Memorandum

To: *Lauren McBennett Mappa, PE*
Water Pollution Control Authority, City of Bridgeport

From: *Kleinfelder and CDM Smith*

Date: *December 2021*

Subject: *Combined Sewer Overflow Long Term Control Plan Update*
Water Pollution Control Authority, City of Bridgeport

Executive Summary

ES.1 Introduction

The Water Pollution Control Authority (WPCA), City of Bridgeport collects and treats wastewater generated in Bridgeport, the sewered portion of Trumbull, and a small number of users in Stratford and Fairfield near the Bridgeport city line. The system consists of 290 miles of sewer pipe, nine pumping stations, and two wastewater treatment plants (WWTPs): the 30 million gallon per day (MGD) West Side WWTP with 58 MGD peak design capacity, and the 10 MGD East Side WWTP with 24 MGD peak design capacity. Part of the collection system is served by combined sewers where wastewater and stormwater are conveyed in a common pipe. During rainstorms, when combined sewer or treatment facility capacity is exceeded, a combination of wastewater and stormwater can discharge via 28 regulators to 25 combined sewer overflow (CSO) outfalls, or can receive primary treatment and disinfection before being discharged at the WWTPs.

WPCA is under an Administrative Order (WRMU18002/ WRMU18002M; see Section 1.3 of this memorandum) that requires update of its CSO Long-Term Control Plan (LTCP) to address CSO. A previous LTCP was submitted to DEEP in July 2011 (referred herein as 2011 LTCP) and provided a plan to control CSO in a 1-year, 24-hour storm. That plan included illicit connection elimination, sewer separation, static weir control, storage tanks, green infrastructure, a storage tunnel, water quality monitoring, and computer modeling. This technical memorandum provides an LTCP Update with a revised plan based upon findings and recommendations in WPCA's Facilities Plan for the West Side and East Side Wastewater Treatment Plants (Facilities Plan) submitted to DEEP on November 24, 2020 and Ash Creek CSO Evaluation of Alternatives submitted to DEEP on December 17, 2020.

The Facilities Plan assessed all critical components at both treatment plants and presented a long-term vision of capital needs for the WWTPs to improve performance and reliability of the treatment systems for a planning period through 2050. The Facilities Plan dovetails with recommendations presented in the 2011 LTCP to comprise a holistic view of the collection and treatment systems yielding cost-effective, timely solutions to improve receiving water quality.

The Facilities Plan recommends a significant increase to wet weather treatment capacity at both WWTPs. This will improve collection system conveyance and reduce CSO. This memorandum summarizes the Facilities Plan's findings, identifies where the approach proposed in the Facilities Plan represents significant improvements upon the 2011 LTCP, and updates WPCA's proposed approach to CSO control.

ES.2 Existing Collection System

Most of the combined sewers are in the older, southern portion of the City along the coast. Separated sewers, primarily built during the 1950s and 1960s, predominate in residential areas in the northern portion of the City. The Pequonnock River is the principal divide between the West Side and East Side service areas. There are 25 active CSO outfalls, 19 in the West Side WWTP service area and six in the East Side WWTP service area. CSOs discharge to Ash Creek, Black Rock Harbor, Burr Creek, Bridgeport Harbor, Cedar Creek, Island Brook, Johnson's Creek, Pequonnock River and Yellow Mill Channel.

The existing collection system is in acceptable condition for its age. Pumping stations have been recently upgraded and are in generally good condition. Preventive maintenance activities by WPCA are ongoing. Problem areas include siphons and storage conduits which need cleaning and repair, and inflow through tide gates. Recent lining and separation projects recommended in the 2011 LTCP are helping to rehabilitate older portions of the collection system and reduce CSO. Section 2 provides more background on the condition and configuration of the collection system and includes a figure showing the general layout.

Under current conditions, assuming a maximum current capacity of 80 to 85 MGD (limited by influent pumps) at the West Side WWTP, CSO from the 1-year, 24-hour design storm is estimated at 44.4 million gallons (MG), with 21 of 22 CSO regulators active. Simulated East Side CSO is 5.4 MG, with all six CSOs active, based on a maximum current capacity of 35 MGD (limited by influent pumps) at the East Side WWTP.

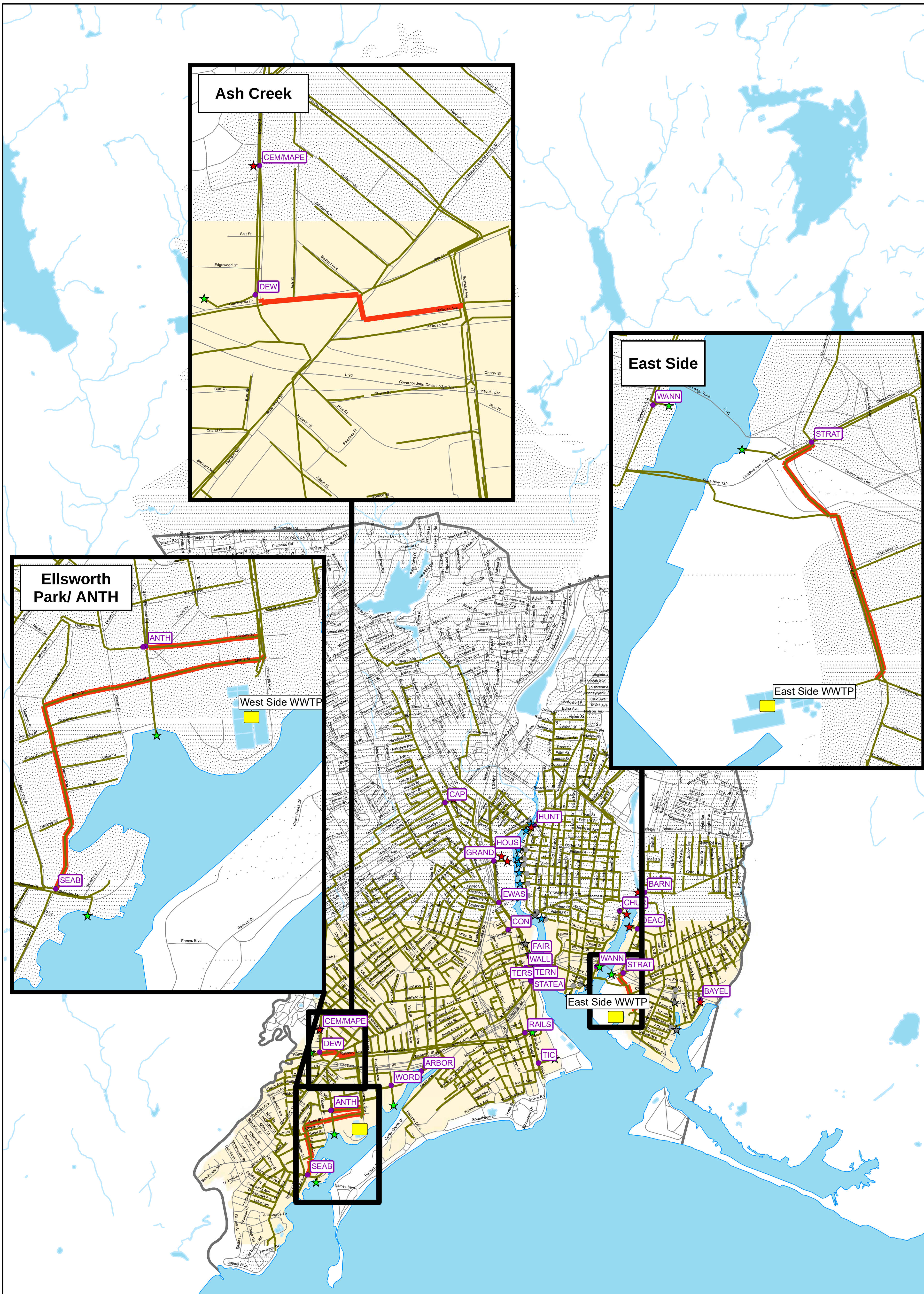
ES.3 Recent CSO Abatement Projects

WPCA has completed multiple CSO abatement projects outlined in the 2011 LTCP listed under Phase I and Phase II of the 2011 LTCP schedule as Central Pequonnock River Water Quality Improvements. Contracts implemented to-date have focused on renewing infrastructure within Bridgeport, maximizing in-line storage, and reducing infiltration and inflow and CSO. These contracts have included installation of 19,000 feet of new pipe (separation), 115,000 feet of sewer lining, cleaning and lining a major siphon, regulator modifications, construction of a new stormwater pump station, and improvements to WPCA's capacity, management, operations, and maintenance (CMOM) program.

While the Facilities Plan was primarily a study of the WWTPs, CSO impacts were evaluated since this evaluation was not included in the 2011 LTCP. Alternatives analyses completed using WPCA's hydraulic model concluded that increasing wet weather capacity of the treatment plants would substantially reduce CSO. The combined sewer system can convey high flow to the WWTPs, but the WWTPs are bottlenecks due to treatment capacity constraints.

The Facilities Plan recommended expanding the West Side and East Side WWTPs to respective wet weather capacities of 200 MGD and 80 MGD. These improvements will halve CSO during the 1-year, 24-hour storm without any other substantial changes to the collection system. Conveyance improvements were recommended in Ash Creek, Ellsworth Park, East Side, and near the ANTH regulator to further increase the conveyance capacity to the WWTPs and control regulators closest to the WWTPs during the 1-year, 24-hour event including CEM/MAPE, DEW, SEAB, ANTH, RAILS, TIC, and WORD on the West Side and DEAC, STRAT, and WANN on the East Side (**Figure ES-1**).

WPCA completed a detailed study of CSO control in the Ash Creek area in 2020 concurrent with the Facilities Plan. While a storage tank was originally planned to control Ash Creek CSO, a conveyance improvement from the Ash Creek area to the expanded West Side WWTP was ultimately recommended for 1-year CSO control at CEM/MAPE and DEW. These recommended improvements were incorporated into the Facilities Plan.



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Legend

- Model Extent
- Modeled Pipes
- Modeled New or Replacement Pipe
- Wastewater Treatment Plants
- Roads
- City Boundary

CSO Regulators

- Active
- Inactive

CSO Outfalls

- Active, Tidegate
- Active, No Tidegate
- Closed
- Converted to Stormwater

Figure ES-1
Conveyance Improvements

Water Pollution Control Authority
City of Bridgeport, CT

December 2021

ES.4 Recommended Update to the LTCP

This LTCP Update was developed based on the screening and evaluation presented in the 2020 Facilities Plan. The analysis relied on system characterization using WPCA's updated SWMM model and incorporated recently completed CSO abatement projects as well as findings of the 2020 Facilities Plan and Ash Creek CSO Evaluation of Alternatives. The overall goal of the CSO LTCP is to control CSO from wet weather events up to and including the 1-year, 24-hour storm. The key components of the recommended plan are:

- Expanded West Side wet weather treatment capacity – West Side WWTP recommendations from the 2020 Facilities Plan include expanded wet weather treatment capacity to 200 MGD
- Expanded East Side wet weather treatment capacity – East Side WWTP recommendations from the 2020 Facilities Plan include expanded wet weather treatment capacity to 80 MGD
- Ash Creek conveyance improvements – New pipe from Ash Creek regulators CEM/MAPE and DEW to the 72-inch interceptor in Bostwick Street as recommended in the 2020 Ash Creek CSO Evaluation of Alternatives
- Ellsworth Park conveyance improvements – New pipe from the SEAB regulator in Ellsworth Park to the 72-inch interceptor in Bostwick Street, and evaluation of consolidating the ANTH regulator to the new conveyance pipe
- Tide gate improvements - Inspect all outfalls and repair missing or leaking tide gates.
- East Side conveyance improvements – New pipe from the STRAT regulator to the East Side WWTP and improvements to the WANN regulator
- Temporary system-wide flow monitoring to assess changes in flow and CSO following the substantial system changes from increased conveyance to and wet weather treatment at the WWTPs after construction is completed
- Continuation of the CSO LTCP – Following the system-wide metering, evaluate the remaining improvements to achieve CSO control of 1-year, 24-hour design storm and implement projects identified by December 31, 2039.

Figure ES-2 compares this LTCP Update's schedule with the schedule recommended in the 2011 LTCP. Most CSO control anticipated in the 2011 LTCP would only be attained once a storage tunnel was completed at the end of the schedule. However, as WPCA's WWTPs are aging and in need of upgrades (see Section 3), increasing plant capacity in the near term is a cost-effective solution to reduce CSO faster than proposed in the 2011 LTCP schedule. The decrease in CSO from 2030 to 2039 (green line in figure) represents further CSO mitigation to be identified following system-wide flow monitoring after the WWTP upgrades.

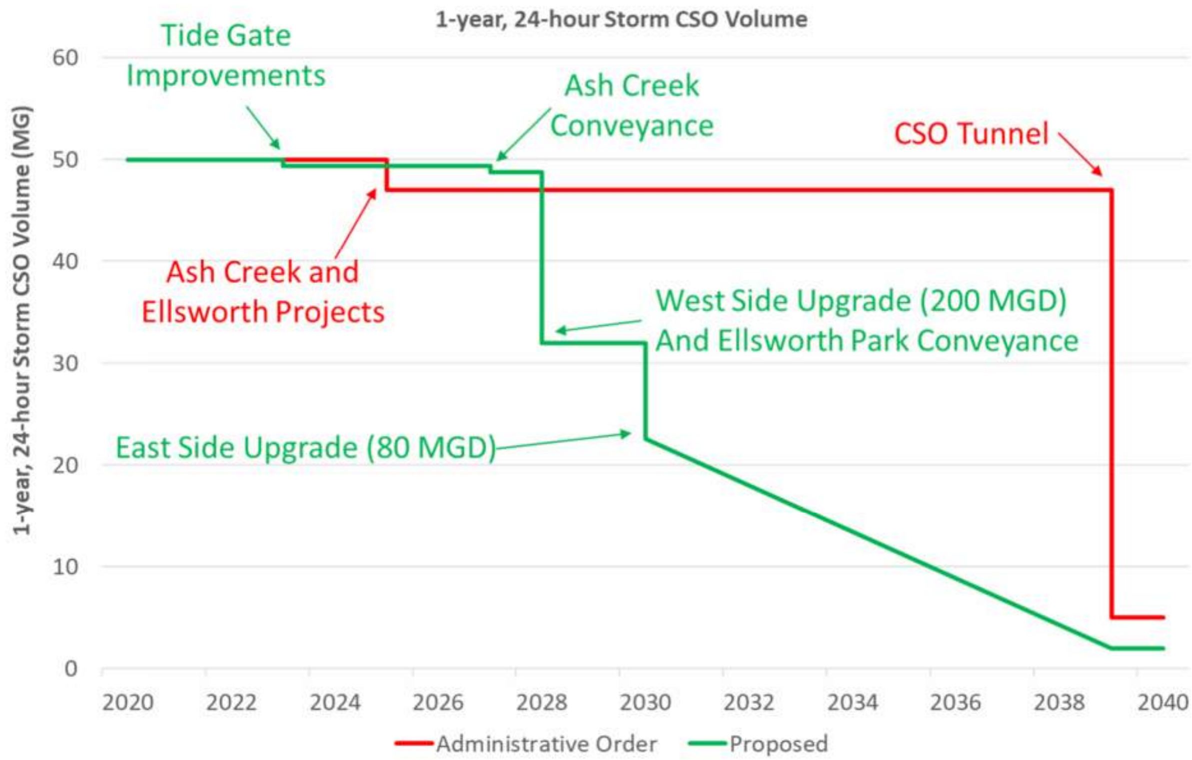

Figure ES-2 Recommended Schedule – CSO Reduction in 1-Year, 24-Hour Storm

ES.5 Financial Capability

The 2020 Facilities Plan includes a detailed financial capability assessment, reviewing multiple alternatives for facilities improvements that each include provisions for CSO abatement as required by the CSO Order. The most desirable options from the technical evaluation of alternatives were carried forward to evaluate the financial impacts of the WWTP upgrades and the CSO abatement program on users and rate payers. The financial assessment evaluated alternatives following an Environmental Protection Agency (EPA) framework. The intent of the evaluation was to assess the affordability of WPCA's capital improvement programs.

Completing projects on the current Administrative Order schedules will put a high burden on sewer rate payers in Bridgeport per current EPA guidance. As noted in the financial capability analysis presented in Section 8, the City is economically stressed as evidenced by low-income growth over the past 20 years and a high poverty rate. The City will face a financial challenge implementing any significant capital program. This problem would be intensified if WPCA were forced to self-fund the projects.

Staggering design and construction of both treatment plants with the Ash Creek and other collection system improvements is projected to keep sewer rates below EPA's high burden designation, but only if Clean Water Fund (CWF) assistance is available in the form of two percent loans and grant funding per the current programs. Even with such assistance, the magnitude of the required rate increases is anticipated to present major financial challenges for WPCA's rate payers. **If CWF assistance is not available in the amounts assumed in the attached financial capability assessment, the financial capabilities of WPCA, and the schedule for completion of the recommended projects, will need to be re-evaluated.**

1 Introduction

1.1 Background

The WPCA collects and treats wastewater generated in Bridgeport, the sewered portion of Trumbull, and a small number of users in Stratford and Fairfield near the Bridgeport city line. The system consists of 290 miles of sewer pipe, nine pumping stations and two WWTPs: the 30 MGD West Side plant and the 10 MGD East Side plant. Because of the age of the collection system, a portion of the collection system is served by combined sewers – where wastewater and stormwater are conveyed in a common pipe to the treatment plants. All wet weather flow in excess of the secondary treatment capacity, up to the design capacity the WWTPS (90 MGD for the West Side and 40 MGD for the East Side), was intended to receive primary treatment before recombining with secondary effluent prior to effluent disinfection and discharge. Today, the WWTPs typically can only accept between 80 to 85 MGD at the West Side and 35 MGD at the East Side during storms due to aging influent pumps. During rainstorms, when combined sewer or treatment facility capacity is exceeded, combined sewage can discharge via 28 regulators to 25 CSO outfalls, or can be partially treated and discharged at the WWTPs. Tables 1-1 and 1-2 list the CSOs in the East Side and West Side systems, respectively.

Table 1-1 East Side NPDES Permitted CSO Regulators

NPDES #	Mnemonic	Location	Receiving Water
18	BARN	Seaview Avenue & Barnum Avenue	Yellow Mill Channel
6	BAYEL	Bay Street & Mildner Drive	Johnson's Creek
22	CHUR	Church Street west of Waterview Avenue	Yellow Mill Channel
16	DEAC	Seaview Avenue & Deacon Street	Yellow Mill Channel
12	STRAT	Connecticut Avenue & Stratford Avenue	Yellow Mill Channel
153	WANN	Waterview Avenue & Ann Street	Yellow Mill Channel
17	WASH[1]	Seaview Avenue & Crescent Avenue	Yellow Mill Channel

[1] Although listed in NPDES permit, this regulator is no longer active

Table 1-2 West Side NPDES Permitted CSO Regulators

NPDES #	Mnemonic	Location	Receiving Water
87	ANTH[2]	St Stephens Road & Anthony Street	Burr Creek
84	ARBOR[2]	Admiral Street & Harbor Street	Cedar Creek
101	CAP	Main Street & Capitol Avenue	Island Brook
93	CEM/MAPE	Mt. Grove Cemetery & Dewey Street	Ash Creek
80	CON	Congress Street & Main Street	Pequonnock River
91	DEW	State Street & Dewey Street	Ash Creek
79	EWAS	East Washington Avenue & Housatonic Avenue	Pequonnock River
50	FAIR	Water Street & Fairfield Avenue	Pequonnock River
77	GRAND	Housatonic Avenue & Grand Street	Pequonnock River
76	HOUS	Housatonic Avenue & N. Washington Avenue	Pequonnock River
33	HUNT	Huntington Road & Vernon Street	Pequonnock River
195	OVER	Congress Street at foot of Crescent Street	Pequonnock River
192	RAIL	Broad Street & Railroad Avenue	Bridgeport Harbor
38	SEAB	Brewster Street & Seabright Avenue	Black Rock Harbor
207	STATE A&B	State Street & Water Street	Pequonnock River
48 47	TERN&TERS[3]	Water Street & Union Square	Pequonnock River
145	TIC	Henry Street & Atlantic Street	Bridgeport Harbor
49	WALL	John Street - west of Water Street	Pequonnock River
40	WORD	Howard Avenue & Wordin Avenue	Cedar Creek
75	COND[1]	Housatonic Avenue between Commercial Street & Grand Street	Pequonnock River
67 66	CREP/CREW[1]	Pulaski Street, Congress Street & Crescent Avenue	Pequonnock River
196	FAIM[1]	Main Street & Fairview Avenue	Island Brook
51	HILL[1]	Water Street & Golden Hill Street	Pequonnock River
78	YARD[1]	Housatonic Avenue & City Yard	Pequonnock River

[1] Although listed in NPDES permit, these regulators are no longer active
[2] ANTH and ARBOR both have two regulating weirs
[3] TERN and TERS share an outfall

1.2 Previous Long-Term CSO Control Plan

WPCA completed and submitted a CSO LTCP in July 2011 in accordance with a prior Administrative Order. As part of the 2011 LTCP, several CSO control alternatives were evaluated to control CSO in a 1 year, 24-hour design storm. Technologies evaluated included low impact “green” technologies, solids and floatables control, collection system controls, sewer separation, regional storage systems, and regional wet weather technologies. Advantages and disadvantages were compiled for each technology. Those showing promise were further analyzed during detailed evaluation of alternatives. Elements of several alternatives were included in the recommended plan as described below:

- **Illicit Connection Elimination Program** to resolve contamination issues in Johnson's Creek, Yellow Mill Channel, the Pequonnock River, Cedar Creek and Ash Creek
- **Sewer Separation** in four sewersheds
- **Real-Time Control** and inflatable dams to be installed at four regulators
- **Low Impact Technologies** to be implemented throughout all phases of the LTCP
- **CSO Storage Tanks** – a 1.5- MG storage tank at Ellsworth Park to capture flows from the SEAB regulator and a 1.5 MG Ash Creek storage tank near the DEW regulator to capture flow from DEW and CEM/MAPE
- **CSO Relief Sewers** to convey overflow from CSO regulators on the Pequonnock River to the TIC regulator which discharges into Bridgeport Harbor
- **Water Quality Monitoring and Modeling** to demonstrate the effectiveness of the relief sewers
- **Deep Rock Storage Tunnel** – to be constructed in two phases if water quality monitoring and modeling indicated its necessity

The 2011 LTCP was approved by DEEP in January 2018 after an updated schedule was submitted on December 20, 2017. The approved LTCP is referred to throughout this memorandum as the "2011 LTCP."

1.3 Regulatory Order Background

The 2011 LTCP was approved by DEEP in January 2018. WPCA then entered into a superseding Administrative Order (WRMU18002) in June 2018 which defines a schedule for implementation of LTCP improvements. On May 28, 2021, DEEP modified the Order and changed some of the milestone dates in the original Order (WRMU18002M).

In March 2019, DEEP signed a second Administrative Order (AOWRMU19001) requiring the WPCA to submit a Wastewater Treatment Facilities Plan to the Commissioner of DEEP by November 30, 2020. The Facilities Plan for the West Side and East Side Treatment Plants (Facilities Plan) was submitted to DEEP on November 24, 2020, fulfilling the requirement of the 2019 order. Administrative Order WRMU18002, the modification (WRMU18002M), and the 2019 order (AOWRMU19001) are included with this memorandum as **Attachments A, B, and C** for reference.

1.4 Purpose

This LTCP Update acknowledges the findings of the 2020 Facilities Plan, identifies where the approach proposed in that plan represents significant improvements from the 2011 LTCP, and updates WPCA's proposed approach to CSO control. This technical memorandum will thus satisfy the requirements of the current Administrative Order (WRMU18002/ WRMU18002M) regarding ongoing LTCP updates. This memorandum also:

- Documents collection system changes since the 2011 LTCP regarding population, development, and industrial contributors.
- Documents CSO abatement completed by WPCA since the 2011 LTCP and the positive outcomes from that work.
- Presents an updated plan for CSO abatement.

1.5 Memorandum Organization

This CSO LTCP Update is presented in eight additional sections:

- **Section 2 – Existing System** presents an overview of Bridgeport's existing collection system.
- **Section 3 – Wastewater Treatment Plants** presents an overview of the existing wastewater treatment plants.
- **Section 4 – Water Quality** presents background on the Clean Water Act, receiving water body classifications, receiving water body impairments, total maximum daily load (TMDL) designations, water quality analysis, upstream pollutant sources, and an overall summary of receiving water quality issues.
- S**ection 5 – Combined Sewer Overflow Model Update** summarizes the data sources available to assess the collection system, reviews updates performed on the model, discusses model calibration, and presents baseline conditions.
- **Section 6 – Summary of CSO Abatement Technologies** describes CSO abatement technologies and assesses their applicability to WPCA's CSO control objectives.
- **Section 7 –Long-Term CSO Control Plan Update Recommended Plan** explores recommendations of the 2011 LTCP and the 2020 Facilities Plan, recommends updates to the LTCP, and explains the benefits of the update to WPCA's collection system.

- **Section 8 – Financial Capability Assessment** presents an overview of WPCA finances and the ability to pay for the improvements outlined.
- **Section 9 – Stakeholder Participation** documents public meetings conducted over the course of the planning process.

There are multiple attachments to this technical memorandum that contain additional detail to supplement what is presented in each Section.

2 Existing System

Bridgeport is the largest city in Connecticut with a population of 149,000. It was settled by colonists in the 1600s and chartered in 1836. Like many other cities in the northeast, combined sewers were originally designed to carry both sewage and stormwater to open discharges into the harbors.

Interceptor sewers were built to convey combined sewage and stormwater to the two treatment plant sites for primary treatment. The 30 MGD West Side WWTP and the 10 MGD East Side WWTP treat wastewater from the West Side and East Side collection systems, respectively.

As interceptor sewers and WWTPs were constructed in the City, CSO regulators remained active through the system providing hydraulic relief during wet weather when the capacity of the interceptor system and/or the treatment facilities were exceeded. Over time, many of these historical CSO regulators have been closed as hydraulic conditions have allowed.

In the 1970s, there were as many as 78 overflow locations. Today, there are 25 CSO outfalls, with 19 serving the West Side collection system, and 6 serving the East Side collection system. **Figure 2-1** presents an overview of the collection system. A more detailed map of the collection system is included as **Attachment D**, which includes regulator names and pump station locations.

Key characteristics of WPCA's existing collection system are outlined below:

- 26 CSO regulators, with 28 CSO weirs discharging to 25 CSO outfalls. Twenty regulators are located in the West Side WWTP tributary area, and six regulators are located within the East Side WWTP tributary area.
- 113 miles of combined gravity sewer, ranging in diameter from 6 to 72 inches for circular sewers, 8-inch by 12-inch to 40-inch by 60-inch for egg-shaped sewers, and 10-inch by 12-inch to 41-inch by 60-inch for rectangular conduits.
- 170 miles of separated gravity sewer, ranging in size from 4 inches to 72 inches for circular sewers, and 10-inch by 15-inch to 20-inch by 30-inch for rectangular conduits.
- Nine pumping stations.

- 7,600 sewer manholes (separated and combined)
- 8,500 catch basins cleaned annually by WPCA (separated and combined)
- Eight sewer siphons
- Five storage conduits ranging in size from 3-feet by 4.5-feet to 4.2-feet to 10-feet

The 2020 Facilities Plan presents additional information on WPCA's collection system.

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System Overview

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CSO Long Term Control Plan Update

2.1 Changes to System Since Last LTCP

WPCA has completed numerous improvements to the collection system since the 2011 LTCP. CSO abatement projects are described in Section 2.2.

The 2020 Facilities Plan evaluated the existing treatment processes and WWTP performance. The Facilities Plan presented a "road map" for upgrades at the WWTPs. As part of this planning process, collection system characteristics were reevaluated, and planning criteria were established for WWTP upgrade projects. Factors considered included changes in population, industry, and wastewater flow from outside communities. Projected flows and loads to the WWTPs were established for planning years of 2030, 2040, and 2050. These projections are described in detail in the Facilities Plan. This evaluation of changes to the collection system included the following:

- Analysis of three years of flow and concentration data, including discussion of trends and peaking factors;
- Flow components analysis;
- Population and other community growth projections to estimate flows and loads through 2050; and
- Recommended flow and loading design criteria for upcoming facilities upgrades.

The City's population is estimated to increase by 9,150 over the next decade as reported in "Plan Bridgeport" adopted by the City on April 22, 2019. The same population increase used from 2020 to 2030 was used to project population to 2040 and 2050. This estimate, although likely conservative compared to Connecticut Data Collaborative estimates for the same timeframe, provides reserve treatment capacity.

Bridgeport also receives wastewater from Trumbull, Fairfield, and Stratford. No additional inter-municipal sanitary flow is anticipated from Fairfield or Stratford, since these towns have their own WWTPs and only a limited number of homes near the city border are served by WPCA. Despite stagnant or decreasing population growth projected in Trumbull, WPCA will plan for a future scenario in which the current daily average limit from Trumbull of 4.2 MGD is achieved. Any future growth or extension of the sanitary system that would potentially exceed the allocation would need to be offset with corrective measures to reduce an equivalent amount of infiltration and inflow (I/I).

The Town of Monroe, located north of Trumbull, does not currently have a sanitary sewer system. However, the Town's Plan of Conservation and Development proposes constructing sewer along Routes 25 and 111 to serve existing and future commercial development. The most logical interconnection would be with Trumbull, from where it would drain to the West Side WWTP. While a connection has not yet been approved by Trumbull or Bridgeport, it was assumed that a connection could be made within the 30-year planning period.

This flows and loads analysis established the projected design conditions for the lifespan of the WWTP upgrades through 2050. Projected average future conditions for each WWTP are included in **Table 2-1** below.

Table 2-1 Projected Design Year (2050) Average Influent Flow and Loads West Side WWTP

	West Side WWTP		East Side WWTP	
	2050	Existing Plant Rating	2050	Existing Plant Rating
Average daily flow (MGD)	25.8	30.0	6.4	10
Biochemical oxygen demand (BOD_5), lb/day	35,000	40,000	6,400	10,000
Total suspended solids (TSS), lb/day	54,000	62,000	6,900	11,000
Total Kjeldahl nitrogen (TKN), lb/day	5,500	6,300	1,300	2,100
Total phosphorus (TP), lb/day	1,000	1,100	180	280

MGD = million gallons per day
lb/day = pounds per day

Additional information on changes to WPCA's wastewater collection system, including information on the updated flow and loads analysis, is presented in the Facilities Plan.

2.2 Recent CSO Abatement Projects

Sewer Separation & Sewer Lining (H Contracts)

WPCA has completed numerous sewer separation and lining projects, as recommended in the 2011 LTCP. The H Contracts (H-1 through H-7) have included a mix of separation and sewer lining work in four west side collection system sewersheds. Targeted sewer separation was completed in the West Side collection system with sewer improvement contracts H-1 in 2012, H-2 in 2013 and 2016, and H-3 in 2019. These contracts have included installation of 19,000 feet of new pipe (separation) and 115,000 feet of sewer lining.

All lining was projects were located in area tributary to the West Side WWTP. WPCA cleaned and lined the Congress Street siphon, which crosses the Pequonnock River below the site of the former Congress Street Bridge. WPCA has also lined the main interceptors to the West Side WWTP along Bostwick Avenue.

These projects have renewed miles of infrastructure within the City of Bridgeport, reducing both I/I and CSO. The hydraulic model was updated to include these recent improvements made since the 2011 LTCP. The extensive model update completed during WPCA's facilities planning efforts are described further in Section 5 of this memorandum.

River Street Pumping Station

A new River Street Pumping Station, tributary to the Bridgeport-Trumbull Interceptor and the West Side WWTP, was constructed in 2013 to replace the Island Brook and River Street Pump Stations. This pumping station is more reliable than the pumping stations it replaced.

Regulator Modifications

Several CSO regulator modifications were made to maximize in-line storage. West Side CSO regulating weirs at CON, ANTH, TER N/S, WALL, FAIR, GRAND, HOUS, and CAP were raised by a foot. STATE A/B was raised by 2 feet. East Side CSO regulating weirs STRAT, BARN, and BAYEL were raised one foot, and the overflow opening at BARN was reduced.

Capacity, Management, Operations, and Maintenance (CMOM)

WPCA is well-equipped and well-staffed to perform preventive maintenance, inspection and repair activities and has an aggressive operations and maintenance (O&M) program. Collection system crews have annual goals to clean 30 miles of sewer, CCTV and clean (if needed) 30 miles of sewer, and clean all 8,500 catch basins. These established goals have been exceeded every year for 15 years. Very few bypass events are annually attributed to WPCA collection system blockages or other failures. These programs to maintain the aging collection system infrastructure will continue.

In 2020, WPCA completed a revised CMOM Self-Assessment Checklist and updated its CMOM Corrective Action Plan (CAP). Completion of the checklist identified areas for additional focus. These are addressed in the CAP. Many of the proposed corrective actions relate to tracking, management, and prioritization. An update of the collection system GIS is currently underway to improve mapping and establish unique identifiers for collection system assets. The CAP also recommended completion of an Asset Management Needs Assessment to review current practices and evaluate if a formal Asset Management System should be deployed. Other areas of focus include improved tracking and logging of response to blockage calls and customer complaints, review and reassessment of chronic maintenance areas, increased public outreach, improved fats, oils, and grease (FOG) management and inspections, improved tracking of cleaning and inspection activities, and development of a right-of-way maintenance program. Items identified in the CAP will be initiated over the next three years in accordance with an established schedule. WPCA remains under contract with its private operator through June 2023. WPCA will consider adjustments in the next contract period that are consistent with its goals and the corrective actions identified in the CMOM Self-Assessment and CAP.

WWTP Facilities Plan

WPCA completed an extensive planning process during the preparation of the 2020 Facilities Plan. Although this was primarily a study of the WWTPs, CSO impacts were evaluated. The study concluded that increasing the wet weather capacity of the treatment plants would substantially reduce CSO. The combined sewer system in Bridgeport can convey large amounts of flow to the WWTPs, but the WWTPs act as bottlenecks due to their limited wet weather treatment capacity. If the WWTPs cannot accept wet weather flow, it is discharged from the collection system as CSO.

The Facilities Plan recommends increasing West Side and East Side WWTP weather capacity to 200 MGD and 80 MGD, respectively. These improvements will eliminate half of the CSO in the 1-year design storm without any other substantial changes to the collection system. Most CSO control originally anticipated in the 2011 LTCP was attained once the storage tunnel was constructed at the end of the schedule (Section 7). As WPCA's WWTPs are aging and in need of upgrades (Section 3), increasing plant capacity in the near-term is a cost-effective solution that will reduce a substantial amount of CSO faster than was proposed in the 2011 LTCP.

Ash Creek Planning Study and Conveyance Improvements

A storage tank was originally planned for the Ash Creek area in the 2011 LTCP. However, a study of other possible CSO controls was completed in 2020, running in parallel with the Facilities Plan. The "Ash Creek Combined Sewer Overflow Evaluation of Alternatives" Study was submitted to DEEP on December 17, 2020. The recommendations of the report were incorporated into the modified Administrative Order WRMU18002M on May 28, 2021.

This study evaluated many alternatives to control CSO in the Ash Creek area, including separation, in-line and off-line storage, downstream conveyance, and green infrastructure. Conveyance improvements to the West Side WWTP were determined to be more cost effective and practical than the storage tank proposed in the 2011 LTCP, due in part to the increased wet weather capacity planned for the West Side WWTP. Proposed conveyance improvements in the Ash Creek area included in the recommended Facilities Plan are 1,600 feet of new 48-inch pipe from DEW to the 72-inch interceptor in Bostwick Avenue.

2.3 Planned Collection System Improvements

Ellsworth Park Conveyance

As with Ash Creek, a storage tank was recommended for the Ellsworth Park area in WPCA's 2011 LTCP. Through the Facilities Plan collection system alternatives evaluation, it was discovered that the SEAB regulator could be controlled to the 1-year level through conveyance and expansion of the West Side WWTP to 200 MGD, without a CSO storage tank. This conveyance alternative for SEAB was included as part of the recommended Facilities Plan.

It is recommended that a more detailed study with metering and an evaluation of alternatives be completed in the SEAB area, similar to the one completed for the Ash Creek area. It is anticipated that conveyance of the SEAB flow to the West Side WWTP will be similarly cost effective and advantageous to conveyance in the Ash Creek area.

Other Collection System Improvements

Several other collection system recommendations were made as part of the facilities planning process. Targeted cleaning in specific areas was recommended, particularly cleaning of the siphons and storage conduits. These are known problem areas and should be cleaned to maintain the capacity of the collection system and reduce CSO. Tidal inflow is also a concern in Bridgeport. Half the CSO outfalls have tide gates, but many of these gates are generally in poor condition. Existing tide gates are believed to be leaky from a combination of rust, debris, and barnacles that prevent the gates from closing properly. During high tide, this can introduce seawater into the collection system through reverse flow in the CSO outfall pipes. Block testing data from 2017 indicated an average of 21 tidal inflow events per outfall per year. The most active regulators for tidal inflow included TERN, FAIR, WALL, STATEA, and ARBOR.

The Facilities Plan recommended that inspections of all outfalls be completed to assess condition of the existing tide gates and repair or replace any as needed. Treating any amount of tidal inflow at the WWTPs is an unnecessary cost, and the presence of tidal inflow in the collection system during a wet weather event could result in an increase in CSO and potential street flooding.

Additional information on the collection system recommendations made in the Facilities Plan can be found in Section 7 of this memorandum, as well as in the Facilities Plan Report itself.

3 Wastewater Treatment Plants

3.1 West Side Wastewater Treatment Plant

The West Side WWTP is located at 205 Bostwick Avenue. It discharges to Long Island Sound via Cedar Creek. Construction of the original interceptors began in the early 1900s. Collected wastewater was conveyed to the site on Bostwick Avenue. Over time, the treatment plant was upgraded, expanded, demolished, and repurposed resulting in the facility that exists today. The plant consists of influent screening ahead of influent pumping, rectangular primary settling tanks, an activated sludge system modified to operate in a Modified Ludzack-Ettinger (MLE) mode for nitrogen removal, rectangular secondary clarifiers, disinfection with sodium hypochlorite and gravity thickeners, and a rotary drum thickener for sludge thickening. Plant effluent is discharged through a 72-inch outfall pipe at a headwall along the north side of Cedar Creek in Black Rock Harbor near the Captain's Cove Seaport restaurant. The most recent major on-site upgrade was in the early 2000s when the activated sludge system was modified to improve nitrogen removal. Dechlorination was also added in the early 2000s. No further major upgrades have been completed. Most equipment has reached the end of its useful life. **Figure 3-1** presents an aerial view of the West Side WWTP**.**

Figure 3-1
Aerial of West Side Wastewater Treatment Plant

The West Side WWTP was designed to achieve secondary effluent quality BOD_5 and TSS (30 mg/L each) at annual average design flow capacity of 30 MGD and peak secondary treatment capacity of 58 MGD. All wet weather flow in excess of the secondary treatment capacity, up to the design capacity of 90 MGD, was intended to receive primary treatment before recombining with secondary effluent prior to effluent disinfection and discharge. Plant data evaluated from 2017 through 2019 revealed an average influent flow of 22.1 MGD, 25 percent less than the design flow of 30 MGD.

The West Side WWTP is aging, undersized, and has inadequate treatment processes. This directly and indirectly compromises its ability to meet permit limits. This includes ineffective screening, no in-line grit removal, undersized primary settling tanks, a secondary treatment system that was reconfigured to impart nitrogen removal but is undersized to do so under year-round flow, load, and temperature conditions, inappropriately designed chlorine contact tanks, and the inability to effectively and efficiently remove scum and solids from the treatment system. In addition, the plant has limited operational instrumentation and controls making operations and control even more difficult.

During the 2017-2019 period analyzed for the Facilities Plan, the plant experienced permit violations related to effluent BOD_5, TSS, fecal coliform and enterococci. During this period, the plant did not meet its waste allocation for total nitrogen removal.

Although the WWTP was designed to accept a peak flow of 90 MGD, today, the plant typically can only accept between 80 to 85 MGD during storms due to the aging influent pumps. From 2017 to 2019 the plant experienced between 20 and 33 secondary treatment bypass events per year, resulting in between 137 and 297 million gallons of primary treated effluent discharge from the WWTP.

Collection system modeling completed during the Facilities Plan has shown that without any improvements in the collection system, up to 160 MGD could currently be conveyed to the plant during the 1-year, 24-hour design storm. Peak flow of 180 to 200 MGD could be conveyed in larger storms. This illustrates that higher flow capacity WWTP options can reduce CSO without any additional collection system improvements.

The WWTP needs substantial upgrades to its treatment processes to continue to meet regulatory limits during average dry weather conditions. To take advantage of the collection system conveyance capacity described previously, the Facilities Plan recommended increasing the West Side WWTP to a 200 MGD wet weather capacity. This recommendation and the concomitant CSO benefit are discussed in Section 7.2. The 2020 Facilities Plan presents additional information regarding existing WWTP processes and recommendations for their improvement.

3.2 East Side Wastewater Treatment Plant

The East Side WWTP, located at 695 Seaview Avenue, discharges to Long Island Sound via Bridgeport Harbor. The East Side WWTP was designed as a primary treatment facility in the 1950s. Between 1969 and 1971, it was upgraded to provide secondary treatment. The East Side plant has unit processes similar to the West Side plant: influent screening ahead of influent pumping, rectangular primary settling tanks, an activated sludge system modified to operate in an MLE mode, disinfection with sodium hypochlorite and gravity thickeners, and a gravity belt thickener for sludge thickening. Plant effluent discharges through a 60-inch outfall pipe to Powerhouse Channel, a dead-end inlet off the east side of the Pequonnock River in the Inner Harbor. **Figure 3-2** shows an aerial view of the site. As with the West Side plant, the East Side plant was modified for interim nitrogen reduction in the early 2000s and dechlorination was added. Limited mechanical improvements have been made since that time. Most equipment is older than its expected useful life.

Figure 3-2
Aerial of East Side Wastewater Treatment Plant

The East Side WWTP was also designed to achieve secondary effluent quality (30 mg/L BOD_5 and TSS) at annual average design flow capacity of 10 MGD and a peak secondary treatment capacity of 24 MGD. All wet weather flow exceeding the secondary treatment capacity, up to 40 MGD, was intended to receive primary treatment before recombining with secondary effluent prior to effluent disinfection. Plant data from 2017 through 2019 reveals an average influent flow of 5.7 MGD, 43 percent less than design flow.

While the East Side WWTP is also aging, undersized, and has inadequate treatment processes, it does a good job meeting permit limits since the influent flow is well below design capacity. As with the West Side plant, the East Side plant has ineffective screening, no in-line grit removal, aging and slightly undersized primary settling tanks, a secondary treatment system that was reconfigured to impart nitrogen removal, and inappropriately designed chlorine contact tanks. Although solids management is more effective at this facility, the East Side WWTP receives scum from the West Side plant which can overload this system. In addition, limited operational instrumentation and controls exist making operations and control even more difficult.

During the 2017-2019 period analyzed as part of the Facilities Plan, the plant experienced a few permit violations related to effluent BOD_5, TSS, fecal coliform, and enterococci. In general though, the East Side plant meets its permit limits. The plant was able to meet its waste allocation for total nitrogen removal all three years. The East Side plant generally does a better job managing solids through peak flow events than the West Side plant.

Although the East Side WWTP was designed to accept 40 MGD peak flow, today, the plant typically can only accept 35 MGD during storms due to the aging influent pumps. From 2017 to 2019, the plant experienced between 5 and 17 secondary treatment bypass events per year, resulting in between 12 and 38 million gallons of primary treated effluent discharge from the WWTP.

Collection system modeling completed during the Facilities Plan has shown that up to 60 MGD could be conveyed to the East Side plant during the 1-year, 24-hour design storm. Peak flows greater than 80 MGD can be conveyed in storms greater than the 1-year, 24-hour design storm. This illustrates that higher flow capacity WWTP options can be an effective strategy for reducing CSO.

The East Side WWTP needs substantial upgrades to its treatment processes to continue to meet regulatory limits under average dry weather operations. To take advantage of the collection system conveyance capacity described previously, the Facilities Plan recommended increasing wet weather capacity to 80 MGD. This recommendation, and its significant CSO benefit, are explained further in Section 7.2. Additional information regarding evaluation of existing WWTP processes and recommendations for improvement of these treatment processes can be found in the Facilities Plan.

4 Water Quality

For the first two decades of implementation of the federal Clean Water Act (CWA), regulatory agencies focused on cleanup of continuous waste discharges. Publicly owned treatment works were typically required to provide secondary treatment, or at least provide a level of treatment greater than primary sedimentation. Industrial dischargers were required to install best available treatment for their discharges.

CSO control presents communities with distinct challenges. CSO control can be expensive. Water quality impacts from CSOs are temporary and primarily limited to during and after storms. In addition, many studies indicate that CSO control alone may not meet water quality objectives, as stormwater runoff also adversely affects water quality during and after wet weather.

In recent years, regulatory agencies have sought coherent policies that associate the environmental benefits of CSO control with the costs to achieve these benefits. Both federal and state agencies recognize that compliance with state water quality standards for CSO is costly. Accordingly, government agencies have developed separate but similar control policies to guide CSO abatement given the technical, social, and economic challenges for communities.

In Connecticut, DEEP has primacy, as Environmental Protection Agency (EPA) has delegated primary enforcement responsibility to the state.

WPCA’s CSO planning efforts are influenced by the critical factors described in this section.

4.1 Receiving Water Body Classifications

Classifications for the receiving water bodies for WPCA CSOs are listed in **Table 4-1**. In the cases where two classifications are provided, each refers to a different stream reach. These classifications correspond to the designated uses described in Section 4.3. The water bodies are shown in **Figure 4-1.** Based on these water quality standards and the requirements of the Administrative Orders, WPCA adopted a 1-year control level in the 2011 LTCP.

Table 4-1 Water Quality Classifications for Major Receiving Waters of WPCA CSOs

Water Body	WWTP Collection System	Current Classification
Ash Creek	West Side	SB/A[1]
Black Rock Harbor	West Side	SB
Bridgeport Harbor	West Side	SB
Burr Creek	West Side	SB
Cedar Creek	West Side	SB
Island Brook	West Side	A
Johnson's Creek	East Side	SB
Pequonnock River	West Side	SB/B/A[1]
Yellow Mill Pond	East Side	SB

1. The Pequonnock River and Ash Creek have varying classifications for different assessment units. CSO from WPCA's combined sewer system discharges to Class SB segments of the Pequonnock and at the boundary of the SB/A classification in Ash Creek.

4.2 Receiving Water Body Impairments

Section 303(d) of the CWA requires each state to identify waterbodies that are not expected to meet surface water quality standards after implementation of technology-based controls or best management practices. Impaired waterbodies in the 303(d) list may require TMDLs to be developed. The 303(d) list is updated every two years. The most recent version was issued by the state of Connecticut in 2020 (DEEP, 2020).

Table 4-2 lists water bodies affected by WPCA's CSOs that are included on Connecticut's 2020 Integrated Water Quality Report. As shown, the water bodies affected by WPCA's CSOs on the state 303(d) list are the Pequonnock River, Bridgeport Harbor, Black Rock Harbor, and Ash Creek. These water bodies fall under EPA Category 5, 4a, and/or 2. Water bodies classified as Category 5 are those for which available data and/or information indicate that one or more designed uses are not being supported and a TMDL or action plan is needed (EPA, 2015). Water bodies in Category 4a are impaired for one or more designated uses that have an established TMDL, and a pollutant has been identified as the cause of the impairment. Water bodies classified as Category 2 are those for which available data and/or information indicate that some, but not all, designated uses are supported.

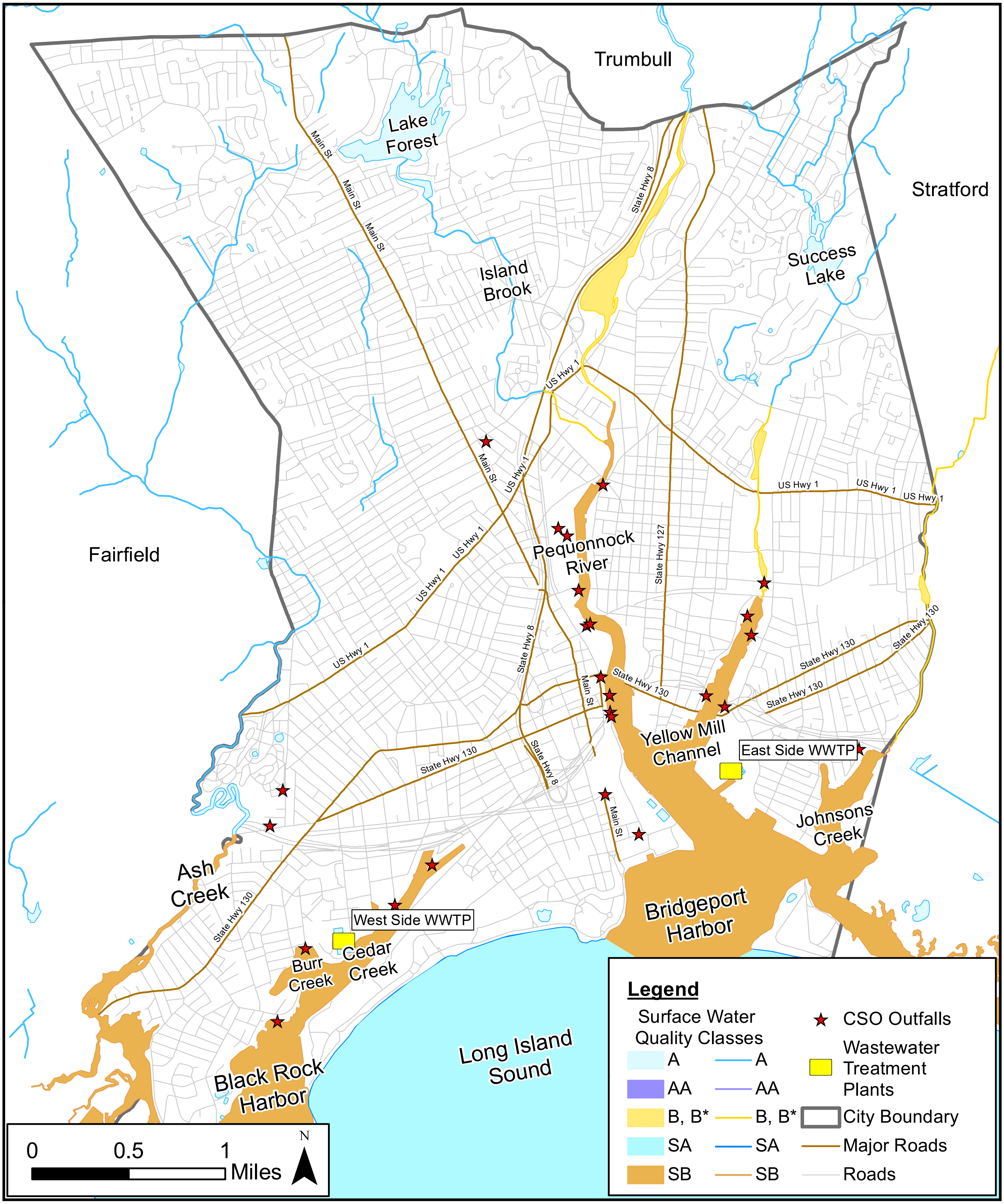


Figure 4-1
Surface Water Quality Classifications

Water Pollution Control Authority
City of Bridgeport
CSO Long Term Control Plan Update

CDM Smith

Table 4-2 Water Bodies on the Connecticut Impaired Waters List

Water Body	Impaired Designated Use	Cause	EPA Category
Pequonnock River	Habitat	Unknown	5
Pequonnock River	Recreation	E. coli	2, 4a, 5
Bridgeport Harbor	Recreation	E. coli	5
Bridgeport Harbor	Shellfish harvest	Fecal coliform	4a
Bridgeport Harbor	Habitat	Dissolved oxygen	4a, 5
Bridgeport Harbor	Habitat	Nutrients	4a, 5
Bridgeport Harbor	Habitat	Polychlorinated biphenyls (PCBs)	5
Bridgeport Harbor	Habitat	Polycyclic aromatic hydrocarbons (PAHs) (Aquatic Ecosystems)	5
Black Rock Harbor	Habitat	Dissolved oxygen	5
Black Rock Harbor	Habitat	Estuarine bioassessments	5
Black Rock Harbor	Habitat	Nutrients	5
Black Rock Harbor	Habitat	Oil and grease	5
Black Rock Harbor	Habitat	PCBs	5
Black Rock Harbor	Habitat	PAHs (Aquatic Ecosystems)	5
Black Rock Harbor	Shellfish harvest, recreation	Fecal coliform	4a
Black Rock Harbor	Shellfish harvest, recreation	Enterococcus	4a
Ash Creek	Commercialized shellfish harvesting where authorized	Fecal coliform	5
Ash Creek	Habitat	Gold	5
Ash Creek	Habitat	Silver	5
Ash Creek	Recreation	Enterococcus	5

Habitat: Habitat for fish, other aquatic life, and wildlife

4.3 TMDL Designations

In its 2020 Integrated Water Quality Report (IWQR), DEEP lists the Pequonnock River, Bridgeport Harbor, Black Rock Harbor, and Ash Creek as impaired based on water quality assessments. TMDLs have been established for several WPCA receiving waters. These TMDLs include the Connecticut Statewide Bacteria TMDL, the Long Island Sound Total Nitrogen TMDL, and the Northeast Regional Mercury TMDL, which is applicable to all waterways in the Northeast (New England and New York). Each state is required to develop a TMDL for any waterbody listed as impaired on its 303(d) list. While no additional TMDLs are anticipated based on the 2020 303(d) list, future assessments by DEEP may result in additional impairments that require additional TMDL development.

4.3.1 Statewide Bacteria TMDL

DEEP issued the Final Connecticut Statewide Bacteria TMDL in September 2012 to reduce bacteria concentrations in waters listed on the state 303(d) list for fecal bacteria-related impairments. The

TMDL identifies criteria for total coliform, E. coli, fecal coliform, and enterococci. These bacteria are used as indicators for public drinking water supplies, freshwater recreation, shellfish consumption, and coastal recreation, respectively. The TMDL sets concentration limits for each water quality classification and specific designated uses.

- In class AA, A, and B water bodies, geometric mean E. coli must be less than 126 colonies/100 mL. Single sample maxima vary according to recreation type: designated swimming areas require a single sample maximum of 235 colonies/100 mL, non-designated swimming areas a maximum of 410 colonies/100 mL, and other recreation areas a maximum of 576 colonies/100 mL. Non-designated swimming areas are defined as areas suitable for swimming but that have not been designated as bathing areas, and waters which support other recreational activities where full body contact is likely.
- In Class SA water waterbodies, the geometric mean fecal coliform must be less than 14 most probable number (MPN)/100 mL; 90 percent of samples must be less than 31 MPN/100 mL.
- In Class SB water waterbodies, the geometric mean fecal coliform count must be less than 88 MPN/100 mL; 90 percent of samples must be less than 260 MPN/100 mL.
- In Class SA and SB water waterbodies, the geometric mean enterococci must be less than 35 MPN/100 mL. Single sample maxima vary according to recreation type: designated swimming areas require a single sample maximum of 104 MPN/100 mL; other recreation areas allow a maximum of 500 MPN/100 mL.

4.3.2 Nitrogen TMDL

DEEP and the New York Department of Environmental Conservation developed a nitrogen TMDL in 2001 to control nutrient loads to Long Island Sound. TMDLs for WPCA's WWTPs are 362 lb/day for the East Side WWTP and 1,041 lb/day for the West Side WWTP .

In 2002, the DEEP Nitrogen Credit Exchange was formed to enable wastewater treatment plants to buy nitrogen credits from the state administered "credit bank" to meet their Wasteload Allocations. In 2018, WPCA spent $1.5 million in nitrogen credits for the West Side WWTP and received $300,000 in nitrogen credits for the East Side WWTP, which released an average nitrogen loading of 1,761 pounds of per day (lb/day) and 271 lb/day, respectively (DEEP, 2018b). Modifications to the WWTPs in the early 2000s have helped reduced nitrogen discharges since 2004. Current effluent total nitrogen loads represent a significant improvement over the baseline average load of 2,852 lb/day and 991 lb/day for the West Side and East Side WWTPs, respectively.

4.3.3 Northeast Regional Mercury TMDL

The principal source of mercury contamination is atmospheric deposition. Therefore, while this TMDL applies to all WPCA's receiving waters, it is not pertinent to its CSO or WWTP discharges.

4.4 Water Quality Analysis

WPCA completed a receiving water body sampling program in 2009 to assess water quality in waterways potentially affected by CSO. The program focused on bacterial indicators and chemical and physical characteristics that could be used to define dry weather conditions and mixing zones during wet weather discharges. Twenty-three monitoring sites were selected, including 15 CSO receiving water sites (two of which are shellfish culture sites), four CSO locations, two recreational beach sites, and two reference sites. Samples were collected during five dry weather events and three wet weather events. Five dry weather samples were also taken at the East Side WWTP influent to provide a comparison of dry and wet weather concentrations.

A total of 120 dry weather fecal coliform, 353 wet weather fecal coliform, and 67 wet weather enterococci samples were collected and analyzed. In addition, continuous measurements of temperature, pH, conductivity, and dissolved oxygen (DO) were made at the end of boating piers in Yellow Mill Channel and Cedar Creek. Section 4 of the 2011 LTCP presents a full description of the sample results (**Attachment E**).

Major conclusions from the sampling program included:

- Exceedances for bacteria observed upstream of CSOs during dry weather may be of higher concern than wet weather CSO sources.
- Results at beach and harbor sampling locations indicated little wet weather impact on bacteria counts.
- Elevated bacteria levels during wet weather observed in Pequonnock River and Cedar Creek during some rain events is likely due to a combination of upstream sources and CSO.
- Low DO in Cedar Creek may be related to factors including channelization and lack of circulation.
- CSO mixing zones could not be determined through visual observation at CSO outfalls nor via analysis of physical and chemical water quality data.

4.5 Upstream Pollutant Sources

Pollution sources upstream of Bridgeport contribute to water quality degradation. The IWQR lists impairments for the Pequonnock River, Bridgeport Harbor, Black Rock Harbor, and Ash Creek due to a mix of E. coli, fecal coliform, dissolved oxygen, nutrients, PCBs, PAHs, estuarine bioassessments, oil and grease, enterococci, gold, silver, and unknown causes (Table 4-2). Potential sources of these impairments as listed in the IWQR include stormwater, illicit discharges, CSO, municipal discharges, landfills, insufficient on-site treatment systems, and/or septic systems.

4.6 Summary

WPCA CSOs discharge to receiving waters with multiple known impairments to recreation, shellfish harvesting, commercial shellfish harvesting, and habitat for fish, marine fish, other aquatic life, and wildlife. All receiving water bodies are Class B or SB with the exception of the upstream portion of Ash Creek, which is Class SB/A, and Island Brook which is Class A.

Water quality sampling results indicate other bacteria sources in Bridgeport waterways in addition to CSO. Bacteria levels during dry weather exceeded water quality standards at multiple sampling locations, including Seaside Park (beach sample), Ash Creek, Cedar Creek, Pequonnock River, Yellow Mill Channel, and Johnson's Creek. A subset of the wet weather samples at the five tributaries showed a pattern of higher bacteria counts in upstream sampling locations than in downstream locations. Sources of bacteria upstream of the CSOs are likely illicit connections, wildlife fecal matter, and stormwater runoff. WPCA launched an investigation to locate suspected illicit connections subsequent to the sampling program.

Wet weather bacteria concentrations were not significantly different than dry weather measurements at beach and harbor sampling locations. Wet weather sampling in Ash Creek, Cedar Creek, Pequonnock River, Yellow Mill Channel, and Johnson's Creek indicated that bacteria is likely due to a combination of upstream sources and CSO.

Chemical and physical water quality monitoring revealed a dissolved oxygen pattern typical of eutrophic waters at Cedar Creek. DO fluctuated diurnally in Cedar Creek between low overnight levels and supersaturation during the day. DO monitoring at Yellow Mill Channel did not indicate DO below the surface water standard for Class B or SB waters (5 mg/L). Low DO in Cedar Creek can likely be attributed to low flow in the Cedar Creek Basin, dredged channels, neighboring Seaside Landfill along Barnum Boulevard, CSO, West Side WWTP effluent, and/or poor circulation.

Mixing zones could not be determined for CSO, despite efforts to define plumes through visual observation, physical and chemical measurements, and bacteria sampling. No evidence of defined plumes was seen in the sampling data. Bacteria sampling data from the tributaries indicate that bacteria is fully mixed within the receiving water before it enters Bridgeport Harbor. Field crews did not observe any color variation, sanitary trash, or other visual indications of CSO in the river or harbor sampling sites. CSO mixing zones are believed to be located in small areas close to the mostly underwater outfalls.

5 CSO Model Update

WPCA's existing collection system model was updated and used to evaluate peak flow delivered by the collection system to the East Side and West Side WWTPs to support the development of the Facilities Plan and this memorandum. WPCA collection system model uses EPA SWMM, the preeminent model for planning, analysis, and design related to stormwater runoff, combined and sanitary sewers, and other drainage systems in urban areas. This section summarizes the model development, data sources, validation, and updated baseline CSO estimates used as the basis for alternatives analysis in the Facilities Plan. **Attachment F** describes the model updates, calibration, and baseline conditions.

5.1 Data Sources

The collection system model was updated with best-available information on the existing collection system, including system improvement projects that WPCA has implemented since the last model update in 2011. Data gathering and analysis for this model update focused on both the physical attributes of the system and system performance. CDM Smith collaborated with WPCA to collect and verify this information, as described below.

SWMM Model

CDM Smith obtained the latest version of WPCA's hydraulic model in June 2019. The model had been maintained by Arcadis since the 2011 LTCP. It had most recently been used to compare simulated and observed overflows during the 2016 and 2017 Pilot Telemetry Program (Arcadis, 2018). The model version used for the pilot telemetry program analysis was the starting point for this analysis.

Spatial and Timeseries Data

Publicly available spatial and timeseries datasets obtained from national and state resources were used to refine model hydrology and set model boundary conditions. These included census block outlines and population, imperviousness, elevation data, hourly precipitation, hourly tide levels, daily river flows, daily temperature, and daily snow depths.

Record Drawings

WPCA provided city-wide mapping including its Fuller sewer atlas and GIS data, as well as record drawings for key locations and projects such as CSO regulators and recent improvements including sewer separation, sewer lining, and the new River Street Pump Station.

Flow and CSO Monitoring

Existing monitoring data were used to calibrate system performance in dry and wet weather, as well as to add a variable baseflow component to the model. Data included CSO block testing results at all available CSO regulators for 2017 and 2019, daily flow at the WWTPs for 2017–2019, CSO level sensing from the 2016-2017 Pilot Telemetry Program, and area-velocity metering data from system-wide (2009 and 1999) and local (Ash Creek 2019-2020) flow monitoring programs.

Additional Information on System Performance

In addition to system monitoring, anecdotal information about system performance was provided by WPCA such as known flooding areas, general condition and verification of tide gates on CSO outfalls, and sediment and debris buildup locations. Field data collected by Kleinfelder during the 2020 Ash Creek CSO Evaluation of Alternatives was also incorporated to the model.

5.2 Model Update

The collection system model was updated and improved to develop baseline conditions for the existing system to support the Facilities Plan and this LTCP Update. The updated model incorporates revised hydraulics, hydrology, and dry weather flow.

5.2.1 Hydraulics

The modeled pipe network builds upon the dataset described in the 2011 LTCP. The starting model network consisted of 3,958 links (pipes, weirs, orifices, and pumps). The updated model has 4,032 links. Details were added at CSO regulators, and pipes were added in the separated sanitary service area in the northern portion of the City. The updated model has a median pipe diameter of 15 inches, including 813 10-inch and smaller pipes. The updated model represents 156 miles of pipe. This updated pipe network is shown in **Figure 5-1**.

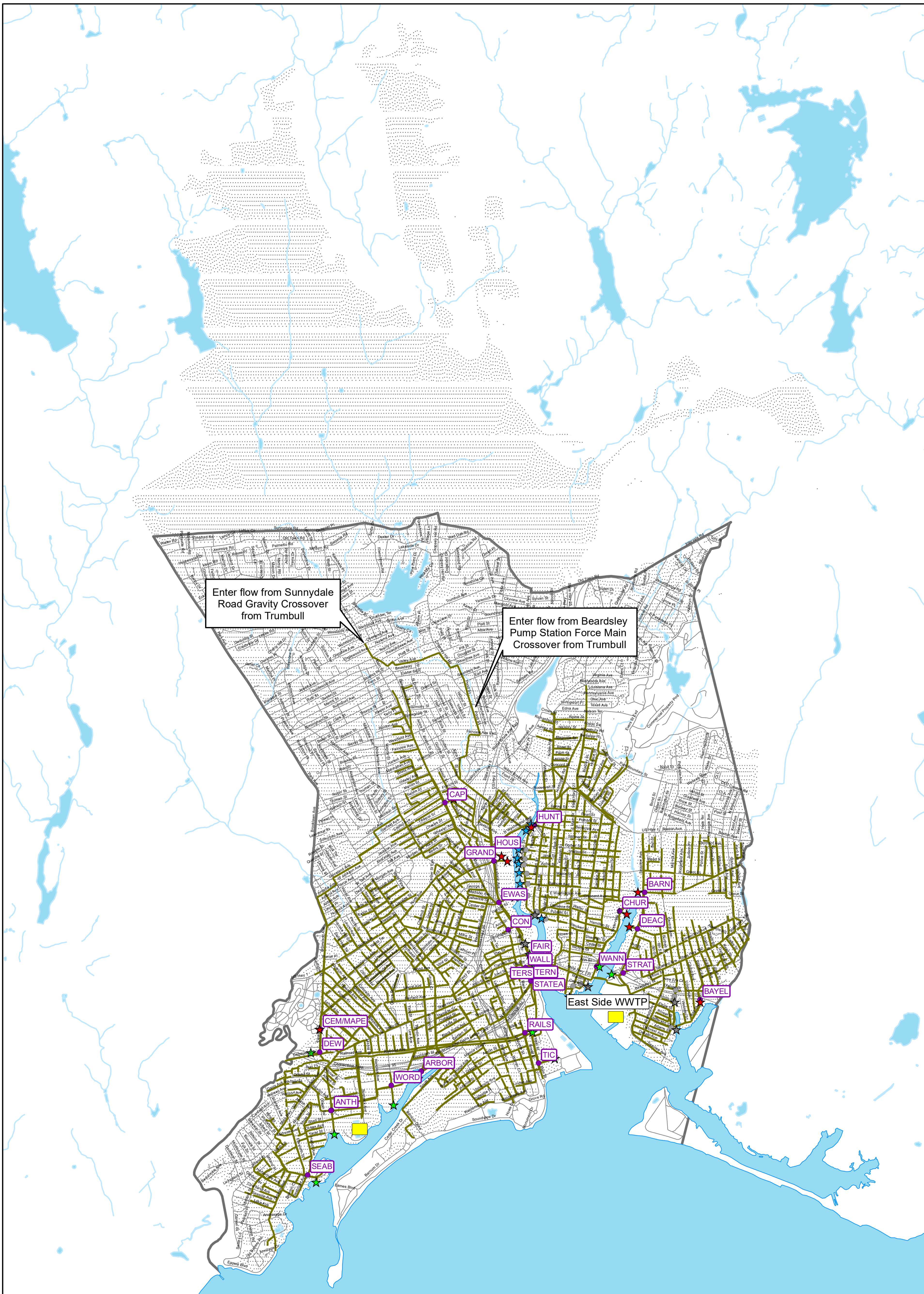
CSO regulator hydraulics were thoroughly checked against record drawings, notes provided by WPCA, and video taken during CSO block-testing inspections. CSO regulator configurations were discussed with WPCA and updated as appropriate, including representation of recent WPCA efforts to raise weirs. The updated model has tide gates at two East Side and eleven West Side CSOs.

The hydraulics of all siphons were reviewed and updated as needed. While no siphon record drawings were available, WPCA provided information about locations and capacity.

Six miles of 24-inch and larger pipe were added to the model to extend the network into separated sanitary sewersheds in the northern portion of the City. The model extension includes the new River Street Pump Station sewershed and two miles of the Bridgeport-Trumbull Interceptor, which receives sanitary wastewater from Trumbull via the Beardsley Pump Station and Sunnydale Crossover. No pipes in the Trumbull collection system were included in the updated model, but its sanitary flow and I/I were explicitly accounted for.

Simulated sediment depths were verified by WPCA and updated as needed. Friction and form losses were completely revised for the model update.

The WWTPs were configured to reflect current operations at both facilities. The starting model contained unique outlet rating curves to control inflow to each facility based on the hydraulic grade line in the collection system. The rating curves were replaced with influent flow limits to each facility. Based on data from WPCA, existing conditions limits were set to 80 MGD and 35 MGD at the West Side and East Side WWTPs, respectively.



0 0.25 0.5 1
Miles

N

Legend

Model Extent
Modeled Pipes
Wastewater Treatment Plants
Roads

City Boundary

CSO Regulators
Active
Inactive

CSO Outfalls
Active, Tidegate
Active, No
Closed
Converted to Stormwater

Figure 5-1
Model Pipe Network

Water Pollution Control Authority
City of Bridgeport, CT

December 2021

5.2.2 Hydrology

The model's surficial hydrology was revised extensively. Subcatchments were re-delineated from the city's 1,900 census blocks. Census blocks were subdivided as needed to eliminate dry pipes and typically routed to the upstream-most model node within the subcatchment. New subcatchments cover the City of Bridgeport and the sewered portion of Trumbull. The updated model contains 2,152 subcatchments in Bridgeport and two in Trumbull as shown in **Figure 5-2**.

Subcatchment area was assigned according to GIS area in fully combined sewersheds. Separated sanitary sewersheds in the northern portion of the City were assigned 5 percent of the GIS area. More recently separated areas within the combined portion of the system were represented with 10 to 99 percent of the GIS area according to the reported degree of separation (**Figure 5-2**).

Imperviousness was assigned using data specifying imperviousness statewide at 1-foot pixel resolution. Effective imperviousness is calibrated in the model through adjustment of the fraction of a subcatchment's impervious surface that drains onto adjacent pervious ground (e.g., roof leaders draining to lawns).

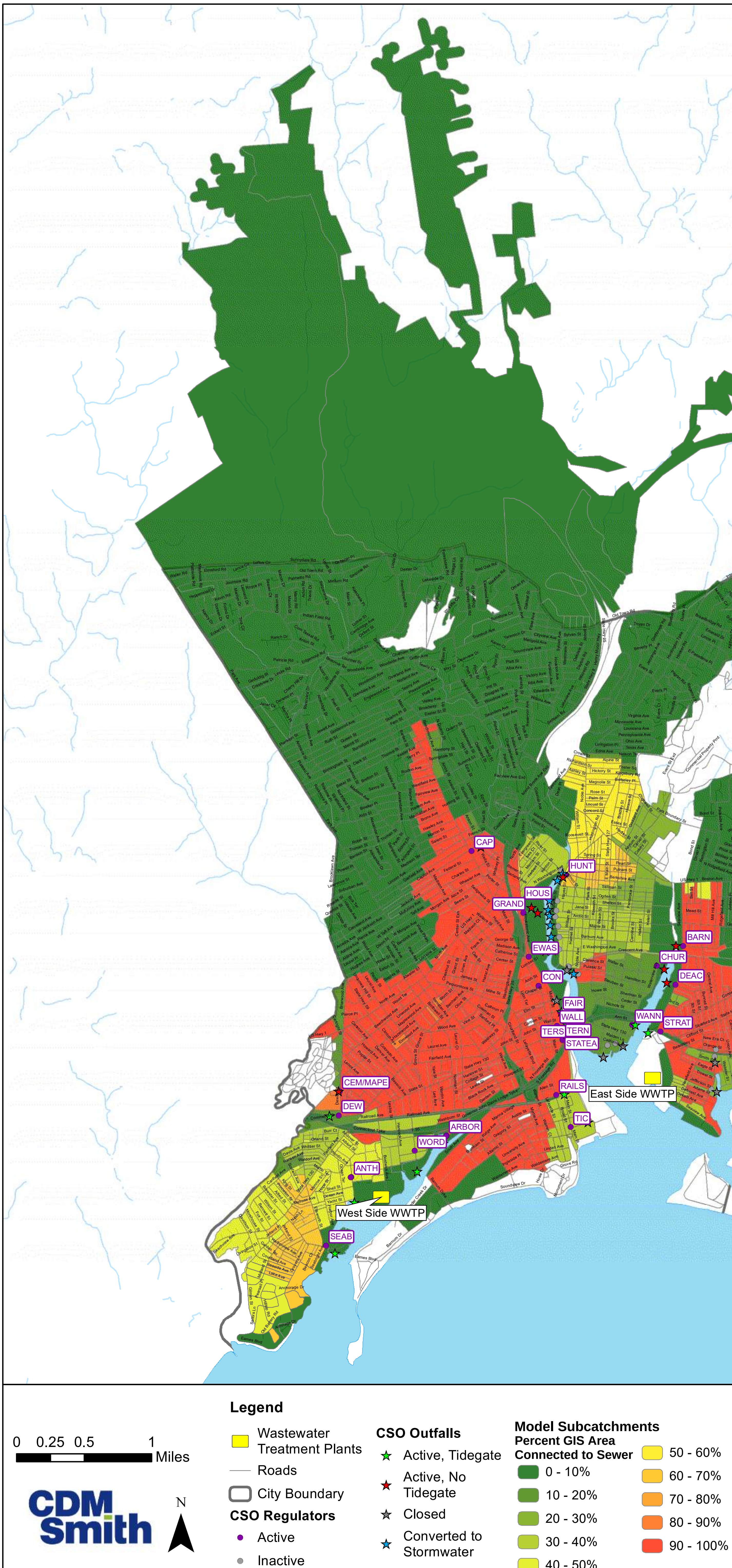
5.2.3 Dry Weather Inflow

Dry weather flow in the model is simulated as the sum of sanitary flow and seasonal and constant groundwater infiltration (GWI).

Sanitary flow was estimated for the West Side and East Side WWTP collection systems and for sanitary inflow from Trumbull using average daily flows (ADF) from each WWTP and monthly records from Trumbull. Sanitary flow was allocated across the system using population data from the 2010 census. Sanitary flow of 63 gallons per capita per day was applied to the East Side and West Side collection systems; 60 gallons per capita per day was assigned for Trumbull. An hourly diurnal pattern was applied to all sanitary inflow nodes.

Seasonally-varied groundwater infiltration was derived from flow observed in the Norwalk River correlated with observed flow at the WWTPs and scaled at each load point according to contributing sewershed area. The Norwalk River was selected for this purpose as GWI typically correlates well with river baseflow within a 25-mile radius. The Norwalk River gauge is the closest gauge to the WWTPs (12 miles west) with 60 years of continuous record.

Constant groundwater baseflow to deep, large pipes was correlated linearly with pipe depth. WPCA executed multiple contracts to line large interceptors and connected pipes on the West Side collection system. Pipes located within lining contracts H-1 through H-7 were not assigned any base infiltration.



CDM Smith

Figure 5-2
Model Subcatchments

Water Pollution Control Authority
City of Bridgeport, CT

December 2021

5.3 Model Calibration

The model was calibrated to the available datasets with consideration of their differing ages and value. Datasets from flow metering programs, CSO monitoring, CSO block testing, WWTP influent flow and water quality ranging from 1999 to 2019 supported model-wide model calibration and validation.

Since WPCA has made many improvements to the collection system over the past two decades, data from the older programs has reduced value for calibration to current conditions. The improvements include sewer separation and lining, which reduce flows throughout the collection system, and weir modifications at CSO regulators, which reduce CSO and allow increased wet weather flow depth. Data from the older programs was used to verify model performance with consideration of the expected changes in system behavior. A higher level of scrutiny was placed on model performance compared with recent CSO measurements and the Trumbull and WWTP data, all of which represent current conditions.

In addition to system-wide calibration, a local model calibration was completed during the 2020 Ash Creek CSO Evaluation of Alternatives. Five flow meters were deployed in the Ash Creek sewershed in December 2019 and January 2020 to assess the existing localized combined sewer system's hydraulic conditions during storm events, specifically as it affects the DEW and CEM/MAPE regulators, and to support model calibration. Model calibration in the Ash Creek sewer is described in the 2020 Ash Creek CSO Evaluation of Alternatives.

5.3.1 Dry Weather

Sanitary flow was estimated from ADF observed at the East Side and West Side WWTPs and monthly flows reported for Trumbull from 2016 through 2019 and allocated according to 2010 census data. The three dry weather components were calibrated based on daily flows and sewage concentrations at the WWTPs.

5.3.2 Wet Weather

The model accounts for drainage from combined areas and I/I from separated and combined areas. Hydrology was calibrated to daily flow data at the WWTPs, depth data from the 2016-2017 Pilot Telemetry Program, and CSO frequency from 2017 and 2019 CSO block testing and checked against the 1999 and 2009 flow monitoring programs.

5.3.3 Validation

A high level of scrutiny was placed on simulated flows at the WWTPs and simulated frequency of CSO. Overall, simulated ADF tracks well with observed values at both facilities. The updated model mimics seasonal variation in baseflow and matches trends of higher spring ADF and lower summer and fall ADF at both facilities. The updated model matches the block testing data reasonably well. East Side CSO and tidal inflow is much less frequent than on the West Side.

The model is reasonably calibrated to dry and wet weather conditions. It robustly represents flow to the WWTPs and discharge via CSOs. It offers a useful tool for assessing the existing state of the system and analyzing the impacts of potential improvements to the WWTPs. A complete explanation of the model update and calibration process can be found in **Attachment F** including validation charts and simulated vs. observed CSO charts.

5.4 Baseline Conditions

The updated model was used to characterize CSO and flow at the WWTPs for the 1-year design storm. This design storm is described in Section 5 of the 2011 LTCP and is the same design storm referred to as the "1 year, 24-hour storm" in Administrator Order WRMU18002. This storm was recorded at Sikorsky Airport on August 20, 1950. Its hourly hyetograph was used to run the model. A total of 2.74 inches of rain was observed over 17 hours, with a peak hourly depth of 0.75 inches.

Peak flows and total volumes for the 1-year design storm are summarized by CSO outfall and WWTP in **Table 5-1**. Total simulated East Side CSO is 5.4 MG, with all six CSOs active, based on a maximum capacity of 35 MGD at the East Side WWTP. West Side CSO totals 44.4 MG, with 21 of 22 regulators active, based on a maximum capacity of 80 MGD at the West Side WWTP.

Table 5-1 Baseline Conditions: 1-Year Design Storm Summary

WWTP	CSO	Overflow Volume (MG)	Peak Overflow Rate (MGD)	Duration of Overflow (hour)
East Side	BARN	0.3	4.1	3.8
	BAYEL	0.9	13.7	4.3
	CHUR	0.4	8.4	2.0
	DEAC	0.4	5.3	2.5
	STRAT	2.2	16.5	6.3
	WANN	1.2	8.8	6.3
West Side	ANTH[1]	5.8	28.1	11.3
	ARBOR[1]	8.2	84.4	6.5
	CAP	0.4	9.6	2.0
	CEM/MAPE	2.6	26.6	5.8
	CON	<0.01	0.2	1.0
	DEW	1.8	15.1	6.5
	EWAS	1.4	13.4	6.3
	FAIR	3.5	19.6	9.8
	GRAND	3.3	28.1	8.8
	HOUS	3.9	22.6	9.5
	HUNT	3.0	29.3	7.0
	OVER	0.3	5.4	2.5
	RAILS	0.2	7.8	1.5
	SEAB	2.3	22.5	7.0
	STATEA	3.0	24.1	8.5
	TERN[2]	1.8	10.8	7.5
	TERS[2]	1.1	6.9	9.0
	TIC	0.3	7.1	1.5
	WALL	1.5	10.0	9.0
	WORD	0	0	0

1 ANTH and ARBOR regulators both have two regulating weirs. CSO reported in this table is the sum of the discharge over both weirs.

2 TERN and TERS share an outfall.

6 Qualitative Screening of CSO Abatement Technologies

This section describes CSO abatement technologies and assesses their applicability to WPCA's CSO control objectives. Many alternative strategies are available to control pollutants discharged from CSOs ranging from no action to complete separation of the combined sewer system (CSS) into separate sanitary and stormwater systems. This assessment considers technologies presented in EPA guidance manuals. Specific factors that identify whether a technology is appropriate for future utilization within the City of Bridgeport include current condition of the sewer system, characteristics of wet weather flow (e.g., peak flow rate, volume, frequency, and duration), hydraulic and pollutant loading, climate, implementation requirements (e.g., land, neighborhood, noise, and disruption), and maintenance requirements.

CSO abatement technologies were classified into five categories:

- Quantity source control measures;
- Quality source control measures;
- Collection system controls;
- Storage technologies; and
- Treatment technologies.

These categories and typical technologies are included in the following sections. **Table 6-1** lists the CSO abatement technologies considered for this planning memorandum and identifies the results of the technology evaluation/screening. These technologies were qualitatively screened based upon the effectiveness of the technology, and its applicability to WPCA's water quality objectives.

Table 6-1 List of CSO Abatement Technologies

CSO Control Technology	Technology Not Feasible, Appropriate, or Applicable	Continue Current Practice	LTCP Technology
QUANTITY SOURCE CONTROL MEASURES			
Porous Pavement	√		
Flow Detention	√		
Area Drain and Roof Leader Disconnection			√
Utilization of Pervious Areas for Infiltration	√		
Catch Basin Modifications	√		
Urban Parks and Green Spaces	√		
Green Roofs	√		
Bioretention	√		
Water Conservation	√		
Infiltration Sumps	√		
QUALITY SOURCE CONTROL MEASURES			
Air Pollution Reduction	√		
Solid Waste Management		√	
Fat, Oil, and Grease Control Programs		√	
Street Sweeping		√	
Fertilizer/Pesticide Control	√		
Snow Removal and Deicing Practices	√		
Soil Erosion Control		√	
Commercial/Industrial Runoff Control		√	
Animal Waste Removal	√		
Catch Basin Cleaning		√	
Catch Basin Modifications - Hoods/Baffles	√		
End-of-Pipe Controls	√		
Staffing and Operation		√	
COLLECTION SYSTEM CONTROLS			
Existing System Management		√	
Regulator Modifications			√
Sewer Cleaning/Flushing		√	
Sewer Separation			√
Infiltration/Inflow Control			√
Polymer Injection	√		
Regulating Devices and Backwater Gates			√
Remote Monitoring and Control/Flow Diversion			√
Relocation of CSO Outfalls & Regulators (Combine & Relocate)			√
CSO Regulation Remote Monitoring			√
STORAGE FACILITIES			
In-Line Storage			√
Off-Line Storage			√
Surface Storage	√		
TREATMENT TECHNOLOGIES			
Satellite Treatment Facilities	√		
Wastewater Treatment Plant Improvements			√
Screening	√		
Sedimentation	√		
Enhanced High-Rate Clarification			√
Chemical Flocculation	√		
Dissolved Air Flotation	√		
Swirl Concentrators	√		
Biological Treatment	√		
Filtration	√		
Disinfection			√

6.1 Quantity Control Measures

Quantity control measures are intended to reduce and/or eliminate portions of the wet weather flow generated in the basin tributary to the CSO regulator.

- **Porous Pavement** reduces quantity of runoff entering the CSS through infiltration through the pavement. Porous pavements are less durable than traditional pavements, especially in colder climates. This technology is not considered feasible for implementation by WPCA, although implementation by private entities should be encouraged.

- **Flow Detention**: Detention ponds, bioretention areas, and bioswale systems located in upstream areas of the tributary basin can temporarily store stormwater runoff, attenuate flow peaks, and minimize potential downstream treatment capacities. This technology is not considered feasible for implementation by WPCA, although implementation by private entities should be encouraged.

- **Area Drain and Roof Leader Disconnection:** In urban areas such as Bridgeport roof leaders from gutters, roofs, and area drains are often connected to the CSS. Direct connection to the system avoids excessive surface runoff across properties to catch basins or street drainage. However, these direct inflow connections increase sewer peak flow rates and volumes by decreasing travel time and preventing runoff from infiltrating into pervious surfaces. This will be considered by WPCA in future LTCP planning efforts.

- **Use of Pervious Areas for Infiltration:** Pervious area infiltration combines aspects of the previous strategies by attempting to maximize the use of pervious areas for infiltration. Due to dense development and a lack of large areas for detention, this technology is not appropriate for CSO control in Bridgeport's CSS.

- **Catch Basin Modifications** can be made to reduce peak stormwater inflows to the CSS. Catch basins within a drainage area can be retrofitted with devices, such as vortex valves, that retard surface water runoff entering the sewer system. This approach can result in increased street flooding and will not be carried forward for additional LTCP analysis.

- **Urban Parks and Green Spaces** reduce impervious area draining to a CSS, thereby helping reduce CSO. These features promote infiltration while providing attractive recreational areas for the community. It is recommended that WPCA should support any efforts for development of such spaces within Bridgeport, but this technology will not be considered further as a practical component of the LTCP.

- **Green Roofs** are a low-impact development (LID) technique which controls the timing and volume of stormwater discharges from impervious roofs. Green roofs can reduce the quantity of stormwater runoff by absorbing precipitation and delaying the peak discharge. This technology is not considered feasible for implementation by WPCA, although implementation by private entities should be encouraged.

- **Bioretention** is an LID technique that filters and infiltrates stormwater runoff from impervious areas. An area of soil and vegetation collects stormwater runoff from impervious areas and allows it to infiltrate. This technology is not considered feasible for implementation by WPCA, although implementation by private entities should be encouraged.

- **Water Conservation:** Efficiently using water to conserve energy and water and reduce wastewater flow is also an LID technique. Water conservation methods include utilization of water efficient fixtures (e.g., low-flush toilets, low-flow faucets), rain harvesting (rain barrels), waterless technologies (composting toilets, waterless urinals), and water recycling (greywater reuse). WPCA should consider periodically encouraging water conservation and consider a public outreach campaign to provide public education on water conservation measures.

- **Infiltration Sumps:** The feasibility of infiltration sumps as a flow control measure depends on subsurface soil conditions. Infiltration sumps are essentially large, deep catch basins with no pipe outlet. They collect storm water and allow it to infiltrate into the soil. Modification of thousands of catch basin sumps within Bridgeport is not considered a cost-effective control method and will not be considered in the future for implementation in WPCA's CSS.

6.2 Quality Control Measures

Quality control measures help to reduce pollutant concentrations at sources in the tributary basins and improve stormwater runoff quality before it enters the CSS. Most of these measures directly address source control before a pollutant is dissolved in rainfall and/or conveyed to the catch basin.

- **Air Pollution Reduction:** Particulate matter in the atmosphere ultimately settles and becomes a source of stormwater runoff contamination. This source of pollution is outside of WPCA's ability to control and will not be targeted as a LTCP technology.

- **Solid Waste Management:** Improper disposal of litter, including leaves, grass clippings, waste paper, wrappings, cigarettes, metal, glass, and paper containers on city streets, in parks and along vacant properties often results in these items entering the collection system and potentially being discharged to the receiving water. WPCA has no jurisdiction over solid waste management but should support any policies made by other entities. Any policies enforced for solid waste management and mitigation in the City of Bridgeport should continue.

- **Fats, Oil, and Grease Programs:** FOG is often improperly disposed of by pouring down the sink and poorly maintained grease traps. FOG builds up in sewers over time, causing blockages and reducing collection system conveyance capacity. WPCA should continue to focus on FOG control practices and could establish a public education initiative to reduce FOG in the CSS.

- **Street Sweeping:** Street sweeping improves the aesthetic environment by removing litter and debris from gutters. This practice can also improve the water quality of surface runoff by reducing the quantity of solids and floatables entering the CSS. The City currently implements a street sweeping program, which should be continued.

- **Fertilizer/Pesticide Control:** Fertilizers and pesticides contribute nutrients and other pollutants to stormwater runoff. Control of fertilizers and pesticides as an overall drainage basin program for CSO mitigation will not be considered by WPCA. However, it is advisable that WPCA staff consider the implications of any fertilizer and pesticide use on WPCA-owned properties within the watersheds.

- **Snow Removal and Deicing Practices:** Salting roadways during the winter to reduce icing can increase surface runoff pollutant loads, particularly chloride concentrations. Improper storage of salt can also contribute to high chloride concentrations, especially if the salt is not covered or protected from rain. The City should ensure that salt and sand are properly stored to avoid wash off into the sewer system. WPCA should ultimately support these actions by the City, but deicing practices will not be considered by WPCA for further study as an alternative to minimize CSO impacts.

- **Soil Erosion Control:** Construction sites and other environmental disturbances can contribute to sediment in surface runoff. This can increase the sediment loadings in CSO, as well as reduce pipe conveyance capacity and therefore increasing CSO. Soil erosion is not a significant source of CSO-related pollution in WPCA's combined sewer service area, but erosion and sediment control practices should continue to be enforced at all construction sites. Additional controls will not be considered.

- **Commercial/Industrial Runoff Control:** CSO pollutant discharge quality can be improved through the control of runoff from commercial and industrial establishments in the drainage area. WPCA should be sure to follow any existing regulations at their fueling stations and any other applicable WPCA owned location. Any existing commercial and industrial runoff control measures should be continued.

- **Animal Waste Removal:** Animal excrement is a source of stormwater pollution, especially nitrogen and pathogenic organisms (E. Coli is an indicator). Proper disposal of animal waste could reduce bacteria and nutrient concentrations in CSO. Because the impact of this pollution source is limited and not within WPCA's responsibility, this technology will not be considered further for CSO abatement.

- **Catch Basin Cleaning:** Catch basins collect and convey surface runoff to a sewer or drainage system. Basins are typically designed with a sump below the outlet pipe to capture sand, grit, and solids. Catch basins require periodic cleaning to remove the solids and floatables captured in the sump. Structures can be cleaned using a bucket or vacuum. Properly maintained catch basins can help to reduce the quantity of solids that enter the CSS. WPCA currently has a catch basin cleaning program, which should be continued.

- **Catch Basin Modifications:** Catch basins can be modified with devices, such as hoods or baffles, to help capture floatables within the catch basin until the sump is cleaned. These devices can effectively remove floatables and coarse solids that may enter the combined system and be discharged to the receiving water. WPCA will not consider modification of all existing catch basins within their CSS but will consider such modifications for new catch basin installation.
- **End-of-Pipe Controls** consist of netting systems or booms in the water to contain floatables which discharge from the end of the pipes. This technology will not be evaluated further. Floatables derived from stormwater runoff from roads and highways are addressed with other programs, such as street sweeping.
- **Staffing and Operations:** Employing staff with competencies in mechanical, construction, electrical, and computer backgrounds has allowed WPCA to ensure successful operation of the CSS. It is critical that these staff are continuously trained in industry standards.

6.3 Collection System Controls

Collection system controls and modifications reduce CSO by removing inflow sources, increasing use of existing interceptor capacity and pipeline storage, and/or optimizing performance of the collection system.

- **Existing System Management:** System management techniques can improve receiving water quality by reducing CSO and capturing first flush pollutant loads. Regular maintenance of CSO regulators and the interceptor piping system is essential to maintain proper hydraulic conditions in the system and minimize CSO frequency. The WPCA should continue current practices to minimize sediment accumulation and other issues within the existing system.
- **Regulator Modifications:** Regulators can be modified to convey more flow to the interceptor or to take advantage of upstream pipeline storage, thereby reducing CSO. These modifications are low cost and simple to implement. Certain modifications were recommended as part of the Facilities Plan. This approach will be carried forward and evaluated as a LTCP component in the future.
- **Sewer Cleaning/Flushing:** Deposition of solids is a common problem in combined systems. As the sewers were designed to handle peak wet weather flow, hydraulic capacity greatly exceeds typical dry weather flow rates. Consequently, dry weather flow velocities are often much lower than the full pipe velocity and may cause solids to settle in the pipelines. Cleaning

helps minimize the effects of sediment deposition, which can decrease the capacity of pipes, and lead to additional CSO. It is recommended that WPCA continue all preventive sewer cleaning and flushing practices. Targeted cleaning in problem areas will be considered as an LTCP component.

- **Sewer Separation:** Sewer separation is defined as the reconstruction of an existing CSS into non-interconnected sanitary and storm sewer systems. The sanitary sewer system is tributary to the WWTPs, and the storm sewer system discharges directly to local receiving waters. WPCA has had success separating sewers in the past and this will be considered as an LTCP technology moving forward.

- **Infiltration/Inflow Control:** To maximize the collection system's capacity both in Bridgeport and from neighboring contributors, it is necessary to remove extraneous flows caused by infiltration and inflow. Infiltration is groundwater that enters the system through broken or cracked pipes, defective joints, depressed manholes, and manhole walls. Replacing or lining defective pipes, pipes joints and manholes can reduce infiltration. The benefits associated with achievable levels of I/I reduction in both the combined and separated portions of WPCA's sewer system will be evaluated as a future LTCP technology.

- **Polymer Injection:** Injecting polymers into a collection system can effectively decrease pipe friction and thereby increase the pipe's hydraulic capacity. Polymer injection requires construction of facilities to store and inject the polymer. In addition, it can cause unintended negative aesthetic impacts if discharged to receiving waters. This will not be evaluated further as a future LTCP technology.

- **Regulating Devices and Backwater Gates:** This technology utilizes control valves and devices to optimize system operations through control of flow into and through the interceptor system. Regulating devices include vortex valves, inflatable dams, and motorized or hydraulically operated sluices or control valves. Replacement of backwater gates on the CSO outfalls was considered during the Facilities plan. This technology will be evaluated in future LTCP efforts.

- **Remote Monitoring and Control/Flow Diversion:** Diverting flow from one drainage basin of limited hydraulic capacity to a drainage basin having excess capacity can reduce the volume and frequency of CSO discharge. Available and existing pipeline capacity may be used to convey flow or as in-line storage. Components of a remote monitoring program include a data gathering system to monitor rainfall, pumping rates, treatment rates and regulator positions; a central computer processing center to provide real time control; and an instrumentation and control system to remotely regulate pumps, gates, valves, and regulators. This technology appears to be promising in combination with regulating devices such as sluice gates to regulate and detain flow. This technology will be considered further for LTCP controls.

- **Relocation of CSO Outfalls & Regulators:** Relocation of CSO outfalls involves routing overflows through new pipe to a new outfall location, sometimes with the goal of discharging to a less sensitive receiving water body. Relocation of regulators may also be done to consolidate CSO to minimize the number of control facilities or to improve regulator access for maintenance. Relocation of CSO outfalls and regulators where applicable to increase ease of access and maintenance of CSO structures will be considered further as a viable CSO control technology.
- **CSO Regulator Remote Monitoring:** Remote monitoring of overflow locations is used to monitor real-time performance during wet weather and to more promptly identify issues that may result in a dry weather discharge. As required by the recent NPDES permit requirement revisions, the WPCA will begin monitoring two regulators on the East Side over the next couple years.

6.4 Storage Technologies

Storage of CSO flows can be performed either at a local site adjacent to a regulator (or other control device) or downstream at a central site that receives consolidated flows and eliminates the need for several facilities. Storage facilities are typically used to hold CSO until after a storm, at which time flow can be conveyed to the treatment facility.

- **In-Line Storage:** The use of in-line storage is considered a cost-effective method of reducing CSOs by utilizing available pipeline storage volume, in-line storage tanks where the dry weather flow passes directly through the tank, or parallel relief sewers. Providing new storage volume or utilizing existing storage capacity helps to both dampen peak flows and detain combined wastewater for later treatment at the WWTPs. WPCA already has several box culverts in the CSS used for in-line storage. Evaluation of further in-line storage opportunities to hold wet weather flows will be considered further as a LTCP measure.
- **Off-Line Storage:** As with in-line storage, off-line storage facilities temporarily store wet weather overflow volumes until the flow can eventually be conveyed and treated at the WWTP. Types of storage facilities include underground tanks or conduits, abandoned pipelines, or deep tunnels. Off-line storage is usually located at individual overflow points for storage of localized CSOs. The storage facilities may also be located near dry weather or wet weather treatment facilities, or at pump stations in lower reaches of the system, where the off-line storage would consolidate overflows conveyed from upstream locations. These facilities can be relatively simple in design and operation and can effectively reduce the frequency of overflows.

  A storage tunnel was included in WPCA's 2011 LTCP. Tunnels are an effective but high-cost solution to CSO control. Tunnels and off-line storage will be considered as a future LTCP control technology, although the impacts of the recommended WWTP upgrades and the impacts on system conveyance must be fully understood prior to considering off-line storage. If implemented, this technology would be constructed later in the LTCP timeline, to ensure proper sizing and effectiveness after the implementation of WWTP upgrades and other CSO controls.

- **Surface Storage:** There are several ways in which stormwater runoff can be captured and stored, prior to entering the collection system. Some means for storage include roof storage, playground storage, natural ponds, or man-made basins or lagoons. In general, open space in densely developed urban areas such as Bridgeport is limited to parking lots and park /recreational areas. Typically, use of these areas for storage of runoff interferes with their intended use; thus, this technology is not desirable and will not be considered further.

6.5 Treatment Technologies

Treatment technologies target reduction of pollutant loads in CSOs to receiving waters. Specific technologies address specific pollutants, such as suspended solids, floatables, chemicals, or bacteria.

- **Satellite Treatment Facilities:** In general, a satellite facility is sited near a regulator structure to capture overflows as they occur, and to take advantage of existing regulating structures to divert overflows to the satellite facility and minimize piping and possible pumping requirements. WPCA is not interested in pursuing satellite treatment facilities within the City of Bridgeport. Satellite treatment plants located around Bridgeport would experience highly varying flow and pollutant loads and would provide an operational challenge that WPCA would prefer to avoid. It is likely that additional staff would be needed to operate and maintain these facilities. Additionally, DEEP does not typically accept this as a CSO technology.

- **Wastewater Treatment Plant Improvements:** Increasing the capacity of the WWTP to handle higher peak wet weather flows is one way to reduce the frequency and volume of untreated CSO upstream in the collection system. This technology was evaluated extensively during WPCA's Facilities Planning efforts (as described in Section 7 of this document). This technology was not evaluated in WPCA's 2011 LTCP.

  Increasing WWTP wet weather capacity was determined to be an affordable way to drastically decrease the overall CSO in the system. This technology will be implemented as upgrades at the West Side and East Side WWTPs occur in the coming years. WPCA's collection system has the ability to convey more flow to the WWTPs than they can currently treat. Expanding the wet weather capacity of the WWTPs will greatly reduce CSO. These improvements are viewed as a valuable CSO LTCP strategy.

- **Screening:** Wastewater treatment screens range from bar racks to coarse/fine screens or microstrainers. Screens remove large solids and floatables from the wastewater flow. Their effectiveness depends on the clear opening of the screen. The size of openings determines the level of treatment achieved. This treatment method is typically inexpensive when compared to other treatment methods. However, it is usually not viewed by DEEP as an effective CSO control method as it lacks coliform control. Screening alone will not be considered further as an independent CSO treatment technology.

- **Sedimentation:** Gravity sedimentation using high surface overflow rates (to conserve space) can achieve 20 to 40 percent BOD removal and 50 to 70 percent TSS removal in CSO. Land requirements and residual solids handling are important considerations in determining the feasibility of sedimentation. To meet all water quality objectives, disinfection following sedimentation would need to be included as part of the treatment process. Sedimentation will not be considered a viable CSO control method for WPCA.

- **Enhanced High-Rate Clarification:** Another process used for treating storm flows is enhanced high-rate clarification. This technology, which can be operated intermittently during storms, is a physical-chemical process in which coagulant and polymer are added to wastewater. The coagulant aggregates the suspended solids in the flow into a floc. High-rate clarification may be viable for implementation at the regularly staffed WWTPs as a wet weather treatment technology but may be more difficult to support at unmanned satellite treatment facilities. High-rate clarification appears to be a promising CSO technology for utilization at the WWTP sites but will not be considered for satellite treatment in Bridgeport.

- **Chemical Flocculation:** Chemical flocculation is a high-rate treatment process utilizing metal salts and polymers to aggregate particles in CSO flow. Depending on their density, the aggregate of particles, or floc, will either sink to the bottom or float to the top where it can be removed. A concentrated sludge is produced, requiring no additional thickening. Chemical flocculation has a lower hydraulic capacity than high-rate clarification and will not be considered further for use in Bridgeport.

- **Dissolved Air Flotation** (DAF) relies on small air bubbles to suspend particulate matter to float to the surface for removal. Oil, grease, and other floatables can also be removed. This technology has been used to treat CSOs and has proved to be relatively effective in removing up to 20 to 50 percent of the suspended solids and floatables. DAF is not recommended for CSO abatement because of operational demands that are further complicated by the characteristics of CSOs, such as the need for start-up on short notice and ability to handle highly variable flow rates. Consequently, DAF is not considered feasible for WPCA's CSOs and will not be considered further.

- **Swirl Concentrators** separate solids and liquids, removing both suspended solids and floatables through rotationally induced forces. Swirls have been reported to remove up to 50 percent of the suspended solids from the combined sewer flow. Swirl concentrators are not given further consideration because of their solids removal efficiencies (TSS recommendations for primary treatment is typically 60 to 70 percent after screening and before any secondary settling), lack of bacteria removal, space requirements, and level of required maintenance.

- **Biological Treatment** processes, including contact stabilization, trickling filters, rotating biological contactors, treatment lagoons, and land application, have been most successfully used in the treatment of sanitary sewage and industrial wastewater. Difficulties arise when treating CSO flow exclusively due to loading variabilities, odors, clogging, O&M costs, and operator expertise. Biological treatment will not be considered as a CSO technology moving forward.
- **Filtration** is a physical treatment process that removes solids by straining wastewater through a filter medium, such as sand, charcoal (carbon adsorption), or membranes. Deep bed filtration can treat high and rapidly varying flows. Filtration can consistently achieve secondary treatment concentration standards for BOD and TSS. Clogging can be a concern with filtration. Filtration is not considered as a viable CSO technology in Bridgeport.
- **Disinfection** is used to destroy pathogenic microorganisms. Many disinfection technologies are available including chlorination, ozonation, and ultraviolet radiation. The most common method is chlorine addition, although its apparent toxicity to aquatic life is a concern. For this reason, dechlorination is often required. Disinfection will be considered further for use to complement other treatment methods and provide additional pathogenic organism treatment, but only hypochlorite and UV disinfection will be considered for use in Bridgeport.

7 Long-Term CSO Control Plan Update Recommended Plan

7.1 Facilities Plan

Expansion of the WWTPs was not evaluated for the 2011 LTCP. The 2020 Facilities Plan assessed all critical components at both treatment plants and presented a long-term vision of the capital needs of the WWTPs to improve performance and reliability of the treatment systems. The Facilities Plan was designed to dovetail with recommendations presented in the LTCP and provide a holistic view of the collection and treatment systems to yield the most cost-effective solutions for improving receiving water quality.

After a thorough evaluation of treatment train alternatives during the Facilities Plan, Option W-200C and Option E-80D were carried forward as the recommended plans for the West Side and East Side WWTP upgrade and expansion, respectively. Option W-200C expands peak capacity of the West Side WWTP from 90 to 200 MGD and employs dual-use primary filtration for primary treatment, Biological Nutrient Removal (BNR) treatment system (for up to 58 MGD) and ultraviolet (UV) disinfection for the entire 200 MGD flow. Option E-80D expands the capacity of the East Side WWTP from 40 to 80 MGD and employs dual-use primary filtration in the location of the existing chlorine contact tanks, converts the existing primary tanks to pre-anoxic zone, modifies the existing bioreactors, and maintains and upgrades the existing secondary clarifiers. A biofilter would be provided for headworks, primary filtration, and sludge processing odorous air flows.

7.2 LTCP Update Recommended Plan

The recommended plan presented in the Facilities Plan included WWTP expansions that will increase the capacity of the West Side WWTP to a peak flow of 200 MGD and the East Side to a peak flow of 80 MGD. The recommended facilities couple cost-effective treatment systems with cost-effective measures to control CSOs in the City by eliminating or reducing in size the remote facilities in the system as planned in the 2011 LTCP. By increasing plant capacity, additional flow can be accepted at each facility for treatment. This benefit occurs immediately at plant start up before any in-system improvements are completed. Collection system improvements that would further increase the flow that can be conveyed to the treatment facility were also identified. By providing the hydraulic capacity at the plant, as system improvements are implemented the higher peak flows could be treated. It is recommended that subsequent to the startup of the expanded treatment facilities, additional system flow monitoring be undertaken to further refine system modeling and calibration, to determine the necessity and scope of further collection system improvements to control CSOs in the 1-year, 24-hour design storm by December 31, 2039.

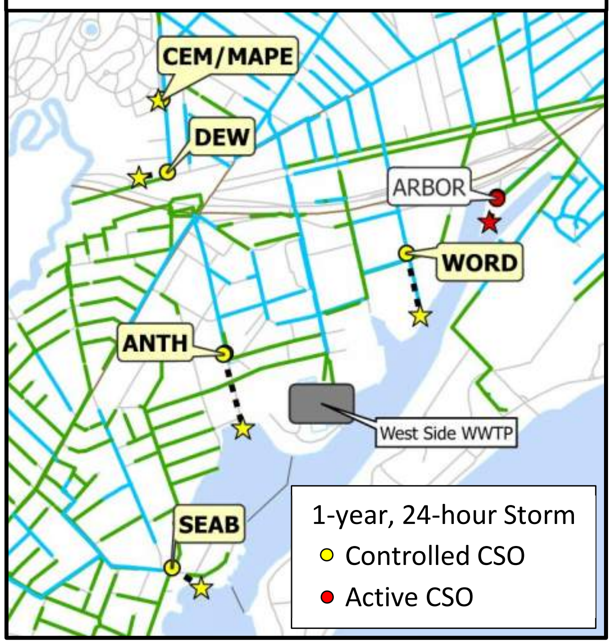
7.2.1 Expanded Wet Weather Treatment at the WWTPs

7.2.1.1 West Side WWTP

The West Side WWTP was designed to accept a peak flow of 90 MGD and treat 58 MGD through secondary treatment with the balance of flow receiving primary treatment and disinfection prior to discharge. Today, the plant typically can only accept between 80 to 85 MGD during storms, so operators “choke” influent gates to limit flow to the plant. This surcharges the collection system and causes CSO.

Collection system modeling has shown that today, if no improvements were made in the collection system, up to 160 MGD could be conveyed to the West Side plant during a 1-year, 24-hour storm. Peak flows upwards of 180 to 200 MGD can be conveyed in storms greater than the 1-year, 24-hour design storm. This illustrates that higher flow capacity WWTP options should be utilized and can be effective prior to construction of collection system improvements. With conveyance system improvements, and a treatment capacity of 180 to 200 MGD, seven of the 22 CSO regulators within the West Side service area are controlled during the 1-year, 24-hour event, resulting in a reduction in CSO by 22.9 MG, over 50 percent. The controlled CSOs are those in close proximity to the plant that discharge into the most sensitive receiving waters: WORD, RAILS, TIC, CEM/MAPE, DEW, ANTH and SEAB. Five of these regulators are shown in **Figure 7-1**. The control of these CSOs through treatment plant expansion and collection system capacity improvements would preclude the need to construct off-site storage at the Ash Creek and Ellsworth Park sites as identified in the 2011 LTCP.

Figure 7-1
CSOs Controlled with Increased Capacity at West Side WWTP and Conveyance Improvements



By capturing these CSOs and sending flow to the treatment plant, the overflows which would have been discharged untreated, resulting in the discharge of trash, floatables, bacteria and solids, are instead sent through screening, grit removal, primary filtration and disinfection dramatically improving the water quality in the receiving waters.

In addition, the reduction in CSOs will be measurable immediately after the upgraded and expanded treatment facility is put into service, whether or not additional collection system improvements are implemented.

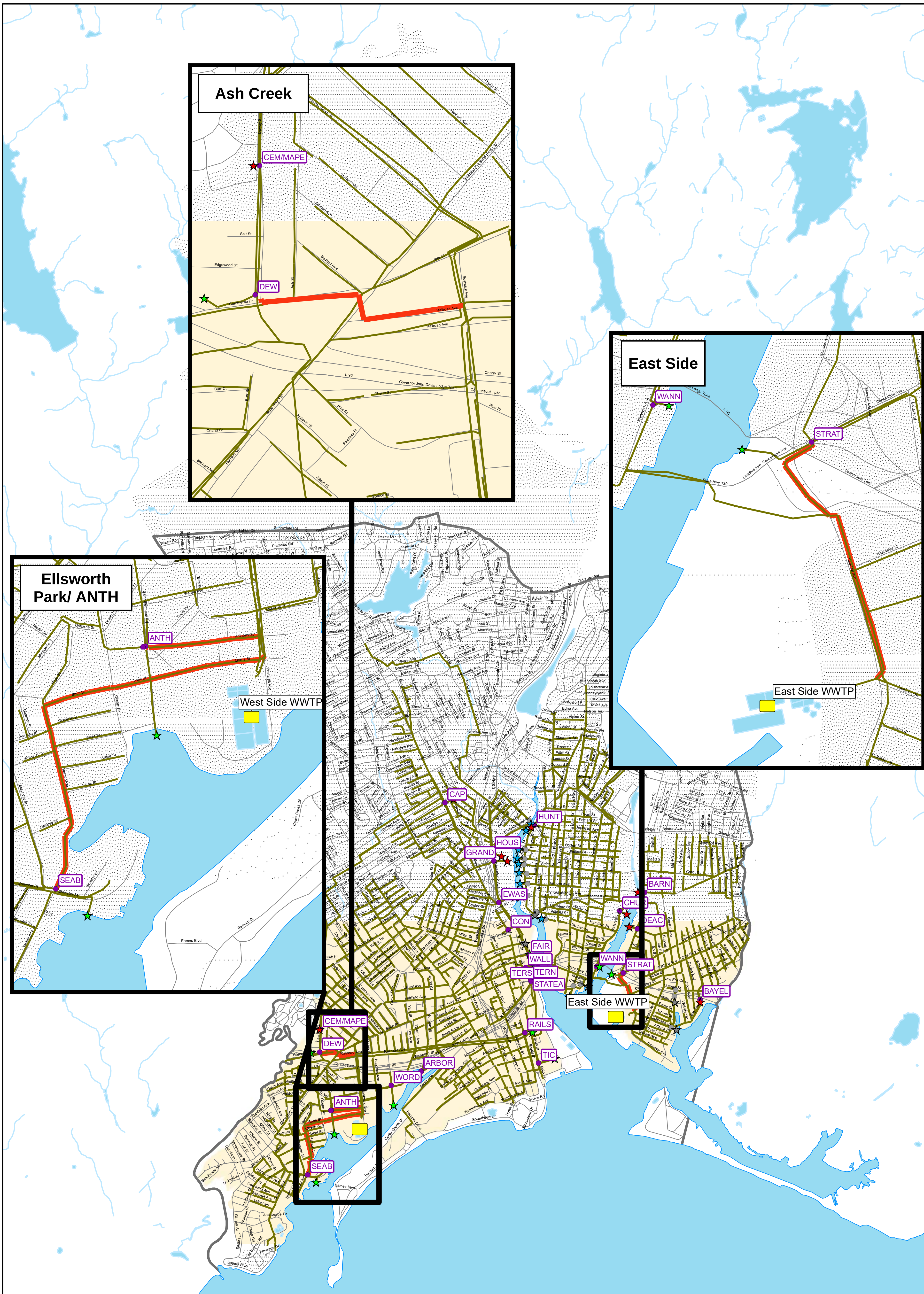
7.2.1.2 East Side WWTP

The East Side WWTP was designed to accept a peak flow of 40 MGD and treat 24 MGD through secondary treatment with the balance of flow receiving primary treatment and disinfection prior to discharge. Today, the plant typically can only accept 35 MGD during storms. The influent gates ahead of the pumping station are throttled to limit flow into the plant when flows are high. This then surcharges the collection system and results in combined sewer overflows.

Collection system modeling has shown that today, if no improvements were made in the collection system, up to 60 MGD could be conveyed to the East Side plant during a 1-year, 24-hour storm. Peak flows upwards of 80 MGD can be conveyed in storms greater than the 1-year, 24-hour design storm. This illustrates that higher flow capacity WWTP options should be utilized and can be effective prior to construction of collection system improvements. With conveyance system improvements, and a treatment capacity of 80 MGD, three of the six CSOs in the East Side service area are controlled during the 1-year, 24-hour event, resulting in a reduction in CSO of 4.4 MG, over 80-percent, with the CSOs responsible for the highest discharges (DEAC, WANN and STRAT) being controlled.

7.2.2 Conveyance Improvements

An alternatives analysis was conducted to evaluate the benefit of expanded wet weather treatment capacity at the WWTPs on improving collection system performance. In each alternative, WWTP wet weather capacity was increased and the resulting reduction of CSO was assessed. Five alternatives were evaluated at the West Side WWTP and three at the East Side WWTP. Wet weather capacities of 90, 140, 160, 180, and 200 MGD were simulated at the West Side WWTP. Capacities of 40, 60, and 80 MGD were simulated at the East Side WWTP. The 180 and 200 MGD West Side alternatives and the 80 MGD East Side alternative included collection system pipe replacements to attain adequate conveyance to the WWTPs. A separate alternatives analysis was conducted to evaluate control at the Ash Creek CSOs and recommended downstream conveyance to the expanded West Side WWTP. This section describes the recommended conveyance enhancements to the system, as shown in **Figure 7-2.**



0 0.25 0.5 1 Miles

N

Legend

- Model Extent
- Modeled Pipes
- Modeled New or Replacement Pipe
- Wastewater Treatment Plants
- Roads
- City Boundary

CSO Regulators

- Active
- Inactive

CSO Outfalls

- Active, Tidegate
- Active, No Tidegate
- Closed
- Converted to Stormwater

Figure 7-2
Conveyance Improvements

Water Pollution Control Authority
City of Bridgeport, CT

December 2021

7.2.2.1 Ash Creek

WPCA's Administrative Order (WRMU18002/WRMU18002M) currently requires submittal of the design plans and specifications for conveyance improvements in Ash Creek area by January 31, 2022. Construction of the approved design must be completed within 790 days (2 years and 2 months) following DEEP approval.

A storage tank was planned for the Ash Creek area prior to the detailed study of CSO control alternatives completed for Ash Creek in 2020. Conveyance improvements from the Ash Creek area to the expanded West Side WWTP were recommended for 1-year CSO control at CEM/MAPE and DEW. These conveyance improvements include construction of 1,600 feet of new 48-inch pipe from DEW to the 72-inch interceptor in Bostwick Avenue as shown on **Figure 7-3**.

Ash Creek CSO control through downstream conveyance and treatment depends on the expanded 200 MGD West Side WWTP as described in the approved 2020 Facilities Plan. A revised schedule for Ash Creek design and construction is presented in Section 7.3

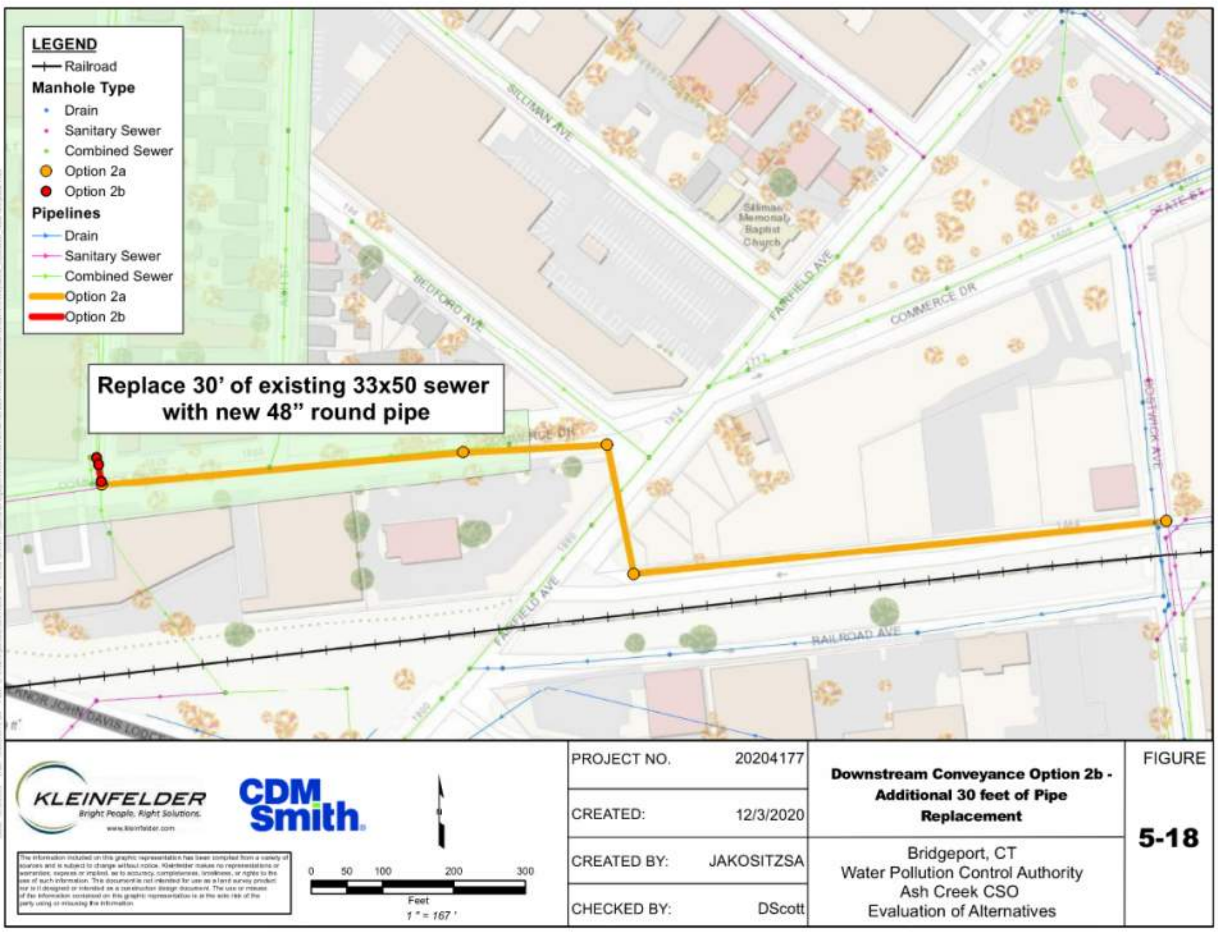


Figure 7-3 Recommended Downstream Conveyance Alternative from 2020 Ash Creek CSO Evaluation of Alternatives

7.2.2.2 Ellsworth Park

WPCA's Administrative Order (WRMU18002/WRMU18002M) currently requires submittal of an alternatives evaluation for CSO controls in the Ellsworth Park area by December 31, 2024. The SEAB CSO regulator is located in Ellsworth Park and discharges to Black Rock Harbor. As with Ash Creek, a storage tank was recommended for Ellsworth Park in the 2011 LTCP. During the alternatives evaluation completed during the Facilities Plan, it was discovered that 1-year control at the SEAB regulator could be attained through conveyance and expansion of the West Side WWTP to 200 MGD. The replacement of 4,300 feet of 24-inch pipe from SEAB to the interceptor with 42-inch pipe was recommended for 1-year CSO control. It is recommended that a more detailed study with metering and evaluation of alternatives be completed in the SEAB area, similar to 2020 Ash Creek CSO Evaluation of Alternatives.

7.2.2.3 ANTH

The ANTH CSO regulator is located downstream of the Ash Creek CSOs. ANTH overflows to Burr Creek, a tributary of Cedar Creek. ANTH is one of the closest CSO regulators to the West Side WWTP. Consolidation to the CSO Storage Tunnel was recommended for ANTH during the 2011 LTCP, meaning CSO control would not be attained until construction of the tunnel in 2039. During the collection system alternatives evaluation completed during the Facilities Plan, it was discovered that 1-year control could be attained at ANTH through conveyance with construction of 1,400 feet of 42-inch pipe from ANTH to the 72-inch interceptor in Bostwick Avenue. The ANTH conveyance pipe could likely be consolidated into the proposed Ellsworth Park conveyance pipe, which runs parallel, one block to the south. It is recommended that consolidation of the ANTH regulator be evaluated in conveyance alternatives during a more detailed study and evaluation of alternatives in the SEAB/Ellsworth Park area.

7.2.2.4 Tide Gate Improvements

As described in Section 2, only half of the CSO outfalls have tide gates to prevent tidal inflow to the combined sewer system. The existing tide gates are generally in poor condition and leak. During high tide, this can introduce seawater into the collection system through reverse flow in the CSO outfall pipes.

It is recommended that these tide gates be inspected further and repaired as soon as possible. Sealing all tide gates during the 1-yr, 24-hour storm results in a 0.4 MG reduction in CSO. Improvements and repairs to the tide gates represent a relatively low-cost system improvement that could result in a significant decrease in tidal inflow. Treating any amount of tidal inflow at the WWTPs is an unnecessary cost, and the presence of tidal inflow in the collection system during a wet weather event could result in an increase in CSO and potentially street flooding.

7.2.2.5 East Side

The 2011 LTCP did not address CSO control in the East Side collection system. Discharge from East Side CSOs is a small fraction of system-wide overflow, so CSO control in the 2011 LTCP focused abatement efforts on the West Side. However, with the proposed expansion in wet weather capacity at the East Side WWTP, it is recommended to pursue CSO reduction through increased collection system conveyance and treatment at the WWTP.

During alternatives analysis completed for the Facilities Plan, the East Side tributary area was evaluated to identify any hydraulic restrictions. Several areas were targeted for improvements that could increase the East Side collection system's delivery to 80 MGD, which exceeds the existing available conveyance capacity of the East Side collection system. The East Side WWTP collection system capacity could deliver 80 MGD if the improvements identified below are completed:

- Increasing 750 feet of 30-inch pipe to 36 inches along Connecticut Avenue (a state road) and Seaview Avenue from the STRAT regulator to the confluence with dry weather flow from the WANN regulator;
- Increasing 1,700 feet of 48 and 54-inch pipe to 60-inch pipe along Seaview Avenue from the STRAT & WANN confluence to the East Side WWTP; and
- Plugging the interconnection between the separated stormwater and sanitary pipes at Waterview Avenue and Cedar Street (near WANN regulator).

These collection system improvements are shown on **Figure 7-4.** The locations of piping improvements are highlighted in blue.

Figure 7-4 East Side Conveyance Improvements

7.2.3 System-Wide Metering

Remaining CSO control recommendations from the 2011 LTCP include storage tanks, relief sewers, and a deep-rock CSO tunnel. Section 6 of this memorandum qualitatively screened other potential CSO technologies for future implementation in WPCA's collection system.

A temporary system-wide flow metering program is recommended after completion of the projects noted in Section 7.2.2. Upgrade and expansion of the WWTPs and construction of the conveyance improvement projects outlined above will substantially alter system conveyance and flow. Flow metering will help quantify the new flow regime and remaining CSO. Targeted local metering may be needed to support design projects.

The last system-wide flow metering program was completed in 2009. In addition to the recommended WWTP expansions and conveyance improvements, multiple CSO improvement projects (Section 2.1) have been completed since 2009 that have also altered flows. Sewer separation and lining contracts have removed flow from the combined system. Ongoing O&M such as pipe cleaning and regulator modifications have increased available in-line storage. The System-Wide Metering program after the 7.2.2 projects have been implemented will identify the remaining CSO during the 1-year, 24-hour design storm and develop a plan to complete the LTCP by December 31, 2039.

7.3 Benefits of Recommended Update to the LTCP

Administrative Orders WRMU18002/WRMU18002M and AOWRMU19001 outline the following schedule to complete WWTP improvements and CSO Control:

- December 31, 2021, and a 5-year recurring schedule thereafter – submit an LTCP Update
- January 31, 2022 – submit design plans and specifications of the Phase III Ash Creek Storage Tank. Complete construction of the approved design within 790 days (2 years and 2 months) following DEEP approval.
- May 31, 2022 – submit design plans and specifications for both WWTP upgrades
- December 31, 2022 – complete all H area CSO contract lining and sewer separation projects
- August 2023 – commence construction of both WWTP upgrades
- December 31, 2024 – submit an evaluation report of CSO control alternatives at SEAB. Complete construction of the approved design within 1,095 days (3 years) following DEEP approval.
- August 30, 2026 – complete construction of both WWTP upgrades
- December 31, 2039 – construct all improvements necessary to comply with CSO control of the 1-year, 24-hour storm

WPCA requested a modification to the design and construction project schedule of the WWTPs to accommodate the significant amount of work necessary to mitigate current issues at both plants and the significant impacts on sewer use rates to the citizens of Bridgeport.

A revised schedule for the WWTP expansion projects is presented in **Table 7-1**. As presented, the West Side WWTP upgrade and expansion will be completed two years after the original construction date presented in the Administrative Order. East Side WWTP improvements will be completed by the end of 2030.

This schedule varies from the dates initially presented in the 2020 Facilities Plan Report due to the delay in the approval of that report. The schedule was adjusted accordingly to account for a later design start for the West Side WWTP and the Ash Creek conveyance improvements. Achieving the remaining milestones as proposed in the schedule below will require state revolving funds in addition to timely review and approval of submittals by DEEP.

With respect to the LTCP milestones, it is recommended that construction of CSO reduction projects beyond the Ash Creek and Ellsworth improvements be delayed until the benefits of increased treatment capacity can be further assessed based upon collection system metering.

Table 7-1 Revised Implementation Schedule

Project Order	Project	Duration (months)	Anticipated Completion Date[1]
1	Design - West Side WWTP (200 MGD)	20	December 31, 2023
2	Design - Ash Creek Conveyance	12	May 31, 2025
3	Study – Ellsworth Park Evaluation of CSO Alternatives	12	December 31, 2024
4	Construction - West Side WWTP (200 MGD)	51	September 30, 2028
5	Design - East Side WWTP (80 MGD)	23	December 31, 2026
6	Construction - Ash Creek Conveyance	26	November 30, 2027
7	Design/Construction –Ellsworth Park	36	September 30, 2028
8	Construction – East Side WWTP (80 MGD)	41	December 31, 2030
9	Long Term Control Plan Update and Approval	24	December 31, 2031

1. All anticipated completion dates assume timely (2 months) DEEP review and approval of future submittals.

The CSO reduction provided by the recommended implementation schedule versus the current CSO Administrative Order schedule is presented in **Figure 7-5**. Although construction of the West Side and East Side WWTPs is proposed to be completed sequentially rather than concurrently, the CSO benefit of upgrading both WWTPs as recommended is still substantial. CSO discharged in the 1-year, 24-hour storm will be halved upon completion of the West Side WWTP upgrade project, whereas in the existing Administrative Order schedule, much of the CSO benefit would not be attained until completion of the CSO storage tunnel a decade later.

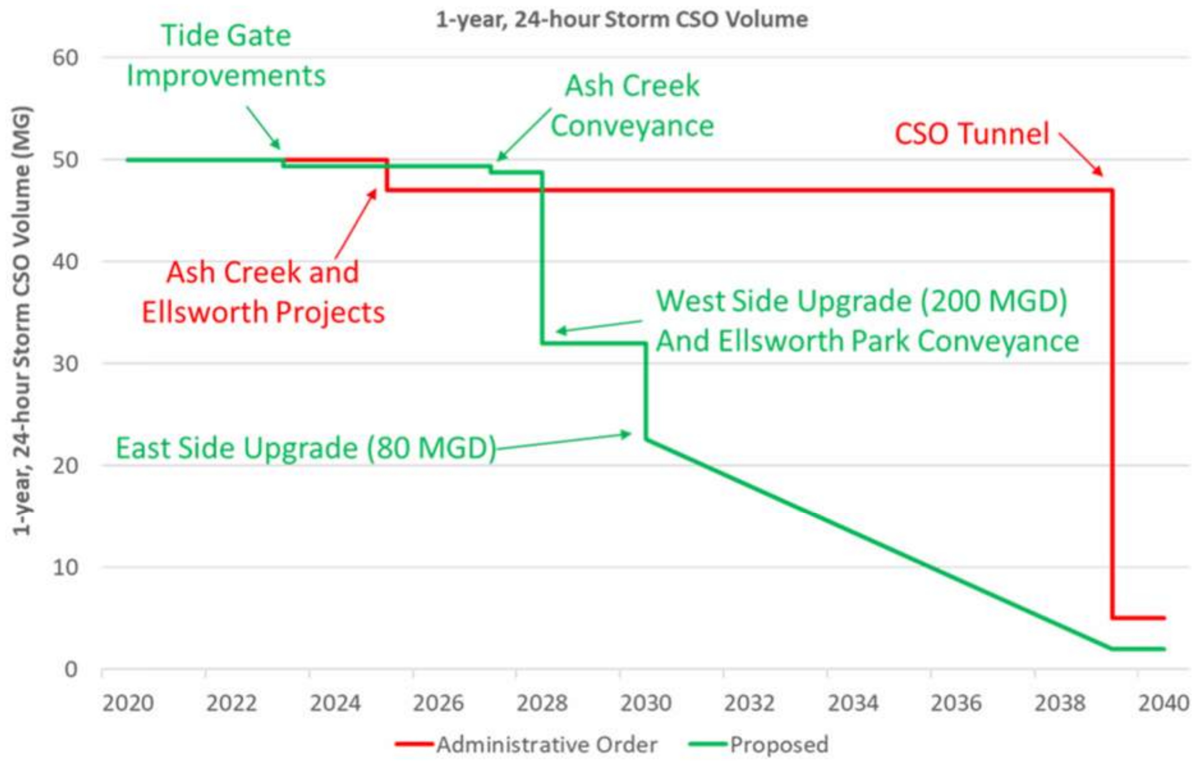


Figure 7-5 Recommended Schedule – CSO Reduction in 1-Year, 24-Hour Storm

8 Financial Capability Assessment

The 2020 Facilities Plan included a detailed financial capability assessment, reviewing multiple alternatives for facilities improvements that each included provisions for CSO abatement as required by the CSO Order. That detailed financial capability assessment is included here as **Attachment G.** A basic introduction, methodology discussion, and summary of findings is included below.

8.1 Introduction

Based on the evaluations presented in the 2020 Facilities Plan, the most desirable options were carried forward to evaluate the financial impacts on users and rate payers of the wastewater treatment plant upgrades and the CSO abatement program. The financial assessment evaluated alternatives following the framework developed by EPA in Combined Sewer Overflows — Guidance for Financial Capability Assessment and Schedule Development (February 1997; modified November 2014). The intent of the evaluation was to assess the affordability of WPCA's capital improvement programs. The first phase of the EPA financial capability assessment estimates the impact of anticipated capital improvements and operating costs on the average residential ratepayer by evaluating the household burden. The household burden is an EPA-defined metric that assesses the typical residential sewer bill as a percent of a community's median household income. Under the EPA guidance process, a household burden exceeding two percent of median household income is deemed a high burden.

The second phase of the EPA process details financial impact indicators, which are benchmarks defined by EPA. These indicators evaluate ancillary factors that may influence an entity's ability to fund the proposed capital plan.

8.2 Methodology and Assumptions

The financial capability assessment from the 2020 Facilities Plan was prepared in accordance with EPA's financial capability assessment guidance document and standard industry practice. Data was obtained from various sources to develop a financial model to project the impact of the anticipated capital program on future revenue requirements and rates for the City and its residents. All data used in the assessment were gathered from either WPCA or credible public sources.

The developed financial capability assessment projected financial changes through FY 2045. Unless specified otherwise, all dollar figures used for this analysis were in future year dollars adjusted for estimated inflation. Given the forecasting horizon, numerous assumptions were necessary and were used in the assessment. The complete financial capability assessment in **Attachment G** describes the critical assumptions used for this analysis.

Financial projections for four distinct capital plans were evaluated in the financial capability assessment:

- Baseline. This assumes no WWTP upgrade or LTCP spending. The baseline alternative assumes capital spending allowances for ongoing renewal and replacement of existing infrastructure. The capital spending carried in the baseline alternative is included in all other alternatives.

- 90/40 Administrative Order Schedule. These two alternatives (with and without CWF grant and loans) follow the capital plan detailed in the existing administrative order schedules and assume that the two WWTPs would be constructed to match their current capacities (90 MGD at the West Side plant and 40 MGD at the East Side plant). This analysis shows the impact of assuming full eligibility for SRF and state grants, as well as the impact of assuming all city General Obligation debt to finance the program.

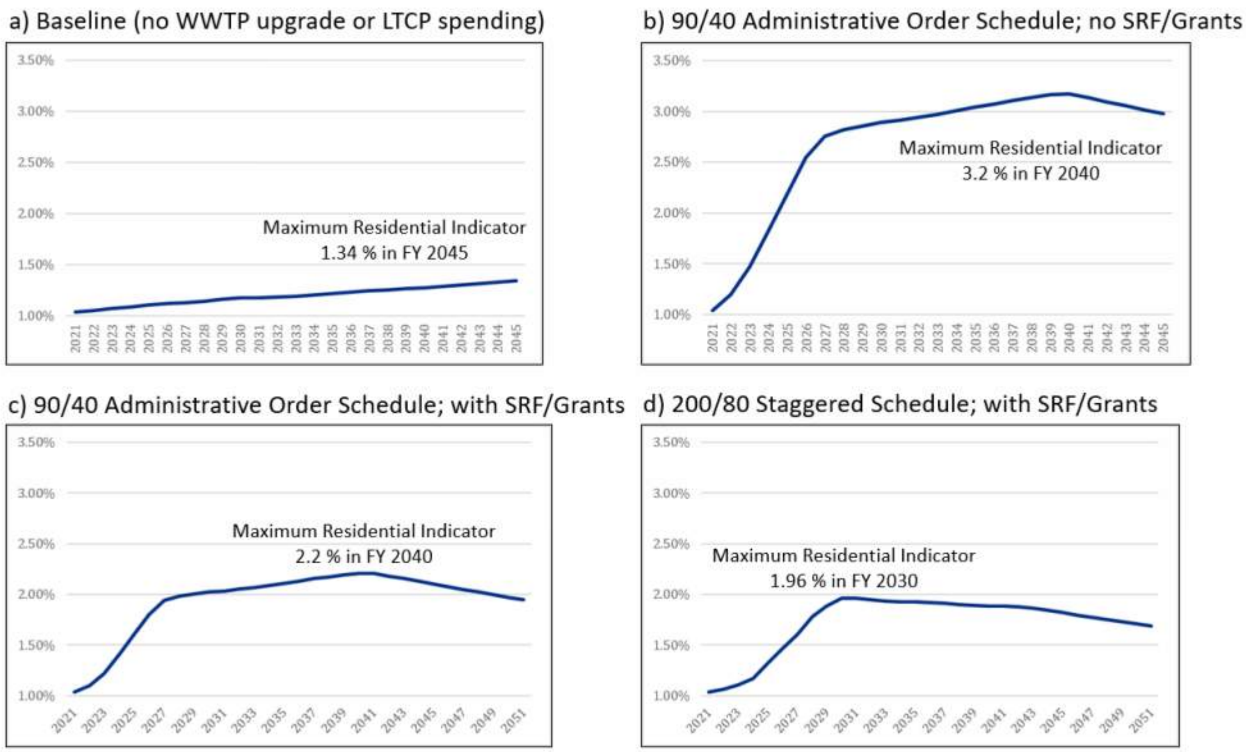
- 200/80 Staggered Schedule. In this alternative the West Side plant would be upgraded followed by the East Side plant. Additionally, the wet weather treatment capacity of both plants would be increased to provide a significant CSO reduction benefit. The West Side WWTP capacity would be increased to 200 MGD and the East Side plant capacity would be increased to 80 MGD. Collection system improvements would be included to address the Ash Creek and Ellsworth Park administrative order.

8.3 Summary

Based on the Phase 1 and Phase 2 evaluations presented in the 2020 Facilities Plan and **Attachment G**, completing projects on the current Administrative Order schedules will place a high burden on Bridgeport's sewer rate payers per EPA guidance. The City has and continues to experience economic stress as evidenced by its low income growth over the past two decades and its high poverty rate. The City will face financial challenge implementing any significant capital program as described in this report. This problem would be intensified if WPCA were forced to self-fund the projects.

The household burden, also known as the Residential Indicator, was projected for each capital plan, assuming project schedules identified in the Facilities Plan. **Figure 8-1** shows the projected Residential Indicator for each capital plan through fiscal year (FY) 2045. The Residential Indicator is lowest for the Baseline alternative (Figure 8-1a), however this alternative is not feasible as it does not meet CSO abatement or WWTP upgrade goals outlined in the Administrative Orders. Residential Indicators for both 90/40 Administrative Order Schedule alternatives exceed the two percent threshold, reaching a maximum of 3.2 percent without loans and grants (Figure 8-1b) and 2.2 percent with loans and grants (Figure 8-1c). Given the magnitude of the household burden and increases in rates, the 90/40 Administration Order Schedule alternatives present a major financial and economic challenges and are likely not feasible. The only alternative that meets CSO abatement goals, upgrades both WWTPs, and maintains a Residential Indicator of less than two percent is the 200/80 Staggered Schedule (Figure 8-1d).

Staggering design and construction of both treatment plants with the Ash Creek and other collection system improvements (Section 7) is projected to keep sewer rates below EPA's two percent high burden designation, but only if CWF assistance is available in the form of two percent loans and grant funding per the current programs. Even with such assistance, the magnitude of the required rate increases is anticipated to present major financial challenges for WPCA. **If CWF assistance is not available in the amounts assumed in the attached financial capability assessment, the financial capabilities of WPCA, and the schedule for completion of the recommended projects, will need to be re-evaluated.**



All projections assume project schedules defined in the 2020 Facilities Plan.

Figure 8-1 Projected Residential Indicators

9 Stakeholder Participation

Engaging stakeholders throughout the planning process is a critical element for success of any project, particularly for one within an Environmental Justice Community. In addition to regular coordination meetings with WPCA General Manager Lauren McBennett Mappa, WPCA consultant Anthony Trelewicz, and Director of Finance Stephen Walker, other stakeholders were informed of the facilities planning efforts as the project progressed.

Updates to WPCA Board of Commissioners were conducted in July 2019, February 2020, August 2020, and November 2020. These meetings were open to the public. Additionally, discussions with DEEP were held in February 2020 and August 2020, to review the Facilities Planning process and its preliminary recommendations. A presentation was also made to the City Finance Committee in August 2020.

As West Side WWTP layouts were developed, two meetings were conducted with the neighboring Captain's Cove Seaport to discuss the potential for easements and land acquisition in October 2020. In November 2020, a site walk was conducted with a Councilman and a State Representative to discuss the residential housing complex located just north of the West Side WWTP site. In December 2020, a presentation was conducted with the nearby Aquaculture School. In March 2021, WPCA hosted a tour with multiple councilmen and State Representatives and conducted a workshop with City and State stakeholders.

DEEP facilitated a Public Scoping Meeting for the Facilities Planning for East Side and West Side Wastewater Treatment Plants on October 29, 2020 to review the results of the facilities planning process including:

- Liquid stream alternatives
- Solids processing alternatives
- Plant consolidation
- High flow management/maximization of flow to WWTPs
- Operability/construction assessment
- Resiliency to storms, flooding and climate change
- Outfall inspection, improvements, and necessary changes
- SCADA evaluation
- Odor control evaluation

Written comments from the public were accepted until November 5, 2020. CDM Smith, WPCA, and DEEP responded to the public comments as part of the environmental impact evaluation (EIE) process. Public comments and responses are included as **Attachment H.**

CDM Smith and WPCA presented information on the Facilities Planning process to the City Council Leadership Committee in January 2021 and completed a workshop with the City Council in March 2021. Additionally, a public meeting presentation followed by a question-and-answer session was held in January.

WPCA completed an EIE in 2021 to satisfy requirements identified in the Connecticut Environmental Policy Act (SLR International Corporation, 2021). Addressing public comments is a critical element of the EIE. In addition to presenting a detailed analysis of potential environmental impacts of actions recommended in the 2020 Facilities Plan, the EIE addressed comments raised during the scoping period from October 6 to November 5, 2020 and during the two public information sessions held October 29, 2020 (scoping meeting) and January 28, 2021 (follow up Public Information meeting). The EIE concluded that the comprehensive responses compiled in Attachment H addressed the public's issues of concern.

The 2020 Facilities Plan was approved by DEEP on December 10, 2021 (See Attachment I). The following meetings are anticipated as the project progresses to preliminary design:

- WPCA Board of Commissioners
- City Council
- DEEP
- West Side WWTP Neighborhood (required under Section 22a-20a CGS)
- East Side WWTP Neighborhood (required under Section 22a-20a CGS)

10 References

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11 List of Attachments

- **Attachment A** – Wastewater Treatment Plant Administrative Order AOWRMU19001
- **Attachment B** – Collection System Administrative Order WRMU18002
- **Attachment C** – Revised Collection System Administrative Order WRMU18002M
- **Attachment D** – Collection System Map
- **Attachment E** – 2011 Bridgeport CSO Long Term Control Plan, Section 4 – CSO Rainfall, Flow, Water Quality Data Collection Program
- **Attachment F** – Hydraulic Model Technical Memorandum M-01
- **Attachment G** – 2020 Facilities Plan for the West and East Side Wastewater Treatment Plants, Section 8 - Financial Capability Analysis
- **Attachment H** – Environmental Impact Evaluation Public Participation Comments and Responses
- **Attachment I** – DEEP Facility Plan Approval Letter