MASSACHUSETTS WATER RESOURCES AUTHORITY

WASTEWATER SYSTEM

MASTER PLAN

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2018 MWRA Wastewater System Master Plan
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APPENDIX

2018 MWRA Water and Wastewater Master Plan - Executive Summary

OVERVIEW

Since its inception, MWRA has expended $8.3 billion on capital initiatives (FY86 through FY18). The 2018 Master Plan documents the investment needs of MWRA's regional water and wastewater systems over the next 40 years (FY19-58) through the identification of 344 prioritized projects estimated at $5.75 billion in 2018 dollars. All projects are either already programmed in the FY19 Capital Improvement Program (CIP) (total of $3.76 billion) or are recommended for consideration in future CIPs (total of $1.99 billion). Development of the Master Plan is a collaborative process involving MWRA's Planning, Operations, Engineering, and Finance staff. The 2018 Master Plan is a comprehensive update of the 2013 Master Plan.

The Master Plan is an important tool for annual capital planning and budgeting and its spending recommendations have been incorporated in MWRA's multi-year financial planning estimates. The draft 2018 Master Plan was used as a reference to help guide development of the CIP spending cap for FY19-23. The final 2018 Master Plan has been updated to be consistent with the final FY19 CIP budget and is intended to be a companion document to facilitate staff and Advisory Board recommendations and allow for comparison of future investment needs between different parts of the water and wastewater systems. The Master Plan provides information on water and wastewater system facilities and operations at a level of detail to provide the reader the context to understand recommended future capital spending. The 2018 Master Plan lists both projects programmed in the CIP and projects recommended for future consideration during the 40-year planning period. The focus is on projects proposed to require capital spending during the next two 5-year CIP cap cycles, FY19-23 and FY24-28. Following these two 5-year periods, potential capital needs during additional 10-year (FY29-38) and 20-year (FY39-58) planning periods are projected. Estimates of project costs and schedules over the shorter term are expected to be more reliable than out-year estimates. The Master Plan is a key reference document that will be updated every five years to reflect changing water and wastewater system needs, updated asset conditions, evolving regulatory requirements, revised priorities identified through new studies, and other appropriate considerations.

The MWRA Master Plan has two volumes, one detailing water system needs and the second detailing wastewater system needs. This comprehensive Executive Summary covers both volumes and summarizes overall costs. The Water System Master Plan includes major chapters on treatment, the transmission system, and the metropolitan system. The Wastewater System Master Plan includes distinct chapters for major facilities (e.g., Deer Island Treatment Plant, Residuals Pellet Plant, remote headworks, sewers, pump stations, etc.). Chapters include project recommendations to address the issues and needs identified during the planning process. Both Water and Wastewater Plans also provide related background information including system goals and objectives, history of the system, and the assumptions which provide the context for master planning, including: regulatory framework, future population estimates, water demand and quality, wastewater flow and quality, residuals volumes, etc. Information on MWRA's Energy Management strategies and programs is also included in both documents.

In June 2018, the Board of Directors set the FY19-23 5-year CIP spending cap at $984.8 million, an increase of $193.1 million over the FY14-18 cap, but less than the FY04-08 and FY09-13 caps which both exceeded $1.1 billion. The CIP spending cap excludes the Infiltration/Inflow Local Financial Assistance and Local Water System Assistance Programs which are driven by member community requests for funding assistance. Staff expect the Board will continue to establish CIP spending caps for future 5-year periods (FY24-28 and beyond) as part of future CIP process discussions. Total Master Plan water and wastewater needs identified for FY19-23 are approximately $1,002 million, including $984 million in projects currently programmed in the CIP and $18 million in new projects recommended for consideration in future CIPs. Total water and wastewater needs identified for FY24-28 are approximately $2,073 million, including $1,756 million in projects currently programmed in the CIP and $317 million in new projects recommended for consideration in future CIPs. MWRA's estimated water and wastewater reinvestment needs for the 40 year planning period are presented in Table 1 and also displayed graphically in Figures 1 and 2. All wastewater and water project costs recommended in the Master Plan are summarized by chapter in Attachments A and B.

Since five year updates for the Water and Wastewater System Master Plans were initiated in 2006, it is clear that master planning efforts have been valuable to MWRA and certain key themes have emerged. On the water side, the 2006 Plan reflected the completion of the MetroWest Tunnel and the Carroll Water Treatment Plant; then began the look ahead towards the future design and construction of UV treatment and the remaining system redundancy. In 2018, distribution system redundancy projects moved closer to completion and a more developed plan for Metropolitan Tunnels redundancy has replaced placeholder values. UV treatment is now in place at both the Carroll and Brutsch water treatment plants. The plan's focus has moved towards continued asset protection for pipelines and facilities.

On the wastewater side, the 2006 Plan identified the increasing needs of Deer Island's asset protection that now represents over half of all wastewater project costs programmed in the CIP. The 2006 Plan identified the need to develop rehabilitation plans for residuals facilities and the headworks. Project schedules and costs have now been programmed in the CIP and headworks upgrades are underway. In 2006, only 15 of 35 CSO Control Plan projects were complete; with an additional $460 million in future spending programmed in the CIP. Today, the last element of the $900 million CSO Control Plan, the $2.5 million 3-year CSO Control Performance Assessment, is underway and will be completed in 2020. The initial interceptor renewal methodology that prioritized future projects based on risk and consequence of failure was developed as part of the 2006 Master Plan. Scheduling of interceptor renewal projects was stretched out to allow other critical expenditures to move forward while constructability and permitting issues are assessed. Major investment in interceptor renewal is now recommended over the next 25 years. For long-term regulatory changes, MWRA continues the initial 2006 theme of monitoring emerging contaminants and environmental issues with no significant near-term spending anticipated.

Efforts to protect coastal facilities from sea level rise moved from planning into construction, and continuing improvements in green energy production and energy efficiency have reduced MWRA's greenhouse gas footprint by 32% between 2006-2016. During the plan period, these efforts will continue; most notably with the combined heat and power project on Deer Island improving MWRA's use of digester gas to produce additional green power.

TABLE 1 - 2018 MWRA MASTER PLAN PROJECT COST SUMMARY ($ in thousands)

Asset	FY19-23	FY24-28	FY29-38	FY39-58	SUBTOTAL FY19-58
Water Treatment and Land Acquisition Programmed in FY19 CIP	13,016	18,204	28,500	0	59,720
Future Recommended - Water Treatment and Land Acquisition	0	3,596	15,000	45,000	63,596
Transmission System and Dams Programmed in FY19 CIP	96,455	576,243	826,278	52,862	1,551,838
Future Recommended - Transmission System and Dams	4,050	7,600	10,850	70,500	93,000
Metropolitan System, Lab, SCADA, Metering, Energy and Info Management Programmed in FY19 CIP	230,769	321,531	60,454	0	612,754
Future Recommended - Metropolitan System, Lab, SCADA, Metering, Energy and Info Management	3,575	7,600	33,700	150,400	195,275
SUBTOTAL - Water Projects Programmed in FY19 CIP	340,240	915,978	915,232	52,862	2,224,312
SUBTOTAL - Future Recommended Water Projects	7,625	18,796	59,550	265,900	351,871
TOTAL WATER PROJECTS	**347,865**	**934,774**	**974,782**	**318,762**	**2,576,183**
Wastewater Treatment and Residuals Programmed in FY19 CIP	324,596	423,977	68,801	0	817,374
Future Recommended - Wastewater Treatment and Residuals	7,400	49,000	140,750	596,000	793,150
Headworks, Tunnels, Pump Stations, CSO Facilities, Sewers, SCADA and Metering Programmed in FY19 CIP	196,396	287,545	35,215	0	519,156
Future Recommended - Headworks, Tunnels, Pump Stations, CSO Facilities, Sewers, SCADA and Metering	3,000	142,900	204,000	342,400	692,300
Community Financial Assistance Programmed in FY19 CIP	123,200	129,100	-40,600	-13,300	198,400
Future Recommended - Community Financial Assistance	0	106,100	48,000	-4,100	150,000
SUBTOTAL - Wastewater Projects Programmed in FY19 CIP	644,192	840,622	63,416	-13,300	1,534,930
SUBTOTAL - Future Recommended Wastewater Projects	10,400	298,000	392,750	934,300	1,635,450
TOTAL WASTEWATER PROJECTS	**654,592**	**1,138,622**	**456,166**	**921,000**	**3,170,380**
TOTAL - Projects Programmed in FY19 CIP	984,432	1,756,600	978,648	39,562	3,759,242
TOTAL - Future Recommended Projects	18,025	316,796	452,300	1,200,200	1,987,321
TOTAL PROJECTS	**1,002,457**	**2,073,396**	**1,430,948**	**1,239,762**	**5,746,563**

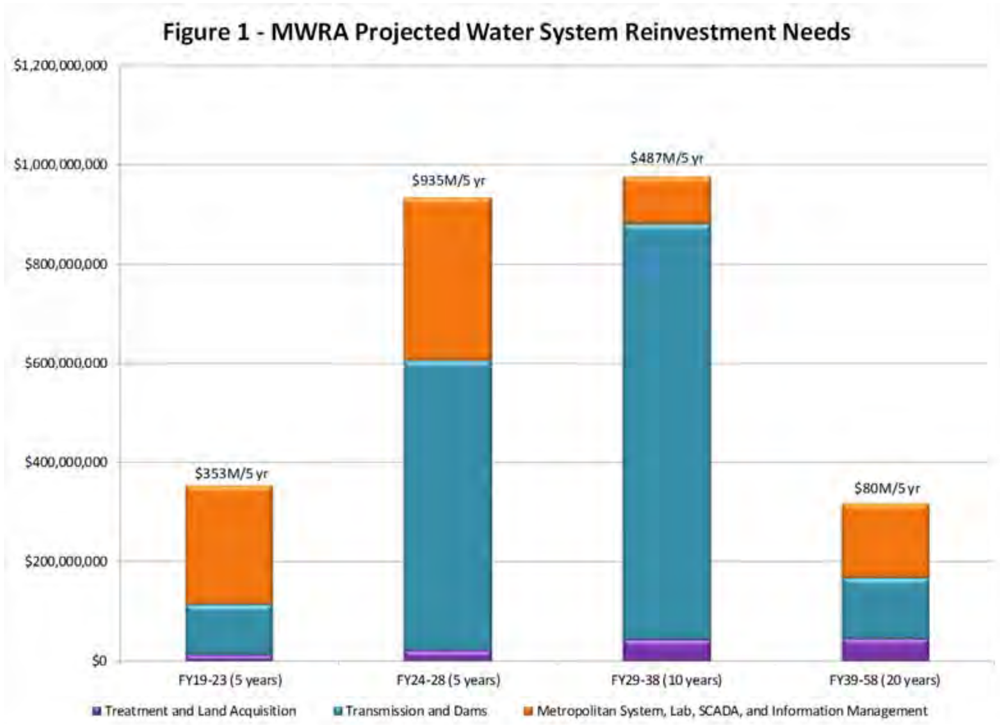
Figure 1 - MWRA Projected Water System Reinvestment Needs
$1,200,000,000
$1,000,000,000
$800,000,000
$600,000,000
$400,000,000
$200,000,000
$0
$353M/5 yr
$935M/5 yr
$487M/5 yr
$80M/5 yr
FY19-23 (5 years)
FY24-28 (5 years)
FY29-38 (10 years)
FY39-58 (20 years)
Treatment and Land Acquisition
Transmission and Dams
Metropolitan System, Lab, SCADA, and Information Management

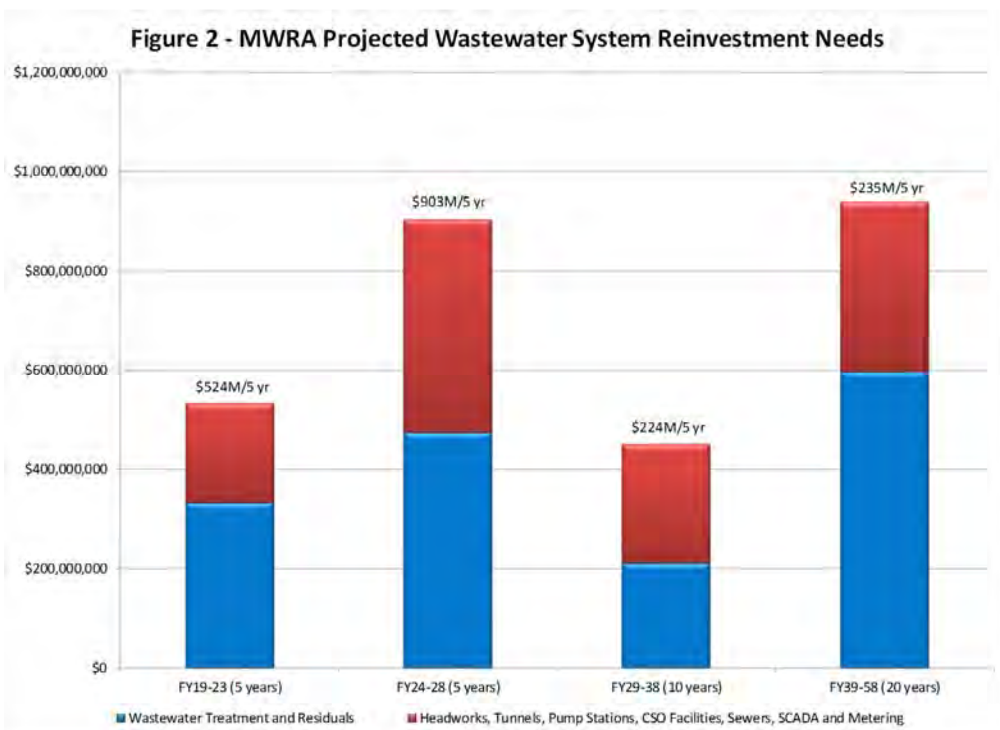
Figure 2 - MWRA Projected Wastewater System Reinvestment Needs
$1,200,000,000
$1,000,000,000
$800,000,000
$600,000,000
$400,000,000
$200,000,000
$0
$524M/5 yr
$903M/5 yr
$224M/5 yr
$235M/5 yr
FY19-23 (5 years)
FY24-28 (5 years)
FY29-38 (10 years)
FY39-58 (20 years)
Wastewater Treatment and Residuals
Headworks, Tunnels, Pump Stations, CSO Facilities, Sewers, SCADA and Metering

All Master Plan projects have been prioritized on a scale from 1 to 5, as follows: 1 – critical; 2 – essential; 3 – necessary, 4 – important, and 5 – desirable. Highest priority projects will resolve critical threats to public health and prevent imminent system failure resulting in significant service loss. High priority projects will improve system reliability and maintain effluent/residuals quality. Lower priority projects will optimize system performance, assure future capacity, and provide more efficient operation. Project ratings were assigned by MWRA senior managers in concert with Operations, Engineering, and Planning staff. Project priority is reviewed during the annual CIP development process.

SUMMARY OF THE 2018 WATER SYSTEM MASTER PLAN

MWRA's water system includes its source reservoirs, treatment facilities, transmission lines, and distribution system facilities and pipelines; the system (excluding the source reservoirs) has an estimated replacement asset value of approximately $6.7 billion. Total water system needs identified for the FY19-58 Master Plan timeframe are approximately $2.6 billion (in current dollars), including all projects currently in the CIP and those recommended for consideration in future CIPs. Approximately 69% of the total water system need addresses major remaining system redundancy costs including interim and long-term Metropolitan Tunnel Redundancy costs, WASM 3 work and remaining water distribution system storage and pipeline redundancy projects. The remaining 31% includes ongoing asset protection projects for valves, pipelines, pump stations, storage facilities, dams, and treatment facilities. Also included are costs for continuing watershed land acquisition, and replacement and optimization of other smaller yet critical assets such as radio and SCADA equipment, lab equipment and facilities, and metering equipment. Table 2 shows the breakdown of project CIP and Master Plan costs by planning period.

TABLE 2 - 2018 Water System Master Plan Cost Summary

	FY19-23	FY24-28	FY29-38	FY39-58	Total Cost ($1000)
Projects Programmed in the FY19 CIP	340,240	915,978	915,232	52,862	2,224,312
Projects Recommended for Future CIPs	7,625	18,796	59,550	265,900	351,871
Total	347,865	934,774	974,782	318,762	2,576,183

The water system needs assessment is based on the following major assumptions and findings:

- The 300-mgd safe yield of MWRA's water system is sufficient to meet future demand for water both within the service area and additional demand outside the service area.
- Modeling efforts indicate that climate change is not expected to have significant impacts on reservoir yield; in fact, safe yield may increase slightly. Changes in climate may encourage surrounding communities to turn to MWRA for portions of their supply as droughts become more frequent or severe.
- No design and construction funds are included to address the impacts on MWRA's water system of potential changes in federal or state regulations. Staff continue to track potential changes to the Federal Lead and Copper Rule which may cause MWRA to reevaluate corrosion control.

- Water supply redundancy and new storage projects provide for system reliability, operational flexibility, and enhanced security. Planning for redundancy for key elements of both the transmission and distribution systems was a focus of both the 2006 and 2013 Water System Master Plans and continues to be a point of emphasis. Projects to address Metropolitan Tunnel Redundancy have now been incorporated into the CIP as have interim projects to address immediate risk reduction needs in the existing tunnel system prior to the implementation of tunnel redundancy. As a placeholder, the Master Plan includes $65 million in future funding for repair or rehabilitation needs for the existing Metropolitan Tunnels once the new tunnels are in service. This value will be refined as the redundancy work is completed and a full inspection and assessment can be done. The Master Plan programs these costs in the FY39-58 planning period. Work on redundancy for the Northern Intermediate High and Southern Extra High service areas has progressed significantly during the past five years as well. Approximately $15 million in new project costs are recommended to enhance redundancy in the Northern Extra High system moving forward.

- Master Plan recommendations include inspections of the Cosgrove Tunnel periodically over the 40-year Master Plan period. The inspection of the Quabbin Tunnel is in the FY19 CIP and is scheduled to begin in FY24. At this time, no funds are included for rehabilitation or repair of those tunnels. However, if inspections of any of the tunnels were to indicate more significant problems, future costs would need to be added.

- The Master Plan again emphasizes the need to continue the systematic cleaning and lining of remaining MWRA-owned, older unlined cast-iron mains to address potential water quality degradation concerns and related health risks. This effort addresses MWRA customer expectations and EPA's anticipated direction for distribution system regulation and reduces pipeline corrosion and leakage. Metropolitan system pipeline expenditures identified in the CIP or recommended in the Master Plan are approximately $321 million (excludes WASM 3 pipe costs). Additionally, the current CIP includes approximately $56 million for an expanded cathodic protection program for the metropolitan system.

- The Master Plan recommends a pipeline study in FY25 to help MWRA assess the ongoing need for rehabilitation beyond currently planned work. The study will look at any pipe remaining to be rehabilitated (mostly constructed since 1950), expected replacement cycles for lined pipes, and assess information on corrosion and other factors.

- The Master Plan recommends continuing to systematically address the long-term need to protect and eventually replace other water system assets, including equipment, valves, pump stations, storage facilities, treatment and transmission system buildings and equipment (not including tunnels or piping), dams, and support systems. Including what is already in the CIP as well as recommended asset protection projects, the overall water system master plan total for this category is approximately $361 million between FY19-58.

- Financial assistance to support member community water system rehabilitation projects to help maintain high quality water is recommended to continue but must be evaluated against competing MWRA CIP needs. Even with the substantial progress made over the last 20 years via MWRA's community water loans, approximately 1,800 miles (27%) of community-owned water mains remain unlined. The Master Plan recommends two additional water loan program phases FY29-48 (each at $250 million in loans over 10 years) to extend the current program approved through FY30. Since there is no grant component to water financial assistance; the impact to MWRA's CIP is minor compared to the sewer grant/loan program.

The Transmission System – Tunnels and Aqueducts, Facilities, and Dams

MWRA's water transmission system consists of over 100 miles of tunnels and aqueducts in daily use which transport water by gravity from the supply reservoirs to points of distribution within the service area. The basic layout of the system as designed is fundamentally sound. System improvements over time have allowed for older facilities, no longer in daily use, to remain as critical emergency standby facilities as long as maintained and linked to new facilities where necessary. The performance standards for a major transmission system are: ability to transport sufficient water to meet the maximum daily demands of the service area, and reliability in that there must be sufficient redundant components to ensure a continued supply of water system if any one "leg" of the system were to fail. MWRA's transmission system ably meets system demands and much of the system has redundant components that may be brought on line.

However, as noted in the previous Master Plans and discussed in this plan, shortfalls in redundancy remain although significant improvements have been completed since the 2013 Master Plan. The Wachusett Aqueduct Pump Station which will provided needed redundancy for the Cosgrove Tunnel is undergoing final testing and is anticipated to be operation soon. Major work has been underway since 2013 to address redundancy for the Metropolitan Tunnels: City Tunnel, City Tunnel Extension and Dorchester Tunnel. As outlined in greater detail in Chapter 7 of this Plan, staff undertook a major review of potential alternatives that would achieve the redundancy goals. Failure of the existing deep rock tunnels is not the major concern; potential failure of surface connections, valves and piping which could require isolation of the tunnel system is of prime concern. However, without redundant facilities, the tunnels cannot be taken off line for inspection, maintenance and needed repairs. In 2017, staff presented a conceptual plan to construct both North and South tunnels to the Board of Directors for their consideration and was given authorization to move forward. A Tunnel Redundancy Department has been formed, initial work is underway and a future contract for preliminary design and MEPA review is expected to be procured in FY20.

In addition, a number of interim improvements have been identified that will further reduce risk prior to new tunnels being constructed. These include improvements at the top of shaft locations; improvements at the Chestnut Hill Emergency Pump Station; Low Service PRV improvements and improvements to the Commonwealth Avenue Pump Station. It is also apparent that rehabilitation of WASM 3 must proceed as soon as possible. Work is underway on all of these projects. Inspection of the Quabbin Aqueduct is included in the FY19 CIP. The 2018 Master Plan also recommends period inspections of the Cosgrove Tunnel and sets aside a placeholder value for longer-term future inspection and rehabilitation of the Metropolitan Tunnels once redundancy is in place.

MWRA, under its 2004 Memorandum of Agreement with the Department of Conservation and Recreation (DCR), is responsible for water supply dams, with a couple of exceptions. MWRA previously paid DCR Division of Watershed Management to perform capital improvements for these dams. Significant work to meet regulatory requirements, ensure dam safety and provide operational flexibility where possible has been completed. Continued long term asset protection of dams remains a critical effort going forward. Additional improvements to allow for increased operational range and flexibility at the Quabbin spillway have been identified as a future project. Overall, between those projects included in the FY19 CIP and recommended work, the Master Plan identifies approximately $1.65 billion in future transmission system spending.

Treatment Plants

Since the 2013 Master Plan, UV disinfection has been completed and operational at both the Carroll Water Treatment Plant (CWTP) and the Brutsch Water Treatment Plant. Although the CWTP has been more recently constructed, there are substantial electrical and mechanical systems which require ongoing replacements and upgrades approximately every ten years. Approximately $41 million of such costs are included in the FY19 CIP and the Master Plan recommends an additional $30 million in the FY 29-58 time period.

The Metropolitan System

The Metropolitan System consists of approximately 284 miles of distribution pipeline east of Shaft 5, twelve storage tanks, twelve pump stations, nine tunnel shafts, and over 4800 valves. The system is divided into 7 pressure zones.

Since the 2013 Master Plan, MWRA has moved towards completion of the two most significant pipeline redundancy projects within the distribution system. For the Northern Intermediate High service area, three contracts are completed and a fourth is expected to be completed in 2020. Total cost for these projects is approximately $55.7 million. For the Southern Extra High service area, one contract is substantially complete and all three contracts are expected to be completed by the end of 2020 at a total estimated cost of approximately $49.4 million. Work has also been completed for the Spot Pond Covered Storage Facility which provides an additional 20 MG of Low Service storage in the northern part of the system. As part of the same project, a pump station which provides redundancy to Gillis Pump Station has also been constructed. These projects significantly improve operational flexibility. Long term, the NIH and SEH also have shortfalls in storage as does the Northern Extra High Service area and these projects are either in the FY19 CIP or recommended in the Master Plan.

Continuing to systematically line remaining older unlined cast iron mains to address water quality degradation concerns remains a goal of pipeline rehabilitation and replacement. Additional funds are also allocated to improved cathodic protection going forward. Overall, Metropolitan system pipeline expenditures identified in the FY19 CIP or the Master Plan are approximately $321 million in the FY19-58 time period. This excludes WASM 3 which is approximately $102 million. The Master Plan recommends a pipeline study in 2025 to help MWRA assess the ongoing need for rehabilitation beyond the above work. The study will look at the expected replacement cycles for lined pipes and assess information on corrosion and other factors.

The 2018 Master Plan also reaffirms the need to systematically protect and replace other MWRA water system assets. The FY19 CIP and the Master Plan allocate $361 million for equipment, valves, pump stations, storage facilities, treatment and transmission buildings and equipment, dams and ancillary support systems between FY19-58.

Land Acquisition

The FY19 CIP includes approximately$6.4 million to enable DCR to acquire parcels of, or interests in, real estate critical to protection of the watershed and source water quality. The Master Plan recommends an ongoing program of approximately $1 million per year through the FY19-58 planning horizon for total of $40 million.

Community Financial Assistance – Local Water System Assistance Program

Even with the substantial progress made over the last 20 years, MWRA estimates that approximately 1800 miles of community water main remain unlined, representing a future community water main replacement/rehabilitation cost of $1.5 billion. For master planning purposes, staff recommend future fourth and fifth phases of the Local Water System Assistance Program be considered for funding in future CIPs. Each new phase is recommended to provide $250 million in interest-free loans (with 10-year loan repayments) during the FY29-38 and FY39-48 time periods. MWRA staff will continue to work cooperatively with the Advisory Board to identify potential program improvements which may be recommended to the Board for approval.

SUMMARY OF THE 2018 WASTEWATER SYSTEM MASTER PLAN

MWRA's wastewater system is a complex network of conduits and facilities receiving flow from 43-member sewer communities covering an area of about 500 square miles. The regional system serves approximately 2.2 million people, including the City of Boston and surrounding metropolitan area. The Deer Island Treatment Plant (DITP) receives an average daily flow of 353 mgd and has a peak wet weather capacity of 1,270 mgd, with additional system capacity available at combined sewer overflow (CSO) outfalls. Residuals from DITP are processed into pellets for beneficial reuse at MWRA's sludge-to-fertilizer plant in Quincy. The MWRA collection system includes four remote headworks facilities, a network of 274 miles of sewer pipelines and cross-harbor tunnels, 13 pump stations, one screening facility, and six CSO treatment/storage facilities. MWRA also operates the Clinton Advanced Wastewater Treatment Plant (AWWTP) providing sewage treatment services to the Town of Clinton and the Lancaster Sewer District. MWRA's goal is to operate and maintain these facilities to provide uninterrupted wastewater collection and treatment service in a safe, cost-effective, and environmentally sound manner.

The scale and scope of MWRA's wastewater system operation – encompassing collections, pumping, CSO, treatment, effluent discharge, and beneficial reuse of residuals – presents challenges in maintenance, rehabilitation, and replacement. MWRA's wastewater infrastructure has an estimated replacement value of approximately $6.8 billion. Deer Island alone has approximately 70,000 pieces of equipment and instrumentation components. Regular maintenance and replacement cycles have become standard plant operating practice, but will become increasingly costly as the plant ages. Capital projects across the system will be implemented while facilities are on-line, posing operational challenges, and project staffing considerations will also need to be weighed. Finally, all system spending is against the backdrop of rates management.

Total wastewater needs identified for the FY19-58 Master Plan timeframe are $3.17 billion (in current dollars), including $1.53 billion already programmed in the FY19 CIP and $1.64 billion recommended for consideration in future CIPs. More than 94 percent, $2.99 billion of the $3.17 billion needs estimate for all wastewater projects are rehabilitation or replacement of existing infrastructure assets at end of their useful life. The remaining $180 million in needs are for projects to optimize existing systems or add capacity, technology upgrades and new equipment to support automated facility operation, condition assessments, and wastewater modeling.

The wastewater system needs assessment is based on the following major assumptions and findings:

- No new communities are expected to join the wastewater system. Future population and employment growth in the service area is projected to modestly increase. These population and growth increases could result in a projected increase of up to 27 mgd of sanitary wastewater flow through 2040. This potential increase represents a 10% increase over the current 270 mgd average dry day flow (last 20 years). MWRA's continued commitment to invest in community infiltration, inflow, and combined stormwater reductions is expected to offset the increase in new sanitary flows.

- Wastewater quality parameters are not projected to change significantly. The need for capital projects to address wastewater quality will most likely be based on revised NPDES permit limits.

- No significant design and construction funds are included for potential long-term regulatory changes that may impact MWRA based on current Deer Island NPDES permit discussions and the 2017 Clinton permit. Future regulatory issues that may have cost implications for MWRA include more stringent limits on nutrients, conventional pollutants, or emerging contaminants; more stringent biosolids reuse criteria; rapid public notification of CSO discharges (location and volume); a higher level of CSO control; more stringent focus on reduction or elimination of sanitary sewer overflows (SSOs); and expansion of MWRA's role in local stormwater permitting and initiatives for promoting green infrastructure.

- Storm surge, together with anticipated sea level rise resulting from the changing climate, will affect a number of MWRA and communities' coastal collection systems and wastewater facilities. Sea level rise was accounted for during the design and construction of the Deer Island Wastewater Treatment Plant. As climate change projections evolve, projected infrastructure impacts, and identification of appropriate projects to counter negative impacts will become a more critical theme of future MWRA Master Plans. The 2018 Master Plan assumes any significant flood mitigation efforts will be undertaken as each MWRA facility is rehabilitated or upgraded, and that simpler measures will be implemented as maintenance efforts. Rehabilitation projects at the Alewife Brook Pumping Station and the Chelsea Creek Headworks have already incorporated anticipated changes in sea level into the design criteria, and other coastal facilities have had flood mitigation measures implemented. Future coastal projects may need to be targeted so that increases in tidal and storm surge inflow do not impact MWRA's ability to provide reliable wastewater collection and treatment.

- Significant asset protection investment at Deer Island will continue, as well as green energy production and energy optimization, with $660 million programmed in the FY19 CIP over the next 10 years. Three of the most expensive Deer Island projects include:
    - The combined heat and power project to optimize use of methane gas and overall energy efficiency ($90 million);
    - Rehabilitation of primary and secondary clarifiers ($134 million); and,
    - A series of odor control and HVAC equipment replacement projects ($85 million).

- The Pelletizing Plant in Quincy will require large-scale equipment replacement which is included in the FY19 CIP at $100 million over the next 15 years.

- The cross-harbor tunnels are assumed to be in good condition. A $1.3 million cross-harbor tunnel shaft study and follow-up $9.7 million shaft rehabilitation project are programmed in the FY19 CIP during FY19-27. A $5 million tunnel inspection and condition assessment project is also programmed in the CIP during FY24-28. The condition of the cross-harbor tunnels and potential need for future investment is a significant unknown for MWRA until the inspection/condition assessment project is complete. Included as a Master Plan recommendation is a $50 million placeholder for future inspection/cleaning/repair of the tunnels in the out years of the planning period (FY46-50).

- Headworks facilities require significant reinvestment that is programmed in the CIP (estimated at over $240 million over the next 10 years). The Chelsea Creek Headworks Upgrade is well into construction and will be followed by the Columbus Park and Ward Street Headworks Upgrades. Improvements programmed in the CIP for the Nut Island Headworks include odor control, HVAC, mechanical, and electrical system upgrades. Upgrade projects at the headworks must be implemented while systems remain on-line, posing operational challenges.

- MWRA's 20 pump stations and CSO facilities, while generally in good condition, are aging and some are in need of rehabilitation or upgrade. The Master Plan reinvestment strategy for these facilities estimates a $163 million need over the next 10 years, only 45% of which is currently programmed in the FY19 CIP.

- No significant additional CSO capital costs are included (other than maintenance of existing facilities) beyond the $2.5 million (through FY21) to complete the 3-year CSO Control Performance Assessment. If regulatory action were to mandate a higher level of CSO control, additional capital needs would be required.

- The average age of MWRA's 226-mile sewer system is approximately 70 years old, with approximately 39% of the sewers more than 100 years old. Overall, the collection system is in reasonably good condition, given its age. MWRA's interceptor renewal program targets the approximate 13 miles (6% of gravity sewers) that have significant physical defects. The sections requiring repair are prioritized based on risk and consequence of failure and are regularly monitored through internal TV inspection. In addition to the gravity sewers and structures, MWRA also maintains 29 miles of force mains, siphons, and CSO/emergency outfalls. The Master Plan reinvestment strategy for all sewer pipelines estimates a $168 million need over the next 10 years, of which 70% is currently programmed in the FY19 CIP.

- Wastewater metering and supervisory control and data acquisition (SCADA) systems will continue to require upgrades based on assumed useful life/obsolescence of the electronic equipment. Much of this equipment is expected to require replacement every 10 to 20 years (programmed in the FY19 CIP at $22 million for the next 10 years).

- Financial assistance to support member community projects for sewer system rehabilitation and infiltration/inflow reduction is planned to continue but must be evaluated against competing MWRA CIP needs. Continued investment in rehabilitation of member community sewer systems is key in minimizing the potential for regional wastewater flow increases, which could require additional future transmission and treatment capacity. The Master Plan carries recommended funds for additional community financial assistance beginning in FY24. Staff will continue to work cooperatively with the Advisory Board to identify potential improvements for community financial assistance programs.

The 2018 Master Plan lists programmed and recommended projects with CIP spending in FY19-58 and focuses on projects proposed to require capital spending during the next two 5-year CIP cap cycles: FY19-23 and FY 24-28. Following these two five year periods, potential capital needs during additional 10-year (FY29-38) and 20-year (FY39-58) planning periods are identified. Wastewater System Master Plan project costs for these planning periods are presented in Table 3, below.

TABLE 3 - 2018 Wastewater Water System Master Plan Cost Summary

	FY19-23	FY24-28	FY29-38	FY39-58	Total Cost ($1000)
Projects Programmed in the FY19 CIP	644,292	840,622	63,416	-13,300	1,534,930
Projects Recommended for Future CIPs	10,400	298,000	392,750	934,300	1,635,450
Total	654,692	1,138,622	456,166	921,000	3,170,380

Wastewater System Master Plan projects during the FY19-23 and FY24-28 timeframes are summarized below under five major headings: (1) Wastewater Treatment - Deer Island and Clinton Plants; (2) Residuals Processing (off-island) at the Pellet Plant, (3) Wastewater Headworks and Cross-Harbor Tunnels, (4) Wastewater Pump Stations, CSO Facilities, and CSO Control Plan, (5) Collection System Sewers, SCADA, Metering, and Community Financial Assistance.

Wastewater Treatment - Deer Island and Clinton Plants, FY19-23 and FY24-28

MWRA's Deer Island Treatment Plant (DITP) is the centerpiece of MWRA's $3.8 billion construction program to alleviate pollution in Boston Harbor. The plant provides primary and secondary treatment of wastewater collected from approximately 2.2 million people in 43 greater Boston communities. Treated wastewater effluent is carried by a 9.4-mile, 24-foot diameter outfall tunnel and discharged into the 100-foot deep waters of Massachusetts Bay. DITP is designed to process a maximum of 1.27 billion gallons per day and components include: influent pumps, primary treatment, secondary treatment, disinfection, dechlorination, the outfall tunnel, sludge digesters, odor control, and on-site power generation.

The Deer Island Treatment Plant is the second largest plant in the country in terms of maximum daily capacity. Its multiple treatment processes, high level of automation, and its uniquely-constructed technical and engineering systems present challenges to operating, maintaining, and replacing the plant’s equipment, structures, and related support systems. Components of DITP came on-line sequentially beginning in January 1995 with construction completed in 2001. Most plant equipment and structures are up to twenty years old and in good condition. The Wastewater System Master Plan identifies $310 million in DITP project needs for the FY19-23 timeframe, $305 million programmed in the FY19 CIP and $5 million recommended for consideration in future CIPs. For the FY24-28 timeframe, the Master Plan identifies $392 million in DITP project needs, $354 million programmed in the FY19 CIP and $38 million recommended for consideration in future CIPs. Some major DITP projects during FY19-28 include: pump variable frequency drive replacements, primary and secondary clarifier rehabilitation (phase 2), sludge digester and storage tank rehabilitation, combined heat and power project, continued electrical equipment upgrades (phase 5), switchgear replacement (phase 2), HVAC equipment replacement, fire alarm system replacement, and as-needed design.

The Clinton Advanced Wastewater Treatment Plant (AWWTP) provides advanced sewage treatment services to the Town of Clinton and the Lancaster Sewer District. MWRA upgraded the treatment plant and sludge landfill in 1992 at a cost of $37 million. The plant provides secondary treatment using an activated sludge process in combination with advanced nutrient removal and dechlorination. Effluent is discharged into the South Branch of the Nashua River. The Clinton AWWTP is 25 years old and in generally good condition. Some equipment rehabilitation and replacement projects are recommended; however, significant reinvestment is not required in the short-term. The Master Plan identifies $8.4 million in project needs for the Clinton Plant for the FY19-23 timeframe, $7.8 million programmed in the FY19 CIP and $0.6 million recommended for consideration in future CIPs. For the FY24-28 timeframe, $4.1 million is programmed in the CIP and $9.5 million is recommended for consideration in future CIPs.

Residuals Processing (off-island) at the Pellet Plant, FY19-23 and FY24-28

Digested sludge is pumped from DITP through two 14-inch, seven-mile-long force mains that are embedded in concrete within the 11-foot diameter Inter-Island Tunnel and connect to the Residuals Pellet Plant in Quincy. The Pellet Plant was built in 1991 and expanded in 2001 to handle sludge production from DITP secondary treatment facilities. The Residuals Pellet Plant is designed to handle up to 180 dry tons per day of residuals with four of the six operational trains running. Current production is 100 dry tons per day (annual average) or 140 dry tons per day on a 5-day operational week. Pellets are distributed for beneficial reuse. The Pellet Plant is operated and maintained under a long-term contract (March 2001 through December 2020, as amended) with a private firm, the New England Fertilizer Company (NEFCo). The annual operating cost is $14 to $16 million per year. Since NEFCo is responsible for all operation, maintenance, and capital improvements for the term of the contract, MWRA has not incurred additional major expenditure at the facility.

In 2018, the facility equipment is 17 to 27 years old. In January 2014, MWRA completed an assessment of long-term technology options for residuals processing and disposal. The study identified a few technology efficiency improvements for the Pellet Plant that will be evaluated in the long-term. Significant reinvestment is anticipated for residuals processing and disposal during the next 10 years.

The Wastewater System Master Plan identifies $13.8 million in Residuals Pellet Plant project needs for the FY19-23 timeframe, $11.5 million programmed in the FY19 CIP and $2.3 million recommended for consideration in future CIPs. For the FY24-28 timeframe, the Master Plan identifies $67 million in Residuals Pellet Plant facilities upgrade design and construction needs, all of which $66 million is programmed in the FY19 CIP.

Wastewater Remote Headworks and Cross-Harbor Tunnels, FY19-23 and FY24-28

MWRA's four remote headworks (Chelsea Creek, Columbus Park, Ward Street, and Nut Island) and 19 miles of cross-harbor tunnels are critical facilities because almost all flow to DITP passes through them. The primary function of the remote headworks is to remove grit and screen out debris from wastewater flow to minimize solids accumulation in the cross-harbor tunnels and protect downstream pump facilities at the DITP. The cross-harbor tunnels (North Metropolitan Relief Tunnel, Boston Main Drainage Tunnel, Inter-Island Tunnel, and Braintree-Weymouth

Tunnel) transport wastewater from the remote headworks to Deer Island. The Wastewater System Master Plan identifies $103 million for FY19-23 and $165 million for FY24-28 in remote headworks and cross-harbor tunnel project needs, almost all of which is programmed in the FY19 CIP.

The Chelsea Creek, Columbus Park, and Ward Street Headworks were all built in 1967 and are over 50 years old. Equipment at the headworks was upgraded by MWRA in 1987 and is over 30 years old. These three older facilities remain operational, but, largely due to age and equipment obsolescence, are in only fair condition and need significant reinvestment. A Headworks Condition Assessment/Concept Design project was completed in FY10 and Preliminary Design was completed in FY12. These projects reviewed the adequacy of existing headworks components and processes and provided replacement/upgrade recommendations based upon current technology. MWRA has developed a prioritized design/construction schedule through FY28 at a cost of approximately $190 million to rehabilitate the three older remote headworks. Design of upgrades for the Chelsea Creek Headworks began in FY11 and construction is scheduled to run through FY21. The second phase of the project will be to design and construct upgrades for both Columbus Park and Ward Street Headworks during FY17-28. The newer Nut Island Headworks, built in 1998, is in good condition. Significant projects to provide mechanical, electrical, odor control, and HVAC upgrades are programmed for the Nut Island Headworks during FY17-29 at an overall cost of $67 million.

The North Metropolitan Relief Tunnel and Boston Main Drainage Tunnel were built in 1953 and are 65 years old. The Inter-Island Tunnel (1996) and Braintree-Weymouth Tunnel (2005) are relatively new. Based on the industry benchmark of 100+ years for useful life for tunnels, it is assumed that the older cross-harbor tunnels are still in good condition. However, the existing condition of the tunnels is unknown; therefore, there is uncertainty associated with the potential for future repair/rehabilitation and risk of a very large future cost. Some deterioration of concrete in the tunnel shafts has been documented and attributed to hydrogen sulfide corrosion. Since the cross-harbor tunnels and shafts are critical facilities, a study/rehabilitation of the effluent shafts, as well as a tunnel inspection are high priorities. These projects are programmed in the FY19 CIP at $15 million during FY19-27.

Wastewater Pump Stations, CSO Facilities, and CSO Control Plan, FY19-23 and FY24-28

The MWRA collection system includes 13 pump stations, one screening facility, and six CSO treatment/storage facilities. The primary function of a pump station is to lift wastewater from an upstream sewer (at a lower elevation) to a downstream interceptor (at a higher elevation) so the wastewater can continue to flow by gravity to MWRA headworks facilities. Most pump stations operate continuously; however, two MWRA pump stations (Framingham and New Neponset Valley Sewer Pump Stations) are designed to operate during peak flows (wet weather) only. The primary function of a combined sewer overflow (CSO) facility is to store and/or treat combined (sanitary and stormwater) flow that exceeds the capacity of the combined sewer system in large rainfall events.

The average age of MWRA’s 20 collection system facilities is 27 years. Six of the 20 facilities are more than 30 years old. The oldest pump station, Alewife Brook in Somerville, is 67 years old and is undergoing a major rehabilitation scheduled for completion in FY20. Two of MWRA’s CSO facilities are 47 years old: the Cottage Farm Pumped CSO Facility and the Somerville Marginal

Gravity CSO Facility. Overall, the 20 collection system facilities are in good condition. Significant automation upgrades were implemented under MWRA's Wastewater Central Monitoring/SCADA Implementation Project during 2007-2009. The CSO facilities have undergone upgrades under the CSO Control Plan. The highest priority immediate needs for wastewater pump stations and CSO facilities are rehabilitation/replacement projects being implemented at the 10 older facilities.

For wastewater pump stations and CSO facilities, the Wastewater System Master Plan identifies $51 million in project needs for the FY19-23 timeframe, $49 million programmed in the FY19 CIP and $2 million recommended for consideration in future CIPs. For the FY24-28 timeframe, the Master Plan identifies $113 million in wastewater pump station and CSO facility needs, $24 million of which has been programmed in the FY19 CIP. Some major projects during FY19-28 include: a condition assessment for the 10 oldest wastewater facilities; and follow-up design and construction of upgrades at the oldest stations (Alewife Brook, Caruso, Chelsea Screen House, DeLauri, Hayes, Hingham, Prison Point, Wiggins - Castle Island Terminal, Cottage Farm, and Somerville Marginal).

MWRA's Long-Term CSO Control Plan, as mandated by the Federal Court, is comprised of 35 wastewater system improvement projects that address 84 CSO outfalls. All 35 of these projects have been completed. The Federal Court schedule required MWRA to commence a 3-year performance assessment in January 2018 and submit a report assessing attainment of the long-term levels of control by December 2020. The Master Plan includes details on project engineering and construction requirements, schedules, long-term levels of CSO control, benefits achieved to date, and future activities. The total cost of the CSO Control Plan (including both previous and future expenditures) is $910 million, of which $902.3 million (99 percent) was expended through FY18. The FY19 CIP includes $7.7 million in spending during FY19-21 to complete the 3-year CSO control performance assessment, additional inflow removal in the Dorchester interceptor, and cured-in-place-pipe lining of the Somerville Marginal pipeline to facilitate in-system storage. There are no future MWRA or community-managed CSO Control Plan projects recommended for consideration in future CIPs. Funds to replace equipment at CSO facilities are included in collections system facilities costs.

Collection System Sewers, SCADA, Metering, and Community Financial Assistance. FY19-23 and FY24-28

The primary function of the collection system is to transport wastewater received from the 43 member sewer communities (through over 1,800 community connections) to the MWRA headworks facilities. Collection system operations are intended to optimize system performance and minimize potential CSOs and SSOs, particularly before and during storm events that stress the system's hydraulic capacity. The collection system includes a network of 274 miles of sewer pipelines - 19 miles of cross-harbor tunnels, 226 miles of gravity sewers, 18 miles of force mains, 7 miles of siphons, 4 miles of CSO and emergency outfalls, and 4,000 manholes and other structures. Internal inspection information (physical, television, and sonar) is used to develop maintenance schedules, identify structural problems, and help define rehabilitation projects.

For collection system sewers, supervisory control and data acquisition (SCADA) systems, wastewater metering, and community financial assistance, the Wastewater System Master Plan identifies $161 million in project needs for the FY19-23 timeframe; $159 million programmed in the FY19 CIP and $2 million recommended for consideration in future CIPs. For the FY24-28 timeframe, the Master Plan identifies $388 million in collection system needs, $233 million programmed in the FY19 CIP and $155 million recommended for consideration in future CIPs. Some major projects during FY19-28 include: a series of prioritized interceptor renewal/asset protection projects ($120 million); sewer siphon structure, manhole, and force main rehabilitation ($18 million); SCADA and wastewater metering ($22 million); and member community financial assistance ($358 million).

The average age of the sewer system is about 70 years old. Approximately 39 percent of sewers are over 100 years old; however, the collection system is in reasonably good condition given its average age. Based on internal TV inspection ratings for gravity sewer pipe, approximately 74 miles (33 percent) are in very good condition (A-rated), 139 miles (61 percent) are in fair to good condition with some defects (B-rated), and 13 miles (6 percent) of interceptors are severely damaged and/or have defects requiring repair (C-rated). The most critical need for the sewer system is rehabilitation construction that will address long-term sewer asset protection for C-rated pipelines. To meet this need, MWRA developed a series of prioritized interceptor renewal/asset protection projects. The gravity sewer inspection ratings have not been used for force mains, siphons, or outfalls; however, based on available data, these also appear to be in reasonably good condition. MWRA continues to monitor hydrogen sulfide corrosion and odor issues in the collection system to prioritize inspections for affected sewers. TRAC staff oversee the pre-treatment work of municipalities and industries. The Wastewater System Master Plan does not include recommendations for future large scale capital projects to target capacity/optimization projects. Collection system operations, particularly in preparation for and during large storm events, are intended to optimize system performance and minimize potential CSOs and SSOs.

The SCADA systems provide a means of monitoring and controlling facilities and equipment from a remote centralized location, as well as providing a continuous record of facility operations. MWRA's Wastewater SCADA system went through a major upgrade from 2007 through 2009 as part of the Wastewater Central Monitoring/SCADA Implementation Project. This project created a unified SCADA system covering all significant wastewater facilities. New facilities have been incorporated into the system. All wastewater facilities can be monitored and controlled at the Chelsea Operations Control Center using the SCADA system. MWRA's wastewater metering system provides rate-basis data on community flows, as well as additional operational support data for hydraulic modeling, capacity analyses, engineering studies, and community flow component (sanitary/infiltration/inflow) estimates. Upgrades to the SCADA and wastewater metering systems are scheduled to continue throughout the 40-year Master Plan schedule.

Since 1993, MWRA has made a commitment to assist member sewer communities to finance infiltration and inflow (I/I) reduction and sewer system rehabilitation projects within their locally-owned collection systems. Funding of community projects through MWRA's I/I Local Financial Assistance Program is provided most recently as 75 percent grants and 25 percent interest-free ten year loans. The program goal is to assist member communities in improving local sewer system conditions to reduce I/I and ensure ongoing repair/replacement of the collection system. It is a critical component of MWRA's Regional I/I Reduction Plan. The FY19 CIP includes a net cost of $198 million (including loan repayments) for approved local distribution through FY30 and loan repayments through FY40. The Master Plan includes placeholders for two additional rounds ($100 million in grant/loans in each round) of CIP funding beginning in FY24 at a net cost of $75 million each. For the FY19-58 timeframe, a total of $348 million is identified for community financial assistance.

Green Power Production and Energy Efficiency

MWRA is an energy intensive organization due primarily to the power needed to transport and treat wastewater, and to a lesser extent, treat and distribute drinking water. MWRA has seen a net reduction of 19.5 percent (about 38 million KWh) in electricity purchases between 2006 and 2017, partly due to increases in renewable electricity production and energy efficiency improvements made throughout the MWRA system. To further reduce greenhouse gas emissions and increase energy efficiency, MWRA will continue to implement cost effective alternative energy projects and continue to incorporate energy efficiency into rehabilitation of facilities, new construction projects and equipment replacement. During FY18, green electric power from MWRA's solar, hydro, wind and digester gas powered generators produced and used on site, or produced and sold to the grid represented about 28 percent of electric power use by all MWRA facilities. At Deer Island, 26 percent of all electric use was generated on site by green power, and if the heat value of the digester gases is included, 62 percent of all power needs were met from green sources. It is anticipated that once the upgraded combined heat and power project is implemented, 65 to 70 percent of electricity needs and up to 90 percent of total power needs at Deer Island will be met by green energy. Chapter 10 of the Water System Master Plan and Chapter 13 of the Wastewater System Master Plan more thoroughly discuss MWRA Energy Management efforts and programs.

Attachment A

2018 Water System Master Plan - Summary of Existing and Recommended Projects

Last revision 4/22/19

Project	Cost ($1000)	FY19-23	FY24-28	FY29-38	FY39-58	Total Cost ($1000)
SUBTOTAL - Existing Projects - Water Treatment and Land Acquisition	59,720	13,016	18,204	28,500	0	59,720
SUBTOTAL - Future Recommended - Water Treatment and Land Acquisition	63,596	0	3,596	15,000	45,000	63,596
SUBTOTAL - Existing Projects - Transmission and Dams	1,551,838	96,455	576,243	826,278	52,862	1,551,838
SUBTOTAL - Future Recommended - Transmission and Dams	93,000	4,050	7,600	10,850	70,500	93,000
SUBTOTAL - Existing Projects - Metropolitan System	592,987	212,743	319,987	60,257	0	592,987
SUBTOTAL - Future Recommended - Metropolitan System	137,500	0	3,000	17,500	117,000	137,500
SUBTOTAL - Existing Projects - Lab Services, SCADA, Metering, Information Management and Security	19,767	18,026	1,544	197	0	19,767
SUBTOTAL - Future Recommended - Lab Services, SCADA, Metering, Information Management and Security	57,775	3,575	4,600	16,200	33,400	57,775
SUBTOTAL - Existing Projects - Energy Management	0	0	0	0	0	0
SUBTOTAL - Future Recommended - Energy Management	0	0	0	0	0	0
SUBTOTAL - Existing Projects - Community Financial Assistance	(141,500)	(8,300)	3,100	(17,900)	(9,500)	(141,500)
SUBTOTAL - Future Recommended - Community Financial Assistance	0	0	0	137,500	(137,500)	0
SUBTOTAL - Existing - ALL (including Community Financial Assistance)	2,082,812	331,940	919,078	897,332	43,362	2,082,812
SUBTOTAL - Future Recommended - ALL (including Community Financial Assistance)	351,871	7,625	18,796	197,050	128,400	351,871
SUBTOTAL - Existing - ALL (without Community Financial Assistance)	2,224,312	340,240	915,978	915,232	52,862	2,224,312
SUBTOTAL - Future Recommended - ALL (without Community Financial Assistance)	351,871	7,625	18,796	59,550	265,900	351,871
TOTAL (including Community Financial Assistance)	2,434,683	339,565	937,874	1,094,382	171,762	2,434,683
TOTAL (without Community Financial Assistance)	2,576,183	347,865	934,774	974,782	318,762	2,576,183

Attachment B

2018 Wastewater System Master Plan - Summary of Existing and Recommended Projects by Chapter

Last revision 4/22/19

Project	Cost ($1000)	FY19-23	FY24-28	FY29-38	FY39-58	Total Cost ($1000)
		5 years	5 years	10 years	20 years	
SUBTOTAL - Existing Projects - Deer Island - Chapter 6	703,127	305,344	353,982	43,801	0	703,127
SUBTOTAL - Recommended - Deer Island - Chapter 6	681,750	4,500	38,500	135,750	503,000	681,750
SUBTOTAL - Existing - Residuals - Chapter 7	102,432	11,488	65,944	25,000	0	102,432
SUBTOTAL - Recommended - Residuals - Chapter 7	82,000	2,300	1,000	0	81,000	84,300
SUBTOTAL - Existing - Headworks and Tunnels - Chapter 8	262,650	103,118	159,532	0	0	262,650
SUBTOTAL - Recommended - Headworks and Tunnels - Chpater 8	115,500	0	5,500	40,000	70,000	115,500
SUBTOTAL - Existing - Sewers - Chapter 9	145,065	20,296	98,496	26,273	0	145,065
SUBTOTAL - Recommended - Sewers - Chapter 9	295,500	1,500	48,000	124,000	122,000	295,500
SUBTOTAL - Existing - Pump Stations and CSO Facilities - Chapter 10	73,407	49,390	24,017	0	0	73,407
SUBTOTAL - Recommended - Pump Stations and CSO Facilities - Chapter 10	250,500	1,500	89,000	40,000	120,000	250,500
SUBTOTAL - Existing - CSO Control Plan (MWRA and Community Managed) - Chapter 11	7,713	7,713	0	0	0	7,713
SUBTOTAL - Recommended - CSO Control Plan (MWRA and Community Managed) - Chapter 11	0	0	0	0	0	0
SUBTOTAL - Existing - SCADA and Metering - Chapter 12	30,321	15,879	5,500	8,942	0	30,321
SUBTOTAL - Recommended - SCADA and Metering - Chapter 12	30,800	0	400	0	30,400	30,800
SUBTOTAL - Existing - Clinton - Chapter 14	11,815	7,764	4,051	0	0	11,815
SUBTOTAL - Recommended - Clinton - Chapter 14	27,100	600	9,500	5,000	12,000	27,100
SUBTOTAL - Existing - Community Support - Chapter 15	198,400	123,200	129,100	-40,600	-13,300	198,400
SUBTOTAL - Recommended - Community Support - Chapter 15	150,000	0	106,100	48,000	-4,100	150,000
SUBTOTAL - Existing - ALL	1,534,930	644,192	840,622	63,416	-13,300	1,534,930
SUBTOTAL - Recommended - ALL	1,633,150	10,400	298,000	392,750	934,300	1,635,450
TOTAL	3,168,080	654,592	1,138,622	456,166	921,000	3,170,380

CHAPTER 1
INTRODUCTION

1.01 Overview of MWRA

Massachusetts Water Resources Authority (MWRA or Authority) was established by the Massachusetts Water Resources Authority Act, Chapter 372 of the Acts of 1984 of the Commonwealth of Massachusetts. In 1985, responsibility for water distribution for 46 municipalities and sewage collection and treatment for 43 municipalities was transferred from the Metropolitan District Commission (MDC) to the MWRA. MWRA’s facilities span from the Quabbin Reservoir in central Massachusetts to the Deer Island Treatment Plant adjacent to Boston Harbor. Approximately 3.1 million people, about 45 percent of the total population of Massachusetts, live in the communities served in whole or in part by MWRA.

MWRA is an independent public agency with the ability to raise revenues from customer communities, bond sales, and grants. In addition to its operating responsibility, MWRA was created to modernize the area’s water and sewer systems and clean up Boston Harbor. MWRA's long-term business plan emphasizes improvements in service and systems and includes aggressive performance targets for operating the water and wastewater systems and maintaining new and existing facilities. Parallel to MWRA's goal of carrying out its capital projects and operating programs is its goal of limiting rate increases to its customer communities. The need to achieve and maintain a balance between these two goals is a critical issue facing MWRA and is reflected each year in its proposed budget. Development of the Water and Wastewater System Master Plans are key components for implementation of MWRA’s long-term business plan. MWRA maintains an extensive web site at **www.mwra.com** that provides information on the development of the agency, organization of the Authority, rates and budget, water and sewer systems, customer communities, ongoing projects, etc.

1.02 Purpose of the Wastewater System Master Plan

MWRA’s Wastewater System Master Plan presents a long-term vision of the capital development needs of the wastewater system and the actions planned for the next forty years to meet those needs. The primary purpose of this Plan is to ensure that key staff from across the Authority engage in proactive planning to enhance system performance while minimizing long-term costs to MWRA ratepayers. The delivery of sewage collection, treatment and disposal service to a major region of the state (2.2 million sewer customers) represents an essential public service. It is MWRA’s responsibility to protect public health, promote environmental quality improvements, support a prosperous economy, maintain customer confidence, and minimize sewer charges. To fulfill this responsibility, significant expenditures for system rehabilitation and improvements will continue. The Wastewater System Master Plan identifies system/facility conditions, operational risks and capital project needs. The Master Plan accounts for all projects currently programmed in MWRA’s FY19 Capital Improvement Program (CIP), and additional projects recommended for consideration in future CIPs. Projects have been prioritized (see Section 1.07) and an implementation schedule recommended that corresponds with MWRA’s annual CIP development and 5-year CIP cap cycles.

Concurrent with development of the 2018 Wastewater System Master Plan, MWRA has also developed a companion 2018 Water System Master Plan. Preparation of a Master Plan (including periodic updates) was recommended by the MWRA Advisory Board to provide a more thorough context for developing, analyzing, and evaluating the annual CIP and is intended to serve as an important tool for future planning, budgeting and rate setting decisions.

1.03 Planning Approach and Time Frame

In its 33-year existence, MWRA has constructed billions of dollars of facilities to repair, replace, and modernize aging infrastructure. MWRA has completed the $3.8 billion Boston Harbor Project, has invested over $300 million in additional treatment and residuals facilities, and has invested over $600 million in upgrades to wastewater interceptors, pump stations, and headworks facilities. In addition, in December 2015, MWRA completed construction and start-up of the last of the 35 projects in its approved $910 million Long-Term Combined Sewer Overflow (CSO) Control Plan (LTCP), in compliance with the Federal Court Order. Pursuant to the Federal Court Order, MWRA commenced a post construction compliance monitoring and three-year performance assessment of its LTCP in January 2018 to demonstrate that it has achieved compliance with the levels of control ("including as to frequency of CSO activation and as to volume of discharge"). MWRA will complete the assessment and submit a report to EPA and DEP in December 2020.

The estimated replacement value of MWRA's wastewater system assets is over $6 billion. Having completed most of the large, mandated construction projects, MWRA has transitioned to the rehabilitation of those portions of the wastewater system that have not been replaced and to planning for the maintenance and asset protection of newer facilities.

For the 2018 Master Plan, MWRA has selected a 40-year planning period through FY58. The Master Plan focuses on projects programmed into the FY19 CIP and projects that are proposed to generate capital spending during the next two 5-year CIP cap cycles FY19-23 and FY24-28. Following these two 5-year periods, additional 10-year (FY29-38) and 20-year (FY39-58) planning periods are utilized. Estimates of project costs and schedules over the shorter term are expected to be more reliable than looking ahead to the out-years.

All projects have been prioritized on a scale from 1 to 5, with the following designations: 1-critical or under construction; 2-essential; 3-necessary; 4-important; and 5-desirable. A detailed list of Master Plan Priority Ratings for the Wastewater System is presented later in this Chapter in Section 1.07. Highest priority projects will resolve critical threats to public health and prevent imminent system failure resulting in significant service loss. High priority projects will improve system reliability and maintain effluent/residuals quality. Lower priority projects will optimize system performance, assure future capacity, and provide more efficient operation. Project ratings are assigned by MWRA senior managers in concert with Planning and Sustainability Department staff. All MWRA proposed projects will be further reviewed and priorities will be reconsidered during the annual CIP development process.

1.04 Organization of the Master Plan

The 2018 Wastewater System Master Plan is organized into Chapters of distinct topics and/or separate asset classes (such as Deer Island, Residuals, Headworks, etc.). Each chapter that recommends capital projects includes a summary section that provides an overview of major findings, recommendations, costs, and broad project schedules. The 2018 Water System Master Plan has been compiled in a separate volume using a consistent format. The Master Plan Executive Summary presents the combined programmed and recommended capital projects for both water and wastewater systems.

1.05 Periodic Updates

Development of MWRA's Master Plan is intended to be an ongoing process rather than a static document. The 2018 Wastewater System Master Plan is an update of the 2013 Wastewater Master Plan. The 2018 Master Plan presents a broad range of recommended projects, some critical (to be completed in the short-term), some lower priority (to be completed in the long-term). Changes in scope, details and scheduling of certain projects may be required over time to respond to emergencies, new regulations, emerging technologies, etc. Although the Master Plan will map out major expenditures for the wastewater system for many years, conditions change and flexibility is important. The Master Plan is intended to be reviewed annually as an integral component of MWRA's CIP development and will be revised periodically to reflect new initiatives and/or major changes in priorities. A complete Master Plan review/update is recommended to be performed no less than every five years.

1.06 MWRA Business Plan

Separate and distinct from the Master Plan, MWRA maintains and periodically updates its Business Plan. The MWRA Business Plan is a strategic roadmap that presents specific steps that the agency will undertake to continue to provide excellent quality drinking water; meet high environmental standards for wastewater effluent discharge; expand use of renewable energy in its facilities, as well as implement other sustainability practices; improve the capacity, performance, and reliability of its water and wastewater systems; promote investor and ratepayer confidence in Authority financial management; and manage its staff and support systems resources effectively. Many themes overlap between the Master Plan and the Business Plan, however, the intended uses and target audience are quite different. The Master Plan is a very detailed listing, explanation, and prioritization of both short and long-term projects that will impact MWRA's capital development needs. Alternatively, the Business Plan is a concise listing of MWRA goals over a relatively short, generally five year, timeframe. A bullet list of core and special initiatives to achieve each stated goal is included in a table format. The concise nature of the Business Plan makes it effective as both a communications document and a management tool.

1.07 Master Plan Priority Ratings for Wastewater System Projects

All projects in the Wastewater System Master Plan have been prioritized on a scale of 1 to 5. A detailed list of priority ratings is presented below. This same prioritization system is also used for new projects proposed in the annual CIP process via the Project Prioritization Assessment Worksheet, whether or not the new project was previously recommended in the Master Plan.

Priority One **Critical/Emergency** Risk moderate to high/Consequence very high

Projects which:

Resolve emergencies or critical threats to public health or worker health and safety

Prevent imminent failure of the system and significant loss of service

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Priority Two **Essential Projects** Risk variable/Consequences high

Projects which are essential to:

Critical facility assessment

Fix existing reliability or capacity problems during dry weather flow conditions

Reduce sanitary sewer overflows from the MWRA system

Address facilities in poor condition where the ability to provide uninterrupted service or adequate flow is compromised.

Upgrade or maintain emergency backup facilities in poor condition

Meet minimum hydraulic performance requirements and service needs

Implement MWRA’s approved CSO control plan

Maintain wastewater effluent and residuals quality

To comply with mandated legal, regulatory or statutory requirements

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Priority Three **Necessary Projects** Risk moderate to high/Consequence moderate to low

Projects which are necessary to:

Improve public health and worker safety

Restore the system's infrastructure where it is seriously deteriorated

Improve hydraulic performance

Significantly improve the effectiveness, efficiency, or reliability of system operations and service delivery including where appropriate, the ability to monitor the system

Maintain consumer confidence

To comply with other legal, regulatory or statutory requirements

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Priority Four **Important Projects** Risk moderate/Consequences low

Projects which are important to:

Maintain the integrity of the system's infrastructure

Produce significant cost savings or revenue gains for MWRA

Monitor system needs and plan appropriate longer-term responses

Provide acceptable working conditions at field sites and at maintenance support facilities

Implement the regional I/I plan

Priority Five **Desirable Projects** Risk/Consequence both low

Projects which are desirable because they would:

Yield worthwhile cost savings, revenue gains, or efficiency improvements for MWRA

Protect the long term value and usefulness of system assets

Solve future problems and conditions which are expected to arise in the latter half of the planning period

Be beneficial towards the improved operation of a local system

CHAPTER 2
MISSION, GOALS AND OBJECTIVES

2.01 MWRA Mission

MWRA's mission is to provide reliable, cost-effective, high-quality water and sewer services that protect public health, promote environmental stewardship, maintain customer confidence, and support a prosperous economy.

MWRA's mission specific to sewage collection, treatment and disposal is established in the Enabling Act, including: efficient and economical operation; repair, replacement, rehabilitation, modernization, and extension of the system; system-wide planning and professional and productive management; reduction of infiltration and inflow in the service area; financing capital and operating expenses on a self-sustaining basis; and establishment and administration of equitable charges.

2.02 Wastewater Goals and Objectives

To set priorities and to guide the planning process, the mission has been translated into the following goals for the wastewater system:

Goal 1: Provide reliable and safe sewer service.

Goal 2: Provide wastewater collection and treatment, pretreatment, residual disposal, and combined sewer overflow control in compliance with state and federal regulations.

Goal 3: Assure appropriate future wastewater collection and treatment capacity.

Goal 4: Manage regional sewer service efficiently and cost-effectively.

For each goal, objectives have been developed to clarify how each goal will be met and to help prioritize the commitment of resources efficiently. The objectives express the philosophy and emphasis that is to be reflected in program planning and project implementation and identify where efforts should be focused and what approaches should be followed in assessing conditions, developing solutions, implementing improvements and meeting appropriate performance standards. These objectives reflect the needs and priorities of the existing wastewater system, as well as the need to plan and adapt to future priorities driven by member communities, regulatory change, or external events.

Individual projects identified during the master planning process have been prioritized. A recommended implementation timetable has been developed to correspond with MWRA's CIP development cycle, with an eye toward the Board's establishment of a spending cap for the FY19-23 period. MWRA's annual CIP development process will refine costs, schedules, cash-flows, and priorities. Ultimately, project scheduling in the CIP will need to balance: (1) system needs, (2) financial and rates implications, and (3) project staffing considerations.

Goal 1: Provide reliable and safe sewer service

Dependable, uninterrupted sewage collection, transport, and disposal is an essential public service that is integral to the health, safety, and economic well being of the region's population. Therefore, MWRA's goal is to operate and maintain the sewer system so that service interruption is kept to an absolute minimum, while customer and workforce safety is maximized.

Objectives

1) Maintain system capacity: Operate and maintain the sewer system to provide essential day-to-day sewage collection, pumping and disposal.

2) Ensure facilities meet condition standards: Identify and rehabilitate or replace facilities and key assets that are in poor condition, are hydraulically deficient, or failing to meet desired performance levels. Identify and prioritize key points within the sewer system where failure or shutdown could lead to an unacceptable disruption in service.

3) Use effective planning to minimize risks: Implement and improve practices to inspect, monitor, and maintain the system and replace key equipment in an efficient way to reduce the risk of service disruptions, such as: pipeline blockages, equipment failure, etc. Plan, practice, and implement effective emergency operations procedures to minimize potential public health impacts.

4) Monitor system performance: Implement and enhance measures for continual monitoring of key system performance parameters.

5) Support work force safety: Provide appropriate workplace and field site conditions and equip crews with the tools, materials, information and training necessary to carry out operational, maintenance, and repair duties safely. Prevent the introduction of hazardous materials into the sanitary sewer system to protect worker health and safety during operation and maintenance activities.

6) Support customer communities: Provide technical and financial assistance to customer communities and coordinate emergency operations procedures with local officials to minimize potential public health impacts, including sanitary sewer overflows (SSOs), and basement backups.

Goal 2: Provide wastewater collection and treatment, pretreatment, residual disposal, and combined sewer overflow control in compliance with state and federal regulations

Since its inception, MWRA has invested significant funds into sewer system relief, wastewater treatment, and combined sewer overflow (CSO) controls to promote environmental quality improvements and meet regulatory requirements. Many capital improvements have been completed and MWRA resources are now being focused on proper operation, maintenance and repair of existing facilities, so that environmental quality improvements are not compromised.

Objectives

1) Provide effective wastewater treatment: Discharge treatment plant effluent that meets, or cost-effectively exceeds, the quality standards set by federal and state regulations and National Pollutant Discharge Elimination System (NPDES) Permits. Monitor emerging trends in treatment technologies.

2) Implement effective federal, state, and local pretreatment standards: As a Publicly Owned Treatment Works (POTW) that receives wastewater from sources subject to National Pretreatment Standards and other industrial users subject to the General Pretreatment Regulations for Existing and New Sources of Pollution (40 CFR Part 403), MWRA is required to operate a pretreatment program (per the regulation) to:
    - Prevent the introduction of pollutants into the sanitary sewer system which will interfere with the operation of the sewer system, including worker health and safety during operation and maintenance activities, and which will interfere with MWRA's use or disposal of residuals from the treatment of sanitary sewerage;
    - To prevent the introduction of pollutants which will pass through the treatment works or otherwise be incompatible with the treatment works; and,
    - To improve the opportunities to recycle and reclaim municipal and industrial wastewaters and residuals.

3) Provide effective residuals processing and disposal: Process and dispose of wastewater residuals cost-effectively using methods that meet the quality standards set by federal and state regulations.

4) Provide effective wastewater collection and CSO control: Manage the sewer system in order to provide effective and reasonable wastewater collection service to member communities, comply with the requirements of NPDES permits, maximize wastewater flow to the treatment plants to minimize CSOs and sanitary sewer overflows (SSOs), and minimize the impact of sewer odors. Implement the approved Long-Term CSO Control Plan and manage the sewer system in accordance with MWRA's Nine Minimum Controls compliance documentation.

5) Provide effective monitoring and reporting of environmental impacts: Implement the Ambient Monitoring Plan for the MWRA Effluent Outfall and monitor CSO impacts as required under MWRA's NPDES permit and the CSO variances for the Charles River and Alewife Brook/Mystic River.

6) Track changes in wastewater legislation and regulations: Track and evaluate modifications to water quality criteria, wastewater treatment, pretreatment, CSO, and sewer system legislation and regulations. Actively represent MWRA's interests in the development and implementation of environmental regulations and policies.

7) Promote member community and customer confidence: Promote member community and customer confidence in MWRA's ability to provide environmentally sound sewage service and effectively monitor and report environmental impacts. Promote greater awareness and educate the community, businesses, and households on how to reduce the introduction of toxic contaminants and hazardous materials into the wastewater system to improve effluent and residual quality.

Goal 3: Assure appropriate future wastewater collection and treatment capacity

System-wide master planning is essential to efficiently repair and upgrade system infrastructure. MWRA must develop appropriate planning tools, design criteria, and performance standards, and work cooperatively with member communities to assure appropriate future system capacity.

Objectives

1) Provide system-wide planning: Periodically update the Wastewater System Master Plan to identify baseline system needs and realistic future capacity requirements. The Master Plan will help prioritize and schedule capital projects based on need and affordability. Implement facilities planning for priority projects identified through the master planning and CIP processes to assure future capacity.

2) Update and refine mapping and modeling tools: Use up-to-date modeling and mapping tools to facilitate system analyses and decision-making. Support records management activities that promote the documentation of accurate, comprehensive, and up to date information that is accessible to appropriate staff.

3) Develop appropriate performance standards: Work cooperatively with member communities to develop reasonable and appropriate design criteria and performance standards to evaluate existing and future system capacity needs.

4) Monitor changes in the collection system: Track and review proposed community system changes, development projects, and other activities that may affect sewer system flows. Consider requests for system expansion in the context of current and anticipated system capacity and within the requirements of MWRA's Enabling Act and MWRA policies. Assess impacts and promote mitigation measures in order to preserve long-term collection, transport, and treatment performance consistent with MWRA's mission.

5) Implement Regional I/I Reduction Plan: Work cooperatively with member communities and continue to implement the regional Infiltration and Inflow (I/I) reduction plan to reduce infiltration and inflow entering the MWRA-owned and community-owned collection systems. The reduction of I/I maintains sewer capacity for transport of sanitary flow.

Goal 4: Manage regional sewer service efficiently and cost-effectively

As a public agency, an important portion of MWRA's mission is to manage the sewer system efficiently and cost-effectively and to minimize sewer charges. Careful attention will be given to efficiency, sustainability of resources, and cost-effectiveness in all activities and decisions to provide the greatest value to ratepayers while meeting appropriate standards of service.

Objectives

1) Maximize efficiency and minimize costs: Operate and maintain the wastewater collection and treatment system to achieve efficient and economical system performance. Emphasize lower-cost preventive maintenance actions to avoid costlier future expenditures for repair or replacement. Continue to implement reliability-centered maintenance. Where appropriate, implement preventive measures that will extend asset life.

2) Implement sustainable and energy efficient practices: Continue to consider opportunities to reduce the energy used to operate the MWRA wastewater system; purchase renewable power where appropriate; and, continue to develop solar, wind and hydroelectric facilities at locations within the system, as feasible. Also, continue to improve the opportunities to recycle and reclaim municipal and industrial wastewaters and residuals.

3) Maintain and enhance measurement and monitoring technologies: Continue to support measurement and monitoring technologies, including Supervisory Control and Data Acquisition (SCADA), to facilitate accurate and reliable sewer rate basis data and monitoring of flow conditions for the purposes of daily and emergency operations, CSO and SSO control, hydraulic modeling, and planning analyses. Review new technologies and implement system upgrades, as appropriate, for improved system monitoring and control that will yield benefits in terms of operational efficiency, flow control and data accuracy.

4) Support work force productivity: Support the productivity of the work force by providing appropriate workplace and field site conditions and equip crews with the tools, materials, training, and information necessary to carry out operational, maintenance, and repair duties efficiently and cost effectively. Move forward with MWRA succession planning to assure continuity of operations.

5) Optimize system operations: In designing long-term improvements, look for opportunities to optimize operation and maintenance of the system.

CHAPTER 3
HISTORY AND BACKGROUND

3.01 Chapter Summary

This chapter provides background information including a historical perspective of wastewater collection and treatment, a summary of the development and overview of the MWRA regional sewer system, a synopsis of the replacement asset value of MWRA's wastewater infrastructure, an outline of MWRA's management structure, and a timeline of MWRA accomplishments.

3.02 History of Wastewater Collection and Treatment

Modern wastewater collection practices were initiated in Hamburg, Germany and London, England during the 1840s. In the early 1800s, residents of Metropolitan Boston dumped their sewage waste into local streams and Boston Harbor. Due to growing public health problems associated with this practice, Massachusetts created a Board of Health in 1869 to investigate the consequences of discharging sewage into local waterways. In 1876, the Legislature authorized the construction of a system to collect wastewater from 18 communities and dispose of it away from drinking water supplies. The Boston Main Drainage System, built between 1877 and 1884, used a series of tunnels, interceptors, and pumping stations to collect and convey wastewater from the greater Boston area to storage tanks on Moon Island before being released on the outgoing tide into Boston Harbor. In 1889, the Metropolitan Sewerage District was created to oversee the regional sewer collection system. In 1898, the Neponset Valley Sewer System was completed and connected to Moon Island via the Boston Main Drainage System. In 1904, the South Sewerage System was completed with a separate discharge to Boston Harbor at Nut Island. The South Sewerage System conveyed wastewater from the Charles River Watershed, the Neponset River Watershed and areas south of the Boston Main Drainage System to Nut Island. The collection system operated by the Metropolitan Sewerage District became recognized as one of the best in the country, though it provided no treatment, but merely collected wastewater and discharged it into Boston Harbor.

In 1919, the Metropolitan District Commission (MDC) was created to manage Parks, Park Engineering, Waterworks, and Sewerage. The MDC assumed jurisdiction of both the North and South Sewerage Systems. During this period, sewage pollution forced the closure of several harbor clam beds. By 1933, due to worsening pollution, all shellfish taken from the harbor required purification. In 1940, planners recommended the construction of wastewater treatment plants at each of the harbor's three raw sewage discharge locations: Moon Island, Nut Island and Deer Island.

A primary wastewater treatment plant was constructed on Nut Island in 1952 to treat discharge from the South Sewerage System and, in 1968, a primary wastewater treatment plant was constructed on Deer Island to treat flows from the Boston Main Drainage (North) System. The untreated Moon Island discharge was restricted to emergency use only. The Deer and Nut Island Treatment Plants combined received average wastewater flows between 300 and 400 million gallons per day (mgd) and peak flows to 900 mgd.

Growing public awareness and concern for controlling water pollution led to enactment of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The 1972 Federal Amendments, as well as updated state laws, mandated primary and secondary treatment for all municipal sewer systems, effectively taking the option for lesser treatment levels away from the states. MDC's Deer and Nut Island Treatment Plants did not comply with these new requirements.

As additionally amended in 1977, the Federal Water Pollution Control Act became commonly known as the Clean Water Act. The Act established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave the United States Environmental Protection Agency (EPA) the authority to implement pollution control programs such as setting wastewater standards for industry and water quality standards for surface waters. The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It also funded the construction of wastewater treatment plants under the construction grants program and recognized the need for planning to address the critical problems posed by nonpoint source pollution.

Subsequent enactments modified some of the earlier Clean Water Act provisions. Revisions in 1981 streamlined the municipal construction grants process, improving the capabilities of treatment plants built under the program. Changes in 1987 phased out the construction grants program, replacing it with the State Water Pollution Control Revolving Fund, more commonly known as the Clean Water State Revolving Fund. This revised funding strategy addressed water quality needs by building on EPA-State partnerships.

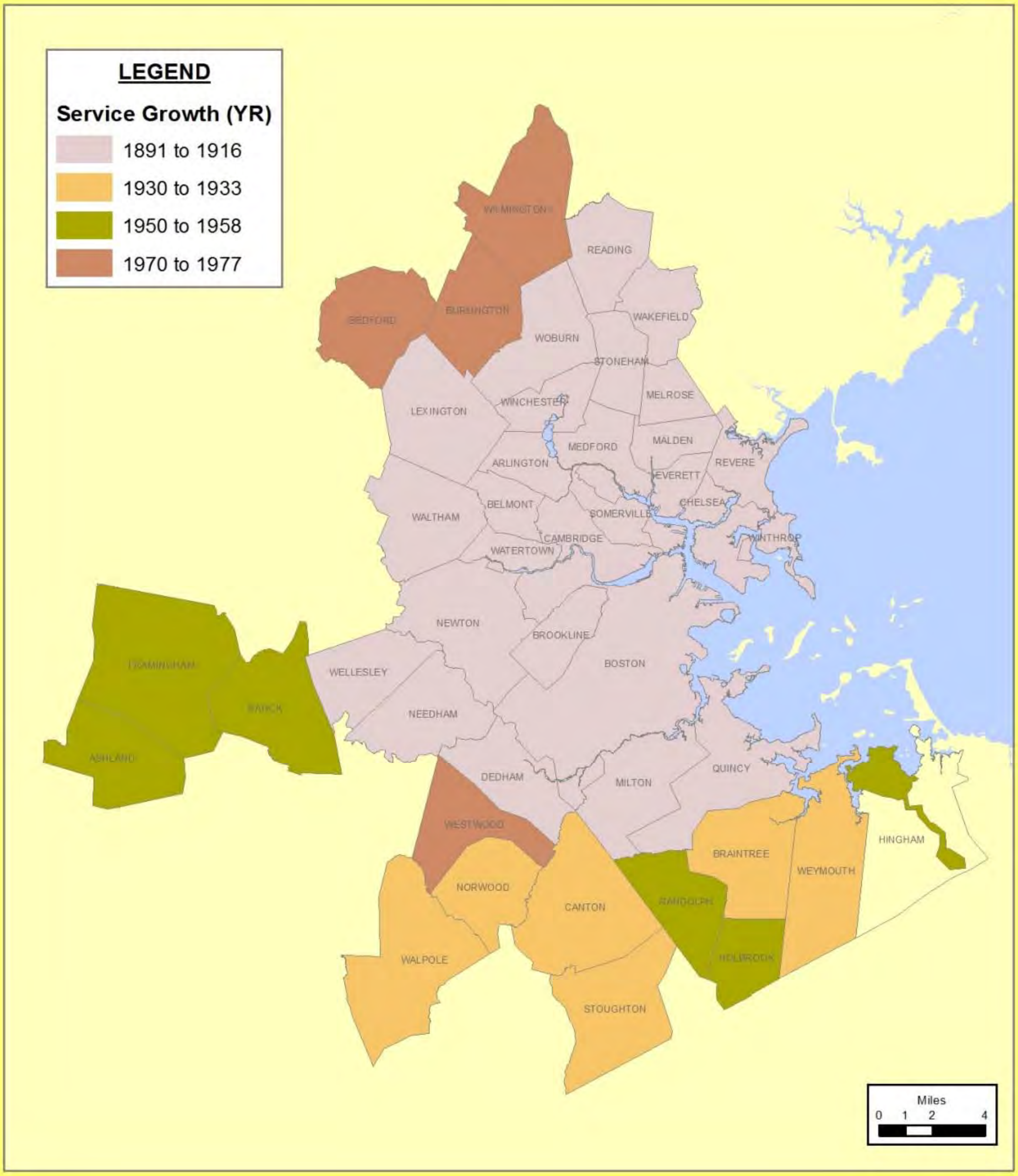
Over the years, many other laws have changed parts of the Clean Water Act. See **www.epa.gov/lawsregs/laws/cwa.html** for more information. Chapter 4 of the Wastewater System Master Plan discusses the regulatory framework affecting MWRA's wastewater system and potential regulatory changes and long-term issues that may impact MWRA.

3.03 Growth of the MWRA Sewer Service Area

Growth of the sewer service area is shown in Figure 3-1. A large portion of the metropolitan Boston sewer system was built from 1891 through 1933. In the 1950s, sewer extensions were made to serve the Hingham North Sewer District, Holbrook and Randolph, as well as Ashland, Framingham, and Natick. During the 1970s, additional sewer extensions were built to serve Bedford, Burlington, Wilmington and Westwood.

MWRA's sewer service area today remains essentially the same as that following the expansion from the 1970s. MWRA serves a total of 43 member sewer communities; of these, 42 entire communities are within the service area and only Hingham (North Sewer District) is partially served by MWRA. Any further expansion of the MWRA sewer service area is subject to MWRA's sewer expansion policies as detailed in Section 3.06 of this Chapter.

FIGURE 3-1
Growth Of The Sewer Service Area



3.04 Transition from MDC to MWRA

By the early 1970s, MDC's Nut Island and Deer Island Treatment Plants were obsolete, in disrepair and often unable to provide an adequate level of treatment. The inability of the system to meet increased wastewater flows, combined with a less advanced level of treatment than required by the Clean Water Act, was a major cause of harbor pollution. In order to provide effective sewer service, the MDC needed the ability to raise sufficient revenues to hire adequate staff, properly maintain facilities and equipment, finance major capital programs, and develop operating budgets that were responsive to existing and future needs. Under the system that existed, it was impossible for MDC to achieve these goals.

In 1982, the City of Quincy sued the MDC for violating the Massachusetts Clean Water Act. Judge Paul Garrity, who presided over the case, ruled that the MDC's practice of releasing inadequately treated wastewater into Boston Harbor violated the state's Clean Water Act. In 1983, the Conservation Law Foundation sued MDC and EPA in Federal Court. In 1984, legislation was enacted to create the Massachusetts Water Resources Authority (MWRA), an independent agency with the ability to raise revenues from ratepayers, bond sales and grants. MWRA's mission included: modernize wastewater treatment to clean up Boston Harbor, repair and upgrade the collection system, increase staff to improve operations and maintenance, and plan for future system needs. In 1985, the United States on behalf of the EPA brought an action against the Commonwealth of Massachusetts, MDC, MWRA and Boston Water and Sewer Commission (BWSC) for Clean Water Act violations. The federal cases were consolidated into the Boston Harbor Case (D. Mass. C.A. No. 85-0489) and the state case was dismissed. The City of Quincy and the Town of Winthrop were allowed to intervene. In the Boston Harbor Case, Judge A. David Mazzone found MDC liable for Clean Water Act violations and also found MWRA liable as a successor in interest to MDC. As part of the Boston Harbor Case, MWRA was required to undertake certain corrective actions to meet wastewater treatment, effluent discharge and combined sewer overflow (CSO) requirements. MWRA responded by instituting an aggressive schedule to plan, construct and operate a new Deer Island Treatment Plant and regional CSO control facilities to comply with the Clean Water Act. The schedule was incorporated into a court order that has dictated many of the Authority's decisions. In 2000, MWRA completed the last significant milestone of the Boston Harbor Project which related to improvements to MWRA's Deer Island Wastewater Treatment Plant and related facilities. The overall cost of the Boston Harbor Project was approximately $3.8 billion. In 2015, MWRA completed construction of the last of the 35 projects in its CSO Long-Term Control Plan, in compliance with the Federal Court Order, at a total cost of $910 million. Currently, there are only two Court-Ordered milestones remaining which relate to a three-year post CSO construction performance assessment which commenced in January 2018 and is scheduled to be completed in December 2020.

A time line of major MWRA accomplishments for the wastewater system is presented in Section 3.09, at the end of this Chapter.

3.05 Overview of the MWRA Regional Sewer System

MWRA's Enabling Act (Section 8 (c)) requires the Authority to provide main sewer services for the area consisting of the following political subdivisions: Arlington, Ashland, Bedford, Belmont, Boston, Braintree, Brookline, Burlington, Cambridge, Canton, Chelsea, Dedham, Everett, Framingham, the North Sewer District of Hingham, Holbrook, Lexington, Malden, Medford, Melrose, Milton, Natick, Needham, Newton, Norwood, Quincy, Randolph, Reading, Revere, Somerville, Stoneham, Stoughton, Wakefield, Walpole, Waltham, Watertown, Wellesley, Westwood, Weymouth, Wilmington, Winchester, Winthrop and Woburn. A link to MWRA's Enabling Act (Chapter 372 of the Acts of 1984) is available on: **www.mwra.com**. To serve the 43 customer communities in metropolitan Boston, MWRA maintains a regional wastewater collection system, a complex network of conduits and facilities that is strongly influenced by seasonal and wet weather conditions. The long-term (29 years of data 1989 - 2017) system average daily flow is approximately 353 mgd (about 300 mgd for last 5 years 2013 - 2017), minimum dry weather flows drop as low as 220 mgd, peak wet weather capacity to the Deer Island Treatment Plant is 1,270 mgd with additional system capacity available at CSO outfalls. The MWRA collection system includes a network of about 274 miles of sewer pipelines (tunnels, gravity sewers, force mains, siphons, and outfalls); one screening facility; 13 pump stations; six CSO treatment/storage facilities; and four remote headworks facilities.

Member communities within the regional collection system are subject to MWRA's Sewer Use Regulations (360 CMR 10.000) which govern the discharge of sewage, drainage, substances, and wastes into any sewer under the control of MWRA, or into any sewer tributary thereto. MWRA's Sewer Use Regulations are intended to protect the public health, safety and welfare, and the environment, and ensure proper and safe operation of the Authority's wastewater treatment facilities by regulating the direct and indirect discharge of wastewater and pollutants to the MWRA's sewerage system.

The Deer Island Treatment Plant is the centerpiece of MWRA's $3.8 billion program to protect Boston Harbor against pollution. The plant treats wastewater in compliance with all federal and state environmental standards and is subject to a National Pollutant Discharge Elimination System (NPDES) permit issued for the plant by EPA and MassDEP. A 9.4-mile, 24-foot-diameter outfall tunnel transports treated effluent into the 100-foot deep waters of Massachusetts Bay. Extensive monitoring ensures that the environment is properly protected. Key components of the Deer Island Treatment Plant include: influent pumps, primary treatment, secondary treatment, sludge digesters, odor control, disinfection, dechlorination, effluent discharge, off-site power supply, and onsite power generation.

When it began operating in 1991, MWRA's sludge-to-fertilizer plant made history by ending sludge discharges into Boston Harbor. The sludge-to-fertilizer plant, located near Fore River in Quincy, recycles organic solids (residuals) produced from the wastewater treatment process into fertilizer. The product is suitable for landscaping, gardening and large-scale agriculture. Using rotating, high-temperature dryers, the plant produces a small, hard granule that is approximately 60 percent organic matter. The pellets contain several important nutrients, such as nitrogen, phosphorus, calcium, sulfur and iron, and because the nitrogen in the fertilizer is in an organic form, it feeds plants slowly over time and minimizes the risk of nitrate pollution.

In addition to operation of regional wastewater facilities for metropolitan Boston, MWRA assumed formal operational responsibility for the Clinton Advanced Wastewater Treatment Plant (AWWTP) in 1987. The plant provides advanced wastewater treatment services to the Town of Clinton and the Lancaster Sewer District. Completed in 1992, MWRA constructed new primary, secondary, and advanced treatment facilities that incorporate rehabilitated portions of the existing plant with new construction. The facilities meet all federal and state environmental standards and the NPDES permit issued by EPA and MassDEP. Key components of the Clinton AWWTP include: preliminary treatment, influent pumps, primary treatment, secondary treatment, advanced nutrient removal, sludge digesters, off-site power supply, on-site power generation using digester gas, odor control, disinfection, and dechlorination. The plant discharges treated effluent into the South Branch of the Nashua River in accordance with the discharge limits of the facility's NPDES permit. Residual materials are pressed and transported to an MWRA-owned landfill for disposal.

3.06 MWRA Sewer Expansion Policies

MWRA has detailed policies that address the procedures and criteria for handling requests for services to locations outside MWRA's water or sewer service areas. MWRA must approve all extensions of service to entities outside the existing service area (see list of MWRA member sewer communities in Section 3.05) pursuant to the applicable policies noted below. This is the case even when an entity outside the service area is not directly connected to an MWRA-owned interceptor, but instead to a community-owned local sewer that is part of the MWRA service area.

At the present time, the demand for sewer expansion to communities outside the service area is low. None of the communities immediately adjacent to the existing sewer service area have expressed strong interest in becoming MWRA member sewer communities.

MWRA’s sewer expansion policies are as follows:

- **OP.04, Sewer Connections Serving Property Partially Located in a Non-MWRA Community.** This policy applies to persons seeking MWRA sewer services for buildings and structures partially within and partially outside MWRA's service area. It is also known as the "Sewer Straddle" policy.

- **OP.11, Admission of New Community to MWRA Sewer System and Other Requests for Sewer Service to Locations Outside MWRA Sewer Service Area.** This policy applies to communities seeking admission to the MWRA sewer system and to all parties seeking sewer services for locations outside the MWRA service area.

3.07 Wastewater System Infrastructure Replacement Asset Value

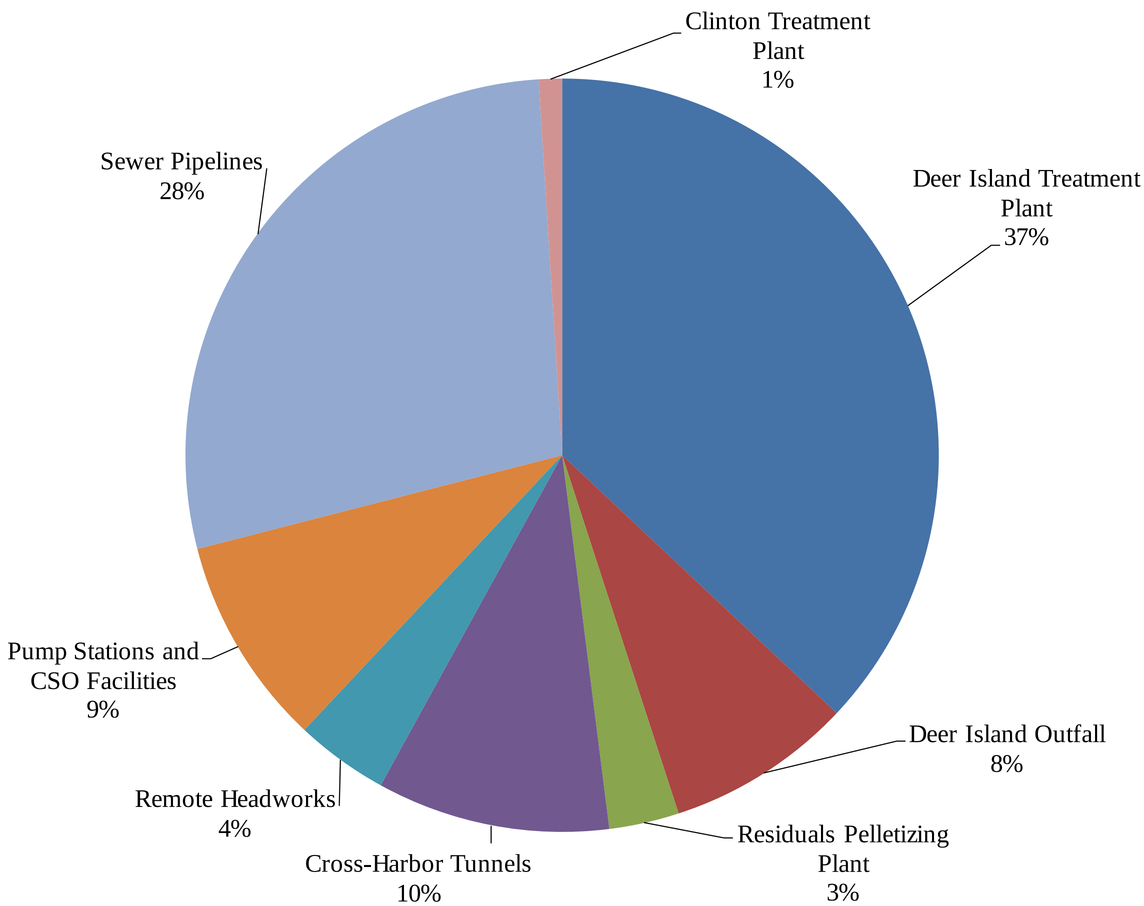
MWRA's wastewater infrastructure is a network of facilities, structures, sewers, tunnels, and outfalls. In preparation of the 2006 Master Plan, staff developed a replacement asset value (cost valuation) of MWRA's infrastructure using MWRA-specific appraisal data and actual MWRA project cost information. For the 2013 and 2018 updates of the Master Plan, the 2006 replacement asset value analysis was reused (in 2006 dollars) with only minor revisions for new facilities added between 2007 and 2017.

MWRA's wastewater infrastructure has an estimated replacement asset value of $6.76 billion, as shown in Table 3-1 and Figure 3-2. The revisions from the 2006 Master Plan replacement asset value analysis were made in four of the asset class categories in Table 3-1. First, an increase of $80 million (change from $190 million to $270 million) in the Remote Headworks category was made to account for the upgrades at the Chelsea Creek Headworks. Second, an increase of $270 million (change from $370 million to $640 million) in the Pump Stations and CSO Facilities category was made to account for the following new facilities: Union Park CSO Facility, BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement Pump Station, and North Dorchester Bay CSO Storage and Pump Facilities, as well as significant upgrades at Alewife Brook Pump Station. Third, an increase of $150 million (change from $1750 million to $1900 million) in the Sewer Pipelines category was made to account for the following new pipelines: Cummingsville Replacement Sewer, Upper Neponset Valley Sewer Replacement, Cottage Farm CSO Brookline Connection pipeline, and East Boston Branch Sewer Relief. Fourth, an increase of $10 million (change from $50 million to $60 million) in the Clinton Treatment Plant category was made to account for the upgrades at the Plant. The replacement asset value estimates detailed in this Section are used in various Chapters of the Master Plan to help estimate reinvestment needs.

TABLE 3-1
Wastewater System Infrastructure Replacement Asset Value

Asset Class	Replacement Asset Value		% of Total
Deer Island Treatment Plant	$2,500	million	37%
Deer Island Outfall	$530	million	8%
Residuals Pelletizing Plant	$200	million	3%
Cross-Harbor Tunnels	$660	million	10%
Remote Headworks	$270	million	4%
Pump Stations and CSO Facilities	$640	million	9%
Sewer Pipelines	$1,900	million	28%
Clinton Treatment Plant	$60	million	1%
TOTAL	**$6,760**	**million**	**100%**

FIGURE 3-2
Wastewater System Infrastructure Replacement Asset Value Total $6.76 Billion



3.08 Outline of MWRA's Management Structure

MWRA is governed by an 11-member Board of Directors. Eight of the 11 members of MWRA's Board of Directors are directly or indirectly appointed by elected officials in MWRA's customer communities. Three members are appointed by the Governor.

MWRA's Executive Director is responsible for implementing MWRA programs, policies and procedures at the direction of the Board of Directors. Five Divisions carry out MWRA's mission: the Executive Office under the direction of the Executive Director, Operations under the direction of the Chief Operating Officer, Administration under the direction of the Director of Administration, Finance under the direction of the Director of Finance, and Law under the direction of the General Counsel. MWRA's overall staffing level as of September 2018 is about 1,150 employees.

Much of the work described in the Wastewater System Master Plan is carried out by the Operations Division under a variety of interrelated departments. Additional information on MWRA's structure, administration, and staffing can be found on the MWRA web site at **www.mwra.com**.

3.09 Time Line of MWRA Wastewater System Accomplishments

1985

- MWRA assumed control of the wastewater system from MDC

1986

- Because the level of wastewater treatment inherited by MWRA was below federal standards, Federal Judge David A. Mazzone defined the court ordered schedule for the Boston Harbor Project
- Sewerage Division Management Services project for initial engineering design/construction advice completed
- Nut Island Treatment Plant (NITP) Immediate Upgrades completed
- Southwest Corridor CSO Project completed

1987

- Purchase of Fore River Shipyard in Quincy as staging area for Boston Harbor Project and site for Residuals Pelletizing Facility
- Equipment Upgrades at Remote Headworks Facilities completed
- Hayes Pump Station (Wakefield) completed
- Reading Extension Relief Sewer completed
- Saint Mary Street CSO Modifications completed

1988

- Deer Island Wastewater Treatment Plant (DITP) groundbreaking
- DITP Electrical Equipment Upgrade completed
- DITP Sludge Thickeners Rebuilding completed

1989

- Both DITP and NITP halted discharge of more than 10,000 gallons per day of floatable pollution (grease, oil, and plastics) known as scum
- DITP Sedimentation Tank Improvements completed
- DITP Chlorination Facilities Rehabilitation completed
- Fox Point Gravity CSO Facility (Dorchester) completed
- Somerville Marginal Gravity CSO Facility Rehabilitation completed
- Belle Isle Siphon Rehabilitation completed

1990

- DITP Cross-harbor Power Cable installed
- Chelsea Screen House completed
- Comprehensive Safety Action Management Program established

1991

- DITP Pump and Power Station Upgrades completed
- Commercial Point Gravity CSO Facility (Dorchester) completed

1992

- Residuals Pelletizing Facility (Quincy) Phase 1 completed allowing daily sludge discharges into Boston Harbor to end
- Clinton Advanced Wastewater Treatment Plant completed
- DITP and NITP Intermediate Upgrades completed
- Hingham Pump Station Replacement completed
- Initial Environmental Studies of Harbor Waster Quality completed

1993

- DeLauri Pump Station (Charlestown) completed
- Caruso Pump Station (East Boston) completed
- System-wide Wastewater Metering System completed
- MWRA initiated the I/I Local Financial Assistance Program to provide grant/loan funding for member community sewer projects

1994

- DITP Primary Treatment Components completed
- Cottage Farm CSO Ventilation System Repairs completed

1995

- Wellesley Extension Replacement Sewer completed
- New Neponset Valley Sewer Pump Station (Canton) completed
- Alewife Brook Pump Station (Somerville) Rehabilitation completed
- Flow-based Sewer Rate Methodology implemented

1996

- New Neponset Valley Relief Sewer completed
- Somerville Baffle Manhole CSO Separation Project completed

1997

- DITP First Phase of Secondary Treatment completed allowing the plant to meet the requirements of the Federal Clean Water Act for the first time
- DITP Outfall Repair completed
- Sewerage Division Plan completed

1998

- Nut Island Headworks and Inter-Island Tunnel connecting the South Collection System flows to DITP began operation ending discharges from the Nut Island Treatment Plant
- DITP Second Battery of Secondary Treatment completed
- Approval received for CSO Facilities Plan and Environmental Impact Report

1999

- Remote Headworks Facilities Additional Upgrades completed
- Hough’s Neck Pump Station (Quincy) Replacement completed
- North Metropolitan Trunk Sewer Rehabilitation completed
- Public Access at Nut Island opened

2000

- DITP 9.4 mile Outfall Tunnel completed moving effluent discharge from the confined waters of Boston Harbor to the deep waters of Massachusetts Bay
- DITP Third and Final Battery of Secondary Treatment completed
- Prison Point Pump Station and Pumped CSO Facility (Cambridge) Upgrade completed
- Constitution Beach CSO Treatment Facility (East Boston) decommissioned
- Closing of CSO Outfalls MWR021 and MWR022 on Charles River Esplanade completed
- Hydraulic Relief Projects at CSO Outfalls CAM005 and BOS017 completed
- CSO Outfall CHE008 Repairs completed

2001

- Boston Harbor Project completed
- Residuals Pelletizing Facility (Quincy) Phase 2 Expansion completed
- 15-year Contract for Residuals Operations and Marketing awarded

- CSO Facilities Upgrades completed at Commercial Point, Cottage Farm, Fox Point, Prison Point, and Somerville Marginal Facilities

2002

- Boston Harbor Project Performance Certification completed
- West Roxbury Tunnel (Sewer Sections 637 and 638) Repairs including the New Haven Street Drop Chamber completed
- MWRA Maintenance and Office Facility in Chelsea opened
- Public Access at Deer Island opened
- Chelsea Trunk Sewer Replacement and Chelsea Branch Sewer Relief CSO Projects completed
- Neponset River CSO Sewer Separation Project completed
- Constitution Beach CSO Sewer Separation Project completed
- CSO Floatables Control for BWSC Project completed

2003

- Quincy Pump Station completed
- Squantum Pump Station (Quincy) completed

2004

- Framingham Extension Relief Sewer and Framingham Pump Station completed
- Wastewater System GIS Mapping Project completed

2005

- Intermediate Pump Station (Weymouth) completed
- Wastewater Metering System Equipment Replacement Project completed

2006

- Judge Richard G. Stearns ruled to amend the CSO Control Program schedule with respect to the Charles, Alewife, South Boston, and East Boston basins largely defining CSO Control Plan spending through 2020
- DITP Dual Fuel Engine Project completed
- Cummingsville Sewer Replacement Project completed
- Stony Brook Sewer CSO Separation Project completed
- South Dorchester Bay CSO Sewer Separation Project completed
- Pleasure Bay Storm Drain CSO Improvements Project completed
- Fort Point Channel CSO Sewer Separation Project completed
- First Version of 40-year Wastewater System Master Plan completed

2007

- Union Park CSO Detention/Treatment Facility (South End) completed
- CSO Plan Floatables Control and Outfall Closings Projects completed
- BOS 019 CSO Storage Conduit (Charlestown) completed
- Clinton AWWTP Permanent Standby Generator Project completed

2008

- Fox Point Gravity CSO Facility (Dorchester) decommissioned
- Prison Point Pump Station and Pumped CSO Facility (Cambridge) Optimization Project completed
- CSO Floatables Control for Cambridge Project completed
- DITP Optimization Projects completed
- First Roof-Mounted Solar Photovoltaic System (100-kW) at DITP completed

- Upper Neponset Valley Sewer Replacement Project completed
- Cummingsville Replacement Sewer Project completed
- Rehabilitation of Sewer Sections 80, 83, and 160 completed
- Clinton AWWTP Soda Ash Replacement Project completed

2009

- Cottage Farm CSO Facility Brookline Connection and Inflow Controls Project completed
- Morrissey Boulevard Storm Drain CSO Improvement Project completed
- Two Wind Turbines (600-kW each) at DITP completed
- Wastewater Central Monitoring Project completed

2010

- Braintree-Weymouth Relief Facilities including Braintree-Weymouth Replacement Pump Station (Quincy) completed
- Bulfinch Triangle CSO Sewer Separation Project completed
- East Boston Branch CSO Sewer Relief Project completed
- Interceptor Connection Relief and Floatables Control at CSO Outfalls CAM002 and CAM401B and Floatables Control at CSO Outfall CAM001 completed
- Fort Point Channel CSO Sewer Separation Project completed
- Second Roof-Mounted Solar Photovoltaic System (180-kW) at DITP completed
- DITP Grit Air Handler Replacements completed
- Melrose Sewer (Melrose Street) Interconnection completed

2011

- North Dorchester Bay CSO Storage and Pump Facilities completed
- Charles River CSO Controls Project completed
- CSO Outfall CAM400 Common Manhole Separation completed
- Somerville Marginal CSO Facility Influent Gate Repair completed
- Wind Turbine (1.5 MW) at DeLauri Pump Station (Charlestown) completed
- DITP Electrical Equipment Upgrade (#3) completed
- DITP Heat Loop Pipe Replacement completed
- DITP Steam Turbine Generator System Modifications completed
- Rehabilitation of Sewer Section 624 (Weymouth) completed

2012

- DITP Primary and Secondary Clarifier Rehabilitation completed
- DITP Gravity Thickener Improvements completed
- DITP North Main Pump Station Motor Control Center Replacement completed
- DITP Central Laboratory Upgrades completed
- Reserve Channel Sewer Separation BWSC CSO Contract 3A completed
- Rehabilitation of Sewer Section 156 (Everett) completed

2013

- Clinton AWWTP Aeration Efficiency Improvements completed
- Cambridge CSO Program CAM004 Stormwater Outfall and Wetlands Basin completed
- Brookline CSO Sewer Separation Project completed
- Brookline MWR010 CSO Outfall Cleaning completed
- SOM01A CSO Interceptor Connection Relief and Floatables Control Project completed
- Cottage Farm CSO Fuel System Upgrade completed
- Second Version of 40-year Wastewater System Master Plan completed

2014

- DITP Multiphase Roof Replacements for Various Buildings completed
- Residuals Facilities Condition Assessment and Technology Review Project completed

2015

- DITP Centrifuge Back-drive Replacements complete
- DITP Digester Modules 1&2 Pipe Replacement completed
- Reserved Channel CSO Sewer Separation Project completed
- MWR003 Gate and Rindge Avenue CSO Siphon Relief Project completed
- CAM004 CSO Sewer Separation Project completed

2016

- DITP North Main Pump Station Variable Frequency Drives Replacement completed
- DITP Electrical Equipment (#4) Upgrade completed
- DITP Cryogenics Chillers Replacement completed
- NI Electrical and Grit and Screenings Upgrades completed
- Prison Point and Cottage Farm CSO Facility Engine Upgrades and Pumps/Gearbox Rebuilds Project completed

2017

- DITP Scum Skimmer Replacement completed
- DITP Secondary Reactor Variable Frequency Drive Replacements
- DITP Power System Improvements completed
- Clinton AWWTP Digester Rehabilitation Project completed
- Chelsea Screen House Upgrades completed

2018

- DITP Butterfly Valve Replacements completed
- DITP Barge Berth and Facility Replacement completed
- DITP Digester Sludge Pump Replacements completed
- DITP NMPS and WTF Butterfly Valve Replacement completed
- DITP Personnel Dock Rehabilitation completed
- Clinton AWWTP Phosphorus Reduction Facilities completed
- Clinton NGRID Gas Line completed
- Caruso Pump Station Improvements completed
- CSO Cambridge Sewer Separation completed
- Third Version of 40-year Wastewater System Master Plan completed

2019

- Alewife Brook Pump Station Rehabilitation completed
- Interceptor Renewal 1, Reading Extension Sewer Rehabilitation completed

CHAPTER 4
WASTEWATER REGULATORY FRAMEWORK
Current and Near-Term Issues and Longer-Term Considerations

4.01 Chapter Summary

The primary regulatory mechanism for the MWRA wastewater system is the National Pollutant Discharge Elimination System (NPDES) Permit Program. The NPDES Program was created by the Clean Water Act of 1972. NPDES regulates point source dischargers such as wastewater treatment plants, direct industrial discharges, combined sewer overflow (CSO) facilities, and stormwater. In Massachusetts, the United States Environmental Protection Agency (EPA) has authorization for writing and administering the permits. Massachusetts is one of a few states that is not delegated to administer its own Clean Water Act programs; therefore, the NPDES discharge permits are issued jointly by EPA and Massachusetts Department of Environmental Protection (MassDEP). This chapter details MWRA's NPDES permits for: (1) the Deer Island Treatment Plant (DITP) and related CSO facilities/outfalls; (2) the Clinton Advanced Wastewater Treatment Plant (AWWTP); (3) stormwater permits for MWRA wastewater facilities and water facilities; (4) discharges from the Carroll Water Treatment Plant (CWTP), Wachusett Aqueduct Pump Station (WAPS) and for hydroelectric generating facilities at Cosgrove and Oakdale; and (5) pesticide application at Wachusett Reservoir. Although the Carroll Water Treatment Plant, WAPS, and the hydroelectric generating facilities at Cosgrove and Oakdale are MWRA water system facilities (not part of the wastewater system); they are included in this chapter to provide the reader a comprehensive review of MWRA's NPDES permitting issues. This chapter highlights near-term changes expected with the issuance of future NPDES permits, other likely near-term changes in wastewater regulation, and longer-term issues that may affect regulation of MWRA's wastewater system and the level of treatment required.

4.02 NPDES Permitting and Reporting for the DITP and MWRA's CSO Facilities and Outfalls

MWRA's NPDES permit for DITP came into effect in August 2000. The permit regulates discharges from the treatment plant outfall in Massachusetts Bay, three CSO treatment facilities (Cottage Farm, Prison Point, and Somerville Marginal), MWRA's five untreated CSO outfalls in the Charles River (MWR010, MWR023, MWR018, MWR019, MWR020), and MWRA's untreated CSO outfall in Alewife Brook (MWR003). MWRA is co-permittee with Boston Water and Sewer Commission for MWRA's Union Park CSO Facility (MWR215); it is expected that Union Park will be included in MWRA's next DITP permit. The 2000 DITP NPDES permit expired in 2005 and has been administratively continued (its provisions remain in force but cannot be modified) while a new permit is being prepared by EPA.

The DITP NPDES permit requires submission of effluent discharge monitoring reports (DMRs) every month. These reports include data on flow, conventional pollutants, priority pollutants, nutrients, toxicity, CSO discharges, and operations of MWRA's collection system. ENQUAL-WW prepares DMR reports based on monitoring data provided by staff within many MWRA departments, including: DITP, Department of Laboratory Services, Toxic Reduction and Control

(TRAC), Field Operations, and Planning. In 2018, DITP received a Platinum 11 award from the National Association of Clean Water Agencies for eleven years without a violation from the National Association of Clean Water Agencies. Contaminant loadings from DITP effluent are well below planning predictions.

In addition to the monthly DMRs, the permit has numerous additional requirements; for example: implement the CSO Nine Minimum Controls and the Long-term CSO Control Plan; quantify CSO discharges; produce a Best Management Practices plan and staffing reports for MWRA facilities; and submit annual reports for the industrial pretreatment program, infiltration/inflow reduction, and demand management. In addition, there are extensive requirements for ambient monitoring in Massachusetts Bay and Boston Harbor.

One unusual requirement is a contingency plan that uses the ambient and effluent monitoring results to report on water quality changes in Massachusetts Bay. If the contingency plan's thresholds are exceeded, MWRA must determine if there are adverse impacts that may be caused by the discharge. Threshold exceedances must be reported to regulatory agencies and the public within five days. The monitoring is reviewed at public meetings by an independent Outfall Monitoring Science Advisory Panel convened by EPA and DEP. Overall, the environmental monitoring has found that DITP discharges can be detected only locally (as increased ammonium) around the outfall, and no adverse impacts of the discharge on the water quality, plankton, bottom-dwelling communities, sediment quality, fish and shellfish of Massachusetts and Cape Cod Bays or Stellwagen Marine Sanctuary have been found.

MWRA staff met with EPA and MassDEP in March 2017 regarding potential conditions to be included in a new DITP/CSO NPDES permit, but additional information exchange is needed before the regulatory agencies can proceed. Future considerations relating to a new permit may include:

- *Enterococcus* limits and potential for added chlorination/dechlorination;
- Co-permittees and the inter-relationships between MWRA and its communities;
- Requirements relating to CSO's, including but not limited to direct measurement, public notification and reporting;
- Ambient Monitoring and the Contingency Plan thresholds; and,
- Nutrient removal requirements.

4.03 NPDES Permitting and Reporting for the Clinton Advanced Wastewater Treatment Plant

MWRA's current NPDES discharge permit for the Clinton Advanced Wastewater Treatment Plant (AWWTP) issued by EPA became effective in March 2017, and replaced the permit issued in 2000. The permit regulates the plant's discharges to the South Branch of the Nashua River. The Clinton permit requires submission of DMRs every month. These reports include data on flow, conventional pollutants, priority pollutants, nutrients, and toxicity. The plant has generally met its permit limits; however, it is not unusual for the flow limit to be exceeded in wet weather. The Clinton plant is expected to meet new copper limits based on current Massachusetts water quality standards for copper, which include site specific criteria for the Nashua River.

The major capital and operating cost impacts of the 2017 NPDES permit on MWRA were the substantially more stringent limits on phosphorus, which required construction of a new phosphorus treatment facility. More stringent phosphorus limits had been anticipated as there are signs of eutrophication in the river, and other dischargers have been subject to more stringent limits. The phosphorus removal facilities are complete and undergoing testing as of Fall 2018. EPA used the 1986 "Gold Book" numerical criterion to calculate phosphorus limits for Clinton. The new treatment facilities for phosphorus removal cost approximately $9.0 million including both design and construction (this project is discussed in more detail in Chapter 14). A compliance schedule in the new permit establishes less stringent phosphorus limits until April 2019, to allow MWRA to complete construction and start-up. The 2017 permit prohibits the use of alum for phosphorus control. MWRA had formerly used alum but has since shifted to ferric chloride for phosphorus treatment at the Clinton AWWTP.

A major item in the 2017 permit is the inclusion of co-permittees for requirements relating to collection system Operation and Maintenance (O&M). The Town of Clinton and the Lancaster Sewer District have specific requirements with which they must comply, even though they did not apply for a NPDES permit. These requirements include reporting unauthorized discharges from the town-owned collection systems (which include Sanitary Sewer Overflows), and Operation and Maintenance requirements for their respective collection systems, including provisions for infiltration/inflow (I/I) reduction programs.

4.04 NPDES Stormwater Permitting and Reporting for MWRA Wastewater Facilities

Stormwater discharges from MWRA facilities are permitted under EPA's 2015 Multi-Sector General Permit for Industrial Facilities (MSGP). This includes treatment plants, headworks, pumping stations, CSO treatment facilities, and residuals facilities. Of MWRA's 28 such facilities, 14 have no stormwater discharge and 13 qualify for "no exposure" status (i.e. stormwater runoff is not exposed to the industrial process) under the MSGP. DITP is the only MWRA facility that is required to carry out stormwater monitoring and reporting under the MSGP.

At DITP, sampling in 2015 indicated elevated bacteria in stormwater discharges to Boston Harbor. However, additional sampling and other evidence showed that stormwater contamination was not related to any wastewater treatment process, but rather was due to runoff from parking lots and a pier where many seagulls roost (a natural source).

There is also a draft Total Maximum Daily Load (TMDL) for pathogens for Boston Harbor, which is designated as impaired because it does not always meet the criteria for unrestricted shell fishing. The loading allocations in the draft TMDL are concentrations equal to the state water quality criteria for the water body. It is not clear when an approved TMDL for pathogens for Boston Harbor will be finalized; the draft was issued for public comment in 2005. If there is an approved TMDL for the receiving water, EPA will specify the monitoring requirements for the stormwater permit to ensure consistency with the TMDL. There are unlikely to be other stormwater permit regulatory issues at DITP that result from a final TMDL.

4.05 NPDES Stormwater Permitting and Reporting for MWRA Water Facilities

In 2016 EPA issued a general permit for stormwater discharges from small municipal separate storm sewer systems (MS4) in urban areas, which became effective July 1, 2017. However, several parties filed petitions for review of the permit in the U.S. Court of Appeals for the D.C. Circuit. On July 13, 2017, EPA postponed the effective date of the permit for one year, to July 1, 2018, and Massachusetts Department of Environmental Protection agreed to follow the Federal schedule. This permit contains a provision for "non-traditional" MS4s, which are stormwater collection systems at federal, state, or county non-transportation facilities. MWRA has two water facilities in the covered region – the Southborough complex and the Gillis Pump Station – that have stormwater collection systems discharging into surface water, and is seeking coverage for these facilities under the small MS4 permit now that it is in effect.

Under the small MS4 permit, MWRA would be required to compile a stormwater management program for each affected facility, and to implement the "six minimum measures" for stormwater pollution control. These include education (staff training), public involvement, illicit discharge detection and elimination, construction runoff control, post-construction stormwater management, and pollution prevention (good housekeeping). Many of these activities (training, stormwater management, and housekeeping) already take place at all MWRA facilities due to other regulatory requirements or best practices. However, the MS4 program would require MWRA to map its stormwater collection systems and assess any risk that there could be illicit connections. Stormwater at the Gillis Pump Station discharges into waters impaired for phosphorus, so additional controls may eventually be required under this permit, depending on monitoring results.

4.06 NPDES Permitting and Reporting for Discharges from the Carroll Water Treatment Plant and Wachusett Aqueduct Pump Station and for Hydroelectric Generating Facilities at Cosgrove and Oakdale

MWRA's NPDES permit for discharges from the CWTP became effective in 2013; it expired in April 2018 and was administratively continued. MWRA applied for a new permit in 2017, as required. The permit is for surface water discharges from annual maintenance activities (generally November – March) in which tanks and equipment are drained and disinfected. The discharges, which are basically dechlorinated drinking water, are tributary to the Wachusett Aqueduct Open Channel which flows into the Sudbury Reservoir.

MWRA also applied for and received coverage under the general NPDES permit for Non-Contact Cooling Water (NCCW) for geothermal discharge from the Wachusett Aqueduct Pump Station (WAPS), currently under construction. This Pump Station will provide redundancy to the Cosgrove Tunnel, allowing for Wachusett Reservoir water to be pumped from the Wachusett Aqueduct into the CWTP in the event of a Cosgrove Tunnel failure. The geothermal heating/cooling system for the facility requires a NPDES permit. MWRA received authorization to discharge as of June 8, 2018, covering testing that started in the summer of 2018 and continuing into the period of routine operation once construction is complete.

MWRA's hydroelectric facilities at the Cosgrove Intake Facility and Oakdale Power Station are covered under NPDES general permits, which expired in December 2014 but have been administratively continued. At Cosgrove, stormwater runoff, roof drains, and the turbine floor sump discharge to wetlands tributary to North Brook within the Concord River Watershed. At

Oakdale, turbine flow, turbine by-pass flow, cooling water, and sump water are discharged to the Quinapoxet River. A draft Hydroelectric General Permit was published in September 2018 for public comment. The draft permit adds monitoring of total suspended solids, which is not expected to be an issue. Also, the draft permit has requirements for protecting aquatic life from being drawn into cooling water intakes; these new requirements are being studied for the possible impact on operations at Cosgrove and Oakdale. When the final general permit is issued, MWRA will reapply for coverage.

4.07 NPDES Permitting and Reporting for Pesticide Application at Wachusett Reservoir and Emergency Reservoirs

MWRA has authorization under the 2016 Pesticide General Permit for two types of reservoir treatments. First, the permit allows for the application of a pesticide (copper sulfate) to control algae growth at Wachusett Reservoir. Specific algae cause taste and odor problems in drinking water. Application of copper sulfate, when necessary, usually occurs in the months of June - September. Second, the permit allows MWRA to apply alum to control phosphorus levels in its emergency drinking water reservoirs, to prevent blooms of toxic cyanobacteria. The alum, which is not a pesticide but is regulated under this permit, binds with phosphorus in the water and sinks to the bottom, preventing the cyanobacteria in well-lit surface waters from using the phosphorus nutrient. Copper sulfate can also be applied if needed should a bloom occur.

The Pesticide General Permit requires visual monitoring and the submission of an annual report detailing activities in the previous year regarding copper sulfate or alum addition. The report requires information for each treatment area and includes a description of the treatment area, pesticide and quantity used, dates of application, adverse incidents, and other relevant information.

4.08 Current and Long-Term Regulatory Issues and Potential Impacts on MWRA

Regulations and enforcement initiatives are always changing in response to evolving environmental issues and changing state and federal policy priorities. Examples of changes in regulations occurring now or in the future that affect MWRA wastewater discharges include:

- <u>MassDEP Authorization for Clean Water Act Programs:</u> It is possible that the Commonwealth’s environmental agency may apply for federal authorization to administer its own Clean Water Act Programs and NPDES permitting. This may lead to higher permitting fees for MWRA, as EPA does not charge fees for permit writing and administration. MWRA could seek offsetting credit for its receiving water monitoring work, as the success of MassDEP authorization depends on the availability of high-quality surface water quality data, collected by MassDEP or others. Oversight by MassDEP could result in more appropriately tailored permits, or permits being reissued in a timelier manner. MassDEP cannot seek authorization without passage of legislation directing it to do so and amendments to existing state clean water laws.

- <u>Bacteria:</u> In 2007, Massachusetts issued new water quality standards for bacteria. It is anticipated that it will <u>not</u> be a problem for Clinton AWWTP to meet the *E. coli* limit in the 2017 NPDES permit. If a new DITP NPDES permit is issued, most likely DITP will have to meet both *Enterococcus* and fecal coliform criteria. Depending on how permit limits are defined, it is not clear whether existing disinfection practices will allow DITP to consistently meet an *Enterococcus* criterion, particularly in wet weather or cold weather. EPA has indicated an openness to seasonal limits, which depending on how they are written, could greatly improve potential compliance. The CSO treatment facilities have historically faced issues in complying with effluent bacteria limits. Treatment at these facilities is challenging, as compared to municipal treatment facilities such as DITP or Clinton AWWTP, because CSO influent characteristics vary widely. The proposed new water quality standards (see next paragraph) may make meeting permit limits slightly easier.

EPA developed additional new recreational water quality criteria in 2012; states generally adopt EPA recommendations. However, Mass. Department of Public Health (DPH), after collaborating with stakeholders like MWRA, beach communities and harbor advocates, submitted its request to EPA to leave State beach posting limits for bacteria unchanged, instead of adopting new, more stringent EPA recommendations that would result in an increase in beach postings statewide. Also, it appears that these newest criteria will not directly affect NPDES testing for wastewater treatment, but there is a potential for the criteria to affect the de-listing and listing of impaired waters and also TMDLs. MassDEP is expected to soon propose some minor changes to the recreational water quality bacteria standards to bring them more closely in line with the 2012 EPA criteria.

- <u>Viruses:</u> EPA is continuing its efforts to develop recreational water quality criteria using coliphage as an indicator for viruses. EPA had targeted the end of 2017 to propose draft recreational criteria for coliphage, but no such proposal was published. If these criteria are finalized, and MassDEP adopts these (as they typically do), this requirement will eventually be a requirement in NPDES permits. Coliphage treatment will require higher disinfection levels than currently used.

- <u>Cyanotoxins:</u> In December 2016 EPA issued a "Request for Scientific Views" for establishing Human Health Recreational Ambient Water Quality Criteria and/or Swimming Advisories for Microcystins and Cylindrospermopsin. The request addressed the importance and need to protect human health from potential recreational exposure to toxic cyanobacterial blooms, as well as recognize that harmful algal blooms have the potential to be a public health issue and can also have negative economic impacts. NACWA submitted comments and asserted that the municipal clean water community will face considerable implementation challenges if these numeric criteria values are adopted as ambient water quality criteria (AWQC) and subsequently used as the basis for wastewater treatment permit limits that may not result in reduction of risk to human health or improve water quality.

- <u>Freshwater Nutrients (phosphorus):</u> EPA has developed recommended numerical nutrient criteria for most freshwater "ecoregions," including the eastern coastal plain which includes most of Massachusetts. States are encouraged to develop site-specific numerical nutrient criteria, but to date Massachusetts has not. Phosphorus TMDLs were developed for the lower Charles River Basin in 2007, and for the middle/upper Charles in 2011. EPA and MassDEP, in conjunction with the Mystic River Watershed Association, are in the process of developing a phosphorus Alternative TMDL (or, "TMDL-lite") for the Mystic River Basin. No completion date for this Alternative TMDL has been set. Regulators use TMDLs to allocate loadings from different sources to specific water bodies. With expected implementation of these TMDLs (or

Alternative TMDLs) through permit modifications, some local communities have already broached requesting approval from the Authority to have their stormwater flows, or a portion, e.g., "first flush" flows, (which contain phosphorus) to be directed to MWRA's sewer system and treated at the DITP.

- Marine Nutrients (nitrogen): The EPA/NEIWPCC working group to develop marine nutrient criteria for the northeast USA has been completed, but the criteria have not yet been incorporated into state environmental management. Nutrient criteria apply to all water bodies, including those considered non-impaired. Nitrogen TMDLs have been developed for select estuaries on Cape Cod, Martha's Vineyard, Nantucket, and for Buzzards Bay. It is not anticipated that nitrogen TMDLs will be developed for Boston Harbor or Massachusetts Bay for the foreseeable future. Nutrient and specifically nitrogen inputs contributed by wastewater to Massachusetts Bay, remain on EPA's radar. EPA added a station to MWRA's outfall monitoring program within the mixing zone in 2011, to obtain more data on whether potential nutrient criteria may be met at that location. MWRA is required to submit an annual report that tracks nutrients throughout the Deer Island plant process plus evaluates nitrogen removal technologies. If in the long-term nutrients become a permit or water quality issue, MWRA may need to evaluate nutrient removal at DITP or perhaps at the Fore River Residuals Processing Facility if side-stream only treatment is necessary.

- Combined Sewer Overflow (CSO) "Right to Know". State legislation has been proposed (but not yet passed into law) which would require rapid public notification of CSO discharges, *i.e.* within an hour or two, and detailed notification of verified CSO locations, durations and volumes within 24 hours. These are challenging requirements given the difficulty in being able to determine if a discharge has occurred and accurately quantifying the discharges in these short timeframes. Due to the complexity of CSO regulator structures, and the difficulty in maintaining sensors in the harsh environment of a combined sewer, it is usually impossible to accurately measure CSO discharges directly. Field measurements require extensive, expensive metering at each outfall and regulator. Then, the data must then undergo careful validation, post-processing, and expert interpretation to determine reasonably accurate activation start and stop times and discharge volumes. MWRA is currently voluntarily providing rapid web posting of CSO discharges at CSO treatment facilities, where discharges can be accurately measured and verified compared to stand alone CSO regulator structures. A law or permit requirement to report CSO discharges from all outfalls would be difficult and expensive to comply with.

- Sanitary Sewer Overflow (SSO) Rule: EPA's proposed SSO rule (2001) included preamble wording prohibiting all SSOs and would have required a collection system management, operations, and maintenance (CMOM) program to manage collection systems to avoid SSOs. This rule was withdrawn; however, EPA and MassDEP will continue to focus on reduction and/or elimination of SSOs. EPA Region 1 has put together a Wastewater Collection System Toolbox for managers, local officials, and other decision-makers to find a range of fact sheets, case studies, ordinances, and other information on how SSOs are being addressed.

- Stormwater NPDES Permitting: MWRA's future role in stormwater regulation or remediation is likely to be a continuing subject of discussion. In April 2016, the final stormwater general permit for small MS4s in Massachusetts was issued and encompasses nearly all of MWRA's wastewater communities. The permit includes dramatic phosphorus reduction requirements for many of the cities and towns with stormwater discharges to the Charles River pursuant to the 2007 and 2011 TMDLs. These requirements may be very difficult for the cities and towns to meet. At least one community along the Charles River has asked MWRA to consider accepting stormwater to facilitate compliance with the nutrient reductions mandated in the final permit. Such requests may increase in the future. Numerous MWRA communities are also subject to TMDLs for bacteria or pathogens. Compliance with municipal stormwater permits issued under these TMDLs may also be an issue for communities.

- CSO Variances: CSO discharges are allowed in the Lower Charles River Basin and the Alewife Brook/Upper Mystic River through MassDEP-issued variances from water quality criteria. Based on a 2006 agreement among EPA, US Department of Justice, MassDEP and MWRA, the variances will be reissued every three years through December 2020. The current variances expire on August 31, 2019. After December 2020, MassDEP is expected to make long-term water quality standards determinations for these receiving waters based on the performance of MWRA's CSO long-term control plan, the impacts of non-CSO sources of pollution, and an updated analysis of the feasibility of attaining Class B uses. MWRA's CSO Control Plan (see chapter 11) leaves minimal CSO discharges to these waters in the long-term and is generally consistent with the Class B(cso) standard, which requires that CSO not contribute to Water Quality Standards exceedance at least 95% of the time. A decision to remove the variances and maintain the Class B water quality standard would require the elimination of CSO discharges. A decision to revise the water quality standard to Class B(cso) could acknowledge that the CSO plan provides the maximum feasible reduction of CSO and meets or exceeds the 95% compliance requirement. MassDEP could extend the variances if there is evidence that requiring a higher level of CSO control from MWRA and the CSO communities would further improve water quality and protect uses. Future interactions between the variances, the CSO long-term control plan assessment, and any future NPDES permits (for MWRA and community CSOs) potentially could be very complex, and would be highly dependent on date of issuance of the actual permit(s) and actual permit language.

- Biosolids Criteria: In September 2016, the MassDEP revised its biosolids criteria to raise the maximum allowable concentration for molybdenum from 25 mg/kg to 40 mg/kg. Prior to this change, MWRA's biosolids periodically exceeded this state regulatory limit for Type I sludge. Molybdenum remains an occasional issue in MWRA's biosolids, though with less frequency than prior to September 2016. Of greater concern are the Massachusetts Department of Agriculture (MDAR) Plant Nutrient Application Requirements for Agricultural Land and Land Not Used for Agricultural Land (330 CMR 31.00). In late 2016, MDAR proposed updates that could impose restrictions upon biosolids that would limit the marketability and use of MWRA's biosolids within Massachusetts. MWRA commented on the proposed updates and requested that MDAR revise its regulations to exempt biosolids from the proposed updates or provide an exemption for biosolids that have been demonstrated by a well-established scientific method to contain organically bound nitrogen and chemically bound phosphorus. The updates to 330 CMR 31.00 became final in January 2018 but did not incorporate MWRA's recommended changes. Instead, MWRA is working to determine if the question of phosphorus availability can be determined by a study conducted by the University of Massachusetts-Amherst Cooperative Extension. It is not clear how the results of such a study could be applied under by MDAR under 330 CMR 31.00.

- Metals Criteria (freshwater): The expected updates to state water quality standards, may incorporate recent updates to EPA metals criteria, which allow consideration of aquatic chemistry factors that affect metal toxicity. In the freshwater systems potentially affected by MWRA discharges, this could result in less stringent permit limits for metals, if consistent with anti-backsliding provisions.

4.09 Potential Long-Term Regulatory Considerations

Provided below is a list of potential regulatory and environmental issues, that MAY impact MWRA (and other coastal dischargers) in the future. MWRA should remain aware of these long-term issues, proactively follow scientific developments as they arise, and develop timely and appropriate recommendations (projects, costs, and schedules) to maintain effective and economical system performance.

- Recreational Use Versus Regulatory Standards: As the harbor and its tributary rivers get cleaner, there may be conflicts between increased recreational use and current regulatory standards. MWRA should prepare for potentially tighter regulatory controls that may be put into place to encourage recreational use.

- Emerging Contaminants: As conventional and EPA priority pollutants are better controlled, awareness among the public, the scientific and engineering, and regulatory communities has shifted to the unknown effects of emerging contaminants (also termed trace organics; endocrine disruptors; microplastics/microbeads; and pharmaceutical and personal care products) which are ubiquitous and largely unregulated. Many of these contaminants appear to be effectively removed by secondary treatment; however, the research on many contaminants is in very early stages. MWRA can anticipate that, long-term, there will be increased regulatory pressure to measure the effectiveness of wastewater treatment on a suite of emerging contaminants and eventual permit limits on these compounds.

- Climate Change: An especially difficult aspect of climate change is its unpredictability. What degree of climate change is occurring and what will the effects be? Issues include sea level rise, impact of more frequent and more intense storms, effects of nutrient and other discharges on the changing ecosystem, and ecosystem change as oceanographic patterns change.

- Green Infrastructure: EPA encourages the use of green infrastructure in remediation of CSO and stormwater impacts. EPA has approved green infrastructure as part of other municipalities' long-term CSO control plans and has incorporated requirements for green infrastructure into enforcement orders and penalties. It is unclear if EPA's initiative for promoting green infrastructure will affect regulatory decisions requiring higher levels of pollution control.

- Integrated Planning Approach Framework: EPA has issued an "Integrated Planning Approach Framework", which is an option to help municipalities meet their CWA obligations while optimizing their infrastructure investments through the appropriate sequencing of work. Adoption of such an approach is voluntary, and could affect how MWRA member communities address stormwater vs. SSOs vs. CSOs, and would encourage regional solutions.

4.10 Interacting With Regulators - MWRA's Environmental Quality Department

MWRA's Environmental Quality Department (ENQUAL) plays a key role in the implementation of Clean Water Act regulations. ENQUAL consists of Water and Wastewater units, responsible for monitoring and reporting on drinking water quality and wastewater quality, respectively. ENQUAL-Wastewater (ENQUAL-WW) staff coordinate the negotiation of surface water discharge permits with state and federal regulators. ENQUAL-WW implements the administrative components of permit reporting for DITP and related CSO facilities, the Clinton AWWTP, and stormwater permitting; as well as ambient monitoring of Boston Harbor, its tributary rivers, and Massachusetts Bay.

MWRA implements an extensive environmental monitoring program in Boston Harbor and Massachusetts Bay, including sampling the water column, sediments, and fish and shellfish. Staff also implement environmental monitoring of CSO impacts on the Charles and Alewife-Mystic Rivers as part of the CSO variance requirements. Staff manage, analyze, and report on data from MWRA facilities and from state environmental agencies, universities, and consultants. Reports are submitted to state and federal regulatory agencies, the Outfall Monitoring Science Advisory Panel, and numerous other individuals and organizations.

Data from these monitoring projects are used by state and federal regulatory agencies in developing regulatory requirements, TMDLs, and assessing whether water bodies are impaired. Because regulatory changes are often (ideally) based on science and engineering, professional environmental scientists and engineers within MWRA are frequently called upon by local, state, and federal agencies to advise on the development and implementation of water quality regulations and also to advise on the design and interpretation of water quality studies. MWRA maintains an extensive amount of data on Boston Harbor and Massachusetts Bay available at www.mwra.com.

CHAPTER 5
WASTEWATER FLOW AND QUALITY TO THE DEER ISLAND TREATMENT PLANT

5.01 Chapter Summary

MWRA has reviewed planning parameters including water use trends, projected population, employment growth, sewer system build-out, potential for sewer system expansion, projected wastewater generation, and potential wastewater quality changes within the MWRA sewer service area. For the Master Plan period, MWRA projects minimal change in future wastewater flow and quality tributary to Deer Island Treatment Plant (DITP). The bullets below provide a summary of the conclusions outlined in this Chapter:

- Future population and employment growth in the MWRA sewer service area is projected to be modest. The Massachusetts Department of Transportation (MassDOT) projects a population increase of 371,377 and an employment increase of 148,051, both between 2010 and 2040. Using existing data on water use in the MWRA service area (residential consumption rate of 55 gallons per capita per day (RGPCD) and 40 gallons per employee per day), these increases in population and employment would result in a projected increase of up to 27 mgd (9 percent increase) of wastewater generation from 2010 through 2040, if water use is used as a proxy for wastewater generation.

- MWRA admission criteria for sewer system expansion (including requirements for inflow reductions) are stringent; therefore, MWRA expects no measureable increase in future wastewater flow to DITP from system growth outside the existing sewer service area. Any increase in sanitary flow must be offset by reductions in inflow.

- Any increase in sanitary flow within the sewer service area may be offset by reductions in infiltration/inflow (I/I) from continued regional sewer system rehabilitation and reductions in stormwater contributions from combined sewer areas due to separation.

- MWRA projects the future DITP average dry day wastewater flow (through 2040) will remain below: (1) the 436 mgd National Pollution Discharge Elimination System (NPDES) permit limit for dry day flow; (2) the 354 mgd used for DITP secondary treatment design (1994 Design Package 29); and (3) the 480 mgd used as the initial basis for DITP design year flow (1988 Secondary Treatment Facilities Plan). Therefore, MWRA anticipates no impact on DITP due to wastewater flow increases in the service area through 2040.

- For flow tributary to DITP, no wastewater quality parameters are anticipated to change significantly for the near future. The need for capital projects to address wastewater quality will most likely be based on revised NPDES permit limits (as discussed in Chapter 4).

There are no existing or recommended CIP projects presented in this Chapter.

5.02 MWRA Sewer Service Area to DITP

MWRA's regional interceptor system tributary to the DITP receives flow from 43 member sewer communities (locally-owned collection systems) covering an area of about 500 square miles. The regional system serves about 2.2 million people, including the City of Boston and surrounding metropolitan area. About 95 percent of buildings within the service area are sewered. Figure 5-1 shows the MWRA sewer service area and the wastewater collection system. All flow from the service area is tributary to MWRA's DITP. The regional collection system encompasses about 274 miles of MWRA-owned sewer pipelines, 5350 miles of publicly-owned community sewers, and 5000+ miles of private sewer service connections. Most of the service area (94 percent) is served by separate sanitary sewers; while portions of five communities (Boston, Brookline, Cambridge, Chelsea, and Somerville) utilize combined sewers.

Community wastewater discharges into the regional collection system are subject to MWRA's Sewer Use Regulations (360 CMR 10.000) which govern the discharge of sewage, drainage, substances, and wastes into any sewer under the control of MWRA, or into any sewer tributary thereto. MWRA's Sewer Use Regulations are intended to protect the public health, safety and welfare, and the environment, and ensure proper and safe operation of the Authority's wastewater treatment facilities by regulating the direct and indirect discharge of wastewater and pollutants to the MWRA's sewerage system. MWRA's Sewer Use Regulations (online at: www.mwra.com) include general requirements and specific prohibitions to minimize infiltration and inflow and regulate the quality of wastewater discharged into the regional collection system. Details on MWRA's industrial permitting and pretreatment program are presented in Section 5.07.

5.03 NPDES Permit for DITP

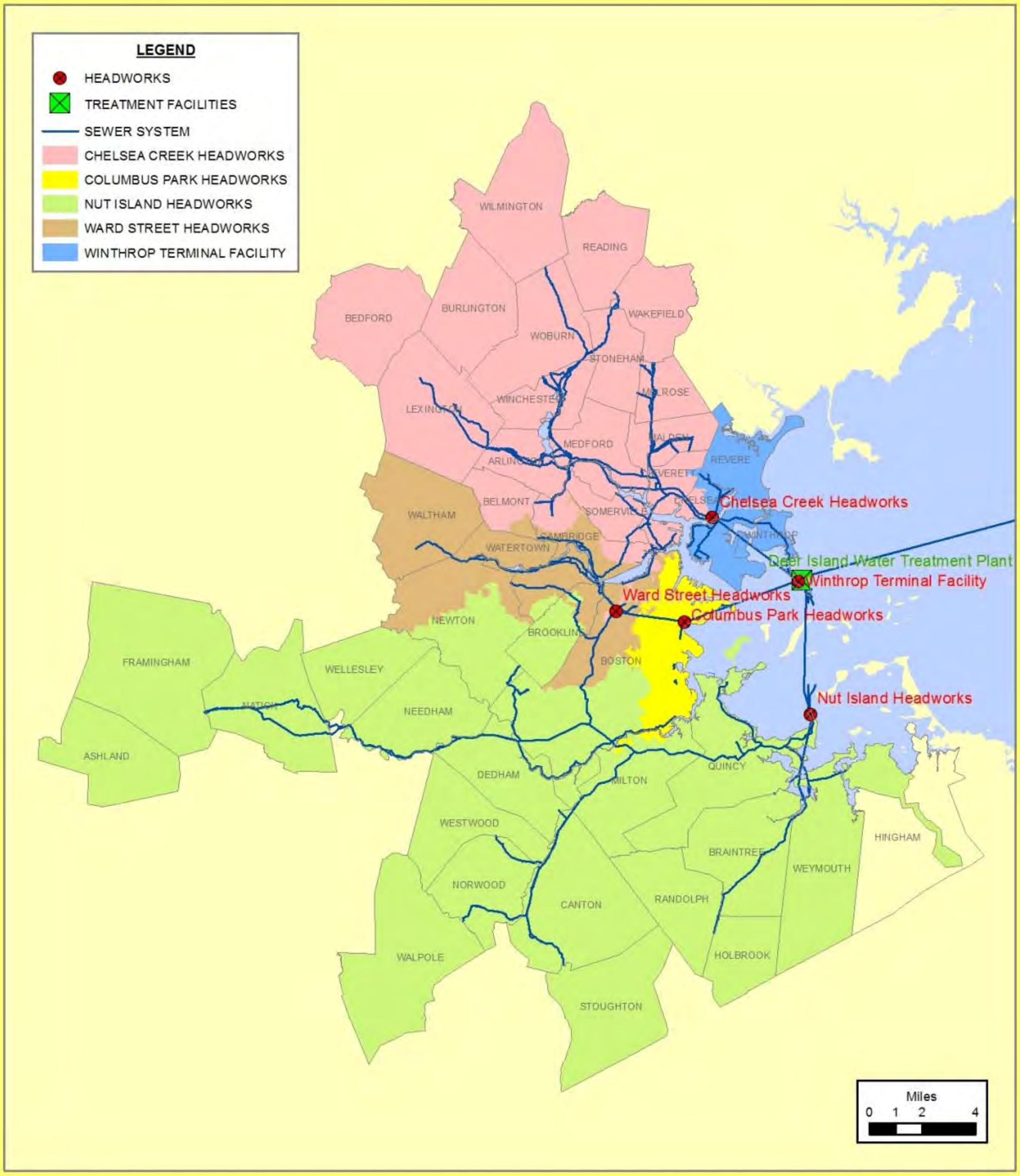
MWRA's NPDES permit for DITP came into effect in August 2000. The current permit, which expired in 2005, has been administratively continued (the provisions of the existing permit remain in force but cannot be modified) while a new permit is being prepared by EPA. Future regulatory requirements and potential changes to the NPDES permit may impact MWRA's recommended capital projects (see Chapter 4 - Wastewater Regulatory Framework). Over the Master Plan period, MWRA expects changes in regulatory requirements related to wastewater flow and quality to have more significant impact on capital project needs than actual changes in future wastewater flow and quality tributary to DITP.

MWRA's NPDES permit requires the Authority to maintain dry day wastewater flow to DITP below 436 mgd (see discussion in Section 5.06). Two reports that address wastewater flow (both submitted annually) are required under the DITP NPDES permit: (1) Summary Report on MWRA's Demand Management Program, which is intended to reduce the sanitary component of wastewater flow; and (2) an Annual Infiltration/Inflow (I/I) Reduction Report that details metered wastewater flows, flow components, and regional efforts to reduce I/I.

The DITP NPDES permit requires submission of effluent discharge monitoring reports (DMRs) every month. These reports include data on flow, conventional pollutants, priority pollutants, nutrients, toxicity, and CSO discharges. Staff also develops a detailed NPDES Compliance Summary Report at the end of each fiscal year. These annual reports are an excellent resource for DITP influent and effluent flow and load data.

FIGURE 5-1

Sewer System Location Plan



5.04 Review of Wastewater Flow to DITP

Wastewater average daily flow to DITP for the last 29 calendar years (CY89 through CY17) and corresponding annual rainfall recorded at the National Oceanic and Atmospheric Administration (NOAA) rain gauge at Boston Logan Airport are listed in Table 5-1. Prior to CY99, MWRA's South collection system was not tributary to DITP and plant flow data from both DITP and the former Nut Island Treatment Plant were combined to derive the total system flow. Wastewater flow data presented in Table 5-1 is tabulated from MWRA's wastewater metering system.

Wastewater is comprised of three separate flow components: sanitary flow, groundwater infiltration, and stormwater inflow. Sanitary flow includes all residential, commercial, institutional, municipal, and industrial sewage, but specifically excludes infiltration and inflow (I/I). I/I is groundwater and rainwater that enter the sewer systems of both MWRA and its member communities through a variety of defects. In addition, five MWRA member communities (Boston, Brookline, Cambridge, Chelsea, and Somerville) have portions of the locally-owned collection systems that are constructed as combined sewers. The volume of wastewater discharged by member communities into MWRA's interceptors is significantly influenced by seasonal and wet weather conditions. About 55 to 65 percent of the annual flow treated at DITP is sanitary flow (approximately 170 mgd) and the remaining 35 to 45 percent is stormwater from combined sewers and I/I that enters the regional sewer system. Potential future change to the sanitary component of wastewater flow to DITP is detailed in Section 5.05. Flows from combined sewers and I/I are further discussed below.

I/I and stormwater from combined sewers use up capacity in the collection system that would otherwise be available to transport sanitary flow. MWRA's efforts to rehabilitate the MWRA-owned collection system (and reduce I/I) are detailed in Chapter 9 – Collection System Sewers. MWRA's projects on combined sewers are detailed in Chapter 11 – Combined Sewer Overflow Control Plan. MWRA's Regional I/I Reduction Plan and efforts to reduce I/I in the 43 locally-owned collection systems tributary to the DITP are detailed in Chapter 15 – MWRA Financial Assistance For Community-Owned Collection Systems. Continued rehabilitation of the regional collection system is intended to at least offset ongoing collection system deterioration to prevent a net increase in regional I/I. In the long-term, continued system rehabilitation and separation of combined sewers may result in lower I/I and stormwater flows in the sewer system, which will offset, to some extent, potential future increases in sanitary flow.

Long-term metering records are analyzed to monitor regional wastewater flow trends. Table 5-1 provides tabular data and Figure 5-2 provides a graph of long-term (29 years 1989-2017) regional flow data for annual average daily wastewater flow and annual rainfall recorded at the NOAA rain gauge at Boston Logan Airport. The 29-year average daily wastewater flow is approximately 353 mgd and the average annual rainfall over the 29-year period is about 43 inches. Comparing the same data for the last five years (2013-2017), the average daily wastewater flow is down to approximately 300 mgd. Note that average annual rainfall over the last five years has been below average at about 39 inches. During the 29-year period of record (1989-2017), the regional wastewater flow trend has been declining. The declining wastewater flow is more evident in Figure 5-3 which displays the five-year running averages (flow and rainfall) as a means of smoothing the annual variability in the data.

TABLE 5-1
DITP Flow Data and Rainfall

Calendar Year	Wastewater Average Daily Flow (mgd)	Logan Annual Rainfall (in)
1989	410	42.4
1990	411	46.5
1991	387	42.3
1992	371	43.7
1993	376	43.2
1994	382	47.6
1995	338	35.1
1996	426	52.7
1997	353	30.4
1998	412	53.7
1999	344	37.9
2000	362	45.6
2001	346	30.7
2002	341	41.1
2003	382	44.4
2004	356	44.6
2005	402	43.7
2006	380	52.8
2007	330	39.5
2008	380	54.5
2009	339	43.5
2010	346	49.7
2011	369	52.4
2012	287	36.7
2013	309	38.8
2014	318	45.3
2015	289	34.8
2016	277	33.1
2017	313	42.7
29 Year Average	353	43.1
Last 5 Year Average (CY13-CY17)	301	38.9

The data displayed in Table 5-1 and Figure 5-2 shows that annual wastewater flow to DITP has varied dramatically (over 140 mgd) from a low below 280 mgd (in CY16) to a high above 420 mgd (in CY96). This variability in annual average flow (40 percent of the long-term average) is influenced by many factors, including:

- Variation in volume, intensity, and duration of rainfall events that increase or decrease stormwater entering combined sewers and I/I entering the regional collection system;

- DITP upgrades and regional sewer interceptor and pumping upgrades that increase flow transmission and treatment capacity;

- Regional combined sewer overflow and system optimization projects that increase the capture and treatment of combined flow; offset by combined sewer overflow separation projects that decrease stormwater tributary to DITP;

- I/I rehabilitation projects that reduce wastewater flow in a local sewer subsystem; however, these projects may not produce a lower net flow reduction at the end of the collection system because of offsetting increases from other I/I sources;

- Increase in service area sewered population resulting in increased wastewater flow; and,

- Decrease in *per capita* water use (portion returned to the sewer system) due to installation of low-flow plumbing fixtures/appliances and conservation trends leading to a decrease in wastewater flow.

FIGURE 5-2
MWRA Long-Term Regional Flow Data
NOAA Annual Rainfall at Logan Airport

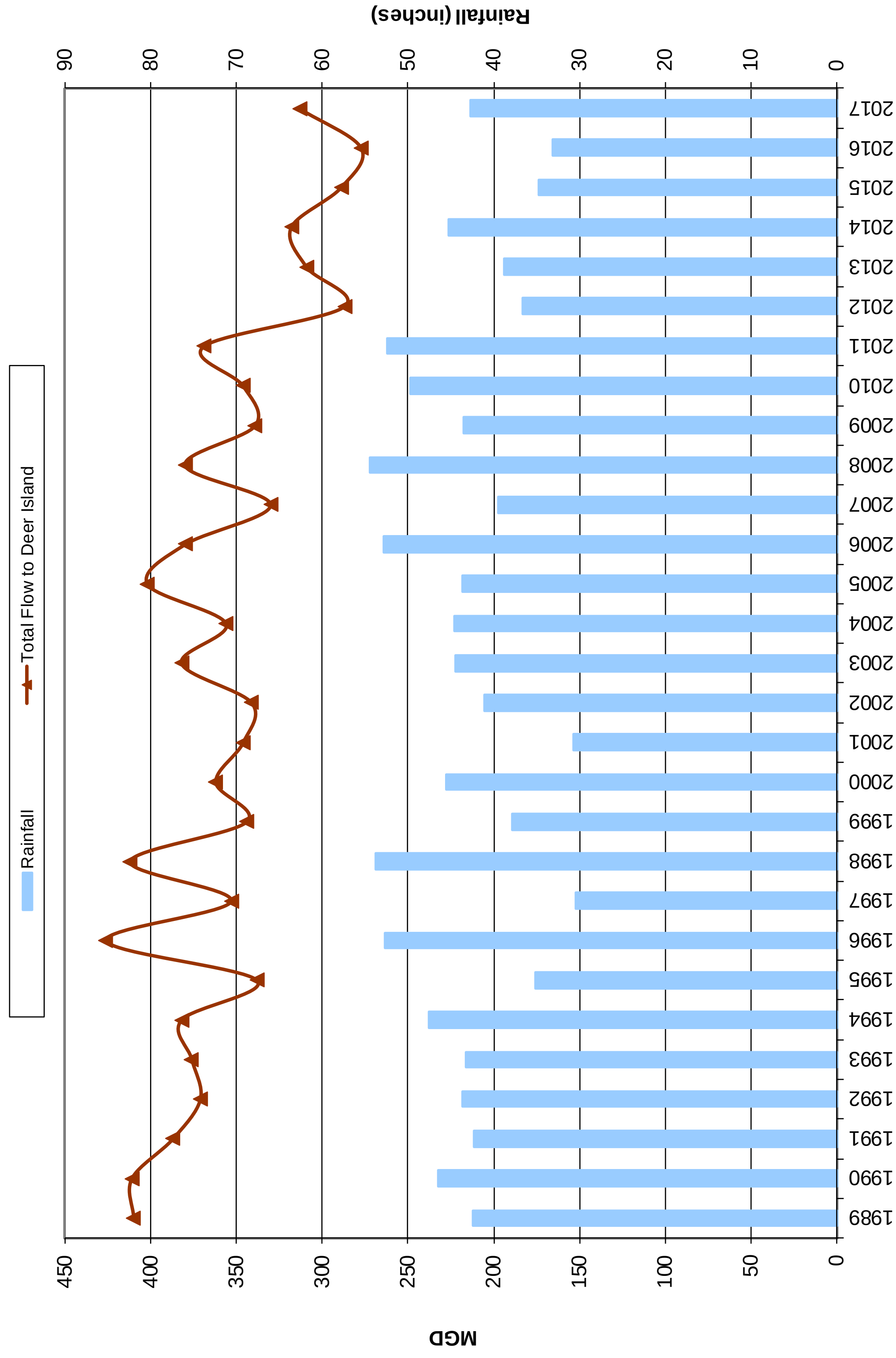
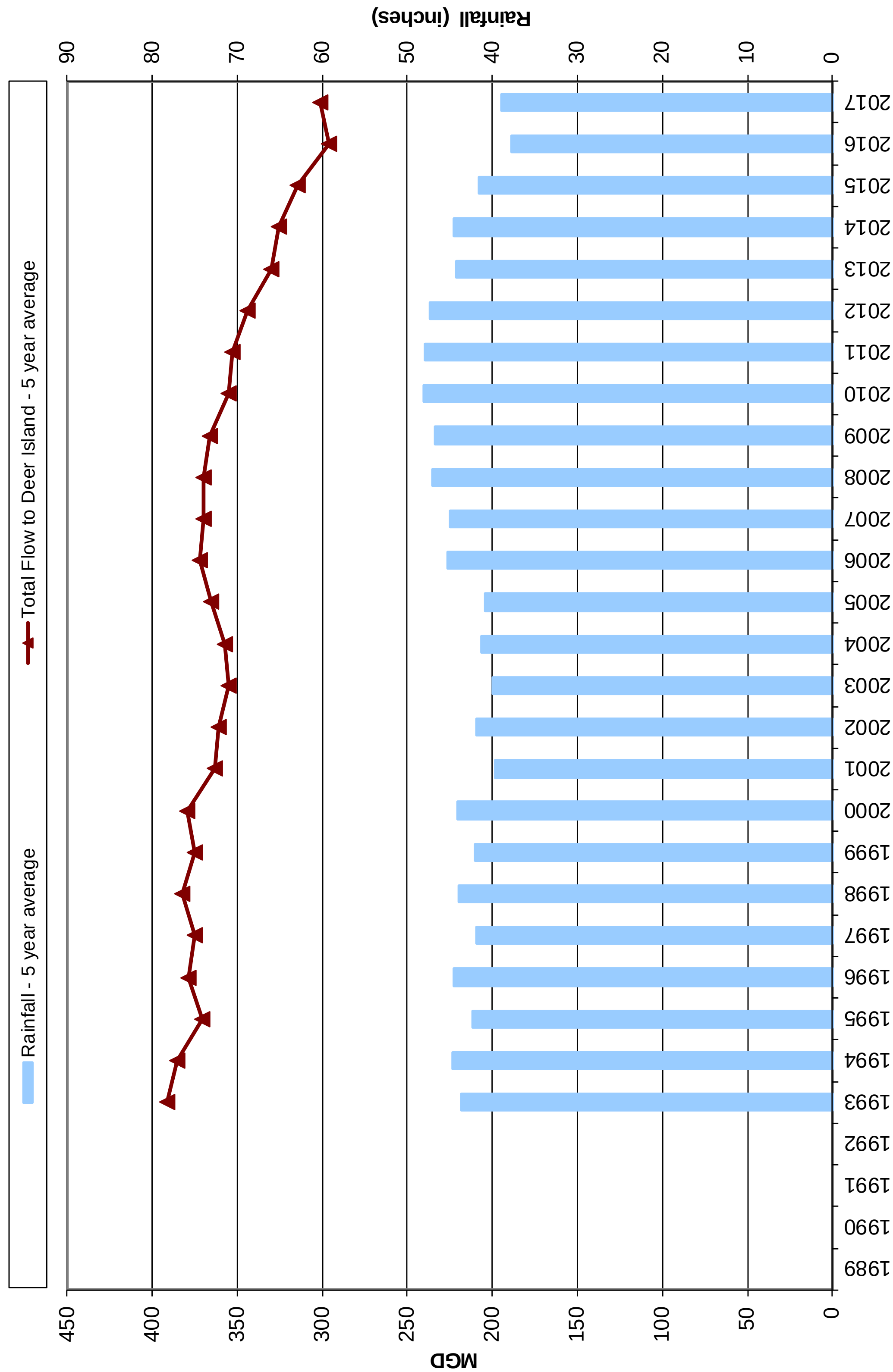


FIGURE 5-3
MWRA Long-Term Regional Flow Data
5-year Running Averages
5 year running NOAA Rainfall Average at Logan Airport



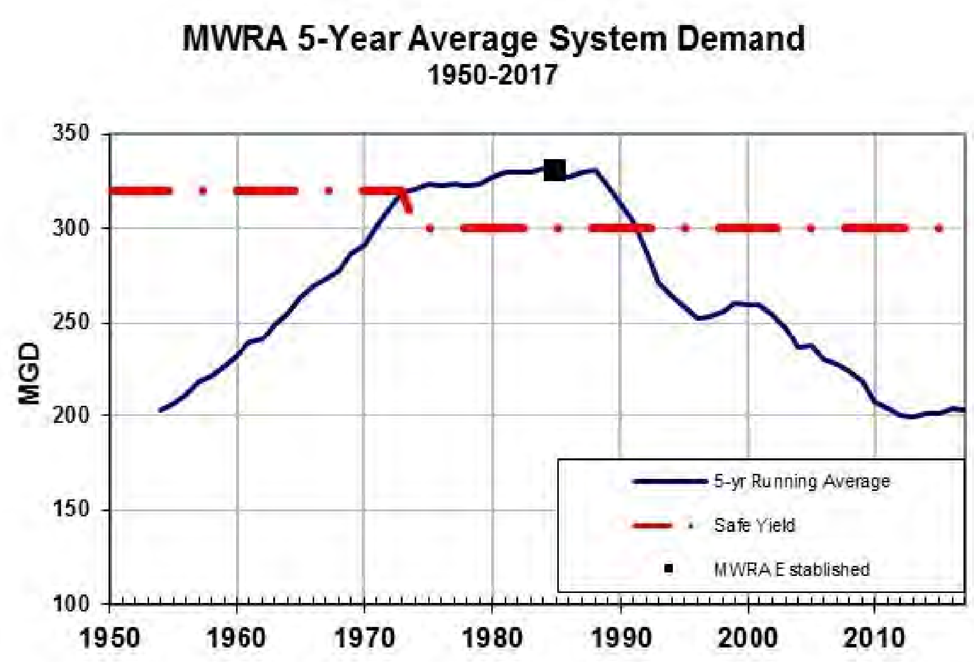
5.05 Potential Future Increase in Sanitary Flow to DITP

There are three ways the sanitary component of wastewater flow may potentially increase in MWRA's sewer service area: (1) increase in water use (per capita) in the sewer service area, (2) increase in sewered population and/or employment in the sewer service area, and (3) expansion of the regional boundary of the sewer service area. The potential for each of these increases are discussed below.

Water Use in the MWRA Sewer Service Area

MWRA water supply and demand are fully detailed in Chapter 4 of the 2018 Water System Master Plan. MWRA continues to implement effective water demand management and water conservation policies and programs for the MWRA-owned and community-owned water distribution systems. The effectiveness of MWRA's conservation efforts over the past 32 years is demonstrated by the fact that baseline water demand (water withdrawal from MWRA reservoirs) has been dramatically reduced from 1985 levels, continues to remain stable, and is comfortably below the system's safe yield of 300 mgd (see Figure 5-4).

FIGURE 5-4



Regional actions that have helped reduce water demand in the MWRA service area include:

- Leak detection surveys of MWRA distribution mains and subsequent leak repairs;
- Leak detection surveys of member community water systems and subsequent leak repairs (required at least every two years under 360 CMR 12.00 – Leak Detection Regulations);
- Improved MWRA wholesale water metering for member community purchases;

- Improved member community water metering for retail purchases reducing unaccounted-for water in local systems;
- Increase in regional water and sewer rates providing a monetary incentive for conservation;
- Plumbing code revisions (including 1.6 or less gallon per flush toilets);
- Broad acceptance and use of low-flow toilets, showerheads, faucets, washing machines, dishwashers, etc.
- MWRA's distribution of free low-flow fixtures (showerheads and faucet aerators);
- MWRA's distribution of free water conservation literature;
- MWRA's school education program that provides classroom presentations and science-based curriculum to promote water conservation awareness for young people; and,
- MWRA's $724 million interest-free loan program (10-year repayment) designed to fund local community water system rehabilitation projects.

Given the focus on conservation in state water policy coupled with regional and national trends of declining residential demand, per capita water use is likely to continue to slowly decline or remain stable at current levels. For the 2018 Wastewater System Master Plan, it will be assumed that sanitary flow (generated from existing data on per capita water use in the sewer service area) will remain at or below the current level and will not increase over the planning period.

Sewered Population and Employment in the MWRA Sewer Service Area

As a baseline, the 2010 US census data has been used to estimate MWRA's sewer service area total population at 2.20 million people (see Table 5-2). As of 2017, Massachusetts Department of Transportation (MassDOT) has adopted population projections to the year 2040 that encompassed all communities in MWRA's sewer service area (also shown on Table 5-2). MassDOT Planning develops population and employment forecasts for a variety of applications, and works closely with state and regional agencies to develop the forecasts. At this time, MassDOT is the sole entity that has recently developed forecasts for both population and employment in the MWRA service area. Using the MassDOT data, total population growth between 2010 and 2040 for the MWRA DITP sewer service area is estimated to increase by 371,377 persons, an increase of 17 percent from the 2010 baseline.

As of 2017, the estimated total population for the MWRA sewer service area is about 2.26 million. However, about 68,000 people (3 percent) of persons in the sewer service area are not yet served by public sewers, but instead are residents served by private on-site septic systems. The unsewered portion of the service area population offsets the estimated increase in total population between the 2010 baseline and current 2017 estimates. Based on this additional analysis, the 2010 census population is a reasonable baseline for use in projecting future sanitary flows.

MassDOT also projected employment growth based on growth projections by industry sector, historic state and regional employment, and sectoral trend data. Table 5-3 shows employment between 2010 and 2040 for the MWRA sewer service area projected to increase by 148,051 persons.

TABLE 5-2
Population Data

MWRA SEWER AREA		
Community	Baseline Total Population (1)	Projected Total Population for 2040 (2)
Arlington	42,844	45,159
Ashland	16,593	20,892
Bedford	13,320	16,093
Belmont	24,729	27,977
BWSC	617,594	743,967
Braintree	35,744	44,036
Brookline	58,732	72,613
Burlington	24,498	28,678
Cambridge	105,162	123,808
Canton	21,561	24,190
Chelsea	35,177	42,054
Dedham	24,729	28,539
Everett	41,667	60,434
Framingham	68,318	75,997
Hingham	22,157	23,426
Holbrook	10,791	11,110
Lexington	31,394	34,717
Malden	59,450	76,825
Medford	56,173	64,380
Melrose	26,983	27,487
Milton	27,003	28,917
Natick	33,006	34,850
Needham	28,886	31,623
Newton	85,146	90,182
Norwood	28,602	30,771
Quincy	92,271	111,114
Randolph	32,112	37,119
Reading	24,747	27,975
Revere	51,755	73,696
Somerville	75,754	101,971
Stoneham	21,437	21,543
Stoughton	26,962	27,209
Wakefield	24,932	26,075
Walpole	24,070	26,910
Waltham	60,632	70,009
Watertown	31,915	36,901
Wellesley	27,982	27,403
Westwood	14,618	15,253
Weymouth	53,743	56,420
Wilmington	22,325	23,836
Winchester	21,374	21,733
Winthrop	17,497	17,311
Woburn	38,120	42,679
TOTAL	**2,202,505**	**2,573,882**

Total projected increase in population: 371,377

(1) 2010 U.S. census data
(2) DOT projections

TABLE 5-3
Employment Data

MWRA SEWER AREA		
Community	Baseline Employment (1)	Projected Employment for 2040 (2)
Arlington	8,796	8,790
Ashland	5,553	5,720
Bedford	15,510	16,566
Belmont	7,299	7,306
BWSC	573,584	646,947
Braintree	23,621	23,993
Brookline	20,015	20,740
Burlington	33,315	38,622
Cambridge	105,746	123,396
Canton	28,179	28,446
Chelsea	16,682	17,138
Dedham	14,658	15,164
Everett	13,417	17,043
Framingham	49,164	55,002
Hingham	14,290	15,362
Holbrook	2,988	2,991
Lexington	18,592	22,506
Malden	14,634	14,984
Medford	18,893	19,255
Melrose	7,063	7,345
Milton	7,459	7,464
Natick	23,807	24,544
Needham	18,060	18,442
Newton	47,269	49,185
Norwood	23,823	24,437
Quincy	36,351	41,944
Randolph	8,247	8,265
Reading	6,061	6,112
Revere	7,980	8,878
Somerville	24,368	32,839
Stoneham	7,798	7,823
Stoughton	13,777	15,512
Wakefield	14,236	14,238
Walpole	10,143	11,090
Waltham	51,816	59,403
Watertown	18,214	18,438
Wellesley	21,859	21,960
Westwood	10,265	12,375
Weymouth	22,147	22,766
Wilmington	19,965	20,353
Winchester	8,576	8,571
Winthrop	4,146	4,184
Woburn	34,323	34,601
TOTAL	**1,432,689**	**1,580,740**

Total projected increase in emploment: 148,051

(1) 2010 DET data
(2) DOT projections

Existing data on water use in the MWRA service area includes the following:

- residential consumption rate of 55 gallons per capita per day (RGPCD); and,
- employee consumption rate of 40 gallons per employee per day.

If water use is used as a proxy for wastewater generation, the projected population increase of 371,377 persons and employment increase of 148,051 persons results in a total projected increase of about 27 mgd of sanitary wastewater flow generation from 2010 through 2040. The projected 27 mgd represents a potential 9 percent increase over the current 300 mgd average daily wastewater flow to DITP over the last five years.

Boundary of MWRA Sewer Service Area and Expansion Policies

The MWRA sewer service area was defined in the Enabling Act that created the Authority, Chapter 372 of the Acts of 1984. Since 1984, there have been no new member communities added to the MWRA sewer system. Some communities adjacent to the MWRA sewer service area are currently served by community or regional wastewater treatment plants, whereas a number are served by onsite septic systems. At the present time, the demand for sewer expansion to communities (or large portions of communities) outside the service area is low. None of the communities immediately adjacent to the existing service area have expressed strong interest in becoming MWRA member sewer communities. MWRA’s sewer expansion policies are as follows:

- **OP.04, Sewer Connections Serving Property Partially Located in a Non-MWRA Community.** This policy applies to persons seeking MWRA sewer services for buildings and structures partially within and partially outside MWRA's service area. It is also known as the "Sewer Straddle" policy.

- **OP.11, Admission of New Community to MWRA Sewer System and Other Requests for Sewer Service to Locations Outside MWRA Sewer Service Area.** This policy applies to communities seeking admission to the MWRA sewer system and to all parties seeking sewer services for locations outside the MWRA service area.

The Enabling Act forms the foundation of the expansion policies and the Act requires that MWRA must find that the safe capacity of the sewer system as extended will be sufficient to meet ordinary wet weather demands and that all feasible actions have been taken by any local body to which the system is extended to minimize infiltration and inflow. The policies detail the criteria MWRA will use to evaluate any request by a community, individual, or other entity. MWRA’s admission criteria are rigorous and include requirements for inflow reductions that will more than offset new wastewater flows (four gallons of inflow removed for each gallon of new sanitary flow).

MWRA receives occasional requests to extend its sewer service to individual projects, institutions, businesses, and/or homes in non-sewered areas in communities adjacent to MWRA. Most of the occasional requests in the past have been for relatively small volumes, but more recently, there have been inquiries and proposals to sewer larger sections in communities outside the existing MWRA sewer service area. Since areas of the MWRA sewer transport system are constrained during severe wet weather events and because OP#11 requires due consideration of feasible alternatives as well as detailed mitigation (including but not limited to 4:1 removal of inflow with a requirement to fully identify feasible inflow removal projects prior to application to MWRA), some proposals to extend the MWRA sewer system do not and will not come to fruition. Those that do are conditioned. As a result, sewer system expansion to outside the existing MWRA sewer service area is likely to result in little or no increase in flow to MWRA's Deer Island Treatment Plant.

5.06 Potential for Future Wastewater Flow Increases to Impact DITP

MWRA's NPDES Permit requires the Authority to maintain a 365 calendar day running average dry day wastewater flow to DITP below 436 mgd. The dry day flow is reported monthly by MWRA as part of the NPDES Operational Performance Summary. For FY18, the 365-calendar day running average dry day flow to DITP was 273 mgd and has averaged 269 mgd over the last five years and 302 mgd over the last twenty years (see Table 5-4). The dry day wastewater flow has less annual variability than total wastewater flow because wet weather flow is more variable due to the impact of stormwater and infiltration/inflow (as detailed in Section 5.04).

TABLE 5-4
Average Dry Day Wastewater Flow to DITP

Fiscal Year	Dry Day Flow (mgd)
1999	307
2000	324
2001	324
2002	294
2003	330
2004	321
2005	345
2006	323
2007	332
2008	286
2009	310
2010	342
2011	283
2012	304
2013	272
2014	268
2015	274
2016	261
2017	271
2018	273
Twenty Year Average	302
Last Five Year Average (FY14-FY18)	269

As discussed in Section 5.05, future sanitary flows in the sewer service area could modestly increase up to approximately 27 mgd through 2040 as a result of population growth, employment growth, and sewer system build-out. Therefore, DITP average dry day wastewater flow through 2040 should remain well below: (1) the 436 mgd NPDES Permit limit for dry day flow; (2) the 354 mgd used for DITP secondary treatment design (1994 DP-29); and (3) the 480 mgd used as the initial basis for DITP design year flows (1988 STFP). In summary, MWRA anticipates no impact on the DITP due to potential wastewater flow increases in the service area through 2040.

5.07 Review of Wastewater Quality to DITP

MWRA samples DITP influent and effluent for a variety of characteristics including conventional wastewater parameters, nutrients, priority pollutants (metals, cyanide, pesticides/PCBs, and organic compounds), fecal coliform bacteria, and whole effluent toxicity. The NPDES permit requires effluent monitoring, with results submitted monthly to EPA and MassDEP. Influent sampling measures wastewater quality prior to treatment. MWRA's ENQUAL Department administers the NPDES permit reporting requirements and develops a detailed NPDES Compliance Summary Report at the end of each fiscal year. These reports are an excellent resource for DITP influent and effluent flow and quality parameters. The reports can be found at: http://www.mwra.state.ma.us/harbor/enquad/trlist.html.

Influent to DITP is classified as a medium load based on average total suspended solids (TSS) of about 180 to 200 mg/L, average total Kjeldahl nitrogen (TKN) of about 35 to 40 mg/L, and average ammonia-nitrogen of about 25 to 30 mg/L. Metals and organic priority pollutant loadings in the MWRA collection system have been decreased over time through two MWRA programs: (1) the Toxic Reduction and Control Department (TRAC) industrial permitting and pretreatment program, and (2) the water supply corrosion control program. Changes in industrial loadings have also affected influent loadings, and state and MWRA programs have substantially decreased loadings of mercury to the waste stream.

Community wastewater discharges (including residential, commercial, industrial, and institutional flows) into the MWRA regional collection system are governed by MWRA's Sewer Use Regulations to protect public health, safety and welfare, and the environment, and ensure proper and safe operation of the Authority's wastewater treatment facilities by regulating the direct and indirect discharge of wastewater and pollutants to the Authority sewerage system. The Sewer Use Regulations (www.mwra.com) include general requirements and specific prohibitions to minimize infiltration and inflow and regulate the quality of wastewater discharged into the regional collection system. The MWRA Sewer Use Regulations are derived from EPA regulations (40 CFR Part 403) and are implemented by MWRA's TRAC Department. The EPA regulations identify three main objectives of the National Pretreatment Program:

- Prevent the introduction of pollutants into the sanitary sewer system which will interfere with the operation of the sewer system, including worker health and safety during operation and maintenance activities, and which will interfere with MWRA's use or disposal of residuals from the treatment of sanitary sewerage;

- To prevent the introduction of pollutants which will pass through the treatment works or otherwise be incompatible with the treatment works; and,
- To improve the opportunities to recycle and reclaim municipal and industrial wastewaters and residuals.

The TRAC Department carries out the requirements of the National Pretreatment Program to meet these objectives. EPA regulations require MWRA to perform permitting, inspection, monitoring, and enforcement activities in accordance with MWRA's NPDES permits and the federal regulations. As of July 2018, the TRAC Department oversees approximately 1,250 permitted industrial and commercial users of the sewer system, including approximately 195 that meet MWRA's definition of Significant Industrial User. TRAC's Industrial Pretreatment Program Annual Report (Industrial Waste Report) documents MWRA's ongoing efforts to implement the requirements of 40 CFR Part 403, General Pretreatment Regulations. The Annual Reports are on the web at: http://www.mwra.com/annual/tracindustrialwastereport/industrialwastereports.htm.

Over the past two decades, the mix of industrial users has transitioned from heavily water dependent industries such as metal products manufacturing to much less water intensive operations such as biotechnology and pharmaceutical research and development. Water conservation measures have been instituted throughout commercial and industrial facilities, reducing the proportion of wastewater attributable to these sources over time. MWRA estimates only about 3 percent of wastewater flow to DITP was discharged from permitted industrial and commercial users of the sewer system. This estimate will be reexamined when MWRA completes a reevaluation of its local limits following EPA's renewal of the Deer Island NPDES permit. The decline in traditional photo-processing and printing operations has resulted in lower discharges of heavy metals into the sewer system during the past two decades as well. However, future impacts to wastewater quality resulting from the growing universe of biotechnology and pharmaceutical research and development facilities are unknown at this time. Traditional pollutant analysis methods do not necessarily reveal all the pollutants being discharged.

MWRA continues to address hydrogen sulfide corrosion and odor issues in the regional collection system (see Chapter 9), which have been attributed to high levels of biochemical oxygen demand (BOD) and sulfates. In 1999, MWRA proceeded with a multi-faceted corrosion and odor control program, including: (1) source reduction in the form of BOD, sulfate and sulfide limits for municipal and industrial discharges; (2) treatment in the form of chemical addition and installation of biofilters at key locations and, (3) asset protection through rehabilitation of affected sewers and related structures. A 2003 Wastewater Characterization Study identified the various components in MWRA's wastewater, with hydrogen sulfide being one of the more important parameters tested. As a follow-up, a project was developed to introduce chemicals into the Framingham Extension Sewer system for hydrogen sulfide and corrosion control. Internal TV and physical inspections continue to be prioritized for affected sewers and TRAC Department staff continue to oversee the pre-treatment work of municipalities and industries in the program. Capital projects to address hydrogen sulfide corrosion and odor issues in the collection system are included as recommendations in Chapter 9.

In summary, DITP influent wastewater quality parameters are not anticipated to change significantly in the near future. However, there are potential changes to wastewater quality that may occur over the long term if the biotechnology and pharmaceutical industries grow and change. Also, there may be an increasing trend for use of drugs and medications now used in hospitals to be used at home, where TRAC programs currently have no jurisdiction. Emerging technologies (like nanotechnologies) are being used in medications, clothing, cosmetics and personal care products. Existing DITP treatment processes are expected to continue to meet NPDES permit limits. However, if new limits for emerging contaminants, nutrients, or conventional pollutants (such as pathogen indicator bacteria) are incorporated into future NPDES Permits, then there may be a need for future capital projects targeting wastewater quality at DITP. Additional current and long-term regulatory issues and potential impacts on MWRA are detailed in Chapter 4.

CHAPTER 6
DEER ISLAND TREATMENT PLANT

6.01 Chapter Summary

MWRA's Deer Island Treatment Plant (DITP) was the centerpiece of MWRA's $3.8 billion construction program to alleviate pollution in Boston Harbor. The plant provides primary and secondary treatment of wastewater collected from approximately 2.2 million people in 43 greater Boston communities. Treated wastewater effluent is carried by a 9.4-mile, 24-foot diameter outfall tunnel and discharged into the 100-foot deep waters of Massachusetts Bay. Components of DITP include: influent pumps, primary treatment, secondary treatment, disinfection, dechlorination, the outfall tunnel, sludge digesters, odor control, and on-site power generation. Extensive monitoring of wastewater effluent and Massachusetts Bay ensures protection of the environment. DITP meets federal and state environmental standards and complies with a stringent National Pollutant Discharge Elimination System (NPDES) permit as described in Chapter 4. MWRA's Clinton Advanced Wastewater Treatment Plant is detailed separately in Chapter 14 of the Wastewater System Master Plan.

This Chapter provides details on the major equipment and processes at DITP - the second largest wastewater treatment plant in the U.S. The components of DITP came on-line sequentially beginning in January 1995 with construction completed in 2001 and performance certification completed in 2002. The plant has a unique combination of treatment processes and automation. Also, the technological and engineering challenges of constructing the facility required uncommon solutions which present additional challenges in its operation, maintenance, and replacement of equipment and related support systems. Most plant equipment and structures are 16 to 22 years old, and due to a rigorous asset management maintenance program have been kept in good condition. Operability of mechanical equipment and maintenance of electric and standby power systems are key elements to minimize risk of component failure, particularly during large storm events when the plant is at full capacity. Key decision making includes the cost-benefit analyses of timing the replacement of aging equipment and planning the kinds and numbers of spare parts to pre-purchase. MWRA and DITP's highly skilled and qualified staff are committed to excellence in the operation and maintenance of this valuable public asset. DITP staff have developed systems, policies, and protocols for assessing the current condition of structures and equipment and determining when to schedule the necessary level of maintenance or replacement.

The replacement asset value of the DITP is $2.5 billion (37 percent of wastewater system asset value) and the outfall tunnel is an additional $530 million (8 percent of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.07.

Major DITP processes and/or facilities are detailed within the Chapter Section noted below:

6.05 Pumping and Preliminary Treatment;
6.06 Primary Wastewater Treatment;
6.07 Secondary Wastewater Treatment;
6.08 Disinfection and Dechlorination;
6.09 Outfall Tunnel and Effluent Discharge;
6.10 Residuals Processing;
6.11 Electrical Generation and Distribution;
6.12 Odor Control Facilities; and,
6.13 Additional Support Systems.

For the Deer Island Treatment Plant, $1,384.877 million in projects is identified in the 40-year Master Plan timeframe (FY19-58). Thirty-eight projects ($703.127 million) are programmed in the FY19 CIP. Thirty-five additional projects ($681.750 million) are recommended for inclusion in future CIPs. Section 6.14 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter. Existing DITP treatment processes are expected to continue to meet NPDES permit flow and wastewater quality parameters. However, if new limits for emerging contaminants, nutrients, or conventional pollutants are incorporated into future NPDES permits, additional future capital projects for DITP beyond those outlined in this chapter may be required. Additional current and long-term regulatory issues and potential impacts on MWRA are detailed in Chapter 4.

Near-term (FY19-23):

- $305.344 million is programmed in the FY19 CIP:
    - $2.799 million for three As-needed Design Services (series 8) and/or construction support;
    - $7.750 million to provide additional As-needed Technical Design Services;
    - $9.811 million for South System Pump Station Variable Frequency Drive Replacement (to include pumps and motors in this cycle);
    - $1.0 million for South System Pump Station Pump Lube System Replacement;
    - $12.388 million for Motor Control Center and Switchgear Replacements (NMPS, WTF, and Admin/Lab buildings);
    - $7.656 million to complete Winthrop Terminal Facility Variable Frequency Drive Replacements;
    - $2.119 million for Miscellaneous Variable Frequency Drive Replacements;
    - $1.90 million to complete Expansion Joint Construction 3 for Clarifiers and Retaining Walls;
    - $134.134 million to complete Clarifier Rehabilitation Phase 2 (primary and secondary) construction;
    - $1.626 million to begin Cryogenics Plant Equipment Replacement;
    - $5.0 million to complete Sodium Hypochlorite and Bisulfite Tanks Rehabilitation;
    - $412,000 to begin Chemical Pipe Replacement;
    - $19.633 million to complete Gravity Thickener Rehabilitation Improvements;
    - $4.322 million to begin Digester and Storage Tank Rehabilitation;
    - $2.0 million for Dystor Tank Membrane Replacements;
    - $3.504 million to begin the Combined Heat and Power (CHP) Facility Energy Alternatives study, design, and construction;

- $2.428 million to begin Hydroturbine Replacement;
- $251,000 to begin Electrical Equipment Upgrades Phase 5;
- $6.821 million for Switchgear Replacement construction;
- $42.796 million to complete HVAC Equipment Replacement;
- $1.735 million to begin Odor Control Rehabilitation plant-wide study, design, and construction;
- $2.424 million for PICS Distributed Process Units (DPU) Replacements;
- $1.247 million to begin Cathodic Protection Replacement;
- $23.398 million to continue Fire Alarm System Replacement;
- $2.750 million for Radio Repeater System Upgrades – Phases 1 and 2;
- $1.0 million to complete Gas Protection System Replacement;
- $4.370 million for Eastern Seawall Repairs; and,
- $68,000 to complete the Document Format Conversion project.

• $4.50 million in needs is identified for FY19-23 and recommended for inclusion in future CIPs:
  - $4.50 million to provide additional As-needed Technical Design Services.

Mid-term (FY24-28):

• $353.982 million is programmed in the FY19 CIP:
  - $12.50 million to provide additional As-needed Technical Design Services;
  - $15.206 million to complete South System Pump Station Variable Frequency Drive Replacement (to include pumps and motors in this cycle);
  - $9.539 million to begin North Main Pump Station Variable Frequency Drive Replacement (to include pumps and motors in this cycle);
  - $417,000 for North Main Pump Station Harmonic Filter Replacement;
  - $2.377 million for Miscellaneous Variable Frequency Drive Replacements;
  - $16.627 million to complete Cryogenics Plant Equipment Replacement;
  - $2.305 million to complete Chemical Pipe Replacement;
  - $20.0 million to complete Sodium Hypochlorite Tank Rehabilitation or Replacement;
  - $20.763 million for Centrifuge Replacements;
  - $33.825 million to complete Digester and Storage Tank Rehabilitation;
  - $5.0 million for Co-Digestion Design/Build Project;
  - $1.798 million for Digester Gas Flare #4 construction;
  - $85.721 million to continue the Combined Heat and Power (CHP) Facility Energy Alternatives study, design, and construction;
  - $8.0 million for Combustion Turbine Generator Rebuilds;
  - $8.732 million to complete Hydroturbine Replacement;
  - $27.181 million to continue Electrical Equipment Upgrades Phase 5;
  - $619,000 for Switchgear Replacement construction;
  - $20.459 million for Switchgear Replacements Phase 2;
  - $2.0 million for East/West Odor Control Air Handler Replacement;
  - $37.915 million to continue Odor Control Rehabilitation plant-wide study, design, and construction;
  - $10.038 million for PICS Distributed Process Units (DPU) Replacements;
  - $4.988 million to complete Cathodic Protection Replacement;

  - $7.943 million to begin Barge Berth and/or Pier Facilities Rehabilitation or Replacement; and,
  - $29,000 to complete Fire Alarm System Replacement.

- $38.50 million in needs is identified for FY24-28 and recommended for inclusion in future CIPs:
  - $7.50 million to provide additional As-needed Technical Design Services;
  - $10.0 million to provide a placeholder budget for Future DI Equipment Replacement;
  - $3.0 million for Future Outfall Inspections;
  - $10.0 million for Future Hydroturbine Generator (HTG) Rehabilitation;
  - $1.0 million for Future Sanitary and Storm System Rehabilitation;
  - $1.0 million for Future Personnel Protection Systems Upgrades or Replacements; and,
  - $6.0 million for Future DI Roof Replacements.

Long-term (FY29-38 and FY39-58):

- $43.801 million is currently programmed in the FY19 CIP:
  - $2.0 million to provide additional As-needed Technical Design Services;
  - $19.881 million to complete North Main Pump Station Variable Frequency Drive Replacements;
  - $19.583 million for North Main Pump Station Harmonic Filter Replacement;
  - $37,000 for Centrifuge Replacements;
  - $2.0 million for Dystor Tank Membrane Replacements;
  - $185,000 to complete the Combined Heat and Power (CHP) Facility Energy Alternatives study, design, and construction;
  - $38,000 to complete Electrical Equipment Upgrades Phase 5;
  - $41,000 to complete Switchgear Replacements Phase 2;
  - $16,000 to complete Odor Control Rehabilitation plant-wide study, design, and construction; and,
  - $20,000 to complete Barge Berth and/or Pier Facilities Rehabilitation or Replacement.

- $638.750 million in needs is identified for FY29-38 and FY39-58 and recommended for inclusion in future CIPs:
  - $60.0 million to provide Future As-needed Design Services;
  - $60.0 million for Future DI Equipment Replacement (placeholder);
  - $45.0 million for Future South System Pump Station Upgrades including VFDs, shafts, motors, MCC replacement, and additional rehabilitation;
  - $50.0 million for Future North Main Pump Station Upgrades including VFDs, shafts, motors, MCC replacement, and additional rehabilitation;
  - $20.0 million for Future Winthrop Terminal Facility Upgrades including VFDs, shafts, motors, MCC replacement, and additional rehabilitation;
  - $30.0 million for Future Miscellaneous Variable Frequency Drive Replacements;
  - $10.0 million for Future Grit Facilities Rehabilitation/Upgrades;
  - $50.0 million for Future Primary and Secondary Clarifier Rehabilitations including concrete repairs and mechanical equipment;
  - $8.0 million for Future Cryogenics Plant Equipment Replacement;
  - $24.0 million for Future Sodium Hypochlorite Tank, Sodium Bisulfite Tank, and Chemical Feed Pipe Evaluation, Rehabilitation or Replacement;

- $3.0 million for Future Outfall Inspections;
- $20.0 million for Future Gravity Thickener and Covers Rehabilitation or Replacement;
- $20.0 million for Future Centrifuge and Back-drive Replacements;
- $25.0 million for Future Digester and Sludge Storage Tank Rehabilitation;
- $2.0 million for Future Dystor Tank Membrane Replacements;
- $8.0 million for Future Digester Sludge Pump Replacements;
- $16.0 million for Future Combustion Turbine Generator (CTG) Rebuilds;
- $4.0 million for Future Steam Turbine Generator (STG) Replacement;
- $6.0 million for Future Heat Loop Pipe Replacement;
- $10.0 million for Future Hydroturbine Generator (HTG) Rehabilitation;
- $25.0 million for Future Electrical Equipment Upgrades;
- $30.0 million for Future Switchgear Replacements;
- $30.0 million for Future Odor Control Air Handler Replacements and Odor Control Upgrades;
- $10.0 million for Future DITP Process Instrumentation Control System (PICS) Distributed Processing Units (DPU) Replacements;
- $40.0 million for Future HVAC Upgrades/Replacement;
- $5.0 million for Future Fuel Supply Pump and Transfer Pipe Replacement or Rehabilitation;
- $1.0 million for Future Leak Protection System Upgrades;
- $2.0 million for Water Storage Tank Cleaning/Rehabilitation and Water Pipeline Rehabilitation;
- $750,000 for Cathodic Protection Testing;
- $1.0 million for Future Sanitary and Stormwater System Rehabilitation;
- $3.0 million for Future Personnel Protection Systems Upgrade/Replacement;
- $2.0 million for Future Barge Berth and/or Pier Facilities Rehabilitation;
- $6.0 million for Future Seawall Repairs and/or Placement of Rip-rap; and,
- $12.0 million for Future DI Roof Replacements.

6.02 Facilities Overview

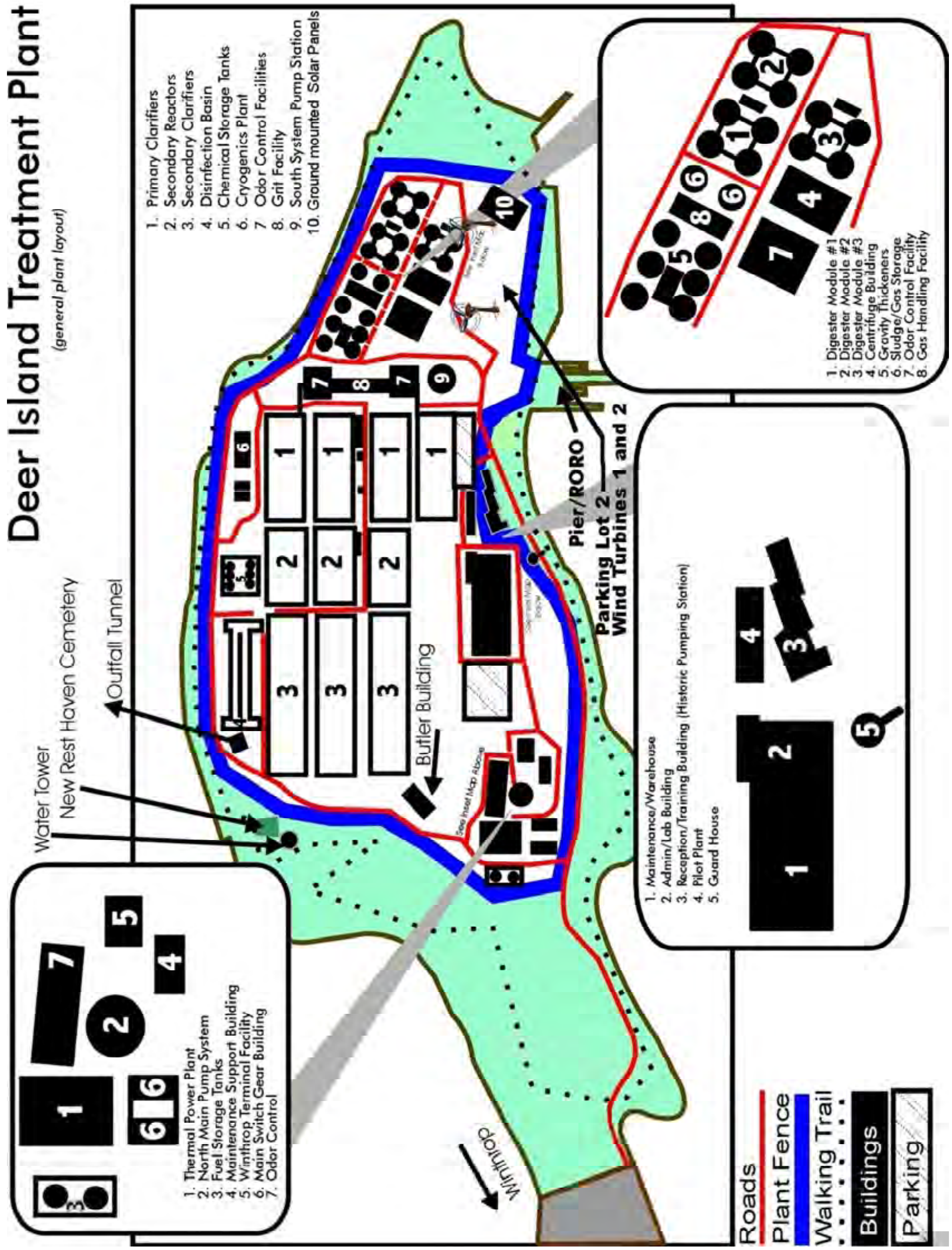
Wastewater from MWRA's 43 member sewer communities enters the DITP via three cross-harbor tunnels: two that serve north system communities and one that serves south system communities (see Figure 6-1). The DITP process layout is shown in Figure 6-2. The limited available acreage on which to build the DITP facilities created space constraints that resulted in uncommon engineering solutions such as stacked clarifiers, centrifugal grit removal, on-site oxygen generation used in pure oxygen activated sludge reactors, and the distinctive egg-shaped digesters.

DITP is designed to process a maximum of 1.27 billion gallons per day of wastewater. The majority of north system flow is tributary to DITP's North Main Pump Station (NMPS) through two deep-rock tunnels, the North Metropolitan Relief Tunnel and the Boston Main Drainage Tunnel. The remainder of north system flow is transported by gravity to the Winthrop Terminal Facility (WTF) through the North Metropolitan Trunk Sewer. Flow from the NMPS and WTF then travels through two force mains to the DITP grit removal facility and is then conveyed to the primary clarifiers. Wastewater from the south system is tributary to the South System (Lydia Goodhue) Pump Station via the Inter-Island Tunnel.

In the primary treatment process, wastewater moves slowly through large clarifier tanks where material either settles to the bottom or floats to the surface. Constantly moving chain and flight mechanisms slowly skim the floatables off the surface into scum collection tubes, and flights moving along the bottom scrape settled solids (primary sludge) into collection hoppers. The collected primary sludge and scum are pumped to gravity thickener tanks for further settling and water removal further concentrating the solids. Supernatant from the gravity thickeners is recycled through the plant and the thickened primary sludge and scum are pumped to anaerobic digesters. The primary clarifier effluent flows by gravity into "reactor/selector" tanks, to begin the biological secondary treatment process. A portion of settled sludge from the secondary clarifiers (containing microorganisms) is returned to these tanks, to keep an optimal concentration of microorganisms present in the reactors as the primary wastewater flows into the first reactor. Oxygen is also injected into the wastewater to promote further growth of these naturally occurring aerobic microorganisms, which feed on the organic matter in the wastewater. At this stage, the wastewater is called "mixed liquor" or "activated sludge". After passing through the reactor/selector tanks, the activated sludge enters the secondary clarifiers, which are operated in the same manner as the primary clarifiers. The secondary sludge settles out, leaving a clearer effluent that overflows the tanks into the secondary effluent channels. This secondary effluent is disinfected and discharged down a shaft into the outfall tunnel where it is dechlorinated and transported 9.4 miles out into the waters of Massachusetts Bay. The DITP effluent is discharged through diffusers along the last 1.25 miles of the outfall where it mixes with ocean currents.

FIGURE 6-1
Deer Island Treatment Plant Location Plan

FIGURE 6-2 DITP Process Layout



Secondary sludge is collected from the bottom of the secondary clarifiers and either recycled to the head of the reactors or pumped to the centrifuge facility where excess water is removed. Thickened secondary sludge is pumped to the anaerobic digesters, and centrate from the centrifuges returns to DITP for treatment. Thickened primary sludge, thickened secondary sludge, and concentrated scum all are mixed in the egg-shaped anaerobic digesters. Each of the 12 digesters holds three million gallons. The anaerobic digestion process involves maintaining a warm, well-circulated, oxygen-free environment to encourage the growth of anaerobic microorganisms. Over time, these microorganisms break down the sludge mixture into simpler compounds (methane gas, carbon dioxide, solid organic byproducts, and water). The methane gas produced in the digesters is used in DITP's Thermal Power Plant, while the digested sludge is pumped to MWRA's Residuals Pellet Plant in Quincy, where it is processed into fertilizer pellets. Pellet Plant operation and residuals disposal are detailed in Chapter 7.

6.03 Management and Staffing

The Director, Wastewater Treatment is responsible for the overall strategy and management of Deer Island, the Residuals Pellet Plant (see Chapter 7) and the Clinton Advanced Wastewater Treatment Plant (see Chapter 14). There are four key staff that manage various Deer Island Departments: (1) Deputy Director, Operations; (2) Deputy Director, Maintenance; (3) Manager, Process Control; and (4) Manager, Engineering Services. DITP Departments (detailed below) comprise approximately 254 approved positions. The process used for development of the annual current expense and capital improvement budgets are also detailed in this Section.

Operations Department

The DITP Operations Department consists of three functional groups: Wastewater Operations, Thermal Plant Operations, and Process Control. Operators and Area supervisors in the Wastewater Operations group are responsible for the operation and regulatory compliance of the wastewater and odor control treatment facilities and are assigned to the four main treatment process functional areas: power and pumping, primary treatment, secondary treatment/disinfection, and residuals. The Thermal Power Plant group is responsible for the operation and regulatory compliance of the on-site Thermal Power Plant, which is critical to providing supplemental and back-up electrical power needed to maintain uninterrupted treatment plant operations at DITP. The Process Control group has Process Monitoring and Process Optimization units. Process Monitoring staff manages the monitoring and adjustment of process control set points, and development and management of day-to-day technical support for the Operations Department and management of the plant’s Process Instrumentation and Control System (PICS), as well as the implementation of any process improvement or optimization initiative. Optimization initiatives managed by the group include efforts aimed at improvement in plant process control, as well as energy or chemical use reduction. The process control department oversees all operating permits for DITP (NPDES, air, and stormwater). Work performed by the Operations Department is supplemented by a series of service contracts, as listed below:

- PICS and instrumentation maintenance;
- All major chemical deliveries;
- Activated carbon replacements and nitrogen purging;
- Digester storage tank repairs;

- Maintenance for boilers, CTGs, STGs, wind turbines and hydroturbines;
- Thermal Power Plant continuous emissions system audits and maintenance;
- Air quality compliance (assistance to Real Property staff); and
- Electric power purchase and supply.

Maintenance Department

The MWRA is committed to providing timely and efficient maintenance for the DITP to protect the facility and equipment assets. The Maintenance Department is responsible for performing preventive, predictive, and corrective maintenance on approximately 70,000 pieces of equipment. This Department consists of 135 staff, including laborers, painters, carpenters, electricians, plumbers, machinists, planner/schedulers, and facility management staff.

The Asset Management Group is in this Department. Asset Management Group responsibilities include optimizing crew size and productivity, developing cross-functional job descriptions, establishing a framework for the long-term maintenance program, construction coordination, and warranty work. A common issue in public utilities is that some amount of staff downtime can result from one tradesperson waiting for another tradesperson to perform a work task. Single-skill labor systems, which emphasize skill separation or specialization, are less flexible and require larger workforces to deliver services. DITP’s workforce flexibility program is intended to minimize staff downtime. Workforce flexibility is the practice of improving quality and productivity through the use of cross-functional training and multiple-skill development for DITP staff. The objective of workforce flexibility is to promote skill sharing for tasks critical to maximizing the effectiveness of human resources. To this end, Deer Island has developed a program to significantly increase the flexibility of its workforce. An agreement with the affected trade unions was reached and staff have been trained to efficiently implement this program.

Work performed by the Maintenance Department is supplemented by a series of service contracts, as listed below:

- Crane and elevator maintenance;
- Centrifuge and oxygen generation facilities maintenance;
- Electrical equipment testing and maintenance;
- Instrumentation maintenance;
- Fuel supply (propane, gasoline and bio-diesel for vehicles);
- Overhead door maintenance;
- Odor control chemical treatment;
- Digester mixer repair and/or refurbishment;
- Janitorial, pest control, grounds keeping, trash removal services;
- Laser alignment, vibration monitoring, and lube oil analysis services;
- Air balancing and lab hood certification support services; and,
- Catch basin inspection and cleaning services.

Engineering Services Department

The Engineering Services Department oversees DITP's capital replacement program, develops technical specifications for service and construction contracts in all disciplines, and provides engineering services for in-house maintenance projects. Plant Engineering staff manage the three "As-Needed Technical Services" contracts, which provides engineering assistance by task order for some of the more complex projects undertaken by the Maintenance Department at Deer Island and at the Clinton Advanced Wastewater Treatment Plant.

Staff in Engineering Services work with all other Deer Island Departments to identify the capital improvement projects necessary to maintain and/or improve facility and equipment assets in order to achieve MWRA and regulatory objectives. The capital improvement program (CIP) budget process involves semi-annual coordination with Project Managers to compile the data and backup documentation for DITP projects. The Department executes and manages contracts necessary for completion of CIP projects, as well as manages the Technical Information Center, where record drawings, contract specifications, and equipment manuals are kept for reference as needed. Engineering Services staff work with other DITP groups and MWRA's Procurement Department to develop, review and edit specifications for obtaining goods and services needed by all areas of DITP from outside suppliers. The contracts cover engineering services, construction projects, supply and delivery of chemicals, maintenance of specialized equipment and systems, and housekeeping (janitorial, pest control, trash removal, grounds keeping, etc.).

Work performed by the Engineering Services Department is supplemented by a series of service contracts, as listed below:

- NEFCo Contract for operation of the Residuals Pellet Plant (see Chapter 7);
- Three As-needed design consultant contracts (CIP task-order contract);
- Technical standards reference sources; and,
- Printing services.

DITP Support Department

The DITP Support Department provides information, personnel and programs necessary to support the other DITP Departments. This Department consists of three functional groups: Administration and Finance, Safety/Security, and Permits. This group reports directly to the Director, Wastewater Treatment. The Administration and Finance group is responsible for development of the DITP current expense budget (CEB), requisitioning of low cost items, and coordination with MWRA's Procurement Department to acquire major services and equipment. The Safety/Security group is responsible for integration of environmental, safety and security initiatives into all plant activities. It also provides direction and leadership to the DITP Emergency Response Team, which is trained to respond to chemical spills and personal injuries. Safety staff issue all DITP photo identification cards and parking passes, oversee the security systems contracts, and participate in annual "right to know" and other training programs for DITP staff and outside contractors. The Permits group is responsible for all plant permits except the NPDES permit.

Work performed by the DITP Support Department is supplemented by a series of service contracts, as listed below:

- Site Security and facility hardening;
- Hazardous waste removal and emergency chemical response;
- Ambulance services (managed by the Town of Winthrop beginning in July 2012);
- Fire extinguishers and alarm systems maintenance;
- Closed circuit TV systems maintenance;
- As-needed locksmith services; and,
- Copier and fax machine maintenance.

DITP Budget Development Process

Annual DITP budgets are developed using a bottom-up approach. All cost center managers review the current expense budget (CEB) to determine appropriate annual needs. Managers coordinate with Department heads and review recent data from all the existing contracts as well as future usage projections to help develop the cost basis for many of the chemical and equipment maintenance items. Recent history is often used to project expected costs for most other items. The Deer Island Director and Deputies review the budget, and make decisions regarding the overall DITP CEB request.

The Engineering Services group compiles the annual capital improvement program (CIP) budget for DITP. Current cost and schedule data on existing projects is reviewed and, as with the CEB, a bottom-up approach for identifying new capital projects is used. Members of all maintenance and operations departments meet with Work Coordination Managers to discuss any DITP issues that need to be addressed within the CIP. New projects, as well as projects previously proposed are reviewed and prioritized by the DI Director and Deputies. Projects believed to be of the highest priority are recommended for consideration in the CIP.

6.04 Operation and Maintenance of DITP

Given the significant value and critical nature of MWRA DITP assets, maintenance is of paramount importance. In 1996, the MWRA Facilities Asset Management Program (FAMP) initiative was created as a comprehensive, agency-wide effort to efficiently and effectively manage water and sewer infrastructure. The goals of FAMP include coordinated, consistent asset inventory; condition assessment; maintenance scheduling; long-term replacement planning; and cost-effective operations and maintenance procedures. During start-up of DITP facilities, MWRA conducted maintenance on a calendar schedule in accordance with the original equipment manufacturers' recommendations. This approach to maintenance was primarily driven by contractual obligations for equipment warranties. The Authority's management team believed that it was important to modify its initial program with the goal of achieving a more holistic approach to maintenance management. A key component of the FAMP initiative was implementation of Reliability Centered Maintenance (RCM) for all of the critical systems at DITP.

The computerized maintenance management software (CMMS) used by MWRA is MAXIMO. This software is used to manage all aspects of the DITP maintenance program including work-order management, planning and scheduling, asset management, resource management, tracking various maintenance costs, and generating reports for analyses. The software has tremendous data storage capabilities and is equipped with built-in failure analysis programs. In addition, MAXIMO contains the historical record for all maintenance activities, allowing staff to better address a problem with a particular facility or piece of equipment. Staff can generate reports that compare current-year spending against historical spending for each asset, process area, and/or facility. This may indicate that an asset is nearing the end of its useful life (i.e., maintenance spending has increased significantly) and can provide advance warning to initiate the replacement planning process. Maintenance staff can prioritize tasks, assign work based on the availability of necessary parts and labor, and analyze equipment failures in order to implement appropriate preventive maintenance measures. MAXIMO's functionality includes a history of yearly costs for all 70,000 pieces of equipment at DITP. Current Condition Assessments are used to assist maintenance staff in determining when a particular asset needs to be scheduled for repair, upgrade, or replacement. DITP relies on an extensive predictive maintenance program, which has almost doubled the equipment tested over the last five years. Several non-invasive condition monitoring methods are used, including: vibration testing/data collection, acoustic ultrasonics, ultrasonic thickness measurement, lube oil sampling and analysis, and infrared thermography. These techniques are used to monitor and/or evaluate each asset’s current and/or future condition. The time frame for a potential failure is indicated and allows the maintenance planning group to respond quickly before the asset is non-operational. The goal of predictive maintenance is to determine early detection and eliminate the possibility of catastrophic failure which could have major operational impacts or environmental and safety consequences for the Plant.

Service and Consultant Contracts Programmed in the FY19 CIP:

- DI As-Needed Design 8-1, 8-2, and 8-3 projects, used to supplement in-house engineering staff, are programmed in the FY19 CIP at a cost of $4.20 million during FY17-20. Expenditures during the planning period (FY19-20) are $2.799 million. The As-Needed Design contracts are task-order contracts with engineering firms that have multiple engineering disciplines (structural, civil, mechanical, electrical, and chemical) as well as other technical consultants with expertise in fields such as hydrology, biology, landscape design, architectural design, marine biology, etc. Three contracts were issued and run concurrently for three years each. These resources are used to supplement the skills of in-house staff and provide assistance with developing specifications for various construction contracts needed to move DITP projects forward.
- DI As-Needed Technical Design Project that acts as a placeholder for CIP funds to be used as the As-Needed Contracts are developed. A total budget of $22.250 million is programmed in the FY19 CIP for expenditure during FY20-29 at approximately $2.2 million per year.

Service and Consultant Contracts Recommended for Consideration in Future CIPs:

- DI Future As-Needed Design (following the current 8-1, 8-2, and 8-3 projects) used to supplement in-house engineering staff is recommended for consideration in future CIPs at a budget of $1.5 million annually during FY21-28 for a total cost of $12.0 million.
- DI Future As-Needed Technical Design (placeholder) Project is recommended for consideration in future CIPs for continuation of the project at a budget of $2.0 million annually for FY29-58 and a total cost of $60.0 million.
- Various CEB-funded service contracts are issued to supplement work performed by DITP staff. Service contracts managed by individual DITP Departments are listed in Section 6.03.

Equipment Replacement Placeholder Recommended for Consideration in Future CIPs:

- DI Future Equipment Replacement Project to provide a long-term placeholder budget for funding new projects and/or increases to existing projects for DITP equipment replacement is recommended for consideration in future CIPs at an estimated cost of $2.0 million annually during the FY24-58 timeframe and a total cost of $70.0 million over 35 years.

6.05 Pumping and Preliminary Treatment

There are three pump stations on Deer Island: the South System (Lydia Goodhue) Pump Station, the North Main Pump Station, and the Winthrop Terminal Facility. North system flows (from the North Main Pump Station and the Winthrop Terminal Facility) pass through DITP grit removal (circular vortex grit chambers) prior to entering the primary treatment process. Each facility is detailed in this Section. Figure 6-3 shows the pumping process flow schematic.

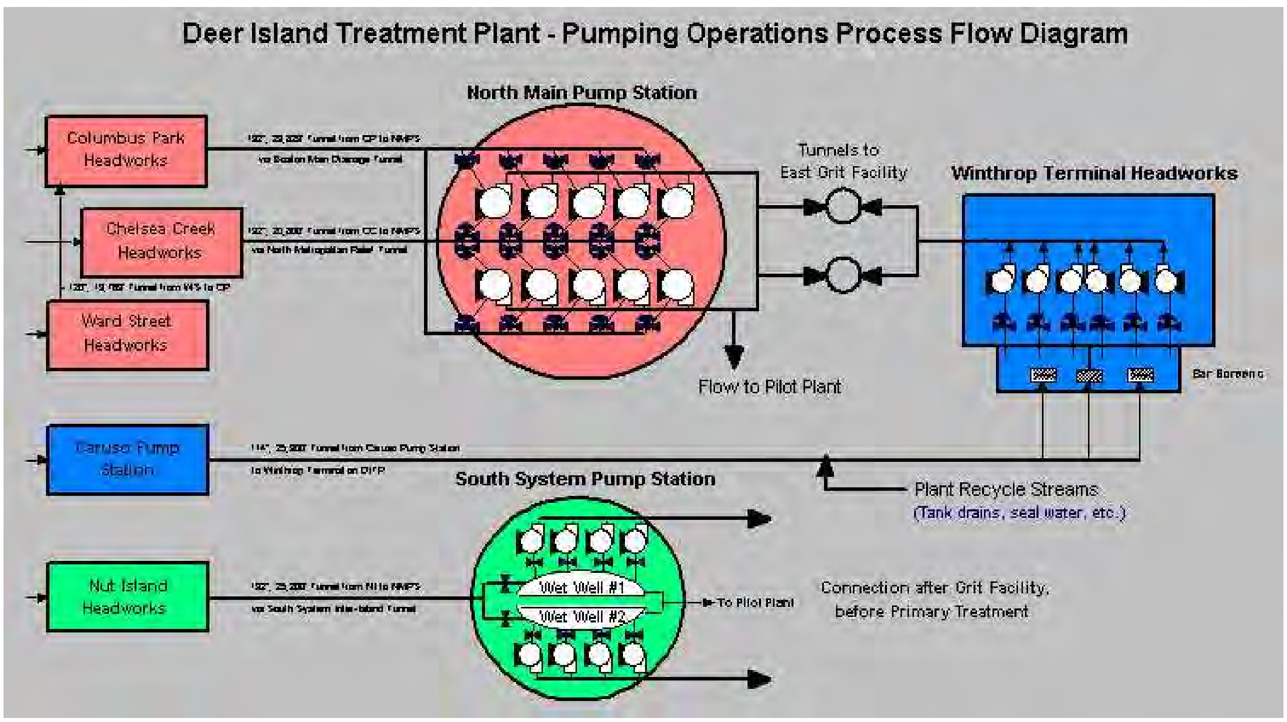


FIGURE 6-3 Pumping Process Flow Schematic

South System Pump Station

Facility Function and Operation: The South System (Lydia Goodhue) Pump Station (SSPS) is located just west of the DITP Grit Facility. Flow is conveyed 4.8 miles across Boston Harbor through the 11.5-foot diameter Inter-Island Tunnel from the Nut Island Headworks. On Deer Island, an 11-foot influent conduit conveys flow to the influent chamber from the north shaft of the Inter-Island Tunnel. Flow is directed from the influent chamber through sluice gates to one or both of the semi-circular wet wells. Each set of four pumps discharges to one of two force mains that deliver south system flows to the North System Grit Facility effluent channel, to be combined with the north system and recycle flows. The total flow is then split between Primary Clarifier Batteries. An alternative discharge location for the south system flows directly to Primary Clarifier Battery D is available, allowing for isolation of the south system flow, however, it is rarely used. In this mode, the two 96-inch force mains discharge into the Battery D primary influent channel ahead of the venturi flow control valve. Two pair of 96-inch motor-operated butterfly valves located in the Pretreatment Gallery can divert the flow. Functional testing was completed in January 1996 and substantial completion was in February 1996. Preventive maintenance continued at SSPS until the Inter-Island Tunnel and Nut Island Headworks were completed. On March 13, 1998, steel plates were removed from the Nut Island effluent channel, allowing flow to the South System Pump Station. On July 8, 1998, all flow from the South System was diverted to the Inter-Island Tunnel for treatment at DITP.

Facility Components: The SSPS has eight raw wastewater pumps, six operating at peak flow and two standby. The two wet wells are each served by four Worthington vertical, non-clog centrifugal pumps rated for 66.7 mgd and equipped with mechanical seals. The 60-inch pump suction piping is equipped with a motorized gate valve to provide a tight shutoff when maintenance is required. The 54-inch pump discharge is equipped with a check valve, a 48-inch flow meter, and butterfly valve.

Hydraulic Performance: The SSPS wet wells were designed to receive from 80 mgd to 400 mgd. Design flows for the SSPS are based on the design pump capacity of 66.7 mgd per pump. Peak flow is based on hydraulic capacity of the High Level Sewer, the Nut Island Headworks, and the Inter-Island Tunnel. Minimum flows of 80 mgd are handled using one or two pumps. Average flows of about 150 mgd are handled using two or three pumps. Peak flows up to 400 mgd are handled using up to six pumps. Since startup of the SSPS, modifications were made to the plant's hydraulic profile under typical operating conditions. The design called for the pump rate to be set by several factors, including the water surface elevation at the Nut Island Shaft and the head loss due to friction in the Inter-Island Tunnel. The set points were modified to keep the Nut Island shaft water elevation as high as possible. The SSPS level is controlled by pumping the amount equal to the inflow, with adjustments made to maintain level in the tunnel shaft. This reduces the head working against the SSPS pumps.

Facility Power: The eight pumps are driven by synchronous electric motors through VFDs. The motors on the ground floor level are connected to the pumps through three sections of shafting. The motors are rated for 343 to 1,250 horsepower with a minimum pump speed of 260 rpm and a maximum of 400 rpm. Two 13.8 kV-to-480V transformers provide station service through a nearby substation and the Thermal Power Plant provides back-up power.

Projects Programmed in the FY19 CIP:

- SSPS Variable Frequency Drives (VFDs) Replacement design, ESDC, and construction is programmed in the FY19 CIP at $25.017 in FY19-26. Previously, the VFDs at the SSPS were replaced in FY07-08.
- SSPS Pump Lube System Replacement to change the pump lubrication system from the current system using grease to a new system using oil is programmed in the FY19 CIP at $1.0 million in FY20. Once installed, the new system will require only routine maintenance and should not require replacement.

Projects Recommended for Consideration in Future CIPs:

- Future upgrades at the SSPS including VFD replacement ($25 million every 15 years); shaft, motor, and MCC replacements ($10.0 million every 20-25 years), and additional rehabilitation needed as the facility ages ($10.0 million) is recommended for consideration in future CIPs at an estimated cost of $45.0 million with a target schedule of FY39-48.

North Main Pump Station

Facility Function and Operation: The North Main Pump Station (NMPS) was initially constructed in 1968 as part of the original DITP. It is located on the northwest corner of Deer Island, near the Thermal Power Plant and was rebuilt in 1991 under the Boston Harbor Project. The NMPS receives flow from the North Metropolitan Relief Tunnel (from the Chelsea Creek Headworks) and the Boston Main Drainage Tunnel (from Columbus Park and Ward Street Headworks). Butterfly and knife gate valves can be configured so that any of the pumps can pump from either of the influent tunnels to either of the two force mains on Deer Island (North System Tunnels 1 and 2), conveying the flow to the DITP Grit Facility.

Facility Components: The NMPS houses ten pumps and motors. The pump station is approximately 120 feet in diameter and has seven levels, from the lowest level where the suction piping is located, up to the ground floor where the pump motors and discharge piping are located. Each motor has a variable frequency drive, and each pump discharges through a flow meter. Knife gates and 60-inch butterfly valves on both sides of each pump allow for maintenance isolation. The discharge side of each pump also has a check valve.

Hydraulic Performance: Four pumps can handle the peak design flow of 350 mgd from the North Metropolitan Relief Tunnel, and four pumps are needed for the peak design flow of 438 mgd from the Boston Main Drainage Tunnel, allowing for two standby pumps. The pumps are valved to pump to North System Tunnel No. 1 or 2. A cross-connection allows the pumps to discharge to either tunnel. Each vertical non-clog centrifugal pump is rated for 110 mgd maximum. Nine of the pumps discharge through a magnetic flow meter; the venturi meter for pump 10 was not replaced. An algorithm in the control system manages the speed of the pumps and adjusts the speed to match headworks flow and maintain a set point shaft level at the remote headworks.

Facility Power: Each pump is driven by a 3,500-hp electric motor with a VFD. Four 13.8-to-4.16 kV transformers in a nearby substation provide power to the NMPS motors as well as to the WTF switchgear and equipment. A second substation with two 4.16kV-to-480V transformers provide station service to the NMPS. Back-up power is provided to all DITP facilities through the Thermal Power Plant's electric power generation equipment.

Recent Upgrades Completed:

- Butterfly valve replacements for the NMPS and Winthrop Terminal Facility were completed in FY18 at a cost of $17.6 million.
- NMPS Variable Frequency Drive (VFD) and motor replacement was completed in FY16 at a cost of $25.7 million.
- NMPS removal of the diesel engines (Enterprise Engines) was completed in FY16.

Projects Programmed in the FY19 CIP:

- NMPS Variable Frequency Drives (VFD) Replacements design, ESDC, and construction is programmed in the FY19 CIP at $29.420 million in FY25-32. This phase of VFD replacement is planned to include motor replacements. Previously, the VFDs at the NMPS were replaced in FY13-16.
- NMPS Harmonic Filter Replacement is programmed in the FY19 CIP at $20.0 million in FY28-32. This project is planned to be reevaluated and may be combined with the VFD replacements.
- NMPS Motor Control Center (MCC) phase 2 sequential replacement of equipment that is currently obsolete and unreliable including ESDC, REI, and construction is programmed in the FY19 CIP at a total cost of cost of $13.066 million in FY17-23. Expenditures during the planning period (FY19-23) are $12.388 million.

Projects Recommended for Consideration in Future CIPs:

- Future upgrades at the NMPS including VFD replacement ($25 million every 15 years); shaft, motor, and MCC replacements ($15.0 million every 20-25 years), and additional rehabilitation needed as the facility ages ($10.0 million) is recommended for consideration in future CIPs at an estimated cost of $50.0 million with a target schedule of FY44-53.

Winthrop Terminal Facility

Facility Function and Operation: The Winthrop Terminal Facility (WTF), also part of the original 1968 Deer Island Wastewater Treatment Plant, was reconstructed in 1991 under the Boston Harbor Project. The WTF is located on the northwest corner of Deer Island, near the North Main Pump Station, and provides both screening and pumping of influent wastewater. The WTF receives flow from the North Metropolitan Trunk Sewer, which serves East Boston, Revere, Chelsea and Winthrop. It also receives flow from DITP's recycle and sanitary flow streams. Influent wastewater is screened by mechanically cleaned bar screens, discharged to one of two wet wells, and then pumped through the North System Tunnels to the DITP Grit Facility.

Facility Components: The motor and pump area of WTF consists of three levels. The sub-basement contains three influent channels, two wet wells, and the pump room which houses six pumps. The basement level contains the screen room and operating floor. The uppermost level houses the screenings discharge area with vacuum/wash press equipment, motor room, and personnel facilities. There is an electrical substation at ground level, adjacent to the motor room.

Hydraulic Performance: The six original lift pumps were replaced in order to pump from the WTF to the force mains leading to the DITP Grit Facility. Some pumps regularly pump to North System Tunnel 1; others pump to North System Tunnel 2. A cross-connection is provided to allow the pumps to discharge to either tunnel. The six pumps are rated for 10 to 32 mgd, (throttled down to deliver low flows). Four pumps are needed to deliver the peak flow of 125 mgd, with two on standby. The number of pumps needed is determined from the water level in the two wet wells. Each pump has its own suction line with an isolation valve downstream of the sluice gates, screens, and wet wells. Each 36-inch discharge line has a check valve, an isolation plug valve, and a magnetic flow meter.

Facility Power: Each pump is equipped with a VFD in conjunction with a 600-hp motor. Station power comes through a nearby substation and the Thermal Power Plant provides back-up power.

Recent Upgrades Completed:

- Replacement of twelve 36-inch and three 48-inch isolation plug valves at the Winthrop Terminal Facility were completed in FY17.

Projects Programmed in the FY19 CIP:

- WTF Variable Frequency Drives (VFDs) replacement that are obsolete and miscellaneous smaller VFDs throughout the DITP is programmed in the FY19 CIP at $11.951 million in FY17-21. Expenditures during the planning period (FY19-21) are $7.656 million.
- Additional Variable Frequency Drives (VFDs) replacement for other miscellaneous smaller VFDs throughout the DITP is programmed in the FY19 CIP at $4.496 million in FY21-26.

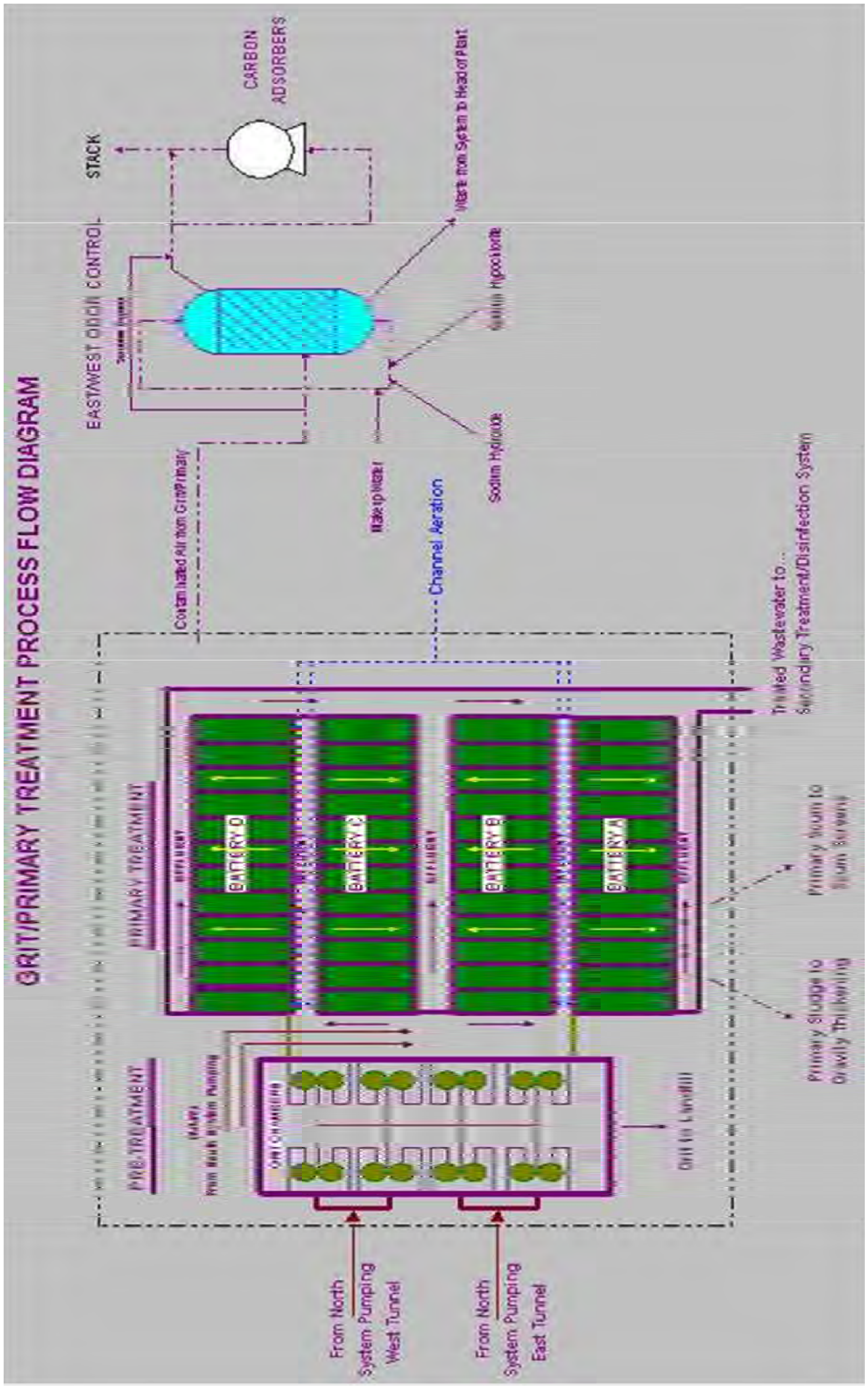
Projects Recommended for Consideration in Future CIPs:

- Future upgrades at the WTF including VFD replacement ($10 million every 15 years); shaft, motor, and MCC replacements ($5.0 million every 20-25 years), and additional rehabilitation needed as the facility ages ($5.0 million) is recommended for consideration in future CIPs at an estimated cost of $20.0 million with a target schedule of FY34-43.
- Future replacement of miscellaneous smaller VFDs throughout DITP is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $10.0 million each cycle with a target schedule of FY34, FY44, and FY54 and a total cost of $30.0 million during the planning period.

Deer Island Grit Facility

Facility Function and Operation: The DITP Grit Facility is designed to remove grit from screened wastewater pumped from the North Main Pump Station and the Winthrop Terminal Facilities. The grit removal facility is designed to protect downstream equipment that could be damaged by grit, such as sludge collector mechanisms, pumps, and centrifuges. North System flows from the NMPS and WTF are transported to the DITP Grit Facility through two 11.5-foot force mains (North System Tunnels east and west). Each tunnel splits into two 7-foot riser pipes, which enter the center influent channel at the Grit Facility, and feeds the circular vortex grit chambers. Substantial completion of the Grit Facility occurred on December 15, 1994, with facility start-up on January 20, 1995. All remote headworks have horizontal-flow grit removal equipment (see Chapter 8). However, flow conveyed to DI through the North Metropolitan Trunk Sewer is only screened at the Winthrop Terminal Facility. Grit removal is accomplished at the DI Grit Facility. The grit process flow diagram is shown in Figure 6-4.

FIGURE 6-4 Grit and Primary Treatment Process Flow Diagram



Facility Components: The structure encloses 16 circular vortex grit chambers, screw classifiers, belt conveyors, air handling units, air compressors, wastewater channels, and two truck loading bays for grit removal and disposal.

Hydraulic Performance: Flow from North System Tunnels 1 and 2 riser pipes enters the grit facility's center influent channel, then enters each of the grit chambers tangentially through an approach channel and undergoes either a clockwise or counterclockwise rotation of 270° before exiting over a weir and into the sloped, common effluent channel. All effluent exits the grit facility on the north side of the building and flows into an effluent distribution chamber. Typically, 14 of the 16 circular vortex grit chambers are in service and two on stand-by. Each unit has a hydraulic loading rate of 23.6 mgd (design average) and 65 mgd (design peak). The grit removal efficiency is dependent on the grit mesh size. Heavy organics and grit are moved to the outer wall of the vortex grit chamber by centrifugal force, then settle to the bottom of the grit chamber where a paddle mixer "washes" the organics from the heavier grit particles. The particles that pass through the mixer settle into the grit hopper at the bottom of the chamber. An airlift system cycles to raise the mixture of grit and water through a pipe at the center of the chamber and discharge it to a screw classifier.

The screw classifier provides further removal of organics and water from the grit, and discharges the washed grit onto belt conveyors. Each belt conveyor serves four grit chambers and transfers the grit to two shuttle conveyors. The shuttle conveyors, each serving eight grit chambers, distribute grit into trailers located in the truck-loading bays. The shuttle conveyor belt direction is reversible so that a second trailer may be filled while the first trailer is still in place. The design loading rate per belt conveyor is 8 tons per hour and shuttle conveyor design loading rate is 16 tons per hour.

Facility Power: The Grit Facility is powered by two 13.8kV-to-480V transformers that provide station service through substation switchgear. The Thermal Power Plant provides back-up power.

Projects Recommended for Consideration in Future CIPs:

- Future upgrades at the DITP Grit Facility to replace/upgrade grit removal and air handling equipment and additional rehabilitation needed as the facility ages (estimated at $5 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY30 and FY50 and a total cost of $10.0 million during the planning period.

6.06 Primary Wastewater Treatment

Facility Function and Operation: Primary wastewater treatment involves distributing the influent into the stacked primary clarifiers, where the flow is slowed so that non-suspended solids settle to the bottom. Chain driven mechanisms supported along the sides of each tank have lateral flights which alternately skim the floatables across the surface of the tank to scum collection troughs, then travel to the bottom of the tanks and move settled sludge to cross-collection channels and into sludge hoppers. The upper and lower tanks are hydraulically connected to allow sludge from the upper tank to settle to the hoppers located in the lower tank. Cross collectors move the settled sludge across the hoppers, to where it is intermittently pumped out by the primary sludge pumps.

The primary treatment process flow diagram is shown in Figure 6-4. A cross-sectional depiction of one stacked clarifier is shown in Figure 6-5.

Figure 6-5: Stacked Primary Clarifier 1

Facility Components: The primary treatment facilities have a total of 48, stacked rectangular clarifiers divided into four batteries (batteries A, B, C, and D), each containing 12 primary clarifiers. The primary treatment facilities were constructed under two construction packages, with Batteries A and B, the Central Blower Facility, and associated galleries and support systems coming online in January 1995. Primary Clarifier Batteries C and D came online in September 1995. The Central Blower Facility provides low-pressure air for the aerated channels throughout the plant.

The primary sludge pumping system transports sludge from the clarifiers to the gravity thickener distribution box at the residuals handling facilities. A total of 18 centrifugal pumps are provided for 12 stacked clarifiers in each battery. Pumps are variable speed, with design capacity of 550 gpm.

The primary scum system is designed to collect floatables in the primary clarifiers. The major components are the collector mechanisms; tip tubes, scum wells, pumps, rotating drum screens, scum concentrators, and primary and concentrated scum piping. Each upper and lower tank is equipped with two 16-inch diameter tip tube skimmers for a total of four tip tubes per clarifier; one for each chain and flight mechanism. The primary scum pumping system transfers scum removed from the primary clarifiers to the gravity thickener complex where it is screened and concentrated prior to digestion. Each of the 14 primary scum pumps is rated for 480 gpm to 775 gpm. Discharge piping from the scum wells in each battery connects into a single 10-inch scum header in the pretreatment gallery, which runs through the gallery to the scum screening facility in the gravity thickener complex. Scum is thickened prior to digestion, to reduce the amount of water going to the digesters. Ten progressive cavity pumps transfer concentrated primary scum from the scum wells to the digesters.

Hydraulic Performance: The hydraulic capacity of the four primary treatment batteries was designed to match the maximum transmission capacity of the north and south collection systems and associated pump stations at 1.27 billion gallons per day. The clarifiers were designed to handle this flow rate through the four batteries with 42 of 48 clarifiers in service. Under normal operation, the North System and South System flows are combined, and treated in two of the four primary batteries. During peak flow periods, or when less than 10 clarifiers are available per battery, additional clarifiers are placed into service. The South System piping is also configured to allow for isolated treatment of South System flows in Primary Battery D.

Flow entering the aerated primary battery influent channels is distributed to each of the stacked clarifiers through submerged inlet ports. Flow moves slowly to the opposite end of the clarifiers and over weirs located behind the scum baffles. Each clarifier discharges into a trough leading to the battery effluent channel, which then empties into a common primary effluent cross-channel spanning the width of the four primary batteries. Primary effluent can then be distributed to the secondary treatment facilities, or bypass secondary through drop shafts and channels leading directly to the disinfection facility.

A flow totalizer sums four primary battery flow meters, providing a raw wastewater total flow measurement for the plant. The design flow range is 75 mgd to 360 mgd for each battery. This flow measurement is also used to pace the feed rate of disinfection chemicals and also flow-paces primary influent composite samplers.

Facility Power: The primary clarifier batteries and related equipment are powered through two substations, each with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Recent Upgrades Completed:

- Clarifier Rehabilitation to replace deteriorated water flushing lines (W3H Flush System) was completed in FY14.
- Clarifier Rehabilitation (primary and secondary) to replace scum skimmer tip tubes was completed in the FY17.

Projects Programmed in the FY19 CIP:

- Expansion Joint Repairs construction 3 for clarifiers and retaining walls will continue the ongoing program to periodically replace failed expansion joints in the concrete clarifier decks and/or various retaining walls. This project is programmed in the FY19 CIP at a cost of $1.90 million during the FY20-22 timeframe.
- Clarifier Rehabilitation Phase 2 for primary and secondary clarifiers design, REI, and construction is programmed in the FY19 CIP at a cost of $135.275 million during FY15-23. Expenditures during the planning period (FY19-23) are $134.134 million. This project is a follow-up to the phase 1 primary and secondary clarifier rehabilitation project. Additional work needed to correct deficiencies includes: influent gate seals, effluent launders, primary sludge removal system, secondary aeration/recirculation system, and concrete corrosion.

Projects Recommended for Consideration in Future CIPs:

- Future upgrades at the DITP primary and secondary clarifiers including concrete repairs and replacement/upgrade to mechanical equipment and additional rehabilitation needed as the facilities age (estimated at $50 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY40 and a total cost of $50.0 million during the planning period.

6.07 Secondary Wastewater Treatment

The secondary wastewater treatment process at Deer Island is a biological process, utilizing microorganisms to break down the compounds present in primary effluent, thereby improving wastewater quality prior to discharge. The microorganisms are mixed with the primary effluent in “selector/reactors”. They are selectors because the mode of operation (aerobic or anaerobic; high vs. low recycle rates; high vs. low microorganism concentrations, etc.) determines the predominant types of microorganisms that will thrive in the environment. They are also reactors because the microorganisms are actively processing (eating and breaking down the various compounds that are present) wastewater in the tanks. The mix of microorganisms and wastewater is also referred to as “mixed liquor” or “activated sludge”. Figure 6.6 shows the secondary treatment processes, including the selector/reactors; the polymer feed locations, the waste & return sludge lines, and the secondary effluent channels.

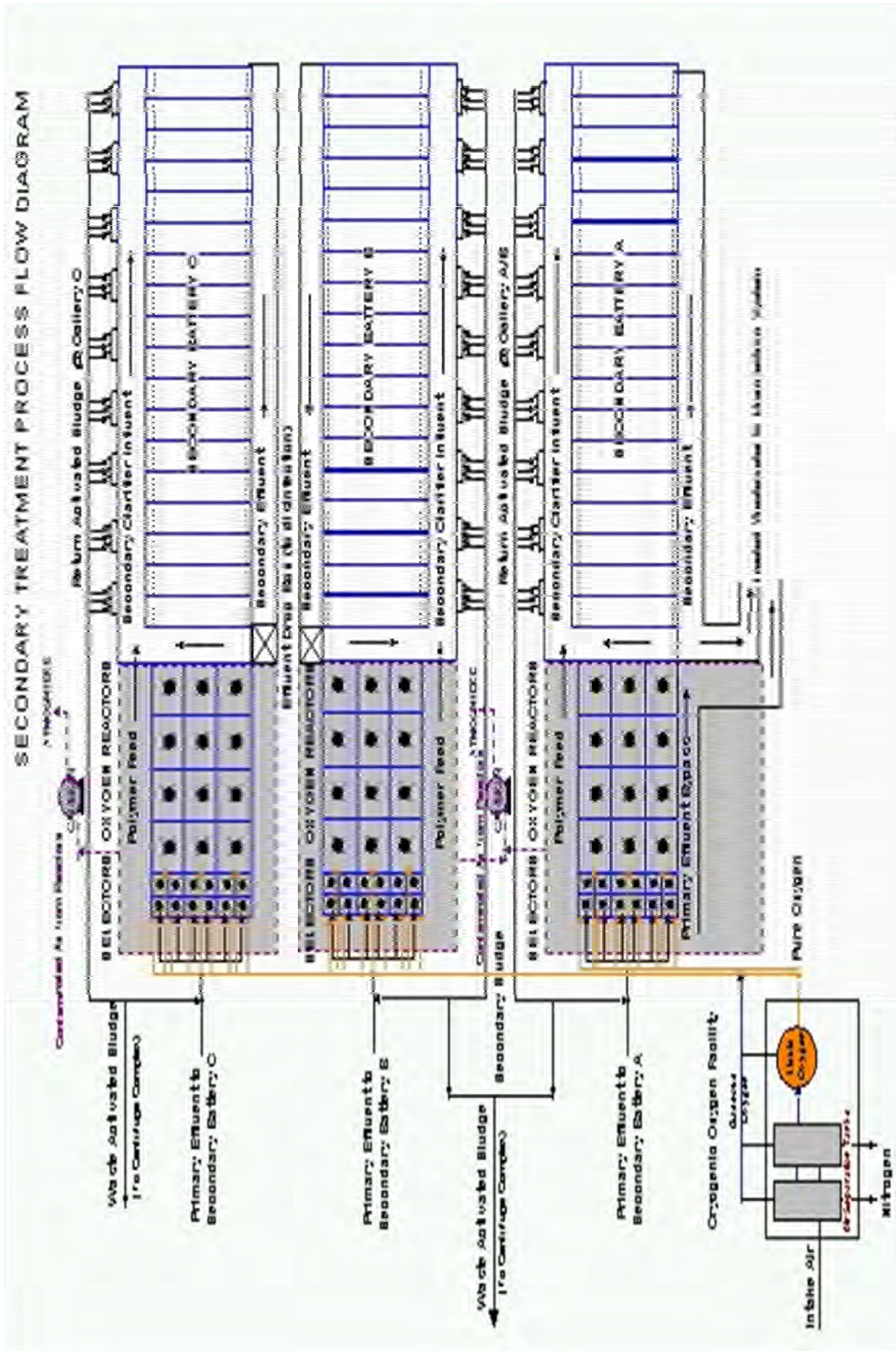
At DITP, the secondary reactor tanks are operated for aerobic microorganisms that require oxygen to survive. Air does not have enough oxygen to maintain the target of greater than 2 mg/l of dissolved oxygen, given the volume of wastewater passing through the secondary reactors. To achieve optimal transfer of oxygen into the wastewater, pure oxygen is maintained in the headspace above the activated sludge in the reactors. This oxygen is generated on-site in the Cryogenics Facility. Large motorized paddles keep the secondary reactor tanks mixed and facilitate the transfer of oxygen into the activated sludge.

After passing through the selector/reactors, the activated sludge enters the secondary clarifiers, which function similarly to the primary clarifiers. The main purpose of the secondary clarifiers is to allow the microorganisms to sink to the bottom of the tanks to be collected and removed. This “secondary sludge” is withdrawn from the clarifiers, with a portion of the flow being reintroduced to the selector/reactors (“return sludge”) to maintain the desired microorganism concentrations. The remaining secondary sludge (“waste sludge”) is thickened and sent to the digesters.

Secondary Selector/Reactors

Facility Function and Operation: Primary effluent flows into the secondary selector/reactors, where it mixes with activated sludge to begin the secondary treatment process. Each of the secondary reactors (designated A, B, and C) has three process trains, to biologically treat the primary effluent wastewater flow. The process trains are compartmentalized into a total of seven stages. Each compartment has openings in the walls to allow passage of activated sludge (mixed liquor), scum/foam, process gas, and purge air to the next stage. Each stage is designed to function as a complete mixed compartment within the process train. The first three stages can function as “selectors” that can be operated for aerobic or anaerobic treatment of the wastewater. Surface aerators and lower mixing impellers are designed to maintain a homogenous mixture within each stage.

FIGURE 6-6 Secondary Treatment Process Flow Diagram



Facility Components: The first and second selector stages are about 43 feet long by 35 feet wide, and each has a two-speed mixer; the third stage is 43-feet long by 70-feet wide and has two dual-speed mixers. Each mixer operates at high speed in the aerobic mode (to aid in oxygen transfer) and low speed in the anaerobic mode (to just keep the activated sludge from settling). The last four stages of each process train are oxygen reactor stages, 70 feet long by 70 feet wide. The gas is vented from the last stage of each process train, through an oxygen vent control valve. Purge air blowers maintain a safe environment by removing detected combustible gases to eliminate a potentially explosive situation.

Hydraulic Performance: All stages have an average liquid depth of 25 feet. High purity oxygen is provided to meet the oxygen demands of the activated sludge process while maintaining a dissolved oxygen concentration greater than 2 mg/l in all reactor stages. The high-purity oxygen gas enters the first selector stage above the liquid surface when the selectors are being operated aerobically. Valves in the oxygen feed line control the oxygen flow to each process train. Oxygen supplied to each process train is transferred to the activated sludge through mechanical surface aeration. Bottom-mixing impellers on each stage's aerator-mixer shaft assembly maintain mixing and suspension of the activated sludge in the tank.

Facility Power: The secondary selector/reactor batteries are powered through six 13.8kV–to-480V transformers providing station service through three substations. The Thermal Power Plant provides back-up power.

Cryogenic Facility

Facility Function and Operation: The Cryogenic Facility separates oxygen from the other components in air, creating concentrated and purified oxygen (in both liquid and gas forms) for use in the secondary selector/reactors. Gaseous oxygen is transferred to the oxygen dissolution system in the reactor basins. The liquid oxygen is transferred to storage. The nitrogen gas waste stream is utilized for cooling the inlet compressed air and then vented to the atmosphere. Facility start-up occurred in January 1997, six months in advance of the start-up time for Secondary Battery A.

Facility Components: The Cryogenic Facility contains two sets of equipment that filter, compress, cool, and separate air to produce pure oxygen. The air separation units (cold boxes) separate air into gaseous oxygen, gaseous nitrogen, and smaller amounts of liquid oxygen. The waste stream from the units is 90-98 percent nitrogen with fractions of oxygen, argon, and other elements. The liquid oxygen system consists of a 1,000-ton storage tank and two 300-ton per day liquid oxygen vaporizers (one operating and one standby). The cryogenic system capacity is 80-300 tons per day.

Facility Power: Two 13.8kV-to-416V transformers provide service power through a nearby substation. The Thermal Power Plant provides back-up power.

Secondary Clarifiers

Facility Function and Operation: There are three secondary clarifier batteries designated A, B, and C, located adjacent to the corresponding reactor/selectors. Each secondary clarifier battery has 18 stacked clarifier sets and receives flow from the corresponding oxygen reactor battery through an aerated influent channel. Flow enters the upper and lower levels of each clarifier via submerged ports. The ports (four upper and four lower) are located at the same elevation in the influent channel. Pipes extend the inlet flow beyond the sludge hopper horizontally into the upper clarifiers and through drop pipes into the lower clarifier. An inlet baffle dissipates energy, providing quiescent flow conditions that promote settling of the solids, and evenly distributes flow entering the tanks. Effluent is collected at the opposite end of the tanks in an effluent trough, which discharges to a 14-foot wide battery effluent channel. Chain and flight sludge collector mechanisms move settled sludge along the bottom of the tanks and scum across the surface, in the same fashion as discussed in the primary clarification sections. A portion of the activated sludge pumped from the collection hoppers is returned to the selector/reactors, and the rest is sent to the centrifuge facility. Secondary effluent flows from each effluent channel into the disinfection facility. Secondary Battery A started operating in June 1997, Battery B by December 1997, and Battery C by December 2000.

Facility Components: Each clarifier has a longitudinal sludge and scum collector, which operate the same as in the primary clarifiers. The flights scrape sludge along the bottom of each tank toward the influent end, rise to the surface, and return to the effluent end of the clarifier, pushing scum along the surface in the upper section and along the underside of the concrete slab in the bottom clarifier. The three secondary clarifier batteries are equipped with 27 return activated sludge pumps. Three pumps are provided for every two clarifiers with two pumps operating and one on standby. Return sludge is measured with a magnetic flow meter on each pump discharge and controlled through the PICS system. Waste sludge is withdrawn from each battery return sludge header with a rate-of-flow controller. Discharge of waste sludge is directed to the residuals facilities or the primary battery influent channel. Each process train is equipped with a scum removal system to remove scum that could otherwise build-up and adversely impact process performance.

A secondary polymer system is provided to dispense polymer into the influent channels of the secondary clarifier batteries to enhance settling and maintain effluent quality during periods of peak flow. There are two polymer systems, one for mixing batches from dry polymer, and one for mixing batches from liquid emulsion polymers. Each system has storage and mixing tanks, dilution tanks, mixers, pumps, piping, and valves required for facility operation. The systems are sized for dosing secondary influent with polymer at 1 to 2 mg/l.

Hydraulic Performance: The secondary clarifiers were designed to process 100 percent of primary effluent under normal dry weather conditions and higher flows up to 700 mgd. Processing flows at too high a flow rate [such as during peak (wet weather) flow conditions above 700 mgd] could disrupt the settling capacity of the clarifier, and decrease the effluent quality. Any primary effluent in excess of the secondary treatment capacity can be routed directly to the disinfection basin, where it is mixed with secondary effluent and chlorinated prior to discharge.

Facility Power: The secondary clarifier batteries and related equipment are powered through two substations, each with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Recent Upgrades Completed:

- Clarifier Rehabilitation to replace deteriorated water flushing lines (W3H Flush System) was completed in FY14.
- Cryogenics Plant Chillers Replacement project to replace three failing air chillers that require frequent maintenance in the oxygen generation plant was completed in FY17.
- Clarifier Rehabilitation (primary and secondary) to replace scum skimmer tip tubes was completed in the FY17.

Projects Programmed in the FY19 CIP:

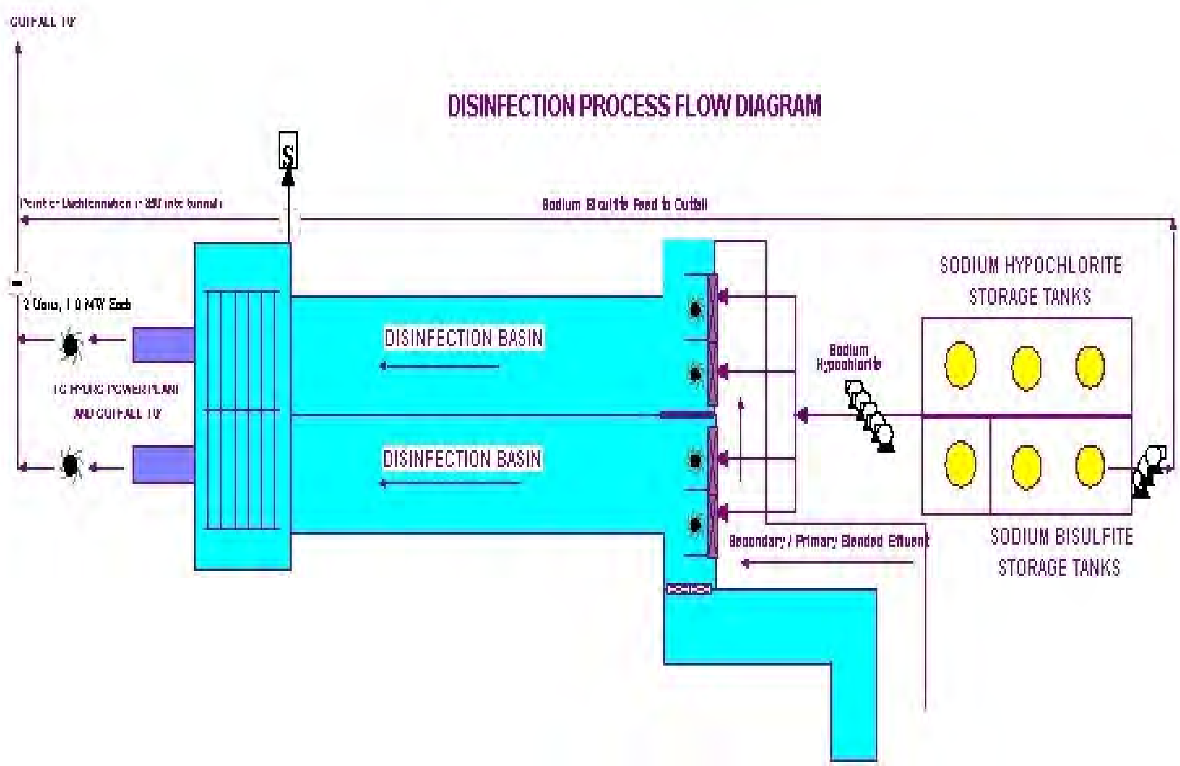
- Cryogenics Plant Equipment Replacement design and construction to replace pumps, valves, motors, sensors, switches, instrumentation, etc. at the oxygen generation plant is programmed in the FY19 CIP at a cost of $18.255 million in FY22-28.
- Expansion Joint Repairs construction 3 for clarifiers and retaining walls will continue the ongoing program to periodically replace failed expansion joints in the concrete clarifier decks and/or various retaining walls. This project is programmed in the FY19 CIP at a cost of $1.90 million during the FY20-22 timeframe.
- Clarifier Rehabilitation Phase 2 for primary and secondary clarifiers design, REI, and construction is programmed in the FY19 CIP at a cost of $135.275 million during FY15-23. Expenditures during the planning period (FY19-23) are $134.134 million. This project is a follow-up to the phase 1 primary and secondary clarifier rehabilitation project. Additional work needed to correct deficiencies includes: influent gate seals, effluent launders, primary sludge removal system, secondary aeration/recirculation system, and concrete corrosion.

Projects Recommended for Consideration in Future CIPs:

- Future Cryogenics Plant Equipment Replacement design and construction and additional rehabilitation needed as the facilities age (estimated at $4.0 million every 10 years) is recommended for consideration in future CIPs with a target schedule of FY37 and FY47 and a total cost of $8.0 million during the planning period.
- Future upgrades at the DITP primary and secondary clarifiers including concrete repairs and replacement/upgrade to mechanical equipment and additional rehabilitation needed as the facilities age (estimated at $50 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY40 and a total cost of $50.0 million during the planning period.

6.08 Disinfection and Dechlorination

The Disinfection Facilities include four sodium hypochlorite storage tanks, two sodium bisulfite storage tanks, two disinfection basins, the disinfection gallery, and associated processes and support systems. Start-up of the permanent disinfection facility occurred on December 14, 1995. Figure 6-7 shows the flow diagram for the disinfection process.



Facility Function and Operation: All plant flow is directed into the disinfection basins for post-treatment chlorination. The outfall bypass conduit remains, to allow use of the existing emergency outfalls in the event the deep-ocean outfall must come off-line. The Disinfection Facilities includes storage and handling facilities to receive sodium hypochlorite deliveries from both truck and barge, and transfer sodium hypochlorite to various locations throughout the plant. Two 12-inch diameter sodium bisulfite solution pipes are attached to the inside wall of the drop shaft and tunnel to deliver dechlorination chemicals to the treated effluent approximately 800 feet downstream of the drop shaft. This takes advantage of a portion of the tunnel volume for chlorine contact time to meet regulatory standards under peak storm conditions.

Sodium Hypochlorite Storage: Four 250,000-gallon tanks are provided for storage of up to 20 percent sodium hypochlorite in an outdoor tank farm surrounded by a containment wall. Each tank is 40 feet in diameter, 30 feet high, covered and vented to the atmosphere through a fume abatement unit. They are top-loaded to prevent the contents from draining if the feed line breaks. As of July 2012 sodium hypochlorite delivery by truck is the least-cost option. Barge delivery was previously used; however, delivery by barge has become prohibitively expensive. Each sodium hypochlorite tank has a storage capacity of several weeks based on the annual average usage. To help avoid rapid sodium hypochlorite decomposition due to high temperatures, the tanks are insulated. The tanks have an ultrasonic monitoring system that displays tank level and high/low level alarms in PICS. The sodium hypochlorite pumped to the disinfection basins is flow-paced to match the metered flows through DITP.

Facility Power: The disinfection basins and related equipment are powered through one substation, with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Projects Programmed in the FY19 CIP:

- Sodium Hypochlorite and Sodium Bisulfite Tank Rehabilitation to strip and reline the chemical tanks most in need of repair is programmed in the FY19 CIP at a cost of $5.0 million in FY19-21. This project may also include rehabilitation to portions of the chemical feed pipeline.
- Chemical Pipeline Replacement design and construction for planned periodic replacement of various chemical pipelines in the disinfection (sodium hypochlorite and sodium bisulfite) and odor control facilities due to deterioration from corrosion is programmed in the FY19 CIP at a cost of $2.717 million during FY22-27.
- Sodium Hypochlorite Tank Rehabilitation or Replacement to strip and reline the four sodium hypochlorite tanks is programmed in the FY19 CIP at a cost of $20.0 million in FY24-27.

Projects Recommended for Consideration in Future CIPs:

- Future evaluation, rehabilitation, replacement, and/or upgrades to the sodium hypochlorite tanks, the sodium bisulfite tanks, and the chemical feed piping system (estimated at $12 million every 10 years) is recommended for consideration in future CIPs with a target schedule of FY37 and FY47 and a total cost of $24.0 million during the planning period.

6.09 Outfall Tunnel and Effluent Discharge

Facility Function and Operation: Disinfected treatment plant effluent can either pass through or bypass the hydropower facility, to the outfall shaft. The outfall chute connects with the tunnel shaft at an invert elevation of 87 feet, which then drops vertically 357 feet to the outfall tunnel invert at elevation – 270 feet. The shaft has a finished inside diameter of 30 feet. From the bottom of the shaft, the outfall tunnel was drilled northeasterly from Deer Island 9.4 miles out into Massachusetts Bay. The outfall tunnel has a finished inside diameter of 24.25 feet for 8.15 miles to the diffuser segment. The precast tunnel liner has six trapezoidal segments in each ring, with neoprene gaskets between all joints. Along the 1.25-mile diffuser segment, the tunnel diameter tapers to maintain an approximately equal head on the diffuser system. The diffuser system consists of 55, 2.5-foot diameter riser pipes, each topped with a mushroom-shaped eight-nozzle diffuser cap that mixes the effluent in the 100-foot deep waters of Massachusetts Bay. The discharge undergoes an initial dilution of at least 70 to 1, which increases depending on the effluent flow rate, the ambient current speed, and ambient stratification. The outfall tunnel and diffuser system were placed into continuous service on September 6, 2000. Figures 6-8 and 6-9 depict the outfall tunnel and a cross-section of a riser and diffuser.

Hydraulic Performance: The anticipated hydraulic performance of the outfall was set forth in the DP-6 Hydraulic Design Report (1995). This report considered the situation where all eight diffuser ports in each of the 55 risers would be open. Instead, it was decided to initially open fewer than the total 440 ports. This reduced number of open ports would convey close to the design peak flow of 1,270 MGD at high tide. The 440 ports were needed to convey the peak design flow with an aged (and hence hydraulically rougher) outfall, for a sea level of 116 feet, corresponding to 100-year storm surge with a 1.9-foot allocation for sea-level rise (M&E, 1989). Another purpose of the reduced number of ports opened initially was to allow verification of the predicted outfall hydraulics, and refine the number of required open ports.

Projects Recommended for Consideration in Future CIPs:

- DI Future Outfall Inspection Project is recommended for consideration in future CIPs (every 20 years) to inspect and make recommendations for cleaning, upgrades, and/or rehabilitation for the DI outfall tunnel, as well as the DI emergency outfalls at an estimated cost of $3.0 million per phase beginning in FY25 and FY45 with a 1-year project duration.

FIGURE 6-8
DITP Outfall Tunnel

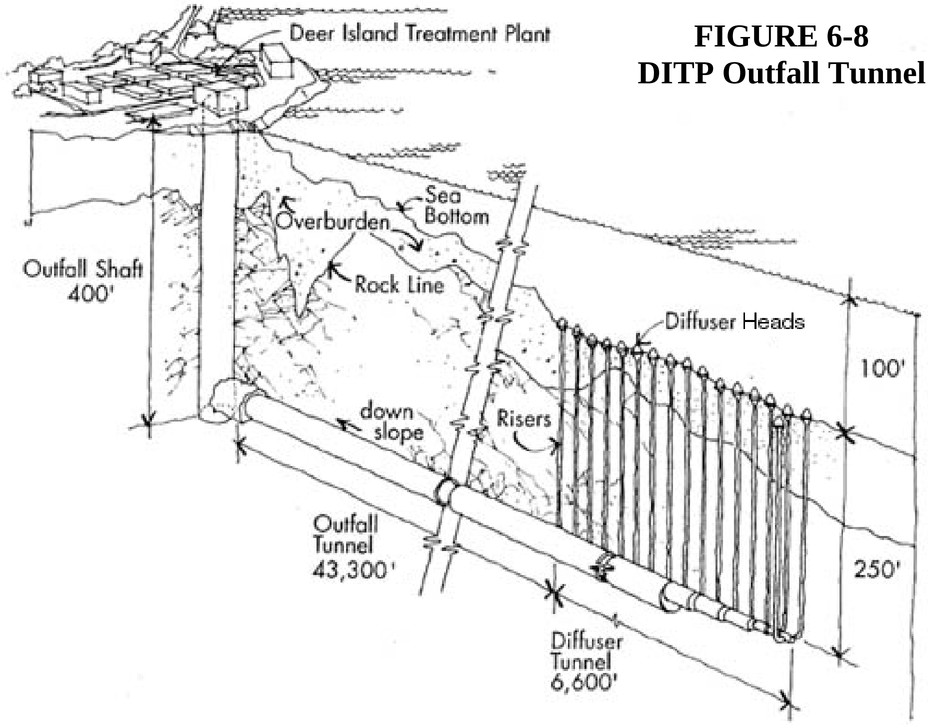
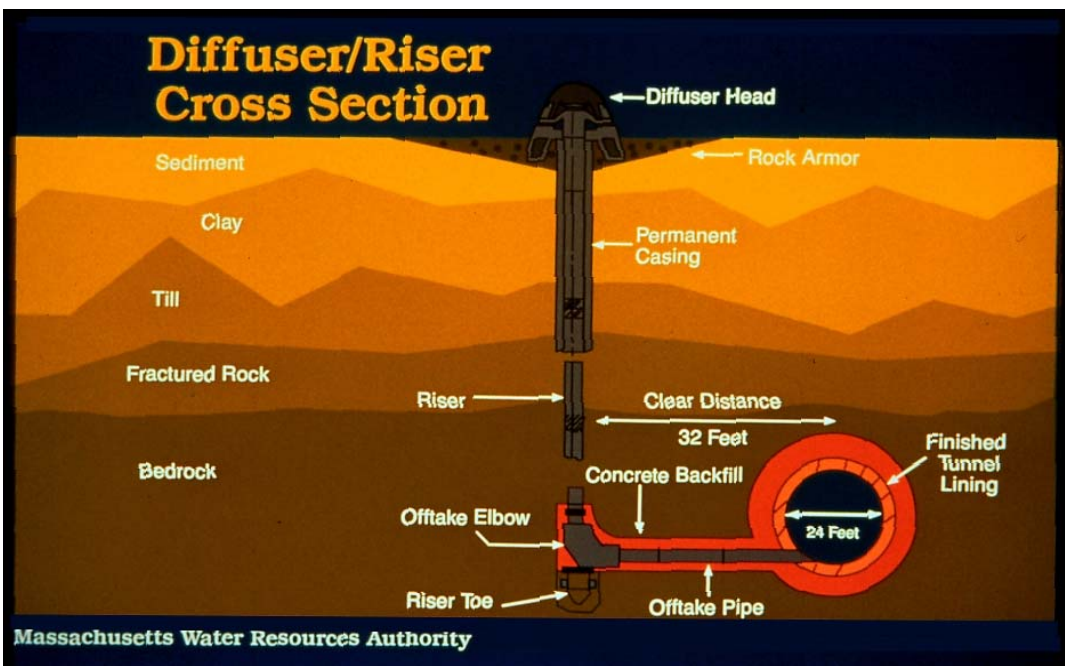


FIGURE 6-9
DITP Outfall Tunnel Cross Section



6.10 Residuals Processing

Residuals processing at DITP includes five major functions: (1) gravity thickening of primary sludge and scum; (2) centrifuge thickening of secondary sludge; (3) digestion of thickened sludge; (4) sludge and digester gas collection and storage; and (5) sludge pumping to the Residuals Pellet Plant. These functions are detailed in this Section.

Gravity Thickening of Primary Sludge

Facility Function and Operation: Six gravity thickeners are used to concentrate sludge and scum removed from the primary clarifier batteries. The primary sludge pumping system transports sludge from the clarifiers to the gravity thickener distribution box. The gravity thickeners allow the sludge to settle and scum to be skimmed from the top of the tank, increasing the solids concentration prior to digestion.

Facility Components: Full-surface skimming equipment is installed in each gravity thickener tank to collect scum and floatables. Each tank has a 12-foot diameter rake arm that revolves around the tank, directing scum toward a scum tip tube. A total of 10 triplex plunger pumps are located in the lower level of the gravity thicker complex. The pump discharge is directed through one of two redundant headers that are connected with the thickened waste sludge headers to form thickened combined sludge leading to the sludge digesters. The gravity thickener overflow exits each tank over a V-notch weir and is pumped as plant recycle flow to the primary treatment facility. Each gravity thickener/scum concentrator is covered and ventilated to an odor control facility.

Hydraulic Performance: All six tanks are able to receive a mixture of primary scum and primary sludge or primary sludge alone. Tanks 1 and 2 are configured to function as either scum concentrators or gravity thickeners. These two tanks, which are capable of receiving screened scum discharged directly from the rotating scum screens, have raised covers with enclosed walkways. The design average flow per concentrator is 2.31 mgd.

Facility Power: The gravity thickener facility and related equipment are powered through one substation, with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Recent Upgrades Completed:

- The CEB contains funds for routine overhauls of gravity thickener equipment at about $50,000 per year. Several of the pie-shaped sections of the fiberglass covers over the gravity thickeners have been replaced using CEB funds, as needed, at approximately $12,000 each. Recoating of the thickener overflow boxes was included in one of the painting and coating contracts.

Projects Programmed in the FY19 CIP:

- Gravity Thickener Rehabilitation Improvements design and construction is programmed in the FY19 CIP at a cost of $19.633 million during FY19-22. This project will be multi-phased including the following components: installation of catwalks around tanks, effluent channel improvements, and upgrades to the roof of the sludge thickener building for access and operating efficiency improvements.

Projects Recommended for Consideration in Future CIPs:

- Future rehabilitation or upgrades to the gravity thickeners and covers (estimated at $20 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY45 and a total cost of $20.0 million during the planning period.

Centrifuge Thickening of Secondary Sludge

Facility Function and Operation: Centrifuges are used to thicken waste sludge from secondary treatment because secondary sludge does not settle well in gravity thickeners. Centrifuges increase the solids concentration from about 0.5 percent to 5 percent before the waste sludge is pumped into the digesters. To aid in the sludge thickening process, the waste sludge is dosed with polymer prior to passing through the centrifuges.

Facility Components: The Centrifuge Building has 12 waste sludge and 4 digested sludge centrifuges. Prior to the Braintree-Weymouth Interceptor coming on line, digested sludge was thickened using centrifuges before being barged from DITP to the Pellet Plant. Currently, the digested sludge is pumped directly to the Pellet Plant at 2 to 3 percent solids concentration. The digested sludge centrifuges are no longer used for this purpose and are available for use as waste sludge centrifuges, or for polymer testing (with some minor piping reconfigurations). The facility also houses dry and liquid polymer feed systems, sludge pumps, and appurtenances. Six centrifuge feed pumps are used for pumping waste secondary sludge to the centrifuge feed header. The thickened waste sludge is discharged into two wet wells and is then pumped to the digesters. The centrate is discharged to one of two centrate wells. The centrate is mixed and pumped to the liquid treatment facilities where it is recycled to either the primary clarifier influent shafts or the primary clarifier effluent channels. There are four polymer systems that use liquid polymer.

Facility Power: The centrifuge building is powered through three substations, each with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Recent Upgrades Completed:

- The CEB includes $275,000 per year for centrifuge refurbishments required for work outside the scope of the annual centrifuge maintenance contract.
- The Centrifuge Back-drive Replacement Project required due to equipment obsolescence was completed in FY15.

Projects Programmed in the FY19 CIP:

- Centrifuge Replacement design and construction is programmed in the FY19 CIP at a cost of $20.8 million during FY24-29.

Projects Recommended for Consideration in Future CIPs:

- A future centrifuge replacement project, including back-drive replacements, (estimated at $20 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY45 and a total cost of $20.0 million during the planning period.

Digestion of Thickened Sludge

Facility Function and Operation: Anaerobic digestion is a biological sludge stabilization process where bacterial microorganisms convert organic material into two main by-products: methane and carbon dioxide. Sludge and concentrated scum is pumped by the thickened primary sludge pumps and the concentrated scum pumps through 10-inch lines into the digester complex. This flow is combined with thickened waste sludge from the centrifuges to form thickened combined sludge, which is the influent flow to the anaerobic digesters. Temperature is one of the critical factors affecting the environment within the digesters and ability to maintain an effective sludge stabilization process. Each of the three digester modules has a separate digester-heating loop to control the temperature of the four egg-shaped digesters. The equipment is located in the basement of each digester module building.

Facility Components: Each of the three digester modules containing four egg-shaped, 3.0 million gallon anaerobic digesters for the digestion of thickened primary and waste activated (secondary) sludge. Module 1, 2, and 3 were completed sequentially in July 1995, December 1995, and December 1997. Three of the four digesters in each module serve as active digesters, while one is typically used for storage of digested sludge. Two sludge and gas storage tanks are located just north of Digester Module 1. All of these facilities are prominently located on the southeast side of Deer Island. The four digesters in a module are oriented in a rectangular pattern with an equipment building in the center of each module. The basement level of the equipment building contains sludge piping, sludge heat exchangers, sludge recirculation pumps, and related process equipment. The upper level contains digester gas piping. A stair and elevator tower provides access to the top of the digesters. The tower is connected to the digesters by elevated walkways.

Hydraulic Performance: The digesters operate in an overflow mode. As raw sludge enters the recirculation loop, digested sludge overflows through telescoping sludge withdrawal pipes to the sludge discharge box located at the top of the digester. Displaced digested sludge exits through the tank's effluent line and flows by gravity to the digested sludge storage tanks.

The digester heating loop is designed to maintain sludge temperatures in each of the 3-million gallon anaerobic digesters within the mesophilic range of 85ºF to 100ºF. The design temperature set point is 98ºF. The primary source of heat for the digester complex is the recirculation of hot water piped from the Thermal Power Plant. Five sludge heat exchangers per module transfer heat from the heat supply loop to the circulating sludge. For each module, six recirculation sludge pumps (two standby) are used for circulating the sludge from the sludge heat exchangers to the digesters. Each sludge heat exchanger also has a dedicated circulating water pump to circulate heated water through the sludge heat exchanger.

A central mechanical draft tube mixing system, sized for a minimum of seven turnovers per day, provides mixing in each of the digesters. The mechanical mixing system is normally operated in the upward flow mode, with periodic reversal of the impeller to help break up any foam or scum layer and to remove accumulated rags and debris from the impeller. If Nocardia bacteria are present, downward pumping will also help control foaming. In the event that this foam control mechanism is not sufficient, the digester gas conveyance system is equipped with foam separators to protect the gas compressors and other components of the gas system. In addition, the facility is equipped with a ferric chloride dosing system to control the formation of struvite.

A co-digestion pilot project was initiated in FY14 following successful bench-scale testing. The project evaluated the impacts of adding food waste, oils and grease to the digesters at DITP and determine what changes in sludge characteristics may result that could have an impact on the residual Pellet Plant process. Co-digestion is intended to develop additional digester gas production resulting in heat/power savings. Unfortunately, the co-digestion trial was halted due to neighborhood concerns due to significant truck traffic associated with the pilot. An attempt to adjust the program to a barge-based operation failed as the project economics determined the pilot to be financially unsustainable. Staff will watch the markets in the future to see if the economics of the operation become more favorable.

Facility Power: Each digester module is powered through a substation, with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Recent Upgrades Completed:

- Digester Sludge Overflow Pipe and Plug Valve construction to replace the most critically deteriorated glass lined piping was completed in FY15 and represents the first phase of sludge piping upgrades.

Projects Programmed in the FY19 CIP:

- Digester and Storage Tank Rehabilitation design, ESDC, REI, and construction to upgrade the three digester modules and two gas handling/sludge storage tanks is programmed in the FY19 CIP at a cost of $38.147 million during FY19-27. This 9-year project represents the second phase of improvements to the sludge digesters and gas handling/sludge storage tanks and will include: sludge piping upgrades, valve replacement, recirculation/mixing system improvements, overflow box upgrades, digester wall steel replacement or repair, digester coating, etc.
- Co-Digestion construction using a design-build contract is programmed in the FY19 CIP at a cost of $5,000 million during FY24-27.

Projects Recommended for Consideration in Future CIPs:

- Future Digester and Storage Tank Rehabilitation design and construction are recommended for consideration in future CIPs (every 15 years) at an estimated cost of $25.0 million for each phase and a target schedule of FY45.

Sludge and Digester Gas Collection and Storage

Facility Function and Operation: The digested sludge overflow from the digester modules flows by gravity into one of the two sludge and gas storage tanks. The gas collected from the top of each digester also flows to these tanks, where special membrane systems maintain an adequate pressure based on the flow of gas. Gas produced in the anaerobic digesters is used to supply as much of DITP's thermal energy requirements as possible. Since the digesters have no usable gas storage, low-pressure gas storage is provided in the two digested sludge and gas storage tanks by a membrane-type gasholder cover. Each tank has a reticulated dome support structure and two membranes. Digester gas is stored in the space between the inner gas membrane and the liquid in the tank. The usable gas volume is 120,000 cubic feet for each tank. Air is pumped into the space between the two membranes to maintain a constant pressure on the methane gas.

Facility Components: These facilities include two 3-million gallon sludge and gas storage tanks, piping, pumps and appurtenances. The gas and sludge storage tanks have two membranes on top, an inner gas membrane and an outer air membrane. Three centrifugal blowers in the gas handling facility supply air to the space between the two membranes. During normal operation, a blower runs continuously and the relief valve opens or closes to control the volume of air in the air chamber in order to maintain system operating pressure. The digester gas handling system collects the digester gas and transfers it to the Thermal Power Plant where the gas is fired in boilers to create steam which is used to heat water, supplying the plant heat loop. If gas production exceeds thermal demand, excess heat is dissipated in a dump condenser. A digester gas purification system is located in the Thermal Power Plant building. It consists of a LO-CAT hydrogen sulfide oxidation process to remove hydrogen sulfide from the digester gas. The LO-CAT system has two flow trains for treating the digester gas, each with an absorber, oxidizer/settler, sulfur-dewatering unit, and chemical feed system.

System Performance: Collection of digester gas to low-pressure storage begins in the gas dome located on each digester cover, from which gas escapes through a 10-inch pipe. Dual-pressure vacuum relief valves and flame arresters are located on the top of each digester. The gas production pipe runs externally along the digester cover, down the digester sidewall through the building roof, to a foam separator in the digester building. From the foam separators, the pipe connects to a gas collection header that receives gas from each digester, and then runs along the upper walkway into the gas and sludge storage tanks. Gas compressors are not required because the gas flows naturally from the digesters due to the internal gas pressure. The addition of digested sludge to the storage tank increases the gas pressure. As pressure increases, the air relief valve opens and the air chamber deflates. If the air chamber is fully deflated and pressure still increases, the flares operate to eliminate surplus gas. If pressure still increases, the emergency relief valves on the gas storage domes will open and release gas. The removal of digested sludge from the storage tank also results in decreasing gas pressure in the system. As the pressure decreases, the air chamber inflates. If the gas pressure is dropping when the air chamber is fully inflated, differential pressure sensed across the gas piping and air piping will shut down the air blower. If gas pressure drops further, the gas compressors will be shut down. If the pressure is still dropping, the emergency relief valves on the gas storage dome will open to protect the tank from excess vacuum.

Facility Power: The sludge and gas storage tanks and equipment are powered through a substation with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Projects Programmed in the FY19 CIP:

- Dystor Tank Membrane Replacements for the two gas handling/sludge storage tanks is programmed in the FY19 CIP at a total cost of $4.0 million. The project includes two phases, $2.0 million expenditure during FY20 and$2.0 million expenditure during FY35.
- Digester Gas Flare #4 design and construction is programmed in the FY19 CIP at a cost of $1.798 million during FY24-28.

Projects Recommended for Consideration in Future CIPs:

- Future Dystor Tank Membrane Replacements are recommended for consideration in future CIPs (every 15 years) at an estimated cost of $2.0 million for each phase and a target schedule of FY50.

Sludge Pumping to the Residuals Pellet Plant

Facility Function and Operation: Digested sludge is pumped from the sludge and gas storage tanks through one of two 14-inch force mains that run approximately seven miles from DITP to the Residuals Pellet Plant in Quincy. The 14-inch pipelines pass through about 300 feet of piping galleries, then run underground about 250 feet alongside the Inter-Island Tunnel shaft. The force mains then penetrate the outer wall into the Inter-Island Tunnel and are embedded in concrete along one side of the 11-foot diameter tunnel. The force mains connect into a vault at Nut Island and continue through the Braintree-Weymouth Tunnel to the Pellet Plant.

Facility Components: Digested sludge is pumped at 2 to 3 percent solids via centrifugal digested sludge pumps that were installed in FY17 to replace the original hydraulic piston diaphragm pumps. The system is designed to have two pumps operating with the third pump on standby, which provides for a maximum flow of 1,600 gpm. Sludge quantities delivered to the pellet plant range between 6 and 9 million gallons per week, depending on sludge production rates at DITP. Under normal operation, the flow rate is maintained at between 1,200 and 1,350 gpm from Monday through Friday. Sludge pumping is shut down Friday night through Monday morning, when the pellet plant is normally unattended. The lines are normally flushed with plant process water (W3H) for 12-24 hours prior to being secured for the weekend to avoid the buildup of sludge material in the lines. With both digested sludge storage tanks in operation, sludge storage capacity without pumping to the Pellet Plant is 5 to 6 days. If one of the tanks is off-line for any reason (as occurred when each of the gas membranes were replaced) sludge storage capacity at Deer Island ranges from two to three days.

Hydraulic Performance: During the first year of operation following completion of the Braintree-Weymouth Tunnel, there were some problems with the pumping system, including mechanical failures of the pumps (mostly corrected under warranty by the vendor), and slamming, hammering, and pipe movement due to the reciprocating nature of the positive displacement piston diaphragm pumps. In addition to premature wear and damage to pump components, the hammering was severe enough to cause a pipe separation in one of the underground force mains. The failed force main was repaired by the contractor under warranty. Re-configuration of the pipe restraints for both force mains near the point of failure was also performed. With one force main in use and the second a redundant element of the system, sludge pumping can continue in the event of the loss of one force main. In FY17, a project to replace the original diaphragm pumps with centrifugal pumps was completed. The new digested sludge pumps are operating efficiently.

The original sludge barge loading station and connection hoses are still in place; however, these were mothballed when the force main sludge pumping system came on line. The barge system for sludge transport had a high cost and no barge is kept available. With the sludge barges decommissioned, loss of both sludge force mains would require either intensive emergency work to repair one of the force mains or rapid acquisition of a suitable sludge barge. Fortunately, the simultaneous loss of both force mains is unlikely, since only one force main is used at a time and the second is held as a back-up.

Recent Upgrades Completed:

- In FY17, the ongoing project to replace the original diaphragm sludge pumps with centrifugal digested sludge pumps was completed. These pumps transfer sludge from DITP to the Residuals Processing Pellet Plant in Quincy. A flushing pump was also added to the sludge pumping system.

Projects Recommended for Consideration in Future CIPs:

- Future Digested Sludge Pump Replacements are recommended for consideration in future CIPs (every 20 years) at an estimated cost of $4.0 million for each phase (total $8.0 million) and a target schedule of FY36 and FY56.

6.11 Electrical Generation and Distribution

Five electric power sources are currently available for DITP: (1) the cross-harbor marine cable connected to Eversource Electric's K Street Substation in South Boston; (2) the Thermal Power Plant at DITP; (3) the Hydropower Facility at the DITP outfall shaft; (4) wind turbines; and (5) three roof-mounted and one ground-mounted solar photovoltaic arrays at DITP. Power from the various sources is distributed on Deer Island via the electrical distribution system which includes an array of switchgear and substations. These facilities are detailed in this Section.

Cross-Harbor Marine Cable

Facility Function and Operation: The primary source of electric power for DITP is a 6-mile marine cable embedded beneath the floor of Boston Harbor. The cable is owned and operated by Harbor Electric Energy Company (HEEC), an unregulated wholly-owned subsidiary of NSTAR, both operating as Eversource Electric. The original cross-harbor cable was installed by HEEC in 1989-90 and placed into service in 1991. Capital, operating and maintenance cost of the original cable and substation were funded under a 25-year interconnection agreement.

A major navigation channel improvement project being planned by the U.S. Army Corps of Engineers (Army Corps) and Massport will allow deep draft ships to enter Boston Harbor and the Reserve Channel. The original cross-harbor marine cable was installed by HEEC at depths that were shallower in some locations than required by the Army Corps permit. The Army Corps required that the marine cable depth problem be rectified to permit the navigation improvement project to proceed. In FY17, extensive negotiations between MWRA and Eversource resulted in an agreement whereby Eversource would construct a new long-term cross-harbor marine electric cable to replace the original cable. As of FY18, the new marine electric cable is under construction by HEEC and is scheduled to be operational by January 2020. No MWRA CIP projects are associated specifically with construction of the new cross-harbor marine cable by HEEC. The cost for the new cable will be passed on to MWRA as increased capacity charges which will be seen in MWRA's CEB likely beginning in FY20.

Facility Components: The cross-harbor marine cable supplies 115,000 volt, 3-phase power from Eversource's K Street Substation in South Boston. The marine cable terminates on Deer Island at the Eversource high voltage substation where it connects to two transformers that step down the system voltage from 115,000 volts to 13,800 volts. The transformers connect to the plant electrical distribution system via two bus duct systems supplying 13,800 volts to Bus "A" and Bus "B" of the Main Switchgear, which provide redundant power throughout the DITP facility.

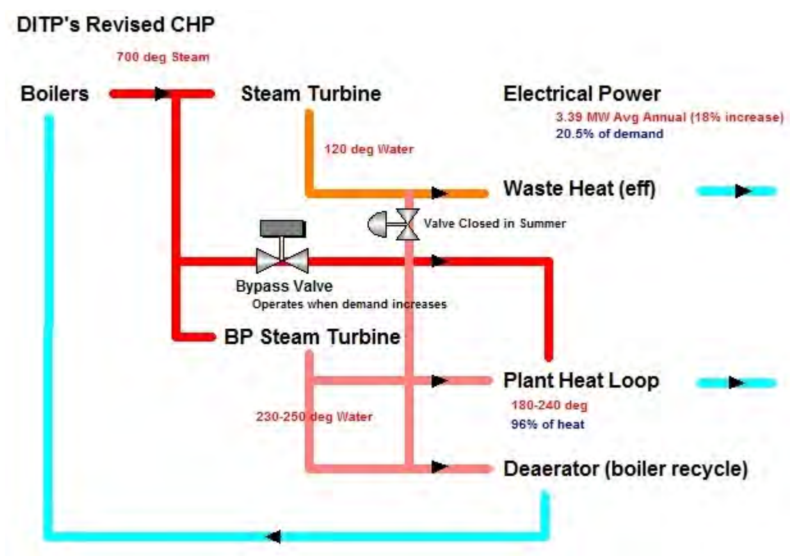
Thermal Power Plant

Facility Function and Operation: The Thermal Power Plant (TPP) is located on the north end of DITP, adjacent to two fuel storage tanks. The TPP contains the boilers required to meet all of DITP's heat loads, as well as generators and ancillary equipment needed to generate supplemental and/or back-up electric power for all of the critical DITP facilities. Power is generated from two combustion turbine generators (CTGs) and one steam turbine generator (STG). The TPP is capable of delivering a total capacity of 71.1 MW of electric power from two CTGs rated at 26 MW each, and one STG rated at 19.1 MW. From the TPP control room, operators monitor and manage the boiler operations as well as matching the generated electric power phasing and conditions to the rest of the Deer Island grid and the incoming power from the cross-harbor marine cable. The wind turbines and solar arrays at Deer Island feed directly into the power distribution system and do not require any phase matching or other efforts by TPP staff. Turnover of the various components of the TPP occurred in three stages between August 1995 and February 1999. The layout of equipment in the Thermal Power Plant is shown on Figure 6-10.

According to a DITP load study analysis conducted from January 1999 to April 2001, the average operating power demand recorded at the Main Switchgear Building was 19.4 MW with a peak operating power demand of 37.5 MW. The TPP typically produces 4 to 5 MW of the operating power demand through the use of the STG. The majority of the power required at Deer Island comes through the cross-harbor marine cable to the main switchgear building. Two outdoor 13.8KV-480V transformers provide station service to the TPP. When in operation, the CTGs and the STG feed power to the DITP grid, synchronized through the TPP control room.

Due to the critical nature of the treatment plant operations, on-site power generation is an integral element of plant operations. Personnel trained in the cold-start procedures for the CTGs and STG staff the Thermal Power Plant around the clock. These units are also run on a routine basis during certain high-energy usage periods for electrical peak shaving. There are also electricians, plumbers, and mechanics that are present on-site, or are on-call during all holidays and off-hours. To minimize the potential downtime in the event of power failure, on certain occasions an electrician is required to be on site. DITP management calls for certain staff to be on-site whenever the overall plant flow exceeds certain limits (usually during high wastewater flow periods during severe weather).

FIGURE 6-10
Thermal Power Plant Process Flow Diagram



Facility Components: Two high-pressure boilers (manufactured by Zurn) are each capable of supplying 150,000 lbs/hr of steam at 620 psig and 750 degrees F. The boilers are capable of burning No. 2 fuel oil, sweetened digester gas, or a combination of the two. Combustion gases exhaust from the boilers to a dual flue steel stack with an exit height of 150 feet. The boiler system is used primarily to supply the DITP's thermal requirements and secondarily to supplement its electrical power load (via the STG). After the high-pressure steam passes through the STG or a dump condenser, the pressure is decreased and the low-pressure steam is used for other heating processes. Two heat exchangers transfer heat from the low-pressure steam system to a high-temperature water loop. The high temperature water loop is the major component of the Central Plant heating system and supplies the DITP's thermal requirements. Water from the hot return line loop is reheated through the high temperature water heat exchangers and sent to the hot supply line loop, from which it is used for treatment processes and heating in all of the other buildings. In compliance with the DITP air permit, a continuous emissions monitoring system contains two sets of data acquisition computers and the various gas analyzers required to monitor the exhaust gases from the boilers.

The steam turbine generator (STG) system expands the high-pressure steam from the Zurn boilers to drive a turbine, which generates electricity to supplement power requirements at Deer Island. The STG system consists of an 18 MW steam turbine generator and a 1.1 MW backpressure turbine (added in 2011) and its required support elements. In the usual mode, the electrical energy produced by the STG is a byproduct of the heat energy produced for central plant heating. If the STG is out of service for maintenance, steam can bypass the STG and pass through a pressure-reducing valve in order to feed the low-pressure steam loop. The 18 MW steam turbine is a 13-stage, impulse type, backpressure turbine manufactured by Siemens Demag Delaval KJMV. The generator is a two-pole, three-phase, water-cooled revolving field AC synchronous generator rated for 20,000 kVA. It is designed to operate at 3,600 rpm, providing 60 Hz of power at 13.8 kV. The 1.1 MW steam turbine is a single stage backpressure turbine; Siemens model SST-060. The generator is a three-phase, water-cooled revolving field AC synchronous generator rated for 1,311 kVA. It has a helical gear that reduces the speed to the generator to 1,800 rpm, and provides 13.8kV of electric power. Both STGs are controlled remotely from the power plant control room but also require some manual operation of valves at the turbine during startup and shutdown, as well as significant coordination of the plant support systems.

Two combustion turbine generators (CTGs) are used for backup electrical power supply in the event of loss of Eversource power to DITP via the cross-harbor marine cable. The CTGs were supplied by Turbo Power and Marine Systems, Inc. (a Division of United Technologies Corporation). Each unit is a self-contained electrical generator powered by a combustion turbine. The CTGs have all the equipment necessary for local operation from each unit's control house and remote operation from the power plant control room. The system uses a Pratt & Whitney GG8 gas generator with a matching power turbine and an electric generator. The CTGs fire number 2 fuel oil, with a water injection system to control NOx emissions. The gas generator produces hot expanding gases that drive the power turbine. By coupling the power turbine to the electric generator rotor, 13.8kV utility-grade electric power is produced. Each CTG produces 26 MW of power at ideal conditions. The combustion gases exhaust through separate 10-foot diameter stainless steel stacks at exit heights of 90 feet. The main source of power to drive the auxiliary CTG equipment when the unit is running is an auxiliary step-down transformer rated 225kVA, 13.8 kV-480 V. A transfer switch is connected to a 480V feeder from the power plant station service system to provide power to the CTG auxiliary equipment when the unit is not running.

Recent Upgrades Completed:

- Heat Loop Pipe Replacement (phase 3) was completed in FY10 as a follow-up to prior phases 1 and 2 to continue upgrades/improvements to heat loop piping.
- In FY11, STG system efficiency modifications were completed to increase electricity production through the addition of a 1.1 MW backpressure turbine.
- Thermal Power Plant dump condenser replacement was completed in FY12.
- Thermal Power Plant fuel system modifications were completed in FY16.
- Thermal power plant boiler control replacement project was completed in FY16.

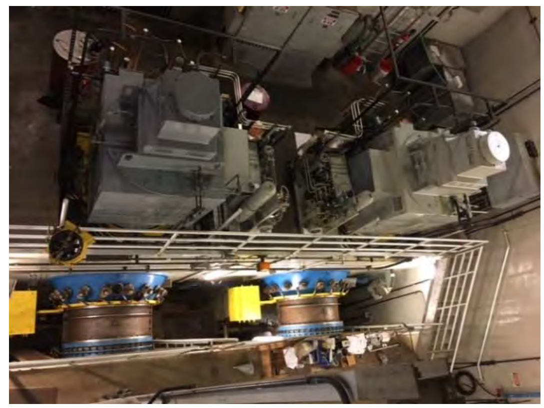
Projects Programmed in the FY19 CIP:

- Combined Heat and Power (CHP) Alternatives study, design, and construction to optimize the use of methane gas production and overall CHP efficiency is programmed in the FY19 CIP at a cost of $89.410 million during FY19-29. The MWRA - Eversource agreement to build a new cross-harbor electric cable will impact the alternatives for this project.
- Combustion Turbine Generator (CTG) Rebuilds in the Thermal Power Plant is programmed in the FY19 CIP at a cost of $8.0 million during FY24-27.

Projects Recommended for Consideration in Future CIPs:

- Future Combustion Turbine Generator (CTG) Rebuilds are recommended for consideration in future CIPs (every 15 years) at an estimated cost of $8.0 million for each cycle (total cost of $16,0 million) with a target schedule of FY40 and FY55.
- Future Steam Turbine Generator (STG) Replacement at Deer Island is recommended for consideration in future CIPs at an estimated cost of $4.0 million during FY30-32.
- Future Heat Loop Pipe Replacement design and construction to continue upgrades/improvements to heat loop piping (similar to prior phases 1, 2, and 3) are recommended for consideration in future CIPs (every 20 years) at an estimated cost of $3.0 million for each cycle (total cost of $6.0 million) and a target schedule of FY30 and FY50.

Hydroturbine Generators



Facility Function and Operation: Electricity is generated using the gravitational force of plant effluent as it drops down the outfall shaft after exiting the disinfection basins, just prior to discharge to the 9.4-mile effluent outfall tunnel. Treated effluent flows from the disinfection basins through two intake channels into the Hydroturbine Generators (HTGs). The Hydropower Facility was commissioned in July 2001. The hydroplant piping arrangement is shown on Figure 6-11.

Facility Components: There are two 1.1 MW HTGs in the Hydropower Facility at Deer Island. The HTGs are horizontal (or slightly inclined) axial flow turbines in a bevel gear bulb configuration. The generators are driven through right-angle drive speed increasers, located in the pit or "bulb" at the upstream end of the turbines. The synchronous generators are vertically mounted on top of the speed increasers. The turbines are Kaplan type with adjustable runner blades and wicket gates. A programmable logic controller (PLC) controls flow through the HTGs. The PLC sets the wicket gate position to maintain an upstream water level in the north end of the disinfection basins. Flow in excess of the HTG capacity (or when the HTGs are shut down) passes over weirs and discharges directly into the outfall chute. When in use, the two HTGs discharge effluent into the turbine effluent conduit that joins the outfall chute and discharges into the effluent outfall tunnel. The downstream water level constantly varies with the ocean tides and plant flow. The difference between the upstream water level and downstream water level is the net head. The PLC calculates the runner blade position based on the wicket gate position and net head, to achieve maximum turbine efficiency.

Projects Programmed in the FY19 CIP:

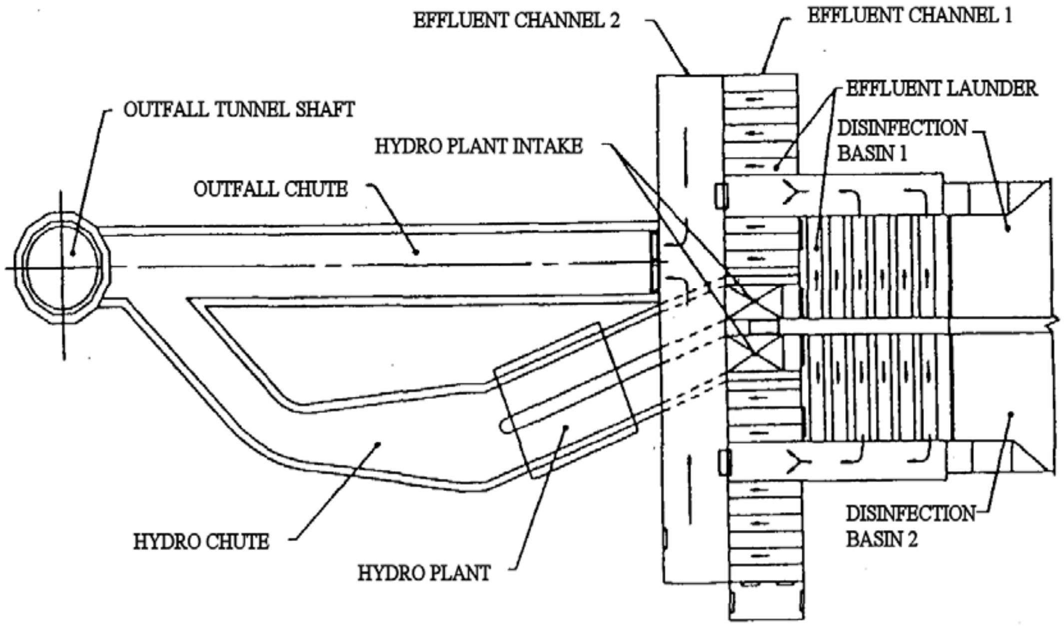
- Hydroturbine Generator (HTG) Replacement design, ESDC, REI, and construction is programmed in the FY19 CIP at a cost of $11.160 million during FY20-26. The HTGs are at the end of their useful life.

Projects Recommended for Consideration in Future CIPs:

- Future Hydroturbine Generator (HTG) Rehabilitation is recommended for consideration in future CIPs (every 20 years) at a cost of $10.0 million each cycle (total cost of $20.0 million) with a target schedule of FY25 and FY45.

FIGURE 6-11

HYDROPLANT ARRANGEMENT



Wind Power

Background on Wind Power Development at Deer Island: As part of MWRA's comprehensive energy strategy, the Authority has explored numerous opportunities to reduce energy costs and increase renewable power, thereby reducing operating costs. MWRA staff worked with Black & Veatch under the direction of, and with funding provided by, the Massachusetts Technology Collaborative on a wind power feasibility study. Black & Veatch performed an initial evaluation of a potential on-site wind energy project at DITP, located within the fence line of the plant. This included the estimation of wind resources (including a review of the wind data generated by the Renewable Energy Research Lab), addressing land use and obstruction issues, reviewing the plant's electrical infrastructure and load profile, identifying possible permit requirements, and a financial analysis. Black & Veatch also recommended future activities for developing wind power projects. While parts of the Black & Veatch study were similar to the Renewable Energy Research Lab work, it was a more detailed assessment and a necessary phase of the technical requirements associated with continued project support from the Massachusetts Technology Collaborative. Results from the study included:

- Identification of three possible sites that could support a wind energy project that could consist of up to four or more turbines, depending on the size selected;
- Confirmation that the DITP's electrical infrastructure and consumption would make an on-site wind energy project feasible; and,
- Production estimates for various turbine types, heights and locations are classified as having "good" capacity factors.

Facility Function and Operation: In November 2009 two horizontal axis 600kW wind turbines were installed in the south parking lot at Deer Island (shown in photo at right). The turbines are manufactured by Vestas RRB India Limited, model Pawan Shakthi 600kW (referred to as PS600). The wind turbines are connected to the Deer Island electrical grid and directly off-set plant electric demand. The turbines are qualified as Class I MA Renewable Portfolio Standard facilities and MWRA earns revenue from the Renewable Energy Certificates (green attribute) sold.

In April 2011 an engineering prototype wind turbine was designed and installed at Deer Island, near the outfall tunnel shaft, by a Massachusetts based company FloDesign Wind Turbine Corporation (shown in photo at left). The wind turbine, rated at 100kW, was also directly connected to Deer Island's electrical grid. Since the turbine was an engineering prototype it was not operated continuously, as the FloDesign Wind engineers made modifications and adjustments to the wind energy system. This turbine design is considered a "Mixer Ejector Wind Turbine," a shrouded, axial-flow wind turbine, that is claimed to be capable of delivering three times more energy per unit swept area with greatly reduced rotor loading as compared to existing Horizontal Axis Wind Turbines. The FloDesign company became Ogin, and has since been dismantled and all assets are being liquidated. MWRA plans to demolish the turbine once approvals from the liquidation firm are obtained given the safety concern of having a non-operating turbine on site with no maintenance.

Current plans are underway for possible development of a fourth wind turbine at DITP should economics favor the project. The selected location is the area where the former Construction Support Building was demolished. Staff received FAA approval for this wind turbine in the spring 2012; however, this has since expired. Grant funding will be sought to help off-set design and construction costs should the economics be viable. The turbine at this location would be a horizontal axis design of up to 600kW, similar to the parking lot wind turbines.

Projects Programmed in the FY19 CIP:

- One wind power project, future DITP Wind Construction at Battery D Location, is programmed in the FY19 CIP at a cost of $5.058 million during FY24-25. All alternative power projects are included in the Wastewater System Master Plan Chapter 13 – Energy Management, Information Management, Laboratory Services, and Security.

Solar Power

Facility Function and Operation: Solar photovoltaic systems are currently installed at Deer Island on the roofs of three buildings the Residuals/Odor Control building (100kW), Maintenance/Warehouse (180kW), and Grit Buildings (222kW), and on the ground in the south parking lot (234kW). The solar panels on the grit building and on the ground were installed under a twenty year "power purchase agreement". MWRA staff are working with a solar energy consultant to conduct a comprehensive solar feasibility study for all MWRA sites, to assess the solar capability, technical, and economic feasibility.

Solar panels are a passive energy source; there is no need for maintenance other than occasional cleaning of the panels. The energy produced is supplied directly to the DITP grid and offsets the total plant demand.

There are no Solar Power projects programmed in the FY19 CIP or recommended for future consideration. The life expectancy for existing solar panels is approximately 25 years. Future solar construction projects are likely to be "power purchase agreements" where a Contractor is selected to install solar panels and the MWRA pays a set rate per kWh for the produced energy from CEB funds. Addition information is included in the Wastewater System Master Plan Chapter 13 – Energy Management, Information Management, Laboratory Services, and Security.

Electrical Distribution

Facility Function and Operation: The electrical distribution system is comprised of various switchgear and unit substations in a secondary selective system. This type of system allows two separate main busses of a double-ended unit substation to be connected to each other through normally open bus tie circuit breakers. The benefit of this system is that if a primary cable or transformer fails and an upstream circuit breaker opens, the bus tie breaker would close and re-energize the affected electrical equipment. The electrical distribution system is designed to function with all five sources of DITP electric power: cross-harbor marine cable, Thermal Power Plant on-site generation, Hydropower Facility on-site generation, Wind Turbine on-site generation, and Solar on-site generation. The connection of all generating sources to the electrical distribution system are supervised by synchronizing equipment and feed power through the main plant switchgear. The synchronization equipment ensures that the power generated is in phase and voltage range with the power supplied by NSTAR.

Facility Components: The electrical distribution system primarily consists of the main switchgear building, 13.8 kV switchgear, unit substations, duct banks, cables, and associated equipment to provide power to all DITP facilities. The main plant switchgear splits the electrical power into two separate, parallel feed systems, which provide redundant power distribution throughout the plant. The 13.8kV main switchgear located in the main switchgear building consists of two redundant sets of switchgear connected through normally open bus tie circuit breakers and bus duct. Circuit breakers and various protective relays are located within the switchgear. The circuit breakers supply power to the various substations situated throughout Deer Island. At the switchgear are protective relays that indicate instantaneous current, time over-current, ground fault, and under voltage conditions, which protect the electrical system. The breakers are electrically interlocked to prevent inadvertent or improper operation.

To maintain a redundant power system throughout the electrical distribution system, two separate 15 kV-rated cable systems ("A" and "B") are located in separate, buried, reinforced concrete ductbank and manhole systems that are tied directly to the DITP electrical substations. The underground medium voltage ductbank system typically consists of 5-inch Schedule 40 PVC conduits. The "A" and "B" ductbank systems run parallel to each other from the main switchgear building using cable which is shielded, stranded, and 500 kcmil single conductor per phase.

The 13.8kV switchgear at the Thermal Power Plant consists of three buses ("A" bus, "B" bus, and "C" swing bus). The "A" and "B" buses are each connected to a combustion turbine generator while the "C" swing bus is connected to the steam turbine generator. The buses are connected with bus tie circuit breakers to allow the steam turbine generator to supply power to either the "A" or "B" side of the power distribution system. The wind turbines are connected to the electrical distribution system at substation 21 on the pier. The solar arrays are tied into other substations closest to where they are located. No personnel involvement is required to synchronize the power supply from these units into the electrical system.

The Residuals Process Area 13.8kV switchgear is an extension of the DITP main switchgear dual-bus system. It is powered from the main switchgear via the medium voltage ductbank and cable system and is comprised of an "A" and "B" bus with a normally open bus tie breaker. Feeder circuit breakers at the residuals switchgear distribute 13.8kV power to the unit substation transformers located in the Residuals Process Area.

Unit substations consist of primary fused switches connected to a 13.8kV transformer primary. The secondary at each substation transformer feeds a 480-volt or 4,160-volt switchgear bus via an incoming line breaker. Each bus has circuit breakers to power various DITP loads. Each unit substation in the electrical distribution system, with the exception of the substation at the Pilot Plant and the Hydro Power Facility, has two primary 13.8kV transformer primary feeders: one from main switchgear bus "A" and one from bus "B", making the substations "double-ended". Normally, each double-ended substation operates with a primary cable terminated to a closed fused switch at the transformer primary. The secondary of each transformer is connected to closed incoming line breakers (the bus-tie breaker is normally open). The substations are designed such that, with the controls in the proper position, a loss of power on either the "A" or "B" bus will result in an automatic bus transfer or the re-energization of the affected bus through the bus tie breaker.

Most process areas are operated at 480 volts. However, several process areas, such as the North Main Pump Station, Winthrop Terminal Facility, South System Pump Station, and the Central Blower Facility, have large motor loads. The medium voltage motor control centers of these process areas are operated at 4,160 volts. At 4,160 volt substations, additional substations are provided to reduce system voltage to 480 volts to provide station service power. The Pilot Plant and the Hydropower service substation are single-ended substations and thus are only powered from the main switchgear bus "A" (Pilot Plant) or bus "B" (Hydropower Facility).

Recent Upgrades Completed:

- As part of DITP's on-going program to replace transformers and bus ducts at the end of their useful lives, electrical equipment upgrades have been made over the last 20+ years. Most recently, Phase 4 Electrical Equipment Upgrades were completed in the FY17.

Projects Programmed in the FY19 CIP:

- DI Electrical Equipment Upgrades Phase 5 design, ESDC, REI, and construction are programmed in the FY19 CIP at a cost of $27.470 million during FY23-29. The project includes transformers that are replaced when they fail or when electrical testing indicates that failure is imminent.
- Switchgear Replacements design and construction to sequentially replace obsolete electrical switchgear throughout the DITP is programmed in the FY19 CIP at a cost of $7.440 million during FY22-24.
- Switchgear Replacements Phase 2 design and construction to continue upgrades to electrical switchgear throughout the DITP is programmed in the FY19 CIP at a cost of $20.50 million during FY24-29.

Projects Recommended for Consideration in Future CIPs:

- DI Future Electrical Equipment Upgrades (beyond Phase 5) to replace transformers, bus ducts, and other electrical equipment is recommended for consideration in future CIPs at an estimated cost of $5.0 million for each five year cycle and a target schedules of FY34, FY39, FY44, FY49, and FY54.
- DI Future Switchgear Replacements (beyond Phase 2) to upgrade/replace electrical switchgear is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $10 million in each cycle with a target schedule of FY35, FY45, and FY55.

Energy Management

MWRA's energy management planning applies to both the water and wastewater systems. For convenience of the reader and organization of the Wastewater and Water System Master Plans, energy management is detailed in both Chapter 13 of the Wastewater System Master Plan, as well as, Chapter 10 of the Water System Master Plan. Many of the energy management recommendations are policy items or relatively low cost projects. Larger cost projects are typically included within the Water or Wastewater Master Plan Chapter related to the specific asset being addressed.

6.12 Odor Control Facilities

Odor control facilities at DITP are located in four buildings. The North Main Pump Station houses the North Odor Control Facilities that treat exhaust gases from the NMPS and WTF operations. The South System (Lydia Goodhue) Pump Station and the Grit Facility are adjacent to the East and West Odor Control facilities, which treat exhaust gases from those two buildings as well as the primary treatment process. The Residuals Odor Control Facility treats exhaust gases from the various residuals processing facilities. The odor control technology used includes packed tower wet scrubbing for removal of total reduced sulfur compounds and volatile organic compounds, followed by carbon adsorption, if required.

Facility Function and Operation: The function of the odor control facilities is to treat off-gases collected in the treatment process, resulting in stack emissions meeting MassDEP air emissions permit limits. The odor control facilities are designed to control concentrations of hydrogen sulfide and total reduced sulfur to levels below 1.0 ppm measured in stack emissions. The scrubber systems are designed for a minimum hydrogen sulfide removal efficiency of 99 percent at inlet hydrogen sulfide concentrations above 5.0 ppm. Two redundant scrubber trains are provided at the North Main Pump Station, one scrubber train is provided at the South System Pump Station and the Residuals Odor Control Facility.

Facility Components: The odor control trains have two-stage wet scrubbers followed by carbon absorbers. Centrifugal exhaust fans draw air through the wet scrubbers and then blow it through heating coils and carbon absorbers before it is discharged back to the atmosphere through the stack. Separate chemical storage tanks are provided for each odor control train.

The wet scrubbing system uses sodium hypochlorite and sodium hydroxide for control of hydrogen sulfide and other inorganic odor causing compounds. Three wet scrubbers are provided for each flow stream, with two usually operating in series and one as standby. The wet scrubbers are packed towers, in which the air stream enters the bottom of the tower and flows upward, while the scrubbing liquid is distributed across the top of the packed bed and flows downward. This counter-current contacting of scrubber solution and odorous air ensures that the odorous gases are absorbed and/or oxidized by the scrubbing solution. Treated gases drawn out of the tower are sent to either the next scrubber in series or to the carbon adsorption system. The scrubber solution is collected out of the bottom of the tower and recirculated to the top of the tower for reuse. A percentage of the scrubber solution is wasted to a floor drain where it flows in acid-resistant piping to the sanitary system. Wasting ensures that fresh chemical will be entering the scrubber system at all times. The make-up water flow rate controls the wasting rate.

Separate chemical storage tanks are provided for each odor control train. Color-coded chemical fill stations are located near the truckway doors, one for sulfuric acid and one for the sodium hydroxide. The fill ports also have different connectors, so only the correct chemical hose can be connected. The sodium hypochlorite tanks are filled from the plant hypochlorite system. Metering pumps feed the various chemicals into the associated scrubber recirculation loop.

Air from the wet scrubbers is heated to reduce the relative humidity and minimize condensation in the carbon adsorption units, which impedes the airflow. The carbon adsorption vessels are horizontal steel tanks, lined with corrosion-resistant material. There are several different vessel sizes that hold varying amounts of carbon, allowing for some operational flexibility. The vessels contain a bed of granular activated carbon several feet thick. The air flows through the carbon bed with the carbon adsorbing VOCs, hydrogen sulfide and other odorous compounds in the air stream. Eventually, the carbon becomes saturated with these compounds and less efficient at removal. Tests are periodically run on air samples (taken from sample ports located on the side of the vessels at different bed depths), to determine when the carbon is saturated and needs to be changed out. Spent carbon is sent to a carbon regeneration facility to be reprocessed for reuse. The carbon adsorption units may also be used exclusively (bypassing the wet scrubbers) if the odorous compound levels are low and it is more cost efficient.

Facility Power: The odor control facilities are powered through a substation with two 13.8kV-to-480V transformers. The Thermal Power Plant provides back-up power.

Recent Upgrades Completed:

- Ten carbon adsorbers that had internal steel deterioration were repaired (if needed) and coated in FY10 and the remainder were rehabilitated in FY12-13.

Projects Programmed in the FY19 CIP:

- DI HVAC Equipment Replacement design, ESDC, REI, and construction to replace odor control and air handler equipment (including DITP Laboratory fume hoods) is programmed in the FY19 CIP at a cost of $44.186 million during FY14-23. Expenditures during the planning period (FY19-23) are $42.796 million.
- DI East/West Odor Control Air Handler Replacement is programmed in the FY19 CIP at a cost of $2.0 million during FY26-27.
- DI Odor Control Rehabilitation Plant-wide study, design, ESDC, REI, and construction is programmed in the FY19 CIP at a cost of $39.666 million during FY22-29. The project involves modifications to the plant-wide odor control system including the digester gas systems and wet scrubber improvements.

Projects Recommended for Consideration in Future CIPs:

- DI Future Odor Control Air Handler Replacements and Odor Control Upgrades is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $30.0 million for each cycle with a target schedule of FY43.

6.13 Additional Support Systems

Additional support systems and utilities required for DITP operation are detailed in this Section, including: Process Instrumentation and Control System (PICS); Department of Laboratory Services; building HVAC control systems; fuel oil facilities; chemical handling systems; water systems; sanitary and stormwater systems; personnel protection systems; and records management.

Process Instrumentation and Control System

Facility Function and Operation: DITP's Process Instrumentation and Control System (PICS) is a modern industrial distributed control system. It is the primary interface used by Operations staff to control wastewater treatment and power plant processes at DITP. PICS provides overall plant-wide process automation and control as well as centralized monitoring for Deer Island staff, enabling operation of facilities with a minimum of off-shift staffing. Process data from PICS is available throughout MWRA via the MIS networked DITP Process Information Archive (PI), which is set up to show current and historic operational data on all of the major functional areas of DITP. This system is essential for environmental compliance reporting and plant optimization efforts. Operation of PICS commenced in January 1995 with the start-up of the new primary treatment process. Since then, PICS has expanded as additional process units have been brought on-line.

Facility Components: The system was installed as part of the Boston Harbor Project under the Process Instrumentation and Control System Contract for the Treatment Plant and the Thermal Power Plant Contract at a cost of approximately $24 million. The PICS system consists of 29 Operator Consoles, 64 field cabinets containing electronic control equipment, and multiple engineering workstations for system modifications. All PICS equipment is networked together by a redundant plant-wide fiber-optic data transmission loop. Overall there are approximately 35,000 input/output points monitored and/or controlled through PICS.

Projects Programmed in the FY19 CIP:

- DI PICS Distributed Processing Units (DPU) Replacements to replace the distributed processing unit cabinets and internal components of the PICS system is programmed in the FY19 CIP at a cost of $12.462 million during FY23-26.

Projects Recommended for Consideration in Future CIPs:

- DI Future PICS DPU and other hardware component replacement is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $5.0 million for each cycle with a target schedule of FY37 and FY52.

Department of Laboratory Services

MWRA's Department of Laboratory Services is client based. Clients include Deer Island, ENQUAL, TRAC, Drinking Water Programs, and member communities. To accommodate the range of laboratory service needs, the geographic range of the MWRA system, and types of samples to be analyzed; MWRA operates laboratory facilities in Chelsea, Clinton, Quabbin, Southborough, and the Central Lab at DITP.

MWRA's Laboratory Services serve both water and wastewater needs and are fully detailed in Wastewater System Master Plan Chapter 13 – Energy Management, Information Management, Laboratory Services, and Security as well as, Chapter 9 of the Water System Master Plan. Costs for Laboratory Services projects (water and wastewater) programmed in the FY19 CIP and/or recommended for future CIPs are included in Chapter 9 of the Water System Master Plan. There is one project included in the DITP costs (as part of DITP Odor Control and HVAC Control Systems) that includes work involved with DITP central laboratory fume hoods, as noted below:

Projects Programmed in the FY19 CIP:

- DI HVAC Equipment Replacement design, ESDC, REI, and construction to replace odor control and air handler equipment (including DITP Laboratory fume hoods) is programmed in the FY19 CIP at a cost of $44.186 million during FY14-23. Expenditures during the planning period (FY19-23) are $42.796 million.

Building HVAC Control Systems

The DITP has two HVAC Building Management Control Systems which were made by different manufacturers (one by Siemens, and one by Johnson Controls); both were installed under different construction contracts as part of the BHP. The two HVAC systems control the heating and cooling in the majority of buildings on Deer Island. Both control systems are obsolete and staff have attempted to replace electronic components piecemeal, as they fail. In addition, the two existing systems do not have the ability to communicate with each other. For consolidation of parts and service and to allow the entire system to communicate to better monitor and control the cooling and heating systems; staff recommend that the two HVAC control systems be replaced with one from a single manufacturer. The system is likely to need replacing every 15 to 20 years.

Projects Programmed in the FY19 CIP:

- DI HVAC Equipment Replacement design, ESDC, REI, and construction to replace odor control and air handler equipment (including DITP Laboratory fume hoods) is programmed in the FY19 CIP at a cost of $44.186 million during FY14-23. Expenditures during the planning period (FY19-23) are $42.796 million.

Projects Recommended for Consideration in Future CIPs:

- Future DI HVAC Upgrades/Replacement including the control system, fan coils, etc. is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $20.0 million for each cycle and a target schedule of FY33 and FY48.

Fuel Oil Facilities

Facility Function and Operation: The plant-wide fuel oil system was designed to supply #2 fuel oil to the two combustion turbine generators (CTGs) and supplemental fuel to the Zurn boilers in the Thermal Power Plant. Deliveries by tank truck are currently the least-cost option, so fuel is off-loaded directly at the fuel storage tank area. When the fuel oil facilities were originally constructed, fuel oil deliveries were primarily made by barge, off loaded at the pier facility, and pumped to fuel storage tanks. However, the fuel pipeline was tested and could no longer maintain adequate pressure, indicating that there was a potential internal leak in the piping. Approximately 3,000 feet of double-walled piping system from the pier to the fuel storage tanks located north of the Thermal Power Plant was filled with concrete and abandoned in place in FY12.

Facility Components: The fuel storage area consists of two 750,000-gallon storage tanks, a tank gauging system, truck unloading station, and containment area. The two tanks are carbon steel, equipped with ladders on both the outside and the inside of the tanks. The fuel tanks hold a 10-day supply of fuel oil based on both an emergency electric load and the January 1999 heating load.

The fuel oil supply piping is routed from the fuel oil transfer pumps to the Thermal Power Plant where it feeds the two CTGs and two boilers. The Thermal Power Plant is equipped with a fuel oil head tank for each CTG, to ensure enough fuel is available to start the CTGs in a power outage when fuel pumping is not possible. Fuel is pumped from the storage tanks directly to the CTGs while maintaining a full level in the head tank. Each fuel pump discharge line has a pressure relief valve, so if the line is over-pressurized it will be relieved to one of the storage tanks. Fusible-link gate valves are installed in the fuel oil piping as it enters and exits the Thermal Power Plant. These emergency gate valves close when the piping reaches a predetermined temperature, to ensure that oil will not be pumped into a burning building. These valves must be replaced after actuation.

The fuel containment area consists of continuous, reinforced concrete slab with walls of a minimum height of 10-feet designed to contain 100 percent of one tank plus 10 percent of the second tank in accordance with Massachusetts regulations. The containment area has a sump to collect rainwater and any oil spills/overflows. The sump flows by gravity into an oil-water separator prior to discharging to the storm drain system. An 8-inch gate valve is installed on the sump discharge line prior to the oil water separator and is opened or closed manually.

Projects Recommended for Consideration in Future CIPs:

- DI Future Fuel Supply Pump and Pipe Replacement or Rehabilitation design and construction is recommended for consideration in future CIPs (every 20 years) at an estimated cost of $5.0 million for each cycle with a target schedule of FY42.
- Future Leak Protection System Upgrade to the leak protection system and chemical/fuel tank containment areas is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $500,000 for each cycle with a target schedule of FY30 and FY45.

Chemical Handling Systems

Facility Function and Operation: Every chemical off-loading area has specific chemical handling procedures and protocol. The pipe connections are often specific for each application and/or color-coded for safety reasons. Each contract specification has chemical delivery instructions, as well as a general section addressing chemical safety. Operations staff involved with chemical handling have all been trained in off-loading procedures and personnel safety apparatus. Chemical delivery trucks are escorted to the proper off-loading location as needed, and DITP staff oversees and, in some cases, assist with the transfer operation if any valves or pumps need to be operated. If the chemical is not easily identified, samples are taken to ensure that the chemical conforms to the expected parameters. Sodium hypochlorite is delivered by truck and pumped directly into the storage tanks. Previously, sodium hypochlorite had been delivered by barge and pumped through nearly a mile of piping to the storage tanks. Truck deliveries have become more cost effective due to the high cost for barging.

Projects Programmed in the FY19 CIP:

- Chemical Pipeline Replacement design and construction for planned periodic replacement of various chemical pipelines in the disinfection (sodium hypochlorite and sodium bisulfite) and odor control facilities due to deterioration from corrosion is programmed in the FY19 CIP at a cost of $2.717 million during FY22-27.

Projects Recommended for Consideration in Future CIPs:

- Future evaluation, rehabilitation, replacement, and/or upgrades to the sodium hypochlorite tanks, the sodium bisulfite tanks, and the chemical feed piping system (estimated at $12 million every 10 years) is recommended for consideration in future CIPs with a target schedule of FY37 and FY47 and a total cost of $24.0 million during the planning period.
- Future Leak Protection System Upgrade to the leak protection system and chemical/fuel tank containment areas is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $500,000 for each cycle with a target schedule of FY30 and FY45.

Water Systems

Facility Function and Operation: The plant-wide potable water (W1) and service water (W2) system consists of a water storage tank and a piping network which conveys water throughout DITP for fire pumps, fire hydrants, emergency eye wash and showers, lavatory facilities, wash-down hydrants, seal water, and all other potable and non-potable services supporting plant operations. The W1 system is fed by a 24-inch dedicated distribution main from the MWRA’s Northern High System. The 24-inch line provides water to the 2-million gallon elevated water tank on the north end of the Island. Two 20-inch lines provide redundant connection from the water tank to the 16-inch W1 loop, which circles the plant area. Each DITP facility is fed from a connection to the 16-inch plant loop. The sizes of the connections vary from 4-inch to 8-inch depending upon the demand of each facility. The W1 system services all potable water requirements as well as the DITP service water system. The W2 system is separated from the W1 system by backflow preventers and provides clean water at hose gates, hot service water, and seal water.

High and low pressure plant process water (W3H and W3L) systems distribute disinfected plant effluent to flushing connections, carrier water connections, hose gates, cooling water, primary sludge dilution water, and foam spray systems throughout the plant. The systems use dedicated piping networks, which are not used by any other plant systems. Both systems draw suction through a common header from the outfall by-pass conduit located beneath the disinfection gallery. The W3H system has variable-speed, split case centrifugal pumps. The W3L system has both variable-speed and constant-speed split case centrifugal pumps. The W3H and W3L system design flow rates are 7,500 gpm and 16,500 gpm, respectively.

Projects Programmed in the FY19 CIP:

- DI Cathodic Protection design, ESDC, and construction to evaluate the current system condition and complete repairs is programmed in the FY19 CIP at a cost of $6.235 million during FY23-25.

Projects Recommended for Consideration in Future CIPs:

- DI Future Water Storage Tank Cleaning/Rehabilitation and Water Pipeline Rehabilitation are recommended for consideration in future CIPs (every 40 years) at an estimated cost of $2.0 million for each cycle with a target schedule of FY40.
- DI Future Cathodic Protection Testing is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $250,000 for each cycle with a target schedule of FY35, FY45, and FY55. This project has an estimated duration of 1-year.

Sanitary and Stormwater Systems

Facility Function and Operation: The sanitary system for DI has been subdivided into three categories: sanitary lines, sump pump discharge lines, and chemical-resistant waste piping. The sanitary lines convey sewage from lavatories, service sinks and floor drains of the various facilities on Deer Island through a gravity system to the Winthrop Terminal Facility for treatment. The piping varies in size from 8-inch to 30-inch and consists of ductile iron, reinforced-concrete, or PVC. A number of sewage ejector pumps, used to lift sanitary waste to an elevation such that it can be discharged into a gravity sewer, are located throughout DITP. The galleries and basements of various structures have a gutter and floor drain system to collect spills, discharge from sampling equipment, and wash down water. Sump pumps located at intervals throughout the plant discharge to the sanitary system.

Chemical-resistant piping is provided at the North Main Pump Station, Administration/Laboratory Building, East and West Odor Control Facilities, Gas Handling Facility, Operation Center and Odor Control Facility. These lines handle chemical wastes generated in the DITP laboratory and odor control facilities. The chemical-resistant waste piping conveys chemical wastes from a source to a point in the sanitary system where the chemical is either neutralized or sufficiently diluted with other sanitary flow.

The DI stormwater drainage system is divided into sixteen drainage areas. Runoff collected from fourteen of the drainage areas is routed to an oil/water separator which removes oils, floating debris, and grit before the storm water is discharged into Boston Harbor. Surface runoff from the vegetated areas of the northeast slopes of the Northern Landform and the southeast slopes of the Southern Landform are allowed to drain naturally to the harbor. The gravity drainage system consists of reinforced concrete and PVC drainage pipe that transports storm water collected in catch basins to the discharge points. Two storm water pump stations, constructed in low lying areas, lift the storm water to a sufficient grade for tie-in to the gravity drainage system. One pump station is located in front of the Reception/Training Building; the other is located in the Residuals Area on Road 9. Prior to developing the standards for the DI stormwater drainage system, a number of single compartment oil/water separators were installed. These units are mainly in the pier and roadway areas to protect the harbor from direct discharges of oil in the event there is a spill or oil leaks from vehicles.

Projects Recommended for Consideration in Future CIPs:

- DI Future Sanitary and Stormwater System Rehabilitation including replacement of ejector pumps and rehabilitation of force mains and gravity pipelines is recommended for consideration in future CIPs (every 25 years) at an estimated cost of $1.0 million for each cycle with a target schedule of FY25 and FY50.

Personnel Protection Systems

Facility Function and Operation: Personnel protection systems at DITP are those systems whose function is to provide security, protection, monitoring, and communication capability to DI staff and to emergency service personnel who may enter the DITP from time to time. There are six plant-wide personnel protection systems: fire alarm, page/party, private branch exchange (telephone), radio, card access, and closed circuit TV.

Maintenance staff routinely tests the DITP fire alarm system that has been in operation for over fifteen years. It is one of the largest fire systems in a single facility in MA and consists of over 2,000 separate points and 57 fire alarm monitoring panels. The local Fire Alarm Monitoring Panels contain circuit boards that are obsolete and staff cannot obtain spare parts. The front end of the system (the main PC which controls the system and the monitors) also requires replacement. Staff will need to replace the fire monitoring system including all pull boxes, strobes, horns, smoke and heat detectors. There are smoke detectors in most of the ductwork throughout the plant. The National Fire Protection Association (NFPA) recommends replacement of duct smoke detectors every 10 years to ensure proper operation of the system. These duct smoke detectors are to be replaced over several years as a CEB-funded project. The fire monitoring system is likely to need replacing every 20 years.

Radio communication is an important safety and security measure at the DITP. Radio communications can be difficult in pipe galleries. A bidirectional radio amplification system is being installed as an upgrade for the radio communication system to ensure emergency radio communications can be sent and received and to meet current safety code. The project is being built in two Phases.

The card access system feeds data to a DITP database, and the closed circuit TV images are digitally recorded. There are annual CEB maintenance contracts in place for the closed circuit TV hardware and software, the card access system, and the telephone/page party systems.

A chain link fence surrounds the entire treatment plant, with approximately 10 access gates along the perimeter of the plant. The majority of the access gates remain locked at all times. Two gates along the main access road also have concrete barriers in front of the gates to prevent unauthorized vehicle access or egress. One access gate allows primary access to the facility, at the Main Guard House. An annual Authority-wide security contract is in place with the contracted security personnel managing the daily traffic to and from the facility on a 24-hour, 365 days per year basis. Security staff use a card reader system to scan employees in and out; issue temporary access placards to authorized vehicles and persons; and observe the janitorial staff as they punch in and out at the Guard House. Members of the Security team also perform periodic inspections around the perimeter of the facility and inside certain buildings during the off-hours and holidays.

The DITP site includes seawalls for protection of the plant from storm tides and a pier/personnel dock. These facilities require routine maintenance and periodic repairs.

Recent Upgrades Completed:

- In FY10, the plant entrance at the main guard house was rebuilt. Permanently mounted card access readers, multiple closed circuit video cameras and hardened steel barrier gates were installed to monitor the gate activity and prevent unauthorized access to the plant in emergency situations.
- In FY14, Phase 3 of the DITP Roof Replacement program was completed.
- In FY18, the first phase of the DI Personnel Dock Rehabilitation Construction project to repair the floats, ladders and aluminum grating of the personnel dock was completed.
- In FY18, rip-rap material was purchased and placed along the northeast sea wall to reduce ocean wave erosion and extend the life of the sea wall.

Projects Programmed in the FY19 CIP:

- The second phase of the DI Barge Berth and/or Pier Facilities Rehabilitation/Replacement is programmed in the FY19 CIP at a cost of $7.963 million in FY24-29. This project will complete major rehabilitation of the DI barge berth and pier facilities resulting from normal wear and storm/tidal damage.
- DI Fire Alarm System design, construction, and REI to upgrade/replace the fire alarm system at the DITP is programmed in the FY19 CIP at a cost of $24.218 million during FY16-24. Expenditures during the planning period (FY19-24) are $23.427 million.
- DI Bidirectional Radio Repeater System Upgrade Phases 1 and 2 are programmed in the FY19 CIP at a cost of $3.0 million during FY18-20. Expenditures during the planning period (FY19-20) are $2.750 million.
- DI Fixed Gas Protection System Replacement project to replace gas detection devices in up to thirteen separate locations is programmed in the FY19 CIP at a cost of $1.0 million during FY19-20.
- DI Eastern Seawall Repairs design, ESDC, REI, and construction to repair the eroded concrete seawall and exposed rebar is programmed in the FY19 CIP at a cost of $4.370 million in FY19-23.

Projects Recommended for Consideration in Future CIPs:

- DI Future Personnel Protection System Upgrade/Replacement is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $1.0 million for each cycle with a target schedule of FY25, FY35, FY45, and FY55.
- DI Future Barge Berth and/or Pier Facilities Rehabilitation is recommended for consideration in future CIPs (every 20 years) at an estimated cost of $2.0 million for each cycle with a target schedule of FY45.

- DI Future Seawall Repairs and/or Placement of Rip-rap to repair or protect the DITP concrete seawall is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $2.0 million for each cycle with a target schedule of FY35, FY45, and FY55.
- DI Future Roof Replacements is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $6.0 million for each cycle with a target schedule of FY25, FY40, and FY55.

Records Management

Facility Function and Operation: The majority of the DITP document collection is from BHP documents. In recent years, technical documents have been added into the DITP document collection from the various construction contracts and in-house maintenance activities. These new document additions not only have increased the volume of the total technical document data at DITP, but also have required continuous update activities on the existing documents, such as making new revisions of existing drawings, modifying SOPs, and updating vendor manuals.

The Technical Information Center (TIC) at DITP manages the activities of maintaining existing documents, receiving and filing incoming documents, controlling distribution of new documents, and making revisions to existing documents based on incoming documents or new information. While responding to daily document requests from MWRA staff, TIC is also converting document formats to improve accessibilities, controlling a mixture of required security levels, increasing storage efficiency, and preserving original copies.

Projects Programmed in the FY19 CIP:

- DI Document Format Conversion project to convert DITP construction documents into electronic format and complete the document-reference database is programmed in the FY19 CIP at a cost of $145,000 in FY18-20. Expenditures during the planning period (FY19-20) are $68,000.

6.14 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to the Deer Island Treatment Plant including existing FY19 CIP and future recommended capital projects are summarized in this Section. Table 6-1 lists each project, its priority ranking, and the proposed expenditure schedule. A description of each project is listed in bullet format. Each project has been noted previously in the Chapter within Sections relating to specific facilities or asset types.

Projects in the Existing FY19 CIP: There are thirty-eight DITP projects programmed in the FY19 CIP. The projects are described below and summarized in Table 6-1 (see line numbers 6.01 through 6.38).

- DI As-Needed Design 8-1, 8-2, and 8-3 projects, used to supplement in-house engineering staff, are programmed in the FY19 CIP at a cost of $4.20 million during FY17-20. Expenditures during the planning period (FY19-20) are $2.799 million. The As-Needed Design contracts are task-order contracts with engineering firms that have multiple engineering disciplines (structural, civil, mechanical, electrical, and chemical) as well as other technical consultants with expertise in fields such as hydrology, biology, landscape design, architectural design, marine biology, etc. Three contracts were issued and run concurrently for three years each. These resources are used to supplement the skills of in-house staff and provide assistance with developing specifications for various construction contracts needed to move DITP projects forward.

- DI As-Needed Technical Design Project that acts as a placeholder for CIP funds to be used as the As-Needed Contracts are developed. A total budget of $22.250 million is programmed in the FY19 CIP for expenditure during FY20-29 at approximately $2.0 million per year.

- SSPS Variable Frequency Drives (VFDs) Replacement design, ESDC, and construction is programmed in the FY19 CIP at $25.017 in FY19-26. Previously, the VFDs at the SSPS were replaced in FY07-08.

- SSPS Pump Lube System Replacement to change the pump lubrication system from the current system using grease to a new system using oil is programmed in the FY19 CIP at $1.0 million in FY20. Once installed, the new system will require only routine maintenance and should not require replacement.

- NMPS Variable Frequency Drives (VFD) Replacements design, ESDC, and construction is programmed in the FY19 CIP at $29.420 million in FY25-32. This phase of VFD replacement is planned to include motor replacements. Previously, the VFDs at the NMPS were replaced in FY13-16.

- NMPS Harmonic Filter Replacement is programmed in the FY19 CIP at $20.0 million in FY28-32. This project is planned to be reevaluated and may be combined with the VFD replacements.

- NMPS Motor Control Center (MCC) and Switchgear Replacement phase 2 sequential replacement of equipment that is currently obsolete and unreliable including ESDC, REI, and construction is programmed in the FY19 CIP at a total cost of cost of $13.066 million in FY17-23. Expenditures during the planning period (FY19-23) are $12.388 million.

- WTF Variable Frequency Drives (VFDs) replacement that are obsolete and miscellaneous smaller VFDs throughout the DITP is programmed in the FY19 CIP at $11.951 million in FY17-21. Expenditures during the planning period (FY19-21) are $7.656 million.

- Additional Variable Frequency Drives (VFDs) replacement for other miscellaneous smaller VFDs throughout the DITP is programmed in the FY19 CIP at $4.496 million in FY21-26.

- Expansion Joint Repairs construction 3 for clarifiers and retaining walls will continue the ongoing program to periodically replace failed expansion joints in the concrete clarifier decks and/or various retaining walls. This project is programmed in the FY19 CIP at a cost of $1.90 million during the FY20-22 timeframe.

- Clarifier Rehabilitation Phase 2 for primary and secondary clarifiers design, REI, and construction is programmed in the FY19 CIP at a cost of $135.275 million during FY15-23. Expenditures during the planning period (FY19-23) are $134.134 million. This project is a follow-up to the phase 1 primary and secondary clarifier rehabilitation project. Additional work needed to correct deficiencies includes: influent gate seals, effluent launders, primary sludge removal system, secondary aeration/recirculation system, and concrete corrosion.

- Cryogenics Plant Equipment Replacement design and construction to replace pumps, valves, motors, sensors, switches, instrumentation, etc. at the oxygen generation plant is programmed in the FY19 CIP at a cost of $18.255 million in FY22-28.

- Sodium Hypochlorite and Sodium Bisulfite Tank Rehabilitation to strip and reline the chemical tanks most in need of repair is programmed in the FY19 CIP at a cost of $5.0 million in FY19-21. This project may also include rehabilitation to portions of the chemical feed pipeline.

- Chemical Pipeline Replacement design and construction for planned periodic replacement of various chemical pipelines in the disinfection (sodium hypochlorite and sodium bisulfite) and odor control facilities due to deterioration from corrosion is programmed in the FY19 CIP at a cost of $2.717 million during FY22-27.

- Sodium Hypochlorite Tank Rehabilitation or Replacement to strip and reline the four sodium hypochlorite tanks is programmed in the FY19 CIP at a cost of $20.0 million in FY24-27.

- Gravity Thickener Rehabilitation Improvements design and construction is programmed in the FY19 CIP at a cost of $19.633 million during FY19-22. This project will be multi-phased including the following components: installation of catwalks around tanks, effluent channel improvements, and upgrades to the roof of the sludge thickener building for access and operating efficiency improvements.

- Centrifuge Replacement design and construction is programmed in the FY19 CIP at a cost of $20.8 million during FY24-29.

- Digester and Storage Tank Rehabilitation design, ESDC, REI, and construction to upgrade the three digester modules and two gas handling/sludge storage tanks is programmed in the FY19 CIP at a cost of $38.147 million during FY19-27. This 9-year project represents the second phase of improvements to the sludge digesters and gas handling/sludge storage tanks and will include: sludge piping upgrades, valve replacement, recirculation/mixing system improvements, overflow box upgrades, digester wall steel replacement or repair, digester coating, etc.

- Co-Digestion construction using a design-build contract is programmed in the FY19 CIP at a cost of $5.0 million during FY24-27.

- Dystor Tank Membrane Replacements for the two gas handling/sludge storage tanks is programmed in the FY19 CIP at a total cost of $4.0 million. The project includes two phases, $2.0 million expenditure during FY20 and $2.0 million expenditure during FY35.

- Digester Gas Flare #4 design and construction is programmed in the FY19 CIP at a cost of $1.798 million during FY24-28.

- Combined Heat and Power (CHP) Alternatives study, design, and construction to optimize the use of methane gas production and overall CHP efficiency is programmed in the FY19 CIP at a cost of $89.410 million during FY19-29. The MWRA - Eversource agreement to build a new cross-harbor electric cable will impact the alternatives for this project.

- Combustion Turbine Generator (CTG) Rebuilds in the Thermal Power Plant is programmed in the FY19 CIP at a cost of $8.0 million during FY24-27.

- DI Hydroturbine (HTG) Replacement is programmed in the FY19 CIP at a cost of $11.160 million during FY20-26.

- DI Electrical Equipment Upgrades Phase 5 design, ESDC, REI, and construction are programmed in the FY19 CIP at a cost of $27.470 million during FY23-29. The project includes transformers that are replaced when they fail or when electrical testing indicates that failure is imminent.

- Switchgear Replacements design and construction to sequentially replace obsolete electrical switchgear throughout the DITP is programmed in the FY19 CIP at a cost of $7.440 million during FY22-24.

- Switchgear Replacements Phase 2 design and construction to continue upgrades to electrical switchgear throughout the DITP is programmed in the FY19 CIP at a cost of $20.50 million during FY24-29.

- DI HVAC Equipment Replacement design, ESDC, REI, and construction to replace odor control and air handler equipment (including DITP Laboratory fume hoods) is programmed in the FY19 CIP at a cost of $44.186 million during FY14-23. Expenditures during the planning period (FY19-23) are $42.796 million.

- DI East/West Odor Control Air Handler Replacement is programmed in the FY19 CIP at a cost of $2.0 million during FY26-27.

- DI Odor Control Rehabilitation Plant-wide study, design, ESDC, REI, and construction is programmed in the FY19 CIP at a cost of $39.666 million during FY22-29. The project involves modifications to the plant-wide odor control system including the digester gas systems and wet scrubber improvements.

- DI PICS Distributed Processing Units (DPU) Replacements to replace the distributed processing unit cabinets and internal components of the PICS system is programmed in the FY19 CIP at a cost of $12.462 million during FY23-26.

- DI Cathodic Protection design, ESDC, and construction to evaluate the current system condition and complete repairs is programmed in the FY19 CIP at a cost of $6.235 million during FY23-25.

- The second phase of the DI Barge Berth and/or Pier Facilities Rehabilitation/Replacement is programmed in the FY19 CIP at a cost of $7.963 million in FY24-29. This project will complete major rehabilitation of the DI barge berth and pier facilities resulting from normal wear and storm/tidal damage.

- DI Fire Alarm System design, construction, and REI to upgrade/replace the fire alarm system at the DITP is programmed in the FY19 CIP at a cost of $24.218 million during FY16-24. Expenditures during the planning period (FY19-24) are $23.427 million.

- DI Radio Repeater System Upgrades – Phases 1 and 2 are programmed in the FY19 CIP at a cost of $3.0 million during FY18-20. Expenditures during the planning period (FY19-20) are $2.750 million.

- DI Fixed Gas Protection System Replacement project to replace gas detection devices in up to thirteen separate locations is programmed in the FY19 CIP at a cost of $1.0 million during FY19-20.

- DI Eastern Seawall Repairs design, ESDC, REI, and construction to repair the eroded concrete seawall and exposed rebar is programmed in the FY19 CIP at a cost of $4.370 million in FY19-23.

- DI Document Format Conversion project to convert DITP construction documents into electronic format and complete the document-reference database is programmed in the FY19 CIP at a cost of $145,000 in FY18-20. Expenditures during the planning period (FY19-20) are $68,000.

<u>Projects Recommended for Consideration in future CIPs</u>: There are thirty-five Deer Island Treatment Plant projects recommended for consideration in future CIPs. The projects are described below and summarized in Table 6-1 (see line numbers 6.39 through 6.73).

- DI Future As-Needed Design (following the current 8-1, 8-2, and 8-3 projects) used to supplement in-house engineering staff is recommended for consideration in future CIPs at a budget of $1.5 million annually during FY21-28 for a total cost of $12.0 million.

- DI Future As-Needed Technical Design (placeholder) Project is recommended for consideration in future CIPs for continuation of the project at a budget of $2.0 million annually for FY29-58 and a total cost of $60.0 million.

- DI Future Equipment Replacement Project to provide a long-term placeholder budget for funding new projects and/or increases to existing projects for DITP equipment replacement is recommended for consideration in future CIPs at an estimated cost of $2.0 million annually during the FY24-58 timeframe and a total cost of $70.0 million over 35 years.

- Future upgrades at the SSPS including VFD replacement ($25 million every 15 years); shaft, motor, and MCC replacements ($10.0 million every 20-25 years), and additional rehabilitation needed as the facility ages ($10.0 million) is recommended for consideration in future CIPs at an estimated cost of at $45.0 million with a target schedule of FY39-48.

- Future upgrades at the NMPS including VFD replacement ($25 million every 15 years); shaft, motor, and MCC replacements ($15.0 million every 20-25 years), and additional rehabilitation needed as the facility ages ($10.0 million) is recommended for consideration in future CIPs at an estimated cost of at $50.0 million with a target schedule of FY44-53.

- Future upgrades at the WTF including VFD replacement ($10 million every 15 years); shaft, motor, and MCC replacements ($5.0 million every 20-25 years), and additional rehabilitation needed as the facility ages ($5.0 million) is recommended for consideration in future CIPs at an estimated cost of at $20.0 million with a target schedule of FY34-43.

- Future replacement of miscellaneous smaller VFDs throughout DITP is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $10.0 million each cycle with a target schedule of FY34, FY44, and FY54 and a total cost of $30.0 million during the planning period.

- Future upgrades at the DITP Grit Facility to replace/upgrade grit removal and air handling equipment and additional rehabilitation needed as the facility ages (estimated at $5 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY30 and FY50 and a total cost of $10.0 million during the planning period.

- Future upgrades at the DITP primary and secondary clarifiers including concrete repairs and replacement/upgrade to mechanical equipment and additional rehabilitation needed as the facilities age (estimated at $50 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY40 and a total cost of $50.0 million during the planning period.

- Future Cryogenics Plant Equipment Replacement design and construction and additional rehabilitation needed as the facilities age (estimated at $4.0 million every 10 years) is recommended for consideration in future CIPs with a target schedule of FY37 and FY47 and a total cost of $8.0 million during the planning period.

- Future evaluation, rehabilitation, replacement, and/or upgrades to the sodium hypochlorite tanks, the sodium bisulfite tanks, and the chemical feed piping system (estimated at $12 million every 10 years) is recommended for consideration in future CIPs with a target schedule of FY37 and FY47 and a total cost of $24.0 million during the planning period.

- DI Future Outfall Inspection Project is recommended for consideration in future CIPs (every 20 years) to inspect and make recommendations for cleaning, upgrades, and/or rehabilitation for the DI outfall tunnel, as well as the DI emergency outfalls at an estimated cost of $3.0 million per phase beginning in FY25 and FY45 with a 1-year project duration.

- Future rehabilitation or upgrades to the gravity thickeners and covers (estimated at $20 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY45 and a total cost of $20.0 million during the planning period.

- A future centrifuge replacement project, including back-drive replacements, (estimated at $20 million every 20 years) is recommended for consideration in future CIPs with a target schedule of FY45 and a total cost of $20.0 million during the planning period.

- Future Digester and Storage Tank Rehabilitation design and construction are recommended for consideration in future CIPs (every 15 years) at an estimated cost of $25.0 million for each phase and a target schedule of FY45.

- Future Dystor Tank Membrane Replacements are recommended for consideration in future CIPs (every 15 years) at an estimated cost of $2.0 million for each phase and a target schedule of FY50.

- Future Digested Sludge Pump Replacements are recommended for consideration in future CIPs (every 20 years) at an estimated cost of $4.0 million for each phase and a target schedule of FY36 and FY56.

- Future Combustion Turbine Generator (CTG) Rebuilds are recommended for consideration in future CIPs (every 15 years) at an estimated cost of $8.0 million for each cycle with a target schedule of FY40 and FY55.

- Future Steam Turbine Generator (STG) Replacement at Deer Island is recommended for consideration in future CIPs at an estimated cost of $4.0 million during FY30-32.

- Future Heat Loop Pipe Replacement design and construction to continue upgrades/improvements to heat loop piping (similar to prior phases 1, 2, and 3) are recommended for consideration in future CIPs (every 20 years) at an estimated cost of $3.0 million for each cycle and a target schedule of FY30 and FY50.

- Future Hydroturbine Generator (HTG) Rehabilitation is recommended for consideration in future CIPs (every 20 years) at a cost of $10.0 million each cycle with a target schedule of FY25 and FY45.

- DI Future Electrical Equipment Upgrades (beyond Phase 5) to replace transformers, bus ducts, and other electrical equipment is recommended for consideration in future CIPs at an estimated cost of $5.0 million for each five year cycle and a target schedules of FY34, FY39, FY44, FY49, and FY54.

- DI Future Switchgear Replacements (beyond Phase 2) to upgrade/replace electrical switchgear is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $10 million in each cycle with a target schedule of FY35, FY45, and FY55.

- DI Future Odor Control Air Handler Replacements and Odor Control Upgrades is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $30.0 million for each cycle with a target schedule of FY43.

- DI Future PICS DPU and other hardware component replacement is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $5.0 million for each cycle with a target schedule of FY37 and FY52.

- Future DI HVAC Upgrades/Replacement including the control system, fan coils, etc. is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $20.0 million for each cycle and a target schedule of FY33 and FY48.

- DI Future Fuel Supply Pump and Pipe Replacement or Rehabilitation design and construction is recommended for consideration in future CIPs (every 20 years) at an estimated cost of $5.0 million for each cycle with a target schedule of FY42.

- Future Leak Protection System Upgrade to the leak protection system and chemical/fuel tank containment areas is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $500,000 for each cycle with a target schedule of FY30 and FY45.

- DI Future Water Storage Tank Cleaning/Rehabilitation and Water Pipeline Rehabilitation are recommended for consideration in future CIPs (every 40 years) at an estimated cost of $2.0 million for each cycle with a target schedule of FY40.

- DI Future Cathodic Protection Testing is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $250,000 for each cycle with a target schedule of FY35, FY45, and FY55. This project has an estimated duration of 1-year.

- DI Future Sanitary and Stormwater System Rehabilitation including replacement of ejector pumps and rehabilitation of force mains and gravity pipelines is recommended for consideration in future CIPs (every 25 years) at an estimated cost of $1.0 million for each cycle with a target schedule of FY25 and FY50.

- DI Future Personnel Protection System Upgrade/Replacement is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $1.0 million for each cycle with a target schedule of FY25, FY35, FY45, and FY55.

- DI Future Barge Berth and/or Pier Facilities Rehabilitation is recommended for consideration in future CIPs (every 20 years) at an estimated cost of $2.0 million for each cycle with a target schedule of FY45.

- DI Future Seawall Repairs and/or Placement of Rip-rap to repair or protect the DITP concrete seawall is recommended for consideration in future CIPs (every 10 years) at an estimated cost of $2.0 million for each cycle with a target schedule of FY35, FY45, and FY55.

- DI Future Roof Replacements is recommended for consideration in future CIPs (every 15 years) at an estimated cost of $6.0 million for each cycle with a target schedule of FY25, FY40, and FY55.

Table 6-1

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Recommended Projects

Last revision 10/24/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF New Facility/System
RF/IC Replacement Facility/Increase Capacity
Opti Optimization
AP Asset Protection
Plan Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT												
6.01	2	DI As-Needed Design 8-1, 8-2 and 8-3	AP	206	19600_7501 19601_7502 19602_7503	4 years	4,200	2,799	FY17-20	2,799				2,799
6.02	1	DI As-Needed Technical Design	AP	206	19311_7121	10 years	22,250	22,250	FY20-29	7,750	12,500	2,000		22,250
6.03	1	DI SSPS VFD Replacement - Design, ESDC and Construction	AP	206	19316_7126 19317_7127	8 years	25,017	25,017	FY19-26	9,811	15,206			25,017
6.04	2	DI SSPS Lube System Replacement	AP	206	19335_7169	2 years	1,000	1,000	FY20	1,000				1,000
6.05	1	DI NMPS VFD Replacements - Design, ESDC and Construction	AP	206	19318_7128 19319_7129	8 years	29,420	29,420	FY25-32		9,539	19,881		29,420
6.06	2	DI NMPS Harmonic Filter Replacement	AP	206	19557_7414	5 years	20,000	20,000	FY28-32		417	19,583		20,000
6.07	1	DI NMPS Motor Control Center (MCC) and Switchgear Replacement - Phase 2 Design, ESDC, REI and Construction	AP	206	19560_7419 19561_7420	7 years	13,066	12,388	FY17-23	12,388				12,388
6.08	1	DI Winthrop Terminal Facility VFD Replacements - Construction	AP	206	19258_6875	5 years	11,951	7,656	FY17-21	7,656				7,656
6.09	1	DI Misc. VFD Replacements	AP	206	19315_7125	6 years	4,496	4,496	FY21-26	2,119	2,377			4,496
6.10	1	DI Expansion Joint Repairs - Construction 3 for Clarifiers and Retaining Walls	AP	206	19218_6705	3 years	1,900	1,900	FY20-22	1,900				1,900
6.11	2	DI Clarifier Rehab Phase 2 (Primary and Secondary) - Design, REI and Construction	AP	206	19347_7394 19348_7395 19351_7397	9 years	135,275	134,134	FY15-23	134,134				134,134
6.12	1	DI Cryogenics Plant Equipment Replacement - Design and Construction	AP	206	19329_7139 19330_7140	7 years	18,255	18,255	FY22-28	1,628	16,627			18,255
6.13	2	DI Sodium Hypochlorite and Sodium Bisulfite Tanks Rehabilitation	AP	206	40256_7449	3 years	5,000	5,000	FY19-21	5,000				5,000
6.14	2	DI Chemical Pipe Replacement - Design and Construction	AP	206	19252_6851 19253_6852	6 years	2,717	2,717	FY22-27	412	2,305			2,717
6.15	1	DI Sodium Hypochlorite Tank Rehabilitation or Replacement	AP	206	19332_7142	4 years	20,000	20,000	FY24-27		20,000			20,000

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Project Types

NF	New Facility/System
RF/IC	Replacement Facility/Increase Capacity
Opti	Optimization
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Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT												
6.16	1	DI Gravity Thickener Rehabilitation	AP	206	19565_7428	4 years	19,633	19,633	FY19-22	19,633				19,633
6.17	1	DI Centrifuge Replacements - Design and Construction	AP	206	19327_7137 19328_7138	6 years	20,800	20,800	FY24-29		20,763	37		20,800
6.18	1	DI Digester and Storage Tank Rehab - Design, ESDC, REI and Construction	AP	206	19290_7052 19291_7053 19345_7373 19161_6240	9 years	38,147	38,147	FY19-27	4,322	33,825			38,147
6.19	3	Co-Digestion - Design/Build	NF	206	19247_6822	4 years	5,000	5,000	FY24-27		5,000			5,000
6.20	1	DI Dystor Tank Membrane Replacements	AP	206	19325_7135	1 year	4,000	4,000	FY20, FY35	2,000		2,000		4,000
6.21	2	DI Digester Gas Flare # 4 - Design and Construction	AP	206	19227_6728 19228_6729	5 years	1,798	1,798	FY24-28		1,798			1,798
6.22	3	DI Combined Heat and Power (CHP) Alternatives - Study, Design and Construction	Opti	206	19229_6730 19274_6963 19275_6964	11 years	89,410	89,410	FY19-29	3,504	85,721	185		89,410
6.23	1	DI CTG Rebuilds	AP	206	19326_7136	4 years	8,000	8,000	FY24-27		8,000			8,000
6.24	3	Hydroturbine Replacement - Design, ESDC, REI, Construction	AP	206	19603_7570 19604_7571	7 years	11,160	11,160	FY20-26	2,428	8,732			11,160
6.25	1	DI Electrical Equipment Upgrades Phase 5 - Design, ESDC, REI and Construction	AP	206	19314_7124 19320_7130	7 years	27,470	27,470	FY23-29	251	27,181	38		27,470
6.26	1	DI Switchgear Replacements - Construction	AP	206	19297_7059	3 years	7,440	7,440	FY22-24	6,821	619			7,440
6.27	1	DI Switchgear Replacements Phase 2 - Design and Construction	AP	206	19322_7132 19323_7133	6 years	20,500	20,500	FY24-29		20,459	41		20,500
6.28	2	DI HVAC Equipment Replacement - Design, ESDC, REI and Construction (including DITP Lab)	AP	206	19307_7094 19309_7111 19310_7110	10 years	44,186	42,796	FY14-23	42,796				42,796
6.29	2	DI East/West Odor Control Air Handler Replacement	AP	206	19336_7170	2 years	2,000	2,000	FY26-27		2,000			2,000
6.30	3	DI Odor Control Rehabilitation Plant-Wide Study, Design ESDC, REI and Construction	AP	206	19188_6538 19191_6592 19303_7088	10 years	39,666	39,666	FY22-29	1,735	37,915	16		39,666
6.31	2	DI PICS Distributed Processing Units (DPU) Replacement	AP	206	19338_7172	4 years	12,462	12,462	FY23-26	2,424	10,038			12,462

Table 6-1

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Project Types

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Opti	Optimization
AP	Asset Protection
Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT												
6.32	3	DI Cathodic Protection - Construction	AP	206	19294_7056	3 years	6,235	6,235	FY23-25	1,247	4,988			6,235
6.33	2	DI Barge Berth and/or Pier Facilities - Rehab/Replacement - Design, ESDC, REI and Construction	AP	206	19224_6725 19225_6726	6 years	7,963	7,963	FY24-29		7,943	20		7,963
6.34	2	DI Fire Alarm System Replacement - Design, Construction and REI	AP	206	19273_6904 19289_7051 19563_7426	9 years	24,218	23,427	FY16-24	23,398	29			23,427
6.35	1	DI Radio Repeater System Upgrades - Phases 1 & 2	AP	206	19312_7122 19324_7134	3 years	3,000	2,750	FY18-20	2,750				2,750
6.36	2	DI Gas Protection System Replacement	AP	206	19333_7167	2 years	1,000	1,000	FY19-20	1,000				1,000
6.37	4	DI Eastern Seawall Repairs Design, ESDC, REI and Construction	AP	206	19222_6723 19223_6724	5 years	4,370	4,370	FY19-23	4,370				4,370
6.38	3	DI Document Format Conversion	AP	206	19241_6791	3 years	145	68	FY18-20	68				68
		SUBTOTAL - Existing Projects - Deer Island					**713,150**	**703,127**		**305,344**	**353,982**	**43,801**	**0**	**703,127**

Table 6-1

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Recommended Projects

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Project Types

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Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT												
		Recommended Projects - Deer Island												
6.39	3	DI Future As-Needed Design at $1.5M per year	AP	New		8 years	12,000	12,000	FY21-28	4,500	7,500			12,000
6.40	3	DI Future As-Needed Technical Design (Placeholder, $2M annually)	AP	new		30 years	60,000	60,000	FY29-58			20,000	40,000	60,000
6.41	3	DI Future Equipment Replacement Project (Placeholder, $2M annually)	AP	new		35 years	70,000	70,000	FY24-58		10,000	20,000	40,000	70,000
6.42	2	DI Future SSPS Upgrades including VFD, Shaft, Motor, and MCC Replacements and Additional Rehabilitation	AP	new		10 years	45,000	45,000	FY39-48				45,000	45,000
6.43	2	DI Future NMPS Upgrades, including VFD, Shaft, Motor, and MCC Replacements, and additional rehabilitation	AP	new		10 years	50,000	50,000	FY44-53				50,000	50,000
6.44	2	DI Future WTF Upgrades, including VFD, Shaft, Motor, and MCC Replacements, and additional rehabilitation	AP	new		10 years	20,000	20,000	FY34-43			10,000	10,000	20,000
6.45	2	DI Future Misc. VFD Replacements at $10M each recurring every 10 years	AP	new		5 years	30,000	30,000	FY34-38, FY44-48, FY54-58			10,000	20,000	30,000
6.46	2	DI Future Grit Facilities Rehabiltation/Upgrade	AP	new		3 years	10,000	10,000	FY30-32, FY50-52			5,000	5,000	10,000
6.47	2	DI Future Primary and Secondary Clarifier Rehabilitation including Concrete Repair and Mechanical Equipment	AP	new		10 years	50,000	50,000	FY40-50				50,000	50,000
6.48	2	DI Future Cryogenics Plant Equipment Replacement - Design and Construction	AP	new		3 years	8,000	8,000	FY37-39, FY47-50			4,000	4,000	8,000
6.49	2	DI Future Sodium Hypochlorite Tanks, Sodium Bisulfite Tanks, and Chemical Feed Pipeline Evaluation, Rehabilitation and/or Replacement	AP	new		2 years	24,000	24,000	FY37-38, FY47-48			12,000	12,000	24,000
6.50	4	DI Future Outfall Inspections ($3M every 20 years)	AP	new		1 year	6,000	6,000	FY25, FY45		3,000		3,000	6,000
6.51	2	DI Future Gravity Thickener and Covers - Rehabilitation or Upgrade	AP	new		5 years	20,000	20,000	FY45-49				20,000	20,000
6.52	2	DI Future Centrifuge and Backdrive Replacements	AP	new		5 years	20,000	20,000	FY45-49				20,000	20,000

Table 6-1

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Recommended Projects

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Project Types

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Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT												
6.53	2	DI Future Digester and Sludge Storage Tank Rehabilitation - Design and Construction ($25M every 15 years)	AP	new		5 years	25,000	25,000	FY45-49				25,000	25,000
6.54	2	DI Future Dystor Tank Membrane Replacements ($2M for both tanks every 15 years)	AP	new		1 year	2,000	2,000	FY50				2,000	2,000
6.55	2	DI Future Digested Sludge Pump Replacements (to Pellet Plant - $4M every 20 years)	AP	new		1 year	8,000	8,000	FY36, FY56			4,000	4,000	8,000
6.56	2	DI Future CTG Rebuilds ($8M every 15 years)	AP	new		2 years	16,000	16,000	FY40-41, FY55-56				16,000	16,000
6.57	3	DI Future STG Replacement	AP	new		3 years	4,000	4,000	FY30-32			4,000		4,000
6.58	2	DI Future Heat Loop Pipe Replacement Design & Construction ($3M every 20 years)	AP	new		1 year	6,000	6,000	FY30, FY50			3,000	3,000	6,000
6.59	3	DI Future HTG Rehabilitation ($10M every 20 years)	AP	new		1 year	20,000	20,000	FY25, FY45		10,000		10,000	20,000
6.60	2	DI Future Electrical Equipment Upgrades (beyond Phase 5, $5M every 5 years)	AP	new		5 years	25,000	25,000	FY34-38, FY39-43, FY44-48, FY49-53, FY54-58			5,000	20,000	25,000
6.61	2	DI Future Switchgear Replacements ($10M every 10 years)	AP	new		4 years	30,000	30,000	FY35-38, FY45-48, FY55-58			10,000	20,000	30,000
6.62	3	DI Future Odor Control Air Handler Replacements and Odor Control Upgrades ($30M every 15 years)	AP	new		5 years	30,000	30,000	FY43-47				30,000	30,000
6.63	2	DI Future PICS Distributed Processing Units (DPU) and Other Hardware Replacements ($5M every 15 years)	AP	new		2 years	10,000	10,000	FY37-38, FY52-53			5,000	5,000	10,000
6.64	2	DI Future HVAC Upgrade/Replacement ($20M every 15 years)	AP	new		5 years	40,000	40,000	FY33-38, FY48-52			20,000	20,000	40,000

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Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT												
6.65	3	DI Future Fuel Supply Pump and Pipe Replacement/Rehab Design & Construction	AP	new		1 year	5,000	5,000	FY42				5,000	5,000
6.66	2	DI Future Leak Protection System Upgrade ($500k every 15 years)	AP	new		1 year	1,000	1,000	FY30, FY45			500	500	1,000
6.67	3	DI Future Water Storage Tank Cleaning/Rehab and Water Pipeline Rehab ($2M every 40 years)	AP	new		2 years	2,000	2,000	FY40-41				2,000	2,000
6.68	4	DI Future Cathodic Protection Testing ($250k every 10 years)	AP	new		1 year	750	750	FY35, FY45, FY55			250	500	750
6.69	3	DI Future Sanitary and Stormwater System Rehab ($1M every 25 years)	AP	new		1 year	2,000	2,000	FY25, FY50		1,000		1,000	2,000
6.70	3	DI Future Personnell Protection Systems Upgrade/Replacement ($1M every 10 years)	AP	new		1 year	4,000	4,000	FY25, FY35, FY45, FY55		1,000	1,000	2,000	4,000
6.71	2	DI Future Barge Berth and/or Pier Facilities Rehab ($2M every 20 years)	AP	new		1 year	2,000	2,000	FY45				2,000	2,000
6.72	3	DI Future Seawall Repairs and/or Placement of Rip-rap ($2M every 10 years)	AP	new		1 year	6,000	6,000	FY35, FY45, FY55			2,000	4,000	6,000
6.73	4	DI Future Roof Replacements ($6M every 15 years)	AP	new		2 years	18,000	18,000	FY25-26, FY40-41, FY55-56		6,000		12,000	18,000
		SUBTOTAL - Recommended - Deer Island					681,750	681,750		4,500	38,500	135,750	503,000	681,750
		SUBTOTAL - Existing and Recommended - Deer Island					1,394,900	1,384,877		309,844	392,482	179,551	503,000	1,384,877

Chapter 7
RESIDUALS PROCESSING AND DISPOSAL (OFF-ISLAND) AT THE PELLET PLANT

7.01 Chapter Summary

Digested sludge is pumped from Deer Island Treatment Plant (DITP) sludge and gas storage tanks through one of two 14-inch, seven-mile long force mains that run from DITP to the Residuals Pellet Plant in Quincy. The 14-inch pipelines are embedded in concrete along one side of the 11-foot diameter Inter-Island Tunnel. The force mains connect into a vault at Nut Island and continue through the Braintree-Weymouth Tunnel to the Residuals Pellet Plant. At the Pellet Plant, digested wastewater sludge from DITP is converted into pellets and distributed for beneficial reuse. Once processed, wastewater sludge is known as residuals or biosolids. The commonly used name for the off-island residuals facility is Residuals Pellet Plant, which will be used in the Wastewater System Master Plan. MWRA's official name for the residuals facility is the Biosolids Processing Facility (BPF).

The Pellet Plant is operated and maintained under a long-term contract with a private firm - the New England Fertilizer Company (NEFCo). The original contract term was March 2001 through December 2015. In 2015, MWRA and NEFCo signed an Amendment to the original contract which extended the contract term an additional five years, through December 2020. The annual operating cost is a function of residuals production and various contractual inflationary indices and has been in the range of $14 to $16 million per year (during the FY14 to FY16 timeframe). Planning for CIP expenditures leading into and after the December 2020 contract expiration date are detailed in this Chapter. The replacement asset value of the Pellet Plant is approximately $200 million (3% of wastewater system asset value). See the detail on Wastewater Infrastructure Replacement Asset Value in Section 3.07.

MWRA's Pellet Plant was built in 1991 and expanded in 2001 to handle the residuals production from DITP secondary treatment facilities. In 2018, the facility equipment will be 17 to 27 years old. In July 2010, a comprehensive Residuals Facility Condition Assessment and Utility Reliability project was completed. This project reviewed the adequacy of existing facility components and processes and generally found the facility to be in good to very good condition. Based on the project findings, NEFCo was directed to pay more attention to equipment obsolescence in the facility's electronics/control systems. The assessment also concluded that the major utility systems lacked redundancy and recommended this deficiency be addressed if MWRA continues pelletizing long-term. In January 2014, MWRA completed an assessment of long-term technology options for residuals processing and disposal. The study identified a few technology efficiency improvements for the Pellet Plant that will be evaluated in the long-term. Significant reinvestment is anticipated for residuals processing and disposal during the 40-year Wastewater System Master Plan timeframe. Staff have identified a series of potential residuals projects which may be refined based on future assessments.

For the Residuals Pellet Plant, operability of mechanical equipment and maintenance of gas/electric/standby power systems are key elements to minimize risk of component failure. Key decision making to minimize risks includes the cost/benefit of when to replace aging equipment and which/how many spare parts to pre-purchase. The residuals pelletizing process is energy intensive and, as such, future uncertainties (long-term energy costs, supply reliability, etc.) need to be considered as part of long-range planning.

For residuals processing and disposal (off-island) at the Pellet Plant, $186.732 million in projects is identified in the 40-year master plan timeframe (FY19-58). Nine projects ($102.432 million) are programmed in the FY19 CIP. Five additional projects ($84.3 million) are recommended for consideration in future CIPs. Section 7.07 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Following completion of the FY19 CIP, an additional project to replace up to 3 drum dryers was approved based on discussions with MWRA management (April 2018) that impacts the FY19-21 budget cycle. This project is estimated at approximately $2.3 million for design and construction. The design cost is based on 15% estimate at $345,000. The decision to do this work was tied to the Residuals Technology Assessment long-term efficiency improvements. A study was completed in FY18 to evaluate replacement of the existing 50 dtpd dryers with larger more efficient 100 dtpd dryers. The study concluded that while the larger units would improve efficiency, the paybacks were too long at greater than 30 years. MWRA delayed maintenance on the existing units until this study was complete. This additional planned spending is a direct impact of the decision to not move to larger dryers. The $2.30 million project is included in the summary tables as the first future recommended project in the Master Plan and is expected to be added to the FY20 CIP.

Near-term (FY19-23):

- $11.488 million is programmed in the FY19 CIP:
  - $389,000 to begin Residuals Facilities Plan and EIR;
  - $1.667 million to begin Residuals Facilities Upgrade phase 1 design and engineering services during construction (ESDC);
  - $1.588 million for Residuals Facilities Upgrade phase 1 construction;
  - $324,000 to complete Residuals Sludge Tank and Silo Coating;
  - $2.220 million to complete Residuals Electrical Improvements;
  - $2.30 million to complete Residuals Mechanical Improvements; and,
  - $3.00 million to complete Residuals Pellet Piping Relocation.

- $2.3 million in needs is recommended for consideration in future CIPs:
  - $2.3 million for Residuals Drum Dryer Replacement design and construction that has been approved for the FY20 CIP.

Mid-term (FY24-28):

- $65.944 million is programmed in the FY19 CIP:
  - $611,000 to complete Residuals Facilities Plan and EIR;
  - $333,000 to complete Residuals Facilities Upgrade phase 1 design and engineering services during construction (ESDC);

  - $15.00 million to complete Residuals Facilities Upgrade phase 2 design and engineering services during construction (ESDC); and,
  - $50.0 million to begin Residuals Facilities Upgrade phase 2 construction.

- $1.0 million in needs is recommended for consideration in future CIPs:
  - $1.0 million for future Pellet Plant Pier Rehabilitation construction.

Long-term (FY29-38 and FY39-58):

- $25.0 million is programmed in the FY19 CIP:
  - $25.0 million to complete Residuals Facilities Upgrade phase 2 construction.

- $81.0 million in needs is recommended for consideration in future CIPs:
  - $2.0 million for future Pellet Plant Technology Assessment and/or Facility update;
  - $75.0 million for future Equipment Replacements; and,
  - $4.0 million for future Building Envelope Rehabilitation.

7.02 Residuals Pellet Plant Overview


Residuals Pellet Plant

Due to space limitations and access issues at Deer Island, the Fore River Shipyard in Quincy was selected as the location for additional MWRA facilities and to support construction of the DITP. The property was acquired by MWRA, renamed the Fore River Staging Area (FRSA), and served as the gateway for staging and marine transport of construction materials and equipment during DITP construction from 1987 to 1992. Phase 1 of the Residuals Pellet Plant was constructed at the FRSA site in 1991 and the phase 2 expansion was completed in 2001. In December 1991, MWRA began the transport of residuals to the Pellet Plant using specially designed barges. In 2005 the barging operation ceased, and instead MWRA began pumping digested residuals from DITP to the Pellet Plant via two 14-inch force mains (one redundant) located within the Inter-Island and Braintree-Weymouth Tunnels.

The Residuals Pellet Plant is designed to handle up to 180 dry tons per day of residuals with four of the six operational trains running. Currently, the plant processes 100 dry tons per day annual average or approximately 140 dry tons per day during NEFCo's 5-day operational week. The larger design capacity and additional operating trains provide for equipment redundancy within the facility. The degree of available redundancy is directly related to the amount of equipment off-line for repair or maintenance. Residual pellets are shipped by rail or truck for beneficial reuse; however, the pellet market is seasonal, so there are large variances in quantities leaving the site.

The Residuals Management Program is part of Wastewater Treatment within the Operations Division. The Director of Wastewater Treatment reports to the Deputy Chief Operating Officer under the overall direction of the Chief Operating Officer. The Residuals Department is headed by an on-site Operations Manager reporting from the Pellet Plant in Quincy with assistance by a manager on Deer Island.

Permitting for the beneficial reuse and disposal of wastewater residuals is regulated by EPA under 40 CFR part 503 (503s). MassDEP is promulgated to authorize residuals reuse and disposal under an Approval of Suitability permitting program. MWRA's Pellet Plant maintains an Approval of Suitability from MassDEP and staff report to EPA pursuant to the 503s regulation. A Conditional Approval also governs the Pellet Plant for Air Pollution Control. In addition, reporting to EPA and MassDEP is also required under MWRA's DITP NPDES permit.

7.03 Pellet Plant Contract Operations, Maintenance, and Ongoing Upgrades

The Pellet Plant is operated and maintained under a contract with NEFCo through December 2020. NEFCo employs approximately 30 staff at the facility and uses use a computerized maintenance management system with features similar to MWRA's MAXIMO work order software system. Facility work orders are regularly scheduled and reported on within the maintenance management system. MWRA staff have direct access to all maintenance records. NEFCo reports all maintenance activities to MWRA monthly along with a list of anticipated major repairs. In addition, NEFCo produces a quarterly executive summary maintenance report for MWRA and MassDEP review.

NEFCo has also been responsible for some capital improvements that are needed to maintain the facility operation through the contract term. The original contract outlined a tentative annual project list; however, projects are revisited regularly based on equipment performance and overall facility needs. NEFCo performs most maintenance with their own forces, but does contract out specialized service on systems such as electrical, elevator, fire alarm, and centrifuge/dryer re-builds. Record plans and operating manuals are kept at the facility. Upgrade projects completed over the last five year include:

- Replacement of facility roof;
- Replacement of dryer drum No. 2;
- Major overhaul of 8 centrifuges;
- Replacement of all 12 polymer pumps;
- Installation of two new polymer systems;
- Replacement of 2 RTO PLCs;
- Replacement of 2 centrifuge back drive motors and the control panel; and,
- Installation of a new fire protection system.

As part of the five-year contract extension with NEFCO, MWRA committed $7 million to fund needed capital improvements. The MWRA projects, together with upgrades NEFCO will continue to make, will maintain the facility through the December 2020 time period. Some of these projects include:

- Painting silos 1-5, the exterior of the tank room, the conference room, and the lobby;
- Major electrical improvements to motor control centers;
- Major mechanical improvements to Separator Conveyors on train 1-6;

- Minor natural gas line improvements to trains 1-6;
- Ongoing major overhaul of all 6 residuals dryer trains with one scheduled every six months; and,
- Ongoing replacement of media and refractory repairs in 4 RTOs with one scheduled every two years in each of four units.

7.04 MWRA Planning For Long-Term Residuals Management

The Pellet Plant Condition Assessment and System Reliability Study completed in July 2010 utilized an independent consultant to assess all major facility equipment components and all support systems, including: power, water, sanitary, and drainage. The next step in facilities planning was to assess what other technology options exist for residuals management and processing, review options that other peer utilities have pursued, and review regulatory trends that may impact decision-making. The Technology Options Assessment was completed in January 2014 with recommendations primarily pertaining to Deer Island digesters/digester gas operations. Long-range recommended improvements to the Pelletizing Plant included replacing several smaller drying trains with a few larger drying trains (without increasing the current capacity of the facility) to achieve energy efficiency gains. This recommendation would require a substantial capital investment for a facility with a long remaining life. Any changes of this type would only be made after considering the estimated payback period. As of 2015, only one large treatment plant utilizes these larger dryer trains, and another was under construction (Detroit). In FY18, staff evaluated the performance of the Detroit dryers. This study concluded that while the units did provide some energy efficiency gains, the paybacks for a replacement of this magnitude were too long (greater than 30 years) so a decision to keep the existing dryers was made. In order to extend the life of MWRA’s Residual Pellet Plant beyond 25 years, staff anticipate that other mechanical, instrumental, HVAC, and electrical systems will need evaluation and some replacement due to age or obsolescence. All of these factors will need to be evaluated in developing the scope for issuance of a new plant operations contract. Staff continue to believe that a competitively bid, long-term agreement for the operation and maintenance of the Pelletizing Plant will provide the agency with the most cost-effective means for biosolids processing beyond 2020. Staff anticipate that competition for long-term operation and maintenance services will grow over the next few years as more of these facilities come on line in the U.S.

There are specific projects programmed in the FY19 CIP including Facilities Planning and EIR (FY22-25), two phases of upgrade design and construction (FY20-32), and a group of specific upgrade projects to address sludge tank and silo coating, electrical improvements, mechanical improvements, and piping relocation as previously discussed.

To estimate long-term capital costs for residuals management, MWRA is assuming that major residuals equipment will be replaced in approximately 15 to 20 year cycles during the 40-year master plan period. Place-holder projects for technology assessments, residuals equipment replacement, and building rehabilitation are recommended for consideration in future CIPs in the FY39-58 timeframe.

7.05 Details on Residuals Pellet Plant Operations

The main processes at the Residuals Pellet Plant include: (1) receiving and temporarily storing pumped residuals from DITP, (2) residuals dewatering using high-speed centrifuges, (3) pelletization and drying, (4) pellet size classification, (5) dust control and air emission scrubbing, (6) pellet storage, (7) shipping/distribution of final pellet product, and (8) Pellet Plant utilities. Details on each process are described below.

Residuals Pumping and Storage: Before the Braintree-Weymouth Tunnel was completed in April 2005, digested residuals from DITP were barged to the Pellet Plant for processing. Since April 2005, MWRA has been pumping digested residuals from DITP to the Pellet Plant via two 14-inch force mains (one redundant) located within the Inter-Island and Braintree-Weymouth Tunnels. While the residuals pumping system has been fairly reliable, there were concerns about excessive pipeline vibration and movement due to the Abel positive-displacement diaphragm pumps, as well as grit and sludge settling in the riser section of the pipe, which constricted the flow. Staff piloted an alternative pump system consisting of a centrifugal pump and high-velocity flushing pump to see if this improved the efficiency, reduced pipe vibration, and cleared the pipe of settled solids. This new system proved successful, and the two remaining diaphragm pumps were replaced with centrifugal pumps in a project that was completed in 2017. During normal operation, three interconnected one million gallon tanks receive incoming liquid residuals from DITP via the pipelines. There is a fourth one-million gallon tank available for backup residuals storage. Centrate (generated from the dewatering process) is pumped back to the MWRA Intermediate Pump Station (IPS) in Weymouth, where it enters the MWRA wastewater collection system (see detail in Chapter 10).

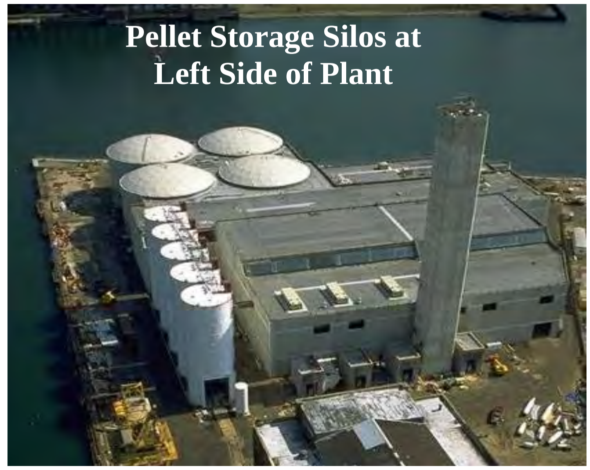
Residuals Dewatering Using Centrifuges: The purpose of each centrifuge is to concentrate the liquid residuals that enter the centrifuge at approximately 2 percent solids content to a wet cake that leaves the centrifuge at approximately 28 percent solids content. Centrifuges concentrate solids on the basis of density, similar to gravity separation of solids in a clarifier with the exception that centrifugal acceleration applies a separation force on the suspended particles up to thousands of times the acceleration of gravity. This increased acceleration results in higher concentration of solids than belt filter presses can achieve. There are a total of twelve centrifuges, two for each pelletizing train. The centrifuges are paired up to discharge into one of six wet cake bins. Each dewatering centrifuge consists of a high speed, rotating cylinder that receives residuals through an injection tube. Centrifugal force pushes solids towards the discharge port resulting in separation of solids from the liquid centrate. Polymer is added to aid the dewatering process.


Dryer Trains

Pelletization and Drying: The facility houses six similar pelletizing trains. Dewatered residuals are deposited in the wet cake storage bins and conveyed to mixing screws where it is combined with dry (96 percent solids) recycled material (small pellets). The recycled material is coated with wet cake while being mixed and conveyed by a set of mixer screws, forming larger, partially wet pellets. The wet pellets are delivered to a pug mill mixer (one for each dryer train). The pug mills perform final mixing and help shape the pellets prior to entering the dryer via the dryer feed conveyor. The interaction of the hot gasses, the mixed material, and the rotary action of the dryer drum produces the final product density (41 lbs. per cubic foot) and moisture content (96 percent solids). A natural gas burner produces hot air to dry the pellets in a rotary drum dryer. The burner system is a semi-automatic system featuring throttling fuel valves, safety shut-off solenoid valves, manual shut-off valves, pressure gauges, and a throttling air valve.

Pellet Size Classification: The air stream and dried pellets enter the Baker-Rullman separator tangentially, which creates a centrifugal motion. The velocity slows to allow separation of the pellets from the air stream. The pellets drop to the bottom of the separator and are conveyed to the screener, which separates the pellets by size. Pellets that are too small fall through the screens, onto the recycle conveyor. Pellets that are too big are crushed into small pellets and sent to the recycle conveyor. The recycle conveyor transports the small pellets to the recycle bin where they are temporarily held, eventually returning to the wet cake bin to begin the drying process again. Pellets that are the correct size are conveyed to the pellet cooler before being pneumatically transported to the storage silos. The air stream, carrying some fine particulate and moisture, is ducted from the top of the separator to the venturi scrubber and packed tower, to remove the particulates before the air is released back into the atmosphere, as discussed further below.

Dust Control and Air Emission Scrubber: The dust system controls fugitive dust generated by the solids handling process equipment. Vent connections at various pieces of equipment are ducted to a dust collector and fan in each of the pelletizing trains. The collected dust is fed via a rotary airlock, to either the recycle conveyor or diverted to a container for off-site disposal. The venturi scrubbers/packed towers (connected in series) are designed to achieve outlet emissions of 0.009 (or less) grains per dry standard cubic foot. The first stage venturi scrubber collects particulate, while the second stage packed tower is used mainly for air/water separation (condensing) and ammonia removal.



Pellet Storage: There are five original and four newer pellet storage silos. Each of the five original silos is 32 feet in diameter and 88 feet high, with a capacity of 34,000 cubic feet. The four newer silos are each 32 feet in diameter and 95 feet high, with a capacity of 38,000 cubic feet. The bottom of each silo has an elevated cone to allow railcar access underneath the row of silos. A dust collector is mounted on the silo deck (the top of each silo) to capture dust in the air exhausted from the silo. Also on the deck of each silo are two 3-inch pneumatic pellet conveyance fill connections, nine thermocouple cables, a level transmitter, and a 24-inch man-way. The silo deck has been designed as an explosion-relief deck. In the event of excessive pressure build-up, the bolts holding the deck will shear and allow the deck to move off the silo walls. Restraining cables connect the deck to the silo walls.

Under the skirt at the bottom of the silo is the PEBCO load-out system and nitrogen purge jets. For each silo, a control panel is located in the silo skirt to operate the load-out system. A panel with the loading scale is provided in Silo 2. The two end silos are provided with electrically operated overhead rollup doors, opened and closed by a local control. Both sets of silos are equipped with a nitrogen distribution system used to control the temperature of the stored product by displacing oxygen and thereby reducing biological activity, preventing overheating. The temperature in each silo is measured at various depths and perimeter locations by the nine thermocouple cables.

Shipping/Distribution of Final Pellet Product: Pellets are stored in the silos until ready for distribution to customers. Pellets can leave the facility via truck or rail. The mode of transportation is usually dictated by the location and receiving capabilities of customers, as well as order size. On a peak day approximately eight trucks leave the site; on an average day only three. Railcar trips are fewer due to their larger unit capacity. During the New England growing season, most pellets leave the site by truck for local customers. During other seasons, customers are located in moderate climate regions and distribution is typically via rail. Additional information on rail transport via the Fore River Railroad is provided in Section 7.6.

To support beneficial reuse of residuals, MWRA directly markets the final pellet product locally for wholesale distribution under the name Bay State Fertilizer. The product is bagged by NEFCo under the terms of their contract. MWRA's Bay State Fertilizer pellets are distributed throughout New England and used by golf courses and sod farms. Local garden supply houses also market the product. In addition, Bay State Fertilizer is available free of charge to all MWRA member communities.

Under the terms of NEFCo's contract with MWRA, NEFCo is required to provide emergency backup landfill capability for residuals cake and/or finished dry pellet disposal. NEFCo maintains an agreement with New England Organics to provide backup space at a number of sites throughout New England and New York. The backup landfill has been used for one 40-day period in 2008 to support disposal of residuals cake while repairs were made at the pellet facility due to a duct fire.

Pellet Plant Utilities and Pier: The Pellet Plant is powered through the local electrical supplier and also utilizes natural gas to fire the rotary dryer system. In addition, there is a small degree of emergency generator power on-site that can accommodate basic building needs during a power outage. The emergency generator cannot power the residuals processing operation. With the completion of the IPS, the facility's water is provided through an MWRA connection and sanitary sewage generated at the Pellet Plant is pumped directly to the MWRA collection system at the IPS. Projects to upgrade electrical and mechanical systems at the Pellet Plant are ongoing. Additional upgrade to utilities (including water, sewer, electrical, and telephone) will be evaluated during facilities planning project. Future projects to rehabilitate the Pellet Plant building envelope (doors, windows, siding, roof, etc.) are recommended for consideration in future CIPs.

Facility Vulnerability to Severe Weather and Flooding: The Residuals Pellet Plant has been identified as being "Likely Affected by a 100 Year Storm". The flood risk for the Pellet Plant Facility and MWRA's benchmark of the current 100 year flood elevation plus an additional 2.5 feet to account for sea level rise and more severe storms should be evaluated as part of the Residuals Facilities Plan project scheduled for FY22-25.

7.06 History of Fore River Railroad and Shipyard

The Fore River Railroad is owned by MWRA and operated under contract by the Fore River Transportation Corporation. The 2.7-mile-long rail line runs from Quincy Point to the Greenbush Commuter Line in Braintree. The railroad ships Bay State Fertilizer from the Residuals Pellet Plant for MWRA and NEFCo, as well as fatty acids for a local manufacturer - Twin Rivers Technologies.

The Fore River Railroad was developed by Thomas A. Watson, assistant to telephone inventor Alexander Graham Bell. Watson used his telephone profits to start an engine and boat factory in East Braintree - the Fore River Shipyard Engine Company. In 1900, the company moved to a new facility at Quincy Point. At first, transporting heavy materials to Watson's new shipyard was a slow and expensive process since the nearest railroad ended over two miles away in East Braintree. In 1902, Watson had a private rail line built along the Fore River to bring supplies directly from East Braintree to the shipyard at Quincy Point. Railroad operations on the new Fore River line began on June 1, 1903. The Bethlehem Steel Corporation purchased the Fore River Shipyard and Railroad just before World War I. In 1919, the Fore River Railroad was formally incorporated as a separate holding from the Bethlehem Steel shipyard. General Dynamics Corp. purchased the shipyard and railroad in 1963.

In 1987, MWRA acquired the Fore River Shipyard and Railroad. From 1987 through 1992, MWRA used the Fore River facilities as a staging area and transportation system for the Boston Harbor Project. The facility was renamed the Fore River Staging Area during this period. MWRA sold most of the shipyard property upon completion of the Boston Harbor Project. MWRA maintains ownership of a 23-acre portion of the former shipyard for the Residuals Pellet Plant operation and the Fore River Railroad to transport its Bay State Fertilizer.

7.07 Summary of Existing and Recommended Capital Projects

Master Plan projects related to off-island residuals processing and disposal at the Pellet Plant are summarized in this Section. Except for the drum dryer replacement project, Table 7-1 lists each project, its cost, its priority ranking, and the proposed expenditure schedule. A description of each project is listed in bullet format.

Residuals drum dryer replacement project at the Pellet Plant was developed at the end of the FY19 CIP at an estimated cost of $2.3 million with a duration of 18 months during the FY20-21 timeframe. This project was not included in the final FY19 CIP, but will be added during the FY20 CIP process. The project will replace worn dryers that are currently impacting the plants planned redundancy. This project was delayed until decision was made on switching to larger dryers.

Projects in the FY19 CIP: There are nine Residuals Pellet Plant related projects programmed in the FY19 CIP. The projects are described below and summarized in Table 7-1 (see line numbers 7.01 through 7.09).

- Residuals Facilities Plan and Environmental Impact Report (EIR) will follow-up on the work completed in the Condition Assessment/Technology Options Assessment Projects. The Residuals Facilities Plan will identify selected options for future design/construction of Pellet Plant upgrades. Cost is estimated at $1.0 million with duration of 4-years during the FY22-25 timeframe and is programmed in the FY19 CIP. The flood risk for the Pellet Plant Facility and MWRA's benchmark of the current 100-year flood elevation plus an additional 2.5 feet to account for sea level rise and more severe storms should be evaluated as part of the Facilities Plan project.

- Residuals Facilities Upgrade Phase 1 Design Services and Engineering Services During Construction (ESDC) to implement priority equipment/process replacements and/or upgrades at the Pellet Plant are programmed in the FY19 CIP at an estimated cost of $2.0 million with duration of 4-years during the FY21-24 timeframe.

- Residuals Facilities Upgrade Phase 1 Construction became the $7 million repository of funds for the MWRA commitment to capital projects as part of the new 5-year agreement with NEFCo. Three projects were separated out of this placeholder in FY18: tank & silo coating, mechanical improvements, and electrical improvements as discussed elsewhere in this chapter and again below. The remaining funds are programmed in the FY19 CIP in the amount of $1.588 million with duration of 3-years during the FY20-22 timeframe. Funds will be allocated to other capital projects at the Residuals Facility during this period as they are needed.

- Residuals Facilities Upgrade Phase 2 Design Services and Engineering Services During Construction (ESDC) to implement all remaining equipment/process replacements and/or upgrades at the Pellet Plant are programmed in the FY19 CIP at an estimated cost of $15.0 million with duration of 9-years during the FY24-32 timeframe.

- Residuals Facilities Upgrade Phase 2 Construction of all remaining construction subphases at the Pellet Plant is programmed in the FY19 CIP at an estimated cost of $75.0 million with duration of 7-years during the FY26-32 timeframe.

- Residuals Sludge Tank and Silo Coating at the Pellet Plant is programmed in the FY19 CIP at an estimated cost of $745,000 with duration of 2-years during the FY18-19 timeframe. Expenditures during the planning period (FY19) are $324,000.

- Residuals Electrical Improvements at the Pellet Plant is programmed in the FY19 CIP at an estimated cost of $2.22 million with duration of 2-years during the FY19-20 timeframe.

- Residuals Mechanical Improvements at the Pellet Plant is programmed in the FY19 CIP at an estimated cost of $2.447 million with duration of 3-years during the FY18-20 timeframe. Expenditures during the planning period (FY19-20) are $2.30 million.

- Residuals Pellet Piping Relocation Improvements at the Pellet Plant is programmed in the FY19 CIP at an estimated cost of $3.0 million with duration of 3-years during the FY19-21 timeframe. This project will relocate piping that conveys pellets from the process area to several storage silos away from a brick wall that has been determined to be unstable.

Projects Recommended for Consideration in Future CIPs: There are five Residuals Pellet Plant related projects recommended for consideration in future CIPs. The projects are described below and summarized in Table 7-1 (see line numbers 7.10 through 7.14)

- Residuals Pellet Plant Drum Dryer Replacement design and construction has been approved to be added to the FY20 CIP at a cost of $2.3 million during FY20-21.

- Residuals Future Pellet Plant Technology Assessment and/or Facilities Update to plan for continued future rehabilitation/upgrade needs is recommended for consideration in future CIPs at a cost of $2.0 million per cycle (approximately every 15 to 20 years) with a long-term projection for FY39-43.

- Residuals Future Pellet Plant Equipment Replacements (design and construction) is recommended for consideration in future CIPs at a cost of $75.0 million. Future equipment upgrades are anticipated to be required at the end of equipment useful life (approximately every 15 to 20 years) with a long-term projection for FY39-58.

- Residuals Future Building Envelope Rehabilitation (design and construction) for periodic rehabilitation of Pellet Plant doors, windows, siding, etc. is anticipated to be needed approximately every 15 to 20 years and is recommended for consideration in future CIPs at a cost of $4.0 million with a long-term projection for FY44-48.

- Residual Future Pellet Plant Pier Rehabilitation is recommended for consideration in future CIPs (planning, design, and construction) at an estimated cost of $1.0 million with a projected schedule for FY24-28. This project is recommended for MWRA to maintain the ability to barge to and from the Residuals Pellet Plant.

Table 7-1

Wastewater Master Plan - Residuals Processing and Disposal at the Pellet Plant (Off-Island)

Existing and Recommended Projects

Last revision 10/25/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF	New Facility/System
RF/IC	Replacement Facility/Increase Capacity
Opti	Optimization
AP	Asset Protection
Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		RESIDUALS												
7.01	1	Residuals Facilities Plan and EIR	Plan	271	26069_7143	4 years	1,000	1,000	FY22-25	389	611			1,000
7.02	1	Residuals Facilities Upgrades Phase 1 Design and ESDC	AP	271	26070_7145	4 years	2,000	2,000	FY21-24	1,667	333			2,000
7.03	1	Residuals Facilities Upgrades Phase 1 Construction	AP	271	26071_7146	3 years	1,588	1,588	FY20-22	1,588				1,588
7.04	2	Residuals Facilities Upgrades Phase 2 Design and ESDC	AP	271	26074_7149	9 years	15,000	15,000	FY24-32	0	15,000			15,000
7.05	2	Residuals Facilities Upgrades Phase 2 Construction	AP	271	26075_7150	7 years	75,000	75,000	FY26-32	0	50,000	25,000		75,000
7.06	1	Residuals Sludge Tank and Silo Coating	AP	271	26076_7151	2 years	745	324	FY18-19	324				324
7.07	3	Residuals Electrical Improvements	AP	271	26077_7152	2 years	2,220	2,220	FY19-20	2,220				2,220
7.08	1	Residuals Mechanical Improvements	AP	271	26078_7153	3 years	2,447	2,300	FY18-20	2,300				2,300
7.09	3	Residuals Pellet Piping Relocation	AP	271	26079_7173	3 years	3,000	3,000	FY19-21	3,000				3,000
		SUBTOTAL - Existing - Residuals					**103,000**	**102,432**		**11,488**	**65,944**	**25,000**	**0**	**102,432**
7.10	3	Residuals Drum Dryer Replacement - Design and Construction	AP	new		2 years	2,300	2,300	FY20-21	2,300				2,300
7.11	3	Residuals Future Pellet Plant Technology Assessment and/or Facility Update	Plan	new		5 years	2,000	2,000	FY39-43				2,000	2,000
7.12	3	Residuals Future Equipment Replacements	AP	new		20 years	75,000	75,000	FY39-58				75,000	75,000
7.13	3	Residuals Future Building Envelope Rehabilitation	AP	new		5 years	4,000	4,000	FY44-48				4,000	4,000
7.14	3	Residuals Future Pellet Plant Pier Rehabilitation	AP	new		5 years	1,000	1,000	FY24-28		1,000			1,000
		SUBTOTAL - Recommended - Residuals					**82,000**	**82,000**		**2,300**	**1,000**	**0**	**81,000**	**84,300**
		SUBTOTAL - Existing and Recommended - Residuals					**185,000**			**13,788**	**66,944**	**25,000**	**81,000**	**186,732**

CHAPTER 8
COLLECTION SYSTEM REMOTE HEADWORKS AND CROSS-HARBOR TUNNELS

8.01 Chapter Summary

MWRA's wastewater collection system is a complex network of conduits and facilities that is strongly influenced by seasonal and wet weather conditions. The long-term (29 years of data 1989-2017) system average daily flow is approximately 353 mgd (about 300 mgd for last 5 years 2013-2017), minimum dry weather flow is approximately 220 mgd, and peak wet weather capacity to the Deer Island Treatment Plant (DITP) is 1,270 mgd with additional system capacity available at combined sewer overflow (CSO) outfalls. The MWRA collection system includes a network of 274 miles of sewer pipelines (19 miles of cross-harbor tunnels, 226 miles of gravity sewers, 18 miles of force mains, 7 miles of siphons, and 4 miles of CSO and emergency outfalls); 13 pump stations; one screening facility; six CSO treatment/storage facilities; and four remote headworks facilities.

In this Chapter, MWRA's four remote headworks facilities (Chelsea Creek, Columbus Park, Ward Street, and Nut Island) and 19 miles of cross-harbor tunnels are detailed. The Intermediate Pump Station and Winthrop Terminal Headworks are also discussed; however, detail on these facilities is presented in Chapter 6 for the Winthrop Terminal Headworks and Chapter 10 for the Intermediate Pump Station.

The remote headworks and cross-harbor tunnels are critical facilities because almost all flow to the DITP passes through them. The primary function of the remote headworks is the preliminary treatment process to remove grit and screen out debris from wastewater flow to minimize solids accumulation in the cross-harbor tunnels and protect the downstream pump facilities at the DITP. The cross-harbor tunnels (North Metropolitan Relief Tunnel, Boston Main Drainage Tunnel, Inter-Island Tunnel, and Braintree-Weymouth Tunnel) transport wastewater from the remote headworks to the DITP. MWRA's goal is to operate and maintain these facilities to provide uninterrupted wastewater collection service in a safe, cost-effective, and environmentally sound manner.

The replacement asset value of the headworks is $270 million (4% of wastewater system asset value) and the cross-harbor tunnels are $660 million (10% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.07. The facilities are detailed within the Chapter Sections noted below:

- 8.03 Chelsea Creek Headworks;
- 8.04 Columbus Park Headworks;
- 8.05 Ward Street Headworks;
- 8.06 Nut Island Headworks;
- 8.07 Intermediate Pump Station;
- 8.08 Winthrop Terminal Headworks;
- 8.10 Boston Main Drainage Tunnel;
- 8.11 North Metropolitan Relief Tunnel;
- 8.12 Inter-Island Tunnel; and,
- 8.13 Braintree-Weymouth Tunnel.

The Chelsea Creek, Columbus Park, and Ward Street Headworks were all built in 1967 and are 50 years old. Equipment at the headworks was upgraded by MWRA in 1987 and is now 30 years old. These three older facilities remain operational, but, largely due to age and equipment obsolescence, are in only fair condition and need significant reinvestment in the immediate future. Upgrades to the Chelsea Creek Headworks began in 2017. The Nut Island Headworks, built in 1998, is relatively new and is in good condition. On January 25, 2016 a dust explosion ignited a significant fire in the odor control area located in the lowest level of the Nut Island Headworks. An overview of fire damage and resulting short-term actions and long-term needs are detailed in Section 8.06. Additionally, mechanical, electrical, and odor control upgrades are planned for Nut Island Headworks; however, major reinvestment is not required in the short-term.

For the headworks, operability of mechanical equipment and maintenance of electric/standby power systems are key elements to minimize risk of facility failure. Malfunction of mechanical equipment may impact sewer service, particularly during large storm events that stress the hydraulic capacity of the facilities, potentially requiring "choking" of the headworks influent gates that can result in upstream CSOs and potential SSOs. Key decision making to minimize risks includes the cost/benefit of when to replace aging equipment and which/how many spare parts to pre-purchase. Other headworks uncertainties include future energy/chemical costs.

A Headworks Condition Assessment/Concept Design project was completed in FY10, and Preliminary Design was completed in FY12 for the three older headworks facilities. These projects reviewed the adequacy of existing headworks components and processes and provided replacement/upgrade recommendations based upon current technology, including gates, mechanical screens, grit removal, odor control, generator, and remote operation of the three remote headworks using SCADA. Information developed has been used by MWRA to produce a prioritized list of recommended design/construction projects that is scheduled over an 18-year period (FY11-28). Programmed in the FY19 CIP are design, construction administration, and resident inspection projects that target upgrades for the three older remote headworks (Chelsea Creek, Ward Street, and Columbus Park Headworks). Also programmed in the FY19 CIP are sequential construction projects for all three headworks. The total cost of the three construction projects is budgeted at almost $190 million. The implementation of sequential design/construction contracts for the three remote headworks (first Chelsea Creek Headworks, second Ward Street and Columbus Park Headworks) was developed to produce both an efficient and cost effective project schedule and to take advantage of lessons learned.

One of the most important themes of the Master Plan, consistent for all MWRA water and wastewater facilities, is prioritization of rehabilitation and replacement projects to facilitate long-term asset protection. A long-term annual asset protection budget is needed as a place-holder to fund smaller scale projects that, individually, may not be seen as high priority. A long-term annual asset protection project targeting the remote headworks facilities is recommended for consideration in future CIPs at an annual budget of $1.0 million during the FY24-58 period for a total estimated cost of $35.0 million over 35 years.

With respect to the cross-harbor tunnels, the North Metropolitan Relief Tunnel and Boston Main Drainage Tunnel were built in 1953 and are 65 years old. The Inter-Island Tunnel (1996) and Braintree-Weymouth Tunnel (2005) are relatively new. The existing condition of the tunnels is unknown; therefore, there is uncertainty associated with the potential for future repair/rehabilitation and risk of a very large future cost. Some deterioration of concrete in the tunnel shafts has been documented and attributed to hydrogen sulfide corrosion. Since the cross-harbor tunnels and shafts are critical facilities, a study/rehabilitation of the effluent shafts, as well as a tunnel inspection are high priorities. The effluent shaft study project began in FY19. Based on the industry benchmark of 100+ years for useful life for tunnels, it is assumed that the older tunnels are still in good condition. A future cross-harbor tunnel inspection, condition assessment, and cleaning/rehabilitation project is recommended for consideration in future CIPs at a placeholder cost of $50.0 million with a target schedule of FY46-50.

For the remote headworks and cross-harbor tunnels, $378.150 million in projects are identified in the 40-year master plan timeframe (FY19-58). Ten projects totaling $262.650 million are programmed in the FY19 CIP. Four additional projects totaling $115.50 million are recommended for consideration in future CIPs. Section 8.14 – Summary of Existing and Recommended Capital Projects includes a list of all projects recommended in this Chapter.

Near-term (FY19-23):

- $103.118 million is programmed in the FY19 CIP:
  - $4.683 million to complete Chelsea Creek Headworks Upgrade design, construction administration, and resident engineering inspection;
  - $49.270 million to complete Chelsea Creek Headworks Upgrade construction;
  - $4.968 million to begin Ward Street and Columbus Park Headworks Upgrade design, construction administration, and resident engineering inspection;
  - $1.895 million to begin Ward Street Headworks Upgrade construction;
  - $41.502 million for Nut Island Headworks odor control system and HVAC improvements design, construction administration, resident engineering inspection; and construction; and,
  - $800,000 to complete the Headworks effluent shaft study.

Mid-term (FY24-28):

- $159.532 million is programmed in the FY19 CIP:
  - $13.315 million to complete Ward Street and Columbus Park Headworks Upgrade design, construction administration, and resident engineering inspection;
  - $50.229 million to complete Ward Street Headworks Upgrade construction;
  - $56.048 million for Columbus Park Headworks Upgrade construction;
  - $25.240 million for Nut Island Headworks mechanical and electrical upgrades design, construction administration, resident engineering inspection, and construction;
  - $9.70 million for Headworks effluent shaft rehabilitation design, construction administration, resident engineering inspection; and construction; and,
  - $5.0 million for the Cross-Harbor Tunnel inspection and condition assessment.

- $5.5 million in needs is recommended for consideration in future CIPs:
  - $5.0 million for long-term wastewater facility asset protection for remote headworks facilities, estimated based on a budget of $1.0 million per year over 5 years; and,
  - $500,000 for pier rehabilitation at the Nut Island Headworks.

Long-term (FY29-38 and FY39-58):

- $110.0 million in needs is recommended for consideration in future CIPs:
  - $30.0 million for long-term wastewater facility asset protection for remote headworks facilities, estimated based on a budget of $1.0 million per year over 30 years;
  - $30.0 million for long-term Nut Island Headworks future equipment replacement; and,
  - $50.0 million as a placeholder cost for long-term cross-harbor tunnel inspection, condition assessment, and cleaning/rehabilitation.

8.02 Facilities Overview

Key information on each headwork facility is provided in Table 8-1. The location of each remote headworks and cross-harbor tunnel is shown on Figure 8-1. The service area tributary to each headwork facility is shown on Figure 8-2.

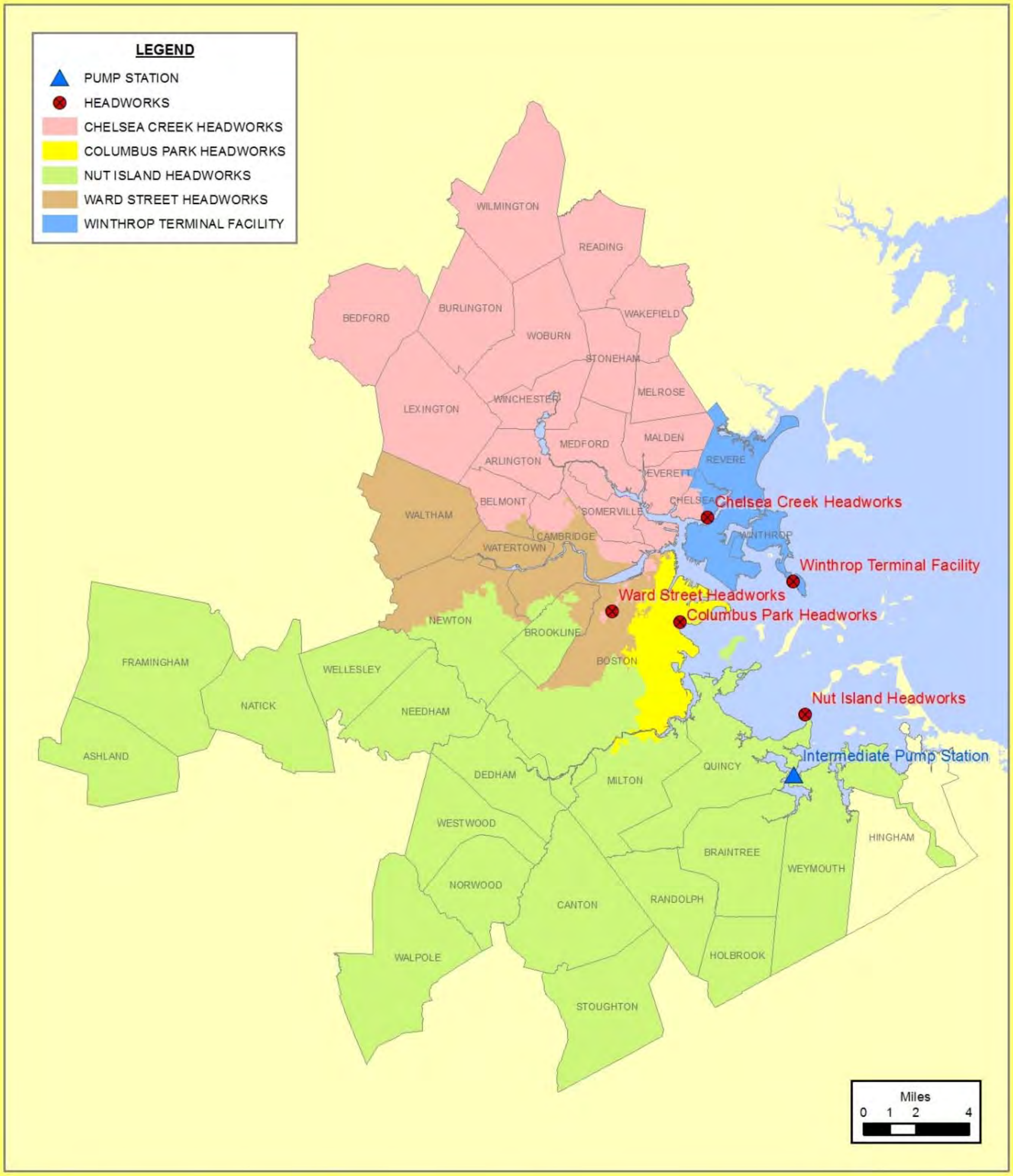
Table 8-1

MWRA Headworks

Facility/Location	Average Daily Flow (MGD)	Peak Capacity (MGD)	Year Built	Flow Received From
Chelsea Creek Headworks Chelsea	100	350	1967 upgrade 1987	North Metropolitan Sewer, North Metropolitan Relief Sewer, East Boston & Revere Branch Sewers, Chelsea & Malden Branch Sewers, Malden Relief Sewer, Wakefield Relief & Edgeworth Branch Sewers, and Wakefield Trunk Sewer
Columbus Park Headworks South Boston	32	182	1967 upgrade 1987	Columbus Park Connection, New Boston Main Interceptor, Dorchester Interceptor and South Boston Interceptor
Intermediate Pump Station (IPS) North Weymouth	12	45	2005	Braintree-Weymouth Extension Sewer, Randolph Trunk Sewer & Holbrook Extension Sewer
Nut Island Headworks Quincy	100	360	1998	High Level Sewer
Ward Street Headworks Roxbury	70	256	1967 upgrade 1987	Boston Main Drainage Relief Sewer, Charles River Valley Sewer, South Charles Relief Sewer, North Charles Metropolitan Sewer, & North Charles Relief Sewer
Winthrop Terminal Headworks Deer Island, Boston	18	125	1970	North Metropolitan Trunk Sewer

FIGURE 8-1
Headworks & Harbor Tunnel Location Plan

FIGURE 8-2
Headworks Service Area



Management of the remote headworks facilities is the responsibility of the Wastewater Operations and Maintenance Department, which is a subset of the Operations Division under the oversight of the Chief Operating Officer and the Deputy Chief Operating Officer. Key supervisory staff reporting to the Director, Wastewater include: Manager, Operations and Manager, Maintenance.

Operation and Maintenance: Each remote headworks has dedicated staff that operate the facility 24-hours per day. A total of about 20 employees are assigned to the facilities; in addition, roving crews supplement dedicated staff for operation and maintenance. All four remote headworks have very similar operations and have current standard operating procedures (SOPs) that contain specific information on facility operation and maintenance procedures. In addition, operation and maintenance manuals, generally furnished by the manufacturer, are available for major equipment (bar screens, grit removal, generators, etc.). Operations data are scanned at the headworks and downloaded to a central computer. All system scans that produce abnormal readings are checked by Area Supervisors and Operations Supervisors. Facility Maintenance and Equipment Maintenance are two consolidated programs made up of the mechanic specialists, machinists, metalworkers, welders, plumbers, HVAC specialists, electricians, building & grounds workers, and facility specialists (carpenters and painters). These groups (a total of about 89 staff) perform maintenance activities at both wastewater and water facilities. Work Coordination in the Operations and Maintenance Department provides scheduling and job planning at all wastewater facilities. All maintenance is scheduled through the MAXIMO system (see detail below).

Facility Operation: Influent gates at headworks facilities are used to control flow to the facility. Mechanical bar screens remove large debris. Screenings are transferred to a screenings dumpster for disposal at an off-site landfill. Grit is removed for disposal off-site. Wastewater flow is metered at each remote headworks and all have odor control systems. Electric service is provided to each facility via local commercial service and all have backup generators for emergency power.

Facility Maintenance: A primary focus of operation and maintenance staff in the Field Operations Department is preventive maintenance. Tasks performed by operational staff are generally defined as light maintenance duties that increase the number of maintenance staff work hours dedicated to maintenance activities. Dedicated staff at the headworks use a handheld monitoring device to perform daily checks of equipment. This information is captured in MWRA's MAXIMO work order system. The MAXIMO computerized maintenance management system records all work activities and work order requests from operations and maintenance personnel. This system gives management the ability to track maintenance needs, prioritize work orders, and generate reports of open and closed work activities. Reports can be generated and information retrieved about the condition of any piece of equipment. Abnormal conditions are noted and forwarded to planner/schedulers for work order processing and further action by the Equipment Maintenance Section. Backlog levels depend on available resources, but daily coordination ensures that primary and critical equipment is functioning at adequate levels at all times. Work is prioritized, with critical equipment receiving the most attention.

MWRA In-House Tasks: The following ongoing in-house tasks related to remote headworks facilities have been performed by MWRA staff during 2014 through 2017:

- Chelsea Creek, Columbus Park, and Ward Street Headworks: dewatering pumps were original equipment and each dewatering pump was replaced;

- Columbus Park and Ward Street Headworks: air compressors were purchased and installed to improve reliability of the compressed air delivery systems;
- Chelsea Creek, Columbus Park, and Ward Street Headworks: upgraded grit system piping was installed;
- Nut Island Headworks: the emergency generator radiator was replaced;
- Nut Island Headworks: the 30 ton air conditioning unit was replaced;
- Nut Island Headworks: the photo luminescent strips and arrows on all odor control facility doors and exits were replaced;
- Nut Island Headworks: the gas monitoring system was upgraded; and,
- Wastewater Collection System Operation and Maintenance Plan was updated as of December 2017.

There are two additional in-house tasks related to the headworks facilities recommended to be completed by MWRA staff:

- Staff should review/update SOPs for all headworks facilities; and,
- Staff should update the 2002 Equipment and Operational Summary for Wastewater Transport Facilities.

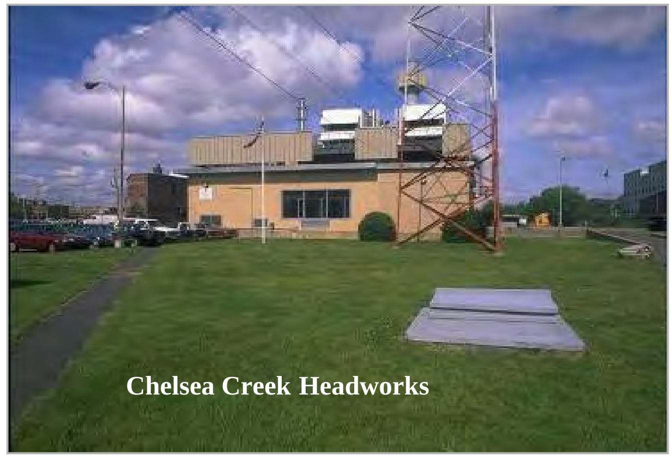
<u>Service Contracts</u>: The in-house maintenance program is supplemented by a series of service contracts, as listed below:

- Architectural, electrical, HVAC, and mechanical engineering design;
- Boiler and water heater service maintenance;
- Compressed air maintenance;
- Crane maintenance;
- Diesel generator maintenance;
- Elevator maintenance;
- Fire & Fire Sprinkler System maintenance;
- Fuel storage tank maintenance;
- Grounds keeping services;
- High voltage maintenance;
- HVAC pneumatic controls maintenance;
- Hydraulics maintenance;
- Instrumentation maintenance;
- Overhead door maintenance; and,
- Pump variable frequency drive maintenance.

<u>Headworks Condition Assessment/Concept Design Project</u>: The Headworks Condition Assessment/Concept Design project was completed in FY10 at a cost of about $670,000 to establish a basis for headworks improvements/upgrades and prioritization of rehabilitation/replacement projects and operational processes for the three older remote headworks facilities (Chelsea Creek, Columbus Park, and Ward Street). Preliminary Design was completed for these three facilities in FY12, and resulted in the sequencing of follow-up design/construction projects that target upgrades from FY11 through FY28. The resulting design/construction projects (first Chelsea Creek Headworks and second Ward Street Headworks and Columbus Park

Headworks) are programmed in the FY19 CIP at a total cost of almost $190 million. The first upgrade construction project, Chelsea Creek Headworks Upgrade - Construction Contract 7161, began in FY17 and is scheduled to be completed in FY21.

8.03 Chelsea Creek Headworks


Chelsea Creek Headworks

- Address: 340 Marginal Street, Chelsea
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 100 mgd
- Peak Capacity: 350 mgd

Facility Function and Operation: The Chelsea Creek Headworks (built in 1967) was placed into operation in 1968 with a major equipment upgrade (fast-track improvements) constructed by MWRA in 1987. The facility provides screening and grit removal, flow metering, and flow control for Deer Island's North Main Pump Station. The facility receives flow from the North Metropolitan Trunk Sewer and North Metropolitan Relief Sewer. Flows in the East Boston Branch Sewer, East Boston Low Level Sewer, Chelsea Branch Sewer, and Revere Branch Sewer, normally tributary to the Caruso Pump Station, can also reach Chelsea Creek Headworks via the Chelsea Screen House/Chelsea Creek Headworks conduits. Flow passing through the headworks exits via a drop shaft into the North Metropolitan Relief Tunnel which crosses under Boston Harbor and connects to the North Main Pump Station at Deer Island. Excess flows tributary to the Chelsea Creek Headworks are designed to overflow a side weir, pass through the Chelsea Screen House, and be conveyed to the Caruso Pump Station via one of the two Chelsea Creek Siphon barrels. However, this is dependent on the pumping rate of the Caruso Pump Station which in turn is limited by the Winthrop Terminal Facility. The Chelsea Creek Headworks serves sixteen north system communities. The tributary area is comprised of separate sanitary sewers, with some combined sewer areas in Cambridge, Chelsea, and Somerville.

Facility Components: Major facility components include: four hydraulic influent sluice gates, four mechanical bar screens, four grit channels with flight chain collectors, four critical depth flumes with flow meters, four hydraulic effluent sluice gates, odor control equipment, instrumentation, and an emergency generator.

Hydraulic Performance: During normal operations four channels are available for use at the Chelsea Creek Headworks, however, during the upgrade construction project one channel at a time has been taken out of service for rehabilitation. Typically, two channels are used during normal (dry weather) flow conditions and three channels are used during peak flow (wet weather) conditions, with one channel held in reserve. Flow entering the facility may be limited by the peak hydraulic capacity of the downstream North Metropolitan Relief Tunnel and pumping capacity at the North Main Pump Station. A third channel is typically brought on line at 200 mgd in anticipation of a large storm. The facility will throttle the influent gates to regulate the amount of flow through the facility. This throttling is referred to as "choking." Choking of the gates may divert excess flow to the Chelsea Screen House, which is tributary to the Caruso Pump Station.

Facility Vulnerability to Severe Weather and Flooding: The Chelsea Creek Headworks has been identified as being "Likely Affected by Storm Within 1 foot below a 100 Year Storm". Under the Chelsea Creak Headworks Upgrade Project, flood protection for the facility is being constructed.

Facility Power: The primary electrical feed is from commercial service. The existing 208 V service is being upgraded to a 480 V service, and the existing 400 KW diesel generator which provides backup power will be replaced with a 1000 KW generator as part of the ongoing Chelsea Creek Headworks Upgrade project. In addition, the existing utility-owned transformer will be replaced with a new, Authority-owned, transformer.

Standard Operating Procedures (SOPs): The facility SOP was developed in 1987 and has received periodic updates. A new Facility Manual will be prepared as part of the ongoing upgrade project.

Record Plans: Record Drawings for the 1987 upgrades for the Chelsea Creek Headworks (MWRA Contract No. S82-1020-C3A) have accession numbers 10526 through 10585. Design Drawings for the original construction for the Chelsea Creek Headworks (Contract No. 216) have accession numbers 56201 through 56296. Design Drawings for furnishing and delivering equipment (Contract No. 253) have accession numbers 57001 through 57012. Design Drawings for the Chelsea Creek Headworks Upgrade (Contract No. 7161) have accession numbers 232564 through 232806.

Condition Assessment and Ongoing Upgrades: The Chelsea Creek Headworks is operational, but (largely due to age and equipment obsolescence) is in only fair condition and needs significant reinvestment which is ongoing. The facility structure is 50 years old and most equipment is 30 years old. Based on the industry useful life benchmark of 50 years for structure and 20 years for equipment, upgrades are warranted. A Condition Assessment/Concept Design project was completed in FY10 to establish a basis for future headworks upgrades. During this project, a complete inventory of the components in the headworks was developed, the physical and performance condition of the components were evaluated, and components were recommended for replacement and upgrade. The assessment was comprehensive and included the gates, mechanical bar screens, grit removal, odor control, chemical systems, HVAC, electrical systems and emergency generators, instrumentation and control, plumbing, pumps, lighting, roofing, structural and architectural components, and the site. A conceptual strategy for uninterrupted wastewater services during construction, construction scheduling, and cost estimates for replacement and upgrade of all components and equipment were developed. A Preliminary Design Report was completed in FY12, followed by Final Design, which was completed in FY16. Construction Contract 7161, Chelsea Creek Headworks Upgrade, was awarded in FY17. It has a four-year construction duration through FY21 and is ongoing.

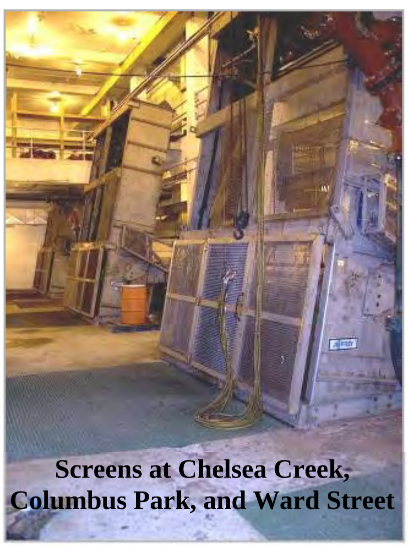
Field Operations has documented concrete corrosion (due to hydrogen sulfide) in the three cross-harbor tunnel drop shafts at the Chelsea Creek, Columbus Park, and Ward Street Headworks.

Projects Programmed in the FY19 CIP:

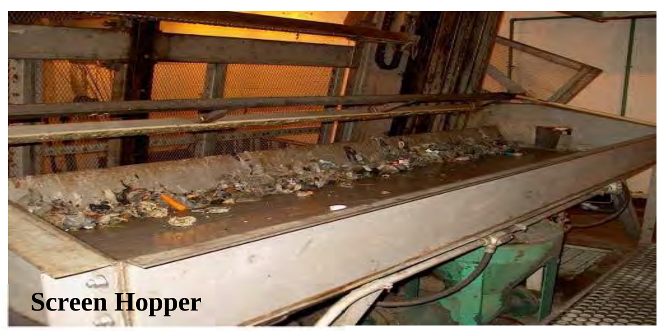
- Chelsea Creek Headworks Upgrade – design, construction administration, and resident engineering and inspection during construction is programmed in the FY19 CIP at a total project cost of $13.080 million during FY11-22. Total expenditures during the planning period (FY19-22) are $4.683 million. The design contract was amended to incorporate MWRA's most recent benchmark for sea level rise and more severe storms.
- Chelsea Creek Headworks Upgrade – construction is programmed in the FY19 CIP at a total project cost of $80.520 million during FY17-21. Total expenditures during the planning period (FY19-21) are $49.270 million. This project is a major upgrade of the entire facility including the screening system, grit collection system, influent and effluent sluice gates, odor control and HVAC systems, emergency generator, instrumentation controls and communication systems, building improvements, and flood protection measures. Uninterrupted operation of the headworks facility is required throughout construction.
- A Headworks Effluent Shaft Study is programmed in the FY19 CIP during FY19-20 at a total cost of $800,000. The study will evaluate concrete corrosion (due to hydrogen sulfide), shaft ventilation, replacement of shaft grating, and instrumentation upgrades. Information developed during this study will help shape the Cross-Harbor Tunnel Inspection/Condition Assessment project (see Section 8.10).
- A Headworks Effluent Shaft Rehabilitation Project including design, construction administration, resident inspection, and construction is programmed in the FY19 CIP as a 4-year project during FY24-27 at a cost of $9.70 million. This project will follow-up on the study recommendations.

Project Recommended for Consideration in Future CIPs:

- A Long-term Wastewater Facilities Asset Protection Project is recommended for the remote headworks (see Section 8.09) at an annual budget of $1.0 million for FY24-58. The total project cost is $35.0 million over 35 years. A portion of these funds would be used for rehabilitation/replacement needs at the Chelsea Creek Headworks.



Screens at Chelsea Creek, Columbus Park, and Ward Street



Screen Hopper

These photos show the screening system typical of all three older remote headworks – Chelsea Creek, Columbus Park and Ward Street. The screening systems are in need of replacement.

8.04 Columbus Park Headworks

- Address: 1305 Columbus Road, South Boston
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 32 mgd
- Peak Capacity: 182 mgd

Facility Function and Operation: The Columbus Park Headworks (built in 1967) was placed into operation in 1968 with a major equipment upgrade (fast-track improvements) constructed by MWRA in 1987. The facility provides screening and grit removal, flow metering, and flow control for Deer Island's North Main Pump Station. The facility receives flow from the Columbus Park Connection (via the New Boston Main Interceptor and Dorchester Interceptor) and the South Boston Interceptor system. Flow passing through the headworks exits via a drop shaft into the Boston Main Drainage Tunnel which crosses under Boston Harbor and connects to the North Main Pump Station at Deer Island. Upstream of the Columbus Park Headworks, the Ward Street Headworks also discharges to the Boston Main Drainage Tunnel. The tributary area includes flow from a large portion of Boston and a very small portion of Milton and is comprised of both combined and separate sanitary sewers.

Facility Components: Major facility components include: four hydraulic influent sluice gates, four mechanical bar screens, four grit channels with flight chain collectors, four critical depth flumes with flow meters, four hydraulic effluent sluice gates, odor control equipment, instrumentation, and an emergency generator.

Hydraulic Performance: Four channels are available for use at the Columbus Park Headworks. Typically, two channels are used during normal (dry weather) flow conditions and three channels are used during peak flow (wet weather) conditions, with one channel held in reserve. It is possible to run all four channels during extreme flows. The combined capacity of the Columbus Park and Ward Street Headworks equals the conveyance capacity of the Boston Main Drainage Tunnel (438 mgd). During significant storm events that exceed the capacity of the Columbus Park Headworks, the influent sluice gates can be choked to prevent flooding of the facility. If the influent flow is choked, a backwater condition can increase discharge at upstream CSO outfalls.

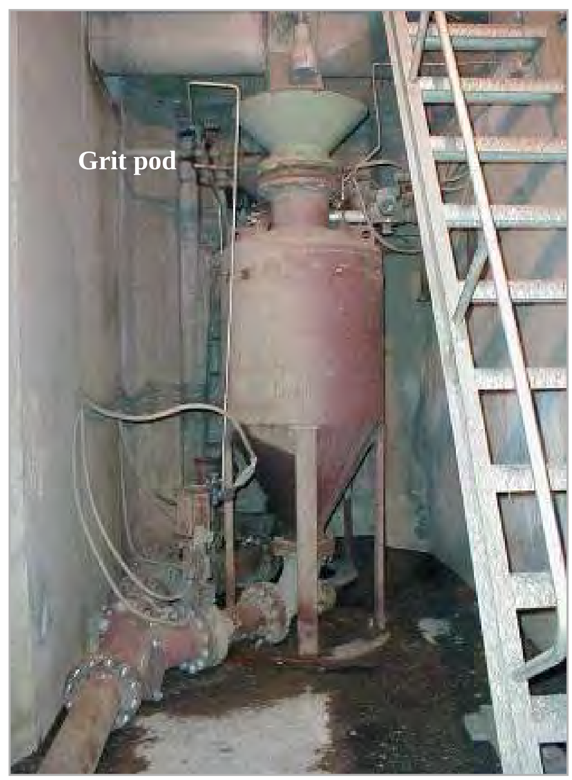
Facility Vulnerability to Severe Weather and Flooding: The Columbus Park Headworks has been identified as being "Very Unlikely to be Affected".

Facility Power: The primary electrical feed is from commercial service. A diesel generator (400 KW) provides backup power. The generator was replaced in 1998.

Standard Operating Procedures (SOPs): The facility SOP was developed in 1987 and has received periodic updates.

Record Plans: Record Drawings for the 1987 upgrades for the Columbus Park Headworks (MWRA Contract No. S82-1020-C3A) have accession numbers 10466 through 10525. Design Drawings for the original construction for the Columbus Park Headworks (Contract No. C-215) have accession numbers 56101 through 56187. Design Drawings for furnishing and delivering equipment (Contract No. C-255) have accession numbers 57025 through 57031.

Condition Assessment and Ongoing Upgrades: The Columbus Park Headworks is operational, but largely due to age and equipment obsolescence is in only fair condition and needs significant reinvestment in the immediate future. The facility structure is 50 years old and most equipment is 30 years old. Based on the industry useful life benchmark of 50 years for structures and 20 years for equipment, upgrades are warranted. A Condition Assessment/Concept Design project was completed in FY10 to establish a basis for future headworks upgrades. During this project, a complete inventory of the components in the headworks was developed, the physical and performance condition of the components were evaluated, and components were recommended for replacement and upgrade. The assessment was comprehensive and included the mechanical bar screens, grit removal, odor control, chemical systems, HVAC, electrical systems and emergency generator, instrumentation and control, plumbing, all gates and pumps, lighting, roofing, structural and architectural components, and the site. A conceptual strategy for uninterrupted wastewater services during future construction, construction scheduling, and costs estimates for replacement and upgrade of all components and equipment were developed. Field Operations has documented concrete corrosion (due to hydrogen sulfide) in the three cross-harbor tunnel drop shafts at the Chelsea Creek, Columbus Park, and Ward Street Headworks.



Photos show grit piping and grit collection pod typical of all three older remote headworks – Chelsea Creek, Columbus Park and Ward Street. The grit removal systems are in need of replacement.

The photo at left shows the odor control media typical of all three older remote headworks – Chelsea Creek, Columbus Park and Ward Street. The odor control systems are in need of replacement.

Projects Programmed in the FY19 CIP:

- Ward Street Headworks and Columbus Park Headworks Upgrade – design, construction administration, and resident engineering and inspection are programmed in the FY19 CIP at a cost of $18.283 million in FY20-28.
- Columbus Park Headworks Upgrade – construction is programmed in the FY19 CIP at a cost of $56.048 million in FY24-28.
- A Headworks Effluent Shaft Study is programmed in the FY19 CIP during FY19-20 at a total cost of $800,000. The study will evaluate concrete corrosion (due to hydrogen sulfide), shaft ventilation, replacement of shaft grating, and instrumentation upgrades. Information developed during this study will help shape the Cross-Harbor Tunnel Inspection/Condition Assessment project (see Section 8.10).
- A Headworks Effluent Shaft Rehabilitation Project including design, construction administration, resident inspection, and construction is programmed in the FY19 CIP as a 4-year project during FY24-27 at a cost of $9.70 million. This project will follow-up on the study recommendations.

Project Recommended for Consideration in Future CIPs:

- A Long-term Wastewater Facilities Asset Protection Project is recommended for the remote headworks (see Section 8.09) at an annual budget of $1.0 million for the FY24-58 period. The total project cost is $35.0 million over 35 years. A portion of these funds would be used for rehabilitation/replacement needs at the Columbus Park Headworks.

8.05 Ward Street Headworks

- Address: 47 Ward Street, Roxbury
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 70 mgd
- Peak Capacity: 256 mgd

Facility Function and Operation: The Ward Street Headworks (built in 1967) was placed into operation in 1968 with a major equipment upgrade (fast-track improvements) constructed by MWRA in 1987. The facility provides screening and grit removal, flow metering, and flow control for Deer Island's North Main Pump Station. The facility receives flow from the Boston Main Drainage Relief Sewer, Charles River Valley Sewer, South Charles Relief Sewer, North Charles Metro Sewer, and North Charles Relief Sewer. Flow passing through the headworks exits via a drop shaft into the Boston Main Drainage Tunnel which crosses under Boston Harbor and connects to the North Main Pump Station at Deer Island. Downstream of the Ward Street Headworks, the Columbus Park Headworks also discharges to the Boston Main Drainage Tunnel. The Ward Street Headworks tributary area includes flow from Belmont, Boston, Cambridge, Newton, Waltham, and Watertown and is comprised of both combined and separate sanitary sewers.

Site History: The Ward Street Headworks occupies the site adjacent to the original Ward Street Pump Station that was constructed in 1901 and decommissioned when the Ward Street Headworks and Boston Main Drainage Tunnel were constructed. The Ward Street Pump Station discharged flow to the High Level Sewer via two 48-inch force mains.

Facility Components: Major facility components include: four hydraulic influent sluice gates, four mechanical bar screens, four grit channels with flight chain collectors, four critical depth flumes with flow meters, four effluent sluice gates, odor control equipment, instrumentation, and an emergency generator.

Hydraulic Performance: Four channels are available for use at the Ward Street Headworks. Typically, two channels are used during normal (dry weather) flow conditions and three channels are used during peak flow (wet weather) conditions, with one channel held in reserve. It is possible to run all four channels during extreme flows. The combined capacity of the Ward Street and Columbus Park Headworks equals the conveyance capacity of the Boston Main Drainage Tunnel (438 mgd). During significant storm events that exceed the capacity of the Ward Street Headworks, the influent sluice gates can be choked to prevent flooding of the facility. If the influent flow is choked, a backwater condition can increase flow to the Cottage Farm CSO Facility.

Facility Vulnerability to Severe Weather and Flooding: The Ward Street Headworks has been identified as being "Very Unlikely to be Affected".

Facility Power: The primary electrical feed is from commercial service. A diesel generator (400 KW) provides backup power. The generator was replaced in 1998.

Standard Operating Procedures (SOPs): The facility SOP was developed in 1987 and has received periodic updates.

Record Plans: Record Drawings for the 1987 upgrades for the Ward Street Headworks (MWRA Contract No. S82-1020-C3A) have accession numbers 10586 through 10645. Design Drawings for the original construction for the Ward Street Headworks (Contract No. C-213) have accession numbers 56001 through 56089. Design Drawings for furnishing and delivering equipment (Contract No. 254) have accession numbers 57013 through 57019.

Condition Assessment and Ongoing Upgrades: The Ward Street Headworks is operational, but largely due to age and equipment obsolescence is in only fair condition and needs significant reinvestment in the immediate future. The facility structure is 50 years old and most equipment is 30 years old. Based on the industry useful life benchmark of 50 years for structures and 20 years for equipment, upgrades are warranted. A Condition Assessment/Concept Design project was completed in FY10 to establish a basis for future headworks upgrades. During this project, a complete inventory of the components in the headworks was developed, the physical and performance condition of the components was evaluated, and components were recommended for replacement and upgrade. The assessment was comprehensive and included the mechanical bar screens, grit removal, odor control, chemical systems, HVAC, electrical systems and emergency generators, instrumentation and control, plumbing, all gates and pumps, lighting, roofing, structural and architectural components, and the site. A strategy for uninterrupted wastewater services during future construction, construction scheduling, and costs estimates for replacement and upgrade of all components and equipment were developed. Field Operations has documented concrete corrosion (due to hydrogen sulfide) in the three cross-harbor tunnel drop shafts at the Chelsea Creek, Columbus Park, and Ward Street Headworks.

Projects Programmed in the FY19 CIP:

- Ward Street Headworks and Columbus Park Headworks Upgrade – design, construction administration, and resident engineering and inspection are programmed in the FY19 CIP at a cost of $18.283 million in FY20-28.
- Ward Street Headworks Upgrade – construction is programmed in the FY19 CIP at a cost of $52.124 million in FY23-28.
- A Headworks Effluent Shaft Study is programmed in the FY19 CIP during FY19-20 at a total cost of $800,000. The study will evaluate concrete corrosion (due to hydrogen sulfide), shaft ventilation, replacement of shaft grating, and instrumentation upgrades. Information developed during this study will help shape the Cross-Harbor Tunnel Inspection/Condition Assessment project (see Section 8.10).
- A Headworks Effluent Shaft Rehabilitation Project including design, construction administration, resident inspection, and construction is programmed in the FY19 CIP as a 4-year project during FY24-27 at a cost of $9.70 million. This project will follow-up on the study recommendations.

Project Recommended for Consideration in Future CIPs:

- A Long-term Wastewater Facilities Asset Protection Project is recommended for the remote headworks (see Section 8.09) at an annual budget of $1.0 million for the FY24-58 period. The total project cost is $35.0 million over 35 years. A portion of these funds would be used for rehabilitation/replacement needs at the Ward Street Headworks.

8.06 Nut Island Headworks

- Address: 147 Sea Avenue, Quincy
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 100 mgd
- Peak Capacity: 360 mgd

Facility Function and Operation: The Nut Island Headworks was placed into operation in 1998. The facility provides screening and grit removal, flow metering, and flow control for Deer Island's Lydia Goodhue (South System) Pump Station. The facility receives flow from the High Level Sewer which carries flow from almost the entire MWRA south collection system (except for flow that passes through the Intermediate Pump Station and is pumped directly to the Inter-Island Tunnel). Flow passing through the Nut Island Headworks exits via a drop shaft into the Inter-Island Tunnel which crosses under Boston Harbor and connects to Deer Island. Excess flows tributary to the Nut Island Headworks are designed to overflow an emergency storage weir. Approximately 2.7 million gallons of storage is available, which will provide approximately 11 minutes of detention at 360 mgd. Once the storage capacity is exceeded, additional relief can be provided by manually activating the three Nut Island emergency outfalls. If the three outfalls do not provide adequate relief, the four emergency spillway gates may be opened to provide the necessary relief. Discharge through the three emergency outfalls must comply with regulations for DITP bypasses. The Nut Island Headworks serves twenty-two south system communities. The tributary area is comprised of separate sanitary sewers.

Facility Components: Major facility components include: six hydraulic influent sluice gates, six electric influent gates, six mechanical bar screens, six manual screen effluent sluice gates, six manual grit chamber main channel influent sluice gates, six electric grit chamber influent channel sluice gates, six vortex type grit chambers with air lift grit pump collectors, two hydraulic headworks effluent sluice gates, two motorized outfall sluice gates, four motorized emergency spillway sluice gates, ultrasonic level sensor in the effluent drop shaft, odor control, and an emergency generator.

Recent Facility Upgrades: The fire alarm system at the Nut Island Headworks was replaced with an upgraded system in FY10 at a cost of $285,000. Construction of improvements to the electrical system and grit/screenings conveyance system at the Nut Island Headworks were completed in FY16 at a cost of $6.4 million. The electrical system was subject to groundwater infiltration and the grit/screenings conveyance system had alignment and operational problems.

Site History: The Nut Island Headworks occupies the site of the original Nut Island Treatment Plant that was constructed in 1952 and decommissioned when the Nut Island Headworks and Inter-Island Tunnel were constructed in 1998. The Nut Island Treatment Plant served all of the south collection system providing preliminary and primary treatment and chlorination prior to discharge through three effluent outfalls. The original treatment plant effluent outfalls were retained for use as emergency outfalls for the Nut Island Headworks.

Hydraulic Performance: Six channels are available for use at the Nut Island Headworks. Typically, two or three channels are used during normal (dry weather) flow conditions and five channels used during peak flow (wet weather) conditions, with one channel held in reserve. Flow entering the facility may be limited by the peak hydraulic capacity of the downstream Inter-Island Tunnel and pumping capacity at the Deer Island's Lydia Goodhue (South System) Pump Station. During peak flow conditions, coordination between the Nut Island Headworks and Intermediate Pump Station is critical, since both discharge to the Inter-Island Tunnel.

Emergency Outfalls: Three emergency outfalls exist from the former Nut Island Treatment Plant. These three outfalls discharge to Quincy Bay and can be activated in an emergency.

- Section 543, 5275 feet of 5-foot diameter cast iron pipe built in 1904;
- Section 543-A, 5545 feet of 5-foot diameter cast iron pipe built in 1904; and
- Section 543-B, 1395 feet of 5-foot diameter cast iron pipe built in 1914.

Emergency Spillway: The function of these 8x8-foot sluice gates is to enable flow to be routed directly to Hingham Bay once emergency storage is fully utilized and the emergency outfall capacity has been exceeded during an extreme emergency condition (such as a failure at the Lydia Goodhue South System Pump Station).

Nut Island Pier: A commercial/industrial pier was built as part of the new Headworks Construction project. It was used for construction equipment and supply access to Nut Island and will be maintained for future MWRA needs. It is also currently used for recreational purposes by the public.

Facility Vulnerability to Severe Weather and Flooding: The Nut Island Headworks has been identified as being "Very Unlikely to be Affected".

Facility Power: The primary electrical feed is from commercial service. A diesel generator (820 KW) provides backup power. The generator was installed in 1998 and is in good condition.

Standard Operating Procedures (SOPs): The facility SOP was developed in 1998 and has received periodic updates.

Record Plans: There are 408 record drawings under MWRA Contract 5858 (Boston Harbor Project (BHP)CP-152). The dates of the record drawings are 1991-1992. The drawings do not have accession numbers because BHP used a different numbering system for record drawings (see Chapter 6).

Condition Assessment and Ongoing Upgrades: The Nut Island Headworks is relatively new (1998) and is in generally good condition. A project to evaluate and make recommendations for improvements to the odor control and HVAC systems was initiated in FY16. On January 25, 2016 a dust explosion ignited a significant fire in the odor control area located in the lowest level of the Nut Island Headworks. An overview of fire damage and resulting short-term actions and long-term needs are detailed in the paragraph below.

January 2016 Odor Control Area Fire: The original Nut Island Headworks odor control system was designed to treat odors and volitile organic carbons (VOCs) in air vented from the facility to four wet scrubbers and five carbon absorbors. Typically, the wet scrubbers were operated during warmer months (more odors) and the carbon absorbers were operated during cooler months (less odors). On January 25, 2016 the Nut Island Headworks odor control system was shut down to facilitate repairs. When an odor control fan was placed back into operation, a dust explosion ignited a significant fire in the odor control area located in the lowest level of the headworks. Due to access issues, the fire was difficult to control and ultimately took over 24 hours to extinguish. The odor control room and adjacent areas sustained extensive damage from smoke, soot, heat, and water from sprinklers and firefighting activities. In the weeks following the fire, extensive cleaning under an emergency contract was completed for the entire headworks facility. A short-term plan was developed to bring the odor control system back into operation (using the carbon units only) and make repairs to other damaged systems. Long-term odor control system replacemnt will be facilitated through a series of CIP projects that are programmed in the FY19 CIP as outlined in the section below.

Projects Programmed in the FY19 CIP:

- Nut Island Headworks Mechanical and Electrical Upgrades project including design, construction administration, resident inspection and construction is programmed in the FY19 CIP as a 5-year project during FY24-29 at a total cost of $25.240 million.
- Nut Island Headworks Odor Control System and HVAC Improvements project including design, construction administration, resident inspection and construction will provide for facility improvements in response to the January 2016 fire. This project is programmed in the FY19 CIP as a 6-year project during FY17-22 at a total cost of $43.950 million. Expenditures during the planning period (FY19-22) are $41.502 million.

Projects Recommended for Consideration in Future CIPs:

- A Long-term Wastewater Facilities Asset Protection Project is recommended for the remote headworks (see Section 8.09) at an annual budget of $1.0 million for the FY24-58 period. The total project cost is $35.0 million over 35 years. A portion of these funds would be used for rehabilitation/replacement needs at Nut Island Headworks.
- The Nut Island Pier is anticipated to require rehabilitation in the future. A $500,000 planning, design, construction project is recommended with project duration of 2-years during the FY24-25 timeframe.
- The Nut Island Headworks has a total replacement asset value of $120 million in 2006 dollars. About $48 million (40 percent of $120 million) of the total replacement asset value can be allocated to equipment type needs. Based on the industry benchmark of 20-year asset useful life for equipment type components at the Nut Island Headworks, staff recommends an anticipated expenditure of $30 million during the FY29-38 timeframe. The recommended $30 million represents only a portion of the total $48 million equipment

replacement asset value, since it is assumed that some of the Nut Island equipment will be rehabilitated/replaced in the short term via planned projects. About $72 million (60 percent of $120 million) of the total replacement asset value can be allocated to structural type needs. Based on the industry benchmark of 50-year asset useful life for structural type components, expenditures for structural type components at the Nut Island Headworks should be planned during the next update of the 40-year Wastewater System Master Plan.

8.07 Intermediate Pump Station

The Intermediate Pump Station (IPS) is located at 50 Bridge Street in North Weymouth and was placed into operation in December 2004. Wastewater is pumped from the IPS into a 42-inch force main and conveyed through the Braintree-Weymouth Tunnel directly to the Inter-Island Tunnel, and ultimately to the Deer Island Treatment Plant. Wastewater flow pumped at the IPS bypasses the Nut Island Headworks, therefore, separate headworks process equipment (screens and grit removal) are an integral part of the IPS. Details on the IPS are included within Chapter 10 – Collection System Pump Stations and CSO Facilities.

Concurrent with the construction of the IPS, the Braintree-Weymouth Tunnel was constructed to link Nut Island in Quincy, the IPS in Weymouth, and MWRA's residuals processing facility (Residuals Pellet Plant – see Chapter 7) at the Fore River Staging Area in Quincy. The Braintree-Weymouth Tunnel is detailed in Section 8.13.

8.08 Winthrop Terminal Headworks

The Winthrop Terminal Headworks is located at the Deer Island Treatment Plant. It is not considered a "remote" headworks. It is an integral part of the Deer Island Treatment Plant facilities and is detailed within Chapter 6 - Deer Island Treatment Plant.

8.09 Remote Headworks and Cross-Harbor Tunnel Long-term Reinvestment Needs Based on Estimated Replacement Asset Value

For the 2006 Master Plan, MWRA staff spent several months developing a replacement cost valuation of MWRA's infrastructure using MWRA-specific appraisal data and actual MWRA project cost information (see Section 3.07). Staff estimated MWRA's headworks facilities have a replacement asset value of $190 million in 2006 dollars. Note that this original estimate has been increased to $270 million in the 2018 Wastewater System Master Plan to account for ongoing upgrades at the Chelsea Creek Headworks. Staff then (in 2006) applied industry benchmarks for asset useful life (50 years for structural components and 20 years for equipment components) to estimate reinvestment needs. For the headworks, 60 percent of the asset value was allocated as structural (50-year useful life) components and 40 percent of the asset value was allocated as equipment (20-year useful life) components. Using the allocated asset value and dividing by the expected useful life produces an overall estimated reinvestment need of $6 million per year for the headworks facilities. It is assumed that the majority of this reinvestment need will be met via specific large-scale headworks rehabilitation/replacement projects similar to those programmed into the CIP. These large scale projects are fully detailed, evaluated, and justified within MWRA's annual CIP process. However, a portion of the long-term reinvestment need is likely to be met via small-scale rehabilitation/replacement projects that, individually, may be difficult to identify/justify within the annual CIP process. To plan and provide for small-scale rehabilitation/replacement projects at the headworks, a long-term Wastewater Facilities Asset Protection Project is recommended for consideration in future CIPs at an annual cost of $1.0 million per year (about 16 percent of the headworks overall estimated annual reinvestment need) during the FY24-58 timeframe; a total cost of $35.0 million over 35 years. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change. Similar long-term asset protection funds are recommended separately for pump station and CSO facilities (in Chapter 10).

Staff estimate MWRA's 19 miles of Cross-Harbor Tunnels have a replacement asset value of $660 million in 2006 dollars. The industry benchmarks for asset useful life for tunnels is 100+ years. The two older cross-harbor tunnels, the Boston Main Drainage Tunnel and North Metropolitan Relief Tunnel (each built in the 1950s), have reached over half of their estimated useful lives. The Inter-Island Tunnel has more recently (1998) come into service. The expected useful life of the cross-harbor tunnels extends to the end of the 40 year planning period of the Wastewater System Master Plan. Based on this, a place holder for future expenditures anticipated to be required for inspection, condition assessment, cleaning, and rehabilitation of the cross-harbor tunnels is recommended for consideration in future CIPs at a cost of $50.0 million during the FY46-50 (long-term) timeframe. A project for inspection and condition assessment of the cross-harbor tunnels is programmed in the FY19 CIP. In addition, projects for study, design, and construction of to evaluate and repair concrete corrosion in the tunnel effluent shafts are also programmed in the FY19 CIP. Once these projects are complete, recommendations for future cross-harbor tunnel capital improvements should be more defined and will be more detailed in future updates of the Wastewater System Master Plan.

8.10 Boston Main Drainage Tunnel

Function and Operation: The Boston Main Drainage Tunnel was constructed in 1953. The tunnel location is shown on Figure 8-1. The Boston Main Drainage Tunnel receives flow from the Ward Street and Columbus Park Headworks, crosses under Boston Harbor, and connects to Shaft "C" and the North Main Pump Station at the Deer Island Treatment Plant. The tunnel is MWRA Sewer Section 174, is constructed of reinforced concrete and has a total length of 37,586 feet (about 7.1 miles) from the Ward Street Headworks effluent shaft to Shaft "C" at Deer Island. The portion from the Ward Street Headworks to Columbus Park Headworks is 10-foot diameter and 13,763 feet long. The portion from the Columbus Park Headworks to Shaft "C" at Deer Island is 11.5-foot diameter and 23,823 feet long. An additional 167-feet of 10-foot diameter tunnel connects Shaft "C" to the North Main Pump Station, however, this portion is part of the North Metropolitan Relief Tunnel.

Hydraulic Performance: The capacity of the Boston Main Drainage Tunnel is 438 mgd. Flow through the Boston Main Drainage Tunnel is controlled by pumping at the North Main Pump Station at the Deer Island Treatment Plant. Flow into the tunnel can be controlled by choking (throttling of influent gates) at the Ward Street and Columbus Park Headworks.

Record Plans: The drawings are from Construction Contract 210 with accession numbers 29183, 29119, 54531 to 54549.

Condition Assessment and Ongoing Upgrades: The existing condition of the Boston Main Drainage Tunnel is unknown. Based on the industry benchmark of 100+ years for useful life for tunnels, it is presumed that the tunnel is in good condition. Field Operations has documented concrete corrosion (due to hydrogen sulfide) in the headworks effluent/cross-harbor tunnel drop shafts. There is concern that concrete falling into the drop shafts could cause pumping problems at Deer Island. A cross-harbor tunnel effluent shaft study project with follow-up design, construction administration, resident inspection, and construction phases are programmed in the FY19 CIP. This project has been previously noted in the remote headworks sections 8.03, 8.04, and 8.05.

Projects Programmed in the FY19 CIP:

- A Cross-Harbor Tunnel Inspection and Condition Assessment project is programmed in the FY19 CIP at a cost of $5.0 million and 3-year project duration during FY25-27. The project will include evaluation of three cross-harbor tunnels: the Boston Main Drainage Tunnel, the North Metropolitan Relief Tunnel, and the Inter-Island Tunnel.

Photos above show the watertight door access at the tunnel shaft and hydrogen sulfide corrosion of concrete walls and steel grate that covers the tunnel shaft. Repair of concrete corrosion in the tunnel shafts is needed.

Projects Recommended for Consideration in Future CIPs:

- A Cross-Harbor Tunnel Inspection, Condition Assessment and Cleaning/Rehabilitation project is recommended for consideration in future CIPs as a long-term place holder for future expenditures anticipated to be required for evaluation and rehabilitation of the cross-harbor tunnels. A 5-year project duration during FY46-50 at a cost of $50.0 million is recommended.

8.11 North Metropolitan Relief Tunnel

Function and Operation: The North Metropolitan Relief Tunnel was constructed in 1953. The tunnel location is shown on Figure 8-1. The North Metropolitan Relief Tunnel receives flow from the Chelsea Creek Headworks, crosses under Boston Harbor, and connects to Shaft No. 1 and the North Main Pump Station and Shaft "C" at the Deer Island Treatment Plant. The 10-foot diameter tunnel is MWRA Sewer Section 210, is constructed of reinforced concrete, and has a total length of 20,773 feet (about 3.9 miles).

Hydraulic Performance: The capacity of the North Metropolitan Relief Tunnel is 350 mgd. Flow through the North Metropolitan Relief Tunnel is controlled by pumping at the North Main Pump Station at the Deer Island Treatment Plant. Flow into the tunnel can be controlled by choking (throttling of influent gates) at the Chelsea Creek Headworks.

Record Plans: There are two Construction Contracts (180 and 190, dated 1949-1952) with a total of 61 drawings. There are accession numbers in 10 different series, non-sequential, that are indexed to the two contracts.

Condition Assessment and Ongoing Upgrades: The existing condition of the North Metropolitan Relief Tunnel is unknown. Based on the industry benchmark of 100+ years for useful life for tunnels, it is presumed that the tunnel is in good condition. Field Operations has documented concrete corrosion (due to hydrogen sulfide) in the headworks effluent/cross-harbor tunnel drop shafts. There is concern that concrete falling into the drop shafts could cause pumping problems at Deer Island. A cross-harbor tunnel effluent shaft study project with follow-up design, construction administration, resident inspection, and construction phases are programmed in the FY19 CIP. This project has been previously noted in the remote headworks sections 8.03, 8.04, and 8.05.

Projects Programmed in the FY19 CIP and Recommended for Consideration in Future CIPs:
- CIP Projects for the North Metropolitan Relief Tunnel are the same as those presented in Section 8.10 under the Boston Main Drainage Tunnel.

8.12 Inter-Island Tunnel

Function and Operation: Construction for the Inter-Island Tunnel began in 1996 and it was placed into operation in July 1998. The tunnel's location is shown on Figure 8-1. The Inter-Island Tunnel receives flow from the Nut Island Headworks and the Intermediate Pump Station (IPS), crosses under Boston Harbor, and connects to the Deer Island Lydia Goodhue (South System) Pump Station. There is an access drop shaft to the tunnel at Long Island. This access shaft is also used as a wastewater connection for BWSC. The 11.5-foot diameter tunnel is MWRA Sewer Section 682, is constructed of reinforced concrete, and has a total length of 25,296 feet (about 4.8 miles). The Inter-Island Tunnel contains two 14-inch ductile iron sludge force mains from the Deer Island Treatment Plant to Nut Island. The Braintree-Weymouth Tunnel connects from the Inter-Island Tunnel at Nut Island to the IPS in Weymouth and also to the MWRA's Residuals Processing Facility (Pellet Plant) at the Fore River Staging Area in Quincy.

Hydraulic Performance: The capacity of the Inter-Island Tunnel is 400 mgd. Flow through the Inter-Island Tunnel is controlled by pumping at Deer Island's Lydia Goodhue (South System) Pump Station. Flow into the tunnel can be controlled by influent gates and operation of the emergency facilities (outfalls and spillway) at the Nut Island Headworks.

Record Plan: There are 43 record drawings under MWRA Contract 5541 [Boston Harbor Project (BHP) CP-151], dated 1999. The drawings do not have accession numbers because BHP used a different numbering system for record drawings (see Chapter 6).

Condition Assessment and Ongoing Upgrades: The existing condition of the Inter-Island Tunnel is unknown. The tunnel was placed into operation approximately 10 years ago. Based on the industry benchmark of 100+ years for useful life for tunnels, it is presumed that the tunnel is in very good condition.

Projects Programmed in the FY19 CIP and Recommended for Consideration in Future CIPs:

- CIP projects for the Inter-Island Tunnel are the same as those presented in Section 8.10 under the Boston Main Drainage Tunnel.

8.13 Braintree-Weymouth Tunnel

Function and Operation: Concurrent with the construction of the Intermediate Pump Station (IPS) in 2005, the Braintree-Weymouth Tunnel was constructed to link Nut Island in Quincy, the IPS in Weymouth, and MWRA's Residuals Processing Facility (Pellet Plant) at the Fore River Staging Area in Quincy. The location of the tunnel is shown on Figure 8-1. The Braintree-Weymouth Tunnel contains:

- 2 - 14-inch ductile iron sludge force mains from Nut Island in Quincy to the Pellet Plant in Quincy, a distance of 2.5 miles;
- 2 - 12-inch ductile iron centrate force mains from the Pellet Plant in Quincy to the IPS in Weymouth, a distance of 0.5 mile;
- 1 - 12-inch ductile iron potable water line from the Pellet Plant in Quincy to the IPS in Weymouth, a distance of 0.5 mile;
- 1 - 42-inch ductile iron raw wastewater force main from the IPS in Weymouth to the Inter-Island Tunnel beneath Nut Island in Quincy, a distance of 2.0 miles; and,
- At Nut Island, there is a chamber with air/vacuum relief valves for both sludge force mains.

Record Plan: Record plans for the Braintree/Weymouth Tunnel have accession numbers 201958 to 201984.

Condition Assessment and Ongoing Upgrades: The Braintree-Weymouth Tunnel is relatively new. No upgrades are ongoing or planned.

Projects Recommended for Consideration in Future CIPs: None. The Braintree-Weymouth Tunnel is not included within the Cross-Harbor Tunnel Inspection and Condition Assessment project because the tunnel is backfilled with grout that secures the internal piping. The internal piping should be inspected as part of MWRA's force main program (see Section 9.09).

8.14 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to collection system headworks and cross-harbor tunnels are summarized in this Section. Table 8-2 lists each project, its priority ranking, and the proposed expenditure schedule. The needs justification for each project has been detailed previously in the Chapter within Sections relating to specific facilities or asset types.

Projects in the FY19 CIP: There are ten headworks and cross-harbor tunnel related projects programmed in the FY19 CIP. The projects are described below and summarized in Table 8-2 (see line numbers 8.01 and 8.10).

- Chelsea Creek Headworks Upgrade – design, construction administration, and resident engineering and inspection during construction is programmed in the FY19 CIP at a total project cost of $13.080 million during FY11-22. Total expenditures during the planning period (FY19-22) are $4.683 million.

- Chelsea Creek Headworks Upgrade – construction is programmed in the FY19 CIP at a total project cost of $80.520 million during FY17-21. Total expenditures during the planning period (FY19-21) are $49.270 million. This project is a major upgrade of the entire facility including the screening system, grit collection system, influent and effluent sluice gates, odor control and HVAC systems, emergency generator, instrumentation controls and communication systems, building improvements, and flood protection measures. Uninterrupted operation of the headworks facility is required throughout construction.

- Ward Street Headworks and Columbus Park Headworks Upgrade – design, construction administration, and resident engineering and inspection are programmed in the FY19 CIP at a cost of $18.283 million in FY20-28.

- Ward Street Headworks Upgrade – construction is programmed in the FY19 CIP at a cost of $52.124 million in FY23-28.

- Columbus Park Headworks Upgrade – construction is programmed in the FY19 CIP at a cost of $56.048 million in FY24-28.

- Nut Island Headworks Mechanical and Electrical Upgrades project including design, construction administration, resident inspection and construction is programmed in the FY19 CIP as a 5-year project during FY24-29 at a total cost of $25.240 million.

- Nut Island Headworks Odor Control System and HVAC Improvements project including design, construction administration, resident inspection and construction will provide for facility improvements in response to the January 2016 fire. This project is programmed in the FY19 CIP as a 6-year project during FY17-22 at a total cost of $43.950 million. Expenditures during the planning period (FY19-22) are $41.502 million.

- A Headworks Effluent Shaft Study is programmed in the FY19 CIP during FY19-20 at a total cost of $800,000. The study will evaluate concrete corrosion (due to hydrogen sulfide), shaft ventilation, replacement of shaft grating, and instrumentation upgrades.

- A Headworks Effluent Shaft Rehabilitation Project including design, construction administration, resident inspection, and construction is programmed in the FY19 CIP as a 4-year project during FY24-27 at a cost of $9.70 million. This project will follow-up on the study recommendations.

- The Cross-Harbor Tunnel Inspection and Condition Assessment project is programmed in the FY19 CIP during FY25-27 at a cost of $5.0 million.

Projects Recommended for Consideration in Future CIPs: There are four headworks and cross-harbor tunnel related projects recommended for consideration in future CIPs. The projects are described below and summarized in Table 8-2 (see line numbers 8.11 through 8.14).

- A Long-Term Wastewater Facilities Asset Protection project for the remote headworks is recommended at an annual budget of $1.0 million per year for expenditures in FY24-58 for a total 35-year cost of $35.0 million. This project will provide annual baseline target expenditures for asset protection projects for the remote headworks facilities.

- The Nut Island Pier Rehabilitation planning, design, and construction project is recommended for a 2-year project duration during FY24-25 at a cost of $500,000.

- The Nut Island Headworks Future Equipment Replacement project is recommended for a 10-year duration during FY29-38 at a cost of $30.0 million.

- A Cross-Harbor Tunnel Inspection, Condition Assessment and Cleaning/Rehabilitation project is recommended as a long-term place holder for future expenditures anticipated to be required for evaluation and rehabilitation of the cross-harbor tunnels. A 5-year project duration during FY46-50 at a cost of $50 million is recommended.

Table 8-2

Wastewater Master Plan - Remote Headworks and Cross-Harbor Tunnels

Existing and Recommended Projects

Last revision 9/7/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF	New Facility/System
RF/IC	Replacement Facility/Increase Capacity
Opti	Optimization
AP	Asset Protection
Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		REMOTE HEADWORKS AND CROSS-HARBOR TUNNELS												
8.01	1	Chelsea Creek Headworks Upgrade - Design/CA/REI	AP	145	10387_6802 10455_7206	12 years	13,080	4,683	FY11-22	4,683				4,683
8.02	1	Chelsea Creek Headworks Upgrade - Construction	AP	145	10445_7161	5 years	80,520	49,270	FY17-21	49,270				49,270
8.03	1	Ward Street Headworks and Columbus Park Headworks Upgrade - Design/CA/REI	AP	145	10510_7429 10538_7636	9 years	18,283	18,283	FY20-28	4,968	13,315			18,283
8.04	1	Ward Street Headworks Upgrade - Construction	AP	145	10511_7430	6 years	52,124	52,124	FY23-28	1,895	50,229			52,124
8.05	1	Columbus Park Headworks Upgrade - Construction	AP	145	10537_7587	5 years	56,048	56,048	FY24-28	0	56,048			56,048
8.06	3	Nut Island Mechanical and Electrical Upgrades - Design, CA/REI and Construction	AP	132	10492_7365 10496_7495 10580_7635	5 years	25,240	25,240	FY24-29		25,240			25,240
8.07	1	Nut Island Odor Control System and HVAC Improvements - Design, CA/REI and Construction	AP	132	10497_7517 10498_7548	6 years	43,950	41,502	FY17-22	41,502				41,502
8.08	2	Headworks Effluent Shaft - Study	Plan	145	10463_7237	2 years	800	800	FY19-20	800				800
8.09	2	Headworks Effluent Shaft Rehabilitation - Design, CA/RI and Construction	AP	145	10530_7549 10531_7550	4 years	9,700	9,700	FY24-27		9,700			9,700
8.10	2	Inspection of Deer Island Cross Harbor Tunnels	Plan	146	10454_7199	3 years	5,000	5,000	FY25-27		5,000			5,000
		SUBTOTAL - Existing - Headworks and Tunnels					**304,745**	**262,650**		**103,118**	**159,532**	**0**	**0**	**262,650**
8.11	3	Long-Term Wastewater Facility Asset Protection (for Remote Headworks) $1M per year for FY24-58	AP	new		Annual	35,000	35,000	FY24-58		5,000	10,000	20,000	35,000
8.12	4	Nut Island Pier Rehabilitation Plan/Design/Construction	AP	new		2 years	500	500	FY24-25		500			500
8.13	3	Nut Island HW Future Equipment Replacement	AP	new		10 years	30,000	30,000	FY29-38			30,000		30,000
8.14	4	Cross-Harbor Tunnel Inspection/Condition Assessment and Cleaning/Rehab	Plan/AP	new		5 years	50,000	50,000	FY46-50				50,000	50,000
		SUBTOTAL - Recommended - Headworks and Tunnels					**115,500**	**115,500**		**0**	**5,500**	**40,000**	**70,000**	**115,500**
		SUBTOTAL - Existing and Recommended - Headworks and Tunnels					**420,245**	**378,150**		**103,118**	**165,032**	**40,000**	**70,000**	**378,150**

CHAPTER 9
COLLECTION SYSTEM SEWERS

9.01 Chapter Summary

MWRA's wastewater collection system is a complex network of conduits and facilities that is strongly influenced by seasonal and wet weather conditions. The long-term (29 years of data 1989-2017) system average daily flow is approximately 353 mgd (about 300 mgd for the last five years 2013-2017), minimum dry weather flow is approximately 220 mgd, and peak wet weather capacity to the Deer Island Treatment Plant (DITP) is 1,270 mgd with additional system capacity available at combined sewer overflow (CSO) outfalls. The MWRA collection system includes a network of 274 miles of sewer pipelines (19 miles of cross-harbor tunnels, 226 miles of gravity sewers, 18 miles of force mains, 7 miles of siphons, and 4 miles of CSO and emergency outfalls); 13 pump stations; one screening facility; six CSO treatment and/or storage facilities; and four remote headworks facilities.

In this Chapter, MWRA's collection system sewers (interceptors, gravity tunnels, force mains, siphons, CSO and emergency outfalls, manholes, CSO regulators and other sewer structures) are detailed. The primary function of MWRA's collection system sewers is to transport wastewater received from its 43 sewer member communities to MWRA headworks facilities. There are over 1800 community connection points to the MWRA's sewer system. Sewer force mains are the discharge piping from sewer pump stations. Sewer siphons, more appropriately know as inverted siphons and also called depressed sewers, are gravity sewers designed to dip under an obstruction, such as a river, subway, conduit, etc. CSO and emergency outfalls are the discharge pipes that release excess flow to receiving waters, generally during large rainfall events or other emergencies. MWRA's goal is to operate and maintain the wastewater collection system to provide uninterrupted service in a safe, cost-effective and environmentally sound manner.

The replacement asset value of the collection system sewer pipelines is $1,900 million (28% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.07. The facilities are detailed within the Chapter Section noted below:

- 9.03 Gravity Sewers;
- 9.04 Gravity Sewer Interceptor Renewal and Asset Protection;
- 9.05 Sewer System Capacity and Optimization Projects;
- 9.06 Gravity Sewer Manholes and Related Structures;
- 9.07 Siphons and Siphon Headhouse Structures;
- 9.08 Force Mains and Related Valves;
- 9.09 CSO and Nut Island Emergency Outfalls; and
- 9.10 SCADA and Wastewater Metering System.

The average age of the sewer system is about 70 years old. Approximately 39 percent of sewers are over 100 years old, another 36 percent are between 51 to 100 years old, and the remaining 25 percent are 50 years old or less. Portions of the older sewers have been relined or rehabilitated via capital projects. MWRA continues to inspect and evaluate all aspects of the wastewater collection system to maintain and upgrade the system in a cost-effective manner. Overall, the collection system is in reasonably good condition. Based on internal TV inspection of the gravity sewer pipe, approximately 74 miles (33 percent) are in very good condition (A-rated under the initial A/B/C system), 139 miles (61 percent) are in fair to good condition with some defects (B-rated under the initial A/B/C system), 13 miles (6 percent) of interceptors are severely damaged and/or have defects requiring repair (C-rated under the initial A/B/C system). MWRA's initial A/B/C gravity sewer rating system has been updated to be consistent with the National Association of Sewer Service Companies' (NASSCO) pipeline defect identification and assessment standards. Details on pipeline condition ratings and development of sewer rehabilitation projects are presented in Sections 9.03 and 9.04. Sewer inspection ratings have not been used for force mains, siphons, or outfalls; however, based on available data, these also appear to be in reasonably good condition.

Through approximately the first 30 years of the MWRA (1985-2014), the majority of MWRA's CIP funds spent on sewer interceptor projects were for a combination of sewer replacement and relief sewer construction that were a priority to solve sewer capacity issues. Currently, the most critical need for the sewer system is rehabilitation construction that will address long-term sewer asset protection. As part of the initial 2006 Wastewater System Master Plan process, staff developed an interceptor renewal methodology to identify and prioritize the planning, design, and construction process for sewer repair/rehabilitation projects. The prioritized list of interceptor renewal projects recommended in the 2006 Master Plan was updated for the 2013 Master Plan and has again been updated for the 2018 Master Plan. More than $120.0 million in interceptor renewal/asset protection projects are programmed in the FY19 CIP (FY19-28). An additional $97.0 million in interceptor renewal/asset protection projects are recommended for consideration in future (mid-term) CIPs (FY24-38) and $95.0 million is recommended for future (long-term) interceptor renewal/asset protection projects during FY39-58. Other priority collection system needs include a system-wide study to address hydrogen sulfide/odor problems and specific projects to rehabilitate pipelines with known hydrogen sulfide deterioration. A priority need for sewer structures is rehabilitation design/construction of siphon headhouse chambers to ensure the integrity of concrete surfaces, stop log grooves and other internal features, upgrade entry hatches, and improve immediate area access to the structures where needed. Lower priority projects to be addressed in the long-term (FY19 and beyond) include asset protection projects for force mains, siphons, and outfalls, as well as, new facilities to increase capacity and optimize system performance.

For collection system sewers, periodic inspection, data management, and scheduled maintenance are key elements to minimize risk of sewer plugging or structural failure. A major uncertainty is the timing and intensity of large storm events resulting in peak wastewater flows that stress the system's hydraulic capacity. Collection system operations, particularly in preparation of and during large storm events, are intended to optimize system performance and minimize potential CSOs and SSOs. Key decision making to minimize risks includes where/how often to perform preventative maintenance activities and the cost/benefit analysis of when to rehabilitate aging sewer pipelines. Planned and scheduled sewer rehabilitation/replacement projects are generally more cost-effective than emergency repairs that need to be made if the system is allowed to run to failure.

For collection system sewers, $440.565 million in projects are identified in the 40-year master plan timeframe (FY19-58). Eighteen projects ($145.065 million) are programmed in the FY19 CIP. Twenty-two additional projects ($295.50 million) are recommended for consideration in future CIPs. Section 9.11 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all recommended collection system projects.

Near-term (FY19-23):

- $20.296 million is programmed in the FY19 CIP:
  - $938,000 to complete construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #1 for the Reading Extension Sewer including portions of Sewer Sections 46, 73, 74, and 75 in Stoneham;
  - $5.588 million to begin rehabilitation study, design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #2 for the North Metropolitan Sewer including portions of Sewer Sections 186, 4, 5, and 6 in Winthrop;
  - $6.634 million for construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #3 for the Dorchester Interceptor including portions of Sewer Sections 240, 241, and 242 in Dorchester;
  - $750,000 for planning, design, and construction of a Malden/Melrose Area Hydraulic and Structural Study and a Portion of Interceptor Renewal/Asset Protection Project #7 in Malden/Melrose including portions of Sewer Sections 41, 42, 49, 54, and 65;
  - $698,000 for a study of relief alternatives for the Randolph Trunk Sewer;
  - $458,000 to begin the System Relief and Contingency Planning Project; and,
  - $5.230 million for Siphon Structure Rehabilitation phase 1 land acquisition, design, construction administration, resident inspection, and construction.

- $1.50 million in needs is identified for FY19-23 and recommended for consideration in future CIPs for continued Annual Manhole Rehabilitation Program (first 5 years) at a target of $300,000 per year.

Mid-term (FY24-28):

- $98.496 million is programmed in the FY19 CIP:
  - $3.556 million to complete rehabilitation study, design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #2 for the North Metropolitan Sewer including portions of Sewer Sections 186, 4, 5, and 6 in Winthrop;
  - $35.689 million for design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #4A for the Cambridge Branch Sewer including portions of Sewer Sections 26 and 27 in Cambridge and Somerville;
  - $11.806 million for design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #4B for the Cambridge Branch Sewer including portions of Sewer Sections 23 and 24 in Everett;
  - $16.20 million for construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #5 for the New Neponset Valley Sewer including portions of Sewer Sections 607, 609, and 610 in Milton;

  - $11.633 million to begin design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #6 including portions of Sewer Sections 12, 14, 15, and 62 in Chelsea;
  - $1.590 million to complete planning, design, and construction of a Malden/Melrose Area Hydraulic and Structural Study and a Portion of Interceptor Renewal/Asset Protection Project #7 in Malden/Melrose including portions of Sewer Sections 41, 42, 49, 54, and 65;
  - $3.064 million for design/construction of biofilters for the Framingham Extension Sewer (FES)/Framingham Extension Relief Sewer (FERS) system to reduce corrosion and control odors;
  - $1.0 million for a System-wide Corrosion and Odor Control Study;
  - $1.0 million for future internal inspection of the West Roxbury Tunnel;
  - $7.442 million to complete the Wastewater Process Optimization project - North System Additional Hydraulic Engineering Analysis and design/construction;
  - $42,000 to complete the System Relief and Contingency Planning Project;
  - $1.362 million for the Wastewater Process Optimization project - North System Additional Hydraulic Engineering Analysis and design/construction million for the Wastewater Process Optimization project – Somerville and Medford Branch Sewer and the Medford Branch Sewer diversion study, design, and construction;
  - $2.813 million to improve portions of the Braintree/Weymouth Relief Facilities including Mill Cove Siphon Sluice Gate design and construction; and,
  - $1.5 million for structural improvements to Outfall MWR023 (outfall to the Charles River) located in the Fenway section of Boston under South System Relief.

- $48.0 million in needs is identified for FY24-28 and recommended for consideration in future CIPs:
  - $12.0 million to complete planning, design, and construction of Interceptor Renewal/Asset Protection Project #7 in Malden/Melrose including portions of Sewer Sections 41,42,49, 54, and 65;
  - $10.0 million for planning, design, and construction of Interceptor Renewal/Asset Protection Project #8 for Sewer Sections 30, 31, and 32 in Cambridge and Charlestown;
  - $500,000 for the Winthrop Terminal Facility System Hydraulic Capacity Study under Wastewater Process Optimization;
  - $1.0 million for the Charles River System Hydraulic Capacity Study under Wastewater Process Optimization;
  - $1.0 million for the South System Hydraulic Capacity Study under Wastewater Process Optimization;
  - $1.5 million to continue the second 5 years of the Annual Manhole Rehabilitation Program with a target of $300,000 per year;
  - $1.0 million for Woburn Sand Catcher Upgrade construction;
  - $6.0 million for phase 2 of Siphon Structure Rehabilitation design and construction;
  - $8.0 million for Sliplining design and construction of Sewer Section 652 - the Fore River Siphon in the Braintree/Weymouth system;
  - $5.0 million for the first 5 years of the Force Main Asset Protection Project; and,
  - $2.0 million for the Outfall Asset Protection Project.

Long-term (FY29-38 and FY39-58):

- $26.273 million is programmed in the FY19 CIP:
    - $312,000 to complete design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #4A for the Cambridge Branch Sewer including portions of Sewer Sections 26 and 27 in Cambridge and Somerville;
    - $24.394 million for design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #4B for the Cambridge Branch Sewer including portions of Sewer Sections 23 and 24 in Everett;
    - $1.567 million to begin design, construction administration, resident inspection, and construction of Interceptor Renewal/Asset Protection Project #6 including portions of Sewer Sections 12, 14, 15, and 62 in Chelsea;

- $246.0 million in needs is identified for FY29-38 and FY39-58 and recommended for consideration in future CIPs:
    - $12.0 million for planning, design, and construction of Interceptor Renewal/Asset Protection Project #9 for Sewer Sections 163 and 164 in Brighton;
    - $30.0 million for planning, design, and construction of Interceptor Renewal/Asset Protection Project #10 for Sewer Sections 21, 52, 53, 78, 79, 111, 112, and 189 in Arlington and Medford;
    - $15.0 million for planning, design, and construction of Interceptor Renewal/Asset Protection Project #11 for Sewer Sections 516, 521, 522, 523, and 524 in Dedham and Hyde Park;
    - $3.0 million for planning, design, and construction of Interceptor Renewal/Asset Protection Project #12 for Sewer Section 618 in Norwood;
    - $80.0 million as a placeholder for future long-term planning, design, and construction of Interceptor Renewal/Asset Protection Project #13 at $4.0 million per year during FY39-58;
    - $30.0 million for Wellesley Extension Replacement Sewer rehabilitation design/construction project;
    - $15.0 million for Neponset Valley Sewer (Sections 515-526 in the South System) Capacity Relief Project planning, design, and construction;
    - $1.0 million for Ashland Extension Sewer Capacity Relief Project planning and design;
    - $9.0 million for continuation of the Annual Manhole Rehabilitation Program for an additional 30 years with a target of $300,000 per year;
    - $6.0 million for phase 3 of Siphon Structure Rehabilitation design and construction;
    - $25.0 million for design and construction for upgrade/relief of the Cambridge Branch Sewer/DeLauri Pump Station Siphon as recommended in the Wastewater Process Optimization project;
    - $5.0 million for the Siphon Asset Protection Project; and,
    - $15.0 million for the Force Main Asset Protection Project.

9.02 Overview of the Collection System

The MWRA's regional collection system receives wastewater flow from 43 member communities, including Boston and the surrounding metropolitan region, serving a sewered population of about 2.2 million in a service area of about 500 square miles. About 95 percent of buildings within the service area are sewered. The location of member communities and general layout of the collection system is shown on Figure 9-1. Each of the 43 sewer member communities owns and operates its local wastewater collection system. Approximately six percent of the service area (30 square miles) is served by combined sewers that are designed to receive both sanitary and storm water flow, in portions of Boston, Brookline, Cambridge, Chelsea, and Somerville. The remaining 94 percent of the collection system service area contains separated sanitary and storm water collection systems. All wastewater flow from the service area is conveyed to the DITP. The regional collection system encompasses about 274 miles of MWRA-owned sewers and 5,350 miles of publicly-owned community sewers connected to MWRA interceptors at over 1,800 connections. There are also over 5,000 miles of private sewer service laterals that connect building plumbing to the community-owned sewers. The history and growth of the wastewater service area is presented in Chapter 3. Additional information on community-owned collection systems is provided in Chapter 15.

The different types of sewer pipelines that comprise the MWRA collection system are listed in Table 9-1 below and shown on Figure 9-2.

TABLE 9-1
Sewers by Type

Sewer Type	Miles	Percent
Gravity Sewers	226	82%
Cross-Harbor Tunnels	19	7%
Force Mains	18	7%
Siphons	7	3%
CSO and Emergency Outfalls	4	1%
TOTAL	**274**	**100%**

The MWRA collection system sewers range in size from 8-inch to greater than 10-feet in diameter. The sewer system has been constructed of a variety of materials and has been built out and sections replaced/rehabilitated over the last 140 years. General representations of the MWRA sewer system by size, material, and year constructed are presented in Figures 9-3, 9-4, and 9-5, respectively.

Management of collection system sewers is the responsibility of the Wastewater Operations and Maintenance Department, which is a subset of the Operations Division under the oversight of the Chief Operating Officer and the Deputy Chief Operating Officer. Two key supervisory staff reporting to the Director, Wastewater are the Manager of Operation and Manager of Maintenance.

FIGURE 9-1

Sewer System Location Plan

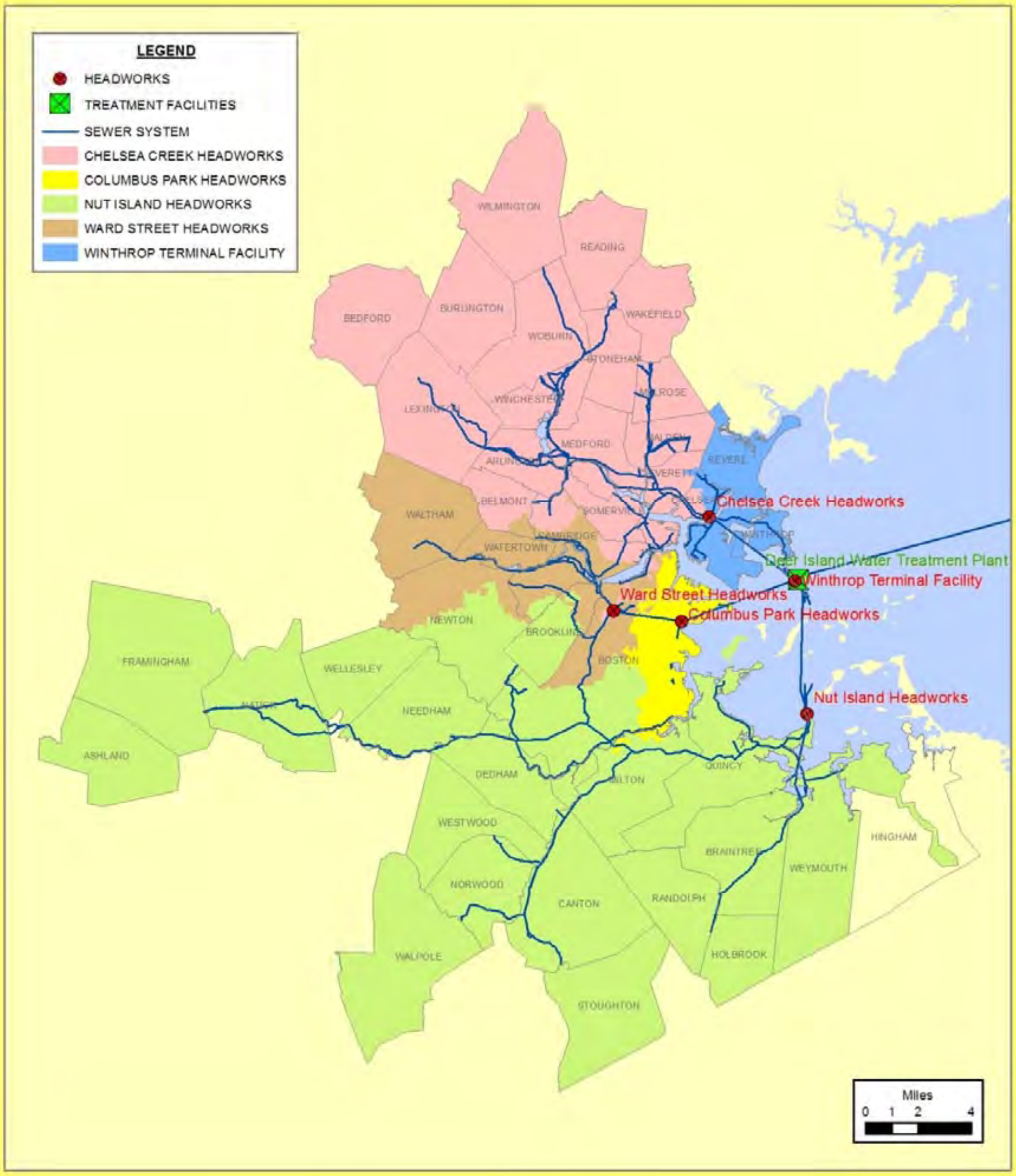


FIGURE 9-2
Sewers By Type

HIGHLIGHTS

Type	*Miles*	*Percentage*
GRAVITY MAINS & OTHER TUNNELS	*226*	*82%*
CROSS HARBOR TUNNELS	*19*	*7%*
FORCE MAIN	*18*	*7%*
SIPHON	*7*	*3%*
CSO & EMERGENCY OUTFALLS	*4*	*1%*
TOTAL	*274*	*100%*

The 274 miles of sewer and resulting data exclude the Deer Island Outfall (9.4 miles) and Misc Facility Piping (3.6 miles).

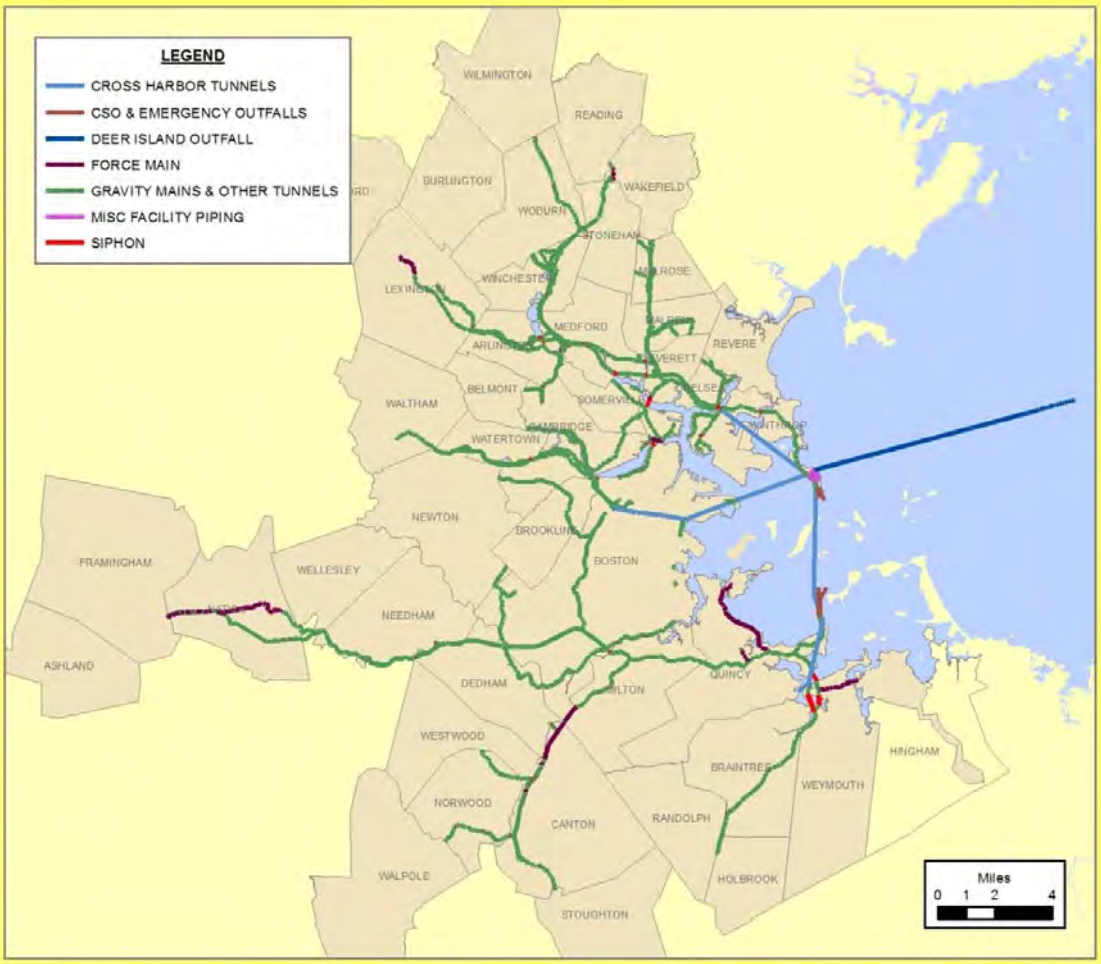


FIGURE 9-3
Sewers By Size

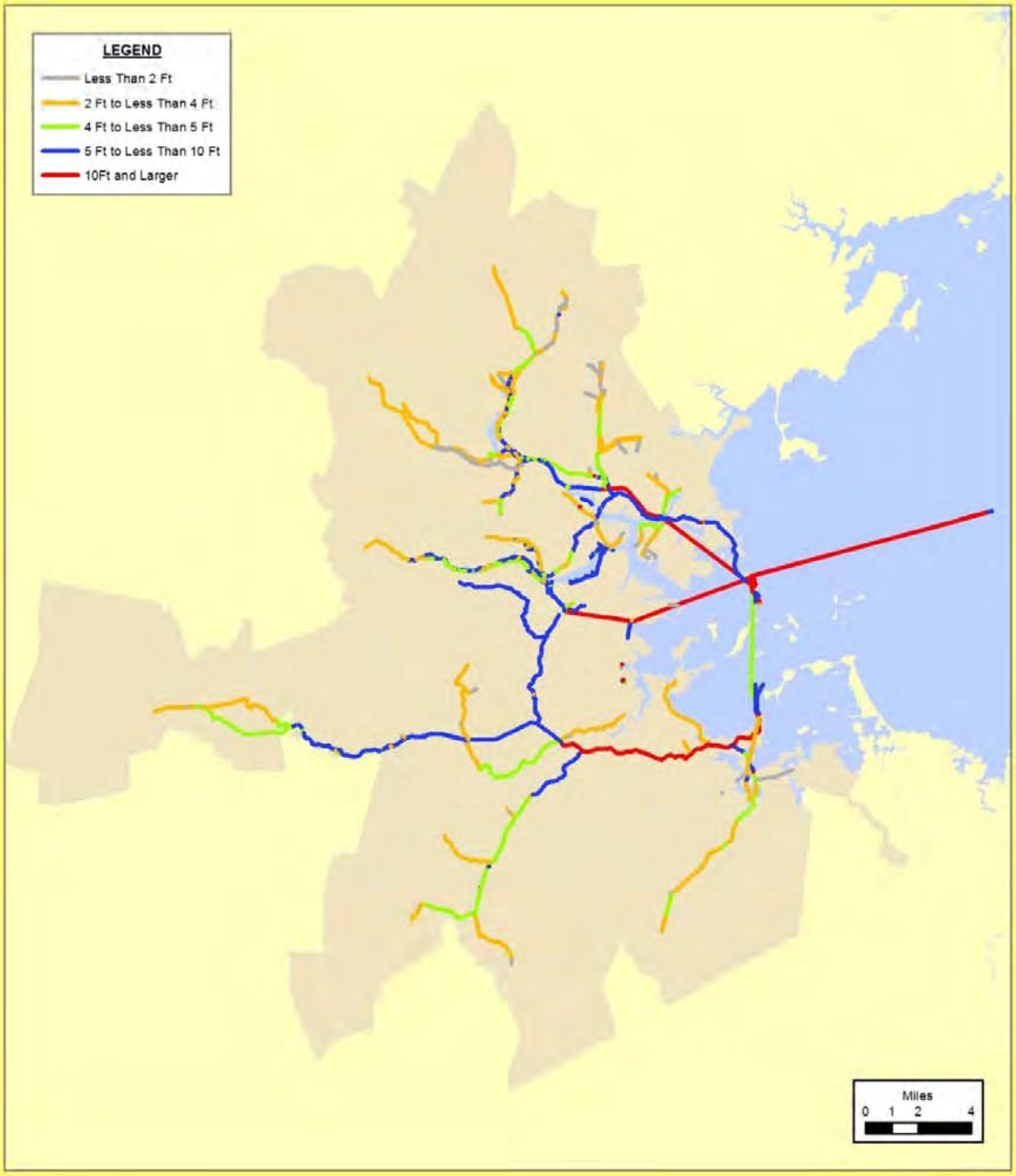


FIGURE 9-4
Sewers By Material

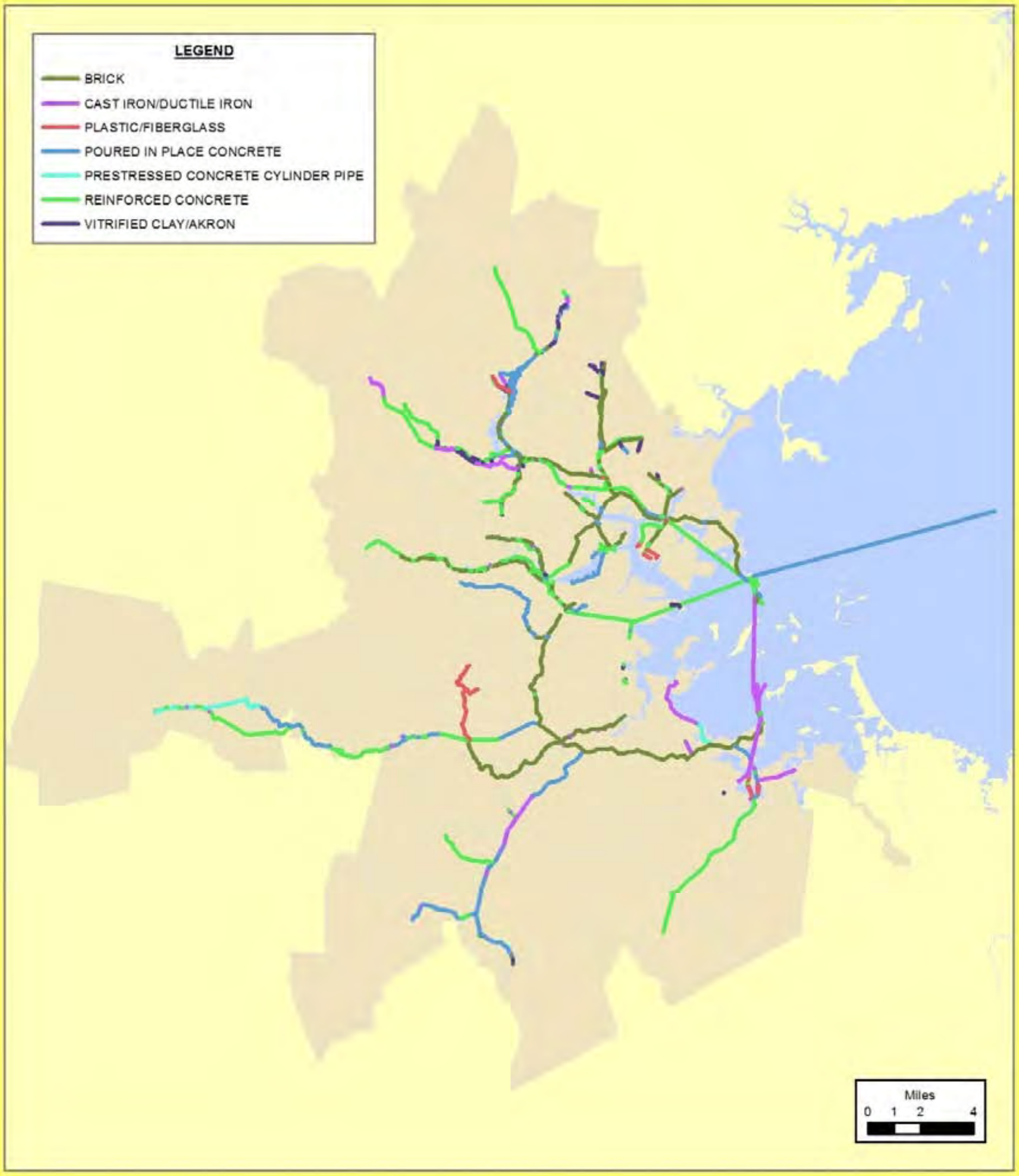
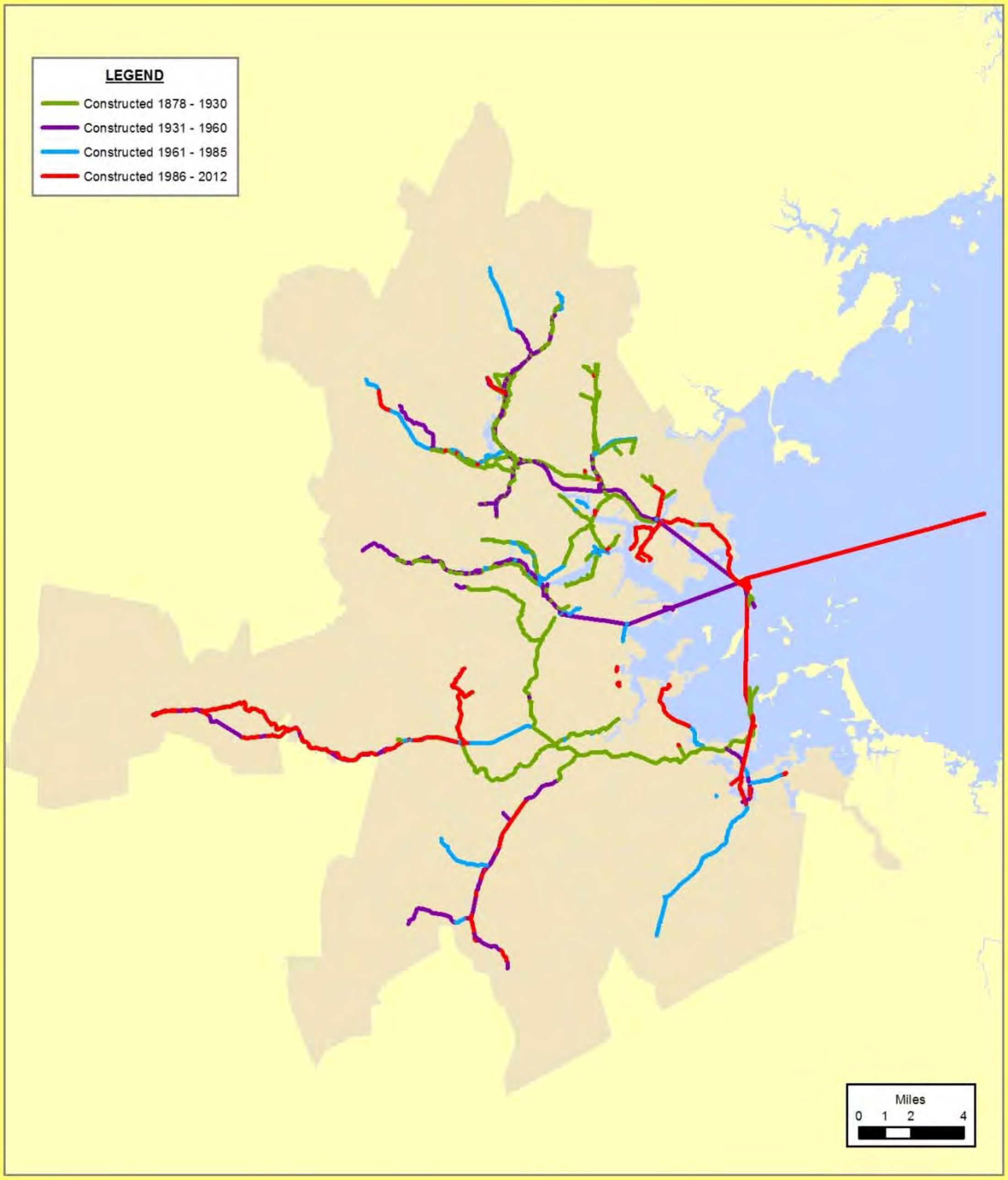


FIGURE 9-5

Sewers By Year Constructed



Operation and Maintenance: A total of about 23 employees are responsible for the operation and maintenance of MWRA collection system sewers. Operation and maintenance activities are based on industry best practices and designed to provide uninterrupted service in a safe, cost-effective and environmentally sound manner, as well as satisfy applicable regulatory requirements. Operation and maintenance practices are detailed in MWRA's Collection System Operation and Maintenance Manual. The Technical Inspection Unit is responsible for all sewer inspections and reporting. Based on pipeline inspection and wastewater flow data review, maintenance activities are scheduled by Work Coordination through the MWRA's MAXIMO maintenance work order system.

MWRA has made significant technological investments to enhance operation and maintenance including: Geographic Information System (GIS) mapping, Sewerage Analysis and Maintenance System (SAMS) attribute data management, InfoWorks hydraulic modeling, and internal sewer inspection utilizing closed-circuit television (CCTV) and sonar technologies. MWRA's extensive inspection program information is used to schedule preventative maintenance, identify structural ratings, identify infiltration/inflow sources, and help define rehabilitation projects. During each inspection, an electronic inspection log is created detailing all pipeline or structure parameters, service connections, and defects observed. A permanent record of each inspection log is maintained in an electronic database and can be used to generate detailed reports.

MWRA In-House Tasks: There are four in-house tasks related to the collection system sewers recommended to be completed by MWRA staff:

- Staff last updated the Collection System Operation and Maintenance Plan as dated December 2017 and submitted the Plan to EPA and MassDEP. The Collection System Operation and Maintenance Plan should be reviewed and updated periodically.

- MWRA sewers that are identified as severely damaged or have defects requiring repair have been grouped into a series of interceptor renewal projects recommended to be rehabilitated over an extended period (see Section 9.04) due to budget and staffing considerations. It is recommended that MWRA staff periodically review updated sewer TV inspection information of all poorly rated pipe and adjust the priority of projects planned in the CIP to ensure the most critical sewer sections receive appropriate priority ranking and project scheduling. In addition, staff should conduct future iterations of the interceptor renewal methodology (recommended to be performed every 5 to 10 years) as updated sewer inspection rating information is incorporated into the electronic database. Use of the most current system physical information will help ensure that the most critical projects are assigned the highest priority ranking.

- Staff should implement an in-house planning and design task to develop plans and specifications for the recommended construction project to rehabilitate the Woburn Sandcatcher (see Section 9.06). The Woburn Sandcatcher project is intended to optimize flow through the division structure, provide appropriate access for system maintenance, and improve debris removal. Use of as-needed consultants may be appropriate.

- Staff should conduct an evaluation of MWRA's sewer force mains and air valves (see Section 9.08). The task should evaluate age and material related factors and other information that may help predict force mains that may be susceptible to failure.

9.03 Gravity Sewers

There are about 226 miles of gravity sewers in the MWRA collection system, accounting for about 82 percent of wastewater collection system pipelines. Gravity sewers include interceptors built using open-cut construction methods, as well as sewers built by tunneling. The major difference between these types of gravity sewers is that open-cut construction allows for placement of sewer manholes, generally every ±300 feet. Sewer manholes provide access for operation and maintenance activities. Access to tunnel sections is dependent on individual site conditions. For example, MWRA's West Roxbury Tunnel (Section 637/638) is a 2.8-mile long gravity tunnel with only three access shafts that requires special operation and maintenance considerations. Key information on MWRA Interceptors is provided in Table 9-2.

Sewer age and construction material are key components that determine the useful life of sewers. The average useful life commonly cited in industry literature for sewer pipes is 100 years. This excludes tunnels and outfalls, that are generally expected to have a longer useful life. The average age of the MWRA sewer system is about 70 years old. Approximately 39 percent of sewers are over 100 years old, another 36 percent are between 51 to 100 years old, and the remaining 25 percent are 50 years old or less. Portions of the older sewers have been relined or rehabilitated via capital projects to significantly extend the useful life. Figure 9-6 provides a more detailed age classification of the sewer system. The sewer system is constructed of a variety of pipe materials as detailed in Figure 9-7. The four most prevalent pipe materials are reinforced concrete (32 percent), brick (26 percent), poured-in-place concrete (22 percent), and cast or ductile iron (10 percent).

TABLE 9-2
MWRA Interceptors

Name	Section #	Community	Material	Approximate Diamter (ft)	Year Built	Length (ft)
Alewife Brook Conduit	176-179	Arlington, Belmont, Cambridge, Medford & Somerville	BR, RC, PIPC	3-10	1948, 1950	18,423
Belmont Extension Sewer, (Metropolitan Sewer)	063	Cambridge	BR, CI/DI	2-3	1904	6,361
Belmont Relief Sewer	081	Belmont/Cambridge	CI, RC	1-3	1927	3,533
Boston Main Drain Relief Sewer	201	Roxbury	PIPC	7	1961	4,821
Boston Marginal Conduit	222	Boston Main, Roxbury	CI/DI, RC, PIPC	5-14	1910	11,559
Braintree-Weymouth Interceptor	622-625	Braintree, Quincy & Weymouth	CI, HDPE, PIPC, RC	1-5	1933-1934, 1982, 2002	15,591
Brighton Branch Sewer, (Extension of High Level Sewer)	580-587	Brighton, Brookline, Newton, & West Roxbury	BR, CI, PIPC	5-7	1907-1909, 1933	26,762
Bryant St Sewer	195, 196	Malden	RC, VC	1-2	1967	2,627
Cambridge Branch Sewer, (Metropolitan Sewer)	023-028, 154	Cambridge, Charlestown, Everett, & Somerville	BR, PIPC	4-7	1892-1895	16,926
Cambridge Marginal Conduit	229	Cambridge	CI, PIPC	4-8	1910	2,361
Castle Island & Conley Terminal Sewer	252	South Boston	VC	1	1960	2,258
Charles River Marginal Conduit	198-200, 215-217	Boston Main, Cambridge, Charlestown	DI, RC	2-10	1973-1974, 1979	8,280
Charles River Valley Sewer	162-165, 190-192, 202-203	Brighton, Brookline, Newton, Roxbury, & Watertown	BR, CI, PIPC, RC	3-9	1891-1892, 1906, 1948, 1954, 1963	44,788
Charlestown Branch Sewer, (Metropolitan Sewer)	031-032	Charlestown	BR, RC	2-3	1895, 1989	10,446
Chelsea Branch Relief Sewer	250	Chelsea	BR, RC	4-6	2001	7,691
Chelsea Branch Sewer, (Metropolitan Sewer)	056-057	Chelsea, Everett	BR, PIPC, RC	2-4	1901, 1999-2001	8,315
Clinton Interceptor	402	Clinton	BR, VC/VTC	2-3	2001	5,131
Cummingsville Branch Relief Sewer	086	Winchester, Woburn	RC, PIPC	3	1952	4,979
Cummingsville Branch Replacement Sewer	248	Winchester, Woburn	PL/FG	2-4	2006	4,992
Cummingsville Branch Sewer, (Metropolitan Sewer)	047	Winchester, Woburn	VC	1-2	1894, 1904, 2006	4,516
Dedham Branch Sewer	532	Canton/Dedham	CI, RC	1-2	1950	2,363
Dorchester Intercepting Sewer	240-242	Dorchester, Milton	BR, CI, PIPC, VTC	1-4	1895-1897	6,784
East Boston Branch Sewer, (Metropolitan Sewer)	036-038, 206-208, 255-256	East Boston	BR, CI, DI, HDPE, PIPC, PVC, RC, VC, VTC	1-6	1894, 2005, 2010	24,716
Edgeworth Branch Sewer, (Metropolitan Sewer)	020	Malden, Medford	BR, CI	2-3	1893, 1987	1,601
Everett Branch Sewer, (Metropolitan Sewer)	055	Malden	PIPC	1	1898	1,550
Extension to Everett in Broadway	066	Malden	VC	1-2	1911	2,625
Framingham Trunk Interceptor, Framingham Extension Sewer	632, 634, 657	Dover, Framingham & Natick	RC, PIPC	2-5	1954-1956, 1998, 2002	30,887
Framingham Extension Relief Sewer	678	Dover, Natick & Wellesley	PIPC	2-5	1999	10,417
High Level Sewer	545-575	Hyde Park, Milton, Quincy, Roxbury & West Roxbury	BR, CI, PIPC, RC	3-15	1900-1904, 1958, 2000	80,089
Holbrook Extension Sewer	656	Braintree, Holbrook, & Randolph	RC	2-4	1973	8,261
Lexington Branch Sewer, (Metropolitan Sewer)	053	Arlington	CI, VC	1-2	1899	4,515
Main Street Branch Sewer, (Metropolitan Sewer)	031	Charlestown	CI/DI, PIPC	1-2	1895	656

TABLE 9-2 (continued)
MWRA Interceptors

Name	Section #	Community	Material	Approximate Diamter (ft)	Year Built	Length (ft)
Malden Extension Sewer, (Metropolitan Sewer)	064	Malden	BR, CI, PIPC, RC	3-6	1907	3,148
Malden Relief Sewer	087, 197	Everett, Malden	BR, RC	4-5	1959, 1969	8,500
Malden Relief Sewer, (Saugus Branch Brook Flood Control Project)	095	Malden	BR, PIPC, RC	2-4	1969	8,988
Melrose Highlands Trunk Sewer	049	Melrose	BR	1-2	1896	3,894
Metropolitan Sewer	010, 012, 014-017, 020-022, 029, 030, 040-046, 048, 052, 054, 058-060, 065, 150, 155, 156, 175, 187-189, 227,228, 654	Arlington, Braintree, Cambridge, Chelsea, Dorchester, East Boston, Everett, Malden, Medford, Melrose, Somerville, South Boston, Stoneham, Winchester & Woburn	BR, CI, DI, PIPC, RC, VC, VTC	1-9	1891-2001	154,494
Millbrook Valley Sewer	077-080, 082-085	Arlington, Lexington, & Medford	BR, CI, PIPC, RC, VC, VTC	1-4	1899, 1925-1934, 1948, 1953, 1967, 2005	34,564
Millbrook Valley Relief Sewer	092-093, 151-152, 172-173	Arlington, Lexington, & Medford	DI, RC	1-6	1965-1967, 1972, 2005	39,754
Mystic Valley Sewer	153, 160	Medford, Winchester, & Woburn	BR, CI, PIPC, VC	1-2	1878-1879, 1950	14,530
Neponset Valley Sewer	243-246, 515-525	Dedham, Dorchester, Hyde Park & Milton	BR, CI, DI, PIPC, RC, VC	1-5	1896-1897, 1963, 1972	36,628
Neponset Valley Relief Sewer	531	Hyde Park, Milton	BR, CI, PIPC	3-6	1935	479
New Mystic Valley Sewer	067-072, 109-110	Medford, Winchester, & Woburn	BR, CI, PIPC, VC	2-6	1913-1914, 1924, 1929, 1937	31,924
New Neponset Valley Sewer	607-615, 619	Canton, Milton	CI, PL, PIPC	1-6	1930-1932, 1992	45,941
New Neponset Valley Relief Sewer	671	Canton	PIPC	5	1992	5,514
New Neponset Valley Sewer Replacement	614	Canton	RC	5	1964	1,076
North Charles Relief Sewer	181-184	Cambridge	PIPC, RC, VC	2-7	1968, 1971-1972, 1976	18,397
North Charles Relief Sewer, Charles River Sewer Crossing	180	Brighton, Cambridge	RC	3-9	1965, 1968	2,857
North Metropolitan Trunk Sewer	003-006, 008-009, 186	East Boston, Winthrop	BR, PIPC, STL	4-15	1894, 1960, 1989, 1993, 1997	24,704
North Metropolitan Trunk Sewer, Belle Isle Inlet	007	East Boston, Winthrop	BR, PIPC	5-14	1895, 1997	1,320
North Metro Relief Sewer	102-103, 105-108, 111-114, 158, 168-169, 193-194	Chelsea, Everett, Medford, Stoneham, Winchester & Woburn	BR, CI, PIPC, RC, VC	3-13	1936-1973, 1950, 1965-1968	71,307
North Weymouth Relief Interceptor	639	Weymouth	CCFP, RC	5	2004	1,655
Old High Level Sewer	247	Roxbury	BR	7	1903	445
Randolph Trunk Sewer	626-628, 655	Braintree, Randolph, & Weymouth	RC	1-4	1958	27,016
Reading Extension Sewer	073-075	Stoneham, Wakefield, & Woburn	CI, RC, VC	1-2	1919, 1921	12,205
Reading Extension Relief Sewer	204-205	Stoneham, Wakefield	DI, RC, PIPC	2-3	1921, 1984	6,393

TABLE 9-2 (continued)
MWRA Interceptors

Name	Section #	Community	Material	Approximate Diamter (ft)	Year Built	Length (ft)
Revere Extension Sewer	159	Chelsea, Revere	VC, VTC	1	1914	1,031
Revere Extension Sewer, (Metropolitan Sewer)	061, 062	Chelsea, Revere	BR, CI	3-5	1904, 2001	7,411
Somerville Marginal Conduit	230	Somerville	RC	7	1971	2,522
Somerville-Medford Branch Sewer, (Metropolitan Sewer)	035	Charlestown, Medford & Somerville	BR, RC, VC	2-4	1895-1896	8,803
South Charles Relief Sewer	001-002, 212, 218-220	Brighton, Brookline, Cambridge, Newton, Roxbury, Waltham, & Watertown	BR, CI, PIPC, RC	2-13	1892, 1903, 1954-1958, 1967	51,194
Stoneham Branch Sewer, (Metropolitan Sewer)	051	Melrose	RC, VC	1	1897, 2001	4,025
Stoughton Extension Sewer	620-621	Canton, Stoughton	BR, PIPC, VC, VTC	2-3	1931-1932	6,558
Stoughton Extension Relief Sewer	670	Canton	BR, DI, PIPC	2-3	1992	9,746
Upper Neponset Valley Sewer	526, 529	Dedham, West Roxbury	BR, CI, PIPC, RC, VC	1-4	1897-1898	3,395
Upper Neponset Valley Replacement Sewer	685-688	Newton, West Roxbury	CCFP, PVC	1-4	2009	22,090
Wakefield Branch Sewer, (Metropolitan Sewer)	050	Melrose	BR, VC	1-2	1897	4,663
Walpole Extension Sewer	616-618	Canton, Norwood	CI, PIPC, RC	2-5	1931, 1957, 1964	16,151
Walpole Extension Relief Sewer	669	Canton, Norwood	BR, DI, PIPC, RC, VC	3-4	1992	7,160
Wellesley Extension Sewer	601	Dedham, Needham	CI, PIPC	1-3	1921	1,502
Wellesley Ext Sewer Replacement	664-668	Dedham, Dover, Needham, & Wellesley	DI, PIPC, RC	2-7	1989-1991	39,622
Wellesley Extension Relief Sewer	629-631, 638	Dedham, Dover, Needham, Wellesley, & West Roxbury	PIPC, RC	2-7	1951-1952, 1956, 1963, 2002	39,839
Westwood Interceptor, Westwood Extension Sewer	635-636	Canton, Norwood, & Westwood	RC	1-3	1961	12,937
Wilmington Trunk Sewer	088-090	Wilmington, Woburn	RC	3-4	1959, 1972, 1974	20,428

FIGURE 9-6 Sewer System Age

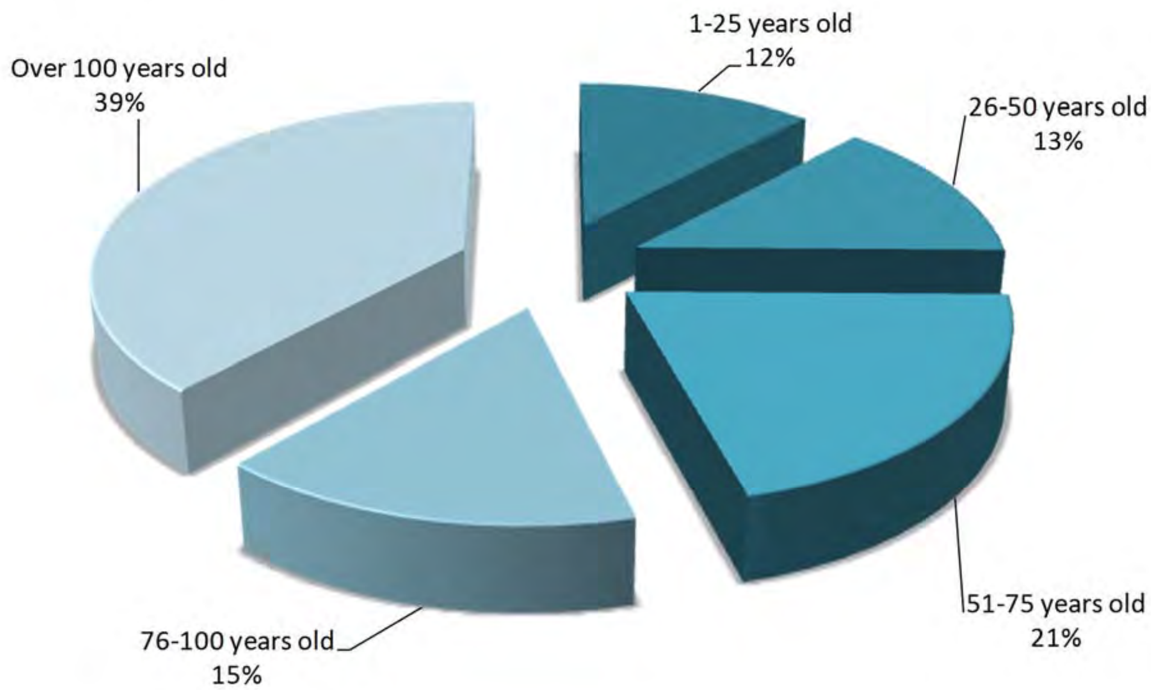
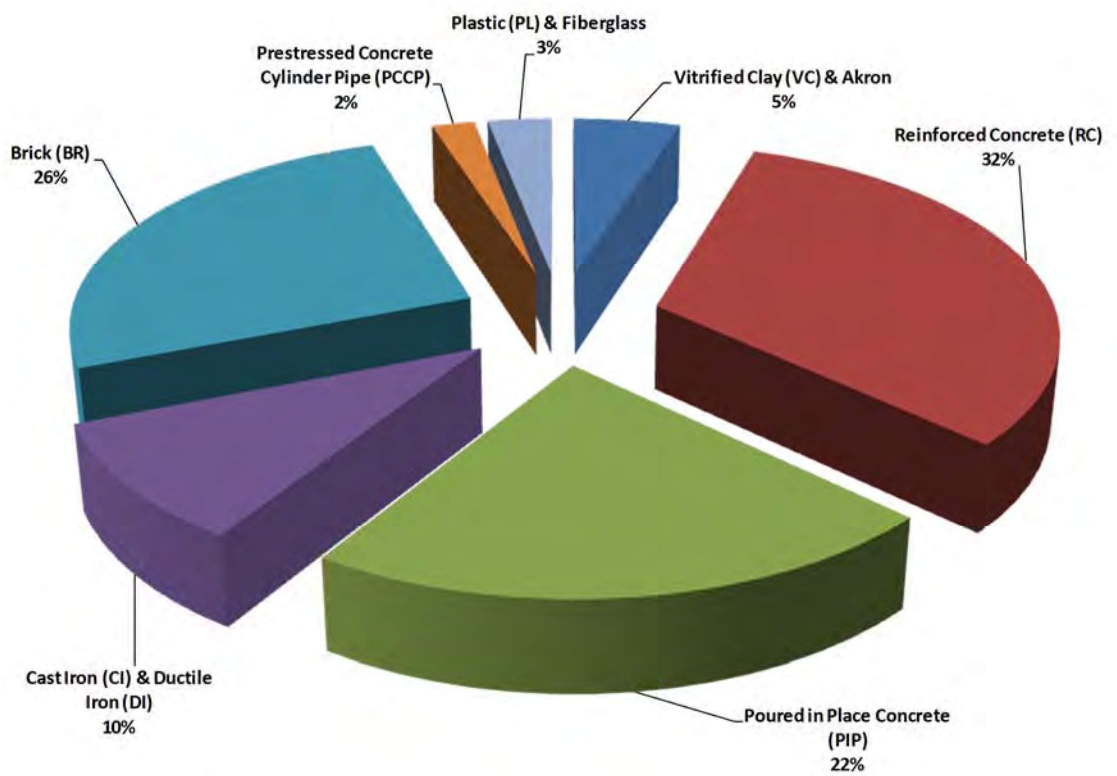


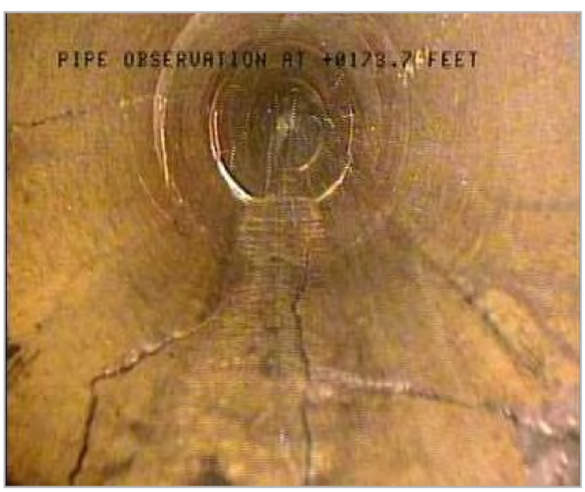
FIGURE 9-7 Pipe Material

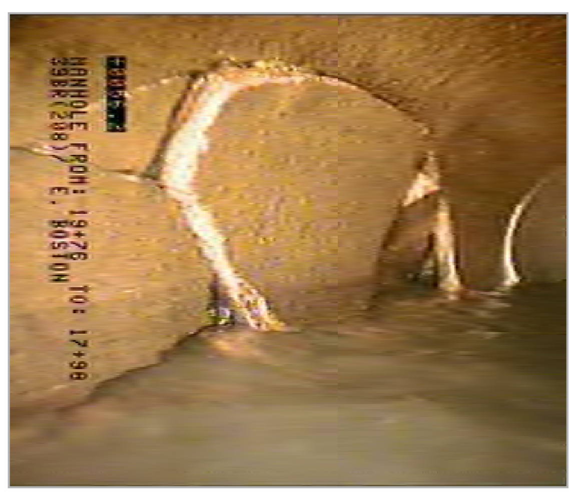


MWRA continues to inspect and evaluate all aspects of the wastewater collection system to maintain and upgrade the system in a cost-effective manner. Overall, the collection system is in reasonably good condition. Based on internal TV inspection of the gravity sewer pipe, approximately 74 miles (33 percent) are in very good condition (A-rated under the initial A/B/C system), 139 miles (61 percent) are in fair to good condition with some defects (B-rated under the initial A/B/C system), and 13 miles (6 percent) of interceptors are severely damaged and/or have defects requiring repair (C-rated under the initial A/B/C system). MWRA's initial A/B/C gravity sewer rating system has been updated to be consistent with the National Association of Sewer Service Companies' (NASSCO) pipeline defect identification and assessment standards. MWRA utilizes the Granite Xp version of internal CCTV inspection software manufactured by CUES, Inc. The software utilizes four main observation categories for inspection scoring by the CCTV inspection field technicians, including: Structural, O&M, Inventory, and Miscellaneous. Observations of sewer defects are rated based on a 0 (best condition) to 100 (worst condition) scale. The updated system software totals up the ratings for each inspection run and will provide MWRA's engineering staff with the best available data to use in prioritizing future interceptor renewal projects. Photos below show the Technical Inspection Unit equipment and some examples of sewer pipe in poor condition in need of repair or replacement.

CCTV Inspection Crew

Inside of CCTV Inspection Truck





Examples of Sewer Pipe in Poor Condition

9.04 Gravity Sewer Interceptor Renewal and Asset Protection

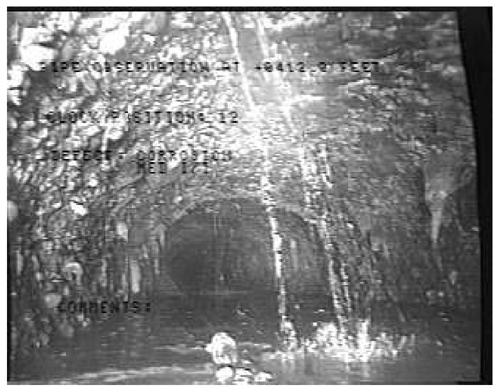
During preparation of the 2006 Wastewater System Master Plan, staff developed a systematic planning process to address interceptor renewal/asset protection needs for MWRA's gravity sewers. A project team with expertise in engineering, operations, planning, modeling, GIS and finance developed an objective interceptor renewal methodology for identifying and prioritizing projects to repair and/or rehabilitate sewer interceptor deficiencies, and develop cost estimates for phased CIP consideration. The in-house team assessed methodologies used by other utilities, entered MWRA condition assessment information into an electronic sewer database, and performed a statistical analysis of pipe attribute data versus sewer inspection condition ratings. Not surprisingly, staff found a correlation between MWRA pipes in poor structural condition (C-rated under the initial A/B/C system) and pipe age and construction material. Nearly two-thirds (65 percent) of pipe in poor structural condition was identified as over 100 years old and an additional 24 percent was identified as 50 to 100 years old. In terms of construction materials, 54 percent of pipe in poor structural condition was identified as constructed of brick. The analysis also indicated a higher than expected percentage of poured-in-place concrete that was 51 to 75 years old was in poor condition, perhaps reflecting a poorer quality of materials used during a certain timeframe.

Based on these results, staff selected a two-pronged approach focusing on risk and consequence of sewer failure to develop a methodology to prioritize MWRA's gravity sewer pipe in poor structural condition for future rehabilitation/replacement. To assign points to pipe sections based on their risk-of-failure, staff developed a weighted scoring system using the factors that could best predict the condition of the pipe: sewer inspection condition rating, pipe age, and pipe material. To assign points to pipe sections based on their consequence-of-failure, staff developed a weighted scoring system based on land use analysis from GIS mapping data (such as, potentially impacted areas from SSOs, population density, residential/commercial/industrial land use, and areas of critical environmental concern). MWRA's wastewater hydraulic model was also used to deduct consequence-of-failure points from pipe sections that were less vulnerable due to the ability to divert or bypass flow in the event of a pipe failure.

After points were calculated for both risk-of-failure and consequence-of-failure components, sewer sections were sorted from high to low, providing a prioritized list. All C-rated pipe (63 of 293 sewer sections) and B-rated pipe (230 of 293 sewer sections) were ranked using the risk-of-failure and consequence-of-failure methodology. A-rated pipe segments were not included in the analysis. Of a possible total score of 600 points, no pipe segments scored more than 500 points, 6 percent of pipe segments scored more than 400 points (all were C-rated), 39 percent scored 300 to 400 points (35 C-rated, 79 B-rated), 44 percent scored 200 to 300 points (11 C-rated, 120 B-rated) and the remaining 11 percent scored fewer than 200 points (all are B-rated). The outcome of the interceptor renewal methodology was a prioritized list of sewer sections to be considered for future rehabilitation/replacement. Below is a sample of the model output.

SECTION	Rank	CIP	Community (Length)	RATING	NDENSITY	NENV_ARE	NCI_AREA	Vulnerability	Consequence points	Risk Points	Total Points
39	1	*	East Boston (3311)	C	90.00	70.00	76.00	-50.00	191.60	280.00	471.60
208	2	*	East Boston (92)	C	93.00	68.00	71.00	-50.00	190.80	280.00	470.80
37	3	*	East Boston (2945)	C	92.00	70.00	76.00	-50.00	194.40	272.00	466.40
240	4		Dorchester (204)	C	99.00	89.00	7.00	-50.00	181.80	271.94	453.74
242	5		Dorchester (60)	C	100.00	70.00	22.00	-50.00	173.20	280.00	453.20
81	6	*	Belmont (22); Cambridge (50)	C	100.00	96.00	88.00	-100.00	188.80	262.10	450.90
27	7		Cambridge (1185); Somerville (2562)	C	84.00	31.00	100.00	-37.25	171.35	272.00	443.35
26	8		Somerville (834)	C	71.00	31.00	66.00	0.00	170.00	272.00	442.00
164	9		Brighton (2997)	C	81.00	66.00	91.00	-82.95	151.05	272.00	423.05
610	10		Milton (1137)	C	52.00	79.00	7.00	-4.77	151.23	269.40	420.63
23	11		Everett (1361)	C	45.00	31.00	90.00	0.00	148.00	272.00	420.00
24	11		Everett (737)	C	45.00	31.00	90.00	0.00	148.00	272.00	420.00
528	13	*	West Roxbury (3897)	C	73.00	84.00	19.00	-50.00	147.60	272.00	419.60
156	14		Everett (297)	C	78.00	31.00	80.00	-50.00	138.20	272.00	410.20
80	15	*	Arlington (3608)	C	88.00	31.00	69.00	-62.28	133.32	271.84	405.16
73	16		Woburn (355)	C	100.00	31.00	25.00	-50.00	136.00	266.43	402.43
62	17		Chelsea (2365)	C	80.00	31.00	73.00	-50.00	136.80	264.00	400.80
2	18		Brighton (5836)	B	87.00	66.00	78.00	0.00	234.60	163.40	398.00
32	19		Charlestown (1518)	C	100.00	31.00	7.00	-50.00	125.20	272.00	397.20
14	20		Chelsea (1788)	C	97.00	31.00	94.00	-100.00	123.20	272.00	395.20
42	21		Melrose (642)	C	39.00	75.00	59.00	-50.00	115.00	280.00	395.00
527	22	*	West Roxbury (1223)	C	34.00	72.00	87.00	-50.00	121.80	272.00	393.80
15	23		Chelsea (617)	C	97.00	31.00	84.00	-100.00	117.20	272.00	389.20
607	24		Milton (1479)	C	11.00	82.00	36.00	0.00	119.00	269.40	388.40
53	25		Arlington (318)	C	89.00	31.00	40.00	-55.35	124.25	263.85	388.10

For the 2006 Wastewater System Master Plan, the interceptor renewal project team's work resulted in the identification of 12 interceptor renewal/asset protection projects recommended to be completed during the 40-year Master Planning period. All of the proposed interceptor renewal projects required a detailed engineering evaluation to determine the most appropriate sewer rehabilitation strategy. The projects were prioritized based on the interceptor renewal methodology; however, excluded were those sewer sections that had already been included in other previously programmed CIP projects. As anticipated, some of the high priority sewer sections identified from the interceptor renewal methodology were included within ongoing or recently complete rehabilitation construction projects, or were already programmed into the CIP within planned interceptor projects. Some previously programmed CIP projects included: FY07 rehabilitation of Sewer Sections 80 and 83 in Arlington; FY08 rehabilitation of Sewer Section 160 in Winchester/Medford; FY10 rehabilitation of Sewer Section 624 in Weymouth; FY11 replacement of Sewer Sections 37, 39 and 208 in East Boston as part of the East Boston CSO Project; and FY11 replacement of Sewer Sections 526, 527, and 528 in West Roxbury under the Upper Neponset Valley Relief Sewer Project.



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Periodic updates of MWRA's interceptor renewal analysis, incorporating the most recent internal inspection data, are recommended. A review of the previously identified sewer sections in poor structural condition was performed during FY14 by the MWRA Engineering Department utilizing the most recent CCTV inspection data. Based on the review, some reprioritizing and reorganizing of the initial interceptor renewal projects was done and some additional sewer rehabilitation projects were added. The 2018 Wastewater Master Plan Interceptor Renewal/Asset Protection projects that are programmed in the FY19 CIP or recommended for consideration in future CIPs are listed later in this Section.

Phased construction of the sewer rehabilitation interceptor renewal projects will help ensure that MWRA meets its goal of operating and maintaining the sewer system to provide uninterrupted wastewater collection service in a safe, cost-effective and environmentally sound manner with attention to preserving and extending the useful life of sewer pipeline assets.

Example of sewer needing rehabilitation

Example of sewer rehabilitated with cured-in-place pipe (CIPP) liner

Hydrogen Sulfide Corrosion and Odor Control: The Authority continues to address hydrogen sulfide corrosion and odor issues in the collection system; most notably in the Framingham Extension Sewer and Framingham Extension Relief Sewer, Wellesley Extension Relief Sewer and Wellesley Extension Sewer Replacement, West Roxbury Tunnel, and Millbrook Valley Relief Sewer Systems. For the Framingham and downstream interceptors, a 1998 report identified instances of corrosion and collapse dating back to 1977 and attributed the problem to high levels of biochemical oxygen demand (BOD) and sulfates. In 1999, MWRA proceeded with a multi-faceted corrosion and odor control program, including: (1) source reduction in the form of BOD, sulfate, and sulfide limits for municipal and industrial discharges; (2) treatment in the form of chemical addition and the installation of biofilters at key locations and, (3) asset protection through rehabilitation of affected sewers and related structures. A 2003 Wastewater Characterization Study identified the various components in MWRA's wastewater, with hydrogen sulfide being one of the more important parameters tested. As a follow-up, a project was developed to purchase and introduce chemicals in to the Framingham Extension Sewer system for hydrogen sulfide and corrosion control. Nitrogen based chemicals are used to provide an oxygen source to the wastewater, preventing or greatly reducing the formation of hydrogen sulfide. Monitoring is accomplished through aqueous and air space sampling. Internal TV and physical inspections continue to be prioritized for affected sewers and TRAC staff continue to oversee the pre-treatment work of municipalities and industries in the program.

Three projects to address hydrogen sulfide corrosion and odor control are programmed in the FY19 CIP, including: (1) FES/FERS Biofilters design and construction, (2) System-Wide Odor Control Study, and (3) West Roxbury Tunnel Future Inspection. The West Roxbury Tunnel (MWRA Sewer Section 637/638) is a 2.8-mile long gravity tunnel with limited access that requires special operation and maintenance considerations. Previous MWRA internal inspections of the West Roxbury Tunnel determined that approximately 12,000 feet of Section 637 is somewhat deteriorated due to hydrogen sulfide corrosion. The future inspection project, currently planned for FY24, will allow MWRA to monitor the structural condition in the West Roxbury Tunnel. Two related MWRA construction projects have been completed: (1) rehabilitation of 1,000 feet of Section 638 an 84-inch sewer upstream of the West Roxbury Tunnel between the Neponset Valley

Connection Chamber and the New Haven Street Drop Shaft and (2) the New Haven Street Drop Shaft Rehabilitation.

Gravity Sewer Asset Protection Projects Programmed in the FY19 CIP:

- Interceptor Renewal/Asset Protection Project #1 for rehabilitation of approximately 14,500 feet of Sections 46, 73, 74, and 75 is programmed in the FY19 CIP at a total project cost of $3.205 million during FY16-20. Design began in FY16 and the construction contract was awarded in FY17. Expenditures during the planning period (FY19-20) are $938,000. The project includes portions of the Reading Extension Sewer and Metropolitan Sewer (15, 18, and 20-inch vitrified clay pipe) located mostly in Stoneham with short stretches in Reading and Woburn. Sewer manholes will be rehabilitated as part of this project. This project was 2012 Master Plan Interceptor Renewal Project #9 and also included Sewer Sections 47 and 153 in Winchester which were reviewed for rehabilitation under the Cummingsville Branch Replacement Sewer Project.
- Interceptor Renewal/Asset Protection Project #2 for rehabilitation construction of Sections 186, 4, 5, and 6 on the North Metropolitan Sewer in Winthrop and Deer Island is programmed in the FY19 CIP at a total cost of $10.244 million in FY17-24. The planning study began in FY17, design is scheduled to begin in FY19, and construction is scheduled to begin in FY23. Expenditures during the planning period (FY19-24) are $9.144 million. Emergency removal of delaminated plastic liner from Section 186 was performed in June 2011. The project will rehabilitate a 108-inch sewer that connects to the Winthrop Terminal Headworks Facility at DITP. Portions of these sewers were previously rehabilitated in 1992-1995 with plastic lining and/or spray applied shotcrete with epoxy lining. This project was included in the 2012 Master Plan, but was not labeled as a numbered Interceptor Renewal Project.
- Interceptor Renewal/Asset Protection Project #3 for rehabilitation of the Dorchester Interceptor Sewer Sections 240, 241 and 242 in Dorchester is programmed in the FY19 CIP at a total project cost of $7.076 million during FY17-22. The design contract was awarded in late FY17 and construction is scheduled to begin in FY19. Expenditures during the planning period (FY19-22) are $6.634 million. This project will rehabilitate approximately 5,500 feet of 42-inch by 28-inch egg shaped and 48-inch by 36-inch elliptical shaped brick sewer that was constructed in 1895-1896 and approximately 1,000 feet of replacement poured-in-place concrete pipe. Sewer manholes will be rehabilitated as part of this project. This project was 2012 Master Plan Interceptor Renewal Project #1.

- Interceptor Renewal/Asset Protection Project #4A (Cambridge Branch A) for rehabilitation of Sections 26 and 27 in Cambridge, Somerville, and Charlestown is programmed in the FY19 CIP at a cost of $36.0 million in FY24-29. Rehabilitation details were developed under the Cambridge Branch Sewer Study which evaluated rehabilitation options for Sewer Sections 23 through 28 and 154 and was completed in FY18 at a cost of $687,000. Based on the study recommendations, the scope of work for projects #4A and #4B (below) may be combined and/or revised. Rehabilitation of Sewer Sections 26 and 27 were 2012 Master Plan Interceptor Renewal Project #3.
- Interceptor Renewal/Asset Protection Project #4B (Cambridge Branch B) for rehabilitation of Sections 23 and 24 in Everett is programmed in the FY19 CIP at a cost of $36.0 million in FY26-31. Rehabilitation details were developed under the Cambridge Branch Sewer Study which evaluated rehabilitation options for Sewer Sections 23 through 28 and 154 and was completed in FY18 at a cost of $687,000. Based on the study recommendations, the scope of work for projects #4A (above) and #4B may be combined and/or revised. Rehabilitation of Sewer Sections 23 and 24 were 2012 Master Plan Interceptor Renewal Project #4. Note that Sewer Section 156 was originally included within this project but was accelerated under a separate design/build rehabilitation project completed in FY12.
- Interceptor Renewal/Asset Protection Project #5 for rehabilitation of Sections 607, 609 and 610 in Milton is programmed in the FY19 CIP at a cost of $16.20 million in FY24-28. Rehabilitation of Sewer Sections 607, 609, and 610 were also 2012 Master Plan Interceptor Renewal Project #5.
- Interceptor Renewal/Asset Protection Project #6 for rehabilitation of Sections 12, 14, 15 and 62 in Chelsea is programmed in the FY19 CIP at a cost of $13.2 million in FY25-30. Rehabilitation of Sewer Sections 12, 14, 15 and 62 were also 2012 Master Plan Interceptor Renewal Project #6.
- Interceptor Renewal/Asset Protection Project #7 for rehabilitation Sections 41, 42, 49, 54 and 65 in Malden and Melrose is programmed in the FY19 CIP at a cost of $2.340 million in FY21-26. Study of the hydraulic interactions of the sewers in the Malden and Melrose area will be performed prior to the development of a sewer rehabilitation plan. The current budget for this project will need to be expanded if significant rehabilitation construction is recommended. Rehabilitation of Sewer Sections 41, 42, 49, 54, and 65 were also 2012 Master Plan Interceptor Renewal Project #7.
- A corrosion and odor control project specific to design and construction of three biofilter air treatment systems to remove hydrogen sulfide from the Framingham Extension Sewer/Framingham Extension Relief Sewer (FES/FERS) and Wellesley Extension Sewer Replacement/Wellesley Extension Relief Sewer (WESR/WERS) is programmed in the FY19 CIP at a cost of 3.064 million in FY24-26. Rehabilitation and/or replacement of hydrogen sulfide metering in the sewers is included in this project.
- A System-wide Corrosion and Odor Control Study to evaluate needs and identify solutions for hydrogen sulfide corrosion and odor problems is programmed in the FY19 CIP at a cost of $1.0 million in FY24-26.
- West Roxbury Tunnel Future Inspection to monitor hydrogen sulfide corrosion of concrete is programmed in the FY19 CIP at a cost of $1.0 million in FY24. The West Roxbury Tunnel was inspected in 1999 and again in 2010 with negligible deterioration noted during that timeframe. A determination for future repair/rehabilitation of the tunnel will be made based on the results of future inspections.

Gravity Sewer Asset Protection Projects Recommended for Consideration in Future CIPs:

- Additional construction and construction administration and resident inspection costs likely to be required under Interceptor Renewal/Asset Protection Project #7 for rehabilitation of Sections 41, 42, 49, 54 and 65 in Malden and Melrose is recommended for consideration in future CIPs at an estimated cost of $12.0 million in the FY24-28 timeframe.
- Interceptor Renewal/Asset Protection Project #8 for rehabilitation of Section 30 in Cambridge and Sections 31 and 32 in Charlestown is recommended for consideration in future CIPs at an estimated cost of $10.0 million in the FY24-28 timeframe. Note that Sewer Sections 31 and 32 in Charlestown were originally part of the 2006 Interceptor Renewal/Asset Protection Project #1; however, this project was reduced in scope in the initial planning phase. Sewer Sections 31 and 32 are in close proximity to Sewer Sections 26 and 27 that are included in Interceptor Renewal/Asset Protection Project #4A.
- Interceptor Renewal/Asset Protection Project #9 for rehabilitation of Sections 163 and 164 in Brighton is recommended for consideration in future CIPs at an estimated cost of $12.0 million in the FY29-38 timeframe. Note that Sewer Sections 163 and 164 in Brighton were originally part of the 2006 Interceptor Renewal/Asset Protection Project #2; however, this project was revised.
- Interceptor Renewal/Asset Protection Project #10 for rehabilitation of approximately 24,000 feet of Sections 21, 52, 53, 78, 79, 111, 112 and 189 in Arlington and Medford is recommended for consideration in future CIPs at an estimated cost of $30.0 million in the FY29-38 timeframe.
- Interceptor Renewal/Asset Protection Project #11 for rehabilitation of approximately 7,200 feet of Sections 516, 521, 522, 523, and 524 in Dedham and Hyde Park is recommended for consideration in future CIPs at an estimated cost of $15.0 million in the FY29-38 timeframe.
- Interceptor Renewal/Asset Protection Project #12 for rehabilitation of approximately 700 feet of Section 618 in Norwood is recommended for consideration in future CIPs at an estimated cost of $3.0 million in the FY34-38 timeframe.
- Future Interceptor Renewal/Asset Protection as a long-term CIP placeholder to provide an annual baseline target expenditure of $4.0 million per year for interceptor asset protection is recommended for consideration in future CIPs at an estimated cost of $80.0 million in the FY39-58 timeframe. As specific projects are identified, they will become sub-phases within the target expenditure.
- Wellesley Extension Sewer Replacement (WESR) reevaluation for rehabilitation and/or relining of approximately 29,000 feet of sewer due to deterioration of the existing lining including design and construction is recommended for consideration in future CIPs at an estimated cost of $30.0 million in the FY34-43 timeframe.

9.05 Sewer System Capacity and Optimization Projects

Through approximately the first 30 years of the MWRA (1985-2014), the majority of MWRA’s CIP funds spent on sewer interceptor projects were priorities due to sewer capacity issues identified through hydraulic modeling and facility planning projects and/or identified by sanitary sewer overflows (SSOs) during peak flow conditions associated with large storm events. Sewer capacity issues are generally addressed by constructing new facilities, typically a combination of sewer replacement and relief sewer construction. Many of MWRA’s past projects to increase sewer capacity were originally recommended in the 1976 Wastewater Engineering and Management Plan for Eastern Massachusetts Metropolitan Area (EMMA) Study, individual facility plans for regional interceptors, the 1994 CSO/System Master Plan, etc. A hydraulic modeling project to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Chelsea Creek Headworks to ensure that system capacity was optimized was complete in FY15. Future similar hydraulic studies may be performed for the remainder of the MWRA regional sewer system (these projects are included in the list as recommended for consideration in future CIPs). The 2018 Wastewater System Master Plan does not include recommendations for future large scale capital projects to target capacity/optimization projects related to extreme event SSOs. MWRA believes it is operating the wastewater collection system at maximum efficiency. If future modeling studies identify potential capital projects for additional optimization, then expenditure of future capital resources will be further investigated. Additional current and long-term regulatory issues and potential impacts on MWRA are detailed in Chapter 4. Existing sewer system capacity and optimization studies programmed in the FY19 CIP or recommended for consideration in future CIPs are presented below.

<u>Gravity Sewer Capacity and Optimization Projects Programmed in the FY19 CIP</u>:

- Randolph Trunk Sewer Relief Study is programmed in the FY19 CIP at a cost of $698,000 during FY21-23. The 3-year project will identify potential system improvements to reduce sanitary sewer overflows that occur at MWRA's Sewer Section 628 in the vicinity of the Pearl Street Siphon during extreme storm events.
- Wastewater Process Optimization - North System Additional Hydraulic Engineering Analysis and Design/Construction is programmed in the FY19 CIP at a cost of $7.442 million during FY24-31. This project may follow-up on recommendations from the North System Hydraulic Capacity Study for optimization projects in the North System tributary to Chelsea Creek Headworks.
- A System Relief and Contingency Planning Study is programmed in the FY19 CIP at a cost of $500,000 during FY21-24. Prolonged operational problems at pump stations and CSO facilities could potentially result in upstream sewer surcharging. This project will review the emergency response plans and the hydraulics associated with sewer surcharging that may be caused by prolonged facility downtime and/or emergency scenarios within the collection system. One aspect of this project will be hydraulic modeling to determine the impact of prolonged operations problems (facility downtime, reduced pumping, loss of screens, etc.). The analysis would identify critical upstream SSO or back-up locations and elevations and the duration of reduced facility capacity that may result in an SSO at various (higher and lower) wastewater flow rates. Projects that may provide emergency system relief to minimize a diminished level of sewer service would be recommended.
- Wastewater Process Optimization - Somerville/Medford Branch Sewer and North Met Sewer Diversion study, design, and construction is programmed in the FY19 CIP at a cost of $1.362 million during FY23-25. This project will evaluate the feasibility and hydraulic optimization benefits of construction of a connection between the upstream end of the Somerville/Medford Branch Sewer and the North Metropolitan Relief Sewer to reduce surcharge and divert flow away from the Cambridge Branch Sewer and DeLauri Pump Station.

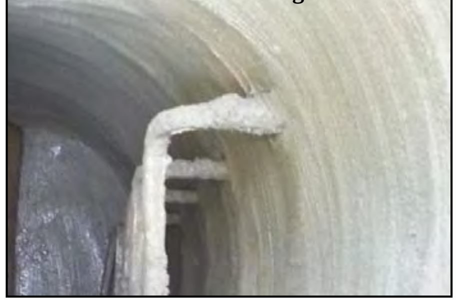
Gravity Sewer Capacity and Optimization Projects Recommended for Consideration in Future CIPs:

- Wastewater Process Optimization – Winthrop Terminal System Hydraulic Capacity Study to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Winthrop Terminal Headworks and to determine the feasibility of increasing and/or optimizing system capacity is recommended for consideration in future CIPs at an estimated cost of $500,000 during FY24-28.
- Wastewater Process Optimization – Charles River System Hydraulic Capacity Study to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Ward Street and Columbus Park Headworks and to determine the feasibility of increasing and/or optimizing system capacity is recommended for consideration in future CIPs at an estimated cost of $1.0 million during FY24-28.
- Wastewater Process Optimization - South System Hydraulic Capacity Study to evaluate the tributary flows and hydraulic capacity of the South Sewer System tributary to Nut Island Headworks and to determine the feasibility of increasing and/or optimizing system capacity is recommended for consideration in future CIPs at an estimated cost of $1.0 million during FY24-28.
- Neponset Valley Sewer (Sections 515-526 in the South System) Capacity Relief planning, design, and construction project is recommended for consideration in future CIPs at an estimated cost of $15.0 million during the FY39-43 timeframe. This project was initially recommended in the 1994 Final CSO Conceptual Plan and System Master Plan. The 3-mile long Neponset Valley Sewer was constructed during 1895-1898. The overall benefits and priority of this project may be further defined during the South System Hydraulic Capacity Study.
- Ashland Extension Sewer Capacity Relief planning and design project is recommended for consideration in future CIPs at an estimated cost of $1.0 million during the FY39-43 timeframe. The project is recommended to identify the feasibility of extending the Framingham Relief Sewer to Ashland. The overall benefits and priority of this project may be further defined during the South System Hydraulic Capacity Study.

9.06 Gravity Sewer Manholes and Related Structures

Sewer manholes are generally constructed on gravity sewers approximately every 300 feet to provide access to the sewer pipeline. Manholes are also commonly constructed at each change in direction and slope. Other related structures (sometimes called special structures) found in the MWRA collection system include grit chambers (for collection of grit/debris), flow diversion chambers, regulators to direct flow to various pipes or outfalls, and tide gate chambers. MWRA's collection system contains about 4,000 manholes and other related structures. Siphons and siphon headhouse structures are discussed in Section 9.07. CSO and emergency outfalls are discussed in Section 9.09. Manholes and related structures require scheduled maintenance activities similar to other components of the collection system. The Technical Inspection Unit performs visual inspections of manholes/structures and assigns structural and infiltration ratings and maintains an inspection log and photo database. Each manhole or structure is scheduled for maintenance, rehabilitation, or re-inspection depending on its structural and infiltration rating. Replacement of manhole frames and covers and structural rehabilitation are prioritized and scheduled through MWRA's MAXIMO maintenance work order system. Funding for manhole and structure repairs has generally been through MWRA's annual current expense budget (CEB). MWRA has been targeting the rehabilitation of approximately 50 to 75 manholes each year through the expenditure of CEB funds. In addition, manholes and structures along the route of sewer rehabilitation projects are reviewed and rehabilitated, as appropriate, within each project.

Manhole Rehabilitation in Cement Mortar Lining



For FY16, MWRA's manhole rehabilitation project produced a low bid cost of $204,000 for internal rehabilitation (via cement mortar lining) of 55 manholes, a cost of approximately $3,700 per manhole. For FY17, MWRA's manhole rehabilitation project produced a low bid cost of $190,000 for internal rehabilitation (via cement mortar lining) of 43 manholes, a cost of approximately $4,400 per manhole. For FY18, MWRA's manhole rehabilitation project produced a low bid cost of $330,000 for internal rehabilitation (via cement mortar lining) of 76 manholes, a cost of approximately $4,350 per manhole. Staff recommend MWRA continue to target long-term manhole rehabilitation via expenditure of approximately $300,000 per year for rehabilitation of 50 to 75 manholes per year (based on condition priority ranking) which will ultimately result in upgrade/rehabilitation of all 4,000 manholes/structures (100 percent of the system) over 50 to 75 years. In practice the overall timeline will be shorter because many manholes/structures will be rehabilitated within interceptor renewal capital projects.

Future manhole and special structure rehabilitation planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change. It is likely that future manhole rehabilitation projects will continue to be funded through the annual CEB rather than as CIP projects. For Master Plan purposes, an Annual Manhole and Special Structure Rehabilitation project is recommended for consideration in future CIPs at a cost of $300,000 per year (based on estimate of $4,500 per manhole at 65 manholes per year) for a total estimated cost of $12.0 million for the 40-year FY19-58 timeframe. The Woburn Sand Catcher is a special structure that requires considerable maintenance; a specific project to improve debris removal from this structure is also recommended.

<u>Manhole and Structure Projects Recommended for Consideration in Future CIPs:</u>

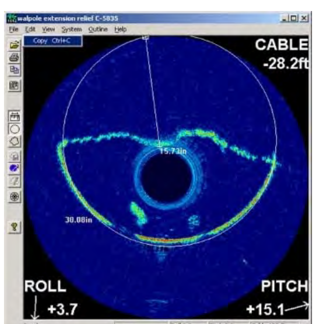
- An Annual Manhole and Special Structure Rehabilitation project is recommended for consideration in future CIPs at a cost of $300,000 per year for a total cost of $12.0 million for the 40-year FY19-58 timeframe. Due to the annual need and relative low cost of this project, it is a candidate for CEB funding. Facilities planning for manhole and structure rehabilitation should consider potential increases in flood elevations and tidal surge due to impacts from climate change.
- A design and construction project to rehabilitate/upgrade the Woburn Sandcatcher is recommended for consideration in future CIPs at an estimated cost of $1.0 million for the FY24-28 timeframe. The project will optimize flow through the division structure, provide appropriate access for system maintenance, and improve debris removal. In-house planning and preliminary design may be required prior to implementation of this project.

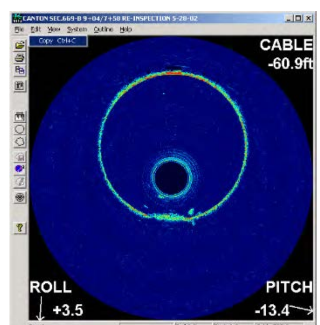
9.07 Siphons and Siphon Headhouse Structures

Sewer siphons, more appropriately know as inverted siphons and also called depressed sewers, are gravity sewers designed to dip under an obstruction, such as a river, subway, conduit, etc. A siphon is always full of water under pressure below the hydraulic grade line of the sewer. Sewer siphons are constructed with special inlet and outlet chambers (headhouses) to facilitate hydraulic control and cleaning. Siphons may have one, two or multiple barrels, and flow is sometimes diverted into one barrel in order to obtain cleaning velocities in the pipe. Preventative maintenance for siphons is a priority for any collection system due to the likelihood of debris and grease build-up that can lead to pipeline blockages and SSOs. The MWRA collection system has 7 miles of siphons including more than 100 separate siphon barrels. Siphons account for about three percent of MWRA's wastewater collection system pipelines. Key information on MWRA siphons is provided in Table 9-3. A sample siphon design drawing is shown in Figure 9-8.

MWRA's operation and maintenance practices for siphons rely in large part on use of sonar scanner inspection equipment. The sonar camera provides a video image of the pipe profile without need to dewater the siphon. This equipment is used as part of a prioritized O&M program to identify debris/grease build-up and pipe defects in all MWRA siphons. Follow-up maintenance and re-inspection are scheduled based on the results of sonar inspections.

The photos below are images from the sonar camera. The left side photo is a siphon barrel with grease build-up on the top of the pipeline. The right side photo shows the same siphon barrel with the sonar image of the full circular pipeline after the grease build-up has been successfully removed.





Based on recent inspections, all of MWRA's siphons are in good condition. No siphon rehabilitation or replacement projects are recommended based on poor physical condition or specific physical defects. As a budget placeholder for long-term planning, a siphon asset protection project is recommended for future years. An additional project specific to Sewer Section 623, the Braintree/Weymouth Interceptor siphon under the Fore River, is also recommended. This project was previously a component of the Braintree/Weymouth Project and will provide sliplining design and construction to reduce the size of one of the existing 1,700-foot long twin 60-inch diameter siphon barrels by inserting a smaller diameter liner into one of the existing siphon barrels. Reduction in siphon size is recommended due to the rerouting of significant flows to the Intermediate Pump Station.

TABLE 9-3
MWRA Siphons

Name	Section #	Community	Material	Approximate Equivalent Diameter (in)	Year Built	Number of Barrels	Length of Longest Barrel (ft)	Total Length of Barrels (ft)
Alewife Brook Conduit	176	Medford	RC	60-66	1948	1	223	223
Alewife Brook Conduit	177	Arlington/Cambridge	RC	60-72	1948	1	553	553
Alewife Brook Conduit	178	Cambridge	RC	48	1948	1	224	224
Alewife Brook Conduit	179	Cambridge	RC	36	1948	1	152	152
Belmont Relief Sewer	081	Cambridge	CI	15	1927	3	23	66
Boston Marginal Conduit	222	Boston Main	PIPC, CI	60-86	1910	2	113	225
Braintree-Weymouth Interceptor	623	Quincy/Weymouth	DI/RC	60-120	1982	2	1706	3410
Braintree-Weymouth Interceptor	625	Weymouth	CI	48	1933	1	1597	1597
Braintree-Weymouth Interceptor	625	Braintree/Weymouth	CI	36	1933	1	743	743
Braintree-Weymouth Interceptor Emergency Mill Cove Relief Siphon	624	Weymouth	PL/PIPC	37-42	1998	1	1948	1948
Cambridge Marginal Conduit	229	Cambridge	CI	48	1910	2	202	402
Charles River Marginal Conduit	216	Boston	RC	36-84	1979	1	516	516
Charles River Marginal Conduit	217	Boston Main	RC	84	1979	1	396	396
Chelsea Creek Siphon	101	Chelsea/East Boston	PIPC	60	1942	2	925	1836
Dedham Branch Sewer	532	Canton/Dedham	CI	12	1950	2	110	219
DeLauri Pump Station	025	Charlestown	PIPC/RC	60-120	1895/1989	2	725	779
East Boston Branch Sewer Relief Project	256	East Boston	Brick, DI, RC	10-26	2010	2	167	344
Fore River Siphon	640	Weymouth	HDPE-ST,	36	2002	2	3680	7351
Framingham Extension Relief Sewer	678	Dover/Wellesley	PIPC	24	1999	2	195	389
Framingham Trunk Interceptor, Framingham Extension Sewer	632	Natick	RC	24	2002	2	227	453
Framingham Trunk Interceptor, Framingham Extension Sewer	634	Natick	RC	24	1954	2	55	109
High Level Sewer	564	Hyde Park/Milton	CI	60	1902	3	167	491
Metropolitan Sewer	059	Melrose	PIPC, CI	50-68	1901	2	95	189
Metropolitan Sewer	150	Winchester	Brick/VC	20-40	1894	1	57	57
Metropolitan Sewer	155	Medford/Somerville	Brick/CI	24-40	1894	1	99	99
Metropolitan Sewer, Cambridge Branch Sewer/DeLauri PS	025	Charlestown	Brick	60	1895	1	1106	1106
Metropolitan Sewer, Cummingsville Branch Sewer	047	Winchester	VC	15-20	1894	1	46	46
Metropolitan Sewer, New Malden River Siphon	019	Everett/Medford	Brick	48	1916	1	346	346
Millbrook Valley Relief Sewer	152	Arlington/Medford	RC	33-54	1966	2	576	1152
Millbrook Valley Sewer	078	Arlington/Medford	CI	15-34	1926	2	186	371
Millbrook Valley Sewer	084	Lexington	VC	12-22	1948	3	118	346
Mystic Valley Sewer	160	Winchester	CI	20	1878/1950	1	204	204
Neponset Valley Relief Sewer	531	Hyde Park/Milton	CI	30	1935	2	153	306
Neponset Valley Sewer	243	Dorchester/Milton	DI	8	1972	2	157	313
Neponset Valley Sewer	245	Dorchester/Milton	CI	8	1963	2	153	306
New Mystic Valley Sewer	067	Winchester	CI	54	1937	1	70	70
New Mystic Valley Sewer	069	Winchester	CI	20-30	1913	2	65	130
New Mystic Valley Sewer	109	Medford	CI, PIPC	48-66	1929	2	76	150
North Metro Relief Sewer	105	Everett/Medford	RC	60-92	1940	2	436	872
North Metro Relief Sewer	107	Medford	CI	54	1938	3	263	768
North Metro Relief Sewer	113	Winchester	CI, PIPC	36-56	1937	2	118	236
North Metro Relief Sewer	158	Medford	CI	54	1942	3	366	1089
North Metropolitan Trunk Sewer, Belle Isle Inlet	007	East Boston/Winthrop	PIPC	58	1895	3	237	705
Randolph Trunk Sewer	626	Braintree/Weymouth	RC	18-30	1973	3	86	256
Randolph Trunk Sewer	628	Braintree	RC	24	1972	2	58	115
Randolph Trunk Sewer	655	Braintree/Randolph	RC	15-28	1972	2	87	174
Walpole Ext Relief Sewer	669	Norwood	DI	30	1992	1	114	114
Walpole Ext Relief Sewer	669	Canton/Norwood	DI	30	1992	1	144	144
Walpole Extension Sewer	616	Canton/Norwood	CI	36	1931	1	103	103
Walpole Extension Sewer	617	Norwood	CI	36	1931	1	104	104
Walpole Extension Sewer	618	Norwood	CI/RC	18-30	1957	2	139	278
Watertown Coll System Improvements, East End Replacement Siphon	211	Brighton/Watertown	DI/RC	12-15	1984	2	255	504
Wellesley Ext Relief Sewer	629	Dedham/Needham	RC	36-60	1956	2	208	378
Wellesley Ext Relief Sewer	630	Dover/Needham	RC	24	1952	2	430	859
Wellesley Ext Sewer Replacement	666	Dedham/Needham	DI/RC	24-84	1990	3	249	498
Wellesley Ext Sewer Replacement	668	Dover/Wellesley	PIPC	36-60	1989	3	130	378
Wellesley Extension Sewer	601	Dedham/Needham	CI	12	1921	2	161	322
Westwood Interceptor, Westwood Extension Sewer	635	Canton/Westwood	RC	12-24	1961	3	321	961

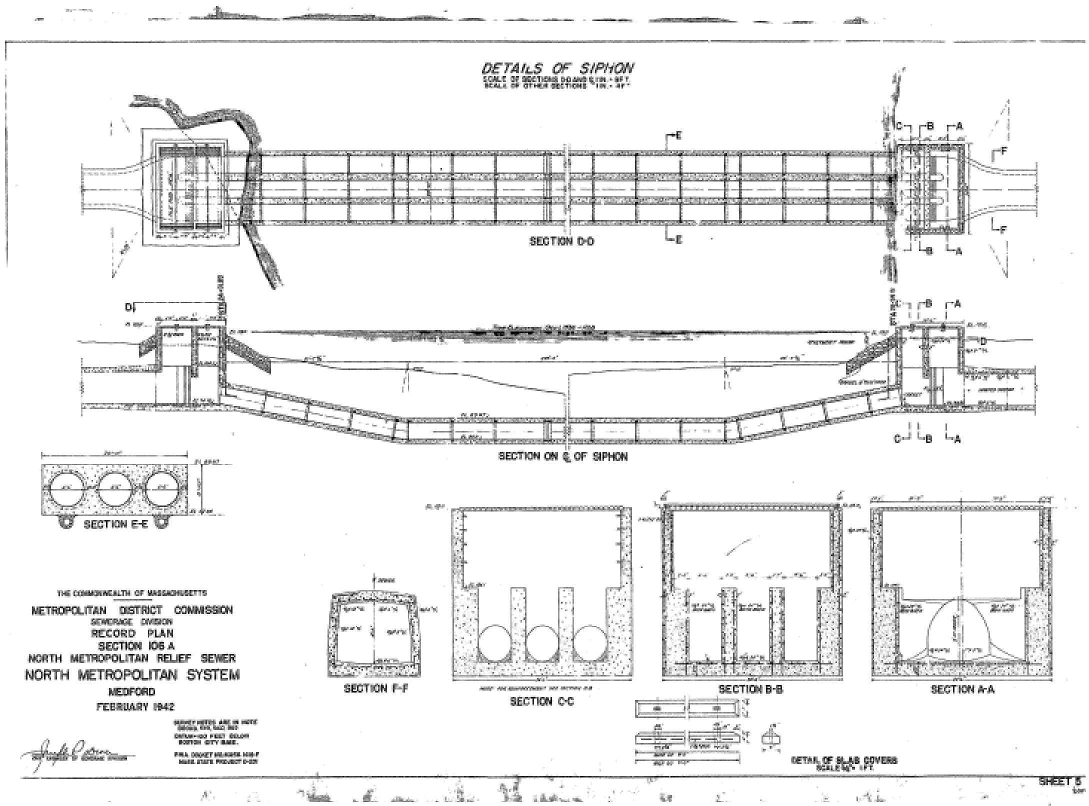


FIGURE 9-8 Example of a three-barrel siphon

Inspection and maintenance of siphon headhouse structures is a regular part of MWRA's scheduled maintenance practices. Both the physical condition and access to the siphon headhouse structures has been a concern for many years. In 1996, MWRA developed a comprehensive report (Siphon Chamber and Connecting Structures Inspection Summary Report) that provided documented results and recommendations from inspection of 146 siphon chambers and connecting structures in the MWRA collection system. A project to design and construct improvements to siphon headhouse structures, based on the report recommendations, continues to be recommended by MWRA staff. The project will address capacity issues, detention time/odor issues, structural repairs, flow diversion using stop planks, structure accessibility, and easements issues. Phase 1 of the siphon structure rehabilitation project is programmed in the FY19 CIP, phases 2 and 3 are recommended for consideration in future CIPs.

<u>Siphon and Siphon Headhouse Projects Programmed in the FY19 CIP</u>:

- Braintree/Weymouth Relief Facilities Mill Cove Siphon Sluice Gates design and construction to allow staff to remotely flush out the siphon and reduce odors is programmed in the FY19 CIP at a total project cost of $2.813 million in FY24-27.

- Siphon Structure Rehabilitation Phase 1 for land acquisition, design, engineering services during construction, resident inspection, and construction of the most critical recommended improvements to a portion of MWRA's siphons and siphon headhouses is programmed in the FY19 CIP at a cost of $5.230 million during FY19-23. This project will include hydraulic capacity review, structural repairs of deteriorated conditions, stop plank construction, installation of new covers and/or appropriate access structures, and procurement of legal access easements and land acquisition to allow for proper maintenance. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change.

<u>Siphon and Siphon Headhouse Projects Recommended for Consideration in Future CIPs:</u>

- Phase 2 Siphon Structure Rehabilitation design and construction project is recommended for consideration in future CIPs at an estimated cost of $6.0 million during the FY24-28 timeframe to make additional improvements (following Phase 1) to siphon headhouses and/or diversion structures. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change.
- Phase 3 Siphon Structure Rehabilitation design and construction project is recommended for consideration in future CIPs at an estimated cost of $6.0 million during the FY29-33 timeframe to make additional improvements (following Phase 2) to siphon headhouses and/or diversion structures. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change.
- Sliplining design and construction of Section 623 Braintree/Weymouth Interceptor siphon under the Fore River to reduce the size of one of the existing 1,700-foot long twin 60-inch siphon barrels by inserting a smaller diameter liner into the existing siphon is recommended for consideration in future CIPs at an estimated cost of $8.0 million in the FY24-28. Reduction in size is recommended due to the rerouting of significant flows to the Intermediate Pump Station.
- A future siphon upgrade design and construction project just upstream of the DeLauri Pump Station (Cambridge Branch Sewer to the DeLauri Pump Station) is recommended for consideration for future CIPs at an estimated cost of $25.0 million during the FY29-33 timeframe to provide a placeholder for design/construction funds for this single barrel siphon located at a critical location.
- A Siphon Asset Protection project is recommended for consideration in future CIPs to provide an estimated $5.0 million placeholder for possible recommendations from the ongoing in-house siphon inspection and maintenance program. This project is recommended for the FY34-38 timeframe.

9.08 Force Mains and Related Valves

Sewer force mains are the discharge piping from sewer pump stations that convey wastewater under pressure to a downstream gravity sewer or, at pumped CSO facilities, they convey treated CSO to a receiving water. There are approximately 18 miles of force main piping in the MWRA collection system, accounting for about seven percent of wastewater collection system pipelines. Approximately 15.5 miles of force main are located outside the facilities they serve. The remaining 2.5 miles of force main piping is integral to the individual facilities. Key information on MWRA force mains is provided in Table 9-4.

MWRA has historically evaluated force mains for replacement/rehabilitation as an integral part of larger pump station replacement or rehabilitation projects. However, two force main rehabilitation projects demonstrate the need for asset protection planning specifically for MWRA's force mains.

- Work in 2004 under the Mill Brook Valley Relief Sewer Rehabilitation project - MWRA Section 172 (MDC Section 93A), led to the identification that the upstream force main, MWRA Section 173 in Lexington (MDC Section 93AFM), also required replacement due to hydrogen sulfide corrosion. In FY07, 1100 feet of 24-inch force main on Section 173 was replaced.

- In April 2010, an emergency repair project was required after failure of a 50-foot section of the Squantum Pump Station force main caused by internal hydrogen sulfide corrosion at a high point in the force main. The repair was made by installing 375 linear feet of cured-in-place-pipe liner inside the 30-inch diameter pre-stressed concrete cylinder pipe portion of the force main.

An in-house task is recommended to review the performance of MWRA's force mains and evaluate age and material related factors. This analysis may help predict force mains susceptible to failure. A force main asset protection project to evaluate the need for force main rehabilitation and prioritize sections for rehabilitation is recommended for consideration in future CIPs. Future evaluation and planning (and design/construction if needed) for replacement of the Squantum Pump Station force main should be a priority under this project.

Air relief valves are an important part of force mains designed to release air that enters or is trapped in the pipe. Because flowing water is subject to changing pressure and velocities, air is continuously coming out of solution when the force main is in service. Air relief valves are located at high points in a force main where air will accumulate. Serious flow restrictions or even blockage can result from air pockets that form in a force main. Also, air pockets can contain corrosive vapors and must be vented to reduce pipeline deterioration. Vacuum relief valves are equally important in force mains. These valves allow air to enter the force main if a vacuum condition occurs during situations such as pump startup, rapid shutdown, or sudden valve closure. Operational problems at air relief valves can lead to SSOs as demonstrated by a minor SSO that occurred in January 2016 at a malfunctioning air relief valve on the Hingham force main on Route 3A in Weymouth. MWRA's air relief and vacuum valves and other force main related components should be reviewed to evaluate performance and O&M policies. Recommendations from this project may require a follow-up CIP project, a place holder is recommended below.

<u>Force Main and Related Valve Projects Recommended for Consideration in Future CIPs:</u>

- A Force Main Asset Protection Project is recommended to provide a place holder for additional rehabilitation of the Squantum Force Main, as well as future recommendations from an in-house force main and related structure evaluation. This project is estimated at $20.0 million with a 20-year duration in the FY24-43 timeframe. It is likely that the majority of force main rehabilitation or replacement construction will continue to be performed as part of larger pump station replacement projects (see Chapter 10).

TABLE 9-4

MWRA Force Mains

Facility/Location	Section	Size	Material*	Length (ft)	Date
Alewife Brook Pump Station/Somerville Pump #4	155	24-inch	CI	168	1948
Alewife Brook Pump Station/Somerville Pump #1, 2, 3	176	66-inch	RC	670	1948
Braintree/Weymouth Replacement Pump Station/Quincy	622	36-inch	DI	34	2007
Caruso Pump Station/East Boston	223	84-inch	RC	227	1985
DeLauri Pump Station/Charlestown	25	60-inch	PIPC	285	1989
Framingham Pump Station/Framingham Force Main extends into Natick	677	36-inch	PCCP	23,660	1999
Hayes Pump Station/Wakefield	205	20-inch	DI	2,330	1984
Hingham Pump Station/Hingham-Weymouth Force Main extends into Weymouth	661/662	20-inch	DI	7,921	1984/1990
Hough's Neck Pump Station/Quincy	588	10-inch	DI	43	1998
Intermediate Pump Station (IPS)/North Weymouth	642A	42-inch	DI	152	2000
Millbrook Valley Relief Sewer/Lexington	173	24-inch	DI	4,894	1967/2007
New Neponset Valley Sewer Pump Station/Canton Force Main extends into Milton	675/676	48-inch	DI	21,409	1992
North Dorchester Bay CSO Storage and Pump Facilities/North Dorchester	259/259A	24-inch	DI	4,000	2011
Prison Point Pump Station and Pumped CSO Facility/Cambridge	198 (dry weather)	18-inch	RC/DI	1,934	1974-1977
	199 (wet weather)	96-inch	RC/DI	2,193	1973-1974
Quincy Pump Station/Quincy	660	30-inch	CI - cement lined 1999	2,754	1923/1999
Squantum Pump Station/Quincy	659	24-inch	DI - CIPP lined 1995	4,582	1969/1995
	659A	30-inch	DI - cement lined 1999	8,115	1969-1970/1999
	659B	30-inch	PCCP	6,307	1970/2010
Union Park CSO Facility/Boston		10-inch	DI	22	2007
Wiggins-Castle Island Terminal Pump Station/Boston	252	8-inch		265	1943/1960

*Notes for materials: CI - cast iron; CIPP - cured-in-place pipe; DI - ductile iron; PCCP - prestressed concrete cylinder pipe; PIPC - poured-in-place conrete pipe; RC - reinforced concrete

9.09 CSO and Nut Island Emergency Outfalls

Some of MWRA's member communities' wastewater collection systems were originally constructed and continue to serve as combined sewers that receive both sanitary flow and stormwater in portions of Boston, Brookline, Cambridge, Chelsea, and Somerville. During larger storm events, wasteweater flow may increase beyond the conveyance capacity of community or MWRA interceptors. Under these conditions, excess wastewater flow may be released to a nearby receiving water via CSO outfalls. MWRA owns and operates some CSO outfalls, while the communities own and operate others. Each MWRA-owned CSO outfall has a specific designation number beginning with "MWR". Some CSO outfalls are downstream of CSO treatment facilities, others discharge untreated CSO. In addition to CSO outfalls, MWRA owns and operates three emergency outfalls at the Nut Island Headworks that can be activated to discharge wastewater to Quincy Bay. Outfalls at the Deer Island Treatment Plant are discussed in Chapter 6.

The MWRA collection system includes 12 CSO and 3 Nut Island emergency outfalls. The total length of these outfall pipes is four miles, accounting for about one percent of wastewater collection system pipelines. Key information on CSO and Nut Island emergency outfalls is provided in Table 9-5. Under MWRA's CSO Control Plan (see Chapter 11), some of the MWRA-owned CSO outfalls have been closed and some remain active. The Nut Island outfalls will remain active for emergency purposes. The Nut Island outfalls were most recently inspected in January 2016 and found to be in adequate condition. A future inspection project is recommended and should also include inspection of all MWRA CSO outfalls. In addition to the recommended future project, one CSO outfall project (Outfall MWR023 Structural Improvements) is programmed in the FY19 CIP. MWRA performed a prior project to clean Outfall MWR023 from the MDC Gatehouse at Charlesgate (in the Fenway area of Boston) to the Charles River. The second portion of the project is to perform structural repairs to Outfall MWR023 during FY24-26.

Outfall Projects Programmed in the FY19 CIP:

- Outfall MWR023 Structural Improvements for future cleaning access and flow diversion is programmed in the FY19 CIP at a cost of $1.5 million in FY24-26. Outfall 023 is at the end of the BWSC Stony Brook Conduit at the Charlesgate gatehouse.

Outfall Projects Recommended for Consideration in Future CIPs:

- A future Outfall Inspection/Assessment Project to provide inspection information and make recommendations for cleaning and/or asset protection repairs for all MWRA CSO and Nut Island emergency outfalls is recommended for consideration in future CIPs at an estimated cost of $2.0 million in the FY24-28 timeframe.

TABLE 9-5
MWRA CSO and Nut Island Emergency Outfalls

Outfall	Section	Facility/Interceptor	Active/Closed	Approx Diameter (ft)	Length (ft)	Material	Year	Receiving Water
NI Emergency	543	NI Headworks	Active	5	5,275	Cast Iron	1904	Quincy Bay
NI Emergency	543-A	NI Headworks	Active	5	5,545	Cast Iron	1904	Quincy Bay
NI Emergency	543-B	NI Headworks	Active	5	1,395	Cast Iron	1914	Quincy Bay
MWR003	176	Alewife Brook Conduit	Active	5	117	Concrete	1950	Alewife Brook
MWR010	190-D	Charles River Valley Sewer	Active	7.5	162	Reinforced Concrete	1948	Lower Charles
MWR018	222-D	Boston Marginal Conduit	Active	6	123	Concrete	1910	Lower Charles
MWR019	222-E	Boston Marginal Conduit	Active	6.5	298	Concrete	1910	Lower Charles
MWR020	222-F	Boston Marginal Conduit	Active	8	378	Concrete	1910	Lower Charles
MWR021	222-G	Boston Marginal Conduit	Closed 3/00	6	207	Concrete	1910	Lower Charles
MWR022	222-H	Boston Marginal Conduit	Closed 3/00	6	387	Concrete	1910	Lower Charles
MWR023	222-A	BWSC Stony Brook Conduit	Active	7	270	Concrete	1910	Lower Charles
MWR201	180-Z	Cottage Farm	Active	6	149	Reinforced Concrete	1967	Upper Charles
MWR203	199-A	Prison Point	Active	6	32	Reinforced Concrete	1973	Lower Charles
MWR205	230-A	Somerville Marginal Below Dam	Active	7	100	Reinforced Concrete	1971	Upper Mystic
MWR205A	230	Somerville Marginal Above Dam	Active	7	200	Concrete	1971	Upper Mystic

9.10 SCADA and Wastewater Metering System

Supervisory Control and Data Acquisition (SCADA) systems provide a means of monitoring and controlling facilities and equipment from a remote centralized location, as well as providing a continuous record of facility operations. The wastewater metering system, comprised of over 200 metering devices, provides data for community flow-based rate assessments, hydraulic modeling, engineering studies, infiltration/inflow estimates, and operations support. Both the SCADA and Wastewater Metering Systems, as well as related existing and future CIP projects, are detailed in Chapter 12.

9.11 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to collection system sewers are summarized in this Section. Table 9-6 lists each project, its priority ranking, and the proposed expenditure schedule. A description of each project is listed in bullet format. This Section is provided as a summary of all existing and recommended capital projects; each project has been detailed previously in the Chapter within Sections relating to specific facilities or asset types.

Projects Programmed in the Existing FY19 CIP: There are eighteen collection system sewer related projects programmed in the FY19 CIP. The projects are described below and summarized in Table 9-6 (see line numbers 9.1 through 9.18).

- Interceptor Renewal/Asset Protection Project #1 for rehabilitation of approximately 14,700 feet of Sections 46, 73, 74, and 75 is programmed in the FY19 CIP at a total project cost of $3.205 million during FY16-20. Expenditures during the planning period (FY19-20) are $938,000. The project includes portions of the Reading Extension Sewer and Metropolitan Sewer located mostly in Stoneham with short stretches in Reading and Woburn.

- Interceptor Renewal/Asset Protection Project #2 for rehabilitation construction of Sections 186, 4, 5, and 6 on the North Metropolitan Sewer in Winthrop and Deer Island is programmed in the FY19 CIP at a total cost of $10.244 million in FY17-24. Expenditures during the planning period (FY19-24) are $9.144 million.

- Interceptor Renewal/Asset Protection Project #3 for rehabilitation of Sewer Sections 240, 241 and 242 in Dorchester (Dorchester Interceptor) is programmed in the FY19 CIP at a total project cost of $7.076 million during FY17-22. Expenditures during the planning period (FY19-22) are $6.634 million.

- Interceptor Renewal/Asset Protection Project #4A (Cambridge Branch 1) for rehabilitation of Sections 26 and 27 in Cambridge, Somerville, and Charlestown is programmed in the FY19 CIP at a cost of $36.0 million in FY24-29. Rehabilitation details were developed under the Cambridge Branch Sewer Study Project which was completed in FY18.

- Interceptor Renewal/Asset Protection Project #4B (Cambridge Branch 2) for rehabilitation of Sections 23 and 24 in Everett is programmed in the FY19 CIP at a cost of $36.0 million in FY26-31. Rehabilitation details were developed under the Cambridge Branch Sewer Study Project which was completed in FY18.

- Interceptor Renewal/Asset Protection Project #5 for rehabilitation of Sections 607, 609 and 610 in Milton is programmed in the FY19 CIP at a cost of $16.20 million in FY24-28.

- Interceptor Renewal/Asset Protection Project #6 for rehabilitation of Sections 12, 14, 15 and 62 in Chelsea is programmed in the FY19 CIP at a cost of $13.2 million in FY25-30.

- Interceptor Renewal/Asset Protection Project #7 for rehabilitation Sections 41, 42, 49, 54 and 65 in Malden and Melrose is programmed in the FY19 CIP at a cost of $2.340 million in FY21-26. Study of the hydraulic interactions of the sewers in the Malden and Melrose area will be performed prior to the development of a sewer rehabilitation plan. The current budget for this project will need to be expanded if significant rehabilitation construction is recommended.

- A corrosion and odor control project specific to design and construction of three bio-filter air treatment systems to remove hydrogen sulfide from the Framingham Extension Sewer/Framingham Extension Relief Sewer (FES/FERS) and Wellesley Extension Sewer Replacement/Wellesley Extension Relief Sewer (WESR/WERS) is programmed in the FY19 CIP at a cost of $3.064 million in FY24-26. Rehabilitation and/or replacement of hydrogen sulfide metering in the sewers is included in this project.

- A System-wide Corrosion and Odor Control Study to evaluate needs and identify solutions for hydrogen sulfide corrosion and odor problems is programmed in the FY19 CIP at a cost of $1.0 million in FY24-26.

- West Roxbury Tunnel Future Inspection to monitor hydrogen sulfide corrosion of concrete is programmed in the FY19 CIP at a cost of $1.0 million in FY24. The West Roxbury Tunnel was inspected in 1999 and again in 2010 with negligible deterioration noted during that timeframe.

- Randolph Trunk Sewer Relief Study is programmed in the FY19 CIP at a cost of $698,000 during FY21-23. The 3-year project will identify potential system improvements to reduce sanitary sewer overflows that occur at MWRA’s Sewer Section 628 in the vicinity of the Pearl Street Siphon during extreme storm events.

- Wastewater Process Optimization - North System Additional Hydraulic Engineering Analysis and Design/Construction is programmed in the FY19 CIP at a cost of $7.442 million during FY24-31. This project may follow-up on the North System Hydraulic Capacity Study for optimization projects tributary to Chelsea Creek Headworks.

- A System Relief and Contingency Planning Study is programmed in the FY19 CIP at a cost of $500,000 during FY21-24. Prolonged operational problems at pump stations and CSO facilities could potentially result in upstream sewer surcharging. This project will review the emergency response plans and the hydraulics associated with sewer surcharging that may be caused by prolonged facility downtime and/or emergency scenarios within the collection system.

- Wastewater Process Optimization - Somerville/Medford Branch Sewer and North Met Sewer Diversion study, design, and construction is programmed in the FY19 CIP at a cost of $1.362 million during FY23-25. This project will evaluate the feasibility and hydraulic optimization benefits of construction of a connection between the upstream end of the Somerville/Medford Branch Sewer and the North Metropolitan Relief Sewer to reduce surcharge and divert flow away from the Cambridge Branch Sewer and DeLauri Pump Station.

- Braintree/Weymouth Relief Facilities Mill Cove Siphon Sluice Gates design and construction to allow staff to flush out the siphon and reduce odors is programmed in the FY19 CIP at a total project cost of $2.813 million in FY24-27.

- Siphon Structure Rehabilitation Phase 1 for land acquisition, design, engineering services during construction, resident inspection, and construction of the most critical recommended improvements to a portion of MWRA's siphons and siphon headhouses is programmed in the FY19 CIP at a cost of $5.230 million during FY19-23. This project will include hydraulic capacity review, structural repairs of deteriorated conditions, stop plank construction, installation of new covers and/or appropriate access structures, and procurement of legal access easements and land acquisition to allow for proper maintenance. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change.

- Outfall MWR023 Structural Improvements for future cleaning access and flow diversion is programmed in the FY19 CIP at a cost of $1.5 million in FY24-26. Outfall 023 is at the end of the BWSC Stony Brook Conduit at the Charlesgate gatehouse.

<u>Projects Recommended for Consideration in Future CIPs</u>: There are twenty-two collection system sewer related projects recommended for consideration in future CIPs. These projects are described below and summarized in Table 9-6 (see line numbers 9.19 through 9.40).

- Additional construction and construction administration and resident inspection costs likely to be required under Interceptor Renewal/Asset Protection Project #7 for rehabilitation of Sections 41, 42, 49, 54 and 65 in Malden and Melrose is recommended for consideration in future CIPs at an estimated cost of $12.0 million in the FY24-28 timeframe.

- Interceptor Renewal/Asset Protection Project #8 for rehabilitation of Section 30 in Cambridge and Sections 31 and 32 in Charlestown is recommended for consideration in future CIPs at an estimated cost of $10.0 million in the FY24-28 timeframe.

- Interceptor Renewal/Asset Protection Project #9 for rehabilitation of Sections 163 and 164 in Brighton is recommended for consideration in future CIPs at an estimated cost of $12.0 million in the FY29-38 timeframe.

- Interceptor Renewal/Asset Protection Project #10 for rehabilitation of approximately 24,000 feet of Sections 21, 52, 53, 78, 79, 111, 112 and 189 in Arlington and Medford is recommended for consideration in future CIPs at an estimated cost of $30.0 million in the FY29-38 timeframe.

- Interceptor Renewal/Asset Protection Project #11 for rehabilitation of approximately 7,200 feet of Sections 516, 521, 522, 523, and 524 in Dedham and Hyde Park is recommended for consideration in future CIPs at an estimated cost of $15.0 million in the FY29-38 timeframe.

- Interceptor Renewal/Asset Protection Project #12 for rehabilitation of approximately 700 feet of Section 618 in Norwood is recommended for consideration in future CIPs at an estimated cost of $3.0 million in the FY34-38 timeframe.

- Future Interceptor Renewal/Asset Protection as a long-term CIP placeholder to provide an annual baseline target expenditure of $4.0 million per year for interceptor asset protection is recommended for consideration in future CIPs at an estimated cost of $80.0 million in the FY39-58 timeframe. As specific projects are identified, they will become sub-phases within the target expenditure.

- Wellesley Extension Sewer Replacement (WESR) reevaluation for rehabilitation and/or relining of approximately 29,000 feet of sewer due to deterioration of the existing lining including design and construction is recommended for consideration in future CIPs at an estimated cost of $30.0 million in the FY34-43 timeframe.

- Wastewater Process Optimization – Winthrop Terminal System Hydraulic Capacity Study to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Winthrop Terminal Headworks and to determine the feasibility of increasing and/or optimizing system capacity is recommended for consideration in future CIPs at an estimated cost of $500,000 during FY24-28.

- Wastewater Process Optimization – Charles River System Hydraulic Capacity Study to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Ward Street and Columbus Park Headworks and to determine the feasibility of increasing and/or optimizing system capacity is recommended for consideration in future CIPs at an estimated cost of $1.0 million during FY24-28.

- Wastewater Process Optimization - South System Hydraulic Capacity Study to evaluate the tributary flows and hydraulic capacity of the South Sewer System tributary to Nut Island Headworks and to determine the feasibility of increasing and/or optimizing system capacity is recommended for consideration in future CIPs at an estimated cost of $1.0 million during FY24-28.

- Neponset Valley Sewer (Sections 515-526 in the South System) Capacity Relief planning, design, and construction project is recommended for consideration in future CIPs at an estimated cost of $15.0 million during the FY39-43 timeframe. This project was initially recommended in the 1994 Final CSO Conceptual Plan and System Master Plan. The 3-mile long Neponset Valley Sewer was constructed during 1895-1898. The overall benefits and priority of this project may be further defined during the South System Hydraulic Capacity Study.

- Ashland Extension Sewer Capacity Relief planning and design project is recommended for consideration in future CIPs at an estimated cost of $1.0 million during the FY39-43 timeframe. The project is recommended to identify the feasibility of extending the Framingham Relief Sewer to Ashland. The overall benefits and priority of this project may be further defined during the South System Hydraulic Capacity Study.

- An Annual Manhole and Special Structure Rehabilitation project is recommended for consideration in future CIPs at a cost of $300,000 per year for a total cost of $12.0 million for the 40-year FY19-58 timeframe. Due to the annual need and relative low cost of this project, it is a candidate for CEB funding. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change.

- A design and construction project to rehabilitate/upgrade the Woburn Sandcatcher is recommended for consideration in future CIPs at an estimated cost of $1.0 million for the FY24-28 timeframe. The project will optimize flow through the division structure, provide appropriate access for system maintenance, and improve debris removal. In-house planning and preliminary design may be required prior to implementation of this project.

- Phase 2 Siphon Structure Rehabilitation design and construction project is recommended for consideration in future CIPs at an estimated cost of $6.0 million during the FY24-28 timeframe to make additional improvements (following Phase 1) to siphon headhouses and/or diversion structures. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change.

- Phase 3 Siphon Structure Rehabilitation design and construction project is recommended for consideration in future CIPs at an estimated cost of $6.0 million during the FY29-33 timeframe to make additional improvements (following Phase 2) to siphon headhouses and/or diversion structures. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change.

- Sliplining design and construction of Section 623 Braintree/Weymouth Interceptor siphon under the Fore River to reduce the size of one of the existing 1,700 foot long twin 60-inch siphon barrels by inserting a smaller diameter liner into the existing siphon is recommended for consideration in future CIPs at an estimated cost of $8.0 million in the FY24-28. Reduction in size is recommended due to the rerouting of significant flows to the Intermediate Pump Station.

- A future siphon upgrade design and construction project just upstream of the DeLauri Pump Station (Cambridge Branch Sewer to the DeLauri Pump Station) is recommended for consideration for future CIPs at an estimated cost of $25.0 million during the FY29-33 timeframe to provide a placeholder for design/construction funds for this single barrel siphon located at a critical location.

- A Siphon Asset Protection project is recommended for consideration in future CIPs to provide an estimated $5.0 million placeholder for possible recommendations from the recommended in-house siphon inspection and maintenance program. This project is recommended for the FY34-38 timeframe.

- A Force Main Asset Protection Project is recommended to provide a place holder for additional rehabilitation of the Squantum Force Main, as well as future recommendations from a recommended in-house force main and related structure evaluation. This project is estimated at $20.0 million with a 20-year duration in the FY24-43 timeframe.

- A future Outfall Inspection/Assessment Project to provide inspection information and make recommendations for cleaning and/or asset protection repairs for all MWRA CSO and Nut Island emergency outfalls is recommended for consideration in future CIPs at an estimated cost of $2.0 million in the FY24-28 timeframe.

Table 9-6

Wastewater Master Plan - Collection System Sewers

Existing and Recommended Projects

Last revision 9/7/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF New Facility/System
RF/IC Replacement Facility/Increase Capacity
Opti Optimization
AP Asset Protection
Plan Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		COLLECTION SYSTEM SEWERS												
9.01	1	Interceptor Renewal #1 - Reading Extension Sections 46, 73, 74, 75 - Design, CA/REI, Construction	AP	145	10447_7163 10448_7164	5 years	3,205	938	FY16-20	938				938
9.02	2	Interceptor Renewal #2 - North Met Sewer Rehabilitation Winthrop Sections 186, 4 5 6 - Study, Design, CA/RI and Construction	AP	145	10505_7421 10506_7422 10507_7423	8 years	10,244	9,144	FY17-24	5,588	3,556			9,144
9.03	2	Interceptor Renewal #3 - Dorchester Interceptor Sections 240, 241, 242 - Design, CA/REI and Construction	AP	145	10467_7279 10525_7512	6 years	7,076	6,634	FY17-22	6,634				6,634
9.04	2	Interceptor Renewal # 4A - Cambridge Branch Sewer Cambridge/Somerville Sections 26/27 - Design, ESDC and Construction	AP	145	10418_6936 10504_7410	6 years	36,000	36,000	FY24-29	0	35,688	312		36,000
9.05	2	Interceptor Renewal # 4B - Cambridge Branch Sewer Everett Sections 23/24 - Design, ESDC and Construction	AP	145	10468_7280 10526_7513	6 years	36,000	36,000	FY26-31	0	11,606	24,394		36,000
9.06	2	Interceptor Renewal # 5 -Milton Sections 607/609/610 Planning/Design, CA/REI and Construction	AP	145	10481_7328 10528_7515	5 years	16,200	16,200	FY24-28	0	16,200			16,200
9.07	2	Interceptor Renewal # 6 - Chelsea Sections 12/14/15/62 Planning/Design, CA/REI and Construction	AP	145	10482_7329 10527_7514	6 years	13,200	13,200	FY25-30	0	11,633	1,567		13,200
9.08	2	Interceptor Renewal # 7 - Malden/Melrose Sections 41, 42, 49, 54, 65 Hydraulic Study and Rehabilitation - Planning/Design and Construction	AP	145	10457_7216 10458_7217	6 years	2,340	2,340	FY21-26	750	1,590			2,340
9.09	2	Corrosion & Odor Control - FES /FERS Biofilters Design and Construction	AP	132	10406_6919 10456_7215	3 years	3,064	3,064	FY24-26	0	3,064			3,064
9.10	3	Corrosion & Odor Control - System-Wide Odor Control Study	Plan	132	10491_7364	3 years	1,000	1,000	FY24-26	0	1,000			1,000
9.11	2	West Roxbury Tunnel - Future Tunnel Inspection	AP	136	10401_6898	1 year	1,000	1,000	FY24	0	1,000			1,000
9.12	5	Randolph Trunk Sewer Relief Study	Plan	147	10461_7220	3 years	698	698	FY21-23	698				698
9.13	3	Wastewater Process Optimization - North System Additional Hydraulic Engineering Analysis and Design/Construction	Opti	141	19401_7412	8 years	7,442	7,442	FY24-31	0	7,442			7,442
9.14	2	System Relief and Contingency Planning	Plan	145	10487_7360	4 years	500	500	FY21-24	458	42			500
9.15	3	Wastewater Process Optimization - Somerville/Medford Branch Sewer and North Met Sewer Diversion - Study/Design/Construction	Opti	141	10413_6931 10414_6932	3 years	1,362	1,362	FY23-25	0	1,362			1,362
9.16	3	Braintree-Weymouth Improvements - Mill Cove Siphon Sluice Gates Design and Construction	Opti	104	10479_7326 10480_7327	4 years	2,813	2,813	FY24-27	0	2,813			2,813
9.17	2	Siphon Structure Rehab Phase 1 - Land Acquisition, Design/CS/RI and Construction	AP	130	10280_6165 10293_6224 10294_6225	5 years	5,230	5,230	FY19-23	5,230				5,230
9.18	3	South System Relief/Outfall #023 Sediment/Debris Cleaning and Structural Improvements - Construction	Opti	139	10386_6801	3 years	1,500	1,500	FY24-26	0	1,500			1,500
		SUBTOTAL - Existing - Sewers					**148,874**	**145,065**		**20,296**	**98,496**	**26,273**	**0**	**145,065**

Table 9-6

Wastewater Master Plan - Collection System Sewers

Existing and Recommended Projects

Last revision 9/7/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF	New Facility/System
RF/IC	Replacement Facility/Increase Capacity
Opti	Optimization
AP	Asset Protection
Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
9.19	3	Additional construction and CA/RI costs for interceptor renewal #7 Malden/Melrose Sections 41/42/49/54/65	AP	new		5 years	12,000	12,000	FY24-28		12,000			12,000
9.20	3	Interceptor renewal #8 Cambridge Section 30, Charlestown Section 31 & 32	AP	new		5 years	10,000	10,000	FY24-28		10,000			10,000
9.21	3	Interceptor renewal #9 Brighton Sections 163 & 164	AP	new		10 years	12,000	12,000	FY29-38			12,000		12,000
9.22	3	Interceptor renewal #10 Arlington/Medford Sections 21/52/53/78/79/111/112/189	AP	new		10 years	30,000	30,000	FY29-38			30,000		30,000
9.23	3	Interceptor renewal #11 Dedham/Hyde Park Sections 516/521/522/523/524	AP	new		10 years	15,000	15,000	FY29-38			15,000		15,000
9.24	3	Interceptor renewal #12 Norwood Section 618	AP	new		5 years	3,000	3,000	FY34-38			3,000		3,000
9.25	3	Future Interceptor renewal Long-Term @ $4 mil/year	AP	new		annual	80,000	80,000	FY39-58				80,000	80,000
9.26	3	Wellesley Extension Replacement Sewer Rehab Design/Construction/CS/RI	AP	new		10 years	30,000	30,000	FY34-43			15,000	15,000	30,000
9.27	3	Wastewater Process Optimization - Winthrop Terminal System Hydraulic Capacity Study	Plan	new		5 years	500	500	FY24-28		500			500
9.28	3	Wastewater Process Optimization - Charles River System Hydraulic Capacity Study	Plan	new		5 years	1,000	1,000	FY24-28		1,000			1,000
9.29	3	Wastewater Process Optimization - South System Hydraulic Capacity Study	Plan	new		5 years	1,000	1,000	FY24-28		1,000			1,000
9.30	4	Neponset Valley Sewer Capacity Relief - Planning/Design/Construct	RF/IC	new		5 years	15,000	15,000	FY39-43				15,000	15,000
9.31	5	Ashland Extension Sewer Capacity Relief - Planning/Design	Plan/NF	new		5 years	1,000	1,000	FY39-43				1,000	1,000
9.32	4	Manhole Rehabilitation @ $300k/year	AP	new		annual	12,000	12,000	FY19-58	1,500	1,500	3,000	6,000	12,000
9.33	4	Woburn Sandcatcher Upgrade Design/Construction	AP/Opti	new		5 years	1,000	1,000	FY24-28		1,000			1,000
9.34	2	Phase 2 Siphon Structure Rehab Design/Construct	AP	new		5 years	6,000	6,000	FY24-28		6,000			6,000
9.35	2	Phase 3 Siphon Structure Rehab Design/Construct	AP	new		5 years	6,000	6,000	FY29-33			6,000		6,000
9.36	4	Sliplining of Section 652 Fore River Siphon in the B/W System - Design/Construction	AP/Opti	new		5 years	8,000	8,000	FY24-28		8,000			8,000
9.37	3	Siphon Upgrade Design/Construction at the DeLauri PS Mystic River Crossing	IC/Opti	new		5 years	25,000	25,000	FY29-33			25,000		25,000
9.38	4	Siphon Asset Protection	AP	new		5 years	5,000	5,000	FY34-38			5,000		5,000
9.39	4	Force Main Asset Protection	AP	new		20 years	20,000	20,000	FY24-43		5,000	10,000	5,000	20,000
9.40	4	Outfall Asset Protection	AP	new		5 years	2,000	2,000	FY24-28		2,000			2,000
		SUBTOTAL - Recommended - Sewers					**295,500**	**295,500**		**1,500**	**48,000**	**124,000**	**122,000**	**295,500**
		SUBTOTAL - Existing and Recommended - Sewers					**444,374**	**440,565**		**21,796**	**146,496**	**150,273**	**122,000**	**440,565**

CHAPTER 10
COLLECTION SYSTEM
PUMP STATIONS AND CSO FACILITIES

10.01 Chapter Summary

MWRA's wastewater collection system is a complex network of conduits and facilities that is strongly influenced by seasonal and wet weather conditions. The long-term (29 years of data 1989-2017) system average daily flow is approximately 353 mgd (about 300 mgd for the last 5 years 2013-2017), minimum dry weather flow is approximately 220 mgd and peak wet weather capacity to the Deer Island Treatment Plant (DITP) is 1,270 mgd with additional system capacity available at combined sewer overflow (CSO) outfalls. The MWRA collection system includes a network of 274 miles of sewer pipelines (19 miles of cross-harbor tunnels, 226 miles of gravity sewers, 18 miles of force mains, 7 miles of siphons, and 4 miles of CSO and emergency outfalls); 13 pump stations; one screening facility; six CSO treatment/storage facilities; and four remote headworks facilities.

In this Chapter, MWRA's collection system pump stations, screening facility, and CSO facilities are detailed. MWRA's remote headworks facilities are detailed in Chapter 8. The primary function of a pump station is to lift wastewater from an upstream sewer (at a lower elevation) to a downstream interceptor (at a higher elevation) so the wastewater can continue to flow by gravity to MWRA headworks facilities. Most pump stations operate continuously; however, two MWRA pump stations (Framingham and New Neponset Valley Sewer Pump Stations) are designed to operate during peak flows (wet weather) only. The primary function of a CSO facility is to treat and/or store combined (i.e. sanitary and stormwater) flow that exceeds the capacity of the combined sewer system in large rainfall events before releasing the excess flow to nearby receiving waters. CSO facilities also operate only during wet weather. MWRA's goal is to operate and maintain all wastewater facilities to provide uninterrupted wastewater collection and treatment service in a safe, cost-effective and environmentally sound manner.

The replacement asset value of the pump stations and CSO facilities is $640 million (9% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.07. The facilities are detailed within the Chapter Section noted below:

- 10.03 Alewife Brook Pump Station
- 10.04 BOS019 CSO Storage Conduit
- 10.05 Braintree/Weymouth Replacement Pump Station
- 10.06 Caruso Pump Station
- 10.07 Chelsea Screen House
- 10.08 Cottage Farm Pumped CSO Facility
- 10.09 DeLauri Pump Station
- 10.10 Framingham Pump Station
- 10.11 Hayes Pump Station
- 10.12 Hingham Pump Station
- 10.13 Hough's Neck Pump Station
- 10.14 Intermediate Pump Station (IPS)

10.15 New Neponset Valley Sewer Pump Station
10.16 North Dorchester Bay CSO Storage and Pump Facilities
10.17 Prison Point Pump Station and Pumped CSO Facility
10.18 Quincy Pump Station
10.19 Somerville Marginal Gravity CSO Facility
10.20 Squantum Pump Station
10.21 Union Park CSO Facility
10.22 Wiggins - Castle Island Terminal Pump Station
10.23 Braintree Howard Street Pump Station
10.24 Decommissioned Facilities and Pipeline Easements

The average age of MWRA's 20 collection system facilities is 27 years. Six of the 20 facilities are more than 30 years old. The oldest pump station, Alewife Brook in Somerville, is 67 years old and is undergoing a major rehabilitation. Two of MWRA's CSO facilities are 47 years old: the Cottage Farm Pumped CSO Facility and the Somerville Marginal Gravity CSO Facility. MWRA's newest facilities include five that are 13 years old or newer: BOS019 CSO Storage Facility in Charlestown, Braintree/Weymouth Replacement Pump Station in Quincy, Intermediate Pump Station (IPS) in North Weymouth, North Dorchester Bay CSO Storage and Pump Facilities in South Boston, and Union Park CSO Facility in Boston's South End.

Overall, the 20 collection system facilities are in good condition. Significant automation upgrades were implemented under MWRA's Wastewater Central Monitoring/SCADA Implementation Project (see Chapter 12). The CSO facilities have undergone upgrades under the CSO Control Plan (see Chapter 11) and two of the former CSO stations (Commercial Point and Fox Point) were decommissioned in 2008 following completion of local sewer separation projects. The highest priority immediate needs for wastewater pump stations and CSO facilities are rehabilitation/replacement projects being implemented at the 10 older facilities. These projects are in various stages of planning, design, construction; some nearing completion and other beginning planning with construction funds programmed in the CIP. Once planning/design for the older facilities is complete and appropriate construction projects are scheduled, planning and condition assessment for the newer facilities will begin. Also recommended is the creation of annual baseline target expenditures for asset protection projects for wastewater pump station and CSO facilities over the long term at an annual budget of $2.0 million during the FY24-58 period. As specific small scale rehabilitation and equipment replacement projects are identified, they will become sub-phases within the target expenditure CIP budget. Prioritization of asset protection projects is a consistent theme throughout the Master Plan. This target expenditure is needed as a place-holder to fund smaller scale projects that, individually, may not be seen as high priority, but are critical to maintaining uninterrupted service in a safe, cost-effective and environmentally sound manner.

For wastewater pump station and CSO facilities, operability of mechanical equipment and maintenance of electric/standby power systems are key elements to minimize risk of facility failure. Malfunction of mechanical equipment may impact sewer service, particularly during large storm events that stress the hydraulic capacity of the facilities, potentially requiring facility shutdown which could result in upstream CSOs and/or potential SSOs. Facilities most impacted by hydrogen sulfide corrosion are likely to require more frequent maintenance and earlier equipment replacement. Key decision making to minimize risks includes the cost/benefit decision of when to replace aging equipment and which/how many spare parts to pre-purchase. Other wastewater facility uncertainties include the future costs of chemicals and power.

For the pump stations and CSO facilities, $323.907 million in projects is identified in the 40-year master plan timeframe (FY19-58). Nine projects ($73.407 million) are currently programmed in the FY19 CIP. Nine additional projects ($250.50 million) are recommended for consideration in future CIPs. Section 10.26 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Near-term (FY19-23):

- $49.390 million is programmed in the FY19 CIP:
  - $3.888 million to complete the Alewife Brook Pump Station improvements design, construction services, resident inspection, and construction;
  - $1.814 million to begin Braintree/Weymouth Replacement Pump Station Improvements – design, construction services, resident inspection, and construction;
  - $1.068 million to begin pump station and CSO facility condition assessment for older facilities;
  - $750,000 for preliminary design/study for rehabilitation of older pump station and CSO facilities;
  - $1.114 million to begin Cottage Farm CSO upgrades - design, construction services, resident inspection, and construction;
  - $1.108 million for DeLauri Pump Station Screens and Security Improvements construction;
  - $33.433 million for Prison Point CSO Facility rehabilitation - design, construction services, resident inspection, and construction;
  - $2.579 million for Wiggins – Castle Island Terminal Pump Station upgrades design and construction; and,
  - $3.636 million to begin Fuel Oil Tank Replacement design and construction phases 1, 2, & 3.

- $1.5 million in needs is identified for FY19-23 and recommended for consideration in future CIPs for Framingham Pump Station force main corrosion and odor improvements.

Mid-term (FY24-28):

- $24.017 million is programmed in the FY19 CIP:
  - $7.046 million to complete Braintree/Weymouth Replacement Pump Station Improvements – design, construction services, resident inspection, and construction;
  - $2.068 million to complete pump station and CSO facility condition assessment for older facilities;
  - $12.903 million to complete Cottage Farm CSO upgrades - design, construction services, resident inspection, and construction; and,
  - $2.0 million to complete Fuel Oil Tank Replacement design and construction phases 1, 2, & 3.

- $89.0 million in needs is identified for FY24-28 and recommended for consideration in future CIPs:
  - $25.0 million for Caruso Pump Station upgrades design and construction;
  - $25.0 million for DeLauri Pump Station upgrades design and construction;
  - $2.0 million for Framingham Pump Station sluice gate replacement and screen automation – study, design, and construction;
  - $12.0 million for Hayes Pump Station upgrades design and construction;
  - $10.0 million for Hingham Pump Station upgrades design and construction;
  - $5.0 million for Somerville Marginal Gravity CSO Facility upgrades design and construction; and,
  - $10.0 million for long-term annual asset protection program for equipment rehabilitation/replacement at all pump stations and CSO facilities, budget based at $2.0 million per year for 10 years.

Long-term (FY29-38 and FY39-58):

- $160.0 million in needs is identified for FY29-38 and FY39-58 and recommended for consideration in future CIPs:
  - $60.0 million for long-term annual asset protection program for equipment rehabilitation/replacement at all pump stations and CSO facilities, budget based at $2.0 million per year for 30 years; and,
  - $100.0 million as a placeholder for future pump station and CSO facility condition assessment and upgrades (plan, design and construct) for newer wastewater pump station and CSO facilities.

10.02 Facilities Overview

The MWRA wastewater collection system includes 13 pump stations, one screening facility, and six CSO treatment/storage facilities. Key information on each pump station and CSO facility is provided in Table 10-1. The general location of each facility is shown on Figure 10-1 and the service area tributary to each pump station is shown on Figure 10-2.

Management of pump stations and CSO facilities is the responsibility of the Wastewater Operations and Maintenance Department, which is a subset of the Operations Division under the oversight of the Chief Operating Officer and the Deputy Chief Operating Officer. Key supervisory staff reporting to the Director, Wastewater include: Manager, Operations and Manager, Maintenance.

TABLE 10-1

MWRA Pump Stations and CSO Facilities

Facility/Location	Average Daily Flow (MGD)	Peak Capacity (MGD)	Year Built (Original)	Flow Received From
Alewife Brook Pump Station Somerville	6.0	75	1951	Alewife Brook Sewer & Conduit, Belmont & Lexington Branch Sewers
BOS019 CSO Storage Conduit	N/A	N/A	2007	Charlestown Branch Sewer
Braintree/Weymouth Replacement Pump Station Quincy	6.0	28	2007	Braintree-Weymouth Interceptor
Caruso Pump Station East Boston	10	80-125	1991	Chelsea Branch Sewer Relief and East Boston Branch Sewer Relief and BWSC East Boston Low Level Sewer
Chelsea Screen House Chelsea	12	32	1990	Chelsea Branch Sewer Relief
Cottage Farm Pumped CSO Facility Cambridge	N/A	233	1971 (plus upgrades)	North and South Charles Relief Sewers
DeLauri Pump Station Charlestown	15	93	1993	Cambridge Branch Sewer
Framingham Pump Station Framingham	N/A	28	1998	Ashland & Framingham Local Sewers
Hayes Pump Station Wakefield	2.5	9	1987	Reading Extension Relief Sewer and Wakefield Local Sewers
Hingham Pump Station Hingham	1.5	7	1992	Hingham Local Sewers
Hough's Neck Pump Station Quincy	0.3	1.3	1999	Quincy Local Sewers
Intermediate Pump Station (IPS) North Weymouth	12	45	2005	North Weymouth Relief Interceptor
New Neponset Valley Sewer Pump Station Canton	N/A	46	1995	New Neponset Valley Sewer
North Dorchester Bay CSO Storage and Pump Facilities	N/A	N/A	2011	South Boston Local Combined Sewers
Prison Point Pump Station and Pumped CSO Facility Cambridge	PS - 2.0 CSO - N/A	PS - 5 CSO - 323	1980	Cambridge Marginal Conduit, Boston Marginal Conduit, CSO from Charlestown Branch Sewer
Quincy Pump Station Quincy	6.0	22	2002	Quincy Local Sewers
Somerville Marginal Gravity CSO Facility Somerville	N/A	145	1971	Somerville-Medford Branch Sewer and Somerville Local Combined Sewers
Squantum Pump Station Quincy	1	7.5	2003	Quincy Local Sewers
Union Park CSO Facility South End, Boston	N/A	300 (BWSC PS)	2007	South End Local Combined Sewers
Wiggins-Castle Island Terminal Pump Station South Boston	0.1	0.5	1960	Castle Island and Connolly Terminal Sewers

FIGURE 10-1
List Of Pump Stations, CSO Facilities, & Screen House

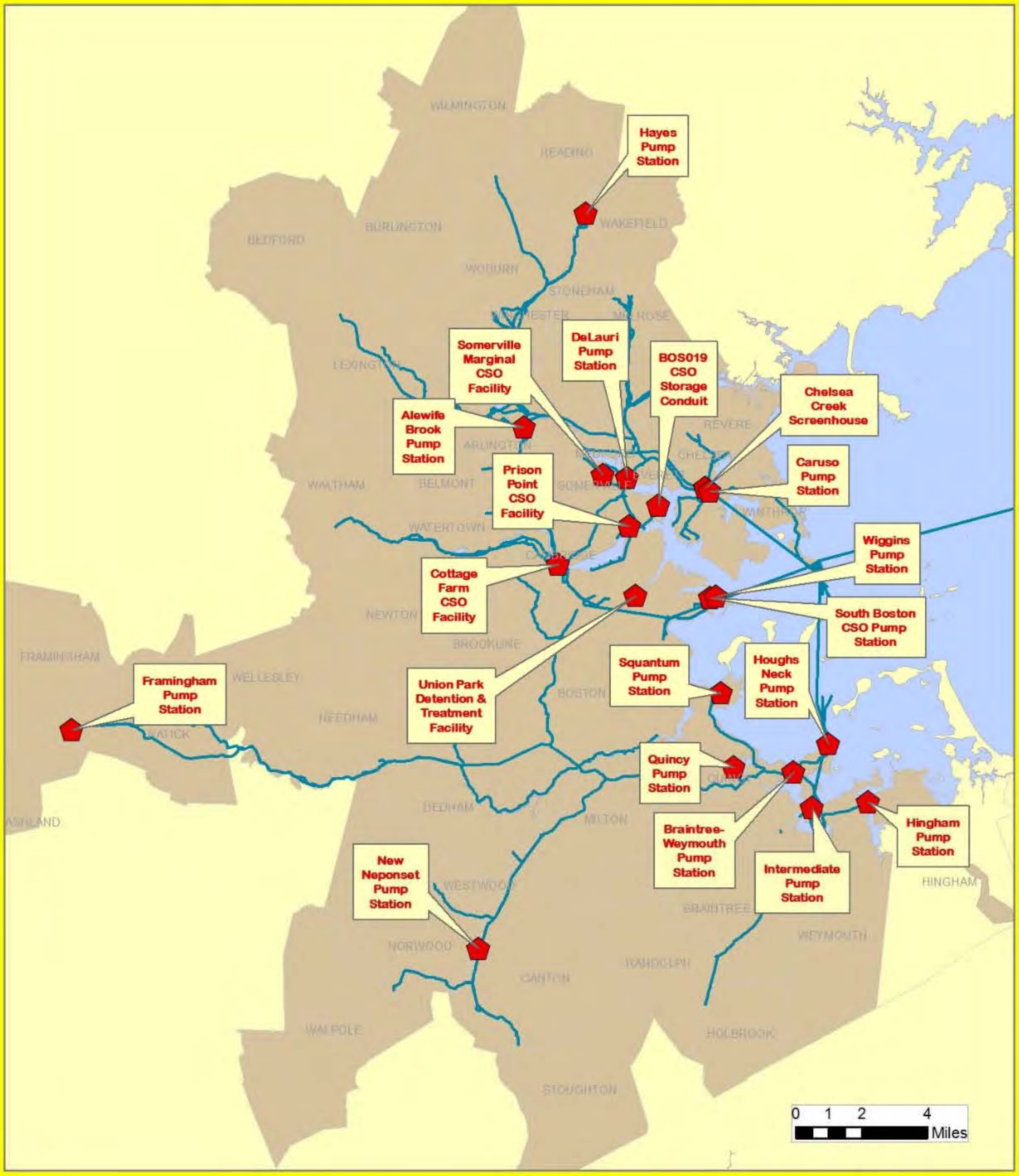
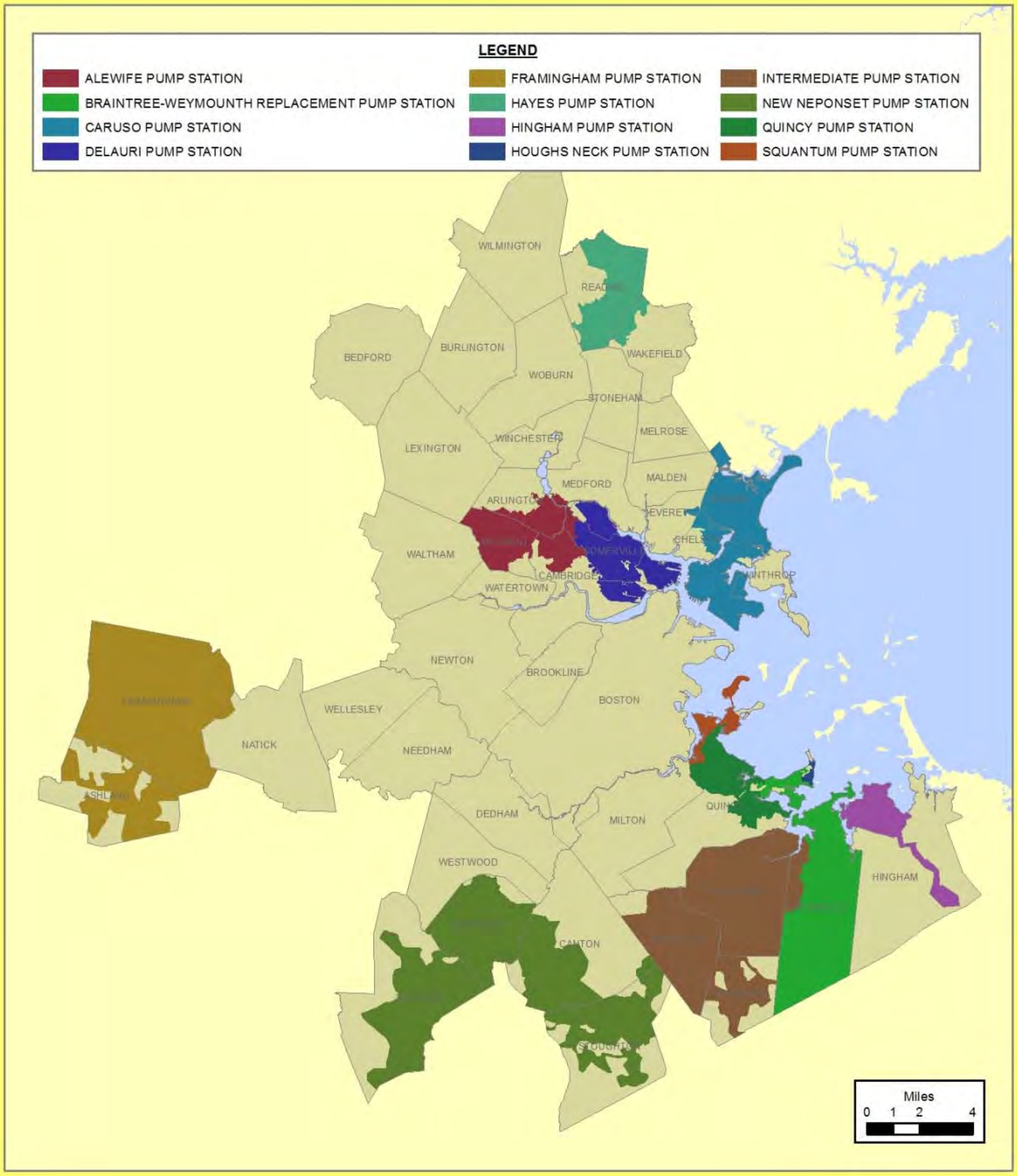


FIGURE 10-2

Pump Station Service Area



Operation and Maintenance: There is no dedicated staff at any MWRA pump station or CSO facility. A total of about 40 staff are employed in roving crews for operation and maintenance. Operations data are scanned at facilities and downloaded to a central computer. All system scans that produce abnormal readings are checked by Area Supervisors and Operations Supervisors. Facility Maintenance and Equipment Maintenance are two consolidated programs made up of the mechanic specialists, machinists, metalworkers, welders, plumbers, HVAC specialists, electricians, building and grounds workers, and facility specialists (carpenters and painters). These groups (total of about 89 staff) perform maintenance activities at both wastewater and water facilities. Work Coordination in the Operations and Maintenance Department provides scheduling and job planning at all wastewater facilities. All maintenance is scheduled through the MAXIMO system (see detail below).

All facility operation staff report to the Chelsea Operation Control Center (OCC) at the beginning of each shift to receive assignments. The OCC is manned continually with an Area Supervisor. There are four shifts for Wastewater Operations: 7AM-3PM; 3PM-11PM; 11PM-7AM; and a relief shift. MWRA's wastewater system facilities are split into four geographic operational areas: Area A includes BOS 019 CSO Storage Conduit, Cottage Farm Pumped CSO Facility, Prison Point PS and Pumped CSO Facility, and Somerville Marginal Gravity CSO Facility; Area B includes Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, and New Neponset Valley Sewer PS; Area C includes Alewife Brook PS, Caruso PS, Chelsea Screen House, DeLauri PS, and Hayes PS; and Area D includes Hingham PS, IPS, North Dorchester Bay CSO Storage and Pump Facilities, Quincy PS, and Squantum PS. Teams of operations staff rove through facilities within the four Areas and electronically collect operational and utility data. Staff also answer alarms and receive deliveries. The OCC contains facility SCADA screens and, from the OCC, staff can remotely control and adjust facility operation. A description of SCADA is provided in Chapter 12. The Wiggins-Castle Island Terminal PS is not included within the four operational areas. This station is checked once per month by operations staff.

The Union Park CSO Facility, located in Boston's South End, is operated through a jointly managed and funded operations contract between BWSC and MWRA. The cost of this operations contract is mostly covered by BWSC (73 percent) given the inclusion of nine other small BWSC-owned pump stations in the contract. The current 3-year contract began on March 1, 2017. At the end of the contract (March 2, 2020), MWRA and BWSC have the option to extend the contract for up to two additional years. MWRA staff review and approve contractor invoices, review reports used for regulatory reporting purposes, and monitor the contractor's performance.

A standard operating procedure (SOP) has been developed specific to each MWRA pump station and CSO facility and contains information on facility operation and maintenance procedures. Some facilities have detailed operation and maintenance manuals that were developed during facility start-up. In addition, operation and maintenance manuals are generally furnished by the manufacturer of each piece of major equipment (pumps, generators, bar screens, etc.). MWRA staff should periodically review/update SOPs for all facilities.

Need for CSO Facilities: Five MWRA member community wastewater collection systems were originally constructed using combined sewers (designed to receive both sanitary flow and stormwater), including portions of Boston, Brookline, Cambridge, Chelsea, and Somerville. During larger storm events, flows may increase beyond the conveyance capacities of local sewers, local connections to MWRA's system or MWRA interceptors. Under these conditions, excess flow can be released to nearby receiving waters. At these locations, collection system relief is needed to mitigate system flooding, backups into basements, and upstream overflows. The release is called a combined sewer overflow (CSO). CSO facilities are designed to treat these overflows by screening out debris (for floatables control), in some cases removing settleable solids using settling/detention basins, providing disinfection to destroy pathogens, and dechlorination of the flow before it enters the receiving water. The Somerville Marginal CSO facility is the only gravity CSO facilities still in service. It is designed for unattended, automatic start-up when wastewater flow reaches a preset level. There are two pumped CSO facilities: Prison Point and Cottage Farm. Both facilities can be remotely activated from the OCC during a wet weather event. If staffing allows, CSO facilities are often manned during activations. Also, given the need to take grab samples to adjust chemical dosage, staff typically are staged at CSO facilities when a storm event is expected to result in facility activation. The MWRA also owns and operates two storage and pump back facilities: BOS019 (Little Mystic Channel) CSO Storage Conduit and North Dorchester Bay CSO Storage and Pumped CSO Facility. Both storage facilities are designed to permit automatic filling and dewatering of the storage facilities.

Facility Operation: Influent gates at pump stations and CSO facilities allow flow to enter the facility, restrict flow into the facility, and isolate the facility from system flow when necessary. Bar screens remove large debris to protect pumping equipment and/or remove the debris from a CSO discharge. At some stations, screenings are ground and returned to the flow downstream of the bar screen or channel grinders are used within the facility's influent channels. Electric or diesel driven pumps maintain the wet well level between target maximum and minimum elevations. Pumps have either a single speed motor or a variable frequency drive to increase or decrease the pump rate. The pumps discharge into a force main that generally connects to a downstream gravity sewer or (for CSO Facilities) discharge to a receiving water. A check valve and manually operated gate valve is generally installed on the discharge pipe from each pump to prevent backflow and allow the pump to be isolated for maintenance. Electric service is provided to most facilities via local commercial service. Most facilities have on-site backup generators for emergency power, or in some cases a portable generator can be transported to the site, as needed. Most facilities also have some form of wastewater flow metering.

Facility Maintenance: A primary focus of operation and maintenance staff is preventive maintenance. Tasks performed by operational staff are generally defined as light maintenance duties that increase the number of maintenance staff work hours dedicated to maintenance activities. This information is captured in MWRA's MAXIMO work order system. The MAXIMO computerized maintenance management system records all work activities and work order requests from operations and maintenance personnel. This system gives management the ability to track maintenance needs, prioritize work orders, and generate reports of open and closed work activities. Reports can be generated and information retrieved about equipment condition. Abnormal conditions are noted and forwarded to planner/schedulers for work order processing and further action by the Equipment Maintenance Section. Backlog levels depend on available resources and are generally in the range of four to six weeks, but daily coordination ensures that primary and critical equipment is functioning at adequate levels at all times. Work is prioritized, with critical equipment receiving the most attention.

MWRA In-House Tasks: The following ongoing in-house tasks related to the pump station and CSO facilities have been performed by MWRA staff during 2014 through 2017:

- Braintree/Weymouth Pump Station: the influent gate actuators 3 & 4 were replaced;
- Braintree/Weymouth Pump Station: the odor control fan shaft and bearings were replaced;
- Caruso Pump Station: the heating boiler was replaced;
- Caruso Pump Station: the VFD's for pumps 1-3 and 1-4 were replaced;
- Cottage Farm CSO Facility: the wet well and detention tank wash down piping system was replaced;
- Cottage Farm CSO Facility: the VFD and cooling unit pump # 4 were upgraded;
- Intermediate Pump Station: the # 2 grit pump and process water pump were replaced;
- Intermediate Pump Station: the grit pipe hangers in the screen room were replaced;
- Prison Point CSO Facility: the auxiliary water pump on diesel engine # 3 was removed and replaced and diesel engine #2 was overhauled;
- Somerville Marginal CSO: installed a new flow meter at the CSO remote building;
- Squantum Pump Station: the VFD for pump # 3 was upgraded;
- Flood Control Barriers were installed at Braintree Weymouth Pump Station, Squantum Pump Station, and Quincy Pump Station;
- The Gas Monitoring Systems were upgraded at Intermediate Pump Station and Prison Point Pump Station; and,
- Wastewater Collection System Operation and Maintenance Plan was updated as of December 2017.

There are three additional in-house tasks related to pump station and CSO facilities recommended to be completed by MWRA staff:

- Staff should review/update SOPs, as needed, for all facilities.
- Staff should update the 2002 Equipment and Operational Summary for Wastewater Transport Facilities.
- MWRA should continue to work with Town of Braintree personnel to finalize a successor Agreement to the 1990 Agreement regarding MWRA's use of Braintree's Howard Street Pump Station. The agreement should be approved by MWRA's Board of Directors. An annual bill should be assessed from Braintree to MWRA and an annual payment should be made by MWRA to Braintree.

Service Contracts: The in-house CEB maintenance program is supplemented by a series of service contracts, as listed below:

- Architectural, electrical, HVAC, and mechanical engineering design;
- Boiler and water heater service maintenance;
- Compressed air maintenance;
- Crane maintenance;
- Diesel generator maintenance;
- Elevator maintenance;
- Fire & Fire Sprinkler System maintenance;

- Fuel storage tank maintenance;
- Grounds keeping services;
- High voltage maintenance;
- HVAC pneumatic controls maintenance;
- Hydraulic Equipment maintenance;
- Instrumentation maintenance;
- Overhead door maintenance; and,
- Pump variable frequency drive maintenance.

Fuel Oil Tank Replacements: All pump station facilities are equipped with back-up power via a diesel generator, except for BOS019 CSO Storage Conduit, North Dorchester Bay CSO Storage and Pump Facilities, and the Wiggins – Castle Island Terminal Pump Station. A project to replace the fuel oil storage tanks at some facilities is programmed in the FY19 CIP at a total cost of $5.636 million including design and three phases (phase 1, 2, and 3) of construction. This 6-year project is scheduled for FY20-25. Both water and wastewater facilities are included in this project, but all costs are carried within this chapter of the Master Plan. Facilities that may be included in this project are: Deer Island Treatment Plant, Columbus Park Headworks, Ward Street Headworks, Alewife Brook Wastewater Pump Station, Caruso Wastewater Pump Station, Commercial Point Wastewater CSO Facility, DeLauri Wastewater Pump Station, Hayes Wastewater Pump Station, New Neponset Wastewater Pump Station, Gillis Water Pump Station, Lexington Street Water Pump Station, the Water Facility in Southborough and vehicle fueling facilities.

Facility Emergency Response: Operation of all collection system Facilities is monitored via the MWRA SCADA system at the Chelsea OCC. Any operational problems at the facilities are identified by Area Supervisors in the OCC. If emergency response is needed, maintenance crews are dispatched. All pump station facilities are equipped with back-up power via a diesel generator, except for BOS019 CSO Storage Conduit, North Dorchester Bay CSO Storage and Pump Facilities, and the Wiggins – Castle Island Terminal Pump Station. Prolonged operational problems at pump stations and CSO facilities could potentially result in upstream sewer surcharging. A project to review the emergency response plan and the hydraulics associated with sewer surcharging that may be caused by prolonged facility downtime and/or emergency scenarios within the collection system is programmed in the FY19 CIP. This project, titled System Relief and Contingency Planning Study, is scheduled for FY21-24 at a cost of $500,000 and is included in Chapter 9 – Collection System Sewers. One aspect of this project will be hydraulic modeling to determine the impact of prolonged operations problems (facility downtime, reduced pumping, loss of screens, etc.). The analysis should identify critical upstream SSO or back-up locations and elevations and the duration of reduced facility capacity that may result in an SSO at various (higher and lower) wastewater flow rates. Projects that may provide emergency system relief to minimize a diminished level of sewer service could be recommended.

Facility Vulnerability to Severe Weather and Flooding: After Super Storm Sandy in October 2012, staff began an evaluation of the vulnerability of MWRA water and wastewater systems to more extreme weather, adopting a benchmark of the current 100-year flood elevation plus an additional 2.5 feet to account for potential future sea level rise and more severe storms, as is in use by other agencies. The analysis identified a number of coastal wastewater and administrative facilities which are either vulnerable to the current 100-year storm event or the more conservative benchmark. The “Report on Severe Weather Preparedness for MWRA Coastal Facilities” was presented as a Staff Summary at the October 16, 2013 Board of Directors meeting (see details in that report). Follow-up information was presented to the Board of Directors in a Staff Summary on December 14, 2016 titled “MWRA’s Climate Change Strategy”. In the Staff Summary, eight wastewater facilities were identified as being “Likely Affected by 100 Year Storm”: Residuals Pellet Plant, Hough’s Neck Pump Station, Squantum Pump Station, Alford Street Facility (former Charlestown Pump Station), Quincy Pump Station, Chelsea Creek Screen House, Braintree/Weymouth Replacement Pump Station, and North Dorchester Bay CSO Storage Tunnel Ventilation Building. These facilities are detailed in this Chapter except for the Residuals Pellet Plant (detailed in Chapter 7). In the Staff Summary, four additional wastewater facilities were identified as being “Likely Affected by Storm Within 1 foot below a 100 Year Storm”: North Dorchester Bay CSO Storage Tunnel Pump Station, Alewife Brook Pump Station, Chelsea Creek Headworks, and Union Park CSO Facility. These facilities are detailed in this Chapter except for the Chelsea Creek Headworks (detailed in Chapter 8).

10.03 Alewife Brook Pump Station

- Address: 392 Alewife Brook Parkway, Somerville
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 6.0 mgd
- Peak Capacity: 75 mgd


Alewife Brook Pump Station

Facility Function and Operation: The Alewife Brook Pump Station was built in 1951. This facility lifts wastewater from four upstream MWRA sewers: Alewife Brook Conduit, Alewife Brook Sewer, Belmont Branch Sewer, and Lexington Branch Sewer. Pumped flow is discharged to the downstream North Metropolitan Trunk Sewer and North Metropolitan Relief Sewer so that gravity flow can continue to the Chelsea Creek Headworks. The tributary area includes parts of Arlington, Belmont, Cambridge, Somerville and a small portion of Medford. The tributary area includes both combined and separate sewers. Continued sewer separation in Somerville and Cambridge should reduce the amount of storm water currently tributary to this pump station.

The first significant rehabilitation of this station was upgrade of the pump motors and gearboxes and installation of variable frequency drives (VFDs) on pump 2, 3, and 4 in 1992. The second upgrade replaced the mechanical bar screen system, updated the HVAC system, and replaced the facility’s windows and doors in 1996. A third upgrade was the replacement of the transformer station, completed in 2001. A fourth upgrade was completed in 2008, with the addition of a VFD to Pump 1, replacement of VFDs on Pumps 2 and 3, and installation of a new 15 MGD pump, pump motor, and VFD for Pump 4, and SCADA instrumentation.

Facility Components: Major facility components include: two influent electric sluice gates, two influent manual sluice gates, two mechanical bar screens, two screenings grinders, four pumps (three at 26 mgd and one at 15 mgd), four electric motors, two electric sluice gates (downstream of the bar screens), redundant wet well ultrasonic depth meters, effluent flow meters and an electric sluice gate at the connection of the wet weather discharge chamber and Alewife Brook Conduit.

Hydraulic Performance: Under certain peak flow conditions, the downstream hydraulic grade line can limit the peak flow that can be pumped by the facility. During a storm event, it is important for the operators of the facility to monitor the water surface in the discharge chamber outside of the pump station, to assure that excessive pumping against the downstream hydraulic grade line does not cause flooding of the discharge chamber. During significant storm events that cause influent flow to exceed the facility's pumping capacity and/or the downstream interceptor system capacity, CSO regulators along the upstream sewer and/or within tributary community connections can discharge to Alewife Brook. MWRA's CSO Control Plan addresses these CSO discharges (see Chapter 11).

Facility Vulnerability to Severe Weather and Flooding: The Alewife Brook Pump Station has been identified as being "Likely Affected by Storm Within 1 foot below a 100 Year Storm".

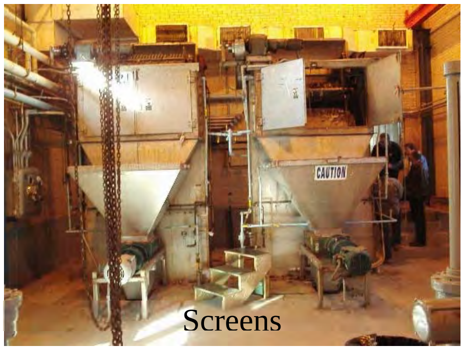
Facility Power: The primary electrical feed is from commercial service via Gordon Street in Somerville. A secondary commercial electrical feed serves the station from Decatur Street in Arlington. When primary power fails, power is automatically transferred from the primary to the secondary source. The commercial power company must be contacted to switch back to the primary power source. A diesel generator (600 kW) provides backup power. The fuel oil storage tank is scheduled to be replaced under the Fuel Oil Tank Replacement Design and Construction project.

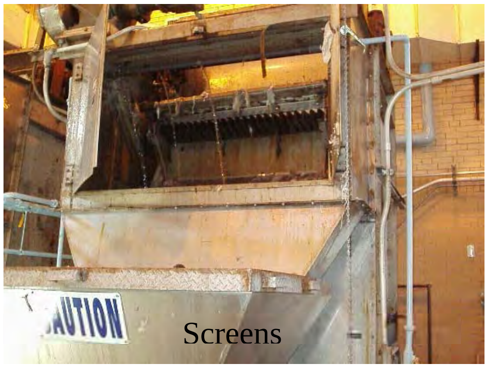
Standard Operating Procedures (SOPs): The Station SOP was developed in 1992 and updated in 2002. The SOP will be updated upon completion of the Alewife Brook Pump Station Rehabilitation project.

Force Main: The three 26 MGD pumps discharge to Section 176A, a 66-inch diameter reinforced concrete force main, 670 feet long, built in 1948. The No. 4 15 MGD pump discharges to Section 155, a 24-inch diameter cast iron force main, 168 feet long, built in 1948.

Record Drawings: Accession Numbers 200260 to 200272, 52452, 200440 to 200465, 603437**,** 512555, 512595 to 512597, 512642 to 512645, and 519822 to 519850.

Condition Assessment and Recent Upgrades: The Alewife Brook Pump Station (1951) is the oldest of the 20 MWRA wastewater facilities reviewed in this Chapter. The Alewife Brook Pump Station Rehabilitation planning, design and construction project that began in FY12 is nearing completion (scheduled through FY20). Some photos of the facility are shown below.





<u>Projects in the Existing FY19 CIP</u>:

- Alewife Brook Pump Station Rehabilitation design, construction administration, resident inspection, and construction project began in FY12 and is scheduled to be completed in FY20 at a total cost of $15.515 million. This project is a comprehensive rehabilitation of the pump station. The project is programmed in the FY19 CIP as a component of the Interceptor and Pumping Facility Asset Protection Project. Total expenditures during the planning period (FY19-20) are $3.888 million. The upgrade will include replacing the three larger station (wet weather) pumps, motors, gear drives VFD drives, the motor control center, and piping (adding pump redundancy and increasing pump reliability/efficiency); replacing sluice gates, climber screens and grinders; updating the HVAC system; updating the electrical system; adding a flow meter, remediating PCB-contaminated paint, modifying the building interior to meet current building codes, new roof, energy efficiency improvements, adding flood protection measures to 2.5 feet above 100-year flood elevation, and security improvements. The fourth pump (smallest of the four pumps) was previously replaced under the SCADA Project.

<u>Projects Recommended for Consideration in Future CIPs</u>:

- Alewife Brook Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough’s Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins – Castle Island Terminal PS.

10.04 BOS019 CSO Storage Conduit

- Address: Corner of Medford Street & Chelsea Street, Charlestown
- Location Map: See Figure 10-1
- Average Daily Flow: N/A – only operated during peak (wet weather) flow
- Maximum Storage Capacity: 670,000 gallons

Facility Function and Operation: The BOS019 CSO Storage Conduit was built in 2007 at the corner of Chelsea Street and Medford Street (under the Tobin Bridge) in the Charlestown neighborhood of Boston at a construction cost of $14.3 million. The facility includes two, 280-foot long, 10-foot by 17-foot underground concrete conduits that provide 670,000 gallons of overflow storage capacity, as well as an above ground pump-out facility and an underground influent gatehouse. The project is predicted to reduce the average annual number of CSO discharges from outfall BOS019 to the Little Mystic Channel from 13 to 2, and reduce total annual discharge volume at this outfall by 86 percent, from 4.4 million gallons to 0.6 million gallons. The stored flows are pumped back to the interceptor system (Charlestown Branch Sewer) for conveyance to Deer Island after each storm passes and system capacity becomes available. An aboveground building houses the dewatering equipment, as well as the activated carbon odor control systems for treating air that is displaced when the conduit fills with combined sewage. During larger storms that cause overflows that exceed the storage volume of the conduit, system relief will continue to be provided through CSO outfall BOS019. For this reason, underflow baffles were installed to provide floatables control.

Facility Components: Major facility components include: 36-inch by 36-inch influent electric sluice gate; twin 6000 gallon flushing chambers each with a 70-inch by 16-inch flushing gate; two 280-foot long, 10x17-foot concrete box conduits to provide 670,000 gallons of off-line storage; activated carbon odor control system; and two 800 gpm dewatering pumps.

Hydraulic Performance: Activation of the BOS019 CSO Storage Conduit during storm events is controlled by a weir upstream of the influent gate. If the hydraulic grade line elevation in the MWRA Charlestown Branch Sewer (Section 32) exceeds the weir elevation, wastewater enters the influent chamber, which automatically opens the influent sluice gate. If the facility capacity is exceeded, the influent gate closes causing the hydraulic grade line in the influent chamber to exceed a second weir. Wastewater overtopping the second weir discharges to the Little Mystic River at outfall BOS019.

Facility Vulnerability to Severe Weather and Flooding: The BOS019 CSO Storage Conduit has been identified as being "Very Unlikely to be Affected".

Facility Power: The primary electrical feed is from local commercial service. Quick connects are provided for hook-up to a back-up diesel generator that would be transported to the facility.

Standard Operating Procedures (SOPs): The Station SOP was developed in 2007.

Record Drawings: Accession Numbers 225830 to 225932.

Condition Assessment and Recent Upgrades: The BOS019 CSO Storage Conduit is relatively new and in excellent condition. No immediate CIP upgrades are anticipated.

Projects Recommended for Consideration in Future CIPs:

- The BOS019 CSO Storage Conduit is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.05 Braintree/Weymouth Replacement Pump Station


Braintree/Weymouth Replacement Pump Station

- Address: 27 Kilby Street, Quincy, MA
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 6.0 mgd
- Peak Capacity: 28 mgd

Facility Function and Operation: The Braintree/Weymouth Replacement Pump Station was completed in 2007. This facility replaced the original Braintree/Weymouth Pump Station built in 1937. The pump station lifts wastewater from the upstream Braintree-Weymouth Interceptor and a local Quincy sewer into the High Level Sewer so that gravity flow can continue to the Nut Island Headworks. The tributary area includes the Adams Shore and Germantown portions of Quincy, the majority of Weymouth, and all of the Hingham North Sewer District (via the MWRA Hingham Pump Station). The entire tributary area consists of separate sanitary sewers. Wastewater flow tributary to the Intermediate Pump Station (IPS) (under normal operating conditions) can be diverted to flow to the Braintree/Weymouth Replacement Pump Station. Similarly, a portion of the wastewater flow tributary to the Braintree/Weymouth Replacement Pump Station (under normal operating conditions) can be diverted to flow to the IPS.

Facility Components: Major facility components include: two hydraulic influent sluice gates, two screenings grinders, three raw wastewater pumps, effluent flow meter, activated carbon odor control system, emergency generator and a lightning protection system. The pump station houses an office, lunch room, locker rooms, radio room, electrical room, generator room, boiler room, pump access room, and odor control room on the first floor level. The lower level houses a valve room with storage area, two wetwells, channels with screenings grinders, influent junction chamber and gates. The attic houses a mechanical area for HVAC equipment. All major areas of the facility contain fire protection sprinklers and internal/external antennas for radio communication.

Hydraulic Performance: No problems. During extreme rainfall events that cause peak flows, the backup pump may be operated to increase the peak pumping capacity from about 28 mgd to about 35 mgd.

Facility Vulnerability to Severe Weather and Flooding: The Braintree/Weymouth Replacement Pump Station has been identified as being “Likely Affected by a 100 Year Storm”.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (750 kW) provides backup power.

Standard Operating Procedures (SOPs): A facility handbook with SOPs was completed in March 2008.

Force Main: Section 622, 36-inch diameter ductile iron pipe, 34 feet long, constructed in 2007.

Record Drawings: Accession Numbers 202591 to 202599, 202604 to 202670, 229118 to 229128, and 603155 to 603194.

Condition Assessment and Recent Upgrades: The Braintree/Weymouth Replacement Pump Station was completed in 2007 and is in very good condition. However, some facility modifications are needed to improve safety, reliability, and performance.

Projects in the Existing FY19 CIP:

- Braintree/Weymouth Replacement Pump Station improvements design, construction services, resident inspection, and construction are programmed in the FY19 CIP as an 8-year project FY19-26 at a total cost of $8.860 million. Facility improvements are recommended to address deficiencies in odor control, solids handling, and pumping operations.

Projects Recommended for Consideration in Future CIPs:

- Braintree/Weymouth Replacement Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.06 Caruso Pump Station


Caruso Pump Station

- Address: 601 Chelsea Street, East Boston
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 10 mgd
  Peak Capacity: Typically 90 mgd, however, design capacity is 125 mgd. Flow at the Caruso Pump Station is restricted by the downstream capacity at the Winthrop Terminal Facility.

Facility Function and Operation: The Caruso Pump Station was built in 1991. The facility lifts wastewater to the North Metropolitan Trunk Sewer which is tributary to the Winthrop Terminal Facility at the Deer Island Treatment Plant. The tributary area includes both combined and separate flow from portions of Chelsea, East Boston, and Everett, and all of Revere. The pump station receives flow from the East Boston Branch Sewer Relief and BWSC's East Boston Low Level Sewer. The pump station also receives flow from the Chelsea Branch Sewer Relief and the Revere Extension Sewer via the Chelsea Screen House and Dry Weather Siphon (this is normal operation). In addition, the station is designed to receive overflow from the Chelsea Creek Headworks via the Wet Weather Siphon (this is an exception to normal operation). There is operational flexibility depending on dry weather/wet weather (average flow/peak flow) conditions at the Caruso Pump Station and connecting sewers to the Chelsea Screen House and Chelsea Creek Headworks. Various gates can be operated to adjust the flow distribution.

Facility Components: Major facility components include: four 21 mgd dry weather pumps, three 50 mgd wet weather pumps, two influent electric sluice gates, two wet well influent electric sluice gates, two influent channel manual roller gates, two mechanical bar screens, and venturi meters for all dry and wet weather pumps.

Hydraulic Performance: Peak (wet weather) flow at the Caruso Pump Station is restricted by the downstream capacity of the Winthrop Terminal Facility. The design capacity of the facility is 125 mgd but typical peak flows are limited to 90 mgd. During wet weather operations, a combination of the smaller pumps (21 mgd) and larger pumps (50 mgd) can be used. Flow during most storm events is pumped using the 21 mgd pumps. The facility is typically run automatically. As flows increase additional 21 mgd pumps are automatically brought on-line at successively higher wet well elevations. If the capacity of the 21 mgd pumps is exceeded and the wet well elevation climbs further, a 50 mgd pump is automatically brought on-line to manage flows.

Facility Vulnerability to Severe Weather and Flooding: The Caruso Pump Station has been identified as being "Very Unlikely to be Affected".

Facility Power: The primary electrical power is from local commercial service. A diesel generator (800 kW) provides backup power. A new 1000 kW generator is being installed under the Caruso Pump Station Improvements CIP project. The fuel oil storage tank is scheduled to be replaced under the Fuel Oil Tank Replacement Design and Construction project.

Standard Operating Procedures (SOPs): An O&M manual was prepared in 1991.

Force Main: The facility's pumps discharge via internal station piping into an effluent channel (force main) Sewer Section 223, an 84-inch diameter reinforced concrete pipe, 227 feet long, constructed in 1985. Sewer Section 223 connects to downstream Sewer Section 009.

Record Drawings: Accession Numbers 201,921 to 201,935 and 227,193 to 227,212.

Condition Assessment and Recent Upgrades: The Caruso Pump Station (1991) is average age for MWRA facilities at 27 years old. The station is in good condition with no major operational problems. Replacement of the standby generator, HVAC system, fire detection/suppression system, and security system upgrades were completed in FY18 under the Caruso Pump Station Improvements CIP project. This 6-year project during FY13-18 was completed at a total cost of $5.282 million. It is anticipated that additional equipment may begin to have operational problems since the 20 year useful life span is passed. The station is included in a project to assess equipment replacement and upgrades.

Projects in the Existing FY19 CIP:

- The Caruso Pump Station is included in the Pump Station and CSO Condition Assessment for MWRA's older Facilities project that is programmed in the FY19 CIP at a total cost of $3.136 million in FY20-24. This 5-year project will provide professional engineering services including planning, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's older pump stations and CSO facilities. Final design and construction phases will be added in the future. The older pump station and CSO facilities included are: Caruso PS, DeLauri PS, Hayes PS, Hingham PS, Somerville Marginal CSO, and Wiggins - Castle Island Terminal PS.

Projects Recommended for Consideration in Future CIPs:

- Caruso Pump Station Upgrades design and construction is recommended for consideration in future CIPs at an estimated cost of $25.0 million during the FY24-28 timeframe. Upgrades to be designed/constructed under this project will be identified in the Condition Assessment project for six of MWRA's older Facilities.

10.07 Chelsea Screen House

- Address: 340 Marginal Street, Chelsea
- Location Map: See Figure 10-1
- Average Daily Flow: 12 mgd
- Peak Capacity: 32.0 mgd

Facility Function and Operation: The Chelsea Screen House was built in 1990 and rehabilitation of the facility's screens and gates was recently completed in FY18. The facility screens sewage before it flows to the Chelsea Creek Siphon, which transports sewage to the Caruso Pumping Station. Screening removes large debris that could damage Caruso Station pumps or accumulate and plug the siphon barrels. The facility also provides screening of flows diverted from the Chelsea Creek Headworks during wet weather events. During normal (dry weather) operation, the facility receives flow from the Chelsea Branch Sewer Relief and Revere Extension Sewers, upstream of the Chelsea Creek Siphon. During peak flow (wet weather) operation, if the Chelsea Creek Headwork is above its capacity and the Caruso Pump Station is below its capacity, wastewater can be diverted from the Chelsea Creek Headworks through the Chelsea Screen House for pumping at the Caruso Pump Station.

Facility Components: Major facility components include: seven hydraulic sluice gates and four mechanical bar screens.

Hydraulic Performance: During peak flow conditions, wastewater flow depth within the screen channels can exceed a critical elevation, preventing the screens rakes from operation.

Facility Vulnerability to Severe Weather and Flooding: The Chelsea Screen House has been identified as being "Likely Affected by a 100 Year Storm". Additional flood protection measures were added under the recently completed Chelsea Screen House Upgrades construction project.

Facility Power: The electrical power is from local commercial service with no backup power.

Standard Operating Procedures (SOPs): An SOP was prepared in 2011.

Record Drawings: Accession Numbers 9740 to 9783 and 600968 to 600969.

Condition Assessment and Recent Upgrades: The Chelsea Screen House (1990) is near average age for MWRA facilities and is 28 years old. The station is in good condition after completion of recent screen and gate rehabilitation. Operation of the seven hydraulic sluice gates and four climbing screens has been a concern as operation and maintenance issues had become a problem since the 20 year useful life span for mechanical equipment had passed. The Chelsea Screen House Upgrades construction project was completed in FY18 at a total cost of $5.833 million. The construction work included replacement of two climber screens, rehabilitation of two other climber screens, replacement of seven sluice gates, the addition of flood protection measures, and implementation of a SCADA system.

Projects Recommended for Consideration in Future CIPs:

- Chelsea Screen House is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.08 Cottage Farm Pumped CSO Facility

- Address: 660 Memorial Drive, Cambridge
- Location Map: See Figure 10-1
- Average Daily Flow: N/A – only operated during peak (wet weather) flow
- Peak Capacity: 233 mgd (limited to 210 mgd by effluent channel and outfall capacity)


Cottage Farm

Facility Function and Operation: The Cottage Farm Pumped CSO Facility was built in 1971 and a major upgrade of the facility was completed by MWRA in 2001. The Cottage Farm Pumped CSO Facility provides relief for the North and South Charles Relief Sewers, and is the primary upstream relief point when flow is restricted at the Ward Street Headworks. During peak (wet weather) flows, the facility provides screening, sedimentation, and disinfection (chlorination and dechlorination) to CSOs prior to discharge to the Charles River via the Cottage Farm Outfall (permitted outfall MWR201). The Cottage Farm Facility predominantly receives flows from the CSO communities of Cambridge and Boston (Brighton), but is also downstream of the MWRA communities of Belmont, Newton, Waltham, and Watertown. The facility services a tributary area of both combined and separate sanitary sewers. During a storm event, water levels in the North and South Charles Relief Sewers can exceed the weir elevation in diversion structures adjacent to the facility and flow into the facility inlet structure. An additional influent line to the facility (Cottage Farm/Brookline Connection) was reconfigured in 2009 (previously this sewer was not in use) to increase hydraulic capacity to the South Charles Relief Sewer on the other side of the Charles River. After chlorination and screening, flows enter a wet well for pumping to the detention tanks. When the volume exceeds the detention tank capacity, flow overtops the detention tank weirs, is dechlorinated, and discharges by gravity to the Charles River through a 96-inch outfall conduit. At the end of a storm, the contents of the detention tanks are drained by gravity back to the North Charles Relief Sewer.

Facility Components: Major facility components include: three inlet structure sluice gates, three course and three fine wet weather flow mechanical screens, six 215,000 gallon sedimentation/detention tanks, four wet weather pumps (three 90 mgd diesels and one 35 mgd electric), two stripping pumps, chemical treatment (chlorination and dechlorination) system, and four flow meters.

Hydraulic Performance: Activation of the Cottage Farm Pumped CSO Facility during storm events controls the hydraulic grade line elevations in the upstream North and South Charles Relief Sewers. Without the facility, combined wastewater would surcharge the upstream system and discharge through several upstream untreated CSO outfalls to the Charles River, including: CAM005, CAM007, CAM009, and CAM011. Choking of the Ward Street Headworks contributes to increased overflow at the Cottage Farm Pumped CSO Facility.

Facility Vulnerability to Severe Weather and Flooding: The Cottage Farm CSO Facility has been identified as being “Likely Affected by a Hurricane only”.

Facility Power: The main pumps are powered by three 780 HP diesel engines. One 300 HP electric pump is also available. The primary electrical power is from local commercial service. A diesel generator (80 kW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 2009.

Force Main: There is no exterior force main. Wastewater is lifted within the Cottage Farm Pumped CSO Facility to detention tanks. The 96-inch diameter outfall is gravity flow to the Charles River. The detention tank drains via gravity flow to the North/South Charles Relief Sewer.

Record Drawings: Accession Numbers 54,813-54,886, 203,308-203,393, and 601,860-601,866.

Condition Assessment and Recent Upgrades: The Cottage Farm Pumped CSO Facility (1971) is 47 years old, twice the average age for MWRA pump station and CSO facilities and is well beyond the 20-year old milestone. In 2001, MWRA completed an upgrade project under the CSO Control Plan (see Chapter 11). The facility upgrades generally included the replacement of the chlorine disinfection system and addition of a dechlorination system, as well as process control and safety improvements. The fuel oil system at Cottage Farm was replaced during FY13 at a cost of $498,000. Also completed in FY16 were air emission upgrades for the Cottage Farm generator to meet EPA National Emissions Standards for Hazardous Air Pollutants regulations. The station remains in fair to good condition, with no major operational problems. It is anticipated that station equipment will begin to have operational problems in the upcoming years. Upgrade of the station is planned based on the recommendations of the 2012 Cottage Farm CSO Planning Report.

Projects in the Existing FY19 CIP:

- The Cottage Farm CSO Rehabilitation Design, Construction Administration, Resident Inspection, and Construction project is programmed in the FY19 CIP at a cost of $14.017 million in FY22-26. This 5-year project will include upgrading of facility equipment including: pumps; sluice gates; screen gearboxes; mechanical, electrical, chemical feed, security, fire alarm, and instrumentation systems; roof and other building upgrades; and flood control measures.

Projects Recommended for Consideration in Future CIPs:

- Cottage Farm Pumped CSO Facility is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.09 DeLauri Pump Station

- Address: 172 Alford Street, Charlestown
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 15 mgd
- Peak Capacity: 93 mgd

DeLauri Pump Station

Facility Function and Operation: The DeLauri Pump Station was built in 1993. The facility lifts wastewater to the Cambridge Branch Sewer, which is tributary to the North Metropolitan Sewer and transports flow to the Chelsea Creek Headworks. The facility receives flow from the Cambridge Branch Sewer, which intercepts flow from the Charlestown Branch and Somerville/Medford Branch Sewers as well as local community sewer systems. The tributary area includes both combined and separate flow from portions of Charlestown, Somerville, Cambridge and Medford, including flow from the dry weather pump station at the Prison Point Pump Station and Pumped CSO Facility. The substantial amount of combined area tributary to the facility results in rapid increases in flow during rainfall events.

Facility Components: Major facility components include: three 46.5 mgd pumps, four screen channel motorized sluice gates, three motorized knife suction gates, three motorized knife pump discharge gates, two automatic bar screen, one venturi meter, activated carbon odor control system and ultrasonic depth meters to monitor the screen channels and wet well.

Hydraulic Performance: The influent line to the facility is a single barrel 60-inch diameter siphon that limits peak flow to the facility. During wet weather events that exceed the station's capacity, surcharging in the upstream Cambridge Branch Sewer may increase the hydraulic grade line in the upstream community-owned sewers and cause overflows to the Prison Point Pump Station and Pumped CSO Facility. As an outcome of the Wastewater Process Optimization Study, further evaluation of the benefits of constructing a redundant siphon crossing the Mystic River from the Cambridge Branch Sewer to the DeLauri Pump Station was recommended (see Chapter 9).

Facility Vulnerability to Severe Weather and Flooding: The DeLauri Pump Station has been identified as being “Very Unlikely to be Affected”.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (600 kW) provides backup power. The fuel oil storage tank is scheduled to be replaced under the Fuel Oil Tank Replacement Design and Construction project.

Standard Operating Procedures (SOPs): An O&M manual was prepared in 1993.

Force Main: Section 25, is a 60-inch diameter poured-in-place concrete force main, 285 feet long, built in 1989.

Record Plans: Accession Numbers: 9,785 to 9,844.

Condition Assessment and Recent Upgrades: The DeLauri Pump Station (1993) is 25 years old, which is about average age for MWRA wastewater facilities. The station is in good condition with the no major operational problems. Upgrades to the facility screens and security systems are ongoing. It is anticipated that equipment will begin to have operational problems as the 20 year useful life span is passed. The station is included in a project to assess equipment replacement and upgrades.

Projects in the Existing FY19 CIP:

- DeLauri Pump Station Screen and Security Improvements construction project is programmed in the FY19 CIP (within the Interceptor and Pumping Facility Asset Protection Project) at a cost of $1.330 million in FY18-20. Total expenditures during the planning period (FY19-20) are $1.108 million. This project will replace existing bar screens, sluice gates, pump valves, and install security upgrades for the facility.
- DeLauri Pump Station is included in the Pump Station and CSO Condition Assessment for MWRA’s older Facilities project that is programmed in the FY19 CIP at a total cost of $3.136 million in FY20-24. This 5-year project will provide professional engineering services including planning, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA’s older pump stations and CSO facilities. Final design and construction phases will be added in the future. The six older pump station and CSO facilities included are: Caruso PS, DeLauri PS, Hayes PS, Hingham PS, Somerville Marginal CSO, and Wiggins - Castle Island Terminal PS.

Projects Recommended for Consideration in Future CIPs:

- DeLauri Pump Station Upgrades design and construction is recommended for consideration in future CIPs at an estimated cost of $25.0 million during the FY24-28 timeframe. Upgrades to be designed/constructed under this project will be identified in the Condition Assessment project for MWRA’s older Facilities.

DeLauri Pump Station/Charlestown Wind Turbine: In 2011, MWRA installed a 1.5 megawatt wind turbine adjacent to the DeLauri Pump Station in Charlestown. The structure is 364 feet high at blade peak and will generate 3 million kilowatt hours of electricity per year. See Chapter 13 for more information on MWRA alternative energy projects.

10.10 Framingham Pump Station

- Address: Arthur Street, Framingham
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: N/A - This station is activated only during peak flow, generally resulting from an extreme storm event.
- Peak Capacity: 28 mgd

Framingham Pump Station

Facility Function and Operation: Construction of the Framingham Pump Station was completed in 1998 as part of the Framingham Extension Relief Sewer (FERS) project. The pump station and relief sewer were constructed to provide relief for the existing Framingham Extension Sewer (FES). The tributary area includes all of Ashland and Framingham and is served by a separate sanitary sewer system. The facility pumps wastewater from upstream community-owned sewers to the FERS that connects to the downstream Wellesley Extension Sewer (and/or the Wellesley Extension Relief Sewer and Wellesley Extension Sewer Replacement) and the High Level Sewer and ultimately flows to the Nut Island Headworks. During average (dry weather) flow, the facility does not normally activate. During peak (wet weather) flow, the facility can be preset to automatically activate at a trigger flow rate; however, current operational procedures are to activate the facility manually.

Facility Components: Major facility components include: three diversion chamber sluice gates, two mechanical bar screens, three pumps, three electric motors, one influent flow meter (a Palmer-Bowlus Flume meter located at the influent diversion chamber), a wet well bubbletube depth meter, an effluent flow meter, a surge arrestor system, an activated carbon odor control system, and a chemical feed system to control odors and corrosion in the FES.

Hydraulic Performance: The facility is operated only during peak flow conditions. There are no hydraulic performance issues.

Facility Power: The primary electrical feed is from local commercial service. A diesel generator (1250 kW), equipped with automatic start circuitry, provides backup power. Only two pumps can operate under generator power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 1999.

Force Main: Section 677, 23,660 feet of 36-inch diameter pre-stressed concrete cylinder pipe with embedded T-Lock lining, constructed in 1999.

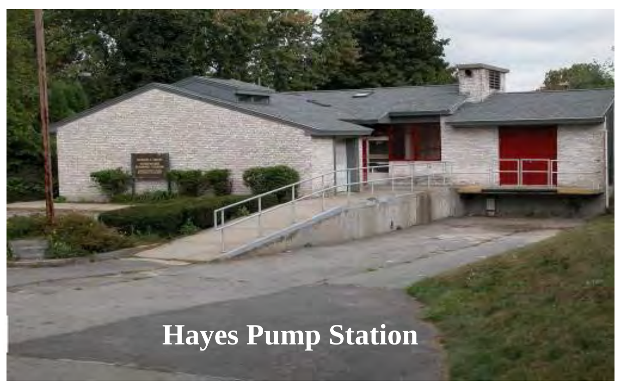
Record Drawings: Accession Numbers 200,854 to 200,911.

Condition Assessment and Recent Upgrades: The Framingham Pump Station (1998) is 20 years old and is in good condition with the only operational problem associated with high levels of hydrogen sulfide corrosion present in the collection system. Planning for sluice gate upgrade is ongoing. Some automation improvements were constructed under the Transport SCADA Implementation project.

Projects Recommended for Consideration in Future CIPs:

- Framingham Pump Station Force Main Corrosion and Odor Improvements project is recommended for consideration in future CIPs at an estimated cost of $1.5 million during the FY21-23 timeframe. Modifications at the Framingham Pump Station under this project may include: pump station automation and optimization improvements, FES flow meter modifications, automation of the force main filling, and modifications to the chemical feed facilities.
- Framingham Pump Station Sluice Gate Replacement and Screening Automation study, design and construction for replacement of three 48-inch sluice gates due to excessive hydrogen sulfide corrosion and screening improvements is recommended for consideration in future CIPs at an estimated cost of $2.0 million during the FY24-28 timeframe.
- Framingham Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.11 Hayes Pump Station


Hayes Pump Station

- Address: 100 Redfield Road, Wakefield
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 2.5 mgd
- Peak Capacity: 9.0 mgd

Facility Function and Operation: The Hayes Pump Station was built in 1987, replacing the former Reading Pump Station originally built in 1921. The Hayes Pump Station lifts wastewater from an upstream portion of the Reading Extension Relief Sewer and upstream community-owned sewers to the downstream portion of the Reading Extension Relief Sewer that connects to the North Metropolitan Relief Sewer and ultimately flows to the Chelsea Creek Headworks. The tributary area includes much of Reading, the northwest corner of Wakefield and several streets in Stoneham. The tributary area is served by a separate sanitary sewer system. The former Reading Pump Station building (located adjacent to the Hayes Pump Station on Summer Street in Reading) is used for odor control operations.

Facility Components: Major facility components include: influent sluice gate, one mechanical bar screen, one backup manual bar screen, three 5.5 mgd pumps, three electric motors, two electric screening bypass sluice gates, ultrasonic depth meters to monitor screening channel and wet well levels, and an effluent flow meter.

<u>Hydraulic Performance</u>: Closure (choking) of the influent sluice gate during extreme storm events has been required to protect the station from flooding and may contribute to elevated hydraulic grade lines in the upstream sewers and surcharge/overflow of the Eaton Street interceptor in Reading.

<u>Facility Power</u>: The primary electrical feed is from local commercial service in Wakefield via the Wakefield Municipal Light Department. A diesel generator (365 kW) provides backup power. The fuel oil storage tank is scheduled to be replaced under the Fuel Oil Tank Replacement Design and Construction project.

<u>Standard Operating Procedures (SOPs)</u>: The facility SOP was last updated in 1987.

<u>Force Main</u>: Section 205, 2330 feet of 20-inch diameter ductile iron pipe, constructed in 1984.

<u>Record Drawings</u>: Accession numbers 9,535 to 9,552 and 200,428 to 200,429.

<u>Condition Assessment and Recent Upgrades</u>: The Hayes Pump Station (1987) is 31 years old, somewhat older than the average age for MWRA collection system facilities. The station is in good condition with no major operational problems. It is anticipated that station equipment will begin to have operational problems since the 20-year useful life span is passed. The station is included in a project to assess equipment replacement and upgrades.

<u>Projects in the Existing FY19 CIP:</u>

- Hayes Pump Station is included in the Pump Station and CSO Condition Assessment for MWRA's older Facilities project that is programmed in the FY19 CIP at a total cost of $3.136 million in FY20-24. This 5-year project will provide professional engineering services including planning, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's older pump stations and CSO facilities. A second phase project will provide additional study and preliminary design services (see below). Final design and construction phases will be added in the future. The older pump station and CSO facilities included are: Caruso PS, DeLauri PS, Hayes PS, Hingham PS, Somerville Marginal CSO, and Wiggins - Castle Island Terminal PS.
- Hayes Pump Station is included in the Pump Station and CSO Rehabilitation Preliminary Design/Study for three of MWRA's older Facilities project that is programmed in the FY19 CIP at a cost of $750,000 in FY21-22. This 2-year project will follow-up on the condition assessment project noted above.

<u>Projects Recommended for Consideration in Future CIPs</u>:

- Hayes Pump Station Upgrades Design and Construction is recommended for consideration in future CIPs at an estimated cost of $12.0 million during the FY24-28 timeframe. Upgrades to be designed/constructed under this project will be identified in the Condition Assessment and Preliminary Design/Study projects for MWRA's older Facilities.

10.12 Hingham Pump Station

- Address: 463 Lincoln Street, Hingham
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 1.5 mgd
- Peak Capacity: 7 mgd

Hingham Pump Station

Facility Function and Operation: The Hingham Pump Station was originally built in 1957 and completely rebuilt by MWRA in 1992. This facility lifts wastewater from upstream community-owned sewers in the Hingham North Sewer District to the Braintree/Weymouth Interceptor that connects to the Braintree/Weymouth Replacement Pump Station. The tributary area is comprised of the entire Hingham North Sewer District and is served by separate sanitary sewers. The Hingham North Sewer District includes North Hingham, Hingham High School, Hingham Junior High School, and Wampatuck State Park.

Facility Components: Major facility components include: an influent gate, two comminutors, three 4.85 mgd pumps, three electric motors, ultrasonic depth meters to monitor influent channel elevation and wet well depths, and an effluent flow meter.

Hydraulic Performance: No problems. Previously, only a stop log chamber was available to isolate the station. Construction of an influent isolation gate was completed in 2012 at a cost of $125,000 to allow the station to be shut down during maintenance or emergency needs.

Facility Vulnerability to Severe Weather and Flooding: The Hingham Pump Station has been identified as being “Very Unlikely to be Affected”.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (200 kW) provides backup power. A new above ground diesel storage tank was installed in FY18.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 1992.

Force Main: Section 661 and 662, 7921 feet of 20-inch diameter ductile iron force main, constructed under two separate contracts in 1984 and 1990.

Record Plans: Accession Numbers 9,586 to 9,604b.

Condition Assessment and Recent Upgrades: The Hingham Pump Station (1992) is 26 years old, near average age for MWRA wastewater facilities. The station is in good condition with no major operational problems and no ongoing upgrades. The isolation gate and diesel storage tank projects were recently completed. It is anticipated that equipment will begin to have operational problems since the station has passed the 20-year old milestone. The station is included in a project to assess equipment replacement and upgrades. Although the station structure is relatively new, cracks in the facility may indicate a foundation problem. This situation is being monitored by operations staff and should be highlighted in the condition assessment study.

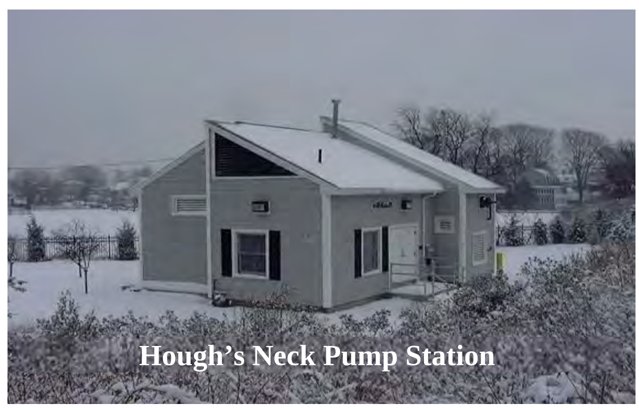
Projects in the Existing FY19 CIP:

- Hingham Pump Station is included in the Pump Station and CSO Condition Assessment for MWRA's older Facilities project that is programmed in the FY19 CIP at a total cost of \$3.136 million in FY20-24. This 5-year project will provide professional engineering services including planning, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's older pump stations and CSO facilities. A second phase project will provide additional study and preliminary design services (see below). Final design and construction phases will be added in the future. The older pump station and CSO facilities included are: Caruso PS, DeLauri PS, Hayes PS, Hingham PS, Somerville Marginal CSO, and Wiggins - Castle Island Terminal PS.
- Hingham Pump Station is included in the Pump Station and CSO Rehabilitation Preliminary Design/Study for three of MWRA's older Facilities project that is programmed in the FY19 CIP at a cost of \$750,000 in FY21-22. This 2-year project will follow-up on the condition assessment project noted above.

Projects Recommended for Consideration in Future CIPs:

- Hingham Pump Station Upgrade design/construction is recommended for consideration in future CIPs at an estimated cost of \$10.0 million during FY24-28. Upgrades to be designed/constructed under this project will be identified in the Condition Assessment and Preliminary Design/Study projects for MWRA's older Facilities.

10.13 Hough's Neck Pump Station


Hough's Neck Pump Station

- Address: Nut Island Avenue, Quincy
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 0.3 mgd
- Peak Capacity: 1.3 mgd

Facility Function and Operation: The Hough's Neck Pump Station was originally built in 1942 and was completely rebuilt by MWRA in 1999. This facility lifts wastewater from upstream community-owned sewers in a small portion of Quincy to the High Level Sewer that connects to the Nut Island Headworks. The 100-acre tributary area is served by separate sanitary sewers.

Facility Components: Major facility components include: one influent sluice gate, one automatic grinder unit, one backup manual bar screen, two submersible pumps, ultrasonic depth meters to monitor the influent channel and wet well depths, an effluent flow meter, and an activated carbon odor control system.

Hydraulic Performance: No problems.

Facility Vulnerability to Severe Weather and Flooding: The Hough's Neck Pump Station has been identified as being "Likely Affected by a 100 Year Storm".

Facility Power: The primary electrical power is from local commercial service. A diesel generator (50 kW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in June 1999.

Force Main: Section 588, 43-feet of 10-inch diameter ductile iron pipe, constructed in 1998.

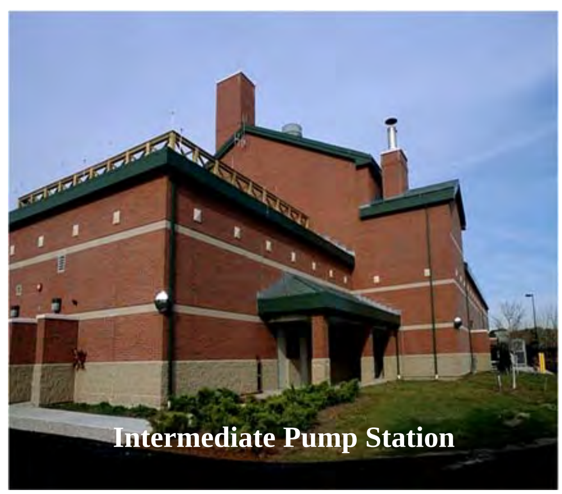
Record Drawings: Accession Numbers 202474 to 202499.

Condition Assessment and Recent Upgrades: The Hough's Neck Pump Station (1999) is 19 years old and is in very good condition. There are no operational problems and no immediate upgrades anticipated.

Projects Recommended for Consideration in Future CIPs:

- Hough's Neck Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.14 Intermediate Pump Station (IPS)


Intermediate Pump Station

- Address: 50 Bridge Street, North Weymouth
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 12 mgd
- Peak Capacity: 45 mgd

Facility Function and Operation: The Intermediate Pump Station (IPS) is located in North Weymouth off Route 3A and was built in 2005. Wastewater is pumped from the IPS into a 42-inch force main and conveyed through the Braintree-Weymouth Tunnel and Inter-Island Tunnel to the Deer Island Treatment Plant. The pump station receives wastewater from Braintree, Holbrook, Randolph, a small portion of Weymouth, and a very small area of Quincy (via the Braintree Howard Street Pump Station). The tributary area is served by separate sanitary sewers. Influent flows to the IPS are from the 60-inch North Weymouth Relief Interceptor downstream of two 36-inch siphons (across the Fore River). Wastewater pumped at the IPS bypasses the Nut Island Headworks; therefore, separate headworks process equipment (screens and grit removal) are an integral part of the IPS. The IPS also receives centrate from MWRA's Residuals Processing Facility at the Fore River Staging Area in Quincy through two 12-inch lines. An additional 12-inch water line supplies potable water from Quincy via the Braintree/Weymouth Tunnel.

Facility Components: Major facility components include: a hydraulic influent sluice gate, grit and screenings removal equipment, four raw wastewater pumps, an effluent flow meter, activated carbon odor control system, an emergency generator, and a lightning protection system. The pump station's first floor level houses an office, lunch room, locker rooms, janitor/laundry room, maintenance storage, radio room, fire pump room, electrical room, generator room, boiler room, mechanical room, container storage room, odor control room, and a truckway. The intermediate level houses a pump motor room and a grit and screenings process area. The lower level houses a pump room, wetwells, channels, and lower sections of the grit and screening process configurations. The attic houses a mechanical room for HVAC equipment. All major areas of the facility contain fire protection sprinklers and internal/external antennas for radio communication.

Hydraulic Performance: No problems.

Facility Vulnerability to Severe Weather and Flooding: The Intermediate Pump Station has been identified as being "Very Unlikely to be Affected".

Facility Power: The primary electrical power is from local commercial service. A diesel generator (2000 kW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was prepared in 2005.

Force Main: Section 642A, 152 feet of 42-inch diameter ductile iron force main, constructed in 2000. This force main discharges to the Braintree/Weymouth Tunnel. Integral to the Braintree/Weymouth Tunnel, the 42-inch force main continues for approximately 2 miles and discharges into the Inter-Island Tunnel.

Record Drawings: Accession Numbers 601305 to 601547.

Condition Assessment and Recent Upgrades: The Intermediate Pump Station (2005) is 13 years old and is one of MWRA's newer wastewater facilities and is in excellent condition. There are no operational problems and no immediate upgrades are anticipated.

Projects Recommended for Consideration in Future CIPs:

- Intermediate Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.15 New Neponset Valley Sewer Pump Station

- Address: University Road, Canton
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: N/A – This station is activated only during peak flow, generally resulting from an extreme storm event.
- Peak Capacity: 46 mgd


New Neponset Valley Sewer Pump Station

Facility Function & Operation: The New Neponset Valley Sewer Pump Station was built in 1995. The facility was constructed to supplement the hydraulic capacity of the 60-inch New Neponset Valley Sewer. The facility pumps wastewater through a 48-inch force main parallel to the New Neponset Valley Sewer to a downstream location where the capacity of the gravity sewer is greater. The tributary area includes Canton, Norwood, Stoughton, and Walpole and is served by separate sanitary sewers. During average (dry weather) flow, the facility is not operated and is isolated from the New Neponset Valley (gravity) Sewer via gates. During peak (wet weather) flow, the station can be activated either automatically or manually when the wastewater flow elevation in the upstream diversion chamber reaches the activation elevation. When the facility is activated, the New Neponset Valley Sewer can be operated in parallel or can be isolated by diversion gates forcing all flow through the pump station.

Facility Components: Major facility components include: three variable speed pumps, one automatic inlet sluice gate, one automatic sluice gate for isolation of the New Neponset Valley Sewer, two motorized slide screen gates, one mechanical bar screen, one manual bar screen, three strap-on ultrasonic flow meters, an activated carbon odor control system (installed in 2010), one ultrasonic and one pressure diversion chamber level sensor, and a redundant ultrasonic wet well level sensor.

Hydraulic Performance: When the facility is activated (during wet weather conditions), it serves to relieve potential surcharging and sanitary sewer overflows in the upstream tributary sewers. The pump station force main discharges to the lower reaches of the New Neponset Valley Sewer near the intersection of Brush Hill Road and Neponset Valley Parkway in Milton. Surcharging in the High Level Sewer during extreme storm events may limit the capacity of the downstream portion of the New Neponset Valley Sewer to transport flow.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (900 kW) provides backup power. The fuel oil storage tank is scheduled to be replaced under the Fuel Oil Tank Replacement Design and Construction project.

Standard Operating Procedures (SOPs): An O&M manual was prepared in 1995.

Force Main: Sections 675, 676, and 676A, 21,409 feet of 48-inch diameter ductile iron pipe, constructed in 1992.

Record Drawings: Accession Numbers 200,587 to 200,635.

Condition Assessment and Recent Upgrades: The New Neponset Valley Sewer Pump Station is in very good condition with no operational problems and no immediate upgrades are anticipated.

Projects Recommended for Consideration in Future CIPs:

- New Neponset Valley Sewer Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.16 North Dorchester Bay CSO Storage and Pump Facilities

- Address: 1950 William J. Day Boulevard, South Boston
- Location Map: See Figure 10-1 and 10-3
- Average Daily Flow: N/A – only operated during peak (wet weather) flow
- Maximum Storage Capacity: 19 million gallons

Facility Function and Operation: The North Dorchester Bay CSO Storage and Pump Facilities were completed and put into operation in 2011. During normal (dry weather) flow conditions, the facility receives minimal infiltration from the tributary stormwater system and tidal waters from leaking tide gates. The dry weather flow tributary area includes portions of South Boston. During storm events, the facility captures stormwater from separate areas that would have discharged to the beaches. BWSC CSO regulators that are overtopped during storm events also add flow to the storage tunnel. Storm water and CSO flows that enter the storage tunnel are screened and pumped back to BWSC's South Boston interceptor, which is tributary to the Columbus Park Headworks.

Facility Components: Major facility components, shown in Figure 10-3, include: 10,830-foot long, 17-foot diameter tunnel that can hold up to a total 19 million gallons of CSO and stormwater flow; CSO and stormwater diversion structures and gates that direct flows into the tunnel at each outfall; a 15 mgd tunnel-dewatering pump station located at MassPort's Conley Terminal adjacent to the downstream end of the tunnel, a 24-inch diameter tunnel dewatering force main; a below-ground tunnel ventilation and odor control building behind the State Police Barracks on Day Boulevard (adjacent to the upstream end of the tunnel).

Hydraulic Performance: Activation of the CSO facility during storm events will eliminate CSO activations up to the 25-year storm and eliminate stormwater discharges up to the 5-year storm.

Facility Vulnerability to Severe Weather and Flooding: The ventilation building for the North Dorchester Bay CSO Storage Facility has been identified as being "Likely Affected by a 100 Year Storm". The North Dorchester Bay CSO Pump Station has been identified as being "Likely Affected by Storm Within 1 foot below a 100 Year Storm".

Facility Power: Electric power is from local electric service. There is no onsite standby generator.

Standard Operating Procedures (SOPs): The facility SOP was developed in 2011.

Force Main: A 4000 foot long, 24-inch diameter tunnel dewatering force main connects to a local BWSC sewer on N Street.

Outfalls: CSO and stormwater diversion structures were constructed at outfalls BOS081, BOS082, BOS083, BOS084, BOS085, BOS086, and BOS087. Outfalls BOS083 and BOS087 are closed.

Record Drawings: Accession Numbers 227,848 to 228,007 and 228,977 to 229,048.

Condition Assessment and Recent Upgrades: The North Dorchester Bay CSO Storage and Pump Facilities (2011) are seven years old and in very good condition. No immediate upgrades are anticipated.

Projects Recommended for Consideration in Future CIPs:

- North Dorchester Bay CSO Storage and Pump Facility is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

FIGURE 10-3

North Dorchester Bay CSO Storage Tunnel and Related Facilities

10.17 Prison Point Pump Station and Pumped CSO Facility


Prison Point Facility

- Address: One Monsignor O'Brien Highway, Cambridge
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 2.0 mgd during normal, dry-weather flow conditions.
- Peak Capacity: 5 mgd peak dry weather pumping, 323 mgd peak wet weather pumping capacity to CSO Outfall MWR203

Facility Function and Operation: The Prison Point Pump Station and Pumped CSO Facility was built in 1980 and an upgrade of the facility was completed by MWRA in 1999. Upgrades of the HVAC and odor controls systems were completed in FY13. During normal (dry weather) flow conditions, wastewater collected in the Cambridge Marginal Conduit and Boston Marginal Conduit is pumped from the facility via an 18-inch force main that discharges to the Charlestown Branch Sewer and ultimately flows to the Chelsea Creek Headworks. The dry weather flow tributary area includes portions of Cambridge and Boston and is served by mostly combined sewers. During peak (wet weather) flows, the facility provides screening, sedimentation, and disinfection treatment for wastewater collected in: (1) the Cambridge Marginal Conduit, (2) the Boston Marginal Conduit, (3) combined sewer overflow from 96-inch McGrath Highway Somerville/Cambridge Sewer, and (4) combined sewer overflow from a regulator on the Charlestown Branch Sewer (60-inch Millers River Overflow Interceptor). Wet weather flows are screened and chlorinated before discharge to the sedimentation/detention tanks (1.2 mg volume). The flow is dechlorinated and discharged to the Upper Inner Harbor at CSO Outfall MWR203 via a 96-inch force main. The wet weather system provides treatment for flows up to 323 mgd and a detention time of approximately 5.5 minutes at peak flow. During smaller storms, the entire CSO volume may be stored in the sedimentation/detention tanks and pumped back to the Charlestown Branch Sewer.

Facility Components: Major facility components include: one influent sluice gate, one dry weather flow sluice gate, three wet weather inlet structure sluice gates, one dry weather flow mechanical screen and grinder, three wet weather flow mechanical screens, six 200,000 gallon sedimentation/detention tanks, two 2.5 mgd dry weather flow pumps, four diesel engine driven wet weather pumps (three 115 mgd and one 58 mgd), one 2.16 mgd stripping pump, chemical treatment (chlorination and dechlorination) system, one influent dry weather flow parshall flume meter, and one effluent wet weather flow meter.

Hydraulic Performance: Activation of the CSO facility during storm events controls the hydraulic grade line elevations in upstream conduits. Without the facility, combined wastewater would surcharge the upstream system and discharge through several upstream CSO outfalls, including: MWR018, MWR019, and MWR020 along the Boston Marginal Conduit, and CAM017 along the Cambridge Marginal Conduit.

Facility Vulnerability to Severe Weather and Flooding: The Prison Point CSO Facility has been identified as being "Very Unlikely to be Affected".

Facility Power: The primary electrical power is from local commercial service. A diesel generator (285 kW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 2006.

Record Drawings: Record drawings for Contract 6795 - HVAC Upgrades were completed in FY13.

Dry Weather Force Main: Section 198, 1,934 feet of mostly 18-inch diameter reinforced concrete pipe, constructed in 1974-1977.

Wet Weather Force Main: Section 199, 2,193 feet of mostly 96-inch diameter reinforced concrete pipe, constructed in 1973-1974.

Outfall MWR203: Section 199, 323 feet of mostly 96-inch, 84-inch, and 72-inch diameter reinforced concrete pipe, constructed in 1973.

Condition Assessment and Recent Upgrades: The Prison Point Pump Station and Pumped CSO Facility (1980) is 38 years old. Equipment replaced as part of the upgrade in 1999, under the CSO Control Plan (see Chapter 11), is 18 years old. The facility upgrade included the replacement of the chlorine disinfection system and addition of a dechlorination system, as well as process control and safety improvements. Instrumentation and control improvements were made in 2007 as part of the SCADA Implementation Program. In FY12, a planning report was completed to evaluate the condition of the facility structures, process equipment, electrical, mechanical, instrumentation, and HVAC systems. The report identified items needing to be upgraded, primarily due to the facility age. Upgrade of the HVAC and odor controls systems were completed in FY13 at a cost of $3.205 million. In FY15-16, the diesel engines were upgraded to reduce air emissions, the shafts and impellers on the wet weather pumps were replaced, and the gear drives serving the pumps were rehabilitated. Additional piping upgrades were completed in FY18. The station is in fair to good condition, but based on equipment age, it is anticipated that station equipment will begin to have operational problems in the upcoming years. A comprehensive station upgrade is underway and is programmed in the FY19 CIP during FY17-22.

Projects in the Existing FY19 CIP:

- The Prison Point CSO Rehabilitation design, construction administration, resident inspection, and construction project is programmed in the FY19 CIP at a total cost of $34.820 million in FY17-22. Total expenditures during the planning period (FY19-22) are $33.433 million. This 6-year project will include upgrading of facility equipment including: dry weather pumps; dry and wet weather screens; influent and effluent sluice gates, flow meter, mechanical, electrical, chemical feed, security, fire alarm, and instrumentation systems; building upgrades; and flood control measures.

Projects Recommended for Consideration in Future CIPs:

- Prison Point Pump Station and Pumped CSO Facility is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.18 Quincy Pump Station

- Address: 41 Fenno Street, Quincy
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 6.0 mgd
- Peak Capacity: 22 mgd

Facility Function and Operation: The Quincy Pump Station was built in 2002. This facility replaced the original pump station built in 1908. The Quincy Pump Station lifts wastewater from upstream community-owned sewers in Quincy to the High Level Sewer that connects to the Nut Island Headworks. The 3,100-acre tributary area is served by separate sanitary sewers.

Facility Components: Major facility components include: three variable speed pumps, one motorized inlet sluice gate, one in-channel grinder, one manual bar screen, one magnetic flow meter, and two wet well level sensors.

Hydraulic Performance: No problems.

Facility Vulnerability to Severe Weather and Flooding: The Quincy Pump Station has been identified as being "Likely Affected by a 100 Year Storm".

Facility Power: The primary electrical power is from local commercial service. A diesel generator (500 kW) provides backup power. A new above ground diesel storage tank was complete in FY18. The new tank will provide 5 days of diesel storage.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 2004.

Force Main: Section 660, 2754 feet of 30-inch diameter cast iron pipe, constructed in 1923 and cement lined in 1999.

Record Drawings: Accession Numbers 600,713 to 600,766.

Condition Assessment and Recent Upgrades: The Quincy Pump Station (2002) is 16 year old and is in very good condition. There are no operational problems and no immediate upgrades are anticipated.

Projects Recommended for Consideration in Future CIPs:

- Quincy Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.19 Somerville Marginal Gravity CSO Facility

- Address: 274 Mystic Avenue, Somerville
- Location Map: See Figure 10-1
- Average Daily Flow: N/A – only operated during peak (wet weather) flow
- Peak Capacity: 145 mgd (dependent on downstream tide elevation)

Facility Function & Operation: The Somerville Marginal Gravity CSO Facility was built in 1971 with some upgrades completed in 2001 under the CSO Control Plan. The facility is designed to provide screening and disinfection to combined sewer overflows prior to discharge to the Mystic River via outfalls SOM007A/MWR205A and MWR205. The facility serves to prevent excessive surcharge and possible flooding in the upstream East Somerville community system. The tributary area (approximately 700 acres) includes both combined and separate sanitary sewers. The station is activated by opening the influent gates when the hydraulic grade line at regulators within McGrath Highway exceeds a high weir elevation and the level in the facility influent structure rises to a predetermined set-point. Flow entering the CSO facility receives screening and disinfection (chlorination) prior to being discharged by gravity to the 7.5x10-foot outfall conduit that receives additional stormwater from downstream systems. The CSO flow is dechlorinated at the downstream remote sampling building. CSO discharges either occur downstream of the Amelia Earhart Dam (through permitted outfall MWR205 during mid to low tides), or upstream of the dam (through permitted outfall SOM007A/MWR205A during mid to high tide). The facility is deactivated when the depth of flow entering the facility falls below a predetermined set-point or the flow through the facility stops due to high downstream tidal elevations.

Facility Components: Major facility components include: two automatic influent sluice gates, two automatic bar screens, two 6,000 gallon hypochlorite storage tanks, two 4,000 gallon sodium bisulfite storage tanks, chemical feed system including a remote sample building, and two flow meters (influent and trans conduit).

Hydraulic Performance: The CSO facility accepts overflow from upstream CSO regulators and storm drains. Upstream CSO regulators provide relief to the local combined collection system that flows to the Somerville-Medford Branch Sewer under dry weather conditions. The facility discharges to the Somerville Marginal Conduit which conveys flow to the Mystic River through one of two outfalls - either downstream of the Amelia Earhart Dam (through permitted outfall MWR205 during mid to low tides) or upstream of the dam (through permitted outfall SOM007A/MWR205A during mid to high tide). Mean high water downstream of the dam is approximately elevation 110 (MWRA base), but can rise to approximately 115 (MWRA base) during extreme tides or storm surges. The normal elevation of the Mystic River Basin is approximately elevation 107 (MWRA base). The two CSO outfall discharges provide operational flexibility and allow the gravity facility to continue to function under high tides.

Facility Vulnerability to Severe Weather and Flooding: The Somerville Marginal CSO Facility has been identified as being “Very Unlikely to be Affected”.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (100 kW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 2009.

Force Main: N/A – Somerville Marginal Gravity CSO is a gravity facility.

Record Drawings: Accession Numbers 10280 to 10295.

Condition Assessment and Recent Upgrades: The Somerville Marginal Gravity CSO Facility (1971) is 47 years old, twice the average age for MWRA facilities and is well beyond the 20-year old milestone. In 2001, MWRA completed an upgrade project under the CSO Control Plan (see Chapter 11). The facility upgrades included replacement of the chlorine disinfection system and addition of a dechlorination system, as well as process control and safety improvements. Additional instrumentation and automation upgrades were performed at the facility in 2007. In addition, the electrically actuated facility influent gates were replaced in FY12 along with the installation of stop logs upstream and downstream of the facility and small dewatering pumps to ensure CSO flow does not enter the receiving water prior to facility activation. The main station building remains in fair to good condition. There are no major operational problems. The separate chemical storage and remote sampling buildings are in very good condition. It is anticipated that station equipment will begin to have operational problems due to the age of the facility. The station is included in a project to assess equipment replacement and upgrades.

Projects in the Existing FY19 CIP:

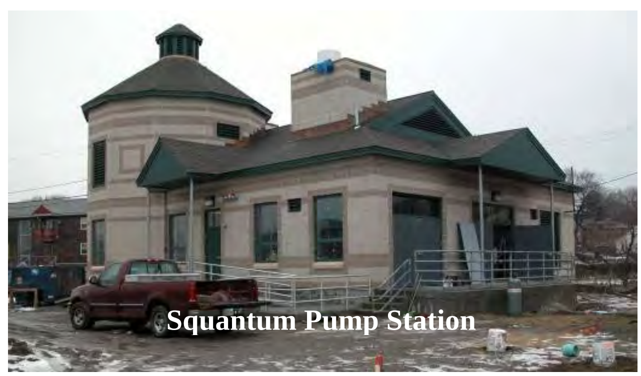
- Somerville Marginal Gravity CSO Facility is included in the Pump Station and CSO Condition Assessment for MWRA's older Facilities project that is programmed in the FY19 CIP at a total cost of $3.136 million in FY20-24. This 5-year project will provide professional engineering services including planning, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's older pump stations and CSO facilities. A second phase project will provide additional study and preliminary design services (see below). Final design and construction phases will be added in the future. The older pump station and CSO facilities included are: Caruso PS, DeLauri PS, Hayes PS, Hingham PS, Somerville Marginal CSO, and Wiggins - Castle Island Terminal PS.
- Somerville Marginal Gravity CSO Facility is included in the Pump Station and CSO Rehabilitation Preliminary Design/Study for three MWRA's older Facilities project that is programmed in the FY19 CIP at a cost of $750,000 in FY21-22. This 2-year project will follow-up on the condition assessment project noted above.

Projects Recommended for Consideration in Future CIPs:

- Somerville Marginal Gravity CSO Facility Upgrades Design and Construction is recommended for consideration in future CIPs at an estimated cost of $5.0 million during the FY24-28 timeframe. Upgrades to be designed/constructed under this project will be identified in the Condition Assessment and Preliminary Design/Study projects for MWRA's older Facilities.

10.20 Squantum Pump Station

- Address: 36 Newland Street, Quincy
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 1.0 mgd
- Peak Capacity: 7.5 mgd



Facility Function & Operation: The Squantum Pump Station was built in 2003. This facility replaced the original pump station built in 1930. The Squantum Pump Station lifts wastewater from upstream community-owned sewers in Quincy to the High Level Sewer that connects to the Nut Island Headworks. The small tributary area (approximately 500 acres) is served by separate sanitary sewers.

Facility Components: Major facility components include: four variable speed pumps, one motorized inlet sluice gate, one in-channel grinder, two manual bar screens, one magnetic flow meter, and two wet well level sensors.

Hydraulic Performance: No problems.

Facility Vulnerability to Severe Weather and Flooding: The Squantum Pump Station has been identified as being "Likely Affected by a 100 Year Storm".

Facility Power: The primary electrical power is from local commercial service. A diesel generator (250 kW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 2004.

Force Main: Sections 659, 659A, and 659B; 4,582 feet of 24-inch diameter ductile iron pipe, constructed in 1969 and rehabilitated with cured-in-place liner in 1995; 8,115 feet of 30-inch diameter ductile iron pipe, constructed in 1969/70 and cement lined in 1999 with approximately 1,000 feet of cured-in-place liner used for the most corroded sections; 6,307 feet of 30-inch diameter pre-stressed concrete cylinder pipe, constructed in 1970. Cathodic protection was installed on the 8,115-foot portion of ductile iron pipe in 2002/2003. In April 2010, 375 linear feet of the 30-inch diameter pre-stressed concrete cylinder pipe portion of force main was repaired with a cured-in-place liner after the failure of a 50-foot section caused by internal hydrogen sulfide corrosion at a high point in the force main. Since the 40-year old force main is nearing the end of its useful life and is subject to internal corrosion from hydrogen sulfide, it should be replaced. In Chapter 9 of the Wastewater System Master Plan (Section 9.08 – Force Mains and Related Valves), a force main asset protection project is recommended for consideration in future CIPs at a total cost of $20.0 million. A portion of these funds may be used for future planning, design, and construction for replacement of the Squantum Pump Station force main.

Record Drawings: Accession Numbers 203,154 to 203,205.

Condition Assessment and Recent Upgrades: The Squantum Pump Station (2003) is 15 years old and is in good to excellent condition. There are no operational problems and no immediate upgrades are anticipated.

Projects Recommended for Consideration in Future CIPs:

- Squantum Pump Station is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough’s Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.21 Union Park CSO Facility

- Address: 120 Malden Street, Boston
- Location Map: See Figure 10-1
- Average Daily Flow: N/A – only operated during peak (wet weather) flow
- Peak Capacity: Approximately 300 mgd (BWSC's pumping capacity)


Union Park CSO Facility

Facility Function and Operation: The Union Park CSO Facility was constructed in 2007. The facility provides detention and treatment to CSO flows that are discharged through BWSC's Union Park Pump Station and ultimately discharge into the Fort Point Channel via outfall BOS070. BWSC's Union Park Street Pump Station, constructed in 1976, provides flood control for the South End neighborhood of Boston. Wastewater flow passes through the CSO treatment facility before entering BWSC's pumping station wet well. The CSO facility is designed to run automatically and includes coarse screens, fine screens, chlorination with sodium hypochlorite, dechlorination with sodium bisulfite and odor control equipment. Flow retained in the CSO detention basin is pumped to a BWSC sewer in Malden Street when capacity becomes available after a storm event.

The Union Park CSO Facility is operated via an outside contract that is jointly managed and paid for by BWSC and MWRA. The cost of the contract is mostly covered by BWSC (73 percent) given the inclusion of nine other small BWSC-owned pump stations in the contract. The current 3-year contract began on March 1, 2017. At the end of the contract (March 2, 2020), MWRA and BWSC have the option to extend the contract for up to two additional years. MWRA staff review and approve contractor invoices, review reports used for regulatory reporting purposes, and monitor the contractor's performance.

CSO Facility Components: Major facility components for the Union Park CSO Facility include: six detention basins, two coarse screens, four fine screens, six 250 gpm dewatering pumps, odor control equipment, and flushing gates.

Union Park Pump Station Pumps: BWSC's Union Park Pump Station includes six wet weather pumps – four 100 mgd diesels and two 17 mgd electric.

Hydraulic Performance: The CSO building was constructed adjacent to the BWSC Union Park Pump Station to house the CSO treatment equipment. The underground detention basins have a combined storage capacity of 2.2 million gallons. The CSO facility storage capacity reduces the number of pumping station discharges to the Fort Point Channel.

Facility Vulnerability to Severe Weather and Flooding: The Union Park CSO Facility has been identified as being "Likely Affected by Storm Within 1 foot below a 100 Year Storm".

Facility Power: The primary electrical power is from local commercial service. A diesel generator (1250 kW) provides backup power.

Standard Operating Procedures (SOPs): An O&M manual was developed in 2008 and updated in 2011.

Force Main: The CSO Facility dewatering force main is a 22-foot long, 10-inch diameter ductile iron pipe that connects to an existing BWSC sewer on Malden Street. The discharge line is owned and maintained by BWSC.

Record Drawings: Accession numbers 225365 to 225586.

Condition Assessment and Recent Upgrades: The Union Park CSO Facility (2007) is 11 years old and is in excellent condition. There are no operational problems and no immediate upgrades are anticipated.

Projects Recommended for Consideration in Future CIPs:

- Union Park CSO Facility is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.22 Wiggins - Castle Island Terminal Pump Station

- Address: Conley Terminal, South Boston
- Location Map: See Figure 10-1
- Average Daily Flow: 0.1 mgd
- Peak Capacity: 0.5 mgd

Facility Function and Operation: The Wiggins - Castle Island Terminal Pump Station was originally built in 1943 by the US Navy and likely upgraded in 1960 when upstream sewers were extended. This facility lifts wastewater from the upstream MWRA Castle Island and Conley Terminal Sewer and discharges flow to a local BWSC sewer on Day Boulevard in South Boston. Wastewater from this station is tributary to the Columbus Park Headworks. The tributary area includes DCR's facilities on Castle Island and MassPort's facilities at Conley Terminal.

Facility Components: Facility components include two 350 gpm pumps and a manual screen.

Hydraulic Performance: No problems.

Facility Vulnerability to Severe Weather and Flooding: The Wiggins – Castle Island Terminal Pump Station has been identified as being “Likely Affected by a Hurricane only”.

Facility Power: The electrical power is from local commercial service. No backup power is provided. A future project to add a generator is recommended.

Standard Operating Procedures (SOPs): There is no written SOP for this facility.

Force Main: The 8-inch diameter force main is short and connects to a local BWSC sewer.

Record Drawings: Accession numbers 201,668 and 42,260 through 42,263.

Condition Assessment and Recent Upgrades: The Wiggins - Castle Island Terminal Pump Station is the second oldest (1960) and the smallest of the 20 MWRA facilities reviewed in this Chapter. The station is in fair to poor condition. The pumps have been replaced by in-house staff as needed and are currently in good condition. The facility is inspected monthly by Operations staff to ensure the facility is in good working order. If Operations identifies that the screen requires cleaning, in-house staff complete the screen cleaning. The entire facility should be evaluated for upgrade or replacement.

Projects in the Existing FY19 CIP:

- Wiggins – Castle Island Terminal Pump Station is included in the Pump Station and CSO Condition Assessment for MWRA’s older Facilities project that is programmed in the FY19 CIP at a total cost of $3.136 million in FY20-24. This 5-year project will provide professional engineering services including planning, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA’s older pump stations and CSO facilities. The older pump station and CSO facilities included are: Caruso PS, DeLauri PS, Hayes PS, Hingham PS, Somerville Marginal CSO, and Wiggins - Castle Island Terminal PS.
- The Wiggins Terminal Pump Station Rehabilitation design and construction project is programmed in the FY19 CIP at a total cost of $2.579 million in FY19-22. This 4-year project will include upgrading of facility equipment and SCADA system.

Projects Recommended for Consideration in Future CIPs:

- Wiggins - Castle Island Terminal PS is included in the Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project that is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough’s Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO

Facility, as well as some older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility, and Wiggins - Castle Island Terminal PS.

10.23 Braintree Howard Street Pump Station

Through agreement with the Town of Braintree, MWRA utilizes Braintree's Howard Street Pump Station to transport wastewater from a small portion of Quincy. MWRA pays Braintree an annual fee for the use of the Town's wastewater facilities. Costs for use of Braintree's Howard Street Pump Station are an annual Field Operations CEB expense.

In 1962, the Massachusetts Legislature enacted "Chapter 684 – An act authorizing the MDC to construct certain sewerage works in the Town of Braintree and to contract with the Town of Braintree for the disposal of sewage from a low area in the City of Quincy." On September 12, 1962, MDC and the Town of Braintree entered into an Agreement that allowed MDC to connect to and use a portion of the available capacity in Braintree's Howard Street Pump Station to transport sewage from a small section of Quincy. Subsequently, the MDC constructed Sewer Section 654 (previously known as Section 125A under MDC nomenclature), a 210 foot, 8-inch diameter vitrified clay pipe constructed in West Howard Street in Braintree. The MDC sewer was put into service on July 1, 1963. The Agreement provided that MDC would pay Braintree annually for use of the Town's sewage facilities.

On March 19, 1990, MWRA and the Town of Braintree signed a successor Agreement regarding MWRA's use of the Town's Howard Street Pump Station. The Agreement provided that MWRA would make payments to the Town for fiscal years 1990 through 1995 equivalent to 25 percent of the total annual cost of operating, maintaining, and constructing capital improvements to the pump station. All MWRA wholesale sewer charges were separate and distinct from payments under the Agreement. On January 15, 2003, the MWRA Board of Directors authorized payment to Braintree for MWRA's past use of the Howard Street Pump Station for fiscal years through 2002, pursuant to conditions of the 1990 Agreement. MWRA and Braintree began negotiations regarding a successor Agreement to the 1990 Agreement; however, as of July 2018, no successor Agreement had been executed. As of July 2018, the last bill from Braintree to MWRA for use of the Town's Howard Street Pump Station (and subsequent payment from MWRA to Braintree) was for FY02.

<u>MWRA In-House Task</u>:

- The MWRA should continue to work with the Town of Braintree to finalize a successor Agreement to the 1990 Agreement regarding MWRA's use of Braintree's Howard Street Pump Station. A new Agreement should be approved by the MWRA Board of Directors. An annual bill should be assessed from Braintree to MWRA and an annual payment should be made by MWRA to Braintree.

10.24 Decommissioned Facilities and Pipeline Easements

Some MWRA pump stations facilities have been decommissioned and no longer serve their original purpose; however, future capital or maintenance expenditures may be needed at some of these facilities. In addition, the potential for maintaining pipeline easements may impact MWRA's decision making. A number of decommissioned facilities have been transferred to the control of the Division of Capital Asset Management (DCAM) or sold and MWRA has no further responsibility for the facilities. A summary is provided in this section.

Decommissioned Facilities with Responsibilities Retained by MWRA

Charlestown Pump Station: The former Charlestown Pump Station, located at 171 Alford Street in Charlestown, was originally constructed in 1895. The function of this station was replaced by the DeLauri Pump Station in 1993. However, the influent siphon to the DeLauri Pump Station (after crossing under the Mystic River), is located beneath the building footprint of the former Charlestown Pump Station. The Charlestown Pump Station building is national register eligible. A Memorandum of Agreement between MWRA, EPA, MHC, and the Advisory Council was signed in 1995. MWRA continues to evaluate reuse options for the facility. Pipeline easements must be maintained to facilitate future rehabilitation options for the influent sewer to the DeLauri Pump Station.

Commercial Point Gravity CSO Facility: The former Commercial Point Gravity CSO Facility, located at 50 Park Street, Dorchester, was built in 1991. The facility provided screening and disinfection to combined sewer overflows prior to discharge to the Commercial Point CSO Outfall (BOS090). The facility was decommissioned by MWRA in 2008 following completion of sewer separation construction in the tributary area. The building is still being maintained by MWRA. In 2018, the facility's underground fuel storage tank was removed eliminating heat and the fire protection system. A demolition cost estimate of approximately $330,000 was prepared in spring of 2009 with the assistance of a task order consultant.

Decommissioned Facilities with only Pipeline Easement Considerations

East Boston Steam Pump Station: The former East Boston Steam Pump Station building, located at 20 Addison Street in East Boston, was constructed in 1894. The function of this station was replaced by the Caruso Pump Station in 1991. The property was transferred to DCAM in 2004. MWRA has no further responsibility for this building. Easement rights were retained for MWRA Sewer Sections in East Boston.

Ward Street Pump Station: The former Ward Street Pump Station, located off Ward Street in Roxbury, was constructed in 1938. The function of this station was replaced by the Ward Street Headworks in 1967. The Ward Street Pump Station building was demolished in 1968. This property was previously transferred to DCAM but easement rights were retained for two 48-inch force mains. Staff should investigate if any additional work may be required to finalize abandonment of the pipelines associated with the former pump station.

Decommissioned Facilities with No Responsibilities Retained by MWRA

Constitution Beach Gravity CSO Facility: The former Constitution Beach Gravity CSO Facility is located in East Boston. The facility provided screening and disinfection to combined sewer overflows prior to discharge to the Constitution Beach CSO Outfall (BOS002/MWR207). It was decommissioned by MWRA in 2000 following completion of sewer separation construction in the tributary area. The building and site were transferred to the control of the Division of Capital Asset Management (DCAM) in 2003. MWRA has no further responsibility for this building.

East Boston Electric Pump Station: The former East Boston Electric Pump Station building, located at 600 Chelsea Street in East Boston, was constructed in 1938. The function of this station was replaced by the Caruso Pump Station in 1991. The property was transferred to DCAM in June 2002. MWRA has no further responsibility for this building.

Fox Point Gravity CSO Facility: The former Fox Point Gravity CSO Facility, located at 170 Freeport Street in Dorchester, was built in 1989. The facility provided screening and disinfection to combined sewage and stormwater runoff prior to discharge to the Fox Point CSO Outfall (BOS089) or the Malibu Beach CSO Outfall (BOS088). The facility was decommissioned by MWRA in 2008 following completion of sewer separation construction in the tributary area. The property was sold to Electrical Workers Local 103 (I.B.E.W.) Educational Corporation in 2014. MWRA has no further responsibility for this building.

Mystic Pump Station/Mystic Shops: The former Mystic Pump Station building, located at two Capen Court in Somerville, was constructed in 1864. The function of this station was replaced by the Alewife Brook Pump Station in 1951. The property was transferred to DCAM and ultimately to the City of Somerville. MWRA has no further responsibility for this building.

10.25 Reinvestment Needs Based on Estimated Replacement Asset Value

MWRA staff developed a replacement cost valuation of MWRA's infrastructure using MWRA-specific appraisal data and actual MWRA project cost information during development of the 2006 Master Plan. For the 2013 and 2018 updates of the Master Plan, the 2006 replacement asset value analysis was reused (in 2006 dollars) with only minor revisions for new facilities added after 2006. One of the revisions was an increase of $270 million (change from $370 million to $640 million) in the Pump Stations and CSO Facilities category that was made to account for the following new facilities: Union Park CSO Facility, BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement Pump Station, and North Dorchester Bay CSO Storage and Pump Facilities, as well as significant upgrades to the Alewife Brook Pump Station. Based on this analysis, MWRA's twenty pump stations and CSO facilities have a replacement asset value of $640 million. Staff then applied industry benchmarks for asset useful life (50-years for structural components and 20-years for equipment components) to estimate reinvestment needs. For pump station and CSO facilities, 60 percent of the asset value was allocated as structural (50-year useful life) components and 40 percent of the asset value was allocated as equipment (20-year useful life) components. Using the allocated asset value and dividing by the expected useful life, produces an overall estimated reinvestment need of $20 million per year for pump stations and CSO facilities. It is assumed that the majority of this reinvestment need will be met via specific large-scale rehabilitation/replacement projects that will be fully detailed, evaluated, and justified within MWRA's annual CIP process. However, a portion of the reinvestment need is likely to be met via small-scale rehabilitation/replacement projects that, individually, may be difficult to justify within the annual CIP process. To provide for small-scale rehabilitation/replacement projects at MWRA's pump station and CSO facilities, a Long-term Wastewater Facility Asset Protection Project (for Pump Station and CSO Facilities) is recommended for consideration in future CIPs at an estimated annual cost of $2.0 million per year (10 percent of the $20 million total estimated annual reinvestment need) during the FY24-58 timeframe. Facility planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change. Facility planning should also include hazardous material removal/disposal and rehabilitation projects which may be identified. Similar long-term asset protection funds are recommended separately for remote headworks (see Chapter 8).

10.26 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to collection system pump stations and CSO facilities are summarized in this Section. Table 10-2 lists each project, its priority ranking, and proposed expenditure schedule. A description and needs justification for each project is listed in bullet format. This Section is provided as a summary of all existing and recommended capital projects; each project has been detailed previously in the Chapter within Sections relating to specific facilities or asset types.

<u>Projects in the Existing FY19 CIP</u>:
There are nine pump station and CSO facility related projects programmed in the FY19 CIP. The projects are described below and summarized in Table 10-2 (see line numbers 10.01 through 10.09).

- Alewife Brook Pump Station Rehabilitation design, construction administration, resident inspection, and construction project began in FY12 and is scheduled to be completed in FY20 at a total cost of $15.515 million. This project is a comprehensive rehabilitation of the pump station. Total expenditures during the planning period (FY19-20) are $3.888 million. The upgrade will include replacing the three larger station (wet weather) pumps, motors, gear drives VFD drives, the motor control center, and piping (adding pump redundancy and increasing pump reliability/efficiency); replacing sluice gates, climber screens and grinders; updating the HVAC system; updating the electrical system; adding a flow meter, remediating PCB-contaminated paint, modifying the building interior to meet current building codes, new roof, energy efficiency improvements, adding flood protection measures to 2.5 feet above 100-year flood elevation, and security improvements.

- Braintree/Weymouth Replacement Pump Station improvements design, construction services, resident inspection, and construction are programmed in the FY19 CIP as an 8-year project FY19-26 at a total cost of $8.860 million. Facility improvements are recommended to address deficiencies in odor control, solids handling, and pumping operations.

- The Pump Station and CSO Condition Assessment for MWRA's older Facilities project is programmed in the FY19 CIP at a total cost of $3.136 million in FY20-24. This 5-year project will provide professional engineering services including planning, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's older pump stations and CSO facilities, including: Caruso PS, DeLauri PS, Hayes PS, Hingham PS, Somerville Marginal CSO, and Wiggins - Castle Island Terminal PS.

- The Pump Station and CSO Rehabilitation Preliminary Design/Study for three of MWRA's older Facilities project is programmed in the FY19 CIP at a cost of $750,000 in FY21-22. This 2-year project will follow-up on the condition assessment project. The three older pump station and CSO facilities included are: Hayes PS, Hingham PS, and Somerville Marginal CSO.

- Cottage Farm CSO Rehabilitation Design, Construction Administration, Resident Inspection, and Construction project is programmed in the FY19 CIP at a cost of $14.017 million in FY22-26. This 5-year project will include upgrading of facility equipment including: pumps; sluice gates; screen gearboxes; mechanical, electrical, chemical feed, security, fire alarm, and instrumentation systems; roof and other building upgrades; and flood control measures.

- DeLauri Pump Station Screen and Security Improvements construction project is programmed in the FY19 CIP at a cost of $1.330 million in FY18-20. Total expenditures during the planning period (FY19-20) are $1.108 million. This project will replace existing bar screens, sluice gates, pump valves, and install security upgrades for the facility.

- Prison Point CSO Rehabilitation design, construction administration, resident inspection, and construction project is programmed in the FY19 CIP at a total cost of $34.820 million in FY17-22. Total expenditures during the planning period (FY19-22) are $33.433 million. This 6-year project will include upgrading of facility equipment including: pumps; dry weather screens; mechanical, electrical, chemical feed, security, fire alarm, and instrumentation systems; building upgrades; and flood control measures.

- Wiggins Terminal Pump Station Rehabilitation design and construction project is programmed in the FY19 CIP at a total cost of $2.579 million in FY19-22.

- The Fuel Oil Tank Replacement Design and Construction project to replace the fuel oil storage tanks at some facilities is programmed in the FY19 CIP at a total cost of $5.636 million including phases 1, 2, and 3 constructions. This 6-year project is scheduled for FY20-25. Both water and wastewater facilities are included in this project, but all costs are carried within this chapter of the Master Plan. Facilities that may be included in this project are: Deer Island Treatment Plant, Columbus Park Headworks, Ward Street Headworks, Alewife Brook Wastewater Pump Station, Caruso Wastewater Pump Station, Commercial Point Wastewater CSO Facility, DeLauri Wastewater Pump Station, Hayes Wastewater Pump Station, New Neponset Wastewater Pump Station, Gillis Water Pump Station, Lexington Street Water Pump Station, the Water Facility in Southborough, and vehicle fueling facilities.

Projects Recommended for Consideration in future CIPs: There are nine pump station and CSO facility related projects recommended for consideration in future CIPs. These projects are described below and summarized in Table 10-2 (see line numbers 10.10 to 10.18).

- Caruso Pump Station Upgrades design and construction is recommended for consideration in future CIPs at an estimated cost of $25.0 million during the FY24-28 timeframe.

- DeLauri Pump Station Upgrades design and construction is recommended for consideration in future CIPs at an estimated cost of $25.0 million during the FY24-28 timeframe.

- Framingham Pump Station Force Main Corrosion and Odor Improvements project is recommended for consideration in future CIPs at an estimated cost of $1.5 million during the FY21-23 timeframe. Modifications at the Framingham Pump Station under this project may include: pump station automation and optimization improvements, FES flow meter modifications, automation of the force main filling, and modifications to the chemical feed facilities.

- Framingham Pump Station Sluice Gate Replacement and Screening Automation study, design and construction for replacement of three 48-inch sluice gates due to excessive hydrogen sulfide corrosion and screening improvements is recommended for consideration in future CIPs at an estimated cost of $2.0 million during the FY24-28 timeframe.

- Hayes Pump Station Upgrades Design and Construction is recommended for consideration in future CIPs at an estimated cost of $12.0 million during the FY24-28 timeframe.

- Hingham Pump Station Upgrade design/construction is recommended for consideration in future CIPs at an estimated cost of $10.0 million during FY24-28.

- Somerville Marginal Gravity CSO Facility Upgrades Design and Construction is recommended for consideration in future CIPs at an estimated cost of $5.0 million during the FY24-28 timeframe.

- A long-term Wastewater Facilities Asset Protection Project is recommended for consideration in future CIPs at an estimated annual cost of $2.0 million per year (10 percent of the $20 million total estimated annual reinvestment need) during the FY24-58 timeframe. The total estimated project cost over 35 years is $70.0 million. This project will provide annual baseline target expenditures for asset protection projects for wastewater pump stations and CSO facilities. As specific projects are identified, they will become sub-phases within the target expenditure. Facilities planning should consider potential increases in flood elevations and tidal surge due to impacts from climate change. Planning should also include hazardous material removal/disposal and rehabilitation projects which may be identified.

- The Future Pump Station and CSO Facility Condition Assessment and Upgrades for Newer Facilities project is recommended for consideration in future CIPs. This project has a placeholder budget estimate of $100.0 million to assess equipment replacement and upgrades (including planning, design, and construction) during the FY34-58 timeframe. This project would target improvements for the newer wastewater pump station and CSO facilities include: BOS019 CSO Storage Conduit, Braintree/Weymouth Replacement PS, Framingham PS, Hough's Neck PS, Intermediate PS, New Neponset Valley Sewer PS, North Dorchester Bay CSO Storage and Pump Facility, Quincy PS, Squantum PS, and Union Park CSO Facility, as well as older facilities that are currently being upgraded or are programmed in the FY19 CIP for rehabilitation during the first 10 years of the planning period (through FY28), including: Alewife Brook Pump Station, Chelsea Screen House, Cottage Farm CSO Facility, Prison Point CSO Facility and Wiggins - Castle Island Terminal PS.

Table 10-2

Wastewater Master Plan - Pump Stations and CSO Facilities

Existing and Recommended Projects

Last revision 9/20/18

Prioritization		**Project Types**	
1	Critical or Under Construction	NF	New Facility/System
2	Essential	RF/IC	Replacement Facility/Increase Capacity
3	Necessary	Opti	Optimization
4	Important	AP	Asset Protection
5	Desirable	Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		WASTEWATER PUMP STATIONS AND CSO FACILITIES												
10.01	1	Alewife Brook Pump Station Rehab - Design/CA/RE/Construction	AP	145	10382_6797 10428_7034	9 years	15,515	3,888	FY12-20	3,888				3,888
10.02	3	Braintree/Weymouth Replacement PS Improvements - Design/CS/RI/Construction	AP	104	10493_7366 19567_7435	8 years	8,860	8,860	FY19-26	1,814	7,046			8,860
10.03	2	PS and CSOs Condition Assessment for Older Facilities	Plan	145	10446_7162	5 years	3,136	3,136	FY20-24	1,068	2,068			3,136
10.04	2	PS and CSOs Rehab - Preliminary Design/Study for Older Facilities	Plan	145	10500_7375	2 years	750	750	FY21-22	750				750
10.05	3	Cottage Farm Pumped CSO Upgrades - Design, CA/RI and Construction	AP	145	10520_7463 10522_7508	5 years	14,017	14,017	FY22-26	1,114	12,903			14,017
10.06	1	DeLauri Pump Station Screens, Gates, Valves and Security Improvements - Construction	AP	145	10488_7361	3 years	1,330	1,108	FY18-20	1,108				1,108
10.07	2	Prison Point CSO Rehabilitation - Design, CA/RI and Construction	AP	145	10486_7359 10519_7462	6 years	34,820	33,433	FY17-22	33,433				33,433
10.08	2	Wiggins Terminal Pump Station - Design and Construction	AP	145	10532_7551 10533_7552	4 years	2,579	2,579	FY19-22	2,579				2,579
10.09	3	Fuel Oil Tank Replacement - Construction P1, Construction P2, Construction P3	AP	145	10535_7554 10536_7555 10539_7637	6 years	5,636	5,636	FY20-25	3,636	2,000			5,636
		SUBTOTAL - Existing - Pump Stations and CSO Facilities					**86,643**	**73,407**		**49,390**	**24,017**	**0**	**0**	**73,407**
10.10	3	Caruso Pump Station Upgrades - Design & Construction	AP	new		5 years	25,000	25,000	FY24-28		25,000			25,000
10.11	3	DeLauri Pump Station Upgrades - Design & Construction	AP	new		5 years	25,000	25,000	FY24-28		25,000			25,000
10.12	3	Framingham PS -Force Main Corrosion and Odor Improvements	NF/AP	new		3 years	1,500	1,500	FY21-23	1,500				1,500
10.13	2	Framingham PS Sluice Gate Replacement and Screening Automation - Study/Design/Construct	AP	new		5 years	2,000	2,000	FY24-28		2,000			2,000
10.14	3	Hayes Pump Station Upgrades - Design & Construction	AP	new		5 years	12,000	12,000	FY24-28		12,000			12,000
10.15	3	Hingham Pump Station Upgrades - Design & Construction	AP	new		5 years	10,000	10,000	FY24-28		10,000			10,000
10.16	3	Somerville Marginal Gravity CSO Upgrades - Design & Construction	AP	new		5 years	5,000	5,000	FY24-28		5,000			5,000
10.17	3	Long-term Wastewater Facility Asset Protection (for PS & CSO Facilities) $2M per year for FY24-58	AP	new		35 years	70,000	70,000	FY24-58		10,000	20,000	40,000	70,000
10.18	4	Future PS and CSO Facility Condition Assessment and Upgrades for Newer Facilities	AP	new		25 years	100,000	100,000	FY34-58			20,000	80,000	100,000
		SUBTOTAL - Recommended - Pump Stations and CSO Facilities					**250,500**	**250,500**		**1,500**	**89,000**	**40,000**	**120,000**	**250,500**
		SUBTOTAL - Existing and Recommended - Pump Stations and CSO Facilities					**337,143**	**323,907**		**50,890**	**113,017**	**40,000**	**120,000**	**323,907**

CHAPTER 11
COMBINED SEWER OVERFLOW CONTROL PLAN

11.01 Chapter Summary

Over the last 30 years, a major component of MWRA's CIP has been the implementation of a long-term plan for control of combined sewer overflows (CSOs). CSOs are discharges of combined wastewater and stormwater flows that exceed the capacity of the sewer system during heavy wet weather events. Through FY18, the vast majority of CSO control plan project spending has been completed.

The CSO long-term control plan, approved by the U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (MassDEP) in final form in 2006, is intended to bring CSOs in the metropolitan Boston area into compliance with the Federal Clean Water Act and Massachusetts Surface Water Quality standards in accordance with national and state CSO policies. Development and implementation of the CSO control plan is subject to orders of the Federal District Court for the District of Massachusetts in the matter of *U.S. v. M.D.C. et al., No. 85-0489-RGS* (the "Boston Harbor Case").

The long-term control plan, as mandated by the Federal Court, comprises 35 wastewater system improvement projects that address 84 CSO outfalls. The CSO projects are described in this chapter, including project engineering and construction requirements, schedules, and approved long-term levels of CSO control, i.e., for each outfall, either elimination of discharge, reduced annual frequency and volume of discharge, and/or treatment. The chapter also reviews the status of work to implement the plan, describes the benefits achieved to date, and discusses future activities.

The total cost of the CSO control plan, including both previous and future expenditures, is $910 million. Spending for CSO Control Plan projects through FY18 totals $902.3 million. The FY19 CIP includes $7.7 million of spending currently programmed in FY19-21. The $7.7 million in future spending includes $2.6 million for the CSO post-construction monitoring program and performance assessments by MWRA, $3.7 million for additional Dorchester Interceptor inflow removal by Boston Water and Sewer Commission (BWSC), and $1.4 million for Somerville Marginal in-system storage cured-in-place-pipe (CIPP) lining. Section 11.07 – Summary of Existing CSO Control Plan Capital Projects includes a consolidated list of all projects with remaining funds programmed in the FY19 CIP for FY19-21. There are no future CSO control projects recommended for consideration beyond 2020. Maintenance and upgrade of CSO facilities and additional costs such as inspection and cleaning of the South Boston CSO tunnel and CSO outfalls will be covered under MWRA's Current Expense Budget or carried under specific facility CIP projects. Costs for maintenance and future rehabilitation of CSO facilities are presented in Chapter 10.

MassDEP has issued variances from current water quality standards for the Lower Charles River Basin and for Alewife Brook/Upper Mystic River Basin, allowing certain CSO discharges to continue until such time as MassDEP is able to make long-term water quality standards determinations for these receiving waters. Through an agreement between MWRA and the EPA and MassDEP, these variances will be extended through 2020, at which time the Massachusetts Surface Water Quality Standards and the level of CSO control for these receiving water will be revisited. Depending on the decisions at that time, additional levels of CSO control may be required. Additional current and long-term regulatory issues and potential impacts on MWRA are detailed in Chapter 4.

11.02 Overview of Combined Sewer Overflow Control Plan

In 1987, MWRA entered a stipulation (First CSO Stipulation) in the Federal District Court Order in the Boston Harbor Case by which it accepted responsibility for developing and implementing a long-term CSO control plan for all combined sewer overflows hydraulically connected to MWRA's system, including the outfalls owned and operated by Boston Water and Sewer Commission (BWSC), Cambridge, Chelsea and Somerville (the CSO communities).

MWRA’s CSO planning efforts were primarily conducted under the System Master Planning phase of the CIP and produced the following components of a broad, incremental and long-term plan to control CSO discharges and meet water quality standards.

Through extensive inspections, system monitoring and modeling, MWRA developed a detailed, field-calibrated assessment of its planned collection and treatment system performance in advance of developing a long-term CSO control plan. The performance assessment accounted for major capital investments in the sewer system already underway or planned by MWRA, including upgrades to the transport system, pumping stations, headworks and Deer Island Treatment Plant (DITP). Together with MWRA’s and CSO communities' efforts in the late 1980s and 1990s to efficiently operate and maintain their respective systems, these improvements were shown to effectively maximize the system's capacity to control wet weather flows and markedly reduce CSO discharges system-wide. From 1988 through 1992, total annual CSO discharge predicted for a typical rainfall year dropped from 3.3 billion gallons to 1.5 billion gallons, with approximately 51 percent of the remaining discharge treated at five MWRA CSO screening/disinfection facilities. The Charles River especially benefited from these improvements.

In 1993-1994, MWRA produced a System Optimization Plan (SOP), which recommended approximately 160 low cost, easily implemented system modifications, such as the raising of overflow weirs, to maximize wet weather storage and conveyance. The SOP projects, which were fully implemented by MWRA and the CSO communities by 1997, further reduced CSO discharge by approximately 20% system-wide.

Building on the Deer Island and SOP improvements, MWRA developed a long-term plan to bring Boston area CSOs into compliance with the Federal Clean Water Act and Massachusetts Surface Water Quality Standards. MWRA recommended an extensive set of projects covering a range of control technologies to achieve long-term, site-specific CSO control goals based on site-specific and watershed-based technology assessments and receiving water impacts and uses. MWRA presented a conceptual plan of these improvements in 1994 and refined the recommendations in a facilities plan and environmental impact report it issued in 1997. The long-term plan received initial federal and state approvals in early 1998, allowing MWRA to move the projects into design and construction.

As MWRA proceeded with implementation of the projects, it evaluated and recommended several adjustments and additions to the long-term plan in the period 1998 through 2006, responding to regulatory inquiries seeking higher levels of control (e.g. Charles River) and new information that raised concerns about construction requirements, cost or CSO control performance (e.g. North Dorchester Bay, Reserved Channel, East Boston, and Alewife Brook). A final, comprehensive long-term control plan was approved by EPA and MassDEP in March 2006, and on April 27, 2006, Federal District Judge Richard G. Stearns approved a joint motion of the U.S. Department of Justice (DOJ), EPA and MWRA for a comprehensive resolution of outstanding issues related to MWRA's CSO program.

Pursuant to the approved motion, MWRA entered a Second CSO Stipulation, which replaced the First CSO Stipulation, by which MWRA agreed to implement 35 CSO control projects and attain levels of CSO discharge frequency and annual volume specific to each of 84 CSO outfalls addressed in the plan. The Second CSO Stipulation states that once MWRA has implemented the recommended plan and demonstrated that it meets the specified levels of control, each CSO community will be solely responsible for the CSOs it owns and operates. As part of the agreement, MassDEP agreed to reissue and EPA agreed to approve five (5) consecutive variances of no more than three years' duration each, through 2020, for the Charles River and Alewife Brook/Upper Mystic River that, as applied to the Authority, are consistent with and limited to the requirements in MWRA's long-term CSO control plan set forth in Schedule Seven of the Boston Harbor Case. This agreement provided greater fiscal certainty to MWRA and its ratepayers relative to the scope and cost of the CSO program through 2020.

The approved long-term plan, presented in Table 11-1 and Figure 11-1, is predicted to reduce total annual CSO discharge volume in a typical rainfall year to 400 million gallons, an 88 percent reduction from the 1988 level of 3.3 billion gallons, and 94 percent of the remaining discharge will be treated at four MWRA screening and disinfection facilities.

By December 2015, all 35 projects in the long-term CSO control plan were complete and operating for their intended environmental benefit. The CSO project schedules were driven by milestones for design and construction in Schedule Seven of the Federal Court Order in the Boston Harbor Case. These project schedule milestones accounted for most of the 184 CSO related milestones in Schedule Seven. MWRA achieved 182 of these milestones by December 2015.

Schedule Seven also requires MWRA to commence a three-year post-construction monitoring program and performance assessment in January 2018 and submit a report verifying attainment of the long-term levels of control by December 2020. The scope and status of this ongoing effort is summarized on page 11-21.

The performance of the sewerage system is constantly improving as MWRA and its communities continue to implement their capital improvement programs. MWRA conducts updated assessments of its system's improving hydraulic performance and presents updated estimates of CSO discharges on an annual basis. MWRA's NPDES permit and the variances for the Charles River and Alewife Brook/Upper Mystic River require MWRA to estimate CSO discharges at each permitted outfall for all storm events each year. This is accomplished by MWRA staff utilizing the InfoWorks collection system model and data from permanent and temporary meters in the interceptor system, at CSO treatment facilities, and at or near other CSO outfalls. MWRA's capital program includes temporary flow metering and other efforts to gather and evaluate new data and track system performance.

TABLE 11-1
Long-term CSO Control Plan by Receiving Water

Receiving Water	CSO Discharge Goals (typical rainfall year) Activations	Volume (million gallons)	Projects*	Capital Cost* ($ million)
Alewife Brook/Upper Mystic River	7 untreated and 3 treated @ Somerville Marginal	7.3 3.5	• Cambridge/Alewife Sewer Separation • MWR003 Gate and Rindge Siphon Relief • Interceptor Connections/Floatables • Connection/Floatables at Outfall SOM01A • Somerville Baffle Manhole Separation • Cambridge Floatables Control (portion)	110.0
Mystic River/Chelsea Creek Confluence and Chelsea Creek	4 untreated and 39 treated @ Somerville Marginal	1.1 57.1	• Somerville Marginal CSO Facility Upgrade • Hydraulic Relief at BOS017 • BOS019 Storage Conduit • Chelsea Trunk Sewer Replacement • Chelsea Branch Sewer Relief • CHE008 Outfall Repairs • East Boston Branch Sewer Relief (portion)	92.0
Charles River (including Stony Brook and Back Bay Fens)	3 untreated and 2 treated @ Cottage Farm	6.8 6.3	• Cottage Farm CSO Facility Upgrade • Stony Brook Sewer Separation • Hydraulic Relief at CAM005 • Cottage Farm Brookline Connection and Inflow Controls • Brookline Sewer Separation • Bulfinch Triangle Sewer Separation • MWRA Outfall Closings and Floatables Control • Cambridge Floatables Control (portion)	88.9
Inner Harbor	6 untreated and 17 treated @ Prison Point	9.1 243.0	• Prison Point CSO Facility Upgrade • Prison Point Optimization • East Boston Branch Sewer Relief (portion)	47.5
Fort Point Channel	3 untreated and 17 treated @ Union Park	2.5 71.4	• Union Park Treatment Facility • BOS072-073 Sewer Separation and System Optimization • BWSC Floatables Control • Lower Dorchester Brook Sewer Modifications	62.0
Constitution Beach	Eliminate		• Constitution Beach Sewer Separation	3.7
North Dorchester Bay	Eliminate		• N. Dorchester Bay Storage Tunnel and Related Facilities • Pleasure Bay Storm Drain Improvements • Morrissey Blvd Storm Drain	253.7
Reserved Channel	3 untreated	1.5	• Reserved Channel Sewer Separation	70.5
South Dorchester Bay	Eliminate		• Fox Point CSO Facility Upgrade (interim improvement) • Commercial Pt. CSO Facility Upgrade (interim improvement) • South Dorchester Bay Sewer Separation	126.6
Neponset River	Eliminate		• Neponset River Sewer Separation	2.4
Regional			• Planning, Technical Support and Land Acquisition	52.8
TOTAL **Treated**		**410** **381**		**910.1**

*Floatables controls are recommended at remaining outfalls and are included in the listed projects and capital budgets.

FIGURE 11-1
Long-Term CSO Control Plan

TABLE 11-2
CSO Project Schedules

Project		Commence Design	Commence Construction	Complete Construction
North Dorchester Bay Storage Tunnel and Related Facilities		Aug 97	Aug 07	May 11
Pleasure Bay Storm Drain Improvements		Sep 04	Sep 05	Mar 06
Hydraulic Relief Projects	CAM005 Relief	Aug 97	Jul 99	May 00
	BOS017 Relief		Jul 99	Aug 00
East Boston Branch Sewer Relief		Mar 00	Mar 03	Jul 10
BOS019 CSO Storage Conduit		Jul 02	Mar 05	Mar 07
Chelsea Relief Sewers	Chelsea Trunk Sewer Relief	Jun 97	Sep 99	Aug 00
	Chelsea Branch Sewer Relief		Dec 99	Jun 01
	CHE008 Outfall Repairs		Dec 99	Jun 01
Union Park Detention/Treatment Facility		Dec 99	Mar 03	Apr 07
CSO Facility Upgrades and MWRA Floatables Control	Cottage Farm Upgrade	Jun 96	Mar 98	Jan 00
	Prison Point Upgrade		May 99	Sep 01
	Commercial Point Upgrade		Nov 99	Sep 01
	Fox Point Upgrade		Nov 99	Sep 01
	Somerville-Marginal Upgrade		Nov 99	Sep 01
	MWRA Floatables Control and Outfall Closings		Mar 99	Mar 00
Brookline Connection and Cottage Farm Overflow Interconnection and Gate		Sep 06	Jun 08	Jun 09
Optimization Study of Prison Point CSO Facility		Mar 06	Mar 07	Apr 08
South Dorchester Bay Sewer Separation		Jun 96	Apr 99	Jun 07
Stony Brook Sewer Separation		Jul 98	Jul 00	Sep 06
Neponset River Sewer Separation			Apr 96	Jun 00
Constitution Beach Sewer Separation		Jan 97	Apr 99	Oct 00
Fort Pt Channel Conduit Sewer Separation and System Optimization		Jul 02	Mar 05	Mar 07
Morrissey Boulevard Storm Drain		Jun 05	Dec 06	Jul 09
Reserved Channel Sewer Separation		Jul 06	May 09	Dec 15
Bulfinch Triangle Sewer Separation		Nov 06	Sep 08	Jul 10
Brookline Sewer Separation		Nov 06	Nov 08	Jul 13
Somerville Baffle Manhole Separation			Apr 96	Dec 96
Cambridge/Alewife Brook Sewer Separation	CAM004 Stormwater Outfall and Detention Basin		Apr 11	Apr 13
	CAM004 Sewer Separation	Jan 97	Jul 98/Sep 12	Dec 15
	CAM400 Manhole Separation	Oct 08	Jan 10	Mar 11
	Interceptor Connection Relief/Floatables Control at Outfalls CAM002, CAM401B and CAM001	Oct 08	Jan 10	Oct 10
	MWR003 Gate and Rindge Ave. Siphon Relief	Mar 12	Aug 14	Oct 15
	Connection Relief/Floatables Control at SOM01A	Mar 12	Sep 13	Jun 14
Region-wide Floatables Control and Outfall Closings		Sep 96	Mar 99	Dec 07

11.03 CSO Control Plan Projects

All 35 projects in the court-mandated long-term control plan (described below) are complete, operational, and achieving CSO control and environmental benefit for their respective receiving water segments.

1. SOMERVILLE BAFFLE MANHOLE SEPARATION

Receiving Water:
Alewife Brook, Upper Mystic River

Completed:
1996

Capital Cost:
$400,000

Description:
City of Somerville separated common manholes connecting local sewer and storm drain systems. City of Somerville performed design and construction with MWRA financial assistance.

CSO Control

Water Quality Benefit:
Eliminated CSO discharges at three City of Somerville outfalls.

CSO Outfalls:
SOM001, SOM006, SOM007

Frequency of Discharge (typical year):
Before project: 2
With project: Eliminated

Annual Discharge Volume (typical year):
Before project: 0.04 million gallons
With project: Eliminated

CSO Reduction by Volume: 100%

2. CONSTITUTION BEACH SEWER SEPARATION

MWRA decommissioned its Constitution Beach CSO Facility after CSO flows were eliminated by BWSC sewer separation.

Receiving Water:
Boston Harbor/Constitution Beach

Completed:
2000

Capital Cost:
$3,731,000

Description:
BWSC installed 14,000 linear feet of storm drain to separate the combined sewer system, remove stormwater flows from area sewers, and eliminate CSO discharges to Constitution Beach, allowing MWRA to decommission the Constitution Beach CSO treatment facility.

CSO Control

Water Quality Benefit:
Eliminated CSO discharges to Constitution Beach to comply with Class SB water quality standards.

CSO Outfalls:
MWR207(BOS002)

Frequency of Discharge (typical year):
Before project: 16 (treated)
With project: Eliminated

Annual Discharge Volume (typical year):
Before project: 1.35 million gallons
With project: Eliminated

CSO Reduction by Volume: 100%

3. HYDRAULIC RELIEF AT OUTFALL CAM005

Receiving Water:
Charles River Basin

Completed:
2000

Capital Cost:
$1,100,000

Description:
MWRA relieved the 40-foot long, 24-inch diameter dry weather connection between the CAM005 regulator and MWRA's North Charles Metropolitan Sewer with a 54-inch additional connection, on Mt. Auburn Street, Cambridge.

CSO Control

Water Quality Benefit:
Minimized CSO discharges to meet B(cso) water quality standards (>95% compliance with Class B).

CSO Outfalls:
CAM005

Frequency of Discharge (typical year):
Before project: 11
With project: 3

Annual Discharge Volume (typical year):
Before project: 3.8 million gallons
With project: 0.84 million gallons

CSO Reduction by Volume: 78%

4. HYDRAULIC RELIEF AT OUTFALL B0S017

Receiving Water:
BOS017: Mystic River/Chelsea Creek Confluence

Completed:
2000

Capital Cost:
$1,195,000

Description:
MWRA installed 190 feet of 36-inch diameter pipe in Sullivan Square, Charlestown, to divert two local (BWSC) combined sewers to a direct connection with MWRA's Cambridge Branch Sewer.
In addition, eliminated a 10-foot long restriction between the Charlestown and Cambridge Branch Sewers.

CSO Control

Water Quality Benefit:
Minimized CSO discharges to meet SB(cso) water quality standards (>95% compliance with Class SB).

CSO Outfalls:
BOS017

Frequency of Discharge (typical year):

Before project: 18
With project: 1

Annual Discharge Volume (typical year):

Before project: 2.5 million gallons
With project: 0.02 million gallons

CSO Reduction by Volume: 99%

5. NEPONSET RIVER SEWER SEPARATION

Receiving Water:
Neponset River

Completed:
2000

Capital Cost:
$2,549,000

Description:
BWSC installed 8,000 linear feet of storm drain to separate the combined sewer system, remove stormwater flows from area sewers, and close CSO regulators, eliminating CSO discharges at the two remaining CSO outfalls to the Neponset River.

CSO Control

Water Quality Benefit:
Eliminated CSO discharges to Neponset River to comply with Class B water quality standards and protect South Dorchester Bay beaches (Tenean Beach).

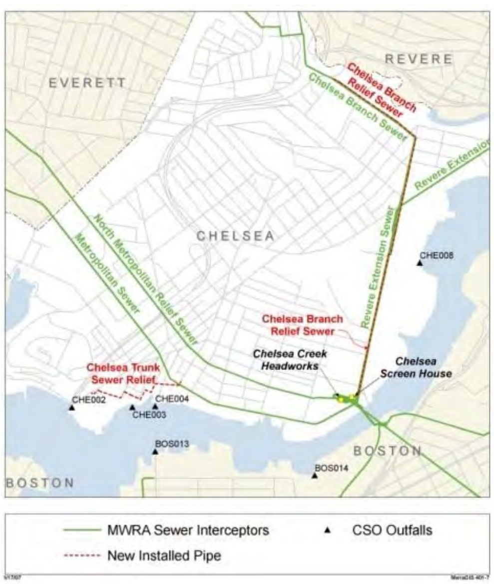
CSO Outfalls:
BOS093, BOS095

Frequency of Discharge (typical year):
Before project: 17
With project: Eliminated

Annual Discharge Volume (typical year):
Before project: 5.8 million gallons
With project: Eliminated

CSO Reduction by Volume: 100%

6. CHELSEA TRUNK SEWER REPLACEMENT
7. CHELSEA BRANCH SEWER RELIEF
8. CHE008 OUTFALL REPAIRS



Receiving Water:
Mystic River/Chelsea Creek Confluence
Chelsea Creek

Completed:
2000-2001

Capital Cost:
$29,779,000

Description:
MWRA replaced 18-inch diameter city-owned trunk sewer with 30-inch pipe, relieved MWRA's Chelsea Branch and Revere Extension Sewers with 48-inch to 66-inch diameter pipe, and rehabilitated Outfall CHE008. Installed underflow baffles for floatables control at all outfalls.

CSO Control

Water Quality Benefit:
Minimized CSO discharges to meet Class SB(cso) water quality standards (>95% compliance with Class SB).

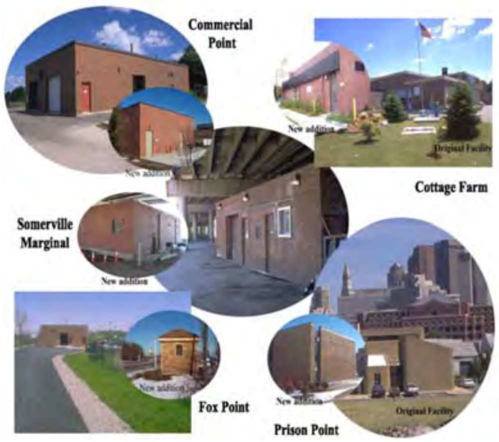
CSO Outfalls:
CHE002, CHE003, CHE004, CHE008

Frequency of Discharge (typical year):
Before project: 8
With project: 4

Annual Discharge Volume (typical year):
Before project: 9.0 million gallons
With project: 0.6 million gallons

CSO Reduction by Volume: 93%

9. UPGRADE COTTAGE FARM CSO FACILITY
10. UPGRADE PRISON POINT CSO FACILITY
11. UPGRADE SOMERVILLE MARGINAL CSO FACILITY
12. UPGRADE FOX POINT CSO FACILITY
13. UPGRADE COMMERCIAL POINT CSO FACILITY



Receiving Water:
Charles River Basin
Upper Inner Harbor
Upper Mystic River
Mystic River/Chelsea Creek Confluence
South Dorchester Bay

Completed:
2001

Capital Cost:
$22,385,000

Description:
MWRA upgraded chlorine disinfection systems, added dechlorination systems, process control and safety improvements.

CSO Control

Water Quality Benefit:
Upgrade treatment to meet water quality standards criteria, including residual chlorine limits.

CSO Outfalls:
MWR201 (Cottage Farm Facility)
MWR203 (Prison Point Facility)
MWR205, MWR205A(SOM007A) (Somerville Marginal Facility)
MWR209(BOS088/BOS089) (Fox Point Facility)
MWR211(BOS090) (Commercial Point Facility)

These projects improved treatment performance, with no effect on discharge frequency or volume.

14. PLEASURE BAY STORM DRAIN IMPROVEMENTS

Receiving Water:
North Dorchester Bay

Completed:
2006

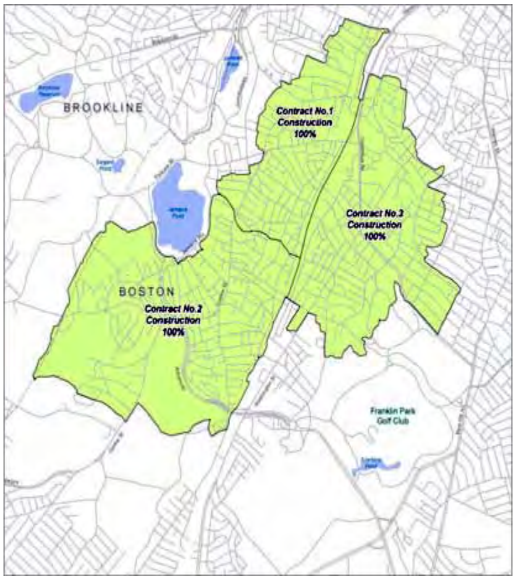
Capital Cost:
$3,195,000

Description (cont):
MWRA constructed a new storm drain system to relocate stormwater discharge from Pleasure Bay to the Reserved Channel.

CSO Control

Water Quality Benefit:
Eliminated storm water discharges to Pleasure Bay Beach.

15. STONY BROOK SEWER SEPARATION



Receiving Water:
Charles River Basin

Completed:
2006

Capital Cost:
$44,246,000

Description:
BWSC installed a total of 107,175 linear feet of storm drain and sanitary sewer to remove stormwater from local sewers serving a 609-acre area in Jamaica Plain, Mission Hill and Roxbury, and disconnected an already-separated storm drain system serving an adjacent 548-acre area from the sewer system.

CSO Control

Water Quality Benefit:
Minimizes CSO discharges to meet B(cso) water quality standards (>95% compliance with Class B).

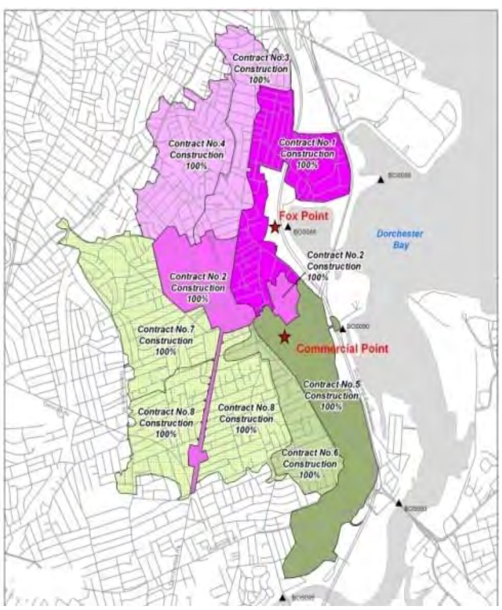
CSO Outfalls:
MWR023 (Stony Brook Conduit)

Frequency of Discharge (typical year):
Before project: 22
With project: 2

Annual Discharge Volume (typical year):
Before project: 44.5 million gallons
With project: 0.13 million gallons

CSO Reduction by Volume: 99.7%

16. SOUTH DORCHESTER BAY SEWER SEPARATION



Receiving Water:
South Dorchester Bay

Completed:
2007

Capital Cost:
$118,800,000

Description:
BWSC installed a total of 150,000 linear feet of storm drain and sanitary sewer to remove stormwater from local sewers serving a 1,750-acre area in Dorchester. Closed all CSO regulators, allowing MWRA to decommission its Fox Point and Commercial Point CSO facilities.

CSO Control

Water Quality Benefit:
Eliminated CSO discharges to Savin Hill, Malibu and Tenean beaches, in compliance with Class SB water quality standards.

CSO Outfalls:
MWR209 (BOS088/BOS089)
MWR211 (BOS090)

Frequency of Discharge (typical year):
Before project: 20 (treated)
With project: Eliminated

Annual Discharge Volume (typical year):
Before project: 30 million gallons
With project: Eliminated

CSO Reduction by Volume: 100%

17. FORT POINT CHANNEL SEWER SEPARATION

Receiving Water:
Fort Point Channel

Completed:
2007

Capital Cost:
$11,917,000

Description:
BWSC installed 4,260 feet of storm drain and 4,300 feet of sanitary sewer to remove stormwater from local sewers serving 55 acres in the Fort Point Channel area. Raised overflow weirs at outfalls BOS072 and BOS073. Replaced tide gates and installed underflow baffles for floatables control at both outfalls.

CSO Control

Water Quality Benefit:
Minimizes CSO discharges to meet Class SB(cso) water quality standards (>95% compliance with Class SB).

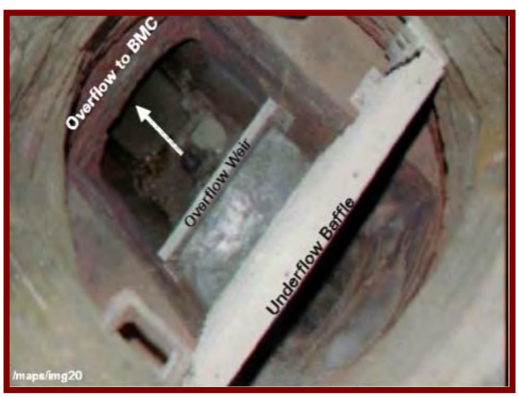
CSO Outfalls:
BOS072, BOS073

Frequency of Discharge (typical year):
Before project: 9
With project: 0

Annual Discharge Volume (typical year):
Before project: 3.0 million gallons
With project: 0.0

CSO Reduction by Volume: 100%

18. REGIONWIDE FLOATABLES CONTROL
19. MWRA FLOATABLES CONTROL AND OUTFALL CLOSING PROJECTS



Receiving Water:
Region-wide

Completed:
2007

Capital Cost:
$1,216,000

Description:
MWRA and the CSO communities installed underflow baffles for floatables control and closed several regulators and outfalls.

CSO Control

Water Quality Benefit:
Complies with EPA Policy Nine Minimum Controls requirement to control solid and floatable material. Eliminated CSO discharges at certain outfalls.

CSO Outfalls:
Various outfalls system-wide.

CSO Control:
The floatables controls do not affect CSO discharge frequency or volume.

20. UNION PARK DETENTION/TREATMENT FACILITY

Receiving Water:
Fort Point Channel

Completed:
2007

Capital Cost:
$49,583,000

Description:
MWRA added a CSO treatment facility to the existing BWSC Union Park Pumping Station, including fine screens, chlorine disinfection, dechlorination, and two million gallons of detention storage.

CSO Control

Water Quality Benefit:
Provides treatment of Union Park pumping station discharges to Fort Point Channel to meet Class SB water quality criteria, including residual chlorine limits, and lowers discharge frequency and volume with on-site detention basins.

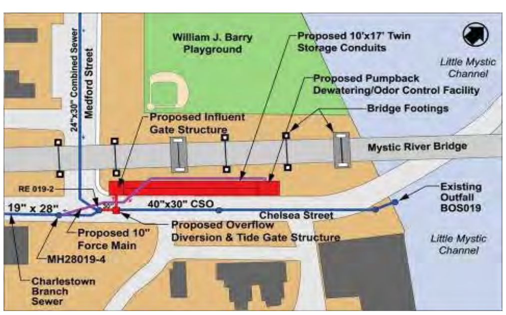
CSO Outfall:
BOS 070

Frequency of Discharge (typical year):
Before project: 25 (untreated)
With project: 17 (treated)

Annual Discharge Volume (typical year):
Before project: 132.0 million gallons
With project: 71.4 million gallons/year

CSO Reduction by Volume: 46%

21. BOS019 CSO STORAGE CONDUIT



Receiving Water:
Upper Inner Harbor (Little Mystic Channel)

Completed:
2007

Capital Cost:
$14,288,000

Description:
MWRA installed twin-barrel 10'x17' box conduit to provide 670,000 gallons of off-line storage, between Chelsea St. and the Mystic Tobin Bridge, Charlestown. Included above-ground dewatering pump station.

CSO Control

Water Quality Benefit:
Minimizes CSO discharges to meet Class SB(cso) water quality standards (>95% compliance with Class SB).

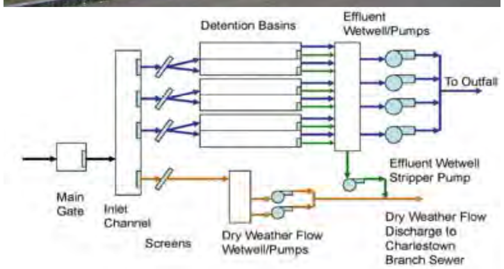
CSO Outfall:
BOS019

Frequency of Discharge (typical year):
Before project: 13
With project: 2

Annual Discharge Volume (typical year):
Before project: 4.4 million gallons
With project: 0.6 million gallons

CSO Reduction by Volume: 86%

22. PRISON POINT CSO FACILITY OPTIMIZATION



Receiving Water:
Upper Inner Harbor

Completed:
2008

Capital Cost:
$50,000

Description:
MWRA minimized treated CSO discharges to the Inner Harbor by optimizing the operation of existing facility gates and pumps to maximize in-system storage and convey more flow to Deer Island.

CSO Control

Water Quality Benefit:
Reduces treated CSO discharges to Upper Inner Harbor.

CSO Outfall:
MWR203 (Prison Point Facility)

Frequency of Discharge (typical year):
Before project: 25 (treated)
With project: 19 (treated)

Annual Discharge Volume (typical year):
Before project: 370.2 million gallons
With project: 283.8 million gallons

CSO Reduction by Volume: 23%

23. COTTAGE FARM BROOKLINE CONNECTION AND INFLOW CONTROLS

Receiving Water:
Charles River Basin

Completed:
2009

Capital Cost:
$3,000,000

Description:
MWRA optimized the combined conveyance capacity of the two MWRA sewers that carry flows across the Charles River by interconnecting overflow chambers outside the Cottage Farm CSO facility, and MWRA supplemented this conveyance capacity by bringing into service a parallel, previously unutilized 54-inch diameter sewer (the "Brookline Connection").

CSO Control

Water Quality Benefit:
Minimizes treated CSO discharges from the Cottage Farm CSO Facility to the Lower Charles River Basin.

CSO Outfall:
MWR201 (Cottage Farm Facility)

Frequency of discharges (typical year):
Before project: 7 (treated)
With project: 7 (treated)

Annual Discharge Volume (typical year):
Before project: 44.5 million gallons
With project: 24.0 million gallons

CSO Reduction by Volume: 46%

24. MORRISSEY BOULEVARD STORM DRAIN

Receiving Water:
North Dorchester Bay

Completed:
2009

Capital Cost:
$32,339,000

Description:
BWSC installed 2,800 linear feet of 12-foot by 12-foot and 8-foot by 8-foot box conduit for stormwater conveyance, with gated connection to North Dorchester Bay CSO Storage Tunnel at upstream end, new outfall to Savin Hill Cove, and pollution prevention measures.

CSO Control

Water Quality Benefit:
Maximizes the level of stormwater control provided by the CSO Storage Tunnel along the South Boston beaches by redirecting stormwater to Savin Hill Cove in large storms.

25. EAST BOSTON BRANCH SEWER RELIEF

Receiving Water:
Boston Harbor and Chelsea Creek

Completed:
2010

Capital Cost:
$85,637,000

Description:
MWRA upgraded its 115-year-old interceptor system serving most of East Boston, using a combination of construction methods: micro-tunneling, pipe-bursting, open-cut excavation and pipe relining.

CSO Control

Water Quality Benefit:
Minimizes CSO discharges to meet Class SB(cso) water quality standards (>95% compliance with Class SB).

CSO Outfalls:
BOS003, BOS004, BOS005, BOS009, BOS010, BOS012, BOS013, BOS014 (BOS006 and BOS007 closed by BWSC)

Frequency of discharges (typical year):
Before project: 31
With project: 6

Annual Discharge Volume (typical year):
Before project: 41.0 million gallons
With project: 8.6 million gallons

CSO Reduction by Volume: 79%

26. BULFINCH TRIANGLE SEWER SEPARATION

Receiving Water:
Boston Inner Harbor and Charles River Basin

Completed:
2010

Capital Cost:
$9,054,000

Description:
BWSC installed a total of 5,290 feet of storm drain and sanitary sewer to remove stormwater from local sewers in a 14-acre area of Bulfinch Triangle/North Station, allowing already-separated storm drains serving an additional 47-acre area of Government Center to be removed from the sewer system, as well. Closed Outfall BOS049 to CSO discharges.

CSO Control

Water Quality Benefit:
Eliminated CSO discharges at Outfall BOS049 to Lower Charles River Basin. Contribute to treated CSO reduction at the Prison Point CSO Facility.

CSO Outfalls:
BOS049

Frequency of discharges (typical year):
Before project: Larger storms only
With project: Eliminated

Annual Discharge Volume (typical year):
Before project: Larger storms only
With project: Eliminated

CSO Reduction by Volume: N/A

27. INTERCEPTOR CONNECTION RELIEF AND FLOATABLES CONTROL AT CAM002 AND CAM401B AND FLOATABLES CONTROL AT CAM001

CAM 002A & B inlet structure-baffle is visible in front of CAM 002A outlet with a steel plate (temporary condition) bolted on the left hand wall on the CAM 002B outlet.

Receiving Water:
Alewife Brook

Completed:
2010

Capital Cost:
$2,904,569

Description:
City of Cambridge upgraded the hydraulic capacities of its connections to MWRA interceptors and installed underflow baffles for floatables control.

CSO Control

Water Quality Benefit:
Together with other Alewife Brook CSO projects, minimizes CSO discharges and their impacts to meet Class B "fishable/ swimmable" criteria >95% of the time.

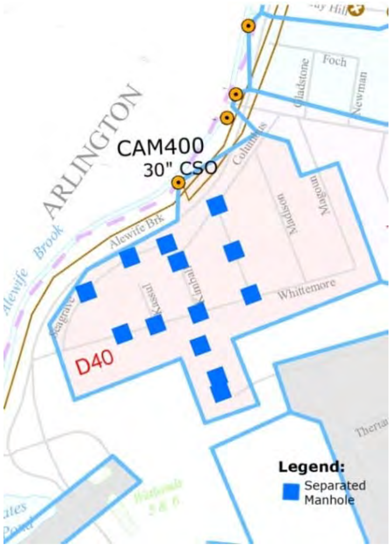
CSO Outfalls:
CAM002, CAM401B, CAM001

Frequency of Discharge (typical year)
Before projects: 25
After projects: 7

Annual Discharge Volume (typical year)
Before projects: 12.1 million gallon
After projects: 3.2 million gallons

CSO Reduction by Volume: 74%

28. CAM400 COMMON MANHOLE SEPARATION



Receiving Water:
Alewife Brook

Completed:
March 2011

Capital Cost:
$4,776,000

Description:
City of Cambridge replaced common storm drain and sewer manholes with separate manholes and associated piping in the local, mostly residential streets bounded by Alewife Brook Parkway, Massachusetts Avenue, Magoun Street and Whittemore Avenue, as well as a portion of the WR Grace property off Whittemore Avenue. Closed Outfall CAM400 to CSO discharges.

CSO Control

Water Quality Benefit:
Together with other Alewife Brook CSO projects, minimizes CSO discharges and their impacts to meet Class B “fishable/ swimmable” criteria >95% of the time. Eliminated CSO discharges to Alewife Brook at Outfall CAM400.

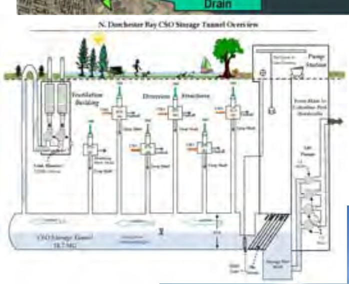
CSO Outfalls:
CAM400

Frequency of Discharge (typical year)
Before project: 10
After project: Eliminated

Annual Discharge Volume (typical year)
Before projects: 0.8 million gallon
After projects: Eliminated

CSO Reduction by Volume: 100%

29. NORTH DORCHESTER BAY STORAGE TUNNEL & RELATED FACILITIES



North Dorchester Bay CSO Storage Tunnel Dewatering Pump Station, Conley Terminal, South Boston

Receiving Water:
North Dorchester Bay

Capital Cost:
$228,405,000
(including Massport land agreement; not including the cost of Morrissey Boulevard storm drain (Project 24))

Completed: May 2011

Description:
MWRA constructed a 10,832-ft., 17-ft. diameter soft-ground tunnel, drop shafts and CSO and stormwater diversion structures along outfalls BOS081-BOS087; 15-mgd tunnel dewatering pump station at Massport’s Conley Terminal; 24-inch force main; and below-ground tunnel ventilation and odor control facility at the upstream end of the tunnel. Eliminated outfalls BOS083 and BOS087.

CSO Control

Water Quality Benefit:
Eliminated CSO and separate stormwater
discharges up to the 25-year storm and 5-year storm, respectively.

CSO Outfalls:
BOS081 BOS083 BOS085 BOS087
BOS082 BOS084 BOS086

Frequency of Discharge (typical year)
CSO: Before project: 17
After project: 0
Stormwater: Before project: 93
After project: 0

Annual Discharge Volume (typical year)
CSO:
Before project: 8.6 million gallons
After project: 0
Stormwater:
Before project: 144 million gallons
After project: 0

CSO Reduction by Volume: 100%

Stormwater Reduction by Volume: 100%

30. BROOKLINE SEWER SEPARATION

Receiving Water:
Charles River Basin

Capital Cost:
$24,715,000

Completed: April 2013

Description:
Town of Brookline installed 9,448 linear feet of new storm drain and 5,840 linear feet of new sewer to separate the combined sewer systems serving a 72-acre area of the town to remove stormwater from the sewer system and reduce CSO discharges to the Charles River Basin.

MWRA rehabilitated its CSO outfall MWR010 in part to accommodate the stormwater flows.

CSO Control

Water Quality Benefit:
Supports the attainment of long term CSO control level at the Cottage Farm CSO facility. Reduces CSO discharges at Outfall MWR010, which activates in extreme storms, only.

CSO Outfalls:
MWR010
MWR201 (Cottage Farm Facility)

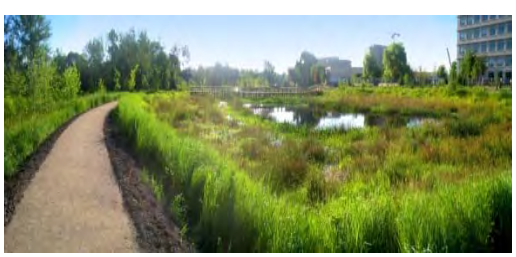
Frequency of Discharge (typical year):
Cottage Farm Facility (treated)
Before project: 7
With project: 5

Annual Discharge Volume (typical year):
Cottage Farm Facility (treated)
Before project: 27.2 million gallons
With project: 18.7 million gallons

CSO Reduction by Volume: 31%

31. CAM004 STORMWATER OUTFALL AND WETLAND BASIN

Rendering of Stormwater Wetland at Alewife Brook, Cambridge



Receiving Water:
Alewife Brook

Capital Cost:
$13,825,000

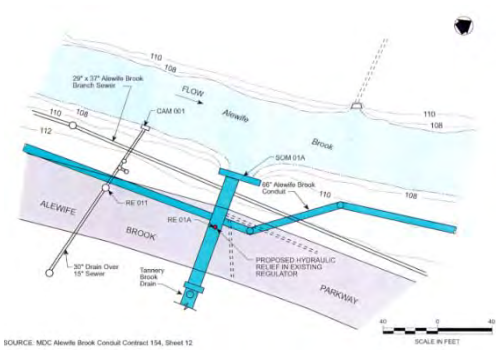
Completed: April 2013

Description:
Cambridge constructed a new 4-foot by 8-foot box culvert storm drain to convey the separated stormwater to a new 3.4 acre wetland in the Alewife Brook Reservation. The wetland will provide 10.3 acre-feet of detention storage of stormwater flows and the attenuation of stormwater flow rate to the Little River and Alewife Brook.

CSO Control

Water Quality Benefit:
Supports the CSO benefits of CAM004 Sewer Separation by mitigating the potential impacts of the separated stormwater on the high water levels and water quality of the Little River and Alewife Brook.

32. SOM01A INTERCEPTOR CONNECTION RELIEF AND FLOATABLES CONTROL



Receiving Water:
Alewife Brook

Capital Cost:
$0.8 M

Completed: December 2013

Description:
MWRA upgraded the size of the local sewer connection between City of Somerville's Tannery Brook Conduit and MWRA's interceptor system and installed an underflow baffle to control the discharge of floatable materials.

CSO Control

Water Quality Benefit:
Together with other Alewife Brook CSO projects, minimizes CSO discharges and their impacts to meet Class B "fishable/ swimmable" criteria >95% of the time.

CSO Outfalls:
SOM01A

Frequency of Discharge (typical year):
Before projects: 10
With projects: Eliminated

Annual Discharge Volume (typical year):
Before projects: 9.9 million gallons
With projects: 1.3 million gallons

CSO Reduction by Volume: 87%

33. CONTROL GATE/FLOATABLES CONTROL at OUTFALL MWR003 and MWRA RINDGE AVENUE SIPHON RELIEF

Receiving Water:
Alewife Brook

Capital Cost:
$3,763,000

Completed:
October 2015

Description:
MWRA replaced the original static overflow weir with an automated weir gate; replaced the 30-inch diameter Rindge Avenue Sewer overflow siphon with a 48-inch diameter siphon; and installed an underflow baffle for floatables control. The project improves the balance of flows in MWRA's twin interceptors and provides greater system relief in large storms, in part to compensate for the closing of Outfall CAM004.

CSO Control

Water Quality Benefit:
Together with other Alewife Brook CSO projects, minimizes CSO discharges and their impacts to meet Class B "fishable/ swimmable" criteria >95% of the time.

CSO Outfalls:
MWR003 and CAM004

Frequency of Discharge (typical year)
MWR003 before projects: 1
MWR003 with projects: 5
CAM004 before projects: 63
CAM004 with projects: Eliminated

Annual Discharge Volume (typical year)

Outfall MWR003
Before projects: 0.1 million gallons
With projects: 1.0 million gallons

Outfall CAM004
Before projects: 24.1 million gallons
With projects: Eliminated

34. RESERVED CHANNEL SEWER SEPARATION

Receiving Water:
Reserved Channel

Capital Cost:
$70,559,000

Completed:
December 2015

Description:
BWSC installed 81,200 linear feet of new sewer and storm drain to separate the combined sewer systems serving a 365-acre area of South Boston tributary to four CSO outfalls along the Reserved Channel.

CSO Control

Water Quality Benefit:
Minimizes CSO discharges to meet Class SB(cso) water quality standards (>95% compliance with Class SB).

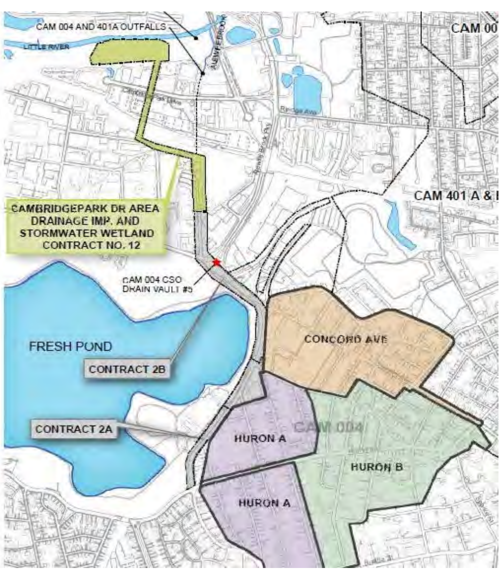
CSO Outfalls:
BOS076, BOS078, BOS079, BOS080

Frequency of Discharge (typical year)
Before project: 37
With project: 3

Annual Discharge Volume (typical year)
Before project: 28 million gallons
With project: 1.5 million gallons

CSO Reduction by Volume: 95%

35. CAM004 SEWER SEPARATION



Receiving Water:
Alewife Brook

Capital Cost:
$100,000,000 (Cambridge and MWRA)
$54,000,000 (MWRA share)

Completed:
December 2015

Description:
Cambridge installed 55,300 linear feet of new or rehabilitated sewer and storm drain to separate the combined sewers serving a 211-acre area of Cambridge east of Fresh Pond Parkway. With the project, the City of Cambridge permanently closed Outfall CAM004.

CSO Control

Water Quality Benefit:
Together with other Alewife Brook CSO projects, minimizes CSO discharges and their impacts to meet Class B “fishable/ swimmable” criteria >95% of the time.

CSO Outfall:
CAM004

Frequency of Discharge (typical year)
Before project: 10
With project: 0

Annual Discharge Volume (typical year)
Before project 4.6 million gallons
With project: 0.0 million gallons

CSO Reduction by Volume: 100%

11.04 Ongoing CSO Control Plan Activity

Dorchester Inflow Removal

BWSC completed the South Dorchester Bay Sewer Separation project in June 2007, in compliance with Schedule Seven. Since then, BWSC has continued to investigate and remove additional sources of inflow to the sewer system tributary to its Dorchester Interceptor to meet sewer system hydraulic performance objectives and control system flooding following the closing of the CSO relief points. MWRA has funded this additional inflow removal work under the BWSC CSO Memorandum of Understanding and Financial Assistance Agreement (the "BWSC MOU/FAA"). The term of the BWSC MOU/FAA ended on June 30, 2017. MWRA and BWSC executed a new, four-year, agreement effective July 1, 2017, by which BWSC will complete the Dorchester Inflow Removal work and MWRA will provide the remaining funds of $3.758 million in the FY19 CIP budget for South Dorchester Bay Sewer Separation – Commercial Point. MWRA will disburse the funds as reimbursements of the BWSC construction costs of projects pre-approved by MWRA.

Somerville Marginal In-System Storage

Under a Memorandum of Agreement between MWRA and the City of Somerville, as approved on September 14, 2016, MWRA agreed to share the cost of the cured-in-place-pipe (CIPP) liner rehabilitation which in total is estimated at $4.2 million. MWRA's CSO Control Plan utilizes both the in-line storage and conveyance capacity of the current brick sewer to control and reduce the CSO volume discharged to the Mystic River from the Somerville-Marginal CSO treatment facility. The FY19 CIP includes $1.4 million in spending in FY19 for this project.

CSO Post Construction Monitoring Program and Performance Assessment

Schedule Seven requires MWRA to commence a post-construction monitoring program and performance assessment in January 2018 and submit a report by December 2020 to EPA, MassDEP and the Court verifying attainment of the long-term levels of control. MWRA submitted a Scope of Work for the monitoring program and performance assessment to MassDEP in May 2017 for public and regulatory review. On November 8, 2017, ahead of and in compliance with the January 2018 milestone, MWRA issued Notice to Proceed with a 40-month (November 2017 through April 2021) consultant contract for related CSO metering, collection system modeling and performance assessments. The contract also includes statistical analyses of receiving water quality data collected by MWRA and correlation of the data with CSO activation measurements and predictions. The FY19 CIP includes $2.924 million in spending on the consultant contract in FY18 through FY21 and an additional $273,000 as a placeholder (FY19-21) for additional System Assessment and Technical Review that may be needed to supplement the consultant contract work.

11.05 Projected Operation and Maintenance Cost Impacts from New Facilities Added Under the CSO Control Plan

Implementation of new MWRA facilities under MWRA managed projects within the long-term CSO control plan have incremental annual operation and maintenance (O&M) cost impacts, as presented in Table 11-3, below. All O&M cost impacts associated with any community implemented CSO project are borne by the respective community.

TABLE 11-3
O&M Cost Impacts of New CSO Facilities

CSO Project	Startup	Annual O&M Cost
Union Park Detention/Treatment Facility	Dec 06	$ 900,000
BOS019 CSO Storage Conduit	Mar 07	50,000
North Dorchester Bay Storage Tunnel and Related Facilities	May 11	80,000*
TOTAL		$1,030,000

* Based on $400,000 cost for inspection and cleaning of the storage tunnel every 5 years beginning in FY18.

11.06 Future Capital Improvement Project Needs for the CSO Control Plan

No additional capital projects are anticipated to be needed for CSO control, through 2020. The Federal Court's substitution of the First CSO Stipulation, dated February 27, 1987, with the Second CSO Stipulation on April 27, 2006, afforded MWRA and its ratepayers an assurance that the long-term CSO control plan recommended by MWRA will meet federal and state requirements at least through 2020. Beyond 2020, higher levels of control and associated additional capital investments may be required by long-term water quality standard determinations MassDEP is scheduled to issue relative to the variances for the Lower Charles River Basin and the Alewife Brook/Upper Mystic River. Also, if in 2020 when MWRA completes the required CSO performance assessment, it determines that the approved long-term levels of control have not been attained at any outfall, MWRA may be obligated and required to implement additional controls to bring the discharges into conformance with the plan goals at MWRA and/or community outfalls.

Other regulatory decisions or changes could require MWRA to develop and implement additional capital improvements to increase the level of control of CSO discharges beyond the levels in the approved long-term control plan, but only for outfalls it owns and operates. This outlook assumes that the required CSO control performance levels recommended in the long-term plan are met with the recommended projects described in this Chapter.

Federal and state regulations governing CSO discharges may evolve prior to or after 2020. MWRA, through staff reviews or through its participation in the National Association of Clean Water Agencies, will stay informed and have input into regulatory discussions, both formally and informally. Additional current and long-term regulatory issues and potential impacts on MWRA are detailed in Chapter 4.

MassDEP is required to review water quality standards every three years (but in fact the reviews are less frequent). Its reviews, which must include public comment, take into account new information regarding the effects of discharges and the feasibility of attaining existing or higher water quality standards. MWRA does not expect that these reviews will change either the assessment of CSO impacts or the appropriate and feasible level of CSO control, at least through the MWRA CSO assessment period ending in 2020.

11.07 Summary of Existing CSO Control Plan Capital Projects

The total cost of the CSO Control Plan (including both previous and future expenditures) is programmed in the FY19 CIP at a cost of $910 million. The FY19 CIP includes $7.713 million of projected spending in FY19 through FY21. The $7.713 million planned to be spent includes $5.158 million to complete and close out the community managed CSO projects and $2.555 million to conduct the MWRA managed CSO post-construction monitoring program and performance assessments. All MWRA and community managed CSO control activities with CIP spending in FY19 and beyond are summarized in the bullets below and in Table 11-4. There are no future MWRA or community managed CSO Control Plan projects recommended for consideration in future CIPs beyond 2020.

- South Dorchester Bay Sewer Separation (Commercial Point) for removal of additional inflow by BWSC from its Dorchester Interceptor tributary systems design and construction is programmed in the FY19 CIP at $3.758 million remaining to be spent during FY19-22.

- Under a Memorandum of Agreement between MWRA and the City of Somerville, as approved on September 14, 2016, MWRA agreed to share the cost of the cured-in-place-pipe (CIPP) liner rehabilitation which is estimated at $4.2 million. MWRA's CSO Control Plan utilizes both the in-line storage and conveyance capacity of the current brick sewer to control and reduce the CSO volume discharged to the Mystic River from the Somerville-Marginal CSO treatment facility. The FY19 CIP includes $1.4 million in spending in FY19 for this project.

- MWRA's CSO post-construction monitoring program and performance assessment is programmed in the FY19 CIP at $2.924 million to be spent during FY18-21. Total expenditures during the planning period (FY19-21) are $2.282 million.

- System Assessment and Technical Review for as-needed support to the MWRA's CSO post-construction monitoring program and performance assessment is programmed in the FY19 CIP at $273,000 to be spent during FY19-21.

Table 11-4

Wastewater Master Plan - CSO Control Plan - MWRA and Community Managed Projects

Existing Projects

Last revision 9/8/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF	New Facility/System
RF/IC	Replacement Facility/Increase Capacity
Opti	Optimization
AP	Asset Protection
Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		CSO CONTROL PLAN												
11.01	1	Additional Inflow Removal Work by BWSC in Dorchester Interceptor Basin (South Dorchester Bay Sewer Separation - Commercial Point) Community Managed Project	Opti	341	32750_7576	2 years	3,758	3,758	FY20-21	3,758				3,758
11.02	3	Somerville Marginal In-System Storage CIPP Lining	AP	324	32748_7539	1 year	1,400	1,400	FY19	1,400				1,400
11.03	1	CSO Performance Assessment Plan MWRA Managed Project	Plan	324	32749_7572	4 years	2,924	2,282	FY18-21	2,282				2,282
11.04	1	CSO Planning & Support - SOP Program, Remaining Portion of Easements, System Assessment and Tech Review MWRA Managed Project	Plan	324	32648_6150 32658_6169 32691_6372	3 years	273	273	FY19-21	273				273
		SUBTOTAL - CSO Control Plan - (MWRA and Community Managed)					**8,355**	**7,713**		**7,713**	**0**	**0**	**0**	**7,713**

CHAPTER 12
WASTEWATER SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) AND WASTEWATER METERING SYSTEM

12.01 Chapter Summary

Supervisory Control and Data Acquisition (SCADA) systems provide a means of monitoring and controlling facilities and equipment from a remote centralized location, as well as providing a continuous record of facility operations. MWRA's Wastewater SCADA system went through a major upgrade from 2007 through 2009 as part of the Wastewater Central Monitoring/SCADA Implementation Project. This project created a unified SCADA system covering all significant wastewater facilities (separate from MWRA's wastewater treatment plants). Both the Deer Island and Clinton Wastewater Treatment Plants have separate SCADA systems operated by plant staff. New facilities such as the North Dorchester Bay (South Boston) CSO Storage and Pump Facilities have been incorporated into the system, and major facility upgrades (Chelsea Creak Headwork, Alewife Brook Pump Station), include SCADA system upgrades to meet anticipated needs into the near future. All wastewater facilities can be monitored and controlled at the Chelsea Operations Control Center using the SCADA system.

MWRA's existing SCADA system is in good condition. Future needs identified in the Master Plan are based on assumed useful life/obsolescence of the electronic equipment. Much of the Wastewater SCADA system components (workstations, servers, routers, switches, data diodes, security and operating software, field instrumentation, data radios, etc.) are maintained and updated using Current Expense Budget (CEB) funds by SCADA staff on an as needed basis. Capital Improvement Program (CIP) funds are used for personal computer and server upgrades, which currently require a 5 to 7-year upgrade cycle to ensure the hardware will continue to function reliably and support the desired operating systems and software. Wastewater SCADA programmable logic controllers (PLCs) along with some communication equipment (microwave radios) are expected to need replacement or upgrade every 15 to 20 years or when a significant enhancement in security architecture is released. PLCs are simply a specialized industrial grade computer which collects, broadcasts, and uses data from the facility to make operational decisions based on a pre-programmed control strategy.

MWRA's wastewater metering system provides rate-basis data on community flows, as well as additional operational support data for hydraulic modeling, capacity analyses, engineering studies, and community flow component (sanitary/infiltration/inflow) estimates. Upgrades to the wastewater metering system are scheduled to continue throughout the 40-year Master Plan period.

The existing MWRA wastewater metering system equipment is in fair condition as the system is 13+ years old and equipment reliability is decreasing. Wastewater metering system equipment is expected to need replacement about every 10 to 15 years. A comprehensive metering system upgrade project began in FY18. Future needs identified in the Master Plan are based on assumed useful life/obsolescence of the electronic equipment.

For SCADA improvements and wastewater metering system upgrades, $61.121 million in projects is identified in the 40-year master plan timeframe (FY19-58). Near-term, mid-term and long-term costs are detailed below. Section 12.05 - Summary of Existing and Recommended Capital Projects includes a consolidated listing of all projects recommended in this Chapter.

Near-term (FY19-23):

- $15.879 million is programmed in the FY19 CIP:
  - $700,000 for Wastewater Central Monitoring - wastewater redundant communications;
  - $920,000 for Wastewater Central Monitoring - wastewater SCADA/PLC upgrades – design and programming services;
  - $580,000 for Wastewater Central Monitoring - wastewater SCADA/PLC upgrades – equipment and hardware;
  - $2.884 million for Wastewater Metering System Equipment Replacement - planning, study and design;
  - $5.00 million for Wastewater Metering System Equipment Replacement - construction;
  - $1.395 million for Wastewater Metering Meter Power – design, construction administration, and resident engineering;
  - $4.00 million for Wastewater Metering System Equipment Replacement - asset protection and equipment purchase; and,
  - $400,000 for Wastewater Metering System Equipment Replacement – meter modems antenna replacement.

Mid-term (FY24-28):

- $5.50 million is programmed in the FY19 CIP:
  - $2.550 million to complete Wastewater Central Monitoring - wastewater SCADA/PLC upgrades – design and programming services;
  - $1.420 million to complete Wastewater Central Monitoring - wastewater SCADA/PLC upgrades – construction; and,
  - $1.530 million to complete Wastewater Central Monitoring - wastewater SCADA/PLC upgrades – equipment and hardware;
- $400,000 is recommended for consideration in future CIPs for Wastewater Microwave Radio replacement during FY24-28.

Long-term (FY29-38 and FY39-58):

- $8.942 million is programmed in the FY19 CIP to continue the Wastewater Metering System Equipment Replacement - asset protection and equipment purchase projected during FY30-31.
- $30.40 million in needs is recommended for consideration in future CIPs:
  - $400,000 during FY44-48 for future Wastewater Microwave Radio replacements; $10.0 million for FY39-58 for future Wastewater Central Monitoring - wastewater SCADA/PLC replacements and upgrades; and,
  - $20.0 million for FY44-48 for future Wastewater Metering System asset protection planning, design, and construction.

12.02 SCADA System Overview

SCADA systems provide a means of monitoring and controlling facilities and equipment from a remote centralized location, as well as providing a continuous record of facility operations. SCADA systems are common in municipal and industrial applications and typically consist of four primary components:

- Field instruments and equipment (e.g., sewage level sensors, valve actuators);
- Input/Output (I/O) devices (e.g., programmable logic controllers (PLCs) that handle data and command signals to and from field equipment);
- Communication and Network devices and media (e.g., telephone lines, radio links, cellular communication, routers, switches); and,
- Hardware and software to interface with SCADA components and provide security, monitoring and controls (e.g., operator workstations, engineer consoles, PLC and HMI programming software, firewalls and data diodes, antivirus and network monitoring software, Active Directory software, etc.).

The goals established in the 1999 SCADA Master Plan are still relevant. They include the following primary and secondary goals:

Primary Goals

- Reduce Transport Operations and Maintenance Costs;
- Operate the Transport System More Efficiently;
- Enhance the Reliability and Performance of Transport System Operations; and,
- Improve Customer Service in the Sewerage Division.

Secondary Goals

- Facilitate Information Access Throughout the Sewerage Division;
- Optimize Transport System Performance via Computerized Decision Support; and,
- Improve Facilities Planning Decision Making Throughout the Sewerage Division.

The Wastewater SCADA system is maintained by MWRA staff. All of MWRA’s major wastewater facilities have been integrated into the SCADA system. This includes four remote headworks facilities, all wastewater pumping facilities, six CSO storage/treatment facilities, and one screen house. Most recently, the SCADA system was extended to the Wiggins – Castle Island Terminal Pump Station by MWRA SCADA staff in FY18. Both the Deer Island and Clinton Wastewater Treatment Plants have separate SCADA systems operated by plant staff.

12.03 Wastewater Central Monitoring/SCADA Implementation Projects

The Wastewater Central Monitoring – Wastewater Redundant Communications Project is programmed in the FY19 CIP at a budget of $700,000 during FY20-23. This project provides a budget for improving and providing redundant communications for critical facilities and data within the wastewater SCADA network. This may include expanding the existing microwave communication network or implementing other communication technologies. This project is a candidate to be funded out of MWRA’s CEB rather than the CIP due to its relative low cost.

Staff estimate that a Wastewater Microwave Radio Replacement project will be required every 20 years. For planning purposes, two future $400,000 projects are recommended for consideration during the FY24-28 and FY44-48 timeframes.

The Wastewater Central Monitoring – Wastewater SCADA/PLC Equipment Upgrade project is programmed in the FY19 CIP at a total budget of $7.0 million during FY19-28. This project will replace existing SCADA/PLCs nearing end of useful life with new PLC platforms and will provide for increased security and improved programming functionality. Secondary goals include standardizing PLC logic and HMI graphics. The overall project has been divided into three phases. Expenditures during the planning period (FY19-28) for design and programming services are $3.470 million. Expenditures during the planning period (FY19-28) for construction services are $1.420 million. Expenditures during the planning period (FY19-28) for equipment and hardware are $2.110 million.

Staff estimate that a Wastewater SCADA/PLC equipment replacement/upgrade project will be required every 20 years or when a significant enhancement in security architecture is released. Replacement/upgrade costs will depend on the level of reconfiguration and reprogramming required. For planning purposes, a Wastewater SCADA/PLC Equipment Upgrade project at a budget of $10.0 million is recommended for consideration in future CIPs during the FY39-58 timeframe. Other future Wastewater SCADA system enhancements will be based on industry standards and assessment recommendations to ensure a secure and reliable system.

12.04 Wastewater Metering System

MWRA's wastewater metering system provides community flow-based rate assessments and data for modeling, engineering studies, infiltration/inflow estimates, and operational support. Installation of MWRA's initial wastewater metering system began in 1989 and was completed in 1994. This first system was comprised of ADS Environmental 3500 wastewater flow meters and facility remote terminal units (RTUs). By 2000, this system required extensive maintenance to function correctly and was near the end of its useful life. In November 2003, MWRA initiated a comprehensive wastewater metering equipment replacement project which was substantially completed in 2005 at an overall cost of $5.138 million.

As of July 2018, MWRA's wastewater metering system is comprised of the following:

- 102 Marsh McBirney Flo-Dar - Radar Based/Area Velocity Flow Meters;
- 27 MGD ADFM – Acoustic Doppler Flow Meters;
- 21 ADS FlowShark - Acoustic Doppler Flow Meters;
- 23 ADS Triton - Acoustic Doppler Flow Meters;
- 2 FloWav - Acoustic Doppler Flow Meters;
- 25 Facility RTUs – Remote Terminal Units;
- 9 Telog – Pressure Level Sensors; and,
- 3 Flume RTUs with depth sensors.

The Marsh McBirney Non-Contact Flo-Dar meters utilize ultrasonic depth and radar velocity as the primary means of measuring flow. The MGD ADFM, ADS FlowShark and ADS Triton + and FloWav are contact meters that utilize submerged ultrasonic depth and velocity as the primary means of measuring flow. The Facility RTUs capture, store, and transmit the signal/data from the respective facility's primary wastewater flow meter. The Telog RU units utilize pressure sensor to measure depth of flow at key interceptor operational sites. The Flume RTUs utilizes ultrasonic depth as the primary means of measuring flow in a flume. MWRA staff have been trained on software and field maintenance/bench technician procedures for all the existing metering equipment.

The above photo shows a typical wastewater meter installed in a sewer manhole. The data recorder is suspended at top of manhole and the depth/velocity sensor is mounted near the wastewater flow at the bottom of the manhole. The photo below is a close-up of the depth/velocity sensor mounted near the wastewater flow.

Comprehensive upgrade of the wastewater metering system is programmed in the FY19 CIP through completion of multiple projects. The planning portion of the metering system upgrade project began in FY18. Five separate projects detailed in the bullets below are planned for the FY18-31 timeframe.

- The Wastewater Metering System Equipment Replacement - planning/study and design will provide for the comprehensive upgrade or replace the existing wastewater metering system (technology, hardware, software, telemetry). All wastewater community flow formulas used for metering will be evaluated, quantified, and updated. This 5-year project is programmed in the FY19 CIP at a total cost of $3.858 million during FY18-22. Expenditures during the planning period (FY19-22) are $2.884 million.

- The Wastewater Metering System Equipment Replacement – equipment replacement construction will follow-up on the design phase. This project will select a contractor via bidding to place the new metering equipment selected specifically for each meter site condition. This project is programmed in the FY19 CIP at $5.0 million during FY21-22.

- The Wastewater Metering System Meter Power – design, construction administration, and resident inspection will select an engineer via RFQ/P to design permanent electric powered pedestal cabinets for a select subset of wastewater meters. The data from these sites will be used to optimize MWRA operation and maintenance activities during normal and wet weather conditions. This project is programmed in the FY19 CIP at $1.395 million during FY20-23.

- The Wastewater Metering System Equipment Replacement – asset protection/equipment replacement phase includes purchase of new metering equipment (hardware and software) for the initial upgrade of the metering system and allows for future equipment upgrades as may be needed over the following ten years. This project is programmed in the FY19 CIP at $12.942 million during FY20-21 and FY30-31.

- The Wastewater Metering System Equipment Replacement – Meter Modems-Antenna Replacement phase includes purchase and replacement of 500 meter modems and associated antennas. This project is programmed in the FY19 CIP at $400,000 during FY19-20.

There is also a Wastewater Metering System related project recommended as a place holder for consideration in future CIPs. The Wastewater Metering System Asset Protection - planning, design, and construction provides a future budget that will allow for a comprehensive rehabilitation, replacement and upgrades of the Wastewater Metering System. For planning purposes, $20.0 million is budgeted over the long-term, projected for the 5-year timeframe FY44-48.

12.05 Summary of Existing and Recommended Capital Projects

Projects in the FY19 CIP: There are four SCADA and five Wastewater Metering System related projects programmed in the FY19 CIP. These projects are described below and summarized in Table 12.1 (see line numbers 12.01 through 12.09):

- Wastewater Central Monitoring – Wastewater Redundant Communications Project is programmed in the FY19 CIP at a budget of $700,000 during FY20-23. This project provides a budget for the purchase of SCADA system components to ensure consistency with MWRA's MIS infrastructure.

- Wastewater Central Monitoring – SCADA/PLC Upgrades – design and programming services project is programmed in the FY19 CIP at a budget of $3.470 million during FY19-28. This design phase will provide for increased security and improved programming functionality. Secondary goals include standardizing PLC logic and HMI graphics.

- Wastewater Central Monitoring – SCADA/PLC Upgrades – construction project is programmed in the FY19 CIP at a budget of $1.420 million during FY24-28. This is the construction phase to replace existing SCADA/PLCs nearing end of useful life with new PLC platforms and will provide for increased security and improved programming functionality.

- Wastewater Central Monitoring – SCADA/PLC Upgrades – equipment and hardware project is programmed in the FY19 CIP at a budget of $2.110 million during FY19-28. This project will provide for future equipment upgrades.

- The Wastewater Metering System Equipment Replacement - planning/study and design will provide for the comprehensive upgrade or replace the existing wastewater metering system (technology, hardware, software, telemetry). All wastewater community flow formulas used for metering will be evaluated, quantified, and updated. This 5-year project is programmed in the FY19 CIP at a total cost of $3.858 million during FY18-22. Expenditures during the planning period (FY19-22) are $2.884 million.

- The Wastewater Metering System Equipment Replacement - construction will follow-up on the design project. This project will select a contractor via bidding to place the new metering equipment selected specifically for each meter site condition. This project is programmed in the FY19 CIP at $5.0 million during FY21-22.

- The Wastewater Metering System Meter Power – design, construction administration, and resident inspection will select an engineer via RFQ/P to design permanent electric powered pedestal cabinets for a select subset of wastewater meters. This project is programmed in the FY19 CIP at $1.395 million during FY20-23.

- The Wastewater Metering System Equipment Replacement - asset protection/equipment replacement phase includes purchase of new metering equipment (hardware and software) for the initial upgrade of the metering system and allows for future equipment upgrades as may be needed over the following ten years. This project is programmed in the FY19 CIP at $12.942 million during FY20-21 and FY30-31.

- The Wastewater Metering System Equipment Replacement – Meter Modems-Antenna Replacement phase includes purchase and replacement of 500 meter modems and associated antennas. This project is programmed in the FY19 CIP at $400,000 during FY19-20.

<u>Projects Recommended for Consideration in Future CIPs:</u> There are two SCADA and one Wastewater Metering System related projects recommended for consideration in future CIPs. These projects are described below and summarized in Table 12.1 (see line numbers 12.10 through 12.12):

- Wastewater Microwave Radio Replacement project will be required every 20 years. For planning purposes, two future $400,000 projects are recommended for consideration during the FY24-28 and FY44-48 timeframes.

- Wastewater SCADA/PLC Equipment Upgrade project is recommended for consideration in future CIPs at a budget of $10.0 million during the FY39-58 timeframe.

- Wastewater Metering System Asset Protection - planning, design, and construction provides a future budget that will allow for a comprehensive rehabilitation, replacement and upgrades of the Wastewater Metering System with $20.0 million budgeted during FY44-48.

Table 12-1

Wastewater Master Plan - SCADA and Wastewater Metering System

Existing and Recommended Projects

Last revision 8/31/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF New Facility/System
RF/IC Replacement Facility/Increase Capacity
Opti Optimization
AP Asset Protection
Plan Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		SCADA & WASTEWATER METERING												
12.01	1	Wastewater Central Monitoring - Wastewater Redundant Communications	AP/Opti	137	10490_7363	4 years	700	700	FY20-23	700				700
12.02	2	Wastewater Central Monitoring - SCADA/PLC Upgrades - Design and Programming Services	AP/Opti	137	10551_7578	10 years	3,470	3,470	FY19-28	920	2,550			3,470
12.03	2	Wastewater Central Monitoring - SCADA/PLC Upgrades - Construction	AP/Opti	137	10552_7579	5 years	1,420	1,420	FY24-28	0	1,420			1,420
12.04	2	Wastewater Central Monitoring - SCADA/PLC Upgrades - Equipment/Hardware	AP/Opti	137	10553_7580	10 years	2,110	2,110	FY19-28	580	1,530			2,110
12.05	2	Wastewater Metering System Equipment Replacement -Planning/Study and Design	Plan	142	10371_6739	5 years	3,858	2,884	FY18-22	2,884				2,884
12.06	2	Wastewater Metering System Equipment Replacement - Construction	RF	142	10411_6929	2 years	5,000	5,000	FY21-22	5,000				5,000
12.07	2	Wastewater Metering System Meter Power - Design/CA/RI	NF	142	10410_6928	4 years	1,395	1,395	FY20-23	1,395				1,395
12.08	2	Wastewater Metering System Equipment Replacement - Asset Protection/Equipment Purchase	AP/RF	142	10451_7191	2 years	12,942	12,942	FY20-21, FY30-31	4,000		8,942		12,942
12.09	2	Wastewater Metering System Equipment Replacement - Meter Modems - Antenna Replacement	AP	142	10590_7639	2 years	400	400	FY19-20	400				400
		SUBTOTAL - Existing - SCADA and Metering					31,295	30,321		15,879	5,500	8,942	0	30,321
12.10	3	Wastewater Microwave Radio Replacement, every 20 years	AP	new		5 years	800	800	FY24-28, FY44-48		400		400	800
12.11	3	Wastewater Central Monitoring - SCADA/PLC Replacement/Upgrade, Future	AP	new		20 years	10,000	10,000	FY39-58				10,000	10,000
12.12	2	Wastewater Metering System Asset Protection Plan/Design/Construct - Future	AP	new		5 years	20,000	20,000	FY44-48				20,000	20,000
		SUBTOTAL - Recommended - SCADA and Metering					**30,800**	**30,800**		**0**	**400**	**0**	**30,400**	**30,800**
		SUBTOTAL - Existing and Recommended - SCADA and Metering					**62,095**	**61,121**		**15,879**	**5,900**	**8,942**	**30,400**	**61,121**

CHAPTER 13
ENERGY MANAGEMENT, INFORMATION MANAGEMENT, LABORATORY SERVICES, AND SECURITY

13.01 Chapter Summary

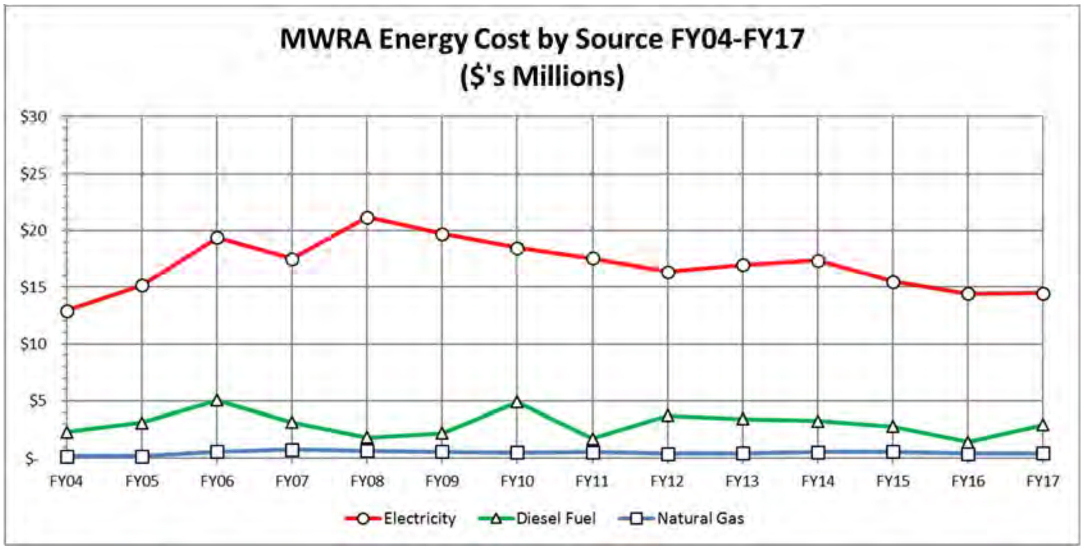
The operation and maintenance of MWRA's water supply and wastewater systems are supported by an array of processes, systems, and equipment. In this chapter, four specific support areas are detailed: (1) energy management, (2) information management, (3) laboratory services, and (4) security. Current conditions and needs of each are discussed below along with corresponding recommendations. Since all four of these support functions apply to both the water and wastewater systems, the discussion and recommendations have been included in both the 2018 Water System Master Plan (see Chapters 9 and 10) and 2018 Wastewater System Master Plan.

13.02 Energy Management

The Energy Management Section presented here is also presented as Chapter 10 of the 2018 Water System Master Plan. Any energy management costs programmed in the FY18 CIP and recommended for consideration in future CIPs are included only in the Water System Master Plan and not in the Wastewater System Master Plan so that there would be no double counting of overall costs.

The MWRA's Deer Island Treatment Plant (DITP) is one of the largest wastewater treatment plants in the world. Along with DITP, MWRA also operates large potable water distribution and sewer collection systems; altogether making MWRA a large energy user in Massachusetts. The cost of powering multiple facilities makes up a significant portion of MWRA's direct expenses. MWRA's total electricity usage[1] in FY17 (for both water and wastewater systems) of 188,300,000 kWh (electricity only) is equivalent to approximately 17,000 homes[2]. MWRA also used 514,580 therms of natural gas in FY17. Energy costs ranged from $15.4 million (8.9% of total direct expenses) in FY04 to $17.9 million (7.9% of budget) in FY17 (due in part to the addition of major new facilities including the Carroll Water Treatment Plant and to the varying price of energy). Spending temporarily escalated to $26 million (13.8% of directs) in FY06 due to the spike in energy costs subsequent to Hurricane Katrina, highlighting the volatility of energy prices. MWRA is also impacted on the wastewater side by weather patterns with major rain events driving energy consumption higher. For these reasons, the MWRA has reinforced efforts to aggressively manage energy usage and costs as an important part of MWRA's overall rates management strategy.

1 Demand vs usage – Demand is the total power needed to run MWRA's facilities. "Purchased" or "procured" energy is that energy not produced on site. Demand (-) purchased = on site generation.
2 In 2016, the average annual electricity consumption for a U.S. residential utility customer was 10,766 kWh. https://www.eia.gov/tools/faqs/faq.php?id=97&t=3



Notes:

- Significant increases in diesel fuel and electricity prices in FY06 to FY07 due to Hurricane Katrina.
- Significant increases in electricity prices again in FY08-FY10 due to market volatility was offset by declining purchases due to self-generation and energy-efficiency projects.
- Diesel fuel purchases increased in FY10 due to extensive CTG use during spring storms.

While MWRA's energy initiatives have focused on all energy sources, the major emphasis has been on reducing costs for electricity since it accounts for over 80% (in FY17) of the energy spending.

Strategies are generally broken into demand-side strategies and supply-side strategies. Demand-side strategies focus on opportunities to implement additional energy conservation measures and maximize the use of existing and potential new base-load self-generation assets to reduce or offset MWRA's need for purchased energy. Supply-side strategies include efforts to focus on reducing energy costs through the optimization of competitive energy supply contracts while maintaining a balanced energy portfolio. Other supply-side initiatives include continued evaluation of the operational and economic feasibility of enrolling back-up generation assets in load reduction programs and evaluating opportunities to shave peak demand, thereby reducing electricity demand charges.

In September 2016, Governor Baker issued *Executive Order 569 – Establishing an Integrated Climate Change Strategy for the Commonwealth*, an order that lays out a comprehensive approach to further reduce greenhouse gas emissions, build a more resilient Commonwealth for future generations, and safeguard residents, municipalities and businesses from the impacts of climate change.

Massachusetts has also incorporated Clean Energy Standards ("CES"), effective calendar year 2017. The CES works in tandem with the Renewable Portfolio, with the intention of increasing the percentage of procured energy to include renewable power. Additionally, Massachusetts promulgated the Clean Peak Standards ("CPS") in July 2018, which further adds the clean energy requirement to procured load, but focuses on peak demand hour consumption.

The new Order ensures that Massachusetts will continue to lead by example and collaborate across state government to reduce greenhouse gas emissions while building resiliency within government operations. The Order also directs the Executive Offices of Energy and Environmental Affairs and Public Safety and Security to lead the development and implementation of a statewide comprehensive climate adaptation plan that will provide a blueprint for protecting the built and natural environment of the Commonwealth, using the best available data on existing and projected climate change impacts.

Governor Baker's Executive Order 569 mirrors the earlier 2007 Executive Order, *Executive Order 484 – Leading by Example – Clean Energy*, which directed state agencies to make strides in energy conservation, develop and use power from renewable sources, and reduce greenhouse gases. Progress was to be tracked and specific targets were set.

The sections below discuss MWRA's work to implement: (1) renewable energy projects, (2) demand-side management programs, (3) supply-side management programs, (4) other sustainability initiatives, (5) Greenhouse Gas Inventory, and (6) recommendations for future work.

Renewable Energy

Consistent with 2007 Executive Order 484, MWRA has made a priority of siting new renewable energy projects at as many facilities as economically feasible and continues to aggressively seek out any available grant and loan funds to improve project paybacks. Each renewable project is reviewed on a case-by-case basis to evaluate the reasonableness of payback periods (including the impact of grants and rebates).

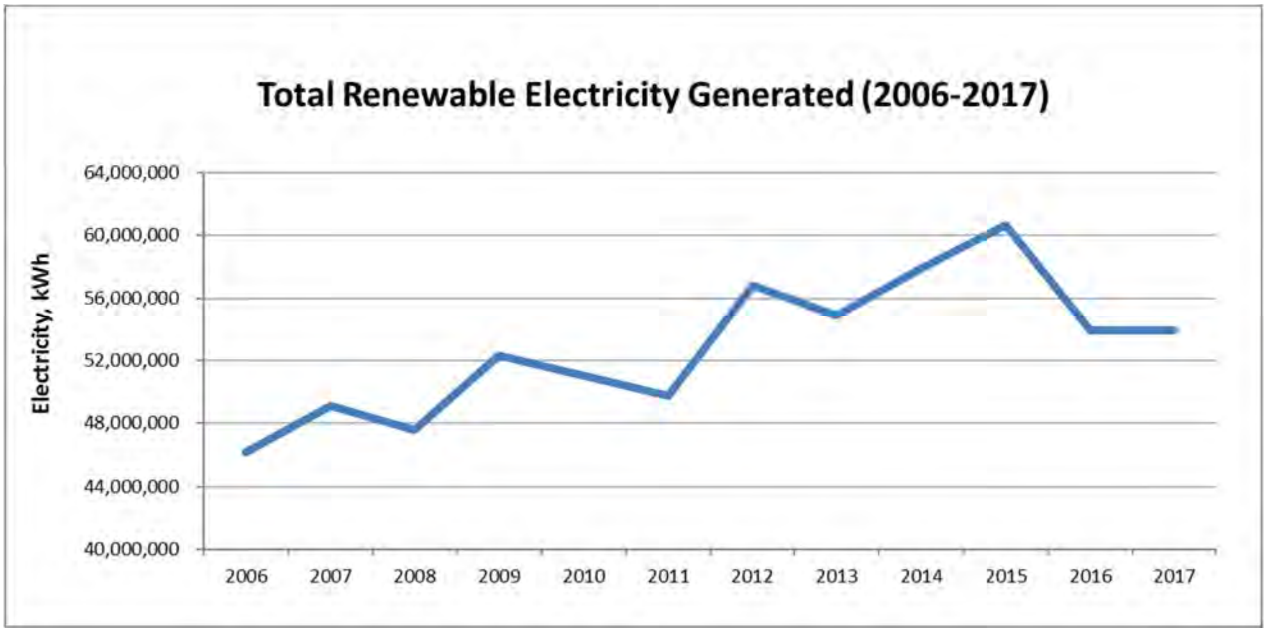
The Quabbin Reservoir supplies water to the metro Boston region from a high elevation (approximately 526 feet). The MWRA is able to capture energy at two hydroelectric facilities, Oakdale and Cosgrove, as the water travels downhill from western Massachusetts to the Metro Boston area. Hydropower is also generated at the Loring Road Covered Storage Facility as water is directed from a higher grade-line into the storage tanks which establish the grade-line of MWRA's Low Service Area. This serves as a more efficient way to dissipate energy and provide a steady flow rate to the tanks. Hydropower generation was also incorporated into the design of facilities at Deer Island to capture energy as flows drop into the outfall shaft and into the outfall tunnel following treatment.

MWRA has also recently finished the Hatchery Pipeline and Hydroelectric project that consists of a water pipeline which taps raw water off of MWRA's Chicopee Valley Aqueduct (CVA) just prior to the Brutsch Hydropower Facility and conveys six million gallons per day of cooler water from deep in the Quabbin Reservoir through a hydropower turbine/generator on the grounds of the Brutsch Hydropower Facility, downstream 4,400 feet to the State's McLaughlin Fish Hatchery. The project has multiple environmental benefits besides operational advantages to the Hatchery. It is an important green energy initiative, since not only does MWRA generate hydropower, the Hatchery's electrical demand associated with pumping water from the Swift River has been eliminated under typical conditions.

Wind energy is captured with turbines at Deer Island and the Charlestown Pump Station. Solar electric panels have been installed at several locations on Deer Island and at the Carroll Water Treatment Plant.

The majority of renewable energy generation comes from methane gas captured from sludge digestion at DITP. The methane generated from the sludge digestion process is collected and used in Deer Island's on-site power plant to create steam that supplies hot water and heat for the facility. This results in the avoided purchase of over 5 million gallons of diesel fuel each year (to heat the facility). The steam is also run through a steam turbine generator that produces electricity, approximately 30 million kWh a year. This system alone generates over 20% of the electricity needed at the Deer Island Treatment Plant.

Agency-wide green power production has increased from 46.1 million kWh in calendar year 2006 to 53.9 million kWh in 2017, an increase of 16.8 percent as shown in the graph below. MWRA's renewable energy generation of 53.9 million kWh (not including the thermal value of digester gas on Deer Island) is equivalent to about 5,000 homes[3]. This is similar to MWRA service area towns the size of Wilmington, Ashland, Bedford, and Swampscott. MWRA continues to look for additional opportunities for renewable energy within the water and wastewater systems.



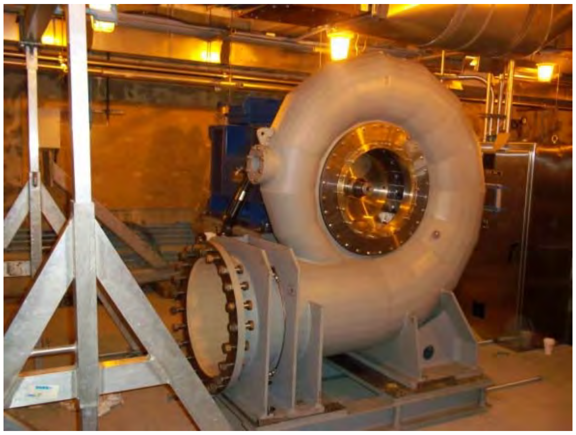
Wind – MWRA has three operating wind turbines: two 600kW at DITP, and one 1.5 MW at Charlestown Pump Station. These three turbines generate approximately 3.5 million kWh per year and provide an average annual savings and revenue of about $530,000 (The savings and revenue value does not include RPS REC revenue).

3 In 2016, the average annual electricity consumption for a U.S. residential utility customer was 10,766 kWh. https://www.eia.gov/tools/faqs/faq.php?id=97&t=3

Solar – Solar photovoltaic systems are currently installed at Deer Island on the roofs of the Residuals/Odor Control, Maintenance/Warehouse, and Grit Buildings (on the ground in the south parking lot). A system is also located on the grounds at the Carroll Water Treatment Plant. The solar photovoltaic systems represent over 1.2 MW of capacity and produces approximately 1.4 million kWh per year of electricity, providing average annual savings and revenue of $166,000 (the savings and revenue value does not include RPS REC revenue). Future solar projects are being considered with the start of the new SMART program in 2018.

Wachusett Aqueduct Pumping Station solar will be a roof and ground mounted array of 93kW capacity (photo at left in October 2018).

Hydroelectric - MWRA has a long history of using hydroelectric energy and continues to look for opportunities to capture the energy of water as it moves from higher to lower elevations. Hydroelectric facilities are currently located at Deer Island, Loring Road, Oakdale, Cosgrove, and Brutsch Hydropower Facility. These facilities represent over 8 MW of capacity and will produce about 23 million kWh of electricity per year with projected annual savings and revenues of over $1,800,000.



Recent Progress in Hydropower - Construction on the Hatchery Pipeline and Hydroelectric Project, a 20-inch water pipeline running from the MWRA's Brutsch Hydropower Facility in Ware to the McLaughlin Fish Hatchery in Belchertown was completed in 2017. The project includes a 65 kW hydropower facility to capture excess energy as water is conveyed from the higher reservoir elevation to the pipeline take-off at the Chicopee Valley Aqueduct. The water in the pipeline replaces the use of river water and flows by gravity, thereby eliminating the energy used to pump water from the river. This reduces the hatchery's electrical demand by an estimated 588,000 kWh annually. Ultimately, after circulating through the hatchery's raceways and treatment, the roughly six million gallons of water each day is discharged into the Swift River. Because of the multiple environmental and operational benefits of this project, the Massachusetts Division of Fisheries and Wildlife and the Massachusetts Department of Fish and Game have joined the MWRA in sponsoring this project. The hydropower component, which is projected to export 440,000 kWh to the grid, attracted two separate grants – one from the Massachusetts Clean Energy Center, and the other from the Massachusetts Executive Office of Energy and Environmental Affairs.

Methane **-** The capture of methane from the digesters was included in the original design contract of the Deer Island Treatment Plant. Co-generation at the Deer Island Thermal Power Plant (capacity of over 6 MW) using methane saves MWRA approximately 5 million gallons per year in annual fuel oil purchases (to heat the digesters and Deer Island buildings). The Power Plant Steam Turbine Generator at Deer Island allows MWRA to use steam from the methane powered boilers to produce electricity (valued at about $2.5 million in FY17). In addition, methane is a potent greenhouse gas; therefore, its capture and use significantly reduces MWRA's carbon footprint. If fuel oil had been used for heating instead of digester gas for the period of 2006-2016, there would have been a net additional 591,645 metric tons of CO_2e emissions. This is equivalent to 1.45 billion miles driven by an average passenger vehicle, or the carbon sequestered by over 696,000 acres of U.S. forests in one year - a land mass about twelve times that of the Boston area.[4] An engineering study is planned to start in FY18 to optimize the use of methane gas production and overall CHP efficiency (see Deer Island section for more details).

4 http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

List of all MWRA Renewable Electricity Generation Facilities and Rated Capacities:

Facility	Rated Capactiy
Methane	
Deer Island Steam Turbine Generator	18 MW
Deer Island Backpressure Steam Turbine Generator	1 MW
Hydro	
Cosgrove Hydro	2 @ 1.7 MW
Deer Island Hydro	2 @ 1 MW
Loring Rd Hydro	200 kW
Oakdale Hydro	3.5 MW
Brutsch Facility Hydro	65 kW
Solar	
Carroll Water Treatment Plant Ground Mounted Solar	496 kW
Deer Island Maintenance/Warehouse Roof Mounted Solar	180 kW
Deer Island Grit Roof Mounted Solar	222 kW
Deer Island Parking Lot Ground Mounted Solar	234 kW
Deer Island Residuals Odor Control Roof Mounted Solar	100 kW
Wachusett Aqueduct Pumping Station Solar	93 kW
Wind	
Charlestown Wind Turbine	1.5 MW
Deer Island Wind Turbine 1	600 kW
Deer Island Wind Turbine 2	600 kW

Energy Optimization Measures – Wachusett Aqueduct Pumping Station

The Wachusett Aqueduct Pumping Station (WAPS) is under construction with a completion date of February 2019 and is currently in testing. This facility will provide a redundant raw water supply from the Wachusett Reservoir to the Carroll Water Treatment Plant via the Wachusett Aqueduct. This facility will be used either during emergency or planned shutdown of the Cosgrove Tunnel. The project includes the construction of a 240 MGD pumping station. A number of green energy attributes including photovoltaic panels and an open-loop geothermal system will be installed to reduce the reliance on fossil fuels and electricity for heating and cooling of the station. The geothermal system will take advantage of the constant supply of water in the Forebay. An outline of green energy attributes for the Wachusett Aqueduct Pumping Station is presented below.

Photovoltaic System

- Photovoltaic system on the roof of the pumping station and on the ground;
- Will generate the equivalent of the electrical power used on average throughout the year while in stand-by mode (not including power for pumping).

Zero Net Energy Improvements

- Cold roof design (double roof with air gap) will be implemented to reduce heating and cooling requirements;
- Insulation values for the roof, walls and basements will be greater than code requirements;
- Air and vapor barrier will be continuous from the foundation through the roof;
- A hard ceiling will be installed in the pump room to minimize the volume of air to be heated and cooled;
- Process pumps will be specified with the minimum pump efficiency of 87% and motor efficiency of 93%;
- Energy Performance will be exceeded with:
  - LED light fixtures on the exterior and interior;
  - Light control system using motion and daylight sensors;
  - Premium efficiency motors and variable frequency drives on all HVAC equipment;
  - Automatic Temperature Control system with set points at 55°F for Heating & 85°F for cooling;
  - Low water temperature heating system will be utilized;
  - Heat Energy Recovery System on the air handling system; and,
  - Geothermal Heating & Cooling for the building and process.

LEED Plus Items

- Porous Pavements will be used in all new parking and storage areas;
- Roof with a Solar Reflective Index greater than 34;
- “Water Sense” ultra-low flow plumbing fixtures;
- No irrigation system will be included, use of native drought resistant plantings;
- Refrigerants used will not contain CFCs;
- Regional materials will be specified where appropriate;
- Ventilation rates above code requirements will be used at 0.2 air changes per hour (ACH) unoccupied and 1 ACH in the occupied mode; and,
- Low VOC emitting materials will be specified.

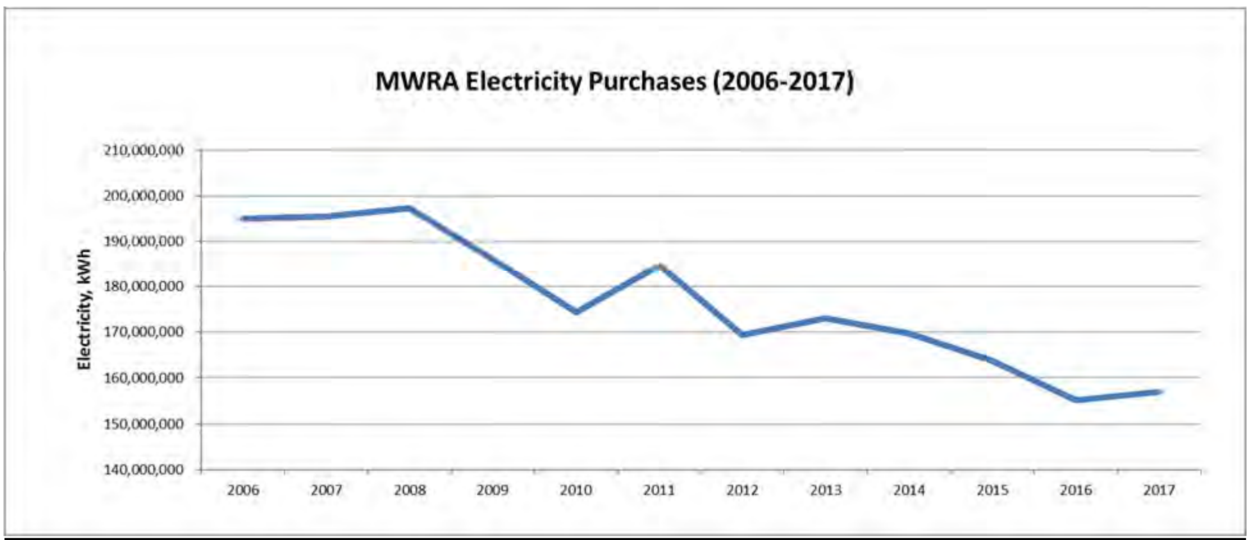
Massachusetts Renewable Energy Portfolio Standard (RPS) – Retail electricity suppliers are required by Massachusetts regulation to provide a portion of their power from renewable energy sources. Renewable energy generators (like MWRA) can sell credits to electricity suppliers to help them meet the regulatory requirements. Since December 2002, MWRA has been selling its renewable energy credits through a competitive bid process. MWRA RPS eligible facilities have increased in recent years due to both new facilities being brought on line, as well as the Green Communities Act regulations that made hydropower eligible in 2009. MWRA receives an average of $1 Million in RPS revenue annually.

Demand-Side Management

MWRA demand side management efforts include:

- Improving equipment energy efficiencies at operating facilities (lighting, variable frequency drives, HVAC system updates, treatment process modifications, etc.);
- Establishing operating protocols to reduce monthly and annual peak energy demand charges; and,
- Enrolling in demand response programs offered by regional grid operators.

Overall, MWRA has seen a net reduction of 19.5 percent (about 38 million KWh) in electricity purchases between 2006 and 2017, partly due to increases in renewable electricity production as discussed above and energy efficiency improvements made throughout the MWRA system. This is offset by increases in energy use at facilities which have seen functional upgrades requiring new energy demands, such as improved CSO capture and the addition of UV disinfection to the Carroll Water Treatment Plant and the Brutsch Hydropower Facility. The graph below shows the electricity purchase trend during this time.



Using both MWRA resources and free or reduced cost assistance from power suppliers whenever available, MWRA has conducted energy audits at almost every MWRA facility - in some cases, returning several years later as improved technologies offered new opportunities for savings.

Some examples of actions undertaken by MWRA to improve efficiency include:

- Installation of new Dissolved Oxygen probes and control panels in 2011 at Deer Island's secondary treatment train enabled 9.2 million kWh annual savings in electricity and $830,000 dollars annually with no impact to effluent quality or secondary capacity.

- Installation of Energy Management Systems in the Chelsea Administration and Maintenance Buildings, Southborough Administration Building, Charlestown Navy Yard Offices, and the Brutsch Hydropower Facility allows MWRA to centralize control of each building's HVAC system components (including thermostats, heat pumps, cooling tower, boilers, and domestic hot water heaters) to allow temperature setback at night and on weekends and holidays, outdoor air reset control, etc. The total energy reduction from all four projects is approximately 1,086,331 kWh and 21,600 therms annually, resulting in a reduction in GHG emissions of 878 metric tons of CO_2e[5] and annual savings of $238,800.

- Insulation of Water Piping at Reservoir Road, Spring Street and Brattle Court Water Pump Stations**.** Custom insulation was installed around the incoming water pipes to eliminate condensation, thereby significantly reducing the need for dehumidification at three facilities, as well as improving safety and reducing maintenance needs. The total energy reduction from these three projects is about 164,800 kWh annually, resulting in a reduction in GHG emissions of 116 metric tons of CO_2e and annual savings of $25,000.

Insulation of Water Piping

- Installation of Energy Efficient Lighting at MWRA Facilities**.** Interior and exterior lighting has been installed at over 40 MWRA facilities, including the Deer Island and Clinton Wastewater Treatment Plants, the Carroll Water Treatment Plant, and Administration Building, most of the water and wastewater pump stations, headworks facilities, CSO treatment facilities, and underground chambers. The energy-efficient lighting has been installed in both offices and process areas, and includes low wattage fluorescent as well as LEDs. In many cases, the installation of LEDs has cut the energy use at a facility by 50-60 percent, while improving working conditions. The annual energy savings from 21 lighting replacement projects over the last 3 years totals 2.3 million kWh, resulting in a reduction of GHG emissions by 1,616 metric tons of CO_2e and annual savings of $254,105.

Energy-efficient lighting at Nut Island Headworks – Explosion-proof LED lighting is being installed at MWRA facilities to reduce energy usage. In most installations, energy usage is being reduced by about 75 percent, while providing a brighter light output and a safer work environment.

5 CO_2e is carbon dioxide equivalent, which is a measure that allows the comparison of the emissions of other greenhouse gases relative to one unit of CO_2.

- Installation of Variable Frequency Drives on motors at MWRA facilities reduces the amount of energy used when the need is less than full power. For example, VFDs were installed at Gillis Water Pump Station, potentially reducing energy usage by approximately 927,000 kWh annually, resulting in a reduction of GHG emissions by 651 metric tons of CO_2e and annual savings of $137,600.

Through the optimization and modification of processes to increase energy efficiency**,** capital investments have been made in lighting, VFDs, HVAC, and other equipment to reduce energy usage and GHG emissions. MWRA is reviewing its operational procedures to identify areas where it can change how it operates to reduce energy usage while still maintaining optimal service. Additional efforts include eliminating the use of chemical mixers at the Carroll Water Treatment Plant and reducing channel blower run time at Deer Island. These changes in operational procedures have resulted in a reduction of about 520,600 kWh and 366 metric tons of CO2e of GHG emissions.

Demand Response Programs - The Carroll Water Treatment Plant (CWTP) and Deer Island Wastewater Treatment Plant participate in a demand response program run by ISO-New England that pays these facilities a monthly “capacity fee” for being available to go on back-up generation during periods of extremely high New England grid electricity demands. Deer Island began participating in 2001 and Carroll in 2008. In FY17, the total revenue received under this program for Deer Island was just under $1 Million and approximately $34k for CWTP.

Supply-Side Management

Due to its large power purchasing, MWRA was an early entrant to the competitive electricity marketplace in 2001. The process has evolved into the creation of three distinct electricity supply contracts:

- Deer Island Wastewater Treatment Plant;
- Larger operations facilities including the Carroll Water Treatment Plant, Nut Island Headworks, Clinton Treatment Plant, and 22 other facilities; and,
- Smaller accounts including some of the pump stations and CSO facilities.

MWRA maintains a balanced electricity portfolio by contracting for a base block of power at a fixed-price and purchasing the balance of the load on the open market at real-time clearing prices.

Other Sustainability Initiatives

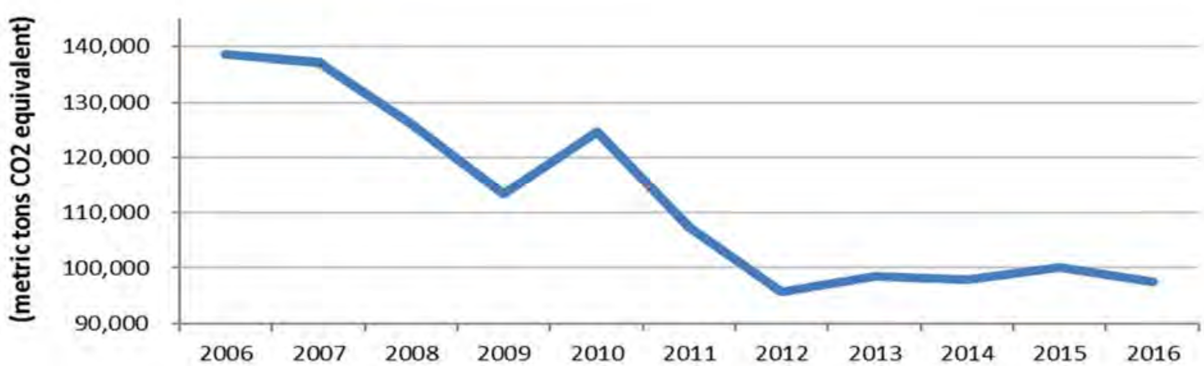
In addition to all the efforts discussed above in support of MWRA and Commonwealth shared goals to increase renewable energy purchases and reduce greenhouse gas emissions at state facilities, MWRA has undertaken additional efforts to directly use more green power by maximizing the use of alternative fuel vehicles (Electric, biodiesel, hybrid, propane, and flex-fuel) representing about 70% of the fleet.

MWRA has recently installed charging stations at its Chelsea facility for a new all-electric vehicle and a hybrid electric vehicle. They are the beginning of an electric vehicle initiative that will help reduce vehicle emissions at MWRA.

Greenhouse Gas Inventory

Over the last eleven years, MWRA has reduced its GHG emissions by 32.1 percent (between 2006 and 2016) as shown in the chart below. The reductions result from a combination of improved efficiency efforts resulting in the reduction of energy needed to run MWRA facilities; increases in MWRA's production of green power; and the gradual greening of the region's electrical power production. The bump-up in emissions during 2010 was due to the spring severe weather that required the Deer Island Plant to use its diesel powered backup generator for an extended period to provide reliable service during the high flow conditions. By continuing to measure and analyze GHG emissions, MWRA is able to quantify its emissions and track the progress it is making from on-going energy conservation efforts, as well as target areas for future reductions.

MWRA GHG Emissions (from 2006 – 2016)



In 2016 the major sources of GHG emissions in the MWRA's operations (as a percent of total emissions) include:

- 46% of MWRA's total emissions is electricity use - 17% from natural gas; 15% from diesel; 22% from a combination of other sources, such as fleet vehicle emissions, fugitive emissions, and process methane emissions.

- 11% of MWRA's GHG emissions are from transporting and treating drinking water, while 89% are from the transport and treatment of wastewater (water distribution primarily uses gravity while wastewater has a higher energy demand for pumping and treatment).

Summary of Existing and Recommended Energy Projects

All Master Plan projects related to energy management are summarized below. Generally speaking, the Authority has done a commendable job in optimizing grants and incentives for past alternative energy projects and energy projects, in general. Going forward, energy projects will continue to be an integral part of the MWRA's philosophy, and future projects will require more attention simply due to the fact that many of the more obvious sites have been claimed. While maintaining an eye toward renewables, a big part of the focus going forward will be on energy efficiency at the equipment level.

Energy Efficiency – The MWRA is an energy intensive organization due primarily to the power needed to transport and treat wastewater, and, to a lesser extent, treat and distribute drinking water. Pumps and other equipment that utilize most of this energy become less efficient over time and require upgrades. The MWRA will be using grants and funding, as available, to address the upkeep and maintenance of this equipment and increase energy efficiency. Working closely with engineering, operations and management will be an important part of this effort as the Authority gravitates from some of the more visible and cost effective projects (i.e., alternative energy projects) toward more equipment intensive assessments. This will include incorporating energy efficiency into new construction/rehabilitation projects, equipment replacements, continuing to conduct energy audits at all facilities and establishing regular audit schedules.

Metering and Real Time Energy Monitoring – The success of a deeper energy efficiency program will be largely dependent on the ability to monitor energy use at the facility and equipment level. Going forward, the Authority will be evaluating monitoring tools at a more granular level to both assess baseline and establish metering techniques to verify savings.

Energy Benchmarking – Over the next two to five years, the MWRA will evaluate its internal progress by benchmarking certain processes and evaluating trends. Benchmarking will also be useful in evaluating the MWRA's performance relative to the rest of the water and wastewater industry. The metering and real time energy monitoring will be instrumental in supporting the benchmarking.

Alternative Energy – Over the next two to five years, the MWRA will evaluate its internal:

- Hydropower – The fish hatchery hydro turbine at the Brutsch Facility is complete as of FY17. Staff will continue to explore alternative locations in the water transmission system which may provide hydropower development potential. Currently, the general consensus is that hydropower facilities going forward will likely require more marginal resources than past due to limited opportunities.

- Solar - Staff are currently working to conduct a comprehensive study for MWRA sites to assess the solar capability and technical/economic feasibility under the Massachusetts "SMART" solar program, effective November 2018. The program is designed to facilitate more stability in the solar subsidy market than the conventional "REC" approach, by guaranteeing a steady tariff rate for twenty years after installation of the project.

- Wind – The MWRA will continue to maintain its current turbines at the Deer Island and Chelsea locations. Staff will continue to evaluate opportunities for wind where economically and technically feasible.

Demand Response – Often associated as being a revenue-only program, demand response contributes to energy optimization at the grid scale. As ISO-NE focuses more and more on peak energy use, demand response programs offer financial incentives to decrease this use. Natural gas is becoming the fuel of choice in the New England region, driving generation pricing for older and dirtier fossil fuel facilities up, which results in these plants being turned on last during high demand. By decreasing peak demand, the MWRA is doing its part in optimizing energy use and quality at the grid level.

Supply-Side Management - Staff will continue supply-side energy management initiatives, maintaining a balanced electricity portfolio using both fixed price contracts and open market prices to minimize energy costs.

Other Sustainability Initiatives – MWRA recently received an electric vehicle charging station from PowerOptions in 2018. Staff will continue to pursue grants and funds for electric vehicles and equipment.

Battery Storage – Energy storage will be an important component to any energy portfolio in the coming years. The MWRA will pursue cost effective approaches toward incorporating energy storage in to its operations, thereby decreasing energy use and reducing retail demand and wholesale capacity costs.

Utility MOUs – The MWRA coordinates with Eversource and National Grid in updating Memorandums of Understanding. The MOUs are intended to further incentivize energy efficiency measures by increasing the reimbursement rate for energy savings.

13.03 Information Management

The Information Management Section presented here is also presented in Chapter 9 of the Water System Master Plan. All information management services costs programmed in the FY19 CIP and recommended for consideration in future CIPs are included only in the MIS Five Year Strategic Plan (MIS Plan) and not in the Water System or Wastewater System Master Plans. However, water mapping and an update to MWRA's hydraulic model of the distribution system are also further discussed in the Water System Master Plan.

MWRA owns and operates many dozens of facilities, miles of tunnels, interceptors and pipelines, dams, treatment facilities and thousands of ancillary structures (manholes, valves, meters etc.). This results in an extensive number and range of documents and records to be maintained and continually updated. Tools for organizing and accessing this information are critical to allow information to be accessed both quickly in emergency situations and in an organized manner to facilitate long-term rehabilitation and replacement of MWRA assets and to design new system components. Information must also be available to document permit or regulatory compliance, protect MWRA assets from damage by outside contractors or utilities, and for responding to litigation, if necessary. Given decreased staffing levels, it is important that procedures and tools for information management be developed and used to facilitate access to the most accurate information in the most efficient manner. This includes the need to ensure that "baseline" information systems at MWRA are brought up to date and include all of the agency's current information and, equally important, that subsequent updates can be systematically added both to the baseline and to all of the other MWRA databases that rely on that baseline information.

In March 2012, MWRA completed a MIS Five Year Strategic Plan ("MIS Plan"). This MIS Plan was a result of conducting a baseline analysis of IT best practices compared with actual MWRA IT operating conditions, identifying the future needs of the business and developing a target state for technologies, and developing a set of programs and plans to meet those needs. Program initiatives were identified within four areas: 1) Technology Infrastructure Program; 2) Application Improvement Program; 3) Information Security Program; and, 4) IT Management Program. The analysis of current water and wastewater information management issues and recommendation are made within the context of the MIS strategic planning efforts. From the four areas identified in the MIS Plan, of greatest relevance to water and wastewater system master planning are those identified under Application Improvement Programs.

An important recommendation from the MIS Plan was that the Authority implement an Enterprise Content Management (ECM) program which would "address the organization's dependence upon paper records, support records management activities, improve access to information, streamline work flows, and replace several existing departmental-level solutions." ECM is an umbrella term which among other things includes document management, records management and work-flow management activities. These endeavors are particularly relevant to MWRA's water and wastewater record drawings, mapping and modeling, and work order management using Maximo. These information management areas are detailed in the subsections below.

Record Drawing Management

Record drawings are a major category of information maintained by MWRA and provide the basis for MWRA's GIS-based mapping and modeling systems. Authority record drawings exist on hardcopy and film, and are located in the Records Center, as well as at a number of MWRA and DCR facilities. A survey of these locations estimates the total number of drawings referencing MWRA infrastructure at 75,000. A subset of 60,000 of those drawings has been electronically scanned to the network. Record drawings at these locations vary from complete sets on MWRA managed contracts, to incomplete sets on pre-MWRA contracts, and partial sets for others. Design Information Systems Center (DISC) staff from the Engineering Department are involved in a review of these drawings in order to secure the latest revision for MWRA use. Drawings secured by DISC are chronicled in a number of pre-MWRA logbooks, recent departmental databases, and/or the Authority-wide document control system.

Organized drawing collections include the Records Center drawing archive, Chelsea water and sewerage microfilm archive, Deer Island (the Technical Information Center–TIC), the Western Operations files, Metro Operations files, and the Wastewater Engineering Unit compilation of recent construction projects, along with other miscellaneous collections. When a request for record drawings is made by staff or by outside consultants or contractors, staff search these sources first. InfoStar, acquired through the Boston Harbor Project, is used as the indexing tool. InfoStar requires replacement since the product is obsolete and there is no vendor support. Newer technology would provide improved efficiency and management control. Extensive documentation of current practices and procedures for processing record drawings, shop drawings, specifications, field sketches, etc. must be completed to ensure that any new system will thoroughly meet Authority needs.

In addition to proper management of records previously developed, there remains concern about missing or inaccurate records and the continued maintenance of multiple databases. As ECM programs are put in place, it will be critical to simultaneously begin to determine what records are missing or inadequate and institute projects to obtain the best available information. As an example, a preliminary review of water system GIS information indicates that approximately 120 record drawings and approximately 250 detail records are missing, incomplete or require updating. In addition, as an ECM approach is developed, historical issues such as non-standardized nomenclatures or lower/upper case differences, different data formats (Access v. Excel as an example) and variability in data collected for projects should be addressed. Mechanisms to efficiently update information so that the updated information is simultaneously available to all users should also be addressed. A broad based group of Authority staff familiar with the Authority's business practices and with both the current uses of these sources of information should be convened by MIS staff to ensure that these issues are addressed. Consultant assistance may be required in the development of missing information.

<u>Current Projects-Records Management</u>

- The Document Control System Software Replacement project has been folded into the Enterprise Content Management CIP project for consistency with the MIS Strategic Plan. Work is scheduled for FY19-20.

Mapping and Modeling

MWRA sewer and water infrastructure data is created from Record Drawings and Detail Records and stored in GIS. GIS is then used to update the hydraulic model. A change in the field brought about by a capital improvement or an in-house project causes a chain reaction of updates: record drawings and detail records need to be updated and finalized, then submitted to GIS so the GIS and the hydraulic model can be updated. An up-to-date GIS and hydraulic model facilitate flow of accurate information during emergencies, future project planning, and even master planning efforts. Thus, many of the recommendations for ensuring updated mapping and modeling data are the same as for ensuring that accurate record drawing information is available.

Program initiatives under the MIS Plan's Application Improvement Program address GIS Applications and Integration. GIS use at the MWRA has increased exponentially over the years for water and wastewater site and routing studies, environmental analyses, hazard mitigation analyses, real property applications and litigation, and many other scientific, environmental and engineering uses. It also has the potential to "spatially enable" other Authority applications including programs such as sewer inspections, PIMS, expanded Maximo functionality and others. The MIS Plan recommends that an agency-wide GIS strategic plan be developed which would identify organizational roles and responsibilities, project priorities and processes for updating the GIS and keeping the data current. Programmed in the FY19 CIP is $350,000 for this project with work scheduled in FY20 to complete the project with expenditure of the remaining $328,000.

Although it is not solely related to mapping and modeling, the MIS Plan also identifies Mobile Integrations as another initiative. The relationship to MWRA's GIS system and to mapping and modeling efforts is that immediate data entry at the source will help to update system information in the timeliest fashion so that subsequent use of that information is accurate. In addition, it can be noted when previously mapped information is determined in the field to be inaccurate.

MWRA's Planning Department within the Operations Division manages the use of the water and wastewater hydraulic models. The water system model is schedule to be updated. Changes in model capability since the initial model was developed are significant and MWRA has much better information on the system and these factors will improve MWRA's ability to model a range of scenarios for various projects.

The following two projects are included in the FY19 CIP to specifically address mapping and modeling needs for the Operations Division.

- The Distribution Systems Facility Mapping Records Development project is currently in the CIP and work is projected to start in FY20. This project is designed to develop or update record drawings and detail records for critical areas within the water distribution system where accurate records do not currently exist. It is anticipated that the initial contract will help to establish parameters for record drawing recording and updating. This would be followed by another contract to target selected areas of the water system where as built information has not been developed. The cost of these two contracts combined is approximately $1.263 million during FY20-23.

- A contract to update and calibrate the hydraulic model is scheduled to commence in FY20 with an anticipated budget of $500,000.

Work Order Management-Maximo

Maximo is currently used as a work order maintenance system and it is designed to provide the planning function for the Maintenance Group. The Work Coordination staff use MAXIMO for planning and scheduling work and reporting on labor utilizations hours and percentage of work orders completed. MWRA staff also use MAXIMO to manage asset repair costs and to evaluate that cost in the determination of further equipment repair or replacement. The data are also used for specialized analyses.

Use of Maximo is always being reviewed and refined. The MIS Plan recommended the migration to Maximo Version 7.5, acquisition of additional modules and richer integrations, reconfiguration, improvements to work flow and reporting and business process improvements to exploit the added functionality. Maximo upgrades are scheduled to be completed in FY19. The upgrade to Version 7.5 will eliminate the need for some in-house developed applications, will provide users a more fully integrated solution, and redundant entries will be eliminated. The added functionality of the updated version will also allow for future integrations, particularly with GIS.

Pretreatment Information Management System

Another application improvement program identified in the MIS Plan with relevance to wastewater operations is the proposed enhancement to the existing Pretreatment Management System (PIMS). This package is used by TRAC to monitor industrial pretreatment permits, inspections, sampling, and enforcement activities for MWRA's 195 Significant Industrial Users and 1,250 permitted facilities. PIMS integrates with MWRA's Laboratory Information Management System which provides the results of samples. According to the MIS Plan, this enhancement program will assess the current state of PIMS implementation with the intent of developing a plan to address both existing functional issues and also to comply with new regulatory requirements. This project is programmed in the FY19 CIP at $3.550 million.

13.04 Laboratory Services

The Laboratory Services Section presented here is also presented in Chapter 9 of the Water System Master Plan. All laboratory services costs programmed in the FY19 CIP and recommended for consideration in future CIPs are included only in the Water System Master Plan and not in the Wastewater System Master Plan so that there would be no double counting of overall costs.

MWRA's laboratory services are client based. Clients include Deer Island, ENQUAL, TRAC Drinking Water Programs (including MWRA communities) and the Department of Conservation and Recreation (DCR). To accommodate the range of program needs, the geographic range of the MWRA system, and the types of samples to be analyzed requires MWRA's Department of Laboratory Services to operate multiple laboratory facilities in Chelsea, Clinton, Quabbin, Southborough, and the Central Laboratory located on Deer Island.

Samples are generally taken by staff within various programs and submitted to the appropriate laboratory location for analyses in compliance with a range of regulatory requirements, though Laboratory Services collects regulatory samples at the Clinton and Deer Island Treatment Plants. For example, TRAC staff sample industrial discharges for permit compliance and ENQUAL Quality Assurance staff obtain samples from the Carroll Water Treatment Plant to ensure proper plant performance and compliance with federal and state drinking water regulations. To provide a sense of the magnitude of work, Laboratory Services analyzes more than 250,000 tests per year for MWRA programs and 43 MWRA member communities. The work for the communities allows MWRA to both ensure sampling consistency and to quickly recognize patterns of bacterial contamination that could potentially occur in the system. MWRA also analyzes all DCR's reservoir and tributary samples in accordance with the MOU between MWRA and DCR.

Given the magnitude of the work effort, Laboratory Services continues to be proactive in identifying current and emerging issues. Staff safety while handling and analyzing samples must be protected through training and use of well-maintained laboratory equipment and facilities. Staff resources must be efficiently allocated to ongoing work while thinking ahead to potential regulatory changes that may occur, particularly the identification of emerging contaminants. The laboratory must work closely with other MWRA departments to try to anticipate which contaminants might actually become a problem in order to focus limited resources on the relevant contaminants. Key questions to be answered when considering which contaminants to gear up for include: (1) how probable is it that a particular contaminant will become a problem, (2) will the concern be short-lived or a long-term problem, and (3) how much training and equipment are involved? A second issue relative to staff resources is the need to staff laboratories seven days a week in order to accommodate various sampling needs and requirements. This is a particular issue at those laboratory sites with limited staff overall. Finally, data management tools must keep pace with both the laboratory work load and significant advances in technology. Projects identified for Laboratory Services address these challenges.

For example, in FY16-17 and continuing into FY19, MWRA has offered to test school lead samples for its member communities. This work was coordinated with a similar effort by MassDEP for non-MWRA communities. So far over 18,000 lead samples have been tested.

Facility needs generally include periodic reconfiguration of space for work efficiency or to adapt to new test and/or equipment requirements. This is of particular importance at the Central Laboratory where this issue is addressed jointly by Laboratory Services, Deer Island managers, Operations, and Finance. In addition, periodic replacement of analytical or safety equipment is necessary. Ventilation equipment is particularly critical in this regard. Fume hoods at the Central Laboratory are now recommended for replacement along with the rest of the HVAC system both to address worker safety and to preserve sensitive analytical equipment. The fume hoods in the metals preparation laboratory were replaced in FY12 because they had corroded due to acid used in metals tests. This is a recurring expense approximately every 15-20 years and would likely be folded into periodic lab renovation contracts.

Data management was addressed in 2009-2010 through the replacement of the 17-year old Laboratory Information Management System (LIMS). The benefits of a new LIMS are more automation, consolidation of data, and the ability to electronically report drinking water results to MassDEP. Any additional data management tools necessary to more fully utilize and interface with the updated LIMS system are identified and coordinated between MIS and laboratory staff.

Summary of Existing and Recommended Laboratory Services Projects

- Fume Hoods and HVAC Systems - In 2010, Laboratory Services and Deer Island Engineering staff concluded that the replacement of the Central Laboratory fume hoods and the Administration/Laboratory Building's HVAC system should be combined into the same design and construction contracts. DITP HVAC equipment replacement design, engineering services during construction, and construction to replace odor control and air handler equipment (including DITP laboratory fume hoods) is programmed in the FY19 CIP at a cost of $44.19 million during FY14-23. This project is carried as a DITP project in Chapter 6 of the Wastewater System Master Plan. This project is likely to present severe logistical issues for the Central Laboratory, though the design contractor has sequenced the laboratory portion of the work into 10 phases of a laboratory section at a time to avoiding the need to shut down large portions of the laboratory for extended periods of time. This will be supported by the use of two laboratory trailers to meet MassDEP laboratory certification requirements and operational needs. These contingencies were addressed during the design contract. The NTP is expected in FY19 and the construction is expected to take 3.5 years.

- Major Laboratory Instrumentation - For decades the trend in environmental laboratory testing has been to detect lower and lower concentrations of contaminants in small quantities of complex samples. Over the past 20 years, decisions have been made as new contaminants have emerged into prominence whether MWRA should perform this testing in-house or contract the work out. These decisions have been weighted by whether the contaminant is likely to be important in MWRA drinking water or wastewater, how many samples are likely to need to be tested, and how expensive or complex the laboratory instruments will be. For example, when MassDEP began regulating perchlorate in drinking water, MWRA decided to contract out the few required samples a year since perchlorate was unlikely to be detected in MWRA drinking water. As MassDEP and EPA continue to regulate more contaminants in drinking water and wastewater, it is likely that eventually MWRA will choose to purchase complex, and therefore expensive, laboratory instruments when the number or tests is likely to be large or the consequences of the testing critical to MWRA's mission. The CIP should continue to carry funding for major laboratory instrumentation, such as ICP-MS (inductively coupled plasma mass spectrometry for metals and high resolution GC-MS (gas chromatography-mass spectrometry) or LC-MS (liquid chromatography-mass spectrometry) for organics. For these types of major laboratory instrumentation, $1.0 million is programmed in the FY19 CIP and spending is projected in FY19-23. Through October 2018, $424,000 of this budget had been expended on major laboratory instrumentation. A budget should be continued for this at $1.0 million for each five years.

- Laboratory Facilities Renovations - Department of Laboratory Services staff, together with other MWRA Operations staff, should develop a system to efficiently and quickly reconfigure laboratory space to accommodate new sampling requirements or new equipment. This will allow the Laboratory to maintain high levels of efficiency with minimum disruptions to ongoing work. Laboratory Services staff should identify any technological changes or equipment that will assist in improving staff efficiency. The Central, Chelsea, and Southborough Laboratories are fairly new, while the Clinton and, in particular, Quabbin Laboratories are showing signs of age. A renovation of the Quabbin Administration Building, which houses the laboratory, is under discussion. A future project to facilitate renovations at all five laboratory facilities is recommended for consideration in future CIPs (planning, design, and construction) at an estimated total cost of $20.0 million over the 40-year planning period FY19-58 (this represents an average annual investment in the five laboratories of $500,000 per year).

- Laboratory Information Management System (LIMS), including Instrument Data Management and Electronic Laboratory Notebooks (ELN) – LIMS is vital to the laboratory operation to keep track of sampling schedules, quality control, and sample custody. MWRA began with LabWare LIMS version 5 and migrated to version 6 several years later. Eventually MWRA will need to adopt version 7, which will be a significant effort to demonstrate that all programs function correctly. This is funded though the MIS CIP budget. Advances in wireless tablet and handheld devices are becoming suitable for use in laboratories. Samples progress from the field to sample receiving, preparation, analysis, data processing, final reporting, and disposal. In the future, each staff in the laboratory is likely to have their own mobile device that is used for all tasks involving samples, instruments, and instrumentation which will increase productivity and reduce the need for paper records. In the mean-time, staff have begun an ELN project at the three Water Quality laboratories which should be completed in FY18. Then staff will pursue ELN opportunities at the remaining two laboratories. MassDEP certification and Massachusetts records retention laws requires that raw data from instruments be retained and accessible for up to 15 years. While the final results and a limited amount of raw data are transferred from the instruments' data systems to LIMS, the bulk of the raw data are retained and archived outside of LIMS. The current approach is labor-intensive, thus a more user-friendly, automated approach is needed. Laboratory Services has identified a need for this type of system as part of the MIS CIP budget.

13.05 Security

The Security Section presented here is also presented in Chapter 9 of the Water System Master Plan. All security costs programmed in the FY19 CIP and recommended for consideration in future CIPs are included only in the Water System Master Plan and not in the Wastewater System Master Plan so that there would be no double counting of overall costs. In addition, costs embedded in the MIS budget are not included.

MWRA's investment in security for water and wastewater pipelines and facilities, as well as, the Authority's information systems, has increased significantly over the past seventeen years. Since 2001, MWRA has invested approximately $9.0 million in security related upgrades specific to security equipment and installation projects. Additional funds have also been expended that were included within individual capital projects for new or rehabilitated facilities. A detailed description of MWRA security measures is not included in the Master Plan due to the sensitive nature of the topic. In general, MWRA has been evaluating and ranking facilities and locations with respect to the critical nature of service delivery for each site. As appropriate, effective security improvements are planned, scheduled, and constructed. In general, MWRA's security improvements include:

- Gate and signage upgrades to limit access in specific areas and to denote areas where the public is welcome;
- Access card readers at facilities to monitor entry;
- Continuous intrusion alarm monitoring;
- Video camera monitoring of key locations;
- Central monitoring of data and alarms for all facilities;
- Automated water quality monitoring;
- Planning and coordination with state and local police, FBI and DHS;
- Planning and drills for incident response; and,
- Contaminant monitoring within the water system.

While much of the obvious security work has focused on MWRA's physical assets and the ability to monitor access and potential physical intrusions; as these measures have been implemented, the focus has shifted towards other types of intrusions. Cyber security has continued to grow in importance and MWRA's ability to effectively monitor and combat attempts to access MWRA systems is a significant priority of both MWRA's MIS staff responsible for the business network and Operations staff responsible for SCADA and PICS. Many of these costs are embedded in the Operations and MIS capital and CEB budgets. Recognizing the important role that employees play in cyber security, there is ongoing annual awareness training for all staff and advanced training for technical staff.

Current Projects-Security

- Additional expenditures under the Security Equipment and Installation project are included in the FY19 CIP at $1.963 million during FY19-23. This project will continue to upgrade security measures for water and wastewater facilities.

- Information systems security is an integral part of the MIS Strategic Plan. MIS security related projects including Information Security Protection Infrastructure Upgrades and Electronic Security Plan Implementation are combined under the Information Security Program and are budgeted in the FY19 CIP at $2.045 million and scheduled during FY19-23.

CHAPTER 14
CLINTON ADVANCED WASTEWATER TREATMENT PLANT

14.01 Chapter Summary

The Clinton Advanced Wastewater Treatment Plant (AWWTP) provides advanced sewage treatment services to the Town of Clinton and a portion of the Town of Lancaster - the Lancaster Sewer District. Since assuming formal operational responsibility for the plant in 1987[1], MWRA has designed and constructed new primary and secondary treatment facilities that incorporate rehabilitated portions of the previous plant with new construction. The upgraded treatment plant and sludge landfill were completed in 1992 at a cost of $37 million. The plant provides secondary treatment using an activated sludge process in combination with advanced nutrient removal and dechlorination. The plant effluent is discharged into the South Branch of the Nashua River in accordance with the discharge limits of the facility's National Pollutant Discharge Elimination System (NPDES) permit. The replacement asset value of the Clinton AWWTP is $60 million (1% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.07.

The Clinton AWWTP is 25 years old and in generally good condition. Some equipment rehabilitation and replacement projects have been completed, some are ongoing or planned, while others are recommended. Significant reinvestment is not required in the short-term. Operability of mechanical/pumping equipment (particularly during large storm events) and technology upgrades to meet regulatory requirements are key elements to minimize risk of component failure. Key decision making for risk avoidance includes the cost/benefit of when to replace aging equipment and which/how many spare parts to pre-purchase. Other Clinton AWWTP needs include future upgrades to the sludge landfill.

One of the most important themes of the Master Plan, consistent for all MWRA water and wastewater facilities, is prioritization of rehabilitation and replacement projects to facilitate long-term asset protection. A long-term annual asset protection budget of $100,000 per year for the 5-year period FY19-23, and expanding to $300,000 per year for FY24-58, is recommended for future consideration to fund smaller scale Clinton projects that, individually, may not be seen as high priority.

For the Clinton AWWTP, $38.915 million in projects is identified in the 40-year master plan timeframe (FY19-58). Five projects ($11.815 million) are programmed in the FY19 CIP. Seven additional projects ($27.10 million) are recommended for consideration in future CIPs. Section 14.10 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter. Additional current and long-term regulatory issues and potential impacts on MWRA are detailed in Chapter 4.

[1] See Section 14.2 for detailed Clinton Wastewater Services History

Near-term (FY19-23):

- $ 7.764 million is programmed in the FY19 CIP:
  - $830,000 to complete upgrades to the phosphorous removal system;
  - $1.234 million to rehabilitate the roofing on various buildings at Clinton AWWTP;
  - $1.90 million to complete the valve and screw pump replacement project;
  - $1.50 million to begin the Clinton AWWTP Rehabilitation project for grit removal facilities, two belt filter presses, and closure of landfill cell #1; and,
  - $2.30 million to complete screw pump replacement – Phase 2 construction.

- $600,000 in needs are recommended for consideration in future CIPs:
  - $500,000 for long-term asset protection (first 5 years at $100,000 per year); and,
  - $100,000 to repair/seal the plant roadway.

Mid-term (FY24-28):

- $4.051 million is programmed in the FY19 CIP to complete the Clinton AWWTP Rehabilitation project for grit removal facilities, two belt filter presses, and closure of landfill cell #1.

- $9.5 million in needs are recommended for consideration in future CIPs:
  - $1.5 million for long-term asset protection (second 5 years at $300,000 per year);
  - $2.0 million to upgrade technology to meet future regulatory requirements;
  - $2.0 million for primary treatment upgrade and additional concrete repairs;
  - $3.0 million to add a UV disinfection system; and,
  - $1.0 million to expand the landfill and add a fourth cell.

Long-term (FY29-38 and FY39-58):

- $17.0 million in needs are recommended for consideration in future CIPs:
  - $9.0 million ($3.0 million in FY29-38 and $6.0 million in FY39-58) to continue long-term asset protection (at $300,000 per year);
  - $6.0 million ($2.0 million in FY29-38 and $4.0 million in FY39-58) to upgrade technology to meet future regulatory requirements; and,
  - $2.0 million in FY39-58 for future valve and pump replacements.

14.02 Clinton Wastewater Service History

At the time the Wachusett Reservoir was constructed in the late 1890s, land for the reservoir was taken from the Town of Clinton. Since the Town’s sewers discharged directly into the Nashua River, the newly dammed reservoir reduced the flow of water which, in turn, inhibited the washing of raw sewage downstream. In consideration, the Commonwealth was authorized to make additional takings of land in Clinton and Lancaster for a sewage treatment plant to serve Clinton, and later Lancaster, and designated the Metropolitan Water Board (and subsequently the MDC) to be responsible for its initial operation and maintenance. The 1898 legislation authorizing the project provided that “the metropolitan water board shall transfer to said town [Clinton] all the works, lands, water rights ... “when” ... the sewage of said town shall have outgrown the normal capacity of the south branch of the Nashua River to properly dispose thereof.” The 1898 legislation expressly envisioned that ownership and responsibility for the treatment plant would be transferred back to Clinton.

Several unsuccessful attempts have been made to transfer ownership of the sewage treatment plant back to Clinton:

- By 1923, the sewer flow had doubled and could no longer be handled by the plant. The MDC attempted to transfer ownership back to Clinton. Though no details are available, it is believed that the Town took MDC to court and prevailed.

- In 1969, MDC again sought to transfer ownership back to Clinton. It is believed that Clinton brought the issue to the attention of the Attorney General where it appears that legislation, adopted in 1954 and discussed below, would have been relied upon by Clinton in support of the MDC's obligation to continue to maintain the facility.

Attempts to transfer responsibility back to Clinton became all the more difficult after 1954 when the Legislature directed MDC to construct, maintain and operate a modernized, replacement plant at its own expense. Thereafter, the provisions of chapter 509 of the Acts of 1980 again required that MDC improve the plant to comply with federal and state standards. While the act also required MDC to "take in consideration the sewerage treatment needs of the towns of Lancaster, Sterling, Bolton and Berlin", the principal users of the facility remain Clinton and the Lancaster Sewer District. The provisions of this 1980 enactment also expressly provided that all users of the facility would pay their proportionate share of both debt service costs and operating, maintenance, and replacement costs "exclusive of the town of Clinton."

Upon the creation of the MWRA in 1985, the Enabling Act generally transferred all of the functions of the MDC Sewerage and Water Divisions to MWRA without any specific mention of the Clinton Wastewater Treatment Plant. Despite an initial disagreement between MWRA and MDC over which agency had the responsibility for the facility, MWRA has operated the plant since its inception.

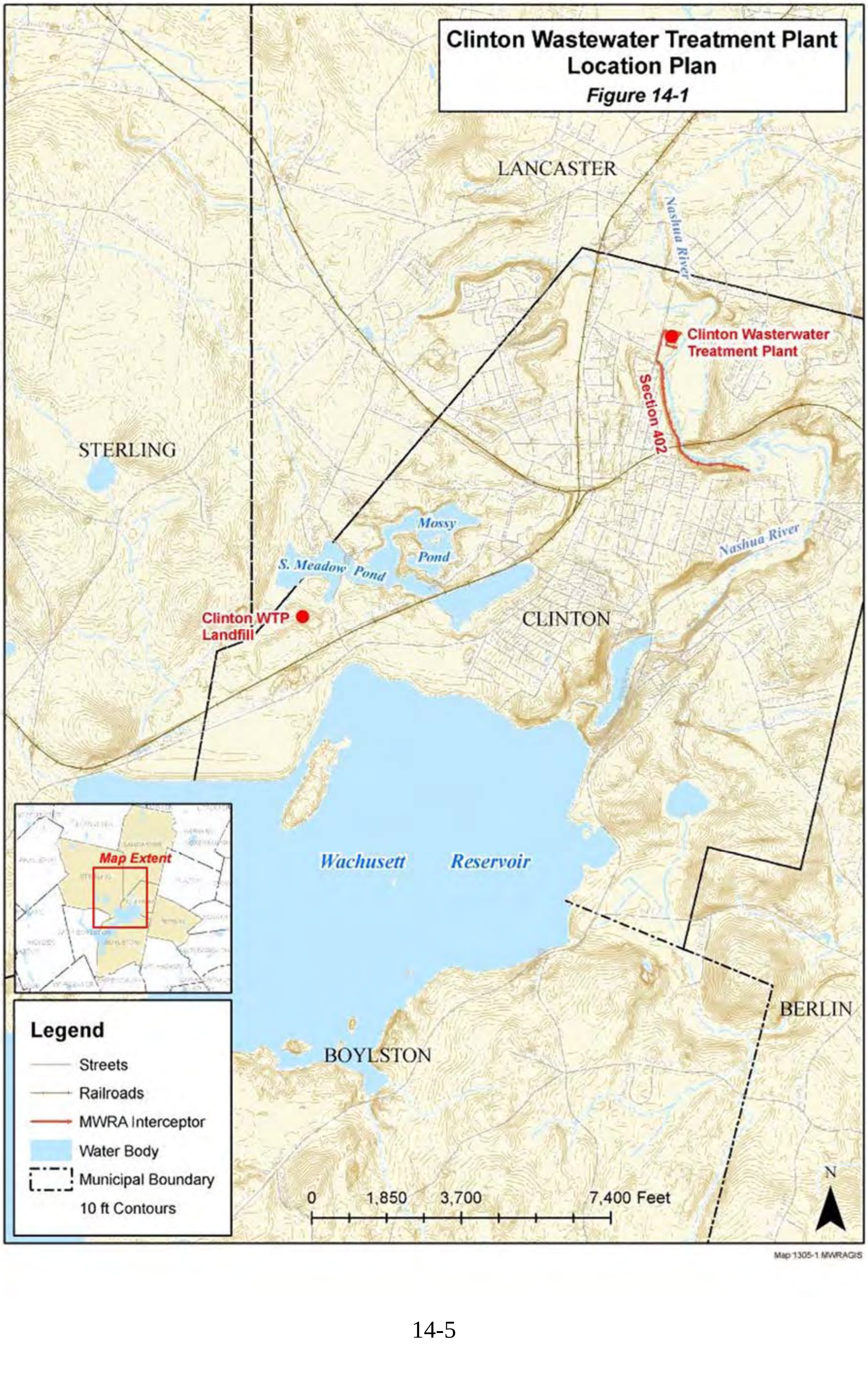
In November 1986, the MWRA Board of Directors voted to file legislation to have MWRA build a new plant in Clinton to be paid for entirely by funds from the state and federal governments. The legislation stipulated that MWRA would run the new plant, but the cost of doing so would be paid by the residents of the Town. As continued compensation for the land taken from the Town at the time the Wachusett Reservoir was built, part of the legislation provided for Clinton to receive an annual payment from the Commonwealth equal to the assessment it pays the MWRA. Subsequently, the provisions of chapter 307 of the Acts of 1987 determined that MWRA would be responsible for the operation of the Clinton AWWTP. That statute also provided that the MDC's Division of Watershed Management would annually pay the Town of Clinton, subject to appropriation, an amount equal to the Town's MWRA user charges, provided that this payment not exceed $500,000. The $500,000 amount was selected because it was believed to be Clinton's share of the total cost of the operations and maintenance of the plant at the time the legislation was written. For many years, the value of services provided to Clinton by MWRA has exceeded the $500,000 cap. As a result, the MWRA ratepayers have subsidized the Town of Clinton's sewer charge by as much as $3.0 million based on the FY19 budget and by more than $25 million over the past 25 years.

MDC's payment obligation under the statute was expressly made subject to a legislative appropriation. From 1987 to 1994, the Legislature failed to appropriate the $500,000 to MDC. During this period, Clinton claimed that the 1987 legislation meant it did not have to pay unless there was an appropriation to MDC. It therefore failed to pay MWRA's annual charges. In response, the MWRA filed a lawsuit against the Town of Clinton in 1991 for nonpayment of its user charges relative to the plant. Clinton defended itself against the suit by joining MDC as a party claiming that it had no obligation to pay absent an appropriation and further asserted that MDC should ultimately shoulder the payment if it was determined that Clinton was required to pay MWRA's charges. The court ruled against Clinton finding that the Town had to pay even without a legislative appropriation and that the MDC would not be liable to the Town for the annual payments. The court entered a judgment in MWRA's favor in the amount of $6.1 million, inclusive of interest.

While the case was on appeal to the Supreme Judicial Court, the Legislature intervened in 1996. The 1996 legislation provided $4 million to MWRA to satisfy Clinton's past due charges and appropriated additional sums needed to upgrade the plant. The legislation also mandated that the parties enter into a settlement agreement which was memorialized in a December 30, 1996 Memorandum of Agreement. That agreement does not contain any provision which determines the parties' rights and responsibilities in the event that the Legislature was to fail to make any future annual $500,000 appropriation. In fact, the agreement mandated that the court judgment in MWRA's favor be vacated and that all parties would reserve all of their rights in the event that the appropriation was not made in the future. Since that time, the Legislature has appropriated the $500,000 annually, although on October 15, 2009 as part of the 9C cuts funding was eliminated, but later restored.

14.03 Facilities Overview

The Clinton AWWTP provides advanced sewage treatment services to the Town of Clinton and a portion of the Town of Lancaster (the Lancaster Sewer District). The location of the Clinton AWWTP and sludge landfill are shown on Figure 14-1, and an aerial photograph of the plant is show in Figure 14-2. MWRA completed construction (and rehabilitation of some older portions of the plant) in 1992. The plant uses an activated sludge process in combination with advanced nutrient removal and dechlorination. Major treatment components include headworks, primary settling tanks, digesters, sludge processor, trickling filters, aeration tanks, secondary tanks, and a chemical addition building. Aeration efficiency improvements were completed in FY13 and a significant upgrade of the phosphorous removal equipment is scheduled to be completed in FY19. The plant effluent is discharged into the South Branch of the Nashua River in accordance with the discharge limits of the facility's NPDES permit.



Clinton Wastewater Treatment Plant
Location Plan
Figure 14-1
LANCASTER
Nashua River
Clinton Wasterwater Treatment Plant
Section 402
STERLING
Mossy Pond
S. Meadow Pond
Nashua River
Clinton WTP Landfill
CLINTON
Map Extent
Wachusett Reservoir
BERLIN
BOYLSTON
Legend
Streets
Railroads
MWRA Interceptor
Water Body
Municipal Boundary
10 ft Contours
0 1,850 3,700 7,400 Feet
N
Map 1305-1.MWRAGIS

FIGURE 14-2
Aerial Photo of Clinton AWWTP

Residual materials are digested, dewatered (pressed), and transported to an MWRA-owned and operated landfill for disposal, which is monitored regularly by staff. MWRA's goal is to operate and maintain the treatment plant to provide uninterrupted wastewater treatment in a safe, cost-effective, and environmentally sound manner.

Management of the Clinton AWWTP is the responsibility of the Superintendent under the supervision of the Director of Wastewater Treatment. Wastewater Treatment is a subset of the Operations Division under the oversight of the Chief Operating Officer. Key staff reporting to the Clinton Superintendent include: Area Manager, Operations Supervisor, and two Area Supervisors. Ten staff positions are responsible for the operation and maintenance of the Clinton AWWTP. In addition, two Laboratory Services staff is assigned to the Clinton AWWTP.

Operation and Maintenance: A primary focus of MWRA staff is preventive maintenance. Daily coordination ensures that primary and critical equipment are functioning at adequate levels at all times. Work is prioritized, with critical equipment receiving the most attention. The in-house maintenance program is supplemented by a series of service contracts.

Sewer Rate Allocation: In accordance with MWRA's Clinton Sewer Service Area rate methodology adopted in 1991, the City of Worcester is charged approximately 7.9 percent of the direct operating expenses of the Clinton AWWTP. Worcester has been paying this annual charge to MWRA or its predecessors since 1914 based on the Agreement that allows Worcester to take water from the Wachusett Watershed. The Town of Clinton and Lancaster Sewer District are allocated proportional shares of the remaining expenses based on annual metered wastewater flow. However, pursuant to Chapter 307, Section 8 of the Acts of 1987, Clinton is only liable for the first $500,000 of its share of operation, maintenance, and capital costs.

14.04 Local Collection Systems

Clinton Collection System: The Clinton wastewater collection system includes approximately 50 miles of sewers ranging in diameter from 8 to 30 inches. Some of the sewer system was built during the mid-1880s as the textile industry and population grew. There are nine public and eleven special connections to the MWRA-owned interceptor. Flows from various sections of Clinton are collected by two circular brick interceptors: (1) the 30-inch Counterpane Brook Interceptor that parallels Counterpane Brook and connects to the MWRA interceptor near High and Allen Streets, and (2) a 30-inch pipe that connects to the upstream end of the 20-inch MWRA interceptor. Most of the Clinton collection system is gravity flow; however, there are seven small pump/lift stations.

Lancaster Collection System: The southern portion of the Town of Lancaster (Lancaster Sewer District) is served by a wastewater collection system initially constructed in 1978. The system includes seven small pump stations and approximately 35 miles of pipeline, primarily 8, 10, and 15-inch diameter lateral sewers. The Sewer District's one main interceptor (15 to 36-inch diameter) collects flow from the lateral sewers and connects to the Clinton AWWTP on High Street. This is the only public connection from the Lancaster Sewer District to the Clinton AWWTP.

14.05 MWRA-Owned Collection System

MWRA owns and maintains approximately one mile of 20, 24, and 30-inch interceptor in Clinton that parallels the South Branch of the Nashua River between High and Williams Streets. The interceptor (MWRA Section 402) is constructed of vitrified clay and brick pipe and serves primarily residential areas. MWRA relined approximately 2500 linear feet of the interceptor in 1992 and the remaining 3000 linear feet in 2000. During the pipeline rehabilitation projects, all MWRA-owned manholes were coated with an epoxy lining. The relined interceptor and manholes are in very good condition. MWRA staff periodically inspect the interceptors and manholes to monitor system condition. A May 2014 internal inspection showed minimal infiltration and no significant defects. In 2010, MWRA interceptor Section 402 was added to the sewer GIS database and GIS maps were developed for the Clinton and Lancaster Sewer District tributary areas to the Clinton AWWTP.

14.06 Wastewater Flow to the Clinton AWWTP

Clinton AWWTP influent and effluent flow data are part of monthly NPDES reporting. Table 14-1 shows the Clinton AWWTP annual effluent average daily flow (ADF) for 2002 through 2017 and annual rainfall from Clinton and Worcester NOAA Rain Gauges.

TABLE 14-1
Clinton AWWTP Annual Effluent Flow and Rainfall Data

Calendar Year	Effluent ADF (mgd)	Clinton Rainfall (inches)	Worcester Rainfall (inches)
CY02	2.27	45.59	44.07
CY03	2.90	44.43	50.52
CY04	2.82	49.24	45.84
CY05	3.34	43.68	59.58
CY06	3.45	52.89	51.29
CY07	2.92	39.27	43.34
CY08	3.32	66.77	63.21
CY09	3.37	53.86	50.08
CY10	3.04	53.09	51.38
CY11	3.41	61.40	67.15
CY12	2.47	45.63	43.88
CY13	2.46	43.06	45.73
CY14	2.55	52.46	53.59
CY15	2.55	40.20	40.34
CY16	2.27	40.93	42.31
CY17	2.50	52.96	43.45
16-year average	**2.85**	**49.09**	**49.74**

The Clinton NPDES Permit limit for effluent flow is 3.01 mgd (rolling annual average using the reporting month and monthly averages for the preceding 11 months). Over the last 16 calendar years (CY02-17), the NPDES Permit effluent flow limit of 3.01 mgd has been exceeded six times in the years: CY05, CY06, CY08, CY09, CY10, and CY11.

The NPDES permit (see Section 14.08 below) requires MWRA, the Town of Clinton, and the Lancaster Sewer District to "control infiltration and inflow (I/I) into the sewer system as necessary to prevent high flow related unauthorized discharges from their collection systems and high flow related violations of the wastewater treatment plant's effluent limitations." Each of the permittee/co-permittees (MWRA, Town of Clinton, and the Lancaster Sewer District) are responsible for the portion of the collection systems that each owns or operates.

The relined MWRA-owned interceptor is in very good condition. The most recent internal inspection showed minimal infiltration and no significant defects. For the 40-year Master Plan period, no future capital projects are recommended for the MWRA-owned interceptor in Clinton. Using CEB funds, MWRA should continue to periodically inspect and maintain the MWRA-owned interceptor and manholes.

Based on previous NPDES permit-required annual reporting to EPA and MassDEP, MWRA estimates Clinton and Lancaster total sanitary flow is about 1.60 mgd, groundwater infiltration ranges from 0.5 mgd (low groundwater) to 2.5 mgd (high groundwater in spring); and stormwater inflow (from a 1.7-inch MassDEP design storm during mid to high groundwater) ranges from 0.8 mgd to 1.4 mgd. As demonstrated by these estimates, I/I entering the locally-owned collection systems significantly increase influent flow to the Clinton AWWTP. MassDEP began requiring wastewater flow control by Clinton and the Lancaster Sewer District via Administrative Orders (AOs): Clinton AO #588 dated July 3, 1985 and Lancaster AO #630 dated July 22, 1986. The Town of Clinton and Lancaster Sewer District are responsible for operating and maintaining the portions of the sewer collection system they own. No MWRA Master Plan CIP projects are recommended for the locally-owned collection system.

14.07 Wastewater Quality at the Clinton AWWTP

On December 21, 2016, EPA issued the Final NPDES permit for Clinton Plant with an effective date of March 1, 2017. This replaced an earlier permit that had been in place since 2000, and a 2002 Administrative Order setting an interim copper limit.

MWRA submits monthly discharge monitoring reports to EPA and MassDEP for Biological Oxygen Demand (5-day), Total Suspended Solids, *E. Coli* (formerly for Fecal Coliform), Total Residual Chlorine, Total Copper, Total Phosphorus, Total Ammonia Nitrogen, Dissolved Oxygen, pH, and Whole Effluent Toxicity. For CY15 and CY16, all permit limits were met. Sampling frequencies and discharge monitoring limits are presented in Table 14-2. The new permit has a much more stringent limit for phosphorus. It also updates the bacterial indicator to *E. coli* to conform to Massachusetts Water Quality Standards, and adds weekly loading limits for TSS and BOD. Any future recommended CIP projects to address wastewater quality will most likely be based on potential future revised NPDES permit limits. See additional discussion in Section 14.08 and in Chapter 4.

TABLE 14-2
Clinton NPDES Sampling Frequencies and Discharge Monitoring Levels

Effluent Characteristic	Units	Discharge Limit			Monitoring Requirement	
		Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type
flow	mgd	3.01 (12 mo. rolling average)	---	Report	continuous	Recorder
BOD_5 (five-day biochemical oxygen demand)	mg/L lbs/day % removal	20 500 85% minimum	20 500 ---	Report Report ---	3/week	24-Hour Composite
TSS (total suspended solids)	mg/L lbs/day % removal	20 500 85% minimum	20 500 ---	Report Report ---	3/week	24-Hour Composite
E. coli	#/100mL	126	---	409	1/day	Grab
Total Residual Chlorine	ug/L	17.6	---	30.4	2/day	Grab
Copper, Total Recoverable	ug/L	11.6	---	14.0	1/week	24-Hour Composite
Total Phosphorus (4/1 - 10/31)*	mg/L lbs/day	0.15 3.8	--- ---	Report Report	3/week	24-Hour Composite
Total Phosphorus (11/1 - 3/31)	mg/L lbs/day	1.0 25.1	--- ---	Report Report	1/week	24-Hour Composite
Total Ammonia Nitrogen (4/1-4/30)	mg/L	1.0	---	Report	1/week	24-Hour Composite
Total Ammonia Nitrogen (5/1 - 5/31)	mg/L	5	---	Report	1/week	24-Hour Composite
Total Ammonia Nitrogen (6/1 - 10/31)	mg/L	2.0	---	3.0	3/week	24-Hour Composite
Total Ammonia Nitrogen (11/1 - 3/31)	mg/L	10	---	35.2	1/week	24-Hour Composite
Dissolved Oxygen	mg/L	---	---	6 mg/L minimum	1/day	Grab
pH	SU	---	---	6.5 - 8.3	1/day	Grab
Whole Effluent Toxicity	%	---	Chronic: C-NOEC 62.5% minimum	Acute: LC50 >100% minimum	quarterly	24-Hour Composite

*Phosphorus compliance schedule through 10/31/2018 (interim limit 1.0 mg/L)

14.08 Clinton AWWTP NPDES Permit

The current NPDES permit (2017 permit) for the Clinton AWWTP was issued on December 21, 2016 and became effective on March 1, 2017. The current NPDES permit supersedes the prior permit issued on September 27, 2000. The 2017 NPDES permit contains changes compared to the prior permit that are outlined in the bullets below:

- The 2017 permit retains the effluent limit on flow, which will likely continue to be problematic because the flow limit, a rolling annual average of 3.01 mgd, is the same as the effluent limit in the prior permit that expired in 2005. Meeting this flow limit would require a reduction in the wet weather flow from the Town of Clinton.

- More stringent limits, year-round, on phosphorus. These limits are consistent with those issued to other POTWs in the Nashua River watershed. The permit includes a compliance schedule to allow MWRA to complete construction and start-up of new phosphorus removal facilities.

- Prohibition on the use of aluminum for phosphorus treatment. Alum previously used for phosphorus removal through 2010 caused aluminum levels in Clinton AWWTP effluent which were determined to have the potential to exceed the chronic water quality standard for aluminum. Alum use for phosphorus removal was discontinued during 2011 and replaced with ferric chloride. The 2017 permit does not have a limit or require monitoring of aluminum, but it does restrict plant operators from using alum to treat phosphorus. It is widely held that EPA's chronic aluminum criterion is unduly stringent and several states have passed less-stringent site-specific criteria, but it is not known if Massachusetts will do this.

- The copper limit was modified in line with Massachusetts Water Quality Standards for copper, which were modified in 2007 to create less-stringent site-specific copper criteria in the Nashua River watershed. The limits in the 2017 Clinton NPDES permit are based on existing discharges and MWRA expects to be able to meet the revised limit.

- EPA revised the freshwater water quality criteria for ammonia in 2013 to be more stringent. However, these more stringent criteria have not been incorporated in Massachusetts Water Quality Standards. The 2017 Clinton NPDES permit does not change the effluent limits for ammonia. In a future permit, effluent limits for ammonia at Clinton AWWTP could drop from the present (a seasonal low of 2 mg/l) to approximately 1 mg/l or slightly lower. In addition, there is a potential for the more stringent limit to apply year-round rather than just in the summer months.

- The 2017 permit includes weekly loading limits for TSS and BOD which could be an issue during heavy storm events, especially considering the impacts of climate change which forecasts larger, heavier rain events.

- *E. coli* replaces fecal coliform as the bacterial indicator of risk from pathogens, consistent with Massachusetts water quality standards. Compliance is not expected to be an issue.

- The 2017 permit names the Town of Clinton and the Lancaster Sewer District as co-permittees specifically for the sections on Operation and Maintenance of the sewer system, and clarifies that each co-permittee is responsible for its own collection system. Thus the permit now provides EPA the ability to directly regulate I/I in these local collection systems.

- The Operation and Maintenance requirements are more extensive in the 2017 permit, but are consistent with requirements in Massachusetts regulations governing wastewater treatment collection and treatment systems.

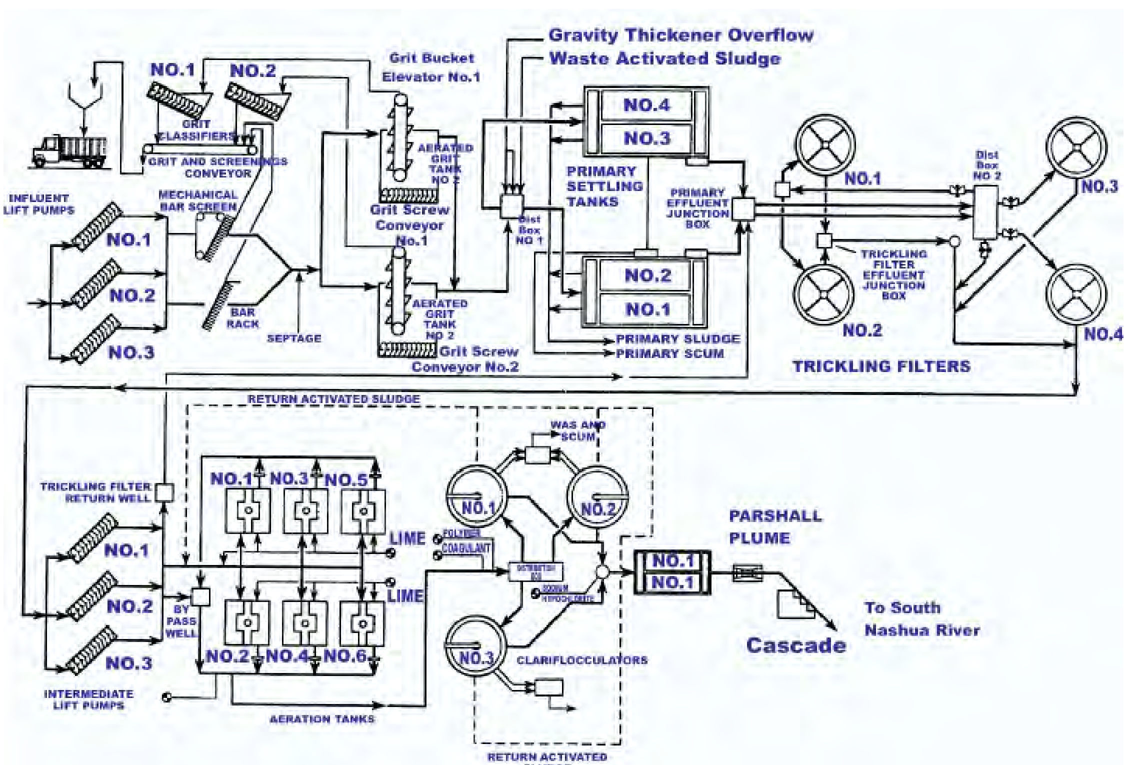
Two MWRA projects are specifically intended to improve plant process technology to meet phosphorous removal requirements. The Clinton aeration efficiency improvements project was completed in FY13 at a cost of $1.865 million. The phosphorus removal (design and construction) project began in FY14 and is scheduled for completion in FY19 at a cost of $9.023 million. Future regulatory requirements and potential changes to the Clinton NPDES Permit may impact MWRA's recommended capital projects (see additional detail in Chapter 4). A total of $8.0 million is recommended for consideration in future CIPs for technology upgrades during the FY24-58 timeframe. All programmed and recommended CIP projects are detailed in Section 14.10.

Wastewater treatment performance at the Clinton AWWTP is excellent; the plant consistently meets its permit limits except for effluent flow which is limited to 3.01 mgd (rolling annual average using the reporting month and monthly averages for the preceding 11 months). The average annual daily flow for six of the last 16 years exceeded the NPDES permit flow limit (see Wastewater Flow Data in Section 14.06). High flows that occur during and after wet weather periods are the result of infiltration and inflow entering the locally-owned collection systems. The 2017 Clinton NPDES permit attempts to address I/I from the Town of Clinton and the Lancaster Sewer District by including them as are co-permittees in two sections of the permit: Part I D – Operation and Maintenance of the Sewer System and Part I E – Unauthorized Discharges.

14.09 Clinton AWWTP Process Operations

Major Clinton AWWTP processes include preliminary treatment, primary treatment, secondary treatment, advanced treatment for nutrient removal, effluent disinfection/dechlorination, and residuals processing/disposal. The plant effluent is discharged into the South Nashua River in accordance with the discharge limits of the facility's NPDES permit. Residual materials are digested, dewatered (pressed), and transported to an MWRA-owned dedicated landfill for disposal. The Clinton AWWTP process flow schematic is presented as Figure 14-3. New disc filtration phosphorus removal facilities are being constructed after the clariflocculators.

FIGURE 14-3 Clinton AWWTP Flow Schematic



Preliminary Treatment and Metering: Wastewater enters the plant through two connections: (1) a 24-inch diameter reinforced concrete sewer connected to the MWRA 30-inch diameter interceptor on High Street (Clinton influent), and (2) an 18-inch diameter reinforced concrete sewer connected to the Lancaster interceptor on High Street (Lancaster Sewer District influent). Flow passes through two separate metering stations (one for Clinton and one for Lancaster flows), then, three influent pumps lift flow to a mechanical bar screen. A manual bar rack is located in parallel for use when the mechanical bar screen is out of service. Flow is then conveyed to two parallel aerated grit chambers where grit is removed using screw grit collectors. Under normal and peak flow conditions, the equipment works well and there are no performance problems. In extreme peak flow conditions, the influent flow can exceed the capacity of the existing influent pumps. A project completed in FY13 added four permanent submersible auxiliary pumps to provide redundancy for influent (two pumps) and intermediate (two pumps) pumping. The addition of the submersible pumps was a component of a larger project that also improved aeration efficiency. Influent gates, to protect the plant from flooding during extreme wet weather events, were installed as part of a rehabilitation project in FY16. A $1.90 million valve and screw pump replacement project is programmed in the FY19 CIP during FY19-21. This project will be followed by the screw pump replacement – Phase 2 construction that is programmed in the FY19 CIP at $2.30 million during FY22-23. Also, a $5.551 million Clinton AWWTP Rehabilitation project is programmed in the FY19 CIP. This project includes the rehabilitation or replacement of grit removal facilities with updated equipment and some additional work during FY22-26. Staff recommend a future $2.0 million CIP project for valve and pump replacement in the FY49-58 timeframe.

Primary Treatment: Primary settling is accomplished in two rectangular tanks, each measuring 82-feet long by 24-feet wide by 9-feet deep. Chain and flight collectors are used for scum and primary sludge that is pumped to residuals processing. Under normal and peak flow conditions, the equipment works well and there are no performance problems. Rehabilitation of the primary clarifiers (concrete walls and walkways) was completed in FY16. Staff recommend a new $2.0 million CIP project for primary treatment upgrades and additional concrete repairs in FY24-28.

Secondary Treatment: From the primary settling tanks, wastewater flows by gravity to four high-rate trickling filters. Two trickling filters are 60-foot diameter (upgraded from original plant) and two are 80-foot diameter (constructed in 1992). Five feet of crushed stone media is used in each tank. Three intermediate pumps lift wastewater from the trickling filters to six 318,000 gallon aeration (activated sludge) tanks (each is 50 by 50 by 17-feet). From the aeration tanks, wastewater is conveyed to three 80.25-foot diameter clariflocculators. Within the activated sludge process, nitrification (the conversion of

ammonia nitrogen to less bioavailable forms of nitrogen) is accomplished by a biological process, which utilizes nitrogen as an energy source. Proper conditions must be maintained, such as dissolved oxygen supply and pH control, to promote microorganism growth in the aeration tanks. In 2008, the soda ash (sodium carbonate) addition system in the aeration process was replaced at a cost of $267,000. A project completed in FY13 at $1.865 million provides aeration efficiency improvements through installation of a fine bubble diffuser system in three of the six secondary aeration tanks to obtain a better oxygen transfer rate while reducing power consumption. Phosphorous removal is accomplished by the addition of ferric chloride in the aeration tanks effluent. The ferric chloride precipitates phosphate at the final clarifiers (clariflocculators), settling it out with the sludge. An ongoing project programmed in the FY19 CIP at $9.023 million will upgrade phosphorous removal process equipment over a 6-year period (FY14-19) to meet the more stringent 2017 Clinton NPDES permit limits. Under normal and peak flow conditions, most of the secondary treatment equipment works well and there are no performance problems.

Disinfection/Dechlorination and Effluent Discharge: Disinfection occurs in two hypochlorite contact tanks, each measuring 100-feet long by 6-feet wide by 14-feet deep. Dechlorination takes place at the overflow cascade of the chlorine contact chamber. Sodium bisulfite is sprayed by injectors into the effluent stream to remove chlorine residual before going to the receiving water. The effluent is discharged through a Parshall flume and a multistep cascade to the South Branch of the Nashua River via a 24-inch outfall. Under normal and peak flow conditions, the equipment works well and there are no performance problems. In the FY24-28 timeframe, staff recommend a CIP project be considered to add an ultraviolet (UV) disinfection system at an estimated cost of $3.0 million.


Digesters

Residuals Process and Sludge Landfill: Primary and secondary sludge is pumped to two 50-foot diameter gravity sludge thickeners. The residuals are then transferred to two 40-foot diameter anaerobic sludge digesters. The digesters are operated in series. The primary tank has a fixed cover, while the secondary tank has a floating gas holding cover. Digested sludge is transferred to a 60-foot diameter sludge holding tank before the dewatering process that uses two belt filter presses. Dewatered sludge is trucked to an MWRA-owned and operated residuals landfill located in Clinton. The double-lined sludge landfill includes a leachate collection system that pumps to the Clinton sewer system. The residuals process equipment works well and there are no performance problems. A 3-year project to clean and rehabilitate both sludge digesters was completed in FY17 at a cost of $3.443 million (this project also included plant-wide concrete repairs and installation of influent gates described above). A $5.551 million Clinton AWWTP Rehabilitation project is programmed in the FY19 CIP. This project includes design and construction for replacement of two belt filter presses with updated equipment and closure of Clinton landfill cell #1 (in


Belt Filter Press

addition to rehabilitation of grit removal facilities) during FY22-26. Landfill cell #1 is at maximum elevation and is a priority to cap in the near future. Staff recommend an additional $1.0 million residuals project be considered in future CIPs in the FY24-28 timeframe to add a fourth cell to the Clinton residuals landfill.

Utilities and Plant Components: The primary electric feed to the Clinton AWWTP is from local commercial service. A project to install a 350 kW permanent diesel standby generator to provide backup electrical power to the secondary treatment portion of the Clinton AWWTP was completed in FY08 at a cost of $230,000. In FY18, the natural gas pipeline (via MWRA/NGrid agreement) was completed to switch the plant from oil to natural gas at a cost of $490,000. Additional recent upgrades include rehabilitation of four process water pumps and upgrade of the security system at the Clinton AWWTP and Clinton sludge landfill.

The sludge digester cleaning/rehabilitation project noted above also included plant-wide concrete repairs. The concrete walls, walkways and structural support beams (primary clarifiers) were significantly deteriorated with rebar exposure in some areas. This project involved repairing/replacing concrete and was completed in FY17. A roof rehabilitation project for a variety of buildings (administration, chemical, headworks, dewatering, and maintenance shop) is programmed in the FY19 CIP at $1.234 million in FY19-20. One additional project recommended for consideration in future CIPs is repair/sealing of the Clinton AWWTP roadway at an estimated cost of $100,000 (FY19-23 timeframe).

14.10 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to the Clinton AWWTP are summarized in this Section. Table 14-3 lists each project, its priority ranking, and the proposed expenditure schedule.

Projects in the Existing FY19 CIP: There are five projects for the Clinton AWWTP programmed in the FY19 CIP. The projects are described below and summarized in Table 14-3 (see line numbers 14.01 through 14.05).

- Phosphorous removal (design, engineering services during construction, and construction) is programmed in the FY19 CIP at a total cost of $9.023 million. This 6-year project began in FY14 and is scheduled for completion in FY19. It will upgrade phosphorous removal process equipment to meet the more stringent 2017 NPDES permit limit. Expenditures during the planning period (FY19) are $830,000.

- A roof rehabilitation project for a variety of buildings (administration, chemical, headworks, dewatering, and maintenance shop) is programmed in the FY19 CIP at a total cost of $1.234 million during FY19-20.

- A valve and screw pump replacement project is programmed in the FY19 CIP at a total cost of $1.90 million during FY19-21. Some maintenance projects are currently stalled awaiting replacement valves in the chemical building.

- A $5.551 million Clinton AWWTP Rehabilitation project is programmed in the FY19 CIP. This project includes design and construction for rehabilitation or replacement of grit removal facilities with updated equipment, replacement of two belt filter presses with updated equipment, and closure of Clinton landfill cell #1 during FY22-26. Landfill cell #1 is at maximum elevation and is a priority to cap in the near future.

- A second screw pump replacement - Phase 2 construction project is programmed in the FY19 CIP at a total cost of $2.30 million during FY22-23.

Projects Recommended for Consideration in Future CIPs: There are seven new projects for the Clinton AWWTP recommended for consideration in future CIPs. The projects are described below and summarized in Table 14-3 (see line numbers 14.06 through 14.12).

- A long-term asset protection project is recommended at $100,000 per year for the 5 year period FY19-23 and expanding to $300,000 per year for the next 35 year period (FY24-58, the remainder of the 40 year Master Plan schedule). This project (total of $11.0 million) will provide annual baseline target expenditures for asset protection to fund smaller scale Clinton projects that, individually, may not be seen as high priority. Future projects to be funded under this budget are anticipated to be similar to many of the relatively small projects recommended for FY19-23.

- Upgrade technology to meet future regulatory requirements and/or upgrade equipment based on new technologies/optimization at $8.0 million is recommended as a place holder for future spending during the 40 year Master Plan period. Estimated costs are $2.0 million each for FY24-28 and FY29-38, and an additional $4.0 million for FY39-58.

- Future replacement of valves and influent/intermediate lift pumps is recommended for the future at an estimated cost of $2.0 million during FY49-58.

- Primary treatment upgrade and additional concrete repairs are recommended at an estimated cost of $2.0 million during FY24-28.

- Addition of an ultraviolet (UV) disinfection system to the Clinton AWWTP is recommended at an estimated cost of $3.0 million during FY24-28.

- Expansion of the Clinton residuals landfill to add a fourth cell is recommended at an estimated cost of $1.0 million during FY24-28.

- Repair/sealing of the Clinton AWWTP roadway is recommended at an estimated cost of $100,000 during FY19-23. Due to the relatively low cost of this project, it may be a candidate for CEB funding.

Table 14-3

Wastewater Master Plan - Clinton Advanced Wastewater Treatment Plant

Existing and Recommended Projects

Last revision 10/5/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF	New Facility/System
RF/IC	Replacement Facility/Increase Capacity
Opti	Optimization
AP	Asset Protection
Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		CLINTON WASTEWATER TREATMENT PLANT												
14.01	1	Clinton Phosphorous Removal - Design, ESDC and Construction	NF	210	19350_7377 19400_7411	6 years	9,023	830	FY14-19	830				830
14.02	3	Clinton Roofing Rehabilitation	AP	210	19405_7450	2 years	1,234	1,234	FY19-20	1,234				1,234
14.03	2	Clinton Valves and Screw Pumps Replacement	AP	210	19344_7372	3 years	1,900	1,900	FY19-21	1,900				1,900
14.04	2	Clinton AWWTP Rehabilitation - Design, ESDC, RE and Construction	AP	210	19343_7371 19406_7451	6 years	5,551	5,551	FY22-26	1,500	4,051			5,551
14.05	3	Clinton Screw Pump Replacement - Phase 2 Construction	AP	210	19408_7591	2 years	2,300	2,300	FY22-23	2,300				2,300
		SUBTOTAL - Existing - Clinton					**20,008**	**11,815**		**7,764**	**4,051**	**0**	**0**	**11,815**
14.06	3	Clinton Long-term Asset Protection @ $100k/yr for FY19-23 & $300k/yr for FY24-58	AP	new		annual	11,000	11,000	FY19-58	500	1,500	3,000	6,000	11,000
14.07	3	Clinton Technology Upgrades to Meet Future Regulatory Requirements	NF	new		35 years	8,000	8,000	FY24-58		2,000	2,000	4,000	8,000
14.08	3	Clinton Future Valve and Pump Replacement	AP	new		10 years	2,000	2,000	FY49-58				2,000	2,000
14.09	3	Clinton Primary Treatment Upgrade and Additional Concrete Repairs	AP	new		5 years	2,000	2,000	FY24-28		2,000			2,000
14.10	4	Clinton UV Disinfection System	NF	new		5 years	3,000	3,000	FY24-28		3,000			3,000
14.11	4	Clinton Landfill Expansion - Fourth Cell	NF	new		5 years	1,000	1,000	FY24-28		1,000			1,000
14.12	4	Clinton Repair/Sealing of Plant Roadway	AP	new		5 years	100	100	FY19-23	100				100
		SUBTOTAL - Recommended - Clinton					**27,100**	**27,100**		**600**	**9,500**	**5,000**	**12,000**	**27,100**
		SUBTOTAL - Existing and Recommended - Clinton					**47,108**	**38,915**		**8,364**	**13,551**	**5,000**	**12,000**	**38,915**

CHAPTER 15
MWRA FINANCIAL ASSISTANCE FOR COMMUNITY-OWNED COLLECTION SYSTEMS

15.01 Chapter Summary

MWRA has 43 member sewer communities within the regional wastewater collection system tributary to the Deer Island Treatment Plant (DITP). Member community-owned sewer systems discharge wastewater to the MWRA interceptor system at more than 1800 connection points. Wastewater discharged by member communities is strongly influenced by seasonal and wet weather conditions. About 55 to 65 percent of the annual wastewater flow treated at DITP is sanitary flow with the remaining flow being stormwater from combined sewers, groundwater infiltration, and stormwater or tidal inflow. Stormwater and infiltration/inflow (I/I) that enter the wastewater collection system use up pipeline capacity that would otherwise be available to transport sanitary flow. During periods of high groundwater and extreme storm events, stormwater and I/I entering the collection system may cause combined sewer overflows (CSOs), sewer surcharging, wastewater backups into buildings, and sanitary sewer overflows (SSOs), as well as increased operating costs.

Not only are the sewer systems of MWRA and its member communities physically connected, they also share a financial bond. MWRA directly passes on the cost of operating and maintaining its wastewater collection and treatment systems to its member communities. Because of these relationships, it is important that MWRA work closely with local community officials, superintendents, and public works staff. The MWRA Advisory Board plays a pivotal role in ensuring that two-way communication and coordination between MWRA and its member communities is in place. Financial assistance programs administered by MWRA for its member communities are shaped by MWRA Advisory Board recommendations.

In this Chapter, MWRA's financial assistance program for rehabilitation of locally-owned collection systems is detailed. The I/I Local Financial Assistance Program is a critical component of MWRA's Regional I/I Reduction Plan. Local sewer system rehabilitation projects funded under the program are intended to at least offset ongoing collection system deterioration to prevent a net increase in regional I/I. Routine annual maintenance and periodic collection system rehabilitation and replacement are key elements to minimize the risk of sewer blockages or structural failure within community-owned systems. Key decision making to minimize risks includes where/how often to perform preventative maintenance activities and the cost/benefit analysis of when to rehabilitate aging sewer pipelines. Through the I/I Local Financial Assistance Program, MWRA is assisting its member communities in operating and maintaining their local collection systems, leading to uninterrupted service in a safe, cost-effective, and environmentally sound manner.

Under MWRA's I/I Local Financial Assistance Program (Phases 1 through 13), $392.585 million is the net total cost for funding community-owned collection system rehabilitation projects in the FY19 CIP. This net total cost includes grants, loans, and loan repayments beginning in May1993 and projected through FY40. The current Phases of the I/I Local Financial Assistance Program (Phases 6 through 13) are programmed in the FY19 CIP at a total cost of198.40 million during the

40-year master plan timeframe (FY19-58). For Master Planning purposes, two additional Program Phases (Phases 14 and 15) are recommended for consideration in future CIPs. Each of the future funding Phases 14 and 15 are recommended at $75.0 million in grants, $25.0 million in interest-free loans, and $25.0 million in community loan repayments. The net capital cost of each recommended future funding Phase is $75.0 million, with the total for the additional two Phases at $150 million. The two additional funding phases are recommended to begin in FY24 and FY25. Prior to expansion of the Program, coordination with the MWRA Advisory Board will be required to develop a recommendation for Board of Directors consideration. The costs noted below represent the net cost of MWRA grants, loans, and loan repayments. Section 15.05 – MWRA I/I Local Financial Assistance Program provides details on grant and loan funding provided to member communities.

Near-term (FY19-23):

- $123.20 million in net program costs are programmed in the FY19 CIP (FY19-23) for the I/I Local Financial Assistance Program (through Phase 13).

Mid-term (FY24-28):

- $129.10 million in net program costs are programmed in the FY19 CIP (FY24-28) for the I/I Local Financial Assistance Program (through Phase 13).

- $106.10 million in additional net program costs are recommended for consideration in future CIPs for FY24-28 for proposed Phases 14 and 15 of the I/I Local Financial Assistance Program.

Long-term (FY29-38 and FY39-58):

- $53.90 million in net program revenue is programmed in the FY19 CIP (FY29-58) for the I/I Local Financial Assistance Program loans (through Phase 13).

- $43.90 million in additional net program costs are recommended for consideration in future CIPs for FY29-38 and FY39-58 for the I/I Local Financial Assistance Program (Phases 14 and 15).

15.02 Stormwater and Infiltration/Inflow Impacts on the Regional Collection System

MWRA's regional interceptor system tributary to the DITP receives flow from 43 member sewer communities (locally-owned collection systems) covering an area of about 500 square miles. The regional system serves about 2.2 million people, including the City of Boston and surrounding metropolitan area. About 95 percent of buildings within the service area are sewered. Figure 15-1 shows the MWRA sewer service area and MWRA’s regional wastewater collection system. All flow from the service area is tributary to the DITP. The regional collection system encompasses about 274 miles of MWRA-owned sewer pipelines, 5350 miles of publicly-owned community sewers, and 5000+ miles of private sewer service connections. Most of the service area (approximately 94 percent) is served by separate sanitary and storm drainage systems. However, portions of five communities (Boston, Brookline, Cambridge, Chelsea, and Somerville) utilize combined sewers that account for six percent of the sewer service area.

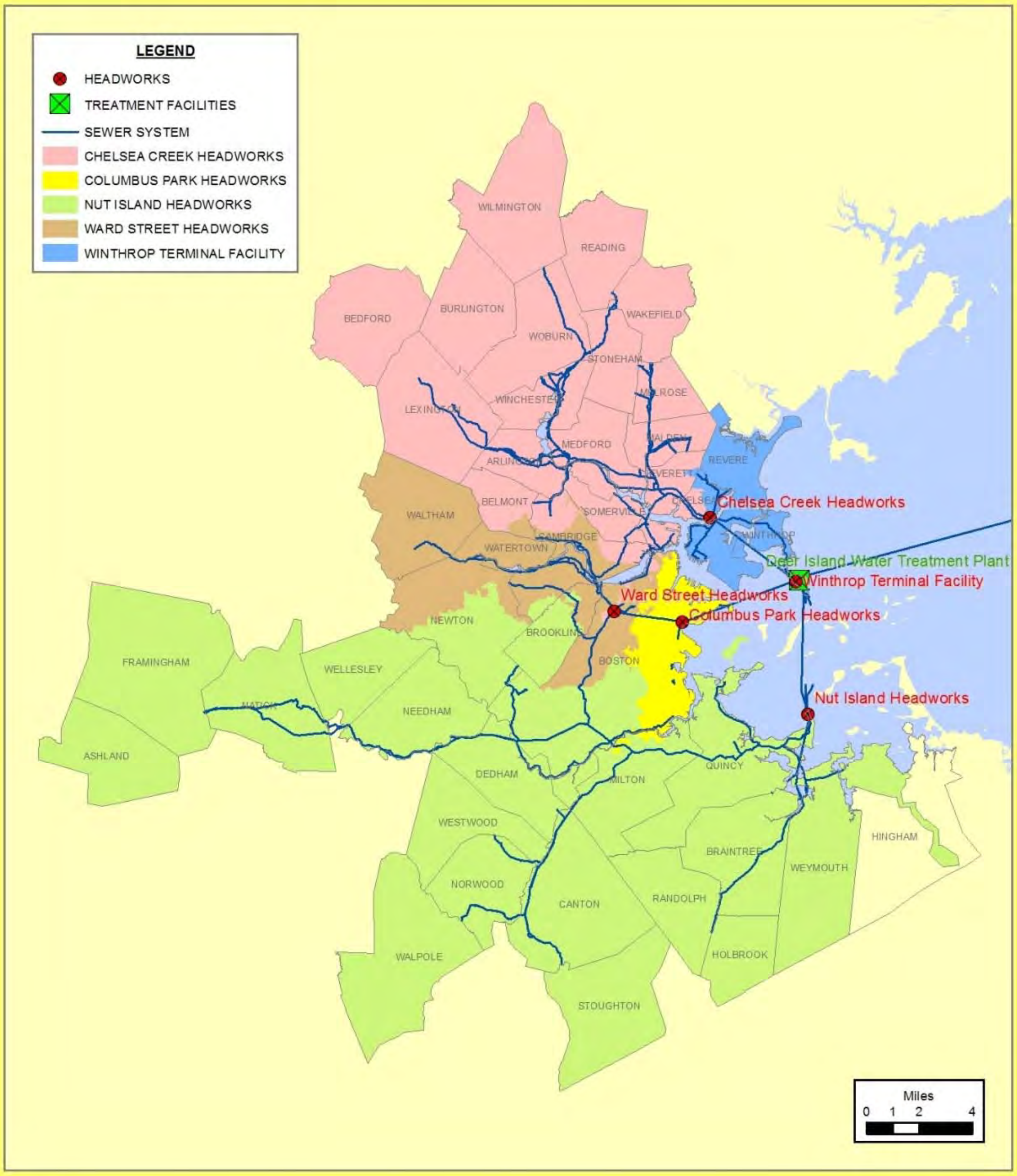


FIGURE 15-1
Sewer System Location Plan

Community-owned sewer systems discharge wastewater to MWRA's interceptor system at more than 1800 connection points. Wastewater discharged by member communities to MWRA is strongly influenced by seasonal and wet weather conditions. The long-term (29 years of data 1989-2017) system average daily flow is approximately 353 mgd (about 300 mgd for last 5 years 2013-2017), minimum dry weather flows drop as low as 220 mgd, and peak wet weather capacity to the DITP is 1,270 mgd with additional system capacity available at CSO outfalls. The average annual wastewater flow contributed from the entire MWRA collection system varies, depending on annual precipitation, from about 275 to 425 mgd. About 55 to 65 percent of the annual flow treated at DITP is sanitary flow with the remaining flow being stormwater from combined sewers and I/I (groundwater infiltration and stormwater inflow) entering the separated sewer system. I/I enter the sewer systems of both MWRA and its member communities through a variety of defects. Stormwater and I/I use up pipeline capacity in the collection system that would otherwise be available to transport sanitary flow. During periods of high groundwater and extreme storm events, stormwater and I/I entering the collection system may cause CSOs, sewer surcharging, wastewater backups into buildings, and SSOs, as well as increased operating costs.

Infiltration into a sanitary sewer

Infiltration and inflow are highest in the spring when: rainfall is high, the groundwater table is elevated, snowpack melts, soil is generally more saturated (a lower percentage of stormwater can infiltrate the ground), and evapotranspiration is low. Infiltration and inflow are lowest in the late summer when: rainfall is low, the groundwater table is low, soil is generally dry (a high percentage of stormwater can infiltrate the ground), and evapotranspiration is high. Infiltration tends to increase and decrease gradually over the course of the year. However, inflow can cause a rapid increase in wastewater flow during and after storm events leading to sewer system surcharging. The volume of infiltration and inflow that enters a collection system typically depends on a variety of factors, including: (1) type of sewer system defects; (2) magnitude and duration of storm events; (3) pre-storm (antecedent) conditions for sewer flow, groundwater elevation, flooding, snowmelt, and storm tide heights. Few problems exist within the regional sewer system during dry weather or as a result of small and medium storm events (those below the MassDEP designated 1.7 inch – six-hour "design" storm level). Wastewater surcharging in sewers and the potential for backups into buildings and SSOs generally only occur during extreme storm events.

Sump pumps connected to building plumbing are sources of private inflow

Inflow into a sewer manhole located in a ponded wetland area

The Authority's Enabling Act (Chapter 372, Acts of 1984) establishes as a goal of MWRA the "reduction of infiltration and inflow for the service areas of the Authority...". The Enabling Act further provides that MWRA "shall also reasonably provide for abatement, reduction and prevention of infiltration and inflow of ground waters, surface waters or storm waters into the sewer system...".

Community wastewater discharges into the regional collection system are subject to MWRA's Sewer Use Regulations (360 CMR 10.000) which govern the discharge of sewage, drainage, substances, and wastes into any sewer under the control of MWRA, or into any sewer tributary thereto. MWRA's Sewer Use Regulations (online at: **www.mwra.com**) are intended to protect the public health, safety and welfare, and the environment, and ensure proper and safe operation of the Authority's wastewater treatment facilities by regulating the direct and indirect discharge of wastewater and pollutants to the MWRA's sewerage system. The Sewer Use Regulations include general requirements and specific prohibitions to minimize infiltration and inflow and regulate the quality of wastewater discharged into the regional collection system. Specifically, the Sewer Use Regulations require new sewer systems and existing system replacements or extensions be designed and built to minimize I/I "to the maximum extent possible." The Sewer Use Regulations also specifically prohibit the following discharges to the MWRA system: groundwater, storm water, surface waters, roof or surface runoff, tidewater, subsurface drainage (except as allowed by a construction site dewatering permit in a CSO area), non-contact cooling or industrial process waters, and uncontaminated contact cooling or industrial process waters.

15.03 MWRA Regional I/I Reduction Plan

The August 2000 NPDES permit for DITP requires MWRA, in cooperation with its member communities, to eliminate excessive I/I to the MWRA sewer system. The permit also requires MWRA to develop and implement a regional I/I reduction plan. The MWRA Board of Directors approved the Regional I/I Reduction Plan on May 23, 2001 and authorized staff to submit the Plan to EPA and MassDEP as required under MWRA's NPDES permit. The Plan was submitted to EPA and MassDEP in June 2001. MassDEP approved the Plan in a letter dated November 19, 2002.

The MWRA Regional I/I Reduction Plan, dated September 2002, is online at: **http://www.mwra.com/comsupport/ii/2010/iiplan.pdf**. The Plan combines recommendations from the I/I Task Force Report (March 2001) with ongoing MWRA I/I reduction initiatives. The Plan replaced the Authority's 1990 I/I Reduction Policy. Implementation of the Regional I/I Reduction Plan focuses on the cooperative efforts of member communities, MassDEP, EPA and MWRA to develop and implement I/I reduction and sewer system rehabilitation projects. Under the Plan, MWRA has full legal and fiscal responsibility for implementation of operation, maintenance, and I/I reduction programs for the MWRA-owned interceptor system. Each member sewer community retains full legal and fiscal responsibility for implementation of operation, maintenance, and I/I reduction programs for community-owned sewers. MWRA provides technical and financial assistance to member communities and works cooperatively with MassDEP, EPA, and other stakeholders to help solve local and regional sewer problems. MWRA's Regional I/I Reduction Plan is organized into five major goals:

1. MWRA will continue its current operation and maintenance program for the MWRA-owned interceptor system leading to the identification, prioritization and rehabilitation of structural and I/I problems.

2. MWRA will work cooperatively with member communities, MassDEP and EPA to eliminate sewer system backups into homes and other buildings and minimize health and environmental impacts of SSOs related to I/I.

3. MWRA will work cooperatively with member communities, MassDEP and EPA to reduce I/I in the regional collection system with emphasis on the following: (1) inflow reduction in areas tributary to sewer backups and SSOs, (2) private source inflow reduction, (3) infiltration that may impact groundwater or surface water resources, and (4) excessive infiltration as defined in MassDEP regulations or guidance documents.

4. MWRA will work cooperatively with member communities, MassDEP and EPA to expand existing efforts to educate and involve the public regarding regional sewer backups, SSOs and I/I reduction issues.

5. MWRA will provide technical assistance and work cooperatively with member communities, MassDEP and EPA regarding guidance on local operation and maintenance and capital improvement programs intended to provide a reasonable level of sewer service to local sewer users/ratepayers.

As required under the August 2000 NPDES permit, MWRA submits an Annual I/I Reduction Report to EPA and MassDEP (prior to September 1 of each year). The MWRA's annual I/I reduction reports, as well as the Regional I/I Reduction Plan (September 2002) and I/I Task Force Report (March 2001) are available online on the MWRA Community Support Program web page at: **http://www.mwra.com/comsupport/communitysupportmain.html**.

15.04 MassDEP Regulations for Sewer Systems

In April 2014, MassDEP revised regulation 314 CMR 12.00: Operation, Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Dischargers. A link to the MassDEP Regulation is: **http://www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-12-00-o-and-m-and-pretreatment-standards-for-wwtps.html**. Regulation Section 12.04 (2) adds significant requirements for Massachusetts sewer system authorities, including the following:

> "All sewer system authorities shall develop and implement an ongoing plan to control infiltration and inflow (I/I) to the sewer system, which shall be submitted upon request of the Department for review and approval. The plan shall describe the preventative maintenance program that identifies and mitigates infiltration/inflow. The plan shall include…"

There are four subsections: 12.04 (2) (a), (b), (c), and (d); subsection highlights are noted below:

- Subsection 12.04 (2) (a): An ongoing program to identify and eliminate sources of I/I is noted with specific references to funding levels and sources.
- Subsection 12.04 (2) (b): An inflow identification and control program that focuses on the disconnection and redirection of public and private sources of illegal inflow. Priority shall be given to removal of public and private inflow sources that are upstream from, and potentially contribute to, known areas of sewer system backups and/or overflows.
- Subsection 12.04 (2) (c): A phased evaluation of the sewer system, consistent with the Department's *Guidelines for Performing Infiltration/Inflow Analysis and Sewer System Evaluation Survey*, to determine its existing condition, the presence and quantity of infiltration and inflow into the system, and locations and risks of wet weather sanitary sewer overflows or by-passes in the sewer system. The phased I/I evaluation is required to be submitted to MassDEP under a very specific time schedule beginning with a community I/I analysis to be submitted before December 31, 2017.
- Subsection 12.04 (2) (d): Sewer system authorities with NPDES discharge permits for combined sewer overflows, and for all sewer systems tributary to such sewer systems, the I/I plan shall include provisions for mitigating impacts from any new connections or extensions where proposed flows exceed 15,000 gallons per day. Such mitigation shall require that four gallons of infiltration and/or inflow be removed for each gallon of new flow introduced to a community collection system.

15.05 MWRA I/I Local Financial Assistance Program

The I/I Local Financial Assistance Program is a critical component of MWRA's Regional I/I Reduction Plan. Specifically, local sewer system rehabilitation projects are intended to at least offset ongoing collection system deterioration to prevent a net increase in regional I/I. In the long-term, system rehabilitation should result in lower I/I, which will allow for future increases in sanitary (residential, commercial, industrial, and institutional) flow without a net increase in total wastewater flow. A second goal of the program is to assist member communities in implementing effective annual local collection system maintenance programs to ensure efficient operation in conjunction with ongoing repair/replacement of the collection system.

MWRA's I/I Local Financial Assistance Program was initiated in May 1993 to provide funding for member sewer communities to perform I/I reduction and sewer system rehabilitation projects within their locally-owned collection systems. Following recommendations from the Advisory Board, the Board of Directors has approved a total program budget of $760.75 million for community distributions through FY30 (13 separate phases of funding). The funds have been allocated among the 43 MWRA sewer communities (see Table 15-1) based on their respective shares of overall MWRA wholesale sewer charges. Financial assistance for Program Phases 1 and 2 (total of $63.75 million) was distributed for approved projects as a 25% grant and a 75% interest-free loan. The grant/loan split was revised for distribution of the Program Phases 3-8 funds (total of $237 million) to a 45% grant and a 55% interest-free loan. All loans under Phases 1-8 required repayments to MWRA over a five-year period beginning one year after the funds were distributed. In FY15, Phase 9 and 10 funds were added to the Program at $80 million for each phase. In FY19, Phase 11 and 12 funds were added to the Program at $100 million for each phase. For Phases 9 through 12, the grant/loan split was modified to 75% grant and 25% interest-free loan and the loan repayment period was extended to 10 years. Also in FY19, an additional $100 million Phase 13 was added as a 10-year interest-free loan only Phase 13.

As of August 2018, $358 million has been distributed to fund 549 local I/I reduction and sewer system rehabilitation projects. Community projects generally take one to three years to complete. Distribution of the remaining $303 million (grant/loans through Phase 12) is approved through FY30 (repayments through FY40). The graph below presents grant and loan distributions and loan repayments (actual as of August 2018 and projected for future years). The additional $100 million loan only Phase 13 is not shown on the graph below but is included in the total allocation of community funds (Phases 1 – 13) as presented on Table 15-1.

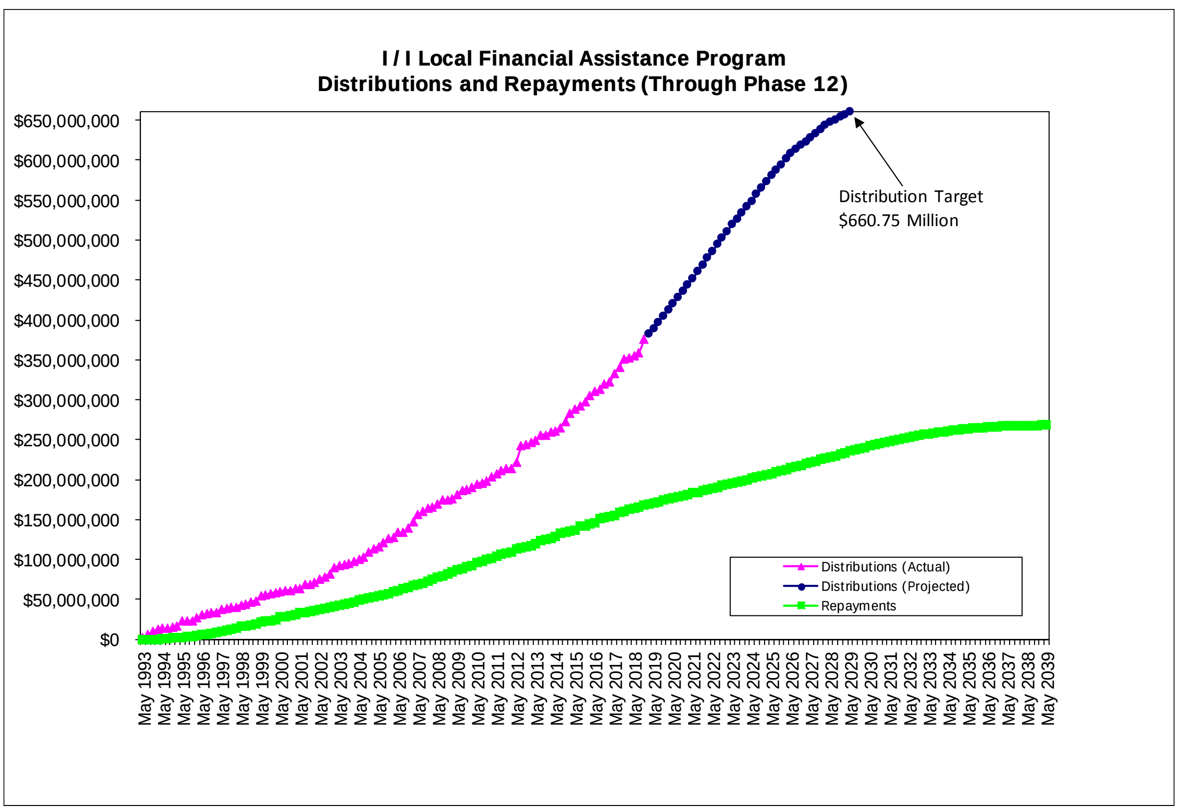


TABLE 15-1

MWRA I/I LOCAL FINANCIAL ASSISTANCE PROGRAM FUNDING SUMMARY AS OF AUGUST 2018

Community	Total Allocations (Phases 1 - 13)	Total Distributions (Phases 1 - 13)	Percent Distributed	Funds Remaining
Arlington	$13,703,000	$8,423,000	61%	$5,280,000
Ashland	$3,818,500	$1,742,450	46%	$2,076,050
Bedford	$5,654,600	$1,999,600	35%	$3,655,000
Belmont	$8,255,100	$2,992,100	36%	$5,263,000
Boston	$218,001,200	$94,112,776	43%	$123,888,424
Braintree	$14,419,000	$7,480,800	52%	$6,938,200
Brookline	$21,355,200	$7,666,200	36%	$13,689,000
Burlington	$8,432,800	$5,102,800	61%	$3,330,000
Cambridge	$39,250,100	$17,579,600	45%	$21,670,500
Canton	$6,635,900	$2,675,900	40%	$3,960,000
Chelsea	$11,760,100	$5,551,100	47%	$6,209,000
Dedham	$9,220,000	$5,740,000	62%	$3,480,000
Everett	$13,381,500	$6,650,500	50%	$6,731,000
Framingham	$20,375,000	$7,255,910	36%	$13,119,090
Hingham	$2,802,500	$1,632,500	58%	$1,170,000
Holbrook	$2,779,600	$896,562	32%	$1,883,038
Lexington	$12,125,300	$7,445,300	61%	$4,680,000
Malden	$20,683,900	$4,593,900	22%	$16,090,000
Medford	$19,637,600	$7,961,600	41%	$11,676,000
Melrose	$10,126,300	$6,076,300	60%	$4,050,000
Milton	$9,014,500	$5,564,500	62%	$3,450,000
Natick	$9,332,600	$5,582,600	60%	$3,750,000
Needham	$9,977,600	$3,218,600	32%	$6,759,000
Newton	$34,937,400	$21,197,400	61%	$13,740,000
Norwood	$11,589,400	$6,879,400	59%	$4,710,000
Quincy	$32,780,000	$19,656,000	60%	$13,124,000
Randolph	$10,070,800	$3,894,800	39%	$6,176,000
Reading	$7,749,100	$4,629,100	60%	$3,120,000
Revere	$16,940,900	$5,502,900	32%	$11,438,000
Somerville	$25,955,800	$10,117,800	39%	$15,838,000
Stoneham	$7,829,900	$4,919,900	63%	$2,910,000
Stoughton	$7,902,900	$4,722,900	60%	$3,180,000
Wakefield	$9,806,900	$5,966,900	61%	$3,840,000
Walpole	$6,110,000	$3,042,000	50%	$3,068,000
Waltham	$22,282,400	$11,377,400	51%	$10,905,000
Watertown	$10,155,800	$4,185,800	41%	$5,970,000
Wellesley	$9,249,700	$3,582,504	39%	$5,667,196
Westwood	$4,302,300	$2,091,300	49%	$2,211,000
Weymouth	$19,100,900	$9,425,900	49%	$9,675,000
Wilmington	$4,232,000	$1,606,000	38%	$2,626,000
Winchester	$6,793,000	$4,183,000	62%	$2,610,000
Winthrop	$5,553,400	$2,807,400	51%	$2,746,000
Woburn	$16,665,500	$10,695,500	64%	$5,970,000
Totals	$760,750,000	$358,428,502	47%	$402,321,498

The MWRA's financial assistance application process and program guidelines are detailed online: **www.mwra.com/comsupport/communitysupportmain.html**. Eligible projects focus on identifying, removing, and assuring elimination of I/I entering the regional collection system, as noted below:

- Engineering services in connection with identification of I/I sources;
- Construction or rehabilitation of sewer and/or storm drain systems;
- Construction or rehabilitation of service laterals or building plumbing;
- Pipeline and manhole lining, sealing, or spot repairs;
- Catch basin, area drain, downspout, or sump pump rerouting; and,
- Engineering planning, design and construction services associated with the above items.

Commitments to provide grants and interest-free loans for local I/I reduction projects are issued by MWRA in the form of financial assistance and loan agreements subject to the availability of Program funds. Financial assistance is distributed quarterly (on or about: February 15, May 15, August 15, and November 15). The financial assistance award is electronically transferred into a Massachusetts Municipal Depository Trust (MMDT) or similar account established by the community. All financial assistance funds, together with the earned interest from the MMDT account, are required to be expended on approved community I/I reduction projects. Both the community and the MWRA receive monthly MMDT account statements to track account expenditures.

15.06 Summary of Existing and Recommended Capital Projects

All grant/loan distributions and loan repayments for Phases 1 through 5 of the I/I Local Financial Assistance Program have been completed through FY18. Table 15-2 lists separately the net costs of I/I Local Financial Assistance Program Phases 6-8, Phases 9 and 10, Phases 11 and 12, and Phase 13 that are programmed in the FY19 CIP. Also listed in Table 15-2 are the net costs of proposed Program Phases 14 and 15 that are recommended for consideration in future CIPs. MWRA staff will continue to work cooperatively with the Advisory Board to identify potential Program improvements which may be recommended to the Board of Directors for approval.

<u>Projects Programmed in the Existing FY19 CIP</u>:

- The I/I Local Financial Assistance Program Phases 6-8 are programmed in the FY19 CIP at net revenue of $7.40 million in the FY19-27 timeframe. The net revenue of the program includes the cost to provide grants and interest-free loans, as well as, the revenue from community loan repayments.
- The I/I Local Financial Assistance Program Phases 9-10 are programmed in the FY19 CIP at net cost of $55.80 million in the FY19-35 timeframe. The net cost of the program includes the cost to provide grants and interest-free loans, as well as, the revenue from community loan repayments.
- The I/I Local Financial Assistance Program Phases 11-12 are programmed in the FY19 CIP at net cost of $150.0 million in the FY19-40 timeframe. The net cost of the program includes the cost to provide grants and interest-free loans, as well as, the revenue from community loan repayments.
- The I/I Local Financial Assistance Program Phase 13 is programmed in the FY19 CIP at zero net cost because the cost of loans are offset by the revenue from community loan repayments.

Projects Recommended for Consideration in Future CIPs:

- For Master Planning purposes, two additional ($100 million each) I/I Local Financial Assistance Program phases (Phases 14-15) are recommended for consideration in future CIPs. Each of the future funding Phases are recommended at $75.0 million in grants, $25.0 million in interest-free loans, and $25.0 million in community loan repayments. The net capital cost of each recommended future funding Phase is $75.0 million. The total cost for two additional funding Phases is $150.0 million. The two additional funding phases are recommended to begin in FY24 and FY25. Prior to expansion of the Program, coordination with the MWRA Advisory Board will be required to develop a recommendation for Board of Directors consideration.

Table 15-2

Wastewater Master Plan - Community-Owned Systems/Community Support

Existing and Recommended Projects

Last revision 9/5/18

Prioritization

1 Critical or Under Construction
2 Essential
3 Necessary
4 Important
5 Desirable

Project Types

NF	New Facility/System
RF/IC	Replacement Facility/Increase Capacity
Opti	Optimization
AP	Asset Protection
Plan	Planning/Study

Line No	Priority	Project	Project Type	FY19 CIP Project No.	FY19 CIP Contract No.	Project Duration	Total Project Cost ($1000)	FY19-58 Planning Period Cost	Schedule	FY19-23	FY24-28	FY29-38	FY39-58	FY19-58 Planning Period Cost
										5 years	5 years	10 years	20 years	
		COMMUNITY-OWNED SYSTEMS/COMMUNITY SUPPORT - SEWER												
15.01	3	I/I Financial Assistance (Phase 6-8 Net Cost) 45% grants and 55% loans	AP	128	multi	22 years	54,000	(7,400)	FY06-27	(6,800)	(600)			(7,400)
15.02	3	I/I Financial Assistance (Phase 9-10 Net Cost) 75% grants and 25% loans	AP	128	multi	21 years	120,000	55,800	FY15-35	66,300	(3,100)	(7,400)		55,800
15.03	3	I/I Financial Assistance (Phase 11-12 Net Cost) 75% grants and 25% loans	AP	128	multi	21 years	150,000	150,000	FY19-39	63,700	107,800	(21,200)	(300)	150,000
15.04	3	I/I Financial Assistance (Phase 13 Net Cost) 100% loans	AP	128	multi	17 years	0	0	FY24-40		25,000	(12,000)	(13,000)	0
		SUBTOTAL - Existing - Community Support					**324,000**	**198,400**		**123,200**	**129,100**	**(40,600)**	**(13,300)**	**198,400**
15.05	3	I/I Financial Assistance (Phase 14 Net Cost) Beginning in FY24 $75 mil grants/$25 mil loans 75% grants and 25% loans	AP	new		17 years	75,000	75,000	FY24-FY40		60,800	15,600	(1,400)	75,000
15.06	3	I/I Financial Assistance (Phase 15 Net Cost) Beginning in FY25 $75 mil grants/$25 mil loans 75% grants and 25% loans	AP	new		17 years	75,000	75,000	FY25-FY41		45,300	32,400	(2,700)	75,000
		SUBTOTAL - Recommended - Community Support					**150,000**	**150,000**		**0**	**106,100**	**48,000**	**(4,100)**	**150,000**
		SUBTOTAL - Existing and Recommended - Community Support					**474,000**	**348,400**		**123,200**	**235,200**	**7,400**	**(17,400)**	**348,400**

CHAPTER 16
RUTLAND-HOLDEN SEWERS

16.01 Chapter Summary

The Rutland-Holden Sewers were constructed to help maintain and protect the purity of the water supplied from the Wachusett Reservoir, the Quinapoxet River (a tributary to the Wachusett Reservoir), and the Ware River. The sewers convey wastewater from the service area in Rutland, Holden, and West Boylston, as well as a force main from Anna Maria College in Paxton, to the treatment facilities of the Upper Blackstone Water Pollution Abatement District located in Millbury. The Department of Conservation and Recreation (DCR) retains ownership of the Rutland-Holden Trunk Sewers and is responsible for entering into agreements with Worcester and the user communities for approving connections, and for any capital improvements. However, in Rutland, the Town's Department of Public Works is the permitting authority for the Trunk Spur Sewers. MWRA has copies of the following DCR Sewer Use Agreements pertaining to the Rutland-Holden sewers (as amended):

- Sewer Use Agreement Between Commonwealth of Massachusetts Department of Conservation and Recreation and Town of Rutland for Intermunicipal Sewer Use dated July 6, 2015;

- Sewer Use Agreement Between Commonwealth of Massachusetts Department of Conservation and Recreation and the Sisters of Saint Ann for Sewer Use dated November 18, 2004; and,

- Sewer Use Agreement Between Commonwealth of Massachusetts Metropolitan District Commission and Town of West Boylston for Intermunicipal Sewer Use dated November 30, 2000.

By Memorandum of Understanding with DCR, MWRA is responsible for operation and maintenance of the Rutland-Holden Trunk Sewers. There are no existing or recommended MWRA capital projects associated with the Rutland-Holden Trunk Sewers proposed for consideration in future CIPs. All operation and maintenance costs associated with the Rutland-Holden Trunk Sewers are annual costs allocated within MWRA's Current Expense Budget (CEB). Should a capital project be required due to a situation such as a major failure, DCR's Division of Water Supply Protection would have capital responsibility. However, since DCR's Division of Water Supply Protection is 100 percent funded by MWRA, it is likely MWRA would be involved in the capital project.

16.02 History of the Rutland-Holden Sewers

The Rutland-Holden Trunk Sewer was authorized under the Acts of 1932. The Metropolitan District Water Supply Commission[1] was authorized to construct, maintain, and operate one or more main sewers, with branch sewers, treatment works and other appurtenances as necessary or desirable, for the purpose of maintaining and protecting the purity of the water supplied from the Wachusett Reservoir, the Quinapoxet River (a tributary to the Wachusett Reservoir), and the Ware River to the Metropolitan Water District and the City of Worcester.

The Rutland-Holden Trunk Sewer became operational in 1934 and initially received wastewater flows from Rutland and Holden municipal sewers and the former Rutland State Hospital in Rutland, and conveyed the wastewater to the Worcester sewer system for treatment and disposal at the Upper Blackstone Wastewater Treatment Plant. In 2003, West Boylston began to convey wastewater flows from newly completed sewers to the Rutland-Holden Trunk and Trunk Relief Sewers via a connection in Holden. When constructed, the trunk sewer was to be turned over to the Metropolitan District Commission (MDC) and maintained as part of the metropolitan water system.[2] Local public sewers and private connections from factories or institutions within Rutland and Holden could be connected to the trunk sewer under the control of MDC with approval of the Department of Public Health. Towns, institutions and other persons connecting were to "pay a reasonable compensation" to the Commonwealth for use of the trunk sewer. Beginning in the 1970's, capacity problems were experienced. Under the Acts of 1979, MDC was authorized to construct a relief sewer. By the mid 1980's the Rutland-Holden Relief Trunk Sewer was completed. It is a ductile iron interceptor in parallel with, and interconnected to, the original Trunk Sewer.

16.03 MWRA's Role in the Rutland-Holden Sewers

MWRA's Enabling Act (Chapter 372 of the Acts of 1984) granted MWRA the right to enter, use, improve, operate, maintain, and manage that portion of the system real property relating to the MDC's sewer and water system infrastructure. However, there was not a clear distinction between the waterworks system (to be managed by MWRA) and the watershed system (to be managed by MDC – now DCR). There was no mention of the Rutland-Holden Sewers in the MWRA Enabling Act. Since the sewers were constructed to protect the purity of the water supply and specifically to protect the Wachusett Reservoir and the Ware River (both listed as part of the watershed system), it would appear the sewers are part of the watershed system, not the waterworks system.

In order to clarify and resolve questions left unclear by the Enabling Act, MDC and MWRA entered into a Memorandum of Understanding (MOU) on April 6, 1986. This MOU set forth the mutual understanding of the joint and separate responsibilities of each agency. It provides that

[1] The Metropolitan District Water Supply Commission was abolished and its powers and duties transferred to the Metropolitan District Commission (MDC) by Chapter 583 of the Acts of 1947. MDC was later abolished and its powers and duties transferred to the Department of Conservation and Recreation (DCR) in 2004.

[2] Legislation in 1939 authorized MDC's predecessor to construct systems of sanitary sewers in Rutland and Holden to divert sewage from the watershed of Wachusett Reservoir, connecting with the Rutland-Holden Trunk Sewer. When constructed, these local sewers were turned over to the respective Towns and were thereafter to be maintained and operated by the Towns. The Towns were to annually reimburse MDC "its proportionate share of the cost to the commission of receiving, caring for and disposing of said sewage," referencing the 1938 agreements.

MDC (now DCR) retains ownership of the Rutland-Holden Trunk Sewers, and is responsible for entering into agreements with Worcester and the user communities for approving connections and for capital improvements, but MWRA agrees to operate and maintain the sewer lines. When MDC was abolished, its former functions related to the Rutland-Holden Sewers transferred to DCR's Division of Water Supply Protection. MWRA and DCR entered into a successor MOU dated April 27, 2004 which continued and updated the prior understanding of the joint and separate responsibilities of each agency relative to the Rutland-Holden Sewers.

16.04 Overview of the Rutland-Holden Sewers

Figures 16-1 and 16-2 show the Rutland and Holden community sewer systems and the Rutland-Holden Trunk and Relief Sewers (note that the two Figures connect). Rutland's municipal sewer system discharges wastewater to the head of the Rutland-Holden Trunk and Trunk Relief Sewers (T/TRS). The T/TRS pass through a portion of Rutland, and essentially bisect Holden before discharging to the Worcester Interceptor. The Holden municipal sewer system discharges wastewater into the T/TRS via several connections along the developed segments of the T/TRS. The Worcester sewer system conveys wastewater to the Upper Blackstone Water Pollution Abatement District's wastewater treatment plant in Millbury, MA. The treated effluent is discharged to the Blackstone River.

Rutland-Holden Trunk and Trunk Relief Sewers: The Rutland-Holden Trunk Sewer (completed in 1938) is 11 miles of 12-inch diameter cast iron pipe with 151 manholes. It begins at manhole 21 (the point at which the "C" and "F" lines discharge to it) and travels primarily cross-country to the Worcester City line. DCR owns the "C" line and the "F" line from manhole 7 to where it enters the relief sewer at manhole 21. The Rutland-Holden Trunk Relief Sewer (completed in 1984) is 8.3 miles of 16-inch and larger (as the pipe proceeds downstream) ductile iron pipe. This sewer parallels the Trunk Sewer and there are numerous hydraulic relief connections between the two. Flow from West Boylston connects to the downstream end of the Rutland-Holden Trunk and Trunk Relief Sewers at manhole 123R in Holden, as shown on Figure 16-2.

Rutland Sewer System: The Rutland municipal sewer system consists of approximately 22 miles of Town-owned gravity collection sewers and approximately 470 manholes. The municipal sewers are constructed of primarily cast iron and some vitrified clay pipe ranging in size from 8 to 10-inches in diameter. In FY16, the average daily wastewater flow was 0.381 mgd. Rutland's municipal sewers discharge to the Rutland-Holden Trunk Sewer's "C" and "F" spur lines that are 8 and 10-inches in diameter and constructed of cast iron pipe. These spur lines discharge to the T/TRS. The system is owned and maintained by the Town of Rutland.

Holden Sewer System: The Holden municipal sewer system consists of approximately 25 miles of Town-owned gravity collection sewers averaging 8-inches in diameter, 16 miles of individual 6-inch service connections, plus approximately 40 miles of newer sewers, constructed in 1998 to 2003, under MDC's Holden-West Boylston sewer project in the Wachusett Reservoir watershed. In FY16, the average daily wastewater flow was 0.884 mgd. Holden's municipal sewers discharge to the Rutland-Holden Trunk and Trunk Relief Sewers in Holden. The system is owned and maintained by the Town of Holden.

West Boylston Sewer System: Portions of West Boylston's sewer system have intermunicipal connections to the Holden sewer system. Portions of West Boylston's sewer system have intermunicipal connections directly to Worcester's sewer system. In FY16, the average daily wastewater flow was 0.310 mgd.

Anna Maria College Sewer Connection: Anna Maria College owns their own wastewater pump station and force main which serve the college in Paxton and discharge to the Rutland-Holden Sewer in Holden. The college's wastewater facilities are operated and maintained by a contractor. In FY16, the average daily wastewater flow was 0.024 mgd.

16.05 Flow Allocation, Treatment Costs, Operation and Maintenance Costs

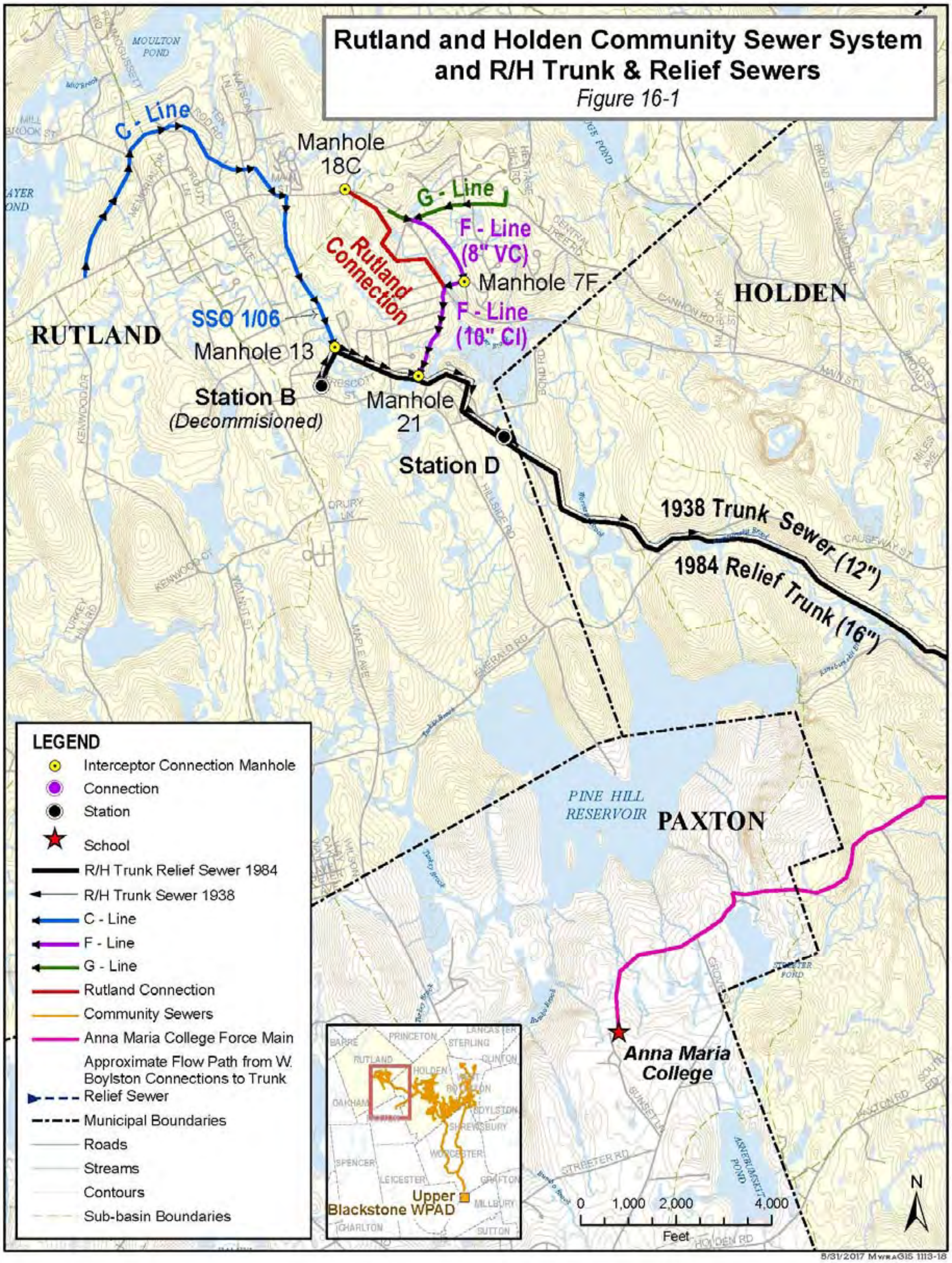
As of 2017, there are four entities that discharge wastewater into the Rutland-Holden Sewer System and are charged for wastewater treatment and sewer system operations and maintenance: (1) Town of Rutland, (2) Town of Holden, (3) Town of West Boylston (which connects via Holden municipal sewer), and (4) Anna Maria College in Paxton which is connected by a cross-country force main.

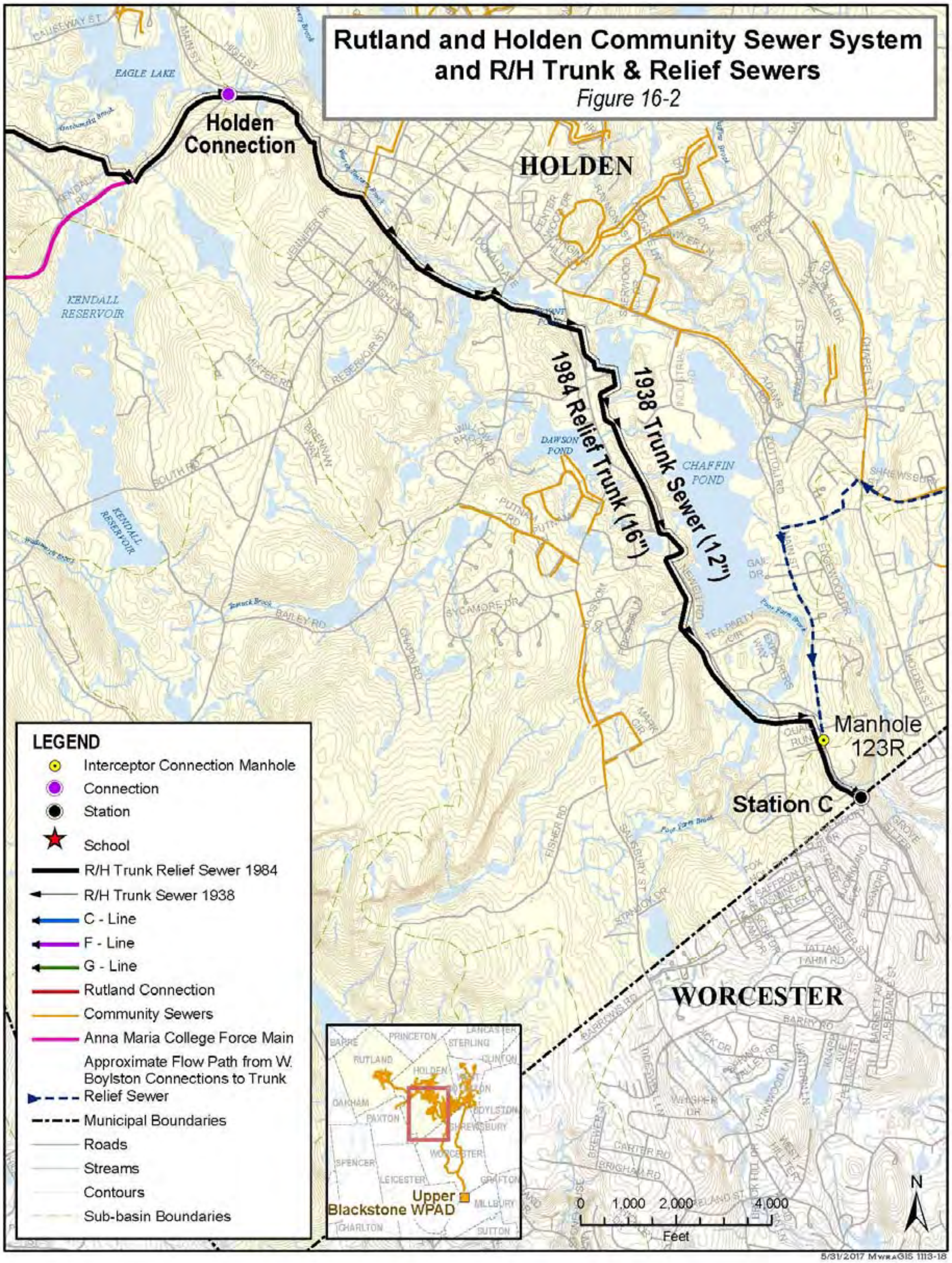
Flow Allocation: The current physical capacity of the Rutland-Holden T/TRS is approximately 2.85 mgd annual average daily flow and 8.95 mgd peak flow. The existing Sewer Use Agreements between DCR and the Towns, and DCR and Worcester (as amended) provide flow allocations for the system. The Rutland-Holden T/TRS are allocated 2.85 mgd annual average daily flow and 8.95 mgd peak flow for contribution into the Worcester Interceptor System. DCR has allocated wastewater flow as follows:

- Rutland - 0.55 mgd at 2020 design flow, with future full build-out at 0.63 mgd;
- Holden - 1.53 mgd at 2020 design flow, with future full build-out at 1.61 mgd;
- West Boylston - 0.59 mgd 2020 design flow, with future full build-out at 0.61 mgd; and,
- Anna Maria College - 0.06 mgd.

Treatment Costs: A flow-based formula for wastewater treatment billing is administered by DCR each fiscal year. The DCR issues bills to the Towns (billing entities) which are to be made payable to the City of Worcester. The formula is applied on a proportional basis depending on flows measured at Monitoring Stations C and D (operated and maintained by MWRA), meters at West Boylston pump stations, and calculations performed by DCR. The percent share values below represent an average over the last five fiscal years of data (FY13-17) and are generally representative of total wastewater flow transported through Worcester to the Upper Blackstone Wastewater Treatment Plant. Treatment costs have been apportioned as follows:

- Rutland - approximately 22.7 percent;
- Holden - approximately 56.7 percent;
- West Boylston - approximately 19.3 percent; and,
- Anna Maria College - approximately 1.3 percent.


Rutland and Holden Community Sewer System
and R/H Trunk & Relief Sewers
Figure 16-1
C - Line
Manhole 18C
G - Line
F - Line (8" VC)
Rutland Connection
Manhole 7F
F - Line (10" CI)
HOLDEN
SSO 1/06
RUTLAND
Manhole 13
Station B (Decommisioned)
Manhole 21
Station D
1938 Trunk Sewer (12")
1984 Relief Trunk (16")
PINE HILL RESERVOIR
PAXTON
Anna Maria College
LEGEND
Interceptor Connection Manhole
Connection
Station
School
R/H Trunk Relief Sewer 1984
R/H Trunk Sewer 1938
C - Line
F - Line
G - Line
Rutland Connection
Community Sewers
Anna Maria College Force Main
Approximate Flow Path from W. Boylston Connections to Trunk Relief Sewer
Municipal Boundaries
Roads
Streams
Contours
Sub-basin Boundaries
Upper Blackstone WPAD
0 1,000 2,000 4,000
Feet
N


Rutland and Holden Community Sewer System
and R/H Trunk & Relief Sewers
Figure 16-2
HOLDEN
WORCESTER
Holden Connection
1984 Relief Trunk (16")
1938 Trunk Sewer (12")
Manhole 123R
Station C
EAGLE LAKE
KENDALL RESERVOIR
CHAFFIN POND
DAWSON POND
LEGEND
Interceptor Connection Manhole
Connection
Station
School
R/H Trunk Relief Sewer 1984
R/H Trunk Sewer 1938
C - Line
F - Line
G - Line
Rutland Connection
Community Sewers
Anna Maria College Force Main
Approximate Flow Path from W. Boylston Connections to Trunk Relief Sewer
Municipal Boundaries
Roads
Streams
Contours
Sub-basin Boundaries
Upper Blackstone WPAD
0 1,000 2,000 4,000
Feet
N
5/31/2017 MWRAGIS 1113-18

<u>Operation and Maintenance (O&M) Costs:</u> Per the current MOU (2004), MWRA as requested by DCR, shall "operate and maintain the sewer lines, including meter readings, gates and valves, manhole inspections and evaluations of problem conditions such as infiltration and inflow and shall be reimbursed for its costs by the sewer users (Holden, West Boylston, Rutland and Anna Maria College) through established payment mechanisms. Operation, maintenance, and repair are defined as those items that can be charged to the users." MWRA issues work orders routinely through its MAXIMO work order program. MWRA does no O&M on the Anna Maria College force main.

MWRA's system tracks the total O&M cost associated with labor, equipment, and materials and applies an MWRA overhead rate. MWRA tabulates costs quarterly, including total operation and maintenance costs, meter station calibrations, and electrical charges. Quarterly sewer O&M charges are apportioned to each Town (or billing entity) based upon metered flow for that quarter. MWRA's Western Operations submits these calculations and backup materials to the Finance Division which in turns issues sewer bills that are made payable to MWRA.

16.06 Special Projects (completed and ongoing 2005 - present)

Tuberculation removed from ca. 1930s 10-inch CI line

<u>Phased Internal TV Inspection:</u> In 2005, MWRA's Wastewater Field Operations staff began periodic projects to clean, televise, and inspect the Rutland-Holden Trunk and Trunk Relief Sewers. The photo at right shows heavy iron tuberculation removed from the Trunk Sewer. The work began at the C-line in Rutland and moved downstream as a multi-phased project. The inspection work is designed to cycle on a five-year period to ensure continued serviceability and to identify potential problems such as blockages or groundwater infiltration. This work is in addition to routine operation and maintenance performed by MWRA Western Operations staff. The Towns were briefed on the project and agreed with the billing plan that spread the project cost over multiple years. No capital costs were included for this project. MWRA recently completed Phase 4 of the current cycle of internal TV inspection work. The next five-year cycle of internal inspections is planned to commence in FY 20.

<u>Wastewater Metering Project:</u> In 2006, MWRA performed sewer flow metering at specific locations to better understand wastewater flow contributions in the Rutland Trunk C spur sewer line. No capital costs were included for this project; the costs were included in MWRA's FY07 Current Expense Budget.

Easement Project 2006: Over several decades, development increased in the Rutland-Holden area along the sewer alignment. This has led to a number of encroachments by abutters on the actual sewer easement, particularly on the Rutland Trunk C spur sewer line. Easement encroachments included: fences, trees, swimming pools, porches, driveways, and foundations. Encroachments cause grounds crews to make special arrangements for access, use alternative equipment, hand-cut when they should machine-cut, and generally make operation and maintenance work less efficient. Some encroachments may also cause structural problems to the sewer pipe. To address this encroachment problem, in 2006, MWRA completed a professional land retracement survey to properly demarcate the sewer and sewer easement along the Trunk Sewer in Rutland and in a specific section of Holden where there were several encroachments observed. The goal of this project was to keep the easement open for operation and maintenance. The strategy was to: (1) document legal easements on current plot plans, (2) provide a copy of the survey to both Town officials and local builders to avoid future encroachments and, (3) provide a certified letter to property owners explaining the easement conditions, and any existing encroachments, with a copy of their plot plan identifying the encroachment and sewer easement. DCR personnel followed-up with the property owners identified with encroachments to ensure they were addressed. No capital costs were included for this project; the costs were included in MWRA's FY07 Current Expense Budget.

Trunk Sewer Repair 2007: As a result of the prior TV inspection work, a segment of cross-country Trunk Sewer off Kendall Road in Holden was found to have substantial spider cracks. MWRA performed in-house repairs on this segment of pipe.


Failed Trunk Sewer off Kendall Road


Excavation of Kendall Road Trunk Sewer

Trunk Sewer Repair 2009: As a result of the prior TV inspection work, a hole in the crown of the Trunk Sewer off Newell Road in Holden was discovered and repaired using cured-in-place-pipe lining by InsituForm.

F-Line Special Cleaning 2010: In December 2010, a specialty sewer cleaning contractor was procured to clean the F-Line from manhole 7F to 21R. Special cleaning equipment was required to eliminate the potential for blockages and SSOs on this line, which had occurred in the past.

C-Line Special TV Inspection 2012: In advance of a planned residential development that included road construction over a segment of sewer with relatively shallow cover, the C-Line from manhole 10 to manhole 13 was jetted and TV-inspected in January 2012 to assess condition. In prior years, there was an SSO along this segment. The inspection identified, and subsequently removed, a long board from the pipe which may have caused an obstruction.

Easement Access Improvements 2014: A large in-house maintenance project was completed in 2014 to correct the segment of Rutland 10-inch CI trunk sewer cross-country easement historically flooded by beaver activity (see before and after photos below). The easement had new drainage works constructed and, once dried out, was brought back up to grade with fill to allow both routine maintenance and access to vactor-jet trucks and TV inspection trucks for regular maintenance. This alignment from manhole 6A to manhole 10 was recently inspected for the first time due to these access improvements.

Photos above show before and after repair of flooded RHS easement MH 6A – MH 10

Injection Grouting Repair 2016: As a result of prior TV inspection work, infiltration leakage was discovered on a pipe segment of the Trunk Sewer near manhole 66 in Holden. The photo below left shows groundwater infiltration entering the sewer before repair. The photo below right shows the sewer after the injection grouting repair process was complete.

Infiltration Entering Trunk Sewer

Injection Grouting Repair

16.07 Summary of Existing and Recommended Capital Projects

There are no existing MWRA capital projects associated with the Rutland-Holden Trunk Sewers and no capital projects proposed for consideration in future CIPs. All operation and maintenance costs associated with the Rutland-Holden Trunk Sewers are annual costs allocated within MWRA's Current Expense Budget. Should a capital project be required due to a situation such as a major failure, the DCR's Division of Water Supply Protection would have capital responsibility. However, since DCR's Division of Water Supply Protection is 100 percent funded by MWRA, it is likely MWRA would be involved in the capital project.

APPENDIX

A Abbreviations

ADF	Average Daily Flow
ADFM	Acoustic Doppler Flow Meters
Authority	Massachusetts Water Resources Authority
AWWTP	Advanced Wastewater Treatment Plant
BOD	Biochemical Oxygen Demand
BPF	Biosolids Processing Facility
BWSC	Boston Water and Sewer Commission
CEB	Current Expense Budget
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
CMR	Code of Massachusetts Regulations
CSO	Combined Sewer Overflow
DCR	Massachusetts Department of Conservation and Recreation
DEP	Massachusetts Department of Environmental Protection
DITP	Deer Island Treatment Plant
DMR	Discharge Monitoring Report
DOJ	U. S. Department of Justice
DP	Design Package
EIR	Environmental Impact Report
ENQUAL-WW	MWRA's Environmental Quality Department – Wastewater unit
EPA	U. S. Environmental Protection Agency
ESDC	Engineering Services During Construction
FRSA	Fore River Staging Area
FY	Fiscal Year
HMI	Human Machine Interface
HVAC	Heating, Ventilation, and Air Conditioning
I/I	Infiltration and Inflow
I/O	Input/Output
IPS	Intermediate Pump Station
lbs	Pounds
kW	Kilowatt (1000 watts)
MAPC	Metropolitan Area Planning Council
MassDOT	Massachusetts Department of Transportation
MassDEP	Massachusetts Department of Environmental Protection
MDC	Metropolitan District Commission
mgd	million gallons per day
MOU	Memorandum of Understanding
MWRA	Massachusetts Water Resources Authority
MSGP	Multi-Sector General Permit
NEFCo	New England Fertilizer Company
NITP	Nut Island Treatment Plant
NOAA	National Oceanic and Atmospheric Administration

NPDES	National Pollutant Discharge Elimination System
OCC	Operation Control Center
O&M	Operation and Maintenance
PC	Personal Computer
PCB	Polychlorinated Biphenyl
PLC	Programmable Logic Controller
POTW	Publicly Owned Treatment Works
RGPCD	Residential Gallons Per Capita Per Day
RTU	Remote Terminal Units
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operating Procedure or System Optimization Plan
SSO	Sanitary Sewer Overflow
STFP	Secondary Treatment Facilities Plan
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TRAC	MWRA's Toxic Reduction and Control Department
T/TRS	Trunk and Trunk Relief Sewer
TV	Television
U.S.	United States
USEPA	U. S. Environmental Protection Agency
UV	Ultraviolet
VFD	Variable Frequency Drive
WRC	Water Resources Commission

B Additional Sources of Information

The reports and planning documents listed below provide a great deal of additional detail on the MWRA wastewater system and recommended capital improvements.

Wastewater Engineering and Management Plan for Boston Harbor - Eastern Massachusetts Metropolitan Area - EMMA Study, March 1976 - This report, including a Summary Report, Main Report, and 16 Technical Data Volumes (with additional appendixes), was prepared to provide guidance for wastewater management to the Metropolitan Sewer District for an 80 year planning period.

Wellesley Extension Sewer Facilities Plan and Environmental Information Document, December 1984 - This report presents the engineering and environmental evaluations and recommendations for replacement/repair/upgrade of the Wellesley Extension Sewer and Wellesley Extension Relief Sewer.

MWRA Secondary Treatment Facilities Plan, March 1988 – This is an eight volume report with each volume detailing a separate aspect of the planning portion of the Boston Harbor Project.

Wastewater Metering System Study, August 1988 - This report recommended design and construction of a wastewater metering system to develop community flow data for evaluation of various sewer rate methodologies.

Framingham Extension Relief Project Final Environmental Impact Report, January 1989 and 1982 Facilities Plan - These reports present the engineering and environmental evaluations and recommendations for upgrades of the Framingham Extension Sewer.

New Neponset Valley Relief Sewer Final Environmental Impact Report and Supplemental Final Facilities Plan, May 1990 - This report presents the engineering and environmental evaluations and recommendations for upgrades of the New Neponset Valley Sewer system.

Final Facilities Plan and Environmental Impact Report for Braintree-Weymouth Relief Facilities, May 1993 - This report presents the engineering and environmental evaluations, and recommendations for replacement and repair of the Braintree-Weymouth Interceptor and pump station, to increase hydraulic capacity and to reduce wastewater overflows.

Quincy Pumping Stations Facility Plan and Environmental Information Document, July 1993 - This report presents the engineering and environmental evaluations, and recommendations for replacement/upgrade of the Hough's Neck, Quincy, and Squantum Pump Stations and force mains.

1994 Final CSO Conceptual Plan and System Master Plan - This report evaluated the cost effectiveness of existing and proposed CSO facilities against other long-term CSO control alternatives, in the context of long-term system-wide wastewater management strategies involving the transport system, infiltration/inflow reduction, and secondary treatment capacity at Deer Island. The report recommended approximately 25 wastewater system improvements to bring CSO discharges into compliance with state water quality standards.

Cummingsville Branch Sewers Facilities Plan, June 1995 - This report presents the alternatives, and the engineering and environmental evaluations for providing increased hydraulic capacity to the Cummingsville Branch Sewer system to prevent surcharging and overflows, and includes recommendations for replacement and rehabilitation of the system.

1996 Siphon Chamber and Connecting Structures Inspection Summary Report - This report provides documented results and recommendations from the inspection of 146 siphon chambers and connecting structures in the MWRA collection system.

Final CSO Facilities Plan and Environmental Impact Report, July 1997 - This report includes facilities planning and environmental assessment for the CSO Control Plan recommended in the 1994 Final CSO Conceptual Plan and System Master Plan. It confirmed or modified the 1994 CSO Conceptual Plan recommendations and presented an updated plan for long-term CSO control.

MWRA Sewerage Division Plan, July 1997 - This Master Plan was written by MWRA staff to provide a long-term guide for Sewerage Division operations, maintenance, capital development and planning decisions in a system-wide format. The plan included a section on the Clinton Wastewater Treatment Plant.

Upgrades to Existing CSO Facilities, Supplemental Environmental Impact Report, September 1998 - This report recommended project changes to implement the 1997 CSO plan, including the addition of dechlorination into the treatment process at CSO treatment facilities.

Upgrades to the Fox Point CSO Facility Supplemental Environmental Impact Report, December 1998 - This report recommended project changes to implement the 1997 CSO plan, including the addition of dechlorination into the treatment process at the Fox Point CSO treatment facility.

1999 Supervisory Control and Data Acquisition (SCADA) Master Plan - This report recommended upgrades to the SCADA system to monitor and control facilities and equipment from a centralized location.

Emergency Evaluation of the High Level Sewer Sections 70 and 71, February 1999 - This report recommended repairs/rehabilitation of a portion of the High Level Sewer.

Re-Assessing Long-Term Floatables Control for Outfalls MWR018, 019 and 020, February 2001 - This report presented updated assessments showing improved system performance and infrequent CSO discharge activations and volumes and proposed deletion of earlier recommended improvements deemed no longer beneficial.

Re-Assessment of CSO Activation Frequency and Volume for Outfall MWR010, April 2001 - This report (including May 31, 2001 supplemental letter report) presented updated assessments showing improved system performance and infrequent CSO discharge activations and volumes and proposed deletion of earlier recommended improvements deemed no longer beneficial.

MWRA Collection System Operation and Maintenance Manual, June 2001 - This manual was developed to meet a requirement of MWRA's NPDES Permit and describes operation and maintenance activities for the collection system.

MWRA Current Equipment and Operational Summary for Wastewater Transport Facilities, June 2002 - This report provides detailed equipment and operational information specific to each facility as an existing conditions baseline for the Wastewater Hydraulic Optimization Project.

2003 Wastewater Characterization Study – This report identified the various components in the wastewater stream with hydrogen sulfide being a component of interest.

Upper Neponset Valley Relief Sewer Phase III Report Final Environmental Impact Report, February 2003 - This report summarizes the alternatives for hydraulic relief of the Upper Neponset Valley Sewer system to eliminate sewer system overflows, and presents the recommended alternative and associated mitigation measures.

Final Variance Report for Alewife Brook and the Upper Mystic River, July 2003 - This report (including July 8, 2003 supplemental letter report) confirmed a revised plan for CSO control for the Alewife Brook watershed.

Final Report on Hydraulic Optimization Alternative Analysis, August 2003 - This report presents the results of hydraulic evaluations of a series of hydraulic optimization alternatives originally identified in a workshop conducted with the consultant and MWRA staff on March 27, 2003 under the Wastewater Hydraulic Optimization Project.

Rutland-Holden Trunk and Relief Sewers, Hydraulic Capacity Evaluation, December 2003 and Sewer System Evaluation Survey, November 2003 - These reports present results of evaluations of the Rutland – Holden sewers.

2004 Cottage Farm CSO Facility Assessment Report - This report evaluated the treatment performance of the Cottage Farm CSO facility, recommended system optimization improvements, and demonstrated that expanding the facility's detention/storage capacity would not be cost-effective.

East Boston Branch Sewer Relief Project Reevaluation Report, February 2004 - This report evaluated CSO control alternatives for East Boston outfalls and confirmed the cost-benefit of the 1997 interceptor relief plan with minor adjustments.

Supplemental Facilities Plan and Environmental Impact Report on the Long-term CSO Control Plan for North Dorchester Bay and Reserved Channel, April 2004 - This report presented a revised plan for North Dorchester Bay outfalls recommending a storage tunnel controlling CSOs up to the 25-year storm and separate stormwater discharges up to the 5-year storm.

MWRA Long Term CSO Control Plan, Fort Point Channel Sewer Separation and System Optimization Project, Level of Control at CSO Outfalls BOS072 and BOS073, June 2004 - This report evaluated alternatives for controlling CSO discharges at outfalls BOS072 and BOS073, recommending sewer separation and CSO regulator modifications.

Recommendations and Proposed Schedule for Long-Term CSO Control for the Charles River, Alewife Brook and East Boston, August 2005 and MWRA Revised Recommended CSO Control Plan for the Charles River, Typical Year CSO Discharge Activations and Volumes, November 2005 - Together these reports recommended additional improvements and higher level of control for the Cottage Farm facility and other Charles River CSO outfalls. They affirmed revised recommended plans for Alewife Brook and East Boston, proposed new schedule milestones, and raised the number of recommended CSO control projects to 35.

December 2006 MWRA Water and Wastewater System Master Plan - This report was MWRA's first comprehensive Master Plan that presented a long-term (40 year) vision of the capital development needs for both the water and wastewater systems.

Prison Point Optimization Study, April 2007 and Proposed Modification of Long-Term Level of Control for the Prison Point CSO Facility, April 2008 - These reports recommended improved operation of wet weather influent gates at Prison Point CSO facility to maximize in-system storage and minimize treated discharges from the facility.

Concept Design Report on Solids Handling Systems, August 2009 and Concept Design Report for Remote Headworks, August 2009 - These reports present the investigations, inventory, evaluations, findings and conclusions of the equipment and systems in the three remote headworks in order to upgrade the headworks. The reports include itemized lists of over 1,000 improvement recommendations.

Residuals Condition Assessment/Utilities Reliability Study, July 2010 - This report evaluated all facility equipment and support systems at the residuals pellet plant.

September 2013 MWRA Water and Wastewater System Master Plan - This report was MWRA's second comprehensive Master Plan that presented a long-term (40 year) vision of the capital development needs for both the water and wastewater systems.

MWRA Wastewater Collection System Operation and Maintenance Plan, December 2017 - This manual was developed to meet requirements of MWRA's Clinton and DITP NPDES Permits and the requirements of 314 CMR 12.03, 12.04, 12.05, and 12.07. The Plan describes operation and maintenance activities for the wastewater collection system and outlines MWRA's infiltration and inflow control plan, sanitary sewer overflow response plan, and presents a risk assessment for sanitary sewer overflows.

Annual Final Capital Improvement Program (CIP) - This report of MWRA's annual CIP, the most recent version being FY19, lists all MWRA capital projects approved by the MWRA Board of Directors for funding and each project's anticipated schedule and expenditure forecast.

Annual Progress Report for the Combined Sewer Overflow Control Plan - This report is filed annually (by March 15) in compliance with the Federal District Court Order in the Boston Harbor Case (U.S. v. M.D.C., et al., No. 85-0489-RGS). Each annual report describes the progress of work to implement the Long-Term Control Plan relative to milestones in the Court-ordered schedule as well as related benefits achieved.

Annual National Pollutant Discharge Elimination System (NPDES) Compliance Summary Report - This report is compiled annually to summarize monitoring and compliance data collected and analyzed by the MWRA's Environmental Quality Department (ENQUAL).

Industrial Pretreatment Program Annual Report (Industrial Waste Report) - This report is compiled annually to document MWRA's ongoing efforts to implement the requirements of 40 CFR Part 403, General Pretreatment Regulations by the Toxic Reduction and Control (TRAC) Department.

MWRA Five Year Progress Report - This report is prepared by MWRA every five years in accordance with Section 22(b) of Chapter 372 of the Acts of 1984 (MWRA's Enabling Act). The most recent Five Year Report for the period 2011-2015 was completed in 2016. The report provides an overview of the accomplishments and challenges of MWRA.