SELECTION AND IMPLEMENTATION OF ALTERNATIVES

CSO Permit Compliance

City of Perth Amboy

and

Middlesex County Utilities Authority (MCUA)

Middlesex County, New Jersey

City of Perth Amboy – NJPDES Permit No. NJ0156132

MCUA – NJPDES Permit No. NJ0020141

Original Submission:

October 1, 2020

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List of Abbreviations

AGC	Aerated Grit Chamber
BCMR	Baseline Compliance Monitoring Report
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CEPT	Chemical Enhanced Primary Treatment
CIP	Cast Iron Pipe
CIPP	Cured-In-Place Pipe
CMP	Corrugated Metal Pipe
COD	Chemical Oxygen Demand
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
CTP	Central Treatment Plant
CWA	Clean Water Act
DEAR	Development and Evaluation of Alternatives Report
DIP	Ductile Iron Pipe
ENR CCI	Engineering News Record Construction Cost Indices
FCA	Financial Capability Analysis
FM	Force Main
fps	feet per second
FSS	Fixed Suspended Solids
FST	Final Settling Tank
GC	General Contractor
GI	Green Infrastructure
HCF	Hundred Cubic Feet
HDD	Horizontal Directional Drilling
HLR	Hydraulic Loading Rate
HRT	High Rate Treatment
I/I	Inflow and Infiltration
LTCP	Long Term Control Plan
MCUA	Middlesex County Utilities Authority
MG	Million Gallons
MGD	Million Gallons per Day
MUA	Municipal Utility Authority
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NMC	Nine Minimum Controls
OH&P	Overhead & Profit

O&M	Operation and Maintenance
OT	Oxygenation Tanks
PAA	Peracetic Acid
PCCP	Prestressed Concrete Cylinder Pipe
PS	Pumping Station
PST	Primary Settling Tanks
PV	Performance Value
PVSC	Passaic Valley Sewerage Commission
RAS	Return Activated Sludge
RCP	Reinforced Concrete Pipe
SE1	Saline Estuary 1
SE2	Saline Estuary 2
SIU	Significant Industrial User
TBL	Triple Bottom Line
TGM	Technical Guidance Manual
THM	Trihalomethanes
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
UVT	Ultraviolet Transmittance
VCP	Vitrified Clay Pipe
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WQS	Water Quality Standards
WRF	Water Reclamation Facility
WWTP	Wastewater Treatment Plant

Appendices

Executive Summary

E.1 Introduction

The City of Perth Amboy (City) and the Middlesex County Utilities Authority (MCUA) 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 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 MCUA 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. NJ0156132 and MCUA's NJPDES Permit No. NJ0020141. 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 MCUA, 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.

Section 1 contains for additional information on the regulatory background and reports completed by the City and MCUA under the LTCP process.

E.2 System Description

The MCUA owns and operates a regional sewerage system that collects wastewater flows from thirty-six (36) communities in Middlesex, Somerset, and Union Counties and provides secondary treatment of these flows at its Central Treatment Plant (CTP) located at 2571 Main Street Extension in Sayreville, New Jersey. The City of Perth Amboy is the only municipality whose collection system has combined sewers. The wastewater is collected by these communities with their own collection systems and discharged to the CTP through seventy-five (75) meter chambers owned and operated by the MCUA. In addition, the MCUA meters flows from four (4) direct industrial participants. The metered flows are then conveyed to the CTP via the MCUA's system of interceptors, trunk sewers and siphons that convey the flows to three regional pumping stations and force mains to the CTP. All flows are pumped to the CTP for treatment and disinfection prior to discharge into the Raritan Bay and the North Channel of the Raritan River.

The City of Perth Amboy owns a sewage and stormwater collection system serving 50,814 residents per the 2010 Census and 3,525 business customers (2007, Census Business QuikFacts). The City of Perth Amboy is served by both combined and separate sewers and owns and operates combined sewer overflows (CSOs). An estimated 41,000 of the City of Perth Amboy's residents are served directly by a combined sewer system which covers approximately 2.5 square miles. An additional 9,800 residents are served directly by a separated sewer system which is conveyed to the combined sewer system. While the City retains ownership of existing sewer infrastructure, the operations of the City's CSO system is performed by Utility Service Affiliates-Perth Amboy (USA-PA), an affiliate of Middlesex Water Company.

Excess flows are discharged at the City's CSO discharge points (outfalls), as indicated in Table ES-1 below.

Table ES-1 - Summary of CSO Structures

CSO Outfall Number	CSO Outfall Location	Receiving Water
P-002	Rudyk Park	Arthur Kill
P-003	Buckingham Ave.	Arthur Kill
P-004	Washington St.	Arthur Kill
P-005	Commerce St.	Arthur Kill
P-006	Fayette St.	Arthur Kill
P-007	Smith St.	Arthur Kill
P-008	Gordon St.	Arthur Kill
P-009	Lewis St.	Arthur Kill
P-010	High St.	Raritan River
P-011[1]	State St.	Raritan River
P-013	Brighton Ave.	Raritan River
P-014	Madison Ave.	Raritan River
P-015	First St.	Raritan River
P-016	Second St.	Raritan River
P-017	Sheridan St.	Raritan River
P-019	Outer Smith St.	Raritan River

Refer to Section 2 for additional information on the sewer system description.

E.3 Baseline Performance Information

A hydrologic and hydraulic (H&H) computer model of the Perth Amboy combined sewer system was created by the City. 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 MCUA) as representative of typical annual conditions and was utilized in this LTCP as the Typical Year (see Section 3).

The H&H model estimates the total overflow volume discharged during the Typical Year from the existing combined sewer regulators on a system-wide basis as 386 million gallons (MG).

Percentage capture is used in the USEPA CSO Control Policy as one means to establish targets for CSO control in the LTCP. This metric is therefore useful for both the characterization of baseline performance and for the forthcoming evaluation of CSO control alternatives. Under the Policy's Presumption Approach, one control option is "the elimination or the capture for treatment of no less than 85 percent by volume of the combined sewage collected in the combined sewer system (CSS) during precipitation events on a system-wide annual average basis…" [59 FR 18962 section II-C4(a)(ii)].

Percentage capture is a more complex metric than CSO volume and frequency. This is the fraction (as a percentage) of wet weather flow in the combined sewer system that is captured for treatment. On a system wide basis, captured flow is the wet weather flow that passes through the headworks of the treatment plant or in Perth Amboy's case, it is the discharge of the Second Street Pumping Station. Of all the wet weather flow that enters the sewer system, the portion that is not captured includes overflows to area waterways at the CSO outfalls or to the surface as combined sewer system flooding.

The average annual (i.e. for the Typical Year) system wide capture for Perth Amboy is 57 percent. Under the baseline condition, the H&H model predicts an average of 61 overflow events during the Typical Year.

Section 3 includes information regarding the Baseline Sewer System Performance analysis.

E.4 Water Quality Objectives

This LTCP will seek to provide water quality benefits to the receiving water bodies commensurate with the expenditure of public funds. The evaluations necessary to define these benefits are being performed pursuant to the Presumption Approach defined by both national policy and the NJPDES CSO permits.

In support of the Presumption Approach, various combinations of technologies were evaluated for a series of control levels. The City's target level of control is 85% capture, as defined in the City's approved NJPDES permit.

A Pathogen Water Quality Model of the complete NY/NJ harbor, including the Arthur Kill and Raritan River/Bay, has been developed by the NJ CSO Group and this model is being used to understand the pollutant sources and their relative contributions for the affected study area. Use of the NJ CSO Group water quality model is expected to indicate which level of control evaluated for the CSO outfalls is needed to demonstrate attainment of WQS and designated uses of the corresponding receiving waters. The Pathogen Water Quality Model is also intended to demonstrate the maximum pollutant reduction benefits reasonably attainable for the receiving waters.

In selecting the CSO control approach for the City and MCUA, 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 MCUA have selected the Presumption Approach with the compliance metric of the capture for treatment of at least 85 percent by volume of the wet weather combined sewage collected by the City's combined sewer system 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.

Section 4 includes details on the Water Quality Objectives.

E.5 Development and Evaluation of Alternatives

A two-tiered approach was applied to the development of CSO control alternatives for the City and MCUA, 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 CSO Control Alternatives" Report, revision date October 2019.

The CSO control technologies screened as potentially viable were formulated into control programs and evaluated.

1. Green Infrastructure
2. Increased Storage
3. Treatment Plant Expansion
4. Inflow and Infiltration Reduction
5. Sewer Separation
6. Satellite CSO Treatment Facilities

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 the 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 total 20-year life cycle cost (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 a mixed technology approach was most appropriate that combined both storage and high rate treatment at CSO locations within the City's CSS. This provided a cost-effective primary control measure for reasonably attainable water quality pollution reduction benefits.

See Section 5 for additional information on the Development and Evaluation of Alternatives.

E.6 Selected CSO Control Approach

The Calibration and Validation of the Pathogen and Water Quality Model (PWQM) prepared by the NJ CSO Group indicates in the vicinity of Raritan Bay, stormwater loading impacts dominate, followed by CSOs, and sources in the upper Raritan River outside the project area. Based on these results, the reduction in CSO loads will only have a limited effect on attainment in criteria due to the dominance of the stormwater and runoff loads.

Given the limited benefit that could be provided by CSO controls in the vicinity of the Raritan River and Raritan Bay, the City and MCUA have selected the Presumption Approach for their LTCP. The target criteria is 85% capture of the volume of wet weather combined sewer flow within the service area served by the City during the Typical Year. The City will further target 2 overflows per year along the beach area (Group 3), which provides a significantly greater level of CSO control than the 85% capture target, while providing significant cost savings versus a zero per year target. This level of control will allow for substantial recreational use by the community if the City elects to pursue public recreational bathing in this area and background water quality is acceptable and meets criteria set by the State of New Jersey for this purpose. The City therefore believes that the 2 per year target best balances water quality objectives with cost effectiveness and affordability considerations.

Section 6 has more information regarding the Selected CSO Control Approach.

E.7 Financial Capability Assessment

A financial capability assessment was prepared to evaluate the ability of the City 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 disproportionate impact on lower income households 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 Perth Amboy residential sewer users (based on median household income) during the program period, exceeding the threshold of 2% of MHI for the period 2040-2050. The impact will be greater on lower income households. A household at or below the bottom 40 percent of income (roughly $40,000) is projected to have a residential burden of over 3.3 percent in FY 2044.

The City recognizes 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 7 presents additional information about the financial capability assessment used to establish this schedule.

E.8 Public Participation Process

Public participation is an important component of the LTCP development process, and the City and MCUA 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:

- Supplemental CSO Team Meeting #6 – December 18, 2019 – DEAR Review Tool refresher, review of DEAR, discussion on alternatives that support use of the beach area, Green Infrastructure prioritization, review siting locations for storage.
- Public Meeting/City Council Presentation #2 – July 8, 2020 – review of regulatory context, alternatives, results of initial financial capability analysis, review of adaptive management provisions, review of drivers of cost, review alternative approaches to potentially limit costs in the initial permit cycles of the program.

Prior to submission of the DEAR, other substantive public participation consisted of:

- A presentation was made to City Council and the Public on July 10, 2019 to review the alternatives evaluated and the plan selection process.
- Regional Partnerships: Ongoing participation in the regional NJ CSO Group, coordination with NJDEP
- Continuation of other public outreach efforts such as maintenance of signage on CSO outfall locations and distribution of flyers through the City Hall.

Throughout the development of the LTCP, the City and MCUA 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 desire to incorporate green infrastructure into the proposed solutions, concern related to extensive costs for the CSO control measures, the financial burden associated with the potential program costs, and federal and State grant funding needs. This public participation feedback has been considered by the permittees and incorporated into the plan selection process to the extent possible.

See Section 8 for additional information regarding the Public Participation Process used by the City and MCUA.

E.9 Selected Long Term Control Plan

The selected plan involves a combination of different CSO control strategies, including sewer separation, green infrastructure, construction of a new force main connecting the City with MCUA directly, satellite storage tanks, and high rate treatment. The recommended plan is technically feasible, effective in meeting the control goals, cost-effective, and suitable to the community by emphasizing construction of City owned property or existing rights-of-way. The components of the selected plan are outlined as follows:

- Current and planned sewer separation projects;
- Green infrastructure projects;
- Main Pumping Station (aka Second Street Pumping Station) - Force Main to MCUA
- CSO Group 4 and 5 - P-017 (Sheridan Street) and P-019 (Smith Street) – satellite storage
- CSO Group 3 – (P-009 through P-016) – Sadowski Parkway near the beach area – satellite storage.
- CSO Group 1 – CSO P-002 (Rudyk Park) – high rate treatment
- CSO Group 2 – CSO P-003 (Buckingham Ave), P-004 (Washington St), P-005 (Commerce St), P-006 (Fayette St), and P-007 (Smith St) – high rate treatment

Program costs including planning level capital costs and 20-year present worth value of operation and maintenance (excluding costs for additional treatment at MCUA associated with the satellite storage facilities)

Table ES-2 – Summary of Selected Long Term Control Plan Project Elements

Implementation Sequence	Description	Planning Cost ($ million)[1]
Over 40 yrs	Sewer Separation	$2.40
Over 40 yrs	Green Infrastructure	$19.86
1	Main PS & FM (13.6 mgd and 1 24-in FM)	$43.94
2	CSO Group 4 and 5 (CSO P-017 & P-019) (Sensitive Area)	$71.81
3	CSO Group 3 (CSO P-009 to P-016) (Sensitive Area)	$195.37
4	CSO Group 1 (CSO P-002)	$4.43
5	CSO Group 2 (CSO P-003 to P-008)	$38.86

Implementation Sequence	Description	Planning Cost ($ million)[1]
TOTAL		$376.67
TOTAL (rounded)		$380 million

[1]2020 dollars

Cost in Table ES-2 are presented in 2020 dollars. These planning level costs include a contingency allowance of 50% (inclusive of general conditions, contractor overhead and profit, legal costs, administrative costs, permitting costs, and overall cost contingency), and an engineering allowance of 20% (inclusive of planning, design, and construction management services). Capital costs do not include land acquisition, unstable subsurface conditions, rock excavation, soil remediation, or other unforeseen or unanticipated or site-specific conditions.

Refer to Section 9 for additional information regarding the Selected Long Term Control Plan and costs associated with it.

E.10 Implementation Schedule

The project costs associated with this 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 for the City of Perth Amboy ratepayers is maintained at acceptable levels. Even so, there will be a period when the cost exceed the EPA high burden threshold for affordability of 2% of median household income.

The City has prioritized the selected projects identified to be effective in reducing combined sewer overflows and have scheduled them for implementation focusing on the potentially sensitive areas identified as the beach area at the initial phases of 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, regulatory/permit requirements, traffic and neighborhood impacts, and maintenance of sewer service throughout construction. The proposed project sequencing is as follows:

Table ES-3 - Anticipated Implementation Schedule

Description	Anticipated Start Year	Anticipated End Year
Sewer Separation	1	40
Green Infrastructure	1	40
Main PS & FM (13.6 mgd and 1 24-in FM)	3	9
CSO Group 4 and 5 (CSO P-017 & P-019) (Sensitive Area)	10	16
CSO Group 3 (CSO P-009 to P-016) (Sensitive Area)	17	23

CSO Group 1 (CSO P-002)	24	30
CSO Group 2 (CSO P-003 to P-008)	31	37

This corresponds to an annual capital spending plan indicated in Figure ES-1, in which the total cumulative capital outlay is nearly $900 million (inflated) over the 40-year implementation schedule.

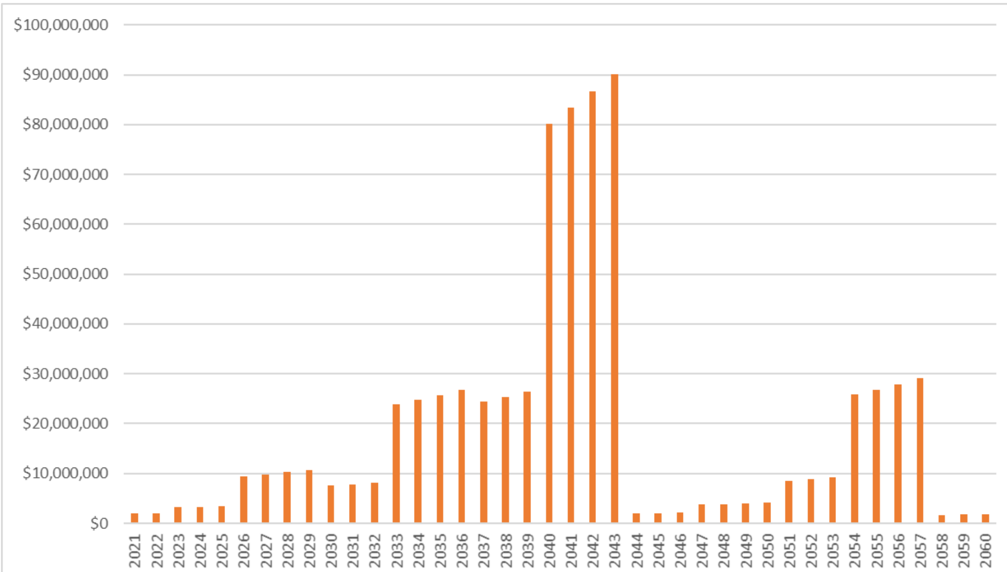

Figure ES-1- Proposed Capital Program Spending by Year (inflated $)

Table ES-4 shows the impact to sewer rates required to fund the proposed capital program spending indicated above.

Table ES-4 - Sewer Rate Analysis

Description	FY 2020	FY 2030	FY 2040	FY 2050	FY 2060
Estimated Household Bill	$330	$540	$1,087	$1,573	$1,383

The City anticipates 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 MCUA 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 they will be potentially significant. 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 MCUA 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.

E.11 Post Construction and 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 water bodies. The City of Perth Amboy and MCUA 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 MCUA to achieve the required CSO control volume reductions under an affordable and sustainable program with broad stakeholder support.

Section 1 Introduction

1.1 Regulatory Context and Objectives

1.1.1 Regulatory Context

United States Environmental Protection Agency's (USEPA) CSO Control Policy (Policy) was issued in April of 1994[1] to elaborate on the 1989 National CSO Control Strategy and to expedite compliance with the requirements of the CWA. The Policy provided guidance to municipal permittees with CSOs, to the state agencies issuing National Pollutant Discharge Elimination System permits (e.g. NJDEP and NJPDES permits). The Policy establishes a framework for the coordination, planning, selection and implementation of CSO controls required for permittee compliance with the CWA.

The Policy includes three major activities required of municipalities with CSO related permits:

- ***System Characterization*** – The identification of current combined sewer system assets and current performance characteristics;
- ***Implementation of the Nine Minimum Controls***[2] – identified in the Policy to ensure that the current combined sewer system is being optimized and property maintained; and
- ***Development of a Long Term Control Plan (LTCP)*** – The analysis and selection of long term capital and institutional improvements to the combined sewer system that once fully implemented will result in compliance with the CWA.

The Policy includes provisions for public and stakeholder involvement (e.g. the CSO Supplemental Committees), the assessment of affordability (rate-payer impacts) and financial capability (permittee ability to finance the long-term controls) as a driver of implementation schedules and two CSO control alternatives. The "presumption" approach is premised on the presumption that the achievement of certain performance standards, e.g. the capture of at least 85 percent of wet weather flows during a Typical Year would result in CWA compliance subject to post-implementation verification. Under the "demonstration" approach, permittees demonstrate that their proposed controls do not cause or contribute to a violation of receiving stream water quality standards.

1.2 Objectives

This document constitutes the City of Perth Amboy's (City) and Middlesex County Utilities Authority (MCUA) Selection and Implementation of Alternatives Report (SIAR) developed jointly

1 59 FR 18688 et seq.

2 The nine minimum controls include: 1) proper operation and regular maintenance; 2) maximizing the use of the collection system for storage where feasible; 3) review and modification of the Industrial Pretreatment Program to minimize CSO impacts; 4) maximization of flow to the wastewater treatment plant; 5) the prohibition of CSOs during dry weather; 6) control of solids and floatables (addressed by NJDEP's requirement of screening or other facilities in the late 2000s); 7) pollution prevention; 8) public notification; and 9) monitoring CSO impacts and controls. 59 FR 18691.

by the City and MCUA for the required "Evaluation of Alternatives" under Part IV Section G.4 of City's and MCUA's New Jersey Pollutant Discharge Elimination System (NJPDES) Permit. The scope of this SIAR is intended to comply with Sections G.2 and G.6 through G.9 of the City's NJPDES Permit (NJ0156132) and MCUA's NJPDES Permit (NJ0020141).

The SIAR constitutes the third and final NJPDES deliverable addressing the control of wet weather overflows from the City's combined sewer systems and the portion of the hydraulically connected system that is owned/operated by the MCUA that services the City of Perth Amboy. The System Characterization Report (2018) documented the physical characteristics and baseline performance of the combined sewer system. The 2019 Development and Evaluation of Alternatives Report (DEAR) documented the evaluation of combined sewer overflow (CSO) control alternatives that meet the water quality-based requirements of the Clean Water Act. The SIAR builds upon the DEAR and presents the City's and MCUA's selected control strategy and preliminary implementation schedule. These three reports collectively comprise a complete Long Term Control Plan (LTCP) as required in the NJPDES permits.

In accordance with the NJPDES Permits' LTCP requirements, a Selection and Implementation of Alternatives Report (SIAR) was originally to be submitted by June 1, 2020. Due to COVID-19 pandemic, both the City and MCUA, as well as other members of the New Jersey CSO Group[3], requested extensions to this due date. NJDEP approved this request and modified the permit required submission date to a revised date of October 1, 2020.

1.3 Background

The City of Perth Amboy owns a sewage and stormwater collection system serving 50,814 residents per the 2010 Census and 3,525 business customers (2007, Census Business QuikFacts). The City of Perth Amboy is served by both combined and separate sewers and owns and operates combined sewer overflows (CSOs). An estimated 41,000 of the City of Perth Amboy's residents are served directly by a combined sewer system which covers approximately 2.5 square miles. An additional 9,800 residents are served directly by a separated sewer system which is conveyed to the combined sewer system. While the City retains ownership of existing sewer infrastructure, the operations of the City's CSO system is performed by Utility Service Affiliates-Perth Amboy (USA-PA), an affiliate of Middlesex Water Company.

Sewage flows from Perth Amboy are pumped to the Woodbridge Township's Keasbey Interceptor which ultimately flows through the MCUA's Heyden Gravity Sewer to the Edison Pump Station, where flow is pumped to the MCUA's Edward J. Patten Water Reclamation Center for treatment. Figure 1-1 displays a map of Perth Amboy's service area system and how it connects to Woodbridge and MCUA. Perth Amboy has been coordinating with MCUA and Woodbridge Township in developing the City's Long-Term Control Plan as required by the City's permit. It has been determined that the Township of Woodbridge (Woodbridge) is not hydraulically connected and therefore was not issued a CSO Permit. The City has coordinated with Woodbridge and Woodbridge has advised the City the Woodbridge interceptor capacity has been reached, so no further flow can be conveyed through it to MCUA.

[3] The New Jersey CSO Group is a regional consortium of CSO permittees.

Perth Amboy and MCUA are also working in cooperation with the Passaic Valley Sewerage Commission (PVSC) to address certain NJDPES permit compliance items through the NJ CSO Group, of which Perth Amboy, MCUA, and PVSC are members. PVSC is developing a Baseline Compliance Monitoring Program Work Plan and Report for which CSO events are monitored and will be maintaining a website for public notification: https://njcso.hdrgateway.com.

This report focuses on the implementation of the selected alternatives and includes descriptions of the sewer system and treatment facilities, baseline sewer system performance, water quality objectives, results of the development and evaluation of alternatives, discussion of the CSO control approach, a financial capability assessment, public participation process update, the selected CSO control plan, an implementation schedule, and a post construction compliance monitoring program.

The public participation process update will provide a summary of the public input received via a variety of outreach activities by Perth Amboy to its CSO Supplemental Team, other direct stakeholders to the LTCP development, residents within the City of Perth Amboy and the general public throughout the development and evaluation of alternatives. The City of Perth Amboy has conducted outreach with its hydraulically connected separately sewered communities via coordination with the MCUA. This information has been used by Perth Amboy and MCUA to support the development of the LTCP and information gathered will be used to satisfy certain NJPDES permit requirements.

This SIAR and LTCP present 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. The City MCUA 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 MCUA to advance the implementation of the selected alternative.

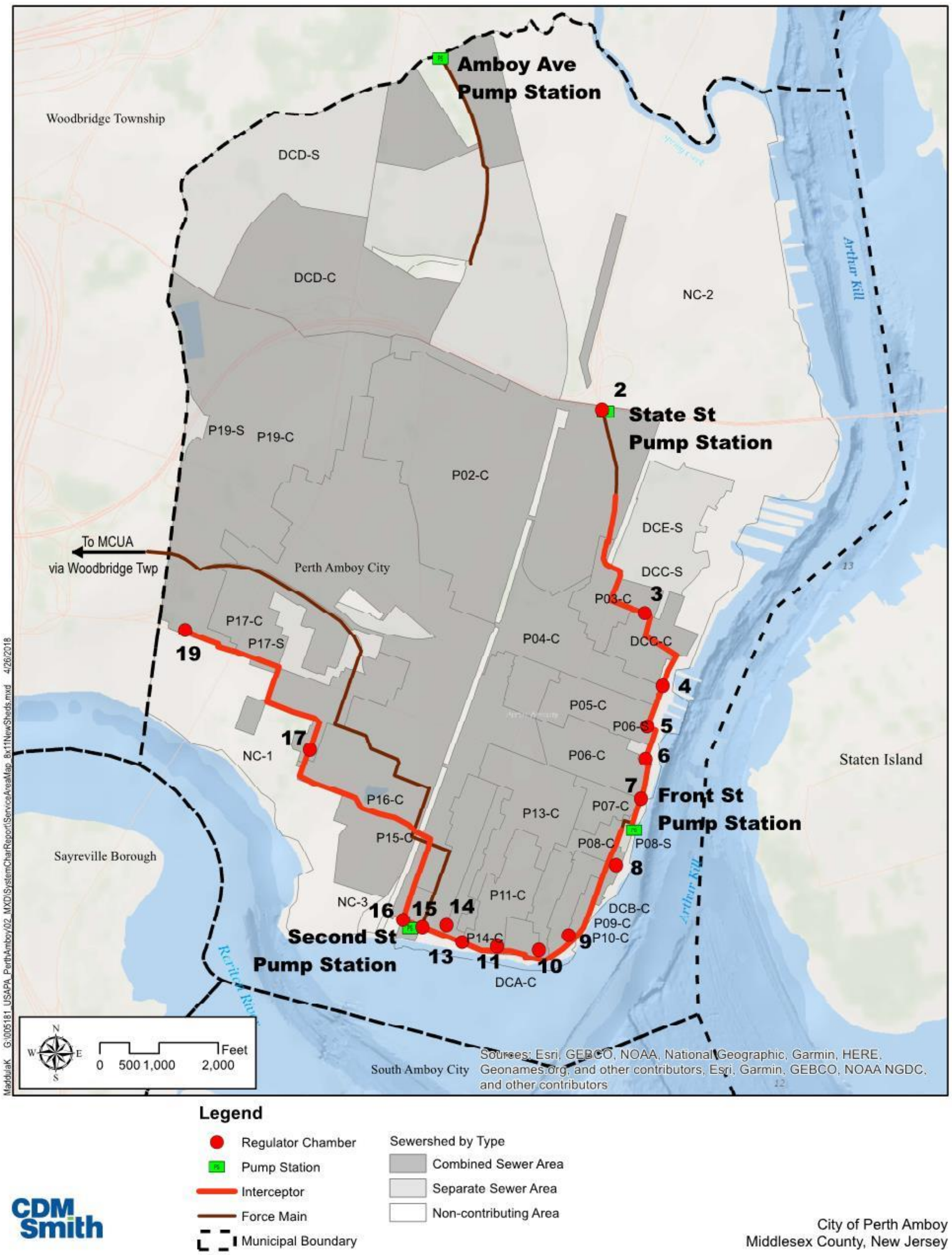

Figure 1-1 - Perth Amboy Service Area

1.4 Related Permit Submissions and Reports

Under Section 1311 of the CWA, all point source discharges to the waters of the United States must be permitted. USEPA Region II has delegated permitting authority in New Jersey to the New Jersey Department of Environmental Protection (NJDEP). The New Jersey Pollutant Discharge Elimination System (NJPDES) permits are reissued on a nominal five-year cycle. All twenty-one New Jersey municipalities and municipal authorities with combined sewer systems were issued new permits in 2015 that set forth requirements for the completion of the system characterization and the development of LTCPs on the following schedule:

- Submittal of the System Characterization Report to NJDEP – July 1, 2018;
- Development & Evaluation of CSO Control Alternatives – July 1, 2019; and
- Selection and Implementation of Alternatives – June 1, 2020 (extended to October 1, 2020 by NJDEP permit modification).

With minor exceptions such as lists of applicable previous studies, the 2015 permits are standardized. The 2015 information to be included in the Development and Evaluation of Alternatives Report is specified in Part IV (Specific Requirement: Narrative) paragraph G-3, G-4, and G-5 of the permits. These requirements are reproduced on Table 1-1 along with the section of the Long Term Control Plan in which the requirements are addressed and a list of the principal sources of data used for each requirement.

All flow from Perth Amboy's sewer system that reaches the Second Street Pumping Station (previously referred to as the Main Pumping Station) is pumped to the Woodbridge Township's Keasbey Interceptor which ultimately gets pumped to the Middlesex County Utilities Authority's Edward J. Patten Water Reclamation Center for treatment.

In 2018 the City and MCUA submitted individual system characterization report and were subsequently approved by NJDEP. For the second submittal in 2019, the City and MCUA worked together on evaluating an array of alternatives and jointly produced the Development and Evaluation of Alternatives Report.

1.5 Report Organization

This report provides the selected alternatives and the implementation plan for the CSO control alternatives predicted to accomplish the requirements of the CWA. As required by the NJPDES Permit Section D.3.b.vi., an overview of the organization and contents of this Selection and Implementation of Alternatives Report and reference to the permit requirement each section fulfills are provided in Table 1-1.

Table 1-1 - Report Organization and Contents

Permit Section	Section No. and Title	Content
-	Section 1 – Introduction	Background, Regulatory Context, Certifications
Part IV G.1.	Section 2 - Sewer System and Treatment Facilities Descriptions	Sewer system overview, combined sewer service area, CSO regulators, CSO outfalls, pumping stations, CSO groups

Permit Section	Section No. and Title	Content
Part IV G.1.	Section 3 - Baseline Sewer System Performance	Hydraulic Model details, Typical Year Selection, future wastewater flow projections, future conditions performance
Part IV G.1. and G.3.	Section 4 - Water Quality Objectives	Receiving waters descriptions, water quality parameters and applicable standards, compliance monitoring program, water quality modeling data, environmentally sensitive areas
Part IV G.4.	Section 5 - Development and Evaluation of Alternatives	Description of Alternatives, Alternatives Evaluation
Part IV G.7.	Section 6 - CSO Control Approach	Peak flow options to MCUA, Single Technology Alternatives, Mixed Technology Alternatives and phasing, MCUA CTP Alternatives
Part IV G.8.c.iv. through vii.	Section 7 - Financial Capability	Annual revenue requirements, residential indicator, financial capability indicators, additional economic factors
Part IV G.2.	Section 8 - Public Participation Process Update	Supplemental CSO Team, public meetings, regional and watershed based partnerships, outreach activities, future public participation
Part IV G.7.	Section 9 - Selected Plan	Description of selected CSO Control approach
Part IV G.6. and G.8.	Section 10 -Implementation Schedule	Scheduling criteria and assumptions, financing plan, factors that could affect implementation schedule, operational plan
Part IV G.9.	Section 11 - Post Construction Compliance Monitoring	Assessment plan approach, data management and analysis

1.6 City of Perth Amboy – Certification

I certify under penalty of law that those portions of this document relating to the collection system owned and operated by the permittee and all attachments related thereto were prepared either: (a) under my direction or supervision; or (b) as part of a cooperative effort performed by members of the NJ CSO group in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system owned and operated by the permittee, 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.

Luis A. Perez Jimenez 9/30/20

Luis A. Perez Jimenez, P.E., MBA, CME
Director of Operations

Date

1.7 Middlesex County Utilities Authority – Certification

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that those portions of this document relating to the treatment and collection system owned and operated by the permittee and all attachments related thereto were prepared either: (a) under my direction or supervision; or (b) as part of a cooperative effort performed by members of the NJ CSO group in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system owned and operated by the permittee, 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.

9/30/20

Joseph P. Cryan
Executive Director

Date

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Section 2

Sewer System and Treatment Facilities Description

2.1 Regional Sewer System Overview

Currently Perth Amboy's combined sewer flows reach the MCUA's CTP via infrastructure owned and operated by two municipalities and one regional authority; City of Perth Amboy, Woodbridge Township and MCUA, respectively. This infrastructure includes:

- Perth Amboy's Infrastructure: Combined Sewer System, Second Street Pumping Station, Force Main and gravity sewer connection to Woodbridge Township's Keasbey Interceptor;
- Woodbridge' Infrastructure: Upper and Lower Keasbey Interceptor to the MCUA's Heyden Gravity Sewer;
- MCUA's Infrastructure: Heyden Gravity Sewer, Perth Amboy Meter Chamber, Woodbridge Meter chamber, Edison Pumping Station and Force Mains to the CTP

2.1.1 Woodbridge's Infrastructure

The infrastructure owned and operated by each municipality has capacity limitations that are addressed in the MCUA's System Characterization Report - Heyden Gravity Sewer (June 2018, Revised December 2018). The report describes the conveyance system in detail and the capacities of the Perth Amboy, Woodbridge and MCUA components of the system. The interrelationship between the various flow sources entering the Heyden Gravity Sewer and Edison Pumping Station are illustrated in Table 2-1. It is important to note there are several participant meter chambers that also contribute flows to this conveyance system between Perth Amboy and the MCUA. The available capacity in each portion of this conveyance system during the Top 20 Storm Events of 2004 is summarized in Table 2-1. Please note that Table 2-1 is the same as in the MCUA's System Characterization Report, except it has been revised to include the capacity and flows for the Woodbridge's Lower Keasbey Interceptor, as requested by Mr. Dwayne Kobesky in his January 15, 2019 NJDEP letter to MCUA. In addition to the capacity limitations described in the MCUA's aforementioned System Characterization Report, there are constraints to the conveyance of Perth Amboy's flows to the CTP via Woodbridge's infrastructure by the terms and conditions in the service agreement between the City of Perth Amboy and Woodbridge Township. The capacity limitations and contractual terms and conditions in the service agreements make this existing conveyance system a very complex as well as contractually and hydraulically limited system.

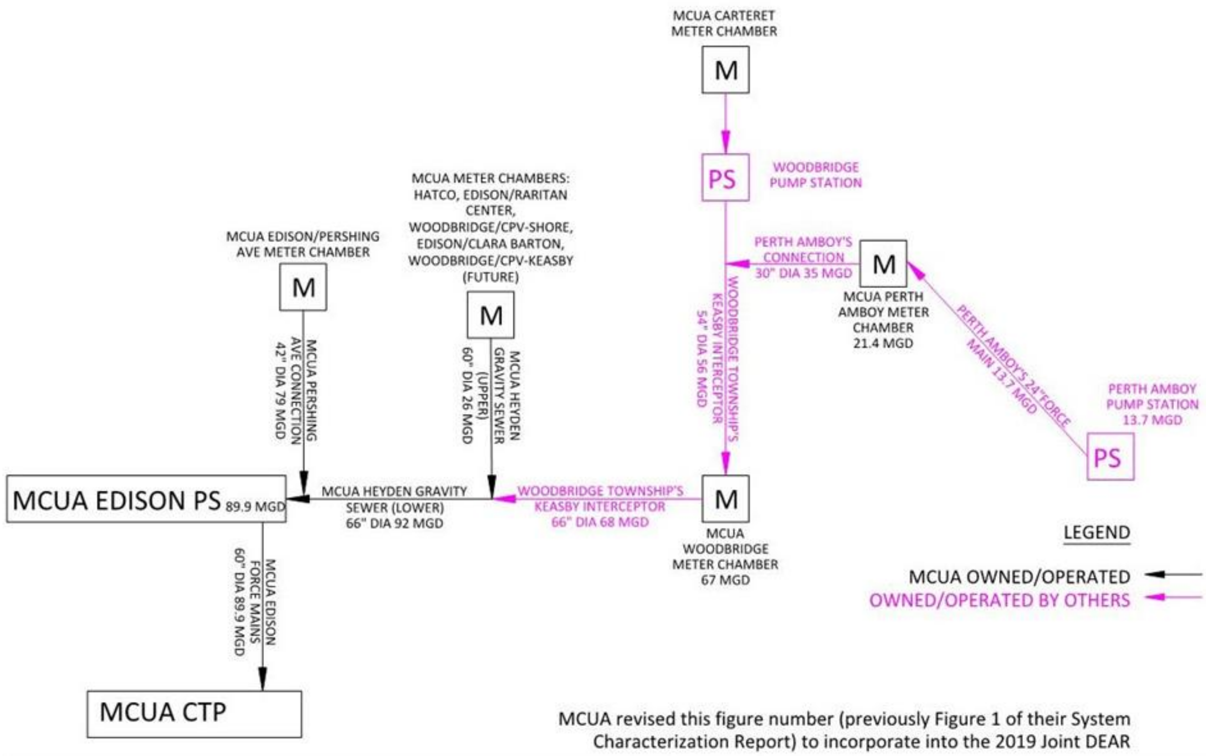

Figure 2-1 – MCUA's Heyden Gravity Collection System Diagram

2.1.2 MCUA's Infrastructure

The MCUA owns and operates a regional sewerage system that collects wastewater flows from thirty-six (36) communities in Middlesex, Somerset, and Union Counties and provides secondary treatment of these flows at its Central Treatment Plant (CTP) located at 2571 Main Street Extension in Sayreville, New Jersey. The City of Perth Amboy is the only municipality whose collection system has combined sewers. The wastewater is collected by these communities with their own collection systems and discharged to the CTP through seventy-five (75) meter chambers owned and operated by the MCUA. In addition, the MCUA meters flows from four (4) direct industrial participants. The metered flows are then conveyed to the CTP via the MCUA's system of interceptors, trunk sewers and siphons that convey the flows to three regional pumping stations and force mains to the CTP. All flows are pumped to the CTP for treatment and disinfection prior to discharge into the Raritan Bay and the North Channel of the Raritan River. These conveyance facilities are located throughout the MCUA's service area as shown on Figure 2-2.

Table 2-1 - MCUA Sewer Capacities and Actual Sewage Flows During Top 20 Events in 2004

Typical Year (2004) Storms -- Ranked by Total Rainfall by PVSC (in)*		Newark Rainfall	Perth Amboy P.S. (Note 1)	Perth Amboy M.C. (Note 1)	Woodbridge Upper Keasbey Interceptor (Notes 3&4)	Woodbridge M.C. (Note 1)	Woodbridge Lower Keasbey Interceptor (Notes 3&4)	Upper Heyden Gravity Sewer (Note 1)	Lower Heyden Gravity Sewer (Note 1)	Edison P.S. (Note 1)	CTP (Note 2)
			Capacity (MGD)								
			13.7	21.4	56	67	68	26	92	89.9	147
Ranking	DATE	(in)	Actual Flow / Capacity (%)								
1	9/28/2004	3.10	80%	51%	78%	65%	64%	35%	57%	63%	109%
	9/29/2004	0.57	68%	44%	63%	52%	52%	28%	46%	50%	214%
2	9/8/2004	2.08	58%	37%	45%	38%	37%	20%	33%	36%	91%
	9/9/2004	0.29	41%	26%	29%	24%	24%	18%	23%	25%	86%
3	7/12/2004	1.59	84%	54%	66%	56%	55%	30%	49%	53%	108%
	7/13/2004	0.40	54%	34%	44%	36%	36%	29%	35%	38%	133%
4	4/12/2004	0.62	58%	37%	41%	34%	33%	24%	31%	34%	79%
	4/13/2004	1.05	59%	38%	61%	51%	50%	24%	44%	47%	135%
	4/14/2004	0.43	59%	38%	56%	47%	46%	27%	42%	45%	158%
5	4/25/2004	0.09	51%	33%	31%	26%	26%	21%	25%	27%	83%
	4/26/2004	1.58	70%	45%	51%	42%	42%	29%	39%	43%	108%
6	7/23/2004	1.63	71%	46%	58%	49%	48%	37%	46%	49%	103%
7	2/6/2004	1.58	75%	48%	73%	61%	60%	34%	54%	58%	151%
8	7/18/2004	1.58	68%	43%	46%	38%	38%	26%	35%	38%	90%
9	11/28/2004	1.50	72%	46%	58%	48%	48%	26%	43%	45%	133%
10	7/27/2004	1.39	64%	41%	60%	50%	49%	29%	45%	48%	106%
11	9/17/2004	0.03	34%	21%	21%	18%	18%	19%	18%	20%	76%
	9/18/2004	1.41	45%	29%	30%	25%	25%	19%	23%	25%	85%
12	6/25/2004	1.39	44%	28%	40%	33%	33%	26%	31%	34%	83%
13	11/12/2004	0.94	81%	52%	46%	38%	38%	20%	33%	35%	89%
14	5/12/2004	1.08	43%	28%	28%	24%	23%	22%	24%	26%	85%
15	11/4/2004	1.00	58%	37%	36%	30%	29%	13%	25%	27%	82%
16	7/5/2004	1.00	49%	32%	30%	25%	25%	20%	24%	26%	88%
17	12/1/2004	1.00	68%	44%	55%	46%	46%	22%	40%	43%	132%
18	8/16/2004	0.94	54%	34%	34%	28%	28%	21%	26%	29%	91%
19	8/21/2004	0.85	43%	27%	27%	23%	22%	21%	22%	24%	84%
20	12/6/2004	0.19	47%	30%	28%	24%	23%	18%	22%	24%	84%
	12/7/2004	0.57	79%	51%	54%	45%	44%	21%	39%	41%	102%
	12/8/2004	0.07	51%	33%	38%	32%	31%	23%	30%	32%	119%

* Reference: Table 2-6, Passaic Valley Sewerage Commission (PVSC) - Typical Hydrologic Year Report, dated May 2018.

Notes:

1. In 2004, the MCUA's CTP effluent discharge was in compliance with the monthly average discharge concentration and loading limitations set forth in its NJPDES Permit No. NJ0020141.
2. Per MCUA's NJPDES Permit No. NJ0020141, the current permitted design capacity of the MCUA Central Treatment Plant is 147 mgd.
3. Woodbridge's Upper and Lower Keasbey Interceptor capacities were calculated based upon available information.
4. MCUA revised this table (previously Table 4-1 in the System Characterization Report) by including the capacity and flows for Woodbridge's Keasbey Interceptor, as requested by Mr. Dwayne Kobesky in the NJDEP's January 15, 2019 letter to MCUA.

Refer to Section 4.2.3 for the Description of the MCUA's CTP (processes, capacity, limitation, etc.) from the DEAR.

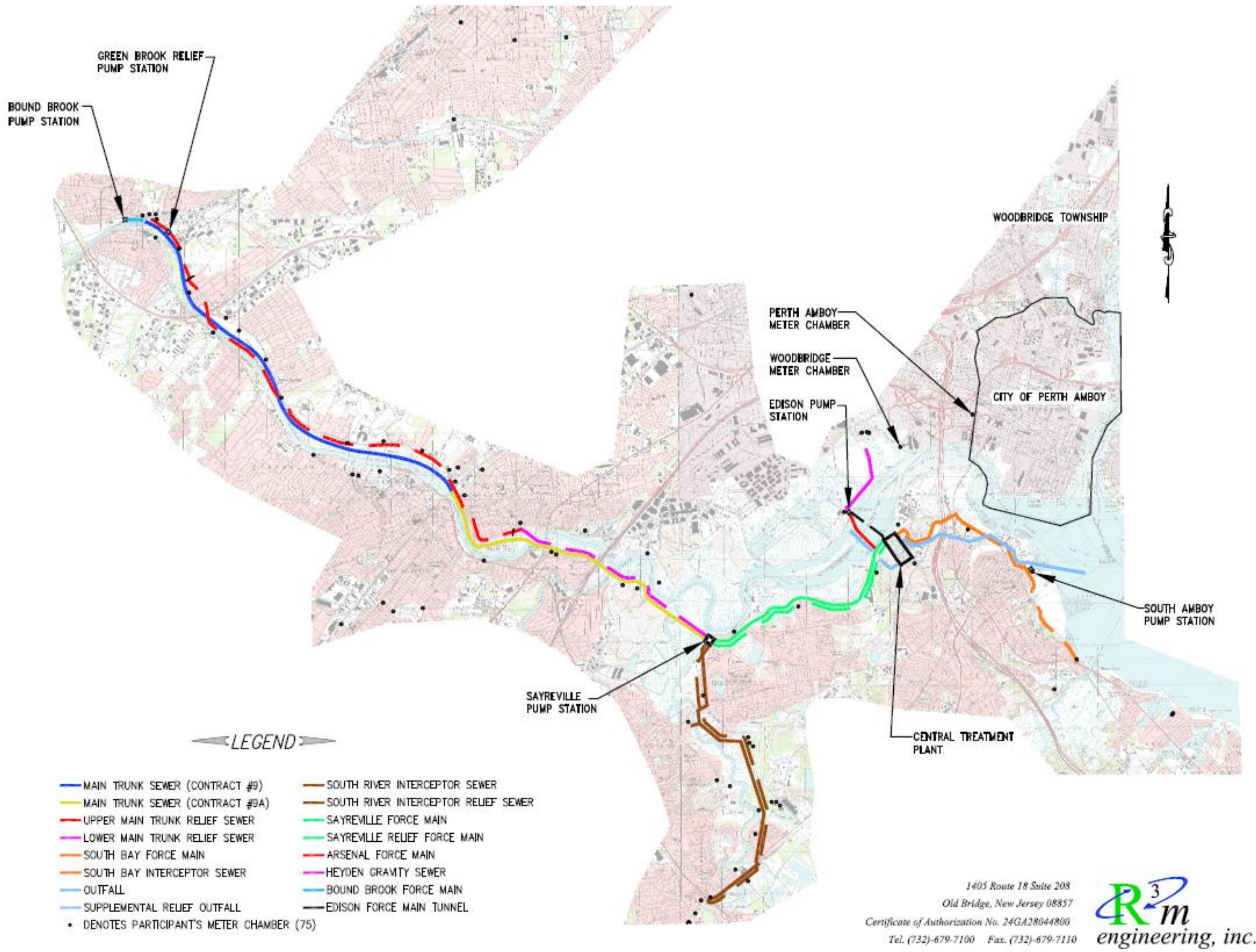

Figure 2-2 - MCUA Conveyance Facilities

2.1.3 MCUA CTP

The MCUA's CTP is rated for 147 MGD average daily flow. The influent flow is screened at the three (3) major pumping stations before pumping to the CTP: Edison Pumping Station, Sayreville Pumping Station, and South Amboy Pumping Station. This pumped flow is directed to the CTP's headworks from where it flows by gravity through the plant.

Preliminary and primary treatment consists of four (4) aerated grit chambers and six (6) rectangular primary settling tanks. Primary effluent flows to the pure-oxygen activated sludge process, consisting of four (4) pure-oxygen oxygenation tanks equipped with mechanical aerators and sixteen (16) circular final settling tanks.

From the oxygenation tanks, the mixed liquor flows to the final settling tanks. The secondary effluent is then disinfected using sodium hypochlorite and discharged ultimately to the Raritan Bay. The plant effluent up to approximately 120 MGD is discharged through the Main Outfall directly to Raritan Bay; and effluent flows greater than approximately 120 MGD are discharged via the supplemental relief outfall to the North Channel of the Raritan River. The Raritan Bay and the North Channel of the Raritan River are SE1 waters.

The primary sludge and waste activated sludge are pumped to eight (8) gravity thickener tanks. The thickened sludge is dewatered with ten (10) belt filter presses. The dewatered sludge cake is stabilized using the alkaline stabilization process or thermal treatment with equipment located in the DuopHase facility. The thickener tanks overflow, belt filter press filtrate and the DuopHase process condensate from the DuopHase facility are collected in the TTO Pumping Station, where it is screened and pumped to the Primary Effluent Channel for treatment.

2.2 Perth Amboy's Combined Sewer System

The details of the City of Perth Amboy's Combined Sewer System are described in the System Characterization Report dated June 28, 2018.

2.2.1 Overview

An estimated 84% of the City of Perth Amboy's residents are served directly by a combined sewer system which covers approximately 2.5 square miles. The other 16% of the residents are served directly by a separated sewer system which is conveyed to the combined sewer system.

The City of Perth Amboy is served by both combined and separate sewers and owns and operates combined sewer overflows (CSOs) and pump stations. The system currently operates under a New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water (DSW) Permit NJ0156132.

The wastewater collection system is a combined system accepting both wastewater and storm water. It is comprised of approximately 366,000 LF of gravity main, ranging in sizes 6" to 84". These mains are constructed of vitrified clay, brick, and concrete, with new or repaired sewer pipelines that are PVC, ductile iron, and concrete. Currently there are approximately 9,750 lateral service connections feeding into this system.

2.2.2 Combined Sewer Service Area

The City's wastewater collection system is made up of approximately 95 miles of main and trunk pipelines. These pipelines flow into the Eastside or Westside Interceptor Sewer and then flow towards the Second Street Pumping Station for pumping to MCUA. These main and trunk lines installed in the past were constructed of vitrified clay, brick, and concrete. Current practice is to use PVC, ductile iron, and concrete for new sewer pipelines and system repairs. There are approximately 1,850 manholes which serve as access points to the collection system, which are as deep as 35 feet. There are approximately 2,000 storm sewer inlets that feed into the combined wastewater system. Within the collection system there are no chemical feed sites, no inverted siphons, and no inverted chambers.

The combined sewer system includes sixteen NJDEP-permitted combined sewer outfalls, with eight outfalls draining to the Arthur Kill and eight outfalls draining to the Raritan Estuary. The separated sewer areas discharge stormwater to the receiving waters and deliver sanitary sewerage to the combined sewer system. Both sanitary and combined sewer flow are conveyed through the City's 4.3 miles of the interceptor pipes which are divided into an Eastside (2.7 miles) and Westside (1.6 miles). The confluence of the two branches is located on the influent sewer line at the City's main pumping station, the Second Street Pumping Station, located on Second Street along the shore of the Raritan Estuary. There are four pump stations within the system: Amboy Avenue Pumping Station, State Street Pumping Station, Front Street Pumping Station, and the Second Street Pumping Station.

All flow from the Second Street Pumping Station is ultimately conveyed to the Middlesex County Utilities Authority (MCUA) Edward J. Patten Water Reclamation Center for treatment. The Second Street Pumping Station is capable of delivering a maximum of 13.6 MGD to MCUA during wet weather. The force main is 24" in diameter. Perth Amboy's flow is recorded in the Perth Amboy meter chamber, which is located upstream of the Woodbridge Township's Keasbey Interceptor. From there, flow is conveyed by gravity sewer to the MCUA's Edison Pumping Station and then to the reclamation center headworks, which is located on the Raritan Bay shoreline, upstream and on the opposite bank from Perth Amboy.

Historically, Perth Amboy has had very few issues in its sewer system related to CSO related flooding. Fats, oil and grease buildup in the sewers have been known to cause sewer backups in certain areas, however, a regular maintenance program has been instated in these areas which has allowed issues to be resolved in a timely manner. The City of Perth Amboy maintains a phone line to respond to questions or concerns raised by the public (732-826-5335 or 732-721-3664). The phone calls are recorded on incident cards and are also entered into a logbook maintained at the Second Street Pumping Station.

2.2.3 Interceptor Sewer System

The Eastside Interceptor branch begins at the State Street Pump Station, which is located beneath the Outerbridge Crossing along the Arthur Kill. The pump station accepts influent flow from the sewershed area tributary to the regulator structure at outfall P-002 and from the area that was previously tributary outfall P-001, which was closed following a sewer separation project. The regulator structure at outfall P-002 is a "leaping weir" structure which is mounted in the crown of the interceptor pipe. Flow enters the leaping weir in an 84" trunk sewer. Incoming flow falls into a 33"interceptor during dry weather conditions. During rainfall events, the flow increases and gains enough energy to "leap" over the interceptor into an 84" overflow pipe which discharges into a small tributary to the Arthur Kill. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe.

The discharge from the State Street Pump Station travels south along State Street and then east along Buckingham Avenue, first by a 24" force main, then by a 24" gravity sewer, and then by a 36" gravity sewer until it reaches the regulator structure on Buckingham Avenue (P-003), which is a leaping weir type structure. Prior to reaching the regulator structure, a small amount of additional contributing area is connected to the interceptor. In addition, there is a known cross-connection between the sewershed areas for outfalls P-002 and P-003 at the corner of Hall Avenue and State Street which diverts high flows from Hall Avenue towards outfall P-003 instead of outfall P-002. The survey was not able to locate the diversion structure, but the downstream end of the connection was confirmed during past field inspections. During dry weather flow conditions, sewerage entering the regulator structure at outfall P-003 drops over the leaping weir and into a 48" interceptor sewer. Overflows "leap" over the weir into the 36" outfall which discharges into the Arthur Kill. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe.

Downstream from the P-003 sewershed, the Eastside Interceptor branch continues through a 48"interceptor to travel south along High Street and then Front Street, picking up an additional sanitary contribution from a large separate sewered development (Harbortown) and the regulated combined sewer flow from diversion structures upstream of outfalls P-004, P-005, P-006 and P-007, which are all leaping weir type structures located on the crown of the interceptor. The influent trunk sewer sizes are 42" by 54", 36", 24" by 36", and 30" by 42", respectively. The overflow pipe sizes are 48", 36", 48", and 42", respectively. All of the overflow pipes have a netting chamber located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe to the Arthur Kill. Outfalls P-005, P-006, and P-007 all have tide gates.

The 48" Eastside Interceptor branch continues to travel south until it reaches the Front Street Pump Station which also accepts the regulated combined sewer flow from the sewershed tributary to outfall P-008, which travels north along Front Street in a 15" sewer. The regulator structure at P-008 is a leaping weir type structure with a 36" influent trunk sewer and a 36" overflow pipe that discharges to the Arthur Kill. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe.

The discharge from the Front Street Pump Station travels west by 36"force main and then south by a 36" gravity sewer along Water Street, accepting the regulated flow from the final Arthur Kill regulator structure, upstream of outfall P-009. This structure is a leaping weir type structure located remotely from the interceptor. Flow enters the regulator structure in a 18" trunk sewer. During dry weather flow conditions, flow drops into an 8" lateral which connects to the interceptor near the intersection of Lewis Street and Water Street. During rainfall events, the flow increases and gains enough energy to "leap" over the interceptor into a 24" overflow pipe which discharges into the Arthur Kill. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe.

The 36"interceptor turns west along Sadowski Parkway where it accepts the regulated combined sewer flow from diversion structures P-010, P-011, P-013, P-014, and P-015, which are all leaping weir type structures, before it readies the Main Pump Station. Regular structures at outfalls P-013 and P-015 are located on the crown of the interceptor. Regulator structures at outfalls P-010, P-11 and P-014 are all located remotely from the interceptor and connect to the interceptor via 12" lateral sewers. The influent trunk sewer sizes are each 24" by 36" and the overflow pipes are each 36" with tide gates. All of the overflow pipes have a netting chamber located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe to the Raritan River. All of these outfalls have tide inflow prevention gates.

The Westside Interceptor branch begins at the regulator structure of P-019, located on Smith Street. The diversion structure is a leaping weir type structure in an elevated chamber. Flow enters the chamber in a 72" sewer. During dry weather flow conditions/ sewerage entering the P-019 structure drops over the leaping weir and into a 15" interceptor sewer. Overflows "leap" over the weir into the 72" outfall which discharges into a swale on the Hess Oil property and eventually into Raritan Bay. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe.

The interceptor runs east along Smith Street and eventually south along Sheridan Street, increasing to 24", until it reaches on Sheridan Street, to the regulator structure at outfall P-017. Prior to reaching the diversion structure, some additional contributing area is connected to the interceptor. This includes area which was formerly regulated by the now decommissioned diversion structure at the former P-018 outfall. The diversion structure at outfall P-017 does not have a leaping weir. The structure consists of the 24" influent, a 30" effluent interceptor in the side wall of the chamber, and a 24" overflow pipe with an elevated invert located in-line with the influent pipe. During dry weather flow conditions, sewage entering the P-017 regulator structure continues through the side wall into to 30" effluent interceptor. During wet weather events, when the level in the chamber increases, surcharge conditions in the interceptor develop and the excess flow is discharged through the overflow pipe. The invert of the overflow pipe is only slightly above the crown of the effluent interceptor pipe. During dry weather conditions, it was observed that the effluent interceptor pipe is close to surcharge.

The 30" interceptor continues south along Sheridan Street, turns east along Patterson Street and runs beneath industrial property at the end of Patterson Street, between Grant Street and Elm Street. A 66"trunk sewer connects to the interceptor on Elm Street, and the effluent 78" interceptor continues to Second Street where it increases to 84" and turns south towards the diversion structure at outfall P-016. Regulator structure P-016 is a "leaping weir" structure. The 84" interceptor enters the leaping weir. Incoming flow falls into a 30"sewer during dry weather conditions and combines with the Eastside Interceptor behind the Main Pump Station. During rainfall events, the flow increases and gains enough energy to "leap" over the interceptor into an 84" overflow pipe which discharges into the Raritan River. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged though the outfall pipe and a tide gate is located at the end of the outfall pipe.

A schematic view of the interceptor system is illustrated in Figure 2-3.

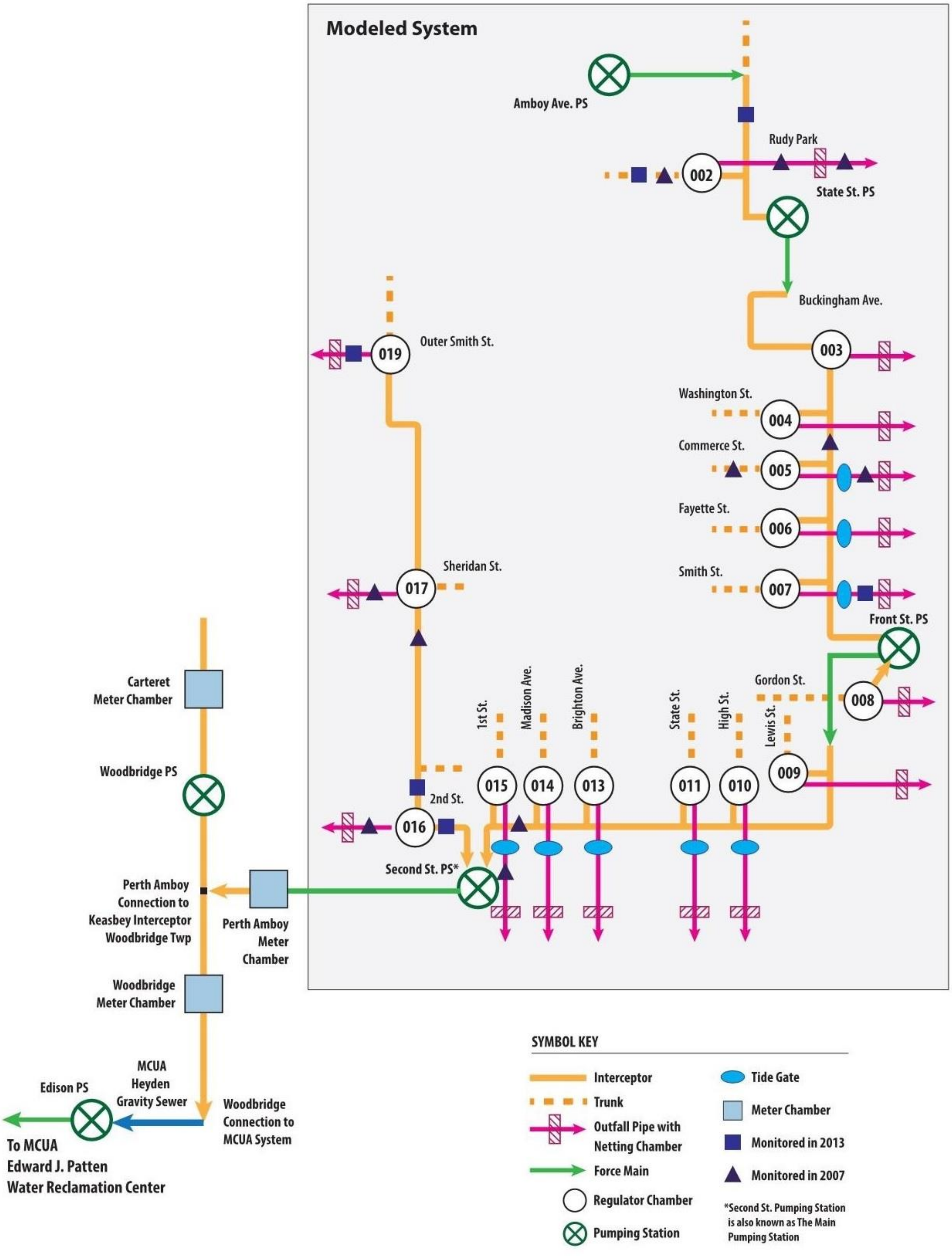

Figure 2-3 - Perth Amboy Combined Sewer System Schematic with Historic Locations

2.2.4 Combined Sewer Overflow Regulators

The City of Perth Amboy collection system has been designed to regulate flows into the interceptor sewers via a series of "leaping weir" structures. These regulator structures allow dry weather flow to be conveyed through an orifice leading to the interceptor collection system, and during rainfall events, the flow increases and gains enough energy to "leap" over the orifice and enter the outfall pipe for discharging into the receiving water. A schematic of a leaping weir configuration is displayed in Figure 2-4.

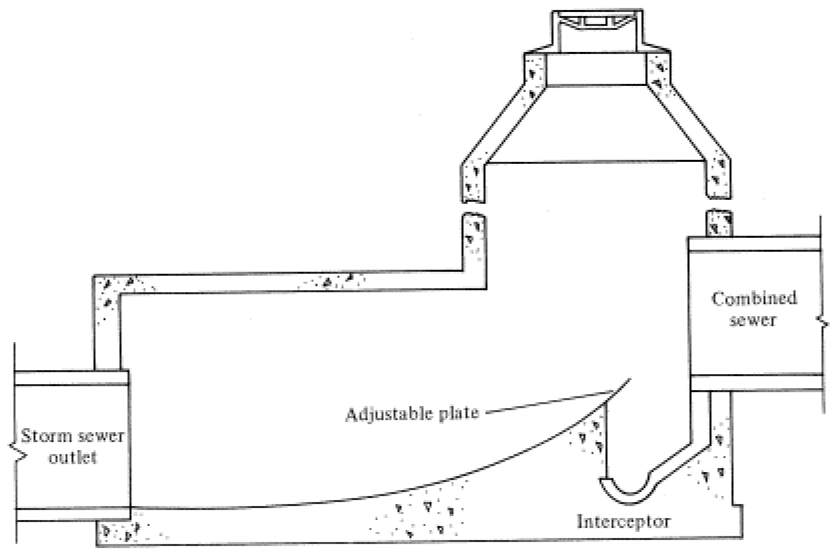

Figure 2-4 - Schematic of Adjustable Leaping Weir Regulator Structure[4]

The exact year of installation of all CSO outfalls is unknown; information presented in this report was taken from drawings dated 1934. These drawings, obtained from the City of Perth Amboy sewer department and prepared by Carr Engineering Associates, P. A., for multiple sewer system projects contain the dimensions of the majority of the regulator structures including configurations of leaping weirs. The dimensions for those leaping weirs not identified in the available plans were assumed using information gathered at the other diversion structures. The leaping weir openings were modeled as bottom outlet orifices connecting the influent trunk sewer with the lower interceptor pipe. A summary of the configurations for the leaping weir diversion structures is presented in Table 2-2.

[4] Source: _Wastewater Engineering: Collection and Pumping of Wastewater._ *Metcalf & Eddy, Inc., 1981.*

Table 2-2 - Leaping Weir Diversion Structure Summary

Diversion Structure ID Number	Influent Pipe Size (ft)	Weir Width (ft)	Weir Length (ft)	Weir Width / Influent Pipe Width	Influent Cross Section (ft^2)	Sump Orifice Cross Section (ft^2)
2	7	3.33	0.667	0.48	38.5	2.2
3	3	1.08	0.667	0.36	7.1	0.7
4	3.5 x 4.5	1.67	0.583	0.48	15.8	1.0
5	2 x 3	1.25	0.417	0.63	6.0	0.5
6	2.33 x 3.5	1.83	0.583	0.79	8.2	1.1
7	2.33 x 3.5	1.33	0.542	0.57	8.2	0.7
8	3	1.08	0.667	0.36	7.1	0.7
9	1.25	0.70	0.700	0.56	1.2	0.5
10	2 x 3	1.25	0.458	0.63	6.0	0.6
11	2 x 3	1.25	0.458	0.63	6.0	0.6
13	2 x 3	1.25	0.458	0.63	6.0	0.6
14	2 x 3	1.25	0.458	0.63	6.0	0.6
15	2 x 3	1.25	0.458	0.63	6.0	0.6
16	7	3.33	0.667	0.48	38.5	2.2
17	Not a leaping weir					
19	6	3.33	0.667	0.56	28.3	2.2

2.2.5 Combined Sewer Outfalls

There are 16 combined sewer outfalls within the City of Perth Amboy, all owned by the city. A summary of these outfalls is located in Table 2-3. The information presented in Table 2-4 is referenced from data contained in the original combined sewer system plans dated 1934; the exact age of the combined sewer outfalls is unknown. All outfalls have solids and floatables controls that were installed in 2000.

Table 2-3 - Combined Sewer Outfall Summary

CSO Outfall Number	CSO Outfall Location	Receiving Water	Outfall Pipe Diameter	Type of Material	Tide Gate?
P-002	Rudyk Park	Arthur Kill	84" elliptical	Brick	No
P-003	Buckingham Ave.	Arthur Kill	36"	Unknown	No
P-004	Washington St.	Arthur Kill	36"	Unknown	No
P-005	Commerce St.	Arthur Kill	36"	Unknown	Yes
P-006	Fayette St.	Arthur Kill	48"	Unknown	Yes
P-007	Smith St.	Arthur Kill	36"*	Brick	Yes
P-008	Gordon St.	Arthur Kill	36"	Unknown	No

CSO Outfall Number	CSO Outfall Location	Receiving Water	Outfall Pipe Diameter	Type of Material	Tide Gate?
P-009	Lewis St.	Arthur Kill	15"	Unknown	No
P-010	High St.	Raritan River	36"	Brick	Yes
P-011[1]	State St.	Raritan River	36"	Unknown	Yes
P-013	Brighton Ave.	Raritan River	24"	Unknown	Yes
P-014	Madison Ave.	Raritan River	36"	Unknown	Yes
P-015	First St.	Raritan River	36"	Unknown	Yes
P-016	Second St.	Raritan River	72"	Unknown	Yes
P-017	Sheridan St.	Raritan River	24"	Unknown	No
P-019	Outer Smith St.	Raritan River	60"	Unknown	No

[1] CSO Outfall P-012 was connected into the State St. outfall (Outfall P-011) during reconstruction of the bulkhead area netting chamber at sidewalk at intersection of Sadowski Pkwy and Catalpa Ave.

The following is a detailed description of each Perth Amboy combined sewer outfall structure:

- **CSO P-002 (Rudyk Park**) discharges overflow from a leaping weir type regulator structure. It is located on the Eastside Interceptor, upstream of the State Street pumping station. This diversion chamber is located at the northern-most CSO point on the interceptor. The leaping weir is mounted in the crown of the interceptor pipe. The main influent sewer is a 33"RCP pipe. The weir is contained in a reinforced concrete diversion chamber that also has two smaller influent sewers feeding into it. The leaping weir is oriented perpendicular to the main influent sewer. Incoming flow "falls" into the interceptor during dry weather, conditions. During rainfall events, the flow increases and gains enough energy to "leap" over the interceptor pipe and is discharged to the outfall. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The outfall pipe is an 84" brick sewer below the Outerbridge Crossing. The Outfall is located in a marsh area below the bridge. From the outfall, any discharge flows by gravity along a small tributary feeding into the Arthur Kill.

- **CSO P-003 (Buckingham Avenue)** is located on Buckingham Avenue at the eastern edge of the City. The diversion structure is located near the intersection of Buckingham Avenue and High Street. The influent sewer is a 36" RCP pipe. The CSO is a leaping weir type structure. Sewerage entering the CSO drops over the leaping weir during dry-weather conditions, into a 48" RCP interceptor. Overflows "leap" over the weir into a 36" Brick Outfall transitioning to a 36" CIP. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. that discharges to the Arthur Kill. The outfall pipe end is held in place by an existing concrete block at the end of the pipe. The outfall is situated in a tidal area and the outfall pipe becomes submerged entirely during high tides. It should be noted that the pipe from the diversion chamber to the existing outfall pipe was recently replaced. Because the diversion structure is located above the mean high tide elevation, there is no tide gate at this location.

- **CSO P-004 (Washington Street)** is a leaping weir type structure. It is located directly on the 48" RCP Eastside Interceptor at Washington Street. The weir is contained within a rectangular concrete chamber. The influent collector sewer is 3'-6" by 4'-6" brick sewer. The leaping weir and interceptor are oriented perpendicular to the influent sewer. Influent sewerage "drops" into the interceptor during dry weather periods. During wet weather events when the flow increases the flow "leaps" the weir and bypasses to an outfall pipe. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The 48" RCP outfall pipe discharges to the Arthur Kill at the Perth Amboy Dry Dock Bulkhead. During high tides, the outfall pipe is approximately 50% submerged. The outfall pipe is completely exposed at low tide.

- **CSO P-005 (Commerce Street)** is a leaping weir type structure located directly on the 48" RCP Eastside Interceptor on Commerce Street. The weir is contained within a rectangular concrete chamber. Flow enters the chamber through a 36" RCP influent collector sewer. The influent sewer is oriented perpendicular to the interceptor sewer. Influent sewerage "drops" into the interceptor during dry weather periods. During wet-weather events, when flow increases, the flow "leaps" the weir and is discharged to the Arthur Kill by a 36"RCP outfall pipe. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. This pipe runs to a tide gate chamber located approximately 10 ft downstream of the diversion structure. A 36" tide gate is mounted on the inlet face of the tide gate chamber. Downstream of the tide gate chambers, the outfall pipe is a 24" by 36" brick sewer. The outfall pipe discharges at the end of a service road at the Perth Amboy Dry Dock Company, at Commerce Street. The existing pipe is partially submerged at low tide and completely submerged at high tide.

- **CSO P-006 (Fayette Street)** is a leaping weir type structure. It is located directly above the 48" RCP eastern interceptor at Fayette Street. The weir is contained within a rectangular concrete chamber. Flow enters the chamber through a 24" by 36" brick influent collector sewer. The leaping weir and interceptor are oriented perpendicular to the influent sewer. Influent sewerage "drops" into the interceptor during dry weather periods. During wet weather events, flow "leaps" the weir and is discharged to the Arthur Kill by a 48" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The outfall sewer is connected to a tide gate chamber located approximately 10 ft downstream of the diversion structure. A 48" tide gate is mounted at the inlet face of to the tide gate chamber. The outfall pipe downstream of the tide gate chamber is a 24" by 36" brick sewer. The outfall pipe discharges point is located at the bulkhead at Fayette Street. The existing outfall pipe transitions to a 48" CIP at the bulkhead. The outfall pipe it not submerged at low tide but is completely submerged at high tide.

- **CSO P-007 (Smith Street)** is a leaping weir type structure. It is located directly on the 48" RCP Eastside Interceptor at Smith Street. The weir is contained within a rectangular concrete chamber. Flow enters the chamber through a 2'-6" by 3'-6" brick influent collector sewer. The leaping weir and interceptor are oriented perpendicular to the influent sewer. Influent sewerage "drops" into the interceptor during dry weather periods. During wet weather events, the flow "leaps" the weir and is discharged to a 42" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe which is connected to a tide gate chamber located approximately 15 ft downstream of the diversion structure. A 42" tide gate is mounted at the inlet face of the tide gate chamber. Downstream of the tide gate chamber, the outfall pipe is a 24" by 36" brick sewer, which discharges to the Arthur Kill. The outfall pipe discharge is located at the historic landmark "Ferry to Tottenville" ferry launch at Smith Street. The outfall pipe is not visible because it is located under the Ferry Launch Dock.

- **CSO P-008 (Gordon Street)** is a leaping weir type structure located remote from the Eastside Interceptor. The weir is contained in a rectangular concrete chamber. Flow enters the chamber through a 36" RCP influent collector sewer. The leaping weir is oriented perpendicular to the influent sewer and is installed in the crown of a 15" VCP lateral sewer line. This lateral conveys dry weather flow, which "drops" through the weir, to the Eastside Interceptor sewer on Front Street. During wet weather events, when flow increases the flow "leaps" the weir and is discharged to the Arthur Kill by a 36" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The diversion chamber is located above the normal high tide level, and there is no tide gate associated with this outfall. The outfall discharges to the Arthur Kill at a point located at the bulkhead behind the Armory Restaurant. The outfall pipe is partially submerged at high tide.

- **CSO P-009 (Lewis Street)** is a leaping weir type structure. It is located on Lewis Street and is remote from the 36" RCP interceptor on Water Street. The weir is contained in a concrete chamber. Flow enters the chamber from a 15" VCP influent collector sewer. The leaping weir is oriented perpendicular to the influent sewer and is installed in the crown of a 12" RCP lateral sewer line. This lateral conveys dry weather flow, which "drops" through the weir, to the lateral sewer. During wet weather events, when flow increases, the wet weather flow "leaps" the weir and is discharged to the Raritan Bay by a 15" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The outfall invert at the diversion chamber is above the influence of normal high tides, and there is no tide gate associated with this outfall. The outfall pipe discharges to the Raritan Bay, behind the bulkhead at Water Street and Lewis Street.

- **CSO P-010 (High Street)** is a leaping weir type structure located on High Street. The CSO is remote from the 33" RCP interceptor on Sadowski Parkway. The weir is contained in a concrete chamber. Flow enters the chamber from a 2' by 3' brick influent collector sewer. The leaping weir is oriented perpendicular to the influent sewer and is installed in the crown of a 12" RCP lateral sewer line. This lateral conveys dry weather flow, which "drops" through the weir, to the 33" RCP Eastside Interceptor on Sadowski Parkway. During wet weather events, when flows increase the flow "leaps" the weir and is discharged to a 36"

RCP outfall pipe. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The outfall pipe is connected to a tide gate chamber approximately 10 ft downstream of the diversion structure. A 36" tide gate is mounted on the inlet of the tide gate chamber. The outfall pipe invert at the chamber is influenced by normal high tides. The outfall pipe downstream of the tide gate chamber is a 24" by 36" brick sewer, which discharges to the Raritan Bay. The outfall pipe transitions to an exposed 36" CIP at the Sadowski Parkway beach. Field inspection of the diversion chamber and tide gate identified no structural damage or signs of deterioration. There were no chronic problems associated with these structures. Inspection of the outfall pipe identified the pipe to be in fair to poor condition. It was noted that the exposed portion of the pipe is exhibiting surface pitting.

- **CSO P-011 (State Street)** is a leaping weir type structure located on State Street. It is located remote from the 33" RCP interceptor on Sadowski Parkway. The weir is contained in a concrete chamber. Flow enters the chamber from a 2' by 3' brick influent sewer. The leaping weir is oriented perpendicular to the influent sewer and is installed in the crown of a 12"VCP lateral sewer line. This lateral conveys dry weather flow, which "drops through the weir, to the 33" RCP Eastside Interceptor on Sadowski Parkway. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. During wet weather events, when flows increase, the flow "leaps" the weir and is discharged to the Raritan Bay by a 36" RCP outfall pipe. The outfall pipe is connected to a tide gate chamber, located approximately 10 ft downstream of the diversion structure. A 36" tide gate is mounted on the inlet of the tide gate chamber. The outfall pipe invert at the chamber and is influenced by normal high tides. The outfall pipe downstream of the tide gate chamber is a 24" by 36" brick sewer. The outfall pipe transitions to an exposed 36" CIP at the Sadowski Parkway beach.

- **CSO P-013 (Brighton Avenue)** is a leaping weir type structure located directly on the 33" RCP eastern interceptor at Brighton Avenue and Sadowski Parkway. The weir is contained within a rectangular concrete chamber. Flow enters the chamber through a 24" by 36" brick influent collector sewer. The leaping weir and interceptor are oriented perpendicular to the influent sewer. Influent sewerage "drops" into the interceptor during dry weather periods. During wet weather events, when flow increases the flow "leaps" the weir and is discharged to a 36" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. This sewer runs to a tide gate chamber located approximately 5 ft downstream of the diversion structure. A 36" tide gate is mounted at the inlet to the tide gate chamber. The outfall pipe invert at the chamber is influenced by normal high tides. The outfall pipe downstream of the tide gate chamber is a 24" by 36" brick sewer. The outfall pipe transitions to 36" CIP at the Sadowski Parkway beach and discharges to the Raritan Bay. The outfall pipe is partially submerged at low tide and is completely submerged at high tide.

- **CSO P-014 (Madison Avenue)** is a leaping weir type structure located on Madison Avenue, remote from the 33" RCP interceptor on Sadowski Parkway. The weir is contained within a rectangular concrete chamber. Flow enters the chamber through a 24" by 36" brick influent collector sewer. The leaping weir and interceptor are oriented perpendicular to the influent sewer. During dry-weather influent sewerage "drops" into a 12" VCP lateral sewer, which conveys flow to a manhole located on the 33" interceptor. During wet weather events, when flow increases, the flow "leaps" the weir and is discharged to a 36" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The outfall is connected to a tide gate chamber located approximately 10 ft downstream of the diversion structure. A 36" tide gate is mounted at the inlet to the tide gate chamber. The outfall pipe invert at the chamber is influenced by normal high tides. The outfall pipe from the tide gate chamber is a 2'-4" by 3'-6" brick sewer. This sewer transitions to a 36" CIP before discharging to the Raritan Bay at the Sadowski Parkway beach. The outfall pipe is partially submerged at low tide and is completely submerged at high tide.

- **CSO P-015 (High Street)** is a leaping weir type structure. It is located directly on the 33" RCP eastern interceptor at First Street and Sadowski Parkway. The weir is contained within a rectangular concrete chamber. Flow enters the chamber through a 24" by 36" brick influent collector sewer. The leaping weir and interceptor are oriented perpendicular to the influent sewer. Influent sewerage "drops" into the interceptor during dry weather periods. During wet weather, when flow increases, the flow "leaps" the weir and is discharged to a 36" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The outfall sewer runs to a tide gate chamber located approximately 5 ft downstream of the diversion structure. A 36" tide gate is mounted at the inlet to the tide gate chamber. The outfall pipe invert at the chamber is influenced by normal high tides. The outfall pipe downstream of the tide gate chamber is a 24" by 36" brick sewer. The outfall transitions to a 36" CIP before discharging to the Raritan Bay at Sadowski Parkway beach. The pipe is partially submerged at low tide and completely submerged at high tide.

- **CSO P-016 (Second Street)** is a leaping weir type structure. It is situated at the invert of the 84" RCP Westside Interceptor at Second Street. The weir is contained within a rectangular concrete chamber. Flow enters the chamber from the 84" RCP interceptor. This pipe conveys all flow from upstream CSO points. Dry weather flow drops through the weir into a smaller 30" RCP interceptor reach oriented perpendicular to the influent sewer. During wet weather events, when flow increases, the flow "leaps" the weir and is discharged to an 84" RCP outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. An 84" tide gate is located directly at the end of the outfall pipe and head wall at the Sadowski Parkway Beach. The outfall pipe is not submerged at low tide and is nearly one third submerged at high tide.

- **CSO P-017 (Sheridan Street)** does not have a leaping weir. Rather, there is an orifice cut directly in the crown of the 30" RCP Westside Interceptor at Sheridan Street. The orifice is contained within a rectangular concrete chamber. Flow enters the chamber through a 24" RCP influent collector sewer. The diversion chamber orifice is directly in the path of the influent sewer. Influent sewerage "drops" into the orifice during dry weather periods. During wet weather events, when flow to the chamber increases, surcharge conditions develop, and the excess flow discharged to a 24" RCP outfall sewer to the Raritan Bay. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. The chamber is not influenced by high tides. However, the existing outfall pipe end is completely buried in river silt. This blocks the outfall pipe and results in surcharging of the diversion chamber. The installation of a new 36" High Density Polyethylene (HDPE) outfall pipe is being planned. The new out fall pipe will discharge to a creek west of Sheridan Street, tributary to the Raritan Bay. This project was completed in late 1996.

- **CSO P-019 (Outer Smith Street)** is a leaping weir type structure located on the 18" RCP Westside Interceptor sewer at outer Smith Street. The weir is contained in a rectangular concrete chamber. Flow enters the chamber through a 72" brick influent collector sewer. The leaping weir and interceptor are oriented perpendicular to the influent sewer. Influent sewerage "drops" into the interceptor during dry weather periods. During wet weather events, when flow increases, the flow "leaps" the weir and is discharged to a 72" brick outfall sewer. A netting chamber is located downstream of the diversion chamber to remove solids and floatables before they are discharged through the outfall pipe. There is no tide gate associated with this CSO. The outfall sewer runs from west to east approximately 300 ft, where it collects additional stormwater flow from a junction box, located in a vacant wooded area on the north side of Smith Street. This junction box receives runoff primarily from a shopping center area, to the north, near New Brunswick Avenue. The vacant land area is at a depressed elevation and holds a significant amount of surface water. It was noted that the primary inlet to the junction box is clogged by debris which has resulted in the retention of surface water. It was further noted that numerous floatables are visible on the water surface. From the junction chamber the outfall pipe runs due south below Smith Street, and discharges to a swale on Hess Oil property. From this swale, the outfall transitions to a 48" RCP and discharges at a bulkhead on the Raritan Bay.

2.2.6 Pumping Stations and Force Mains

There are four (4) pumping stations (PS) within the combined sewer system. The locations of the pump stations and their respective service areas are shown in Figure 1-1. A summary characterization of the pump stations is provided in Table 2-4.

Table 2-4 - Summary of Perth Amboy Pumping Stations

Pumping Station Name	Address	Date Went into Operation	Pump Data			Last Major Maintenance
			Number of Pumps	Motor Size per Pump	Pump Station	
Amboy Avenue Pump Station	15 Amboy Avenue Perth Amboy, NJ	1998	2	25 HP	0.75 MGD 525 gpm @ 70 ft TDH	2004: Rebuilt pump 1 2007: Rebuilt pump 2
State Street Pump Station	806 State Street Perth Amboy, NJ	1998	2	75 HP	4.6 MGD 3,200 gpm @ 50 ft TDH	2003: Rebuilt pump 1 2009: Rebuilt pump 2

Table 2-4 - Summary of Perth Amboy Pumping Stations

Pumping Station Name	Address	Date Went into Operation	Pump Data			Last Major Maintenance
			Number of Pumps	Motor Size per Pump	Pump Station	
Front Street Pump Station	256 Front Street Perth Amboy, NJ	1999	2	125 HP	7 MGD 4,800 gpm @ 58 ft TDH	2009: Overhauled both pumps
Second Street Pumping Station	End of Second Street & Sadowsky Pkwy Perth Amboy, NJ	1988	3	300 HP	13.6 MGD 9,500 gpm @ 175 ft TDH	2004: Overhauled pump 2 2008: Pump 3 VFD replaced 2010: Overhauled pump 1

The following is a detailed description of each Perth Amboy pumping station:

- **Amboy Avenue Pumping Station -** This pumping station is the smallest in capacity, rated at 350 gpm. The station is a steel “can” unit, containing two dry pit vertical centrifugal pumps, one operational and one spare. The pump station is equipped with an emergency generator. The pump conveys a portion of the flow within combined sewer service area #002, via an 8" diameter force main.

- **State Street Pumping Station –** This pumping station is located on the Eastside Interceptor and is the second smallest in capacity, rated at 3,200 gpm. This station pumps are contained in a brick and block building, originally constructed in the late 1930s which has been updated over the years. The station has two dry pit vertical centrifugal pumps, one operational, one standby. The pump station is equipped with an emergency generator. Flow from the entire combined sewer area #002 is conveyed through a 24" force main.

- **Front Street Pumping Station –** This pumping station is located on the Eastside Interceptor and is the second largest in capacity, rated at 4,800 gpm. The pumps are contained in a below grade structure. Two dry-pit vertical centrifugal pumps are located in the station, one operational and one spare. The pumping station receives flow from the Eastside Interceptor above CSO #007 and conveys this flow through a 16" force main along Smith Street. Downstream of this point the Eastside Interceptor resumes gravity flow.

- **Second Street Pumping Station –** This is the main pumping station which receives all combined sewerage conveyed by the City’s interceptor sewers. It is rated at a capacity of 9,500 gpm (13.6 MGD), however, measured pumping rates are limited to maximum values between 12 and 13 MGD, or roughly 10% below the rated maximum. The lower measured maximum values may reflect typical pump wear, and perhaps normal metering accuracy limitations. This pumping station was constructed in 1988 at the site of Perth Amboy’s decommissioned Wastewater Treatment Plant. The station contains three vertical centrifugal pumps; one operational, one stand by and one spare. Flow entering the pumping station is conveyed to the Keasbey Metering Station in Woodbridge Township. The flow is ultimately received at the MCUA regional wastewater treatment plant. The

Hazard Mitigation Improvements at the Second Street PS have been finalized with construction with completed in August 2020. Capacity of the station remains unchanged.

2.2.7 Other Flow Controls

Historically, much of the Perth Amboy interceptor sewer and collection system has been subject to hydraulic capacity problems. These problems have been associated with tidal intrusion, sewer line blockages and silt and debris accumulation.

Tidal intrusion was the most prolific problem prior to the installation of tide gates in 1988 and 1989. These gates were installed downstream of any CSO structures, where overflow pipe inverts were lower than 6.0 ft in elevation. Such low elevations allow tidal water to enter the combined system during high tide. Tide gates largely alleviated this problem. However, occasional problems can develop when tide gates become unseated due to debris. When this situation occurs, tidal water can enter the interceptor system during high tide causing the main pumping station to send river water to the wastewater treatment plant for treatment. A summary of all tide gates associated with Perth Amboy's outfalls is included in Table 2-5.

Perth Amboy installed solids and floatable controls on all of its CSO outfalls in 2000. These systems consist of between ½" mesh nets (minimum bar strength of 75 lbs) of dimensions 30" square at the mouth by eight feet long. The outfall chambers have between one and four nets and work in conjunction to the hinged bar screens to reduce the amount of solid and floatables that discharges through the outfall. A summary of all solid and floatable controls associated with Perth Amboy's outfalls is included in Table 2-6.

Table 2-5 - Outfall Tide Gate Summary

CSO Outfall Number	Tide Gate Location (Street)	Tide Gate	Tide Gate Structure Type	Tide Gate Diameter (in)
P-002	Rudyk Park	No	N/A	N/A
P-003	Buckingham Ave.	No	N/A	N/A
P-004	Washington St.	No	N/A	N/A
P-005	Commerce St.	Yes	Chamber	36
P-006	Fayette St.	Yes	Chamber	48
P-007	Smith St.	Yes	Chamber	42*
P-008	Gordon St.	No	N/A	N/A
P-009	Lewis St.	No	N/A	N/A
P-010	High St.	Yes	Chamber	36
P-011	State St.	Yes	Chamber	36
P-013	Brighton Ave.	Yes	Chamber	36
P-014	Madison Ave.	Yes	Chamber	36
P-015	First St.	Yes	Chamber	36
P-016	Second St.	Yes	At Outfall	84
P-017	Sheridan St.	No	N/A	N/A
P-019	Outer Smith St.	No	N/A	N/A

Table 2-6 - Netting Chamber Solids and Floatable Controls Summary

CSO Outfall ID Number	Netting Chamber Control Location (Street)	Number of Nets
P-002	Rudyk Park	4
P-003	Buckingham Ave.	4
P-004	Washington St.	2
P-005	Commerce St.	1
P-006	Fayette St.	2
P-007	Smith St.	1
P-008	Gordon St.	2
P-009	Lewis St.	2
P-010	High St.	2
P-011	State St.	1
P-013	Brighton Ave.	1
P-014	Madison Ave.	1
P-015	First St.	1
P-016	Second St.	4
P-017	Sheridan St.	1
P-019	Outer Smith St.	4

2.2.8 CSO Outfall Groups

The City of Perth Amboy owns and operates 16 CSO outfall points which discharge to the Arthur Kill (Saline Estuary SE2) and Raritan River (Raritan Estuary; Saline Estuary SE1).

The outfalls that discharge to the Arthur Kill include CSOs P-002 through P-009, and the outfalls that discharge to the Raritan River include CSOs P-010, P-011, P-013 through P-017, and P-019.

The CSOs are divided into groups to evaluate consolidation alternatives. The groups are identified by receiving water and the proximity of the CSO outfall points to each other. Table 2-7 summarizes the CSO groups and Figure 2-5 shows the CSO Groups on the service area map.

Table 2-7 - CSO Outfall Groups Summary

<table>
<tr><th>CSO Outfall Group Number</th><th>CSO Outfall Number</th><th>CSO Outfall Location</th><th>Receiving Water</th><th>Outfall Pipe Diameter</th></tr>
<tr><td>1</td><td>P-002</td><td>Rudyk Park</td><td>Arthur Kill</td><td>84" elliptical</td></tr>
<tr><td rowspan="6">2</td><td>P-003</td><td>Buckingham Ave.</td><td>Arthur Kill</td><td>36"</td></tr>
<tr><td>P-004</td><td>Washington St.</td><td>Arthur Kill</td><td>36"</td></tr>
<tr><td>P-005</td><td>Commerce St.</td><td>Arthur Kill</td><td>36"</td></tr>
<tr><td>P-006</td><td>Fayette St.</td><td>Arthur Kill</td><td>48"</td></tr>
<tr><td>P-007</td><td>Smith St.</td><td>Arthur Kill</td><td>36"</td></tr>
<tr><td>P-008</td><td>Gordon St.</td><td>Arthur Kill</td><td>36"</td></tr>
</table>

CSO Outfall Group Number	CSO Outfall Number	CSO Outfall Location	Receiving Water	Outfall Pipe Diameter
3	P-009	Lewis St.	Arthur Kill	15"
	P-010	High St.	Raritan River	36"
	P-011[1]	State St.	Raritan River	36"
	P-013	Brighton Ave.	Raritan River	24"
	P-014	Madison Ave.	Raritan River	36"
	P-015	First St.	Raritan River	36"
	P-016	Second St.	Raritan River	72"
4	P-017	Sheridan St.	Raritan River	24"
5	P-019	Outer Smith St.	Raritan River	60"

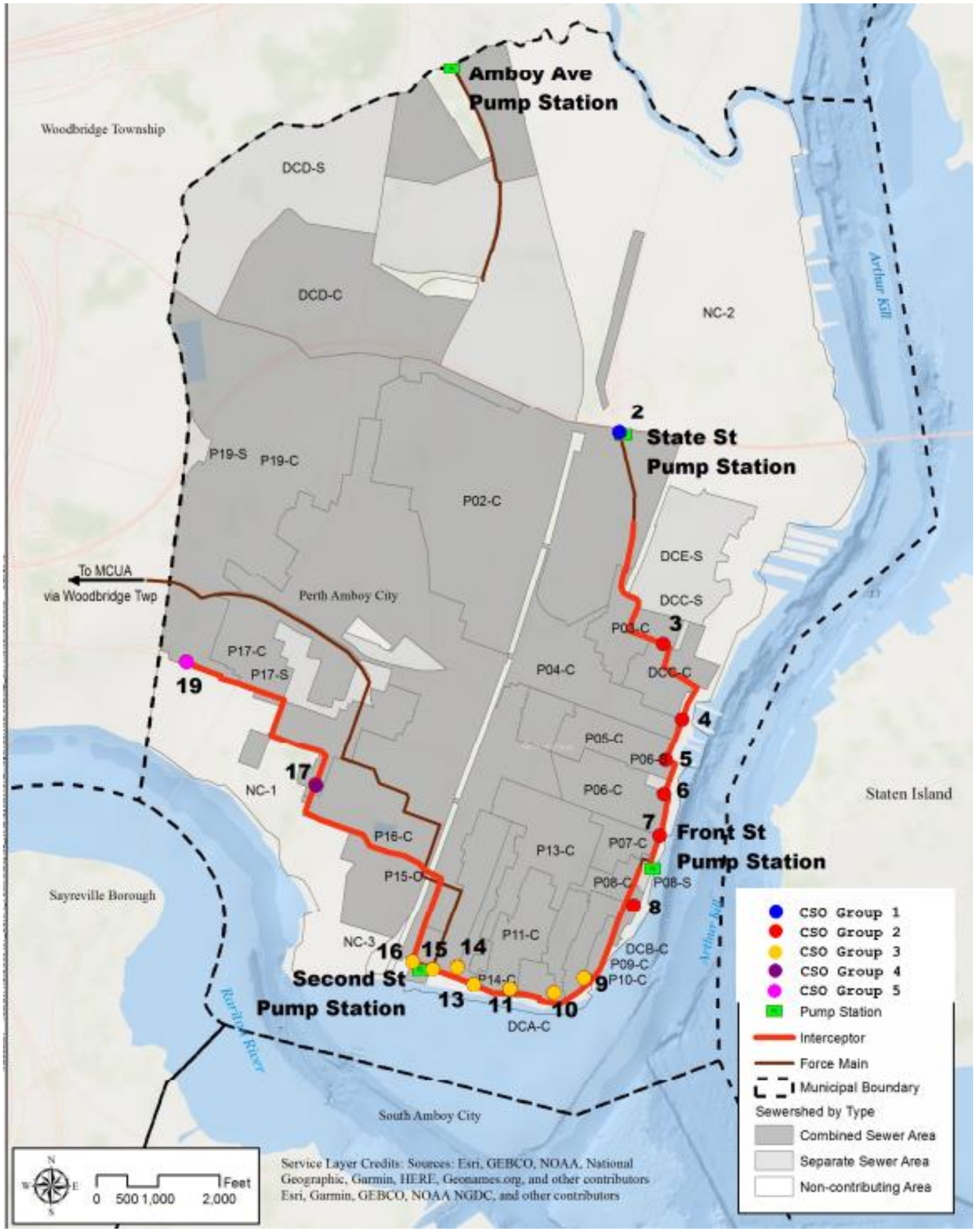

Figure 2-5 - CSO Outfall Groups

- **CSO Group 1 –** The CSO P-002 diversion chamber is located at the northern-most CSO point on the Eastside Interceptor. The outfall discharges to a marsh area below the Outerbridge Crossing. From the outfall, the discharge flows by gravity along a small tributary feeding into the Arthur Kill. This CSO will be evaluated separately because of the distance to the other CSOs and its large annual CSO volume (36 percent).

- **CSO Group 2 –** CSO P-003 through P-008 are located along the eastern shoreline of Perth Amboy and the outfalls discharge to the Arthur Kill. They are located upstream of Front Street Pumping Station and make up to 20 percent of the total annual CSO volume.

- **CSO Group 3 –** Although CSO P-009 discharges to the Arthur Kill, near the confluence with the Raritan Bay, it is grouped with P-010, P-011, and P-013 through P-016 because they are all near the beach along the southern shoreline of Perth Amboy and downstream of the Front Street Pumping Station. The total annual CSO from these seven outfalls add up to 45 percent of the system total annual CSO volume and is the biggest group by volume or peak flow. P-016 is the single largest CSO (26 percent) in the entire system.

- **CSO Group 4 –** CSO P-017 outfall discharges to a creek west of Sheridan Street, tributary to the Raritan Bay. This CSO will be evaluated separately because of the distance to other CSOs.

- **CSO Group 5 –** CSO P-019 outfall discharges to a swale on Hess Oil property, and from this swale, the outfall transitions to an RCP and discharges at a bulkhead on the Raritan Bay. This CSO will also be evaluated separately because of the distance to other CSOs.

Section 3
Baseline Sewer System Performance

3.1 Background

The H&H model of the City's interceptor sewer system was originally developed and used in analysis for compliance with NJPDES General Permit in 2007. In September 2012 Perth Amboy entered into an Administrative Consent Order (ACO) with the USEPA. As part of that ACO, flow monitoring was conducted in 2013 and the H&H model was subsequently updated. Under the current 2015 permit, the City collected depth velocity and flow data at three locations in the west portion of the system and flows at three pump stations. Two rain gauges were installed to collect the corresponding rainfall data.

In 2012, the model was updated under the ACO with the U.S.EPA. Under the current 2015 permit, the model was updated and calibrated to reflect system conditions in 2015. This section describes the model updates and the calibration and validation process in detail.

3.2 Model Extent and Updates

Perth Amboy's Baseline Condition Model uses the U.S. EPA Storm Water Management Model (SWMM 5) software Version 5.1.12. The modeled pipe network is in NAVD88 vertical datum and NAD 1983 New Jersey state plane coordinate system. Figure 3-1 shows the spatial extent of the Baseline Condition Mode.

The City's Baseline Condition Model includes the following hydraulic components:

- The Eastside Interceptor starting from P-2 and the Westside Interceptor starting from P-19;
- Three pump stations modeled as ideal pumps with limiting flow at the influent pipe: State Street, Front Street, Main Pump Station;
- Sixteen combined sewer regulators: P-2, P-3, P-4,P-5, P-6, P-7, P -8, P -9, P -10, P -11, P -13, P -14, P -15, P -16, P17 (the only regulator not configured as a leaping weir), and P -19 (note that CS0 012 was connected to CSO 011 and is now closed and is therefore not included in this list);
- Sixteen combined sewer outfalls with tide gates and tidal boundary condition (defined using the Sandy Hook, NJ, Station 8531680)

Survey data was used as the primary source for the modeled hydraulic elements, supplemented by available as-built drawings and sewer system maps. Field verifications were conducted to further resolve data gaps. Major updates made in 2017 are:

- Manhole rims based on the latest DEM data;

- Pipe sizes near Elm St on the Westside Interceptor between P-17 and P16 based on meter installation reports;
- Pump station wet well dimensions based on field investigations.

The Baseline Condition Model covers approximately 2.6 square miles of combined sewer service area and 0.7 square miles of separate sewer service area in the City. Sewersheds were delineated based on contributing areas to each overflow. The following updates were made in 2017:

- Catchment delineation was updated based on actual geographic areas;
- Catchment type (combined or separate) was updated based on input provided from the City;
- Catchment infiltration parameters (for the Modified Green-Ampt method) were updated based on the most prevalent native soil type for the study area, which is silt loam (National Resources Conservation Service (NRCS) SSURGO soils layer). These parameters were later adjusted during calibration;
- Imperviousness of each catchment was updated using the 2012 land use data published by NJDEP;
- The slope for each model catchment was updated using the average catchment area slope calculated using the 2002 NJDEP 10-Meter DEM.

Other updates include:

- Monthly evaporation factors were updated using published pan evaporation rate data in NOAA NWS TR34 (Table II) and the conversion factor to free water surface evaporation published in TR33.

Sanitary flow was developed from metering data and distributed into upstream catchments using population data from the 2010 Census.

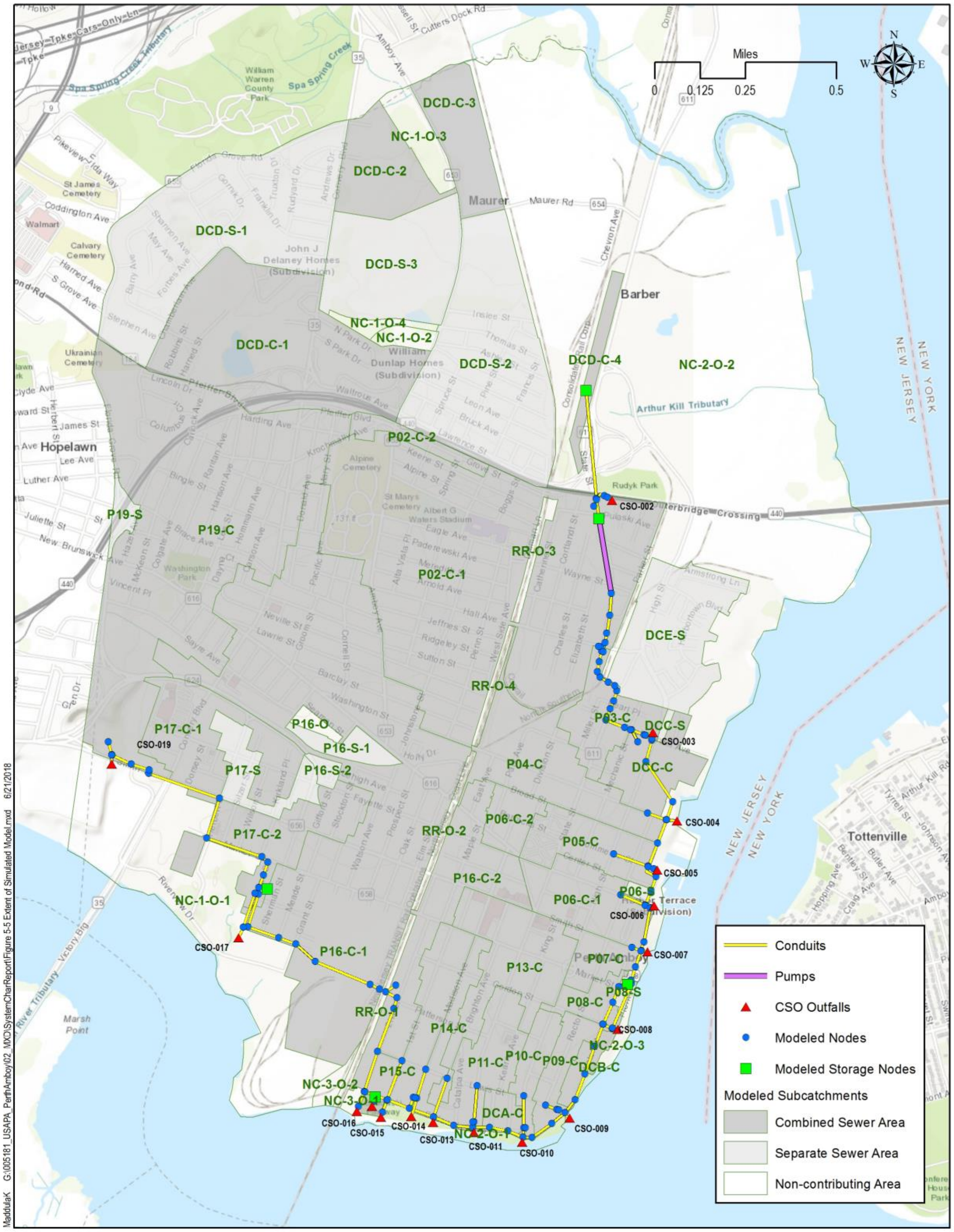

Figure 3-1 - Baseline Condition Model Extent

3.2.1 Rainfall and Sewer Flow Monitoring

Under the current 2015 NJPDES permit, Perth Amboy submitted a System Characterization Report Work Plan which was approved by NJDEP in November 2016. Supplementing the work plan was the Combined Sewer System Rain Gauge and Flow Metering QAPP also approved by NJDEP in November 2016, from which flow monitoring was conducted in 2017. This section covers the details of the metering program and the subsequent rainfall data analysis. Previous metering efforts in 2007 under the General Permit and in 2013 under the ACO with U.S.EPA were described in detail in the documents *Combined Sewer Overflow Discharge Characterization Study* of 2007 and *Flow Monitoring Pilot Study Report* of 2014, both of which were submitted as Appendices to the System Characterization Work Plan.

3.2.1.1 Collection System and Interceptor Sewer Monitoring

In April 2017, Perth Amboy contracted with the firm Flow Assessment Inc. to install three (3) temporary flow meters along the West Side Interceptor, and three permanent flow recording devices at three pump stations. The location of these meters and gauges recording devices are displayed in Figure 3-2 and Figure 3-3. The most upstream temporary meter was located on the 72-inch diameter trunk sewer immediately upstream of the CSO19 regulator structure on Smith Street. The second temporary meter was located on the 30-inch interceptor between CSO17 and CSO16 regulators off of Elm Street. The third temporary meter was located along the 84-inch diameter interceptor upstream of the CSO16 regulator at Second Street and Lewis Street. All three devices were continuous wave area-velocity type meters which recorded both depth and velocity. The permanent flow recording devices were installed at the State Street, Front Street and Second Street Pump Stations to replace outdated circular flow chart devices. These meters are SCADA-type recording devices which record pump discharge flow data in digital format that can be readily used for model calibration or validation. The temporary flow meters recorded data in 5-minute increments. The temporary metering program ended in early August 2017 after the data adequacy was demonstrated in CDM Smith's June 23, 2017 memorandum to the City.

Meter data collected in 2007 and 2013 was used to supplement the 2017 data in model calibration and validation as appropriate. Figure 3-3 shows meter locations in a schematic format.

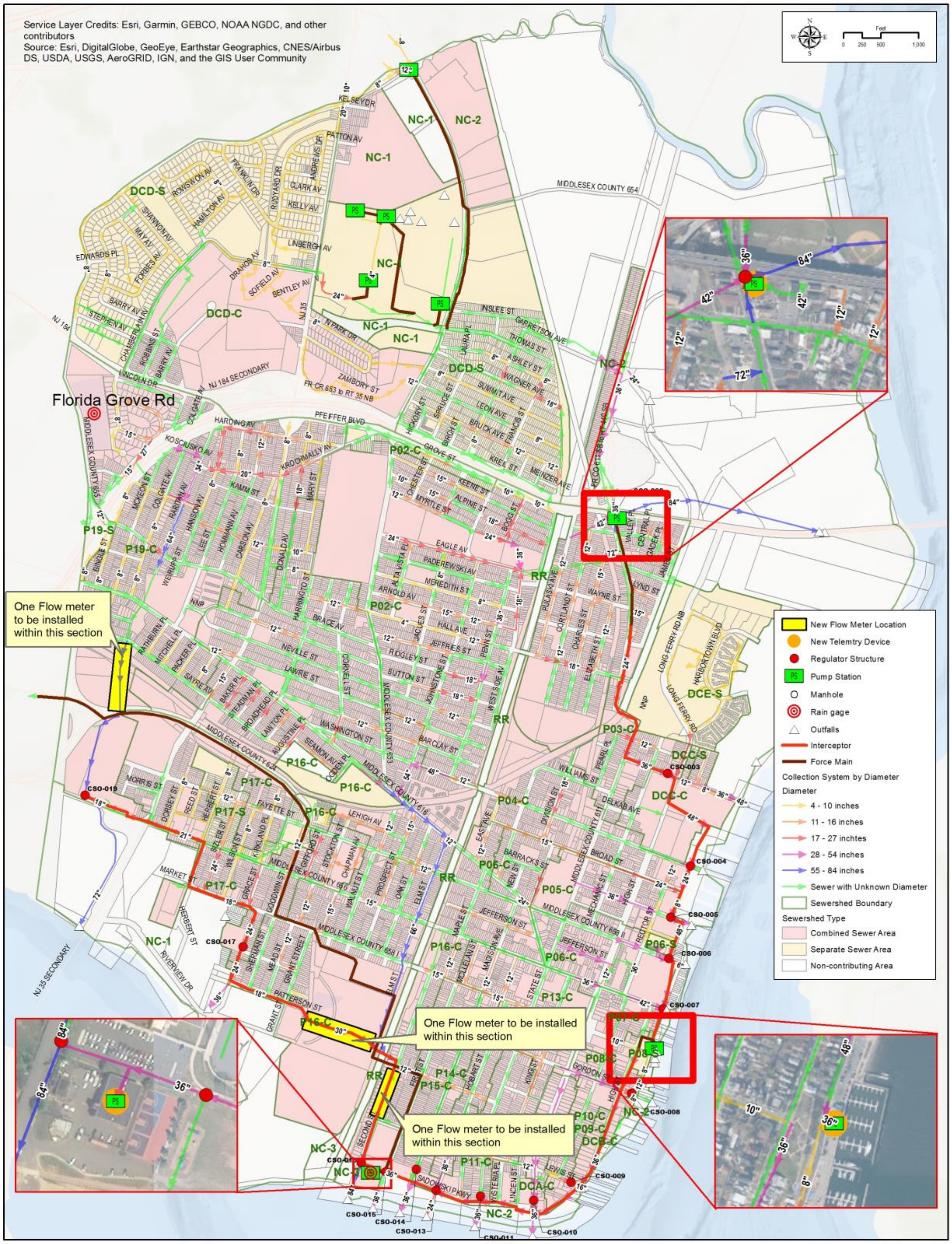

Figure 3-2 - Locations of Flow Meter Installations for 2017 Monitoring

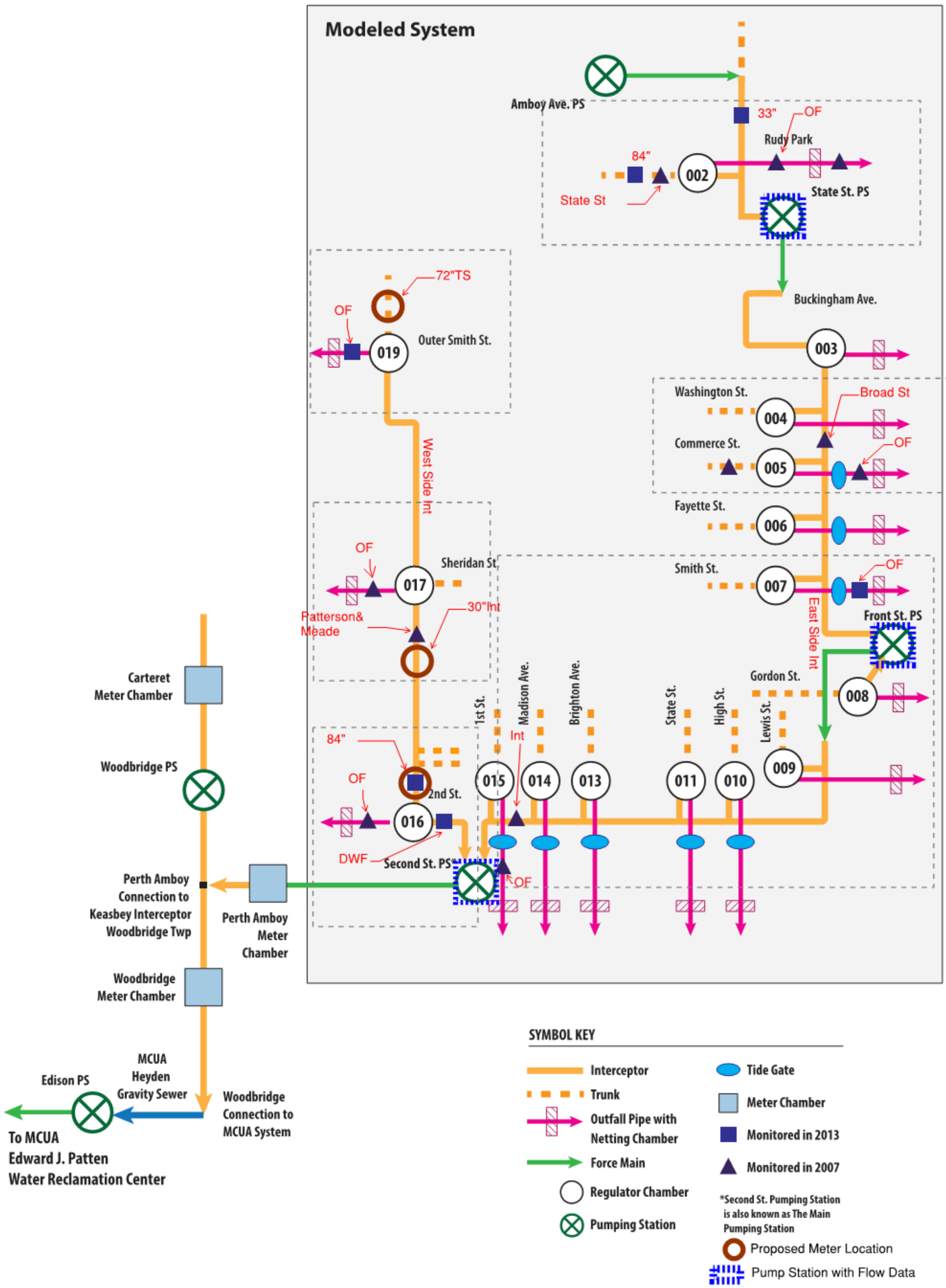

Figure 3-3 - Perth Amboy Combined Sewer System Schematic with Flow Monitoring Locations

3.2.1.2 Rainfall Monitoring

To capture the spatial variation in precipitation events, two tipping bucket rain gauges were deployed during the 2017 monitoring period (April – August 2017) with one at Second Street Pump Station and the other one between Florida Grove Road and Christopher Court on the north side of a cemetery (see Figure 5-1). The rain gauges recorded data in 5-minute increments. The same locations were used in 2007 and 2013.

Two regional gauges were selected for quality control Perth Amboy's 2017 project rain gauges, Newark International Airport gauge and New Brunswick gauge. Newark International Airport gauge is maintained by National Weather Service with high quality hourly data. The New Brunswick gauge is part of the Rutgers' gauge network in New Jersey which records precipitation data at 5-minute interval with limited quality control. These two gauges, displayed in Figure 3-4, reside on the north (Newark International Airport) and south (New Brunswick) side of the Perth Amboy system which are helpful in evaluating spatial variability.

Figure 3-4 - Regional Rain Gauges Used for Quality Control of Project Gauges

3.2.2 Model Extent and Updates

Perth Amboy's Baseline Condition Model uses the U.S. EPA Storm Water Management Model (SWMM 5) software Version 5.1.12. The modeled pipe network is in NAVD88 vertical datum and NAD 1983 New Jersey state plane coordinate system.

The City's Baseline Condition Model includes the following hydraulic components:

- The Eastside Interceptor starting from P-2 and the Westside Interceptor starting from P-19;
- Three pump stations modeled as ideal pumps with limiting flow at the influent pipe: State Street, Front Street, Second Street Pumping Stations;
- Sixteen combined sewer regulators: P-2, P-3, P-4,P-5, P-6, P-7, P -8, P -9, P -10, P -11, P -13, P -14, P -15, P -16, P17 (the only regulator not configured as a leaping weir), and P -19 (note that CS0 012 was connected to CSO 011 and is now closed and is therefore not included in this list);
- Sixteen combined sewer outfalls with tide gates and tidal boundary condition (defined using the Sandy Hook, NJ, Station 8531680)

Survey data was used as the primary source for the modeled hydraulic elements, supplemented by available as-built drawings and sewer system maps. Field verifications were conducted to further resolve data gaps. Major updates made in 2017 are:

- Manhole rims based on the latest DEM data;
- Pipe sizes near Elm St on the Westside Interceptor between P-17 and P16 based on meter installation reports;
- Pump station wet well dimensions based on field investigations.

The Baseline Condition Model covers approximately 2.6 square miles of combined sewer service area and 0.7 square miles of separate sewer service area in the City. Sewersheds were delineated based on contributing areas to each overflow. The following updates were made in 2017:

- Catchment delineation was updated based on actual geographic areas;
- Catchment type (combined or separate) was updated based on input provided from the City;
- Catchment infiltration parameters (for the Modified Green-Ampt method) were updated based on the most prevalent native soil type for the study area, which is silt loam (National Resources Conservation Service (NRCS) SSURGO soils layer). These parameters were later adjusted during calibration;
- Imperviousness of each catchment was updated using the 2012 land use data published by NJDEP;
- The slope for each model catchment was updated using the average catchment area slope calculated using the 2002 NJDEP 10-Meter DEM.

Other updates include:

- Monthly evaporation factors were updated using published pan evaporation rate data in NOAA NWS TR34 (Table II) and the conversion factor to free water surface evaporation published in TR33.

Sanitary flow was developed from metering data and distributed into upstream catchments using population data from the 2010 Census.

3.2.3 Model Calibration and Validation

The hydrological processes involved in this model include precipitation, evaporation, surface runoff, and infiltration. Calibration was conducted to reproduce metered flow in dry weather as well as during wet weather. In addition to calibrating the hydrologic parameters to observed flow data, the hydraulic parameters in the Baseline Condition Model were also calibrated to depth and velocity data wherever available.

3.2.4 Calibrated Model Adjustment

Model parameters were adjusted iteratively within reasonable bounds to obtain the best possible agreement with metered data. Model parameters that were adjusted during dry weather calibration include:

- Average baseflow values
- Average sanitary flows
- Monthly baseflow patterns
- Manning's N, minor loss factor, and pipe slope to calibrate to observed depth and velocity

During wet weather calibration, the following parameters were adjusted to best reproduce metered flow volumes and peak rates, as well as hydrograph shapes:

- Soil infiltration rates
- Percentage routed (fraction of rainfall transferred from impervious to pervious surface)
- Catchment width (hydrograph shape factor)
- Unit hydrograph (RTK) processes (used in some areas to represent prolonged post-event responses)
- Pump station capacities (set at the maximum recorded flow)

Orifice dimensions and overflow weir elevations (to represent the leaping weir configurations).

Perth Amboy's calibrated and validated Baseline Condition Model well represents the dry-weather and wet-weather performance of the system. Some discrepancies between the modeled and observed data have been noted, and can be attributed to a variety of causes, including spatial variability of the monitored storms and observed data quality issues as detailed in the appendices. The model has been calibrated to shift any model bias to slight over-prediction of flows, rather than under-prediction, as a means to ensure that any eventual facility sizing applications will not result in under-sized facilities.

3.3 Typical Year Selection

There has been extensive investigation of long term hydrologic data performed by PVSC as part of their current efforts under the October 2015 Combined Sewer Management permit issued to them by NJDEP. This investigation has been conducted for the purpose of selecting a Typical Year precipitation record for use in their CSO LTCP development process and is documented in the Typical Hydrologic Year Report (May 2018) submitted by PVSC to NJDEP.

The City of Perth Amboy is a member of the NJ CSO Group. PVSC has shared with the Group their information on the Typical Year rainfall analysis, recognizing that individual members of the Group would likely want to coordinate on the use of a common Typical Year precipitation record for purposes of their individual CSO LTCPs. There is also a need for the Group to coordinate on a common Typical Year for generating land-side loads from CSOs and plant effluent discharges for the water quality modeling of the CSO receiving waterbodies being performed by the PVSC team on behalf of the Group.

After the extensive investigation by PVSC, their report recommends use of the calendar year 2004 as the typical hydrologic year, specifically use of the unadjusted hourly precipitation record at the Newark Airport for this annual period. Perth Amboy has reviewed the report, certified its approval of the report, and thereby accepted the selected Typical Year as proposed by PVSC on behalf of the NJ CSO Group members for use in the LTCP development process.

The reader is directed to PVSC Typical Hydrologic Year Report and the PVSC System Characterization Report, for further information about the selection of the Typical Year precipitation record and the supporting analysis.

3.4 Baseline Condition Overflow Statistics

The Baseline Condition Model estimates the total overflow volume in the Typical Year to be 386 MG using 2004 Newark Airport. Table 3-1 lists the simulated annual CSO statistics for each CSO outfall. CSO volume, duration, and frequency were calculated using 24-hour inter event time.

P-016 discharges over 100 MG in the Typical Year and is the largest CSO discharge point by volume, making up 26 percent of the system wide annual volume. P-002 and P-019 are the next two largest overflows with each discharging roughly 60 MG in the Typical Year. Together these three largest CSO discharge points account for about 60 percent of the total annual CSO volume in the system. Two of these three largest CSO discharge points are located along the Westside Interceptor and discharge to the Raritan River.

The annual overflow duration ranges from over 900 hours to about 80 hours. P-003 has the longest overflow duration of 939 hours. This duration is exceptionally long and impacted by two factors. First, P-003 is located on the Eastside Interceptor immediately downstream of the State Street Pumping Station. Second, the capacity of the State Street Pumping Station is less than the peak flow rate from the upstream trunk sewers during most storms, which requires storage of the excess flow in the wet well and upstream trunk sewers. Stored flow is then gradually released into the downstream interceptor, which causes a prolonged period of elevated flow entering P-003 regulator after each storm and long overflow durations.

Table 3-1 - Simulated Annual CSO Volume, Duration and Frequency

Location	Volume (MG/yr)	Duration (Hours/yr)	Frequency (Events/yr)	Peak Overflow Rate (MGD)	Percent of Total CSO	Receiving Water
P-002	63.2	501	70	195.9	16%	Arthur Kill
P-003	32.0	939	61	46.0	8%	Arthur Kill
P-004	9.2	382	71	31.4	2%	Arthur Kill
P-005	10.0	321	64	27.5	3%	Arthur Kill
P-006	19.0	174	36	62.7	5%	Arthur Kill
P-007	5.2	218	64	24.6	1%	Arthur Kill
P-008	2.8	132	59	18.5	1%	Arthur Kill
P-009	1.7	161	63	15.9	0%	Arthur Kill
P-010	1.6	114	59	21.5	0%	Raritan River
P-011	10.2	377	66	47.1	3%	Raritan River
P-013	33.1	394	69	44.5	9%	Raritan River
P-014	12.3	334	65	18.5	3%	Raritan River
P-015	14.0	418	71	33.8	4%	Raritan River
P-016	101.0	327	61	148.5	26%	Raritan River
P-017	8.6	82	33	35.9	2%	Raritan River
P-019	62.3	274	56	135.2	16%	Raritan River
System Total	386.4					
Maximum	101.0	939	71	195.9		
Minimum	1.6	82	33	15.9		
Average	24.1	321	61	56.7		
Median	11.3	324	64	34.9		

Outfall-specific overflow frequency ranges from 71 to 33 events for the Typical Year with a system-wide average of 61 events per year. Peak overflow rate is the largest flow rate that discharges from an outfall during the Typical Year. It ranges from 16 MGD (P009) to 196 MGD (P002). P016 and P019 also have very high peak overflow rates of over 100 MGD. The outfalls that have high annual CSO volumes also have high peak overflow rates.

3.5 Baseline Percentage Capture

Percentage capture is used in the USEPA CSO Control Policy as one means to establish targets for CSO control in the LTCP. This metric is therefore useful for both the characterization of baseline performance and for the forthcoming evaluation of CSO control alternatives. Under the Policy's Presumption Approach, one control option is "the elimination or the capture for treatment of no less than 85 percent by volume of the combined sewage collected in the combined sewer system (CSS) during precipitation events on a system-wide annual average basis…" [59 FR 18962 section II-C4(a)(ii)].

Percentage capture is a more complex metric than CSO volume and frequency. This is the fraction (as a percentage) of wet weather flow in the combined sewer system that is captured for treatment. On a system wide basis, captured flow is the wet weather flow that passes through the headworks of the treatment plant or in Perth Amboy's case, it is the discharge of the Second Street Pumping Station. Of all the wet weather flow that enters the sewer system, the portion that is not captured includes overflows to area waterways at the CSO outfalls or to the surface as combined sewer system flooding.

To calculate percentage capture, first the wet weather period needs to be defined. In this case, simulated total flow entering the sewer system is compared to the dry weather flow rate (base groundwater flow and sanitary diurnal flow) for every time step. When the former is more than 10 percent greater than the latter, this time step is flagged as a wet weather time step. Wet weather time steps are flagged for the entire Typical Year. Simulated total wet weather flow (total system wet weather inflow) that entered the modeled sewer network is then summed for all the wet weather time steps. Finally, the system wide percentage capture is calculated using the following formula for fraction captured (which can be converted to a percentage):

$$Percentage\ Capture = 1 - \frac{(Total\ CSO\ Volume + Total\ Flooding\ Volume)}{(Total\ System\ Wet\ Weather\ Inflow)}$$

The system wide capture for Perth Amboy is 57 percent. The exact same method is used in alternative analysis to evaluate the impact on system wide percent capture.

Section 4

Water Quality Objectives

This LTCP will seek to provide water quality benefits to the receiving water bodies commensurate with the expenditure of public funds. The evaluations necessary to define these benefits are being performed pursuant to the Presumption Approach defined by both national policy and the NJPDES CSO permits.

In support of the Presumption Approach, various combinations of technologies were evaluated for a series of control levels. The City's target level of control is 85% capture, as defined in the City's approved NJPDES permit.

4.1 Background

The CSO control objectives for both the City of Perth Amboy and MCUA are to comply with the current requirements of the following NJPDES Permits:

- City of Perth Amboy –NJPDES Permit No. NJ0156132
- MCUA – NJPDES Permit No. NJ0020141

MCUA's additional objective in this regard is to assist the City of Perth Amboy in developing any CSO alternatives that maximize storage or treatment at the CTP.

More specifically, both the City's and MCUA's NJPDES CSO permits indicate at least one of the following criteria must be met if the permittee chooses the Presumption Approach (G.4.f)

i. No more than an average of 4 overflow events per year.

ii. The capture for treatment of at least 85 percent by volume of the combined sewage collected by the combined sewer system on a system wide annual average basis.

iii. The elimination or removal of the mass of pollutants causing water quality impairment for volume that would be captured in (ii) above.

These objectives address the Presumption Approach requirements in the EPA CSO Policy and the NJPDES CSO permits, and a range of control levels have been evaluated to enable cost/performance considerations to be incorporated into the final selection of controls based on the City and MCUA selecting the Presumption Approach. As defined in the selected Long Term Control Plan presented in Section 9 of this report, Perth Amboy will implement all recommended LTCP capital projects to achieve the criteria for the Presumption Approach.

4.2 Receiving Waters Description

The sixteen outfalls in the City discharge into two receiving waters, the Arthur Kill and Raritan River. The baseline discharges into each receiving water are listed below in Table 4-1.

Table 4-1 - Baseline CSO Discharge by Receiving Water

Receiving Water	Baseline Annual CSO, MG
Arthur Kill	141.5
Raritan River	244.9
Total	**386.4**

A Pathogen Water Quality Model of the complete NY/NJ harbor, including the Arthur Kill and Raritan River/Bay, has been developed by the NJ CSO Group and this model is being used to understand the pollutant sources and their relative contributions for the affected study area. Use of the NJ CSO Group water quality model is expected to indicate which level of control evaluated for the CSO outfalls is needed to demonstrate attainment of WQS and designated uses of the corresponding receiving waters. The Pathogen Water Quality Model is also intended to demonstrate the maximum pollutant reduction benefits reasonably attainable for the receiving waters.

4.2.1 Arthur Kill

Arthur Kill is a tidal straight of approximately 10 miles that connects Newark Bay with Raritan Bay. Perth Amboy sits on the western shore of the Arthur Kill. Arthur Kill serves as a boundary between New York and New Jersey and is primarily used as a navigational channel for nearby industrial sites. It is periodically dredged for maintenance as a navigation route for commercial ship passage. The New Jersey stream classification for Arthur Kill along Perth Amboy's boundary is Saline Estuary 2 (SE2).

4.2.2 Raritan River

The Raritan Estuary is a tidally influenced body of water at the base of the approximately 70 mile long Raritan River and extends easterly to the Raritan Bay and further to the Atlantic Ocean. Portions of the estuary are at the border of New Jersey and New York state. The New Jersey stream classification for Raritan Estuary is Saline Estuary 1 (SE1). In the *NJCSO Group Compliance Monitoring Program Report* (CMPR) developed by PVSC on behalf of the NJ CSO Group which Perth Amboy is a member of, the beach area between P010 and P016 was identified as a potential sensitive area.

4.3 Water Quality Parameters and Applicable Standards

4.3.1 Water Quality Classifications and Listed Impairments

Water Quality Classifications are described in Sections 4.2.1 and 4.2.2.

None of the affected water bodies have listed impairments. However, the NJ CSO Water Quality model

4.3.2 Receiving Water Uses

Per NJAC 7:9B-1.12, the designated uses of the receiving waters are:

Saline Estuarine 1 (SE1):

7. Shellfish harvesting in accordance with N.J.A.C. 7:12;
8. Maintenance, migration and propagation of the natural and established biota;
9. Primary contact recreation; and
10. Any other reasonable uses.

Saline Estuarine 2 (SE2)

1. Maintenance, migration and propagation of the natural and established biota;
2. Migration of diadromous fish;
3. Maintenance of wildlife;
4. Secondary contact recreation; and
5. Any other reasonable uses.

4.4 Water Quality Data Analyses

4.4.1 Baseline Compliance Monitoring Program

The City of Perth Amboy is a member of the NJ CSO Group. The Passaic Valley Sewerage Commission (PVSC) is conducting extensive receiving waterbody investigations on behalf of the Group, in support of the October 2015 Combined Sewer Management permits issued to each of the Group's members. PVSC has developed a *Baseline Compliance Monitoring Report* (BCMR) which details the current receiving waterbody water quality conditions.

4.4.1.1 Program Description

The BCMP was designed 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 water bodies. The resulting model will be used to support the development of CSO Long Term Control Plans (LTCPs) by the Passaic Valley Sewerage Commission (PVSC) and participating members of the NJ CSO Group, of which the City and MCUA are members.

4.4.1.2 Receiving Waterbody Monitoring and Modeling

The City of Perth Amboy is a member of the NJ CSO Group. As the leader of the group, PVSC is conducting extensive receiving waterbody investigations on behalf of the members and in support of the October 2015 Combined Sewer Management permits issued to each member. The reader is directed to the PVSC submission, Baseline Compliance Monitoring Report, for additional information. The City of Perth Amboy is a cooperative partner in this effort.

4.4.1.3 Rainfall and Typical Annual Hydrologic Record

There has been extensive investigation of long-term hydrologic data performed by PVSC as part of their current efforts under the October 2015 Combined Sewer Management permit issued to them by NJDEP. This investigation has been conducted for the purpose of selecting a Typical Year precipitation record for use in their CSO LTCP development process and is documented in the Typical Hydrologic Year Report (May 2018) submitted by PVSC to NJDEP.

As noted earlier in this report, the City of Perth Amboy is a member of the NJ CSO Group. PVSC has shared with the Group their information on the Typical Year rainfall analysis, recognizing that individual members of the Group would likely want to coordinate on the use of a common Typical Year precipitation record for purposes of their individual CSO LTCPs. There is also a need for the Group to coordinate on a common Typical Year for generating land-side loads from CSOs and plant effluent discharges for the water quality modeling of the CSO receiving waterbodies being performed by the PVSC team on behalf of the Group.

After the extensive investigation by PVSC, their report recommends use of the calendar year 2004 as the typical hydrologic year, specifically use of the unadjusted hourly precipitation record at the Newark Airport for this annual period. Perth Amboy has reviewed the report, certified its approval of the report, and thereby accepted the selected Typical Year as proposed by PVSC on behalf of the NJ CSO Group members for use in the LTCP development process.

The reader is directed to PVSC *Typical Hydrologic Year Report* and the PVSC System Characterization Report, for further information about the selection of the Typical Year precipitation record and the supporting analysis.

4.5 Consideration of Environmentally Sensitive Areas

There has been a detailed investigation of the subject waterbodies relative to the established criteria used to designate Sensitive Areas as defined in the USEPA CSO Control Policy (59 FR 18,688; April 19, 1994) and reiterated in the NJDEP Combined Sewer Management permit issued in October 2015 to Perth Amboy. This work has been performed by PVSC on behalf of the NJ CSO Group, as part of the current efforts under the October 2015 Combined Sewer Management permits issued by NJDEP to the individual members of the Group. The reader is directed to the Consideration of Sensitive Areas Report, submitted by PVSC on behalf of the NJ CSO Group, for further information about Sensitive Areas in the subject waterbodies. It should be noted that the PVSC report describes one area in Perth Amboy that the City has identified for special consideration. This area is also described below in this section.

Bathing beaches are located on the north shore of the Raritan Bay, near the confluence of the Raritan River and the Arthur Kill, at the southeastern boundary of the City of Perth Amboy, displayed in Figure 4-1. These beaches are not currently designated by the City for recreational bathing use due to water quality concerns, specifically periodic non-attainment of pathogen water quality standards in the vicinity of the beaches. For this reason, signs have been installed by the City at the beaches to advise the public not to swim or enter the water in this area. However, there is significant public interest in restoring public use of the beaches for recreational bathing and there are active discussions underway to accomplish this objective.

The cause or causes of non-attainment are not yet fully known, but the discharge of CSOs at seven CSO outfalls located in the immediate area of the beaches is believed to be a significant factor. The City plans to conduct additional analysis of water quality conditions in the subject waterbody to determine the feasibility of achieving sufficient improvement to support restoration of public use of the beaches for recreational bathing. This additional analysis will be conducted during development of the final LTCP documentation.

The City of Perth Amboy advised PVSC of these circumstances for purposes of the aforementioned Consideration of Sensitive Areas Report prepared by PVSC on behalf of the NJ CSO Group. The City took this action recognizing that the USEPA CSO Control Policy defines Sensitive Areas to include “waters with primary contact recreation” (which includes recreational bathing beach waters). The CSO Policy states that such areas should be given special consideration in the Long term Control Plan, including elimination or relocation of CSO discharges.

Because the subject beaches are not currently designated by the City as public use bathing beaches, and only occasional and unauthorized recreational bathing occurs there, the City does not regard the beaches as a Sensitive Area. Further, as noted above, the City has not yet determined that it is feasible to restore water quality to the extent necessary to support safe public use of the beaches for recreational bathing, as pathogen discharges upstream on the Raritan River and/or from other sources into the Raritan Bay may preclude attainment of water quality standards even after the local CSO discharges are addressed.

However, because there has been significant public interest in and discussion of restoring the beaches for public use as recreational bathing beaches, this area is being acknowledged here. If the City at some future time determines that it is feasible to achieve sufficient water quality improvement to support safe public use of the beaches for recreational bathing, the subject beach area could be designated as a Sensitive Area at that time.

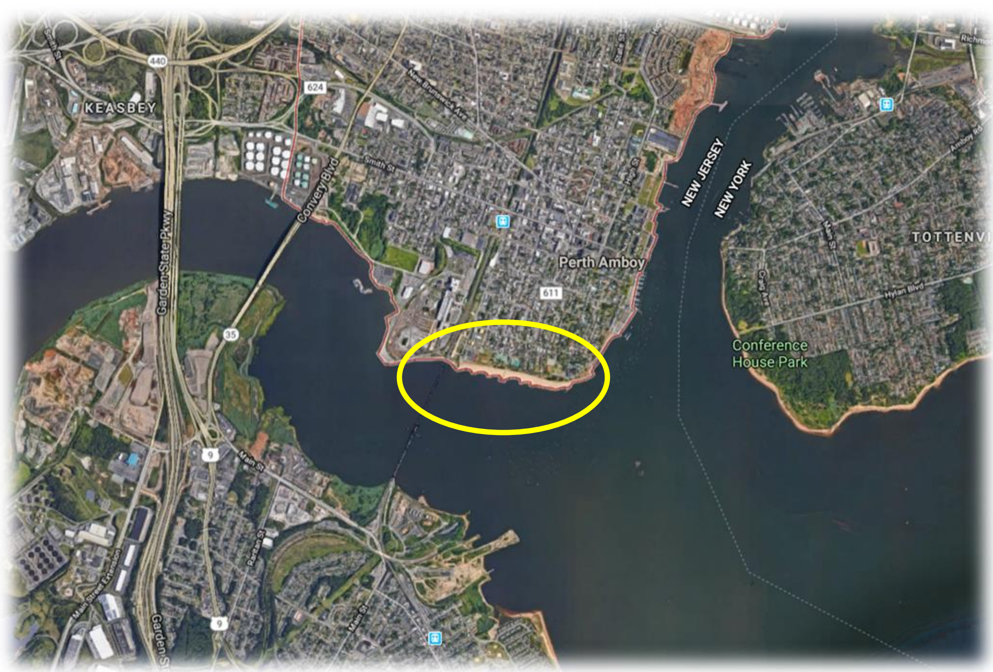

Figure 4-1 - Area of Proposed Bathing Beaches (not currently designated for use)

4.6 Summary

The City's water quality objectives are to comply with their NJPDES permit and support the local efforts to provide for recreational use of the beach along the Sadowski Parkway beach water quality conditions permitting.

Further discussion of the water quality objectives and limitations on it are included in Section 6.

Section 5

Development and Evaluation of Alternatives

The City of Perth Amboy and MCUA submitted the Development and Evaluation of Alternatives Report (DEAR) on July 1, 2019, and a revised version on November 5, 2019 to address NJDEP comments. The DEAR report contains detailed descriptions of the alternatives considered. The following sections summarize these alternatives, with a focus on the alternatives that are part of the selected plan.

5.1 Introduction

The technologies included in Table 5-1 were evaluated in the DEAR in general terms of effectiveness and feasibility. Technologies that have major drawbacks or are not applicable for implementation or that offer no benefit to the CSO mitigation program were eliminated from further consideration. Technologies that should be considered as long-term CSO mitigation alternatives were evaluated further in the DEAR. Specific factors that deem whether a technology is appropriate include: the current condition of the sewer system, the characteristics of the wet weather flow (location, peak flow rate, volume, frequency and duration), hydraulic and pollutant loading, climate, implementation requirements (land, neighborhood, noise, disruption), and maintenance requirements.

The CSO abatement technologies considered for this report have been identified by the following categories:

6. Viable Technologies for Significant Control;
7. Useful but Limited Application;
8. Technologies with Major Drawbacks (eliminated from further consideration); and
9. Not Applicable (eliminated from further consideration).

Table 5-1 - Screening of CSO Control Technologies

CSO Control Technology	Viable Alternative for Significant Control	Useful but Limited Application	Alternatives with Major Drawbacks	Not Applicable
Rain Gardens		X		
Right-of-Way Bioswales		X		
Enhanced Tree Pits		X		
Green Roofs		X		
Permeable Pavement		X		
In-Line Storage				X
Off-Line Storage	X			

CSO Control Technology	Viable Alternative for Significant Control	Useful but Limited Application	Alternatives with Major Drawbacks	Not Applicable
Sewage Treatment Plant Expansion or Storage at STP	X			
Regulator Modifications		X		
Inflow and Infiltration Reduction			X	
Sewer Separation		X		
Screening	X			
Vortex/Swirl Separation			X	
Ballasted Flocculation	X			
Compressed Media Filtration		X		
Disinfection	X			
Bypass	X			

Summaries of the alternatives in the first two categories are included in Section 5.2.

For comparison of total capital and operating costs among alternatives, we have chosen to present 20-year lifecycle costs assuming a discount rate of 2.75%. This is for comparison purposes only in this section. We anticipate the actual cost of the program will warrant a longer implementation timeframe to achieve affordability.

5.2 Description of Alternatives

Following is a summary of alternatives considered as part of the Development and Evaluation of Alternatives Report.

5.2.1 Green Infrastructure

Green Infrastructure (GI) practices are designed to reduce the volume and/or peak of stormwater runoff that entering the combined sewer system. In bioretention systems, such as a rain garden or bioswale, the runoff is routed to a permeable surface and allowed to infiltrate back into the ground. By preventing this stormwater from ever entering the collection system, the volume of overflow and associated pollutant loads discharging to the receiving waters is reduced. In detention systems, runoff is routed to a storage unit and returned to the combined sewer collection system, ideally after conveyance and treatment capacity have returned. By attenuating these flows, the conveyance system can accept a greater percentage of the overall runoff volume over a longer period of time, resulting in a net reduction of overflow volume and pollutant loads to the receiving waters.

For the purpose of this LTCP, GI is applied as an alternative assuming 10 percent of the runoff from impervious areas of the City is treated by GI. This is slightly less than the goal of 15-20 percent recommended by the Supplemental CSO team. If the City is able to achieve implementation of higher levels of green infrastructure, this can be viewed as a factor of safety for the provisions contained in the LTCP or can be used to rationalize the design of improvements once those improvements are undertaken by the City.

The green infrastructure technology recommended are bioretention systems, which include any of the following vegetated practices described here in more detail.

5.2.1.1 Rain Gardens

A rain garden consists of a shallow depressed area that is designed to collect stormwater runoff from surrounding surfaces. The collected water infiltrates into the ground, evaporates back into the atmosphere, or is transpired by the vegetation. To increase water absorption and promote infiltration, rain garden designs typically include an upper layer of amended soil with high porosity.

Plant selection and maintenance is critical to the long-term viability of a rain garden. Native plants should be selected that are capable of withstanding periods of ponded water as well as periods of dryness. Using native plants helps to reduce the amount of maintenance that will be required.

Rain gardens can be implemented on public and private properties to capture and retain runoff. When properly designed and maintained they can provide aesthetic improvements to the urban landscape, natural wildlife habitat, and education opportunities for schools. Their shallow and relatively simple design means they can often be constructed without the use of heavy machinery.

5.2.1.2 Right-of-Way Bioswales

The right-of-way bioswale is a curb-side green infrastructure design being widely employed as part of New York City's green infrastructure program for CSO control. To date several thousand units have been constructed or are in construction. There are several variations of the design with different widths and depth (right-of-way green strips, right-of-way raingardens) but the functionality is essentially the same.

The typical right-of-way bioswale is between 4 and 5 feet wide by 10 to 20 feet long. They are constructed in the existing sidewalk, with curb cuts to allow street runoff traveling along the gutter to enter the bioswale on the upstream side and excess flow to return to the street on the downstream side. It is this conveyance aspect of the practice that makes it a bioswale instead of a deep raingarden.

On the surface, the right-of-way bioswale looks and functions much like a rain garden described above. The unit includes a shallow ponding area, and a vegetative surface that may or may not include a tree. However, whereas a raingarden is generally less than a foot deep, the right-of-way bioswale is approximately 4 ½ feet deep. The first 2 ½ to 3', depending on the design is made up of an engineered soil designed to allow for rapid infiltration. The lower portion of the bioswale is a stone base to provide storage.

The right-of-way makes up a significant amount of a city's impervious cover. Sidewalks and streets are generally pitched to capture and convey runoff directly towards the collection system, making them efficient locations to intercept the flow. Furthermore, the municipality already has ownership of these areas.

5.2.1.3 Enhanced Tree Pits

Enhanced tree pits, or stormwater trees, can appear similar to a standard city tree pit. Unlike a standard tree pit, however, they utilize an underground system designed to infiltrate runoff. The underground system includes engineered soil capable of rapidly infiltrating water, crushed stone, and an underdrain system. Although they can be built individually, they become more effective when they are installed as a connected multi-unit linear system. In such a system, permeable pavement can be used between the tree pits to allow additional water to infiltrate into a subsurface stone layer that connects the tree pits.

Enhanced tree pits are already in use in cities across the United States as stormwater control measures. They can be constructed in sidewalks, in parking lots, courtyards, etc.

5.2.1.4 Green Roofs

A green roof generally consists of a vegetated layer on top of a lightweight soil medium, below which lies an underdrain system and waterproof membrane. The depth of the soil medium will determine the type of vegetation that can be sustained and also the weight of the vegetated roof.

A portion of the precipitation that falls on the vegetated surface is retained in the soil medium and eventually released back to the atmosphere through evaporation and taken up through transpiration. The underdrain system acts as additional detention system before the excess water is eventually discharged through the buildings downspouts to the ground or directly into the combined sewer system.

5.2.2 Increased Storage

Storage technologies are used to store flow for subsequent treatment at the wastewater treatment facility when downstream conveyance and treatment capacity are available. Two general types of storage were considered in the DEAR: in-line storage, which is storage in series with the sewer; and off-line storage, which is storage in parallel with the sewer. Off-line storage was considered further in the DEAR including consideration for storage tanks and deep tunnel storage. Off-line storage is storing the sewerage in a system that is not on the typical flow path of dry weather flow. Off-line storage systems use tanks, basins, tunnel or other structures located adjacent to the sewer system for storing wet weather flow that is above the capacity of the conveyance system. The wastewater flows from the collection or conveyance system is diverted to off-line storage when conveyance capacity of the collection system has been exceeded. They can be used to attenuate peak flows, capture the first flush, or to reduce the frequency and volume of overflows. Wastewater flows diverted to storage facilities must be stored until sufficient conveyance or treatment capacity becomes available in downstream facilities.

Off-line storage is not a flow through facility and thus ancillary facilities must be constructed for a complete installation. Ancillary facilities typically include some type of flow diversion or regulator structure, possibly coarse screening to keep large solids from entering the tank, and some type of tank drain facility to divert the sewerage back to sewer system. To keep solids from accumulating within the tank, most storage facilities also provide facilities to flush solids from the bottom of the tanks into the pumping sump or gravity sewer.

The recommended plan includes off-line storage tanks based on their lower construction costs compared to deep tunnel storage.

5.2.2.1 Off-line Storage Tanks

The most prevalent form of off-line storage for CSO discharges is the concrete/steel tank. Large volume storage requirements can best be accommodated by the construction of off-line storage facilities at or near the CSO outfall. The design and sizing of these facilities are based upon computer modeling of drainage area and collection system to develop an understanding of the frequency and volumes associated with individual outfalls.

Advantages of off-line storage using concrete tanks are simplicity of operation and maintenance, and capability to handle high flow and water quality variations. In addition, storage tanks have the capacity for storage and collection of solids even when storm events exceed the design capacity of the off-line storage tank. In these cases, the off-line storage tank acts like a sedimentation tank. Storage tanks, in conjunction with fine screening of CSO discharges above the storage volume, are used as a primary means of CSO control throughout Europe.

5.2.2.2 Deep Tunnel Storage

This control alternative involves the capture and storage of CSO discharges in a tunnel during wet weather events and pumping the stored overflow back into sewer when conveyance and treatment capacity is available. New methods of construction have made deep tunnel storage a competitive option when considering the relatively low land requirements. Limitations of deep tunnels primarily include the need for specialized high-lift pumping stations and the inability to provide any treatment when the overflow exceeds the deep tunnel storage volume.

5.2.3 Treatment Plant Expansion and Storage at CTP

The MCUA and Perth Amboy are required to consider maximizing flow to the Treatment Plant as one of the Nine Minimum Controls established by the USEPA. This section outlines the ability and limitation on directing flows to the MCUA's Central Treatment Plant (CTP). Originally, options for treating or storing flows that are received by the MCUA from Perth Amboy's combined sewer system were evaluated and presented in the DEAR. During the initial development of the SIAR, PA indicated that the selected long-term plan would be conveying the baseline flow (maximum of 13.6 MGD) which is the flow limit from the agreement between the City of Perth Amboy and Woodbridge Township as indicated earlier in Section 2 and in the DEAR, but for extended period of time. Since the storage and dedicated high rate treatment (HRT) alternatives were evaluated to receive additional flows (higher than the baseline of 13.6 MGD), it was determined that these alternatives would not be evaluated further for long-term implementation.

The original evaluations to expand the CTP's capacity, provide CSO storage, or provide flow bypass and HRT and disinfection are based on the three (3) potential CSS flow rates projected from the Perth Amboy CSO system as indicated in the DEAR:

- Direct CSO Flows up to 13.6 MGD to the CTP for full-treatment. The duration of this flow rate may extend beyond the normal peak period for various storm events to handle the CSS flows stored within Perth Amboy.
- Direct flows up to a maximum rate of 42 MGD to the CTP for full-treatment.
- Direct flows up to a maximum rate of 54 MGD to the CTP for full-treatment.

Based on further evaluation, it is determined that the City would convey up to a maximum of 13.6 MGD instantaneous flow rate of the CSO to MCUA; therefore, only the first scenario (13.6 MGD) is evaluated further in this SIAR. Capacity Expansion at the MCUA CTP

Based on this evaluation done for the MCUA CTP in the DEAR, the CTP would not be able to receive and treat increased peak CSS flow rates greater than 13.6 MGD from Perth Amboy, such as the 42 MGD and 54 MGD of CSS flow rates being contemplated, without substantial capacity increases to most unit processes which are evaluated under Section 4.2.3 of the DEAR.

The CTP expansion alternative represents the most complex, costly and disruptive to plant operations alternative. Therefore, this alternative is not being considered further.

Since it is determined that the City would convey up to 13.6 MGD maximum instantaneous flow rates to MCUA CTP, the alternatives for MCUA CTP Storage or HRT as evaluated and presented in the October 2019 DEAR are not applicable and therefore, are not evaluated further.

5.2.3.1 Directing Combined Sewer Flows to the CTP

A new direct force main can be constructed to convey flow to the CTP from Perth Amboy. The proposed force main to convey flow directly from the Second Street Pumping Station in Perth Amboy to the CTP would be approximately 2 miles in length and would be installed by horizontal directional drilling (HDD) under the Raritan River as shown in Figure 5-1. This conceptual alignment could be significantly impacted by existing and future development in these areas. Based on the flow rate of 13.6 MGD from the Perth Amboy Second Street Pumping Station, there would be one 24-inch diameter force main.

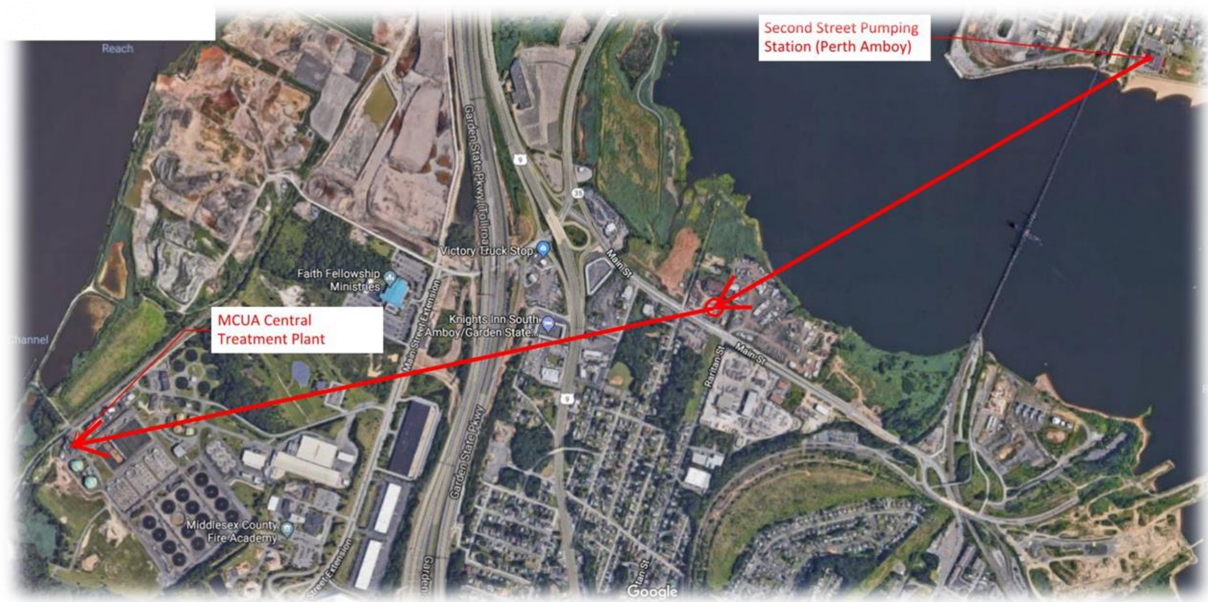

Figure 5-1 - Concept Force Main - Perth Amboy Second St Pumping Station to MCUA CTP

If Perth Amboy were to pump its CSS flow to the CTP directly, it would not pump any flow through the Keasbey Interceptor to the CTP. Therefore, flows will not be directed through both the existing interceptor and new force main at the same time. If Perth Amboy pumps CSS flows directly to the CTP up to a maximum of 13.6 MGD, the flow would be directed to a new connection (to be determined by Perth Amboy) and the flows would go to the existing headworks to receive full-treatment. It is anticipated that Perth Amboy would provide fine-screening (maximum ½" clear spacing) before pumping to the CTP.

During the dry weather periods Perth Amboy would pump a maximum of 13.6 MGD to the CTP on a regular basis to flush-out settled solids in the force mains. During the wet weather period, the 13.6 MGD maximum instantaneous flow rates would be pumped through Woodbridge via the Keasbey Interceptor for extended periods of time or directed to the headworks via a new forcemain to receive full treatment though the CTP.

5.2.4 Regulator Modifications

Regulator modifications for CSO control often include enlarging the connection between the regulator and the interceptor or raising the overflow weir which lead to increased capture. It is a useful CSO control technology but have limited application when used alone. Regulator modifications are included in the selected plan at nine of the regulators including P-003, P-009, P-010, P-011, P-013, P-014, P-015, P-016, and P-017. A $50,000 allowance per regulator for modifications has been assumed for cost estimation purposes.

Seven of the regulators to be modified are in Group 3 and will increase capture of combined sewer flow. The details of the modification are summarized in Table 5-2. The capture line (orifice) connecting the regulator to the interceptor will be enlarged and the weir will be raised for all but one regulator. This will allow more flow to be conveyed into the interceptor and reach the Second

Street Pumping Station. The weir offset is anticipated to be less than or equal to the radius of the upstream trunk sewer. The model did not show any significant impact of the raised weir on hydraulic grade line in the trunk sewer.

Table 5-2 - Modifications of Regulators in CSO Group 3

CSO	Orifice (ft)		Weir crest offset (ft)		Trunk sewer diameter (ft)
	Before	After	Before	After	
P009	0.7'x0.667'	1'x1'	0.1	0.5	1.5
P010	1.25'x0.458'	1.25'x1'	0.1	1.5	3
P011	1.25'x0.458'	1.25'x1.25'	0.1	1.5	3
P013	1.25'x0.458'	1.25'x1'	0.15	1.5	3
P014	1.25'x0.458'	1.25'x1'	0.1	1	3
P015	1.25'x0.458'	1.25'x1'	0.1	1.5	3
P016	0.833'	3.33'x2.5'	NA	NA	7

On the Westside Interceptor, modification of P-017 regulator will limit the wet weather flow heading towards P-016. Regulator modification at P-017 (see Table 5-3) will throttle the capture of combined flow and prevent it from heading toward P-016. Because P-017 is not a large CSO and P-016 is one of the largest, throttling capture flow at P-017 will increase annual overflow at P-017 by 7.6 MG and relieve the surcharge condition in the Westside Interceptor between P-017 and P-016 as well as reduce the size of the storage or treatment facility for the beach area.

Table 5-3 - Regulator Modifications at P-017

CSO	Orifice, ft		Weir crest offset, ft		Trunk sewer diameter, ft
	Before	After	Before	After	
P-017	1.5'x1.5'	1'x1'	2.6	2.2	2

5.2.5 Inflow and Infiltration Reduction

5.2.5.1 City of Perth Amboy

To maximize the collection system's capacity, it is necessary to remove extraneous flows caused by infiltration and inflow (I/I). Infiltration is groundwater that enters the system through broken or cracked pipes, defective joints, depressed manholes, and manhole walls. Replacing or lining defective pipes, pipe joints and manholes can reduce infiltration. Infiltration problems are generally difficult to isolate, which impacts the cost-effectiveness of this measure. Often, significant lengths of sewer must be rehabilitated before gaining significant infiltration reductions.

Only 16 percent of the City's sewer system is separated, and this portion of the system contributes relatively little wet weather response compared to the 84 percent of the system that is combined. Infiltration and inflow reduction on a system-wide scale is extremely costly to achieve, and the actual reduction levels to be achieved are not known until after the extensive sewer rehabilitation efforts are completed and evaluated with post-improvement flow monitoring. Given these considerations, this LTCP will consider sewer separation inside of Perth Amboy in a limited way.

5.2.5.2 MCUA

All municipalities serviced by MCUA, except the City of Perth Amboy, are separate sewer areas. The MCUA has been working with all Participant connected sewer systems to maximize available flow capacity at the CTP. The MCUA has a program in place to encourage its Participants to reduce excessive Infiltration and Inflow (I/I) from entering their respective collection systems as required by each Participant in accordance with Article VI (I) of the Agreement between MCUA and each Participant, which states the following:

"Each Municipality and all public corporations discharging sewage into the Local Sewerage System of a Municipality will maintain its Local Sewerage System in such a manner as to exclude any excessive infiltration and/or inflow from entering into the local Sewerage System. If excessive infiltration and/or inflow exists or occurs, the Municipality and public corporation will affect such repairs, or other measures, so as to eliminate the excessive infiltration inflow to normally allowable limits which are acceptable to the DEP and / or USEPA. Furthermore, if as a result of a sewer evaluation survey, rehabilitation work is shown to be required, each Municipality and public corporation will perform such work as may be necessary to rehabilitate its Local Sewerage System."

MCUA provided a summary of this Program in its May 10, 2019 letter to NJDEP and USEPA and included information in the October 2019 DEAR.

The MCUA has undertaken several capital projects to address infiltration/inflow concerns within portions of their existing Main Trunk Sewer system. The MCUA initiated planning studies for the long-term rehabilitation of approximately 35,000 lineal feet of 60-inch and 66-inch CMP extending along the Raritan River between Bound Brook and Highland Park where the pipe is constructed of asphalt line Corrugated Metal Pipe (CMP) installed in 1955. To date, the MCUA has committed over $13 million to reline and rehabilitate approximately 14,000 feet of trunk sewer using trenchless technologies including segmental slip lining and Cured-In-Place Pipe (CIPP) technologies, or replacement of certain sections that may be required. Phase I involving approximately 6,000 feet of 60-in and 66-inch CMP has been completed, and Phase II involving approximately 8,000 feet of 60-in and 66-inch has been completed, as well as over 2,000 feet of smaller connecting sewers.

MCUA is currently coordinating the design for Phase III rehabilitation of approximately 4,400 LF of CMP pipe as well as several siphons, meter chambers and connecting gravity sewer pipes with an estimated construction cost of approximately $12.5 million, and final phases of rehabilitation for the remaining CMP portions of the MTS is planned for 2021/2022 at a range of costs between $10 million and $15 million dollars. In total, the MCUA will be committing between $35 million and $40 million to rehabilitate its CMP portions of the Main Trunk Sewer. These projects will significantly reduce I/I within these sections of the MTS system.

5.2.6 Sewer Separation

Sewer separation is defined as the reconstruction of an existing combined sewer system into separate non-interconnected sanitary and storm sewer systems. The sanitary sewer system is tributary to the wastewater treatment plant, and the storm sewer system discharges directly to local receiving waters.

Typically, to separate an existing combined sewer area, either a new drainage system is constructed, or new sewer pipelines are installed, and the existing combined sewer is used as the sanitary or separate storm drain, respectively. Construction of new sanitary sewers is preferable due to the added benefit of reducing infiltration associated with deficiencies in the existing sewers. If portions of the combined sewer system were found to be susceptible to structural failure, they would likely require complete replacement and two new pipes would likely be constructed for the separate sewer and storm drain systems.

Unlike storage and treatment alternatives, which reduce the frequency of CSO discharges, full sewer separation of a combined sewer system eliminates CSOs by diverting all sanitary flow to the wastewater treatment plant and discharging stormwater to receiving waters. The USEPA CSO abatement policies require that combined sewer system separation be evaluated as a step in CSO facilities planning. Although full separation eliminates CSOs, it may not, in all cases, be the most appropriate alternative in terms of addressing site-specific water quality objectives. Full separation eliminates pollutant loadings to receiving waters caused by the sanitary flow in CSOs; however, impacts caused by stormwater pollutants remain and often increase. Such pollutants may include bottles, cans, cups, wrappers, cigarette butts, leaves, sediment, and other items that enter the storm drains.

Under the USEPA Phase II stormwater program, communities are required to assess their stormwater quality. The USEPA "Report to Congress, Impacts and Control of CSOs and SSOs" dated August 2004 states that implementation of stormwater controls may be necessary following separation to obtain pollutant load reductions necessary for attainment of water quality standards.

Partial separation is a useful CSO control technology, but with limited application. Partial separation projects target specific areas where CSO reduction benefits may outweigh the construction costs and other impacts.

5.2.7 Satellite CSO Treatment Facilities

According to the National CSO Policy, satellite CSO treatment needs to meet primary treatment standards, which requires multiple treatment processes. The combination of pre-treatment and disinfection has been used extensively throughout the country for effective CSO satellite treatment. A screening facility will also be considered upstream of the pre-treatment process, specifically climber-type mechanical bar screens because they have been found to be more reliable and significantly lower in operation and maintenance requirements than other screen types. Of the various types of technologies evaluated in the DEAR, ballasted flocculation and compressed media filtration are considered for pre-treatment technology, while sodium hypochlorite is the selected disinfectant, with sodium bisulfite for dechlorination before discharging into the receiving water. The Densadeg ballasted flocculation system was further evaluated in the DEAR because of the lower cost estimates compared to other ballasted flocculation system and the compressed media filtration system.

The following sections describe the different components of the satellite CSO treatment facilities.

5.2.7.1 Screening Facility

Climber-type mechanical bar screens have proven to be a relatively simple and inexpensive means of removing floatables and visible solids. They are typically the screen of choice in treatment facilities and are used at a many CSO treatment facilities. There have been hundreds of Climber Screens® installed in CSO applications across the US. Mechanical bar screens operate successfully to remove floatables and visible solids over the fluctuations in flow rates seen in CSOs. Bar screens will remove essentially 100 percent of all rigid objects of which the minimum dimension is more than the spacing between the bars, which is assumed to be a minimum bar spacing of ½". Slight removal of TSS, total phosphorous, and total nitrogen (typically 5%, 3%, and 2%, respectively) can be achieved with the solids removal. As screenings are removed from the CSO flows, they generate a waste stream for disposal. These screenings must be either transferred to the interceptor sewer for ultimate disposal at the WWTP or removed and stored in a container for onsite removal at a convenient time. The collection of screenings can be performed using conveyors, screenings compactors, or pumps.

Hydraulic losses through bar screens are a function of approach velocity, and the velocity through the bars. The head loss across the bar screen increases as the bar screen becomes clogged, or blinded. Instrumentation provided with mechanically cleaned screens is typically configured to send a signal to the cleaning mechanism so the head loss across the screen is limited to 6 inches.

5.2.7.2 High Rate Clarification (Ballasted Flocculation)

High rate clarifiers (HRC) typically have a much smaller footprint than conventional sedimentation tanks. Typically HRC are divided into trains of certain treatment capacities, such as 50 MGD. When additional treatment capacity is needed, the number of trains is increased. For example, 200 MGD HRC layout could consist of four, 50 MGD trains, or a 400 MGD HRC layout could consist of eight 50 MGD trains.

The DensaDeg® is a is a high-rate settling clarifier process combining solids contact, ballast addition and solids recirculation to provide enhanced, high-rate settling of solids. Different from ACTIFLO®, recycled sludge, instead of microsand, is added to increase floc density and precipitation. The DensaDeg® process can be fully automated and the process train(s) can sit idle for extended periods of time and still be fully operational within 30 minutes of start-up. It can be installed at the treatment plant or at a satellite facility within the collection system. Installations at the WWTP also enable the sludge produced by the unit to be processed. When installing the DensaDeg unit in a remote CSO location, the flows will vary widely, and the sludge must be stored so it can be put back into the interceptor at periods of low flow.

The DensaDeg® ballasted flocculation process is sized for the peak hour or day flow to prevent flow from exceeding the capacity of the unit. The units are designed for a surface-loading rate of 40-60 gallons per minute per square foot. When starting up the unit it takes 30 minutes for the process to reach steady state conditions and no sludge inventory is required for startup. The DensaDeg® ballasted flocculation process is very effective in removing vast quantities of pollutants. Its performance in terms of contaminants removal include TSS removal of 80-90 percent, typically providing effluent <30mg/L TSS (inlet dependent) and BOD percent-removal similar in magnitude to TSS percent-removal, when treating typical municipal WW which is 30-40 percent of total BOD. Removal could be higher depending on soluble ratio.

The head loss through the units at peak flow rates are reportedly less than two feet.

5.2.7.3 Compressed Media Filtration

The compressible media filtration is a process that uses a synthetic, porous filter media. The filter is unusual in a number of ways: (1) the synthetic media is highly porous (89% percent), (2) filter media and bed properties can be modified because the media is compressible, (3) the fluid to be filtered flows both around and through the media instead of only flowing around the filtering media (as in granular media filters), (4) the fluid that is filtered is used to backwash the filter, (5) to backwash the filter, filter bed volume is increased mechanically, and (6) the filter operates at high filtration rates (up to 40 gal/min/sq. ft.) Performance of the filter, with respect to removal of turbidity and total suspended solids, is similar to the performance of other more conventional filters with the exception that filtration rate is more than 3 to 6 times the rate of other filters. Also, percent backwash water required is significantly less than that used in conventional filtration technologies (typically 1 to 2% percent versus 6 to 15% percent).

Compressible media filtration is commercially available as either the "Fuzzy Filter" by Schreiber Industries or the "FlexFilter" by WesTech (both are proprietary technologies covered by patents or pending patents). Both technologies use synthetic fiber spheres as filter media; however, they have different flow configuration, method of bed compression, composition of the synthetic fibers, and media washing details.

The Fuzzy Filter receives the influent at the inlet pipe located at the bottom of the unit. The influent is pressurized upward through the compressed filter media and the effluent is piped out towards the top of the unit. Porous plates are used to both compress the filter media as well as open up the filter bed to allow movement during backwashing.

The FlexFilter receives the inflow from the influent channel. The influent channel is connected to the influent basin where the filter vessels are located. As the influent water accumulates in the influent basin, compression is added to the reinforced rubber sidewalls on the bottom of the filter vessel and compresses the filter bed laterally as the water elevation rises. As the water level in the influent basin reaches the inlet weir elevation, the influent water pours over the influent weir and passes downward through the compressed media bed. Since the bottom of the filter bed compresses more than the top of the filter bed, a porosity gradient is established through the filter bed to capture the largest particles in the upper portion of the filter bed while reserving the deeper portions of the bed to trap finer particles. As particles collect within the media bed, the influent level above the bed rises to a point that signals the need for the media to be cleaned.

The filters use air scouring in the wash cycle to clean the media. During the wash cycle, the feed to the filter is stopped, allowing the media to uncompress. The air scour is initiated along with a small amount of backwash water. The length of the backwash cycle is adjustable. Once cleaned, the filter is put back into service.

Compressed media filters are useful but with limited application due to the following requirements:

- 7 to 8 feet of headloss;

- Influent TSS concentration to the FlexFilter is limited to less than 100 mg/L. Higher TSS concentrations will increase the backwash time resulting in overall reduced performance of the units. The Fuzzy Filter is only used as a polishing step for CSO treatment to meet the most stringent treatment objectives;
- Fuzzy Filter does not have a history of treating flows larger than 50 MGD while the FlexFilter has been applied at the 100 MGD Springfield Ohio WWTP treating combined sewer overflow.

5.2.7.4 Disinfection

Hypochlorite is a commonly used disinfectant in water and wastewater treatment and has been applied as a CSO disinfectant. It can be produced on site or can be delivered in tanker trunks with concentrations between 3 to 15 percent of available chlorine. Hypochlorite decays over time. The decay rate can increase as a result of exposure to light, time, temperature increase or increased concentration of the compound. The solution can be stored for 60 to 90 days before the disinfecting ability degrades below recommended values (5% concentration). Degradation of the solution over time is a major disadvantage of sodium hypochlorite for CSO applications, due the variability of the size and frequency of rain events. There are two types of hypochlorite: Sodium hypochlorite ($NaOCl$) and Calcium hypochlorite ($Ca(ClO)_2$). Sodium hypochlorite is often referred to as liquid bleach or soda bleach liquor, while Calcium hypochlorite is manufactured either as a grain or powder under various names, and all have either approximately 35 percent or 65 percent available chlorine content. Sodium hypochlorite is the most widely used of the hypochlorites for potable water and waste treatment purposes. Although it requires much more storage space than high-test calcium hypochlorite and is costlier to transport over long distances, it is more easily handled and gives the least maintenance problems with pumping and metering equipment. It will be used as the basis for evaluating disinfection alternatives.

Based on molecular weight, the amount available as chlorine is 0.83 lbs/gal for a 10% solution of sodium hypochlorite and 1.25 lbs/gal for a 15% solution.

The use of chlorine disinfection of wastewater can result in several adverse environmental impacts especially due to toxic levels of total residual chlorine in the receiving water and formation of potentially toxic halogenated organic compounds. Chlorine residuals have been found to be acutely toxic to some species of fish at very low levels. Other toxic or carcinogenic chlorinated compounds can bioaccumulate in aquatic life and contaminate public drinking water supplies. For this reason, excess chlorine must be dechlorinated. Sodium bisulfite is the most commonly used chemical for dechlorination due to the ease of handling, fewer safety concerns, economic reasons, and availability. Sodium bisulfite can decay about 40 % over a period of six-months. The storage should consider the release of sulfur dioxide when the sodium bisulfite is stored in a warm environment; a water scrubber is typically used to diffuse and dissolve off-gas. Another operational problem is the crystallization of sodium bisulfite when the temperature drops below the saturation point: -6.7^{0}C for 25% solutions and 4.4^{0}C for 38% solutions.

5.3 Alternatives Evaluation

5.3.1 Performance Considerations

One of the main objectives for CSO control is to support public use of the existing beach for swimming and other recreational uses. This objective is assumed to require full capture and control of CSO discharge for CSO group 3 through 5, i.e. outfalls P-009 through P-019.

The above outfall groups discharge to the Raritan River. In order to improve water quality in the Arthur Kill, a range of control levels were evaluated, i.e. 0, 4, 8, 12, and 20 overflows per year for CSO Groups 1 and 2.

System wide percent capture was also considered during the evaluation to show the impact of CSO control on the overall system. The formula used to calculate system wide percent capture was presented in Section 3.5 of this report. The level of control required for these two groups to achieve 85 percent capture is 20 overflows per year.

5.3.2 Cost Considerations

5.3.2.1 Basis for Perth Amboy's Cost Estimation

The basis for the cost estimates came from the following sources:

- Preliminary planning level construction cost estimates, annual operation costs, and estimated annual maintenance labor costs for HRT, screens, and disinfection referenced the Passaic Valley Sewerage Commissioners CSO Long Term Control Plan Updated Technical Guidance Manual, dated January 2018, by Greeley and Hansen and CDM Smith (PVSC TGM).

- Updated cost guidance for sewer separation, green infrastructure, relief pipe, and satellite storage tanks is from the April 3, 2020 Memo Updated Guidance on Costing for LTCP CSO Planning from Greeley and Hansen/CDM Smith for the PVSC Permittee Group.

- Operation and maintenance cost basis are also calculated based on a draft memorandum entitled PVSC Alternatives Capital and Life Cycle Cost Assumptions, March 20, 2019 by Greeley and Hansen and CDM Smith (O&M costs for pumping stations, storage, tunnels, and conveyance pipelines/sewers)

- Deep ocean outfall unit cost ($10,000 per ft diameter/ft length) plus 25% on construction cost assumed to be 20-year present value for annual O&M

- Sewage pumping station construction costs were obtained from EPA Cost Estimating Manual, Combined Sewer Overflow Storage and Treatment, December 1976. The costs were escalated to March 2020 cost and were adjusted using the Newark, NJ location factor.

- The 20-year present value for O&M is calculated using a discount rate of 2.75% (taken from the Rate for Federal Water Projects, NRCS Economics, Department of the Interior)

Where planning level costs were not available, allowances for smaller components of the work (like regulator modifications) were assigned based on professional judgement.

- Regulator modifications ($50,000 per regulator)

- Sewer separation unit cost per acre ($500,000 per acre)

5.3.2.1.1 Costs for Additional Flow to MCUA

Scenarios evaluated in Section 5.4 of the report have additional CSS flows from Perth Amboy that will be delivered to the MCUA CTP for treatment. The total costs for these alternatives include a line item cost for additional volume to be treated at the MCUA CTP, which will be the MCUA Sewer Use Charge (SUC). The 20-year present value for MCUA treatment was calculated based on a SUC of $1,770/MG as calculated by the City based on the last year of audited financial data from MCUA and flows summarized in tables throughout Section 5.4. A discount rate of 2.75% was used in the present value calculation (from the Rate for Federal Water Projects, NRCS Economics, Department of the Interior).

5.3.2.2 Basis for MCUA's Cost Estimation

Perth Amboy shall be responsible for all costs associated with the proposed force main to the CTP, including planning, design, construction and commissioning of the force main and infrastructure at the MCUA's CTP as necessary for connecting the force main to the MCUA's Headworks. MCUA will review and have final say on the infrastructure to be constructed at the CTP site. The engineering, legal and administrative costs that the MCUA would incur to monitor and approve the work at the MCUA's CTP site for the work to be performed by Perth Amboy are anticipated to be nominal and covered within the MCUA's annual operating budget. Similarly, the MCUA's operating and maintenance costs related to the PA's force main are expected to be nominal, based on the reported reduced loadings from additional CSS flow to be stored within Perth Amboy's system. The actual flows and loadings would be factored into the MCUA's annual user charges assessed to Perth Amboy.

5.3.3 Siting and Implementation Considerations

Most facilities are located on City owned property or paper streets within the right-of-way.

A single satellite storage facility is tentatively sited at the intersection of Smith Street and Convery Boulevard. This location will require coordination with NJDOT.

5.3.4 Scenarios of Peak Flow to MCUA

Three scenarios were evaluated in the DEAR in Section 6.2 that represent the range of flows that can be delivered to the downstream end of the Perth Amboy gravity collection system with minimal or no improvement to the existing interceptors and subsequently delivered directly to MCUA CTP by new pumping facilities at the downstream end of Perth Amboy. The only pumping scenario evaluated further and included in the recommendation is Pumping Scenario 1, described in Table 5-4.

Table 5-4 – Peak Flows to MCUA CTP Scenarios

Pumping Scenario	Peak Flow to MCUA (mgd)	Description
1	13.6	This flow represents current condition and assumes the construction of a new pumping station and one 24-inch force main to convey this peak flow directly to MCUA CTP.

5.4 Applicable CSO Control Technologies

Viable CSO control technologies were discussed in Section 5.2 of this report, with detailed evaluation of their feasibility for the City of Perth Amboy and MCUA. The applicable CSO LTCP technologies are presented in Table 5-5. A range of overflow frequencies at specific outfalls and system wide percent capture were used to evaluate the performance of these alternatives as detailed in Section 5.3.

Table 5-5 – Summary of Applicable BMP and CSO Control Technologies

BMP / CSO Control Technology	Type of Control
Green stormwater infrastructure	Source Quantity Control
Sewer Separation	Source Quantity Control
Regulator Modifications and Collection System Improvements	Collection System Control
Off-line Storage	Storage
WWTP Improvements	Treatment
Screening	Treatment
Ballasted Flocculation	Treatment
Compressed Media Filtration	Treatment
Disinfection	Treatment

In the DEAR, a few of the above technologies were evaluated individually for system wide application at different levels of control including 1) satellite storage at each outfall group, 2) satellite CSO treatment at each outfall group, and 3) system-wide tunnel storage. The single technology alternatives were calculated based on the assumption that 13.6 mgd can be delivered to the downstream end of Perth Amboy gravity collection system and subsequently delivered directly to MCUA CTP by new pumping facilities at the downstream end of Perth Amboy. The peak flow of 13.6 mgd to MCUA represents the current condition but is also the only flow condition considered further in this SIAR.

5.4.1 Single Technology Alternatives

Three technologies considered feasible for potential system-wide control of CSO discharges were evaluated individually for system wide application to. They are 1) satellite storage at each outfall group, 2) satellite CSO treatment at each outfall group, and 3) system-wide tunnel storage. The satellite storage and treatment options were sized to achieve different level of controls (i.e. 0, 4, 8, 12, and 20 overflows per year) at all CSO Groups, and the tunnel storage option was evaluated for 0 and 4 overflows per year. The analysis done for the single technology alternatives was based on Pumping Scenario 1 (13.6 MGD to MCUA defined in Section 5.3.1) and provides the initial evaluation of system-wide CSO control alternatives. Once this analysis was completed, the selected plan was developed by mixing and matching options at each of the CSO groups to meet the considerations discussed in Section 5.3 including performance, cost, and siting and implementation.

5.4.1.1 Satellite Storage

Concrete storage tanks are an effective way of providing CSO control. In this alternative, the new pumping station pumps at an existing rate of 13.6 mgd (Pumping Scenario 1) and a storage tank is used for each CSO Group to store the overflow for different levels of control. Table 5-6 summarizes the tank sizes needed for each CSO group to achieve 0, 4, 8, 12, and 20 overflows per year. They were calculated based on the CSO stats of the baseline condition.

Table 5-6 - Storage Tank Volumes for Satellite Storage

CSOs per Year		0	4	8	12	20
CSO Group		Storage Tank Volume (MG)				
1	P-002	7.6	3.5	2.8	1.8	1.0
2	P-003 - P-008	7.4	3.5	3.1	2.6	1.4
3	P-009 - P-016	17.9	7.8	7.1	5.6	3.4
4	P-017	1.1	0.6	0.3	0.2	0.1
5	P-019	7.7	2.9	2.6	2.0	1.1
Total		41.6	18.3	15.9	12.2	7.0

Consolidation pipes will be needed to bring overflow from each individual outfall to the consolidated storage tank for CSO Groups 2 and 3. For CSO Group 2, land is available around CSO P-005. The estimated consolidation pipes needed to bring overflow from the other five overflows are roughly 4,700 linear feet. For CSO Group 3, roughly 3,000 linear feet of consolidation pipes will be needed to convey overflows from 6 outfalls to the storage sited between CSO P-014 and CSO P-015. The consolidation pipe sizes needed to achieve the different levels of controls are listed in Table 5-7.

Table 5-7 – Satellite Storage Consolidation Pipe Size

CSOs per Year		0	4	8	12	20
CSO Group		Pipe Diameter (ft)				
2	P-003 - P-008	5.5	5	5	5	4
3	P-009 - P-016	7	7	6.5	6.5	5.5

The amount of flow stored in these satellite tanks will be discharged back into the sewer system after the flow recedes to dry weather conditions and will ultimately reaching MCUA's WWTP for treatment. This will increase the total amount of flow the City sends to MCUA because the flow stored will be conveyed to MCUA at a maximum flow rate of 13.6 MGD over a longer period of time. This, in turn, will result in additional cost for the City. The annual volume of the additional flow for different levels of control are listed in Table 5-8.

Table 5-8 - Stored Volume for Treatment at MCUA for Storage

CSOs per Year		0	4	8	12	20
CSO Group		Annual Stored Volume (MG/yr)				
1	P-002	63.2	55.2	50.7	40.8	27.8
2	P-003 - P-008	78.3	72.3	69.8	64.2	46.7

CSOs per Year		0	4	8	12	20
CSO Group		Annual Stored Volume (MG/yr)				
3	P-009 - P-016	173.9	160.7	156.3	141.1	107.3
4	P-017	8.6	7.5	5.2	3.3	1.3
5	P-019	62.3	55.9	54.0	47.2	32.2
	Total	386.4	351.6	336.0	296.6	215.4

With the satellite storage at each CSO group, the remaining annual overflows are summarized in Table 5-9 along with their corresponding system wide percent capture. Eighty-five percent capture falls between 12 to 20 overflows per year.

Table 5-9 – Satellite Storage Remaining Annual Overflow Volume and Percent Capture

CSOs per Year		0	4	8	12	20
CSO Group		Total Overflow Volume (MG/year)				
1	P-002	0.0	8.0	12.5	22.5	35.4
2	P-003 - P-008	0.0	6.0	8.5	14.1	31.6
3	P-009 - P-016	0.0	13.2	17.6	32.8	66.6
4	P-017	0.0	1.1	3.4	5.2	7.3
5	P-019	0.0	6.5	8.4	15.2	30.2
Total		0.0	34.8	50.3	89.8	171.0
SYSTEM WIDE CAPTURE		100%	96%	94%	90%	81%

Figure 5-2 plots the total costs for the satellite storage facilities with their corresponding levels of control in both overflow frequency (primary X-axis) and system wide percent capture (secondary X-axis). As the targeted overflow frequency drops, the slope of the cost increase gets steeper.

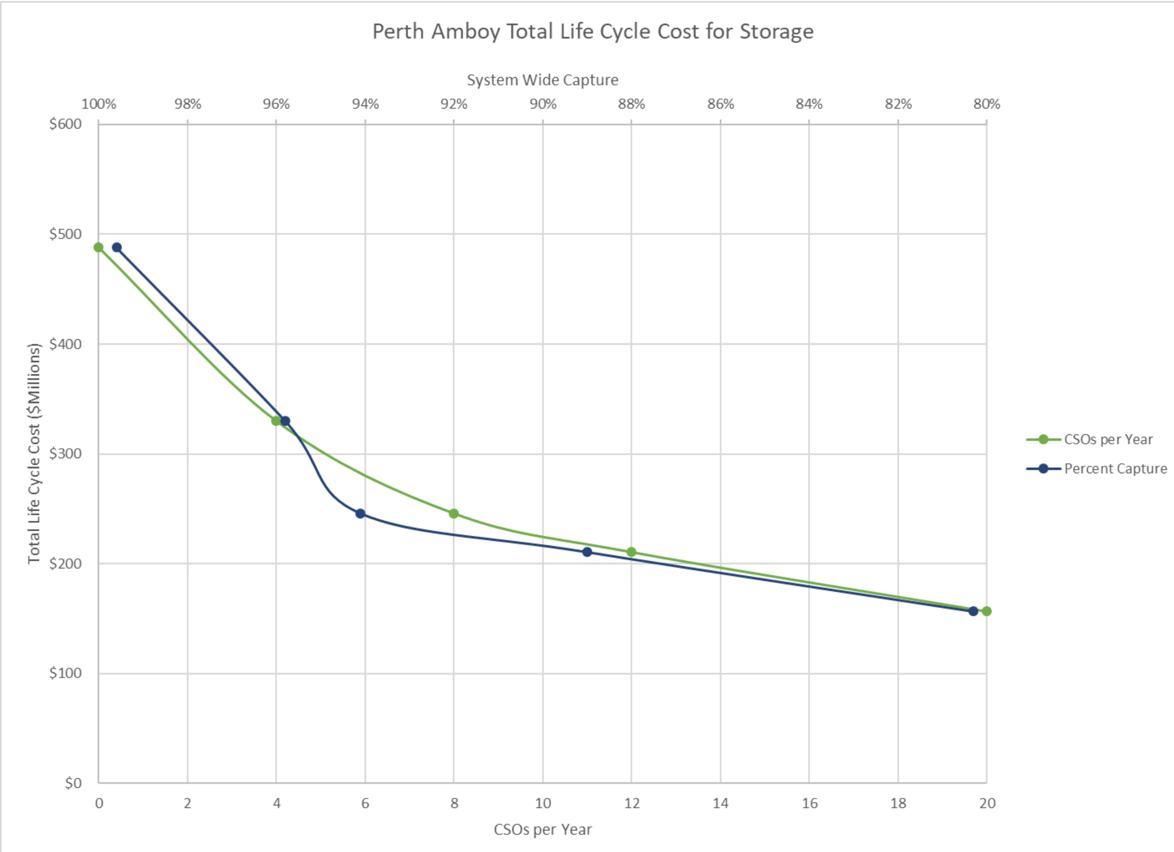

Figure 5-2 - Cost Curve for System Wide Satellite Storage

5.4.1.2 Satellite Treatment

According to the National CSO Policy, satellite CSO treatment needs to meet primary treatment standards, which requires multiple treatment processes. The combination of pre-treatment and disinfection has been used extensively throughout the country for effective CSO satellite treatment. Of the various types of technologies evaluated, ballasted flocculation and compressed media filtration are considered for pre-treatment technology, while sodium hypochlorite is the selected disinfectant, with sodium bisulfite for dechlorination before discharging into the receiving water.

In this alternative, the new pumping station pumps at existing pumping rate of 13.6 mgd (Pumping Scenario 1) and a satellite treatment facility is used for each CSO Group to treat the overflows to different levels of control. The maximum rate of treatment needed for each CSO group are listed in Table 5-10 to achieve different levels of control.

Table 5-10 - Satellite Treatment Facility Size

CSOs per Year		0	4	8	12	20
CSO Group/mgd		High Rate Treatment Facility Flow Rate (mgd)				
1	P-002	195.9	98.3	53.0	32.1	18.7
2	P-003 - P-008	210.7	112.2	68.5	38.5	23.7

CSOs per Year		0	4	8	12	20
CSO Group/mgd		High Rate Treatment Facility Flow Rate (mgd)				
3	P-009 - P-016	329.9	255.0	158.6	94.5	61.5
4	P-017	35.9	34.0	17.8	10.7	4.1
5	P-019	135.2	84.2	49.1	29.9	20.5

The overflow will be treated at each of the five satellite treatment systems and discharged into the receiving waters. Thus, no extra volume will be sent to MCUA for treatment. The consolidation pipes needed for CSO Group 2 and 3 are listed in Table 5-11.

Table 5-11 - Satellite Treatment Consolidation Pipe Size

CSOs per Year		0	4	8	12	20
CSO Group		Pipe Diameter (ft)				
2	P-003 - P-008	5.5	4.5	4	3.5	3
3	P-009 - P-016	8	7.5	6.5	5.5	4.5

With the satellite treatment at each CSO group, the remaining system wide annual overflow volumes are summarized in Table 5-12 along with their corresponding system wider percent capture. Eighty-five percent capture occurs with greater than 20 overflows per year.

Table 5-12 - Satellite Treatment Remaining Annual Overflow Volume and Percent Capture

CSOs per Year		0	4	8	12	20
CSO Group		Total Overflow Volume (MG/year)				
1	P-002	0.0	1.4	4.3	7.6	12.5
2	P-003 - P-008	0.0	1.2	3.5	7.4	11.5
3	P-009 - P-016	0.0	0.7	5.2	13.4	22.9
4	P-017	0.0	0.0	1.5	2.9	5.0
5	P-019	0.0	0.5	2.8	6.2	9.7
Total		0.0	3.9	17.2	37.5	61.6
SYSTEM WIDE CAPTURE		100%	99%	98%	95%	93%

Between the two types of ballasted flocculation presented in PVSC's TGM, DensaDeg and Actiflo, the cost of DensaDeg is consistently less costly at all targeted CSO flows. The compressed media filter presented in PVSC's TGM is the WWETCO FlexFilter™ by WesTech, had similar estimated total life cycle costs to the DensaDeg ballasted flocculation system. Figure 5-3 shows the cost curves for the two ballasted floc systems and the compressed media filter. Although the FlexFilter has lower costs than the DensaDeg system for 4, 8, and 12 CSOs per year, the DensaDeg system was chosen for costing analysis of satellite CSO treatment due to other drawbacks and limitations of the FlexFilter, including the high (up to 8 feet) headloss through the system and the low influent TSS concentration required.

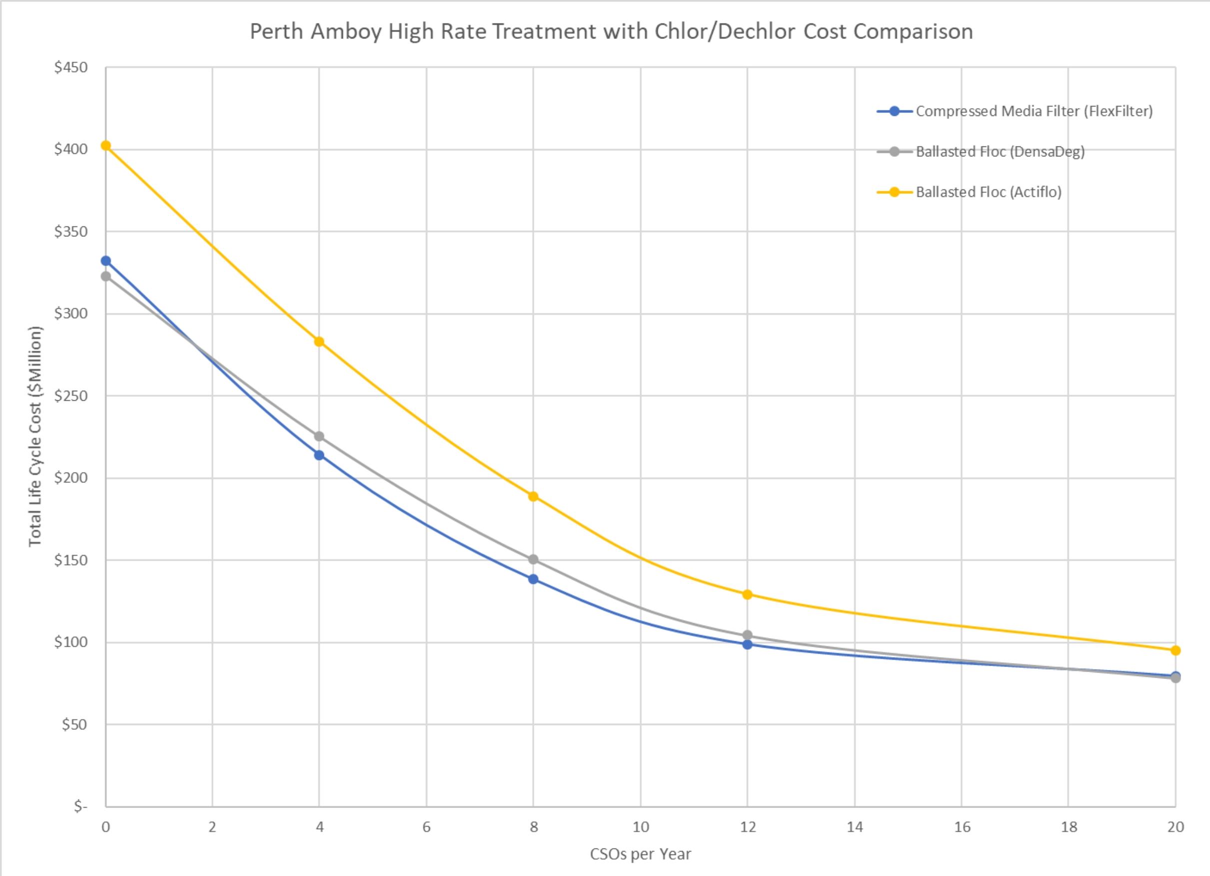

Figure 5-3 - Satellite Treatment Cost Comparison

Due to the need of a new ocean outfall for the consolidated CSO treatment facility along the beach (CSO Group 3), the overall cost for CSO treatment is higher than that for storage. However, satellite treatment is more effective in system wide percent capture. At 20 overflows per year, system wide percent capture can reach over 90 percent (Table 5-12). Figure 1-1Figure 5-4 plots the total costs of satellite treatment with their corresponding targeted overflow frequencies. Levels of control are shown in both overflow frequency (primary X-axis) and system wide percent capture (secondary X-axis). As the targeted overflow frequency drops, the slope of the cost increase gets steeper.

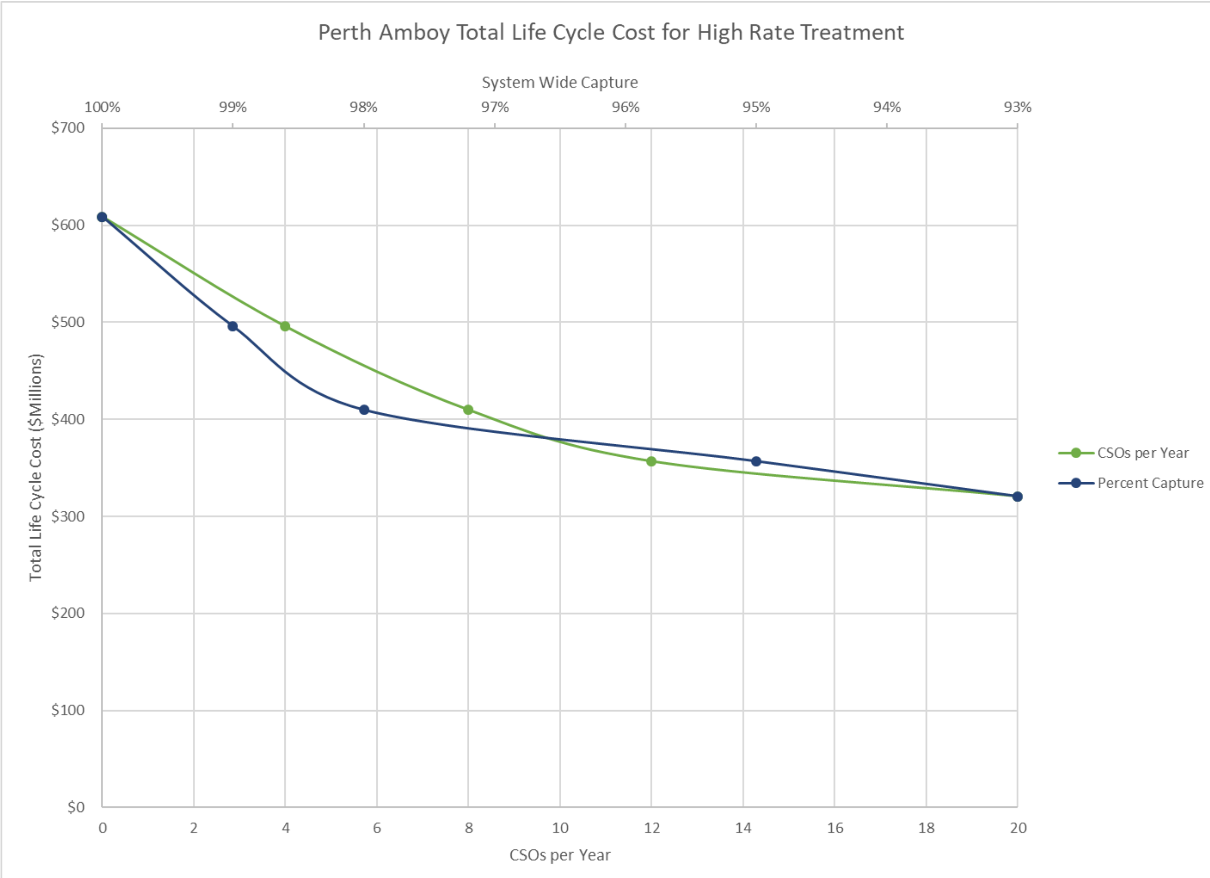

Figure 5-4 - Cost Curve for System Wide Satellite Treatment

5.4.1.3 Tunnel Storage

Deep tunnel storage is another off-line storage technology that is evaluated with Pumping Scenario 1 (13.6 MGD to MCUA defined in Section 5.3.4). A conceptual alignment of the tunnel is shown in Figure 5-5. Five drop shafts are sited with multiple consolidation pipes to bring overflows into the tunnel from each regulator that are far from the drop shaft.

Table 5-13 lists the length and size of each tunnel section as well as those of the consolidation pipes for control level of 0 overflows per year. A pumping station located adjacent to the tunnel will be needed to pump flow stored in the tunnel into the downstream gravity system and ultimately MCUA's CTP for treatment. The additional annual volume is 386.5 MG for the Typical Year.

Table 5-14 lists the length and size of each tunnel section as well as those of the consolidation pipes for control level of 4 overflows per year. The additional annual volume is 279.3 MG for the Typical Year.

Figure 5-5 - Conceptual Layout for Deep Tunnel Storage

Table 5-13 - Deep Tunnel Summary for 0 CSO Overflows per Year

Outfall	Vol (MG)	Peak Discharge (MGD)	Consolidation sewer length, ft	Consolidation Sewer dia, in	Tunnel length, ft	Tunnel dia, ft
CSO-002	7.6	195.9	1,000	108		
CSO-003	1.8	46.0				
CSO-004	1.0	30.6	2,200	84		
CSO-005	1.2	27.5			5750	
CSO-006	2.4	62.7				
CSO-007	0.7	24.6		84		
CSO-008	0.3	18.5	2,500			
CSO-009	0.1	15.91				22
CSO-010	0.1	21.50				
CSO-011	1.0	47.13	2,900	96	6070	
CSO-013	2.9	44.49				
CSO-014	1.1	18.47				
CSO-015	1.4	33.84	0	-		
CSO-016	11.2	148.55	600	96	1000	
CSO-017	0.6	35.8	600	54	2900	
CSO-019	7.7	135.2	3,400	90		
Total	41.2		13,200		15,720	

Note: Additional CSS flow to be treated at MCUA CTP is 386.5 MG per year.

Table 5-14 - Deep Tunnel Summary for 4 CSO Overflows per Year

Outfall	Vol (MG)	Peak Discharge (MGD)	Consolidation sewer length (ft)	Consolidation Sewer dia (in)	Tunnel length (ft)	Tunnel dia (ft)
CSO-002	3.33	98.32	1,000	84		
CSO-003	0.81	18.92				
CSO-004	0.51	25.90	2,200	72		
CSO-005	0.47	15.77			5750	
CSO-006	0.98	32.09				
CSO-007	0.29	11.21		66		
CSO-008	0.17	8.36	2,500			14
CSO-009	0.08	8.17				
CSO-010	0.09	10.93				
CSO-011	0.60	25.14	2,900	84	6070	
CSO-013	1.18	41.49				
CSO-014	0.43	16.33				
CSO-015	0.61	23.45	0	-		
CSO-016	4.78	129.48	600	90	1000	

Outfall	Vol (MG)	Peak Discharge (MGD)	Consolidation sewer length (ft)	Consolidation Sewer dia (in)	Tunnel length (ft)	Tunnel dia (ft)
CSO-017	0.63	34.04	600	54	2900	
CSO-019	3.05	84.23	3,400	78		
Total	18.0		13,200		15,720	

Note: Additional CSS flow to be treated at MCUA CTP is 352.4 MG per year.

The costs for the tunnel alternative are presented in Table 5-15. The costs for the deep tunnel have been reevaluated using a different basis for cost estimating than what was presented in the DEAR that more closely matches the conceptual configuration of the deep tunnel in Perth Amboy.

Table 5-15 - Deep Tunnel Life Cycle Costs

CSO Overflows Per Year	0	4
Description	**Costs ($Million)**	
Deep Tunnel, Consolidation Sewer, Drop Shaft, and Drainage Pumping Station Life Cycle Cost	$503.3	$379.1
Second Street Pumping Station Upgrade Life Cycle Cost[1]	$11.4	$11.4
New Force Mains from Second St PS to MCUA CTP (1 24-in) Life Cycle Cost	$60.9	$60.9
Additional Treatment at MCUA CTP Life Cycle Cost[2]	$7.4	$6.7
Total	$583.0	$458.2

1. Based on upgrading pumping station to drain the tunnel in two (2) days.
2. The 20-year present value for MCUA treatment was calculated based on a cost of approximately $1,250/MG provided by MCUA and flows summarized in Tables 6-11 and 6-12.

5.4.2 Selected Mixed Technology Alternatives

Each of the alternatives in Section 5.4.1 considered only one type of technology to achieve various levels of system-wide control represented by overflow frequency throughout the system. This was useful as an initial evaluation step and was followed by evaluation of more complex scenarios employing a mix of technologies. This section presents the selected mixed technology alternative, which includes satellite storage or treatment, regulator modifications, green infrastructure and sewer separation, as well as different levels of control targets in different parts of the system.

As stated in Section 4, the CSO control objectives are to support public use of the existing beach at the mouth of Raritan River and to improve water quality in Arthur Kill. These objectives lead to a control target of 2 overflows per year at all the outfalls on the Raritan River and a range of between 27 to 47 overflows per year levels of control at the outfalls on the Arthur Kill. System wide capture of 85% percent was also used as a criterion to evaluate system wide performance.

The selected mixed technology alternative is presented in a specific sequence. As each technology or technology group is implemented at a CSO group, the cumulative impact is assessed with remaining annual CSO volume and percent capture rate for the whole system. Summary tables are provided for facility sizing, system wide impact (CSO volume and percent capture), and costs.

In the selected alternative, Pumping Scenario 1 is used while satellite storage is applied to achieve 2 per year overflows on the Raritan River and 85 percent total system capture. This results in 27, 40 or 47 per year overflows on the Arthur Kill. This does not include any increased conveyance at the pumping station.

5.4.2.1 Sewer Separation

The selected plan includes 8 acres of sewer separation in Perth Amboy to be done in equal increments over the span of the implementation schedule. To reduce the amount of wet weather flow that enters into the Raritan River side of the Eastside Interceptor along the beach area, fifty percent sewer separation will be implemented in the small (8 acre) sewershed between P-008 and P-009 along the water front. This small sewershed contributes wet weather runoff directly into the Eastside Interceptor downstream of Front Street Pumping Station, so the proposed separation is proposed to further reduce the wet weather flow in this part of the system.

5.4.2.2 Green Infrastructure

The selected plan includes green technology to be installed to control runoff coming from 10 percent (46.8 acres) of the impervious area in Perth Amboy. The selected plan assumes the green infrastructure will be installed in equal increments over the span of the implementation schedule. The implementation of green infrastructure has the potential to reduce number of overflows at each outfall, but it does not change the peak flow at the Second Street Pumping Station.

5.4.2.3 CSO Group 4 (P-017) and 5 (P-019)

Since P-017 and P-019 both discharge to the Raritan River, these two outfalls are targeted for full containment in the Typical Year, i.e. 2 overflows per year. Satellite storage is recommended to achieve the control target because these outfalls are located upstream from the beach. Storage would be preferred over CSO treatment because storage does not discharge treated flows into the receiving water and has no potential of impacting water quality around the beach area.

A storage tank would be sited near each of the overflows with 0.9 MG at P-017 and 3.1 MG at P-019. The total stored volume at these two facilities that needs to be sent to MCUA for treatment is 59.9 MG for the Typical Year.

With P-017 and P-019 with just 2 overflows during the Typical Year, system wide capture increases to 64 percent with 324.8 MG remaining annual CSO volume.

The storage tank total life cycle costs for CSO Group 4 and CSO Group 5 are $19.0 million and $52.8 million, respectively.

5.4.2.4 CSO Group 3 (P-009 through P-016)

P-010 to P-016 are located along the beach area on Raritan River. Although P-009 discharges into the Arthur Kill, its proximity to the confluence of the two receiving waters and the fact that it is downstream of Front Street Pumping Station makes grouping it with P-010 through P-016 a logical choice. Two storage options were evaluated for this group of outfalls to achieve 2 overflows per year. Due to the beach, storage would be preferred over CSO treatment because storage does not lead to any discharge of treated flows into the receiving waters in the vicinity of the beach.

The first option is to use one consolidated surface storage facility as detailed below.

- New CSO storage facility with 7.8 MG capacity between P-014 and P-015
- Remaining overflows from P-009 through P-014 is diverted through a consolidation pipe and westwards to the new storage facility
- Remaining overflows from P-015 and P-016 are also diverted to the same storage facility
- The stored CSO flow can be pumped back into the Second Street Pumping Station once the flow in the system recedes back to dry weather flow.
- 148.0 MG/year more flow will be sent to MCUA for treatment if storage is used.

The second option is to have storage using a deep tunnel along the beach area. The details are listed below.

- Tunnel dimension would be an inside diameter of 15 feet and a total length of 6,300 feet with a capacity of 7.8 MG
- The estimated depth of the tunnel would be 90 feet to 150 feet depending on the soil conditions determined during detailed design
- Overflows from P-009 through P-016 would be directed through a consolidation pipe to an estimated 4 to 5 drop shafts located along the tunnel
- The stored CSO flow can be pumped back into the Second Street Pumping Station once the flow in the system recedes back to dry weather flow.
- 148.0 MG/year more flow will be sent to MCUA for treatment if storage is used.

System wide capture with either of the above storage can reach 81 percent with 170.8 MG remaining CSO volume for the entire system.

The costs for a storage tank and a tunnel to achieve the 2 per year overflow frequency target for CSO Group 3 are summarized in Table 5-17. The storage tank is more costly than the tunnel.

Table 5-16 - CSO Group 3 Storage Costs

Total Life Cycle Cost for CSO Group 3 ($Million)	
CSOs per Year	2/yr
Storage Tank[1]	$140.6
Tunnel[2]	$197.8

Costs Include:

1. Storage tanks, coarse screens, diversions, control gates, pumping/flushing/ventilation facilities, 20 yr PV O&M, 20 yr PV MCUA additional treatment cost, consolidation pipes, and land acquisition. The 20-year present value for MCUA treatment was calculated based on a cost of $1,250/MG provided by MCUA.

2. Pumping station, consolidation piping, drip shafts, land acquisition, 20 yr PV MCUA additional treatment cost, and 20 yr PV O&M. The 20-year present value for MCUA treatment was calculated based on a cost of $1,250/MG provided by MCUA.

5.4.2.5 Second Street Pumping Station and Direct Force Main

The Second Street Pumping Station will be upgraded to allow for direct pumping of flow through the new force main that connects directly to the head of the MCUA CTP. The design flow of the new pumping station will be 13.6 mgd (Pumping Scenario 1) with no increase in the peak flow sent to MCUA. A new 24-inch force main will be constructed under the Raritan River utilizing HDD to direct flow from the Second Street Pumping Station to the CTP for full treatment, as discussed in Section 5.2.3.2. These improvements will not impact the Annual CSO discharges or the system wide percent capture.

The total life cycle costs for a new pumping station and direct force main is $43.9 million, which includes 20 year present worth O&M costs for the pump station and force main.

5.4.2.6 CSO Group 1 (P-002)

P-002 is the largest CSO that discharges to Arthur Kill and is located at the northeast corner of the system, three-quarters of a mile north of P-003. A satellite treatment or storage facility for P-002 has been evaluated. The storage or treatment facilities were evaluated to a control target of 27 and 40 overflows per year, respectively.

If storage is used, the storage tank size needed to achieve 27 overflows per year is 0.3 MG. The annual stored volume at P-002 that will be sent to MCUA for treatment is 10.2 MG. The resulting annual system wide CSO overflow volume is 160.6 MG and percent capture is 82 percent.

If high rate treatment is used, the facility size required would be 1.2 mgd to meet the 40 overflows per year control target, which would increase the system wide capture to 85 percent with remaining annual CSO volume of 133 MG.

The costs for storage and treatment to achieve the 27/year and 40/year overflow frequency target, respectively, for CSO Group 1 are summarized in Table 5-17.

Table 5-17 - Mixed Technology Group 1 Costs

CSOs per Year	Total Life Cycle Cost for CSO Group 1 ($mil)
Storage (27 overflows/year)[1]	$7.9
Treatment (40 overflows/year)[2]	$4.43

Costs Include:

1. Storage tanks, coarse screens, diversions, control gates, pumping/flushing/ventilation facilities, 20 yr PV O&M, 20 yr PV MCUA additional treatment cost, and land acquisition. The 20-year present value for MCUA treatment was calculated based on a cost of $1,250/MG provided by MCUA.
2. FlexFilter capital cost includes screening, conduits, filter matrix, disinfection contact/post event water, UV and PAA disinfection, backwash and effluent pumping from spreadsheet provided by G.A. Fleet Associates, Inc.

5.4.2.7 CSO Group 2 (P-003 through P-008)

The last CSO group considered is CSO Group 2 which include seven outfalls from P-003 through P-008. They discharge into Arthur Kill with 78.3 MG of overflow in the Typical Year. A consolidated storage or treatment facility with consolidation pipes are evaluated to achieve 27 and 47 overflows per year, respectively.

If using storage, the size of the storage tank needed to achieve 27 overflows per year is 1.0 MG, and the additional stored volume that needs to be sent to MCUA for treatment is 29.7 MG per year. The resulting annual system wide CSO overflow volume is 131 MG per year and percent capture is 85 percent.

If CSO treatment is used instead of storage, the facility size needed for 47 overflows per year is 1.3 mgd. The system wide annual CSO overflow volume would go down to 106 MG, and the system wide percent capture would go up to 88 percent.

With the overflows discharging to Raritan River fully contained and P-002 controlled to 27 or 47 overflows per year, either CSO storage or treatment will result in 85 or higher percent system wide capture.

The costs for storage and treatment to achieve the 27/year or 47/year overflow frequency target, respectively, for CSO Group 2 are summarized in Table 5-18.

Table 5-18 – Mixed Technology Group 2 Costs

CSOs per Year	Total Life Cycle Cost for CSO Group 2 ($Million)
Storage (27 overflows/year)[1]	$61.6
HRT (47 overflows/year)[2]	$36.0

Costs Include:

1. Storage tanks, coarse screens, diversions, control gates, pumping/flushing/ventilation facilities, 20 yr PV O&M, 20 yr PV MCUA additional treatment cost, consolidation pipes, and land acquisition. The 20-year present value for MCUA treatment was calculated based on a cost of $1,250/MG provided by MCUA.
2. FlexFilter capital cost includes screening, conduits, filter matrix, disinfection contact/post event water, UV and PAA disinfection, backwash and effluent pumping from spreadsheet provided by G.A. Fleet Associates, Inc..

5.5 Summary

Each of the single technology alternatives considered only one type of technology to achieve various levels of system-wide control represented by overflow frequency throughout the system. This was useful as an initial evaluation step and was followed by evaluation of more complex scenarios with a mix of technologies to optimize the cost and effectiveness of an overall CSO Control Approach.

5.5.1 Summary of Selected Mixed Technology Alternative

Following is a summary of the Selected Mixed Technology Alternative selected by the City.

Table 5-19 – Summary of Selected Mixed Technology

IS	Component	Target Level of control	Peak flow to MCUA (mgd)	Storage			Treatment	Remaining Annual CSO (MG)		System Wide Capture (%)	
				Tank Vol (MG)	Additional Vol/yr to MCUA (MG)	Cumulative vol/yr to MCUA (MG)	HRT facility size (mgd)				
1	CSO Group 4	2/yr	13.6	0.9	61.6	61.6	36	324.8		64%	
1	CSO Group 5	2/yr	13.6	3.1			107				
2	CSO Group 3	2/yr	13.6	7.8	154	215.6	285	170.8		81%	
3	Second St PS	NA	13.6	NA	NA	NA	NA	170.8		81%	
4	CSO Group 1	27/yr / 40/yr	13.6	0.3	10.2	225.8	1.2	160.6^{S}	133^{T}	82%^{S}	85%^{T}
5	CSO Group 2	27/yr / 47/yr	13.6	1.0	29.7	255.5	1.3	130.9^{S}	106^{T}	85%^{S}	88%^{T}

IS = Implementation Schedule

S: If storage is used to control CSO.

T: If treatment is used to control CSO.

Table 5-19 summarizes the sizes of the facilities needed to achieve different levels of control at different outfall groups and the progression of CSO reduction and system wide capture increase as more overflows gets stored or treated.

Table 5-20 – Selected Mixed Technology Costs

Implementation sequence	Items		Cost ($Million)
Duration	Sewer Separation Capital – 8 acres		$2.40
Duration	Green Infrastructure Capital		$18.26
Duration	Green Infrastructure 20-yr Present Worth O&M		$1.60
1	CSO Group 4 and 5 (CSO P-017 & P-019)	Capital Cost Regulator Modifications (1) P-017	$0.05
		Capital Cost Surface Storage Tank CSO Group 4	$17.23
		Land Acquisition CSO Group 4	$0.80
		Captial Cost Surface Storage Tank CSO Group 5	$48.24
		Land Acquisition CSO Group 5	$2.76
		Total Capital	**$69.09**

Implementation sequence	Items		Cost ($Million)
		20-year Present Worth O&M Surface Storage Tank CSO Group 4	$1.00
		20-year Present Worth O&M Surface Storage Tank CSO Group 5	$1.72
		Total 20-year PW O&M	**$2.72**
		Sub Total	**$71.81**
		Additional Annual Volume to MCUA CTP (MG)	*59.9*
2	CSO Group 3 (CSO P-009 to P-016)	Capital Cost Regulator Modifications (7) P-009, 010, 011, 013, 014, 015, 016	$0.35
		Capital Cost Deep Storage Tunnel CSO Group 3	$155.6
		Capital Cost Consolidation Sewer CSO Group 3	$21.8
		Land Acquisition CSO Group 3	$3.2
		Total Capital	**$180.4**
		20-year Present Worth O&M Surface Storage Tank CSO Group 3	$9.53
		20-year Present Worth O&M Consolidation Sewer CSO Group 3	$5.41
		Total 20-year PW O&M	**$14.9**
		Sub Total	**$195.4**
		Additional Annual Volume to MCUA CTP (MG)	*148.0*
3	Main PS & FM (13.6 mgd and 1 24-in FM)	Capital Cost New Pumping Station 13.6 MGD Capacity	$10.75
		Captial Cost 1 New 24-inch Force Mains	$24.29
		Total Capital	**$35.05**
		20-year Present Worth O&M Pumping Station	2.73
		20-year Present Worth O&M Force Main	$6.17
		Total 20-year PW O&M	**$8.89**
		Sub Total	**$43.94**
4	CSO Group 1 (CSO P-002)	Capital Cost FlexFilter CSO Group 1	$3.99
		Land Acquisition CSO Group 1	$0.07
		Total Capital	**$4.05**

Implementation sequence	Items		Cost ($Million)
		20-year Present Worth O&M FlexFilter CSO Group 1	$0.38
		Total 20-year PW O&M	**$0.38**
		Sub Total	**$4.43**
5	CSO Group 2 (CSO P-003 to P-008)	Front St PS modification - Limit PS flow to 3.5 MGD	$0.10
		Capital Cost Regulator Modifications (1) P-003	$0.05
		Capital Cost FlexFilter CSO Group 2	$6.79
		Capital Cost Consolidation Sewer & New Outfall CSO Group 2	$25.10
		Land Acquisition CSO Group 2	$0.07
		Total Capital	**$32.11**
		20-year Present Worth O&M FlexFilter CSO Group 2	$0.38
		20-year Present Worth O&M Consolidation Sewer & New Outfall CSO Group 2	$6.37
		Total 20-year PW O&M	**$6.75**
		Sub Total	**$38.86**
	Total		**$376.67**

1. "Additional Cost for Treatment at MCUA" is the 20-year present value for MCUA treatment that was calculated based on a cost of $1,250/MG provided by MCUA.

Table 5-21 – Selected Mixed Technology Alternative - Summary of Estimated Costs

IS	LTCP Element	Total Capital Cost ($mil)	Total 20-yr Present Worth O&M Cost ($mil)	Total Present Worth Cost ($mil)	LTCP Cumulative Cost ($mil)	System Wide Capture (%)
1	Sewer Separation	$2.4	-	$2.4	$2.4	57%
2	Green Infrastructure	$18.3	$1.6	$19.9	$22.3	57%
3	CSO Group 4 and 5	$69.1	$2.7	$71.8	$94.1	64%
4	CSO Group 3	$180.4	$15.0	$195. 4	$289.4	81%
3	Main PS & FM	$35.1	$8.9	$44.0	$333.4	81%
5	CSO Group 1	$4.1	$0.4	$4.4	$337.8	85%
6	CSO Group 2	$32.1	$6.8	$38.9	$376.7	88%

Table 5-20 and Table 5-21 include the costs for the Selected Mixed Technology Alternative.

Section 6

Selected CSO Control Approach

6.1 Background

The City's NJDPES permit indicates in Section G.4 that they shall evaluate a reasonable range of CSO control alternatives, in accordance with MCUA and the Nine Minimum Controls (NMCs) detailed in Part IV.G that will meet the water quality-based requirements of the CWA using either the Presumption Approach or the Demonstration Approach (as described in Sections G.4.f.and G.4.g). The DEAR report, as summarized in Section 6 of this report, documented the detailed evaluation of CSO control alternatives. This Section 7 describes the selection of the specific CSO controls that are included in the LTCP.

6.2 Water Quality Benefits by Level of Control

In July 2020 the New Jersey CSO Group completed an updated draft of Pathogen Water Quality Model (PWQM) Report originally dated January 2020. The PWQM is being used to provide support for the development of LTCPs for the NJ CSO Group of which the City and MCUA are members. This report also provides some information for the basis of the Baseline Conditions to show that the calibration, validation, and baseline inputs were developed in a consistent manner.

6.2.1 Receiving Water Quality Simulations

6.2.1.1 Methodology

Previous calibration of the HEP PATH TMDL model was based on conditions from the mid-to-late 1980s, and then was recalibrated to data from 2002 and 2004. However, substantial environmental improvements have occurred since that time and are likely to continue to occur. The NYCDEP Harbor Survey Data shows dramatic improvement in bacteria levels, particularly in the Hudson River, over the past 10 years. In addition, dredging of portions of the NY/NJ Harbor has continued changing the circulation patterns within sections, particularly Newark Bay. Therefore, a calibration/validation of the bacteria calculations were performed using primary data collected during this project under a related QAPP data collected under the Baseline Compliance Monitoring Program QAPP, the NJHDG Annual Program, and the NYCDEP Harbor Survey. The model was considered calibrated/validated when the comparison of results and data met the standard of best professional judgment.

While a majority of the data was obtained for the NY Harbor and Newark Bay, several data points within the model were applicable to the Raritan River and Raritan Bay which is the area of focus for the City and MCUA. The data points used in the development of the model are shown in Figure 6-1 (taken from Calibration and Validation of PWQM, Jun 2020, pg. 36)

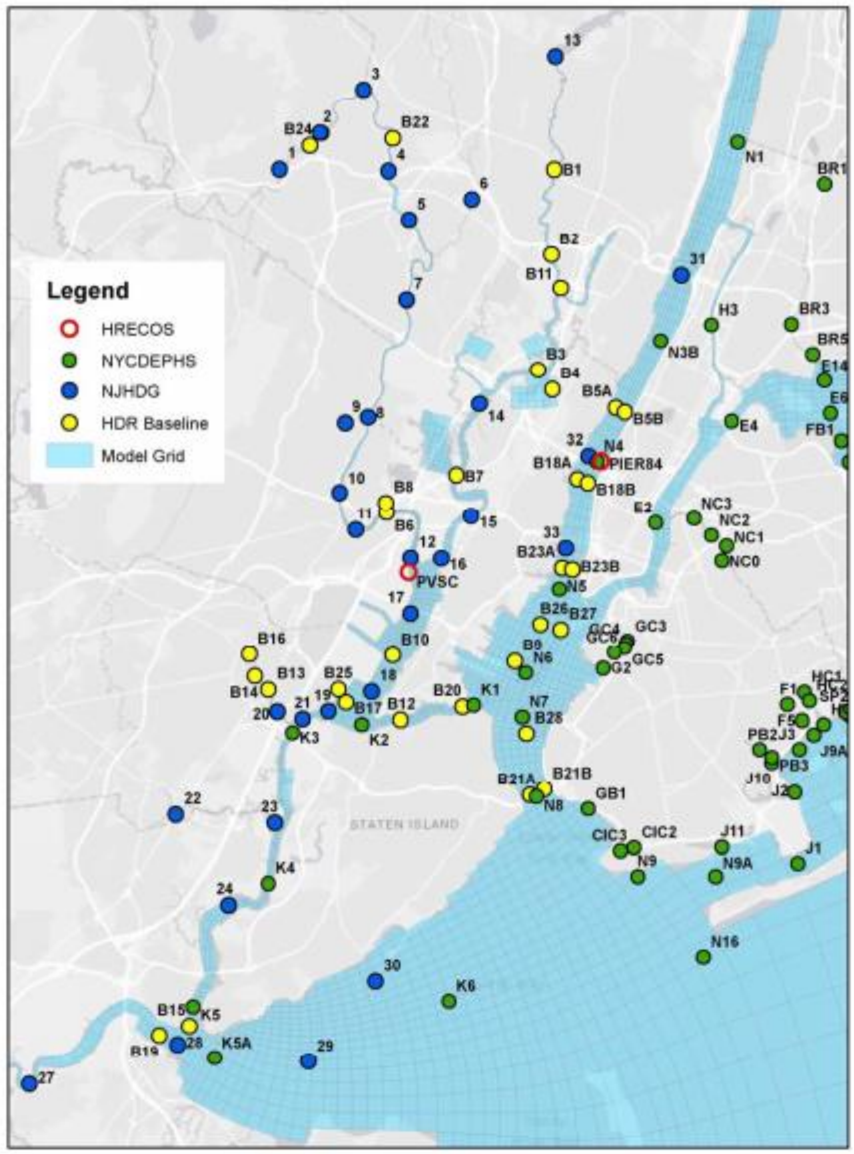

Figure 6-1 - NJ Dischargers Group, HDR, and MERI Water Quality Stations

6.2.1.2 Results for Water Quality Attainment

The following summary information is taken from the Calibration and Validation of PWQM Report dated January 2020.

With regard to the following tables, the following definitions are relevant:

- Assessment Unit (AU) Numbers are model identifiers.
- Baseline % Attainment – refers to model projection of assessment unit compliance with relevant water quality criteria.

- 100% Control % Attainment – refers to model projection of assessment unit compliance with relevant water quality criteria assuming all CSO discharges have been controlled in accordance with the National CSO Policy and NJPDES permit requirements.

Table 6-1 – Assessment Unit Attainment in FW2 and FW2/SE2 Waterbodies under Baseline and 100% Control Conditions

Assessment Unit Name	Assessment Unit Number	Baseline % Attainment	100% Control % Attainment
Raritan R Lwr (MileRun to I-287 Piscataway)	02030105120160-01	0.0	0.0

Taken from Table 6-1 in Calibration and Validation PWQM, pg. 202, Jun 2020 for PVSC by HDR under subcontract to Greeley and Hansen and CDM Smith

Table 6-2 – Assessment Unit Attainment in SE1 Waterbodies under Baseline and 100% CSO Control

Assessment Unit Name	Assessment Unit Number	Baseline % Attainment	100% Control % Attainment
Raritan Bay (West of Thoms Ck)	02030104910010-01	93.0	94.0
Sandy Hook Bay (East of Thoms Ck)	02030104910020-01	0.0	0.0
Raritan Bay (Deep Water)	02030104910030-01	100.0	100.0
Raritan R Lwr (Lawrence Bk to Mile Run)	02030105120170-01	8.0	8.0
Raritan R Lwr (below Lawrence Bk)	02030103180070-01	31.0	32.0

Taken from Table 6-2 in Calibration and Validation PWQM, pg. 202-203, Jan 2020 for PVSC by HDR under subcontract to Greeley and Hansen and CDM Smith

Table 6-3 - Assessment Unit Attainment in SE2 Waterbodies under Baseline and 100% CSO Control

Assessment Unit Name	Assessment Unit Number	Baseline % Attainment	100% Control % Attainment
Arthur Kill waterfront (below Grasselli)[1]	02030103180070-01	100.0	100.0

[1]This Assessment Unit had to be divided into two pieces because it spanned two waterbody classifications.

Taken from Table 6-3 in Calibration and Validation PWQM, pg. 203, Jan 2020 for PVSC by HDR under subcontract to Greeley and Hansen and CDM Smith

Table 6-4 - Assessment Unit Attainment in SE3 Waterbodies under Baseline and 100% CSO Control

Assessment Unit Name	Assessment Unit Number	Baseline % Attainment	100% Control % Attainment
Arthur Kill waterfront (below Grasselli)[1]	02030103180070-01	100.0	100.0

[1]This Assessment Unit had to be divided into two pieces because it spanned two waterbody classifications.

Taken from Table 6-4 in Calibration and Validation PWQM, pg. 204, Jun 2020 for PVSC by HDR under subcontract to Greeley and Hansen and CDM Smith

6.2.2 Component Responses

"Components are defined as the various sources of pollutants to the receiving water. A component analysis can quantify the impacts of the source categories (either geographical, type, or both) to assess which are most influential in a particular time or location. This phase is helpful to establish the level of load control to target during LTCP development. The PWQM was applied to simulate eight component analyses to assess the impacts of various source categories on water quality. The following source categories were evaluated: CSO, stormwater and runoff, the Hudson River, other rivers, NJ STPs, NY/CT STPs, dry-weather loads, and sources from New York City. Each source component was run separately, and the individual pieces were summed to calculate the total concentration. The output provides information as to the importance of the various sources in locations throughout the model domain. The analysis was completed on a station basis using depth averaged concentrations."[5]

The following graphic depicts the output for the Raritan River B-19 sampling location:

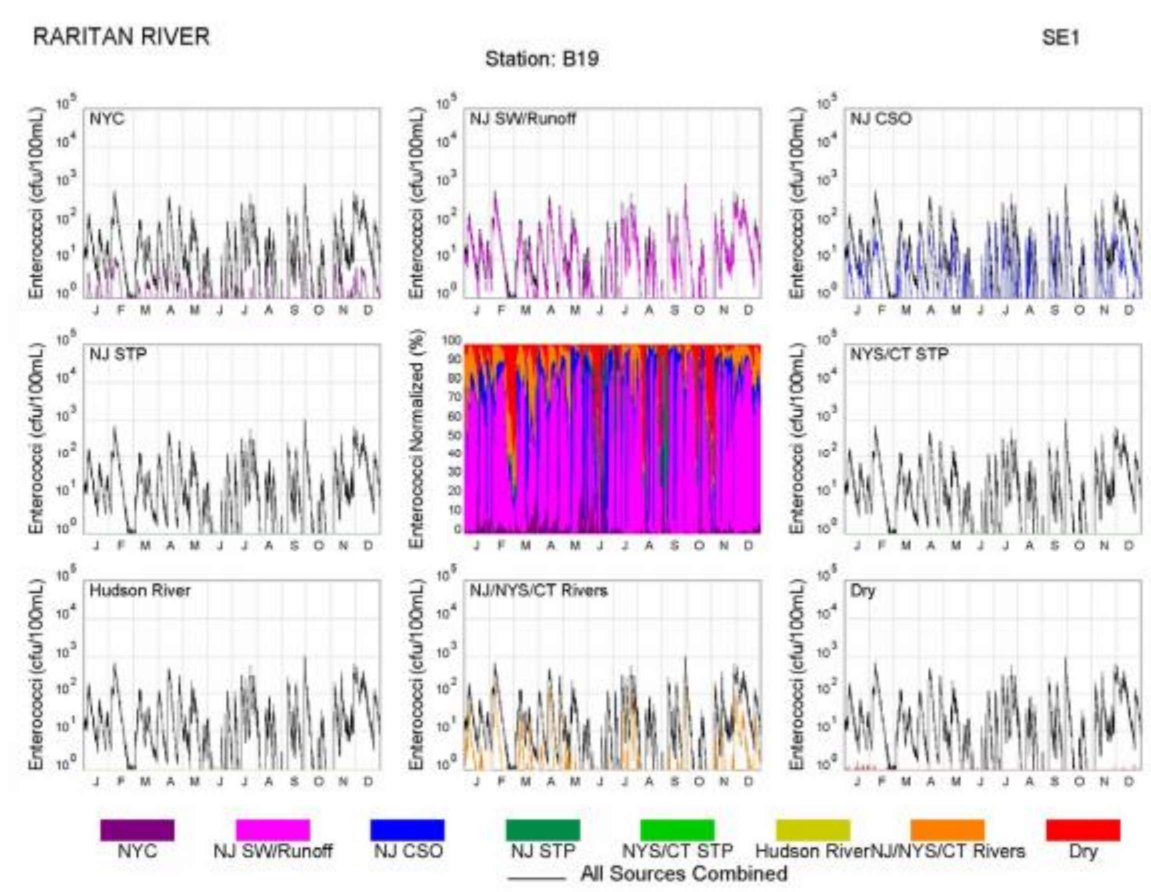

Figure 6-2 - Component Analysis for Enterococci at Station B19

[5] Calibration and Validation of Pathogen Water Quality Model for the Passaic Valley Sewerage Commission (Final), June 2020, p. 205.

The Calibration and Validation PWQM draft report further indicates "[t]he enterococci component analysis. SE1 waterbody, Raritan Bay at station B19 near the mouth of the river, is presented in Figure [6-2]. At this station, stormwater loading impacts dominate, followed by CSOs, and sources in the upper Raritan River outside the project area. Based on these results, the reduction in CSO loads will only have a limited effect on attainment in criteria due to the dominance of the stormwater and runoff."[6]

6.2.3 Cost-Benefit Analysis

The City evaluated costs to achieve 0 overflows per year at Group 3 (CSOs beach along Sadowski Parkway) and compare them with a variety of control levels. This evaluation is summarized in

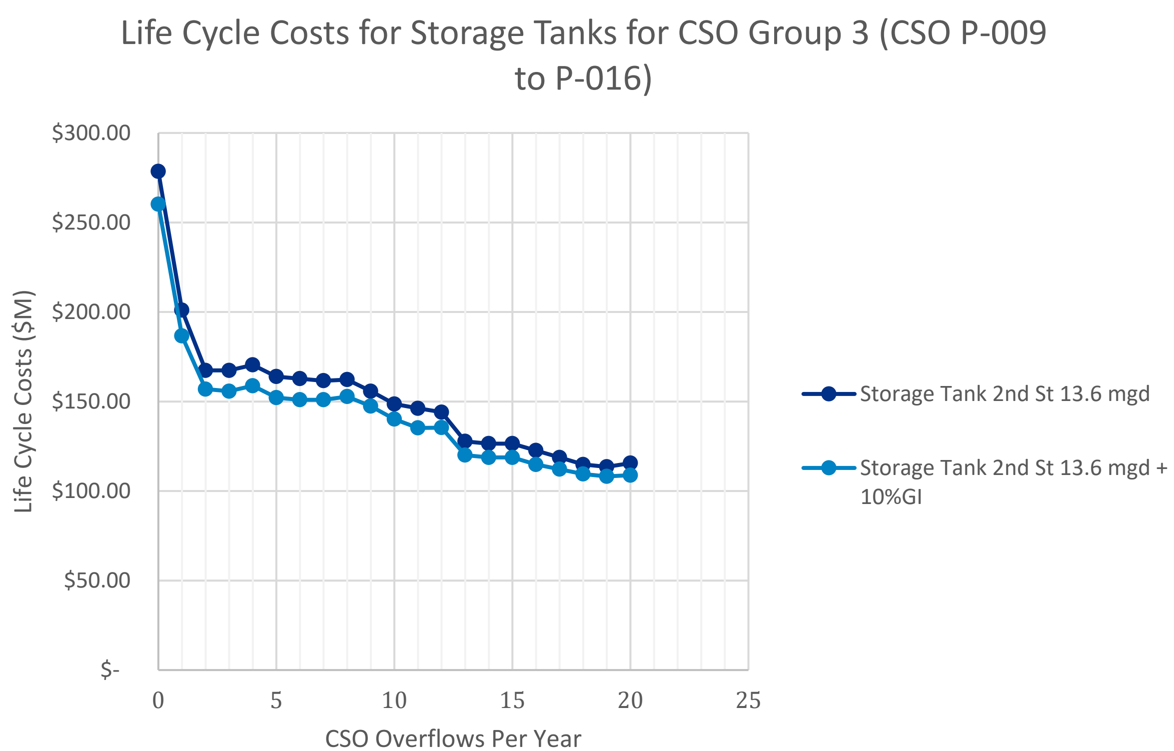

Figure 6-3 - Cost Benefit Analysis for Level of Control - CSO Group 3

Figure 6-3 shows a dramatic reduction in costs by targeting 2 overflows per year at CSO Group 3. Figure 6-3 serves as the basis for the City's selection of 2 overflows per year along CSO Group 3 while still targeting 85% capture overall on completion of the implementation of the LTCP.

6.2.4 Impact to LTCP Approach

In accordance with the USEPA CSO Policy and as described in the City's NJPDES permit at G.4.f, the Presumption Approach is indicated as:

[6] Calibration and Validation of Pathogen Water Quality Model for the Passaic Valley Sewerage Commission (Final), June 2020, p. 205.

A program that meets any of the criteria listed below will be presumed to provide an adequate level of control to meet the water quality-based requirements of the CWA, provided the Department determines that such presumption is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas described above.

Combined sewer flows remaining after implementation of the NMCs and within the criteria specified below shall receive minimum treatment in accordance with:

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

Solids and floatables disposal; and

Disinfection of effluent, if necessary, to meet WQS, protect designated uses and protect human health, including removal of harmful disinfection chemical residuals/by-products (e.g. chlorine produced oxidants), where necessary.

The permittee must demonstrate any of the following three criteria below:

i. *No more than an average of four overflow events (see below) per year from a hydraulically connected system as the result of a precipitation event that does not receive the minimum treatment specified below. The Department may allow up to two additional overflow events per year. For the purpose of this criterion, an 'event' is:*

   In a hydraulically connected system that contains only one CSO outfall, multiple periods of overflow are considered one overflow event if the time between periods of overflow is no more than 24 hours.

   In a hydraulically connected system that contains more than one CSO outfall, multiple periods of overflow from one or more outfalls are considered one overflow event if the time between periods of overflow is no more than 24 hours without a discharge from any outfall.

ii. *The elimination or the capture for treatment of no less than 85 percent by volume of the combined sewage collected in the CSS during precipitation events on a hydraulically connected system-wide annual average basis.*

The 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 Section (ii) above.

Given the limited benefit provided by CSO controls in the vicinity of the Raritan River and Raritan Bay, the City and MCUA have selected the Presumption Approach for their LTCP. The target criteria is 85% capture of the volume of wet weather combined sewer flow within the service area served by the City during the Typical Year with Perth Amboy implementing all recommended LTCP capital projects to achieve the criteria for the Presumption Approach.

Section 7

Financial Capability Assessment

7.1 Background and Purpose

This section of the SIAR presents a Financial Capability Analysis (FCA) relating to the development of the CSO Long Term Control Plan (LTCP) required under Paragraph G(8)(a) of the Combined Sewer Management section of a permittee's NJPDES discharge permit. The FCA assessment is based upon the EPA document "Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule development," (EPA Guidance Document) published February 1997[7], as supplemented by EPA's November 2014 memorandum entitled "Financial Capability Assessment Framework for Municipal Clean Water Act Requirements".[8]

This document supports the twofold purposes of the FCA as envisioned in the 1994 CSO Control Policy[9] (Policy). This FCA is intended to determine whether the recommended capital plan is an affordable future investment strategy as defined by the Policy and related guidance documents and could be accommodated under the proposed LTCP implementation schedule.

The Financial Capability Assessment is a two phased process.

- Phase One determines a Residential Indicator (RI) that is the percentage of a permittee's service area median household income (MHI) expended on wastewater (including stormwater) management. The approach outlined in the EPA guidance documents uses the residential indicator, which is calculated as the typical household bill as a percentage of median household income (MHI), to gauge affordability. A residential indicator in excess of 2 percent creates a high burden on the residents of an area; an indicator between 1 and 2 percent poses a mid-range burden, while an indicator under 1 percent is considered low burden.

- Phase Two determines the permittee Financial Capability Indictor (FCI). The financial capability indicator is an assessment of the permittee's debt burden, socioeconomic conditions, and financial operations.

These two measures are subsequently entered into a financial capability matrix, suggested by EPA, to determine the level of financial burden placed on residential customers and the permittee by the existing and projected future expenditures to operate, maintain, and enhance the wastewater management system.

The projected future expenditures driving the RI and imposing demands upon the financial capability of the City and MCUA will include the current base expenditures for operations and

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[7] EPA 832-B-97-004

[8] November 24, 2014 memorandum from Ken Kopocis, Deputy Assistant Administrator, Office of Water (OW) and Cynthia Giles, Assistant Administrator, Office of Enforcement and Compliance (OECA) to Regional Administrators

[9] Combined Sewer Overflow Policy, Section II-C(8), Vol 59 No 75, FR 18694

maintenance and debt service with the anticipated implementation of CSO controls, stormwater controls, conveyance / collection system rehabilitation, and other operational, maintenance, and capital improvements to the municipal sewer systems. The future CSO control expenditures will be in addition to all other expenditures necessary to maintain the appropriate levels of service required to meet public needs, protect public health and the environment and to maintain regulatory compliance under the Clean Water Act, the New Jersey Water Pollution Control Act and the Safe Drinking Water Act.

7.2 Methodology and Assumptions

This report and financial capability assessment have been prepared in accordance with the EPA's financial capability assessment guidance document as modified and standard industry practices. Data was obtained from various sources to develop a financial model for the purpose of projecting the impact of the proposed capital program on the future revenue requirements and rates for the City and its residents. These analyses are based largely on information provided by the City of Perth Amboy. All data used in this report have been gathered from either the City or credible, public sources.

This financial capability assessment projects financial changes over a 40-year time frame. Given the forecasting horizon, numerous assumptions are necessary and have been used in this assessment. The following describes some of the critical assumptions used for this analysis:

- Consistent with the EPA guidance, only sewer related costs are included in this analysis.
- General operating and maintenance costs are assumed to inflate at an average annual rate of 3.0 percent, based on historical patterns. The CPI has increased at an average annual rate of 2.6% over the past 30 years. Given the long-term forecast, the City believes that 3.0 percent is a reasonable assumption.
- The City's sewer and stormwater collection system is currently operated and maintained by Middlesex Water Company (under a subsidiary, Utility Service Affiliates). It is assumed that the $6.7M annual fixed service fee is split 50/50 between water and wastewater, and remains constant through the end of the contract period. At the end of the contract term in FY 2028, it is assumed the contract will be reissued/recompeted. The analysis assumes a 15% increase in the fixed fee in FY 2029 as a result of the new contract. The projections include a 15% increase in the fixed fee contract every 10 years.
- The City conveys its wastewater to Middlesex County Utilities Authority (MCUA) via Woodbridge and Edison collection system (the Woodbridge's Lower Keasbey Interceptor, refer to Section 2) for treatment and disposal at the Central Treatment Plant (CTP). MCUA assesses charges to the participating communities based on budgeted annual expenses and proportional levels of flow and loadings. The City of Woodbridge and the City of Perth Amboy have an inter-municipal agreement, and Woodbridge charges Perth Amboy for the use of its sewer system.
- The MCUA's annual assessment is made for all thirty-six municipalities that contribute flow to the MCUA based on the estimated costs to direct, treat and discharge treated effluent to the Raritan River and Bay, while also beneficially reusing solids collected in the wastewater

process. These assessments are to address costs by the MCUA to undertake, among other things, the planning, financing, construction, maintenance, and operation of the various sewerage facilities primarily in and about the County of Middlesex, New Jersey. As the selected plan by Perth Amboy will not increase flow to the CTP beyond the current contractual limit of 13.6 MGD, no additional capital improvements are planned and therefore no review of financial capability for the MCUA is required

- The MCUA assesses *Sewer Use Charges* to its 27 Participants: 23 municipalities and 4 large industrial direct dischargers to its sewerage system. The City of Perth Amboy is one of the MCUA's Participants and is charged for the use of the MCUA's wastewater collection and treatment systems.
- The annually develops a *Schedule of Debt Service Rates* and a *Schedule of O&M Rates* to cover its debt service and O&M costs, herein referred to as the *Sewer Use Charges*. The *Schedules of Rates* are applied to each Participant quarterly based on flow volume (million gallons per quarter), and for loadings of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) based on tons per quarter, and for Chlorine Demand (CD) based hundred-weight per quarter.
- The *Sewer Use Charge* is estimated for each Participant based on the anticipated flow volumes and loadings for the following fiscal year (FY). The Participants pay the *Sewer Use Charge* to the MCUA in four equal quarterly payments based on the estimated sewage volume and loadings for the year. The MCUA reviews the estimated costs after the end of the year and adjusts the *Sewer Use Charge* for each Participant to reflect the actual flows and loadings measured. These represent the actual *Sewer Use Charge* for the FY.
- The MCUA's actual *Sewer Use Charge* for all Participants between 2015 and 2019 averaged 2.7% per year. A 3% per year increase in the *Sewer Use Charge* in the future would be a reasonable assumption to make, particularly considering that the impacts of the current COVID-19 pandemic on the MCUA's finances have yet to be determined. MCUA's *Sewer Use Charge* is established annually and based on many variables that impact the Schedule of Rates and Charges for all Participants, including Perth Amboy. Therefore, MCUA would not be able to guarantee Perth Amboy how the MCUA's Schedule of Rates and Charges might change in the future.
- Perth Amboy's current maximum flow is approximately 12.0 MGD
- An additional 0.16 MGD in flow is anticipated in FY 2037 as part of the first phase of the LTCP (CSO Group 4 and 5 (CSO P-017 & P-019)).
- An additional 0.41 MGD in flow is anticipated in FY 2044 as part of the second phase of the LTCP (CSO Group 3 (CSO P-009 to P-016)). With the additional flow from the first phase, the total additional flow accounts for a 4.8% increase over current flows.
- Total existing revenue bond service for the water/wastewater utility is assumed to be allocated 59% to wastewater. Existing SRF (NJEIT loans) is assumed 100% wastewater related.

- Capital costs are projected to increase at an average annual rate of 4.0 percent, based on historical trends. The average annual increase in the ENR CCI over the last 30 years is 3.9%.
- Miscellaneous revenues are assumed to remain constant over the projection period. The wastewater portion of total miscellaneous revenues (water and wastewater combined) is assumed to be 54%.
- Incremental Operations and Maintenance (O&M) resulting from program implementation has been estimated and included in the analysis. The total amount of incremental O&M over the 40-year period is $21.7M annually (2020 $). It is assumed that incremental O&M increases over time and is inflated annually at the rate of O&M inflation.
- This analysis has been conducted assuming the City would finance its future capital costs (non-LTCP and LTCP related) by issuing revenue bond debt, at a rate of 6.0 percent for a term of 20 years, with issuance costs of 1.0 percent.
- A long-term non-LTCP renewal and replacement plan has been developed based on the City's asset inventory and condition assessment. For this analysis, the estimated costs of asset renewals are grouped into 5 year totals and assumed that the annual spending is spread equally over the 5-year period. The City also maintains its own 5-year CIP, which is carried in addition to the inventory and condition assessment. The total non-LTCP capital spending for the 40-year period is anticipated to be $69.1M (2020 $).
- The City currently charges a minimum fixed base charge by customer class for sewer customers, and a commodity rate based on usage. For FY 2020, the quarterly base charge for a residential sewer customer is $24.13, which includes an allowance of 5 HCF/quarter. The volumetric residential sewer rate is $4.82/HCF for all usage over 5 HCF/quarter.
- This analysis assumes that FY 2020 rates are set at a level to generate revenues sufficient to meet expenses. The change in projected annual rates follows the annual change in revenue requirements.
- Median household income (MHI) for Perth Amboy in 2018 was estimated to be $53,011, based on U.S. Census Bureau data. MHI is assumed to increase 1.2 percent annually, which represents the historical rate since 2009.
- To be consistent with the EPA guidance, it was necessary to determine residential only sewer consumption, and the associated residential dwelling units accounting for that consumption. The City charges for sewer based on a customer's water consumption, so based on an analysis of the City's water consumption records and Census data for dwelling units, the typical residential dwelling unit consumes 68 hundred cubic feet (HCF) annually, or roughly 51,000 gallons per year. This information is summarized in Table 7-1 below.

Table 7-1 - Calculation of Residential Consumption

Category	Value
Residential Dwelling Units	15,946
Residential Consumption	1,090,941
Residential Consumption per Dwelling Unit (HCF)	**68.41**

7.3 Annual Revenue Requirements

This evaluation is focused on the next 40 years, over which period LTCP capital spending is estimated to be $342.1M (2020 dollars) and $758.9 million when inflated. This is exclusive of planned operating and maintenance having a present worth of $34 million based on 20-years and discount rate of 2.75%.

In addition to spending on the identified LTCP projects, as part of the City non-LTCP CIP and the long-term non-LTCP renewal and replacement plan developed, the City has identified $139.5M in inflated capital spending over the projection period. This means that over the 40-year projection period, the total inflated projected capital spending will be approximately $898.5 million.

Figure 7-1 below details the annual capital spending for this program in inflated dollars through FY 2060. A more detailed description of the projects associated with the spending totals are included in Section 9.

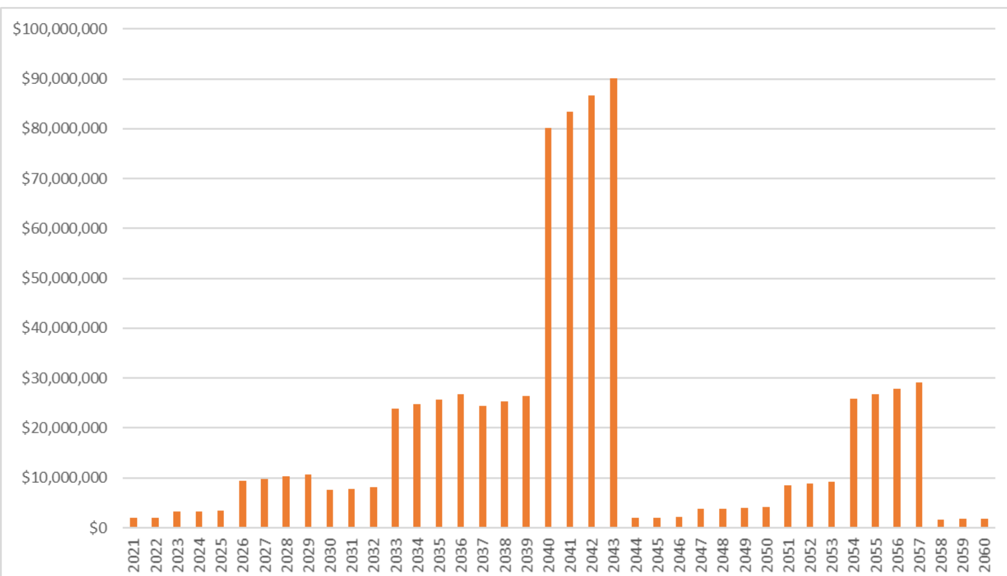

Figure 7-1 - Proposed Capital Program Spending by Year (Inflated $)

The projected revenue requirements will be summarized in three main components:

- Operations and maintenance costs (O&M), which includes the service fee for collection system operations, disposal and treatment costs, and incremental costs attributable to the LTCP.

- Debt service and capital expenditures.
- Miscellaneous revenue.

The following sections summarize the total projected expenses and revenue requirements.

7.3.1 Operation and Maintenance Costs

There are O&M costs associated with all aspects of the wastewater, stormwater, and wet weather systems operation. Perth Amboy's wastewater collection system is operated and maintained under contract by Utility Services Affiliates, a subsidiary of Middlesex Water Company. Perth Amboy remits an annual fixed service fee of $6.7M to the contract operator for operations of both the water and wastewater systems, under contract terms which runs through FY 2028. It is assumed that the $6.7M annual fixed service fee is split 50/50 between water and wastewater, and that split remains constant through the end of the contract period. As previously noted, the projections assume a 15% increase in the fixed fee every 10 years to reflect the assumed contract recompete.

Perth Amboy's sewage is conveyed to the Middlesex County Utilities Authority for treatment. MCUA allocates its costs to its Participants through annual treatment and disposal assessments, based on proportional sewage volume (million gallons per Quarter) and BOD, TSS and CD loadings (tons per Quarter) from each Participant. Perth Amboy's O&M expenses have been separated into four general categories:

- Operating Expenses — general operating costs of the City related to the sewer utility (e.g. salaries and wages, professional services).
- Utility Services Affiliates Fixed Service Fee - fixed service fee for contract operations and maintenance of the City's sanitary and storm collection system.
- MCUA Sewer Use Charge (SUC) — assessment payment to MCUA for sewage collection, treatment and disposal for the MCUA's O&M and Debt Service costs.
- Incremental Perth Amboy O&M Costs — anticipated incremental O&M and cost increases resulting from implementation of the LTCP.

Between FY 2015-2019, the City of Perth Amboy accounted for approximately 5% of the total estimated SUC's assessed to the MCUA Participants. Future estimated assessments from the MCUA to the City may remain consistent with their accounted percentage based upon the average increase referenced in Section 7.2, however, the MCUA cannot guarantee that future estimated assessments will follow historical increases. For the purpose of this report, the historical average annual increase in the MCUA estimated assessment of 1.27% is used for the financial projections contained in this LTCP. CDM Smith is concerned this assumption is low based on comparison with national averages for sewer utility costs. This report recognizes there is substantial uncertainty in making this assumption as there is no factual trending basis for a greater rate of increase at this time. Since the MCUA Sewer Use Charge (SUC) assessment is roughly half of Perth Amboy's current O&M budget, future assessments above historical increases can have a material impact on the projected expenses along with other contributing factors, and proportionally diminish Perth Amboy's capacity to pay for capital improvements as part of the LTCP. Perth Amboy's total O&M expenditures are projected to grow from $7.6 million in FY 2020 to over $18.5 million in FY 2060. This represents an average annual cost increase of 2.2 percent. Anticipated O&M expenses over time are summarized in increments in Table 7-2.

Table 7-2 – Operations and Maintenance

O&M Category	FY 2020	FY 2030	FY 2040	FY 2050	FY 2060
Operating Expenses	$402,188	$540,507	$726,397	$976,217	$1,311,953
USA/PA Fixed Service Fee	$3,350,000	$3,852,500	$4,430,375	$5,094,931	$5,859,171
MCUA Sewer Use Charge (SUC)	$3,875,415	$4,396,510	$5,055,884	$5,926,902	$6,723,845
Incremental O&M	$0	$757,332	$1,142,051	$1,946,034	$2,778,967
Total Operations and Maintenance	**$7,627,603**	**$9,546,849**	**$11,354,706**	**$13,944,084**	**$16,673,936**

Incremental O&M expenses are non-capital sewer costs resulting from implementing the LTCP. Table 7-3 summarizes the estimated incremental O&M. The table shows the annual cost (2020 $) and the year in which the costs are assumed to begin.

Table 7-3 - Incremental O&M (2020 $)

Description	Annual Cost	Start Year
Green Infrastructure	$2,772	2023
CSO Group 4 and 5 (CSO P-017 & P-019) 0 overflows/year	$560,754	2030
CSO Group 3 (CSO P-009 to P-016) 0 overflows/year	$68,800	2037
Main Infl PS and Force Main to MCUA (20 MGD)	$169,414	2044
CSO Group 1 (CSO P-002) 20 overflows/year	$25,032	2051
CSO Group 2 (CSO P-003 to P-008) 20 overflows/year	$25,140	2058

7.3.2 Debt Service and Capital Expenditures

Capital costs can be financed through amounts generated in annual rates as cash funded capital, or through bonded debt as debt service. The debt service and capital expenditures have been separated into three categories: existing debt service, anticipated debt service, and cash funded capital.

Existing debt service represents the wastewater related debt that is outstanding as of FY 2019. Since the revenue bonds issued to date are for both water and wastewater related projects, the amounts carried in this analysis only represent the allocated wastewater portion.

Cash funded capital is the annual capital projects that the City elects to fund directly through current year rate revenue without issuing debt. As noted in the assumptions, the City has assumed the entirety of its major capital program costs to be debt financed, (i.e. anticipated debt service) so cash funded capital represents capital outlay items identified in the operating budget, and increased annually at the rate of capital inflation.

Anticipated debt service represents the assumed debt service payments on the capital costs described in Section 7.3.

Table 7-4 shows the projected capital and debt obligations in increments through FY 2060, including the costs associated with the proposed LTCP.

Table 7-4 – Debt Service and Capital

Description	FY 2020	FY 2030	FY 2040	FY 2050	FY 2060
Existing Debt Service	$6,026,647	$4,340,336	$0	$0	$0
Anticipated Debt Service	$117,716	$8,539,335	$33,854,008	$51,311,570	$39,773,426
Cash Funded Capital	$501,696	$742,633	$1,099,278	$1,627,200	$2,408,653
Total Debt Service and Capital	**$6,646,058**	**$13,622,304**	**$34,953,285**	**$52,938,769**	**$42,182,079**

7.3.3 Miscellaneous Revenue

The City's miscellaneous or non-rate sewer revenue consists of all revenue generated by the City that is not directly related to sewer rates. Table 7-5 summarizes the miscellaneous revenues through the projection period in increments.

Table 7-5 - Projected Miscellaneous Revenue

Miscellaneous Revenue	FY 2020	FY 2026	FY 2032	FY 2038	FY 2044	FY 2050
Wastewater Miscellaneous Revenue	$197,360	$197,360	$197,360	$197,360	$197,360	$197,360
Cell Tower Rentals	$116,144	$116,144	$116,144	$116,144	$116,144	$116,144
Total Miscellaneous Revenue	**$313,504**	**$313,504**	**$313,504**	**$313,504**	**$313,504**	**$313,504**

7.3.4 Revenue Requirement

The revenue requirement is the total revenue that must be generated annually through sewer rates to fund the City's sewer expenses. The sewer revenue requirement is calculated by subtracting non-rate sewer revenue from total sewer expenses. Table 7-6 shows the total revenue requirement, which includes the projections for implementing the projects in the LTCP. The total revenue requirement is projected to grow from approximately $14.0 million in FY 2020 to approximately $67.8 million in FY 2060, equivalent to an average annual increase of 4.0 percent.

Table 7-6 - Projected Revenue Requirement, Increments

Description	FY 2020	FY 2026	FY 2032	FY 2038	FY 2044	FY 2050
Operations and Maintenance	$7,627,603	$9,546,849	$11,354,706	$13,944,084	$16,673,936	$7,627,603
Debt Service and Capital	$6,646,058	$13,622,304	$34,953,285	$52,938,769	$42,182,079	$6,646,058
Total Expenses	**$14,273,661**	**$23,169,153**	**$46,307,991**	**$66,882,853**	**$58,856,015**	**$14,273,661**
Less Miscellaneous Revenue	$313,504	$313,504	$313,504	$313,504	$313,504	$313,504
Revenue Requirement	**$13,960,157**	**$22,855,650**	**$45,994,488**	**$66,569,349**	**$58,542,512**	**$13,960,157**

Table 7-7 shows the revenue requirement projections for the next 10 years, through FY 2030. Within the next 10 years, the revenue requirement is projected increase at an average annual rate of 5.1 percent. In certain years, the annual increases exceed 15 percent, with an increase in FY 2041 projected at over 18 percent. The decrease in revenue requirement in FY 2030 is driven largely by existing debt service being paid off that year.

Table 7-8 shows the average annual increase in revenue requirement for 5-year periods.

Table 7-7 - Projected Revenue Requirement, Next 10 Years

Year	Revenue Requirement	Annual Increase
2020	$13,960,157	
2021	$14,790,808	6.0%
2022	$15,644,528	5.8%
2023	$16,596,238	6.1%
2024	$17,543,009	5.7%
2025	$18,112,733	3.2%
2026	$19,596,840	8.2%
2027	$20,001,619	2.1%
2028	$21,294,986	6.5%
2029	$23,572,564	10.7%
2030	$22,855,650	-3.0%
Average Increase		**5.1%**

Table 7-8 - Revenue Requirement Average Annual Increase, 5-Year Increments

Years	Average Annual Increase
2020-2025	5.3%
2025-2030	4.8%
2030-2035	4.9%
2035-2040	9.7%
2040-2045	10.3%
2045-2050	-2.4%
2050-2055	-1.7%
2055-2060	-0.9%

Figure 7-2 graphically depicts the projected revenue requirement for the LTCP annually for the projection period.

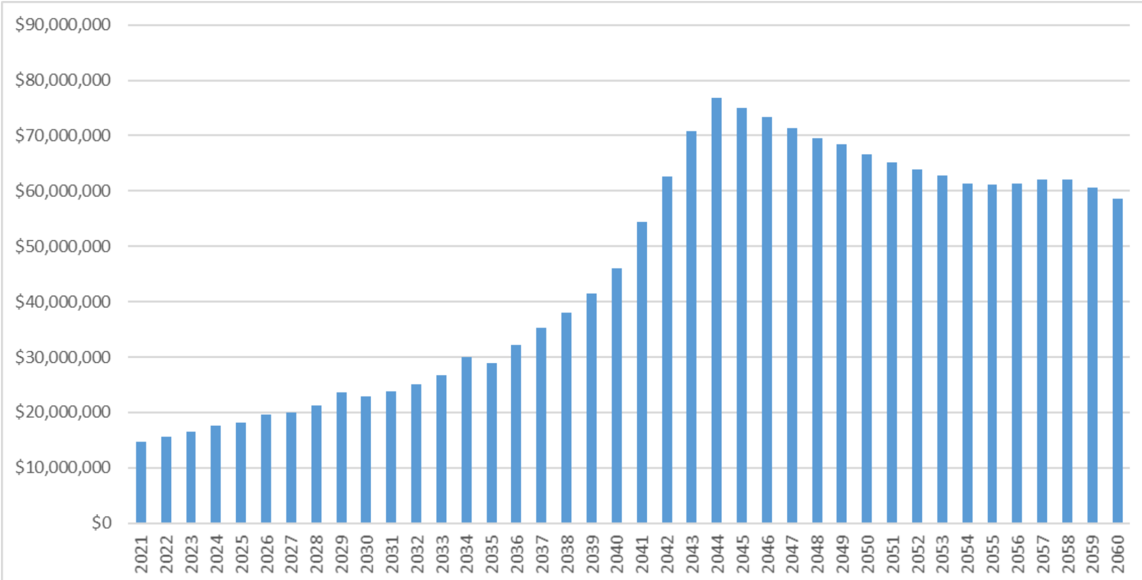

Figure 7-2- Projected Revenue Requirement – With Proposed Program

The projected revenue requirements shown in Figure 7-2 will directly translate into increased sewer rates and burden for City's households. Sewer rate increases are assumed to generally follow the same rate of annual revenue requirement increase. As discussed, nearly 50% of Perth Amboy's total O&M is related to the MCUA fee. We believe the assumption that MCUA charges to Perth Amboy will increase at an annual rate of 1.3% throughout the projection period is overly conservative, and understates the overall projected costs.

The revenue requirement under the program is expected to more than double over the next 10 years, and triple by FY 2033. For the first 10 years of the projections, that would equate to an average annual increase of 9.8 percent, with several years over double-digit increases. Revenue requirement increases of this magnitude will translate into significant rate increases both in the short term and into the future.

7.4 Residential Indicator

The Residential Indicator measures the financial impact of the current and proposed wastewater treatment and CSO controls on residential users. Development of this indicator starts with the determination of the current and proposed wastewater treatment and CSO control costs per household (CPH). Second, the service area's CPH estimate and the median household income (MHI) are used to calculate the Residential Indicator. Finally, the Residential Indicator is compared to established financial impact ranges to determine whether CSO controls will produce a possible high, mid-range or low financial impact on the permittee's residential users. Worksheets are provided to aid in developing the Residential Indicator.

The "Residential Indicator" is defined as the typical dwelling unit sewer bill compared to MHI and is used as a benchmark by the EPA in assessing the affordability of a proposed program. The current sewer household bill in Perth Amboy is $330 based on the City's estimate of annual sewer use of 68 hundred cubic feet per residential dwelling unit.

The projected growth in the typical household sewer bill, MHI and the corresponding Residential Indicator are shown in Table 7-9 for the proposed program. Figure 7-3 shows graphically the increase in the household burden through FY 2060. For the first 10 years, residents will face average annual rate increases of 5.1 percent; over the first 20 years, the average annual increase is 6.1 percent. These are rapid and significant increases to the user base in Perth Amboy and suggests that implementing the proposed program will be potentially problematic.

Table 7-9 – Residential Indicator

Description	FY 2020	FY 2030	FY 2040	FY 2050	FY 2060
Estimated Household Bill	$330	$540	$1,087	$1,573	$1,383
MHI	$54,291	$61,169	$68,919	$77,650	$87,488
Residential Indicator	0.61%	0.88%	1.58%	2.03%	1.58%

The residential indicator exceeds 2 percent in FY 2042 under the proposed program. The household burden reaches 2.5 percent by FY 2044, which is well above the EPA high burden threshold for affordability. The household burden remains over 2 percent through FY 2050, at which point portions of debt service are paid off.

A program of this size will create a significant burden on the City's residents and may be beyond the resources of the City and its residents.

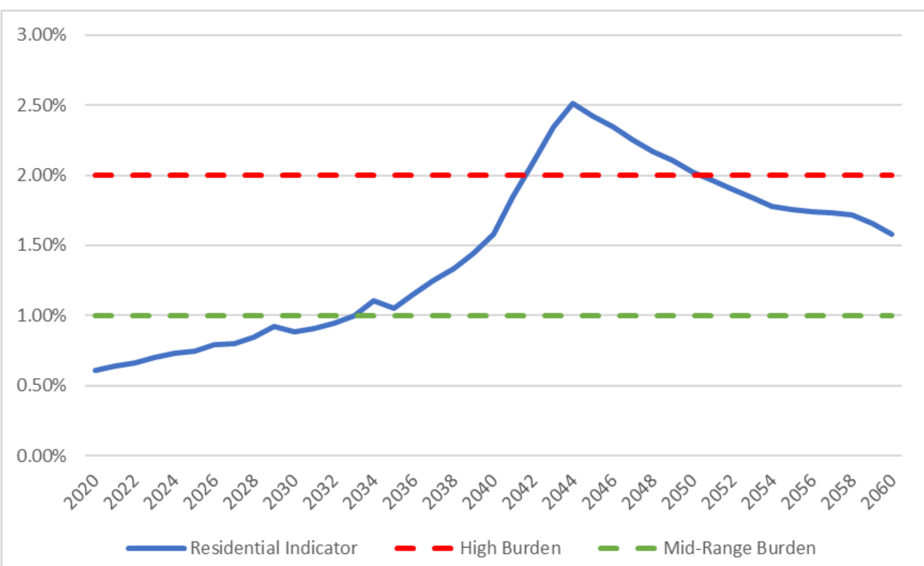

Figure 7-3 - Projected Household Bill, MHI and Residential Indicator

The above figure shows the impact on households with household income at the median. A household at or below the bottom 40 percent of income (roughly $40,000) is projected to have a residential burden of over 3.3 percent in FY 2044, nearly 1.5 times the EPA high burden threshold.

7.5 Financial Capability Indicators

This section presents the Phase 2 financial impact indicators, as defined by United States Environmental Protection Agency benchmarks in the *Combined Sewer Overflows — Guidance for Financial Capability Assessment and Schedule Development* (EPA, February 1997). These indicators evaluate ancillary factors that may have an effect on the city of Perth Amboy's ability to fund the proposed recommended plan outlined in the LTCP. This assessment identifies three categories, each with two indicators as listed below:

- Debt Indicators:
  - Bond Rating
  - Overall Net Debt
- Socio-economic Indicators:
  - Median Household Income
  - Unemployment Rate
- Financial Management Indicators:
  - Property Tax Revenue
  - Property Tax Collection Rate

While the first phase of the assessment (Residential Indicator) is a time-series analysis, the Phase 2 assessment is a cross-sectional view of the City's financial capability.

The two debt indicators used in Phase 2 of the financial capability assessment are bond rating and overall net debt. These indicators are indicative of the City's capacity to gain access to capital markets to raise the necessary capital to implement the anticipated CIP.

7.5.1 Bond Rating – Indicator 1

The bond rating indicator is intended to address a general capacity to undertake debt. While rating designations vary by credit rating agencies, long-term bond ratings range from AAA/Aaa (high grade) to C/D (in default). Table 7-10 shows the City's most recent A2 rating from Moody's Investors Service. Benchmarks for this indicator and include the ratings as follows:

- ***Strong (Score = 3)*** — a high grade or strong bond (e.g., Aaa or AAA, Aa or AA, A).
- ***Mid-Range (Score = 2)*** — a medium grade bond (e.g., Baa or BBB). These are the minimum "investment grade" bond ratings.
- ***Weak (Score = 1)*** – a speculative or "junk" bond (e.g. Ba or BB, or lower)

Based on the benchmarks provided in the EPA guidance document, this indicator is rated strong and earns a score of 3.

Table 7-10 – Current Bond Rating

Item	Value
Rating agency	Moody's Investors Service
Rating	A2
Bond Rating Indicator Score	3

7.5.2 Net Debt as Percentage of Full Market Value – Indicator 2

Overall net debt is the amount of tax-backed bonded debt for all taxing units not supported by revenue from sewer user fees. Indicator scores for overall net debt are based on the percentage of the full-market property value. The EPA guidance document benchmarks for overall net debt are:

- ***Strong (Score = 3)*** — overall net debt is below two percent of the full-market property value.
- ***Mid-Range (Score = 2***) — overall net debt is two to five percent of the full-market property value.
- ***Weak (Score = 1)*** — overall net debt is more than five percent of the full-market property value.

Data for this indicator was largely taken from the City's annual debt statement and is shown in Table 7-11.

Table 7-11 – Overall Net Debt Rating

Item	Value
Direct net debt	$91,623,617
Debt of overlapping entities (proportionate share of multi-jurisdictional debt)	$0
Overall net debt (2019)	$91,623,617
Market value of property (2019)	$3,409,801,971
Overall net debt as a percent of full market property value	2.69 percent
Overall Net Debt Indicator Score	2

The overall net debt for the City in 2019 was approximately $91 million. The City's market value of property (equalized valuation) is approximately $3.4 billion, which makes the overall net debt approximately 2.69 percent of full-market property value. Thus, this indicator is rated as "mid-range" using the EPA guidelines, which equates to a score of 2.

The two socio-economic indicators used in Phase 2 of the financial capability assessment are unemployment rate and median household income. These indicators are indicative of the City's general economic condition.

7.5.3 Unemployment Rate – Indicator 3

Unemployment rate is a measure of the City's labor force that is unemployed but seeking employment. The EPA guidance document benchmarks for unemployment rate are:

- ***Strong (Score = 3)*** — unemployment rate is more than one percent below the national average.
- ***Mid-Range (Score = 2)*** — unemployment rate is within one percent (+/-) of the national average.
- ***Weak (Score = 1)*** — unemployment rate is more than one percent above the national average.

The unemployment rate for Perth Amboy, as compared to the national average, is shown in Table 7-12. The City's average unemployment rate in 2018, according to the U.S. Bureau of Labor Statistics, was 6.4 percent, 2.5 percent more than the national average rate of 3.9 percent. Since the City's unemployment rate is more than one percent of the national average, it gives the City a "weak" rating of 1 for this indicator. Although the data from 2018 indicates the City is on the weak scale for this criterion, it is also important to note that these unemployment figures represent values from before the current pandemic, the impacts of which will increase the unemployment figures significantly.

Table 7-12 – Unemployment Rate

Item	Value
Permittee: Perth Amboy Unemployment Rate (2018 Average)	6.4 percent
U.S.: Average National Unemployment Rate (2018 Average)	3.9 percent
Comparison of Perth Amboy with National Average (2018 Average)	2.5 percent above
Unemployment Rate Indicator Score	1

7.5.4 Household Income – Indicator 4

This indicator is related to the Residential Indicator in that they both consider median household income (MHI). While the Residential Indicator is a comparison of MHI and average annual household bills, the median household income indicator focuses solely on Perth Amboy's MHI by comparing it to the national median household income. Thus, this benchmark is a measure of the relative wealth or poverty of the service area. The EPA guidance document benchmarks for median household income are:

- ***Strong (Score = 3)*** — MHI is more than 25 percent above the national average.

- ***Mid-Range (Score = 2)*** — MHI is within 25 percent (+/-) of the national average.
- ***Weak (Score = 1)*** — MHI is more than 25 percent below the national average.

The City and national MHI values, shown in Table 7-13, are based on the most recent Census Bureau, American Community Survey (ACS) data. Perth Amboy's MHI is 13.6 percent below national MHI and has a mid-range rating, with a rating score of 2.

Table 7-13 – Median Household Income Comparison

Item	Value
Most recent Perth Amboy estimate (2018 ACS)	$53,011
Most recent Census estimate (2018 ACS)	$60,293
Compare Permittee with Average National MHI	13.7 percent below
Median Household Income Indicator Score	2

The two financial management indicators are property tax revenues and tax collection efficiency. The indicators are used to assess a community's capacity to support debt.

7.5.5 Property Tax Revenues Compared to Property Value – Indicator 5

Property tax revenue — expressed as a percent of full market property value — is an indicator of the funding capacity available to support debt, based on the wealth of the community. The EPA guidance document benchmarks for property tax revenues are:

- ***Strong (Score = 3)*** — property tax revenue is below two percent of the full-market property value.
- ***Mid-Range (Score = 2)*** — property tax revenue is two to four percent of the full-market property value.
- ***Weak (Score = 1)*** — property tax revenue is more than four percent of the full-market property value.

In the City, property tax revenues collected in 2019 were approximately $99.1 million; based on a full-market property value of $3.4 billion at that time. As shown in Table 7-14, the calculated property tax revenue indicator for the City is 2.91 percent, which places the City in the "mid-range" range with a rating score of 2.

The City funds the operations and maintenance of the sewer and stormwater systems through rate revenue, not property taxes, so this indicator has limited analytical value to the financial impact summary.

Table 7-14 - Property Tax Revenues

Item	Value
Full market value of real property (2019)	$3,409,801,971
Property tax revenue (2019)	$99,080,366

Item	Value
Property tax revenue as a percentage of full market property value	2.91 percent
Property Tax Revenue Indicator Score	2

7.5.6 Property Tax Revenue Collection Rate – Indicator 6

The last Phase 2 indicator is the property tax collection rate. This indicator represents the relationship of property taxes collected versus property taxes levied. The EPA guidance document benchmarks for property tax collection efficiency are:

- ***Strong (Score = 3)*** — property taxes collected are above 98 percent of the property taxes levied.
- ***Mid-Range (Score = 2)*** — property taxes collected are between 94 and 98 percent of the property taxes levied.
- ***Weak (Score = 1)*** — property taxes collected are less than 94 percent of the property taxes levied.

Computation of this indicator rating is shown in Table 7-15 and is based on the City's financial statements. The City's property tax collection rate is 99.5 percent of the taxes levied. This data is indicative of strong financial capability yet is of limited value because the City relies on sewer rate revenue for sewer funds, not property taxes.

Table 7-15 – Property Tax Collection Efficiency

Item	Value
Property tax revenue collected (2019)	$99,080,366
Property taxes levied (2019)	$99,631,224
Property tax revenue collection rate	99.5 percent
Tax Collection Efficiency Indicator Score	3

7.5.7 Financial Indicator Scores Matrix

Table 7-16 shows the EPA's Phase 2 Financial Impact Indicator benchmarks used to evaluate the six indicators. The indicators are shown in the left-hand column. The corresponding EPA benchmarks for each indicator are shown for "strong", "mid-range" or "weak" ratings. The highlighted boxes in this table indicate where the City falls within the framework of these indicators.

Table 7-16 - Financial Impact Assessment Benchmarks

Indicator	Strong (Score = 3)	Mid-Range (Score = 2)	Weak (Score = 1)
1. Bond Rating	AAA to A (S&P) or	BBB (S&P) or	BB to D (S&P) or
	Aaa to A (MIS)	Baa (MIS)	Ba to C (MIS)
2. Overall Net Debt	Below 2 percent	2 percent to 5 percent	Above 5 percent

Indicator	Strong (Score = 3)	Mid-Range (Score = 2)	Weak (Score = 1)
3. Unemployment Rate	>1 percent below National Average	±1 percent of National Average	>1 percent above National Average
4. Median Household Income	>25 percent above adjusted National MHI	±25 percent of adjusted National MHI	>25 percent below adjusted National MHI
5. Property Tax Revenue	Below 2 percent	2 percent to 4 percent	Above 4 percent
6. Property Tax Collection Rate	Above 98 percent	94 percent to 98 percent	Below 94 percent

The values and scores of the six indicators for Perth Amboy are summarized in Table 7-17. An overall (average) score below 1.5 is considered weak and an overall score above 2.5 is considered strong. An overall score between 1.5 and 2.5 is considered mid-range.

Table 7-17 – Financial Impact Assessment Benchmarks

Indicator	Value	Score
1. Bond Rating	A2	3
2. Overall Net Debt	2.69 percent	2
3. Unemployment Rate	2.5 percent above	1
4. Median Household Income	13.7 percent below	2
5. Property Tax Revenue	2.91 percent	2
6. Property Tax Collection Rate	99.5 percent	3
Overall Financial Impact Indicator Score		**2.17**

Table 7-17 shows the overall, un-weighted average score for the Phase 2 evaluation is 2.17, which falls in the mid-range of the financial capability scale.

7.6 Potential Impacts of COVID-19 Pandemic on Affordability

The projections and conclusions concerning the affordability of the CSO control program proposed in this LTCP by the City and MCUA and their respective financial capabilities to finance the CSO control program are premised on the baseline financial conditions primarily of the City as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the COVID-19 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. At a minimum, we anticipate some reduction in municipal revenues and household incomes into the future.

7.6.1 City Revenue

This Financial Capability Assessment cannot reflect the currently unknowable impacts on municipal revenues stemming from the national economic upheaval resulting from the COVID-19 pandemic. It is however extremely likely that the City and MCUA, 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.

The National Association of Clean Water Agencies (NACWA) has analyzed the financial consequences on the nations clean water agencies and predicts 20% reductions in sewer revenues and further indicates "[R]evenue drops will vary across the country and over time; some communities with major commercial/industrial sectors are projecting reductions closer to 30-40%. If these revenue losses are not addressed, clean water utilities we have no choice but to make up for them in future rate increases, creating even more of an affordability challenge for low-income households." [10]

The impact of a 20% to 40% revenue loss, along with increased costs that have been and will continue to be experienced by 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 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 are somewhat variable with wastewater flows, e.g. chemical and electrical power usage but this variability is lessened by the reality that stormwater flow in a combined system is not affected by billed water consumption. In addition, labor costs are not directly variable with costs, 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, but it is more likely they will remain static. As costs do not decline proportionately to billed flow, it can be expected that user charge rates will be raised to generate sufficient revenue to sustain current operations. However, the relationship between changes in costs and revenues and the resultant changes in user charge rates is complex and neither the City nor MCUA has analyzed the possible outcomes. At this point it can be assumed that user rate increases may be necessary to simply maintain current operations, and these rate increases will potentially erode the financial capabilities to fund the CSO LTCP.

7.6.2 Potential Median Household Income Impacts

The impacts of the COVID-19 pandemic on median household incomes in the City of Perth Amboy cannot be determined at this point.

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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[10] NACWA Press Release, "*Recovering from Coronavirus Mitigating the Economic Cost of Maintaining Water and Wastewater Service in the Midst of a Global Pandemic and National Economic Shut-Down*", https://www.nacwa.org/docs/default-source/resources---public/water-sector-covid-19-financial-impacts.pdf?sfvrsn=98f9ff61_2, accessed September 23, 2020.

7.6.3 Implications for the Long Term CSO Control Program

The City anticipates the financial implications of the COVID-19 pandemic will be discussed as more information becomes available and more specifically with NJDEP during the review of the SIAR and as the 2021 – 2025 NJPDES permit is developed.Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, Permittees like the City will be reticent to commit to long term capital expenditures for CSO controls without the incorporation of meaningful adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this SIAR based on emergent economic conditions beyond the permittees' control. As detailed in Section 10 of this SIAR, these provisions could include scheduling the implementation of specific CSO control measures to occur during the five-year NJPDES permit cycles. A revised affordability assessment should be performed during review of the next NJPDES permit to identify controls that are financially feasible during that particular permit period.

7.7 Conclusion

The proposed LTCP will have a significant impact on Perth Amboy households. The program will create sustained rate increases over a long period of time, with certain years projected to require double digit increases.

There is substantial uncertainty as to the affordability of this LTCP. Under more typical circumstances, such uncertainty would be generally limited to sewer use charges assessed by MCUA to be borne by the City. However, the current COVID-19 pandemic situation introduces a level of uncertainty that is far higher than any historical norm. It many ways, the City cannot rely on what has happened in the past to predict or gauge outcomes into the future.

A program of this size will create a significant burden on the City's residents and ispotentially beyond the resources of the City and its residents. The full impact of the current COVID-19 pandemic on the City's residents is still relatively unknown and it will likely be several months (or years) before any insights begin to emerge as to the greater impact the COVID-19 pandemic will have on the City's finances. However, it is almost certain that area unemployment will increase in the short term, which will create an additional strain on the City and its residents to be able to afford a significant capital program. The City should anticipate a decline in revenues because of the spike in unemployment and the liberalization of payment rules, and it is reasonable to expect that decline to continue for some period of time. Any reductions in revenue collections will only worsen the City's ability to afford a major capital plan. Coupled with the projections provided above (which does not explicitly include future impact of COVID-19 related drop in revenue), and given the uncertainty surrounding the full impact of COVID-19, the City's ability to afford any level of capital investment is likely compromised.

Section 8

Public Participation Process

Perth Amboy has taken into consideration the input from the CSO Supplemental team, hydraulically connected communities, other community stakeholders, Perth Amboy residents and the general public. Perth Amboy recognizes that community priorities can evolve during the course of planning and implementing the CSO LTCP and has and continues to intend to engage new stakeholders and proactively solicit input to ensure that community needs are taken into consideration throughout the LTCP process. The overall outcome goals include a better-informed public, broader distribution of LTCP process information, identification of the City as the source for technical information and informational resources, and more public awareness of and participation in the LTCP Process.

8.1 Background

The goals of Perth Amboy's public participation and Supplemental CSO team initiatives are to:

- Increase public awareness of public health concerns related to CSOs and flooding issues in Perth Amboy;
- Inform community stakeholders and rate payers of the LTCP process and potential infrastructure investments required to address CSO reductions; and
- Facilitate involvement from a variety of stakeholders in order to make informed decisions on the final LTCP that reflect the contemporary and future planning needs of the Perth Amboy community.

Perth Amboy has made public participation a continual process throughout the three phases of the LTCP development and has fostered regular public involvement as phases of the LTCP have been implemented. As Perth Amboy met with various outside entities, the following outcomes were sought to be achieved:

- Cultivate an ongoing dialogue among direct stakeholders and Supplemental CSO team members with Perth Amboy officials involved in LTCP development;
- Improved public awareness of the costs, benefits and affordability considerations of investments in sewage and stormwater infrastructure improvements;
- Focus on areas of mutual benefit to Perth Amboy's LTCP requirements and interests of outside entities; and
- Inform Perth Amboy officials of the needs of the rate paying community and ensure that decisions regarding facility and infrastructure improvements account for considerations to Perth Amboy in the near term and within the designated planning/implementation period.

8.2 Supplemental CSO Team

The Supplemental CSO Team was formed in early 2017 and convened its first meeting in March 2017. A list of Team members is included in Table 8-1. When selecting members for this initial team, the City desired to select members that best represent the community and offer a diverse array of backgrounds and experience to provide robust feedback. It was also important to ensure the geographic distribution of residents and businesses across the service area. Team members were solicited to reflect the diverse perspectives from and within the City, as well as points of view from other stakeholders who have an interest in the City LTCP.

Table 8-1 - Supplemental CSO Team (Alphabetical by Name)

Member	Representing
Kevin Aiello – before 9/30/19 Lisa Oberreiter – after 9/30/19	Middlesex County Utilities Authority
Bob Castillo	Chemtura Corp
Larry Cattano	City of Perth Amboy Police Department
Frank Hoffman	DPW Director
TBD	City of Perth Amboy, Fire Department
Jeff Rauch	City of Perth Amboy, Planning Department (Center State Engineering)
Jamie Rios	City of Perth Amboy, Department of Code Enforcement
William (Bill) Schultz	Raritan River Keeper
Renee Skelton	City of Perth Amboy, citizen
Joseph S. Vicini	Tropical Cheese

The overarching goal of the Supplemental CSO Team is to serve a liaison-type role between the City of Perth Amboy and the residents, business owners and other non-governmental organizations within the community. The expectation is that team members will help engage and inform the public; provide perspective on local issues, priorities and public sentiment; and regularly attend meetings. Participants are not expected to be experts in stormwater management, engineering or construction; one of the Team's assets is having an outside non-expert perspective and be able to refine how the City communicates these issues to the public through education of the team. Team members are asked to participate throughout the entire LTCP development. Locations for these meetings have been the Perth Amboy Fire Department Offices, but subsequent meetings and public forums of the Team will consider offering variety in meeting times and locations to accommodate a wider availability. Details of the meetings held to date are included in Section 8.3.

8.2.1 Supplemental CSO Team Meetings

Six Supplemental CSO (SCSO) Team Meetings were held with dates and meeting content summarized in Table 8-2.

Table 8-2 - Supplemental CSO Team Meetings

Session	Date	Meeting Content
1	March 21, 2017	Introduction, Infrastructure Overview for Separate and Combined Sewer Systems, Regulatory Background

Session	Date	Meeting Content
2	March 09, 2018	Review of Service Area, Program Progress, Next Steps
3	March 29, 2019	Development and Evaluation of Alternatives Report (DEAR) Review of Scenario Matrix
4	May 21, 2019	Distribution of Flyers for Combined and Separate Sewer Systems, Update on Green Team, Status of DEAR including Basis of Cost and Performance Considerations
5	June 17, 2019	Green Team Solutions Forum, DEAR Draft and Review Tool to be provided, Supplemental CSO Team Next Steps
6	December 18, 2019	Green Team Update, Refresher on DEAR Review Tool, Status of DEAR and SIAR, Supplemental CSO Team Next Steps
7	August 24, 2020	Green Team Update, CSO Refresher, Summary of LTCP contents, Next Steps in advance of submission.

The first meeting held in March 2017 introduced the initial members of the SCSO Team. Some general terms and acronyms were defined to set the groundwork for this session and future sessions. The Perth Amboy service area was reviewed with a map and statistics regarding the population, area served, miles of interceptor sewers and pumped flows. MCUA and PVSC were introduced as related permittees to Perth Amboy. CDM Smith was introduced as the lead engineering consultant. The purpose, expectations, and ground rules for the SCSO team were reviewed. An overview of separate and combined sewer systems was presented in a series of figures, and then a regulatory background was summarized related to the management of the combined sewer system and the LTCP in Perth Amboy. A brief review of the progress to date of the work completed for the previous and current permits was provided, along with a program schedule and milestones for future work to be completed.

The second meeting held in March 2018 included a brief recap of the previous meeting and review of the service area and related permittees. The three steps of the LTCP were presented, including the System Characterization, Development and Evaluation of Alternatives, and Selection and Implementation of Alternatives. An overview of the progress to date was discussed, which includes currently working towards the system characterization. Near term milestones were discussed which included System Characterization Report and Public Participation Process Report deliverables. The content of these reports was reviewed as well. Potential means of pre-screening locations for mitigation alternatives was discussed including green infrastructure and storage and treatment locations.

The third meeting held in March 2019 included a brief reintroduction and then a program progress to date, with a review of the program schedule and milestones and what has been completed and the near-term milestone of submitting the DEAR. The content of the DEAR was reviewed, and examples of CSO control alternatives were presented including green infrastructure, increased storage, increased treatment at the MCUA CTP, inflow/infiltration reduction, sewer separation, and treatment of CSO discharges. A matrix of scenarios and alternatives was presented as well. The fourth meeting held in May 2019 included a reintroduction and recap of the prior meeting. Distribution of flyers that explain combined and separated sewer systems was discussed. The status of the DEAR was discussed, including progress of the draft report and assignment of the five CSO groups. The CSO control objectives and the three general categories for alternatives screening were presented. Cost curves comparing CSO high rate treatment alternatives were presented and discussed related to the basis of cost and performance considerations. Cost curves comparing storage and high rate treatment were also presented and discussed. Preliminary costs were presented for high rate treatment and storage.

The fifth meeting held in June 2019 included an introduction, ground rules refresher, and prior meeting recap. The Green Team Solutions Forum to be held in June 2019 was discussed. The status of the DEAR was discussed including provisions for distribution draft report for SCSO team along with a Review Tool to assist the SCSO Team with their review. The Review Tool sections and content was presented and discussed. Next steps for the SCSO Team were presented, including that the SCSO Team review of the DEAR concurrent with the NJDEP review.

The sixth meeting held in December 2019 followed a similar format to previous meetings which included and introduction, ground rules refresher, and a prior meeting recap. Next, the DEAR review tool was gone over section by section summarizing the content of each section. The goal of the review tool is to provide a high level overview of the DEAR. If any topic should need to be reviewed in more detail, the review tool can be used to locate the relevant section in the DEAR to be referenced and reviewed. The status of the DEAR was then reviewed, including the dates for receipt of comment, responses provided, and approval. The due date for the SIAR was reviewed, along with the progress of the components of the report. Supplemental CSO Team next steps were reviewed and included getting comments on alternatives provided in the DEAR, prioritizing areas to be targeted for Green Infrastructure, and review of siting for satellite storage locations.

A seventh meeting was held remotely on August 24, 2020. This meeting served to present CSO refresher concepts from past meetings and to summarize the anticipated content of the LTCP for team members. The anticipate schedule to submit the LTCP was also discussed.

Feedback received by the SCSO team during the team meetings focused on the following:

- Clarifying the many aspects of the LTCP process and options discussed during the meetings
- Expressed desire to have LTCP elements be functional and resilient, and reflective of impacts due to climate change.
- Expressed interest in green infrastructure along with the understanding that a goal of reducing CSOs by 10% was likely reasonable.
- Further supported the LTCP goal of protecting the beach area as a sensitive area and its use for public bathing.
- Expressed desire to co-locate public amenities with CSO facilities to the greatest extent possible.

The City is committed to meeting with the Supplemental CSO team on a quarterly or near-quarterly basis moving forward. The anticipated meeting schedule for the upcoming year is as follows

- December 2020
- March 2021
- June 2021
- September 2021

As in the past, notice of the meetings will be coordinated to the identified members via email. Once the meeting date has been set, a notice will be posted to the City's website and at the City Clerk's office. Referrals to the City's Constituent Concern Form will be made at all future Supplemental CSO Team meetings, and references will be included on all postings to the City's website regarding the LTCP and postings at the City Clerk's office.

8.3 Public Input Opportunities

The City of Perth Amboy has collected public input on the development of the LTCP through City meetings open to the public such as City Council meetings, its engagements with the Supplemental CSO team, and feedback received through the engagement methods described in Sections 8.2, 8.5 and 8.8. The City recognizes the importance of offering residents of Perth Amboy the ability to comment on the potential infrastructure improvements and initial costs for these improvements. Perth Amboy's duty to provide transparency and raise awareness of the LTCP are vital to the rate payers and having appropriate forums for providing public comment will enhance the final selected alternative.

8.3.1 LTCP Progress Updates

Perth Amboy has developed LTCP Progress Updates through CSO Supplemental Team meetings, which are detailed in Section 8.2. CSO Supplemental Team meetings are the primary outlet for developing two-way communication for LTCP updates to the affected public and community stakeholders. In addition, Perth Amboy is able to discuss LTCP progress through the variety of collaborations that Perth Amboy has taken on through their Perth Amboy Green Team and Perth Amboy SWIM.

The City recognizes the need to consider meetings open to the public to educate rate payers on the development of the LTCP. Perth Amboy will consider appropriate junctures in the LTCP development for such public meetings and rely on feedback from the CSO Supplemental Team and other community stakeholders on the proper format for such meetings and types of messaging to convey to the affected and interested public. Municipal council meetings and other local governmental body meetings open to the public would be additional forums for presenting LTCP development to the public and gathering direct feedback.

It is envisioned that public meetings would occur in phases of the LTCP development when the LTCP alternatives have been defined, and the purpose of the meetings would be for the City to explain to the residents the potential costs, benefits and impacts of these alternatives. In addition, the purpose of the meetings would be for the City to explain how these alternatives would translate to potential rate increases in the future and the direct benefits to overflow reduction and potential flooding mitigation. There will potentially be two (2) public meetings with LTCP related topics. In the Spring of 2019, two (2) public meeting will be held to present the evaluation of alternatives and to seek attendees' preferences and concerns for the alternatives. In the

The public meetings were advertised on the City's website and via public announcements in local newspapers. The public meetings offered a way to communicate with residents and provide additional methods for collecting feedback from the public.

Presentations to the City Council and public attendees of the meetings were made as follows:

- July 10, 2019 – presentation included background on National CSO Policy, types of CSO controls, regulatory requirements, summary of Development and Evaluation of Alternatives analysis,
- July 8, 2020 – presentation included review of CSO basics, and the scale of anticipated program costs.

Progress updates to the public would be open sessions assessable to both CSO and non-CSO (i.e. separate sewer system) served communities. Discussions regarding the potential for reducing infiltration and inflow in separate sewer system portion of the service area as a means of freeing additional capacity in combined sewers could be discussed at these public meetings and considered within potential technologies as part of the LTCP development.

8.3.2 Public Feedback in Decision-Making Process

Perth Amboy has a robust network for collecting public comment including:

- Supplemental CSO Team Meetings;
- NJ CSO Group Meetings;
- Meetings with Perth Amboy Green Team, Perth Amboy SWIM and Perth Amboy Environmental Commission;
- City Council Public Meetings;
- Constituent Concern Forms via the City of Perth Amboy website; and
- Potential future meetings to present specific LTCP developments.

These opportunities for public comment are vital to aiding Perth Amboy officials of the existing issues and concerns from members of the community and will be tracked and documented within the final LTCP Report. The City will inform the residents of all these feedback mechanisms by making the information available on the City website and on the social media pages. For the Constituent of Concern Forms, a link will be made available on social media pages, the availability of the form will be communicated to the attendees of the City Council Public meetings, and all other methods of future engagement initiatives. Perth Amboy will group comments by type and jointly respond to types of public comment to explain how these community concerns are being addressed in the development of the LTCP. Do date, the City has not received any Constituent Concern Forms related to LTCP issues.

Additional planned future engagement initiatives that include methods for receiving feedback are discussed in Section 8.11 and include:

- Survey's provided following infrastructure tours;
- The Constituent Concern Form on the City's website; and
- Direct feedback from attendees of public meetings.

The LTCP has been discussed at two (2) City Council Meetings held on July 10, 2019 and July 8, 2020. In the future, LTCP topics will be added to the Agenda which is made available on the City's website ahead of the meeting. Meeting minutes will be recorded during the public meetings and any comments or feedback received will be compiled and considered in the LTCP process.

8.3.3 Public Review of Key Draft Submittals

The City makes all key draft submittals available for review at the Water Department offices. Currently, the City maintains copies of the following submittals: Discharge Monitoring Reports, Progress Reports, System Characterization Work Plan, Baseline Compliance Monitoring Work Plan, Map of combined and separated sewers, System Characterization Report, Public Participation Process Report, Compliance Monitoring Program Report, Consideration of Sensitive Areas Plan. There has been no interest in reviewing them thus far, but the City will make additional efforts to make the presence of the documents known to the affected public. The City will make copies available in the City' Clerk's office and indicate the availability of the reports on the City's website. The City will evaluate the possibility of making the reports available for download on the City's website. The timeline for distribution of future draft reports will closely follow the requirements of the City's NJPDES permit.

8.4 NJ CSO Group

The City of Perth Amboy is a member of the NJ CSO group. The group was formed as a cooperation in meeting the requirements of the CSO Permits that its members are addressing within the general NY/NJ Harbor Estuary region. This example of governmental partnership allows for members to utilize the collective resources and strengthens the overall consistency and quality of the deliverables required to meet CSO Permit requirements. The group consists of the member municipalities and municipal authorities identified in Table 8-3.

Table 8-3 - NJ CSO Group Membership

- City of Bayonne
- Borough of East Newark
- City of Elizabeth
- Borough of Fort Lee
- Town of Guttenberg
- Town of Harrison
- Jersey City MUA
- Town of Kearny
- North Bergen MUA – Central
- North Bergen MUA - Woodcliff
- City of Patterson
- City of Perth Amboy
- Village of Ridgefield Park
- Passaic Valley Sewerage Commission (PVSC)
- Middlesex County Utilities Authority (MCUA)
- Bergen County Utilities Authority (BCUA)
- Joint Meetings of Essex and Union County (JMEUC)
- North Hudson Sewerage Authority – Adams Street WRRF
- North Hudson Sewerage Authority – River Road WRRF

The NJCSO Group targets meeting on a quarterly basis. Member communities are invited to attend as well as NJDEP representatives and other organizations and members of the public. Topics discussed at the meeting are related to the development of the LTCP and discuss compliance matters and summarized in Table 8-4.

Table 8-4 - NJ CSO Group Discussion Topics

- Ambient Monitoring Program
- Ambient Modeling Program
- Sensitive Areas
- Supplemental CSO Team
- Financial Capability analysis
- Alternative Evaluation
- CSO Notification Website
- Water Quality Monitoring Program
- Receiving Water Quality Monitoring
- Typical Hydrologic Year

8.5 Community Outreach and Collaborations

There are several initiatives that Perth Amboy has undertaken to engage active citizen participation through collaboration with community organizations that has enhanced the development of the LTCP. In addition, the City has actively participated in a regional network of municipalities which are also developing CSO LTCPs.

The City of Perth Amboy has established a Green Collaborative, with a community-based green infrastructure initiative as a central component of this collaboration. The members of this collaboration include Perth Amboy SWIM, the citizen-led Perth Amboy Green Team, and the Perth Amboy Environmental Council. These three entities are working together to develop green infrastructure projects that reflect the community improvements that Perth Amboy are seeking. The collaboration leverages diversity of opinion and outreach networks of these organizations to educate and improve advocacy for green infrastructure and the importance of stormwater management issues in Perth Amboy. An overview of each organization is described below and a diagram of the roles of each partner is displayed in Figure 8-1.

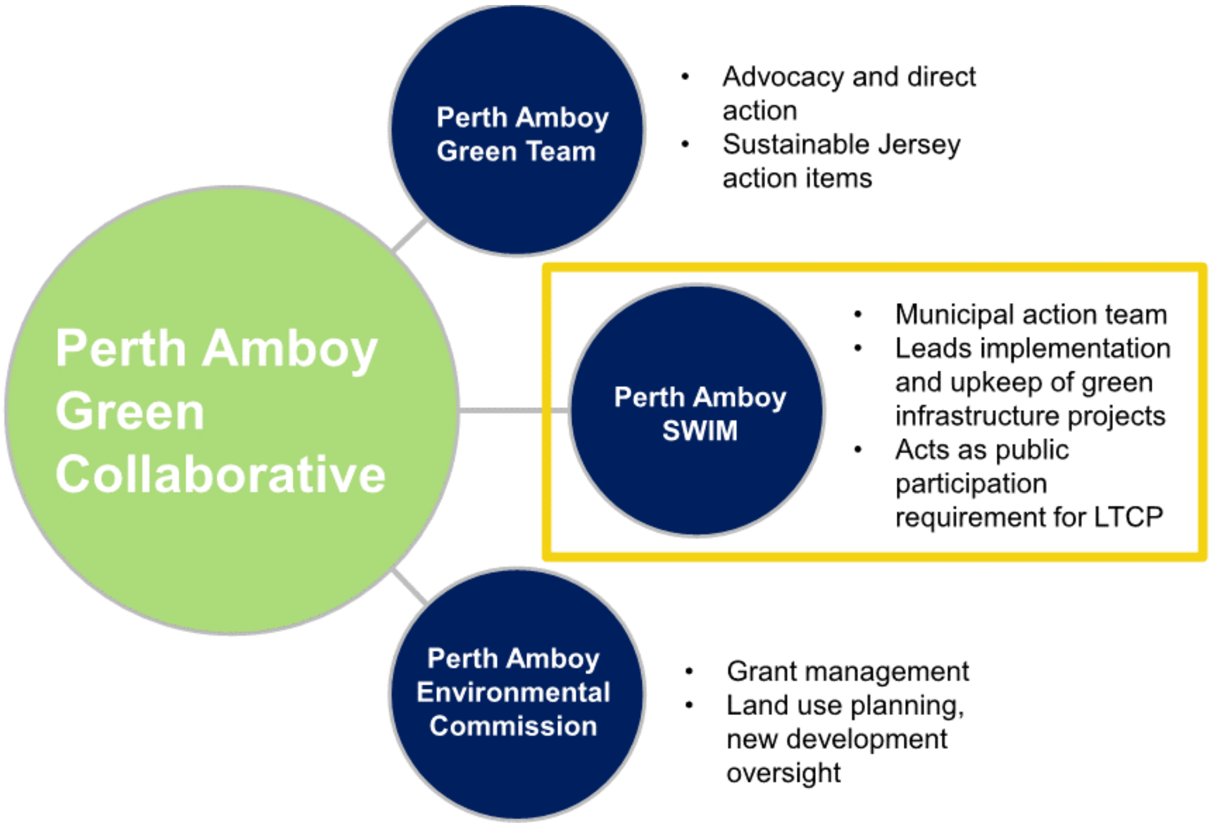


Figure 8-1 - Perth Amboy Green Collaborative Overview

Source: City of Perth Amboy and Rutgers Cooperative Extension

Perth Amboy SWIM is a collaboration of community members and stakeholders committed to improving the quality of life of residents by addressing combined sewer and stormwater pollution, flooding, and economic development through the strategic implementation of green infrastructure, educational programming and public outreach. The City of Perth Amboy is a partner with 10 other organizations, including NJDEP, to collaborate and implement green infrastructure projects within the City. SWIM has developed a Green Infrastructure Feasibility Study to document the potential for green infrastructure in the City and identifying locations for initial pilot projects, as displayed in Figure 8-3. SWIM has also implemented several green infrastructure projects within the community, and example in Washington Park is displayed in Figure 8-2.

Figure 8-2 - Perth Amboy SWIM Green Infrastructure Pilot Project in Washington Park
Source: City of Perth Amboy – Office of Mayor Diaz

The existing efforts of the Green Collaborative have been utilized in the development of the LTCP because green infrastructure has been considered during the development and evaluation of alternative step in the LTCP process as a method for reducing stormwater in the combined sewer systems. The community participants that are a part of the Green Collaborative have utilized their existing connections to communicate to the affected public to improve advocacy for green infrastructure and the importance of stormwater management issues in Perth Amboy.

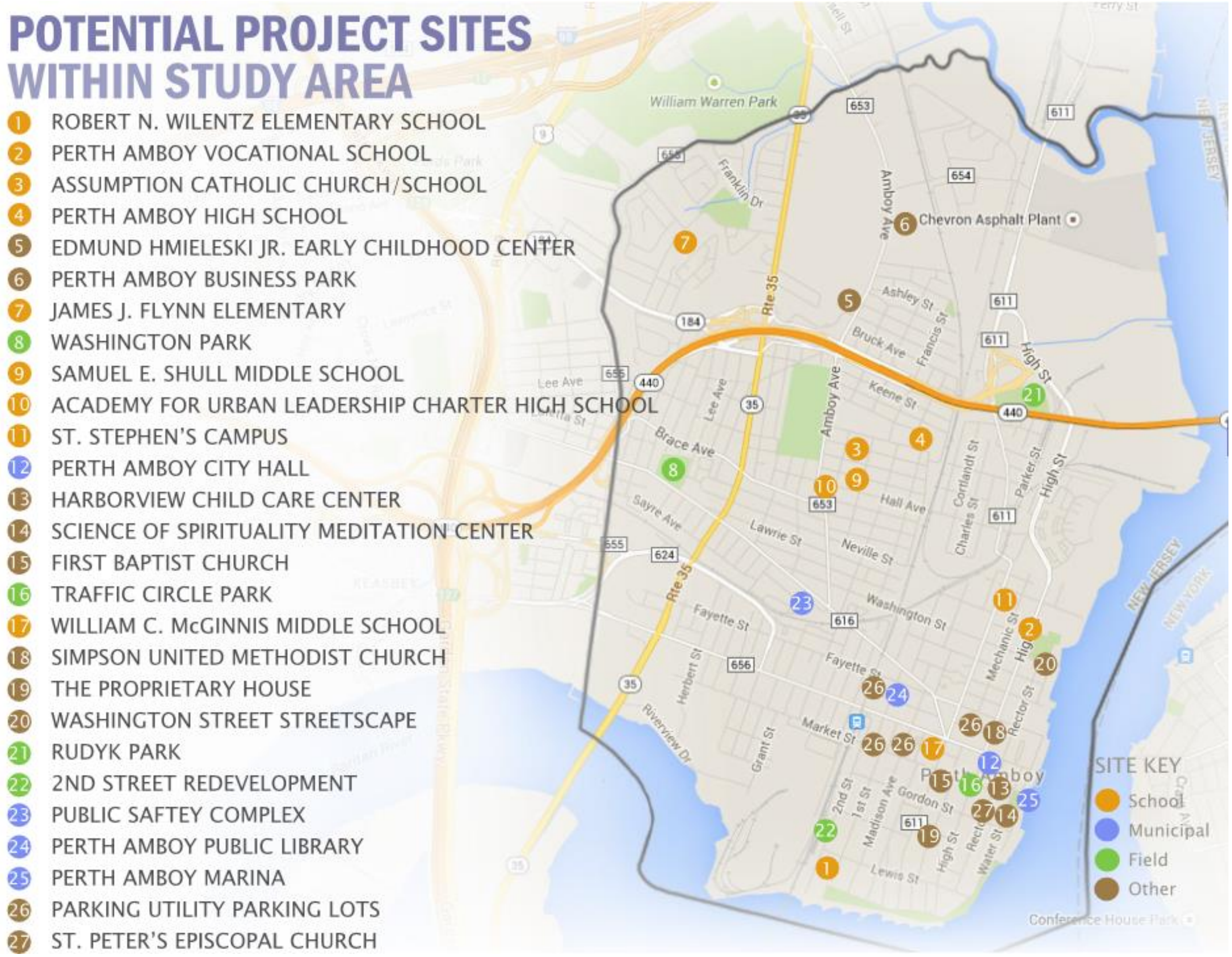


Figure 8-3 - Areas of Potential Green Infrastructure Projects (Perth Amboy SWIM)

Source: Rutgers Cooperative Extension Water Resources Program

8.6 Posters, Flyers, Brochures and Handouts

Targeted printed materials have been distributed by Perth Amboy and are related to the specific initiatives and the LTCP. The following are examples of materials distributed to residents and posted online for public education:

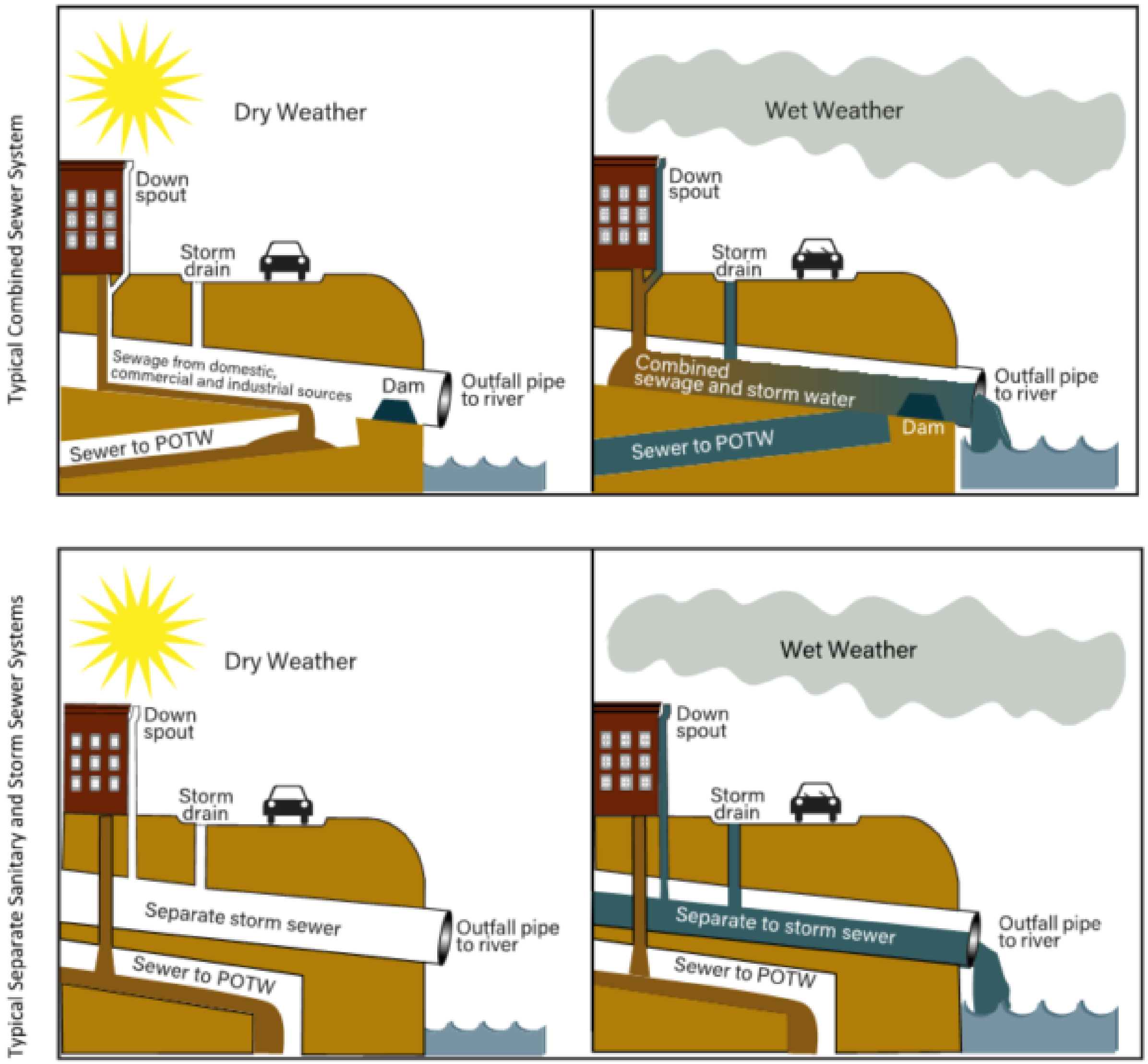
- The Perth Amboy Green Team, with assistance from the City, developed a community brochure discussing the benefits of green infrastructure, as displayed in Figure 8-4. Educating the affected public about the benefits of green infrastructure is directly related to the development of the LTCP because green infrastructure will be considered during the development and evaluation of alternatives for the LTCP.

Figure 8-4 - Green Infrastructure Informational Brochure - Perth Amboy Green Team

- Perth Amboy has worked with residents and business owners to promote awareness of proper disposal of fats, oils and grease (FOG) and the challenges which these substances create if they enter the sewer system. This outreach work was conducted through direct meetings with restaurants and other businesses that handle a large quantity of FOG materials, and also through informational handouts mailed to residential rate payers.

- Perth Amboy provided a handout that illustrates the difference between a combined sewer system and a separated sewer and stormwater system, shown in Figure 8-5. The handout is intended to educate the public about the combined sewer system in Perth Amboy.

What is the difference between a Combined Sewer System and Separated Sewer and Stormwater Systems?



POTW = Publically Owned Treatment Works

Figure 8-5 - Combined Sewer System Handout

The extent of the distribution of these materials has been focused on making copies available at City Hall as it the City's policy. Additional information regarding the LTCP will be added City's website under Sewer Department tab. We note the City's efforts to promote awareness of proper disposal of fats-oils-grease (FOG) have generally been effective.

The brochure developed by the Perth Amboy Green Team and future handouts will be placed in public locations, including the City Clerk's office, and will be made available on the City website for download.

8.7 Media Coverage and Press Release

In May 2016, Perth Amboy submitted a press release to announce its award of a Build It Green (BIG) Competition grant from New Jersey Future, in partnership with Re:Focus Partners and support of Geraldine R. Dodge Foundation and Robert Wood Johnson Foundation. This grant was awarded to fund engineering support services to design a green infrastructure project, the 2nd Street Greenway (Figure 8-6). The primary goal of this initiative is to improve stormwater management and reduce potential for combined sewer overflow. A secondary goal of this investment is to aid in improving the quality of life in Perth Amboy neighborhoods and create aesthetically inviting areas for conducting business. This latter goal will require direct outreach among Perth Amboy officials and property owners in areas adjacent to green infrastructure installations.

During the development and evaluation of alternatives and selection and implementation of alternatives steps in the LTCP process, Perth Amboy intends to develop press releases, engage with the local newspapers, and utilize the City's multi-lingual website to communicate community outreach opportunities to the affected public. The media can be utilized to advertise public meetings that include LTCP agenda items and help educate readers and listeners on the complex challenge of planning for the LTCP in Perth Amboy.

The development of the 2nd Street Greenway demonstrates direct outreach to the community to improve the final project design. City officials held a workshop to define community priorities that also went directly to the site to determine the impacts of the project on the surrounding neighborhood. A follow-up design alternatives workshop allowed for feedback on potential project options which enhanced the final design and strengthened community acceptance for the project. Perth Amboy had assistance with NJDEP officials for this project which also helped to educate all parties on the regulatory acceptance of green infrastructure designs. The lessons gained from this project will aid Perth Amboy in consideration for green infrastructure projects among the technologies considered for the LTCP alternatives analysis. Figure 8-6 is a graphic showing some of the design elements of the 2nd Street Greenway project.

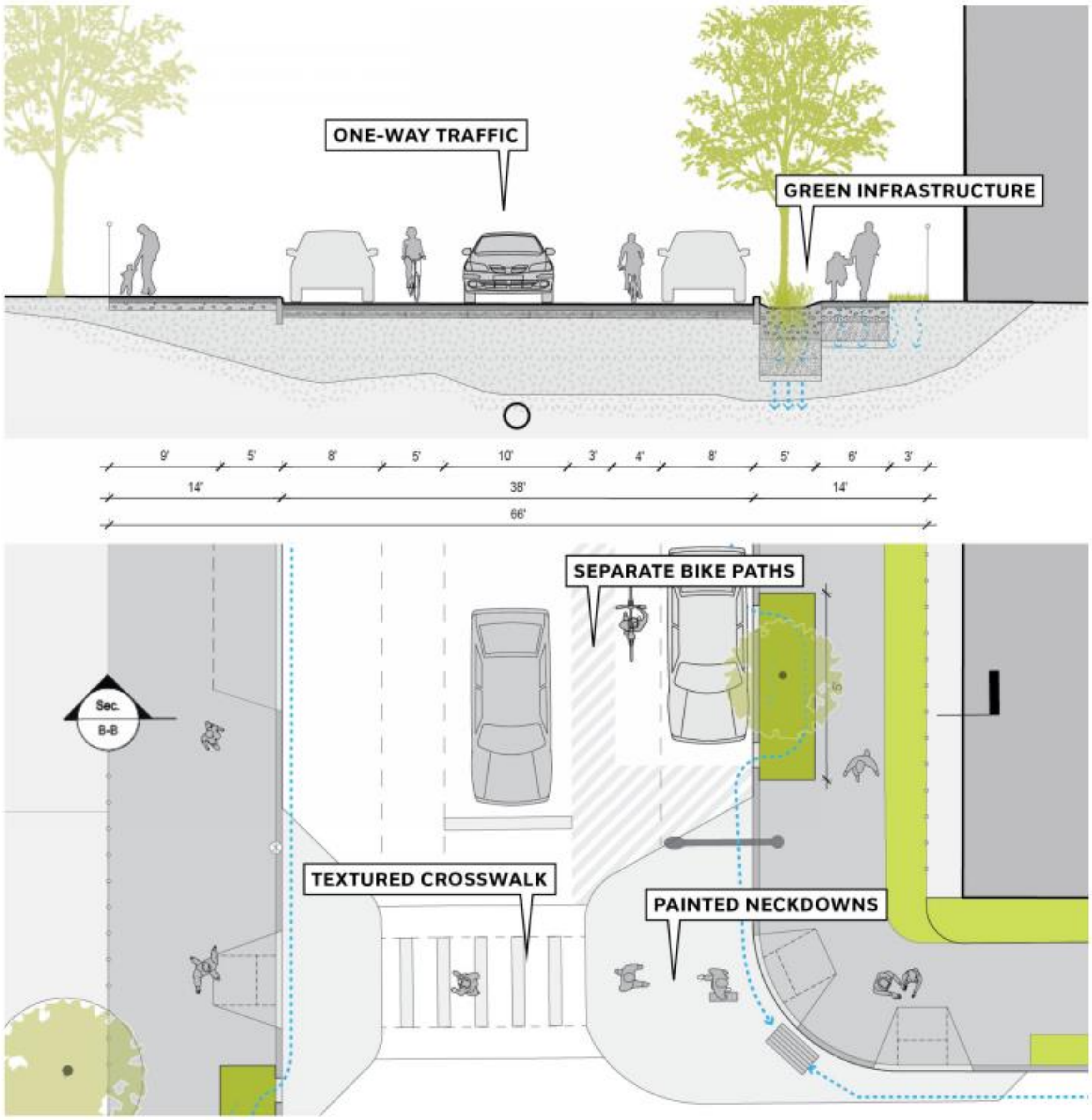


Figure 8-6 - Sample Design Elements of 2nd Street Greenway Project

Source: Small Cities with Big-City Infrastructure Problems, Re:Focus Partners, 2017.

8.8 Social Media and Websites

The City has also used their website, email, and partnering organizations to distribute general education and program notices. The City's website is an existing resource for Perth Amboy information and can also be utilized to provide links to partnering organizations websites. It is the City's goal to utilize the website as a central hub of information for progress updates and details of the LTCP.

The City has made updates to their website to include a separate link for the Water and Sewer Department https://www.perthamboynj.org/government/departments. This page now also includes a link to a page that has information about the Long Term Control Plan (LTCP). On this page, there is a link to the CSO Notification System and water quality mapping. Additional discussion of this is included in Section 8.10.

8.9 CSO Identification Signs

The City has developed educational signage for areas along the waterfront to educate the public on CSO issues and signage to accompany green infrastructure projects to showcase the functionality of the visible stormwater infrastructure. This method was selected because it is directly available to the public that frequents and is active along the waterfront and areas that are implementing green infrastructure projects. The signage includes the City website address with directions on how to submit a Constituent Concern Form (https://www.perthamboynj.org/community/online_forms/constituent_concern_form) if there are additional questions or concerns that the public has regarding the CSO issues and green infrastructure projects with a goal to provide another way for receiving feedback from the affected public.

8.10 CSO Notification System

The website https://njcso.hdrgateway.com/ is intended to satisfy the NJDEP requirement that communities notify the public when and where CSOs may be occurring as a result of wet weather.

This web site applies computer models and information about recent rainfall to determine whether CSOs may be occurring in the NJCSO Group municipalities. The following provides a detailed description about how this process works.

8.10.1 Determining if a CSO May Be Occurring

Each of the municipalities that participates in this CSO Notification web application owns a computer model of its sewer collection system (that is, the drainage and piping systems that convey rainfall runoff and sanitary sewage to a sewage treatment plant). These models can be used to determine how the sewer system responds to a particular rainfall pattern.

Because it takes time to set up and run these computer models, it is not practical to use them to simulate a storm that is in progress. However, by setting up and running the models for a series of different rainfall conditions ahead of time, we can develop a good understanding of what rainfall conditions do and do not cause CSOs. The model results generated in this way can be used to develop a “rule curve” to define how much rain is required over a given length of time to potentially cause a CSO at a particular regulator. A graphical example of a rule curve is shown in Figure 8-7.

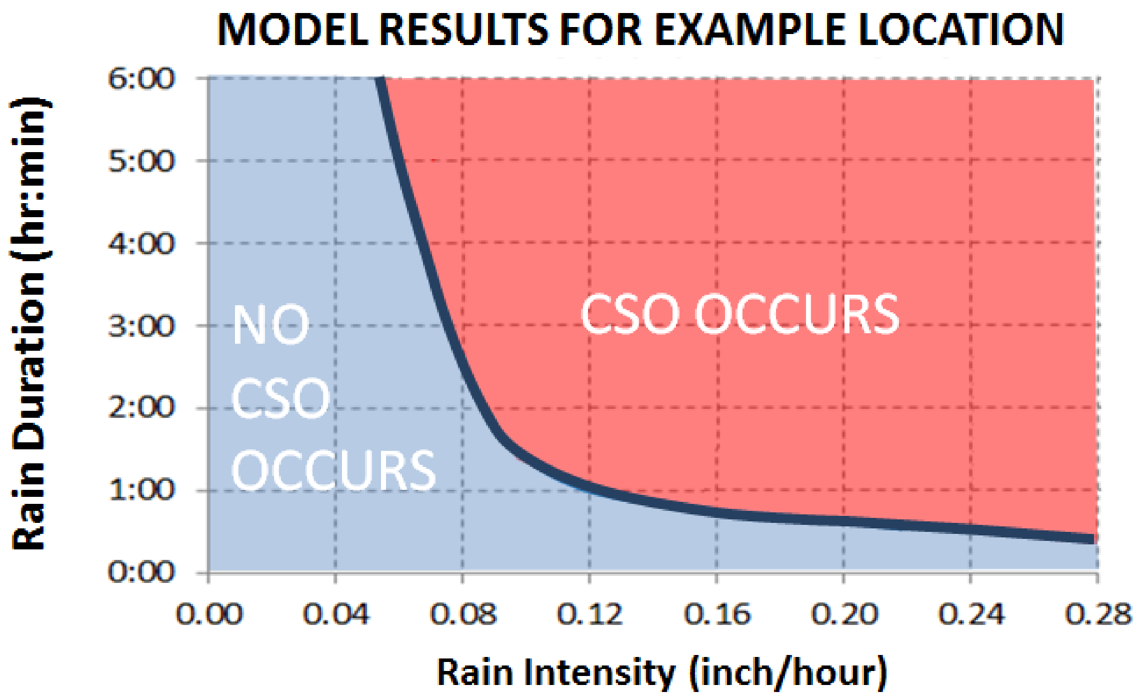


Figure 8-7 - CSO Notification Website CSO Rule Curve

To assess if a CSO is likely to be occurring at a given time from a particular regulator, the rainfall measured over that regulator's drainage area is compared to the rule curve for that regulator. If the measured rainfall exceeds the threshold defined by the rule curve, then a CSO is likely to be occurring; if not, then a CSO is unlikely to be occurring. To ensure that current and recent rainfall conditions are accounted for, rainfall measured over the most recent hour, the most recent two (2) hours, the most recent three (3) hours, and so on up to the most recent nine (9) hours, are compared to the thresholds associated with the same intervals from the rule curve. If measured rainfall during any of these intervals is found to meet the CSO threshold from the rule curve, then a CSO is likely to be occurring at this location; otherwise, a CSO is not likely to be occurring at this location.

8.10.2 Illustrative Example

The following provides an example step-by-step procedure to determine if a CSO may be occurring at the location associated with the rule-curve graphic shown above:

1. Identify the 1-hour threshold: Find the 1-hour duration on the y-axis and move to the right to the curve, then move down to find the corresponding rainfall value on the x-axis (0.12 inches/hour).

2. Compare the actual rainfall to the threshold: If the actual rainfall over this regulator area was 0.12 inches or more over the last hour, then a CSO is likely (and we can **EXIT** the loop); otherwise, we know that the most recent hour of rain, by itself, was insufficient to cause a CSO. However, we still need to check if there was enough rain prior before the most recent hour to cause a CSO, so we go to the next step.

3. Identify the 2-hour threshold: Find the 2-hour duration on the y-axis and move to the right to the curve, then move down to find the corresponding rainfall value on the x-axis (0.09 inches/hour). Because this interval is 2 hours, the threshold amount of rainfall is 0.18 inches (= 2 hours x 0.09 inches/hour).

4. Compare the actual rainfall to the threshold: If the actual rainfall over this regulator area was 0.18 inches or more over the last 2 hours, then a CSO is likely (and we can **EXIT** the loop); otherwise, we know that the most recent two hours of rain, by itself, was insufficient to cause a CSO, but we still need to check if prior rain is sufficient to cause a CSO, so we go to the next step.

5. Repeat the above steps to increase the interval length by one hour, until we get to an interval for which the actual rainfall meets or exceeds the CSO threshold, indicating a CSO is likely (and we can **EXIT** the loop). If we get through all intervals for which a defined CSO threshold exists (rules at some regulators extend to longer intervals than at other regulators) without meeting a CSO threshold, ***CSO is not likely to be occurring at this location.***

8.11 Future Public Participation

As the LTCP development advances, Perth Amboy is committed to finding new ways to reach out to rate payers and improve awareness of the cost and scope of potential infrastructure improvements. The City will need to consider which engagement efforts will be most effective for communicating to the community and will seek guidance through the Supplemental CSO Team. Areas where the City can improve awareness in the future include the following methods. A description of why the methods were selected and desired outcomes for each method are included.

- Developing public tours to highlight infrastructure issues and ways that Perth Amboy is making improvements and requesting feedback from attendees with post tour surveys. This method was selected to provide a method of face-to-face communication with the affected public. The goal will be to provide additional information on complex issues in a setting that will illustrate issues concisely and provide another way to receive direct feedback from those that attend the tours.

- For the Constituent of Concern Forms, a link will be made available on social media pages, the availability of the form will be communicated to the attendees of the City Council Public meetings, and all other methods of future engagement initiatives. Perth Amboy will group comments by type and jointly respond to types of public comment to explain how these community concerns are being addressed in the development of the LTCP. Do date, the City has not received any Constituent Concern Forms related to LTCP issues.

- Utilizing public meetings to engage the public prior to major submittals for the LTCP Process. Meetings will be schedule prior to the submittal of the Development and Evaluation of Alternatives and Selection and Implementation of Alternatives. The meetings will be publicized through mailings, media advisories and the Perth Amboy City website. The schedule and agendas for these meetings will be made available on the City's website.

This method of public outreach was selected because it is a face-to-face communication method that will allow for direct feedback from the affected public, community groups, and other stakeholders.

The items highlighted in this section are among the more common engagement methods that Perth Amboy is considering for improving public awareness. The City will continue to develop its strategy of engagement based on the feedback received from the Supplemental CSO Team and public comment that comes to the City officials at public meetings.

Section 9

Selected Long Term Control Plan

9.1 Introduction

The approved Development and Evaluation of Alternatives Report (DEAR) for the City and MCUA presented a variety of control strategies that would result in the system-wide capture and treatment of 85% of wet weather flows to the combined sewer system during a Typical Year while also providing for 2 overflows per year along the beach area (CSO Group 3 location). For this SIAR, the City and MCUA have refined their control strategies and are proposing a long-term control program that will result in meeting the 85% volume capture performance target as described in the DEAR.

9.2 Selected Long Term Control Program Overview

The selected Long Term Control Plan represents an integrated plan that will be implemented as two separate programs overseen separately by the City and MCUA.

9.2.1 Overview

The selected long-term control plan program elements that are the responsibility of the City consists of seven (7) program elements that will have phased implementation schedules (detailed in Section 10). The elements of the program are:

1. Sewer Separation – the City plans to continue to pursue sewer separation as has been its practice moving forward. For the purpose of the LTCP, we have assumed the sewer separation will target a total of 8 acres over a 40-year period.

2. Green Infrastructure – we anticipate a planning and design period for the first 2 years, then implementation program for the remaining 38 years. The target coverage of Green Infrastructure is 46.8 acres or 10% of the directly connection impervious area within the City.

3. Second Street Pumping Station and Force Main to MCUA – to provide direct conveyance from the Second Street Pumping Station to MCUA, the LTCP includes planning, design, and construction of a single 24-inch diameter force main to connect the City directly to the MCUA influent headworks. The City will coordinate with MCUA throughout the planning, design, and construction phases of this program element.

4. CSO Group 4 and 5 (CSO P-017 and P-019) – improvements at CSO Group 4 and 5 include the planning, design, and construction of satellite storage that can allow for CSO flows from these locations to be conveyed to MCUA at a reduced rate over a longer period of time, and allow the Second Street Pumping Station to maintain a peak pumping rate of 13.6 mgd.

5. CSO Group 3 (CSO P-009 to P-016) – improvements at CSO Group 3 include the planning, design, and construction of satellite storage that can allow for CSO flows from these locations to be conveyed to MCUA at a reduced rate over a longer period of time, and allow the Second Street Pumping Station to maintain a peak pumping rate of 13.6 mgd.

6. CSO Group 1 (CSO P-002) – improvements at CSO Group 1 include the planning, design, and construction of a high rate treatment facility in and around Rudyk Park.

7. CSO Group 2 (CSO P-003 to P-008) – improvements at CSO Group 2 include the planning, design, and construction of consolidation sewers high rate treatment facilities to serve CSOs discharging to the Arthur Kill.

8. Treatment Plant Expansion – no expansion of the MCUA facility is planned as part of this LTCP. However, the MCUA has been working with all participant connected sewer systems in their service area to maximize available flow capacity at the CTP.

9. Infiltration and Inflow Reduction – infiltration and inflow will be considered by the City as part of the ongoing sewer separation projects. Refer to discussion included in Section 5.2.4. The MCUA has a program in place to encourage its Participants to reduce excessive Infiltration and Inflow (I/I) from entering their locally owned collection systems. For example, the MCUA has received I/I reduction plans outlining short and long term goals, along with periodic I/I progress reports from participants experiencing excessive I/I in their locally owned collection systems.

9.2.2 Plan Element 1 – Sewer Separation

Plan Element 1 will be the responsibility of the City.

The City has historically tried to have at least one sewer separation project (which sometimes includes cured-in-place-pipe rehabilitation) ongoing at any one time. This effort most recently involved sewer separation in the vicinity of State Street, James Street, Parker Street and the Outer Bridge Crossings and also includes areas off State Street from Pulaski Avenue to Maurer Road. The City plans to continue these and similar efforts into the future and anticipates no issues in achieving the sewer separation and sewer rehabilitation anticipated in this plan.

The LTCP estimates a minimum of 8 acres of currently combined sewer system will be separated over the life of the plan. This area corresponds to a sewershed just downstream of the Front Street Pumping Station that contributes runoff directly to the Eastside Interceptor along the beach.

9.2.3 Plan Element 2 – Green Infrastructure

Plan Element 2 will be the responsibility of the City.

Based on a GIS analysis, there is a total of 468.1 acres of directly connected impervious area (DCIA) within the City of Perth Amboy. The City is targeting implementation of green infrastructure for 10% of that area, or 46.8 acres over the life of the LTCP. The City will target implementation of these green infrastructure improvements in 1 or 2 year timeframes likely to be coincided with permit cycles.

The City anticipates the Green Infrastructure installations will be located in any of the four (4) previously proposed study areas (*Planning and Technical Support for Incorporating Green Infrastructure in Long Term Control Plans*, by eDesign Dynamics, Oct, 2018). Two of the areas were studied in detail in the report and were identified as the Washington Park Study Area and Downtown Study Area.

The Supplemental CSO Team has also indicated a desire for the City to focus on priority areas such as the following:

- Willow Pond/Little League Field parking areas;
- Waterfront Park;
- Sunshine Alley;
- Green space between Madison Avenue and the Robert N. Wilentz School;
- Perth Amboy Train Station;
- Bioswales or tree pits;
- Old Firehouse Facility – porous pavements

9.2.4 Plan Element 3 – Main Pumping Station and Force Main to MCUA

Plan Element 3 will primarily be the responsibility of the City, and coordination with MCUA will be required.

Plan Element 3 consists of a new Main Pumping Station at Second Street and a new dedicated force main to convey wastewater directly to MCUA.

A new direct force main can be constructed to convey flow to the CTP from Perth Amboy, directly from the Second Street Pumping Station in Perth Amboy to the CTP (approximately 2 miles in length). This would be installed by horizontal directional drilling (HDD) under the Raritan River. The feasibility of this option, particularly related to the subsurface conditions along the route as well as legal and access rights, will be further investigated as part of the planning phase for Plan Element 3.

For this Plan Element 3, Perth Amboy would pump CSS flows directly to the MCUA up to a maximum instantaneous flow of 13.6 MGD, the flow would be directed to a new receiving chamber at the MCUA CTP to be connected to the existing headworks and receive full-treatment.

9.2.5 Plan Element 4 - CSO Group 4 and 5

Plan Element 4 will be the responsibility of the City and includes the construction of satellite storage at CSO P-017 to P-019

Plan Element 3 (CSO Group 4 and 5) consists of planning, design, and construction of satellite storage facilities to be located in the vicinity of CSO P-017 (Sheridan Street) with an approximate size is 0.9 million gallons and in the vicinity of CSO P-019 (Smith Street) with an approximate size of 3.1 million gallons.

9.2.6 Plan Element 5 – CSO Group 3

Plan Element 5 will be the responsibility of the City and includes the planning, design, and construction of satellite storage at CSO P-009 through P-016.

Plan Element 5 (also referred to as CSO Group 3) consists of storage and pumping facilities to be constructed in an around the existing Main Pumping Station (aka Second Street Pumping Station) and Sadowski Parkway, along the beach area. The storage facility has an approximate volume of 7.8 million gallons.

9.2.7 Plan Element 6 – CSO Group 1

Plan Element 6 will be the responsibility of the City.

Plan Element 6 (CSO Group 1) includes planning, design, and construction of high rate treatment in and around CSO P-002 located in Rudyk Park. The high rate treatment facility will have a peak flow rate of approximately1.2 mgd.

9.2.8 Plan Element 7 – CSO Group 2

Plan Element 7 will be the responsibility of the City.

Plan Element 7 (also referred to CSO Group 2) includes planning, design, and construction of high rate treatment in and around CSO P-003 (Buckingham Ave), P-004 (Washington St), P-005 (Commerce St), P-006 (Fayette St), and P-007 (Smith St), and P-008 (Gordon St). Each of these CSOs discharges to the Arthur Kill with and has a limited service area. We anticipate a combined level of treatment of 1.3 mgd.

9.2.9 Plan Element 8 – Treatment Plant Expansion and Storage

Based on an evaluation conducted for the MCUA CTP in the DEAR, the CTP expansion alternative represents the most complex, costly and disruptive to plant operations alternative. Therefore, this alternative is not being considered further.

Since it is determined that the City would convey up to 13.6 MGD maximum instantaneous flow rates to MCUA CTP, the alternatives for MCUA CTP Storage or HRT are not applicable and therefore, are not evaluated further.

9.2.10 Plan Element 9 – Infiltration and Inflow Reduction

Plan Element 9 will be the joint responsibility of the City and MCUA.

As discussed in the DEAR, since the majority of the City's system is combined, infiltration and inflow reduction efforts will have a very minimal impact on CSO flows. Therefore, the City will only consider them in a limited way in the context of sewer separation which the City intends to pursue throughout the LTPC implementation program.

The MCUA has been working with all participant connected sewer systems in their service area to maximize available flow capacity at the CTP. The MCUA has a program in place to encourage its Participants to reduce excessive Infiltration and Inflow (I/I) from entering their locally owned collection systems. For example, the MCUA has received I/I reduction plans outlining short- and long-term goals, along with periodic I/I progress reports from participants experiencing excessive I/I in their locally owned collection systems.

The MCUA has allocated the necessary funding for several capital projects to address I/I by relining 14,000 feet of Main Trunk Sewer (MTS) and 2,000 feet of Meter Chamber connections. Stop logs were replaced with slide gates and operators at eight locations throughout the system to maximize flow capacity at the CTP. To date, over $14 million has been dedicated to relining and rehabilitation of their MTS (MTS Phase I and MTS Phase II).

MCUA is currently coordinating the design for Phase III rehabilitation of approximately 4,400 feet of the MTS as well as several siphons, meter chambers and connecting gravity sewer pipes with an estimated construction cost of $12.5 million. The design of the final phase of rehabilitation for the remaining MTS is planned for 2022 with estimated costs projected to $10-$15 million. In total, the MCUA is expected to commit $36-$41 million to rehabilitate their MTS, significantly reducing I/I within these sections and maximizing available flow capacity at the CTP.

MCUA plans to continue this I/I Program as described in Section 5.2.5.

9.3 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 include:

- Capital Costs - Construction costs – based on reference cost curves, technical guidance manual, past project experience, and specific technology cost estimates. These planning level costs include a contingency allowance of 50% (inclusive of general conditions, contractor overhead and profit, legal costs, administrative costs, permitting costs, and overall cost contingency), and an engineering allowance of 20% (inclusive of planning, design, and construction management services). Capital costs do not include land acquisition, unstable subsurface conditions, rock excavation, soil remediation, or other unforeseen or unanticipated or site-specific conditions.

- 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. These costs were used to develop the 20-year present value of any given selected alternative.

- The costs may be indexed to the Engineering News Record (ENR) Construction Cost Index (CCI) for July 2020, with value of 11,439.

Table 9-1 - Summary of Program Costs

Implementation sequence	Items		Cost ($Million)
Duration	Sewer Separation Capital – 8 acres		$2.40
Duration	Green Infrastructure Capital		$18.26
Duration	Green Infrastructure 20-yr Present Worth O&M		$1.60
1	Main PS & FM (13.6 mgd and 1 24-in FM)	Capital Cost New Pumping Station 13.6 MGD Capacity	$10.75
		Capital Cost 1 New 24-inch Force Mains	$24.29
		Total Capital	**$35.05**
		20-year Present Worth O&M Pumping Station	$2.73
		20-year Present Worth O&M Force Main	$6.17
		Total 20-year PW O&M	**$8.89**
		Sub Total	**$43.9**
2	CSO Group 4 and 5 (CSO P-017 & P-019)	Capital Cost Regulator Modifications (1) P-017	$0.05
		Capital Cost Surface Storage Tank CSO Group 4	$17.23
		Land Acquisition CSO Group 4	$0.80
		Capital Cost Surface Storage Tank CSO Group 5	$48.24
		Land Acquisition CSO Group 5	$2.76
		Total Capital	**$69.09**
		20-year Present Worth O&M Surface Storage Tank CSO Group 4	$1.00
		20-year Present Worth O&M Surface Storage Tank CSO Group 5	$1.72
		Total 20-year PW O&M	**$2.72**
		Sub Total	**$71.8**
		Additional Annual Volume to MCUA CTP (MG)	*59.9*
3	CSO Group 3 (CSO P-009 to P-016)	Capital Cost Regulator Modifications (7) P-009, 010, 011, 013, 014, 015, 016	$0.35
		Capital Cost Deep Storage Tunnel CSO Group 3	$155.6
		Capital Cost Consolidation Sewer CSO Group 3	$21.3
		Land Acquisition CSO Group 3	$3.2
		Total Capital	**$180.4**

Implementation sequence	Items		Cost ($Million)
		20-year Present Worth O&M Surface Storage Tank CSO Group 3	$9.53
		20-year Present Worth O&M Consolidation Sewer CSO Group 3	$5.41
		Total 20-year PW O&M	**$14.9**
		Sub Total	**$195.4**
		Additional Annual Volume to MCUA CTP (MG)	*148.0*
4	CSO Group 1 (CSO P-002)	Capital Cost FlexFilter CSO Group 1	$3.99
		Land Acquisition CSO Group 1	$0.07
		Total Capital	**$4.05**
		20-year Present Worth O&M FlexFilter CSO Group 1	$0.38
		Total 20-year PW O&M	**$0.38**
		Sub Total	**$4.4**
5	CSO Group 2 (CSO P-003 to P-008)	Front St PS modification - Limit PS flow to 3.5 MGD	$0.10
		Capital Cost Regulator Modifications (1) P-003	$0.05
		Capital Cost FlexFilter CSO Group 2	$6.79
		Capital Cost Consolidation Sewer & New Outfall CSO Group 2	$25.10
		Land Acquisition CSO Group 2	$0.07
		Total Capital	**$32.11**
		20-year Present Worth O&M FlexFilter CSO Group 2	$0.38
		20-year Present Worth O&M Consolidation Sewer & New Outfall CSO Group 2	$6.37
		Total 20-year PW O&M	**$6.78**
		Sub Total	**$38.8**
	Total		**$377 million**

Section 10

Implementation Schedule

10.1 Background

Section to summarize project lists, costs, and schedule milestones. Describe regulatory requirements and scheduling factors considered.

10.2 Scheduling Criteria and Assumptions

The implementation of CSO controls by the City of Perth Amboy will require a long-term commitment of scarce financial resources. However, the City realizes the reduction of CSOs also presents an intergenerational opportunity to serve as a catalyst for sustainable redevelopment and growth in the City of Perth Amboy.

The implementation scheduling strategy proposed in this SIAR has been is informed by the following:

- The City will focus initially on projects that will serve to reduce overflows through the implementation of green infrastructure and sewer separation. The restoration of hydraulic capacity and limitation of CSO will be revisited on the completion of these initial program to refine the size of storage and HRT facilities.

- The complete implementation of the CSO control strategy presented in this SIAR will span decades; and will be implemented in the midst of changes and uncertainties. Therefore, ongoing performance monitoring and adaptive management will be required to adjust the control program to match available resources of the City.

10.2.1 Sensitive and Priority Areas

The City of Perth Amboy has identified the CSO Group 3 (CSO P-009 through P-016) along the beach defined generally by Sadowski Parkway as a sensitive area. Prioritizing this area includes implementation of controls for CSO Group 4 (CSO P-017 Sheridan St) and CSO Group 5 (CSO P-019 State St).

10.2.2 Sequencing and Phasing

The implementation schedule will synchronize projects, milestones and activities to coincide with the five year NJPDES permit cycles.

10.2.3 Financial Impacts

The projected costs to fully implement the CSO control strategy are far greater than the financial resources currently available to the City of Perth Amboy.

10.3 Financing Plan

10.3.1 Program Costs and Spending Projections

The City of Perth Amboy has identified over $350 million in improvements. These improvements have been scheduled out over a 40-year time horizon.

The long term CSO control planning process set forth in the NJPDES permits is based on the logical progression from system characterization to a broad evaluation of control alternatives to the selection of the optimal control strategy for a given permittee. Included in this process is a consideration of the impacts of the long term controls on ratepayer affordability and on the permittee's financial capability to finance the controls. Per the USEPA CSO Control Policy, these financial factors serve to inform the setting of the implementation schedule for the long term controls.

The logic of the long term control planning process is challenged when as documented in Section 7, the affordability of CSO controls for the City is limited. There is a gap between the estimated costs of the selected long term control program and the economic and financial resources of the residents and City.

10.3.2 Expenditure Schedule

Assuming no impact to the City's finances due to the COVID-19 pandemic, the anticipated expenditure schedule as presented in Section 5.5 would approximate that shown in Table 10-1.

Table 10-1 - Anticipated LTCP Expenditure Schedule

Description	Yr1-5	Yr5-10	Yr10-15	Yr15-20	Yr20-25	Yr25-30	Yr30-35	Yr35-40
Anticipated LTCP expenditures (1)	$10.66	$32.64	$50.66	$85.99	$108.80	$3.51	$19.26	$12.84

(1) Includes costs for capital costs for Planning, Design, and Construction only and do include O&M.

10.3.3 Sewer Rate Analysis

Assuming no impact to the City's finances due to the COVID-19 pandemic, the anticipated sewer rate increase is as presented in Section 7.5. The anticipated sewer rate increases are:

Table 10-2 - Anticipated Sewer Rates

Description	FY 2020	FY 2030	FY 2040	FY 2050	FY 2060
Estimated Household Bill	$330	$540	$1,087	$1,573	$1,383

10.3.4 Program Funding Strategy

The City will likely have to utilize a variety of approaches in order to fund the LTCP program. They are described below.

10.3.4.1 Alternative Implementation Schedules

The base case affordability / financial capability assessment assumes a 40 year implementation schedule based on typical durations for facilities planning and design of 3 years, and a typical construction timeframe of 4 years.

The assumed start date for the implementation program is based on the submittal and approval of the SIAR in 2020 and coincides with the effective date of the next NJPDES permit. The impacts of extending this implementation period has been evaluated. The impacts of extending the implementation schedule will depend on the aforementioned impacts to revenue, household income, and inflation as they relate to the residential indicator.

In order to achieve some level of affordability, the City has already lengthened the implementation to a forty (40) year period. If as is assumed in the base-case affordability model that costs will continue to outpace income growth, affordability decreases as the implementation period is extended. Obviously, if inflation is not included in the analysis, extending the implementation period will improve affordability. However, even with an implementation period set to 40 years, the residential indicator for this City is anticipated to rise above the high burden threshold between 2040 and 2050.

10.3.4.2 External Funding Needs

A meaningful CSO control program is marginally feasible in the near term for the City. Uncertainties regarding the economic condition and financial resources of the residents and the City call into question the ability of the City to fund the overall program for its anticipated duration without either a significant reduction in capital costs through the reduction in the targeted level of controls or through external funding that would effectively reduce the capital expenditures by the City. It has been demonstrated in Section 6 (cost and performance considerations) that a Presumption based control strategy targeting 85% control of Typical Year wet weather is the least-cost path towards compliance with the performance metrics in the CSO Policy and in the NJPDES permit. Therefore, the path forward must include significant external funding through the State of New Jersey or through a yet to be promulgated federal funding program.

10.4 Factors that Could Affect Implementation Schedule

10.4.1 Easements and Land Acquisition

Most facilities are located on City owned property or paper streets within the right-of-way.

A single satellite storage facility is tentatively sited at the intersection of Smith Street and Convery Boulevard. This location will require coordination with NJDOT.

10.4.2 Impacts of Inflation

The 1997 USEPA guidance document on affordability and financial capability assessment does not account for inflation beyond bringing older cost or income data to the current year. This simplification eliminates the need to project economic trends such as household income or construction costs. As a result, if the potential effects of inflation are not considered, the affordability of long term CSO controls can be overstated. Nationally, the growth in the cost of wastewater services have outpaced the growth in household incomes.

Obviously, the future rates of inflation cannot be known. Therefore, the scope and schedule for implementing the long term control program outlined above will need to be based on iterative re-evaluations of affordability and financial capability under the adaptive management process detailed in Section 10.6 of this document. This adaptive management strategy will include empirical triggers for reconsidering the type, scale and scheduling of control elements within the context of interim targets to be established in future NJPDES permits.

10.5 Construction and Financing Schedule

Part IV Paragraph G.8(a) of the NJPDES permits requires the submittal of a Construction and Financing Schedule as an early long term control program deliverable to NJDEP. Due to the financial constraints facing the City, the scope of this document will need to be broadened into a comprehensive program financing and funding strategy that addresses, from a financial perspective, what the City can accomplish within a reasonable timeframe.

Developing a workable funding strategy will require a partnership between the City, MCUA, NJDEP and likely other state and regional agencies such as the New Jersey Department of Community Affairs and Department of Transportations. Related agencies such as Middlesex County will likely also play a role in helping to leverage any County road and highway projects to support green stormwater infrastructure or sewer separation coincident with road work.

State Programs beyond the New Jersey Clean Water Revolving Loan Program that target low income areas, transportation or economic redevelopment potentially could be leveraged with specific CSO projects, e.g. coordinating local sewer separation with the water and sewerage needs of a redevelopment or roadwork project. In addition, new state legislation and appropriations actions may be required by the State Legislature. These could be pursued with and through NJDEP and the other New Jersey combined sewered municipalities and authorities.

Current federal funding for public water and wastewater systems is limited pending new Congressional action on infrastructure programs. Existing programs such as the Water Infrastructure Finance and Innovations Act (WIFIA) – which provides loans from the US Treasury Department (Administered by USEPA) are likely of limited applicability to the City. In the past Congressional appropriations to the US Army Corps of Engineers Civil Works funding through Sections 219 and 206 of the Water Resources Development Act have been used successfully in other regions towards CSO control funding.

While current federal funding is not robust, it is apparent that longer term strategic investments in the nation's infrastructure are being considered. To the extent possible, opportunities to include CSO work as it applies to New Jersey should be considered as part of these efforts. Previous successful examples include Rouge River Program in the Detroit area and the 3 Rivers Wet Weather Program (Pittsburgh) which together channeled more than $300 million in federal funding towards municipal wet weather and CSO control projects.

The Construction and Financing Schedule and all aspects of the long term control program implementation will incorporate adaptive management as described more fully in Section 10.7 of this document. As detailed there, the City propose that the implementation schedule for the CSO control program be synchronized with the five year NJPDES permit cycles. Specific enforceable CSO control program targets will be negotiated during the NJPDES renewal process. These targets will be subject to revision due to forces beyond the control of the City including but not limited to natural disasters (e.g. hurricane), pandemics or other disasters along with resultant economic downturns which disrupt the revenues available to the City or the abilities of the rate payers to pay their sewer bills. It is proposed that the Construction and Financing Schedule include specific metrics defining triggering events.

A key component of adaptive management will be the inclusion of an affordability and financial capability trigger in the Construction and Financing Schedule. The projects and activities to be included in each five-year permit cycle would be selected and scheduled such that the residential indicator in the City at that time not exceed the 2.0% of median household income triggering the USEPA high burden definition. Should economic or other conditions occur in the future such that the residential indicators exceed 2.0% during a given permit cycle or lead to reasonable expectations that the 2.0% value be exceeded in subsequent permit cycles the projects and activities in subsequent permit cycles will be modified in cooperation with NJDEP.

10.6 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 Perth Amboy and MCUA have separately implemented an Operation and Maintenance (O&M) Program and have each 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 MCUA 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, primarily by the City. The City is prepared to operate and maintain the facilities associated with the LTCP.

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 MCUA 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 or shared assets. Training will be provided where necessary, to ensure that staff are able to operate any new CSO control assets.

The City and MCUA concurrently 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, below grade combined sewer storage tanks. The City has some experience with operating certain types of green infrastructure.

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 inspection, operation and maintenance of green infrastructure;
7. Routine operating procedures and training for the combined sewer flow below grade storage tanks, including dewatering pump station, flushing system, grit removal, and odor control system;

The selected LTCP involves pumping the City's CSS flows to the MCUA CTP at a maximum flow rate of 13.6 MGD. This is the same as PA's current maximum flow rate discharged to the MCUA's system via the Woodbridge collection system. On that basis, the impact on the CTP's operations and maintenance (O&M) practices and costs is anticipated to be minimal. There would also be a need for the MCUA to meter and sample Perth Amboy's flow to the CTP.

10.7 Adaptive Management

The implementation schedule outlined in this section includes an evaluation at the completion of each five-year NJPDES permit cycle. Based on these evaluations, the City and MCUA will revise the LTCP as necessary with NJDEP's coordination and approval. This process exemplifies the concept of adaptive management.

EPA has indicated the following relevant to adaptive management:

- Adaptive management is variously defined and discussed in multiple EPA documents;
- Adaptive management was historically incorporated into natural resources management in 1970s;

- The EPA Superfund Task Force (STF) defined adaptive management as: "…formal and systematic site or project management approach centered on rigorous site planning and a firm understanding of site conditions and uncertainties."
- Adaptive management is rooted in sound use of science and technology;
- Encourages continuous re-evaluation and prioritization of activities to account for new information or changing conditions.

In the context of the SIAR, adaptive management assumes that while the CSO control goals will remain constant, the strategic approaches to achieving the goals must be adjustable.

The City and MCUA will also be subject to a variety of future conditions beyond their control which may materially affect the benefits, feasibility and scheduling of the CSO controls described in this SIAR, thereby triggering a need to revise the LTCP.

The City and MCUA will inform NJDEP upon becoming aware of any circumstances that would precipitate a change to the LTCP and detail for NJDEP the following:

- An analysis of the issues and implications posed by the condition;
- An analysis of the impacts on the implementation of the LTCP or the efficacy of the controls; and
- A proposed plan of action to address the adverse conditions that will preserve the City's and MCUA's compliance with their respective NJPDES permits and the requirements of the CSO Control Policy.

The City anticipates 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 MCUA 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 they will be potentially significant. 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 MCUA 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 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 6. 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 for this Long Term Control Plan 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 and MCUA 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 at least one sampling location in the Raritan 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 Perth Amboy 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. 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 within the City boundary and conveyed to the MCUA 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 City of Perth Amboy combined 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 9. 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 combined 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 satellite storage and high rate treatment facility projects. However, the frequency of monitoring will be dependent upon the implementation of projects. For example, it may not be necessary to update 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 in close proximity to the City of Perth Amboy. 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.

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 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 or supplement 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 three representative locations, as was used 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 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 MCUA 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, if any;
- 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 MCUA 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 MCUA'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 MCUA'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 to align with the proposed implementation schedule.

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. Such recommendations are relevant if the State is to pursue a broader regional water quality program that can address the overall water quality of the Raritan River upstream of the Perth Amboy discharge locations.

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's web site.

As noted in Section 10, 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, 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 MCUA 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 MCUA to achieve the required CSO control volume reductions at the most sustainable cost and with the support of all relevant stakeholders.

Appendix A

Public Meeting Materials

CDM Smith

CSO Permit Compliance
Selection and Implementation of Alternatives Report

Presentation to the City of Perth Amboy

Howard Matteson, P.E, BCEE

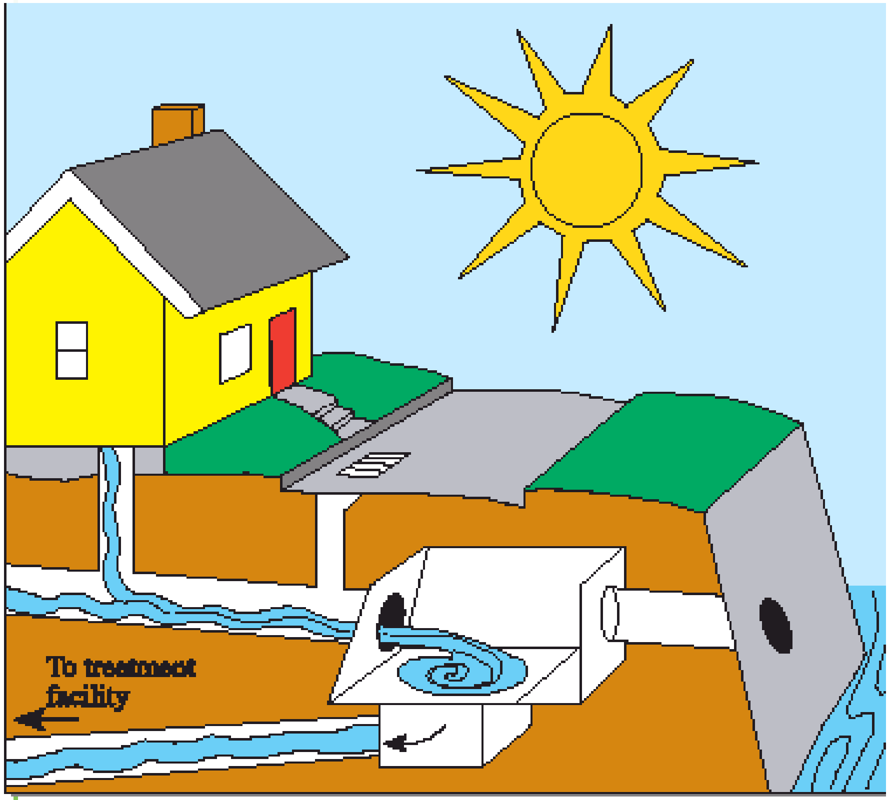
Ted Burgess, P.E., D.WRE

July 08, 2020

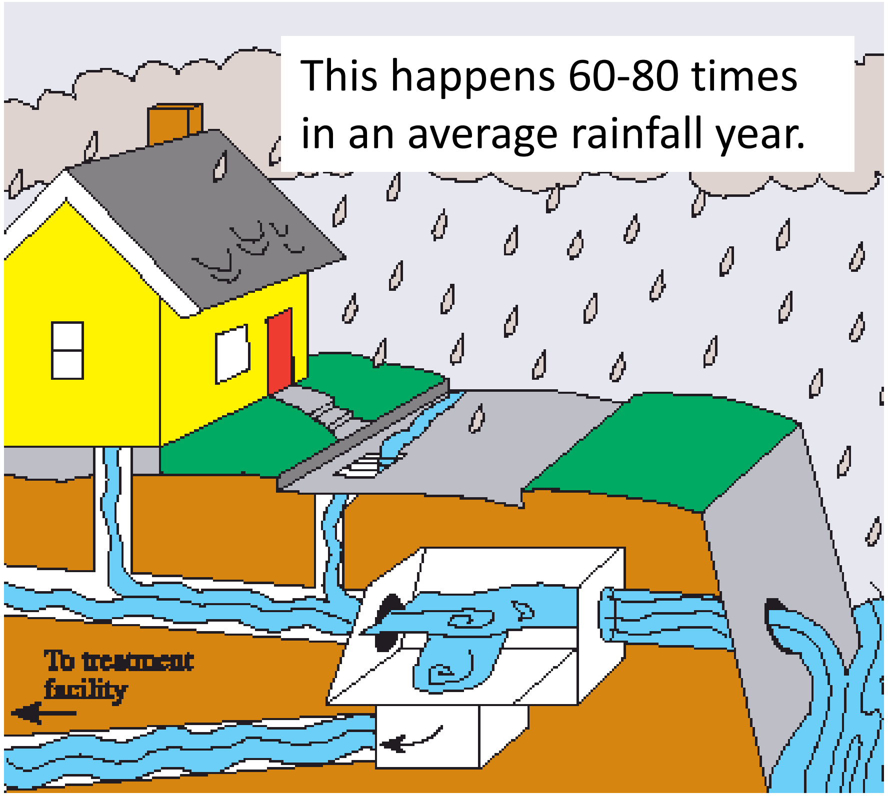
CDM Smith

What are Combined Sewer Overflows (CSOs) and why do they occur?

Dry weather



Wet weather



National CSO Situation

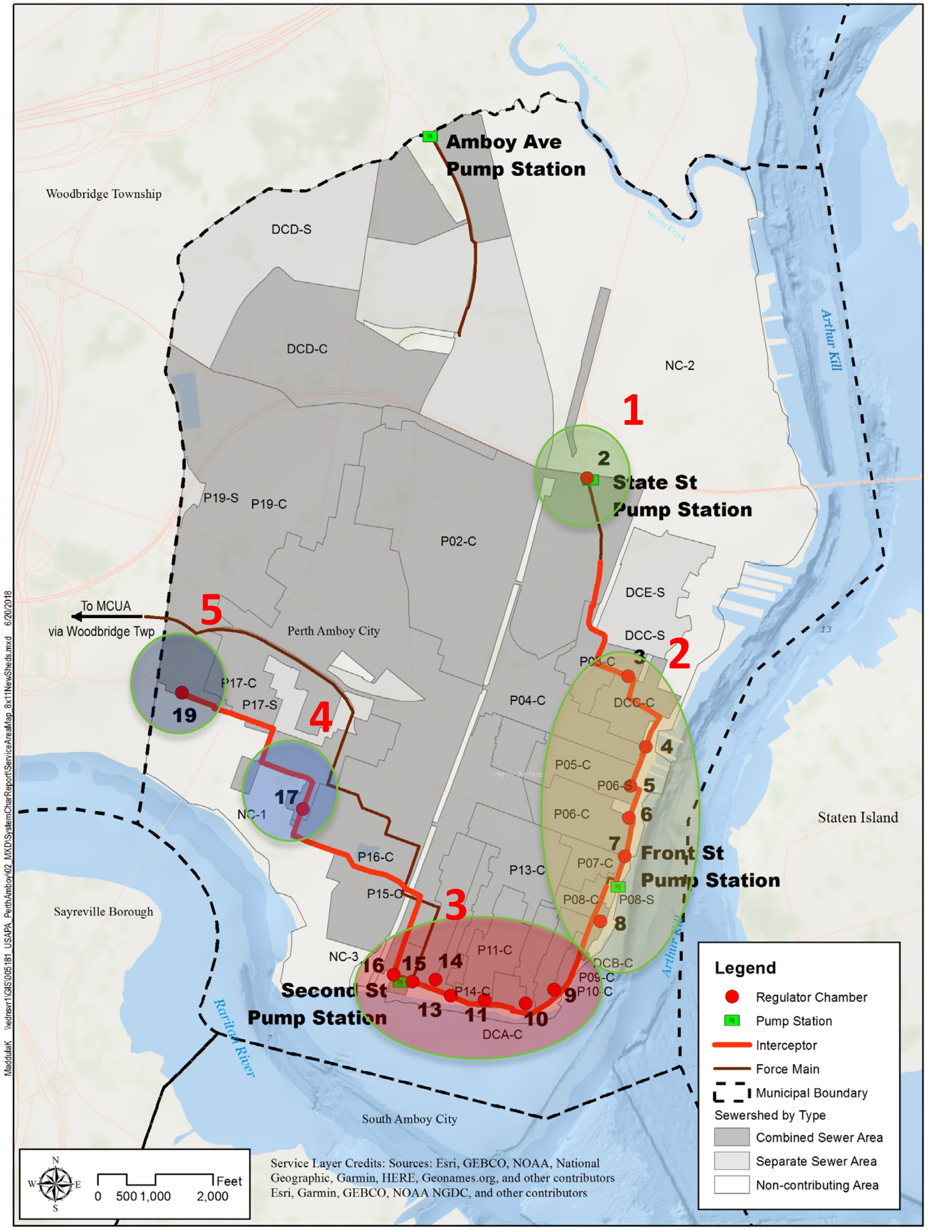
- 1994 U.S.EPA National CSO Policy requires a Long-Term CSO Control Plan (LTCP)
- LTCPs have produced huge (multi-billion $) CSO programs in many large, older cities
- CSO programs are typically 4-5 year planning efforts (LTCP), followed by 20+ year implementation schedules
- CSO discharges can be reduced, eliminated or controlled by:
  - Separating combined sewers into storm and sanitary lines
  - Capturing CSOs in large storage tanks or tunnels for later treatment at the WWTP
  - Treating CSOs at or near the point of discharge with special high-rate treatment processes
  - Reducing the rate of stormwater runoff using green infrastructure facilities to capture stormwater before it enters the sewer

Local CSO Situation – Regulatory Compliance

- 2012 Federal Consent Decree lodged, EPA Region 2 now deferring to NJDEP
- NJDEP using the NJPDES permit process (rather than administrative or judicial decrees/orders) to enforce regulatory compliance going forward
- Perth Amboy and MCUA each issued independent CSO permits by NJDEP
- MCUA and Perth Amboy coordinating development of single LTCP:
  - Allows for a 5-year (versus 3-year) LTCP schedule
- Last element of LTCP is *Selection and Implementation of Alternatives Report* (SIAR) due September 30, 2020 (extended date)

Perth Amboy's Combined Sewer System

- CSO Group Number



Permit Considerations

- Cost and Performance Considerations
  - Cost vs permit requirements to achieve EITHER 4 overflows per year or 85% capture by CSO volume (for treatment)
- Alternatives Considered
  - Satellite Storage
  - Satellite Treatment
  - Tunnel Storage
  - Size of facilities can be reduced by implementing Green Infrastructure, sewer separation, etc.

Sensitive Areas

- Outstanding National Resource Waters
- National Marine Sanctuaries
- Waters with threatened or endangered species and their habitat
- Waters with primary contact recreation
- Public drinking water intakes or their designated protection areas
- Shellfish beds

Includes Bathing Beaches

CSO Policy requires CSOs to sensitive areas be "eliminated or relocated wherever physically possible and economically achievable".

CSO Control Strategy – 0 Overflows to Beach Area

- Group 1 (CSO-002)(Rudyk Park) – High Rate Treatment (HRT) or Storage
  - 20 overflows per year
- Group 2 (CSO-003 thru 008) – discharges to Arthur Kill – HRT or Storage
  - 20 overflows per year
- Group 3 (CSO-009 thru 016) – Beach area – Storage
  - 0 overflows per year
- Group 4 (CSO-017) – Sheridan St – Storage
  - 0 overflows per year
- Group 5 (CSO-019) – Smith St – Storage
  - 0 overflows per year

CSO Control Strategy – 0 Overflows to Beach Area

Group Designation	Target Overflows Per Year	Planning Level Cost (40 yr plan)
Sewer Separation	-	$3 million
Green Infrastructure	-	$21 million
Group 1 (CSO-002)(Rudyk Park)	20	$44 million
Group 2 (CSO-003 thru 008) – discharges to Arthur Kill	20	$81 million
Group 3 (CSO-009 thru 016) – Beach area	0	$320 million
Group 4 (CSO-017) – Sheridan St	0	$22 million
Group 5 (CSO-019) – Smith St	0	$110 million
TOTAL		**$600 million**

At completion – achieves >90% capture

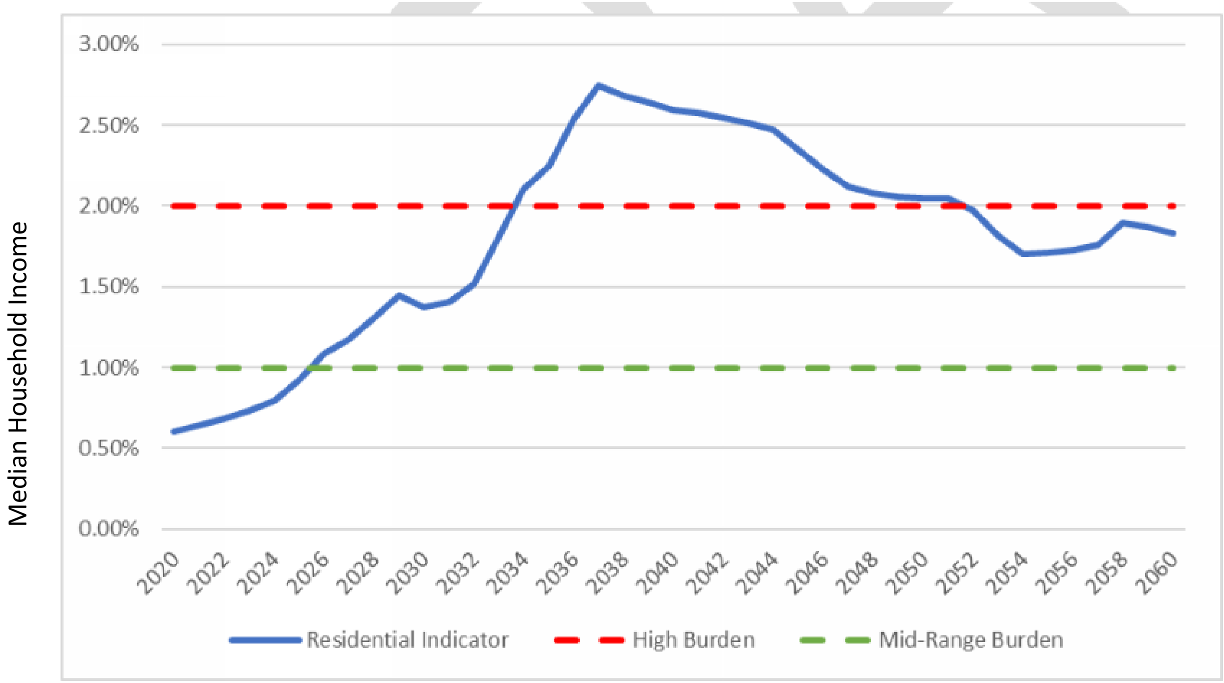
Financial Capability Assessment

Table 7-17 – Financial Impact Assessment Benchmarks

Indicator	Value	Score
1. Bond Rating	A2	3
2. Overall Net Debt	2.69 percent	2
3. Unemployment Rate	2.5 percent above	1
4. Median Household Income	13.7 percent below	2
5. Property Tax Revenue	2.91 percent	2
6. Property Tax Collection Rate	99.5 percent	3
Overall Financial Impact Indicator Score		**2.17**

<1 – low burden
1-2 – mid range burden
2-3 – high burden

Financial Capability Assessment



Assumes 0 OF/year at beach area

Figure 7-3 - Projected Household Bill, MHI and Residential Indicator

The above figure shows the impact on households with household income at the median. A household at or below the bottom 40 percent of income (roughly $40,000) is projected to have a residential burden of over 3.6 percent in FY 2037, over 1.5 times the EPA high burden threshold.

*Perth Amboy Median Household Income: $53,011 [American Community Survey (Census), 2018]

Implementation Schedule – Design and Construction

- Sewer Separation – all years
- Green Infrastructure – all years
- Group 4 & 5 (Smith & Sheridan) - Years 1-8
- Group 3 (Beach Area) – Year 9-16
- Second St PS and FM – Year 17-23
- Group 1 (Rudyk Park) – Years 24-30
- Group 2 (Arthur Kill outfalls) – Years 31-37

Adaptive Management Addresses Affordability Concerns

- LTCP includes re-evaluation at end of each 5-yr permit cycle
- Revise LTCP as necessary with each new permit
- Adaptive Management Approach Provides Flexibility
  - Assumes that while the CSO control goals will remain constant, the strategic approaches to achieving the goals must be adjustable.
  - Recognizes City will also be subject to a variety of future conditions beyond their control which may materially affect the benefits, feasibility and scheduling of the CSO controls in the LTCP.

Drivers of Cost

- Current Financial Capability Assessment accounts for:
  - 0 overflows per year along Raritan (Groups 4 & 5) and Beach area (Group 3)
  - Treatment capacities/volumes at:
    - Group 1 (CSO-002) - Rudyk Park; and
    - Group 2 (CSO-003 thru 008) – discharges to Arthur Kill

Alternative Approach

- No longer target 0 overflows per year along beach.
- Target more overflows per year but still achieve 85% capture at program completion.
- Does not preclude opening beach but will restrict usage for several days following wet weather events and until water quality meets State criteria.
- By considering the above, facility size can be reduced.
- Can reduce costs by up to 1/3.

Alternative Approach

- Recognize City's CSO program is one aspect of a broad regional water quality effort.
- Initial years focus on low cost program elements to allow time for the broader regional water quality program to form and get started before the City commits to spending big CSO $:
  - Green Infrastructure
  - Storm Sewer Mapping & Sewer Separation
  - Dry Weather Water Quality Sampling
- Will limit impact to rates in short term, with higher costs toward end of the LTCP implementation.

Questions and Final Discussion

Regulatory Compliance Requirements and Strategy for Combined Sewer Overflows

Presentation to the City of Perth Amboy

Howard Matteson, P.E, BCEE

Ted Burgess, P.E., D.WRE

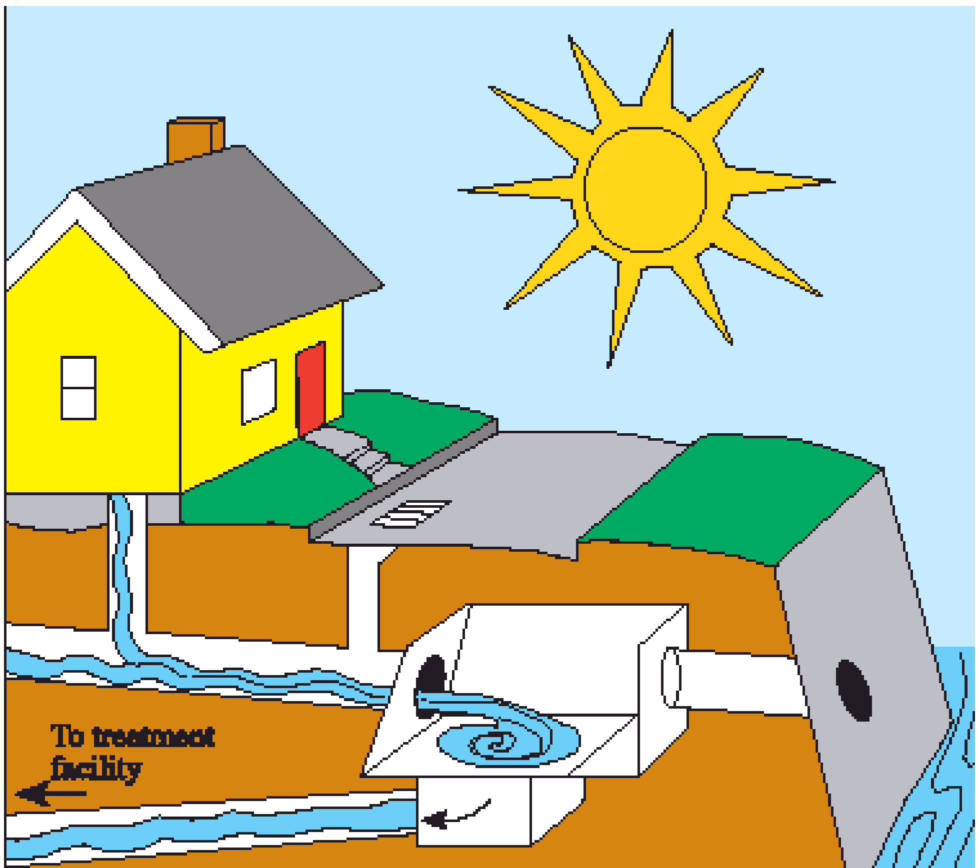
July 10, 2019

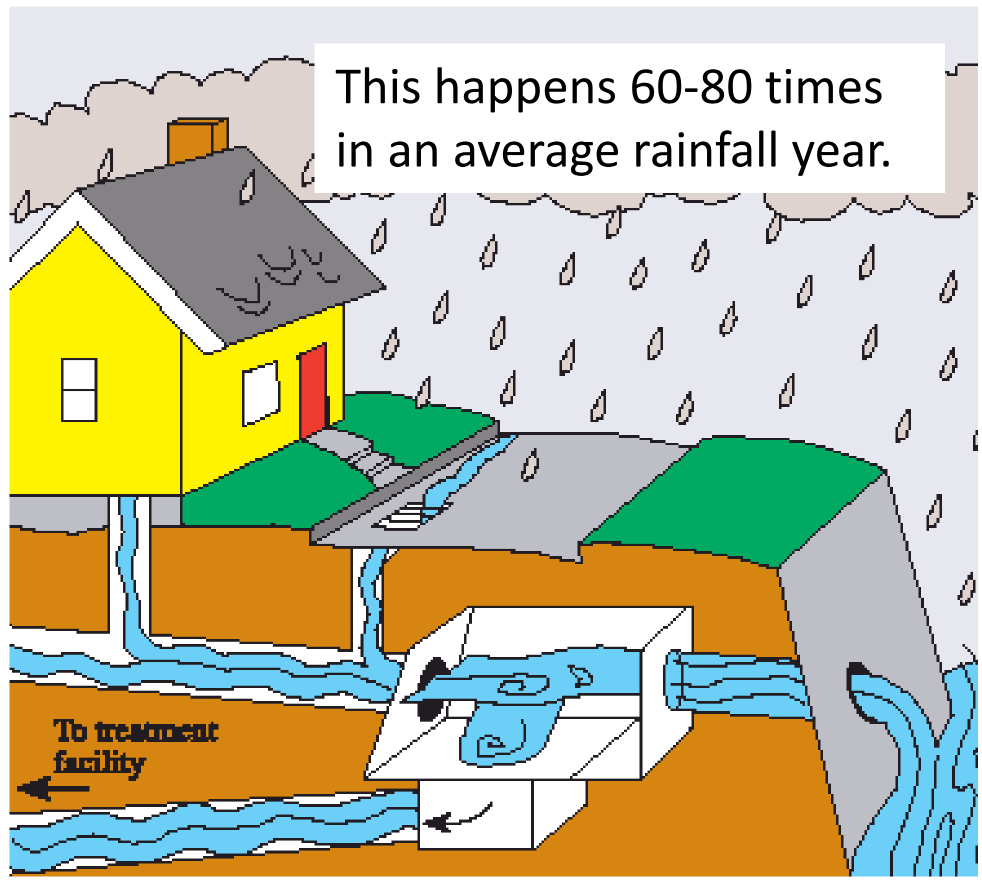
CDM Smith

What are Combined Sewer Overflows (CSOs) and why do they occur?

Dry weather

Wet weather





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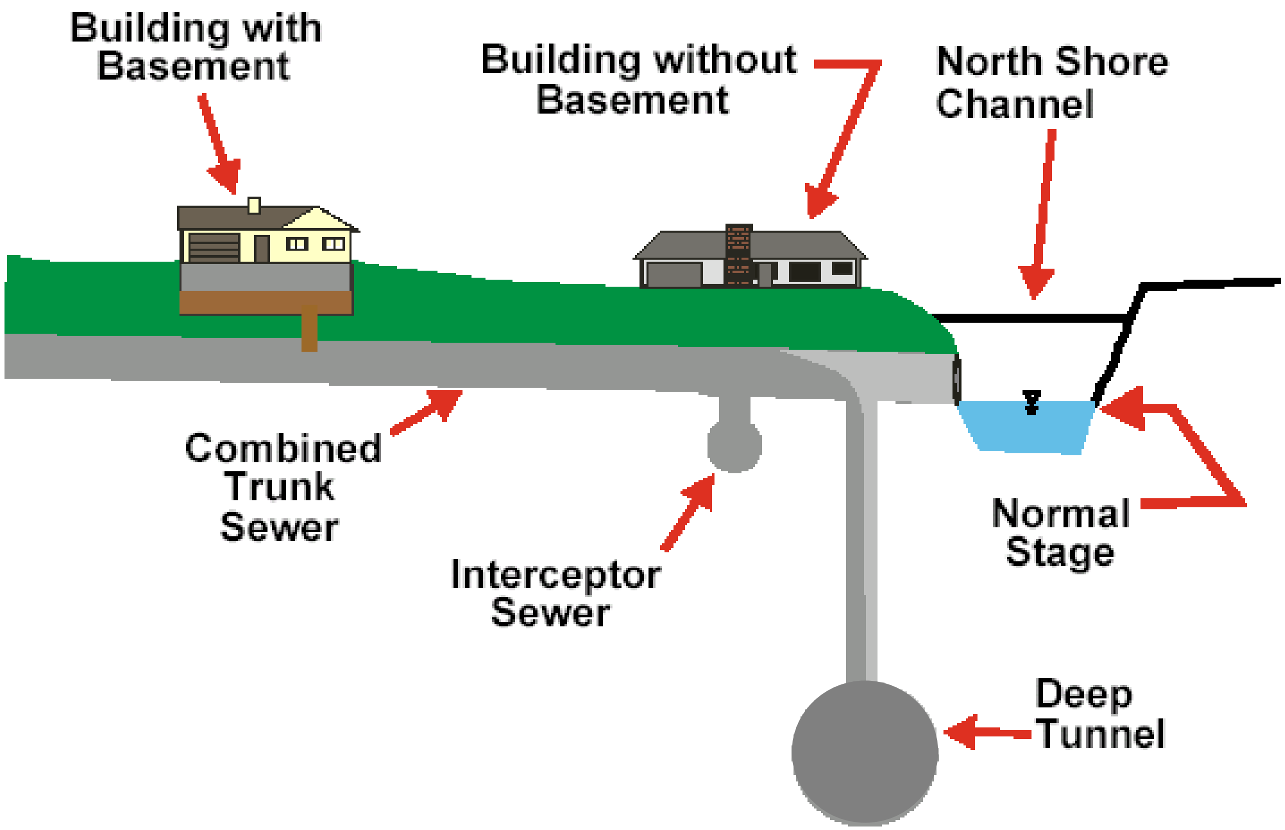
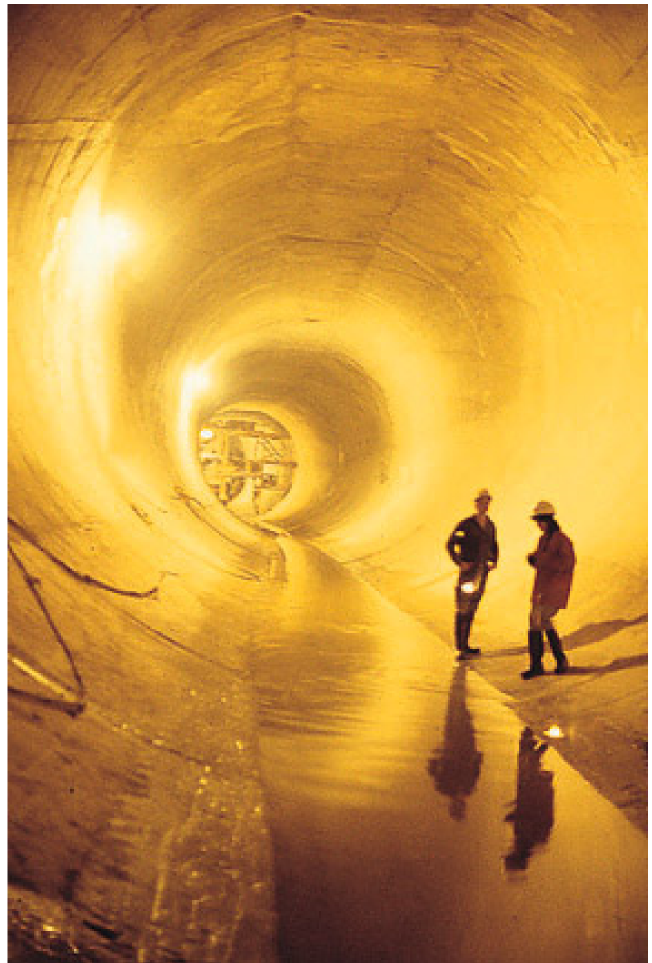
  - Separating combined sewers into storm and sanitary lines
  - Capturing CSOs in large storage tanks or tunnels for later treatment at the WWTP
  - Treating CSOs at or near the point of discharge with special high-rate treatment processes
  - Reducing the rate of stormwater runoff using green infrastructure facilities to capture stormwater before it enters the sewer

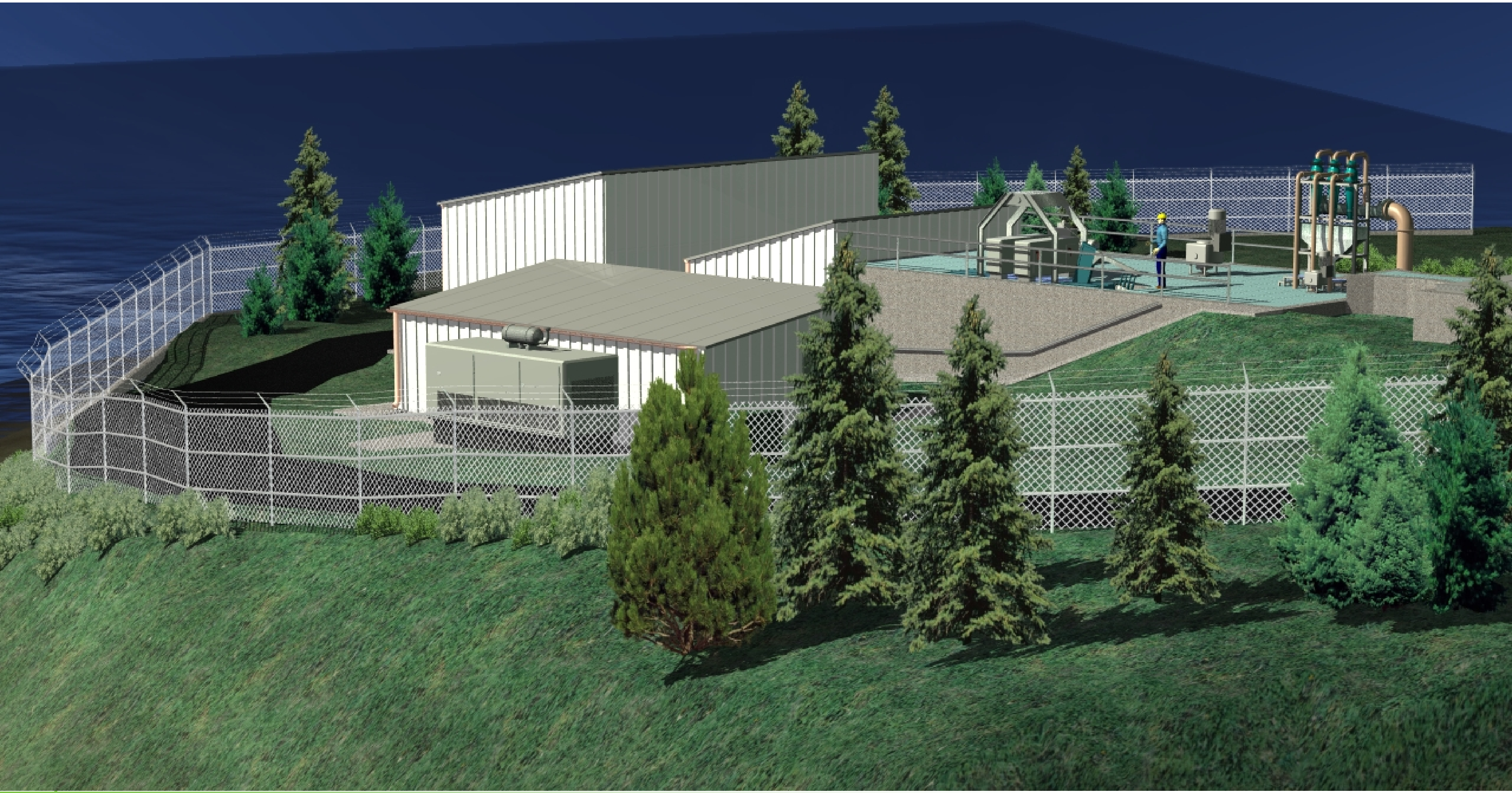
Surface Storage Basin for CSO Control (Detroit)

CSO Tunnel (Chicago)



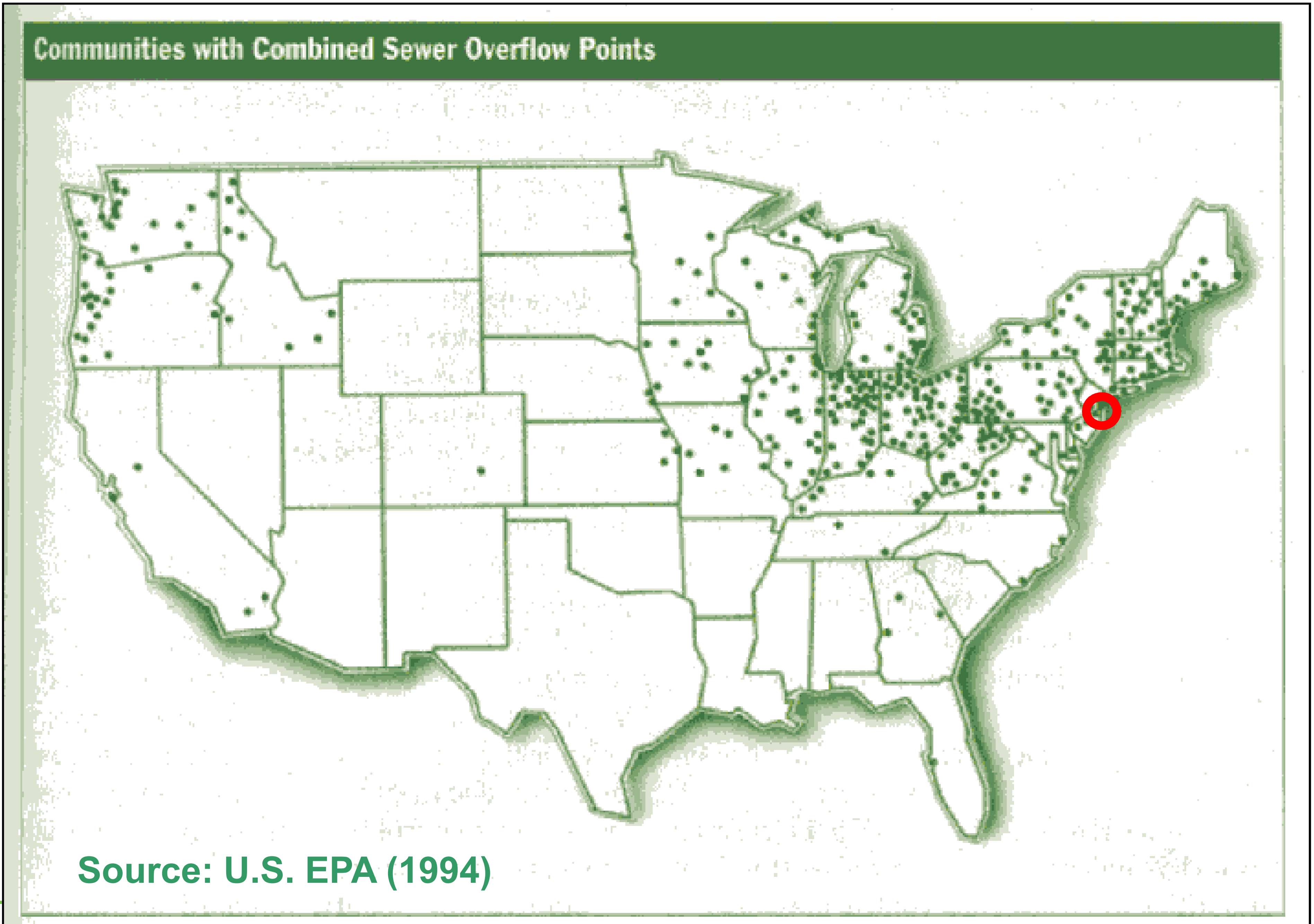


High-Rate CSO Treatment Facility (Bremerton, Washington)



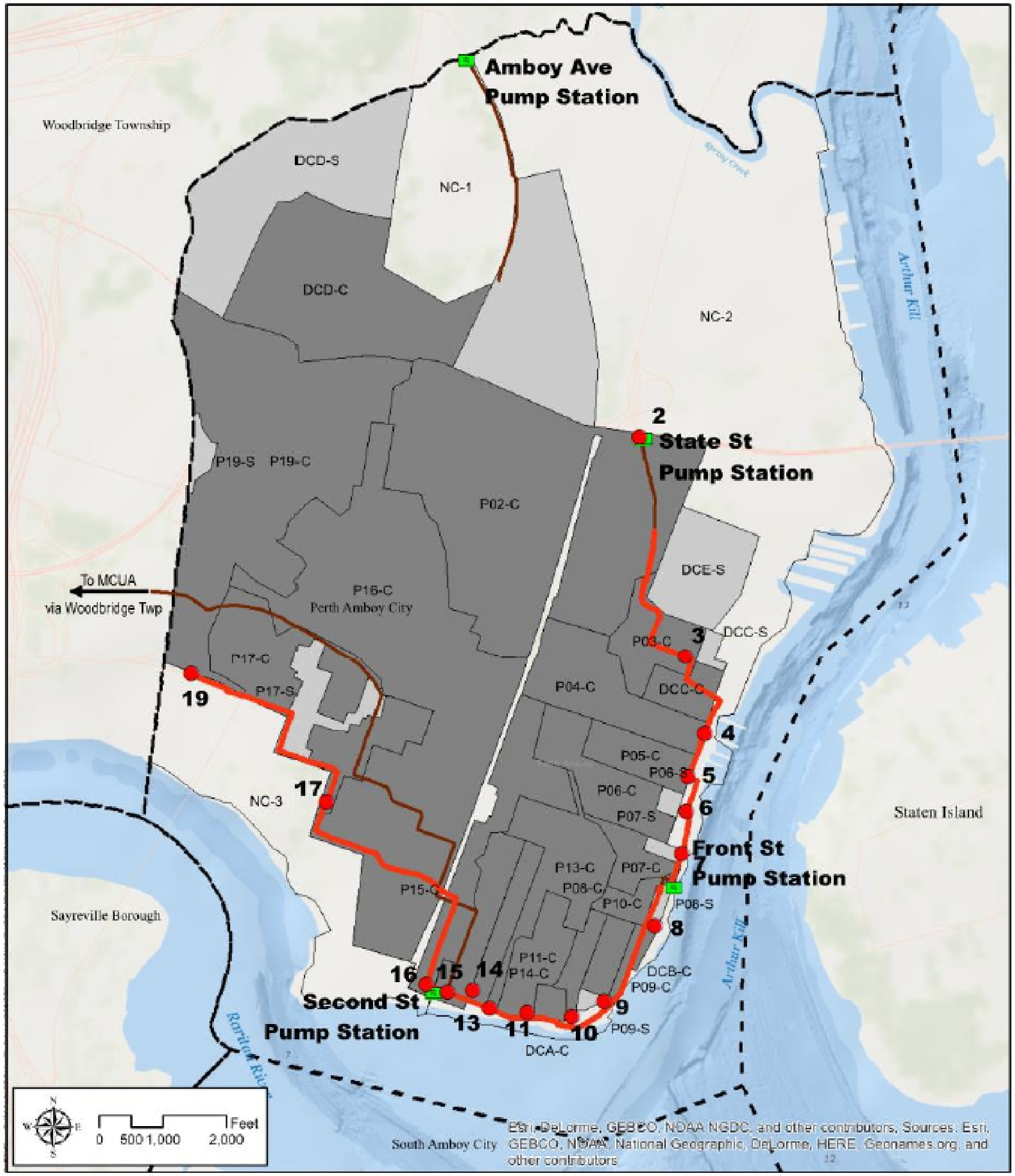
Green Infrastructure (examples from NYC and Hartford, Connecticut)

Location of Communities with CSOs



Source: U.S. EPA (1994)

Perth Amboy's Combined Sewer System



Local CSO Situation – Regulatory Compliance

- 2012 Federal Consent Decree lodged, but now…
- EPA Region 2 deferring to NJDEP (at least for now)
- NJDEP using the NJPDES permit process (rather than administrative or judicial decrees/orders) to enforce regulatory compliance going forward
- Perth Amboy and MCUA each issued independent CSO permits by NJDEP
- NJDEP expects coordination with MCUA in addressing CSO permit requirements:
  - Allows for a 5-year (versus 3-year) LTCP schedule
  - Allows independent (but coordinated) Long Term Control Plans be developed by Perth Amboy and MCUA

What is involved in the Long Term Control Plan?

- Characterize system performance – modeling and monitoring used to determine capture of wet weather flow, annual frequency and volume of overflow
- Public participation (Supplemental CSO Team)
- Evaluation of alternatives to control CSO impacts to target levels:
  - Demonstrate compliance with water quality standards, OR
  - Capture 85% of wet weather flow for treatment
- Evaluate cost/performance trade-offs
- Affordability analysis:
  - Typically sewer rates $\leq$ 2% of household income
- Implementation schedule

Deliverables to DEP Required by CSO Permit

2018-2019 (sets up the program to address CSOs)

Submit System Characterization Report	July 1, 2018
Submit Public Participation Process Report	July 1, 2018
Submit Compliance Monitoring Program Report	July 1, 2018
Submit Consideration of Sensitive Areas Plan	July 1, 2018
Submit Development and Evaluation of Alternatives Report	July 1, 2019

Post-2019 (the actual plan to address CSOs)

Submit Selection and Implementation of Alternatives Report in the Final LTCP	**June 1, 2020**

Sensitive Areas

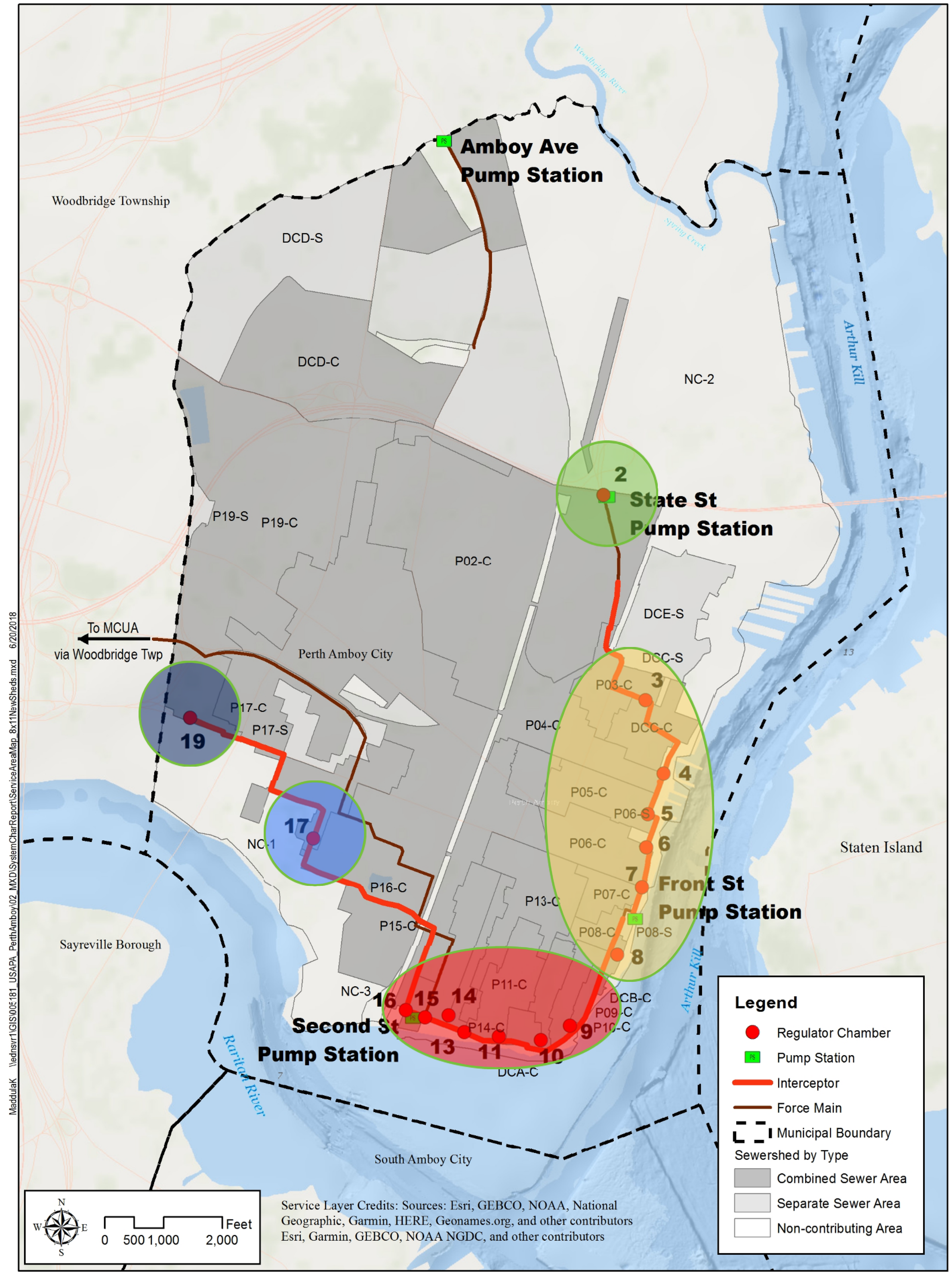
- Outstanding National Resource Waters
- National Marine Sanctuaries
- Waters with threatened or endangered species and their habitat
- Waters with primary contact recreation
- Public drinking water intakes or their designated protection areas
- Shellfish beds

Includes Bathing Beaches

CSO Policy requires CSOs to sensitive areas be "eliminated or relocated wherever physically possible and economically achievable".

Development and Evaluation of Alternatives Report (DEAR)

- Established Five (5) CSO Groups
- Groups allow us to use similar approaches at CSO that are proximate to one another or share common receiving water bodies



Development and Evaluation of Alternatives Report (DEAR)(con't)

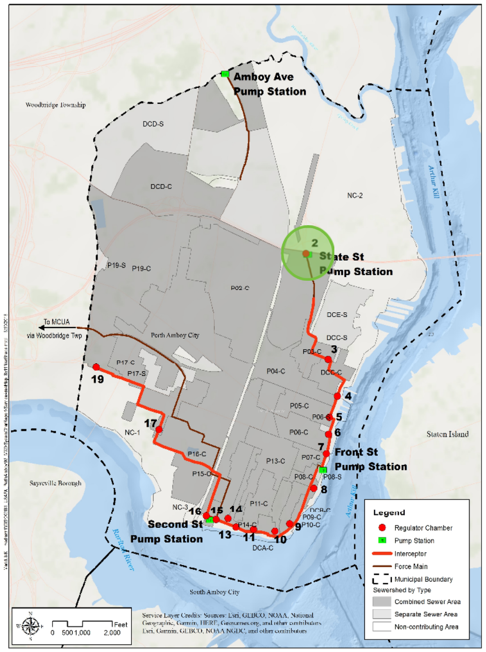
- CSO Control Objectives
  - Compliance with NJPDES Permit Requirements
  - Protection of Sensitive Areas
  - Improve Water Quality
  - Address input from Supplemental CSO Team - keep new infrastructure as unobtrusive and resilient as possible, and keep focus on green infrastructure
- Identification and Screen of Control Technologies
  - Green Infrastructure
  - Increase Storage (offline)
  - Treatment Plant Expansion (MCUA)
  - Regulator Modifications
  - Inflow and Infiltration Reduction, Sewer Separation
  - Treatment of CSO discharges

Development and Evaluation of Alternatives Report (DEAR)(con't)

- Cost and Performance Considerations
  - Cost vs permit requirements to achieve either 4 overflows per year or 85% capture by CSO volume (for treatment)
- Alternatives Considered
  - Satellite Storage
  - Satellite Treatment
  - Tunnel Storage
  - Size of facilities can be reduced by implementing Green Infrastructure, sewer separation, etc.

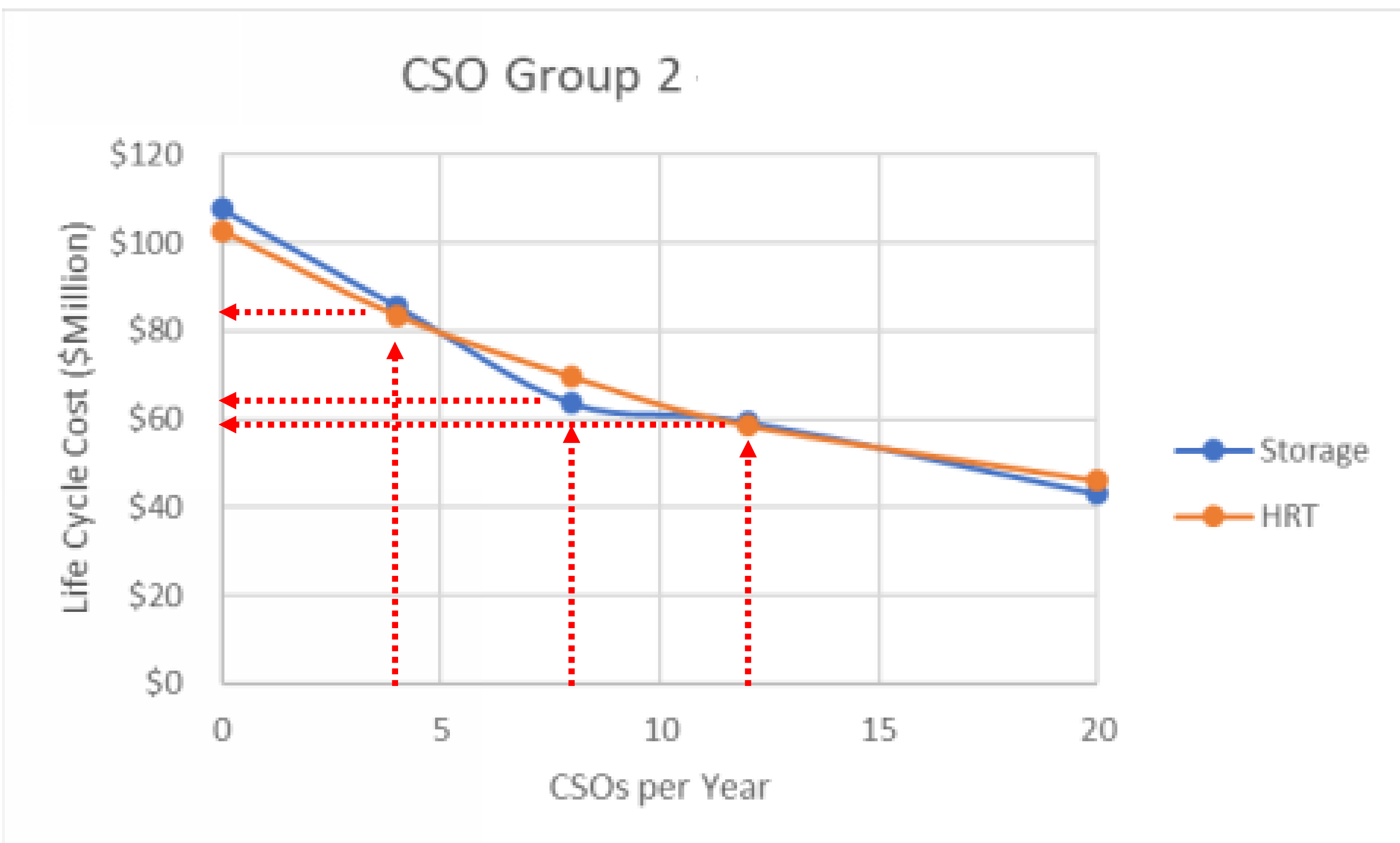
Development and Evaluation of Alternatives Report (DEAR)(con't)

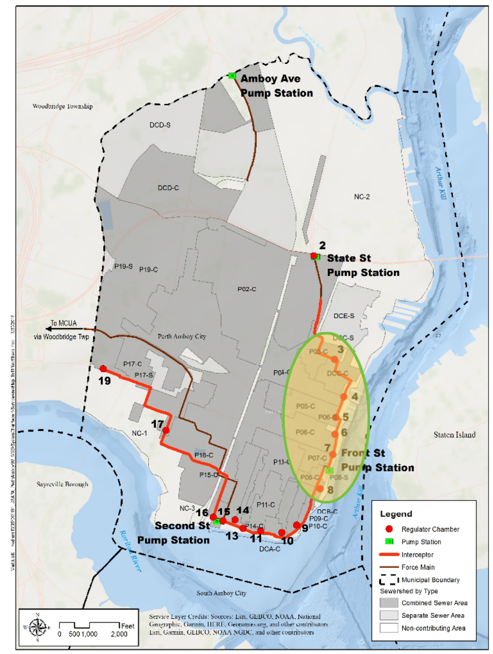
- CSO Group 1 (State Street PS)



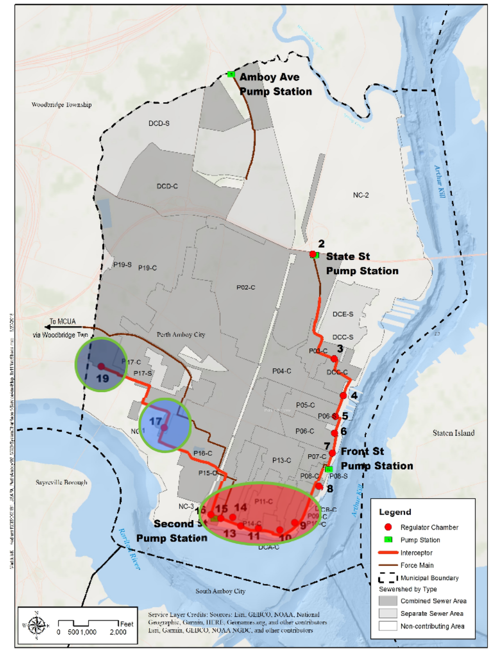
Development and Evaluation of Alternatives Report (DEAR)(con't)

- CSO Group 2 (Arthur Kill)





Development and Evaluation of Alternatives Report (DEAR)(con't)



- CSO Group 3 (Sadowski Parkway/Beach)
- CSO Group 4 (Sheridan Street)
- CSO Group 5 (Smith Street)
- Using a similar approach to each aligned with eliminating untreated overflows (i.e 0/yr) to provide additional protection for beach area
- Depends on capacity assigned to Second Street Pumping Station
- Capacity of PS affects size of storage and/or HRT required

Development and Evaluation of Alternatives Report (DEAR)(con't)

- Using a mixed approach will lower the City's overall cost.
- Range of total planning level costs is $350 - $600 mil.

Next Steps

- Selection and Implementation of Alternatives Report (June 1, 2020)
  - Financial Capability Analysis is performed to define what rate of spending on CSO controls is affordable to the community
  - Final decisions are negotiated with NJDEP on:
    - Sizing (and thus **cost**) of the facilities to be included in the LTCP
    - Sequence and schedule (and thus the **rate of spending**) for construction of the selected alternatives

Questions and Final Discussion

Appendix B

Project Cost Information

CDM Smith

City of Perth Amboy - Long Term Control Plan
SIAR Cost Break Down (9/30/2020)

Implementation Sequence	Components	Cost Component	Quantity	Unit	Cost ($ million) (2020$)
Over 40 years	**Sewer Separation**	Sewer Separation Capital Cost - 8 acres	8	acres	**$ 2.40**
Over 40 years	**Green Infrastructure**	Green Infrastructure Capital Cost (10%)	46.8	acres	**$ 18.26**
		Green Infrastructure 20-year Present Worth O&M			**$ 1.60**
1	Main PS & FM (13.6 mgd and 1 24-in FM)	Capital Cost New Pumping Station 13.6 MGD Capacity	13.6	MGD	$ 10.75
		Captial Cost 1 New 24-inch Force Mains	1	No.	$ 24.29
		Total Capital			**$ 35.05**
		20-year Present Worth O&M Pumping Station			$ 2.73
		20-year Present Worth O&M Force Main			$ 6.17
		Total 20-year PW O&M			**$ 8.89**
		Subtotal			**$ 43.94**
2	CSO Group 4 and 5 (CSO P-017 & P-019) (Sensitive Area) 2 overflows/yr	Capital Cost Regulator Modifications (1) P-017	1	No.	$ 0.05
		Captial Cost Surface Storage Tank CSO Group 4	0.9	MG	$ 17.23
		Land Acquisition CSO Group 4	0.2	acres	$ 0.80
		Captial Cost Surface Storage Tank CSO Group 5	3.1	MG	$ 48.24
		Land Acquisition CSO Group 5	0.8	acres	$ 2.76
		Total Capital			**$ 69.09**
		20-year Present Worth O&M Surface Storage Tank CSO Group 4			$ 1.00
		20-year Present Worth O&M Surface Storage Tank CSO Group 5			$ 1.72
		Total 20-year PW O&M			**$ 2.72**
		Subtotal			**$ 71.81**
		Additional Annual Volume to MCUA CTP (MG)			***59.90***
3	CSO Group 3 (CSO P-009 to P-016) (Sensitive Area) 2 overflows/yr	Capital Cost Regulator Modifications (7) P-009, 010, 011, 013, 014, 015, 016	7	No.	$ 0.35
		Capital Cost Deep Storage Tunnel CSO Group 3	7.8	MG	$ 155.58
		Capital Cost Consolidation Sewer CSO Group 3			$ 21.30
		Land Acquisition CSO Group 3	0.9	acres	$ 3.20
		Total Capital			**$ 180.43**
		20-year Present Worth O&M Deep Tunnel Storage CSO Group 3			$ 9.53
		20-year Present Worth O&M Consolidation Sewer CSO Group 3			$ 5.41
		Total 20-year PW O&M			**$ 14.94**
		Subtotal			**$ 195.37**
		Additional Annual Volume to MCUA CTP (MG)			***148.00***

City of Perth Amboy - Long Term Control Plan
SIAR Cost Break Down (9/30/2020)

Implementation Sequence	Components	Cost Component	Quantity	Unit	Cost ($ million) (2020$)
4	CSO Group 1 (CSO P-002) 40 overflows/yr	Capital Cost FlexFilter HRT CSO Group 1	1.2	MGD	$ 3.99
		Land Acquisition CSO Group 1	0.02	acres	$ 0.07
		Total Capital			**$ 4.05**
		20-year Present Worth O&M FlexFilter CSO Group 1			$ 0.38
		Total 20-year PW O&M			**$ 0.38**
		Subtotal			**$ 4.43**
5	CSO Group 2 (CSO P-003 to P-008) 47 overflows/yr	Front St PS modification - Limit PS flow to 3.5 MGD			$ 0.10
		Capital Cost Regulator Modifications (1) P-003	1	No.	$ 0.05
		Capital Cost FlexFilter HRT CSO Group 2	1.3	MGD	$ 6.79
		Capital Cost Consolidation Sewer & New Outfall CSO Group 2			$ 25.10
		Land Acquisition CSO Group 2	0.02	acres	$ 0.07
		Total Capital			**$ 32.11**
		20-year Present Worth O&M FlexFilter CSO Group 2			$ 0.38
		20-year Present Worth O&M Consolidation Sewer & New Outfall CSO Group 2			$ 6.37
		Total 20-year PW O&M			**$ 6.75**
		Subtotal			**$ 38.86**
Total LTCP Implementation Present Value Cost					**$ 376.67**

Appendix C

Anticipated Planning, Design, Bidding, and Construction Schedule

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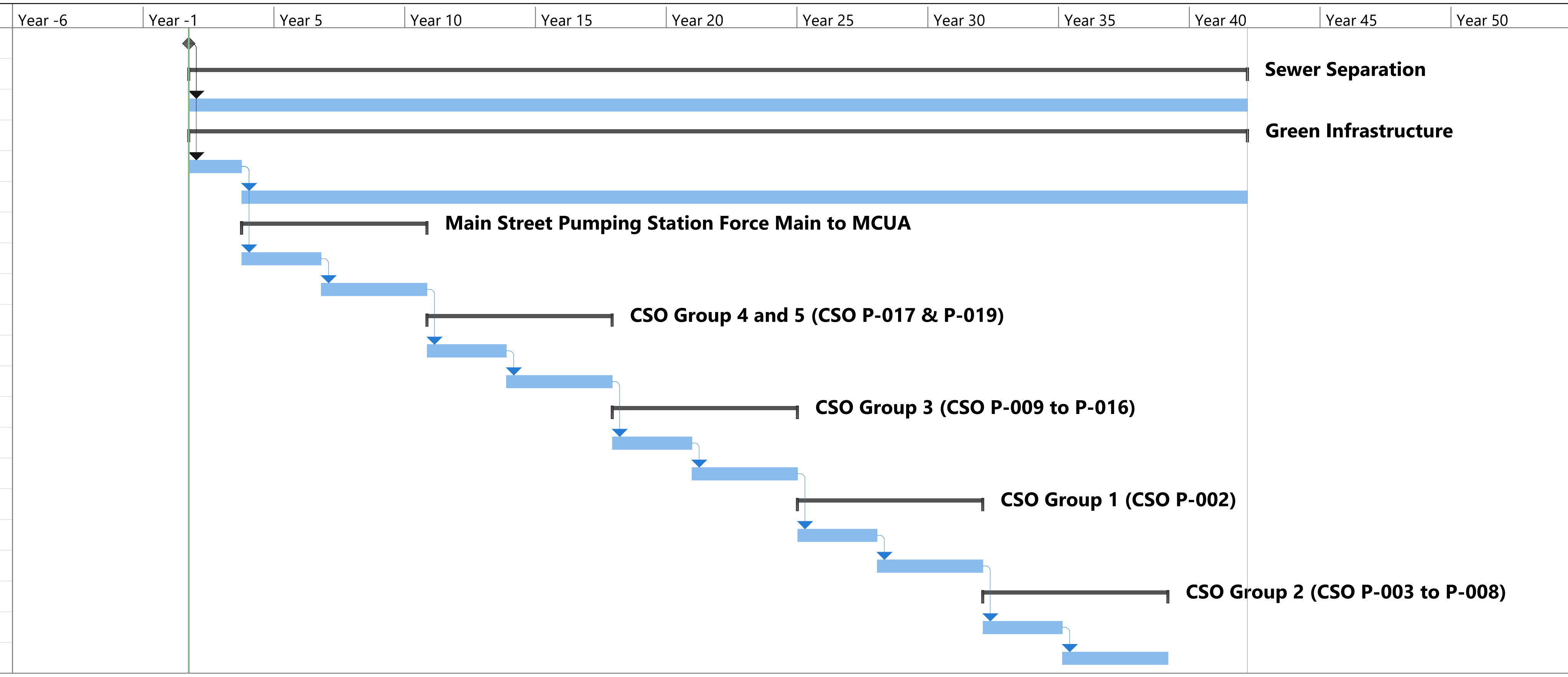
Perth Amboy and MCUA - Long Term Control Plan

Anticipated Planning, Design, Bidding, and Construction Schedule

ID	Task	Task Name	Duration
1		LTCP Approval	0 mons
2		**Sewer Separation**	**480 mons**
3		Planning, Design, Bidding, Construction	480 mons
4		**Green Infrastructure**	**480 mons**
5		Planning, Design, Bidding	24 mons
6		Construction	456 mons
7		**Main Street Pumping Station Force Main to MCUA**	**84 mons**
8		Planning, Design, Bidding	36 mons
9		Construction	48 mons
10		**CSO Group 4 and 5 (CSO P-017 & P-019)**	**84 mons**
11		Planning, Design, Bidding	36 mons
12		Construction	48 mons
13		**CSO Group 3 (CSO P-009 to P-016)**	**84 mons**
14		Planning, Design, Bidding	36 mons
15		Construction	48 mons
16		**CSO Group 1 (CSO P-002)**	**84 mons**
17		Planning, Design, Bidding	36 mons
18		Construction	48 mons
19		**CSO Group 2 (CSO P-003 to P-008)**	**84 mons**
20		Planning, Design, Bidding	36 mons
21		Construction	48 mons



Project: PerthAmboy_LTCP_Sch
Date: Wed 9/30/20

Task | Milestone ◆ | Summary

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