Tighe&Bond
Engineers | Environmental Specialists

171471-003
June 18, 2019
Revised July 2, 2019

Mr. Michael McManus, General Superintendent
Holyoke Department of Public Works
63 Canal Street
Holyoke, MA 01040

Re: Draft CSO Long-Term Control Plan Update Report - Phase 1

Dear Mr. McManus:

Tighe & Bond is pleased to submit to the City of Holyoke two copies of the draft Combined Sewer Overflow Long-Term Control Plan (CSO LTCP) Update – Phase 1, which was prepared in accordance with the March 2018 CSO LTCP Update Work Plan that was approved by the Massachusetts Department of Environmental Protection (MassDEP) and the U.S. Environmental Protection Agency (EPA). This evaluation was also conducted in accordance with our October 11, 2018 agreement with the City for this effort.

Executive Summary

This report includes the following Phase 1 tasks:

- Sewer system characterization
- Review of changes to water quality standards and CSO policies
- Review of recent wastewater treatment facility and Berkshire Street CSO Treatment Facility flow and operating data
- Review of CSO activity data
- Review of Connecticut River water quality and quantity data
- Updating the hydraulic model of the combined sewer system
- Developing and comparing CSO abatement alternatives
- Providing CSO abatement recommendations

Phase 2 tasks, which have not yet been performed, include:

- Performing a climate vulnerability assessment
- Performing a financial capability assessment
- Developing an implementation schedule, which will be based on the results of the financial capability assessment
- Implementing a Public Participation Program
- Preparing a final report that includes the Phase 1 and Phase 2 tasks

1 Sewer System Characterization

The City of Holyoke's wastewater collection system consists of approximately 137 miles of sewer mains, approximately 61% of which is combined. These sewers range from brick conduits, concrete pipes and vitrified clay (VC) pipes in the older portions of the sewer system to reinforced concrete pipes, asbestos cement (AC) pipes and polyvinyl chloride (PVC) pipes in the newer sections of the sewer system. Portions of the wastewater collection system are over

100 years old. The wastewater collection system includes several major interceptor sewer lines that receive wastewater flow from area collector sewers and convey that wastewater flow towards the City's wastewater treatment facility (WWTF). The interceptor sewers and key sewers reviewed in greater detail as part of this evaluation include:

- The North Interceptor
- The South Interceptor
- The Front Street Interceptor
- The Highland Park Interceptor
- The Day Brook Sewer
- The Jefferson Street Sewer

These sewer mains were included in the hydraulic model because they are the main lines conveying combined flow from upstream regulators to the WWTF. Refer to the sewer system schematic in Figure EX-1 for the locations of these sewers.

A total of 12 active combined sewer outfalls still remain in the City and are controlled by 17 regulators. A summary of these CSOs and regulators is presented below in Table EX-1. These CSOs are also shown in the schematic in Figure EX-1.

TABLE EX-1
CSOs Summary

CSO No.	Regulator No.	Location	Receiving Water
2	2	Providence Hospital	Connecticut River
7	7	Northampton St./Glen St. intersection	Connecticut River
8	8	Springdale Park	Connecticut River
9	9[1]	Berkshire St.	Connecticut River
11	11	Jackson St.	Connecticut River
16	16	Front St./Appleton St. intersection	First Level Canal
17	17	Front St./Lyman St. intersection	First Level Canal
18	18	Walnut St.	Connecticut River
18	18A	Essex St./Walnut St. intersection	Connecticut River
18	18B	Highland Park Pump Station	Connecticut River
19	19	Yale St.	Connecticut River
20	20	Cleveland St.	Connecticut River
21	21[2]	River Terrace	Connecticut River
21	21B[2]	River Terrace	Connecticut River
23	23A	Jefferson St., between Madison Ave. and Dartmouth St.	Connecticut River[3]
23	23B	Jefferson St. at Dartmouth St.	Connecticut River[3]
23	23C	Dartmouth St., just east of Jefferson St.	Connecticut River[3]

[1]Overflows from this regulator are currently treated at the Berkshire St. CSO Treatment Facility.
[2]There are 2 overflow points within the one regulator.
[3]During an overflow event, a portion of the discharge may infiltrate into the ground before reaching the river.

The major changes within the wastewater collection system that have occurred since the May 2000 Draft CSO LTCP was completed include:

1. Sewer separation projects in the Jones Ferry Road, Appleton Street, and Mosher Street areas (tributary to CSOs 3, 13 and 14, respectively).
2. The removal of Green Brook from the sewer system.
3. Regulator modifications at CSOs 2, 7, 8, 9, 11, 13, 16, 18A, 19, 20 and 23.
4. The Berkshire Street CSO Treatment Facility was constructed to treat combined overflows from the CSO 9 Regulator.

These changes have resulted in an estimated 67% reduction in annual combined sewer overflow volume since the draft CSO LTCP was prepared.

There are seven wastewater pumping stations in the City: Jones Ferry Road, Smith's Ferry, Mosher Street, Jackson Street, Cabot Street, Highland Park and Springdale Park. These pump stations are shown on Figure EX-1.

The design of sewer separation in the Jackson Street Area, which is tributary to CSO 11, is complete, and bidding is pending final permitting from the U.S. Army Corps of Engineers (USACE) and easement resolution.

A map of the City of Holyoke's wastewater collection system is included in Appendix A. The map illustrates key features of the sewer system and shows the sewersheds upstream of each active CSO.

2 CSO Activity and Wastewater Flow Data

The City has a comprehensive CSO monitoring program in place to monitor CSO activity and to ensure that the CSO regulators are operating properly that includes block testing and flow monitoring. This program is implemented by Suez, who has a contract with the City to operate and maintain the City's wastewater collection system, pump stations, and WWTF, as well as components of the City's storm drainage and flood control systems. This program is in accordance with EPA and MassDEP permits and regulations.

2.1 CSO Activity and Flows

General observations are as follows:

1. The greatest number of CSO activations occur at the CSO 18 (Walnut Street) and CSO 20 (Cleveland Street) Regulators. Suez has reported that the high number of overflows at CSO 20 are related to 1.) an undersized outlet pipe on Oxford Road (a 16-inch diameter sewer with a flat-slope) and 2.) high flows from the Smith's Ferry Pump Station, which discharges into the gravity system a short distance upstream of the CSO 20 Regulator.
2. The greatest quantity of annual untreated CSO volume discharged to the Connecticut River or the First Level Canal is from CSOs 8 (Springdale Park), 9 (Berkshire Street), 18 (Walnut Street) and 21 (River Terrace), with annual overflow volumes ranging from 28.1 to 41.0 million gallons (MG).
3. The smallest quantity of annual untreated CSO volume discharged to the Connecticut River or the First Level Canal is from CSOs 2 (Providence Hospital), 7 (Northampton Street/Glen Street), 19 (Yale Street) and 23 (Jefferson Street), with annual overflow volumes ranging from 0.1 to 0.6 MG.

2.2 WWTF Flow Data

Average and maximum daily wastewater flow data measured at the WWTF from 2011 to 2018 was also reviewed as part of this evaluation. The data illustrates that the annual average flows, which ranged from 6.8 to 9.5 MGD, are well below the average daily design flow of the WWTF of 17.5 MGD. The average daily flow entering the WWTF exceeded the average daily design flow of 17.5 MGD an average of 5 times annually over the period from 2011 to 2018. The maximum flow through the WWTF exceeded the peak design flow of 37 MGD an average of 30 times annually over the period from 2011 to 2018.

2.3 Berkshire Street CSO Treatment Facility Flow Data

The Berkshire Street CSO Treatment Facility was constructed downstream of the CSO 9 outfall, which is the largest outfall in the City. The CSO Treatment Facility consists of a pump station, screening equipment, and a chlorine contact chamber.

The treatment facility was originally designed so that wastewater flow exceeding the capacity of the influent pumps (103 MGD) would overtop a weir wall in the wetwell, drop into the Return Channel adjacent to the wetwell, and then flow by gravity to the CSO 9 outfall pipe, which conveys the wastewater flow to the Connecticut River. However, shortly after facility startup, it was determined that if the flow level reached the overflow level in the pump station wetwell, basement backups would occur, and sewage would surcharge in the system to the point that the combined flow would exit the system through manholes on Main Street. In order to address the hydraulic issue described above, a 10-foot wide by 10-foot high opening was cut in the weir wall and was sealed by a new slide gate (Gate 4). Suez has established gate operating parameters to minimize bypasses as described below:

1. Gate 4 is opened when either the flow rate to the CSO Treatment Facility is 165 MGD for 150 seconds or the wastewater level in the pump station wet well is at or above 59.5 feet for 180 seconds.
2. Gate 4 is closed when the flow rate drops to 120 MGD.

CSO treatment facility operating data collected over the last 10 years, from 2009 to 2018, was reviewed as part of this evaluation. An average of 206 million gallons (MG) of combined flow was directed to the Berkshire Street CSO Treatment Facility annually over the last 10 years. Of that amount, an average of 174± MG (84%) was treated annually either through the CSO treatment facility or the secondary WWTF. The remaining 32± MG of combined flow (16%) bypassed the treatment facility annually and was discharged to the Connecticut River without treatment. The Berkshire Street CSO (CSO 9) Treatment facility was active an average of 42 days/year over the last 10 years from 2009 to 2018. On 9 days/year, on average, untreated combined flow was also discharged to the Connecticut River without treatment.

3 Watershed and Receiving Water Characterization

Information on the characteristics of the Connecticut River and its watershed was provided in the CSO LTCP Update report. The Connecticut River, which is approximately 410 miles long, is the largest river in New England. The Connecticut River flows from the Connecticut Lakes in northern New Hampshire, along the Vermont/New Hampshire boundary, and then through Massachusetts and Connecticut, eventually discharging into the Long Island Sound at Old Saybrook.

The Connecticut River Watershed, which is the largest river ecosystem in New England, includes a land area of approximately 11,000 square miles over four New England states (Vermont, New Hampshire, Massachusetts and Connecticut). The Nature Conservancy named the Connecticut River Watershed one of the "Last Great Places" in 1993. The watershed of the mainstem of the Connecticut River within Massachusetts encompasses 660 square miles and includes all or part of 44 communities, including the City of Holyoke.

The portion of the river along Holyoke is approximately 11 miles long and can be divided into two sections: the portion upstream (north) of the Holyoke Dam, which is approximately 6 miles long and the portion downstream (south) of the Holyoke Dam, which is approximately 5 miles long. The watershed north of the Holyoke Dam is generally characterized by rural development, while the watershed south of the dam is more urbanized. There are dikes and floodwalls along the southern section of the river to prevent flood damage during high river level periods that restrict public access to that portion of the river.

In recognition of the Connecticut River's significance to the region, several programs and projects have focused on the protection and restoration of the Connecticut River and revitalization of the communities along the river. For example, the entire Connecticut River watershed was designated as a national fish and wildlife refuge in 1991. The Silvio O. Conte National Fish and Wildlife Refuge Act was passed to conserve, protect and enhance the plant, fish and wildlife species within the watershed. In addition, the Connecticut River was designated by the Federal Government in 1998 as one of fourteen "American Heritage Rivers" in the country. Federal support for the protection and restoration of the Connecticut River and revitalization of the communities along it was provided through this program.

Recreational activities in and along the Connecticut River include primary contact recreation (swimming and water skiing), secondary contact recreation (fishing and boating), and hiking/walking. Most of these recreational activities, however, occur upstream of the Holyoke Dam.

Sensitive areas along the river identified during the study include:

1. Near the Holyoke Dam, because the dam acts as a staging area and temporary bottleneck for uprunning fish. CSO 18 is just upstream of the dam.
2. Although there are no designated public swimming areas along the Connecticut River, swimming is common above the dam at Long Pond Cove and at "High Rock". High Rock is located just downstream of CSO 21 and Long Pond Cove is located downstream of CSO 19.
3. Boating is common in the vicinity of the Sue Panitch River Access Center, an existing public boat launch site at the end of Jones Ferry Road. CSO 2 is just downstream of the boat launch location.

Recent river water quality data confirms that bacteria levels exceed water quality standards.

The Connecticut River is impacted by CSO discharges from the City of Holyoke and other nearby communities along the river, including the Cities of Springfield and Chicopee. Average annual CSO discharges from the three communities are as follows:

Community	Annual CSO Volume (MG)
Holyoke	163[1]
Chicopee	110
Springfield	447

[1]CSO 11 will be eliminated as part of a sewer separation project that has been designed and will soon be bid, which will reduce the total average annual overflow volume by 18 MG to 145 MG.

In addition to the CSO discharges to the Connecticut River, there are stormwater discharges to the river from Holyoke and other communities along the river that impact water quality. In the early 2000's, Holyoke, Springfield, and Chicopee partnered with MassDEP and the Pioneer Valley Planning Commission to update a Connecticut River water quality model. The development of the model and an analysis of results is provided in Springfield's Final Long Term CSO Control Plan, dated May 2012. Springfield concluded in their Plan that while CSOs contributed to E. coli in the river, the overall volume of stormwater into the river is so much greater than CSO volume that the majority of E. coli in the river during rain events can be attributed to stormwater, rather than CSOs.

The Pioneer Valley Planning Commission (PVPC), in collaboration with the Connecticut River Conservancy (CRC), has compiled bacteriological (*E. coli*) data collected from 2012 to the present at multiple locations along the river from Vermont to Connecticut. The data shows that water quality standard exceedances for bacteria were measured in the river within each of the communities where samples were taken, regardless of whether the community has a separate sewer system or a combined sewer system with CSO discharges to the river. In addition, there does not appear to be a significant difference in the number of water quality exceedances upstream of the Holyoke Dam vs. downstream of the Dam. This data may also be indicating that stormwater discharges have a significant impact on water quality within the Connecticut River.

4 Wastewater Collection System Modeling

A hydrologic and hydraulic model of the Holyoke wastewater collection system was developed as part of the development of the draft CSO LTCP in the late 1990s. The model simulated CSO activity in the City during various size storm events and was used to develop and evaluate CSO abatement alternatives. At that time, the Storm Water Management Model (SWMM) software was used to create the model. That model software was selected because it was accepted by EPA and MassDEP, was commonly used for sewer system modeling, and was used for the sewer system modeling in the City performed as part of the regional CSO study in the late 1980s. The regional model was used, where appropriate, to facilitate the development of the more up-to-date sewer system model as part of the May 2000 draft CSO LTCP.

The model developed as part of the draft CSO LTCP was provided to the City in the early 2000s and was updated by Suez, the City's Contract Operator for the wastewater system, to reflect CSO abatement projects that have proceeded since the draft CSO LTCP was prepared. The City's model was refined as part of this project, and then used to develop and evaluate CSO abatement alternatives. The following changes were made to the sewer system model in an effort to improve accuracy:

1. Surface and pipe invert data were collected along the Front Street Interceptor, the Jefferson Street Sewer and the Day Brook Sewer and the data collected was used to refine pipe slopes and depths in the model.
2. Record drawings for the North, South and Highland Park Interceptors were reviewed and sewer data in the model was adjusted based on this data, where appropriate.
3. Changes were made at the CSO 9 Regulator to better reflect how Suez indicated they control the flow split between the WWTF and the Berkshire Street CSO Treatment Facility.
4. Changes were made at the Highland Park Pump Station to better reflect the actual pump rates based on pump flow data provide by Suez.
5. An additional sewershed and regulator were added to the model on Dartmouth Street, near Jefferson Street, in CSO 23.
6. An additional CSO (CSO 17), located at the Front Street/Lyman Street intersection, was identified by the City and added to the model.

5 CSO Control Policies

National CSO Control Policy – Under EPA's current (1994) CSO control policy, permittees are required to characterize their sewer systems, demonstrate implementation of the nine minimum controls (NMCs) established by the policy and develop a long-term CSO control plan. Compliance with the NMCs is documented by the City annually, as required by its WWTF National Pollutant Discharge Elimination System (NPDES) permit. The EPA policy also requires that the long-term CSO control plan be developed using either a "presumption" approach or a "demonstration" approach. Under the *presumption approach*, compliance with water quality standards is presumed, if one of the following performance criteria is met:

1. No more than an average of four overflow events per year occur on an annual average basis.
2. The elimination or capture for treatment of no less than 85 percent by volume of the combined wastewater flow collected on a system-wide annual average basis [during precipitation events], (as clarified in the 1995 EPA Guidance for Long-Term Control Plan Document).
3. The elimination or removal of no less than the mass of pollutants causing water quality impairment for the volume reductions noted in Item 2 above.

The presumption approach does not release municipalities from the overall requirement of meeting applicable water quality standards. If the permitting authority determines that the long-term CSO control plan will not result in attainment of water quality standards, more stringent controls may be required.

Under the *demonstration approach*, compliance with water quality standards is confirmed through the CSO control planning process. This approach provides flexibility in developing a long-term CSO control plan. While not necessarily satisfying the performance criteria of the presumption approach, the plan must be proven to adequately meet water quality standards. The demonstration approach depends on a detailed assessment of receiving waters and the impacts of CSO discharges and other sources of wet weather pollutants on water quality.

The Presumption Approach was used in this evaluation.

Massachusetts CSO Control Policy - MassDEP's CSO policy, issued most recently in August 1997, established the following goals:

1. Elimination of receiving water impacts is the primary goal.
2. Where the elimination of CSOs is not feasible, the goal is minimization of impacts to the maximum extent feasible and attaining the highest water quality achievable. In these areas, the identification and protection of critical uses is essential.

6 Development of CSO Abatement Alternatives

A wide variety of technologies and approaches for the abatement of CSO impacts on receiving water quality were considered as part of this evaluation. The CSO abatement technologies ranged from relatively low-cost, "soft" approaches, such as street sweeping and catch basin cleaning, to high-cost, high-tech approaches, such as the construction of satellite treatment or storage facilities to abate CSO discharges. The different types of available CSO abatement technologies and approaches are generally classified under one of the categories listed below, as recommended in EPA's 1995 *Combined Sewer Overflows: Guidance for Long-Term Control Plan*:

- Source controls
- Collection system controls
- Storage technologies
- Treatment technologies

Although it is recommended that the City pursue many of the source controls and collection system controls described in the report, such as the removal of infiltration/inflow (I/I) sources previously identified in the wastewater collection system, the majority of the source controls and collection system controls identified are expected to provide only a small (or no) reduction in CSO discharges. As such, the abatement alternatives developed in this report have focused on those abatement measures that are expected to have a significant impact on CSO discharges, including sewer separation, stormwater storage, CSO storage, satellite CSO treatment and upgrading the existing wastewater treatment facility.

6.1 Screening Level Analysis

A screening level analysis was first performed that compared the screening level costs for sewer separation, storage and treatment for each CSO. In accordance with the approved Work Plan, costs were developed for CSO storage and treatment facilities that reduce the number of untreated overflows per year to no greater than 0, 4, or 8 in this screening level analysis. This comparison was used to identify alternatives that could be eliminated from further review. Generally, sewer separation is the preferred abatement alternative, where affordable, as noted in the 1997 Massachusetts Guidance for Abatement of Pollution from CSO Discharges. As such, where sewer separation was determined to be a lower cost than storing or treating CSO discharges (or a similar cost to CSO storage or treatment), then sewer separation was recommended. Note that the sewer separation costs were primarily compared to the cost of CSO facilities that reduce the number of untreated overflows per year to no greater than 4. As noted previously, one of the Federal CSO policy performance criteria under the Presumption Approach is that no more than an average of 4 overflow events per year occur on an annual average basis.

The screening level costs include estimated capital costs and operation and maintenance costs over a 20-year period for the alternatives evaluated. The capital costs include construction costs and engineering costs. The construction costs include material costs, installation costs, general conditions costs, the contractor's overhead and profit, and a 30% contingency. The sewer separation costs include the cost of rehabilitating existing combined sewer piping that will either be converted to a storm drain or a sanitary sewer. The inclusion of these costs is appropriate since some existing piping is typically found during the sewer separation design to be in poor condition, requiring rehabilitation. In order to fairly compare CSO treatment/storage facility alternatives to sewer separation alternatives, the cost of rehabilitating existing piping was also included in the CSO facility alternatives since these piping improvements will still be needed.

Sewer separation was determined to be the least expensive alternative during the screening level analysis for CSOs 2, 8, 18A, 19, 20 and 23. CSO storage and treatment facilities were less expensive for CSO 18 and a CSO treatment facility was less expensive for CSO 21. Conveyance of the CSO 7 overflows to the South Interceptor was determined to be less expensive than sewer separation, storage or treatment.

Where CSO storage or treatment was determined to be a lower cost based on the screening analysis, a siting analysis was performed to determine whether there is available land that is suitable for construction of a storage or treatment facility. The siting analysis considered land ownership, space available, neighborhood impacts, and the amount of site improvements that would be necessary.

6.2 CSO 18 Alternatives Analysis

For CSO 18, The only significant open land identified near the CSO regulator and outfall is park land owned by the City (Pulaski Park). The park is bordered by a residential neighborhood to the south, Route 202 to the west, and the Connecticut River and the First Level Canal to the north and east. Pulaski Park is over 14 acres in size and includes walking paths, benches, a playground, a spray park, a basketball court, a volleyball court and a skate board park. The majority of these park facilities are located at the eastern end of the park. The Highland Park Wastewater Pump Station is located within the park, near the western end. The most western section of the park is located between the pump station and Route 202 and is a wooded area adjacent to the railroad tracks. Because there are currently no developed recreational facilities within this wooded section of the park, this location was selected for a proposed CSO treatment or storage facility.

Concerns related to siting a CSO facility at this location include:

1. The park land is protected under Article 97 of the Amendments to the Constitution of the Commonwealth, EOAA Land Disposition Policies, and a change in its use would require special legislation. As such, acquisition of this land for a CSO facility may be difficult.
2. Pulaski Park was placed on the National Historic Register in 2004. Because the park is a historic location, construction of a CSO facility at the park may not be allowed.
3. Pulaski Park has been the focus of restoration efforts by the City, as is noted in the City's 2013-2018 Open Space and Recreation Plan. As evidence of this, over the last 10 years, the City constructed a new playground, spray park, and benches. In addition, a cross-fit training facility is being constructed at the park and is near completion.
4. A new CSO facility at the park could have a negative aesthetic impact on park users and the adjacent residential neighborhood.
5. There is the potential for odors associated with storing and/or treating wastewater flow, which may impact park users and the adjacent residential neighborhood.

Because of the siting concerns noted, additional abatement alternatives for CSO 18 were considered through supplemental analyses.

6.2.1 Supplemental CSO 18 Analyses

A more detailed analysis of CSO abatement alternatives for Drainage Area 18 was performed that included refining CSO storage and treatment costs. In addition, because of the concerns noted regarding siting a CSO facility in Drainage Area 18, at Pulaski Park, partial sewer separation alternatives were developed that result in 4, 8 and 16 overflows per year. The alternatives that would result in 4 or 8 overflows per year were established based on the Work Plan. The remaining partial sewer separation alternative was developed to reduce costs based on the configuration of the existing piping in this drainage area. Hydraulic modeling simulations indicate that this lower cost partial sewer separation alternative results in 16 overflows per year.

Complete sewer separation provides the greatest level of abatement but is the most expensive alternative. Partial sewer separation alternatives provide the advantage of allowing the City to more easily implement additional abatement in this drainage area, if determined to be necessary, when compared to CSO storage/treatment alternatives. In addition, the sewer separation alternatives provide the benefit of not requiring the construction of a CSO facility in Pulaski Park, which may not be allowed because the park is protected land and a historic location. Partial sewer separation that results in 8 overflows per year is not recommended since it provides a lower level of abatement than sewer separation that results in 4 overflow per year with only a small reduction in cost.

As noted above, there are significant siting concerns related to construction of a storage or treatment facility at Pulaski Park. The CSO 18 alternatives were reviewed in greater detail as part of the development of system-wide alternatives.

6.3 CSO 21 Alternatives Analysis

For CSO 21, because the CSO 21 Regulator is located at the bottom of a steep embankment, the most appropriate location for a CSO treatment facility is at the bottom of this embankment. However, flat ground at the bottom of the embankment is limited. As such, significant earthwork/regrading would be needed in order to construct a treatment facility at this location and provide vehicle access to it. The cost of a CSO treatment facility at this location was increased to reflect the difficult site conditions.

Concerns related to siting a CSO facility at this location include:

1. The property where the CSO 21 Regulator is located and the proposed location of the CSO 21 treatment facility is privately owned; the property owner may not be willing to sell the property to the City. If the City were to attempt to take the land by eminent domain, significant legal action may be necessary.
2. Construction of a CSO treatment facility at this location will be challenging due to the small area of flat land and the steep slopes.
3. The treatment facility would be located in a residential neighborhood; the construction of a CSO treatment facility at this location may not be accepted by the nearby residents.
4. There is the potential for odors associated with treating wastewater flow at this location, which may impact the adjacent residential neighborhood.

Considering the above concerns and the fact that there is only a small difference in cost between sewer separation in Drainage Area 21 and the cost of constructing a CSO treatment facility (1% difference), sewer separation is recommended over construction of a CSO treatment facility at CSO 21.

Sending additional combined flow to the WWTF or the Berkshire Street CSO Treatment Facility were also considered during the screening level analysis. It was determined that neither facility has surplus capacity to accommodate additional flow and that there is little space available to expand these facilities. In addition, it was noted in the report that improvements at the WWTF to provide additional nitrogen removal may be necessary in the future and that these improvements may require use of the little space available to construct additional tankage to meet nitrogen removal requirements. In addition, in order to convey additional combined flow from upstream areas (CSOs 18, 19, 20, 21 and 23) to the existing treatment facilities, a new interceptor would need to be constructed because the Front Street Interceptor has insufficient surplus capacity to accommodate the upstream CSO discharges.

6.4 Day Brook Alternatives Analysis

Day Brook is a significant water course that enters the combined sewer system at the upstream end of the CSO 9 Drainage Area. In order to reduce untreated CSO 9 discharges, detention and removal of Day Brook from the sewer system were evaluated in this study. The cost to detain flow peaks from Day Brook during wet weather events was estimated as approximately $1.8 million and this alternative would reduce the annual volume of overflow during a typical year by 6.8 MG. Several Day Brook removal pipeline alternatives were considered in this evaluation. The estimated capital cost of the preferred layout for a new storm drain that would convey Day Brook to the canal system is $12.5 million. The removal of Day Brook from the sewer system would reduce the annual overflow volume by approximately 7.9 MG during a typical year and reduce the average daily flow to the WWTF by approximately 1.2 MGD.

6.5 System-Wide Alternatives Analysis

A total of six system-wide alternatives to reduce the number of CSO activations and the CSO flow volume to the Connecticut River annually were developed and are summarized in Table EX-2. Model simulations indicate that during a typical year each of the six alternatives will reduce the total City-wide CSO flow volume by 90% or more. In addition, model simulations indicate that each alternative will result in the elimination or capture for treatment of no less than 85 percent by volume of the combined wastewater flow collected on a system-wide annual average basis.

The Federal CSO policy indicates that under the *presumption approach*, compliance with water quality standards is presumed, if one of the following performance criteria is met:

1. No more than an average of four overflow events per year occur on an annual average basis.
2. The elimination or capture for treatment of no less than 85 percent by volume of the combined wastewater flow collected on a system-wide annual average basis [during precipitation events], (as clarified in the 1995 EPA Guidance for Long-Term Control Plan Document).
3. The elimination or removal of no less than the mass of pollutants causing water quality impairment for the volume reductions noted in Item 2 above.

Based on Item 2 above, each of the six system-wide alternatives developed meets the CSO policy goals.

TABLE EX-2

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Summary of System-Wide Alternatives

System-Wide Alternatives (Costs in $M)	Capital Cost ($M)[1,3,4]	Total Project Cost ($M)[2,3,4]	No. of Overflow Activations Remaining	Annual CSO Volume Removed (MG)	% CSO Removal[5]	Annual % of System Flow Removed/ Captured[6]	Advantages	Disadvantages
Alternative 1				**131**	**93%**	**94%**	-Greatest level of abatement -Greatest reduction in flow to the WWTF -Eliminates CSO discharges to a sensitive area of the river (just upstream of dam at CSO 18)	-Highest cost alternative -Will likely take the longest to complete
7 - Sewer separation -	$4.6	$4.6	0					
Day Brook - Remove flow from sewer system -	$13.0	$10.4	3					
18 - Full Sewer Separation -	$50.4	$50.4	0					
Separation of 2, 8, 18A, 19, 20, 21, 23 -	$50.0	$50.0	0					
Subtotal	**$118.0**	**$115.4**				**$/gal:**	**$0.88**	
Alternative 2				**124**	**92%**	**95%**	-≤4 activations/year achieved at all CSOs -Reduces CSO discharges to a sensitive area of the river (just upstream of dam at CSO 18)	-Area 18 storage facility would be located on Parks & Rec land; change in use requires special state legislation
7 - Convey overflow to the South Interceptor -	$0.2	$0.6	4					
Day Brook - Detention -	$1.5	$2.0	3					
18 - Storage - 4 Activations (2.5 MG) -	$20.4	$30.6	4					
Separation of 2, 8, 18A, 19, 20, 21, 23 -	$50.0	$50.0	0					
Subtotal	**$72.1**	**$83.2**				**$/gal:**	**$0.67**	
Alternative 3				**122**	**91%**	**95%**	- ≤4 activations/year achieved at all CSOs -Lower cost than Alts 1 & 2	-Area 18 treatment facility would be located on Parks & Rec land; change in use requires special state legislation -Does not reduce the number of CSO discharges to the river, although treatment would be provided
7 - Convey overflow to the South Interceptor -	$0.2	$0.6	4					
Day Brook - Do Nothing -	$0.0	$0.0	3					
18 - Treatment - 4 Activations (62 MGD) -	$20.1	$32.8	4					
Separation of 2, 8, 18A, 19, 20, 21, 23 -	$50.0	$50.0	0					
Subtotal	**$70.3**	**$83.4**				**$/gal:**	**$0.69**	
Alternative 4				**117**	**90%**	**94%**	-≤4 activations/year achieved at all CSOs -Lower cost than Alts 1, 2, & 3	-Area 18 storage facility located on Parks & Rec land; change in use requires special state legislation
7 - Convey overflow to the South Interceptor -	$0.2	$0.6	4					
Day Brook - Do Nothing -	$0.0	$0.0	3					
18 - Storage - 4 Activations (2.5 MG) -	$20.4	$30.6	4					
Separation of 2, 8, 18A, 19, 20, 21, 23 -	$50.0	$50.0	0					
Subtotal	**$70.6**	**$81.2**				**$/gal:**	**$0.69**	
Alternative 5				**122**	**91%**	**95%**	-≤4 activations/year achieved at all CSOs -Reduces CSO discharges -Does not rely on obtaining Parks & Rec land for siting a CSO facility -Additional abatement is more easily implemented	-High cost
7 - Convey overflow to the South Interceptor -	$0.2	$0.6	4					
Day Brook - Do Nothing -	$0.0	$0.0	3					
18 - Partial Sewer Separation - 4 Activations -	$38.7	$39.8	4					
Separation of 2, 8, 18A, 19, 20, 21, 23 -	$50.0	$50.0	0					
Subtotal	**$88.9**	**$90.4**				**$/gal:**	**$0.74**	
Alternative 6				**116**	**90%**	**93%**	-Lowest cost alternative -May be completed in a shorter timeframe -Does not rely on obtaining Parks & Rec land for siting a CSO facility -Additional abatement is more easily implemented	-CSO 18 still >4 activations per year; contingent on approval of 85% reduction
7 - Convey overflow to the South Interceptor -	$0.2	$0.6	4					
Day Brook - Do Nothing -	$0.0	$0.0	3					
18 - Partial Sewer Separation - 16 Activations -	$24.9	$27.2	16					
Separation of 2, 8, 18A, 19, 20, 21, 23 -	$50.0	$50.0	0					
Subtotal	**$75.1**	**$77.8**				**$/gal:**	**$0.67**	

[1]Capital cost estimates include construction costs, engineering costs (20%) and a construction contingency (30%).

[2]Total cost includes total capital cost, O&M, and an allowance for routine sewer system lining/replacement.

[3]Costs are based on an October 2018 Engineering News Record Construction Cost Index of 11,183. **Costs will be updated based on the ENR CCI in December 2019 at report completion.**

[4]These are Engineer's Opinions of Probable Capital Costs. Tighe & Bond has no control over the cost or availability of contractor's labor, equipment or materials, or over market conditions or the contractor's method of pricing, and the Opinions of Probable Construction Costs are made on the basis of Tighe & Bond's professional judgment and experience. Tighe & Bond makes no guarantee nor warranty, expressed or implied, that the cost of the Work will not vary from the Opinions of Probable Construction Costs.

[5]Percentage of 1976 annual total combined sewer system flow that is no longer released untreated to the river. Original volume, prior to any CSO abatement, estimated to be 475 MG per the 2019 model results.

[6]Percentage of 1976 annual total combined sewer system flow that is captured for treatment or eliminated during storm events. The dry weather flow is not included in the calculation.

The system-wide analysis evaluated, through hydraulic modeling, the total impact on the wastewater collection system of the proposed improvements under each alternative. The following components of the system-wide alternatives were considered for this analysis:

- **Day Brook** – Three alternatives were considered for Day Brook: do nothing, detention to reduce peak flows during storm events, or completely removing the brook flow from the sewer system through the construction of a drain pipe to convey the brook to the Connecticut River or the canal system. Model results indicate that if Day Brook is not removed from the sewer system or detained, the number of untreated discharges to the Connecticut River at CSO 9 would still be reduced to 4 per year, on average, due to the proposed improvements in other areas, which will reduce flows to the CSO 9 Regulator.
- **WWTF Upgrades** - Similar to the above, if no improvements to the WWTF are made to accommodate additional flow, the number of untreated discharges to the Connecticut River at CSO 9 would still be reduced to 4 per year, on average, due to the proposed improvements in other areas.
- **CSO 7 -** The South Interceptor is expected to have the capacity to accommodate the overflow from CSO 7 since the flow removed through separation in Drainage Areas 2 and 8 is predicted to be greater than the flow added by the CSO 7 overflow during each of the storms measured in 1976 (the typical year used for the model simulation).
- **CSO 18 –** As discussed above, CSO abatement through complete sewer separation, partial sewer separation, storage, and satellite treatment, was considered.
- **CSOs 2, 8, 18A, 19, 20, 21, and 23 -** Each alternative included the complete sewer separation of Drainage Areas 2, 8, 18A, 19, 20, 21 and 23, which were determined to be more appropriate and/or cost effective than satellite treatment or storage alternatives during the screening analysis.

Note that System-Wide Alternative 1 was developed to represent the alternative that is expected to provide the greatest level of abatement. However, this alternative would have the highest cost.

7 Summary and Recommendations

Alternative 6 is recommended, which includes the following components listed in Table EX-2:

TABLE EX-3
Recommended Plan (Alternative 6)

Drainage Area	Recommended Abatement	Capital Cost ($M)	Total Project Cost ($M)
11[1]	Sewer separation	$8.0	$8.0
2, 8, 18A, 19, 20, 21 & 23	Sewer separation	$50.0	$50.0
7	Divert flow to South Interceptor	$0.2	$0.6
18	Partial sewer separation (≤16 overflows/year)[2]	$24.9	$27.2
TOTAL		**$83.1**	**$85.8**

[1]Design of sewer separation in this area is complete and bidding is pending final United States Army Corps of Engineers (USACE) permitting and easement resolution.

[2]This alternative will eliminate or capture for treatment no less than 85 percent by volume of the combined wastewater flow collected on a system-wide annual average basis, which is one of the acceptable performance criteria described in the National CSO policy under the Presumption Approach.

The recommended plan is the lowest cost alternative and meets the federal CSO policy goal under the Presumption Approach of eliminating or capturing for treatment of no less than 85 percent by volume of the combined wastewater flow collected during rain events on a system-wide annual average basis. The recommended plan results in a 90% reduction in overflow volume annually and results in the capture or elimination of 93% by volume of the combined wastewater flow collected on a system-wide annual average basis. Alternative 1, which provides the greatest level of abatement, would be almost 50% more expensive than the recommended alternative (Alternative 6), while providing only 3% (15 MG) more CSO removal.

Advantages of this alternative include:

1. Lowest cost.
2. Meets the water quality goals under the Presumption Approach.
3. Likely to be more quickly implemented than more expensive alternatives.
4. It does not require the construction of a CSO treatment or storage facility at Pulaski Park in Drainage Area 18, which might not be allowed because the park is a historic site and is protected land in accordance with under Article 97 of the Amendments to the Constitution of the Commonwealth, EOAA Land Disposition Policies (a change in its use would require special legislation). In addition, the construction of a CSO facility at Pulaski Park has the potential to impact the adjacent neighborhood and park users.
5. Partial sewer separation of Drainage Area 18 removes more overflow volume than treatment or storage for the same number of overflows.
6. Additional abatement is more easily implemented with sewer separation alternatives, if determined to be necessary in the future.

In addition, to the above, note that the recommended alternative provides only a slightly lower level of abatement than Alternative 1, which provides the greatest level of abatement, as shown below:

Alternative	Total Project Cost ($M)[1]	% CSO removal
1	$115.4	93%
6	$77.8	90%

[1]Includes capital costs, operation & maintenance costs over a 20-year period, and an allowance for sewer lining/replacement over the 20-year period.

We also recommend that the City continue to pursue source and collection system controls, including, in particular, the following:

1. Public education
2. Quantity control measures, including:
    a. Implementing/enforcing the City's stormwater regulations.
    b. Installing local flow detention/treatment devices, such as vortex separators, where appropriate.
    c. Infiltration/inflow removal – as noted earlier in this report, approximately 2.6 MGD of I/I was determined to be cost-effective to remove in a prior I/I study report. We recommend that the City determine whether improvements have

been made to remove these sources from the sewer system and that, subsequently, the City remove the remaining I/I sources previously identified.

3. Quality control measures, including:
    a. Street cleaning
    b. Solid waste management
    c. Regular catch basin cleaning
4. Collection system controls, including:
    a. Sewer line flushing

A proposed implementation schedule will be prepared once the affordability analysis has been completed during Phase 2.

Acknowledgments

We wish to thank you and Robert Peirent for your assistance throughout the project and the development of this report.

This report was prepared by Tighe & Bond personnel under the general supervision of William Hardy, PE and David Popielarczyk, PE.

Very truly yours,

TIGHE & BOND, INC.

William N. Hardy, PE
Chief Operating Officer

TIGHE & BOND, INC.

David J. Popielarczyk, PE
Principal Engineer/Associate

Enclosure

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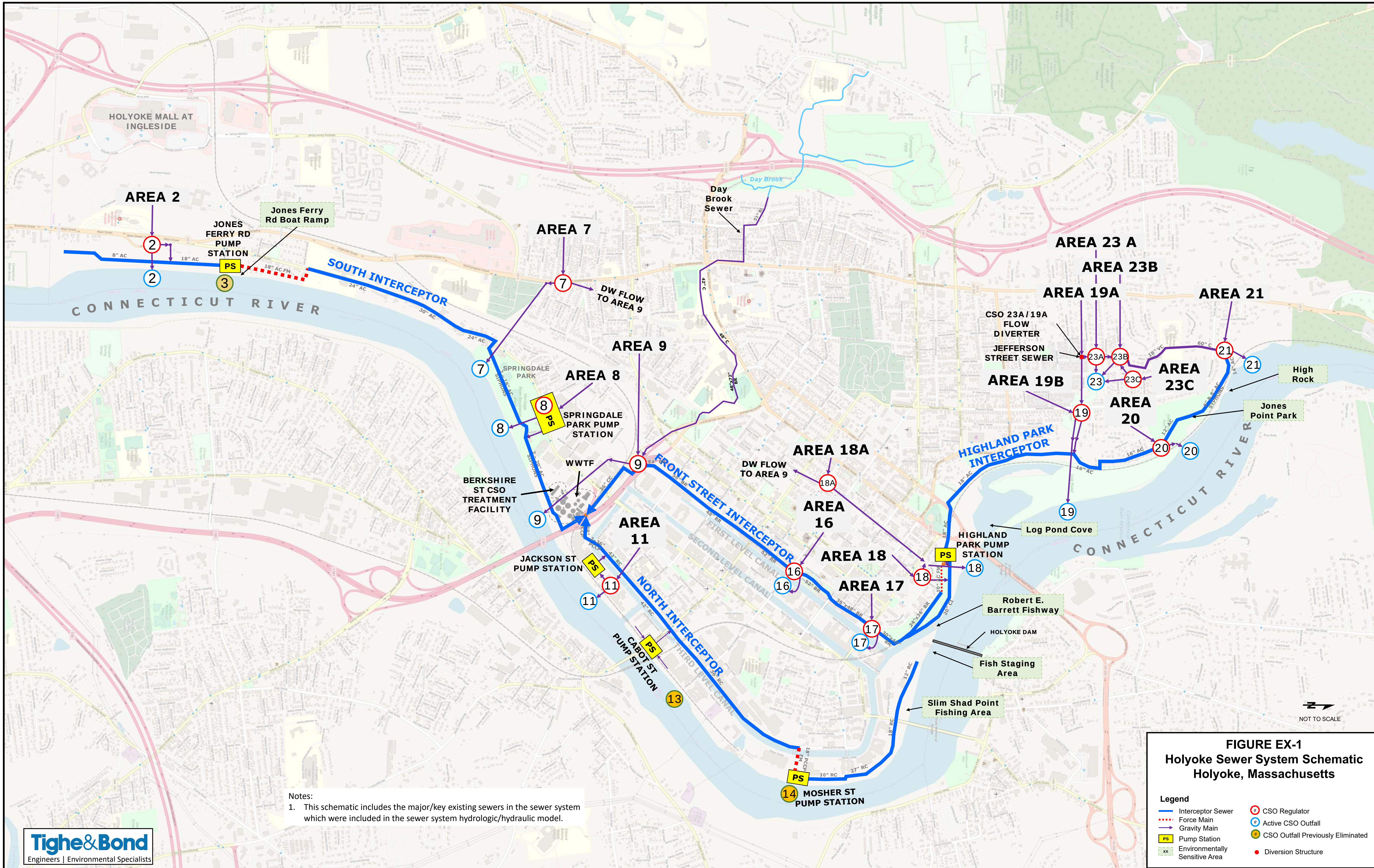

FIGURE EX-1
Holyoke Sewer System Schematic
Holyoke, Massachusetts

Notes:

1. This schematic includes the major/key existing sewers in the sewer system which were included in the sewer system hydrologic/hydraulic model.

Appendix A
City of Holyoke Wastewater Collection System Map


Holyoke CSO LTCP
Holyoke, Massachusetts
DRAFT
EASTHAMPTON
W. SPRINGFIELD
CHICOPEE
SOUTH HADLEY
Connecticut River
Holyoke Community College
Ingleside Mall
Soldier's Home in Holyoke
Holyoke Dog Park
Community Field
Holyoke Shopping Center
Peck Middle School
Holyoke Hospital
Holyoke High School
Forestdale Cemetery
Springdale Park
Jones Point Park
Sue Ellen Panitch River Access Center
CSO 2 REGULATOR
JONES FERRY RD PUMP STATION
PIPES IN THIS AREA HAVE NOT BEEN UPDATED TO REFLECT THE JONES FERRY ROAD SEWER SEPARATION PROJECT, WHICH SEPARATED AREA 3.
SOUTH INTERCEPTOR
CSO 7 REGULATOR
CSO 8 REGULATOR
SPRINGDALE PARK PUMP STATION
CSO 9 REGULATOR
BERKSHIRE ST. CSO TREATMENT FACILITY
WWTF
JACKSON ST PUMP STATION
CSO 11 REGULATOR
CABOT ST PUMP STATION
MOSHER ST PUMP STATION
PIPES IN THIS AREA HAVE NOT BEEN UPDATED TO REFLECT THE MOSHER STREET AND APPLETON STREET SEWER SEPARATION PROJECTS, WHICH SEPARATED AREAS 13 AND 14.
CSO 16 REGULATOR
CSO 17 REGULATOR
FRONT ST INTERCEPTOR
HOLYOKE DAM
CSO 18 REGULATOR
HIGHLAND PARK PUMP STATION
HIGHLAND PARK INTERCEPTOR
CSO 19 REGULATOR
CSO 20 REGULATOR
CSO 19A REGULATOR
CSO 23A REGULATOR
CSO 23B REGULATOR
CSO 23C REGULATOR
CSO 21 REGULATOR
First Level Canal
Second Level Canal
Third Level Canal
Drainage Areas Inset Map
CSO 23A/23B/23C REGULATOR
CSO 18A REGULATOR
Legend
Interceptor Sewer
Sanitary Sewer
Combined Main
Drainage Line
Force Main
Sewer/Combined Manhole
CSO Regulator
Drainage Area Boundary
Pump Station
CSO Outfall
Building
Parcels
Lakes and Ponds
CSO Number
Recreational Open Space
Numbered Route
Private Road
Interstate Highway
Town Boundary
1 inch = 600 feet
Feet
Notes:
1: The Smiths Ferry Pump Station which is not shown on this map, is 6,600 feet north of CSO 21.
2: Inset Maps at 200 Scale. (1:2,400)
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Engineers | Environmental Specialists