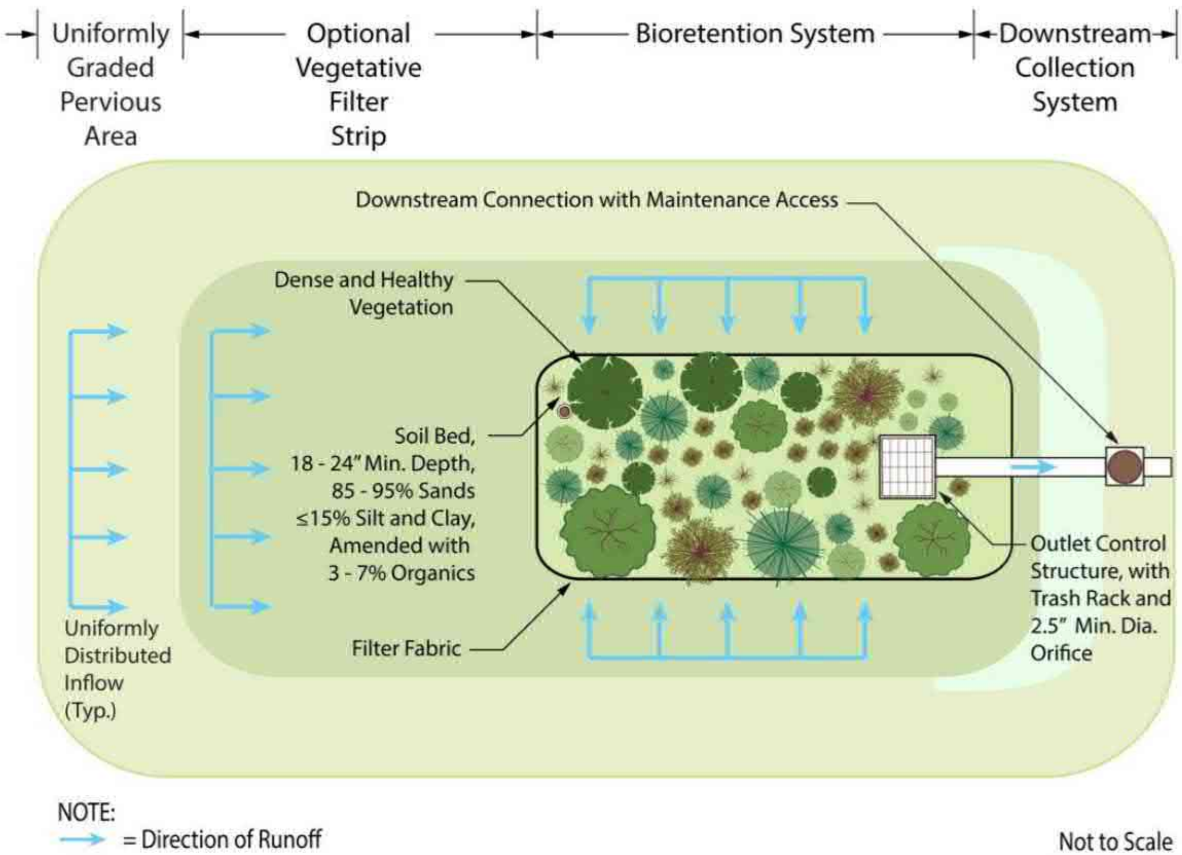


Figure 7-27: Basin 037 Sewer Separation

7.7 Green Infrastructure Pilot Program

The purpose of green stormwater infrastructure (GSI) is to reduce runoff volumes, peak flows, and/or pollutant loads. GSI contributes to CSO volume reduction primarily by infiltrating runoff into soil. Additionally, GSI can deliver a broad range of ecosystem services or benefits to people regarding, for example, flooding reduction, aesthetics, air quality, water quality, groundwater recharge, wildlife habitats, urban heat island reduction, quality of life, recreation and increased property values.[1] Because of these benefits, there is often strong support for GSI among some segments of the public. Although experience in other cities and modeling of local conditions has shown that GSI alone would not be effective in reducing CSOs to the required level, if the extent and effectiveness of GSI can be determined, the scale of other CSO control measures can be reduced accordingly.

A typical rain garden (also referred to as a GSI bioretention system) is shown in Figure 7-28 below.



Source: New Jersey Stormwater BMP Manual, updated March 2020, NJDEP.

Figure 7-28: Typical Rain Garden Illustration

To be appropriate for specification in a LTCP, GSI must be reliably effective in controlling CSOs and economically competitive with other methods. However, there is uncertainty about GSI's CSO reduction effectiveness, primarily regarding the extent to which its installation is restricted by conflicts with utilities or infrastructure, and by limited infiltration potential of native soils. Experience in other cities indicates that up to 85% of locations identified by desktop assessment as potential sites for GSI were later determined

[1] United States Environmental Protection Agency, Greening CSO Plans: Planning and Modeling Green Infrastructure for Combined Sewer Overflow (CSO) Control, March 2014. Publication # 832-R-14-001.

to be infeasible after site-specific field investigation. Because of this uncertainty, the extent or site location distribution of GSI to be implemented as part of the LTCP cannot be specified at this stage of the process. Specifying too little could result in missed potential benefits, while overcommitting could misconstrue the success of an LTCP because there could be too few opportunities to install GSI or it may not perform as expected.

Therefore, the approach of adaptive management is appropriate for implementing GSI in a LTCP. The City has recognized the community and aesthetic benefits of green infrastructure as well as potential for stormwater runoff storage or detention. The Development and Evaluation of Alternatives Report determined that rain gardens and permeable pavement have the greatest potential for widespread installation in the City. It was noted that the available data on soils and groundwater levels in the City of Elizabeth classifies the majority of the City as “urban land” and the infiltration potential of the soil is not defined and previous field studies have been inconclusive regarding the infiltration potential of the existing soils. Further, limited location-specific information is available on the operations and maintenance requirements of green infrastructure.

As such, prior to City-wide implementation of green infrastructure, the City intends to implement a Green Infrastructure Pilot Program to gain a more comprehensive understanding of the costs and benefits of this control strategy. Such an approach is consistent with that of New York City (NYC), who also completed a pilot monitoring program prior to expanding to a City-wide implementation. The NYC pilot program was initiated to evaluate the effectiveness of various green infrastructure practices and to provide data to extrapolate the runoff reduction benefits on a large scale. A pilot program of this type evaluates the effectiveness of the investigated controls at reducing the volume and rate of stormwater runoff from the drainage area through measuring quantitative aspects like inflow and outflow rates, as well as qualitative issues like maintenance requirements, appearance, and community perception.

The City of Elizabeth intends to incorporate green stormwater infrastructure at locations throughout the City on a pilot basis, potentially scaling up depending on the effectiveness of the program or limiting implementation of GSI under the LTCP to the Pilot Program.

Consistent with the approach in NYC, the City will perform desktop investigations, field visits and geotechnical (infiltration) testing to identify suitable locations for infiltration. Prospective sites will be identified from areas maintained and controlled by the City and pilot locations will be selected based on input from City staff, elected officials and the public. The City will initially select up to 10 sites where rain gardens will be installed, along with interpretive signage to explain its purpose and function.

Consistent with the NYC program, rain garden sites would be monitored both through remote monitoring as well as regular site visits to obtain performance information on infiltration, discharges, and pollutant removal. This monitoring may include water quantity, water/soil quality, and rainfall, or other monitoring. This type of performance monitoring will allow the City to evaluate the efficacy of the sites and potential benefits to the community, and provides insight into maintenance requirements and any adjustments that could be made to optimize performance.

A report will be developed following pilot program implementation, documenting the overall integration of the feature into the community, as well as any feedback from the surrounding community about any construction disturbance, aesthetics, public education, or any other benefits of having this additional green space in the community. Infiltration rates will be tracked on an ongoing basis to record performance and identify requirements for maintenance. The costs of installation, including any permitting requirements will be evaluated. The annual cost of monitoring and maintenance to ensure that the rain gardens are operating as designed will also be evaluated.

If the City determines that the CSO volume reduction performance and community benefit outweigh the cost of installation and maintenance relative to other CSO control alternatives, the green infrastructure pilot program may be scaled up to install additional GSI at locations deemed appropriate by the City. It is noted that GSI is not being relied on at this point to reach the CSO LTCP volume reduction targets, but depending on the success of the pilot program, an adaptive management approach may be used to update the modeling results and refine the proposed CSO controls.

The City is currently implementing green infrastructure such as rain gardens, both at Kenah Field as well as part of the Trumbull Street Stormwater Control Project, as shown in the figures below.

Figure 7-29: Kenah Field Park Rain Garden

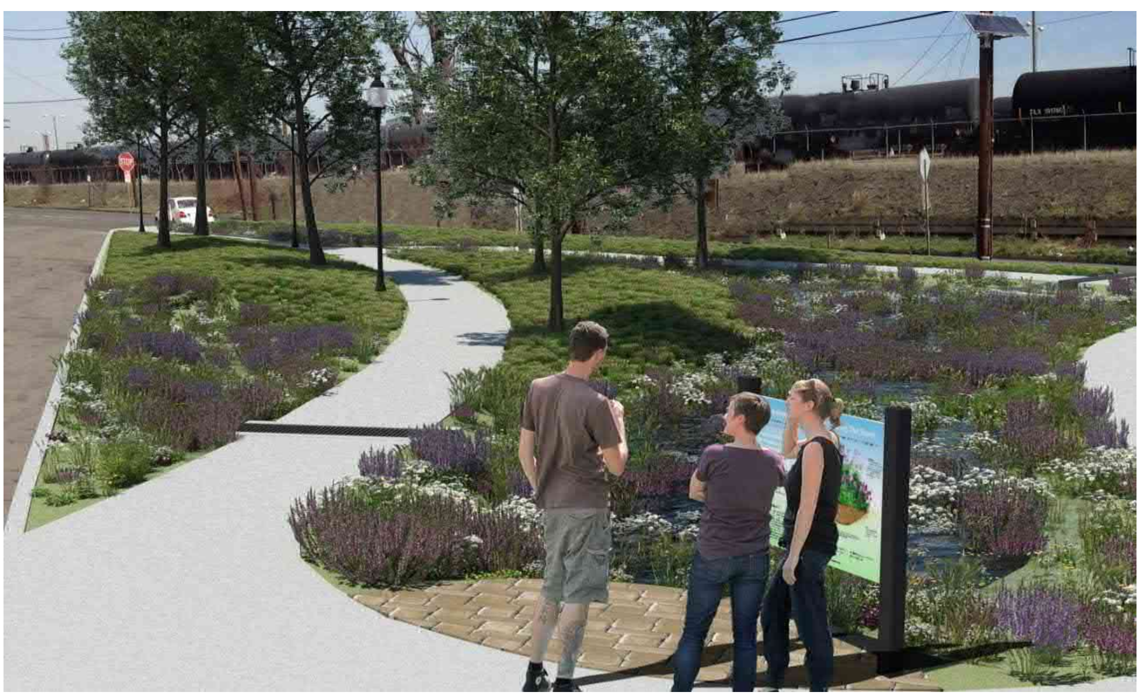


Figure 7-30: Trumbull Street Stormwater Control Project Rain Garden Rendering

7.8 Percent Capture After Plan Implementation

The hydraulic model was updated to include the CSO LTCP component projects described in the preceding sections, and the estimated CSO overflow volumes following LTCP implementation are as follows:

Table 7-6: Typical Year Overflow Volume by Outfall - After CSO LTCP Implementation

Outfall No.	Annual Total CSO Volume, MG
001A	19.4
002A	16.9
003A	58.2
005A	16.0
008A	5.26
010A	12.6
012A	0.00
013A	10.8
014A	0.00
016A	0.47
021A	0.37
022A	23.9
026A	7.04
027A	0.11
028A	0.15
029A	11.90
030A	1.61
031A	8.20
032A	2.24
034A	32.2
035A	1.02
036A	34.6
037A	0.00
038A	0.12
039A	8.50
040A	0.00
041A	43.7
042A	6.85
043A	0.00
Total CSO Volume, MG	**322**

Comparing this output data and the CSO overflow volumes from the existing conditions model simulation, it was determined that 1,832 MG of CSO flow is captured for a percent capture of 85.1%, as shown in the table below. As such, the requirements for the Presumption Approach for a minimum of 85% of CSO volume capture is achieved.

Table 7-7: System-Wide Percent Capture After Plan Implementation

Item	Elizabeth system only, TAPS	Full JMEUC system
Total Wet Weather Flow (MG)	2,154	4,550
Wet Weather Flow Captured (MG)	1,832	4,228
CSO Volume (MG)	322	322
Percent Capture	85.1 %	92.9 %

The following table provides a comparison between existing overflow volumes from each outfall versus post implementation of the recommended CSO controls, categorized by receiving waterbody.

It can be seen from the figure below that the greatest reduction in CSO overflow volumes is in the Upper Elizabeth River.

Table 7-8: Overflow Volumes - Existing vs. After Plan Implementation

Receiving Water	Outfall No.	Existing Conditions - Overflow Volume (MG)	After Plan Implementation - Overflow Volume (MG)	Percent Change
Arthur Kill / Newark Bay	001A	48.5	19.4	-60.0%
	002A	24.5	16.9	-31.0%
	030A	2.00	1.61	-19.5%
	031A	12.3	8.20	-33.3%
	032A	2.40	2.24	-6.67%
	034A	66.6	32.2	-51.7%
	037A	47.7	0.00	-100%
	039A	9.50	8.5	-10.5%
Lower Elizabeth River	021A	0.90	0.37	-58.9%
	022A	53.5	23.9	-55.3%
	026A	50.3	7.04	-86.0%
	027A	21.5	0.11	-99.5%
	028A	22.2	0.15	-99.3%
	029A	32.7	11.9	-63.6%
	035A	34.6	1.02	-97.1%
	038A	8.30	0.12	-98.6%
	040A	11.8	0.00	-100.0%
	042A	8.70	6.85	-21.3%
	043A	0.00	0.00	-100%
Upper Elizabeth River	003A	57.7	58.2	0.87%
	005A	85.4	16.0	-81.3%
	008A	8.70	5.26	-39.5%
	010A	12.8	12.6	-1.56%
	012A	4.50	0.00	-100%
	013A	14.6	10.8	-26.0%
	014A	0.40	0.00	-100%
	016A	14.6	0.47	-96.8%

Receiving Water	Outfall No.	Existing Conditions - Overflow Volume (MG)	After Plan Implementation - Overflow Volume (MG)	Percent Change
	036A	33.8	34.6	2.37%
	041A	176	43.7	-75.1%
Total Overflow Volume (MG)		**866**	**322**	**-62.8%**

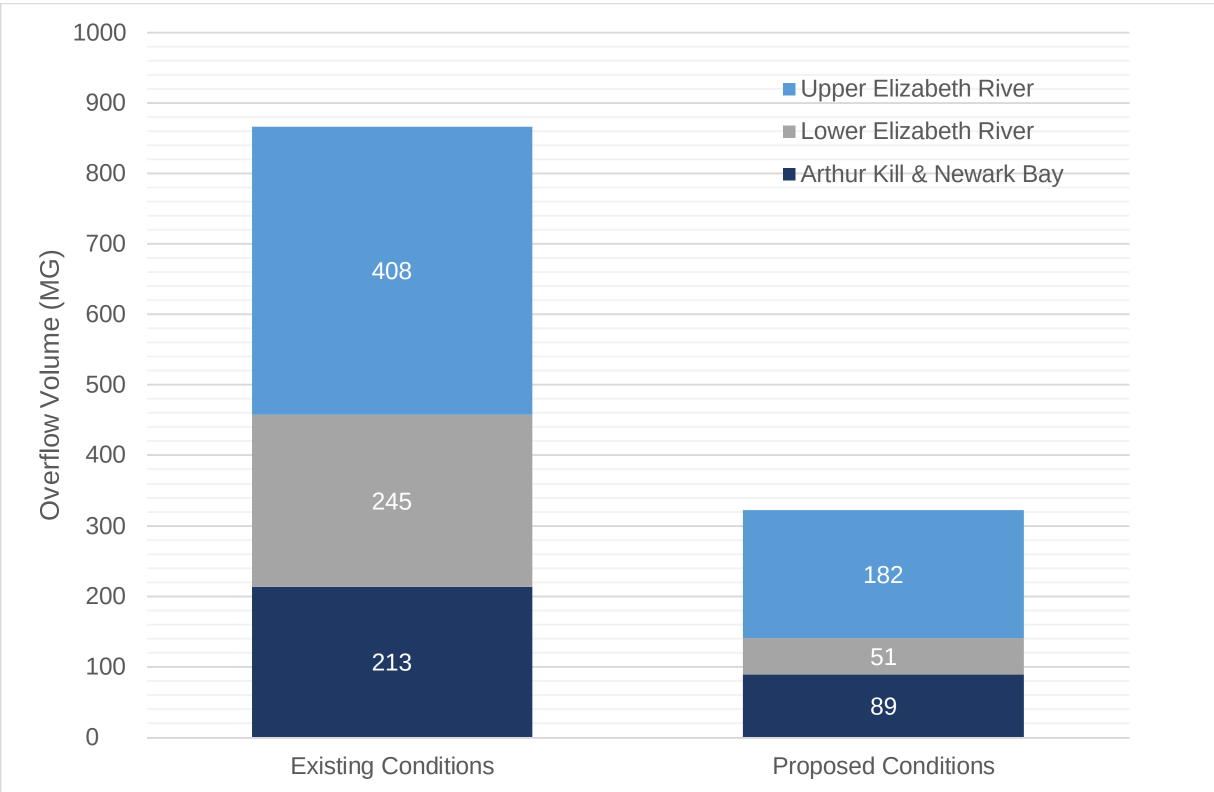


Figure 7-31: Overflow Volumes - Existing Versus After LTCP Implementation

7.9 Cost Summary

Cost estimates for the CSO control programs have been developed for the recommended CSO LTCP. The costs provided are meant to provide an order of magnitude estimate and are considered Class 4 estimates as defined by the Association for the Advancement of Cost Engineering International (AACE International). Class 4 estimates are prepared for a number of purposes, such as strategic planning studies, confirmation of economic and/or technical feasibility, or selection of a feasible alternative. The accuracy range of Class 4 estimates is classified as -30% to +50%. The estimates have been developed specifically for the projects described. The information and costs presented in this report are for planning purposes only, and all assumptions and information must be verified in subsequent development stages.

The program costs are presented as follows:

- Capital cost – including construction costs with contingency and non-construction project costs.

- o Construction costs – based on reference cost curves, technical guidance manual, past project experience, and specific technology cost estimates. These costs are intended to include contractor's general conditions, overhead, and profit. A 25% construction cost contingency has been applied.
- o Non-construction costs – allowances have been applied for non-construction costs as 3% of the total construction cost for legal and administrative expenses, 10% for planning and design costs, and 10% for construction phase services.

- Annual operations and maintenance (O&M) costs – annual costs for labor, power, chemicals, parts, equipment overhauls, and other supplies and services to operate and maintain the facilities.
- The costs may be indexed to the Engineering News Record (ENR) Construction Cost Index (CCI) for June 2020, with a corresponding national ENR-CCI value of 11,436.

7.9.1 Capital Cost

These costs are summarized in Table 7-9 below. This cost estimate accounts for all of the proposed control plan components summarized in the sections above, except the already completed local stormwater projects. This control program also assumes that the CSO control level objective is 85% capture of CSO volume.

Table 7-9: CSO Control Plan Capital Cost Estimate

Project Name	Capital Cost (2020 $)
South Second Street Stormwater Control	$ 2,810,000
Atlantic Street CSO Storage Facility	$ 8,210,000
Lincoln Avenue Stormwater Drainage Improvements	$ 2,820,000
Park Avenue Stormwater Control	$ 8,580,000
Basin 012 Sewer Separation	$ 270,000
Basin 037 Sewer Separation	$ 4,590,000
Green Infrastructure Pilot Program	$ 1,280,000
Trenton Avenue Pumping Station - Phase 1 Upgrade	$ 610,000
Trenton Avenue Pumping Station - Phase 2 Upgrade	$ 9,250,000
New Wet Weather Pump Station	$ 41,370,000
New Wet Weather Pump Station Force Main to JMEUC	$ 11,930,000
New CSO WWTF	$ 20,890,000
Easterly Interceptor Improvements	$ 2,530,000
Bridge Street Siphon Upgrade	$ 2,630,000
Lower Westerly Interceptor Upgrade	$ 36,210,000
Palmer Street Branch Interceptor Upgrade	$ 4,280,000
Palmer Street Siphon Upgrade	$ 2,530,000
Pearl Street Branch Interceptor Upgrade	$ 5,480,000
R027/028 Regulator Modifications	$ 500,000
R040 Regulator Modifications	$ 500,000
Upper Westerly Interceptor Upgrade	$ 21,510,000
Morris Avenue Siphon Upgrade	$ 2,140,000
Total	**$ 190,920,000**

The values are presented in 2020 dollars, and include construction costs, with overhead and profit as well as the following contingencies:

- General requirements = 10%
- Cost contingency = 25%
- Legal and administrative expenses = 3%
- Planning and design costs = 10%
- Construction phase services = 10%

No land acquisition costs or cost for treatment of stormwater runoff are included.

Detailed costs for each of the projects are included in Appendix B.

7.9.2 Annual Operation & Maintenance Costs

Annual operation and maintenance (O&M) costs were determined for each of the recommended CSO LTCP projects, and are summarized as follows.

- **Progress Street, South Street, South Second Street, Lincoln Avenue and Park Avenue stormwater control projects:** Based on the "Updated Guidance on Costing for LTCP CSO Planning" produced by Greeley and Hansen/CDM Smith for the PVSC Permittee Group in April 2020, the O&M costs for proposed relief pipelines are expected to be absorbed within existing O&M budgets as the pipe that will be implemented is new and should require less maintenance than other parts of the system. Therefore, no new O&M costs are included for these projects.
- **Trumbull Street stormwater control project and Atlantic Street CSO storage facility project:** Based on the "Updated Guidance on Costing for LTCP CSO Planning" produced by Greeley and Hansen/CDM Smith for the PVSC Permittee Group in April 2020, it was assumed that the proposed 1 MG storage facilities would require a visit by a crew following each storm event for flushing, cleaning and overall maintenance, and that there would be 60 storm events per year. The cleaning cost per day was assumed to be $1,500, which includes the cost of a water truck, a jet vac truck and two operators. It was assumed that 1 MG tanks would require ¾ of a day. As such, the annual O&M cost for each of these projects was estimated as $67,500.
- **Basins 012 and 037 sewer separation:** Based on the "Updated Guidance on Costing for LTCP CSO Planning" produced by Greeley and Hansen/CDM Smith for the PVSC Permittee Group in April 2020, it was assumed that there is no additional O&M cost as this work should not lead to an increase in O&M efforts associated with maintaining the sewer system, which presumably is maintained today.
- **Green Infrastructure pilot program:** The cost was developed with the assumption that the pilot program may be comprised of rain garden installations. Based on the "Audit Report on the Department of Environmental Protection's Maintenance of Rain Gardens" produced by City of New York Office of the Comptroller in December 2019, in New York City, the total expenditure for 2511 rain gardens annual maintenance including staffing salaries, general supplies and other related services was approximately $2,400 per rain garden, as such the annual O&M cost for the pilot program for ten rain gardens was estimated as $24,000.
- **Pump Station improvements – Trenton Avenue Phase 1, Phase 2 and New wet weather pump station:** The cost estimate for the pump station O&M was based on two components - 1. Energy and labor costs, and 2. Treatment cost to convey additional volume to the JMEUC WWTF. For Phase 1 and Phase 2 TAPS improvements, the energy and labor costs were assumed to be equivalent to the O&M costs of the existing TAPS. The additional treatment cost was based on flow, BOD and TSS loading, with unit costs taken from the Q3 2019 Adjustment Bill

to the City of Elizabeth from JMEUC as flow charged at $557.07 per MG, BOD charged at $891.28 per ton, and TSS at $569.33 per ton. The corresponding average wet weather influent data was provided by JMEUC as BOD concentration of 109 mg/L and TSS concentration of 120.7 mg/L. Costs for additional treatment were calculated based on the additional volume of flow conveyed to the JMEUC WWTF as estimated by the hydraulic model. The Phase 1 O&M cost was estimated as $166,000, the Phase 2 cost estimated as an additional $87,000, and the new wet weather pump station estimated as $183,400. As such, the full proposed expansion would have a cumulative total annual additional O&M cost of approximately $436,400.

- **New Combined Sewer Flow Treatment Facility:** An estimate for O&M costs was prepared, including chemical and energy costs for facility operations and labor costs for facility operations maintenance, as well as costs for parts replacement for a total of $363,000.
- **Easterly interceptor, Westerly interceptor, siphon, regulator and branch interceptor improvements:** Based on the “Updated Guidance on Costing for LTCP CSO Planning” produced by Greeley and Hansen/CDM Smith for the PVSC Permittee Group in April 2020, the O&M costs for proposed pipeline improvements are expected to be absorbed within existing O&M budgets as the pipe that will be implemented is new and should require less maintenance than other parts of the system. Therefore, no new O&M costs are included for these projects.

Section 8
Financial Capability Assessment

8.1 Background

A key component of the Long Term Control Plan (LTCP), as noted in Part IV.G.8. of the NJPDES CSO Permits, is to develop an implementation plan for the selected control alternatives that recognizes the financial context of the permittees. A Financial Capability Assessment has been completed to evaluate the financial capability of the City of Elizabeth and its sewer system ratepayers to support future investments required for a proposed CSO control program. The objective is to balance the schedule for LTCP implementation with the financial and economic capability of the permittees and ratepayers. The assessment is made for the City of Elizabeth alone, as the costs to maintain the combined sewer system and control the CSO discharges from it that are the subject of this LTCP are the responsibility of the City of Elizabeth and other users of the combined sewer system. This section outlines the existing sewer system costs, financial capability indicators, and the ability of residential sewer system users to fund the costs of the CSO control plan.

The methodology for this analysis is based primarily on the publication “Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development” (February 1997) from the United States Environmental Protection Agency (EPA). This EPA guidance document consists of ten worksheets based on a two-phase approach to develop: (1) a Residential Indicator; and (2) Financial Capability Indicators. These indicators are then entered into a financial capability matrix to obtain an overall financial burden assessment. A total sewer system residential share cost exceeding 2% of median household income is considered to be a high financial burden on a community. The guidance is supplemented by a November 2014 EPA memorandum entitled “Financial Capability Assessment Framework for Municipal Clean Water Act Requirements”.

The EPA guidance provides for consideration of the impact on residential rate payers and the financial capability of the permittee based on several prescribed indicators. Permittees are also encouraged to provide any additional information that would provide insight into any unique or atypical circumstances, so that all relevant information is evaluated to ensure that a full understanding of the financial capability guides the development of the implementation schedule. While the EPA provides guidance to obtain a snapshot of the financial health of the community at a specific point in time, additional time-variable data such as population, debt service, income growth and sewer utility cost increases must also be considered to develop a dynamic representation of financial capability. This exercise assists to define the capital investment limits for high burden CSO control measures and to guide the development of an implementation plan for these measures which provides flexibility to account for community affordability.

Data utilized for this Financial Capability Assessment includes the 2017 American Community Survey from U.S. Census, the City of Elizabeth approved municipal budget for the Sewer Utility from Fiscal Year 2017 through 2019, and additional information provided by the City including sewer flows, billing categories, information about sewer connections, flow and facility charges, and additional costs to the City not directly referenced in the municipal Sewer Utility budget.

All the data presented in this section reflects conditions prior to the COVID-19 health and financial crisis. Potential impacts from COVID-19 should be considered and are discussed in Section 9.6.

8.2 Current Annual Sewer System Costs

In order to determine the existing financial burden on municipal residents, it is necessary to calculate the annual costs associated with operating the current sewer system, including the combined and separate sanitary and storm sewer system components. The costs are made up of annual operating and maintenance costs and the annual debt service.

The City of Elizabeth's Sewer Utility Fund is used to account for the receipts and expenditures arising from the operations of its municipal Sewer Utility and the assets and liabilities related to these activities. Table 8-1 presents the Fiscal Year 2019 adopted annual budget for the Sewer Utility Fund.

Table 8-1: Total Annual Sewer System Costs

Annual Operations and Maintenance Expenses (Excluding Depreciation)	
Municipal Sewer Utility Appropriations	
Operating	
Salaries & Wages	$0
Other Expenses	$0
Joint Meeting	$12,000,000
Management Fee	$2,100,000
Capital Improvements (Cash Funded)	
Down Payments on Improvements	$0
Capital Improvements Fund	$2,000,000
Capital Outlay	$3,392,624
Subtotal	$19,492,624
Annual Debt Service (Principal and Interest)	
Municipal Sewer Utility Appropriations	
Debt Service	
NJEIT Loans	$23,894
Sewer System Lease Payments - Principal & Interest	$1,926,580
Payment of Bond Principal	$3,150,000
Payment of Bond Interest	$1,016,014
Payment of BANS Notes	$1,500,000
Payment of BANS Interest	$41,137
Wastewater Treatment Bonds-Principal	$2,375,449
Wastewater Treatment Bonds-Interest	$474,302
Subtotal	$10,507,376
Total Annual Sewer System Cost	**$30,000,000**

For the Fiscal Year 2019, the total annual sewer utility budget was $30,000,000. This utility fund captures most of the costs associated with operating the municipal sewer system and providing clean water programs for combined, sanitary, and stormwater systems. The fund includes budget items for operations and maintenance, existing debt service, and cash funded capital costs. However, the Sewer Utility Fund does not reflect the cost of services covered by the municipal tax levy for general administrative and operational services, of which a portion can be allocated to providing sewer service. These items include salary and wages, utilities, insurance and benefits for various municipal departments, such as the Departments of Public Works, Engineering, Planning, Administration, Finance, and Law. The sewer system allocation of these general tax levy services is estimated to be over $1,500,000. Because these tax levy costs of service have not been incorporated in the subsequent residential sewer bill calculations, the average residential sewer costs presented underestimates the actual sewer system costs, and corresponding residential financial burden.

8.3 Residential Indicator Affordability Measure

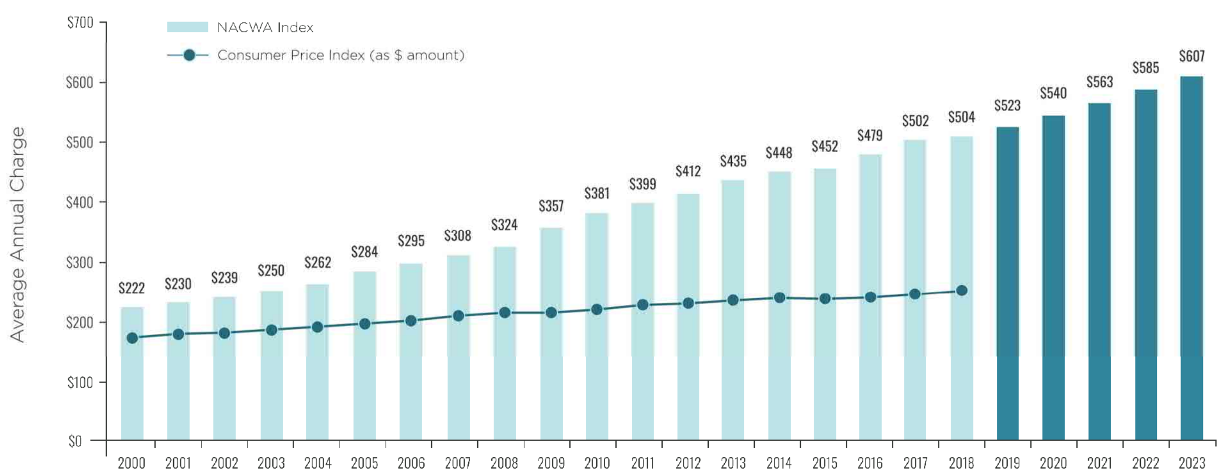
Per EPA guidance, the Residential Indicator is used to determine the total annual cost of wastewater collection and treatment (including LTCP costs) to the permittee. A portion of the total cost is allocated to residential customers based on their flow proportion based on data provided from the City, and the total residential cost is divided by the number of households to determine an average wastewater cost per household (CPH).

This value is compared to the median household income (MHI) for the permittee, and if it is 2% or greater, it indicates that the wastewater cost has a large economic impact on residents, meaning that the community is likely to experience economic hardship in complying with federal water quality standards.

8.3.1 Dynamic Model Methodology

The guidance from the EPA reflects a static model of affordability which does not account for time-varying factors such as inflation, population changes, income growth and cost of utilities. However, EPA indicates that additional information that would provide insight into financial capability should be included for consideration in establishing the implementation schedule. A dynamic cost model provides such insight.

Income growth from 2000 through 2017 was obtained from the United States Census Bureau. This data was annualized, to obtain an income growth of approximately 1.5% per year. Comparatively, the cost of wastewater services was obtained from the National Association of Clean Water Agencies (NACWA) 2018 Cost of Clean Water Index and is presented in Figure 8-1. The figure shows that the average annual service charge has doubled in the last 15 years and that projected rates are expected to increase 3.3% to 3.7% per year, with the average charge for wastewater services increasing by 3.9% in 2018.



Source: National Association of Clean Water Agencies, 2018 Cost of Clean Water Index

Figure 8-1: Average Annual Sewer Service Charge, 2000-2018

This data shows that sewer utility costs are rising significantly faster than income growth rates, and can be expected to continue on this trend. Such a disparity between these two factors has significant implications on affordability over a 20 to 30-year planning period.

A dynamic financial model was developed in order to account for these time-variable factors, in order to provide a more accurate and detailed representation of the City’s sewer cost affordability. The following assumptions regarding the financial conditions for the City of Elizabeth were input into the model to estimate future costs:

- Annual household income was estimated to growth at a rate of 1.5% per year, based on an annualized rate of historical income growth from 2000 to 2017, from the United States Census Bureau.
- Current wastewater system costs were based on the Fiscal Year 2019 Municipal Sewer Utility Fund appropriations and escalated annually based on the rates noted below.
- Existing sewer system operation and maintenance (O&M) cost was estimated to escalate at an annual rate of 3.5% for up to a 30-year period, then at the rate of income growth.
- Existing sewer system debt service cost was estimated to escalate at the annual rate of income growth.
- The construction cost inflation rate was assumed to be 3.0% per year, based on the 2000-2019 Engineering News Record Construction Cost Index.
- Operation and maintenance cost escalation for CSO control projects was assumed to be 2.75% per year.

8.3.2 Residential Share

Metered consumption and sewer use charge data by meter size from the City of Elizabeth was used to determine the percentage of total flow attributed to residential consumers. Residential flow was determined as the sum of flows from Class 1 users (meter size 5/8" and ¾") and from users categorized as Residential 1" meter and above. It was determined that residential flows represent approximately 75% of total flows, as presented in the table below.

Table 8-2: Residential Share of Flows

Customer Type	Description	Annual Consumption (x 1000 gal)	Percent of Total
Residential	Class 1 (5/8", 3/4") & Residential 1" and above	2,851,783	75%
Commercial	Commercial/Non-IUP - 1" and larger	794,237	21%
Industrial	Industrial User Permit (IUP) Charges	167,670	4%
	Subtotal	**3,813,691**	**100%**

Data from the Census Bureau's 2017 American Community Survey indicated that the total number of households in the service area is 40,219. It was previously determined that the current sewer system costs are approximately $30 million per year, resulting in a cost per household of approximately $560 per year, or $46.67 per month.

Per the Census Bureau's 2017 American Community Survey, the 2017 median household income (MHI) was $45,186. Escalating this by 1.5% per year for two years yields an approximate 2019 MHI of $46,552. As such, the current sewer system residential costs per household represent approximately 1.2% of the median household income.

8.3.3 State Revolving Loan Financing Program

The City of Elizabeth and JMEUC anticipates that the capital costs for the Long Term Control Plan projects would be financed primarily through low interest loans from the New Jersey Water Bank (formerly New Jersey Environmental Infrastructure Financing Program). This State revolving loan program for clean water projects is administered through the New Jersey Department of Environmental Protection and the New Jersey Infrastructure Bank, or I-Bank. At this time, no reasonable assessment can be made of additional funding opportunities such as grants.

The financing analysis assumes that the CSO control program will be funded through 20-year loans from the New Jersey Water Bank, with loans closed annually for the scheduled distribution of capital outlays. For these planning purposes, an effective annual interest rate of 1.5% per year was used, based on a market interest rate of 6% applied to 25% of the loan principal and 0% interest applied to 75% of the loan principal.

8.3.4 Projected Residential Indicator

The Residential Indicator of LTCP affordability represents the residential share of current and planned wastewater treatment and CSO controls as a percentage of median household income. With the capital costs for the selected LTCP alternatives described in Section 7.9, the additional annual debt service and operating costs for the LTCP projects were calculated and projected in the dynamic financial model for the implementation schedules considered.

The Residential Indicator was determined for each year within the planning period with the total capital costs for the selected CSO control program of $191 million, the existing sewer system costs, and the projected cost and income escalation factors. The model projects that given the high CSO program costs, the escalating existing sewer system costs, and the low current household incomes, the 2% high burden threshold level for the Residential Indicator will be exceeded even with a planning period of 40 years.

Figure 8-2 presents the projected Residential Indicator, or average residential sewer bill as a percent of median household income, over time. The time scale shown covers the period required to fully retire additional debt service associated with LTCP projects based on a selected 40-year capital outlay schedule. The graph compares the Residential Indicator for the estimated costs of maintaining the existing sewer system only (i.e., no LTCP costs) and the Residential Indicator with the additional LTCP cost included. The flattening of the existing sewer system cost curve after the 30-year interval marks the discontinuation of the differing cost escalation, because sewer rate increases cannot be reliably predicted beyond this time horizon.

8.4 Financial Capability Indicators

The second phase of the financial capability assessment involved evaluating financial capability indicators. These indicators characterize the permittee's debt burden, socioeconomic conditions, financial operations, and the ability to secure the funding necessary to implement the LTCP. Under this phase of the assessment, a financial capability index was developed based on following six individual indicators listed by the EPA:

- Debt Indicators:
    - Bond Ratings
    - Overall Net Debt as % of Full Market Property Value
- Socioeconomic Indicators:
    - Unemployment Rate
    - Median Household Income
- Financial Management Indicators:
    - Property Tax Revenues as % of Full Market Property Value
    - Property Tax Revenue Collection Rate

8.4.1 Bond Rating

The City of Elizabeth's bond rating is AA2, based on the bond rating letter dated March 8, 2019 from Moody's Investor Service.

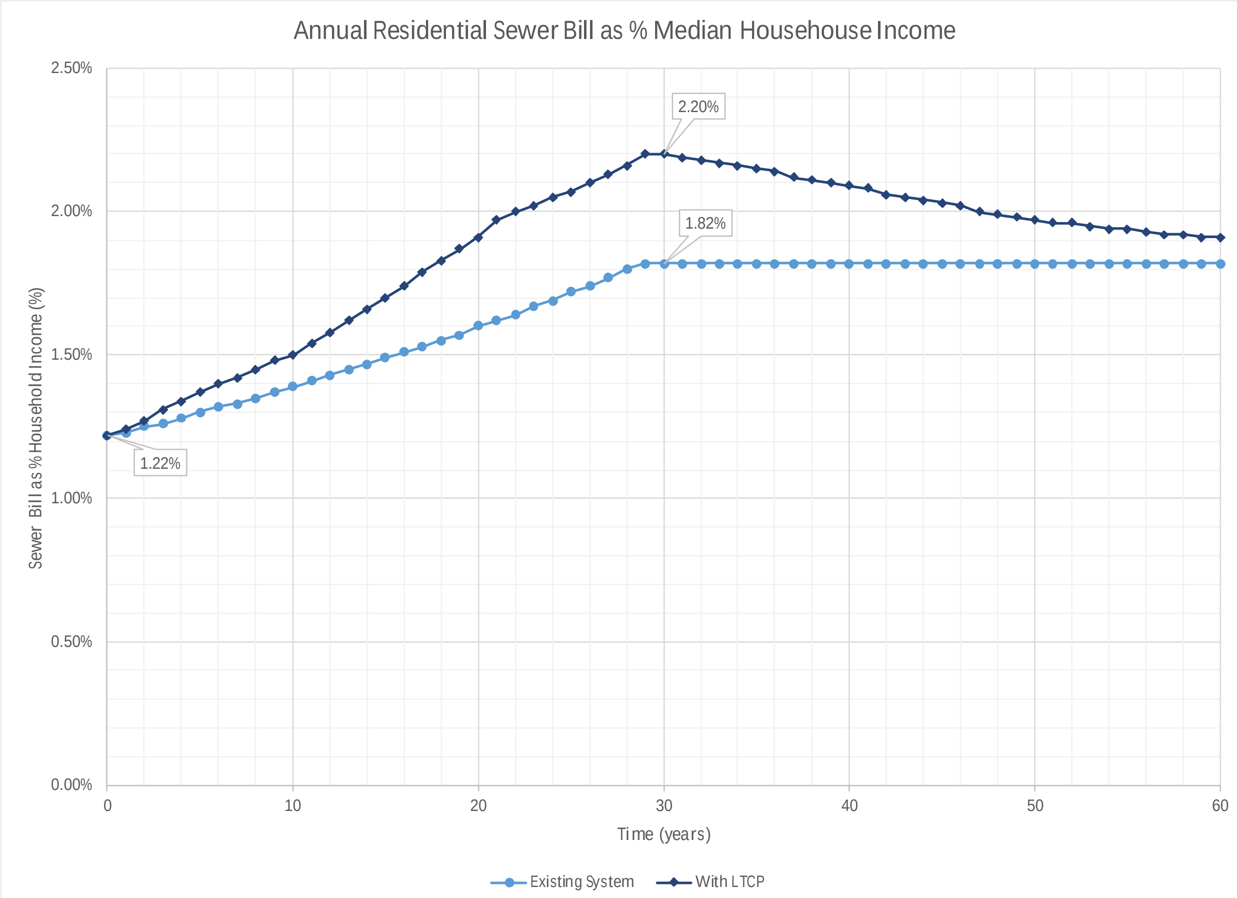


Figure 8-2: Residential Indicator Over Time

8.4.2 Net Debt as a Percentage of Full Market Property Value

The City of Elizabeth's Annual Debt Statement for 2019 indicates following debt information, where the valuation of real property divided by the net debt produces the net debt as a percentage of the equalized valuation.

Table 8-3: City of Elizabeth 2019 Debt Statement

Item	Amount
Net Debt	$137,911,000
Equalized Valuation of Real Property (Average of 2016, 2017 and 2018)	$7,550,130,000
Net Debt as Percentage of Equalized Valuation	1.83%

As such, the net debt as a percentage of full market property value is 1.83%.

8.4.3 Unemployment Rate

From the US Census Bureau's 2017 American Community Survey, the unemployment rate for the City of Elizabeth is reported as 8.7%. This is relative to the average national unemployment rate according to the US Census Bureau's 2017 American Community Survey, which is reported as 6.6%.

8.4.4 Household Income

Per the US Census Bureau's 2017 American Community Survey, the 2017 estimate for median household income for the City of Elizabeth (MHI) was $45,186. The 2017 estimate for national MHI was $57,562.

8.4.5 Property Tax Revenues as a Percentage of Full Market Property Value

According to data from the City of Elizabeth, property tax revenues represented 3.32% of total market property values, as shown in the table below.

Table 8-4: City of Elizabeth - Property Tax Revenues as a Percentage of Full Market Property Value

Item	Amount
2018 Equalized Valuation of Real Property	$7,550,130,000
2018 Property Tax Revenues	$250,321,000
Property Tax Revenues as a Percentage of Full Market Property Value	3.32%

8.4.6 Property Tax Revenue Collection Rate

The table below provides information from the City of Elizabeth on the tax revenue collection rate, represented as the tax levy divided by cash collections, which for 2018 was 97.58%.

Table 8-5: City of Elizabeth - Property Tax Revenues as a Percentage of Full Market Property Value

Item	Amount
2018 Tax Levy	$256,532,000
2018 Cash Collections	$250,321,000
Tax Revenue Collection Rate	97.6%

8.4.7 Financial Capability Indicator Score

Table 8-6 contains the benchmarks defined by the EPA for the financial capability indicators and matrix scoring. A strong indicator is allocated a score of 3 points, mid-range indicator is allocated 2 points, and weak indicator is allocated 1 point. The Financial Capability Indicator score is then calculated as a simple average of the ratings.

Table 8-6: EPA Financial Capability Indicator Benchmarks

Indicator	Strong (3 points)	Mid-Range (2 points)	Weak (1 point)
Bond Rating	AAA-A (S&P) or Aaa-A (Moody's)	BBB (S&P) or Baa (Moody's)	BB-D (S&P) or Ba-C (Moody's)
Overall Net Debt as a Percent of Full Market Property Value	Below 2%	2%-5%	Above 5%
Unemployment Rate	More than 1 percentage point below the National average	±1 percentage point of National average	More than 1 percentage point above the National average
Median Household Income	More than 25% above adjusted National MHI	±25% of Adjusted National MHI	More than 25% below adjusted National MHI

Indicator	Strong (3 points)	Mid-Range (2 points)	Weak (1 point)
Property Tax Revenues as a Percent of Full Market Property Value	Below 2%	2%-4%	Above 4%
Property Tax Collection Rate	Above 98%	94%-98%	Below 94%

Table 8-7 summarizes the Financial Capability Indicators and rating score for the City of Elizabeth. The overall score of 2.0 represents a Financial Capability Indicator rating at the boundary between a Weak to Mid-Range assessment.

Table 8-7: City of Elizabeth Financial Capability Indicator Score

Indicator	Value	Category	Score
Bond Rating	AA2	Strong	3
Overall Net Debt as a Percent of Full Market Property Value	1.83%	Mid-Range	2
Unemployment Rate	8.7% (2.1% above National average)	Weak	1
Median Household Income	$45,186 (±25% of Adjusted National MHI)	Mid-Range	2
Property Tax Revenues as a Percent of Full Market Property Value	3.32%	Mid-Range	2
Property Tax Collection Rate	97.6%	Mid-Range	2
		Overall Score:	2
		Rating:	Weak to Mid-Range

8.5 Financial Capability Matrix

The Financial Capability Matrix combines the Residential Indicator and Financial Capability Indicator to establish an overall financial capability assessment as set by the EPA guidance method. Table 8-8 shows the Financial Capability Matrix as given by the EPA. With the City of Elizabeth's high Residential Indicator score and weak to mid-range Financial Capability Indicator score, the overall affordability assessment is that the LTCP projects represent a High Burden on the City residential sewer system users.

Additional information and associated worksheets are provided in Appendix C.

Table 8-8: Financial Capability Matrix

Permittee Financial Capability Indicators Score	Residential Indicator (Cost per Household as a % of MHI)		
	Low (Below 1%)	Mid-Range (Between 1.0 and 2.0%)	High (Above 2.0%)
Weak (Below 1.5)	Medium Burden	High Burden	High Burden
Mid-Range (Between 1.5 and 2.5)	Low Burden	Medium Burden	High Burden
Strong (Above 2.5)	Low Burden	Low Burden	Medium Burden

8.6 Additional Economic Factors

Several additional factors should be considered in evaluating the community's ability to afford the proposed CSO control program and setting an implementation schedule, as outlined below.

The EPA guidance document notes that while its methodology provides a common basis for financial burden discussions, the indicators it measures may not present the most complete picture of the permittee's financial capability. In order to supplement the items measured in the EPA guidance, a review was performed per the "Affordability Assessment Tool for Federal Water Mandates" (2013), produced by the American Water Works Association (AWWA), Water Environment Federation (WEF), and the United States Conference of Mayors.

8.6.1 Poverty Factors

The City of Elizabeth's poverty rate as well as income distribution provide additional insight into the City's sewer cost affordability, particularly in terms of demonstrating a disproportionate burden on lower income populations.

Due to the variability of income levels across the service area, some households will experience more severe financial impacts and economic hardship as a result of implementation of the LTCP, and will result in residential costs as a percentage of household income that are much greater than the median for the City as a whole.

According to the US Census Bureau 2017 American Community Survey, 18.1% of the population in Elizabeth is living below the poverty line. This compares to the national average poverty rate of 14.6%. The cost share of the CSO LTCP would have a higher burden on these low-income households.

Most of the proposed CSO controls outlined in the LTCP do not involve siting of new facilities, as they are primarily upgrades to existing sewer infrastructure within public roadways or at existing pumping or treatment facilities. These improvements for increased conveyance and treatment capacity will provide water quality benefits for the overall system and all residents within the sewer service area. Siting of stormwater control projects were selected based on vulnerability to flooding, and provide the flood mitigation benefits to the impacted community. Proposed green infrastructure locations for the pilot program will be selected based on suitable site conditions, and care will be taken to ensure that these sites are distributed throughout the city equitably.

8.6.2 Household Income Distribution

The distribution of household incomes in the City of Elizabeth and the United States were also obtained from the United States Census Bureau database. The income distribution for the City versus nationally was determined by quintiles, and is shown in Table 8-9.

Table 8-9: Income Distribution by Quintile

Quintile	Annual Household Income (2017 $)	
	City of Elizabeth	National Average
1 – lowest 20%	Below $ 20,640	Below $ 23,660
2 – 20 to 40%	$ 37,260	$ 45,560
3 – 40 to 60%	$ 56,600	$ 72,860
4 – 60 to 80%	$ 88,590	$ 121,950
5 – highest 20%	Above $ 88,590	Above $ 121,950

The table shows that the household income for Elizabeth is lower than that of the national average for each quintile (i.e., 20 percentile distribution groups), demonstrating that the City has lower income residents compared to the national average. The upper limit of the EPA affordability guidance is 2% of the median household. For Elizabeth, this equates to 2% of $45,186, which is $904 per household (in 2017 dollars). However, this amount disproportionately burdens lower income households, as it reflects more than 2% of the income for over 55% of the population (22,168 households), more than 3% for over 37% of the population (15,009 households), and more than 10% for 8% of the population (3,299 households).

Figure 8-3 provides a comparison of the Residential Indicator affordability measure, corresponding to the cost per household as a percent of the household income, using the lowest 20th percentile income value as the basis versus the median income. The average residential sewer bill including the LTCP project costs were financed over a 40-year period and this average cost per household was divided by the different income bases. At the peak of the LTCP funding program, the average sewer bill is estimated to represent about 4.70% of income for the 20th percentile (i.e., households with the lowest financial capability) compared to 2.20% of income at the middle of the income distribution.

8.6.2.1 Income Growth Trends

The annualized growth in MHI for Elizabeth was compared to that of the United States, for the period from 2000 to 2017 based on data from the US Census. While annualized income growth for the United States has been 1.9% over this period, it has been only 1.5% for Elizabeth. This slower growth in income further reflects the community's burden in financing the CSO LTCP projects, especially as costs are projected to be incurred through the implementation schedule of up to 40 years.

8.6.2.2 New Jersey Department of Community Affairs Distress Score

New Jersey established the Municipal Revitalization Index (MRI), formerly known as the Municipal Distress Index (MDI) ranking in the 1990s to assist in prioritizing state municipal funding assistance. In this index, distress is defined as "a multi-dimensional municipal condition linked to fiscal, economic, housing, and labor market weakness in conjunction with a resident population that is generally impoverished and in need of social assistance."

A municipality's ranking depends upon its scores for the following indicators:

1. Children on Temporary Assistance for Needy Families (TANF) per 1,000 persons
2. Unemployment rate
3. Poverty rate
4. High school diploma or higher
5. Median household income
6. Percentage of households receiving Supplemental Nutrition Assistance Program (SNAP) assistance (i.e., food stamps)
7. Ten-year % population change
8. Non-seasonal housing vacancy rate
9. Equalized 3-year effective property tax rate
10. Equalized property valuation per capita

In the 2017 Municipal Revitalization Index, Elizabeth ranks 28 out of the 565 communities evaluated in New Jersey.[2] This means that it falls within the top 5% of the ranking, indicating that the community is highly distressed, making it a strong candidate for state funding, and at particular risk when considering the additional financial implications of the CSO LTCP.

[2] https://www.nj.gov/dca/home/NJ_MRI_Report.pdf

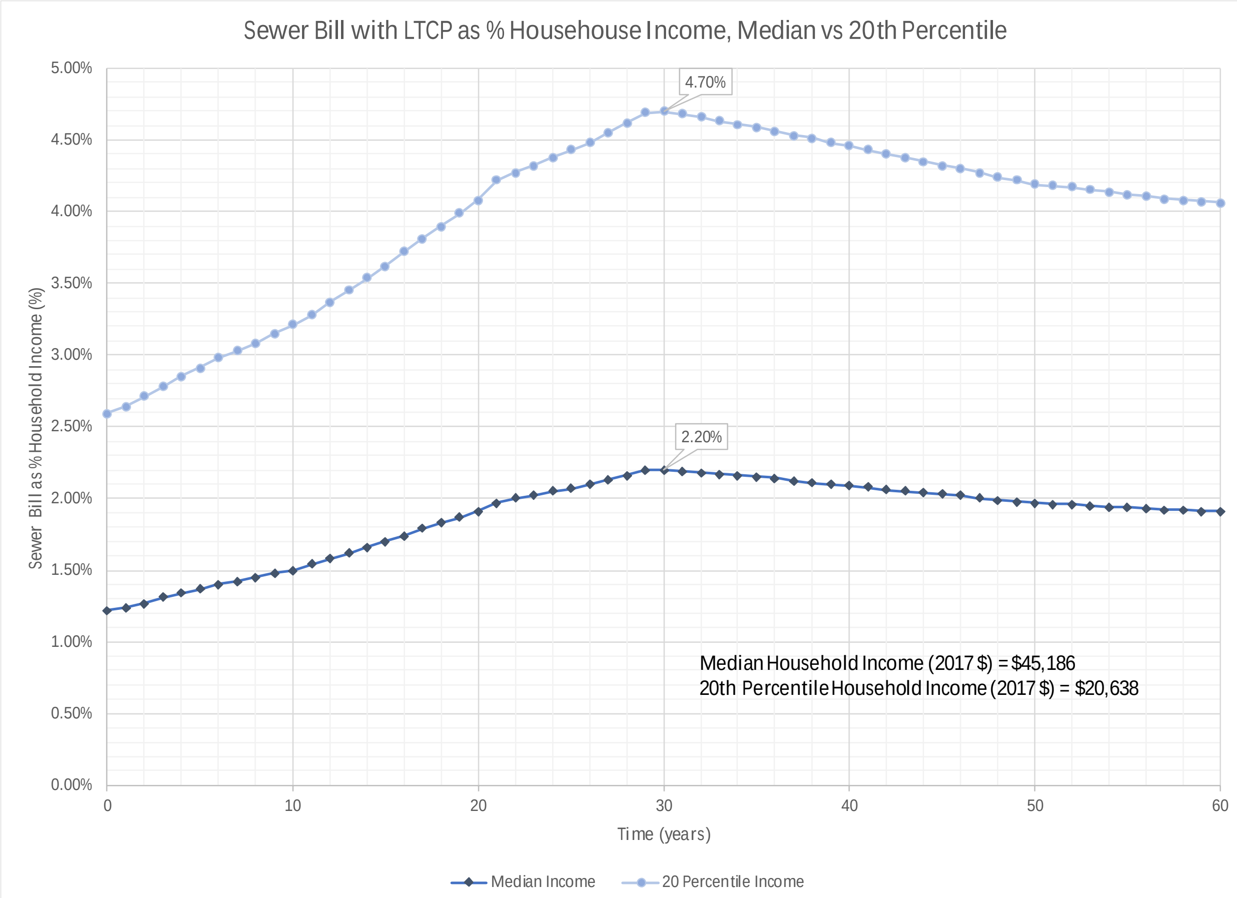


Figure 8-3: Residential Indicator Over Time: 20th Percentile Comparison

8.6.3 Cost of Living Factors

Cost of living factors specific to the City of Elizabeth also present additional insights into the affordability of sewer rate increases likely to be required for the LTCP implementation. Some key cost of living considerations are outlined below.

8.6.3.1 Cost of Living Index

The cost of living for the City of Elizabeth is approximately 30% higher than the national average,[3] while earning an income that is about 73% of the national MHI (US Census Bureau 2017 American Community Survey). Further, the Census statistics indicate that 31% of households in the City received food stamps or participated in the Supplemental Nutrition Assistance Program in 2017, and 10% of families had no work income in the past 12 months.

[3] https://www.infoplease.com/business-finance/us-economy-and-federal-budget/cost-living-index-selected-us-cities1

8.6.3.2 Housing Costs

Housing costs for the Elizabeth-Newark urban area are 68% higher than the national average.[4] Housing prices are also known to be higher in the New York – Newark metropolitan area than nationally. The US Census Bureau 2017 American Community Survey indicates that 25% of households in Elizabeth are owner-occupied, while 75% of households are renter-occupied.

Based upon a 2017 study by the National Low Income Housing Coalition, the fair market value of a two-bedroom apartment rental in Union County was $1,288 per month, whereas the monthly rent affordable at the mean renter wage is $1,000. This fair market value is equivalent to 34.2% of the Elizabeth median household income, while it is typically understood that a full-time worker should be able to afford a modest and safe rental home without spending more than 30% of his or her income on housing costs.[5] This disproportionate expenditure on housing costs for City of Elizabeth residents will also impact households' ability to afford increased sewer utility rates as a result of the CSO LTCP.

8.6.4 Property Tax Costs

According to the Elizabeth City Budget, the average residential tax for 2017 in Elizabeth was $9,712, including Elizabeth taxes of $5,900 along with local school and Union County. This compares with a national average local property tax levy of $3,500 for a similarly priced home.

The high housing costs and tax burdens for Elizabeth households reduce their effective household income. As such, wastewater costs, and particularly increases in wastewater costs, would put a disproportionate burden on the household spending when considering other costs that must be borne by the household.

8.6.5 Water Utility and Sewer Bill Costs

Utility costs are known to be about 30% higher in the Elizabeth-Newark urban area, relative to the national average.[6] As demonstrated in Section 8.3.1, annual income growth in the City has been approximately 1.5% per year. Comparatively, the average charge for wastewater services nationally is expected to increase 3.3% to 3.7% per year. Because sewer utility and construction costs are rising significantly faster than income growth rates, and can be expected to continue on this trend, the impact of escalating sewer system costs over the planning period must be considered.

8.7 Summary

The cost of the proposed CSO LTCP projects as outlined in Section 7 as well as the consideration of the affordability factors listed above indicate that the LTCP represents a High Burden on the City of Elizabeth residents. The City and JMEUC recognize the financing program for the LTCP must be planned so as to maintain reasonable sewer charges and rates and a supportable total debt amount. As such, an implementation schedule of 40 years is proposed. Details on the phases and milestones for the implementation of the selected CSO control program are presented in Section 9 of this report. An adaptive management approach will be taken during the extended implementation period to re-evaluate economic conditions, funding sources and their availability, and make any adjustments to the schedule that may be possible or warranted, as is also further described in Section 9.

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[4] https://www.infoplease.com/business-finance/us-economy-and-federal-budget/cost-living-index-selected-us-cities1
[5] https://nlihc.org/sites/default/files/oor/OOR_2017.pdf
[6] https://www.infoplease.com/business-finance/us-economy-and-federal-budget/cost-living-index-selected-us-cities1

Section 9
Implementation Schedule

This section presents the recommended implementation schedule for the selected Long Term Control Plan (LTCP) projects, including a proposed construction schedule and financing plan. The proposed implementation schedule fulfills the requirements described in Section G.8 of New Jersey Pollutant Discharge Elimination System (NJPDES) Combined Sewer Overflow (CSO) permits issued to the City of Elizabeth and Joint Meeting of Essex and Union Counties (JMEUC). The implementation schedule has been determined based on factors such as flooding areas, discharges to sensitive areas, receiving water quality and uses, financial capability of the community, and other water quality-related infrastructure improvements, including those related to stormwater improvements that would be connected to CSO control measures. Grant and loan availability, previous and current residential, commercial and industrial sewer user fees and rate structures, and other viable funding mechanisms and sources of financing have been considered in the financing plan.

The Financial Capability Assessment provided in Section 8 plays a major role in the determination of an acceptable implementation schedule and should be referred to concurrently with the information presented herein. As indicated in the NJPDES CSO Permits, the financial resources necessary to implement the current and projected clean water related infrastructure improvements required by the permittees must be integrated into an overall financing plan so that the implementation schedule for CSO control measures is fair and reasonable.

Per the assessment presented in Section 8, the City and JMEUC have selected a multi-phase Long Term Control Plan with a 40-year implementation period because of the extensive scale and costs associated with the program. The selected CSO control program involves many different projects with costs that represent a high financial burden to the local residential sewer users. With the recommended 40-year implementation schedule, the sewer charges and total sewer utility debts for the City of Elizabeth are controlled so that the program is more affordable and the annual cost burden on rate payers is reduced.

9.1 Scheduling Criteria and Assumptions

The City and JMEUC have prioritized the selected projects identified to be highly effective in reducing combined sewer overflows and has scheduled them for early implementation. The target CSO control approach of capturing 85% of the combined sewage inflow volume on an average annual system-wide basis reduces the overflow volumes broadly across the different receiving waters and the water-quality benefits will apply widely to the local waterbodies.

A thorough assessment of the potential need for a higher prioritization of any specific CSO discharge location in the City due to the presence of sensitive areas has been conducted and is summarized in Section 4. It was found that there are no Outstanding Natural Resource Waters, National Marine Sanctuaries, bathing beaches, public drinking water intakes, or shellfish beds in the City of Elizabeth and JMEUC study area. No primary contact recreation has been observed or reported within the study area and the areas in the vicinity of the CSO discharge points are not conducive to primary contact recreation uses. Overall, it was determined that there are no exceptional water quality elements or uses for the City and JMEUC receiving waters that would distinguish any CSO outfall discharge area as being more critical or of greater concern for prioritization than other discharge areas.

Sequencing of the component projects for the LTCP is necessary to ensure that the projects are constructed in a logical progression and incorporate the time required to conduct field investigations, obtain necessary permits and approvals, and develop facility planning, preliminary design, and detailed design documents, while considering the City's fiscal context and affordability to its ratepayers.

The sequence and phasing of the recommended CSO control projects was developed based on the time required to complete each project, the water quality goals, regulatory considerations, typical construction sequencing practices, and the findings of the affordability analysis. The duration for each project was estimated based on factors including the time required to complete the design, bidding and construction phases, acquisition of property or easements where required, regulatory/permit requirements, traffic and neighborhood impacts, and maintenance of sewer service throughout construction.

Some additional considerations in the sequencing of specific projects include:

- Stormwater control projects which are already underway to address local flooding concerns should be prioritized and completed according to original schedule.
- Detailed geotechnical investigations must be completed as part of the Green Infrastructure (GI) Pilot Program
- The Trenton Avenue Pumping Station (TAPS) Phase 1 Upgrade should be completed in the short-term based on its effectiveness and NJDEP input received on the Development and Evaluation of Alternatives Report.
- Major interceptor improvements should be completed after additional pumping and treatment systems are available downstream.
- The completion of the new wet weather pumping station and force main construction should coincide with the completion of the new combined sewer flow treatment facility at the JMEUC plant.
- Upgrades to the downstream portion of the Westerly Interceptor must be completed before the upstream portion, so that the downstream portion has the capacity to convey the additional flows.

9.2 Implementation Schedule

Table 9-1 below outlines the sequencing plan for the recommended CSO control component projects, as well as the estimated project duration for completion. The overall implementation schedule has been planned for a total duration of 40 years to incorporate affordability considerations for City ratepayers. The years noted represent the number of years after New Jersey Department of Environmental Protection (NJDEP) approval of the CSO LTCP.

Three stormwater control projects are noted as having been already completed. Following approval of the Long Term Control Plan, two additional stormwater control projects will be initiated, as well as Phase 1 upgrade to the Trenton Avenue Pumping Station. Other projects to be completed early in the implementation schedule include additional stormwater control projects, selected sewer separation, initiation of the green infrastructure pilot program, and Phase 2 upgrades to the Trenton Avenue Pumping Station. Mid-term projects include the new proposed pump station, new force main to the treatment plant, and the new combined sewer flow treatment facility at the JMEUC WWTF site. Long-term projects include increased conveyance through upgrades to the Westerly interceptor and associated regulators, siphons and branch interceptors.

Table 9-1: CSO LTCP Project Sequencing Plan

Project Name	Start Year (after approval)	Estimated Project Duration
Progress Street Stormwater Control Project	Completed	Completed
Trumbull Street Stormwater Control Project	Completed	Completed
South Street Flood Control Project	Ongoing	Ongoing

Project Name	Start Year (after approval)	Estimated Project Duration
South Second Street Stormwater Control	1	4
Lincoln Avenue Stormwater Drainage Improvements	1	3
Trenton Avenue Pumping Station - Phase 1 Upgrade	1	2
Atlantic Street CSO Storage Facility	1	5
Park Avenue Stormwater Control	1	5
CSO Basin 012 Sewer Separation	2	2
Green Infrastructure Pilot Program	2	7
Trenton Avenue Pumping Station - Phase 2 Upgrade	4	7
CSO Basin 037 Sewer Separation	5	6
Easterly Interceptor Improvements	6	5
New Wet Weather Pumping Station Force Main to JMEUC	9	9
New Wet Weather Pumping Station	11	10
New Combined Sewer Flow Treatment Facility at JMEUC	12	9
Bridge Street Siphon Upgrade	16	7
Palmer Street Branch Interceptor Upgrade	16	7
Palmer Street Siphon Upgrade	16	7
Lower Westerly Interceptor Upgrade	21	10
Pearl Street Branch Interceptor Upgrade	23	7
R027/028 Regulator Modifications	27	4
R040 Regulator Modifications	27	4
Upper Westerly Interceptor Upgrade	31	10
Morris Avenue Siphon Upgrade	31	7

Note: Estimated project duration includes planning through construction and is based on factors including property acquisition, permitting requirements, and maintenance of sewer service throughout construction.

The preliminary implementation schedule for the LTCP in a bar chart format is presented in Figure 9-1.

The total annual overflow volume as estimated for the Typical Year from the hydraulic model decreases in steps during the course of the implementation period as the CSO control projects are completed. Figure 9-2 shows the estimated percent capture versus time corresponding to the recommended implementation schedule. Considering the wet weather inflow captured from the Elizabeth sewer system only, which is the metric being used to assess the system performance against the target control level, the percent capture is scheduled to increase from 58.2% to 65.5% by Year 5, with the implementation of the Trenton Avenue Pump Station Phase 1 upgrade, CSO Basin 012 sewer separation, and other projects. This corresponds to a 12.5% increase in the percent capture value and a reduction of an estimated 159 million gallons (MG) of total annual overflow volume system-wide based on the Typical Year, compared to the future baseline sewer system overflow volume of 898 MG.

The percent capture for the Elizabeth only wet weather inflow is estimated to increase to 69.4%, 71.9%, 76.0%, and 85.0% by Years 10, 20, 30, and 40, respectively, per the project implementation schedule. The corresponding estimated total annual overflow volume reductions are 240, 294, 382, and 576 million gallons, respectively, from the future baseline overflow volume. Significant progress is made towards the target control value in stages as the additional pumping and treatment capacity projects are placed into service. Nonetheless, the downstream conveyance improvements must be constructed and available so that the additional combined sewer flows from the upstream CSO basins along the Elizabeth River can be conveyed in the latter schedule to reach the overall 85% control level.

Project milestones for the first five years of LTCP implementation are presented in Table 9-2.

Table 9-2: Project Milestones for First Five Years of Implementation

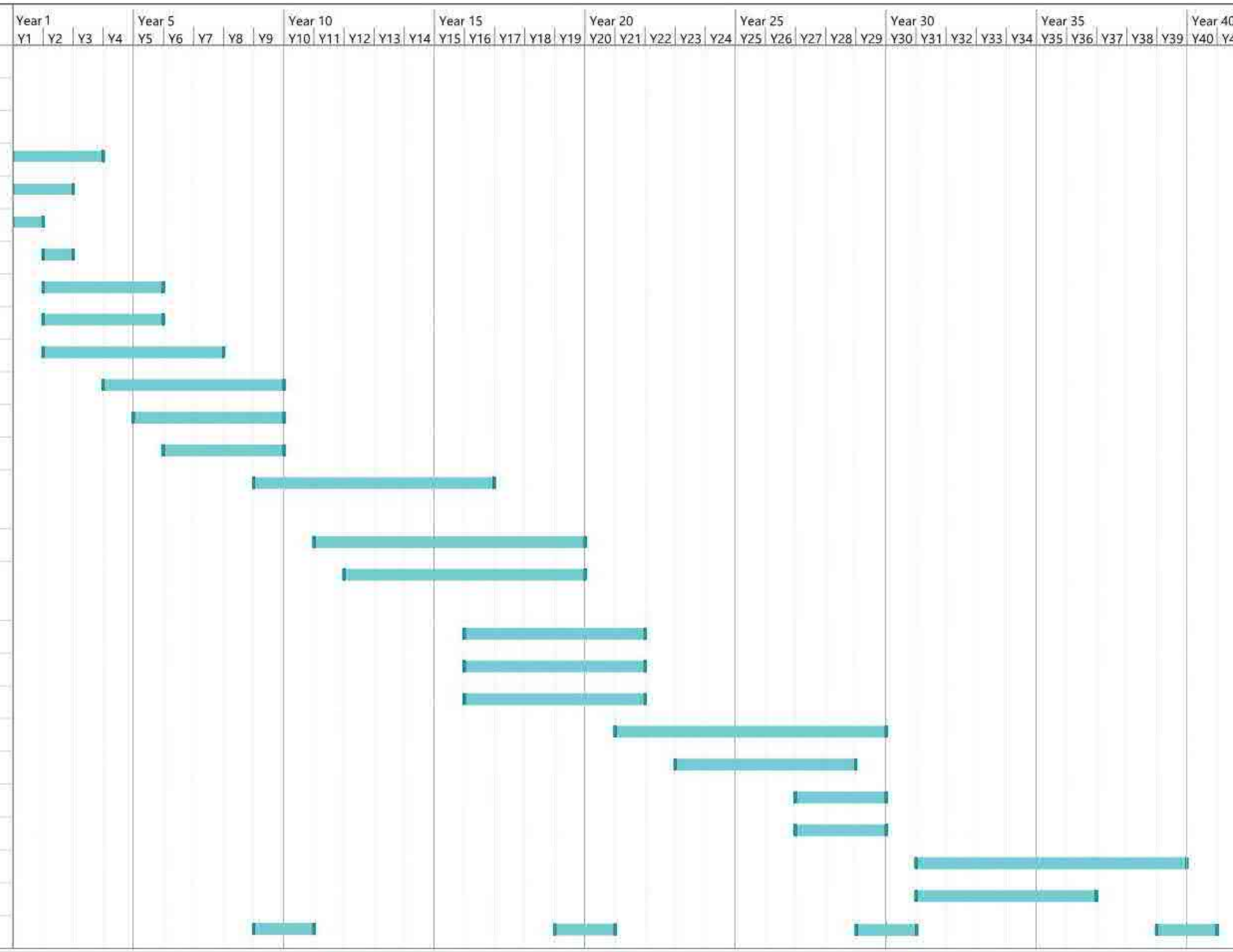
Year	Milestones
1	• Continue design for South Second Street Stormwater Control Project • Complete design for Lincoln Avenue Stormwater Drainage Project • Complete design for Trenton Avenue PS Phase 1 Upgrade • Continue design for Atlantic Street CSO Storage Facility • Continue planning and design for Park Avenue Stormwater Control
2	• Complete design and start construction for South Second Street Stormwater Control Project • Start construction for Lincoln Avenue Stormwater Drainage Project • Complete construction for Trenton Avenue PS Phase 1 Upgrade • Initiate design for CSO Basin 012 Sewer Separation • Complete design for Atlantic Street CSO Storage Facility • Complete design for Park Avenue Stormwater Control • Initiate desktop siting analysis for Green Infrastructure Pilot Program
3	• Continue construction for South Second Street Stormwater Control Project • Complete construction for Lincoln Avenue Stormwater Drainage Project • Complete construction for CSO Basin 012 Sewer Separation • Continue design for Atlantic Street CSO Storage Facility • Continue design for Park Avenue Stormwater Control • Complete geotechnical investigations and site suitability for Green Infrastructure Pilot Program
4	• Complete construction for South Second Street Stormwater Control Project • Start construction for Atlantic Street CSO Storage Facility • Start construction for Park Avenue Stormwater Control • Initiate design for Green Infrastructure Pilot Program • Initiate design for Trenton Avenue Pumping Station - Phase 2 Upgrade
5	• Continue construction for Atlantic Street CSO Storage Facility • Continue construction for Park Avenue Stormwater Control • Continue design for Green Infrastructure Pilot Program • Continue design for Trenton Avenue Pumping Station - Phase 2 Upgrade • Initiate design for CSO Basin 037 Sewer Separation

City of Elizabeth and
Joint Meeting of Essex
and Union Counties (JMEUC)

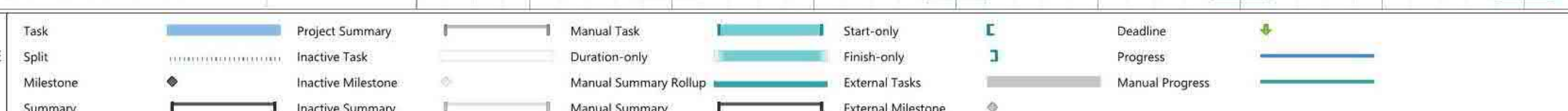
Selection and Implementation of Alternatives Report
Long Term Control Plan Implementation Schedule

Combined Sewer Management Permit Compliance
October 2020

ID	Task Mode	Task Name	Project Duration (Years)
1		Progress Street Stormwater Control Project	Completed
2		Trumbull Street Stormwater Control Project	Completed
3		South Street Flood Control Project	Completed
4		South Second Street Stormwater Control	4
5		Lincoln Avenue Stormwater Drainage Improvements	3
6		Trenton Avenue Pump Station - Phase 1 Upgrade	2
7		CSO Basin 012 Sewer Separation	2
8		Atlantic Street CSO Storage Facility	5
9		Park Avenue Stormwater Control	5
10		Green Infrastructure Pilot Program	7
11		Trenton Avenue Pump Station - Phase 2 Upgrade	7
12		CSO Basin 037 Sewer Separation	6
13		Easterly Interceptor Improvements	5
14		New Wet Weather Pump Station Force Main to JMEUC	9
15		New Wet Weather Pump Station	10
16		New Combined Sewer Flow Treatment Facility at JMEUC WWTF	9
17		Bridge Street Siphon Upgrade	7
18		Palmer Street Branch Interceptor Upgrade	7
19		Palmer Street Siphon Upgrade	7
20		Lower Westerly Interceptor Upgrade	10
21		Pearl Street Branch Interceptor Upgrade	7
22		R027/028 Regulator Modifications	4
23		R040 Regulator Modifications	4
24		Upper Westerly Interceptor Upgrade	10
25		Morris Avenue Siphon Upgrade	7
26		Post Construction Compliance Monitoring	2



Project: City of Elizabeth & JME
Date: 09/14/2020



Page 1

Figure 9-1: Long Term Control Plan Implementation Schedule

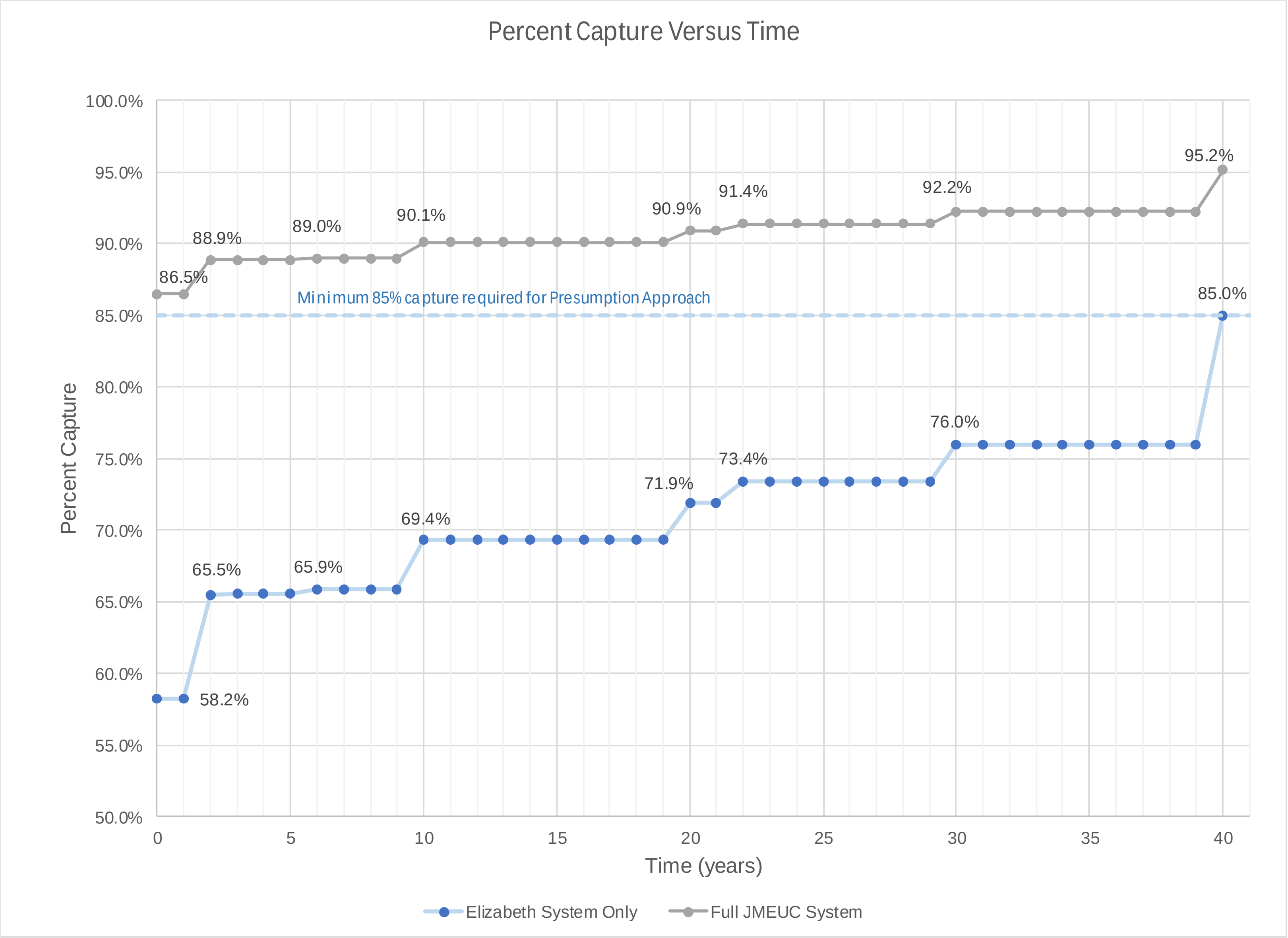


Figure 9-2: Percent Capture Metrics During Implementation Period

9.3 Financing Plan

Section 8 summarizes the findings of the Financial Capability Assessment. In order to fund the implementation of the selected CSO Control Program, it will be necessary for the City to increase sewer rates to residents. The City must also budget for other Clean Water Act projects outside of the CSO program, for example potential future treatment of stormwater discharges, which will impact the City's funding availability. Considering the affordability impacts to residents of the City of Elizabeth that are described in Section 8, the implementation schedule of 40 years was selected.

9.3.1 Program Costs and Spending Projections

Based on the proposed project implementation schedule, the associated annual costs were determined. Figure 9-3 presents the projected annual costs, both for the existing sewer program as well as with the recommended LTCP program costs included.

System costs are comprised of operational and maintenance costs as well as debt service. It is assumed that new debt service for the LTCP program is retired on a rolling basis over a period of 20 years, as such the costs are laid out to 60 years after implementation, or 20 years following the completion of construction of the proposed LTCP projects. The existing sewer operational and maintenance cost is assumed to escalate at an annual rate of 3.5% and debt service is escalated at an annual rate of 1.5%, while new LTCP operational and maintenance costs are assumed to escalate at an annual rate of 2.75% with construction cost inflation rate assumed to be 3.00%, with income growth rate increasing at 1.5% annually, as discussed in more detail in Section 8.

9.3.2 Expenditure Schedule

The capital outlay schedule for the LTCP program is presented in Figure 9-4 below, based on the annual costs of the project sequencing and implementation schedule. It can be seen that the years of greatest capital outlays are in years 16 and 17, when the annual capital payments will exceed $9 million. This coincides with the initiation of the interceptor upgrade projects, as well as the ongoing construction of the new combined sewer flow pumping station, force main, and treatment facility. There is also a significant expenditure above $5 million annually in the first five years of implementation, with the construction of stormwater control projects, sewer separation, the green infrastructure pilot project, and upgrades to the Trenton Avenue Pumping Station.

The total cumulative capital outlay is $191 million to be spent over the 40-year implementation schedule.

9.3.3 Cost Per Gallon of Annual Overflow Volume Removed

A useful metric in evaluating the cost-effectiveness of a CSO control program is the cost per gallon of overflow volume reduction, on a system-wide annual average basis. This metric will vary over the course of the implementation schedule as shown in Figure 9-5 for the projected capital cost expenditures and overflow volume reductions. At Year 10, with the completion of the Trenton Avenue Pump Station upgrades, the CSO Basin 012 and 037 sewer separation work, the Atlantic Street storage tank, and various stormwater control projects, the investments correspond to approximately $0.18 per gallon for an estimated 240 MG decrease in the total annual overflow volume system-wide based on the Typical Year. The cost per gallon of total annual overflow volume removed rises during the construction of the additional pumping and treatment facilities, but then falls to $0.33 per gallon at the end of the implementation period with the completion of the conveyance improvements, for the total overflow volume reduction of 576 MG. This cost per gallon metric for the selected plan compares favorably to other control program alternatives based on values determined during the alternatives evaluation phase.

9.3.4 Sewer Rate Analysis

An analysis was completed to assess the potential year-by-year sewer rate impacts associated with implementation of the LTCP, based on the proposed project implementation schedule. These rate impacts are for illustrative purposes only, and costs as well as available financing will be confirmed in subsequent design phases.

The projected annual clean water program costs were determined based on two factors: estimated average annual operations and maintenance expenses and estimated capital improvement costs. In addition, the City must also consider the annual debt service. The annual wastewater cost per household was calculated by dividing the residential share of the total annual costs by the total number of households in the City.

Figure 9-6 presents the projected average monthly residential sewer bill, both with the existing sewer program and with proposed LTCP costs included. The LTCP costs are based on the project sequence proposed to be implemented over a period of 40 years. It can be seen that over the first 30 years of the implementation period, the existing sewer program would increase the average sewer bill at a rate of about 2.9% per year, while with the LTCP program included, the average sewer bill increases at an approximately 3.5% per year increase over the first 30 years. The intent of the proposed project sequencing and financing plan is to find a balance in achieving the required CSO volume reductions while maintaining reasonable and affordable charges to the City's ratepayers.

With the proposed LTCP projects, at certain years during the 40-year implementation period, the cost to the average household exceeds 2% of the median household income, as shown in Section 8. The fiscal constraints and economic realities for the City of Elizabeth justify the proposed extended 40-year implementation schedule, and will allow the City to achieve the objective water quality benefits while reducing the financial impacts and the economic hardship to the community.

9.3.5 Sources of Funding

The City of Elizabeth and JMEUC anticipate that the capital costs for the Long Term Control Plan projects would be financed primarily through low interest loans from the New Jersey Water Bank (formerly New Jersey Environmental Infrastructure Financing Program). These loans would be serviced by rents and generated from sewer user charges. The New Jersey Water Bank is a State revolving loan program for clean water projects that is administered through the New Jersey Department of Environmental Protection and the New Jersey Infrastructure Bank, or I-Bank. At this time, no reasonable assessment can be made of additional funding opportunities such as federal or State grants. Financing through the I-Bank is described further in Section 8. It is noted that the proposed 40-year implementation schedule is predicated on the availability of sufficient funding through the New Jersey Water Bank when required. If sufficient funds are not available from the New Jersey Water Bank or from a similar source at an equivalent borrowing cost, then it may be necessary to delay the implementation of scheduled projects due to financing challenges beyond the permittees' control.

The City of Elizabeth may also choose to investigate the creation of a stormwater utility to generate additional revenues, however this has not been included in funding considerations. In early 2019, the State of New Jersey passed legislation allowing the creation of stormwater utilities. As such, municipalities could charge a user fee reflecting a user's impervious area to support improvements to sewer systems which receive flow from these impervious areas. Revenue from a stormwater utility could be diverted to projects such as flood control and CSO improvements, providing an additional revenue source to pay off loans from the New Jersey Water Bank.

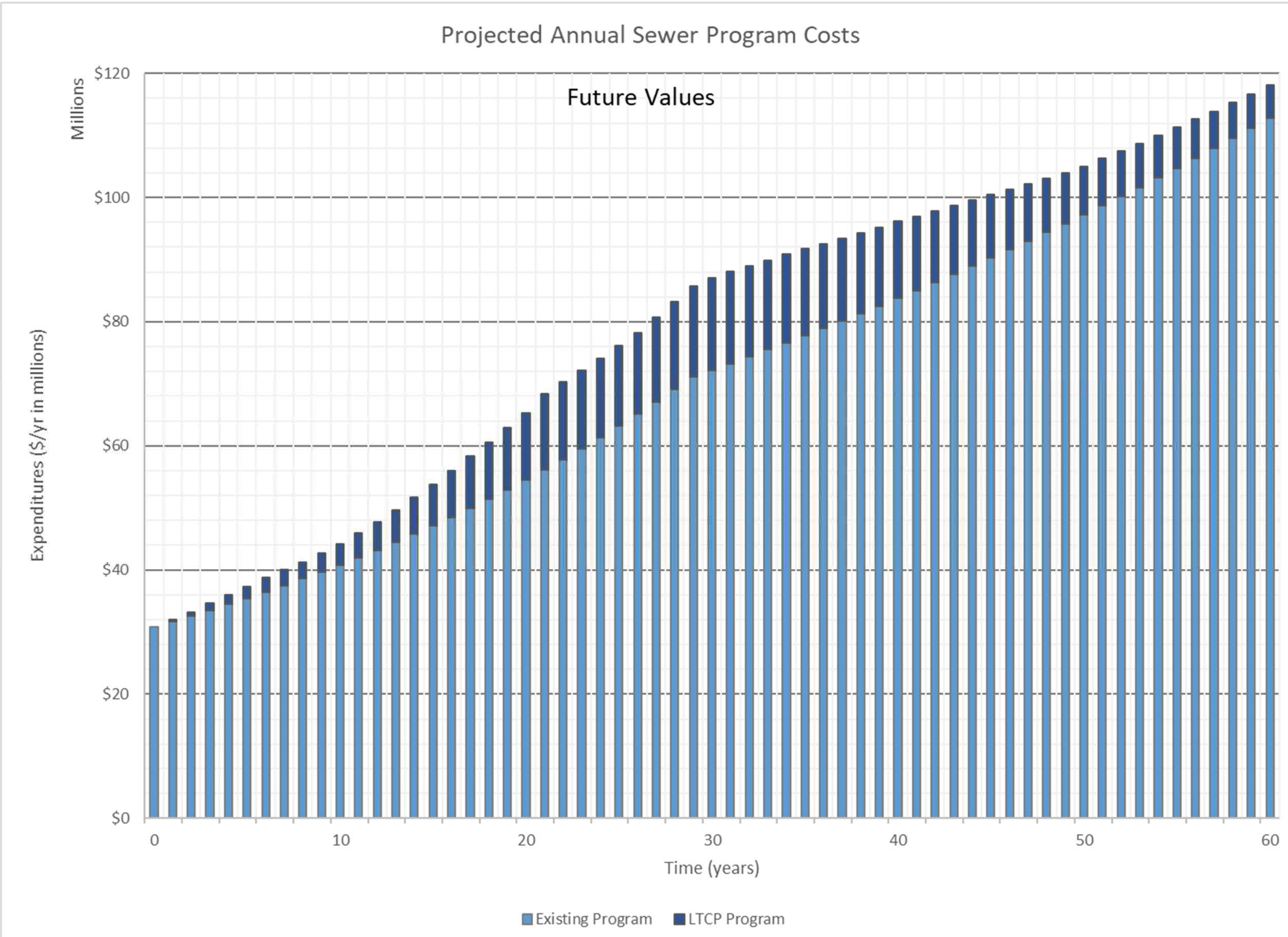


Figure 9-3: Projected Annual Sewer Program Costs

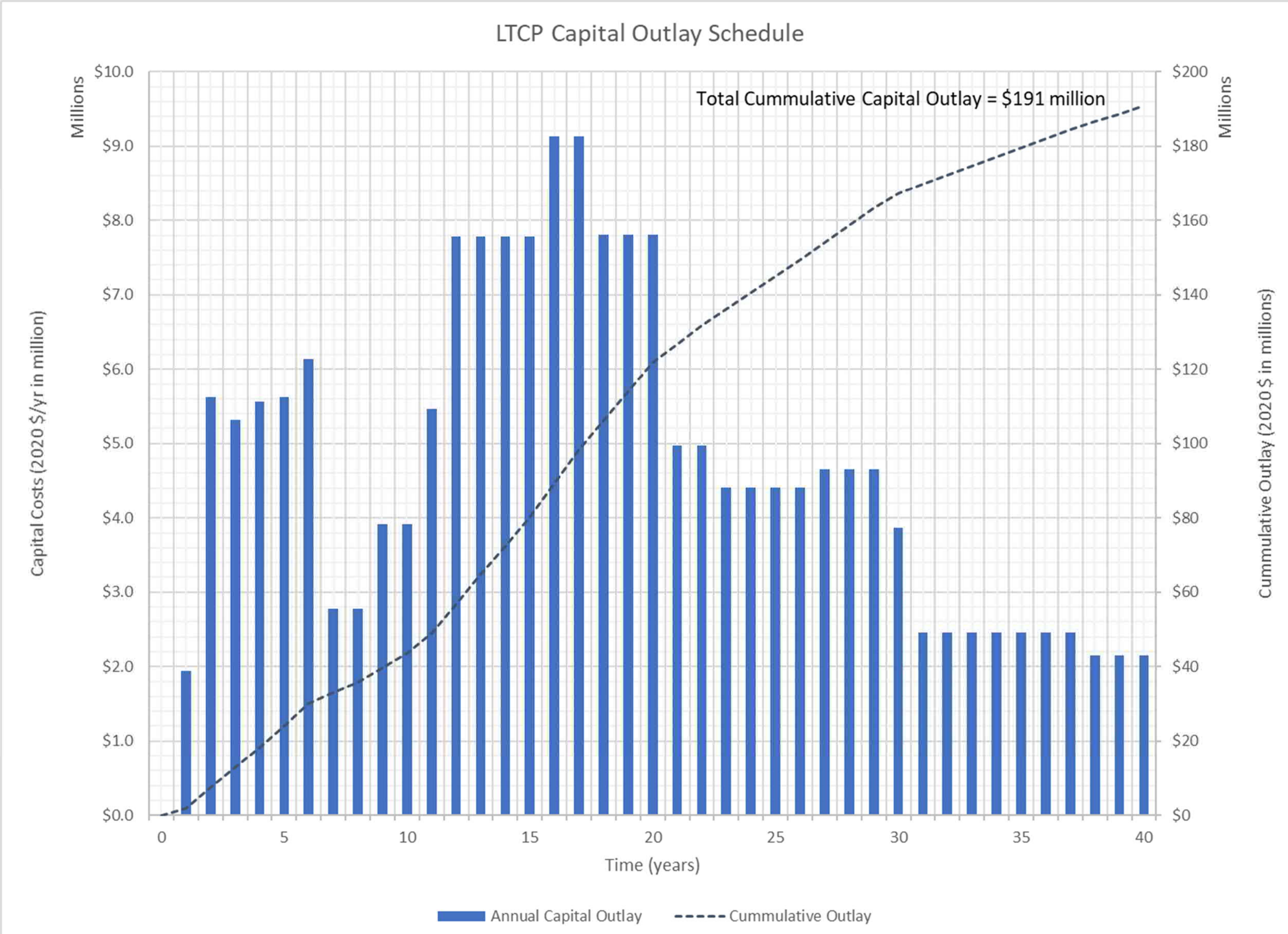


Figure 9-4: CSO LTCP Capital Outlay Schedule

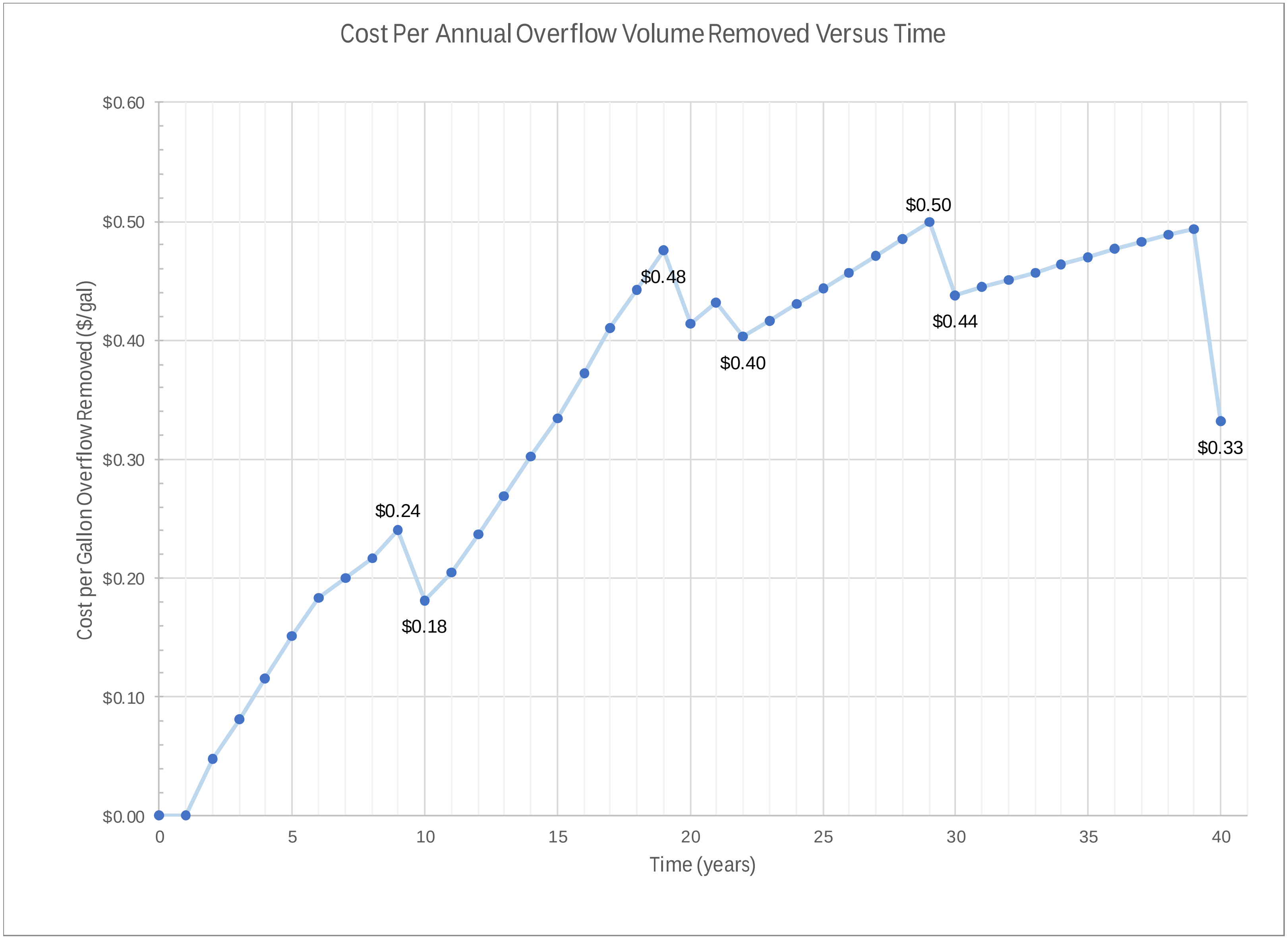


Figure 9-5: Cost per Total Annual Overflow Volume Removed

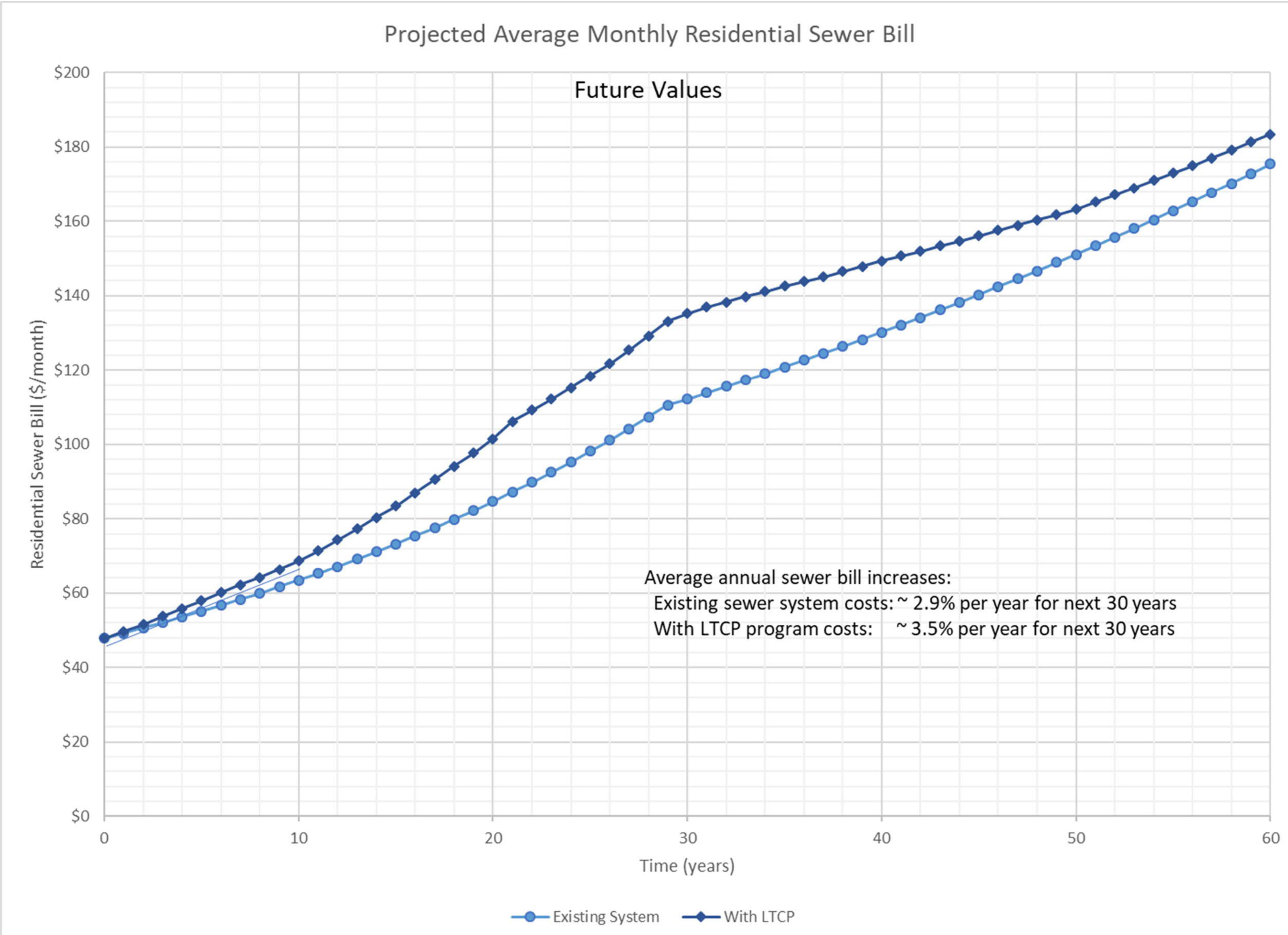


Figure 9-6: Projected Average Monthly Residential Sewer Bill

9.4 Environmental Justice Considerations

Environmental justice represents a condition where no group or community, regardless of its race, ethnicity, wealth, geographic location, or political affiliation, is impacted disproportionately by environmental hazards, disasters, or pollution and the challenges to address them. In other words, it involves fair treatment so that no group or neighborhood receives a greater share of anticipated benefits or bears a greater burden of unavoidable impacts related to a project.

No environmental justice issues are anticipated for the selected Long Term Control Plan. The CSO controls outlined in this LTCP do not involve siting of facilities on new properties to be acquired by the permittees. The improvements for increased conveyance and treatment capacity will provide water quality benefits for the overall system and all residents within the sewer service area. Construction will take place throughout the City mostly within the public roadways, following the alignment of the existing sewers. Construction impacts will be temporary and no permanent adverse impacts to any specific community is expected. Siting of stormwater control projects were selected based on vulnerability to flooding, and are not correlated with incomes or other social, economic, demographic, or geographic factors. Proposed green infrastructure locations for the pilot program will be selected based on suitable site conditions, and care will be taken to ensure that these sites are distributed throughout the city equitably.

9.5 Adaptive Management

Adaptive management is a key element for the effective implementation of the projects in the selected CSO control program. Adaptive management is the systematic use of information to improve operations, especially in the face of uncertainty. It involves testing, monitoring, getting feedback and making course-corrections if necessary. Strategies to support adaptive management include open communication with the permitting agency and streamlined approval processes for budget and implementation schedule change requests. An adaptive management system accepts uncertainty as an inherent and pervasive feature of the planning process and integrates an iterative cycle of planning, executing, monitoring, reviewing, and updating actions into the decision-making approach.

The City intends to implement the components of the CSO LTCP using an adaptive management approach, in order to ensure that the City’s decision-making process and investments are in line with the financial environment, technological advances, and local support at the time. As additional data is obtained through activities such as flow monitoring, water quality monitoring, asset management analyses, and technology evaluation, this information will be used to refine future project planning, design, and implementation steps.

There are several factors that could affect the implementation schedule, which will require adaptive management to keep the implementation of the CSO projects on track. These include:

- Easements and land acquisition: Because the City and JMEUC, as applicable, will ultimately be responsible for the operation and maintenance for LTCP facilities, they must be able to acquire (purchase) the property on which the facilities are sited or obtain permanent easements that will allow for maintenance, as well as potential future upgrades. Depending on factors such as the property owner (public, private, railroad, etc.), or the current or planned occupancy, the process of obtaining an easement or acquiring a property to site a project may have an impact on the implementation schedule.
- Permitting: The timeline to receive required permits can have a significant impact on the project schedule, particularly in areas where there are unique regulatory considerations such as Green Acres, flood hazard area, or wetlands. For example, green infrastructure implementation in existing green spaces may be impacted by Green Acres permitting projects, and large conveyance projects such as improvements to the Westerly Interceptor and siphon upgrades may

be subject to a lengthy permitting process requiring coordination between the City, State, United States Army Corps of Engineers and other parties. Treatment Works Approval will also be required for modifications to sanitary and combined sewer systems. If unforeseen circumstances related to permitting arise, the implementation schedule may need to be lengthened or project sequencing adapted accordingly. In addition, any future changes to environmental policy, such as potential treatment of stormwater discharges, is unknown at this time and increased regulatory requirements could impact the implementation of proposed projects.

- Public acceptance: Public acceptance refers to the degree to which community residents, businesses and institutions would be impacted or perceive the alternative to be favorable or unfavorable. The decision-making process and the components of the selected CSO control plan have been presented to the public throughout the development of the LTCP, including providing the public with several opportunities to comment and provide feedback. Even so, during implementation, new or renewed concerns may be introduced by the public, which could have an impact on project implementation. This concerns could include construction disturbance (traffic, noise, dust), visibility/aesthetics of the project and its fit into the surrounding community, impact to community spaces and cultural/historic resources, and considerations of environmental justice. Addressing these concerns may require adaptation of project implementation, in terms of projects selected, project location, or construction methods.
- Environmental: There is significant uncertainty associated with the future potential impacts of climate change. Future conditions such as changes in precipitation patterns and sea level rise will impact the effectiveness of proposed CSO control projects. Current research on climate change impacts should be considered throughout the implementation schedule, and projects may be modified to consider these impacts, both to adjust capacities and ability to capture/treat CSO flows, as well as structural considerations to provide resiliency to potentially vulnerable infrastructure.
- Financial conditions: As demonstrated by the COVID-19 pandemic, financial situations can change dramatically in a short period of time. In general, if financial conditions change, the capital availability constraints will need to be identified and addressed, which may require changes to the implementation schedule. Implications specific to the COVID-19 pandemic are discussed in Section 9.6.
- Financial capability assessment (FCA) guidance: In September 2020, the United States Environmental Protection Agency (EPA) announced its proposed 2020 Financial Capability Assessment guidance document, describing changes to the existing assessment to include additional considerations for economically disadvantaged communities. Updates to the EPA guidance may impact the affordability analysis, and in turn the LTCP implementation schedule presented. As such, elements of the LTCP may be revised in the future to incorporate the EPA's proposed approach.

The main components of the CSO LTCP implementation that are likely to be particularly impacted by the adaptive management approach are as follows:

- Changes in strategy or technology: The strategies and technologies available to address combined sewer overflows, and their associated costs, are constantly changing and evolving. Projects of the right type and size based on the best available information at the time should be implemented. If a new strategy is identified that achieves equal or better environmental benefits at a lower cost, then the plan should be adapted accordingly. The goal remains to provide the maximum benefit to the environment with the minimum impact to the citizens.
- Post-Construction compliance monitoring: The post-construction compliance monitoring (PCCM) is a continuous process to determine whether the CSO controls specified in the LTCP are meeting the regulatory requirements as planned (described further in Section 11 of this report). Following the ongoing review of post construction performance data, the City and JMEUC will

evaluate the need for additional controls or revision of existing controls to meet WQS and will revise the LTCP to implement the appropriate controls.

- Green infrastructure: The findings from the GI pilot project will be used to inform the further expansion of GI throughout the City, and results based on effectiveness and cost may be used to refine GI design.

Incorporating adaptive management into project planning will allow the City to demonstrate that it is achieving the greatest and earliest CSO control project benefits at a sustainable cost that reflects the dynamic nature of project implementation.

9.6 Projected Impacts of COVID-19 Pandemic

The COVID-19 pandemic will have impacts on the affordability of the CSO LTCP, including potentially reduced sewer utility revenues, cost increases, unplanned expenses, reduced household incomes, and other factors. Considering the adaptive management practices noted above, a suitable approach to address likely financial challenges is develop a schedule for incremental improvements and then revisit additional controls as financial conditions change or as new control technologies emerge. It is recommended that the emerging financial challenges due to COVID-19 be reviewed by NJDEP and provisions be made to allow proposed CSO controls to be rescheduled due to economic conditions beyond the permittees' control.

The projections and conclusions concerning the affordability of the CSO control program proposed in this report and the permittee's financial capability to finance the CSO control program are premised on the baseline financial conditions of 2019 Fiscal Year as well as the economic conditions in New Jersey and the United States generally at the time that work on this Selection and Implementation of Alternatives Report commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues and household incomes.

9.6.1 Potential Wastewater Utility Revenue Impacts

The Financial Capability Assessment provided in Section 8 cannot reflect the currently unknowable impacts on wastewater utility revenues stemming from the national economic upheaval resulting from the COVID-19 pandemic. It is however extremely likely that the City of Elizabeth and municipal wastewater utilities in general across the United States will face significant and potentially permanent declines in revenues from households unable to pay their water and sewer bills and the sudden decline in industrial and commercial demands for potable water and wastewater treatment.

On March 20, 2020 the National Association of Clean Water Agencies (NACWA) issued a press release stating that:

> "**NACWA conservatively estimates the impact to clean water utilities nationwide of lost revenues due to coronavirus at $12.5 Billion**. This is a low-end estimate, assuming an average loss of revenue of 20% which is well within the range of what individual utilities are already projecting. Some utilities are anticipating closer to a 30% or 40% loss in revenue. This estimate is based on the substantial historical utility financial data NACWA has on file through its Financial

> Survey and recent reports from NACWA members on the decrease in usage they are observing in their systems over the last few weeks."[7]

The impact of a 20% to 40% revenue loss, along with increased costs that have been and will continue to be experienced by water and wastewater utilities such as overtime and the writing off of customer accounts receivable could have a profound impact on the affordability of the proposed CSO controls and the permittee's ability to finance them.

Most of the costs of a municipal wastewater system are relatively fixed within broad operating ranges. Debt service and other capital costs are fixed once incurred. Some operating costs vary with wastewater flows, such as chemical and electrical power usage, but due to the inflow contributions, flows in combined sewer systems are generally less impacted by changes in water consumption. Labor costs are not directly variable, e.g. a twenty percent reduction in billed flow would not result in a need for twenty percent less labor. Maintenance costs might go down somewhat as equipment operating times may be reduced.

As costs do not decline proportionately to billed flow, it can be expected that user charge rates must be raised to generate sufficient revenue to sustain current operations. The relationship between changes in costs and revenues and the resultant changes in user charge rates is complex, and the effects of COVID-19 on sewer rates is yet to be determined. At this point it can be assumed that user rate increases may be necessary to simply maintain current operations, and these rate increases will likely erode the financial capability of the City residents to fund the CSO LTCP.

9.6.2 Potential Median Household Income Impacts

The impacts of the pandemic on median household incomes (MHI) in the City of Elizabeth cannot be determined at this point. Historical analogies may provide some useful, albeit disturbing, context but are not presented as predictive:

- U.S. median household income fell by 6.2% from $53,000 in 2007 to $49,000 in 2010. In New Jersey, the MHI decreased by around 4.0% for the same period.[8]
- The U.S. unemployment rates rose from 5.0% in December of 2007 to 9.9% in December of 2009.[9]
- Data on impacts of the Great Depression on median household income are not available. As a proxy, the personal income per capita data are available. For 1929 this was $700. By 1933 this figure bottomed out at $376, a decline of 46%. Unemployment for the same period rose from around 3.0% to 25%.[10]

While a quantifiable assessment of the impact of the pandemic on median household income is not feasible at this time, reduction in base year MHI can be expected. This will further exacerbate the impacts of the revenue reductions described above on LTCP affordability, as higher base user charge rates will absorb an increased portion of lower MHI.

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[7] NACWA press release: Coronavirus Impacting Clean Water Agencies; Local Utilities and Ratepayers Need Assistance March 20, 2020

[8] Source: Fact Sheet: Income and Poverty Across the States, 2010 Joint Economic Committee, United States Congress, Senator Robert P. Casey, Jr. Chairman.

[9] Source: Bureau of Labor Statistics data series LNS1400000

[10] Source: Federal Reserve Economic Data (FRED) data series: A792RC0A052NBEA

9.6.3 Implications for the Long Term CSO Control Program

The potential implications of the COVID-19 pandemic, including the possible need to amend the LTCP implementation and financing program, should be highlighted and acknowledged. The City of Elizabeth and JMEUC anticipate that the financial implications of the COVID-19 pandemic will be discussed with NJDEP during the review of this report and as the renewal permit is developed.

Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, the City and JMEUC cannot commit to the construction and financing schedule for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this report based on emergent economic conditions beyond the permittees' control. Under the adaptive management considerations described in Section 9.4, these provisions could include scheduling the implementation of specific CSO control measures to occur during an initial five-year period and allowing an amended affordability assessment to be submitted during the next NJPDES CSO permit period to update the controls that are financially feasible during the subsequent period. Although a complete implementation schedule is being proposed as part of this Selection and Implementation of Alternatives Report, a revised affordability assessment should be performed during review of the next NJPDES permit to re-evaluate and validate the financial conditions and to identify any revisions to the proposed controls that may be required.

Section 10
Operational Plan

An Operational Plan is required under the New Jersey Pollutant Discharge Elimination System (NJPDES) Combined Sewer Overflow (CSO) Permit Section G.6.a as follows:

> "Upon Departmental approval of the final LTCP and throughout implementation of the approved LTCP as appropriate, the permittee shall update the [Operation and Maintenance] O&M Program and Manual in accordance with D.3.a and G.10, to address the final LTCP CSO control facilities and operating strategies, including but not limited to, maintaining Green Infrastructure, staffing and budgeting, I/I, and emergency plans."

As required under Section F of the NJPDES CSO Permits, the City of Elizabeth and the Joint Meeting of Essex and Union Counties (JMEUC) have separately implemented an Operation and Maintenance (O&M) Program and prepared a corresponding Manual to manage the various assets associated with the treatment works owned by each permittee, including as applicable the combined sewer collection system, the CSO outfalls, solids/floatables facilities, regulators, and related appurtenances. The City and JMEUC annually review, and update as needed, their associated O&M program and manual.

With the implementation of the LTCP program, new sewer system infrastructure and treatment facilities for CSO control will be constructed, placed into service, and operated. The City of Elizabeth and JMEUC are prepared to operate and maintain the facilities associated with the LTCP. JMEUC will be responsible for operating and maintaining the proposed combined sewer flow treatment facility and associated systems at its wastewater treatment plant site. The City of Elizabeth will be responsible for operating and maintaining the other selected CSO control projects, which will become part of the Elizabeth sewer system.

As the proposed CSO control facilities are implemented, the existing O&M programs and manuals will be expanded and updated accordingly as part of the LTCP operational plan. The City and JMEUC will continue to review the O&M Program and Manual on an annual basis and make updates to reflect any additional operations and maintenance requirements for new system assets. Training will be provided where necessary, to ensure that staff are able to operate any new CSO control assets.

The City of Elizabeth and JMEUC currently operate and maintain facilities equivalent or very similar to the assets to be provided under the selected LTCP. These CSO control facilities and operating strategies include new sanitary sewer mains, new large diameter conveyance piping, upgraded and new pumping systems, new wastewater screening and disinfection treatment facilities, a below grade combined sewer storage tank, and green infrastructure roadway rain gardens. Based on the proposed LTCP projects, future revisions to the O&M program and manual may include:

1. Updates to organization structure, system descriptions, and resource and budget requirements.
2. Standard operating procedures, inspection checklists, and maintenance schedules for new equipment and facilities.
3. Updates to material and equipment inventories and emergency plans.
4. Updates to record keeping and reporting procedures.
5. Training of staff on new equipment and unit processes.
6. Routine operating procedures and training for the real-time controls and modified operating strategy for additional pumping from the existing Trenton Avenue Pumping Station.

7. Routine operating procedures and training for the inspection, operation and maintenance of roadway rain gardens, including weeding, trash and debris removal, mulch/vegetation replacement as needed.
8. Routine operating procedures and training for the combined sewer flow below grade storage tank, including dewatering pump station, flushing system, grit removal, and odor control system.
9. Additional siphon cleaning and maintenance requirements.

Section 11
Post-Construction Compliance Monitoring

New Jersey Pollutant Discharge Elimination System (NJPDES) Combined Sewer Overflow (CSO) Permits require a Compliance Monitoring Program as one of the nine elements of the Long Term Control Plan (LTCP). The objective of the Compliance Monitoring Program is to compare findings from the baseline monitoring program to system performance during and after LTCP implementation, in order to evaluate the effectiveness of implemented CSO controls and to review compliance with water quality standards. As specified in Section G.9.a of the CSO Permits, the Compliance Monitoring Program is to include the following items at a minimum:

- Ambient in-stream monitoring;
- Discharge frequency for each CSO (days and hours per month);
- Duration of each discharge for each CSO (number of days);
- Quality of the flow discharged from each CSO, including pathogen monitoring; and
- Rainfall monitoring.

The work previously completed with the NJ CSO Group related to the Baseline Compliance Monitoring Report and the Pathogen Water Quality Model is described in Section 4. The portion of the Compliance Monitoring Program conducted after implementation of the LTCP is specifically referred to as the Post-Construction Compliance Monitoring Program (PCCMP) and is the focus of this section. The PCCMP aims to continue the monitoring initiated in the Baseline Compliance Monitoring Report through the CSO LTCP implementation schedule, in order to determine the effectiveness of CSO controls that have been implemented. Monitoring for the PCCMP will be continued at intervals during and following the completion of the LTCP. The PCCMP described in this section has been developed based on the instructions outlined in the “Post Construction Compliance Monitoring Guidance” document produced by United States Environmental Protection Agency (EPA) in May 2012.

11.1 Compliance Monitoring Approach

Post-construction monitoring will be completed to evaluate the incremental reduction in overflow rates and volumes as CSO control facilities are placed into operation. For the selected presumption approach, the National CSO Policy and the NJPDES Permit require an 85% wet weather capture on an annual system-wide basis for the Typical Year. Wet weather capture will be determined on a system-wide basis using the hydraulic and hydrologic (H&H) model that will be calibrated and updated using post-construction monitoring data and evaluated over the model Typical Year, which has been previously approved by the New Jersey Department of Environmental Protection (NJDEP). This is the performance criteria that will be used for the LTCP capital projects. The reader should refer to Section 3 for additional information regarding the H&H model development and Typical Year performance.

The approach provided herein has been developed for the purposes of providing adequate data to evaluate the effectiveness of the CSO control measures constructed during the implementation of the LTCP. The evaluation of the control measures will be based on the performance criteria established above and will be used to verify that the Permittees are in compliance with their respective NJPDES Permits. The program will be conducted during the LTCP implementation to corroborate that the completed CSO control measures are performing effectively, while providing sufficient data to identify and remedy underperforming control measures.

The post-construction monitoring will to demonstrate that CSOs will be reduced to the levels predicted in the recommended plan based on the typical year conditions to meet the Clean Water Act (CWA) requirements. Pathogen loads, contributed by the remaining CSOs, based on post-construction monitoring will be compared to non-CSO loads to the receiving waters estimated in the LTCP (or Baseline Compliance Monitoring Report previously approved by NJDEP). Any reductions in non-CSO loads as a result of then-current water quality compliance requirements in the receiving waters will also be considered. This information, as developed and made available during post-construction monitoring, will be used to assess CSOs compliance with the current NJPDES Permit and water quality standards (WQS).

As rainfall varies substantially from year to year and from storm to storm, it will require normalizing rainfall to the typical year to assess performance. The same is true for receiving water monitoring where the variables include other pollutant sources that are also driven by wet weather conditions. For these reasons and in accordance with the CSO Policy, the LTCP is based on “typical year” conditions.

The baseline hydraulic and hydrologic model developed in Infoworks ICM for the Long Term Control Plan development will be updated to reflect the sewer system configuration as the selected CSO control projects are completed. The revised model will be used to determine the effectiveness of the CSO control program in meeting the overflow volume reduction and combined sewage percent capture goals, based on the Typical Year simulation runs. Updates to the hydraulic model will be made at key points during the implementation period, at which time new monitoring data will be collected to calibrate and validate the revised model simulation runs as needed. The timing and protocols for the sewer system monitoring data and model updates will be coordinated with the New Jersey Department of Environmental Protection based on conditions to be identified in NJPDES permit renewals, including Quality Assurance Project Plan (QAPP) submittal requirements. Once the H&H model has been determined to be adequately calibrated, a continuous simulation of the Typical Year (2004) will be run to compare the remaining CSO discharge volume to baseline conditions and determine whether the CSO control measures are achieving the projected performance.

Key elements of the proposed PCCMP are:

- Ambient water quality monitoring and modeling to measure and assess the water quality impacts of CSOs on receiving streams;
- Calibration and validation of collection system modeling as needed based on sewer flow and rainfall monitoring data obtained during the LTCP implementation period to determine whether CSO control measures are meeting targeted performance levels;
- Reporting of progress to regulatory agencies and the public, including the anticipated submission of periodic progress reports and monthly discharge monitoring reports to the New Jersey Department of Environmental Protection.

11.2 Ambient Water Quality Monitoring and Modeling

As members of the NJ CSO Group, the City of Elizabeth and the Joint Meeting of Essex and Union Counties (JMEUC) will continue to participate in this regional collaboration to monitor ambient water quality during implementation of the LTCP. It is anticipated that routine sampling and analyses for bacterial indicator organisms will be performed under the New Jersey Harbor Dischargers Group water quality monitoring program, including for sampling locations along the Elizabeth River. The extent of source and wet weather event sampling remains to be determined in conjunction with the NJ CSO Group.

It is further anticipated that through the NJ CSO Group, the water quality monitoring data will be used to update the pathogen water quality model and model simulation runs will be conducted to assess water quality changes at certain regular intervals during the Long Term Control Plan implementation.

Information on the ambient water quality monitoring and modeling provided by the NJ CSO Group will be documented in the individual LTCP progress reports.

For the purposes of addressing the PCCMP ambient monitoring requirements, planning at this time involves utilizing water quality sampling data collected by the existing New Jersey Harbor Dischargers Group sampling program to supplement the findings of the collection system modeling and to support the water quality modeling efforts, to be performed upon the implementation of all CSO control measures to verify that the remaining CSOs are not precluding the attainment of water quality standards for pathogens. For purposes of defining the implementation of all CSO control measures, implementation of all CSO Control measures is defined as the implementation of all projects within all NJ CSO Group Permittees.

11.3 Combined Sewer System Monitoring and Modeling

The compliance monitoring program for combined sewer overflow discharge frequency, duration, and volume will build on the current online CSO notification system developed as part of the NJ CSO Group (https://njcso.hdrgateway.com/) and utilized for monthly discharge monitoring reports. The CSO notification system is a public information tool advising on the status of CSO occurrences in the City of Elizabeth and certain other communities participating in the NJ CSO Group. The website will continue to provide up-to-date information regarding where CSO discharges may be occurring or that discharges are unlikely to be occurring in the City of Elizabeth. Given the number of overflow outfalls within the City, it is not practicable or affordable to have sensors deployed at each regulator throughout the system to monitor the frequency and duration of CSO events.

The compliance monitoring system will use the approved hydrologic and hydraulic model to simulate the combined sewer overflow performance based on the precipitation record from the Newark Liberty International Airport. Overflow statistics will be generated from model simulation runs with the sewer system configuration representing the completed CSO control projects. As improvements are made to the collection system, the City will update the model to reflect these conditions, in order to determine the system response to these improvements and gain an understanding of their effectiveness. Overflow data will be collected from the model, including the frequency, duration, and volume of overflow at each outfall for a given period.

The performance criteria developed in this report is based on a percentage of the total volume entering the combined sewer system that is “captured” for treatment at the JMEUC wastewater treatment facility (WWTF), as part of the Presumption Approach. Upon full implementation of the CSO control measures of the LTCP, the performance criteria will be a minimum of 85% capture by volume of the system-wide wet weather volume for treatment from the Elizabeth sewer system based on the Typical Year (2004). The minimum 85% capture by volume meets the requirements of the Presumption Approach, and this minimum capture amount may increase based on the selected CSO control measures detailed in Section 7. Actual overflow volume will vary from one year to another after full implementation of the CSO control measures, based on real-life precipitation conditions. Recognizing the hydraulics of the combined sewer system and the interconnection between CSO regulators, CSO control measures that do not achieve the performance criteria as a result of other controls that have yet to be completed will not be fully evaluated until all CSO control measures are constructed.

Additional sewer flow monitoring data will be collected in the future after the implementation of major CSO control projects to update the hydraulic model so that a properly calibrated and validated model representing the actual sewer system configuration is available for compliance monitoring and reporting. The data collection and modeling updates will be performed following a Quality Assurance Project Plan, which will be submitted to NJDEP for approval if and as required. The number and location of flow meters will vary depending on the sewer system changes. The major sewer system model updates are expected to occur on approximately a 5-year cycle, coinciding with the completion of significant conveyance improvement projects. However, the frequency of monitoring will be dependent upon the implementation of projects. For example, it may not be necessary to re-calibrate the model during the first five years of implementation given that most of the major projects will not have been constructed during this period.

11.4 Rainfall Monitoring

The Liberty International Airport, Newark NJ rain gauge (COOP286026), a National Weather Service gauge, is located in close proximity to the Elizabeth and JMEUC service area. Precipitation data with different intervals are available at this gauge including high quality daily data, quality controlled hourly data, and raw 1-minute data. Rainfall will continue to be monitored at this location for use in confirming the model response as part of the PCCM.

The City of Elizabeth has also installed a rain gauge on a semi-permanent basis at the Hanratty Memorial Complex and ball field (914 Westfield Avenue). This rainfall data may also be used to supplement the Newark Liberty International Airport data set, especially for the northwestern section of the City. Temporary gauges for additional rainfall monitoring data collection may be proposed as part of a sewer system model update QAPP.

11.5 Combined Sewer Overflow Water Quality Monitoring

Water quality monitoring at select combined sewer regulators will be coordinated with ambient water quality monitoring and modeling updates, particularly for source and wet weather event sampling activities. This data will be used to update the pathogen water quality model if required. The extent of the overflow sampling activities remains to be determined in conjunction with the NJ CSO Group, but it is anticipated that the sampling will be limited to up to seven representative regulator basins, as for the system characterization studies, and coordinated with a QAPP for ambient water quality modeling updates.

11.6 Reporting

To demonstrate compliance under the Presumption Approach, the City and JMEUC will continue to update and calibrate the H&H model after the implementation of CSO control measures and post-construction monitoring phase data has been collected. The model will be used to simulate the combined sewer system performance and to demonstrate compliance with the performance criteria identified, i.e., a minimum of 85% capture by volume of the system-wide wet weather volume during the Typical Year.

Reporting on the post-construction compliance monitoring program will be completed at regular intervals following completion of major project milestones as established through discussion with the NJDEP and then scheduled in NJPDES permit renewals. The Permittees will submit a series of milestone reports to the NJDEP detailing the implementation and performance of CSO control measures. A LTCP update or an Adaptive Management Plan will be developed in the event that CSO control measures exceed or do not meet the identified performance criteria.

The PCCMP will evaluate whether the CSO control measures are achieving the required performance objectives. The progress and evaluation of the CSO control measure implementation will be reported to the NJDEP, and to the public through a series of reports, namely the PCCMP Reports, which will include any necessary adaptive management actions for over-performing or under-performing CSO control measures. The City and JMEUC will also continue to submit the monthly Discharge Monitoring Reports (DMRs) as required by their respective NJPDES Permits.

The PCCMP Reports will present:

- A statement setting forth the deadlines and other terms that the permittees were required to meet since the last reporting period;
- A general description of work completed within the prior period, and a projection of work to be completed within the succeeding period;
- A summary of principal contacts with NJDEP during the reporting period relating to CSOs or implementation of the LTCP;
- NJPDES permit violations;
- A summary of flow and hydraulic monitoring data collected by the permittees during the reporting period;
- A description of the CSO control measures completed within the reporting period and a projection of CSO control measure work to be performed during the next period; and,
- An evaluation of the effectiveness of the CSO control measures constructed to date, including proposed adjustments to the components of the recommended plan (adaptive management), if needed

The City and JMEUC will submit a PCCMP Report to the NJDEP at the end of each NJPDES Permit cycle (in 5-year increments). The final PCCMP Report will be submitted to the NJDEP for their review and approval within 1-year after the last LTCP project has been implemented. The purpose of the final PCCMP Report shall be to evaluate and document the system-wide performance of the City and JMEUC's fully implemented LTCP CSO control measures. The Report shall include an assessment of whether the control measures are meeting the performance criteria and complying with water-quality based CWA requirements and the City and JMEUC's respective NJPDES permits. It is noted that additional data collection for ambient water quality, sewer flow, overflow water quality, and rainfall monitoring is not recommended for at least the next 5 years because of the extended time required to construct the significant CSO control projects.

Given the impacts of upstream loading, it is recommended that any future regulatory effort to further reduce bacteria loadings to the receiving streams be assigned to the background and non-CSO contributors.

In order to advise the public of overflows, the existing notification system will continue to be utilized. This system notifies the public of the occurrence of CSOs based on rainfall monitoring near the representative CSO outfalls. Links to the notification system at https://njcso.hdrgateway.com/ will be maintained on the City of Elizabeth web site.

As noted in Section 9, adaptive management will be a key element in the successful implementation of the selected CSO control projects. As part of adaptive management, a flexible approach to implementation will be employed that involves testing, monitoring, getting feedback, and having open communication channels with stakeholders. Based on this information gathered, the implementation plan will be regularly re-evaluated as part of each permit cycle, and components will be adapted and updated as necessary.

Should the post-construction monitoring suggest that the CSO control measures are exceeding or lagging the projected performance levels, the performance factors and deficiencies responsible for the exceedance or shortfall will be identified. Modified, reduced, or additional control measures will then be implemented to allow the permittees to meet the 85% wet weather capture percentage performance criteria based on the simulation of the Typical Year. The City and JMEUC will consider multiple adaptive management actions for over-performing or under-performing CSO control measures, including eliminating or reducing the size of proposed facilities, revising technologies, or constructing additional control systems.

If needed based on the performance of the implemented CSO control measures, an Adaptive Management Plan will be developed and submitted to NJDEP as part of the PCCMP Report for that reporting period. Upon review and approval of the Adaptive Management Plan by the NJDEP, the permittees will implement the approved adaptive actions in accordance with the schedule set forth in the plan. It is anticipated that this adaptive management approach will allow the City and JMEUC to achieve the required CSO control volume reductions at the most sustainable cost and with the support of all relevant stakeholders.