Appendix G

Selection and Implementation of Alternatives Report for City of Bayonne

PREPARED BY T&M ASSOCIATES

SELECTION & IMPLEMENTATION OF ALTERNATIVES

THE CITY OF BAYONNE | CSO LONG TERM CONTROL PLAN

Prepared on behalf of SUEZ

Table of Contents

Figures

Tables

Appendices

SECTION A - INTRODUCTION

The City of Bayonne is a developed, urban community located in southern Hudson County across the Hudson River from New York City. The City encompasses an area of approximately five (5) square miles and is bordered by Jersey City to the north, Newark Bay to the west, the Kill Van Kull to the south, and the Upper New York Bay to the east. The City's combined sewer system (CSS), permitted under New Jersey Pollutant Discharge Elimination System (NJPDES) Permit No. NJ0109240, is currently operated by SUEZ through a forty (40) year agreement established in December 2012 with United Water. While the City of Bayonne owns all the combined sewage collection, control and discharge facilities, and pump stations, the City does not currently own any treatment facilities. Therefore, all combined sewer flows in the City that are conveyed to the Oak Street Pumping Station (OSPS) are transported to the Passaic Valley Sewer Commission (PVSC) wastewater treatment plant via a force main, parts of which the City wholly owns, and parts of which the City co-owns with the Jersey City Municipal Utility Authority (MUA) and the Kearny MUA. The flow from the force main enters directly into the primary treatment facility at the PVSC treatment plant in Newark, New Jersey. Under the City's existing service agreement with PVSC, wastewater flows from the City of Bayonne to the PVSC plant are restricted to an average daily flow of 11 MGD and a peak flow of 17.6 MGD. This, along with local and regional hydraulic constraints, limited the amount of flow that can be transported for treatment during wet weather events, thus resulting in excess combined sewage being discharged into the receiving waters as Combined Sewer Overflows (CSOs). The City's CSS has twenty-eight (28) permitted outfalls through which CSOs may be discharged to receiving waters. Sixteen (16) of the outfalls discharge to Newark Bay, which is classified as Saline Estuary (SE3) waters; nine (9) outfalls discharge to the Kill Van Kull, which is also classified as Saline Estuary (SE3) waters; and three (3) outfalls discharge to Upper New York Bay (lower Hudson River), which is classified as Saline Estuary (SE2). These classifications of the receiving waters determine measures that are appropriate for the USEPA's long term CSO control goal. The Bayonne City's CSO outfalls and associated receiving waters are depicted in Figure A-1.

PVSC NJDEP Permit Part IV.G Section 10 requires that permittee is "responsible for submitting a Long Term Control Plan (LTCP) that addresses all nine elements in Part IV.G". The nine elements are listed below:

1. Characterization Monitoring & Modeling of the Combined Sewer System
2. Public Participation Process
3. Consideration of Sensitive Area
4. Evaluation of Alternatives
5. Cost/Performance Considerations
6. Operational Plan
7. Maximizing Treatment at the Existing STP
8. Implementation Schedule
9. Compliance Monitoring Program

Elements 1, 2, 3, and 9 will be addressed in the Regional Selection and Implementation of Alternatives Report (SIAR). The Regional SIAR will also include the typical year selection and NJDEP approved Typical Hydrologic Period Report. This report addresses the remaining factors.

Through its CSO permit under the New Jersey Department of Environmental Protection (NJDEP), the City is required to cooperatively develop a CSO LTCP with PVSC and its hydraulically connected CSO permittees. Each permittee is required to develop all necessary information for the portion of the hydraulically connected system they own.

The City previously submitted a Development and Evaluation of CSO Control Alternatives Report (DEAR) as part of the Section D.3.b.v of the NJPDES permit requirements. The report included evaluation of a wide range of CSO control measures, and their effectiveness and costs for performance analyzed within the guidelines of the EPA CSO Control Policy. Now, pursuant to Section D.3.b.vi of the NJPDES permit requirements, the City is required to submit an approvable "Selection and Implementation of Alternatives Report".

This report summarizes the CSO control analysis performed and presents the rationale for the selected alternative, and the recommended long-term control plan for the City of Bayonne. The plan represents the best balance among performance, cost, affordability, water quality and public benefits, and practical and non-monetary factors.

Separately, PVSC will submit a regional alternative for all PVSC communities. This report covers the Bayonne-only municipal alternative.

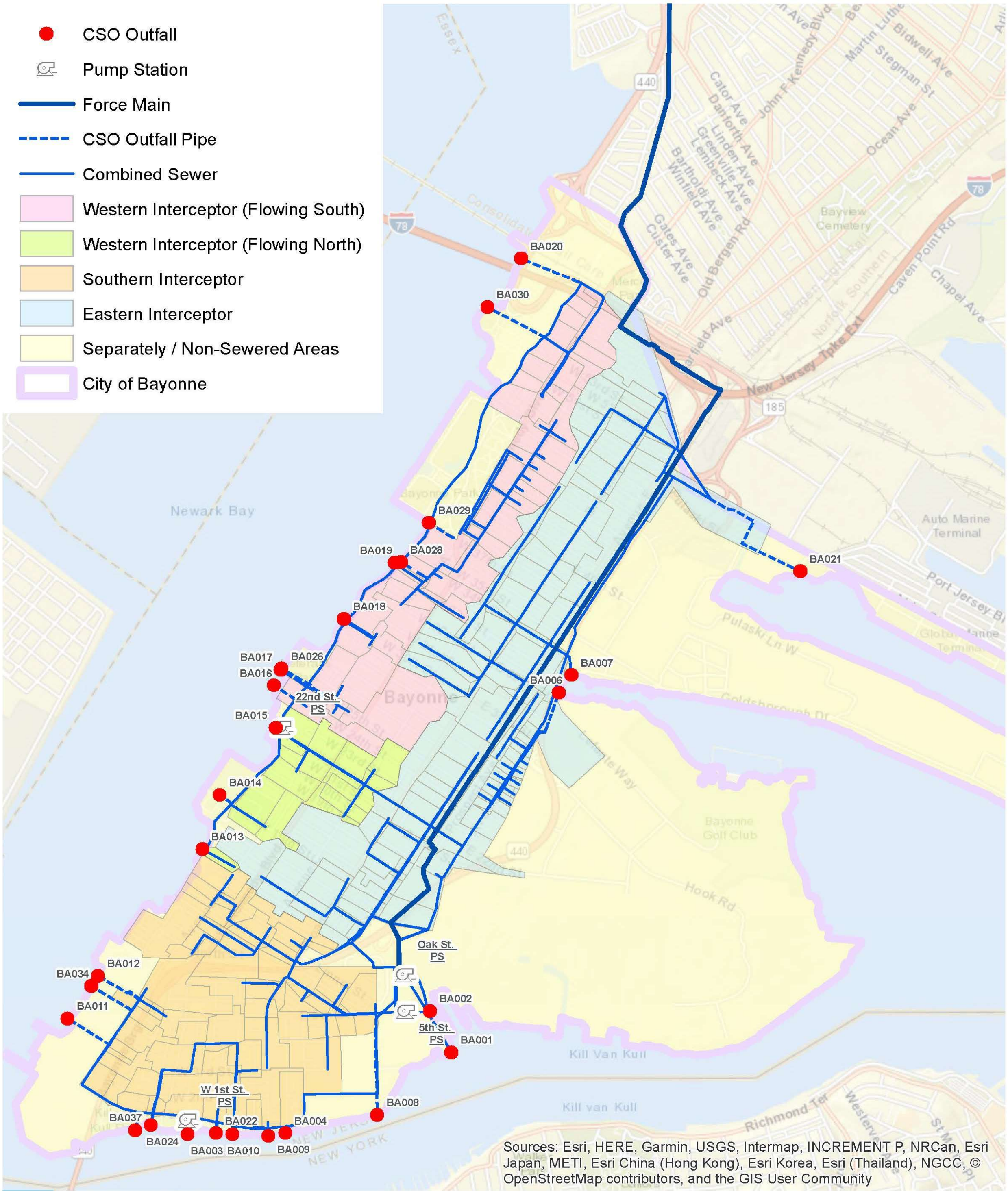

Figure A-1 | Bayonne Outfall Location Map

SECTION B - SCREENING OF CSO CONTROL TECHNOLOGIES

B.1 INTRODUCTION

This assessment considers technologies presented in the DEAR. A wide variety of CSO control measures were reviewed to identify the options that have the greatest potential in Bayonne to achieve the CSO control goals. Technologies identified as options during the screening process were subsequently used to develop CSO control alternatives and evaluate for effectiveness and costs.

As part of the screening process, each CSO control technology was evaluated for its effectiveness to achieve the following goals: 1) achieving water quality standards and designated uses of the receiving waters, 2) reducing pollutant-of-concern discharges, 3) reducing CSO-discharge frequency, 4) reducing CSO-discharge volumes. Other considerations in the evaluation of CSO-control technologies included implementation requirements (land, neighborhood, noise, disruption) and operational factors.

B.2 SCREENING OF CONTROL TECHNOLOGIES

As noted in the DEAR, screening of available CSO source control technologies, collection system technologies, and storage and treatment technologies were conducted based upon:

- if a measure is already in place, or
- if a measure is not in place but it will meet, partially meet or not meet the LTCP objectives, or
- if a measure is not in place but will meet, partially meet, or not meet objectives in combination with other technologies.

In regard to the primary CSO control goal for bacteria reduction and volume reduction, the technologies were categorized as follows:

- **High** – Technologies that will have a significant (≥ 65%) impact on the CSO control goal and are among the best technologies available to achieve that goal. Therefore, they may be considered for further evaluation.
- **Medium** – Technologies that are somewhat effective at achieving the CSO-control goal (35-65%) but are not considered among the most effective technologies to achieve that goal.
- **Low** – Technologies that will have a minor impact (≤ 35%) on this CSO-control goal. Therefore, they will need other positive attributes to be considered for further evaluation.
- **None** –Technology that will have zero or negative effect on the CSO control goals.

The screening of each CSO-control technology was then conducted with the following in mind:

- Predicted effectiveness at reaching the primary goals of bacteria and overflow volume reduction;
- Implementation and operational factors, and whether to consider combining the technology with other technologies;
- If the technology is currently implemented; and
- If the technology can be recommended for the alternative evaluation.

Technologies not recommended due to various reasons such as cost, maintenance, public acceptance, etc. were removed from consideration. Table B-1 lists each of the CSO abatement technologies considered and includes recommendations to include in alternatives evaluation.

Table B-1 | CSO Control Technology Screening Results

CSO Control Technology Screening Results								
TECHNOLOGY GROUP	PRACTICE	PRIMARY GOALS		COMMUNITY BENEFIT	IMPLEMENTATION AND OPERATION FACTORS	CONSIDER COMBINING W/ OTHER TECHNOLOGIES	BEING IMPLEMENTED	RECOMMENDATION FOR ALTERNATIVES EVALUATION
		BACTERIA REDUCTION	VOLUME REDUCTION					
Source Control Technologies								
Stormwater Management	Street/Parking Lot Storage (Catch Basin Control)	Low	Low	- Reduced surface flooding potential	Flow restrictions to the CSS can cause flooding in lots, yards and buildings; potential for freezing in lots; low operational cost. Effective at reducing peak flows during wet weather events but can cause dangerous conditions for the public if pedestrian areas freeze during flooding.	No	No	No
	Catch Basin Modification (for Floatables Control)	Low	None	- Water quality improvements - Reduced surface flooding potential	Requires periodic catch basin cleaning; requires suitable catch basin configuration; potential for street flooding and increased maintenance efforts. Reduces debris and floatables that can cause operational problems with the mechanical regulators.	No	Yes	No
	Catch Basin Modification (Leaching)	Low	Low	- Reduced surface flooding potential - Water quality improvements	Can be installed in new developments or used as replacements for existing catch basins. Require similar maintenance as traditional catch basins. Leaching catch basins have minor effects on the primary CSO control goals.	No	No	No
Public Education and Outreach	Water Conservation	None	Low	- Reduced surface flooding potential - Align with goals for a sustainable community	Water purveyor is responsible for the water system and all related programs in the respective City. However, water conservation is a common topic for public education programs. Water conservation can reduce CSO discharge volume but would have little impact on peak flows.	Yes	No	Yes
	Catch Basin Stenciling	None	None	- Align with goals for a sustainable community	Inexpensive; easy to implement; public education is needed. Is only as effective as the public's acceptance and understanding of the message. Public outreach programs would have a more effective result.	Yes	Yes	No
	Community Cleanup Programs	None	None	- Water quality improvements - Align with goals for a sustainable community	Inexpensive; sense of community ownership; educational BMP; aesthetic enhancement. Community cleanups are inexpensive and build ownership in the city.	Yes	Yes	No
	Public Outreach Programs	Low	None	- Align with goals for a sustainable community	Public education program is ongoing. Permittee should continue its public education program as control measures demonstrate implementation of the NMC.	Yes	Yes	No
	FOG Program	Low	None	- Water quality improvements - Improves collection system efficiency	Requires communication with business owners; Permittee may not have enforcement authority. Reduces buildup and maintains flow capacity. Only as effective as business owner cooperation.	Yes	Yes	No
	Garbage Disposal Restriction	Low	None	- Water quality improvements	Permittee may not be responsible for Garbage Disposal. This requires an increased allocation of resources for enforcement while providing very little reduction to wet weather CSO events.	Yes	No	No
	Pet Waste Management	Medium	None	- Water quality improvements	Low cost of implementation and little to no maintenance. This is a low-cost technology that can significantly reduce bacteria loading in wet weather CSO's.	Yes	Yes	No
	Lawn and Garden Maintenance	Low	Low	- Water quality improvements	Requires communication with business and homeowners. Guidelines are already established per USEPA. Educating the public on proper lawn and garden treatment protocols developed by USEPA will reduce waterway contamination. Since this information is already available to the public it is unlikely to have a significant effect on improving water quality.	Yes	No	No

	Hazardous Waste Collection	Low	None	- Water quality improvements	The N.J.A.C. prohibits the discharge of hazardous waste to the collection system.	Yes	Yes	No
Ordinance Enforcement	Construction Site Erosion & Sediment Control	None	None	- Cost-effective water quality improvements	In building code; reduces sediment and silt loads to waterways; reduces clogging of catch basins; little O&M required; contractor or owner pays for erosion control. A Soil Erosion & Sediment Control Plan Application or 14-day notification (if Permittee covered under permit-by-rule) will be required by NJDEP per the N.J.A.C.	Yes	Yes	No
	Illegal Dumping Control	Low	None	- Water quality improvements - Aesthetic benefits	Enforcement of current law requires large number of code enforcement personnel; recycling sites maintained. Local ordinances already in place can be used as needed to address illegal dumping complaints.	Yes	Yes	No
	Pet Waste Control	Medium	None	- Water quality improvements - Reduced surface flooding	Requires resources to enforce pet waste ordinances. Public education and outreach are a more efficient use of resources, but this may also provide an alternative to reducing bacterial loads.	Yes	Yes	No
	Litter Control	None	None	- Property value uplift - Water quality improvements - Reduced surface flooding	Aesthetic enhancement; labor intensive; City function. Litter control provides an aesthetic and water quality enhancement. It will require city resources to enforce. Public education and outreach are a more efficient use of resources.	Yes		
	Illicit Connection Control	Low	Low	- Water quality improvements - Align with goals for a sustainable community	Site specific; more applicable to separate sanitary system; new storm sewers may be required; interaction with homeowners required. The primary goal of the LTCP is to meet the NJPDES Permit requirements relative to POCs. Illicit connection control is not particularly effective at any of these goals and is not recommended for further evaluation unless separate sewers are in place.	Yes	Yes	No
Good Housekeeping	Street Sweeping/Flushing	Low	None	- Reduced surface flooding potential	Labor intensive; specialized equipment; doesn't address flow or bacteria; City function. Street sweeping and flushing primarily addresses floatables entering the CSS while offering an aesthetic improvement.	Yes	Yes	No
	Leaf Collection	Low	None	- Reduced surface flooding potential - Aesthetic benefits	Requires additional seasonal labor. Leaf collection maximizes flow capacity and removes nutrients from the collection system.	Yes	Yes	No
	Recycling Programs	None	None	- Align with goals for a sustainable community	Most Cities have an ongoing recycling program.	Yes	Yes	No
	Storage/Loading/Unloading Areas	None	None	- Water quality improvements	Requires industrial & commercial facilities designate and use specific areas for loading/unloading operations. There may be few major commercial or industrial users upstream of CSO regulators.	Yes	No	No
	Industrial Spill Control	Low	None	- Protect surface waters - Protect public health	PVSC has established a pretreatment program for industrial users subject to the Federal Categorical Pretreatment Standards 40 CFR 403.1.	Yes	Yes	No
Green Infrastructure Buildings	Green Roofs	None	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Local jobs - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permittee or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof vegetation. Portions of Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	No	No

	Blue Roofs	None	Medium	- Reduced heat island effect - Property value uplift - Local jobs - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permittees or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof debris. Portions of the Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	No	No
	Rainwater Harvesting	None	Medium	- Reduced surface flooding- Reduced basement sewage flooding- Align with goals for a sustainable community- Water Saving	Simple to install and operate; low operational resource demand; will require the Permittees or private owners to implement; requires regular cleaning of gutters & pipes. Portions of the Cities have densely populated areas, but this technology is limited to capturing rooftop drainage. Capture is limited to available storage, which can vary on rainwater use. Can be difficult to require on private properties.	Yes	Yes	Yes
Green Infrastructure Impervious Areas	Permeable Pavements	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Cost-effective water quality improvements - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Not durable and clogs in winter; oil and grease will clog; significant O&M requirements with vacuuming and replacing deteriorated surfaces; can be very effective in parking lots, lanes and sidewalks. Maintenance requirements could be reduced if located in low traffic areas and can utilize underground infiltration beds or detention tanks to increase storage.	Yes	No	Yes
	Planter Boxes & Tree Pits	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltration and evapotranspiration of runoff in developed areas. Flexible and can be implemented even on a small-scale to any high-priority drainage areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	No	Yes
Green Infrastructure Pervious Areas	Bioswales	Low	Low	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Local jobs - Passive and active recreational improvements - Reduced surface flooding - Reduced basement sewage flooding - Community aesthetic improvements - Reduced crime - Align with goals for a sustainable community - Increased pedestrian safety through curb retrofits	Site specific; good BMP; minimal vegetation & mulch O&M requirements; not as flexible or infiltrate as much stormwater as planter boxes. Technology requires open space and is primarily a surface conveyance technology with additional storage & infiltration benefits. Can be modified with check dams to slow water flow. Limited open space in most Cities means land can be utilized in more effective ways with the existing infrastructure.	Yes	No	Yes
	Free-Form Rain Gardens	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Passive and active recreational improvements - Reduced surface flooding - Reduced basement sewage flooding - Community aesthetic improvements - Reduced crime - Align with goals for a sustainable community	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltration and evapotranspiration of diverted runoff. Rain Gardens are flexible and can be modified to fit into the previous areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	No	Yes

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

Storage & Treatment Technology

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

SECTION C - Evaluation of Alternatives

C.1 INTRODUCTION

After undergoing the technology screening process, selected control technologies were carried forward for more detailed analysis. This additional analysis includes evaluating the performance of each alternative's ability to achieve the targeted levels of CSO control by utilizing hydrologic/hydraulic (H&H) models that allow for combining various control technologies. Alternatives that could achieve the CSO-control objectives were evaluated based on a broad range of considerations including technical merit, implementation potential and operations aspects, social impacts, public acceptance, and costs, as outlined in the DEAR submitted to NJDEP. The objective of the alternatives analysis was to develop solutions to control CSOs and cost–effectively address CSO related water quality compliance issues. The evaluation performed compared CSO discharges with and without implementation of various CSO-control alternatives, all else equal. The submitted DEAR included level of CSO control reductions to 20, 12, 8, 4, and zero CSOs per year. After submittal and approval of the DEAR, alternatives that could achieve 85% capture of the combined sewage volume were developed utilizing the overflow volume reductions achieved at the targeted frequencies.

The DEAR alternatives evaluation also analyzed a variety of Green Infrastructure (GI) technologies which would eliminate runoff from the first inch of rainfall on 5% and 10% of impervious areas. While the GI is not anticipated to have major impact on the CSO volume or frequency, it is expected to enhance Bayonne, improve water quality, and receive public support.

The section below summarizes the development and evaluation of CSO control alternatives for the City of Bayonne.

C.2 DEVELOPMENT & EVALUATION OF ALTERNATIVES

Alternatives were developed using CSO control technologies identified during the screening process, included in the DEAR. A calibrated H&H model was used for the development and performance analysis of various separate and combined technologies. To evaluate performance, the model utilized the same "typical-year" hydrologic condition – the rainfall recorded in 2004 at Newark Airport in Newark, New Jersey. The model also used the 2045 build year conditions and the anticipated demographic conditions (e.g., population, sanitary flow). Together, these conditions created a "future baseline" condition model as the platform for performance analysis. Figure C-1 presents a map of the major sewer-system elements that comprise the Bayonne model. Performance analyses considered a range of CSO control goals, such as number of CSO events per year, percent capture of combined sewage, and reduction of pathogen discharges. In addition to performance considerations, probable 20-year life cycle costs for each CSO control measure were developed to determine the feasibility of each alternative. These costs provided an additional method to compare alternatives at the same level of control.

Subsequent to the DEAR, Bayonne and the other PVSC municipalities analyzed scenarios to achieve capturing 85% of the combined sewage collected in the CSS during precipitation events on a system-wide, annual average basis. As such, no more than 15% of the total flow collected in the CSS during storm events is discharged without receiving minimum treatment.

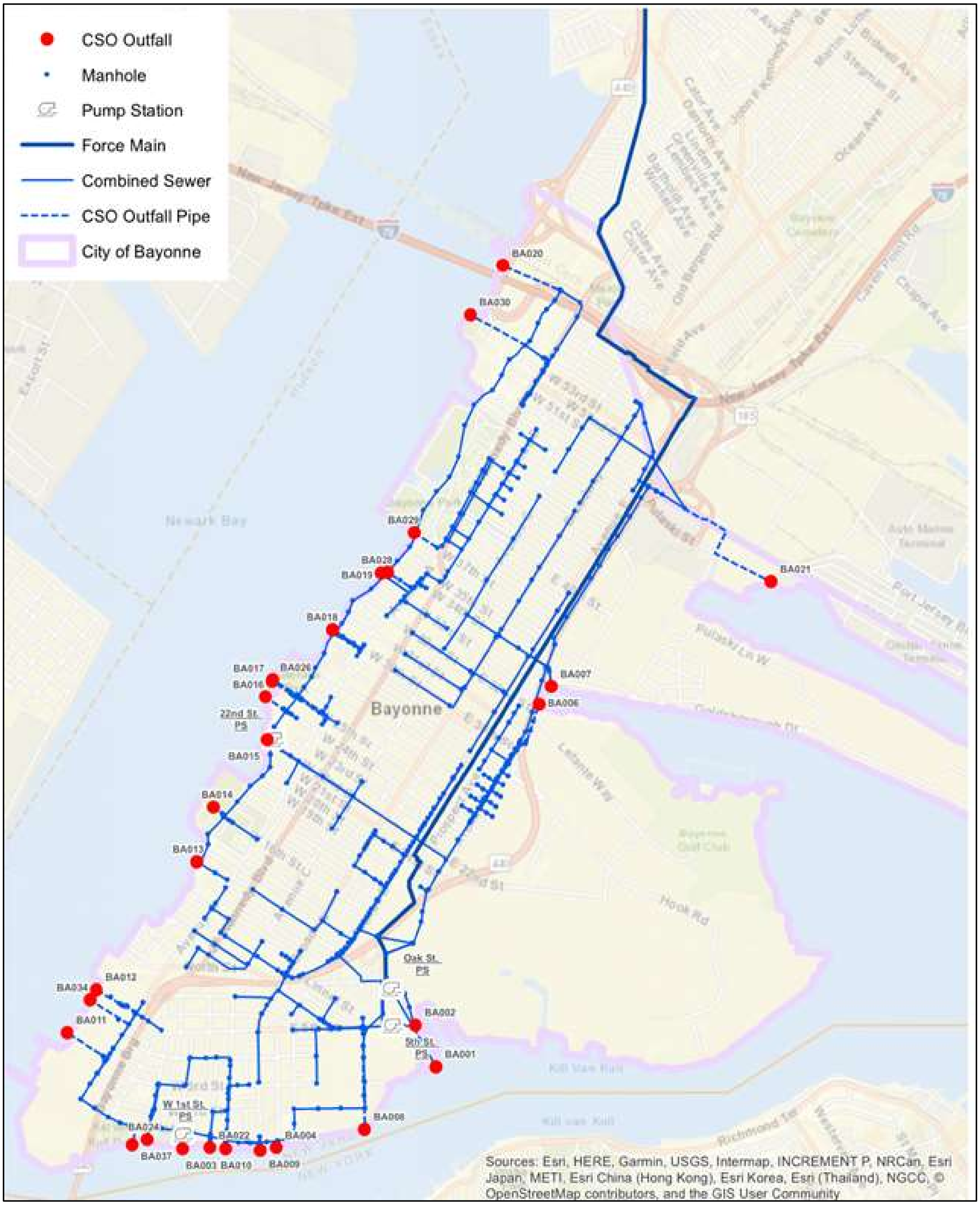

Figure C-1 | Bayonne Combined Sewer System Model Elements

C.2.1 Alternatives Control Performance

The DEAR identified CSO control alternatives for further consideration in the Long Term Control Plan. During the Development and Evaluation of Alternatives, several of these CSO control technologies were eliminated from further consideration, while others have been included in the municipal and regional control alternatives.

Water Conservation: To evaluate the potential impact of water conservation in the City, analyses assumed a 10% reduction of base (sanitary dry weather) flows. The modeling analyses indicate that such a reduction in base flows would reduce annual CSO volume by about 10 MG (1.3%) and would have no impact on the CSO-event count. Water conservation was assumed to be an ongoing measure in place through utilization of low water-use fixtures.

Green Infrastructure: Impervious surfaces (including rooftops, streets, sidewalks, parking lots) in Bayonne cover approximately 1,000 acres. Compared to the baseline of 748 MG of CSO volume and 60 CSOs/yr, GI management of runoff from 5% of the impervious area (or ~50 acres) reduces CSO volumes by about 25 MG (~3.4%) and decreases the CSO-event count by 1 (<2%). GI management of runoff from 10% of the impervious area (or ~100 acres) reduces CSO volumes by 50 MG (~6.7%) and decreases the CSO-event count by 1 (that is, no further decrease in CSO-event count from the 5% control level). Because GI can achieve relatively small reductions of CSO frequency and volume that fall short of desired performance objectives on its own, GI was considered a "complementary" solution for the development of the LTCP.

Additional Conveyance: The contracted maximum rate that Bayonne can transport wastewater to PVSC for treatment is 17.6 MGD. With minor upgrades to the Oak Street Pump Station, the existing peak flow could be increased to about 20 MGD. The modeling analyses indicated that with increasing the peak conveyance rate to 20 MGD, the impact on the frequency and volume of CSO events would be minor.

Based on the regional solutions examined by PVSC, there is an additional ~10 MGD of capacity that can be conveyed to PVSC from the force main communities. Either Jersey City or Bayonne can be provided with this additional capacity for wet weather conveyance. Per PVSC, there is greater regional benefit to providing this capacity to Bayonne. The PVSC team has noted that 27.8 MGD is the maximum permissible flow from Bayonne, including this additional capacity. The 40 MGD capacity of the OSPS is not anticipated to be fully utilized given this restriction.

Per the direction of PVSC, Bayonne is to consider two municipal alternatives – keeping the OSPS at the current pumping rate of 17.6 MGD and increasing the pumping rate to 27.6 MGD.

To enable the Oak Street Pump Station to be able to pump at a capacity of 27.6 MGD, improvements would be required, including upsizing about 6,000 feet of force main (including 4,400 feet of 24-inch diameter pipe and about 1,600 feet of 30-inch diameter pipe) to make the entire force main a 36-inch diameter pipe. Increasing the peak conveyance rate to 27.6 MGD would help in capturing 85% of the combined sewage volume, as directed by PVSC. This does not reduce CSO event frequencies, which are driven by outfalls that are independent of hydraulics at the Oak Street Pump Station. Therefore, this option was required to combine with CSO storage to develop an alternative that meets the requirements of the Presumptive approach.

Sewer Separation: Complete separation of combined sewers would eliminate CSOs to achieve the zero CSOs per year target. However, to the extent that the existing CSS captures stormwater, separation would increase discharges of stormwater, which would be subjected to current and future MS4 permitting requirements. Redevelopment is a common practice in Bayonne; where feasible the City will work with developers to provide sewer separation in concurrence with development projects.

Outfall Consolidation/Relocation: Outfall consolidation/relocation can be applied to reduce the number of outfall locations, CSO events, and/or CSO discharges to certain areas. For the purpose of alternatives evaluation, outfall consolidation/relocation was considered in combination with other alternatives, such as off-line storage tanks and tunnels.

Off-line Storage Tanks at Individual Outfalls: For the purpose of alternatives evaluation, below grade off-line storage tanks were considered at individual outfall locations with assumed dewatering for each tank within three days at two possible conveyance rates (17.6 and 27.6 MGD). Modeling analyses indicated that storage tanks are needed for both pumping rates.

Storage Tanks at Consolidated Locations: After submittal of the DEAR, scenarios were developed for the capture of 85% of the combined sewage collected in the system during precipitation events. As such, modeling was performed in order for storage tanks to meet this criterion. Two scenarios were modeled – the current OSPS pumping rate of 17.6 MGD and an increased conveyance rate of 27.6 MGD. The modeling software optimized tank locations for the offline storage analysis, given location and available land constraints.

Deep Tunnel in Bayonne: Three different deep-tunnel configurations were evaluated. Initially, a single tunnel aligned along the shoreline was assumed such that each existing outfall would deliver its overflow via its own drop shaft to the tunnel. This configuration represents a high-end cost due to the length of the tunnel as well as the maximum number of drop shafts. Then, a second configuration was developed, consolidating drop shafts to the same nine (9) locations determined for storage tanks. Finally, a third configuration was developed, again with the nine consolidated drop shafts, but using three (3) independent tunnel segments rather than a single tunnel. Each of these configurations represents similar performance to the consolidated off-line tank scenario described above, but at a different cost, as presented in Section C.2.2. Further, as with off-line storage tanks, the wastewater conveyance rate of 40 MGD to PVSC would be required for fewer than 12 CSO events per year. A local deep tunnel was not found to represent a viable CSO-control alternative in Bayonne.

Regional Deep Tunnel: The City also cooperated with North Bergen and Jersey City, neighboring municipalities that also send flows through a shared force main, to consider the possibility of utilizing a regional off-line storage tunnel for CSO flows from North Bergen, the western side of Jersey City, and Bayonne. To intercept CSO discharges, the analysis considered a regional tunnel extending roughly 18 miles, from the northern end of North Bergen to the southern end of Bayonne, at a vertical depth of 120 ft below ground. The regional tunnel would be dewatered to the Jersey City West Side Pump Station (JCWSPS), assuming the maximum rate that wastewater can be sent to PVSC's STP is 45.4 MGD (as indicated in the hydraulic model). With this dewatering limitation, tunnels would achieve the 20 and 12-CSO event frequency performance objectives, but not the 8, 4, or 0-CSO-event frequency objectives (the stored volumes cannot be dewatered quickly enough). Because the costs of the tunnel alternatives exceeded the costs of other options, this alternative was not evaluated further.

CSO Disinfection: Pathogens represent the pollutant of concern for CSO discharges. USEPA approved peracetic acid (PAA) as a primary disinfectant for wastewater in 2007. Several case studies applying PAA for CSO treatment have been undertaken in the US, including a demonstration study (HMM, 2017) conducted in Bayonne. A growing number of wastewater treatment plants in the United States have adopted PAA as a primary disinfectant. The main advantage of PAA over sodium hypochlorite is a longer "shelf life" without product deterioration. In addition, a relatively small footprint is required for PAA-disinfection facilities. For the purposes of this analysis, sizes of disinfection facilities were determined using the design peak CSO-flow rate at each outfall under the scenarios that all but 20, 12, 8, 4 and 0 CSO events are treated annually with 99.9 percent removal of pathogens. CSO Disinfection was not found to represent a viable CSO-control alternative in Bayonne.

C.2.2 Alternatives Cost Performance

Cost is a significant factor in determining the feasibility of each alternative. Probable life-cycle costs were generated as present value (PV) for a 20-year period. Estimates include capital, operation and maintenance (O&M), and contingencies as described in the DEAR. These costs are presented in Table C-1, which compares alternatives at the same level of control.

Alternative	20-Yr Life-Cycle Costs ($M)						
	20 CSO Events/year	12 CSO Events/year	8 CSO Events/year	4 CSO Events/year	0 CSO Events/year	85% CSO Capture by Volm.	Green Infrastructure
Regional Deep Tunnel, Hudson County - costs do not include estimates for increased conveyance	1,708	1,831	1,968	2,111			
Storage Tunnel in Bayonne - 4 and 8 overflows were discarded due to high costs implications.							
Single Segment	833	902					
Three Segment	716	786					
Complete Sewer Separation					828		
Individual Storage Tanks by Outfall - 20 CSOs with 17.6 MGD and 12 CSOs with 20 MGD conveyance to PVSC, 4 and 8 CSOs scenarios were discarded due to high costs implications.	473	617					
Consolidated Offline Storage Tanks - includes sewer consolidation; conveyances to PVSC of 17.6 MGD for 20 CSOs, 20 MGD for 12 CSOs and 40 MGD for 8 and 4 CSOs.	425	512	626	671			
PAA Disinfection at Consolidated Tanks for Untreated CSO Events - conveyances to PVSC of 17.6 MGD for 20 CSOs, 20 MGD for 12 CSOs and 40 MGD for 8 and 4 CSOs.	425	533	604	649			
PAA Disinfection with FlexFilter Pre-treatment at Outfalls for Untreated CSO Events	220	352	365	549			
Hudson County Regional 85% Volume Capture using Storage and 17.6 MGD Conveyance to PVSC						339	
Hudson County Regional 85% Volume Capture using Storage and 27.6 MGD Conveyance to PVSC						256	
Control of Runoff from 5% of the Impervious Area - reduces CSO volumes by 3.4% and decreases in yearly CSO-event count by 1 (<2%). (As noted, this is a complementary solution due to cost and efficacy)							44 to 311 depending on technology used
Control of Runoff from 10% of the Impervious Area - reduces CSO volumes by 6.7%, and no further decrease in CSO-event count from the 5% control level. (As noted, this is a complementary solution due to cost and efficacy)							88 to 622 depending on technology used

Table C-1 | 20-Year Life Cycle Costs for CSO Control Targets

SECTION D - SELECTION OF RECOMMENDED LTCP

D.1 INTRODUCTION

This report only considers the Bayonne municipal solutions as PVSC will submit a separate report that details potential regional solutions.

D.2 LTCP SELECTION PROCESS

The Long Term Control Plan was developed by following the Evaluation of Alternatives requirements of the NJPDES permit, including:

- Evaluate a reasonable range of CSO control alternatives that will meet the water quality-based requirements of the CWA using either the Presumption Approach or the Demonstrative Approach.
- Submit the Evaluation of Alternatives Report that will enable the permittee, in consultation with the Department, the public, owners and/or operators of the entire collection system that conveys flows to the treatment works, to select the alternatives to ensure the CSO controls will meet the water quality-based requirements of the CWA, will be protective of the existing and designated uses in accordance with NJAC 7:9b, give the highest priority to controlling CSOs to sensitive areas, and address minimizing impacts from SIU discharges. (already submitted)
- Select either Demonstration or Presumption Approach for each group of hydraulically connected CSOs and identify each CSO group and its individual discharge locations
- Evaluate a range of CSO control alternatives predicted to accomplish the requirements of the CWA.
    - Use an NJDEP approved hydrologic, hydraulic, and water quality model.
    - Utilize the models to simulate the existing conditions and conditions as they are expected to exist after construction and operation of the chosen alternatives.
    - Evaluate to practical and technical feasibility of the proposed CSO control alternatives, and water quality benefits of constructed and implementing various remedial controls and combination of such controls and activities which shall include, but not be limited to the controls below:
        - Green infrastructure
        - Increased storage capacity in the collection system
        - STP expansion or storage at the plant
        - I/I reduction
        - Sewer separation
        - Treatment of CSO discharge
        - CSO related bypass of the secondary treatment portion of the STP in accordance with NJAC requirements

The DEAR developed possible alternatives to control CSOs to meet regulatory requirements and targeted overflow frequencies. Subsequent to the DEAR, the City of Bayonne, along with all other PVSC permittees selected the Presumptive approach of capturing 85% by volume of the combined sewage collected in the CSS during precipitation events to comply with the NJPDES LTCP requirements. CSO control alternatives evaluated during the DEAR were then refined into alternatives that could meet the 85% volumetric capture requirements.

D.3 SELECTION OF ALTERNATIVE

Selection of the LTCP considered several factors including technical feasibility and applicability for CSO controls at Bayonne in conjunction with the hydraulically connected communities. In general, the selection factors included receiving water quality standards, uses, LTCP goals, and implementation and maintenance requirements. Pathogen reduction in CSO discharges, frequency and volume of untreated CSO discharges, cost, and public opinion also were included. The various options were evaluated based on:

- Performance capabilities and effectiveness under future (Baseline) conditions.
- Capability to beneficially integrate with hydraulically connected communities.
- Community benefits (GI, as an example), and potential social and environmental impacts.
- Costs implications and affordability.
- Risk and potential safety hazards to operators and public.
- LTCP Regulatory (US EPA and NJSPDES) requirements

Also considered were regional solutions versus municipality-only solutions. The regional solution, involving a parallel sewer servicing some municipalities served by PVSC, allows for Bayonne to have a higher discharge volume (285 MG) while the PVSC region as a whole achieves 85% capture. There are many other factors affecting the regional solution, including intermunicipal agreements, regulatory approval, and agreement on flow volume. The regional solution also allocates cost in a way that requires all municipalities to share fairly in the overall costs. The regional solution is covered in a separate SIAR submitted by PVSC.

The City of Bayonne has selected two potential municipal-only alternatives that meet the requirements of the NJDEP regulatory standards while providing a cost effective solution. The preferred municipal solution includes increased conveyance of 27.8 MGD from the OSPS to PVSC.

D.3.1 Description of Alternatives

For the municipal only alternative, Bayonne evaluated options for 17.6 MGD and 27.8 MGD conveyance from the OSPS to PVSC. This solution, in which Bayonne must meet all the LTCP requirements within their municipal borders, limits the discharge to 220 MG. Each alternative also includes the CSO storage tanks and the implementation of GI improvements to manage 3-5% of the overflow volume.

Municipal Only Alternative 1b with 17.6 MGD of conveyance consists of the following:

- Offline storage tanks
- GI Projects to manage 3-5% of overflow volume
- OSPS improvements to ensure long term operability and stability of the system.

Hydraulic modeling was performed to determine how much offline storage is needed to meet the 85% by volume capture requirements. Flow modeling also determined the best location of these tanks based on overflow volume, frequency, and available space for tankage. Seven tanks are needed to store a volume of 24.8 MG. While no regulatory changes are needed, the OSPS is in need of improvements to ensure operational reliability.

Municipal Only Alternative 1b with 27.8 MGD of conveyance consists of the following:

- Offline storage tanks
- GI Projects to manage 3-5% of overflow volume
- Upgrades to the Oak Street Pump Station and the OSPS force main.

Five tanks are needed to store a volume of 19.8 MG. In this scenario the OSPS is assumed to pump wastewater to PVSC at a rate of 27.8 MGD. Upgrades to the pump station as well as 6,000 LF of force main are included. This rate was provided to Bayonne by PVSC, as an additional 10.2 MGD of conveyance is available to either Bayonne or Jersey City. For this to happen, PVSC must allow for Bayonne to pump at this increased rate. Additionally, NJDEP must allow for these changes to the associated permits. Approximately 6,000 LF of existing force main will need to be replaced with 36” pipe to accommodate the increase in OSPS flow.

D.3.1.1 *Pump Station/Force Main Improvements*

The OSPS conveys flow to the PVSC wastewater treatment plant. This pump station is in need of updates to ensure continued reliable operation regardless of whether 17.6 MGD or 27.8 MGD is conveyed.

At the beginning of 2020, an analysis was performed on the OSPS to determine what upgrades would be needed to continue a flow rate of 17.6 MGD and/or meet the 27.8 MGD flow rate. This analysis resulted in the necessary improvements included in Table D-1.

Oak Street Pump Station Improvements		
Priority	Item	Risk
1	HVAC System in Stormwater Bar Screen Room	5
2	Replace Sanitary Bar Screens	4.5
3	HVAC System in Electrical Room & Dry Pit	4.5
4	Replace Sanitary HVAC & Install Fire Alarm	4
5	Replace Standby Generator & Remove UST	4
6	Replacement of Dry Pit Sanitary Pumps	3
7	Replace Grit Removal/Handling System	2.5
8	Replace Damaged Safety Railing	2
9	Install Gas Detection System	2

Table D-1 | Oak Street Pump Station Assessment

Items ranks with a risk score of 2 or higher were determined to be very high risk and of immediate concern. This proposed list of improvements does not include items of lower risk. As such, all of these items are deemed to be necessary and included in both alternatives.

Based on information provided by HDR and the DEAR, the existing force main can convey up to 20 MGD to PVSC. Flows above that rate will require upsizing approximately 6,000 LF of 24-inch and 30-inch force main to 36-inch force main. Improvements needed for the 17.6 and 27.8 MGD options are as follows.

17.6 MGD

- Reliability upgrades to existing pump station

27.8 MGD

- Upgrade existing pumps to convey 27.8 MGD
- Increase existing 24-inch and 30-inch force main to 36-inch diameter

D.3.1.2 *Offline CSO Storage Tanks*

Offline CSO Storage was selected as the primary CSO control technology for the municipal only alternatives. The hydraulic model was used to identify which CSO storage tanks provide the most economical approach for achieving the overflow reductions required to meet the 85% volumetric capture goals.

The 17.6 MGD conveyance scenario results in overflow storage tanks being needed at 7 locations providing a total storage volume of 24.8 MG. They are shown in Table D-2.

Alternative 1b Selected Improvements – OSPS 17.6 MGD Conveyance		
Tank Location	Size (MG)	Location Notes
BA001/002	14	Former location of Bayonne WWTP; existing tankage to be repurposed.
BA007	3.2	Coordination with developer required.
BA021	2.0	Coordination with PANYNJ required.
BA015	2.0	Location acceptable as is.
BA017	1.6	Location acceptable; coordinate with proposed redevelopment.
BA010	1.0	Coordinate to ensure location is within clean soils area.
BA014	1.0	Location acceptable as is.
Total	**24.8**	

Table D-2 | Oak Street Pump Station Assessment

The 27.8 MGD conveyance scenario is similar to the 17.6 MGD option, with the exception that the pump station and force main are moving more flow and fewer tanks are needed. Table D-3 illustrates the offline storage needed for this option.

Alternative 1b Selected Improvements – OSPS 27.8 MGD Conveyance		
Tank Location	Size (MG)	Location Notes
BA001/002	11	Former location of Bayonne WWTP; existing tankage to be repurposed.
BA007	3.2	Coordination with developer required.
BA021	2.0	Coordination with PANYNJ required.
BA015	2.0	Location acceptable as is.
BA017	1.6	Location acceptable; coordinate with proposed redevelopment.
Total	**19.8**	

Table D-3 | Storage Requirements for Alternative 1b with 27.8 MGD Conveyance

Storage tank locations and volumes are shown in Figure D-1.

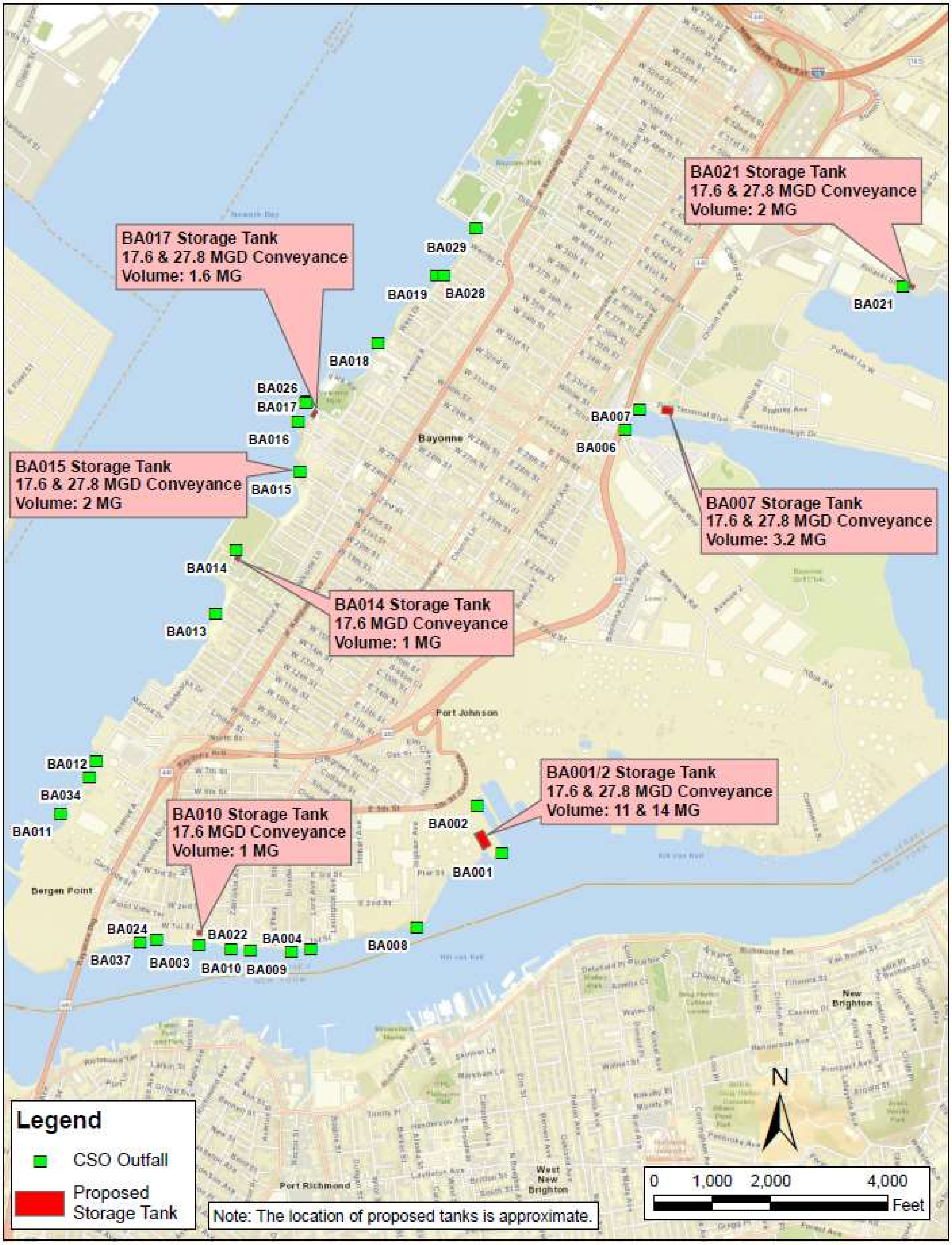

Figure D-1 | Bayonne Outfall Storage Location Map

BA001/002 is located at the old wastewater treatment plant (WWTP) site, as shown in Figure D-2. This is the location of approximately 50% of the Bayonne overflow volume, so increasing storage at this location is an important part of meeting the goals of the LTCP. It is intended to repurpose the existing tanks to store overflow. This storage location is the largest, requiring 14 MG for the 17.6 MGD pumping scenario or 11 MG for the 27.8 MGD pumping scenario.

Figure D-2 | BA001/002 Storage Tank Location

This site, at **BA007**, is currently under construction. It is planned to be redeveloped with a roadway and waterfront walkway. There is parking planned as part of the mixed-use development and the tank could be installed under the parking lot. The City of Bayonne has indicated a willingness to work with the developer for tank installation. This tank is to be sized to contain 3.2 MG. The tank location is shown in Figure D-3 while the preliminary developer's plan with the tank located is provided in Figure D-4.

Figure D-3 | BA007 Storage Tank Location

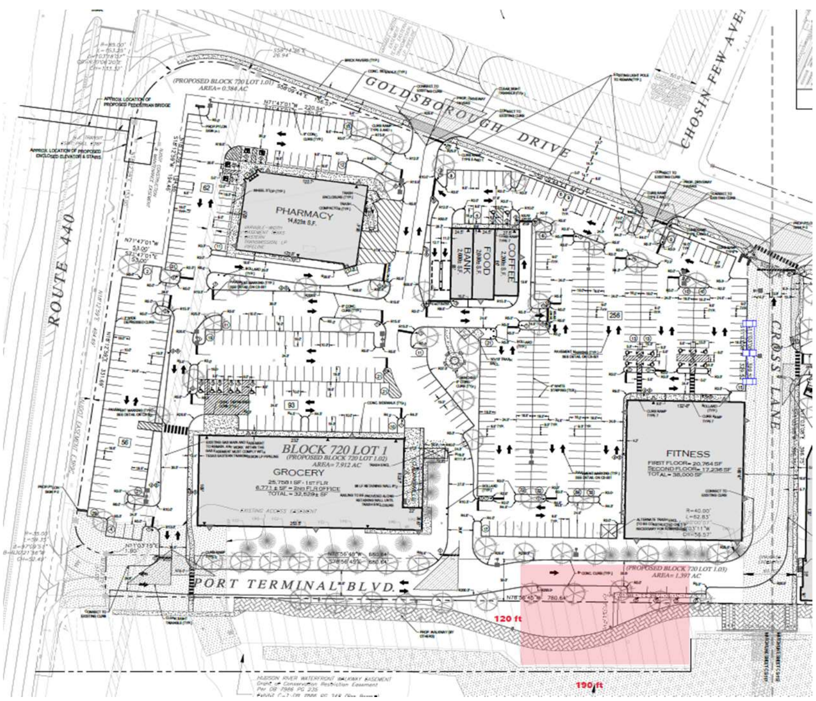

Figure D-4 | Developer's Plan for BA007 Storage Tank

BA021 is located on the east side of Bayonne, on Port Authority of New York and New Jersey land. It is recommended to locate this tank under existing parking, so that the beach and waterfront area remains undisturbed. This tank is sized at 2 MG. Coordination with the Port Authority is required.

Figure D-5 | BA021 Storage Tank Location

BA015 is located on the west side of Bayonne, near an area also being redeveloped. The proposed tank location is shown in Figure D-6. This development is planned to include underground storage tanks. While the developer currently has approximately 0.4 MG of storage planned (see Figure D-7), approximately 2 MG of storage is needed based on the hydraulic model. Bayonne has indicated a willingness work with this developer to install appropriately sized tanks in the area.

Figure D-6 | BA015 Tank Location

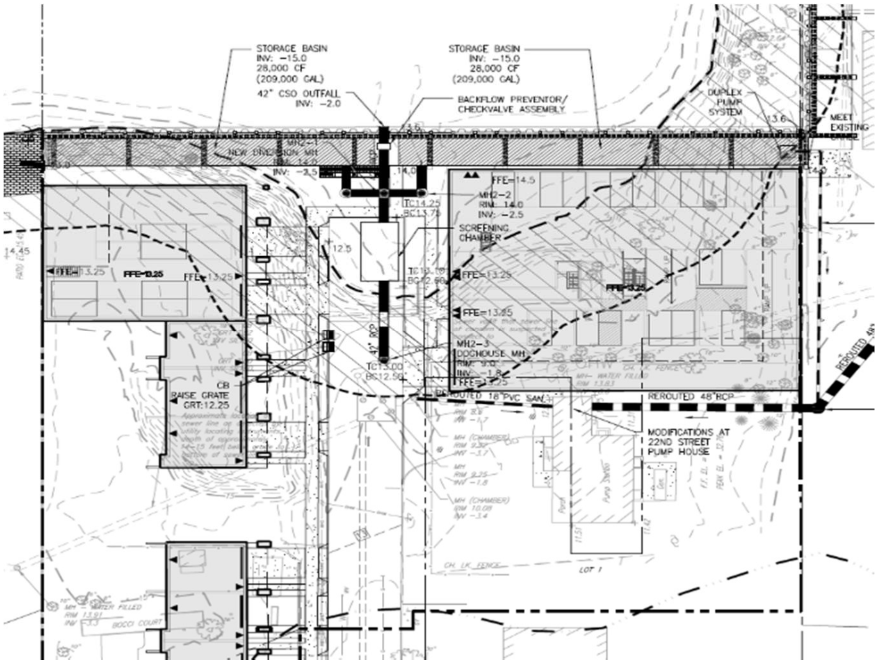

Figure D-7 | Developer Plans for BA015 Area

BA017 is located on the east side of Bayonne. This tank location is a proposed park and waterfront area. The tank will be located in green space to the north of the proposed parking area. This tank is sized at 1.6 MG. Figure D-8 illustrates this location.

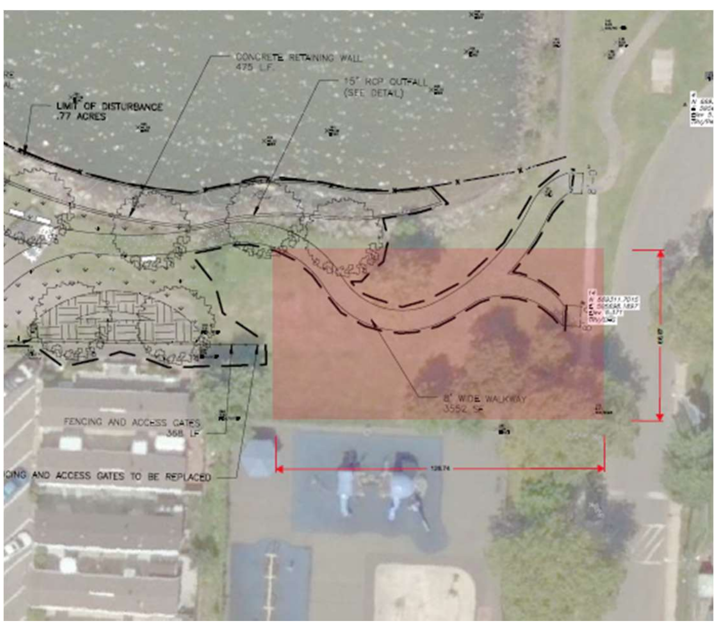

Figure D-8 | Storage Tank Location for BA017

BA010 is located at the southern end of Bayonne. This tank is proposed to be 1 MG for the 17.6 MGD pumping scenario and is shown in Figure D-9. This tank was not required for the 27.8 MGD pumping scenario. This area of Bayonne is currently under a chromium-impacted soil survey. It is recommended to avoid this area. As such, the tank is recommended to be installed under the parking lot and within the area that is not under investigation. This is the area shown in white in Figure D-9.

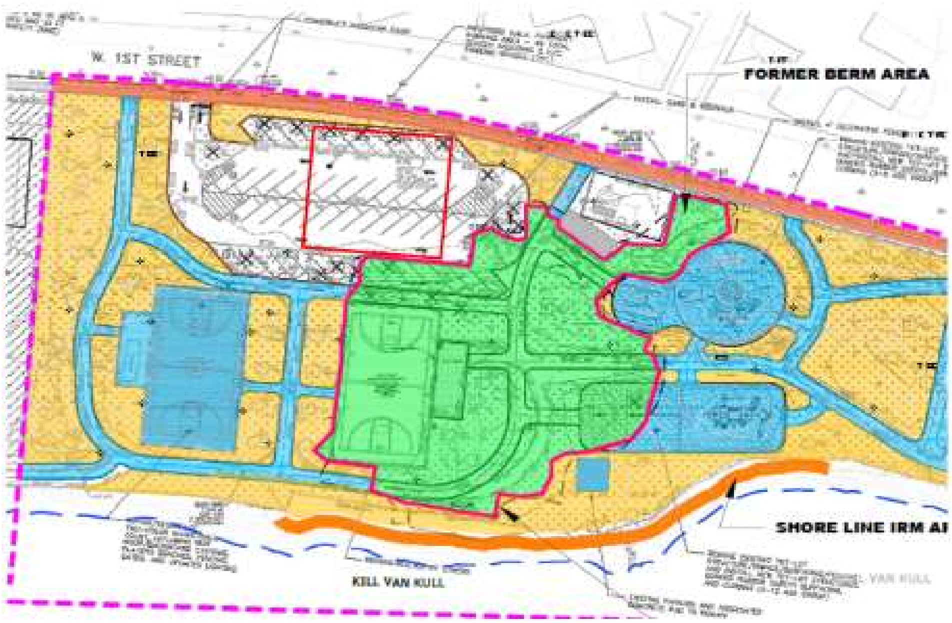

Figure D-9 | Storage Tank Location for BA010

Figure D-10 | Storage Tank Location for BA014

BA014 is located in a park area on southeast side of Bayonne. This tank is sized at 1 MG for the 17.6 MGD pumping scenario. It is proposed to be located under existing tennis courts in the park area. This tank was not required for the 27.8 MGD pumping scenario. The tank location for BA014 is shown in Figure D-10.

D.3.1.3 *Green Infrastructure*

GI will be incorporated into either alternative. GI inclusion in the alternatives will provide important benefits to the community by improving the surrounding air quality, reducing the heat island effect, reducing surface flooding, and providing public education opportunities. GI options consist of tree pits, pervious pavement, and underground detention basins. An underground detention basin is already under design through a City project at Fitzpatrick Park.

Example GI projects and implementation costs are provided as part of this report. However, actually siting and sizing green infrastructure practices will require additional investigations, including geotechnical investigations, that go beyond this planning level study. Site specific drainage area analysis will be performed during the planning and design stages of each project, however preliminary estimates indicate that roughly 40 total drainage acres managed is feasible.

Bayonne plans to route at least 3% of impervious surface runoff to tree pits, pervious pavement, and underground detention basins. Figure D-11 and Figure D-12 show example concepts for the Mary J. Donohoe School and at 1st & Avenue C housing, respectively. Tree pits, represented in green in the figures below, could be located along the roadways while providing room for safe sidewalks and pedestrian movement. Tree pits would receive runoff from the road and adjacent impervious surfaces, represented in yellow in the figures. If site conditions limit tree pit feasibility, pervious pavement can be installed at existing parking lots and playgrounds within the properties. Downspouts can be routed to GI systems to collect rainfall from rooftops.

Figure D-11 | Example of GI at Mary J. Donohoe School

Figure D-12 | Example of GI at 1st & Avenue C Housing

Early green infrastructure work will include the Fitzpatrick Park GI project, currently under development, which encompasses approximately 5.74 acres of tributary area, including the park area of 0.67 acres. The total volume of the basin is 37,692 cubic feet. The underground detention basin proposed for the park will consist of approximately 1,890 linear feet of 48" high density polyethylene (HDPE) pipe with an outlet structure.

Four other possible GI projects are proposed during the first 10 years of the LTCP schedule. Possible project locations include, Mary J. Donohoe School, Midtown School, 1st & Avenue C housing, and Henry E Harris School. Each school and housing location would provide approximately 1 to 2.5 acres of impervious surface managed by GI. Tree pits and pervious pavement are proposed for these locations.

Future GI implementation will each include approximately 27 acres of additional GI managed impervious surfaces. Nine housing projects and nine schools have been evaluated as possible options for development during these later phases. These phases are planned for construction beginning in 2031 and 2041, respectively. The goal for all three phases is to manage a total of 40 acres of impervious surface to GI within 30 years.

D.3.2 Remaining Overflows

Flow modeling was completed for both 1b municipal solutions – OSPS pumping rates of 17.6 MGD and 27.8 MGD with 5% GI. Table D-4 and Table D-5 illustrate the existing overflow volume and anticipated overflow volume with the 17.6 and 27.8 MGD solutions, respectively. Both solutions meet the 220 MG volume goal needed to meet the 85% removal requirement. The models assume that the wet-weather period excludes the initial 0.1" of rainfall and includes the trailing 12 hours, beginning 0.1" prior to the end of the storm. The baseline percent capture for Bayonne is 48.9%. The scenarios achieve >85% capture.

Alternative 1b Selected Improvements – OSPS 17.6 MGD Conveyance with 5% GI				
Outfall	Existing		Proposed	
	Volume (MG)	Frequency	Volume (MG)	Frequency
BA001	379.8	50	61.2	10
BA002	12.0	10	0	0
BA003	6.8	24	4.2	18
BA004	0.2	4	0	1
BA006	11.4	29	10.3	29
BA007	56.0	32	7.5	5
BA008	5.9	18	4.3	17
BA009	3.1	25	2.5	23
BA010	15.3	31	2.6	9
BA011	5.1	32	4.8	32
BA012	11.5	37	11.0	36
BA013	0.5	17	0.5	15
BA014	13.2	32	0.7	1
BA015	45.4	46	4.0	6
BA016	5.7	32	5.6	33
BA017	51.9	54	8.0	11
BA018	13.7	45	13.4	45
BA019	34.9	31	33.9	31
BA020	9.6	30	9.2	29
BA021	53.1	40	11.0	7
BA022	0.0	0	0.0	0
BA024	0.4	7	0.4	7
BA026	1.3	8	0.5	6
BA028	0.0	1	0.0	0
BA029	7.4	24	7.1	23
BA030	1.5	14	1.5	13
BA034	0.2	7	0.2	7
BA037	1.1	8	0.9	8
BA006_STORM	25.9	64	25.9	64
Total CSO Volume	747.3		205.2	

Table D-4 | Overflows for Alternative 1b with 17.6 MGD Conveyance with 5% GI

Alternative 1b Selected Improvements – OSPS 27.8 MGD Conveyance with 5% GI				
Outfall	Existing		Proposed	
	Volume (MG)	Frequency	Volume (MG)	Frequency
BA001	262.3	43	44.2	8
BA002	11.4	9	0	0
BA003	6.0	23	5.6	23
BA004	0.2	4	0.1	3
BA006	9.8	29	9.2	29
BA007	53.3	32	6.7	5
BA008	4.0	17	3.1	15
BA009	2.9	24	2.7	23
BA010	13.4	31	12.9	29
BA011	5.1	32	4.9	32
BA012	11.5	37	11.1	36
BA013	0.5	17	0.5	15
BA014	13.2	32	12.8	32
BA015	45.4	46	3.8	4
BA016	5.7	32	5.7	33
BA017	51.9	54	7.4	9
BA018	13.7	45	13.5	45
BA019	34.9	31	33.9	31
BA020	9.6	30	9.2	29
BA021	52.3	42	10.0	7
BA022	0.0	0	0.0	0
BA024	0.4	7	0.4	7
BA026	1.3	8	0.5	6
BA028	0.0	1	0.0	1
BA029	7.4	24	7.1	23
BA030	1.6	14	1.5	13
BA034	0.2	7	0.2	7
BA037	1.1	8	1.0	8
BA006_STORM	25.9	64	25.9	64
Total CSO Volume	618.9		207.8	

Table D-5 | Overflows for Alternative 1b with 27.8 MGD Conveyance with 5% GI

D.3.3 Ability to Meet Water Quality Standards

Per the permit, it is noted that:

"The 'Presumption' Approach, in accordance with NJAC 7:14A-11 Appendix C provides: 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."

Bayonne is meeting the requirements of capturing 85% by volume of the combined sewage collected in the CSS. No more than 15% of the total flow collected in the CSS during storm events is discharged without receiving minimum treatment. By this method, the water quality standards are met.

D.3.4 Non-Monetary Factors

Throughout the LTCP planning process, the participating public emphasized a desire to have green infrastructure included in Bayonne's LTCP. Although green infrastructure was found to provide some benefit to CSO reductions, it was not deemed feasible to have a green only or primary green LTCP that could achieve the overflow reduction targets. Ultimately Bayonne has decided to include a commitment to constructing green infrastructure practices as part of their LTCP due to the public's input on this matter.

D.3.5 Cost Opinion

To provide consistency in cost estimating throughout the communities that discharge wastewater to PVSC, PVSC released "Updated Guidance on Costing for LTCP CSO Planning" to all PVSC permittees. As per the memo, it "provides updated guidance on costing with a goal of establishing standardized unit pricing for improved consistency and ability to evaluate short-listed alternatives…". Cost guidance was provided for satellite storage tanks and pipe installation, among other infrastructure. However, no cost guidance was provided for pump station improvements, thus no guidance is applicable to the potential upgrades at the OSPS.

For calculating the life cycle cost, PVSC provided a Present Worth Factor (PWF) of 15.227 to all permittees.

To calculate O&M cost, per the memo, it was assumed that storage facilities would require a visit by a crew following each storm event for flushing, cleaning, and overall maintenance, and that there would be 60 storm events per year. Tank maintenance time was based on the tank size (3/4 day for 1 MG tank, versus 2 days for a 10 MG tank).

The capital and O&M costs for installing and maintaining GI were provided by PVSC as part of their costing guidance. Based on this document, capital costs for GI are $390,000 per acre and O&M costs are $2,250 per year per acre. These costs are specifically from the PVSC provided document and actual costs may vary from these assumptions.

No information was provided by PVSC for pump station costs. Costs were based on a previously completed analysis by the City of Bayonne. Pump station O&M costs were estimated at 5%.

Bayonne recently completed a study related to the OSPS that involved costs for future improvements. Table D-6 provides details on the necessary pump station improvements and costs.

Oak Street Pump Station Upgrade Cost	
Upgrade Feature	Estimated Capital Cost
HVAC System in Stormwater Bar Screen Room	$1,000,000
Replace Sanitary Bar Screens	$2,000,000
HVAC System in Electrical Room & Dry Pit	$1,400,000
Replace Sanitary HVAC & Install Fire Alarm	$950,000
Replace Standby Generator & Remove UST	$1,600,000
Replacement of Dry Pit Sanitary Pumps	$1,200,000
Replace Grit Removal/Handling System	$1,600,000
Replace Damaged Safety Railing	$40,000
Install Gas Detection System	$150,000
20% Contingency	$1,998,000
Total	**$11,928,000**

Table D-6 | Oak Street Pump Station Upgrade Costs

Costs for pipes by diameter were also provided by PVSC. Per PVSC guidance, $3,800/LF is to be used for 36-inch pipe. Based on existing record plans, approximately 6,000 LF of pipe is needed to be increased in size to accommodate the increase in pumping rate.

D.3.5.1 *17.6 MGD OSPS Option*

Costs for the 17.6 MGD OSPS option are provided in Table D-7. These costs were all developed using the PVSC guidance memorandum. This option has three components – green infrastructure, storage tanks, and upgrades to the pump station. The OSPS pumping rate is 17.6 MGD. Seven (7) tanks are needed to store a volume of 24.8 MG.

Alternative 1b Selected Improvements – OSPS 17.6 MGD Conveyance and 5% GI			
Tank	Updated Capital Cost ($M)	Updated Annual O&M Cost ($M)	Updated Life Cycle Cost ($M)
BA001/002	160.58	0.22	163.92
BA007	47.45	0.11	49.20
BA021	32.18	0.09	33.60
BA015	32.18	0.09	33.60
BA017	26.77	0.08	28.05
BA010	18.16	0.07	19.20
BA014	18.16	0.07	19.20
Green Infrastructure	15.6	0.09	16.97
PS	12	0.6	21.14
Total	**363.08**	**1.27**	**384.09**

Table D-7 | Costs for Alternative 1b with 17.6 MGD Conveyance

D.3.5.2 *27.8 MGD OSPS Option*

This option has four components: green infrastructure, storage tanks, pump station upgrades and force main upgrades.

The same cost standardization memo was followed for this option and the costs for the tanks are the same. Storage tanks are not needed at BA010 and BA014 in this option. The five (5) tanks will store a volume of 19.8 MG.

Table D-8 provides the cost of offline storage with 27.8 MGD OSPS conveyance.

Alternative 1b Selected Improvements – OSPS 27.8 MGD Conveyance and 5% GI			
Item	Updated Capital Cost ($M)	Updated Annual O&M Cost ($M)	Updated Life Cycle Cost ($M)
BA001/002	131.58	0.20	134.58
BA007	47.45	0.11	49.20
BA021	32.18	0.09	33.60
BA015	32.18	0.09	33.60
BA017	26.77	0.08	28.05
Green Infrastructure	15.60	0.09	16.97
OSPS Upgrade to 27.8 MGD	12	0.6	21.14
36" Force Main	22.87	0.06	23.91
Total	**320.76**	**1.33**	**341.06**

Table D-8 | Costs for Alternative 1b with 27.8 MGD Conveyance

D.3.6 Selection of Recommended Alternative

The selected alternative(s) provide offline storage, green infrastructure, reliability improvements to the pump station and potential increased conveyance from the OSPS to PVSC. Due to the regulatory uncertainty surrounding additional conveyance to PVSC, options with and without increased conveyance are provided.

Information about the recommended alternative(s) is included in Table D-9.

Summary of Selected Alternatives					
Alternative	% Capture	Volume Captured (MG)	CSO Events	Capital Cost ($M)	Life Cycle Cost ($M)
Offline Storage & GI with 17.6 MGD from OSPS	86	542.1	487	363.08	384.89
Offline Storage & GI with PS & FM Upgrade to 27.8 MGD from OSPS	86	411.1	537	320.76	341.06

Table D-9 |Summary of Selected Alternatives

D.4 Description of Recommended LTCP

Bayonne's preferred municipal only LTCP is Alternative 1b with 27.8 MGD of conveyance which consists of offline storage tanks, GI, and upgrades to the Oak Street Pump Station and related force main. Five (5) tanks are needed to store a volume of 19.8 MG. Additionally, the OSPS is assumed to pump wastewater to PVSC at a rate of 27.8 MGD. This rate was provided to Bayonne by PVSC, as an additional 10.2 MGD of conveyance is available to either Bayonne or Jersey City. For this to happen, PVSC must allow for Bayonne to pump at this increased rate. Additionally, NJDEP must allow for these changes to the associated permits. Additionally, approximately 6,000 LF of existing force main will need to be replaced with 36" pipe.

If agreement can't be reached on pumping additional flows to PVSC, Bayonne would revert to Alternative 1b with 17.6 MGD of conveyance consisting of offline storage, GI, and upgrades to the Oak Street Pump Station to meet the 85% by volume overflow removal requirements. Flow modeling was performed to determine the best location of the tanks based on overflow volume, frequency, and available space for tankage. Seven (7) tanks are needed to store a volume of 24.8 MG. This alternative allows for the Oak Street Pump Station to pump at agreed upon flow of 17.6 MGD to PVSC. No regulatory changes are needed.

SECTION E - FINANCIAL CAPABILITY

The PVSC consultant team developed the Financial Capability Assessment (FCA) on behalf of each Permittee within the PVSC district. This included establishing the FCA model, with input from the municipality, preparing a municipality specific FCA Memorandum, and authoring this section of the Selection and Implementation Report.

E.1 INTRODUCTION

This section of the City of Bayonne's Selection and Implementation of Alternatives Report (SIAR) quantifies the projected affordability impacts of Bayonne's proposed long term CSO controls for the Bayonne combined sewer system (CSS) and updates the 2019 preliminary FCA memo that was intended to guide the development and selection of long term controls. This section is excerpted from a memorandum prepared by the Passaic Valley Sewerage Commission (PVSC) which is incorporated as Appendix P of PVSC's SELECTION AND IMPLEMENTATION OF ALTERNATIVES FOR LONG TERM CONTROL PLANNING FOR COMBINED SEWER SYSTEMS - REGIONAL REPORT (Regional Report).

The Financial Capability assessment is a two-step process including Affordability which evaluates the impact of the CSO control program on the residential ratepayers and Financial Capability which examines a permittee's ability to finance the program. Affordability is measured in terms of the Residential Indicator (RI) which is the percentage of median household income spent on wastewater services. Total wastewater services exceeding 2.0% of the median household income are considered to impose a high burden by USEPA. The financial capability analysis uses metrics similar to the municipal bond rating agencies.

USEPA encourages the use of additional information and metrics to more accurately capture the impacts of the proposed CSO controls on the permittee and its residents. Therefore, this FCA includes information on the impacts of future costs among lower income residents and within the context of local costs of living.

Detailed discussion of the FCA for the PVSC service area and Permittees can be found in the Regional Report and a detailed analysis of the City of Bayonne's FCA can be found in the FCA Memorandum specifically written for Bayonne attached as part of Appendix P of the Regional Report.

E.2 BASELINE CONDITIONS (without CSO Controls)

The estimated annual cost for wastewater services for a typical single-family residential user for 2020 is $650. Based on the estimated MHI of $59,900 the Residential Indicator was approximately 1.2% in 2020, or at the border between what the EPA guidance defines as a low burden and a medium burden. By definition the current residential indicator for one half of the households is greater than the 1.2%.

In Bayonne, 15.7% of the population was living below the poverty line. The total Census households are broken out by income brackets on Table E-1 below, along with the respective current Residential Indicators by income bracket. The RI for each bracket was calculated from the mid-point income within the bracket. At the lowest income levels, the current RI is already more than 3.5%.

Current Residential Indicator Analysis				
Income Bracket	Households		Bracket Average Income	Bracket RI at Typical Cost per Household
	Number	Cumulative		
Less than $10,000	2,189	2,189	$5,000	14.0%
$10,000 to $14,999	1,061	3,250	$12,500	5.6%
$15,000 to $24,999	2,403	5,653	$20,000	3.5%
$25,000 to $34,999	2,410	8,063	$30,000	2.3%
$35,000 to $49,999	3,046	11,109	$42,500	1.7%
$50,000 to $74,999	4,496	15,605	$62,500	1.1%
$75,000 to $99,999	2,826	18,431	$87,500	0.8%
$100,000 to $149,999	3,302	21,733	$125,000	0.6%
$150,000 to $199,999	2,011	23,744	$175,000	0.4%
$200,000 or more	1,469	25,213	$200,000	0.4%
Total	**25,213**			

Table E-1 | Analysis of the Current Residential Indicator

PVSC has developed a time-based model that calculates annual costs and revenue requirements based on assumed program costs, schedules and economic variables such as interest and inflation rates. The residential indicator is calculated for each year based upon the costs per typical residential users which changes annually based on the annual system revenue requirements.

The estimated inflationary impacts on wastewater costs per typical single-family residential user without additional CSO control costs are shown on Table E-2. The costs are projected to the year 2051. The use of 2051 is based on the LTCP implementation schedule for Bayonne's Municipal Control Alternative in Section F of this SIAR report which targets the completion of capital improvements through 2050.

The regional alternative developed by PVSC and the combined sewered municipal permittees within its service area would result in lowered overall costs for the control of CSOs within the PVSC service area. Under this approach both the costs of the regional facilities such as a relief interceptor and the resultant savings would be allocated amongst the PVSC municipalities with combined sewer systems. As the basis of this allocation remains under discussion as of the writing of this SIAR, the FCA focuses on implementation of the Municipal Control Alternative. Should the permittees come to agreement on the cost allocation for the Regional Control Plan, the FCA will be revisited to reassess the affordability and schedule for implementation of the LTCP.

Assuming inflation, the projected cost per typical single family residential user are projected to increase from $701 in 2020 to $2,298 in 2051 with a Residential Indicator of 2.2%. Thus, assuming inflation the residential indicator will exceed the 2.0% EPA high burden trigger without the incremental costs of CSO controls.

2051 Projected Residential Indicator Without LTCP		
Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2051
RI	0.8%	1.4%
Annual $	$701	$1,528

Table E-2 | Bayonne Projected Residential Indicator in 2051 Without CSO Controls

E.3 SUMMARY AND CONCLUSION

E.3.1 Affordability

Bayonne has identified a long term CSO control strategy that will achieve 85% capture of wet weather flows during the typical year utilizing controls within and implemented by the City. These controls are summarized on Table E-3.

Bayonne Municipal CSO Control Costs				
	17 MGD CONVEYANCE to PVSC		27 MGD CONVEYANCE to PVSC	
CSO Control Element	Capital Costs ($ millions)	Incremental Annual O&M Costs ($ millions)	Capital Costs ($ millions)	Incremental Annual O&M Costs ($ millions)
Green Infrastructure	$15.6	$90,000	$15.6	$90,000
OSPS Improvements	$12.0	$600,000	$12.0	$600,000
Forcemain Capacity Increase	N/A	N/A	$23.0	$60,000
Storage Tanks	N/A	N/A	N/A	N/A
BA010	$18.2	$69,000	N/A	N/A
BA015	$32.2	$93,000	$32.2	$93,000
BA007	$47.5	$115,000	$47.5	$115,000
BA017	$26.8	$85,000	$26.8	$85,000
BA021	$32.2	$93,000	$32.2	$93,000
BA014	$18.2	$69,000	N/A	N/A
BA001/002	$160.6	$219,000	$131.6	$20,000
Totals	**$363.1**	**$1,432,000**	**$320.8**	**$1,156,000**

Table E-3 | Bayonne's Selected CSO Controls

Implementation of the $363 million 17 MGD (conveyance to PVSC) Bayonne Municipal Control Alternative results in projected annual costs per typical single family user of $1,336 (without inflation) and works out to a residential indicator of 2.4% in 2051, the first year after the projected full implementation of the controls ending in 2050. Accounting for inflation, annual costs would grow to $3,825 with a residential indicator of 3.6% in 2051 as shown in Table E-4.

Implementation of the $321 million 27 MGD (conveyance to PVSC) Bayonne Municipal Control Alternative results in projected annual costs per typical single family user of $1,222(without inflation) and works out to a residential indicator of 2.2% in 2051. With inflation, annual costs would grow to $3,642 with a residential indicator of 3.5% in 2051 also as shown in Table E-4.

Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2051					
		No LTCP		With 17 MGD Conveyance ($363M Capital Costs)		With 27 MGD Conveyance ($321M Capital Costs)	
		With Inflation	Without Inflation	With Inflation	Without Inflation	With Inflation	Without Inflation
RI	1.2%	2.2%	1.2%	3.6%	2.4%	3.5%	2.2%
Annual $	$701	$2,298	$701	$3,825	$1,336	$3,642	$1,222

Table E-4 | Bayonne Projected Residential Indicator Upon Full Implementation of the Municipal Control Alternative

This analysis does not reflect the current and lingering financial impacts as a result of the COVID -19 pandemic and should be revisited upon memorializing the LTCP implementation schedule in the City's next NJPDES Permit.

E.3.2 Financial Capability Assessment

The second part of the financial capability assessment - calculation of the financial capability indicator for the permittee - includes six items that fall into three general categories of debt, socioeconomic, and financial management indicators. The six items are:

- Bond rating
- Total net debt as a percentage of full market real estate value
- Unemployment rate
- Median household income
- Property tax revenues as a percentage of full market property value
- Property tax revenue collection rate

Each item is given a score of three, two, or one, corresponding to ratings of strong, mid-range, or weak, according to EPA-suggested standards. The overall financial capability indicator is then derived by taking a simple average of the ratings. This value is then entered into the financial capability matrix to be compared with the residential indicator for an overall capability assessment.

As shown on Table E-5, the overall score for the financial indicators is 2.2 yielding an EPA Qualitative Score of "midrange". This calculation is based on the use of six of the six indicators that are applicable to Bayonne. The derivation of this score is presented in the detailed FCA memorandum presented in Appendix P of the PVSC Regional Report. As each of the financial indicators are generally based upon publicly available data from 2017 or earlier, this analysis does not reflect the current and lingering impacts of the COVID -19 pandemic and should be revisited upon memorializing the LTCP implementation schedule in the City's next NJPDES Permit.

Financial Capability Benchmarks		
Indicator	**Rating**	**Numeric Score**
Bond Rating	Mid-Range	3
Overall Net Debt as a Percent of Full Market Property Value	Weak	2
Unemployment Rate	Strong	3
Median Household Income	Mid-range	2
Property Tax as a Percent of Full Market Property Value	Mid-Range	2
Property Tax Collection Rate	Strong	3
Total		13
Overall Indicator Score: (numeric score / number of applicable indicators)		2.2
EPA Qualitative Score		**Mid-Range**

Table E-5 | Permittee Financial Capability Indicator Benchmarks

E.3.3 Implementation Feasibility Implications

While having a relatively high current median household income; structural financial limitations facing the City of Bayonne and the high projected (current dollar) cost of the Municipal Control Alternative CSO controls are projected to result in untenably high household burdens at between 3.5% and 3.6% assuming inflation. Even if inflation is not factored into the analysis, the resulting residential indicators ranging from 2.2% to 2.4% would be well over the 2.0% high burden threshold. Moreover, the reality of the high poverty rates, low household incomes compared to the rest of New Jersey and nationally and the high costs of living in Bayonne argue strongly that the EPA metric understates the impacts of the CSO control costs on the residents of the City.

Additional economic factors are presented in the Bayonne FCA Memorandum presented in Appendix P of the SELECTION AND IMPLEMENTATION OF ALTERNATIVES FOR LONG TERM CONTROL PLANNING FOR COMBINED SEWER SYSTEMS - REGIONAL REPORT enforcing the limits to the affordability of CSO controls and the City's financial capability.

E.3.4 Potential Impacts of the Covid-19 Pandemic in Affordability

The projections and conclusions concerning the affordability of the Municipal Control Alternative proposed in this SIAR by the City of Bayonne and Bayonne's financial capability to finance the CSO control program are premised on the baseline financial conditions of Bayonne as well 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 pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues and household incomes.

Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, Bayonne will be reticent 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 SIAR based on emergent economic conditions beyond the permittees' control. As detailed in Section F of Bayonne's 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 next permit period.

SECTION F - RECOMMENDED LONG TERM CONTROL PLAN

F.1 INTRODUCTION

The recommended LTCP is intended to meet the requirements of the presumption approach while meeting financial capability threshold. Based on data available at the time of this report, constructing either of the Selected Alternatives will result in a residential indicator above the 2% threshold considered to be a high burden to ratepayers.

Therefore, the recommended LTCP has been designed in a phased approach. This enables the City to monitor CSO volume improvements as projects are constructed and placed into service. This adaptive management strategy will help the City progress towards meeting the LTCP requirements while maximizing the impact of available dollars. It will also allow the City to reevaluate the proposed CSO improvements throughout the 30 year implementation schedule as more information becomes available through the post construction monitoring program and as other programs are occurring within the City. For example, the City is already requiring sewer separation for new development and redevelopment projects near the waterfront. The reduction in CSO volume from these types of activities may allow for the downsizing or elimination of one or more storage tanks included in the 30 year implementation schedule while still achieving the 85% volume capture target.

F.2 RECOMMENDED LTCP

Of the two LTCPs considered in this report, they are ranked in order of preference as follows:

1. Increase capacity of OSPS to 27.8 MGD, increase force main diameter to 36" where needed, implement 3-5% GI and build the required 5 storage tanks.
2. Provide reliability improvements to OSPS for 17.6 MGD pumping rate, implement 3-5% GI and build the required 7 storage tanks.

Due to the regulatory uncertainty surrounding additional conveyance to PVSC, options with and without increased conveyance are provided.

As described in previous sections of this report, the recommendations include the following:

- 27.8 MGD Conveyance
    - Increase OSPS capacity to 27.8 MGD
    - Increase existing 24" and 30" force main to 36" to support additional flow from OSPS
    - Implement GI to manage 3-5% of CSO volume (including existing 25% green roof program)
    - Construct 5 storage tanks
- 17.6 MGD Conveyance
    - Implement reliability improvements at OSPS to continue pumping 17.6 MGD
    - Implement GI to manage 3-5% of overflow volume (including existing 25% green roof program)

- Construct 7 storage tanks

The recommended alternatives are summarized in Table F-1

Summary of Selected Alternatives					
Alternative	% Capture	Volume Captured (MG)	CSO Events	Capital Cost ($M)	Life Cycle Cost ($M)
Offline Storage & GI with 17.6 MGD from OSPS	86	542.1	487	363.08	384.89
Offline Storage & GI with PS & FM Upgrade to 27.8 MGD from OSPS	86	411.1	537	320.76	341.06

Table F-1 | Summary of Selected Alternatives

F.3 IMPLEMENTATION COST

Implementation costs are provided for both options at this time. Effort was made to provide some consistency in expenditures over time. Bayonne is committed to GI throughout the LTCP implementation process; as such GI is included throughout the duration.

Implementation costs are based on the project recommendations provided in this report. As noted previously, PVSC cost guidance was used where applicable. Capital and O&M costs are averaged into in an equivalent annual cost and summed for a given year.

Implementation of the full recommended LTCP will significantly exceed the USEPA high-burden residential indicator of 2%. This is projected to occur in year 2031 for both the 17.6 MGD and 27.8 MGD options.

Table F-2 and Table F-3 provide the implementation costs for both conveyance alternatives, along with the RI % in each year.

Implementation Costs – 27.8 MGD Conveyance				
Year	Capital	O&M	Total	Projected Residential Indicator
2021	$6,520,000	$0	$6,520,000	1.2%
2022	$6,520,000	$3,000	$6,523,000	1.2%
2023	$24,278,926	$606,000	$24,884,926	1.3%
2024	$24,278,926	$609,000	$24,887,926	1.5%
2025	$8,186,667	$705,250	$8,891,917	1.6%
2026	$520,000	$768,250	$1,288,250	1.7%
2027	$16,337,174	$771,250	$17,108,424	1.7%
2028	$16,337,174	$774,250	$17,111,424	1.8%
2029	$16,337,174	$777,250	$17,114,424	1.9%
2030	$520,000	$894,854	$1,414,854	2.0%
2031	$520,000	$897,854	$1,417,854	2.0%
2032	$520,000	$900,854	$1,420,854	2.0%
2033	$520,000	$903,854	$1,423,854	2.1%
2034	$520,000	$906,854	$1,426,854	2.1%
2035	$520,000	$909,854	$1,429,854	2.1%
2036	$13,903,490	$912,854	$14,816,343	2.1%
2037	$13,903,490	$915,854	$14,819,343	2.2%
2038	$520,000	$1,003,408	$1,523,408	2.4%
2039	$520,000	$1,006,408	$1,526,408	2.4%
2040	$16,612,260	$1,009,408	$17,621,668	2.4%
2041	$16,612,260	$1,012,408	$17,624,668	2.5%
2042	$520,000	$1,111,658	$1,631,658	2.7%
2043	$520,000	$1,114,658	$1,634,658	2.7%
2044	$520,000	$1,117,658	$1,637,658	2.6%
2045	$33,414,752	$1,120,658	$34,535,411	2.6%
2046	$33,414,752	$1,123,658	$34,538,411	2.8%
2047	$33,414,752	$1,126,658	$34,541,411	3.0%
2048	$33,414,752	$1,129,658	$34,544,411	3.2%
2049	$520,000	$1,329,650	$1,849,650	3.5%
2050	$520,000	$1,332,650	$1,852,650	3.4%
Total	**$320,766,548**	**$26,795,623**	**$347,562,171**	**3.5% in 2051**

Table F-2 | Implementation Costs for 27.8 MGD Conveyance

Implementation Costs – 17.6 MGD Conveyance				
Year	Capital	O&M	Total	Projected Residential Indicator
2021	$9,597,500	$0	$9,597,500	1.2%
2022	$9,597,500	$3,000	$9,600,500	1.3%
2023	$16,612,260	$74,800	$16,687,060	1.3%
2024	$16,612,260	$77,800	$16,690,060	1.4%
2025	$6,520,000	$174,050	$6,694,050	1.5%
2026	$6,520,000	$777,050	$7,297,050	1.6%
2027	$16,337,174	$780,050	$17,117,224	1.7%
2028	$16,337,174	$783,050	$17,120,224	1.8%
2029	$16,337,174	$786,050	$17,123,224	1.9%
2030	$520,000	$903,654	$1,423,654	2.0%
2031	$13,903,490	$906,654	$14,810,143	2.0%
2032	$13,903,490	$909,654	$14,813,143	2.1%
2033	$16,612,260	$997,208	$17,609,468	2.2%
2034	$16,612,260	$1,000,208	$17,612,468	2.3%
2035	$9,597,500	$1,096,458	$10,693,958	2.4%
2036	$9,597,500	$1,099,458	$10,696,958	2.5%
2037	$520,000	$1,171,258	$1,691,258	2.6%
2038	$520,000	$1,174,258	$1,694,258	2.6%
2039	$520,000	$1,177,258	$1,697,258	2.6%
2040	$520,000	$1,180,258	$1,700,258	2.6%
2041	$520,000	$1,183,258	$1,703,258	2.7%
2042	$520,000	$1,189,258	$1,709,258	2.7%
2043	$520,000	$1,192,258	$1,712,258	2.7%
2044	$40,665,606	$1,195,258	$41,860,865	2.6%
2045	$40,665,606	$1,198,258	$41,863,865	2.9%
2046	$40,665,606	$1,201,258	$41,866,865	3.1%
2047	$40,665,606	$1,204,258	$41,869,865	3.4%
2048	$520,000	$1,426,234	$1,946,234	3.7%
2049	$520,000	$1,429,234	$1,949,234	3.6%
2050	$520,000	$1,432,234	$1,952,234	3.6%
Total	**$363,079,963**	**$27,723,689**	**$390,803,653**	**3.6% in 2051**

Table F-3 | Implementation Costs for 17.6 MGD Conveyance

F.4 FINANCIAL IMPACTS

The financial impacts of the LTCP are described in detail in Section E. Based on current projections, the USEPA high-burden residential indicator of 2% would be greatly exceeded with the full implementation of the alternatives described in this report. As demonstrated in Table F-2 and Table F-3, that threshold is reached after the first 10 years of the project schedule after approximately $115M to $120M in CSO related capital improvements. The residential indicator continues to rise throughout the remaining implementation schedule, reaching as high as 3.5% for the 27.8 MGD alternatives and 3.7% for the 17.6 MGD alternative.

Based on these current projections, Bayonne cannot afford to implement all of the projects identified in either alternative.

Bayonne will continue to evaluate improvements to CSO control as they are constructed (GI, the first tanks, etc) to determine if adjustments can be made to current control strategies while still meeting LTCP goals.

F.5 IMPLEMENTATION SCHEDULE

This LTCP was developed based the best information and technological resources available at the time, with the understanding that certain assumptions are required to recommend control strategies and move ahead with implementation. The use of some assumptions is necessary to advance this program in the face of uncertainty. Employment of adaptive management principles during implementation will allow the program to benefit from the availability of improved information and respond to changing conditions or priorities. As post-construction data becomes available, implementation of planned improvements will be reevaluated and potentially expanded, reduced or otherwise modified in scope to optimize the cost-benefit of each project. Projects considered for implementation, but ultimately not included in the LTCP due to the financial capability of Bayonne will also be reconsidered in the context of the conditions present at that time.

Table F-4 and Table F-5 provide the full implementation schedule for both the 27.8 MGD and the 17.6 MGD conveyance options. Full implementation of these schedules, however, is not achievable at this time due to the financial impacts described above. An adaptive management strategy will be required, where the ability to implement the LTCP projects on the proposed schedule will reevaluated over time based upon future economic conditions.

Implementation Schedule - 27.8 MGD Conveyance							
Alternative 1b Selected Improvements	Updated Capital Cost ($M)	Updated Annual O&M Cost ($M)	Updated Life Cycle Cost ($M)	Year(s) Constructed	# Years to Construct	Average Capital Cost/Year ($M)	Average Equivalent Annual Cost ($M)
Phase 1 GI	5.20	0.03	5.66	2021-2030	10	0.52	0.56
OSPS Improvements	12	0.6	21.14	2021 & 2022	2	6	6.76
2.0 MG Storage Tank at BA015	32.18	0.09	33.60	2023 & 2024	2	16	16.63
Forcemain Capacity Increase	23	0.06	23.91	2023-2025	3	8	7.94
3.2 MG Storage Tank at BA007	47.45	0.11	49.20	2027 & 2029	3	16	16.37
Phase 2 GI	5.20	0.03	5.66	2031-2040	10	0.52	0.56
1.6 MG Storage Tank at BA017	26.77	0.08	28.05	2036	2	13	13.84
Phase 3 GI	5.20	0.03	5.66	2041-2050	10	0.52	0.56
2.0 MG Storage Tank at BA021	32.18	0.09	33.60	2040-2041	2	16	16.63
11.0 MG Storage Tank at BA001/002	131.58	0.20	134.58	2045-2049	4	33	34.00

Table F-4 | Implementation Schedule for 27.8 MGD Conveyance

Implementation Schedule – 17.6 MGD Conveyance							
Alternative 1b Selected Improvements	Updated Capital Cost ($M)	Updated Annual O&M Cost ($M)	Updated Life Cycle Cost ($M)	Year(s) Constructed	# Years to Construct	Average Capital Cost/Year ($M)	Average Equivalent Annual Cost ($M)
Phase 1 GI	5.20	0.03	5.66	2021-2030	10	0.52	0.56
1.0 MG Storage Tank at BA010	18.16	0.07	19.20	2020-2022	2	9	9.40
2.0 MG Storage Tank at BA015	32.18	0.09	33.60	2023 & 2024	2	16	16.63
OSPS Improvements	12	0.6	21.14	2025 & 2026	2	6	6.76
3.2 MG Storage Tank at BA007	47.45	0.11	49.20	2027 & 2029	3	16	16.37
Phase 2 GI	5.20	0.03	5.66	2031-2040	10	0.52	0.56
1.6 MG Storage Tank at BA017	26.77	0.08	28.05	2031-2032	2	13	13.84
2.0 MG Storage Tank at BA021	32.18	0.09	33.60	2033-2034	2	16	16.63
1.0 MG Storage Tank at BA014	18.16	0.07	19.20	2035-2036	2	9	9.40
Phase 3 GI	5.20	0.03	5.66	2041-2050	10	0.52	0.56
14.0 MG Storage Tank at BA001/002	160.58	0.22	163.92	2044-2049	4	40	41.47

Table F-5 | Implementation Schedule for 17.6 MGD Conveyance

F.6 BASIS FOR LTCP DEVELOPMENT AND IMPLEMENTATION SCHEDULE

The LTCP schedule was designed to provide consistency in expenditures over time. Additionally, projects that are more critical (the OSPS improvements) are at the beginning of the plan implementation. Bayonne is currently working with a developer regarding a potential tank location at BA010, so this has been included at the beginning of the applicable schedule. The largest tank, at outfall BA001/002 is last as the required size of the tank may change based on implementation of earlier improvements.

Per the LTCP permit, the following is required regarding the schedule:

- Yearly milestones
- Adequately addressing areas of sewage overflows, including to basements, streets and other public and private areas
- CSO overflows that discharge to sensitive areas are considered the highest priority
- Use impairment of the receiving water
- Financial capability
- Grant and loan availability
- Previous and current residential, commercial, and industrial sewer user fees and rate structure
- Other viable funding mechanisms and sources of financing
- Resources necessary to design, construct, and/or implement other water related infrastructure improvements

F.7 CSO REDUCTION VERSUS TIME

Hydrologic and hydraulic modeling was performed to determine the CSO reduction at each outfall based on the selected alternative. As tanks are constructed, CSOs will be reduced. Additionally, the 27.9 MGD conveyance alternative includes the reduction in CSO volume due to increased pumping.

Hydraulic modeling performed for this LTCP examined overflows for pre and post implementation scenarios. Interim overflow values (for example, after tanks BA015 and BA007 have been constructed) were not determined through the model. To ensure only factual information is provided at this time, overflows shown in this table only reflect the tanks listed, not all of the outfalls. Additionally, these values reflect anticipated overflow volumes at the end of implementation of the LTCP.

For Alternative 1b – 27.8 MGD, the CSO reduction is shown in Table F-6.

CSO Reduction for Alternative 1b – 27.8 MGD from OSPS							
	No Improvement		Total		Reduction		Year in
Project	# Overflows	Overflow Volume	# Overflows	Overflow Volume	# Overflows	Overflow Volume	Service
No Improvement	743	618.9					
Storage Tank at BA015	46	45.4	4	3.8	42	41.6	2024
Storage Tank at BA007	32	53.3	5	6.7	27	46.7	2029
Storage Tank at BA021	42	52.3	7	10.0	35	42.3	2029
Storage Tank at BA017	54	51.9	9	7.4	45	44.5	2036
Storage Tank at BA001/002	43	262.3	8	44.2	35	218.1	2049

Table F-6 | CSO Reduction for Alternative 1b - 27.8 MGD

For Alternative 1b – 17.6 MGD, the CSO reduction is shown in Table F-7.

CSO Reduction for Alternative 1b – 17.6 MGD from OSPS							
	No Improvement		Total		Reduction		Year In
Project	# Overflow s	Overflow Volume	# Overflow s	Overflow Volume	# Overflow s	Overflow Volume	Service
No Improvement	752	747.3					
Storage Tank at BA010	31	15.3	9	2.6	22	12.7	2022
Storage Tank at BA015	46	45.4	6	4	40	41.4	2024
Storage Tank at BA007	32	56	5	7.5	27	48.4	2029
Storage Tank at BA017	54	51.9	11	8	43	44.0	2032
Storage Tank at BA021	40	53.1	7	11	33	42.1	2034
Storage Tank at BA014	32	13.2	1	0.7	31	12.6	2036
Storage Tank at BA001/002	50	379.8	10	61.2	40	318.6	2049

Table F-7 | CSO Reduction for Alternative 1b – 17.6 MGD