Massachusetts Water Resources Authority

Wastewater System Master Plan

December 2006

BOARD OF DIRECTORS

Prepared under the direction of

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together with the participation of MWRA staff.

*Ian A. Bowles, newly appointed Chair in January 2007

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January 2007

Katherine Haynes Dunphy, Chairwoman
MWRA Advisory Board
11 Beacon Street
Boston, MA 02108

Dear Chairwoman Dunphy:

This letter transmits to the Advisory Board MWRA's Master Plan for its water and wastewater systems. The Master Plan documents infrastructure investment needs over the next 40 years, identifies nearly 300 projects estimated at $3.2 billion in 2006 dollars, and prioritizes projects for consideration in the annual Capital Improvement Program (CIP). Approximately $2.3 billion of the identified projects in the Master Plan are for rehabilitation or replacement of existing MWRA infrastructure, driven by the need to both reinvest in the $5 billion in new facilities created since the agency's inception and in other facilities and infrastructure where attention is still needed.

The Master Plan has two volumes, one for wastewater and one for water, and is the product of a two and one-half year effort involving planning, operations, engineering and finance staff. Staff presented prioritized Master Plan project recommendations to the Board of Directors in the fall of 2006, and more refined project scopes and budgets were proposed and evaluated during the Proposed FY08 CIP development process.

The Advisory Board advocated for master planning to guide development of the annual CIP. The sizing of the Proposed FY08 CIP approved by the Board of Directors in December 2006 for transmittal to the Advisory Board reflects near-term rates management and capital project staffing considerations. The Master Plan is being transmitted as a companion document to the Proposed FY08 CIP to facilitate the Advisory Board's annual review process.

We appreciate your continued support and look forward to your comments.

Sincerely,

Frederick A. Laskey
Executive Director

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MWRA Master Plan - Executive Summary

OVERVIEW

The Master Plan documents the investment needs of MWRA's regional water and wastewater systems over the next 40 years, identifies 292 corresponding projects estimated at $3.2 billion in 2006 dollars, and prioritizes projects for consideration in the Capital Improvement Program (CIP) beginning in FY08. It is the product of a two and one-half year in-house effort involving Planning, Operations, Engineering and Finance staff[1]. During the process, MWRA's Board of Directors, Advisory Board and Advisory Committees were briefed and provided input at regular intervals.

The Master Plan is intended to serve as the principal framework for annual capital planning and budgeting and its spending recommendations have been incorporated in the MWRA's multi-year financial planning estimates. The Plan is a key reference document that will be updated every five-to-ten years to reflect changing needs and priorities, regulatory requirements, and other considerations as appropriate.

Approximately $2.3 billion of the identified projects are replacement of existing infrastructure at end of useful life. Staff determined early in the planning process that rehabilitation and replacement of existing assets would create the largest demand for future capital spending, driven by reinvestment in both in the $5 billion in new facilities created since the agency's inception and in other facilities and infrastructure where rehabilitation or replacement was still needed.

The CSO Program at $461 million is the next largest category of project spending; these projects have been approved by EPA and the court as part of MWRA's Long Term CSO Control Plan. The addition of two water system member communities in 2006 and the Board's discussion of the potential of using MWRA's robust water supply to serve communities in water-stressed basins on its borders gave greater urgency to filling in gaps in the water system, as did vulnerability assessments undertaken in response to the events of September 11, 2001. Current and anticipated regulatory requirements for drinking water, along with water quality, energy management and security considerations, also shaped the Master Plan. Issues being debated nationally that could impact the MWRA system, such as climate change and pharmaceuticals in wastewater, are identified in the Master Plan, but there are no project-specific recommendations at this time.

MWRA's Advisory Board advocated for master planning to guide development of the annual CIP, adjust unrealistically low out-year spending projections, and coordinate the various planning studies underway or planned throughout the agency. MWRA last produced a system-wide water plan in 1993 and wastewater plan in 1997. In 2001, the planning functions of the then-separate Waterworks and Sewerage divisions were merged as part of a new Operations Division. In 2003, an independent Planning Department

[1] The work of Lise Marx and Carl Leone to coordinate this effort and write much of the document is particularly acknowledged.

reporting to the Executive Director was established to coordinate planning toward the goal of producing an updated Master Plan for both the water and wastewater system. In December 2003, debt service assistance was eliminated by then-Governor Swift; it was restored in subsequent years but at greatly reduced levels. MWRA responded to the debt service assistance cuts by eliminating projects in the FY06 CIP. A completed master plan process was viewed as critical to CIP rebuilding.

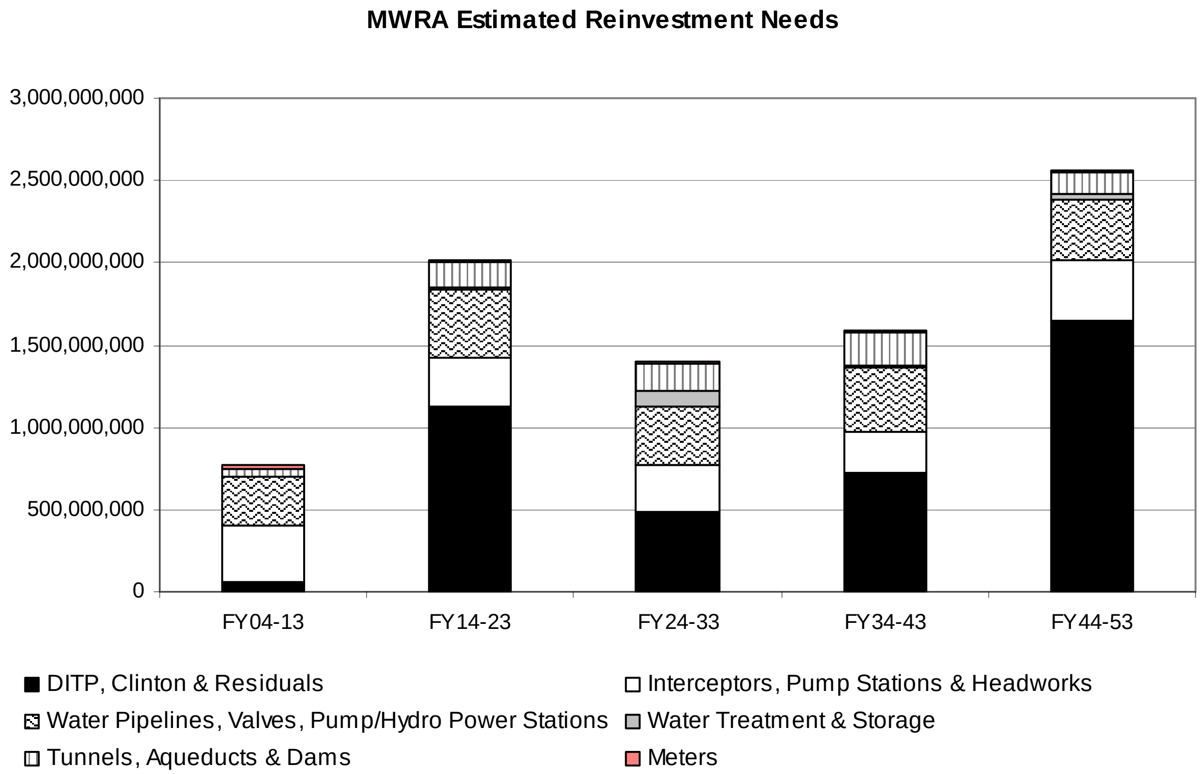
In developing Master Plan project recommendations, staff considered various studies and assessments, previous CIP projects, and asset maintenance histories. Projects were evaluated and prioritized by planning, operations and engineering managers using criteria for water and wastewater projects (see Attachment 1) developed by a broad-based staff committee. A full-day staff retreat was held in June 2006 to present preliminary findings and project recommendations.

Staff presented prioritized Master Plan project recommendations for the wastewater and water system to the Board of Directors in the fall of 2006, and more refined project scopes and budgets were proposed and evaluated during the FY08 CIP development process. The sizing of the proposed FY08 CIP approved in December 2006 for transmittal by the Board of Directors to the Advisory Board for review reflects near-term rates management and capital project staffing considerations. The Proposed FY08 CIP includes all projects receiving a Priority 1 or Priority 2 ranking and a recommended $1 billion spending cap for FY09-13. The Master Plan is intended to be a companion document to the Proposed FY08 CIP to facilitate Advisory Board review this year, as well as in the future.

The MWRA Master Plan has two volumes: a Wastewater Master Plan and a Water Master Plan. The Wastewater Master Plan includes distinct chapters for major facilities (e.g., Deer Island Treatment Plant) or groups of similar facilities (e.g., pump stations, sewers). The Water Master Plan includes major chapters on treatment, the transmission system and the metropolitan system. Chapters include project recommendations to address the issues and needs identified during the planning process. The Wastewater and Water Master Plans also describe the history of the systems and related background information, system goals and objectives, and the assumptions which provide the context for system master planning, including the regulatory framework. As such, the Master Plan is a key agency reference document.

MWRA selected a 40-year Master Plan timeframe commencing with the FY08 CIP cycle and continuing through FY48 because it was consistent with estimated reinvestment cycles for existing MWRA water and wastewater facilities and infrastructure. As shown in Figure 1, reinvestment needs are expected to peak in FY44-53 largely because substantial structural components at MWRA's largest facility, the Deer Island Treatment Plant, will require replacement at end of useful life. The Master Plan focuses on projects recommended for FY07-08 and projects that are proposed to generate capital spending during the next two 5-year CIP cap cycles FY09-13 and FY14-18. Following these two 5-year periods, additional 10-year (FY19-28) and 20-year (FY29-48) planning periods are utilized. Estimates of project costs and schedules over the shorter term are expected to be more reliable than out-year estimates.

Figure 1



The MIS Master Plan document is under development and will address MWRA's technological and system needs. The MIS Plan consists of $6,115,000 for approved projects in the current FY07 CIP (project milestones through FY10) and an additional $5,450,000 for new projects through FY18. Investment in the MIS Master Plan represents approximately 1% of MWRA CIP requirements. The major areas of focus are: replacing aging systems and the network architecture, improving disaster recovery, enhancing data integration, consolidating server/computing resources, and implementing applicable best practices as part of software vendor solutions. The goal is to continue to support efficient administrative, financial, operational, engineering and planning functions with cost-effective technology.

SUMMARY OF THE WASTEWATER MASTER PLAN

Total wastewater needs identified for the FY07-48 Master Plan timeframe are over $2 billion (in current dollars), including $461 million for the Court-approved CSO Control Plan. The needs assessment is based on the following major conditions and assumptions:

- Needs estimates extend through FY48. However, projects, timelines and cost estimates beyond FY18 will be revisited in the next iteration of the Master Plan.

- No new communities are expected to join the wastewater system, and population growth in the existing service area is expected to be modest.

- No design and construction funds are included for potential regulatory changes that may impact facility design and construction.

- The cross-harbor tunnels are assumed to be in good condition; the timeframe for tunnel rehabilitation is beyond the master planning period.

- Staff continue to track research on climate change[2] but cannot yet make any definitive statements regarding potential impacts on the MWRA water/wastewater system.

MWRA's wastewater infrastructure has an estimated replacement value of over $6 billion. The scale and scope of MWRA's operation – encompassing collections, treatment, and beneficial reuse of residuals – presents challenges in maintenance, rehabilitation and replacement. Deer Island alone has nearly 26,000 equipment components (valves, electrical, mechanical and HVAC) and over 46,000 instrumentation components; regular maintenance and replacement cycles have become standard plant operating practice but will become increasingly costly as the plant ages. Older headworks facilities now require significant reinvestment, and interceptors, while generally in fair-to-good condition, are aging and some sections now need rehabilitation or replacement. The residuals facility is expected to require large-scale equipment replacement at the end of the current operating contract with NEFCo in 2015, and MWRA will need to develop and implement a plan for long-term plant operation. 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.

Over 70%, $1.47 billion of the $2 billion needs estimate for all wastewater projects, is to replace facility equipment and structural components at the Deer Island Treatment Plant, headworks and pump stations, and to rehabilitate interceptors. The other $600 million in needs are for CSO Control Plan projects, interceptor projects that add system capacity, new equipment that supports automated facility operation (SCADA), and various studies.

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[2] For example, a report issued in October 2006 by the Union of Concerned Scientists, "Climate Change in the U.S. Northeast", assesses the impact of two greenhouse gas emission scenarios, higher and lower, and concludes that by 2100 Northeast cities including Boston could be experiencing 30 or more days each summer with temperatures hitting 90 degrees Fahrenheit or more under the low emissions scenario and 60 days or more under the high emissions scenario. Also, the Climate Long-Term Impacts on Metro Boston (CLIMB) study examined infrastructure impacts and indicated that non-MWRA communities might have shortfalls in local supplies by 2050.

In its briefings to the Board of Directors and others, staff focused on the FY07-18 (12-year) timeframe because it relates directly to the current and upcoming CIP cycles, and because estimates of project costs and timeframes are more reliable than in the out-years. The Master Plan identifies $500 million in wastewater system needs in the period for which funds are not currently included in the Final FY07 CIP. The Master Plan recommends rehabilitation and replacement projects to correct system and/or structural deficiencies, replace equipment cyclically due to operability/end-of-life issues, and repair/replace interceptors in poor condition. Adding these unmet project needs to the $670 million in wastewater projects currently included in the Final FY07 CIP results in a total wastewater capital needs assessment of $1.2 billion in FY07-18.

Staff expect the Board will set a CIP spending cap for the FY09-13 period as part of the FY08 CIP process. Total wastewater needs identified for FY09-13 are approximately $485 million, including $120 million in new projects, and $365 million in projects currently programmed in the CIP (the CSO Control Plan accounts for $273 million or 75% of the cost of already-programmed projects In FY09-13).

Master Plan findings and recommendations for wastewater priority projects during the FY07-18 timeframe are summarized below under five major headings: (1) Treatment - Deer Island and Clinton plants; (2) Residuals (off-island), (3) Collection System Facilities, Sewers and Cross-Harbor Tunnels; (4) CSO Control Plan; and (5) Community Financial Assistance. All Wastewater Treatment and Sewer System projects recommended in the Master Plan are listed in Attachment 2-A.

All projects have been prioritized on a scale from 1 to 5, with 1 being projects considered critical and 5 considered 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 Planning and Coordination Department staff. All MWRA projects (water, sewer, and business support) will be further reviewed during the FY08 CIP development process.

Treatment - Deer Island and Clinton Plants, FY07-18

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.

The Master Plan identifies $215 million in project needs for the FY07-18 timeframe, $204 million for Deer Island and $11 million for Clinton, including all projects currently in the FY07 CIP. Approximately half of the $215 million, $105 million, is already programmed in the FY07 CIP.

Residuals (off-island)

MWRA's sludge-to-fertilizer plant in Quincy – also known as the Residuals Processing Facility - recycles sludge (residuals) from the Deer Island Treatment Plan to produce pellets marketed for beneficial reuse. This facility is operated and maintained under a long-term contract, which expires in December 2015, with the New England Fertilizer Company (NEFCo).

Since the contractor is responsible for all operations, maintenance and capital improvements for the term of the contract, MWRA has not budgeted for any major expenditures within the existing FY07 CIP; however, staff are currently undertaking a reliability assessment of the utilities that support the facility that may lead to recommendations for infrastructure upgrade projects. The most significant short-term need identified in the Master Plan is implementation of a comprehensive Facilities Plan to assess the condition and needs of the existing equipment and facility; review new technology options, regulatory developments, and plans of other similarly-sized utilities; and recommend a long-term approach for residuals management. For the long-term, the current Residuals Processing Facility will likely need to be completely rehabilitated or replaced either in-kind or with another technology beginning in FY14.

No Residuals funds are programmed in the FY07 CIP. The Master Plan identifies a total of $77 million in recommended priority needs in the FY08-18 timeframe, which includes the post-NEFCo period.

Collection System Facilities, Sewers and Tunnels

For the wastewater collection system, $382 million in projects is identified in the FY07-18 timeframe, including $87 million in projects in the FY07 CIP and $295 million in proposed projects. Discussion on the collection system is presented in three sections: headworks, pump stations, and CSO facilities; collection system sewers; and cross-harbor tunnels.

Headworks, Pump Stations, and CSO Facilities: For the four remote headworks and twenty 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 "choking" of the facility influent gates which can result in upstream CSOs or 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.

The Chelsea Creek, Columbus Park, and Ward Street Headworks (all built in 1967) are almost 40 years old; equipment upgraded in 1987 is now almost 20 years old. These facilities remain operational, but are in only fair condition. The highest priority need for the Headworks is a comprehensive facility plan and subsequent upgrades.

The average age of MWRA's 20 pump stations and CSO facilities is 17 years old and, overall, these facilities are in good-to-excellent condition. Only five of these facilities are more than 20 years old. The oldest pump station, Alewife Brook in Somerville, is 55 years old. Two of MWRA's CSO treatment facilities (Cottage Farm and Somerville Marginal) are 35 years old; however, significant rehabilitation and upgrades have been performed as part of the CSO Control Plan. MWRA's newest facilities include five that have been constructed since 2002 or are soon to be completed: Quincy Pump Station (2002), Squantum Pump Station (2003), Intermediate Pump Station (2005), Union Park CSO Facility (scheduled for 2007), and Braintree-Weymouth Replacement Pump Station (scheduled for 2007).

The highest priority immediate needs for sewer pump station and CSO facilities are small scale equipment rehabilitation and replacement projects. Significant automation upgrades are being implemented under MWRA's Wastewater Central Monitoring/SCADA Implementation Project. The CSO facilities have also undergone upgrades under the CSO Control Plan and two of the stations (Commercial Point and Fox Point) are scheduled to be decommissioned in 2008 following completion of sewer separation projects.

<u>Collection System Sewers</u>: The primary function of the collection system is to transport wastewater received from the 43 sewer member communities (through over 1,800 community connection points) 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. Key decision making to minimize risks of sewer plugging or structural failure includes where/how often to perform preventive maintenance activities and the cost/benefit of when to rehabilitate aging sewer pipelines. Internal inspection information (physical, television, and sonar) is used to develop a cleaning schedule, to identify structural problems and infiltration, and to help define rehabilitation projects.

The majority of MWRA's past CIP funds spent on sewer interceptor projects were for new interceptors (a combination of sewer replacement and relief sewer construction) that were a priority to solve sewer capacity issues. The most critical need for new interceptor projects is now sewer rehabilitation construction that will eliminate known structural deficiencies as well as hydrogen sulfide-related corrosion.

Overall, the collection system is in reasonably good condition, given its average age of about 70 years. Approximately 33 percent of sewers are over 100 years old and another 25 percent are between 51 to 100 years old. Based on internal TV inspection ratings for gravity sewer pipe, approximately 18 miles (8 percent) of interceptors are severely damaged ("C-rated"), 139 miles (61 percent) are in fair to good condition with some damage ("B-rated"), and 52 miles (23 percent) are in very good condition ("A-rated")[3].

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[3] An additional 18 miles (8 percent) of gravity sewer, mostly newly constructed interceptors, were unrated at the time of the analysis. The gravity sewer inspection "A"/"B"/"C" ratings have not been used for force mains, siphons, or outfalls; however, based on available data, these facilities also appear to be in reasonably good condition.

As part of the Master Plan process staff developed an interceptor renewal methodology to identify and then plan/design/construct sewer repair/rehabilitation projects targeting “C” rated (severely damaged) pipe.

Cross-Harbor Tunnels: The cross-harbor tunnels transport wastewater from the remote headworks to the Deer Island Treatment Plant. The existing condition of the cross-harbor tunnels is unknown; however, some deterioration of concrete in the tunnel shafts has been attributed to hydrogen sulfide corrosion. The older tunnels, the North Metropolitan Relief Tunnel and Boston Main Drainage Tunnel (1953), are more than 50 years old, while the Inter-Island Tunnel (1995) and Braintree-Weymouth Tunnel (2005) are relatively new. Based on the industry benchmark of 100+ years for useful life for tunnels, it is presumed that the tunnels are still in good condition. Since the condition of the cross-harbor tunnels is unknown, an inspection/condition assessment project is recommended.

CSO Control Plan

MWRA’s long-term CSO Control Plan includes $461 million in court-ordered projects (both MWRA and community managed); all are included in the FY07 CIP. Under the Master Plan, there are no future MWRA or community managed CSO Control Plan projects recommended for consideration in the CIP. Funds to replace equipment at CSO facilities are included in the funds for Collections System Facilities.

Community Financial Assistance

Since 1993, MWRA has made a commitment to assist member sewer communities 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 as 45 percent grants and 55 percent interest-free loans. The loans are repaid to the Authority over five years. 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. This program is a critical component of MWRA’s Regional I/I Reduction Plan.

The current FY07 CIP includes a net cost of $14 million (including repayments) for approved local distribution through FY15. The Master Plan includes placeholders for two additional rounds ($40 million in grant/loans in each round) of CIP funding beginning in FY12 and FY17 at a net cost of $18 million each. For the FY07-18 timeframe, a total of $34 million is identified for community financial assistance.

SUMMARY OF THE WATER MASTER PLAN

Total water system needs identified for the FY07-48 Master Plan timeframe are approximately $1.1 billion (in current dollars), including all projects currently in the CIP. The needs assessment is based on the following major assumptions and findings:

The 300 mgd safe yield of the MWRA water system is sufficient to meet future demand for water both within the service area and additional demand outside the service area as may be approved[4].

- There is adequate treatment plant capacity, and generally adequate transmission capacity under normal operations to meet MWRA system needs under the demand planning scenario assuming current CIP projects are completed. Distribution capacity is generally adequate with the exception of a few weak spots.

- MWRA's transmission system lacks redundancy in some key areas: some issues are already being addressed, and the Master Plan recommends that other issues be addressed in the near-term. There are also areas within the distribution system without adequate redundancy which the Master Plan addresses.

- MWRA falls short of its goal of distribution system storage sufficient to meet one day of demand. The Master Plan recommends addressing the system's highest risk areas.

- No design and construction funds are included to address the impacts on the MWRA water system of potential changes in federal or state regulations[5]. Continuation of MWRA's ongoing program to systematically replace old, cast-iron water mains is recommended as this approach provides better quality

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[4] Staff used the following demand planning scenario to arrive at this conclusion: continuation of current base demand in the existing MWRA service area (230 mgd, based on five year average demand in FY2004); projected increased demand from very modest population and employment growth through 2030 in the service area (13 mgd); a total of approximately 5 mgd from new communities actively pursuing admission and/or increased withdrawals from MWRA; potential additional demand for MWRA water from partially-served communities (planning assumption is up to 18 mgd); and potential additional demand for MWRA water by as many as 22 communities not currently and actively pursuing admission to MWRA but within reasonable proximity to the MWRA water service area and that have or may face water deficits (up to 10 mgd).

[5] There are currently no anticipated changes in regulations which might require MWRA to add filtration to the Carroll Water Treatment Plant; however, any major national event similar to the Milwaukee *cryptosporidium* outbreak could cause EPA to change course. The FY07 CIP already includes funds to meet the requirement of the Long Term 2 Enhanced Surface Water Treatment Rule, adopted in January 2006, for a second treatment process at both the CWTP and Ware Water Treatment Plants by 2014; staff propose to add ultraviolet light (UV) disinfection at both plants.

water and is consistent with EPA's anticipated direction on distribution system regulation.

- No funds are included for rehabilitation of the tunnels. Funds are included to inspect transmission tunnels in light of their average age of 53 years (excluding the new MetroWest Tunnel).

- As noted in the Wastewater discussion, staff continue to track research on climate change but cannot yet make any definitive statements regarding potential impacts on the MWRA water/wastewater system.

- Infrastructure needs estimates extend through FY48. However, projects, timelines and cost estimates beyond FY18 will be revisited in the next Master Plan iteration.

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 value of over $6 billion. Over the last ten years, the system has benefited from the $1.7 billion Integrated Water Supply Improvement Program which included watershed protection, construction of new water treatment, transmission and storage facilities, and relining or replacing of MWRA and community water pipes. SCADA technology has been adopted throughout the system, a rehabilitation program to complete the upgrading of pump stations is now underway, and MWRA has rehabilitated 63 miles of its distribution system pipeline and constructed approximately 22 miles of new pipeline since 1993 when the last water system Master Plan was developed.

Notwithstanding MWRA's success in carrying out this comprehensive infrastructure improvement effort, there remain system infrastructure challenges that the Master Plan recommends be addressed over the next 40 years. The major challenges not yet addressed in the CIP, and staff's assessment of the cost and timing of addressing them, are as follows:

- Providing transmission redundancy in the eastern part of the system from Shaft 5 east to Chestnut Hill and in the western part of the system for the Cosgrove Tunnel, $203.5 million, FY11-23,

- Addressing important distribution system redundancy problems areas in the Northern Intermediate High and Southern Extra High systems, including the need for redundant piping, additional storage and, in the NIH, a back-up station for the Gillis Pump Station at Spot Pond. Other redundancy improvements include the Chestnut Hill Connecting Mains project, and the Section 75 Extension. These projects also improve operational flexibility by permitting other assets to be taken off-line for rehabilitation. $105 million, FY07-24.

- Adding storage capacity in the Low Service service area at Spot Pond to further advance toward MWRA's goal for system storage under emergency conditions, $36 million, FY09-18.

- Continuing to systematically line approximately 51 additional miles of old cast-iron MWRA pipeline to address potential water quality degradation concerns and related health risks in light of MWRA customer expectations and EPA's anticipated direction for distribution system regulation, and continuing to replace/rehabilitate 16 miles of steel pipes prone to corrosion and susceptible to leaks, $140 million, FY09-48.

- Continuing to help member communities rehabilitate their own old cast-iron mains (2,300+ miles of community pipes are unlined) and replace lead services in light of potential impact on water quality at the tap, allocating Local Financial Assistance Program loan repayments to extend community funding similar to a revolving loan fund. $125 million in new interest-free loans, FY14-23.

- Ensuring system security by continued physical hardening of facilities, replacing surveillance equipment as needed or as technological advances support, and tracking developments in real time water quality monitoring. Water supply redundancy and storage projects provide operational flexibility and enhance system security.

- Systematically addressing the long-term need to protect and eventually replace other MWRA's water system assets, including equipment, facilities, dams, and support systems, $177 million, FY08-48.

All water projects recommended in the Master Plan are listed in Attachment 2-B.

Master Plan findings and recommendations for water priority projects during the FY07-18 timeframe are summarized below. In its briefings to the Board of Directors and other parties, staff focused on the FY07-18 (12-year) timeframe because it relates directly to the current and upcoming CIP cycles, and because estimates of project costs and timeframes are more reliable than in the out-years. The Master Plan identifies $433 million in water system needs in this period for which funds are not currently included in the CIP. Adding these unmet project needs to the $438 million in water projects currently included in the Final FY07 CIP results in a total water system capital needs assessment of $871 million in FY07-FY18.

Staff anticipate that the Board will set a CIP spending cap for the FY09-13 period as part of the FY08 CIP process. Total water needs identified for FY09-13 are approximately $382 million, including $122 million in new projects and $260 million in projects currently programmed in the CIP.

All projects have been prioritized on a scale from 1 to 5, with 1 being projects considered critical and 5 considered 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 fix existing reliability problems related to single points of failure, address facilities in poor condition where the ability to provide uninterrupted service or adequate flow is compromised, and meet basic hydraulic performance requirements, including adequate distribution storage. Lower priority projects will maintain infrastructure integrity and maintain efforts to manage system demands. Project ratings were assigned by MWRA senior managers in concert with Planning and Coordination Department staff. All MWRA projects (water, sewer, and business support) will be further prioritized during the FY08 CIP development process.

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 earlier, shortfalls in redundancy remain which the Master Plan recommends be addressed.

The Master Plan process has also considered the needs of over 75 facilities that are part of the transmission system. Inspections of key facilities and top-of-shaft structures were recently completed, and reports on condition assessment, recommendations and costs are being developed. Improvements to halt any ongoing deterioration and ensure safe and secure facility operation may be the short-term course of action for many of the buildings, with the study serving as the blueprint for the requirements to fully bring the asset up to its original condition, if desired, over a longer time frame.

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. Based on fall 2005 inspections, several major categories of work were identified, some of which are recommended by the Master Plan for inclusion in the CIP.

In the near-term, the Master Plan identifies approximately $276 million in transmission system project needs for the FY07-18 timeframe, including all projects currently in the FY07 CIP.

Treatment Plants

The Master Plan recommends $73 million in treatment plant projects in the FY07-18 timeframe, including $62 million in projects already in the FY07 CIP and $11 million in additional recommended spending for consideration in the FY08 CIP process.

The Metropolitan System

The Metropolitan System consists of 284 miles of distribution pipeline east of Shaft 5, eleven storage tanks, eleven pump stations, nine tunnel shafts, and approximately 4700 valves. The system is divided into 7 pressure zones.

As noted earlier, there is a need to address important distribution system pipeline redundancy problems areas in the Northern Intermediate High (NIH), Southern Extra High (SEH), and the WASM 3 service areas and, more generally, in service areas with single spine mains. The NIH and SEH also have shortfalls in shortage, as does the Southern High System. The Blue Hills Covered Storage project will address the shortfall in the Southern High service area. An additional 20 mg of storage is also proposed for the Northern Low service area (near Spot Pond). The distribution system network has approximately 100 miles of unlined cast-iron pipe, posing water quality concerns, and 47 miles of steel pipe, prone to corrosion and susceptible to leaks; both are recommended for continued focus over the long-term, as are valve replacements. Over half of MWRA member communities' water systems have more than 40 percent of their pipes unlined. The second phase of MWRA pump station replacement and modernization will be completed by FY11, but instrumentation, electrical and mechanical systems will need to be addressed for those stations in phase one. Facility automation and meter system upgrades need to addressed cyclically as well.

Land Acquisition

The FY07 CIP includes a total of $19 million to enable DCR to acquire parcels of, or interests in, real estate critical to protection of the watershed and source water quality, FY07-12.

Community Financial Assistance – Local Pipeline Assistance Program

This program makes $25 million in loans available annually to MWRA communities for pipeline relining and replacement in proportion to each community's share of total unlined pipe miles. Communities are required to pay back principal for each year's loan during a ten-year period beginning one year after project funding is approved. The Master Plan recommends allocating Local Financial Assistance Program loan repayments to extend community funding similar to a revolving fund. Currently $255.5 million has been approved by the Board of Directors to date, of which $119 million has been distributed to communities for 147 projects. Staff recommends that $125 million in loan repayments be made available to communities for additional Local Pipeline Assistance Program loans in the FY14-23 timeframe.

Attachment 1

2006 Wastewater

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

Attachment 2A

Wastewater Master Plan

Existing and Future Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT											
		Plant Optimization Program											
6.1	1	As-Needed Design Phases 4-1 & 4-2	Opti	in	2 years	1,134	now-FY07	1,134					1,134
6.2	1	As-Needed Design Phases 5-1 & 5-2	Opti	in	2 years	1,800	FY07-09	1,050	750				1,800
6.3	1	Long-Term As-Needed Design 1 & 2	Opti	in	4 years	3,200	FY09-13		3,200				3,200
6.4	1	Ancillary Modifications Design (ESDC/REI) and Construction 2-2	Opti	in	4 years	3,574	now-FY08	3,574					3,574
6.5	2	Ancillary Modifications Preliminary Design, Final Design, and Construction 4	Opti	in	5 years	4,783	FY08-12	360	4,423				4,783
		SUBTOTAL - Deer Island Plant Optimization				**14,491**		**6,118**	**8,373**				**14,491**
		Asset Protection Program - *Equipment Replacement Category:*											
6.6	1	Equipment Replacement Project	AP	in	N/A	18,653	now-FY16	300	4,900	13,453			18,653
6.7	1	Primary Clarifier Rehab Construction	AP	in	3 years	6,041	FY09-11		6,041				6,041
6.8	2	Cathodic Protection Evaluation	AP	in	2 years	250	FY09-10		250				250
6.9	3	Pump Packing Replacement	AP	in	2 years	200	FY07-08	200					200
6.10	2	LOCAT Scrubber Replacement Construction	AP	in	1 year	3,008	FY09-10		3,008				3,008
6.11	3	Grit Blower Replacement Construction	AP	in	1 year	335	FY08-09		335				335
6.12	2	Thickened Primary Sludge Pump Replacement	AP	in	3 years	5,789	FY08-11	210	5,579				5,789
6.13	1	Centrifuge Back-drive Replacements	AP	in	2 years	2,161	FY08-09	900	1,261				2,161
		CATEGORY SUBTOTAL				**36,437**		**1,610**	**21,374**	**13,453**	**0**	**0**	**36,437**
		Asset Protection Program - *Architectural Category:*											
6.14	3	Study/Concept Design- Concrete Repairs	AP	in	1 year	300	FY07-08	300					300
6.15	1	Expansion Joint Repairs 2 & 3	AP	in	6 months ea.	312	FY07-10	156	156				312
		CATEGORY SUBTOTAL				**612**		**456**	**156**	**0**	**0**	**0**	**612**

Wastewater Master Plan

Existing and Future Projects

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Prioritization		Project Types		FY07 CIP Notes	
1	Critical	NF	New Facility/System	in	included in FY07 CIP (bold)
2	Essential	RF/IC	Replacement Facility/Increase Capacity	new	new project, not previously in CIP
3	Necessary	Opti	Optimization	prev	included in prior CIP, but deleted
4	Important	AP	Asset Protection		
5	Desirable	Plan	Planning/Study		

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		Asset Protection Program - *Utilities Category:*											
6.16	1	Electrical Equipment Upgrades 2, 3, 4	AP	in	avg. 2 years	7,757	now–FY11	3,610	4,147				7,757
6.17	1	VFD Replacements (NMPS, WTF, Misc.)	AP	in	avg. 2.5 years	11,029	now-FY10	3,214	7,815				11,029
6.18	1	Power System Improvement Design and Construction	AP	in	4 years	7,905	now-FY10	2,401	5,504				7,905
6.19	1	DI Electrical Modifications	AP	in	1.5 years	2,000	FY07-09	1,777	223				2,000
6.20	1	Switchgear Replacements Design & Construction (Admin/Whse, All other DITP)	AP	in	avg. 1 yr each	4,447	FY08-11	1,009	3,438				4,447
6.21	1	PICS Replacement Construction	AP	in	1 year	1,582	FY10-11		1,582				1,582
6.22	2	Sodium Hypochlorite Pipe Replacement Design & Construction	AP	in	1 year	2,983	FY10-12		2,983				2,983
6.23	3	Pipeline Replacement Design and Constr 2	AP	in	2 years	1,672	FY09-11		1,672				1,672
6.24	1	Heat Loop Pipe Replacement Construction 2	AP	in	0.5 years	1,260	FY07	1,260					1,260
6.25	3	Fuel Transfer Pipe Replacement Design & Construction	AP	in	3 years	1,672	FY12-14		308	1,364			1,672
6.26	1	North Main Pump Station - Motor Control Center Design & Construction	AP	in	3 years	3,704	FY07-10	309	3,395				3,704
6.27	3	Second Deaerator Design and Construction	AP	in	3 years	353	FY08-10	12	341				353
		CATEGORY SUBTOTAL				**46,364**		**13,592**	**31,408**	**1,364**	**0**	**0**	**46,364**
		Asset Protection Program - *Support Category:*											
6.28	4	DISC Application	AP	in	2 years	125	FY07-08	125					125
6.29	3	Document Format Conversion	AP	in	5 years	353	FY07-12	116	237				353
		CATEGORY SUBTOTAL				**478**		**241**	**237**	**0**	**0**	**0**	**478**
		Asset Protection Program - *Specialties Category:*											
6.30	1	Primary Clarifier & Gravity Thickener Rehab - Design	AP	in	4 years	1,200	FY07-11	600	600				1,200
6.31	4	Gravity Thickener Improvements - Construction	AP	in	1 year	2,014	FY09		2,014				2,014
6.32	1	Sodium Hypochlorite Tank Liner Removal & Repair	AP	in	1 year	552	FY07	552					552
6.33	3	Metals Lab Fume Hood Replacement	AP	in	1 year	134	FY07-08	134					134
6.34	3	Metals Lab Modification Construction	AP	in	2 years	919	FY07-08	919					919
6.35	5	Lab Sample Area Modifications Design and Construction	AP	in	3 years	552	FY08-10	55	497				552

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
6.36	1	Clinton Soda Ash Replacement	AP	in	1 year	288	FY07-08	288					288
6.37	2	Clinton Permanent Standby Generator	AP	in	1 year	259	FY07-08	259					259
		CATEGORY SUBTOTAL				**5,918**		**2,807**	**3,111**	**0**	**0**	**0**	**5,918**
		SUBTOTAL - Deer Island Asset Protection				**89,809**		**18,706**	**56,286**	**14,817**	**0**	**0**	**89,809**
		SUBTOTAL - Existing Projects - Deer Island				**104,300**		**24,824**	**64,659**	**14,817**	**0**	**0**	**104,300**
		RECOMMENDED PROJECTS - DEER ISLAND											
6.38	1	As-Needed Technical Design $200k for FY13, $750K annually	AP	new	Annual	26,450	Annually beginning FY13		200	3,750	7,500	15,000	26,450
6.39	2	Equipment Replacement Project	AP	new	Annual $2M expense	70,000	FY11-12, then yearly FY16-48		4,000	6,000	20,000	40,000	70,000
6.40	1	Future SSPS VFD Replacements, $6M each	AP	new	3 years	24,000	FY16, 26, 36, 46			6,000	6,000	12,000	24,000
6.41	2	SSPS Pump Lube System Replacement	AP	new	2 years	1,700	FY08-09	700	1,000				1,700
6.42	3	Future SSPS shaft &/or Motor Replacements ($1.5M each)	AP	new	2 years	4,500	FY14, 29, 44			1,500		3,000	4,500
6.43	1	Future NMPS VFD Replacements, $6.5M each	AP	new	3 years	22,100	FY18, 28, 38, 48			2,600	6,500	13,000	22,100
6.44	1	North Main Pump Sta. Motor Control Ctr. Design & Constr. ($3.5M each)	AP	new	3 years	7,000	FY28, 48				3,500	3,500	7,000
6.45	3	Future NMPS shaft &/or Motor Replacements ($2.2M each)	AP	new	2 years	6,600	FY15, 30, 45			2,200		4,400	6,600
6.46	5	Enterprise Engine Removal	AP	new	1 year	600	FY14			600			600
6.47	1	Future WTF VFD Replacements, $1.4M each	AP	new	1 year	4,200	FY19, 29, 39				1,400	2,800	4,200
6.48	3	Future WTF shaft &/or Motor Replacements ($800k each)	AP	new	2 years	2,400	FY16, 31, 46			800		1,600	2,400
6.49	1	Cryogenics Plant Equipment Replacement - valves, instruments, etc. ($2M each time)	AP	new	1 year	8,000	FY14, 24, 34, 44			2,000	2,000	4,000	8,000
6.50	2	Cryogenics Plant – Cooling Towers & Related Equipment Replacement ($450k each time)	AP	new	1 year	900	FY19, 29				450	450	900
6.51	3	Secondary Clarifier Rehabs ($4M each time)	AP	new	2 years	12,000	FY14, 29, 44			4,000		8,000	12,000
6.52	1	Secondary Clarifier Drive Chain ($250k each time)	AP	new	1 year	750	FY19, 29, 39				250	500	750
6.53	1	Sodium Hypochlorite Tank Rehabs ($625k/tank). Includes tank 3 emergency repair in FY07/08	AP	new	3 years	11,875	FY07-09; 17, 27, 37, 47	625	1,250	2,500	2,500	5,000	11,875
6.54	4	Sodium Bisulfite Tank Rehabs ($500k/tank)	AP	new	3 years	3,000	FY15, 30, 45			1,000		2,000	3,000
6.55	2	Barge Berth and/or Pier Facilities Rehab ($1M each time)	AP	new	1 year	2,000	FY11, 31, 51		1,000			1,000	2,000
6.56	4	DI Outfall Modifications Construction/REI	AP	prev	2 years	1,550	FY14-15, 25, 35, 45			1,100	150	300	1,550
6.57	1	Centrifuge Replacements (cost is $1.3M per centrifuge; replace 4 every 10 years).	AP	new	1 year	20,800	FY14, 24, 34, 44			5,200	5,200	10,400	20,800
6.58	1	Digested Sludge Pump Replacements (to FRSA)	AP	new	1 year	4,000	FY10, 30		2,000			2,000	4,000
6.59	1	Dystor Tank Membrane Replacements ($750k for both tanks)	AP	new	1 year	3,000	FY15, 25, 35, 45			750	750	1,500	3,000

Wastewater Master Plan

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								2 years	5 years	5 years	10 years	20 years	
6.60	5	DI Cross-Harbor Cable Dredging Construction	AP	new	1 year	20,000	FY09-10		20,000				20,000
6.61	1	Heat Loop Pipe Replacement Construction phase 3 ($1.6M FY08-09, then $75 every 8 yrs)	AP	new	1 year	1,900	FY08/09; FY17, 25, 33, 41	800	800	75	75	150	1,900
6.62	1	CTG Rebuilds ($2M each time)	AP	new	2 years	6,000	FY15, 30, 45			2,000		4,000	6,000
6.63	3	Replace STG at Deer Island	Opti	new	2 years	3,500	FY11-13		3,500				3,500
6.64	5	DI Wind Power	Plan	prev	1 year	150	FY08	150					150
6.65	5	DI Wind Power Construction	NF	prev	1 year	1,200	FY10		1,200				1,200
6.66	1	Future Misc. VFD Replacements, $2M each	AP	new	3 years	6,667	FY18, 28, 38, 48			667	2,000	4,000	6,667
6.67	1	Electrical Equipment Upgrades Phase 5 and up ($2M for FY11 & 12, then $500k per yr)	AP	new	2 years	20,000	FY11-48		2,500	2,500	5,000	10,000	20,000
6.68	1	Switchgear Replacements Design & Construction (all DITP areas - $5M each)	AP	new	4 years	16,250	FY18, 28, 38, 48			1,250	5,000	10,000	16,250
6.69	3	DI Grit & Odor Ctrl Air Handler Replacements	AP	new	2 years	3,000	FY09, 24, 39		1,000		1,000	1,000	3,000
6.70	2	Pipeline Replacement/Upgrades	AP	new	1 year	500	FY26, 41				250	250	500
6.71	2	PICS Distributed Processing Units (DPU) Replacements ($4M each time)	AP	new	2 years	8,000	FY15, 35			4,000		4,000	8,000
6.72	1	PICS Replacement Construction ($1.8M each)	AP	new	1 year	5,400	FY15, 30, 45			1,800		3,600	5,400
6.73	2	HVAC Control System	AP	new	1 year	3,000	FY10, 25, 40		1,000		1,000	1,000	3,000
6.74	3	HVAC Fan Coil Replacement ($1M each)	AP	new	2 years	3,000	FY09, 24, 39		1,000		1,000	1,000	3,000
6.75	2	Fire Alarm System	AP	new	1 year	5,100	FY10, 25, 40		1,700		1,700	1,700	5,100
6.76	2	Leak Protection System Upgrade ($300k each)	AP	new	1 year	900	FY11, 26, 41		300		300	300	900
6.77	4	DI Eastern Seawall Repairs Design & Construction	AP	prev	2 years	1,700	FY11-13		1,700				1,700
6.78	3	DI Seawall Refurbishment Design/Construction	AP	new	2 years	3,500	FY11, 23, 35, 47		500		1,000	2,000	3,500
6.79	5	DI Personnel Dock Rehab Construction	AP	prev/new	1 year	4,000	FY10, 22, 34, 46		1,000		1,000	2,000	4,000
6.80	4	Cathodic Protection Testing	AP	new	FY08	120	FY08	120					120
		SUBTOTAL - Recommended - Deer Island				351,312		2,395	45,650	52,292	75,525	175,450	351,312
		SUBTOTAL - Existing and Recommended - Deer Island				455,612		27,219	110,309	67,109	75,525	175,450	455,612
		RESIDUALS											
7.1	1	Residuals Plant Electric System Reliability Design/Construct	AP	new	1 year	620	FY08	620					620
7.2	2	FRSA Pier Rehabilitation	AP	new	2 years	700	FY08-09	350	350				700
7.3	1	Residuals Condition Assessment and Facilities Plan	Plan	new	2 years	1,000	FY09-10		1,000				1,000
7.4	1	Residual Upgrades - Design & Constr Services (50% of cost for design, 50% is for ESDC/REI)	AP	new	Des FY11-12, Cons FY14-18	8,000	Des FY11-12, Cons FY14-18		4,000	4,000			8,000
7.5	1	6 Rotary Dryer Replacements	AP	new	3 years	60,000	FY14, 29, 44			20,000		40,000	60,000
7.6	2	12 Centrifuge Replacements (avg. 18 yr life)	AP	new	2 years	36,000	FY15, 33			18,000		18,000	36,000
7.7	2	Pumping Systems Upgrade	AP	new	2 years	6,000	FY15, 30, 45			2,000		4,000	6,000

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								2 years	5 years	5 years	10 years	20 years	
7.8	2	Sludge Feed Conveyor Replacements	AP	new	1 year	3,000	FY15, 30, 45			1,000		2,000	3,000
7.9	2	Sludge Storage Tank Rehabilitation	AP	new	1 year	3,000	FY16, 31, 46			1,000		2,000	3,000
7.10	1	6 Air Scrubber Replacements	AP	new	2 years	9,000	FY16, 31, 46			3,000		6,000	9,000
7.11	2	Replace 9 Pellet Storage Silos	AP	new	2 years	6,000	FY16, 31, 46			2,000		4,000	6,000
7.12	1	Plant MCC Replacements	AP	new	2 years	4,500	FY17, 32, 47			1,500		3,000	4,500
7.13	2	Rail System Rehabilitation	AP	new	2 years	3,000	FY17, 32, 47			1,000		2,000	3,000
7.14	2	Utility Upgrades	AP	new	2 years	6,000	FY17, 32, 47			2,000		4,000	6,000
7.15	3	Polymer System Upgrade	AP	new	1 year	3,000	FY17, 32, 47			1,000		2,000	3,000
7.16	3	Thermal Oxidizer Rehabilitation (avg. 18 yr life)	AP	new	3 years	24,000	FY17, 35			12,000		12,000	24,000
7.17	3	Building Envelope Rehabilitation	AP	new	2 years	5,000	FY17, 33, 48			2,000		3,000	5,000
7.18	2	Odor Control System Rehabilitation	AP	new	1 year	1,500	FY18, 33, 48			500		1,000	1,500
		SUBTOTAL - Recommended - Residuals				180,320		970	5,350	71,000	0	103,000	180,320
		REMOTE HEADWORKS AND CROSS-HARBOR TUNNELS											
8.1	1	HW Condition Assessment and Facility Plan for 3 Older Remote Headworks	AP	in S10399	2 years	2,000	FY07-08	2,000					2,000
8.2	1	HW Screen Replacement for 3 Older Remote Headworks	AP	in S10387	3 years	5,000	FY09-12		5,000				5,000
		SUBTOTAL - Existing - Headworks and Tunnels				7,000		2,000	5,000				7,000

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								2 years	5 years	5 years	10 years	20 years	
8.3	1	HW Facility Plan Upgrades for 3 Older Remote Headworks	AP	new	20 years	35,000	FY09-28		10,000	15,000	10,000		35,000
8.4	3	Nut Island HW Fire Alarm & Wiring Conduit Replacement	AP	prev	1 year	200	FY09-13		200				200
8.5	3	Nut Island HW Mechanical Systems	AP	new	3 years	3,800	FY09-13		3,800				3,800
8.6	4	Nut Island Pier Rehabilitation Plan/Design/Construction	AP	new	2 years	500	FY14-18			500			500
8.7	3	Nut Island HW Future Equipment Replacement	AP	new	10 years	30,000	FY19-28				30,000		30,000
8.8	1	Cross-Harbor Tunnel Inspection/Assessment	Plan	prev	1 year	3,000	FY09-13		3,000				3,000
8.9	2	Cross-Harbor Tunnel Shaft Repairs Plan/Design/Construction	AP	new	3 years	5,000	FY14-18			5,000			5,000
		SUBTOTAL - Recommended - Headworks and Tunnels				77,500			17,000	20,500	40,000		77,500
		SUBTOTAL - Existing and Recommended - Headworks and Tunnels				84,500		2,000	22,000	20,500	40,000		84,500
		COLLECTION SYSTEM SEWERS											
9.1	1	Interceptor AP - existing Arlington Sections 80/83 Rehab	AP	in S145	2 years	578	now-FY08	578					578
9.2	1	Interceptor AP - existing Winchester/Medford Section 160 Rehab	AP	in S145	3 years	3,389	now-FY09	2,344	1,045				3,389
9.3	1	Cummingsville Replacement Sewer	RF/IC	in S127	2 years	2,041	now-FY08	2,041					2,041
9.4	1	Upper Neponset Valley Relief Sewer	RF/IC	in S131	3 years	36,377	now-FY09	35,825	552				36,377
9.5	3	Wastewater Process Opti/Somerville Sewer Connection Design/Construct	Opti/IC	in S141	4 years	1,136	FY09-12		1,136				1,136
9.6	2	Wastewater Process Opti/Cambridge Branch Sewer/DeLauri Siphon Plan	Plan	in S141	2 years	150	FY12-13		150				150
9.7	2	Outfall 023 Structural Improvements	AP	in S139	3 years	1,500	FY08-10	800	700				1,500
		SUBTOTAL - Existing - Sewers				45,171		41,588	3,583				45,171
9.8	2	Interceptor AP - interceptor renewal #1 Charlestown/Dorchester Sections 31/32/240/242	AP	new	3 years	2,000	FY09-13		2,000				2,000
9.9	2	Interceptor AP - interceptor renewal #2 Brighton Sections 163/164	AP	new	3 years	5,000	FY09-13		5,000				5,000
9.10	2	Interceptor AP - interceptor renewal # 3 Cambridge/Somerville Sections 26/27	AP	new	3 years	5,000	FY09-13		5,000				5,000
9.11	2	Interceptor AP - interceptor renewal #4 Everett Sections 23/24/156	AP	new	3 years	3,000	FY14-18			3,000			3,000
9.12	2	Interceptor AP - interceptor renewal #5 Milton Sections 607/609/610	AP	new	3 years	4,000	FY14-18			4,000			4,000
9.13	2	Interceptor AP - interceptor renewal #6 Chelsea Sections 12/14/15/62	AP	new	3 years	7,000	FY14-18			7,000			7,000

Wastewater Master Plan

Existing and Future Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
9.14	2	Interceptor AP - interceptor renewal #7 Malden/Melrose Sections 41/42/49/54/65	AP	new	4 years	10,000	FY14-18			10,000			10,000
9.15	3	Interceptor AP -interceptor renewal #8 Cambridge Section 30	AP	new	3 years	2,000	FY19-28				2,000		2,000
9.16	3	Interceptor AP - interceptor renewal #9 Winchester/Woburn/Stoneham Sections 46/47/73/74/75/153	AP	new	4 years	9,000	FY19-28				9,000		9,000
9.17	3	Interceptor AP - interceptor renewal #10 Arlington/Medford Sections 21/52/53/78/79/111/112/189	AP	new	5 years	24,000	FY19-28				24,000		24,000
9.18	3	Interceptor AP - interceptor renewal #11 Dedham/Hyde Park Sections 516/521/522/523/524	AP	new	3 years	7,000	FY19-28				7,000		7,000
9.19	3	Interceptor AP - interceptor renewal #12 Norwood Section 618	AP	new	3 years	1,000	FY19-28				1,000		1,000
9.20	3	Interceptor AP - interceptor renewal #13 Future @ $5 mil/year	AP	new	annual	100,000	FY29-48					100,000	100,000
9.21	1	B/W Rehabilitation of Section 624 Construction	AP	prev	3 years	5,000	FY09-11		5,000				5,000
9.22	3	FES/FERS Corrosion and Odor Control (biofilters) Design/Construct	AP	prev	5 years	5,000	FY09-13		5,000				5,000
9.23	3	Wellesley Extension Replacement Sewer Rehab Design/Construction/CS/RI	AP	prev	9 years	24,000	FY14-22			15,000	9,000		24,000
9.24	2	FES Tunnel Rehab Design/Construct	AP	prev	2 years	8,500	FY14-18			8,500			8,500
9.25	2	Odor Control Study (systemwide)	Plan	new	3 years	1,000	FY09-13		1,000				1,000
9.26	1	West Roxbury Tunnel Corrosion Rehab	AP	prev	8 years	80,000	FY11-18		5,000	75,000			80,000
9.27	3	Randolph Trunk Sewer Relief Study	Plan	new	2 years	750	FY08-09	250	500				750
9.28	3	Cambridge Branch Sewer/DeLauri Siphon Design/Construct	IC/Opti	prev	5 years	23,000	FY19-28				23,000		23,000
9.29	4	Neponset Valley Relief Sewer Plan/Design/Construct	RF/IC	prev	10 years	12,000	FY19-28				12,000		12,000
9.30	5	Ashland Extension Sewer Planning/Design	Plan/NF	prev	2 years	1,000	FY19-28				1,000		1,000
9.31	5	North System Hydraulic Capacity Study	Plan	new	2 years	200	FY09-13		200				200
9.32	4	Manhole Rehabilitation @ $100k/year	AP	new	annual	4,000	FY09-FY48		500	500	1,000	2,000	4,000
9.33	4	Woburn Sandcatcher Construction	AP/Opti	new	1 year	1,000	FY09-13		1,000				1,000
9.34	4	Force Main Asset Protection	AP	new	5 years	5,000	FY19-28				5,000		5,000
9.35	3	New Sonar Inspection Equipment	NF	new	1 year	130	FY09-13		130				130
9.36	4	Siphon Asset Protection	AP	new	5 years	5,000	FY19-28				5,000		5,000
9.37	4	B/W Sliplining of Section 652 Fore River Siphon Design/Construction	AP/Opti	prev	2 years	7,000	FY19-28				7,000		7,000
9.38	2	Siphon Structure Rehab Design/Construct	AP	prev	8 years	8,000	FY09-16		5,000	3,000			8,000
9.39	4	Outfall Asset Protection	AP	new	2 years	800	FY19-28				800		800
		SUBTOTAL - Recommended - Sewers				370,380		250	35,330	126,000	106,800	102,000	370,380
		SUBTOTAL - Existing and Recommended - Sewers				415,551		41,838	38,913	126,000	106,800	102,000	415,551

Wastewater Master Plan

Existing and Future Projects

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Prioritization		**Project Types**		**FY07 CIP Notes**	
1	Critical	NF	New Facility/System	in	included in FY07 CIP (bold)
2	Essential	RF/IC	Replacement Facility/Increase Capacity	new	new project, not previously in CIP
3	Necessary	Opti	Optimization	prev	included in prior CIP, but deleted
4	Important	AP	Asset Protection		
5	Desirable	Plan	Planning/Study		

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		WASTEWATER PUMP STATIONS AND CSO FACILITIES											
10.1	1	B/W Relief Facility Completion	NF	in S104	2 years	13,745	now-FY08	13,745					13,745
10.2	1	PS and CSO Facility AP - existing projects at 7 facilities - Alewife Brook, Caruso, Chelsea Screen House, Cottage Farm, Framingham, Hingham, and Prison Point	AP	in S145	5 years	3,705	now-FY11	976	2,729				3,705
		SUBTOTAL - Existing - Pump Stations and CSO Facilities				**17,450**		**14,721**	**2,729**				**17,450**
10.3	2	Alewife PS Improvements-Additional Costs to Existing AP Project	AP	new	2 years	2,000	FY09-13		2,000				2,000
10.4	2	Chelsea Screen House Sluice Gate Rehabilitation Design/Construct	AP	new	3 years	500	FY09-18		100	400			500
10.5	3	Framingham PS -Force Main Corrosion and Odor Improvements	NF/AP	new	3 years	1,500	FY09-13		1,500				1,500
10.6	2	Framingham PS Sluice Gate Replacement Design/Construct	AP	new	2 years	500	FY09-13		500				500
10.7	3	Framingham PS Screening Automation Study/Design/Construct	Plan/NF	new	3 years	150	FY09-18		50	100			150
10.8	2	PS and CSO Condition Assessment/Facilities Plan for 10 Older Facilities	Plan	new	3 years	3,000	FY10-12		3,000				3,000
10.9	3	PS and CSO Condition Assessment Facilities Plan Upgrades for 10 Older Facilities Design/Construct	AP	new	10 years	120,000	FY14-23			60,000	60,000		120,000
10.10	3	Long-term Wastewater Facility Asset Protection (for HW, PS & CSO Facilities) $2.0M per year for FY11-13, $3.5M per year for FY14-48	AP	new	annual	128,500	FY11-48		6,000	17,500	35,000	70,000	128,500
10.11	4	PS and CSO Future Plan/Upgrades for 8 Newer Facilities	AP	new	20 years	70,000	FY29-48					70,000	70,000
		SUBTOTAL - Recommended - Pump Stations and CSO Facilities				326,150			13,150	78,000	95,000	140,000	326,150
		SUBTOTAL - Existing and Recommended - Pump Stations and CSO Facilities				343,600		14,721	15,879	78,000	95,000	140,000	343,600

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Existing and Future Projects

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Prioritization

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		CSO CONTROL PLAN (MWRA managed projects)											
11.1	1	North Dorchester Bay	NF	in S339	6 years	218,042	FY07-12	103,646	114,396				218,042
11.2	1	East Boston Branch Sewer Relief	RF/IC	in S347	5 years	63,033	FY07-11	4,104	58,929				63,033
11.3	1	BOS019 CSO Storage Conduit	NF	in S348	2 years	5,832	FY07-08	5,832					5,832
11.4	1	Union Park Detention/Treatment Facility	NF	in S350	2 years	4,695	FY07-08	4,695					4,695
11.5	1	MWRA003 Gate & Siphon	NF/IC	in S355	5 years	1,960	FY09-13		1,960				1,960
11.6	1	Charles River CSO Controls	Opti	in S357	6 years	6,000	FY07-12	850	5,150				6,000
11.7	1	CSO Support	Plan	in S324	15 years	12,709	FY07-21	6,924	5,347	195	243		12,709
		SUBTOTAL - CSO Control Plan (MWRA Managed)				**312,271**		**126,051**	**185,782**	**195**	**243**		**312,271**
		CSO CONTROL PLAN (Community managed projects)											
11.8	1	Dorchester Sewer Separation (Fox Point)	NF	in S340	4 years	1,899	FY07-10	1,568	331				1,899
11.9	1	Dorchester Sewer Separation (Commercial Point)	NF	in S341	4 years	13,457	FY07-10	9,143	4,314				13,457
11.10	1	Stony Brook Sewer Separation	NF	in S344	1 year	3,120	FY07	3,120					3,120
11.11	1	Cambridge 02-04 Sewer Separation (Alewife)	NF	in S346	8 years	33,235	FY07-14	4,021	29,202	12			33,235
11.12	1	Cambridge Floatables Control	NF	in S352	3 years	1,869	FY07-09	1,625	244				1,869
11.13	1	Fort Point Channel Sewer Separation	NF	in S356	2 years	5,534	FY07-08	5,534					5,534
11.14	1	Morrissey Boulevard Drain	NF	in S358	4 years	19,015	FY07-10	11,575	7,440				19,015
11.15	1	Reserved Channel Sewer Separation	NF	in S359	11 years	57,393	FY07-17	3,035	34,426	19,932			57,393
11.16	1	Brookline Sewer Separation	NF	in S360	9 years	9,000	FY07-15	400	8,145	455			9,000
11.17	1	Bulfinch Triangle Sewer Separation	NF	in S361	9 years	4,000	FY07-15	225	3,600	175			4,000
		SUBTOTAL - CSO Control Plan (Community Managed)				**148,522**		**40,246**	**87,702**	**20,574**			**148,522**
		SUBTOTAL - CSO Control Plan (All Projects)				**460,793**		**166,297**	**273,484**	**20,769**	**243**	**0**	**460,793**
		SCADA & WASTEWATER METERING											
12.1	1	Wastewater Central Monitoring/SCADA	AP/Opti	in S137	3 years	15,873	FY07-09	15,246	627				15,873
12.2	1	Wastewater Metering System Equipment Replacement	RF	in S142	phase 2 - 3 years	1,587	now-FY16	265	122	1,200			1,587
		SUBTOTAL - Existing - SCADA and Metering				**17,460**		**15,511**	**749**	**1,200**			**17,460**

Wastewater Master Plan

Existing and Future Projects

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Prioritization

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FY07 CIP Notes

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
12.3	2	Wastewater SCADA Related PC Upgrades, $50k every 5 years	AP	new	1 year	400	FY09-48		50	50	100	200	400
12.4	3	Wastewater SCADA Equipment (PLC) Replacement/Upgrade	AP	new	3 years	5,000	FY19-48				2,000	3,000	5,000
12.5	3	Wastewater Data Radio Replacement	AP	new	3 years	100	FY19-48				50	50	100
12.6	2	Wastewater Metering System Asset Protection Plan/Design/Construct $5M every 10 years	AP	new	3 years	20,000	FY14-48			5,000	5,000	10,000	20,000
		SUBTOTAL - Recommended - SCADA and Metering				25,500			50	5,050	7,150	13,250	25,500
		SUBTOTAL - Existing and Recommended - SCADA and Metering				42,960		15,511	799	6,250	7,150	13,250	42,960
		CLINTON WASTEWATER TREATMENT PLANT											
14.1	1	Clinton Soda Ash Replacement	AP	in S19302	1 year	0	FY08	0*					0
14.2	2	Clinton Permanent Standby Generator	AP	in S19308	0.3 years	0	FY08	0*					0
		SUBTOTAL - Existing - Clinton				**0**		**0**					**0**
14.3	3	Long-term Asset Protection @ $300k/yr for FY14-48	AP	new	annual	10,500	FY14-48			1,500	3,000	6,000	10,500
14.4	3	Landfill Cell #1 Closure Plan/Implementation	AP	new	2 years	200	FY09-13		200				200
14.5	3	Rubber Roofing Rehab	AP	new	1 year	150	FY09-13		150				150
14.6	3	2 Digesters - Internal Inspection Cleaning & Rehab	AP	new	2 years	350	FY09-13		350				350
14.7	3	Process Water Pumps (4) System Replacement/Rehabilitation	AP	new	2 years	175	FY09-13		175				175
14.8	4	Security Upgrades for Plant/Landfill	NF	new	2 years	100	FY09-13		100				100
14.9	3	Plant Processes Technology Improvements	Opti	new	5 years	3,000	FY14-18			3,000			3,000
14.10	3	Technology Upgrades to Meet Future Regulatory Requirements	NF	new	5 years	2,000	FY14-18			2,000			2,000
14.11	3	Influent (3) and Intermediate (3) Lift Pump Replacement	AP	new	5 years	750	FY14-18			750			750
14.12	4	Repair/Sealing of Plant Roadway	AP	new	1 year	100	FY14-18			100			100
14.13	3	Grit Removal Facilities Rehab/Replacement	AP	new	5 years	700	FY14-18			700			700
14.14	3	Belt Filter Press Replacement	AP	new	5 years	1,500	FY14-18			1,500			1,500
14.15	4	Landfill Expansion - Fourth Cell	NF	new	5 years	1,000	FY19-28				1,000		1,000
14.16	4	Secondary Clariflocculator - Fourth Tank	NF	new	5 years	1,000	FY19-28				1,000		1,000
14.17	4	UV Disinfection System	NF	new	5 years	3,000	FY19-28				3,000		3,000
		SUBTOTAL - Recommended - Clinton				24,525		0	975	9,550	8,000	6,000	24,525
		SUBTOTAL - Existing and Recommended - Clinton				24,525		0	975	9,550	8,000	6,000	24,525

Wastewater Master Plan

Existing and Future Projects

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		COMMUNITY-OWNED SYSTEMS/COMMUNITY SUPPORT - SEWER											
15.1	3	I/I Financial Assistance (phases 1-6)	AP	in S128	14 years	14,000	now-FY20	3,600	15,000	(1,100)	(3,500)		14,000
		SUBTOTAL - Existing - Community Support				**14,000**		**3,600**	**15,000**	**(1,100)**	**(3,500)**		**14,000**
15.2	3	I/I Financial Assistance (phase7) $18 mil grants/$22 mil loans	AP	new	13 years	18,000	FY12-24		3,000	10,000	5,000		18,000
15.3	3	I/I Financial Assistance (phase 8) $18 mil grants/$22 mil loans	AP	new	12 years	18,000	FY17-28			3,000	15,000		18,000
		SUBTOTAL - Recommended - Community Support				36,000			3,000	13,000	20,000		36,000
		SUBTOTAL - Existing and Recommended - Community Support				50,000		3,600	18,000	11,900	16,500		50,000

		TOTAL - Existing - ALL WASTEWATER				**666,174**		**268,541**	**365,204**	**35,686**	**(3,257)**	**0**	**666,174**
		TOTAL - Recommended - ALL WASTEWATER				**1,391,687**		**3,615**	**120,505**	**375,392**	**352,475**	**539,700**	**1,391,687**
		TOTAL - Existing and Recommended - ALL WASTEWATER				**2,057,861**		**272,156**	**485,709**	**411,078**	**349,218**	**539,700**	**2,057,861**

Attachment 2B

Water Master Plan

Existing and Future Projects

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		WATER QUALITY											
6.1	1	John J. Carroll Water Treatment Plant	NF	in, S542	8 years	56,524	FY07-14	6,972	44,140	5,412			56,524
6.2	1	Quabbin Water Treatment Plant Design/Construct	NF	in, S543	5 years	5,876	FY08-12	235	5,641				5,876
		SUBTOTAL - Existing - Water Quality				62,400		7,207	49,781	5,412			62,400
6.3	2	Carroll Water Treatment Plant Ancillary Modifications 1 & 2	AP	new	3 years	7,600	FY09-11		7,600				**7,600**
6.4	3	Carroll WTP Asset Protection	AP	new	ongoing	50,000	FY16-48			3,000	10,000	37,000	**50,000**
6.5	3	Chicopee Valley WTP Asset Protection	AP	new	3 years	4,000	FY27-29				2,000	2,000	4,000
		SUBTOTAL - Future - Water Quality				61,600		0	7,600	3,000	12,000	39,000	61,600
		SUBTOTAL - Existing and Future - Water Quality				124,000		7,207	57,381	8,412	12,000	39,000	124,000
		TRANSMISSION SYSTEM											
7.1	1	Chicopee Valley Aqued. Redundancy	NF	in, S615		5,199	FY07-08	5,199					5,199
7.2	2	Norumbega Covered Storage	NF	in, S544		1,084	FY07-10	503	581				1,084
7.3	2	MetroWest Tunnel (CP-6)	NF	in, S604		70,995	FY07-13	19,803	51,123	69			70,995
7.4	1	Wachusett Res Spill Impr/Winsor Dam Repairs	AP	in, S620		8,925	FY07-09	6,852	2,073				8,925
7.5	1	Sudbury / Weston Aqueduct Repairs	Plan/AP	in, S617		3,199	FY07-09	3,191	8				3,199
7.6	2	Quabbin Transmission System	Plan/AP	in, S616		1,029	FY07-10	885	144				1,029
7.7	3	Waterworks FAMP Cosgrove Valve Seat Replacement Design/Construct	AP	in, S766		600	FY08-09	75	525				600
7.8	3	Waterworks FAMP Cosgrove Turbine Isolation Design	Opti	in, S766		480	FY16-18			480			480
		SUBTOTAL - Existing - Transmission				**91,511**		**36,508**	**54,454**	**549**			**91,511**

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								2 years	5 years	5 years	10 years	20 years	
7.9	1	Engineering Studies for Dam Risk	Plan	new	1 year	250	FY08	250					250
7.10	2	Immediate Repairs to Dams	AP	new	4 years	4,000	FY09-12		4,000				4,000
7.11	1	Redundancy Study & Tunnel Inspection Feasibility Assessment	Plan	new	2 years	1,500	FY09-10		1,500				1,500
7.12	1	Winsor Power Station (Pipeline Replacement Ph 1) Design/Construct	AP	prev	5 years	5,000	FY09-13		5,000				5,000
7.13	2	Oakdale Station Phase 1A (Electrical) Study/Preliminary Design	AP	new	3 years	3,000	FY10-12		3,000				3,000
7.14	2	Shaft 12 Quabbin Aqueduct Sluice Gate Design/Construct	Opti	new	2 years	2,000	FY10-11		2,000				2,000
7.15	2	Tunnel Inspections (Quabbin, CTE,CT)	AP	new	1 year	2,000	FY11		2,000				2,000
7.16	1	Wachusett Aqueduct Pressurization Design/Construct	Opti	new	8 years	100,000	FY11-18		10,000	90,000			100,000
7.17	3	Waterworks FAMP Roofs	AP	new	20 years	900	FY09-28		300	300	300		900
7.18	3	Quabbin Lookout Tower (electric highline replacement) Design/Construct	AP	new	2 years	500	FY09-10		500				500
7.19	3	Waterworks FAMP Transmission Facilities Construction	AP	new	10 years	9,000	FY10-19		3,000	5,000	1,000		9,000
7.20	1	Long-Term Redundancy	Opti	prev	10 years	100,000	FY14-23			50,000	50,000		100,000
7.21	3	FAMP Masonry Dam Repointing	AP	new	ongoing	3,000	FY14-48			1,000	1,000	1,000	3,000
7.22	3	FAMP Rehabilitation of Earthen Dams	AP	new	ongoing	3,000	FY14-48			1,000	1,000	1,000	3,000
7.23	4	Oakdale Station Rehab Ph 2 Design/Construct	AP	prev	5 years	8,625	FY14-18			8,625			8,625
7.24	3	Waterworks FAMP Cosgrove Turbine Isolation Construction	Opti	new	3 years	1,900	FY18-20			900	1,000		1,900
7.25	4	Winsor Dam Hydroelectric Design/Construct	AP	prev	5 years	1,534	FY09-13		1,534				1,534
		SUBTOTAL - Future - Transmission				246,209		250	32,834	156,825	54,300	2,000	246,209
		SUBTOTAL - Existing and Future - Transmission				337,720		36,758	87,288	157,374	54,300	2,000	337,720

Water Master Plan

Existing and Future Projects

Last revision 01/12/2007

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		METROPOLITAN SYSTEM											
8.1	1	Weston Aqueduct Supply Mains (WASMs)	AP	in, S730	10 years	55,564	FY07-16+	3,241	30,852	21,471			55,564
8.2	1	Chestnut Hill Connecting Mains-6995 Final Design CA/RI	NF	in, S719	6 years	1,404	FY07-12	140	1,264				1,404
8.3	1	NIH Redundancy & Covered Storage	Plan/NF	in, S722	7 years	7,264	FY07-13	824	6,440				7,264
8.4	2	Blue Hills Covered Storage	NF	in, S545	4 years	34,166	FY07-10	18,815	15,351				34,166
8.5	2	Valve Replacement-Ph 6&7, equipment	AP	in, S677	5 years	7,095	FY07-11	3,528	3,567				7,095
8.6	2	Walnut St. Pipeline Rehabilitation	AP	in, S732	3 years	3,303	FY07-09	2,008	1,295				3,303
8.7	2	Heath Hill Road Pipe Replacement	AP	in, S683	3 years	7,394	FY07-09	7,126	268				7,394
8.8	2	Southern Spine Distribution Mains	AP	in, S721	10 years	49,316	FY07-16+	3,462	28,191	17,663			49,316
8.9	2	Rehab of Other Pumping Stations	AP	in, S704	5 years	24,775	FY07-11	12,982	11,793				24,775
8.10	2	James L. Gillis Pump Station Rehab.Final Hazmat	AP	in, S689	2 years	741	FY07-08	741					741
8.11	2	Spot Pond Supply Mains - Rehabilitation	AP	in, S713	4 years	9,885	FY07-10	9,131	754				9,885
8.12	2	New Connecting Mains - Shaft 7 to ..	NF	in, S702	9 years	47,320	FY07-15	8,839	37,513	968			47,320
8.13	2	Lynnfield Pipeline	NF	in, S731	4 years	4,000	FY07- 10	425	3,575				4,000
8.14	2	Nor Extra High Serv - New Pipelines	AP/NF	in, S708	10 years	5,115	FY07-16+	3	33	5,079			5,115
8.15	2/3	Nor Low Service Rehab-- Secs. 8/37/38/97A	AP	in, S723	9 years	17,210	FY07-15	1,200	11,800	4,210			17,210
8.16	3	NHS - Section 27 Improvements - Construction	AP	in, S692	9 years	2,578	FY07-15	2	16	2,560			2,578
8.17	3	NHS - Revere & Malden Pipeline Improvements	AP	in, S693	10 years	8,191	FY07-16	1,674	1,057	5,460			8,191
8.18	3	Waterworks FAMP Walnut Hill Tank Design/Construct	AP	in, S766	2 years	1,300	FY09-12		1,300				1,300
8.19	4	Waterworks FAMPMeter Vault Manhole Retrofits	AP	in, S768	4 years	1,417	FY15-18			1,417			1,417
8.20	5	Cathodic Protection Of Distr.Mains-Install 2,3&4	AP	in, S712	3 years	1,268	FY19-28				1,268		1,268
		SUBTOTAL - Existing - Metropolitan System				**289,306**		**74,141**	**155,069**	**58,828**	**1,268**		**289,306**

Water Master Plan

Existing and Future Projects

Last revision 01/12/2007

Prioritization

1 Critical
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Project Types

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FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
8.21	1	SEH Concept Study/EIR	Plan	new	2 years	1,000	FY07-09	750	250				1,000
8.22	1	NIH Redundant Pipeline Design/Construct	NF	new	5 years	24,000	FY09-13		24,000				24,000
8.23	2	NIH Storage Design/Construct	NF	new	7 years	10,000	FY09-16		7,000	3,000			10,000
8.24	2	SEH - Sections 77/88 Redundancy Design/Construct	NF	new	5 years	25,000	FY11-16		7,000	18,000			25,000
8.25	2	Chestnut Hill Connecting Mains (Final Pipe & Facilities Rehab. Ch 149 & 30)	NF	prev	2 years	5,600	FY10-12		5,600				5,600
8.26	2	NH - Sections 70, 71, and 79 Study and Condition Assessment	Plan	new	2 years	1,000	FY10-12		1,000				1,000
8.27	2	Valve Replacement Phase 8 & 9	AP	new	10 years	6,000	FY09-18		3,000	3,000			6,000
8.28	3	Section 80 Rehabilitation Design/Construct	AP	prev	5 years	7,119	FY10-14		6,000	1,119			7,119
8.29	3	Northern High (sections 70, 71 and 79) Design/Construct	AP	prev	10 years	35,670	FY15-24			15,670	20,000		35,670
8.30	3	Waterworks FAMP Meters- Venturi Tubes	AP	new	10 years	10,000	FY09-18		5,000	5,000			10,000
8.31	2	NIH - section 89/29 Rehabilitation Design/Construct	AP	new	4 years	5,000	FY14-17			5,000			5,000
8.32	2	NIH - Gillis Redundancy	NF	new	5 years	10,000	FY14-18			10,000			10,000
8.33	2	SEH Storage	NF	new	5 years	10,000	FY13-18		500	9,500			10,000
8.34	3	SEH - Sections 30, 40, 44 & 39 Design/Construct	AP	new	4 years	10,000	FY15-18			10,000			10,000
8.35	3	Fisher Hill Pipeline Rehabilitation Construction	AP	prev	2 years	2,711	FY16-18			2,711			2,711
8.36	3	NHS - Sections 33, 49, 49A & 50 Design/Construct	AP	prev	5 years	8,000	FY14-18			8,000			8,000
8.37	3	Spot Pond Supply Mains (Sections 66 & 57) Design/Construct	AP	prev	7 years	29,671	FY15-22			20,000	9,671		29,671
8.38	3	Southern Spine Distribution Mains (Section 19) Design/Construct backs up Heath Hill	AP	prev	5 years	8,088	FY12-16		1,500	6,588			8,088
8.39	3	Section 75 Extension Design/Construct	NF	new	4 years	4,400	FY13-16		1,000	3,400			4,400
8.40	4	Section 83 DropHole Rehabilitation Design/Construct	Opti	new	3 years	3,000	FY16-18			3,000			3,000
8.41	2	SEH Sections 77/88 Rehabilitation Design/Construct	AP	new	5 years	5,000	FY19-23				5,000		5,000
8.42	3	Northern High Service Pipeline Rehabilitation Design/Construct Sections 54, 55, 56, 69	AP	prev	5 years	16,288	FY23-28				16,288		16,288
8.43	3	Northern High Service Pipeline Rehabilitation (Sections 13-18 & 48) Design/Construct	AP	prev	5 years	18,363	FY19-23				18,363		18,363

Water Master Plan

Existing and Future Projects

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Prioritization

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FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
8.44	4	Waterworks FAMP Pump Station Instrumentation/Electrical/Mechanical	AP	new	ongoing	56,000	FY16-48			2,000	4,000	50,000	56,000
8.45	4	Parallel Main to Meters 55 & 68	NF	new	4 years	5,000	FY21-24				5,000		5,000
8.46	2	Low Service Storage near Spot Pond Study/EIR	NF	prev	2 years	1,000	FY09-11		1,000				1,000
8.47	3	Low Service Storage Design/Construct	NF	prev	4 years	35,000	FY12-15		17,500	17,500			35,000
		SUBTOTAL - Future - Metropolitan System				352,910		750	80,350	143,488	78,322	50,000	352,910
		SUBTOTAL - Existing and Future - Metropolitan System				642,216		74,891	235,419	202,316	79,590	50,000	642,216
		COMMUNITY ASSISTANCE											
8.48	3	Water Local Pipeline Assistance Program	AP	in	12 years	(96,500)	now-FY18	15,500	22,000	(100,000)	(34,000)		(96,500)
		SUBTOTAL - Existing - Community Assistance				**(96,500)**		**15,500**	**22,000**	**(100,000)**	**(34,000)**	**0**	**(96,500)**
8.49	3	Water Local Pipeline Assistance Program	AP	new	10 years	0	FY14-23			50,000	(31,000)	(19,000)	0
		SUBTOTAL - Future - Community Assistance				0		0	0	50,000	(31,000)	(19,000)	0
		TOTAL - Existing and Future - Community Assistance				(96,500)		15,500	22,000	(50,000)	(65,000)	(19,000)	(96,500)
		ANCILLARY SERVICES											
9.1	3	Central Monitoring SCADA Implementation	Opti	in	2 years	450	FY07-08	250	200				450
9.2	3	Distribution System Facilities Mapping - Records Development	AP	in	2 years	1,268	FY07-13	930	338				1,268
		SUBTOTAL - Existing - Ancillary Services				**1,718**		**1,180**	**538**	**0**	**0**	**0**	**1,718**
9.3	3	Update Record Management Software	AP	new	1 year	30	FY08	30					30
9.4	3	Document Control Program	AP	prev	2 years	900	FY08	900					900
9.5	3	Evaluate Use of Wind Power at Select Facilites	Plan	new	18 months		FY08						
9.6	3	Energy Audits at Select Facilites @ $20,000 per facility (supplier pays half)	Opti	new & prev	5 years	120	FY08-12	20	100				120

Water Master Plan

Existing and Future Projects

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Prioritization		**Project Types**		**FY07 CIP Notes**	
1	Critical	NF	New Facility/System	in	included in FY07 CIP (bold)
2	Essential	RF/IC	Replacement Facility/Increase Capacity	new	new project, not previously in CIP
3	Necessary	Opti	Optimization	prev	included in prior CIP, but deleted
4	Important	AP	Asset Protection		
5	Desirable	Plan	Planning/Study		

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
9.7	3	GC-MS or LC-MS Lab Equipment	AP	new	2 years	1,000	FY09-10		1,000				1,000
9.8	3	Chromatography Data Management Sewer	AP	new	1 year	250	FY09		250				250
9.9	3	Waterworks Modem Replacement	AP	new	5 years	200	FY09-13		200				200
9.1	3	Waterworks SCADA PC Upgrade - 50k every 5 yrs.	AP	new	1 year	150	FY11-31		50	50	50		150
9.1	3	Water Data Radio Replacement	AP	new	3 years	100	FY09-13		100				100
9.12	5	Micro Hydroturbine Feasibility Study - possible installation of pilot micro hydroturbine at test location	Plan	new	2 years	70	FY09-10		70				70
9.13	3	Waterworks Meter Replacement	AP	new	1 year	5,000	FY15-16			5,000			5,000
9.14	4	Radio Feedline and Antennae Replacement	AP	new	1 year	1,000	FY14-16			1,000			1,000
9.15	3	Waterworks SCADA Equipment (PLC) Replacement/Upgrades	AP	new	1 year	2,000	FY21				2,000		2,000
		SUBTOTAL - Future - Ancillary Services				10,820		950	1,770	6,050	2,050	0	10,820
		TOTAL - Existing and Future - Ancillary Services				12,538		2,130	2,308	6,050	2,050	0	12,538

	Cost ($1000)	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
TOTAL - Existing Projects (w/o Community Assistance) - ALL WATER	**444,935**	**119,036**	**259,842**	**64,789**	**1,268**	**0**	**444,935**
TOTAL - Future Projects (w/o Community Assistance) - ALL WATER	**671,539**	**1,950**	**122,554**	**309,363**	**146,672**	**91,000**	**671,539**
TOTAL - Existing and Future Projects (w/o Community Assistance) - ALL WATER	**1,116,474**	**120,986**	**382,396**	**374,152**	**147,940**	**91,000**	**1,116,474**

	Cost ($1000)	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
TOTAL - Existing Projects (w/ Community Assistance) - ALL WATER	**348,435**	**134,536**	**281,842**	**(35,211)**	**(32,732)**	**0**	**348,435**
TOTAL - Future Projects (w/ Community Assistance) - ALL WATER	**671,539**	**1,950**	**122,554**	**359,363**	**115,672**	**72,000**	**671,539**
TOTAL - Existing and Future Projects (w/ Community Assistance) - ALL WATER	**1,019,974**	**136,486**	**404,396**	**324,152**	**82,940**	**72,000**	**1,019,974**

WASTEWATER AND WATER MASTER PLAN SUMMARY

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
		TOTAL - Existing - ALL WASTEWATER				**666,174**		**268,541**	**365,204**	**35,686**	**(3,257)**	**0**	**666,174**
		TOTAL - Recommended - ALL WASTEWATER				**1,391,687**		**3,615**	**120,505**	**375,392**	**352,475**	**539,700**	**1,391,687**
		TOTAL - Existing and Recommended - ALL WASTEWATER				**2,057,861**		**272,156**	**485,709**	**411,078**	**349,218**	**539,700**	**2,057,861**
		TOTAL - Existing Projects (w/ Community Assistance) - ALL WATER				**348,435**		**134,536**	**281,842**	**(35,211)**	**(32,732)**	**0**	**348,435**
		TOTAL - Recommended (w/ Community Assistance) - ALL WATER				**671,539**		**1,950**	**122,554**	**359,363**	**115,672**	**72,000**	**671,539**
		TOTAL - Existing and Recommended Projects (w/ Community Assistance) - ALL WATER				**1,019,974**		**136,486**	**404,396**	**324,152**	**82,940**	**72,000**	**1,019,974**
		TOTAL - ALL WASTEWATER AND WATER EXISTING (w/Community Assistance)				**1,014,609**		**403,077**	**647,046**	**475**	**(35,989)**	**0**	**1,014,609**
		TOTAL - ALL WASTEWATER AND WATER RECOMMENDED (w/Community Assistance)				**2,063,226**		**5,565**	**243,059**	**734,755**	**468,147**	**611,700**	**2,063,226**
		TOTAL - ALL WASTEWATER AND WATER PROJECTS (w/Community Assistance)				**3,077,835**		**408,642**	**890,105**	**735,230**	**432,158**	**611,700**	**3,077,835**

CHAPTER 1
INTRODUCTION

1.1 Overview of MWRA

The Massachusetts Water Resources Authority (MWRA) 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 western Massachusetts to the Deer Island Treatment Plant in Boston Harbor. Approximately 2.5 million people, about 44 percent of the total population of Massachusetts, live in the communities served in whole or in part by the MWRA.

MWRA is an independent public agency with the ability to raise revenues from ratepayers, bond sales and grants. In addition to its operating responsibility, the 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 in the development of both the Wastewater and Water System Master Plans.

1.2 Purpose of the Wastewater Master Plan

MWRA's Wastewater 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 (over 2 million customers) represents an essential public service. It is the 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 Master Plan identifies system/facility conditions, operational risks and capital project needs. The Master Plan accounts for all projects included in MWRA's FY07 Capital Improvement Plan (CIP), projects previously eliminated as line items in earlier CIP cycles, and newly-identified projects. Projects have been prioritized and a recommended implementation timetable developed that corresponds with the annual CIP development cycle.

Concurrent with the development of the Wastewater Master Plan, the MWRA is also developing a companion Water System Master Plan. Preparation of an updated Master Plan was recommended by the MWRA Advisory Board to provide a more thorough context for developing, analyzing, and evaluating the annual CIP and are intended to serve as the principal framework for future planning, budgeting and rate setting decisions.

1.3 Planning Approach and Time Frame

In its two-decade existence, MWRA has constructed billions of dollars of facilities to repair, replace, and modernize aging infrastructure. The $3.8 billion Boston Harbor Project has been completed, $400 million has been invested in new sewer interceptors and pump stations, and planning is substantially complete to conclude the $800 million Combined Sewer Overflow Control Program with construction to continue through 2016. The estimated replacement value of MWRA's wastewater system assets is over $6 billion. MWRA, having completed many large construction projects over the last 20-plus years, is now in transition with a need to rehabilitate those portions of the system that have not been replaced, and provide for maintenance and asset protection of newer facilities. Development of the Master Plan will continue the transition with respect to capital projects, shifting MWRA's primary focus from construction of new facilities to maintenance and rehabilitation/replacement.

For the Master Plan, MWRA has selected a 40-year planning period through FY48. The Master Plan focuses on projects recommended for FY07-08 and projects that are proposed to generate capital spending during the next two 5-year CIP cap cycles FY09-13 and FY14-18. Estimates of project costs and schedules over this shorter term are expected to be more reliable than looking ahead to the out-years. Following these two 5-year periods, additional 10-year (FY19-28) and 20-year (FY29-48) planning periods are utilized.

All projects have been prioritized on a scale from 1 to 5, with 1 being projects considered critical and 5 considered 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 Planning and Coordination Department staff. All MWRA projects will be further prioritized during the FY08 CIP development process.

1.4 Organization of the Master Plan

The Wastewater Master Plan is organized into Chapters for 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 project schedules. The Water System Master Plan has been compiled in a separate volume using a consistent format. The Master Plan Executive Summary presents the combined existing and recommended capital projects for both water and wastewater. The Executive Summary is a synopsis of information presented to the Board of Directors in three separate staff summaries on September 13, October 11, and November 15, 2006. In addition, information from the MIS Master Plan is also incorporated in the Executive Summary.

1.5 Periodic Updates

The Wastewater Master Plan is intended to represent an ongoing process; it is not intended to be a static document. The 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 this Plan will map out major expenditures for the wastewater system for many years, conditions change and flexibility is important. The Plan is intended to be reviewed annually as an integral component of MWRA's Capital Improvement Program 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.

1.6 Sources of Information

A variety of existing reports and planning documents were reviewed during the development of the Master Plan. Some of these are listed below:

<u>Wastewater Engineering and Management Plan for Boston Harbor – Eastern Massachusetts Metropolitan Area - EMMA Study, March 1976</u> – This report, including a Summary Report, Main Report, and 16 Technical Data Volumes (with additional appendixes), was prepared by Metcalf & Eddy, Inc. under contract to MDC. This study was prepared to provide guidance for wastewater management to the Metropolitan Sewer District for an 80 year planning period.

<u>MWRA Secondary Treatment Facilities Plan, March 1988</u> – This eight volume report was prepared by Metcalf & Eddy, Inc. under contract to MWRA. Each volume details a separate aspect of the planning portion of the Boston Harbor Project.

<u>1994 Final CSO Conceptual Plan and System Master Plan</u> - 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 a long-term CSO control plan that included decommissioning the Constitution Beach CSO facility following sewer separation in East Boston (completed 2000), upgrading the five remaining CSO facilities (completed 2000-2001), decommissioning the Commercial Point and Fox Point CSO facilities following sewer separation in Dorchester (construction underway; to be completed in 2008), and constructing a new CSO facility at the BWSC Union Park Pumping Station (completed 2006).

<u>1996 Siphon Chamber and Connecting Structures Inspection Summary Report</u> – This report provides documented results and recommendations from the inspection of 146 siphon chambers and connecting structures in the MWRA collection system.

<u>1997 Final CSO Facilities Plan and Environmental Impact Report</u> - This report involved facilities planning and environmental assessment for the long-term CSO control plan recommended in the 1994 Final CSO Conceptual Plan and System Master Plan. It confirmed the 1994 CSO facility-related recommendations listed above.

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.

1998 Upgrades to Existing CSO Facilities Supplemental Environmental Impact Report - This report recommended project changes to implement the 1997 CSO plan, including the addition of chemical force mains, off-site buildings for chemical dosing, sampling and/or control systems.

1998 Upgrades to the Fox Point CSO Facility Supplemental Environmental Impact Report - This report recommended project changes to implement the Fox Point facility upgrades in the 1997 CSO plan, including the addition of a chemical force main and off-site building for sampling and control.

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 was prepared by Metcalf & Eddy, Inc. under the Wastewater Hydraulic Optimization Project (MWRA Contract 6733). The report provides detailed equipment and operational information specific to each facility. The report was prepared to provide an existing conditions baseline for the Optimization Project.

2004 Cottage Farm CSO Facility Assessment Report - This report evaluated the treatment performance of the Cottage Farm CSO facility and recommended system optimization improvements at the facility. It also demonstrated that expanding the facility's detention/storage capacity would not be cost-effective.

CHAPTER 2
MISSION, GOALS, AND OBJECTIVES

2.1 Wastewater Mission

MWRA's fundamental mission regarding sewage collection, treatment and disposal service is established in the Enabling Act, and includes: 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. Based on the above excerpts from the Enabling Act, MWRA's Wastewater Mission can be framed as:

> *Provide reliable, safe, and efficient sewage collection, treatment and disposal services that protect public health, promote environmental quality improvements, support a prosperous economy, maintain customer confidence, and minimize sewer charges.*

2.2 Wastewater Goals and Objectives

For the purposes of setting priorities among needs and guiding the planning process, this basic wastewater mission is articulated in four distinct goals:

Goal 1: Provide reliable and safe sewer service.

Goal 2: Provide environmentally sound wastewater collection and treatment, residual disposal, and combined sewer overflow control.

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

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

A list of objectives has been developed to clarify how each goal will be met and to help prioritize the commitment of resources in an efficient manner. 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 and 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 FY09-13 period. MWRA's annual CIP development process will refine costs, schedules, cash-flows, and priorities for projects proposed in the FY09-18 timeframe. Ultimately, project scheduling in the CIP will need to balance meeting system needs with financial and rates implications and 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. In this regard, it is the MWRA's goal to operate and maintain the sewer system so that the potential for a 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 any remaining facilities and key assets that are in poor condition or are hydraulically deficient or are 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: To reduce the risk of service disruptions, pipeline blockages, equipment failure, etc.; implement and improve practices to inspect, monitor, and maintain the system and replace key equipment in an efficient way. Plan and implement effective emergency operations procedures to minimize potential public health impacts.

4) Monitor system performance: Implement and enhance measures that allow 24/7 monitoring of key system performance.

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.

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 environmentally sound wastewater collection and treatment, residual disposal, and combined sewer overflow control.

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 shifted to ensure proper operation, maintenance and repair of new facilities, so that environmental quality improvements are not compromised. Completion of the federally mandated CSO control plan represents MWRA's most significant capital project over the next decade.

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. Since regulatory standards may lag scientific knowledge, monitor emerging trends in treatment technologies.

2) 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.

3) Provide effective wastewater collection and combined sewer overflow (CSO) control: Implement the approved CSO Control Plan and maintain compliance with Nine Minimum Controls Plan. Implement appropriate improvements to the sewer system to maximize wastewater flow to the treatment plant to limit CSOs within NPDES Permit limits and minimize sanitary sewer overflows (SSOs) and impact of sewer odors.

4) Provide effective monitoring and reporting of environmental impacts: Implement the approved harbor monitoring and reporting plan as required under MWRA's NPDES permit. Evaluate emerging trends in wastewater treatment monitoring and implement cost effective improvements.

5) Track wastewater legislation and regulations: Closely track and evaluate modifications to wastewater treatment, CSO and sewer system legislation and regulations. Actively represent the MWRA's interests and continue to play an active role in the development and implementation of environmental regulations and policies.

6) 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 of what can be done at the community, business and household level to reduce the discharge of toxins and 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. An important element of future planning is the development of appropriate design criteria and performance standards. MWRA must develop appropriate planning tools and work cooperatively with member communities to assure appropriate future system capacity.

Objectives

1) Provide system-wide master planning: Develop and periodically update the Wastewater 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.

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 by staff that promote the documentation of accurate, comprehensive, and up to date information with access available to appropriate staff.

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

4) Target facilities planning activities to key wastewater functions: Implement facilities planning for priority projects identified through the master planning process to assure future capacity, such as maintenance/repair of Deer Island equipment, headworks conditions assessment, long-term residuals disposal, interceptor renewal, etc. As appropriate, continue to implement the recommendations of previous facilities plans that have recommended development of additional system capacity.

5) Provide careful review of system expansion requests: 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.

6) Implement Regional I/I Reduction Plan: Work cooperatively with member communities and continue to implement the regional I/I reduction plan to reduce infiltration and inflow entering the MWRA-owned and community-owned collection system. The reduction of I/I provides 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 and cost-effectiveness in all activities and decisions to provide the greatest value to the ratepayers while meeting appropriate standards for 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 more costly future expenditures for repair or replacement. Continue to implement reliability-centered maintenance.

2) Plan for optimized system performance: During planning and design of system improvements, look for opportunities to optimize operation and maintenance of the system and reduce energy costs. Where appropriate, consider implementation of preventive measures that will extend asset life.

3) Implement measurement, monitoring, and SCADA technologies: Implement measurement and monitoring technologies to facilitate accurate and reliable sewer rate basis data and monitoring of flow conditions for the purposes of daily and emergency operations, hydraulic modeling, and planning analyses. Employ appropriate SCADA technologies for improved system monitoring and control that will yield benefits in terms of operational efficiency and flow control precision.

4) Support work force productivity: Support the productivity of the work force by providing appropriate workplace and field site conditions, and equipping crews with the tools, materials and information necessary, to carry out operational, maintenance, and repair duties efficiently and cost effectively.

CHAPTER 3
HISTORY AND BACKGROUND

3.1 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.

3.2 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 the 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 Federal Water Pollution Control Act Amendments of 1972, 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 treatment plants did not comply with these new requirements.

As 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. The Clean Water Act also continued requirements to set water quality standards for all contaminants in 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 new 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 http:\\www.epa.gov/region5/water/cwa.htm for more information. Chapter 6 discusses the regulatory framework affecting MWRA's wastewater system and potential regulatory changes and long-term issues that may impact MWRA.

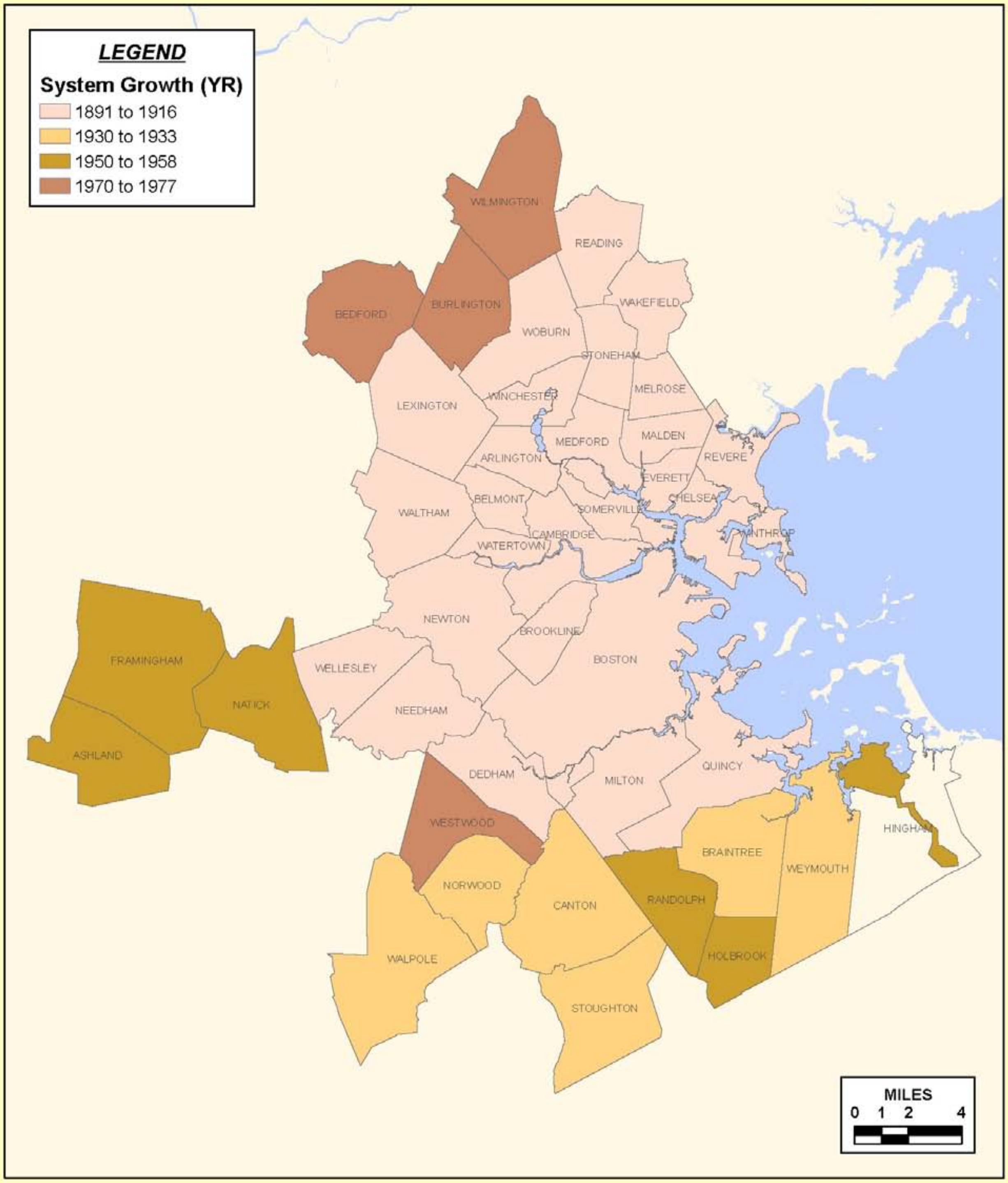
3.3 Growth of the Sewer Service Area

Growth of the sewer service area is shown in Figure 3-1. A large portion of the metropolitan Boston sewer system was built from the 1880s 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 added 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. The Hingham North Sewer District includes the waterfront commercial area in North Hingham, residential areas generally bounded by Beal, Elm, and Water Streets, Hingham High School, Hingham Junior High School, and Wampatuck State Park. Any further expansion of the MWRA sewer service area is subject to MWRA's sewer expansion policies as detailed in Section 3.6 of this Chapter.

Figure 3-1:

Growth Of The Sewer Service Area



3.4 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 of 1972, 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, an independent agency with the ability to raise revenues from ratepayers, bond sales and grants. MWRA's mission included: modernizing 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 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, discharge and combined sewer overflow ("CSO") requirements. MWRA responded by instituting an aggressive schedule to plan, construct and operate new treatment and 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.

The MWRA continues to be a defendant in the Boston Harbor Case (D. Mass. C.A. No. 85-0489) which is now presided over by Federal District Judge Richard G. Stearns. The only corrective action remaining in the Boston Harbor Case is CSO-related. The Authority now has 35 CSO projects, 16 of which are complete. The estimated cost to complete the Authority's long-term CSO control plan is now $855 million, including contingency and escalation of unawarded contracts.

A time line of major MWRA accomplishments for the wastewater system is presented in Section 3.9, at the end of this Chapter.

3.5 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. An unofficial version of MWRA's original Enabling Act (Chapter 372 of the Acts of 1984) is available on the MWRA web site – www.mwra.com. To serve these 43 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 system average daily flow is approximately 360 mgd, minimum dry weather flow is approximately 260 mgd, peak wet weather capacity to the Deer Island Treatment Plant is 1,270 mgd with additional system capacity available at combined sewer overflow (CSO) outfalls. The MWRA collection system includes a network of 275.5 miles of sewer pipelines (18.1 miles of cross-harbor tunnels, 227 miles of gravity sewers, 20 miles of force mains, 7 miles of siphons, and 3.4 miles of CSO and emergency outfalls); one screening facility; 13 pump stations; 6 CSO treatment facilities; and four remote headworks facilities.

Community wastewater discharges into the MWRA regional collection system are subject to 360 CMR 10.000, the rules and regulations of the MWRA governing the discharge of sewage, drainage, substances, and wastes into any sewer under the control of the MWRA, or into any sewer tributary thereto. MWRA's sewer use rules and regulations are intended to protect the public health, safety and welfare, and the environment, and to 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.

MWRA's Deer Island Treatment Plant is the centerpiece of MWRA's $3.8 billion program to protect Boston Harbor against pollution from Metropolitan Boston's sewer systems. The plant treats wastewater in compliance with all federal and state environmental standards and subject to the National Pollution Discharge Elimination System (NPDES) permit issued for the plant by EPA and DEP. A 9.5-mile, 24-foot-diameter outfall tunnel transports effluent into the 100-foot deep waters of Massachusetts Bay. Extensive environmental 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, on-site power generation using digester gas, odor control, disinfection, dechlorination, and effluent discharge.

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) left over 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, phosphorous, 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 Wastewater Treatment Plant 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 new facilities meet all federal and state environmental standards and the NPDES permit issued by EPA and DEP. Key components of the Clinton Wastewater Treatment plant include: preliminary treatment, influent pumps, primary treatment, secondary treatment, advanced nutrient removal, sludge digesters, on-site power generation using digester gas, odor control, disinfection, and dechlorination. The plant discharges its effluent into the South 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.

3.6 MWRA Sewer Expansion Policies

MWRA has detailed policies that address the procedures and criteria for handling requests for services to locations outside the MWRA's water or sewer service areas. MWRA must approve all extension of service to entities outside the existing service area (see list of MWRA member communities in Section 3.5) pursuant to the applicable policy 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. Much of the growth in the metropolitan Boston area is being driven toward “smart growth” policies leading to redevelopment of previously occupied sites in areas likely to be served by existing sewers. None of the communities immediately adjacent to the existing sewerage service area have expressed interest in becoming MWRA member sewer communities.

The 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.

3.7 Wastewater Infrastructure Replacement Asset Value

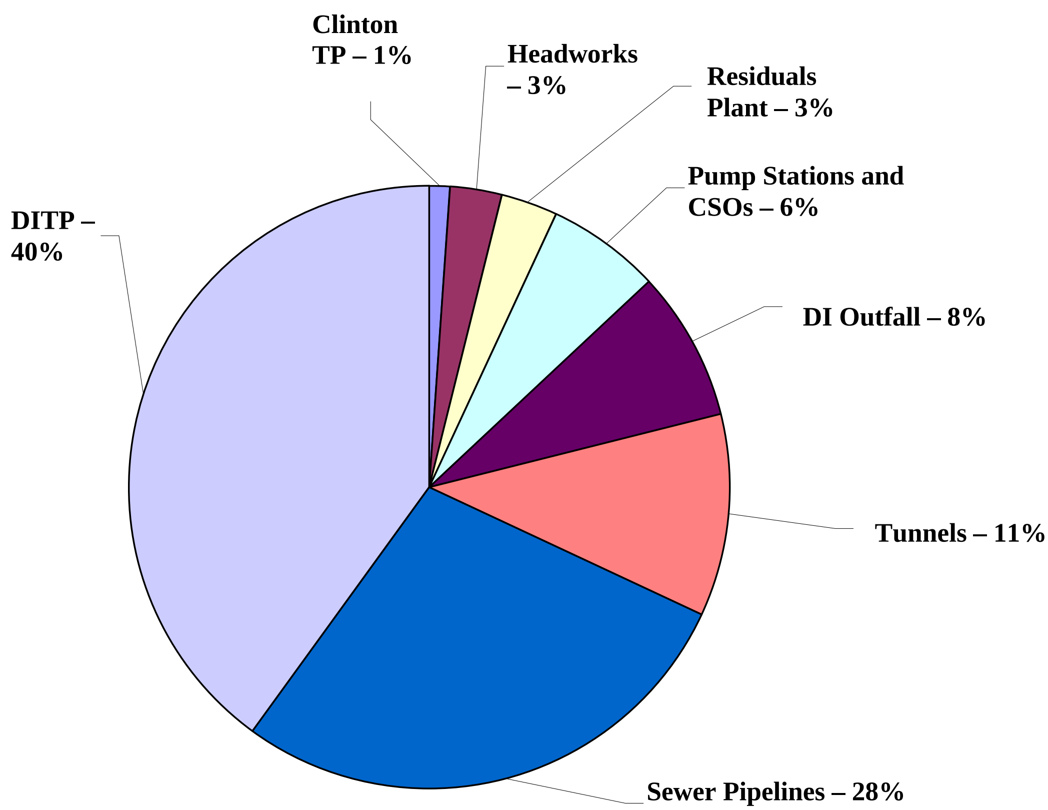
MWRA wastewater infrastructure is a network of facilities, structures, sewers, tunnels, and outfalls. In 2004, staff spent several months developing a replacement cost valuation of MWRA’s infrastructure using MWRA-specific appraisal data and actual MWRA project cost information. The wastewater infrastructure has an estimated replacement asset value of $6.25

billion, as shown in Table 3-1 and Figure 3-2. 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
Sewerage Infrastructure Replacement Asset Value

Asset Class	Replacement Asset Value	% of Total
Deer Island Treatment Plant	$ 2,500 million	40 %
Deer Island Outfall	$ 530 million	8 %
Residuals Pelletizing Plant	$ 200 million	3 %
Cross-Harbor Tunnels	$ 660 million	11 %
Remote Headworks	$ 190 million	3 %
Pump Stations and CSO Facilities	$ 370 million	6 %
Sewer Pipelines	$ 1,750 million	28 %
Clinton Treatment Plant	$ 50 million	1 %
TOTAL	$ 6,250 million	100 %

FIGURE 3-2



TOTAL REPLACEMENT ASSET VALUE $6.25 billion

3.8 Outline of MWRA's Management Structure

MWRA is governed by an 11-member Board of Directors who are appointed by the Governor or directly or indirectly by elected officials in MWRA customer communities. Eight of the 11 members of MWRA's Board of Directors are directly or indirectly appointed by the 61 customer communities. Three members are appointed by the Governor.

Executive Director Frederick A. Laskey is responsible for implementing MWRA programs, policies and procedures at the direction of the Board of Directors. Five Divisions carry out the MWRA's mission – Executive Office, Operations, Finance, Law, and Support Services. MWRA's overall staffing level as of 2006 is 1,255 employees.

Much of the work described in the Wastewater Master Plan is carried out by the Operations Division. In 2000, wastewater and water system operations and maintenance, treatment, laboratory services, and engineering and construction functions were integrated to form the Operation Division under the supervision of the Chief Operating Officer.

Additional information on MWRA's structure, administration and staffing can be found on the MWRA web site – www.mwra.com.

3.9 Time Line of MWRA Wastewater Accomplishments

1985

- The newly created MWRA assumed control of the sewer system from the MDC
- Because the level of wastewater treatment inherited by the MWRA was below federal standards, Federal Judge David A. Mazzone ordered schedule for Boston Harbor Project

1987

- Deer Island Wastewater Treatment Plant groundbreaking
- Purchase of Fore River Shipyard in Quincy as staging area for Deer Island construction and site for residuals pelletizing facility
- Equipment upgrades at remote headworks facilities
- Hayes Pump Station completed

1989

- Both Deer Island and Nut Island treatment plants halted discharge of more than 10,000 gallons per day of floatable pollution (grease, oil, and plastics) known as scum
- Fox Point Gravity CSO Facility completed

1990

- Cross-harbor power cable installed to Deer Island
- Chelsea Screen House completed

1991

- Residuals pelletizing facility completed, allowing daily sludge discharges into Boston Harbor to end
- Caruso Pump Station completed
- Commercial Point Gravity CSO Facility completed

1992

- Clinton Wastewater Treatment Plant completed
- Hingham Pump Station completed

1993

- DeLauri Pump Station completed

1994

- New primary treatment plant a Deer Island completed, increasing the system's overall capacity and the effectiveness of its treatment
- Wellesley Extension Sewer Replacement completed
- Wastewater metering system completed

1995

- Primary treatment began at new Deer Island Treatment Plant
- New Neponset Valley Sewer Pump Station completed

1996

- New Neponset Valley Relief Sewer completed
- New flow-based sewer rate methodology implemented

1997

- First phase of secondary treatment at Deer Island Treatment Plant completed, increasing the level of solids removal for dry weather flows to 80 percent and allowing the plant to meet the requirements of the federal Clean Water Act for the first time

1998

- Nut Island Headworks and Inter-Island Tunnel connecting the South System flows to Deer Island began operation, ending discharges from the Nut Island Treatment Plant
- Second battery of secondary treatment at Deer Island Treatment Plant completed
- Framingham Extension Relief Sewer and Framingham Pump Station completed
- Approval received for CSO Facilities Plan and Environmental Impact Report

1999

- Hough’s Neck Pump Station completed
- Public access at Nut Island opened

2000

- Completion of 9.5 mile Deer Island outfall tunnel allows MWRA to move effluent discharge from the confined waters of Boston Harbor to the deep waters of Massachusetts Bay
- Third and final battery of secondary treatment at Deer Island Treatment Plant completed
- Prison Point CSO Facility upgrade was completed
- Constitution Beach CSO Treatment Facility was decommissioned
- Construction to permanently close CSO outfalls MWR021 and MWR022, along the Charles River Esplanade was completed
- Construction of CAM005 Hydraulic Relief, BOS017 Hydraulic Relief, and city-owned Chelsea Trunk Sewer Replacement were completed
- Through MWRA funding, BWSC completed Neponset River sewer separation and Constitution Beach sewer separation, ending CSO discharges to these receiving waters

2001

- 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
- CSO Plan floatables control and outfall closings projects completed

2002

- Quincy Pump Station completed
- Repairs to portions of Sewer Sections 138 and 137 (including the New Haven Street Drop Chamber) were completed
- Chelsea maintenance and office facility opened
- Public access at Deer Island opened

2003

- Squantum Pump Station completed

2005

- Intermediate Pump Station and Braintree-Weymouth Relief facilities completed
- Wastewater metering system equipment replacement completed
- Braintree-Weymouth Replacement Pump Station begun
- Upper Neponset Valley Sewer Replacement Project begun

2006

- Judge Richard G. Stears ruled to amend the CSO Control Program schedule with respect to the Charles, Alewife, South Boston, and East Boston basins which will control CSO spending through 2020
- Cummingsville Sewer Replacement Project completed
- Union Park Street CSO Facility completed

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

4.1 Chapter Summary

The primary regulatory mechanism for the MWRA wastewater system is the National Pollutant Discharge Elimination System (NPDES). This chapter describes MWRA's existing NPDES Permits and highlights potential near-term changes with the expected issuance of a new NPDES permit for the combined Deer Island Treatment Plant, MWRA's five CSO facilities and its CSO outfalls in the Charles River and Alewife Brook. The chapter also describes other likely near-term changes in the wastewater regulatory regime and lays out longer-term issues that may affect the regulation of MWRA's wastewater system. Finally, the chapter describes the operation of MWRA Environmental Quality Department.

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

4.2 National Pollutant Discharge Elimination System Permitting and Reporting

The NPDES Program was created by the Clean Water Act of 1972. NPDES regulates point source dischargers such as wastewater treatment plants and CSO facilities. In Massachusetts, NPDES discharge permits are issued jointly by DEP and USEPA. MWRA has two NPDES permits: one for the Deer Island Wastewater Treatment Plant (DITP), the five CSO facilities, and MWRA's CSO outfalls in the Charles River and Alewife Brook, and the other for the Clinton Advanced Wastewater Treatment Plant (CLTP).

The essential component of both permits is the submission of monthly Discharge Monitoring Reports (DMR) to EPA and DEP. The DMRs include the results from effluent monitoring and biotoxicity (biotoxicity is reported quarterly for CLTP and twice annually for the CSO facilities). MWRA's reports are prepared by its Environmental Quality Department (ENQUAD). ENQUAD prepares these reports based on data provided by many sources, among them DITP, CLTP, Laboratory Services, TRAC, and Field Operations. ENQUAD also monitors compliance with stormwater permits at several MWRA facilities. ENQUAD's role and responsibilities are detailed more fully in Section 4.5.

The DITP permit is considerably more complex in its reporting requirements than the CLTP permit. The DITP requires a number of ancillary reports in addition to the DMRs. For example, Best Management Practices (BMP) for MWRA facilities and reports on infiltration and inflow (I/I) in the MWRA sewer system are mandatory. Additionally, the DITP permit has unusually extensive and stringent ambient monitoring requirements, and the permit requires the submittal of reports on receiving water monitoring in Massachusetts Bay and Boston Harbor. MWRA staff present the results of ambient and DITP monitoring to EPA, DEP, and the independent Outfall Monitoring Science Advisory Panel (OMSAP), who review the monitoring results at public meetings, and decide whether the results merit further investigation.

Overall, the environmental monitoring has found that the DITP discharges can be detected only locally around the outfall, and no adverse impacts of the discharge on the ecology (plankton, water quality, bottom-dwelling communities) of Massachusetts and Cape Cod Bays or Stellwagen Marine Sanctuary were found. Contaminant loadings from DITP effluent over the past five years are well below predictions.

As of December 2006, MWRA is awaiting new permits for DITP and the CSO facilities, as well as CLTP. The current permits expired in 2005, but remain in force until EPA issues new permits.

4.3 Near-Term Regulatory Issues and Potential Impacts on MWRA

Any entity that is subject to governmental regulation must be ready to deal with regulatory change; many changes can be foreseen. Examples of changes in the regulatory regime are:

- Water quality criteria: Water quality criteria generally tend to become more stringent, in keeping with the "pollutant elimination" concept. Biosolids criteria and monitoring also tend to become more stringent. Massachusetts periodically re-classifies water body segments, and if segments are classified "upward" this may affect MWRA facilities.

    - Bacteria: To comply with the BEACH Act, Massachusetts has issued new draft water quality criteria that include new bacteria standards. The ability of treatment facilities to meet these standards has not been evaluated nationally (or state-wide).

    - Freshwater Nutrients: EPA has developed recommended nutrient criteria (usually phosphorus) for most freshwater "ecoregions", including the eastern coastal plain which includes most of Massachusetts. States are encouraged to develop site-specific nutrient criteria, but Massachusetts has not.

    - Marine Nutrients (usually nitrogen): No EPA-recommended criteria have yet been developed for marine waters, although EPA has produced a guidance document for states to do so. Site-specific criteria are recommended. DEP and EPA have been developing nutrient TMDLs for water bodies in Massachusetts, essentially these function as site-specific criteria.

      Dealing with nutrient issues is an active area of research for the wastewater community. The Water Environment Research Foundation continues to carry out both technological and environmental studies of nutrients. Nutrients have been on the radar screen for DITP since the early planning stages. In fact, DITP must submit an annual report that tracks nutrients throughout the plant and also evaluates nutrient removal technologies. Measurable increases in ammonium are found in the outfall nearfield, but no adverse effects of DITP nutrient discharges have been found.

    - Mercury: Regulation of this toxic metal is becoming more stringent. Massachusetts policies focus on source reduction. However, increasing regulation of treatment plant mercury discharges is likely, and depends on levels of fish contamination in the receiving waters.

- SSO Rule: EPA's proposed SSO rule included preamble wording prohibiting all sanitary sewer overflows (SSOs) and would have required collection system management, operations, and maintenance (CMOM) program to manage collection systems to avoid SSOs. This rule was withdrawn; however, EPA and DEP will continue to focus on reduction and/or elimination of SSOs.

- Blending: A previous blending policy which would have specifically allowed blending was withdrawn by EPA, due to pressure from environmental groups that wanted blending prohibited. EPA is drafting a new blending policy that will certainly include limitations on blending.

The following sections detail the likely impacts of these regulatory issues on MWRA facilities and receiving waters.

<u>Deer Island Treatment Plant</u>

Operational expenses that DITP may incur due to regulatory changes:

- Bacteria criteria: DEP has drafted new bacteria criteria consistent with the BEACHES Act. It is possible that DITP may 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 enable DITP to consistently meet an *Enterococcus* criterion.

- Blending/secondary bypass: DITP is designed to blend, consistent with EPA's CSO Policy. Blending primary-treated effluent with final effluent occurs during storms when flow through the plant exceeds the capacity of the three secondary batteries. Any flow over the secondary treatment capacity is treated by the primary batteries and then blended with the secondary effluent before disinfection and discharge. Since 2005, DITP has been gradually increasing its secondary capacity as a result of improvements to its secondary clarifiers, oxygen plants and the completion of the sludge pipeline to Fore River. MWRA's next permit will likely include limitations on blending; the appropriate flow levels for blending will be a subject of active negotiation with EPA.

<u>Combined Sewer Overflows</u>

- New bacteria criteria may affect permit compliance and operation of CSO facilities.

- CSO discharges are allowed in the Charles River and Mystic River through variances from water quality criteria which will end in 2020 based on an agreement among EPA, DEP and MWRA. The variances are reviewable every three years. If the variances were not renewed, and if the water quality standards (classifications) were not changed, entities that have CSOs which discharge into these water bodies would be required to eliminate the CSO.

Clinton Treatment Plant

- Effluent phosphorus: Draft state water quality standards include more stringent phosphorus criteria. CLTP may be required to change its existing seasonal phosphorus treatment to year-round nutrient removal or new nutrient removal technologies.

- Effluent copper: EPA copper criteria have been a persistent problem state-wide because of relatively high natural background levels. Draft state copper criteria are less stringent. CLTP has received interim permit limits as part of an EPA-imposed Administrative Order. If Clinton has to meet the current or more stringent limits, it is likely that MWRA would do a site-specific study of the effect of Clinton copper discharges on the river.

Fore River Pelletizing Plant

- If nutrients become a permit or water quality issue, MWRA may need to evaluate nutrient removal at Fore River.

Boston Harbor and Rivers

- Stormwater can be a significant source of pollutants to receiving waters, especially in an urban environment such as Boston. MWRA's future role in stormwater regulation or remediation is likely to be a continuing subject of discussion.

4.4 Long-Term Considerations

Provided below is a list of potential regulatory and environmental issues, purely speculative, 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 efficient and economical system performance.

- As the harbor gets cleaner, there may be conflicts between increased recreational uses and current regulatory standards. MWRA should prepare for potentially tighter regulatory controls that may be put into place to encourage recreational use.

- Present discharge regulations focus on limiting the discharge of pollutants. Future regulations may incorporate more concepts of ecosystem management. For example, the new oceans policies at both the federal and state level (proposed) use this concept. This may change the way POTWs operate.

- Endocrine disruptors and pharmaceuticals are the most commonly cited "emerging pollutants" which are currently not regulated and have recently been the object of scientific scrutiny. Control of emerging pollutants would require new technologies not yet developed.

- Climate change and its implications are complicated and difficult to predict. What degree of climate change is occurring; what will the effects be? Issues include sea level rise, effects of nutrient and other discharges on the ecosystem, ecosystem change as oceanographic patterns change.

4.5 Interfacing With Regulators: MWRA's Environmental Quality Department

MWRA's Environmental Quality Department plays a key role in the implementation of Clean Water Act regulations. Staff negotiate permits with state and federal regulators. The Department implements the administrative components of permit reporting for DITP and CLTP and CSO facilities, and also oversees the ambient monitoring of Boston Harbor, its tributary rivers, and Massachusetts Bay. 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 the Department 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. In addition, environmental monitoring overseen by the Department is linked to the implementation of changes in MWRA operations through MWRA's Contingency Plan, which is incorporated into DITP's NPDES permit. The Contingency Plan establishes a framework for evaluating the results of environmental monitoring and using those results to assess if MWRA discharges are, or are not, affecting the environment.

MWRA staff and consultants implement an extensive environmental monitoring program in Boston Harbor and Massachusetts Bay, sampling the water column, sediments and fish and shellfish. Special monitoring projects include tracking contaminated sediments with the U.S. Geological Survey, and water quality modeling. 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.

The Environmental Quality Department is within the Operations Division and reports to the Chief Operating Officer; it has 17 staff and the annual budget in FY07 is approximately $4.7 million, of which $3.3 million is for contracted professional services.

CHAPTER 5
REVIEW OF WASTEWATER FLOWS AND LOADS

5.1 Chapter Summary

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

- Given the increased focus on state water policy, long-term per capita water use is likely to decrease. For the Wastewater Master Plan, it will be assumed (conservatively) that sanitary flow (generated from 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.

- Future population and employment growth in the MWRA sewer service area is projected to be very modest. The MAPC projects a population increase of 160,000 persons and an employment increase of 125,000 persons, resulting in a projected increase of 14 mgd of wastewater generation from 2000 through 2030.

- In light of rigorous MWRA admission criteria for sewer system expansion (including requirements for inflow reductions), MWRA expects no net increase in future wastewater flow to the DITP from system growth outside the existing sewer service area.

- As a result of water use, population growth, employment growth, sewer system build-out, and sewer system expansion, future sanitary flows in the sewer service area could increase 14 mgd through 2030. The projected 14 mgd represents a potential four percent increase over the current 360 mgd average daily wastewater flow to DITP. However, any increase in sanitary flow may be offset by reductions in I/I (from continued sewer system rehabilitation), resulting in minimal future net increase in wastewater flow.

- The future DITP average dry day wastewater flow (through 2030) should remain 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 flow (1988 STFP). Therefore, MWRA anticipates no impact on the DITP due to potential wastewater flow increases in the service area through 2030.

- No wastewater load parameters are anticipated to change significantly for the foreseeable future. The need for capital projects to address wastewater loads 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.

5.2 MWRA Sewer Service Area

The MWRA's regional collection system receives flow from 43 member sewer communities covering an area of over 500 square miles. The system serves about 2.1 million people, including the City of Boston and surrounding metropolitan area. About 95 percent of the service area is sewered. Figure 5-1 shows the MWRA sewer service area and the interceptor system, as well as, the areas served by five separate MWRA headworks facilities. All flow from the service area is tributary to MWRA’s Deer Island Treatment Plant. The collection system encompasses about 240 miles of MWRA-owned interceptors, 5100 miles of publicly-owned local sewers, and 5000+ miles of private sewer service connections. Most of the service area is served by separate sanitary sewer and storm drainage systems. However, portions of five communities (Boston, Brookline, Cambridge, Chelsea, and Somerville) utilize combined sewers.

Community wastewater discharges into the MWRA regional collection system are subject to 360 CMR 10.000, the MWRA rules and regulations governing the discharge of sewage, drainage, substances, and wastes into any sewer under the control of the MWRA, or into any sewer tributary thereto. MWRA’s Sewer Use Rules and Regulations are intended to protect the public health, safety and welfare, and the environment, and to 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. MWRA’s Sewer Use Rules and Regulations have general requirements and specific prohibitions to minimize infiltration and inflow and regulate the quality of wastewater discharged into the regional collection system. MWRA’s Sewer Use Rules and Regulations are available on-line (mwra.com).

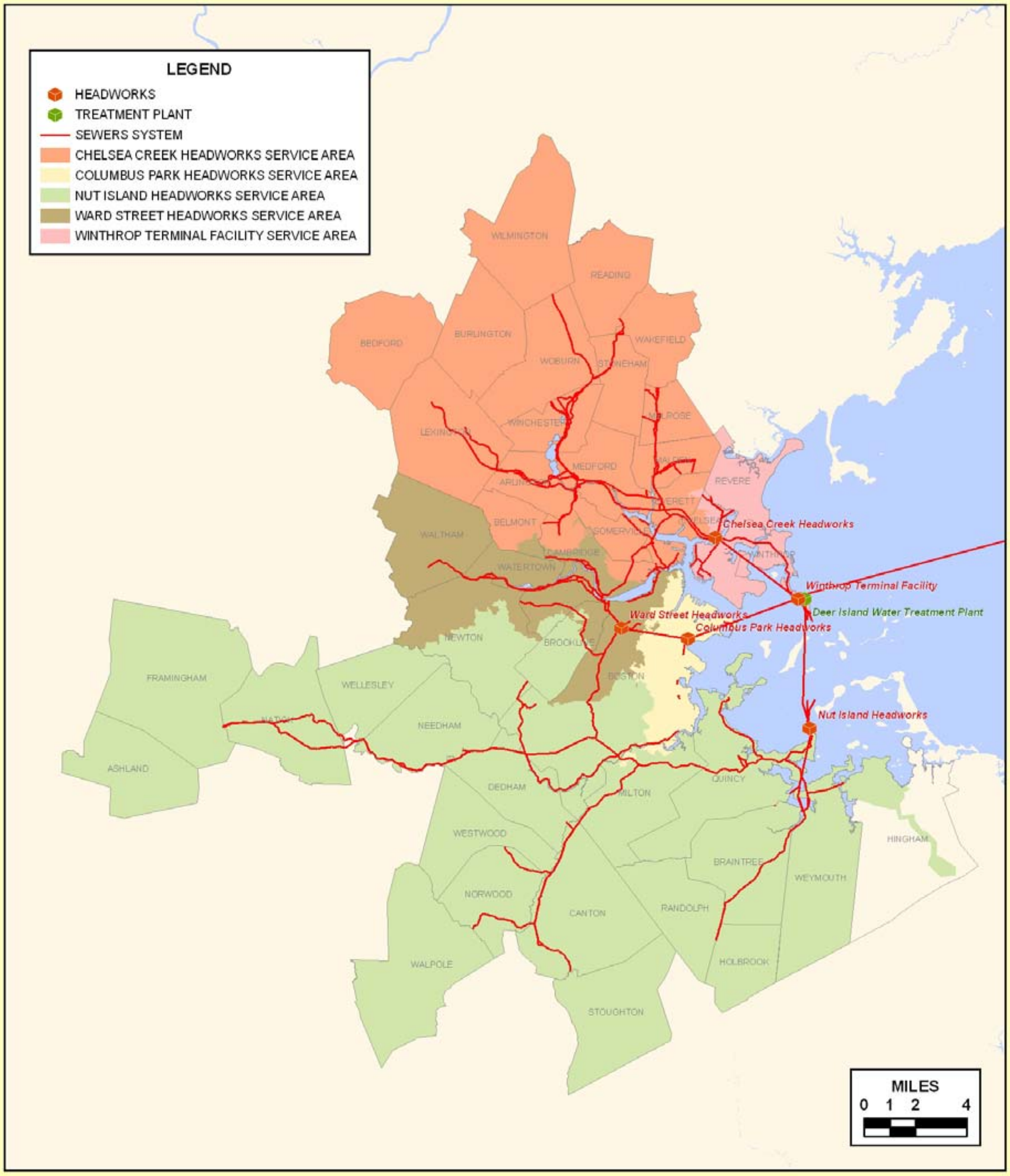
5.3 National Pollution Discharge Elimination System (NPDES) Permit

As of December 2006, MWRA is awaiting a new NPDES Permit for the DITP. The current permit, which expired in 2005, remains in force until EPA issues a new permit. Future regulatory requirements and potential changes to the NPDES Permit may impact MWRA’s recommended capital projects (see Chapter 4). Over the Master Plan period, MWRA expects changes in regulatory requirements related to wastewater flows and loads to have more significant impact on capital project needs than actual changes in the flows and loads tributary to the DITP.

MWRA’s NPDES Permit requires the Authority to maintain dry day wastewater flow to the Deer Island Wastewater Treatment Plant below 436 mgd (see discussion in Section 5.5). Two reports that address wastewater flow (both submitted annually on September 1) 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 I/I Reduction Report that details metered wastewater flows, flow components, and regional efforts to reduce I/I.

MWRA’s Environmental Quality Department 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 load data and have been used as a reference for this Chapter.

Figure 5-1:
MWRA Sewer System Location Plan



5.4 Review of Wastewater Flows

Wastewater average daily flow (ADF) to the DITP for the last eight fiscal years (FY99 through FY06) and corresponding annual rainfall are listed in Table 5-1. Prior to FY99, MWRA's South collection system was not tributary to the DITP.

Table 5-1

Fiscal Year	Wastewater Average Daily Flow (mgd)	Annual Rainfall (inches)
FY99	350	33.4
FY00	356	46.1
FY01	367	40.8
FY02	317	33.9
FY03	378	43.6
FY04	356	42.0
FY05	392	43.1
FY06	397	55.8
Eight Year Average	364	42.3

Wastewater is comprised of three separate flow components: sanitary flow, groundwater infiltration, and stormwater inflow. Sanitary flow includes all residential, commercial, institutional, 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. Wastewater discharged by member communities into MWRA's interceptors is strongly influenced by seasonal and wet weather conditions. More than half of the annual flow treated at DITP enters the regional sewer system from infiltration and inflow. High levels of I/I consume capacity in the collection system that would otherwise be available to transport sanitary flow. MWRA's Regional I/I Reduction Plan and efforts to reduce I/I in locally-owned collection systems tributary to DITP are detailed in Chapter 15 – MWRA Financial Assistance For Community-Owned Collection Systems. While future sanitary flow is likely to see a small increase, rehabilitation of the regional collection system will 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 flow with minimal future net increase in wastewater flow.

Potential increase to the sanitary component of wastewater flow may be realized through three avenues: (1) increased water use (per capita) in the MWRA sewer service area; (2) increased sewered population and employment in the MWRA sewer service area; and (3) expansion of the existing MWRA sewer service area. The potential for sanitary flow increases due to these three criteria are discussed in the subsections that follow.

Water Use in the MWRA Sewer Service Area

MWRA water supply and demand are fully detailed in Chapter 4 of the Water System Master Plan. MWRA continues to implement effective water demand management/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 20 years is demonstrated by the fact that baseline water demand (water withdrawal from MWRA reservoirs) has been dramatically reduced from 1985 levels, continues to moderately decline, and is comfortably below the system's safe yield of 300 mgd (see Figure 5-2).

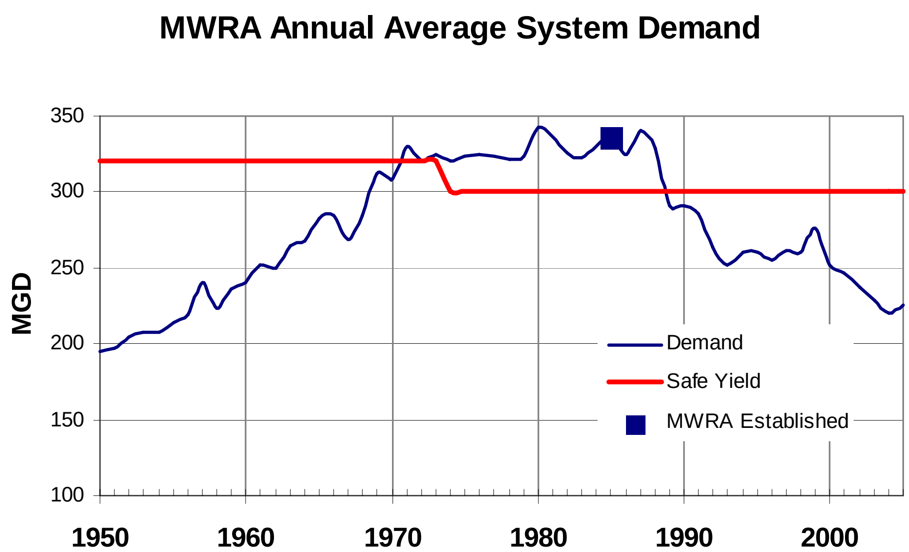


Figure 5-2 MWRA Reservoir Withdrawals

The following bullets list regional actions that have helped reduce per capita water demand in the MWRA service area:

- Leak detection surveys of MWRA distribution mains and subsequent leak repairs;
- Leak detection surveys (at least every 2 years) of member community distribution mains and subsequent leak repairs;
- Improved water metering;
- Plumbing code revision (1.6 gallon per flush toilet);
- Distribution of free water saving fixtures (showerheads, faucet aerators, toilet dams);
- Distribution of free water conservation literature;
- Classroom presentations to promote water conservation awareness for young people;
- A $255 million interest-free loan program designed to fund local community water pipeline rehabilitation projects (targeting unlined water mains); and,
- Significant water and sewer rate increases.

Given the increased focus on state water policy, long-term per capita water use is likely to decrease. For the Wastewater Master Plan, it will be assumed (conservatively) that sanitary flow (generated from 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 presented in Table 5-2, the baseline (2000 census) MWRA sewer service area total population is 2.14 million people. Of this total, about 80,000 (4 percent) are currently unsewered residents served by on-site septic systems, and about 2.06 million (96 percent) are connected to the regional sewer system. In January 2006, MAPC published population projections for the years 2010, 2020, and 2030. These projections include all communities that are part of the MWRA sewer service area. Forecast methodologies include a detailed assessment of birth and death rates, age-groups, community growth trends, and net migration, to develop a picture of likely growth patterns and trends. Communities collaborated and reviewed the projections, which underwent public review prior to finalization. As noted on Table 5-2, population growth between 2000 and 2030 for the MWRA sewer service area is projected (by MAPC) to increase by 120,541 persons, an increase of 6 percent. In addition to the increase in population, it is reasonable to assume some of the unsewered area will become sewered due to build-out of the collection system. Assuming 50 percent of the unsewered population (40,000 persons) are added to the projected population increase, a total sewered population increase of approximately 160,000 persons is estimated for 2030. For water consumption, a residential consumption rate of 65 gallons per capita per day (gpcd) is assumed and used to estimate an increased residential sanitary flow of about 10 mgd (based on the projected 160,000 person population increase). This projection is conservative, as some water consumed is not returned as wastewater.

MAPC also projected employment growth based on growth projections by industry sector, historic state and regional employment and sectoral trend data from the U.S. Bureau of Labor Statistics and the Massachusetts Department of Employment and Training. MAPC's employment growth between 2000 and 2030 for the MWRA sewer service area is projected (by MAPC) to increase by 125,000 persons. Most of the jobs projected by the MAPC will be professional, business services, educational, health services, office, and service type jobs. MAPC assigned rates of per employee water consumption that varied by employment sector (such as: 23 gpcd for professional, business, financial, education, government, and health services sectors; 93 gpcd for retail and hospitality sectors; and 15 gpcd for basic employment and manufacturing). On average, wastewater generation per employee across all sectors in the MWRA service area was 33 gpcd. Using MAPC's employment forecast through 2030 (increase of 125,000 employees) and an estimate of 33 gallons per employee per day, there would be an additional 4 mgd of commercial/industrial/institutional wastewater generation by 2030. This projection is conservative, as some water consumed is not returned as wastewater.

In summary, future population and employment growth is projected to be very modest. The MAPC projected population increase of 160,000 persons and employment increase of 125,000 persons results in a projected increase of 14 mgd of wastewater generation from 2000 through 2030. The projected 14 mgd represents a potential 4 percent increase over the current 360 mgd average daily wastewater flow to DITP.

Table 5-2
MWRA SEWER SERVICE AREA POPULATION DATA

Community	Baseline Total Population (1)	Projected Total Population for 2030 (2)
Arlington	42,388	44,163
Ashland	14,674	20,565
Bedford	22,876	13,863
Belmont	24,194	25,752
BWSC	592,347	624,395
Braintree	33,829	35,296
Brookline	57,184	30,454
Burlington	22,876	24,721
Cambridge	101,650	116,222
Canton	20,775	22,865
Chelsea	35,081	38,831
Dedham	23,464	26,317
Everett	38,037	39,307
Framingham	66,913	72,008
Hingham	19,882	25,636
Holbrook	10,786	11,308
Lexington	30,356	33,265
Malden	56,340	61,978
Medford	55,766	57,628
Melrose	27,134	27,635
Milton	26,062	28,151
Natick	32,173	35,139
Needham	28,911	30,725
Newton	83,627	83,595
Norwood	28,586	30,025
Quincy	88,026	93,740
Randolph	30,962	33,936
Reading	23,708	26,731
Revere	47,284	51,055
Somerville	77,493	79,867
Stoneham	22,219	25,189
Stoughton	27,149	29,893
Wakefield	24,801	27,617
Walpole	22,826	25,243
Waltham	59,684	63,842
Watertown	32,330	33,066
Wellesley	26,758	28,238
Westwood	14,117	17,769
Weymouth	53,987	63,610
Wilmington	21,362	25,366
Winchester	20,810	21,822
Winthrop	18,303	19,055
Woburn	37,258	39,646
Total	2,144,988	2,265,529

(1) 2000 US Census Data

(2) Metropolitan Area Planning Council Projections

Expansion of the Existing MWRA Sewer Service Area

The boundary of the MWRA sewer service area was established by the Enabling Act that created the Authority, Chapter 372 of the Acts of 1984. Many communities adjacent to the MWRA sewer service area are currently served by community or regional wastewater treatment plants. The remaining unsewered communities are served by onsite septic systems. The Enabling 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. All requests for sewer service to locations outside the current MWRA service area are covered under MWRA Operating Policy 11 – *Admission of New Community to MWRA Sewer System and Other Requests for Sewer Service to Locations Outside MWRA Sewer Service Area*. This policy details 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 wastewater flow). Based on policy requirements, it is assumed that any future new connections from outside the sewer service area (system expansion) will result in no net increase in wastewater flow to the MWRA Deer Island Treatment Plant.

At the present time, the demand for sewer expansion to communities outside the service area is low. Much of the growth in the metropolitan Boston area is being driven toward "smart growth" policies leading to redevelopment of previously occupied sites in areas likely to be served by existing sewers. Unlike the waterworks system, where communities have expressed interest in admission to MWRA, no non-MWRA sewer communities have expressed interest in becoming part of the MWRA sewer service area. There have been requests by applicants (other than communities) to join the MWRA wastewater system under MWRA Operating Policy 11; however, the amount of wastewater generated collectively totals less than 0.1 mgd.

5.5 Potential for Flow Impact on the Deer Island Treatment Plant

MWRA's NPDES Permit requires the Authority to maintain a 365 calendar day running average dry day wastewater flow to the DITP below 436 mgd. The dry day flow is reported monthly by MWRA as part of the NPDES Operational Performance Summary. For fiscal year 2006, the 365-calendar day running average dry day flow to the DITP was 323 mgd and has averaged about 323 mgd over the last seven years (see Table 5-3).

As discussed in Section 5.4, future sanitary flows in the sewer service area could increase up to four percent (approximately 14 mgd) through 2030 as a result of water use, population growth, employment growth, sewer system build-out, and sewer system expansion. Therefore, the future DITP average dry day wastewater flow (through 2030) should remain 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 2030.

Table 5-3
History of 365 Calendar Day Running Average Dry Day Wastewater Flow to DITP

Fiscal Year	Running Dry Day Flow (mgd)
2000	324
2001	324
2002	294
2003	330
2004	321
2005	345
2006	323
Seven Year Average	323

5.6 Review of Wastewater Loads

Community wastewater discharges into the MWRA regional collection system are governed by MWRA's Sewer Use Rules and 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. 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. Effluent sampling is required under the NPDES Permit, with sampling records are submitted monthly to EPA and MADEP. Influent sampling identifies the background wastewater load prior to treatment. MWRA's Environmental Quality 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 load parameters (available on-line at mwra.com).

Influent flow to DITP is classified as a weak/medium load based on average total suspended solids (TSS) of about 200 to 250 mg/L; average total kjeldahl nitrogen (TKN) of about 30 to 35 mg/L; and average ammonia-nitrogen of about 15 to 20 mg/L. TSS and carbonaceous biochemical oxygen demand (cBOD) removal efficiencies are above the theoretical secondary treatment removal efficiency of 85 percent. For FY05, TSS and cBOD removal efficiencies were determined to be 94 and 92 percent, respectively. 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 (TRAC) industrial permitting and pretreatment program and (2) the water supply corrosion control program. Both metal and organic pollutant loadings in DITP effluent have steadily declined over the last fifteen years.

MWRA tests DITP's effluent toxicity every month. Toxicity testing provides an overall view of effluent quality, ensuring that the effluent does not adversely affect the environment. In 1989, EPA found that surfactants (most commonly used in household detergents to improve cleaning power) were the probable cause of most acute toxicity in DITP's effluent. No acute toxicity could be attributed to metals or pesticides. There were no NPDES permit effluent quality violations at DITP for FY05 and FY06, and there have been no toxicity violations of the permit since FY01.

The Authority continues to address hydrogen sulfide corrosion and odor issues in its 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 purchase and 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 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/effluent load parameters are not anticipated to change significantly for the foreseeable future. Existing DITP treatment processes are expected to continue to meet current NPDES Permit limits. The need for future capital projects to address wastewater loads will most likely be based on revised NPDES Permit limits (as discussed in Chapter 4).

CHAPTER 6
DEER ISLAND TREATMENT PLANT

6.1 Chapter Summary

MWRA's Deer Island Treatment Plant (DITP) is the centerpiece of MWRA's $3.8 billion program to protect Boston Harbor against pollution from Metropolitan Boston's sewer systems. The plant provides primary and secondary treatment of wastewater collected from approximately 2.5 million people in 43 greater Boston communities. Wastewater is treated in compliance with all federal and state environmental standards and subject to the National Pollution Discharge Elimination System (NPDES) permit issued for the plant by the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MA DEP). The precedent-setting NPDES permit sets stringent conditions and limits on the effluent discharges from the plant and establishes many other important requirements (See detail in Chapter 4). A 9.5-mile, 24-foot diameter outfall tunnel transports DITP effluent into the 100-foot deep waters of Massachusetts Bay. Extensive monitoring ensures that the environment is properly protected. Key components of the DITP Plant include: influent pumps, primary treatment, secondary treatment, disinfection/dechlorination, effluent discharge via the outfall tunnel, sludge digesters, odor control, and on-site power generation.

The DITP is one of the most automated wastewater treatment facilities in the country. The MWRA has made a considerable capital investment in the plant and is committed to ensuring that this valuable public asset is operated and maintained in the best possible manner. The DITP has a skilled and qualified staff dedicated to providing the highest quality of asset management, ensuring that the treatment plant is operated and maintained to the satisfaction of regulatory agencies and the public.

This Chapter provides details on the major equipment and processes at Deer Island. The DITP may not be unique in that it is perhaps the 2nd largest wastewater treatment plant in the U.S. (in maximum daily capacity), but it is certainly unique given the combination of treatment processes utilized, the degree of automation, and the revolutionary solutions to the technological and engineering challenges addressed in constructing the facility. These uncommon solutions present additional challenges in the means and methods of operating, maintaining, and eventually replacing the structures along with the tens of thousands of individual pieces of equipment and related support systems that are integral to the plant.

Various components of DITP have sequentially come on-line following their completion, since January 1995. In general, most plant equipment and structures are up to ten years old and in good condition. Operability of mechanical equipment and maintenance of electric/standby power systems are key elements to minimize risk of component failure. Malfunction of mechanical equipment may impact wastewater treatment, particularly during large storm events that require the plant to operate at full capacity. 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 DITP uncertainties include technology upgrades to meet future regulatory requirements.

As soon as any item of equipment or structural component is placed in service, the clock starts ticking toward the inevitable date when the decision must be made to repair, rehabilitate, or replace each item. In addition, in a project of this size, scope and complexity, there are equipment or component problems that may only become evident several weeks, months, or years after start-up. Deer Island developed two Capital Programs to manage the needed projects under each scenario. The "DI Plant Optimization" category includes ancillary modification projects intended to correct deficiencies or make improvements to equipment/components identified following start-up of the facilities. This program will be phased out, and all future projects will fall under the second capital program, "DITP Asset Protection". This program is further broken down into sections covering projects that can be categorized as "equipment replacement", "architectural", "utilities", "support", or "specialties".

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 following Table indicates the level of expenditure for DITP since FY04, and projections for the 40 year Master Plan period (FY09-48).

Budget Category	FY04–08 (000s)	FY09-13 (000s)	FY14-18 (000s)	FY19-28 (000s)	FY29-48 (000s)
CEB	$8,000	$25,000	$25,000	$50,000	$100,000
CIP- DI Plant Optimization	$26,038	$8,373	$0	$0	$0
CIP- DI Asset Protection	$24,766	$56,286	$14,817	$0	$0
CIP Recommended Projects	$2,395	$45,650	$52,292	$75,525	$175,450
Total CEB & CIP	$61,199	$135,309	$92,109	$125,525	$275,450

The replacement asset value of the DITP is $2.5 billion (40% of wastewater system asset value) and the outfall tunnel is $530 million (8% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.7. Major DITP processes and/or facilities are detailed within the Chapter Section noted below:

6.5 Pumping and Preliminary Treatment;
6.6 Primary Wastewater Treatment;
6.7 Secondary Wastewater Treatment;
6.8 Disinfection and Dechlorination;
6.9 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, $455.612 million in projects is identified in the 40-year Master Plan timeframe (FY07-48). Thirty-seven projects ($104.3 million) are currently programmed in the FY07 CIP. Forty-three additional projects ($351.312 million) are recommended for inclusion in the

FY08 CIP. Section 6.14 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $89.483 million is currently programmed in the CIP (FY07-13):
  - $6.134 million to provide technical design services and/or construction support;
  - $3.574 million for equipment modification of VFDs and DC chokes at the SSPS;
  - $4.783 million for equipment modifications of cryogenics facility, plant-wide odor control systems, digester gas, and scrubber improvements;
  - $5.2 million to provide a placeholder for future, as needed, equipment replacement;
  - $6.041 million to replace equipment in the primary clarifiers;
  - $250,000 to evaluate piping systems cathodic protection;
  - $200,000 to replace pump packing seals with mechanical seals (SSPS, NMPS, and WTF);
  - $3.008 million to replace the TPP high-maintenance digester gas wet scrubber system:
  - $335,000 to replace grit blower system for improved grit handling;
  - $5.789 million to replace thickened primary sludge pumps;
  - $2.161 million to replace centrifuge back-drive due to equipment obsolescence;
  - $300,000 to evaluate protective coatings for concrete repairs in the secondary clarifiers;
  - $312,000 to replace failed expansion joints in the clarifier decks and retaining walls;
  - $7.757 million for electrical upgrades to replace transformers and bus ducts;
  - $11.029 million to replace VFDs at the NMPS, WTF, and other facilities;
  - $7.905 million to modify DI's electrical system (from FY04 power outage);
  - $2 million for additional modifications to DI's electrical system (from FY06 outage);
  - $4.447 million to replace electrical switchgear;
  - $1.582 million to replace/upgrade DITP PICS;
  - $2.983 million to replace sodium hypochlorite piping;
  - $1.672 million to replace disinfection/odor control chemical pipelines;
  - $1.26 million to replace heat loop piping;
  - $308,000 to replace diesel fuel transfer pipeline;
  - $3.704 million to replace the NMPS MCC equipment;
  - $353,000 to install a second deaerator for feed water to the Zurn boiler;
  - $125,000 to implement a plant-wide computerized DISC database;
  - $353,000 to implement a DI construction document database;
  - $1.2 million to design primary clarifier/gravity thickener improvements;
  - $2.014 million for gravity thickener improvements;
  - $552,000 to repair sodium hypochlorite tank liner;
  - $134,000 to replace metals lab fume hood;
  - $919,000 to make improvements to the metals lab;
  - $552,000 to modify the lab sample area;
  - $288,000 to replace the Clinton soda ash system; and,
  - $259,000 to install a Clinton permanent standby generator for backup power.

- $48.045 million in needs is identified for FY07-08 and FY09-13 and recommended for inclusion in the FY08 CIP:
  - $200,000 to provide technical design services and/or construction support;

- $4 million to provide a placeholder for future, as needed, equipment replacement;
- $1.7 million to replace the SSPS pump lubrication system;
- $1.875 million to rehabilitate the sodium hypochlorite tanks;
- $1 million to rehabilitate the barge berth and pier facilities;
- $2 million to replace digested sludge pumps (to FRSA);
- $20 million as a placeholder for DI cross-harbor cable dredging construction;
- $1.6 million to replace heat loop piping;
- $3.5 million to replace the DI STG with more efficient equipment;
- $150,000 to study the feasibility of DI wind power turbines;
- $1.2 million as a placeholder for construction to of DI wind power turbines;
- $2.5 million for Phase 5 electrical equipment upgrades;
- $1 million to replace DI grit and odor control equipment;
- $1 million to upgrade the HVAC Control System;
- $1 million to replace fan coils in the Admin/Lab HVAC system;
- $1.7 million to upgrade/replace DI fire alarm system;
- $300,000 to upgrade the DI leak protection system;
- $1.7 million to repair the eroded concrete eastern seawall;
- $500,000 to repair southern seawall erosion;
- $1 million to repair the DI personnel dock; and,
- $120,000 for cathodic protection testing.

Mid-term (FY14-18):

- $14.817 million is currently programmed in the CIP (FY14-18):
  - $13.453 million to provide a placeholder for future, as needed, equipment replacement;
  - $1.364 million to replace diesel fuel transfer pipeline.

- $52.292 million in needs is identified for FY14-18 and recommended for inclusion in the FY08 CIP:
  - $3.75 million to provide technical design services and/or construction support;
  - $6 million to provide a placeholder for future, as needed, equipment replacement;
  - $6 million for future VFD replacements at the SSPS;
  - $1.5 million for future SSPS shaft and/or motor replacements;
  - $2.6 million for future VFD replacements at the NMPS;
  - $2.2 million for future NMPS shaft and/or motor replacements;
  - $600,000 to remove the diesel Enterprise engines from the NMPS;
  - $800,000 for future WTF shaft and/or motor replacements;
  - $2 million to replace cryogenic plant equipment;
  - $4 million to rehabilitate the secondary clarifiers;
  - $2.5 million to rehabilitate the sodium hypochlorite tanks;
  - $1 million to rehabilitate the sodium bisulfite tanks;
  - $1.1 million to re-inspect, clean out and close-off old DITP outfalls;
  - $5.2 million to replace worn centrifuges;
  - $750,000 to replace the gas and sludge storage tank membranes;
  - $75,000 to replace heat loop piping;
  - $2 million to rebuild the TPP CTGs;
  - $667,000 for miscellaneous VFD replacements throughout DITP;

- $2.5 million for phase 5 electrical equipment upgrades;
- $1.25 million to replace obsolete electrical switchgear; and,
- $5.8 million to replace components of the PICS system.

Long-term (FY19-28 and FY29-48):

- $250.975 million in needs is identified for FY19-28 and FY29-48 and recommended for inclusion in the FY08 CIP:
  - $22.5 million to provide technical design services and/or construction support;
  - $60 million to provide a placeholder for future, as needed, equipment replacement;
  - $18 million for future VFD replacements at the SSPS;
  - $3 million for future SSPS shaft and/or motor replacements;
  - $19.5 million for future VFD replacements at the NMPS;
  - $7 million to replace the NMPS MCC equipment;
  - $4.4 million for future NMPS shaft and/or motor replacements;
  - $4.2 million for future VFD replacements at the WTF;
  - $1.6 million for future WTF shaft and/or motor replacements;
  - $6 million to replace cryogenic plant equipment;
  - $900,000 to replace cryogenic plant cooling tower equipment;
  - $8 million to rehabilitate the secondary clarifiers;
  - $750,000 to replace the secondary clarifier drive chains;
  - $7.5 million to rehabilitate the sodium hypochlorite tanks;
  - $2 million to rehabilitate the sodium bisulfite tanks;
  - $1 million to rehabilitate the barge berth and pier facilities;
  - $450,000 to re-inspect, clean out and close-off old DITP outfalls;
  - $15.6 million to replace worn centrifuges;
  - $2 million to replace digested sludge pumps (to FRSA);
  - $2.25 million to replace the gas and sludge storage tank membranes;
  - $225,000 to replace heat loop piping;
  - $4 million to rebuild the TPP CTGs;
  - $6 million for miscellaneous VFD replacements throughout DITP;
  - $15 million for phase 5 electrical equipment upgrades;
  - $15 million to replace obsolete electrical switchgear;
  - $2 million to replace DI grit and odor control equipment;
  - $500,000 to replace chemical pipelines;
  - $7.6 million to replace components of the PICS system;
  - $2 million to upgrade the HVAC Control System;
  - $2 million to replace fan coils in the Admin/Lab HVAC system;
  - $3.4 million to upgrade/replace DI fire alarm system;
  - $600,000 to upgrade the DI leak protection system;
  - $3 million to repair southern seawall erosion; and,
  - $3 million to repair the DI personnel dock.

6.2 Facilities Overview

In planning and constructing a facility to treat wastewater from MWRA's 43 member sewer communities, engineers had two relatively small peninsulas (Deer Island and Nut Island) with existing treatment plants that had to remain in operation while other facilities were built around them. The facilities were only accessible through narrow roadways in residential communities. One of the first tasks required for construction of the DITP facilities was the creation of the water-access infrastructure (personnel ferry docks and truck roll on/roll off piers) needed to transport the thousands of workers and countless tons of materials to the site without negatively impacting the adjoining neighborhoods. The limited available acreage on which to build the new facilities created space constraints that resulted in uncommon engineering solutions such as stacked clarifiers, centrifugal grit removal, on-site oxygen generation, and the distinctive egg-shaped digesters that have become a notable part of the Boston skyline. In addition to building the treatment facilities under an aggressive construction schedules, the project also required construction of two lengthy deep-rock tunnels (the 9.5 mile Outfall Tunnel, as well as, the 4.8 mile Inter-Island Tunnel) and conversion of the Nut Island Treatment Plant to a headworks facility. The entire $3.8 billion project is known as the Boston Harbor Project (BHP).

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. The location of the DITP, cross-harbor tunnels, and effluent outfall tunnel are shown on Figure 6-1. The general DITP process layout is shown in Figure 6-2.

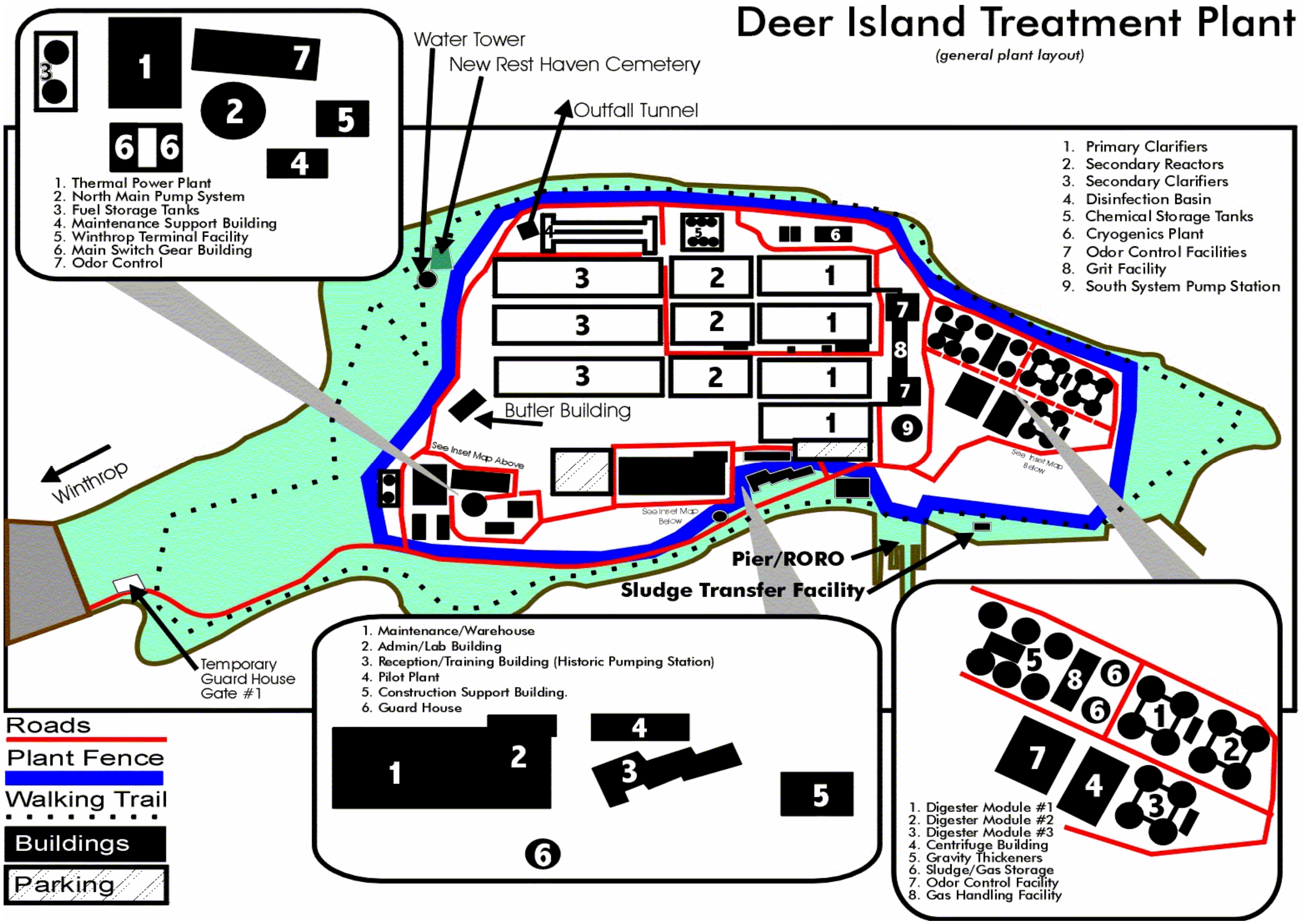
The DITP is designed to process a maximum of 1.27 billion gallons per day of wastewater. The majority of north system flow is tributary to DITP's North Main Pump Station (NMPS) through two deep-rock tunnels, the North Metropolitan Relief Tunnel and the Boston Main Drainage Tunnel. The remainder of north 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 then conveyed to the primary clarifiers. Wastewater from the south system is tributary to the Lydia Goodhue (South System) Pump Station via the Inter-Island Tunnel. South system flow is introduced directly into the DITP primary clarifiers.

In the primary wastewater treatment process, wastewater moves slowly through large clarifier tanks. The slow rate of movement allows non-suspended solids to settle to the bottom of the tanks. 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 (sludge) into collection hoppers. The collected sludge and scum is pumped to gravity thickener tanks for further settling and water removal, resulting in greater concentration of solids. Supernatant from the gravity thickeners is recycled through the plant and the thickened primary sludge and scum is pumped to anaerobic digesters.

Figure 6-1:

MWRA Deer Island Treatment Plant Location Plan

Figure 6-2


Deer Island Treatment Plant
(general plant layout)
1. Thermal Power Plant
2. North Main Pump System
3. Fuel Storage Tanks
4. Maintenance Support Building
5. Winthrop Terminal Facility
6. Main Switch Gear Building
7. Odor Control
Water Tower
New Rest Haven Cemetery
Outfall Tunnel
1. Primary Clarifiers
2. Secondary Reactors
3. Secondary Clarifiers
4. Disinfection Basin
5. Chemical Storage Tanks
6. Cryogenics Plant
7 Odor Control Facilities
8. Grit Facility
9. South System Pump Station
Butler Building
See Inset Map Above
See Inset Map Below
Winthrop
Pier/RORO
Sludge Transfer Facility
Temporary
Guard House
Gate #1
1. Maintenance/Warehouse
2. Admin/Lab Building
3. Reception/Training Building (Historic Pumping Station)
4. Pilot Plant
5. Construction Support Building.
6. Guard House
1. Digester Module #1
2. Digester Module #2
3. Digester Module #3
4. Centrifuge Building
5. Gravity Thickeners
6. Sludge/Gas Storage
7. Odor Control Facility
8. Gas Handling Facility
Roads
Plant Fence
Walking Trail
Buildings
Parking

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 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 9.5 miles out into the waters of Massachusetts Bay. The DITP effluent is discharged through diffusers along the last 1.5 miles of the outfall where it mixes with ocean currents.

Secondary sludge is collected from the bottom of the secondary clarifiers and pumped to the centrifuge facility where excess water is removed. Thickened secondary sludge is pumped to the anaerobic digesters, and centrate from the digesters 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.

A large portion of the process descriptions provided in various portions of this Chapter were taken from the "Performance Certification" reports, which were completed following the construction and first year of operation of each component of the DITP. Performance certification of publicly-owned treatment facilities is required by funding agencies as a condition of Federal and State grant programs to demonstrate that the facilities function as the design intended. The Lead Design Engineers for DITP (Metcalf & Eddy) were also retained to evaluate the facilities and draft the Performance Certification reports. Performance Certification for DITP was completed in two phases. In the first phase, 10 construction packages (CPs) and 14 plant-wide systems were evaluated starting in 1996, with the final reports provided in 1998. Under the second phase, initially 17 construction packages and 7 plant-wide systems were evaluated, with final reports submitted in 2001/2002. The scope of work was then modified to include the Outfall Tunnel and Secondary Battery C projects, as well as, an overall facilities certification report. The Performance Certification project was completed in December 2002. Each facility was evaluated based on 15 performance standards, in three categories: Process, Operations & Maintenance, and Physical Facilities/Equipment. The performance standards involved evaluating the plant systems using parameters such as hydraulics, process efficiency, permit compliance, operation and maintenance practices, staffing and training, completion in accordance with plans and specifications, spare parts inventory, and warranty issues, among other factors. The reports identified facilities that met the requirements; provided recommendations that did not affect certification but could improve the process if implemented; and included corrective action plans for facilities that did not meet all of the requirements for Performance Certification. MWRA staff then implemented corrective action plans in order to bring each area of the plant up to the performance standard. Subsequently, all systems passed Performance Certification.

6.3 Management and Staffing

The Deer Island Director is responsible for the overall strategy and management of Deer Island, the Residuals Pellet Plant (see Chapter 7) and the Clinton Treatment Plant (see Chapter 14). The Deputy Directors from each of the four Deer Island Departments report to the Director of Deer Island. The Director's Office executes programs that provide reliable operations, maintenance, and support to satisfy regulatory agencies and the public. The DITP organization has evolved and been restructured to better suit the operation and maintenance intensive organization of today versus plant start-up needs required previously. To effectively operate and maintain the DITP, the Director allocates personnel among four organizational Departments as follows: Operations; Maintenance; Operations and Maintenance Support; and Capital Programs and Contract Services. The four Departments (detailed below) comprise approximately 254 approved positions.

Operations Department

The Operations Department consists of two functional groups: Wastewater Operations and Process Control. Operators and Area Supervisors in the Wastewater Operations group are responsible for the operation and regulatory compliance of the wastewater treatment facilities and are assigned to the four main treatment process functional areas: power and pumping, primary treatment, secondary treatment/disinfection, and residuals. 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 DITP NPDES permit compliance programs. Process Optimization staff are responsible for 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. Regular coordination meetings are held between Wastewater Operations and Process Control staff to determine if there is a need to refine plant set-up, as well as to communicate any existing or planned equipment outages that affect day-to-day operation, and thus necessitate appropriate system adjustment. The Operations Senior Shift Manager defines any adjustments to the plant set-up in written memorandums that are posted in the Central Control Room, where status white boards are constantly updated regarding any temporary revisions to the plant set-up.

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

- PICS maintenance;
- All major chemicals deliveries;
- Activated carbon replacements and nitrogen purging;
- Digester storage tank repairs; 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 preventive, predictive, and corrective maintenance of approximately 30,000 pieces of equipment. This Department consists of 145 staff, including laborers, painters, carpenters, electricians, plumbers, machinists, planner/schedulers, engineering and facility management staff.

The Asset Management and Plant Engineering Group are also 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. The Plant Engineering Group develops technical specifications for service and construction contracts in all disciplines, and provides engineering services for in-house maintenance projects. Plant Engineering staff manage one of the two "As-Needed Technical Services" contracts, which provides engineering assistance by task order for some of the more complex projects undertaken by the Maintenance Department.

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:

- Maintenance for boilers, CTGs, STGs, and hydroturbines;
- Crane and elevator maintenance;
- As-needed technical consulting (CIP task-order contract);
- 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;
- Janitorial, pest control, public access grounds keeping, trash removal services;
- Laser alignment, vibration monitoring, and lube oil analysis services; and,
- Air balancing and lab hood certification support services.

Operations and Maintenance Support Department

The Operations and Maintenance Support Department provides information, personnel and programs necessary to support the other DITP Departments. This Department consists of four functional groups: Administration and Finance, Safety/Security, Permits, and Thermal Power Plant. 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 DI staff and outside contractors. The Permits group is responsible for all plant permits except the NPDES permit. 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 Deer Island.

Work performed by the Operations and Maintenance 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;
- Fire extinguishers and alarm systems;
- Closed circuit TV systems maintenance;
- As-needed locksmith services;
- Thermal Power Plant chemicals;
- Thermal Power Plant continuous emissions system audits and maintenance;
- Air quality compliance (assistance to Real Property staff); and
- Copier and fax machine maintenance.

Capital Programs and Contract Services Department

The DITP Capital Programs and Contract Services Department works with all other DI 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 is administered and managed by this Department, which involves semi-annual coordination with Project Managers to compile the data and backup documentation for DITP projects. The Department also executes and manages contracts necessary for completion of CIP projects, as well as, manages the Technical Information Center, Contract Services Development, and the Residuals Pellet Plant. Contract Services staff work with other DITP groups to develop, review and edit the specifications for obtaining goods and services 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.). Contract Services staff also coordinate between the DITP Project Managers and the Procurement Department to expedite the contract requisitions and specifications through the development, review, advertisement, and award processes. The Department maintains a database of major contracts issued and managed by DITP, as well as an electronic library and hard copy file of the specifications and other contract documents.

Work performed by the Capital Programs and Contract Services Department is supplemented by a series of service contracts, as listed below:

- NEFCo Contract for operation of the Residuals Pellet Plant;
- As-needed consultant contract (CIP task-order contract);
- Grit and screenings hauling and disposal;
- Technical standards reference sources; and,
- Printing services.

Budget Development

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 Capital Planning group compiles the annual capital improvement program (CIP) budget for Deer Island. 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 Deer Island 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.

6.4 Operation and Maintenance

Given the significant value and critical nature of MWRA 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 DI 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 existing program with the goal of achieving a more holistic approach to maintenance management. A key component of the FAMP initiative was implementation of a new maintenance strategy called Reliability Centered Maintenance (RCM). In the spring of 2000, the MWRA retained a consultant to evaluate the DITP maintenance strategy. The Consultant reviewed the existing program and recommended changes to improve plant and equipment reliability. After a thorough examination of seven different maintenance strategies, the Consultant recommended reliability-centered maintenance (RCM) as the most comprehensive and appropriate strategy for Deer Island. The MWRA instituted a pilot program to examine RCM on Primary Clarifier Battery A, then completed twelve other system analyses. The results were favorable, and staff began implementing this strategy for all of the critical systems at Deer Island. RCM analysis of the critical systems took five years to complete, and periodic reviews will occur in the future. In the RCM process (through the use of structured questions and a "decision tree"), maintenance and operations staff jointly recommend the most appropriate maintenance requirements (including tasks, frequencies and trades involved) for a physical asset (a system or a component) to maintain its function as it is operated at each facility. Experience has shown that the original equipment vendor's preventive maintenance recommendations tend to be conservative and do not always adjust for varying operating scenarios.

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. In FY06, the MAXIMO system was upgraded to an intranet version to allow continued customer support, take advantage of web-based software maintenance, and to utilize new functionality. As part of the FAMP consultant support services, several reports and features were added to MAXIMO to assist in the budgeting process. MAXIMO's functionality was improved to include a history of yearly costs for all 30,000 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. The following information presents sample asset assessments as of July 2006:

Pump Stations

- Permanent condition monitoring devices (vibration and temperature) are installed;
- Normal pump preventive maintenance completed based on run times;
- Recently refurbished several pumps in NMPS and SSPS;
- General condition - good.

Primary Tanks

- Inspected annually as part of preventive maintenance program;
- Tank wear shoes are being replaced due to failures in all tanks;
- Drive chains are being replaced as failures occur;
- CIP project to improve scum system and replace longitudinal chains;
- Current condition – good.

Secondary Tank/Disinfection

- Scum tip tubes refurbished in Batteries A/B with SS components;
- Current condition – good.

Centrifuges

- Inspections completed monthly including vibration analysis;
- Permanent continuous vibration and temperature monitoring protect equipment;
- Recommended run hour refurbishments have started (20,000 - 25,000 hours);
- In addition to wear and tear refurbishments, warranty modifications have been completed;
- Overall in good condition, keeping ahead of wear and tear issues.

Digesters

- Digesters cleaned and inspected 1999-2000;
- Cleaning and inspection contracted;
- Next inspection scheduled for five to ten years;
- Digesters are in good condition other than struvite formation.

Digester Mixers

- Handheld vibration readings of mixers are taken quarterly in addition to normal preventative maintenance;
- Mixers in fair condition;
- 2-3 Digester mixers refurbished annually under CEB until all mixers are refurbished;
- Mixer impellers have wear and struvite buildup and bearings require replacement.

Hypochlorite Tanks

- Rubber lining inspections completed for all tanks in 2001/2002;
- Inspections contract w/ Corrosion Probe as part of As-Needed Engineering contract;
- CIP funding to repair two tanks, one tank is being relined;
- Current Condition – fair, one additional tank needs to be relined.

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 6.3. CIP-funded contracts are issued for on-going engineering services (As-Needed Design contracts, used to supplement in-house engineering staff) and all other approved CIP projects. The As-Needed Design contracts are task-order contracts with engineering firms that have multiple engineering disciplines (structural, civil, mechanical, electrical, chemical) as well as other technical consultants with expertise in fields such as hydrology, biology, landscape design, architectural design, marine biology, etc. Three as-needed design contracts are programmed in the FY07 CIP under Plant Optimization (As-Needed Design 4-1 and 4-2 at $1.134 million; As-Needed Design 5-1 and 5-2 at $1.8 million; and Long-Term As-Needed Design 1 and 2 at $3.2 million). 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.

6.5 Pumping and Preliminary Treatment

There are three pump stations on Deer Island: the Lydia Goodhue (South System) 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.

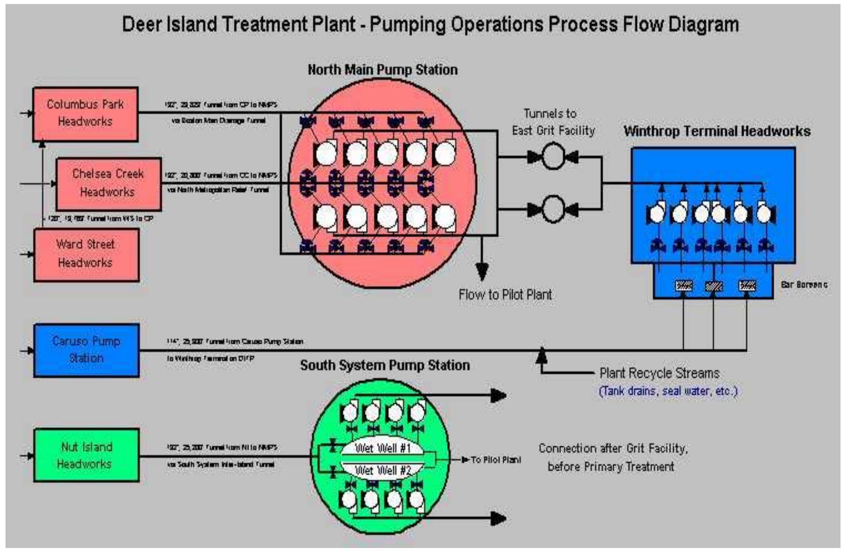


Figure 6-3

South System Pump Station

Facility Function and Operation: The South System Pump Station (SSPS), named the Lydia Goodhue Pump Station upon commissioning, was completed under the CP-104 contract. The 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 the flow to the influent chamber from the north shaft of the Inter-Island Tunnel. The 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. The alternative discharge location for the south system flows is directly to Primary Clarifier Battery D, allowing for isolation of the south system flow. 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, satisfying Milestone 11 of the Court Order.

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.

Ongoing and Recommended Upgrades:

- A CEB contract is being implemented in FY06-07 to replace 8 flow meters (S420, $483,000 scheduled for May – November 2006) that have begun to fail due to the corrosion in the harsh environment of the wet well areas.
- Ancillary Modifications Design [including engineering services during construction and resident inspection (ESDC/REI)] and Construction 2-2 for installation of variable frequency drives (VFDs) and DC chokes at the SSPS, included in the FY07 CIP at $3.574 million to be completed through FY08. The VFDs are expected to need replacing every 5-7 years.
- Pump Packing Replacement project to replace remaining pump packing seals with mechanical seals for SSPS, NMPS, and WTF, included in the FY07 CIP at $200,000 during FY07-08.
- Electrical Equipment Upgrades 2, 3, and 4 (contracts 6767 at $1.9 million and 6855 at $4.9 million) include replacement of the A and B bus ducts with cable bus (in addition to work at other substations), is part of DITP's on-going program to replace transformers and bus ducts at the end of their useful lives, included in the FY07 CIP at a total cost of $7.757 million to be completed through FY11.
- Future SSPS VFD Replacements to replace obsolete variable frequency drives in the South System Pump Station is recommended for consideration in the FY08 CIP and estimated at $6 million every 10 years beginning in FY16.
- SSPS Pump Lube System Replacement to replace the pump lubrication system, recommended for consideration in the FY08 CIP and estimated at $1.7 million in FY08-09.

Once installed, the new system will require only routine maintenance, not replacement. Cost is estimated at $1.7 million in FY08-09.

- Future SSPS shaft and/or Motor Replacements to replace worn shafts and/or obsolete motors in the South System Pump Station, recommended for consideration in the FY08 CIP and estimated at $1.5 million in FY14, and $.5 million every 15 years.

North Main Pump Station

Facility Function and Operation: The North Main Pump Station (NMPS) was constructed in 1968 as part of the original DITP. It is located on the northwest corner of Deer Island, near the Thermal Power Plant. The NMPS receives flow from the north system through two deep-rock tunnels, which connect to three suction headers – one for the North Metropolitan Relief Tunnel (from the Chelsea Creek Headworks) and two for 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 distributed control system manages the speed of the pumps operating, 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.

Ongoing and Recommended Upgrades:

- Pump Packing Replacement project to replace remaining pump packing seals with mechanical seals for SSPS, NMPS, and WTF, included in the FY07 CIP at $200,000 during FY07-08.
- Electrical Equipment Upgrades 2, 3, and 4 is part of DITP's on-going program to replace transformers and bus ducts at the end of their useful lives, included in the FY07 CIP at a total cost of $7.757 million to be completed through FY11.
- VFD Replacements (NMPS, WTF, and miscellaneous other facilities) for installation of variable frequency drives (VFDs) to replace obsolete equipment at the NMPS, WTF, and other facilities throughout DITP, included in the FY07 CIP at $11.029 million to be completed through FY10. The VFDs are expected to need replacing every 5-7 years.
- North Main Pump Station – Motor Control Center (MCC) Design and Construction to replace obsolete MCC equipment and replace cracked end rings in the NMPS motors, included in the FY07 CIP at $3.704 million during the FY07-10 timeframe (Contracts 6971 & 6972).
- Future NMPS VFD Replacements to replace obsolete variable frequency drives in the North System Pump Station, recommended for consideration in the FY08 CIP and estimated at $6.5 million every 10 years beginning in FY18.

- North Main Pump Station Motor Control Center Design and Construction to replace the North Main Pump Station MCC equipment as it becomes obsolete/unreliable, recommended for consideration in the FY08 CIP and estimated at $3.5 million in FY28 and 48.
- Future NMPS shaft and/or Motor Replacements to replace worn shafts and/or obsolete motors in the North Main Pump Station, recommended for consideration in the FY08 CIP and estimated at $2.2 million in FY15, and $2.2 million every 15 years.
- Enterprise Engine Removal to remove the diesel engines from the North Main Pump Station building, recommended for consideration in the FY08 CIP and estimated at $600,000 and recommended for FY14.

Winthrop Terminal Facility

Facility Function and Operation: The Winthrop Terminal Facility (WTF), also part of the original Deer Island Wastewater Treatment Plant, was constructed in 1968. 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 and climber screen penthouse, 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 thorough a nearby substation and the Thermal Power Plant provides back-up power.

Ongoing and Recommended Upgrades:

- Under recently completed Ancillary Modifications Construction projects the WTF screens, screen press, hoppers, vacuum conveyance system, and conduits were replaced and the inlet chamber rehabbed and a building addition was constructed to enclose the screenings containers. WTF switchgear was also recently replaced.
- Pump Packing Replacement project to replace remaining pump packing seals with mechanical seals for SSPS, NMPS, and WTF, included in the FY07 CIP at $200,000 during FY07-08.
- Electrical Equipment Upgrades 2, 3, and 4 is part of DITP's on-going program to replace transformers and bus ducts at the end of their useful lives, included in the FY07 CIP at a total cost of $7.757 million to be completed through FY11.
- VFD Replacements (NMPS, WTF, and miscellaneous other facilities) for installation of variable frequency drives (VFDs) to replace obsolete equipment at the NMPS, WTF, and other facilities throughout DITP, included in the FY07 CIP at $11.029 million to be completed through FY10 (Contracts 6902 and 6903). The VFDs are expected to need replacing every 5-7 years.
- Future WTF VFD Replacements to replace obsolete variable frequency drives in the Winthrop Terminal Facility, recommended for consideration in the FY08 CIP and estimated at $ 1.4 million every 10 years beginning in FY19.
- Future WTF shaft and/or Motor Replacements to replace worn shafts and/or obsolete motors in the Winthrop Terminal Facility, recommended for consideration in the FY08 CIP and estimated at $800,000 in FY 16, and $800,000 every 15 years.

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.

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.

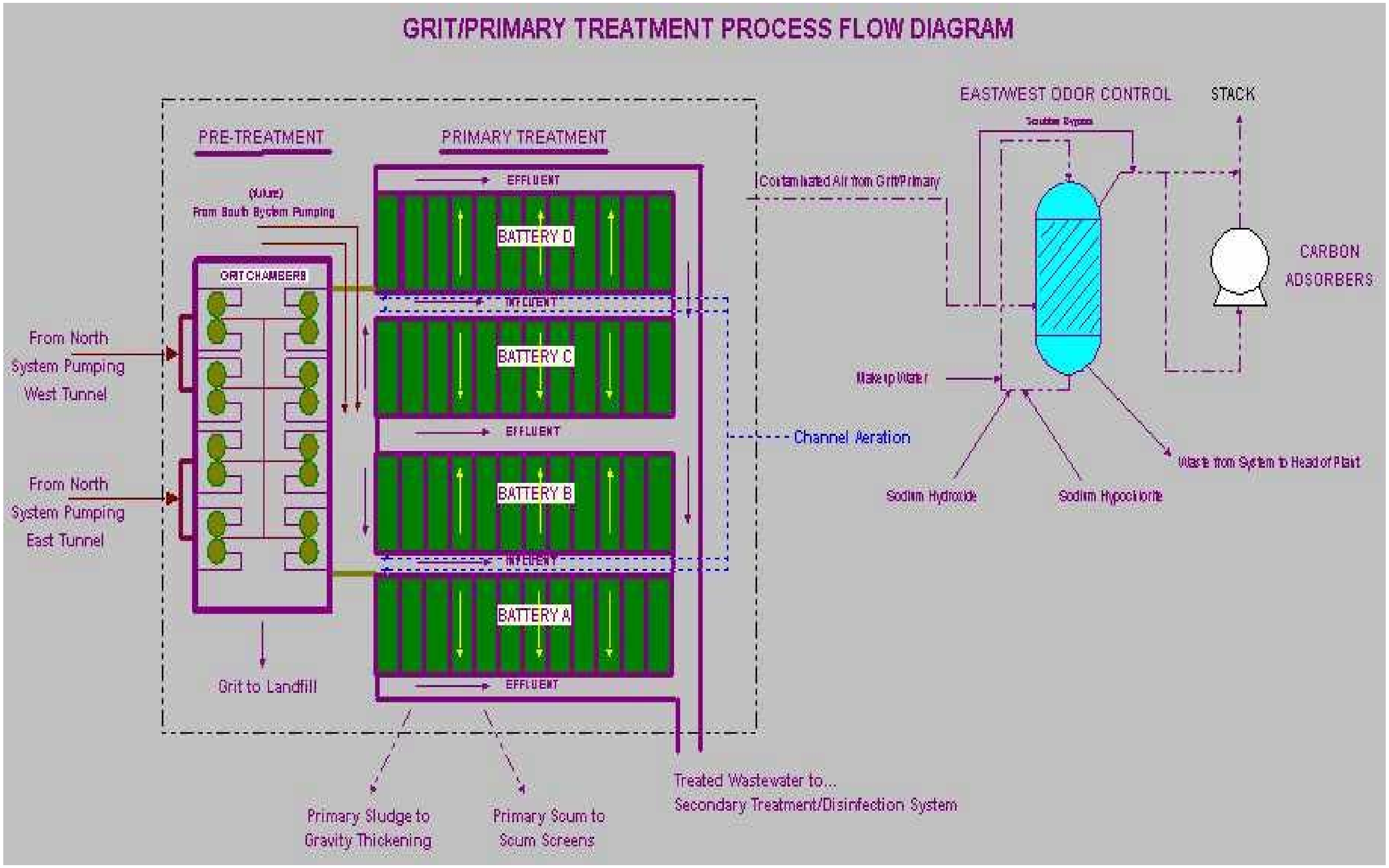
The screw classifier provides further removal of organics and water from the grit, and discharges the washed grit onto belt conveyors. Each belt conveyor serves four grit chambers and transfers the grit to two shuttle conveyors. The shuttle conveyors, each serving eight grit chambers, distribute grit 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.

Ongoing and Recommended Upgrades:

- Grit Blower Replacement Construction (Contract 7052) to replace a high-maintenance grit blower with a dedicated air-handling/compressor system for improved grit handling, included in the FY07 CIP at $335,000 during FY08-09.

Figure 6-4


GRIT/PRIMARY TREATMENT PROCESS FLOW DIAGRAM
PRE-TREATMENT
PRIMARY TREATMENT
EFFLUENT
BATTERY D
INFLUENT
BATTERY C
EFFLUENT
BATTERY B
INFLUENT
BATTERY A
EFFLUENT
GRIT CHAMBERS
From North System Pumping West Tunnel
From North System Pumping East Tunnel
Grit to Landfill
Primary Sludge to Gravity Thickening
Primary Scum to Scum Screens
Treated Wastewater to...
Secondary Treatment/Disinfection System
Contaminated Air from Grit/Primary
Channel Aeration
EAST/WEST ODOR CONTROL
STACK
CARBON ADSORBERS
Makeup Water
Sodium Hydroxide
Sodium Hypochlorite
Waste from System to Head of Plant

6.6 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.

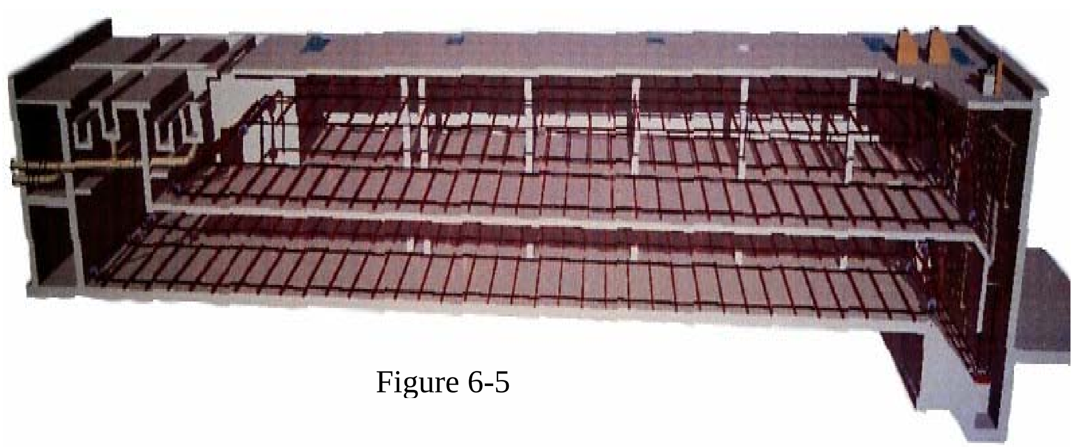


Figure 6-5

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 CP-105 consisting of Primary Clarifier Batteries A and B, the Central Blower Facility, and associated galleries and support systems. Construction of Batteries A and B provided primary clarification of half of the design flow, including primary sludge and scum collection and removal, while batteries C and D were constructed. Functional testing for CP-105 was completed and partial turnover occurred on December 23, 1994; start-up occurred on January 20, 1995. Primary Clarifier Batteries C and D were constructed under CP-130, which completed testing and start-up 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 the 12 stacked clarifiers in each battery. The pumps are variable speed, with a 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.

Ongoing and Recommended Upgrades:

- The clarifier chain and flight skimmer systems are driven by deck-mounted motors with a set of chains running from the deck to the cogs beneath the water surface, which moves the skimmers. Most of the chain used in the whole system remains submerged, but this drive chain passes in and out of the water, increasing the rate of corrosion. In Drive Chain Replacement 1, new chain was purchased through a purchase order. As sections of chain fail, maintenance staff replaced it with pre-purchased chain.
- Primary Clarifier and Gravity Thickener Rehabilitation Design (Contract 6965) to select a consultant to design the primary clarifier rehabilitation and the gravity thickener improvement projects, included in the FY07 CIP at $1.2 million during the FY07-11 timeframe.

- Primary Clarifier Rehabilitation Construction (Contract 6899) to replace longitudinal chains, sprockets, wall expansion joints, chain drives, tip tubes, hose bibs, actuators, drive motor systems, and adding more drop boxes in the primary clarifiers, included in the FY07 CIP at a total cost of $6.041 million during the FY09-11 timeframe.
- Expansion Joint Repairs 2 and 3 to continue the ongoing program to periodically replace failed expansion joints in the concrete clarifier decks and/or various retaining walls, included in the FY07 CIP at $312,000 during the FY07-10 timeframe. This project is scheduled to be performed in two phases (2 and 3), estimated at $156,000 each. Prior projects to repair the upper-deck expansion joints that had failed (Contracts 6668 and 6669) were completed in 2003 at a total cost of $454,000.
- VFD Replacements (NMPS, WTF, and miscellaneous other facilities) for installation of variable frequency drives (VFDs) to replace obsolete equipment at the NMPS, WTF, and other facilities throughout DITP, included in the FY07 CIP at $11.029 million to be completed through FY10. This project will include work within the primary treatment facilities.

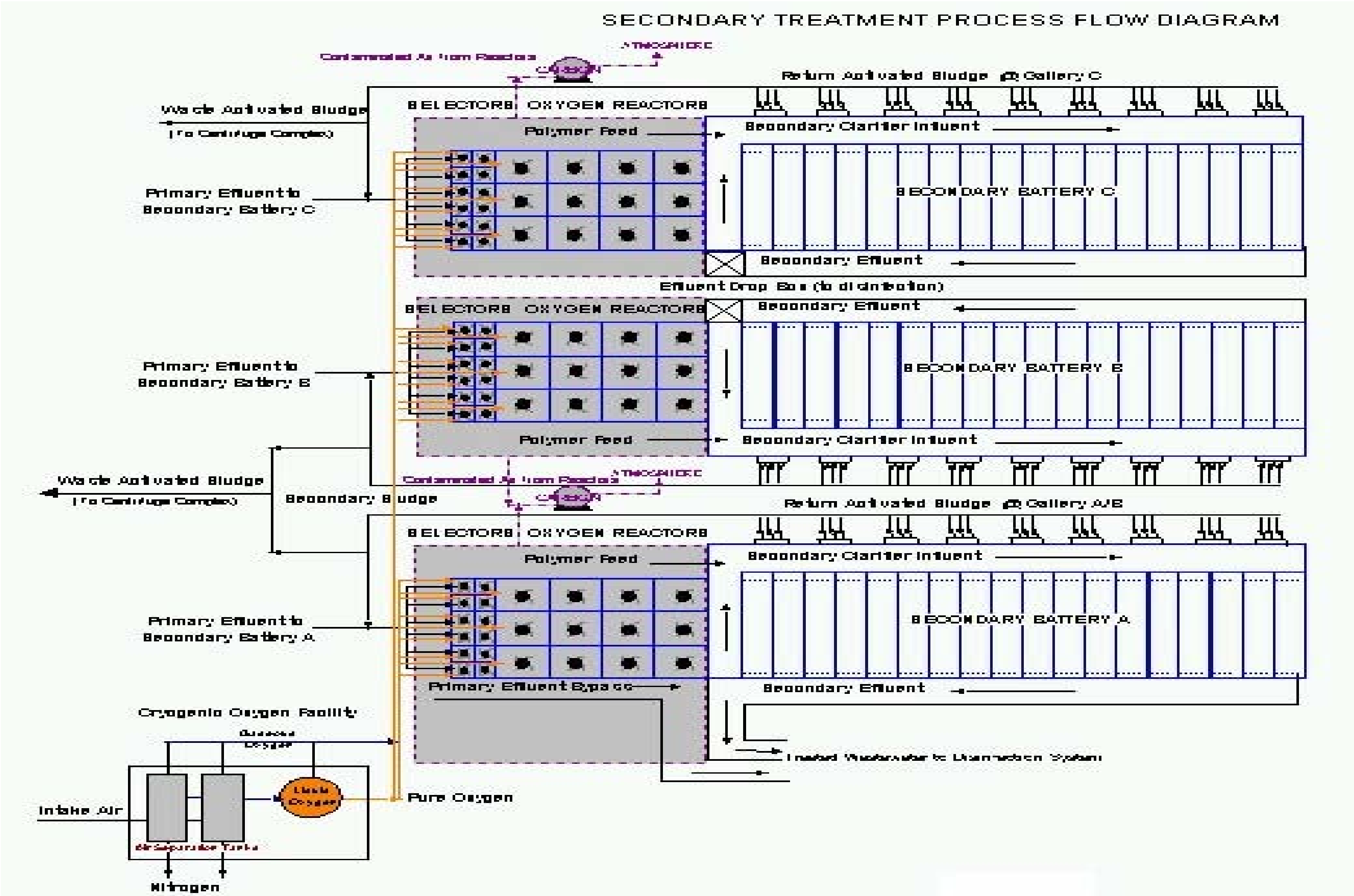
6.7 Secondary Wastewater Treatment

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.

Figure 6-6


SECONDARY TREATMENT PROCESS FLOW DIAGRAM
Return Activated Sludge @ Gallery C
Waste Activated Sludge
(To Centrifuge Complex)
SELECTORS
OXYGEN REACTORS
Polymer Feed
Secondary Clarifier Influent
SECONDARY BATTERY C
Secondary Effluent
Primary Effluent to Secondary Battery C
Effluent Drop Box (to disinfection)
SELECTORS OXYGEN REACTORS
Secondary Effluent
Primary Effluent to Secondary Battery B
SECONDARY BATTERY B
Polymer Feed
Secondary Clarifier Influent
Waste Activated Sludge
(To Centrifuge Complex)
Secondary Sludge
Return Activated Sludge @ Gallery A/B
SELECTORS
OXYGEN REACTORS
Polymer Feed
Secondary Clarifier Influent
SECONDARY BATTERY A
Primary Effluent to Secondary Battery A
Primary Effluent Bypass
Secondary Effluent
Cryogenic Oxygen Facility
Pure Oxygen
Intake Air
Nitrogen

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.

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.

Ongoing and Recommended Upgrades:

- As part of routine maintenance, when necessary, major pieces of equipment such as aerator mixer motors may be sent off-site for refurbishment.

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 to 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 to 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.

Ongoing and Recommended Upgrades:

- Ancillary Modifications Preliminary Design, Final Design [including engineering services during construction and resident inspection (ESDC/REI)] and Construction 4 for modifications to the cryogenic facility, plant-wide odor control systems, digester gas, and scrubber improvements, included in the FY07 CIP at $4.783 million to be completed during FY08-12. Under Contracts 6592, 7088 and 6538 improvements and modifications to the Cryogenic Facility are planned to improve functionality, provide more options for continued operation while performing periodic maintenance and reducing system downtime.
- Cryogenics Plant Equipment Replacement to replace equipment, valves, instrumentation, etc. at the Cryogenics Plant, recommended for consideration in the FY08 CIP and estimated at $2 million dollars every 10 years beginning in FY14.
- Cryogenics Plant Cooling Tower and Related Equipment Replacement to replace the cooling towers and related equipment at the Cryogenics Plant, recommended for consideration in the FY08 CIP and estimated at $450,000 every 20 years beginning in FY19.

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. Flow from each effluent channel continues to the disinfection facilities. 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. Processing flows at too high a flow rate [such as during peak (wet weather) flow conditions] 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.

Ongoing and Recommended Upgrades:

- Under previously completed Ancillary Modifications Design & Construction 3-1 (Contracts 6591 & 6537 for $4.3M total, completed November 2004) secondary clarifier upgrades were made including: cross collector hatches, intermediate hatch covers, safety railings, influent and effluent channel drains and sluice gates, RSL piping modifications, and scum collection system modifications.

- Study/Concept Design – Concrete Repairs (Contract 6727) for protective coatings on concrete below the water line in the secondary clarifiers and disinfection basins, included in the FY07 CIP at $300,000 during the FY07-08 timeframe.
- VFD Replacements (NMPS, WTF, and miscellaneous other facilities) for installation of variable frequency drives (VFDs) to replace obsolete equipment at the NMPS, WTF, and other facilities throughout DITP, included in the FY07 CIP at $11.029 million to be completed through FY10. This project will include work within the secondary treatment facilities.
- Secondary Clarifier Rehabs to replace interim hatches, longitudinal chains, expansion joints, A/B crossover, etc in the secondary clarifiers, recommended for consideration in the FY08 CIP and estimated at $4 million in FY14, and again in FY29 and FY44.
- Secondary Clarifier Drive Chain to replace drive chains in the secondary clarifiers, recommended for consideration in the FY08 CIP and estimated at $250,000 in FY19, and again in FY29 and FY39.

6.8 Disinfection and Dechlorination

The Disinfection Facilities were constructed under CP-204 and CP-241. CP-204 included three sodium hypochlorite storage tanks, the disinfection gallery and associated processes, and support systems. The disinfection basins were constructed under CP-241. The 50-foot wide disinfection gallery lies at the southern end of the disinfection basins and contains chemical and plant-water process equipment, piping, and appurtenances. Start-up of the permanent disinfection facility occurred on December 14, 1995. Figure 6-7 shows the flow diagram for the disinfection process.

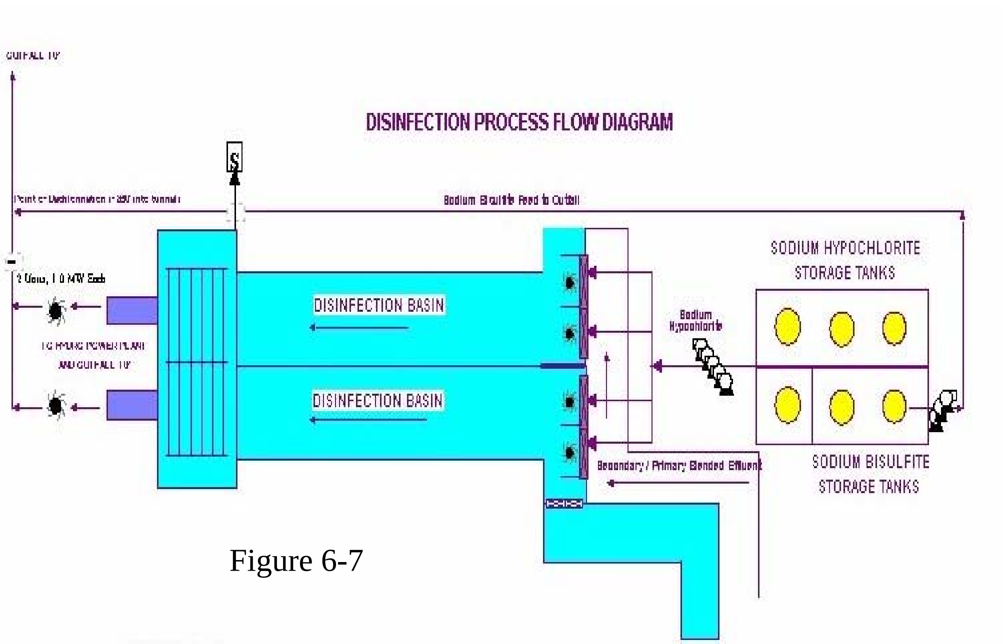


Figure 6-7

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.

Facility Components: The disinfection basin influent channel contains sluice gates and roller gates, covering the submerged openings into the basins. 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. Barge delivery is provided as the primary method of sodium hypochlorite transport due to the large volume required.

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.

Hydraulic Performance: 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.

Ongoing and Recommended Upgrades:

- Disinfection hose pumps are routinely replaced under the CEB.
- A future CEB project is under development to replace the view ports in the chemical containment tray that runs beneath the sodium hypochlorite and bisulfite lines.
- Study/Concept Design – Concrete Repairs (Contract 6727) for protective coatings on concrete below the water line in the secondary clarifiers and disinfection basins, included in the FY07 CIP at $300,000 during the FY07-08 timeframe.
- Sodium Hypochlorite Pipe Replacement Design and Construction (Contracts 6853 and 6854) to replace the PVC piping that transports sodium hypochlorite from the barge to the storage tanks, included in the FY07 CIP at $2.983 million in FY10-12. The pipeline has had joint leakage problems, requiring frequent attention from maintenance staff.
- Pipeline Replacement Design and Construction (Contracts 6851 and 6852) for planned periodic replacement of various chemical pipelines in the disinfection and odor control facilities due to deterioration from corrosion, included in the FY07 CIP at $1.672 million in FY09-11.

- Sodium Hypochlorite Tank Liner Removal and Repair (Contract 7089 and Contract 6764) to remove the failed lining in one of the four hypochlorite tanks (tank number 1) and repair any wall corrosion prior to tank relining, included in the FY07 CIP at $552,000 in FY07. As of July 2006, tank 3 had also developed a leak and staff are in development of a plan for coordinating this work with the tank 1 work.
- Sodium Hypochlorite Tank Rehabs to strip and reline sodium hypochlorite tanks is recommended for consideration in the FY08 CIP. Emergency repair of 3 tanks is included in FY07-08. Cost is estimated at $625,000 every 10 years beginning in FY07.
- Sodium Bisulfite Tank Rehabilitation to strip and reline the bisulfite tanks, recommended for consideration in the FY08 CIP and estimated at $1 million every 20 years beginning in FY11.
- Barge Berth and/or Pier Facilities Rehab to maintain the barge berth areas and piers for deliveries of sodium hypochlorite and fuel, recommended for consideration in the FY08 CIP and estimated at $1 million every 20 years beginning in FY11.

6.9 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 invert elevation 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 tunnel was drilled northeasterly from Deer Island 9.5 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. 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 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 was placed into continuous service on September 6, 2000.

A Tunnel Boring Machine (TBM) manufactured specifically for this project bored the tunnel to a 27-foot rough diameter at approximately 100 feet per day. Tunnel lining was completed as the tunnel advanced, using precast, segmented concrete to reduce the construction time and meet the court ordered schedule. The precast liner has six trapezoidal segments in each ring, with Neoprene gaskets between all joints. The annulus between the rock surface and the outside diameter of the lining was filled with pea stone and grouted. As the tunnel was being bored, a drilling barge completed installing the 55 risers spaced out over the last 1.25 miles of the tunnel to achieve mixing over a wide area of Massachusetts Bay and take advantage of the natural mixing with the ocean currents. The area around each effluent diffuser was dredged, and a temporary 6-foot diameter casing driven into the seabed to maintain accessibility to the hole while drilling and contain drilling fluids. A hole was advanced to solid bedrock and a permanent 5-foot diameter casing was grouted into place. A 4.25 foot diameter rock bit completed the drilling to near the invert of the tunnel. Upon completion, the riser pipe was connected to the diffuser head and the assembly was lowered into the hole. At this point the temporary casing was cut off so the diffuser could be tied into the permanent casing and the annulus grouted. The area beneath the diffuser head was also grouted.

Rock armor was placed around the diffusers once the protective dome was installed. The finished diameter of the riser is 2.5 feet. Each riser has a riser cap with eight, eight-inch discharge ports spaced around the cap for flow dispersion. After all diffusers were connected, the temporary ventilation and the rail systems were removed from the outfall tunnel starting from the diffuser area back to the shaft. Start-up of the tunnel was completed under a separate contract. Figures 6-8 and 6-9 depict the outfall tunnel and a cross-section of a riser and diffuser.

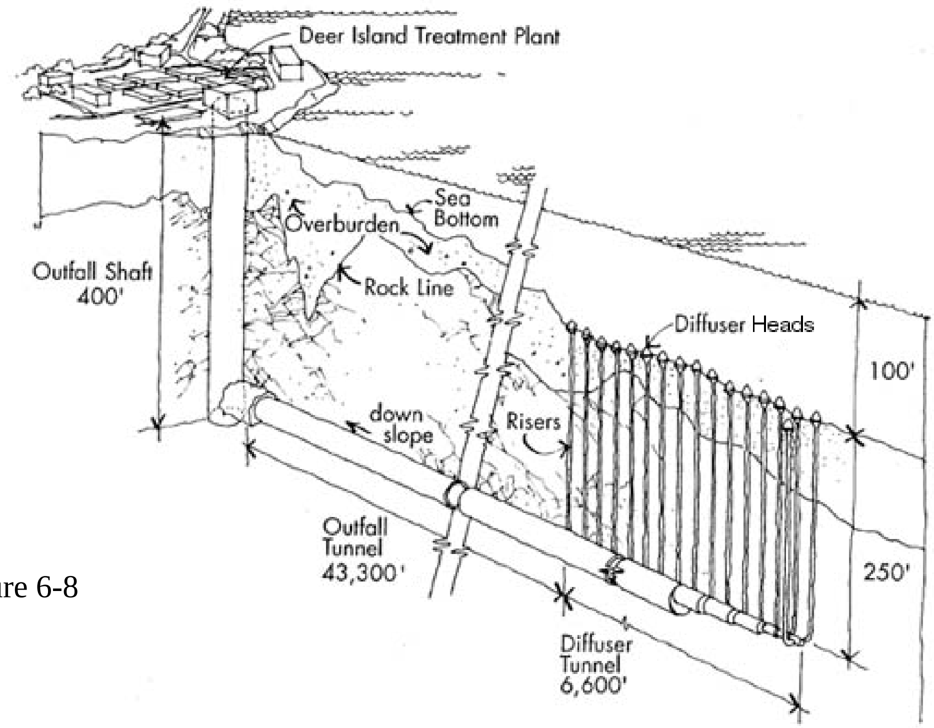
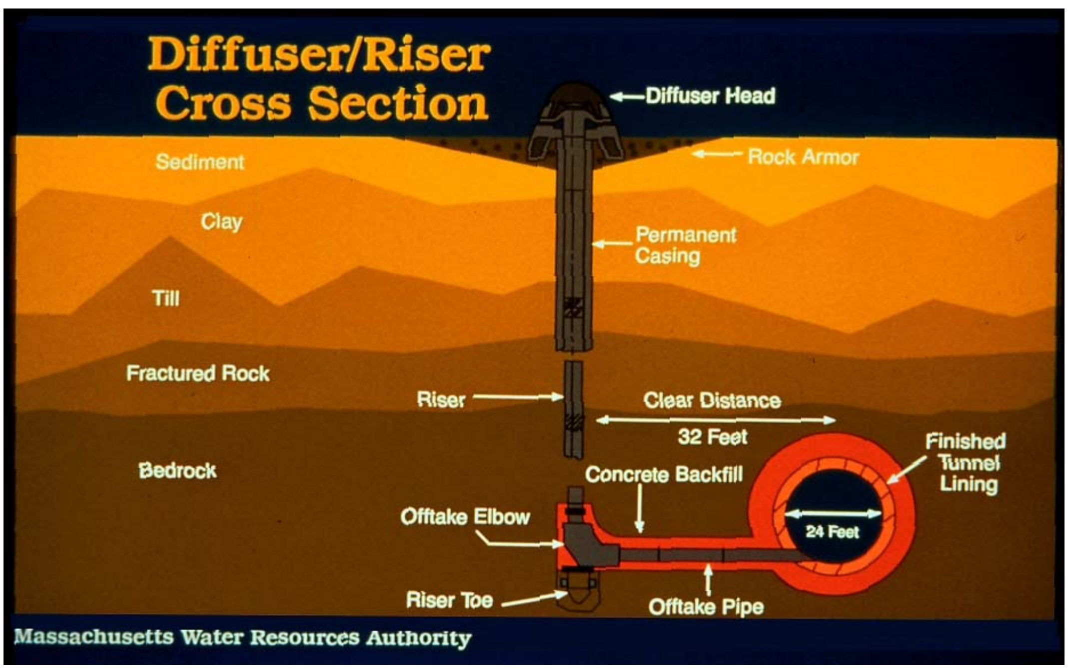


Figure 6-8



Facility Components: CP-282 consisted of the outfall chute from the disinfection facility, the hydropower facility, the tunnel shaft, the outfall tunnel, riser pipes, and diffusers.

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 ft, 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.

Ongoing and Recommended Upgrades:

- DI Outfall Modifications Construction/REI to re-inspect, clean out and close-off old DITP outfalls, recommended for consideration in the FY08 CIP and estimated at $1.1 million for a 2-year duration (initial project) during the FY14-18 timeframe. Future upgrades are anticipated to cost $150,000 every 10 years after the initial project, for a total estimated cost of $1.55 million.

6.10 Residuals Processing

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

Gravity Thickening

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.

Ongoing and Recommended Upgrades:

- 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. The thickener overflow boxes need to be recoated; this work will be included in one of the painting and coating contracts.
- Thickened Primary Sludge Pump Replacement (Contracts 7053 and 7054) to design and construct the replacement of the thickened primary sludge pumps to reduce water use and maintenance costs, included in the FY07 CIP at $5.789 million during the FY08-11 timeframe.
- Primary Clarifier and Gravity Thickener Rehabilitation Design (Contract 6965) to select a consultant to design the primary clarifier rehabilitation and the gravity thickener improvement projects, included in the FY07 CIP at $1.2 million during the FY07-11 timeframe.
- Gravity Thickener Improvements - Construction (Contract 6966) to install catwalks, remove concrete in the effluent channel, and modify roofing for sludge thickeners to improve staff access and operating efficiency, included in the FY07 CIP at $2.014 million in FY09.

Centrifuge Thickening

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. Dry polymer was initially used; however there were problems with polymer caking; clogging storage totes, and slip hazards due to polymer dust on the floor. The use of liquid polymer eliminated these problems.

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.

Ongoing and Recommended Upgrades:

- The CEB includes $275,000 per year for centrifuge refurbishments, required for work outside the scope of the annual centrifuge maintenance contract.
- Centrifuge Back-drive Replacements (Contract 7054) due to equipment obsolescence, included in the FY07 CIP at $2.161 million in FY08-09. These items are expected to need replacing every 7 to 10 years.
- Centrifuge Replacements to replace worn centrifuges is recommended for consideration in the FY08 CIP. The cost per centrifuge is estimated at $1.3 million. The program calls for 4 centrifuges to be replaced every 10 years, at a cost of $5.2 million beginning in FY14.

Sludge Digestion Facilities

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 two 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. The primary side and secondary sides of this system transfer heat across water to water, and then water to sludge heat exchangers, to heat individual digesters within a given module.

Facility Components: Two digester modules, each containing four egg-shaped, 3.0 million gallon anaerobic digesters were constructed under CP-301 for the digestion of thickened primary and waste activated (secondary) sludge. Module 1 was substantially complete on July 10, 1995. Module 2 was substantially completed on December 8, 1995. A third digester module was constructed under CP-303, and was completed in December 1997. Three of the four digesters in each module serve as active digesters, while one of the digesters 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, which connects to a main header. The digested sludge flows by gravity through the header system 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. Each sludge heat exchanger is a tube-in-tube design and has a design heat transfer rating of 3 MBTU/hour under fouled conditions. 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 that may have formed, as well as 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.

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.

Ongoing and Recommended Upgrades:

- Since start up of the digester facilities, a number of the draft tubes (digester mixing equipment) were removed by maintenance staff and rebuilt by an outside contractor, as needed.
- Under previously completed CIP Ancillary Modification Design & Construction 1 (6364 and 6499, $12 million total, completed in March 2006), digester gas meters were replaced and additional isolation valves were installed to allow for nitrogen gas purging without shutting down an entire module for improved maintenance and system flexibility.
- Digested Sludge Pump Replacements (to FRSA) to replace the pumps that pump sludge to the pellet plant, recommended for consideration in the FY08 CIP and estimated at $2 million in FY10 and again in FY30.

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: 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.

<u>Facility Power</u>: 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.

<u>Ongoing and Recommended Upgrades</u>:

- The gas storage tank membranes were replaced (CIP contract 7006, $640,000 total) after one of the outer membranes tore. The torn membrane was replaced in September 2004 and the other tank membrane was replaced in 2005. Based upon experience, it is expected that the membranes will need replacing every 8 to 10 years.
- The original digester gas chiller installed with the gas handling facility was oversized and did not operate well at the low end of the operating range. It was replaced under CIP project 7005, Digester Chiller Replacement, completed in May of 2006 for $574,000.
- Dystor Tank Membrane Replacements to replace the gas and sludge storage tank membranes, recommended for consideration in the FY08 CIP and estimated at $750,000 every 10 years, beginning in FY15.

Sludge Pumping to the Residuals Pellet Plant

<u>Facility Function and Operation</u>: 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 Braintree-Weymouth Tunnel to the Pellet Plant.

<u>Facility Components</u>: Digested sludge is pumped at 2 to 3 percent solids via three 250 horsepower hydraulic piston diaphragm pumps. Each pump is rated up to 800 gpm. 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 Saturday morning. Sludge

pumping is shut down Saturday night through Monday morning, when the pellet plant is normally unattended. 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 over the past year) 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. If two of the diaphragm pumps were to fail, a single diaphragm pump can barely keep up with the sludge production at Deer Island. It has been demonstrated that with sufficiently high head in the sludge storage tanks, some sludge can be pumped to the Pellet Plant by utilizing the centrifugal chopper pumps (furnished under Contract 5316 as tank recirculation pumps); however, these pumps cannot pump adequate quantities under all necessary head and pressure conditions.

The sludge barge loading station and connection hoses are still operable, but due to the high cost, no barge is kept available. With the sludge barges decommissioned, loss of both force mains would require either intensive emergency work to repair one of the force mains, or rapid acquisition of a suitable barge. Fortunately, the simultaneous loss of both force mains is unlikely, since only one main is used at a time.

Ongoing and Recommended Upgrades:

- DITP is currently initiating a project to determine the practicality of installing a back-up centrifugal pumping system to enable sludge pumping in the event of simultaneous mechanical failure of the maintenance-intensive piston diaphragm pumps. It is anticipated that such a back-up system is possible, but more detailed feasibility investigation is required. No project schedule or cost estimate has been developed.

6.11 Electrical Generation and Distribution

Three electric power sources are currently available for the DITP: the cross-harbor marine cable connected to NSTAR’s K Street Substation in South Boston; the Thermal Power Plant on Deer Island; and the Hydropower Facility at the DI outfall shaft. A fourth option, wind power, is under study. 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 17-mile marine cable embedded beneath the floor of Boston Harbor. The cable is owned and operated by Harbor Electric Energy Company, an unregulated wholly-owned subsidiary of NSTAR. The cross-harbor cable was placed into service in 1991. Capital, operating and maintenance cost of the cable and substation are funded under a 25-year interconnection agreement that expires in 2015. The interconnection agreement may be extended under terms to be negotiated commencing at least two years prior to the expiration of the agreement.

Facility Components: The cross-harbor marine cable supplies 115,000 volt, 3-phase power from NSTAR's K Street Substation in South Boston. The marine cable terminates on Deer Island at the NSTAR 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.

Ongoing and Recommended Upgrades:

- DI Cross-Harbor Cable Dredging Construction is recommended to be added to the CIP as a contingency at $20 million during the FY09-10 timeframe. As a result of a major navigation channel improvement project being planned by the U.S. Army Corps of Engineers (Army Corps) and Massport, a dispute has arisen in which the Army Corps asserts that the cable was not installed at the appropriate depth in certain locations, as specified in its Army Corp permit, and portions must be relocated to permit the navigation improvement project to proceed. The MWRA has formally disclaimed any liability and responsibility for relocating the cable, nonetheless, the MWRA is including a $20 million contingency fund in the CIP. It is expected that the Army Corps will proceed with its schedule to have the cable relocated by June 2008.

Thermal Power Plant

Facility Function and Operation: The Thermal Power Plant (TPP) is located on the north end of Deer Island, 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 70 MW of electric power from two CTGs rated at 26 MW each, and one STG rated at 18 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. Turnover of the various components of the TPP occurred in three stages between August 1995 to 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. Deer Island management calls for certain staff to be on-site whenever the overall plant flow exceeds certain limits (usually when severe weather is forecast).

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 loop hot return line is reheated through the high temperature water loop heat exchangers and sent to the loop hot supply line, 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 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 steam turbine is a 13-stage, impulse type, backpressure turbine manufactured by IMO Industries Inc., Delaval Turbine Division. The generator is a two-pole, three-phase, water-cooled revolving field 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 STG is controlled remotely from the power plant

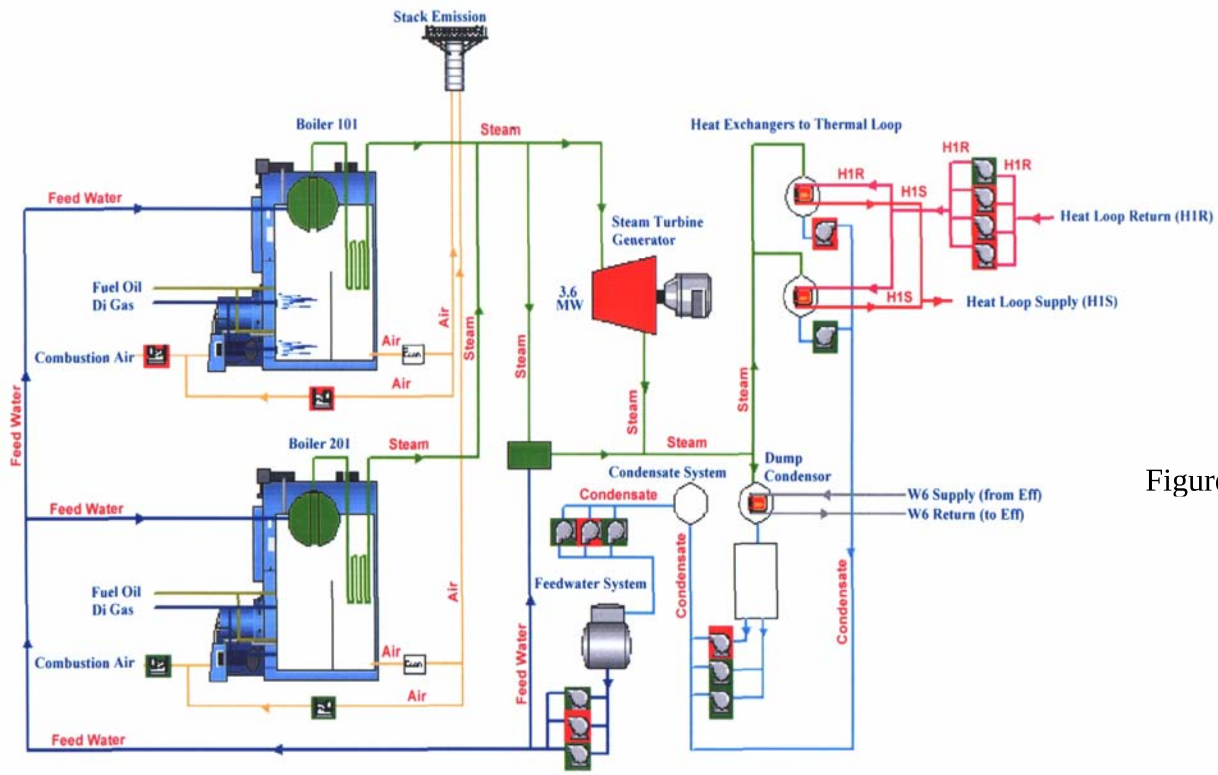
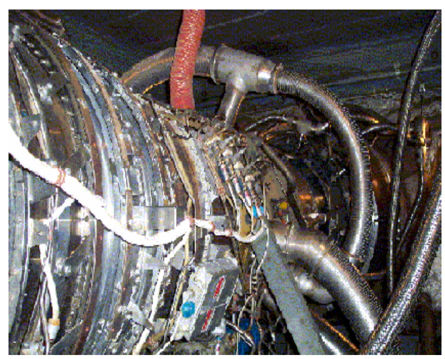


Figure 6-10

control room but does require some manual operation of valves at the turbine during startup and shutdown, as well as significant coordination of the plant support systems.

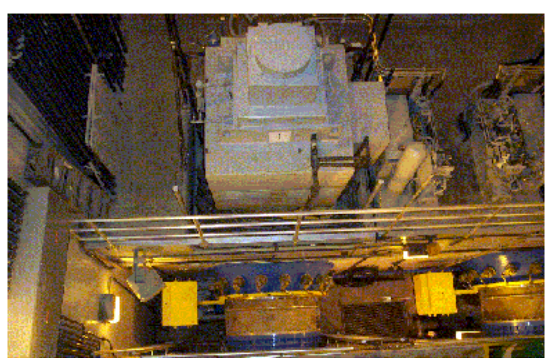


Two combustion turbine generators (CTGs) are used for backup electrical power supply in the event of loss of NSTAR power to DITP via the cross-harbor marine cable. The CTGs were supplied by Turbo Power and Marine Systems, Inc. (a Division of United Technologies Corporation) and were installed under CP-431. 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 #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.

Ongoing and Recommended Upgrades:

- Previously completed CIP Ancillary Modifications Design and Construction 2-1 (Contracts 6590 and 6536, July 2001 to September 2003, $3.65 million combined total) involved replacing bus ducts with cable bus for the TPP switchgear, in addition to NMPS work..
- The PICS monitors and controls in the TPP control room were upgraded in 2005 (CEB).
- LOCAT Scrubber Replacement Construction (Contract 7056) to replace the Thermal Power Plant's high-maintenance digester gas wet scrubber system with a dry scrubber system, included in the FY07 CIP at $3.008 million in the FY09-10 timeframe. A $500,000 CEB project was initiated in FY07 to investigate options to upgrade or replace the LOCAT system (the equipment that scrubs hydrogen sulfide and other compounds from the digester gas).
- Heat Loop Pipe Replacement Construction 2 (Contract 6883) is the second phase of sequential replacement of heat loop piping, included in the FT07 CIP at $1.26 million in FY07. Sections of heat loop piping that have experienced leaks. Some were previously replaced under Heat Loop Construction 1 (6876, $615,000 completed in December 2005).
- Power System Improvements Design and Construction (Contracts 7060 and 7061) to design and construct modifications to Deer Island's electrical system as recommended after an FY04 power outage, included in the FY07 CIP at $7.905 million with projects being completed through FY10. This project will help to correct back-up power issues.
- DI Electrical Modifications (Contract 7094) to construct additional modifications to Deer Island's electrical system (not already identified and covered in other projects) recommended after the FY06 outage, included in the FY07 CIP at $2.0 million in FY07-09. This project will help to correct back-up power issues.
- Second Deaerator Design and Construction to install a second, small deaerator to supply feed water to one Zurn boiler, included in the FY07 CIP at $353,000 in FY08-10.
- Heat Loop Pipe Replacement Construction phase 3 to replace the heat loop piping, recommended for consideration in the FY08 CIP and estimated at $1.6 million in FY08-09, and $75,000 every 8 years beginning in FY17.
- CTG Rebuilds to rebuild the combustion turbines in the Thermal Plant, recommended for consideration in the FY08 CIP and estimated at $2 million every 15 years beginning in FY15.
- Replace STG at Deer Island to evaluate and install more efficient equipment, recommended for consideration in the FY08 CIP and estimated at $3.5 million for a 2-year project during the FY11-13 timeframe.

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 9.5-mile effluent outfall tunnel. Treated effluent flows from the disinfection basins through two intake channels into the Hydroturbine Generators (HTGs). Bouvier Hydropower of Grenoble, France manufactured the HTGs (now owned by VA Tech Hydro USA Corp., Charlotte, North Carolina). The Hydropower Facility was commissioned in July 2001.

<u>Facility Components</u>: 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.

<u>Ongoing and Recommended Upgrades</u>:

- Two years after the facility began operating, one HTG was inoperable when a piece of the turbine came loose and jammed in the runner. The second unit also became inoperable after it developed a significant oil leak. A contract to evaluate and correct the problems (CEB Contract S409 for Hydroturbine Repairs, $530,000) was completed from August 2005 to May 2006.

Figure 6-11

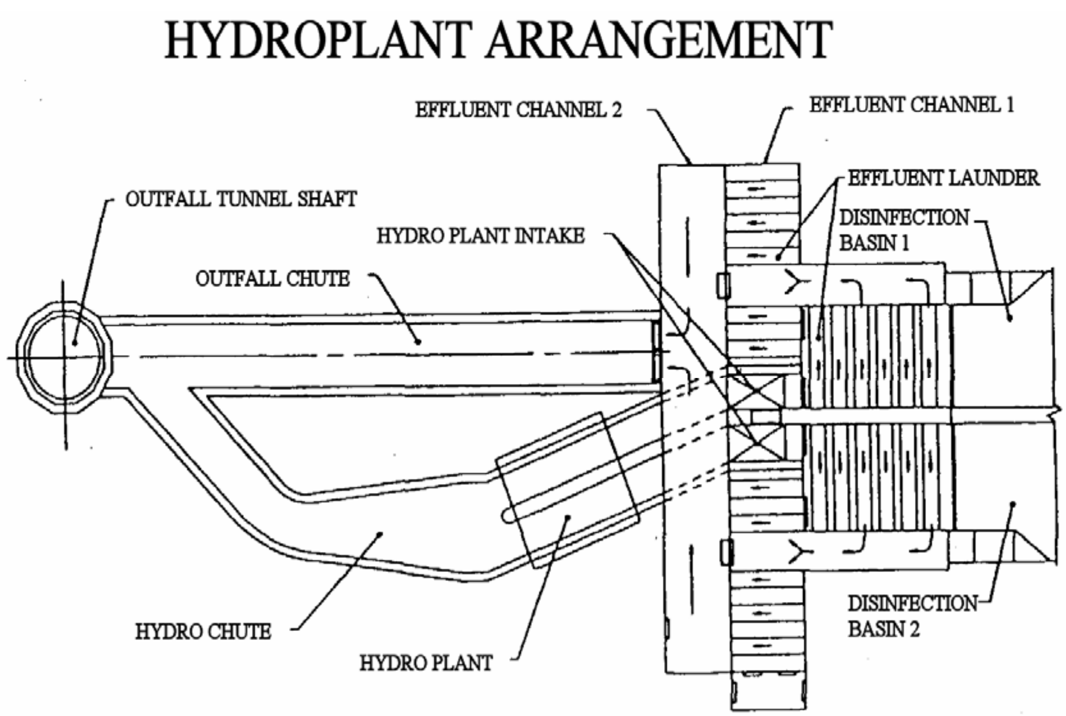
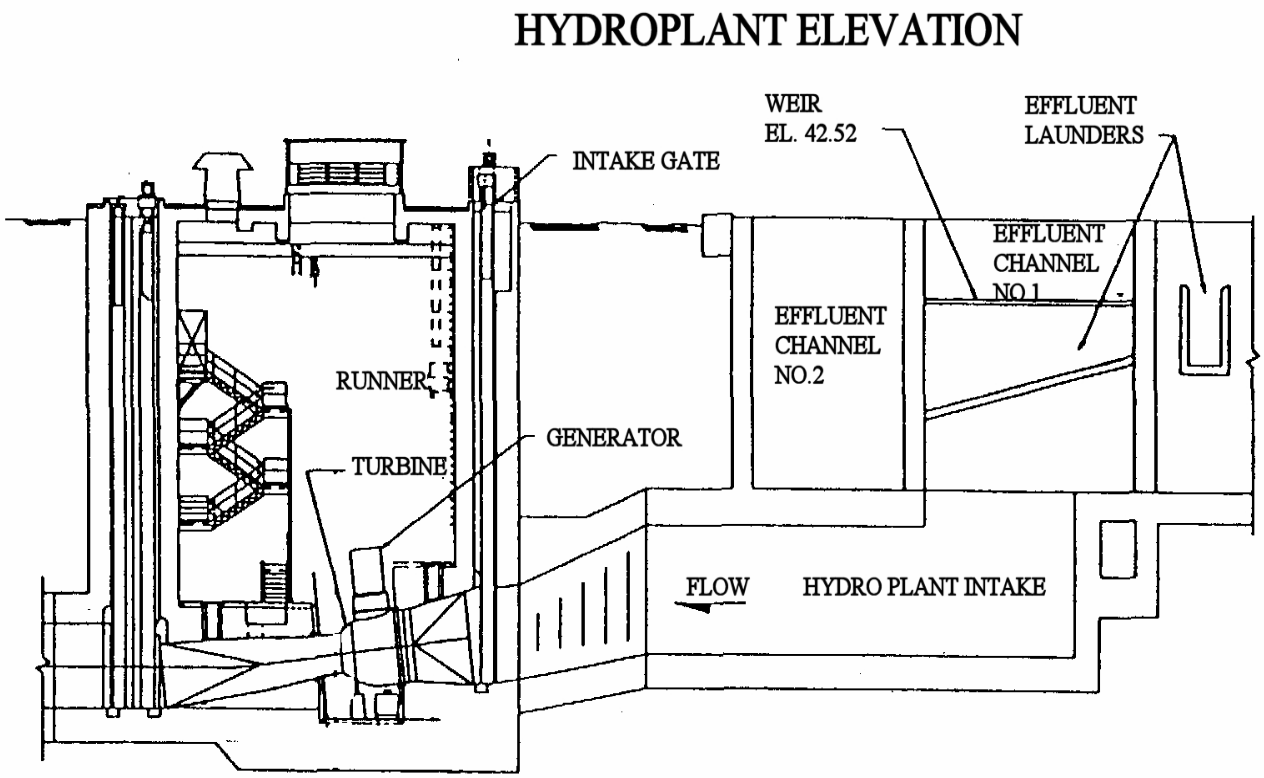


Figure 6-12



Wind Power

Facility Function and Operation: As part of MWRA's comprehensive energy strategy, staff are exploring opportunities for developing wind power on Deer Island. This effort is being undertaken to increase renewable power on Deer Island, thereby reducing operating costs. During the past several years, MWRA has explored numerous opportunities to reduce energy costs and increase renewable power as a result of the restructuring of the electricity market. First, MWRA opted to leave "Standard Offer" power, and began purchasing power for DITP in the competitive electricity market. Second, MWRA enrolled and certified its digester gas-fueled electrical generation as a renewable power source. Under the Massachusetts Renewable Portfolio Standard regulations, firms supplying power to customers in Massachusetts must carry a defined percentage of their total power supply as renewable energy. This requirement can be met by either investing in the purchase of power generated from renewable sources, or by purchasing Renewable Certificates. Renewable Certificates are issued to generators of power from renewable sources with one Certificate issued for every megawatt hour of power generated. These Certificates may be sold apart from the actual power.

A similar opportunity exists using wind power. MWRA will be in a position to reduce reliance upon retail market power by installing wind turbine generators at DITP (considered renewable energy); thus, MWRA would be able to sell the Renewable Certificates produced by the wind turbines. 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 on 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 the wind power project. 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.

Ongoing and Recommended Upgrades: The overall wind power findings are favorable and MWRA, B&V and the Massachusetts Technology Collaborative are currently working on a project plan. The plan will meet FAA requirements for air navigation safety and be economically viable for MWRA. The size and cost of a wind power project will depend on negotiations with FAA to find a favorable project. For planning purposes, two projects are recommended for the FY08 CIP.

- DI Wind Power is a one year study of the feasibility of installing wind power turbines at Deer Island and other MWRA facilities, recommended for consideration in the FY08 CIP and estimated at $150,000 in FY08.
- DI Wind Power Construction is a placeholder for construction to install wind power turbines at Deer Island or other MWRA facilities, to be constructed contingent upon obtaining applicable regulatory permits and approvals, recommended for consideration in the FY08 CIP and estimated at $1.2 million in FY10.

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 buses 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 three sources of DI electric power: cross-harbor marine cable (NSTAR), Thermal Power Plant on-site generation, and Hydropower Facility 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 to each other 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 undervoltage 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" power system of the distribution 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).

Ongoing and Recommended Upgrades:

- Electrical Equipment Upgrades 2, 3, and 4 is part of DITP's on-going program to replace transformers and bus ducts at the end of their useful lives, included in the FY07 CIP at a total cost of $7.757 million to be completed through FY11.
- VFD Replacements (NMPS, WTF, and miscellaneous other facilities) for installation of variable frequency drives (VFDs) to replace obsolete equipment at the NMPS, WTF, and other facilities throughout DITP, included in the FY07 CIP at $11.029 million to be completed through FY10.
- Switchgear Replacements Design and Construction to replace switchgear in the Administration/Lab Building (Contract 6900 in FY08) and all other switchgear on DI that has not been replaced previously (Contracts 7058 and 7059 in FY10), included in the FY07 CIP at a total cost of $4.447 million during the FY08-11 timeframe. This group of projects is an on-going program to sequentially replace obsolete electrical switchgear throughout the plant.
- Future Miscellaneous VFD Replacements to replace obsolete variable frequency drives throughout the DITP Facility, recommended for consideration in the FY08 CIP and estimated at $1.5 million every 15 years beginning in FY19.
- Electrical Equipment Upgrades Phase 5 and Up to replace transformers and bus ducts, recommended for consideration in the FY08 CIP and estimated at $2 million per year for FY11 and FY12, and $500,000 annually through FY48.
- Switchgear Replacements Design and Construction to replace obsolete electrical switchgear through the DI plant, recommended for consideration in the FY08 CIP and estimated at $1.25 million in FY18, and $ 5 million every 10 years through FY48.

Energy Management

MWRA's energy management planning applies to both the water and wastewater systems. For convenience of the reader, energy management is detailed in both Chapter 13 of the Wastewater 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. For example, a project to replace the Deer Island steam turbine generator (STG) with more efficient equipment is recommended (and costs included) earlier in this Chapter within the Subsection on the Thermal Power Plant. A second example are the projects to study and construct wind turbines on Deer Island (or other MWRA facilities) recommended (and costs included) earlier in this Chapter under the Subsection on Wind Power.

6.12 Odor Control Facilities

Odor control facilities at DITP are located in three buildings. The North Main Pump Station (originally 380 by 100-feet) had a 36 by 66-foot addition constructed under CP-102. This facility houses the East and West Odor Control Facilities that treat exhaust gasses from the preliminary and primary treatment facilities. The Lydia Goodhue (South System) Pump Station also houses odor control equipment. The Residuals Odor Control Facility treats exhaust gasses from the various residuals processing facilities. The 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 Massachusetts DEP 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 ppmv 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.

Ongoing and Recommended Upgrades:

- Staff estimate the carbon absorbers will need replacing in about 15 to 20 years. No project cost estimate or schedule has been developed. This project should be included in a future update of the Master Plan.
- Ancillary Modifications Preliminary Design, Final Design [including engineering services during construction and resident inspection (ESDC/REI)] and Construction 4 for modifications to the cryogenics facility, plant-wide odor control systems, digester gas, and scrubber improvements, included in the FY07 CIP at $4.783 million to be completed during FY08-12. This project includes improvements and upgrades in all DITP odor control facilities such as recoating the chemical containment areas of the wet scrubbers, replacing CPVC chemical piping with PVDF, installing drains in the condensate piping for the carbon absorbers to reduce corrosion, replacing odor control dampers and air flow meters, etc.
- Pipeline Replacement Design and Construction (Contracts 6851 and 6852) for planned periodic replacement of various chemical pipelines in the disinfection and odor control facilities due to deterioration from corrosion, included in the FY07 CIP at $1.672 million in FY09-11.
- DI Grit and Odor Control Air Handler Replacements to replace corroded air handlers, grit and odor control areas is recommended for consideration in the FY08 CIP. The project has a duration of 2 years, and is expected to cost $1.0 million in FY09, with an additional $1.0 million needed every 15 years (FY24 and 39).

- Pipeline Replacement/Upgrades to periodically replace chemical pipelines throughout the Deer Island Treatment Plant, recommended for consideration in the FY08 CIP and estimated at $250,000 in FY26 and again in FY41.

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; Deer Island Central Laboratory; fuel oil facilities; water systems; sanitary and stormwater systems; building HVAC control systems; personnel protection and chemical handling systems; records management; and the Clinton Wastewater Treatment Plant.

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.

Ongoing and Recommended Upgrades:

- The previously completed CIP Equipment Condition Monitoring (Contract 6594, completed in January 2005) involved adding temperature and vibration monitoring devices to critical equipment in the NMPS, Thermal Power Plant, Centrifuge Facility, Cryogenics Facility, and the Gas Handling Facility. Approximately $100 million in equipment was tied into PICS with local display panels to monitor pumps, compressors, motors, shafts, and bearings. PICS has been further expanded to include conditioning monitoring systems that were designed and installed as part of MWRA's FAMP initiative, as well as the Braintree/Weymouth Relief Facilities project.
- PICS Replacement Construction (Contract 6884) to replace/upgrade components of the DITP Process Information Control Systems including keypads, consoles, and software due to obsolescence, included in the FY07 CIP at $1.582 million during the FY10-11 timeframe. The backbone of the PICS system (hardware/processing modules, field cabinets, and data transmission loop) is expected to remain viable until at least 2015 to 2020. Staff anticipates routine maintenance of PICS as a major MWRA asset until the 2008 to 2010 timeframe when the operator console portion of the system (which uses computer technology similar to office and desktop uses) will need replacement.
- PICS Distributed Processing Units (DPU) Replacements to replace the distributed processing unit cabinets and internal components of the PICS system, recommended for consideration in the FY08 CIP and estimated at $4 million in FY15, and again in FY35.
- PICS Replacement Construction to replace obsolete hardware components of the Process Information Control System, recommended for consideration in the FY08 CIP and estimated at $1.8 million in FY15, and an additional $1.8 million every 15 years.

Deer Island Central Laboratory

MWRA's laboratory services are client based. Clients include Deer Island, ENQUAD, TRAC and Drinking Water Programs including MWRA communities. To accommodate the range of program needs, the geographic range of the MWRA system and types of samples to be analyzed requires multiple facilities and MWRA operates laboratory facilities in Chelsea, Clinton, Quabbin, Southborough and the Central Lab is located on Deer Island.

MWRA's Laboratory Services serve both water and wastewater needs and are fully detailed in Chapter 9 of the Water System Master Plan. Costs for all future Laboratory Services projects (water and wastewater) recommended for the FY08 CIP are included in Chapter 9 of the Water System Master Plan. The Laboratory Services description from the Water System Master Plan is also presented in Chapter 13 of the Wastewater Master Plan (for convenience of the reader) and the recommended projects are summarized. No costs for future/recommended Laboratory Services projects are included in the Wastewater Master Plan.

There are three Deer Island Central Laboratory projects included in the existing FY07 CIP that are integral to the Deer Island budget. These three projects are detailed below and included in the summary of projects and costs for the Wastewater Master Plan.

Ongoing Upgrades:

- Metals Lab Fume Hood Replacement, included in the FY07 CIP at $134,000 during the FY07-08 timeframe.
- Metals Lab Modifications Construction to construct metals lab improvements (replacement of metal fixtures that may contaminate metals samples, installation of filtered air supply, and reconfiguration of the workspace), included in the FY07 CIP at $919,000 during the FY07-08 timeframe.
- Lab Sample Area Modifications Design and Construction for DI Central Lab improvements in the physical layout for better workflow and to capture fumes from sample containers and bottle wash process, included in the FY07 CIP at $552,000 during the FY08-10 timeframe.

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. Fuel oil is primarily delivered by barge (due to the large amount of oil required), off loaded at the pier facility and pumped to fuel storage tanks. Deliveries by tank truck can also be offloaded directly at the fuel storage tank area. A double-walled piping system is routed from the pier to the fuel storage tanks located north of the Thermal Power Plant.

Facility Components: The off-loading system includes a 6-inch flange for a hose connection from the barge. The line increases to 12-inches and a check valve and gate valve are provided at the connection area, with a containment pan located beneath the assembly to collect any spills. The 12-inch line continues in the pier pipe chase to the on-island marine valve pit. A 12-inch butterfly valve is located on this piping to provide an emergency shut off. Approximately 3,000 feet of buried double-walled fuel transfer piping runs from the marine valve pit to the fuel oil storage tanks.

The double-walled piping consists of a 12-inch, schedule 40 steel pipe centered inside a 16-inch 10-gauge carbon steel containment pipe. The containment pipe is coated with fusion bonded epoxy finish and is cathodically protected. Heat shrink sleeves have been installed on all joints. The fuel pipe is centered in the containment pipe with supports spaced at approximately 10-foot intervals. The supports do not restrict air flow in the annulus and allow the containment pipe to drain. End seals prevent moisture from entering the annulus. Both the containment and product lines are provided with high point vents and low point drains.

The leak detection system consists of a cable sensitive to petroleum products, installed near the bottom of the containment pipe. The cable is terminated in an alarm panel located in the Thermal Power Plant. The system was designed with four manholes along the piping so the leak sensing cable can be replaced without excavation of the containment pipe.

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.

<u>Ongoing and Recommended Upgrades</u>:

- Fuel Transfer Pipe Replacement Design and Construction (Contracts 6969 and 6970) to replace the diesel fuel transfer pipeline from the pier/barge area to the fuel storage tanks at the Thermal Power Plant, included in the FY07 CIP at $1.672 million during the FY12-14 timeframe.

Water Systems

<u>Facility Function and Operation</u>: 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 DI 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.

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, are 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 was completed in sections, under CP 044, 048, 211, and 260. The collection 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 area to protect the harbor from direct discharges.

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 controls 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 to 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.

<u>Ongoing and Recommended Upgrades</u>:

- HVAC Control System to upgrade/replace the HVAC control system at the DI plant, recommended for consideration in the FY08 CIP and estimated at $1 million every 15 years beginning in FY10.
- HVAC Fan Coil Replacements to replace fan coils in the Admin/Lab HVAC system, recommended for consideration in the FY08 CIP and estimated at $1 million in FY09, and again in FY24 and FY39.

Personnel Protection and Chemical Handling Systems

<u>Facility Function and Operation</u>: Personnel protection systems on DI 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 ten years. It is one of the largest fire systems in a single facility in the State and consists of over 2000 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 alarm monitoring system with the exception of all pull boxes, strobes, horns and heat detectors. There are also 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 15 to 20 years.

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.

The Safety Unit oversees all DI safety programs. Annual "right to know" and "Integrated Contingency Plan" training is provided to MWRA staff and "contractor orientation" training to outside contractors before they start any projects. All contractor-submitted safety plans for DITP projects are reviewed to ensure that all needed safety placards are properly placed throughout the plant. DI staff participate in periodic evacuation and safety drills, with immediate assessment in order to improve any observed deficiencies. The Safety Unit also manages all emergencies at DI, in coordination with on-site Emergency Response Team (ERT) staff, specially trained for any possible contingency. Information has been disseminated to all staff and contractors regarding emergency protocol and the existence of a DI emergency telephone number that is answered 24 hours per day by Safety or Operations staff. If necessary, emergency calls are placed to the appropriate first-responders from Winthrop (fire, ambulance, and police), the City of Boston, and/or the State Police. Contracts are in place for emergency response from outside hazardous chemical and material specialists.

Every chemical off-loading area has specific chemical handling procedures and protocol. The pipe connections are often specially suited 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 barge in quantities of 300,000 gallons or more, and pumped through nearly a mile of piping to the storage tanks. For these deliveries, an Operations shift manager or his/her designee observes all connections, directs barge staff when to begin pumping, and monitors the entire off-loading procedure. This may also include having a staff member travel through the underground pipe galleries to ensure no leakage is occurring.

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 carry a portable card reader 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.

Ongoing and Recommended Upgrades:

- Fire Alarm System to upgrade/replace the fire alarm system at the DI plant, recommended for consideration in the FY08 CIP and estimated at $1.7 million every 15 years beginning in FY10.
- Leak Protection System Upgrade to upgrade the leak protection system, recommended for consideration in the FY08 CIP and estimated at $300,000 every 15 years beginning in FY11.
- DI Eastern Seawall Repairs Design and Construction to repair the eroded concrete seawall at Deer Island, recommended for consideration in the FY08 CIP and estimated at $1.7 million for a 2-year project during the FY11-13 timeframe.
- DI Seawall Refurbishment Design and Construction to repair southern seawall erosion and damage, recommended for consideration in the FY08 CIP and estimated at $500,000 with a duration of 2 years during FY11. An additional $1 million is needed every 12 years (FY23, 35, and 47).
- DI Personnel Dock Rehabilitation Construction to repair the floats, ladders and aluminum grating of the personnel dock is recommended for consideration in the FY08 CIP. The project is expected to last 1 year during the FY09-13 timeframe and cost $1.0 million. An additional $1 million is scheduled every 12 years.

Records Management

Facility Function and Operation: The majority of the DI document collection is from BHP documents. In recent years, technical documents have been added into the DI 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, 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, increase storage efficiency, and preserve original copies. Detail on the type of documents included in Records Management are noted below:

- *Technical Specifications* – About 215 hard copy technical specifications (half from BHP and half is from DI construction and service contracts) serve as reference tools. Their contents never get revised. A current effort is to scan the documents in-house and store the scanned files on a server.
- *Contract Drawings* - All contract drawings are obtained from the consultants; 9,400 were from BHP while 776 are from DITP contracts after the completion of BHP. These drawings depict the as-built location, layout and dimension of the pipes, structures, and buildings of DITP and are grouped in the disciplines of Architectural, Civil, Mechanical, Electrical, HVAC, Plumbing, and Structural. BHP drawings are considered as the base drawing set for DITP. This drawing set requires a routine update to reflect the changes from the post-BHP construction contracts and the DI maintenance activities. As a result, new revisions need to be generated on a regular basis. The existing formats of the BHP drawing set are hard copies, electronic (raster file only) and aperture cards. The aperture cards are stored in DITP, Record Center, and DISC/Chelsea. When receiving a new set of as-built contract drawings from consultants or generating a new revision to existing BHP contract drawings, new aperture cards need to be created. TIC manages the task of creating new aperture cards and distributes the original cards to the Record Center as well as keeping one copy at DITP.

- *Schematics* – Plant-wide schematic drawings that display equipment and structure(s) of 22 separate systems served at DITP. Most of the original plant-wide schematics were created by M&E in hard copy and the CAD format. A number of schematic drawings have been updated due to the field changes.
- *Plant-wide Systems* - Similar to the Plant-wide schematics, the plant-wide system drawings also display equipment and structure on systems served at DITP; however, these are scaled drawings, displaying the exact layout and the locations of various systems on the island, including underground utility structures. The CM created plant-wide system drawings and a number of them have been updated. These drawings are in CAD format only and are usually generated as-needed.
- *Shop Drawings* - Shop drawings are supplied by equipment vendors. There are approximately 70,000 shop drawings in TIC that display the details of parts, assemblies, control panels, loops, etc. The shop drawings are replaced as the existing equipment is replaced. All BHP shop drawings were transmitted to DITP in hard copies and in aperture cards. A format conversion project is currently underway to scan all of the aperture cards into electronic format. The future shop drawings will be maintained in hard copy and electronic format only.
- *Operations and Maintenance Manuals* - O&M manuals contain regulatory requirements relating to the operation, safety, and general maintenance of a specific area and describes process, equipment, control principles, and general operating procedures. There are seven O&M manuals written based on functional areas of the plant. These O&M manuals were developed by the BHP CM and transmitted to the DITP in both hard copy and WordPerfect format. Since WordPerfect is no longer supported by MWRA's MIS standard, hard copy is the only available media to the plant staff. If necessary, the documents can be scanned, but usually the formatting needs extensive editing to be consistent with other document formatting.
- *Vendor Manuals* - DITP has 582 vendor manuals specific to vendor supplied equipment and systems. They are organized by the original BHP construction packages. Because these manuals contain important and specific information regarding to the equipment, DI Maintenance staff frequently references them. Due to the continuous construction and in-house maintenance activities including replacement, addition, and deletion of equipment, this set of documents is updated on a regular basis. An effort is underway to organize these documents by the type of equipment.
- *Standard Operating Procedures (SOPs) and System Operating Job Procedures (SOJPs)* - DITP SOPs and SOJPs were prepared as one set of documents, so that each SOP manual includes the SOJPs. Seventeen sets of documents give detailed instructions regarding the operations within specified areas and facilities. They are used as a reference guide for day-to-day operations. Since the transmittal of the original SOPs from the CM, plant staff had revised two SOPs to reflect the changes to the operations as a result of the Braintree-Weymouth contract. Both hard copies and electronic files are available at DITP. Similar to the O&M manuals, the electronic format is in WordPerfect (no longer the Authority's MIS standard), hard copy is the only available media to plant staff.

Ongoing and Recommended Upgrades:

- DISC Application is a project to provide the Design Information System Center (DISC) hardware, software, and contract services to implement a plant-wide computerized database of all DITP systems, included in the FY07 CIP at $125,000 in FY07-08.
- Document Format Conversion is a project to convert DI construction documents into electronic format and complete the document-reference database, included in the FY07 CIP at $353,000 during the FY07-12 timeframe.

Clinton Wastewater Treatment Plant

Facility Function and Operation: The Clinton Wastewater Treatment Plant provides advanced sewage treatment services to the Town of Clinton and a portion of Lancaster, the Lancaster Sewer District. MWRA assumed formal operational responsibility for the plant in 1987 and constructed new primary and secondary treatment facilities in 1992. The Clinton Plant is detailed in Chapter 14; however, a brief discussion is included here because two Clinton projects currently programmed in the FY07 CIP are carried under the Deer Island Treatment Plant CIP budget. The two existing projects represent a total cost of $547,000. Seventeen additional Clinton projects ($24.525 million) are recommended for inclusion in the FY08 CIP. The recommended projects are detailed in Chapter 14 and, beginning with the FY08 CIP, will be carried under a separate Clinton Treatment Plant CIP Budget.

Projects in the Existing FY07 CIP:

- Clinton Soda Ash Replacement is programmed in the FY07 CIP at $288,000. This one year project will replace all existing equipment, piping, and wiring between the dual discharge bin activator and the existing discharge lines from the slakers to the slurry tanks. The new dry system will provide dual trains from the existing bin activator to the slurry tanks and consist of the following major components: two knife gate valves, two lump breakers, two pre-feeders, two intermediate hoppers, two screw feeders, two solution tanks with electric mixers, one control panel, piping and valves to connect the existing service water piping system, and one new silo air dryer. Discussions were held with the bin activator manufacturer and, based on an assessment of existing equipment, it was determined that the existing soda ash dry delivery system, truck unloading station, silo, and dual discharge bin activator are in good condition and should remain in service as part of a new dry delivery system. The existing slurry tanks and soda ash dosing system in the basement level are also recommended to remain in service as part of this upgrade. This project is recommended to be completed in FY08.
- Clinton Permanent Standby Generator is a project to install a new 350 KW permanent diesel standby generator to provide backup electrical power to the secondary treatment portion of the Clinton Treatment Plant. This one year project is programmed in the FY07 CIP at $259,000 and will replace all secondary system electrical power backup, automatic transfer switches, and concrete pad for permanent generator mount. In addition, a manual transfer switch will be incorporated to allow operators to transfer power from the new backup generator to the primary portion of the plant. The project will provide backup electrical power in the event the utility source is disrupted due to unforeseen circumstance such as severe weather, storm or accident. A permanent standby backup generator for the primary treatment process is already in place. This project is recommended to be completed in FY08.

6.14 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to the Deer Island Treatment Plant are summarized in this Section. Table 6-1 lists each project, its priority ranking, and the 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 noted previously in the Chapter within Sections relating to specific facilities or asset types.

Projects in the Existing FY07 CIP: There are thirty-seven Deer Island Treatment Plant projects programmed in the FY07 CIP. The projects are described below and summarized in Table 6-1 (see line numbers 6.1 through 6.37).

- As-Needed Design Phases 4-1 and 4-2 to provide technical design services and/or construction support for specialized/complex engineering issues, included in the FY07 CIP at $1.134 million for projects being completed through FY07.

- As-Needed Design Phases 5-1 and 5-2 to provide technical design services and/or construction support for specialized/complex engineering issues, included in the FY07 CIP at $1.8 million for projects during the FY07-09 timeframe.

- Long-Term As-Needed Design Phases 1 and 2 (to supplement As-Needed Design Phases 4 and 5) and provide technical design services and/or construction support for specialized/complex engineering issues, included in the FY07 CIP at $3.2 million for two separate contracts to be issues in two year cycles during FY09-13.

- Ancillary Modifications Design [including engineering services during construction and resident inspection (ESDC/REI)] and Construction 2-2 for installation of variable frequency drives (VFDs) and DC chokes at the South System Pump Station, included in the FY07 CIP at $3.574 million to be completed through FY08.

- Ancillary Modifications Preliminary Design, Final Design [including engineering services during construction and resident inspection (ESDC/REI)] and Construction 4 for modifications to the cryogenics facility, plant-wide odor control systems, digester gas, and scrubber improvements, included in the FY07 CIP at $4.783 million to be completed during FY08-12.

- Equipment Replacement Project to provide a placeholder for future, as needed, equipment replacement, included in the FY07 CIP at $18.653 million for projects to be completed through FY16. Projects identified in a CIP phase are deducted from this total, then shown under a new sub-phase added to the CIP.

- Primary Clarifier Rehabilitation Construction (Contract 6899) to replace longitudinal chains, sprockets, wall expansion joints, chain drives, tip tubes, hose bibs, actuators, drive motor systems, and adding more drop boxes in the primary clarifiers, included in the FY07 CIP at a total cost of $6.041 million during the FY09-11 timeframe.

- Cathodic Protection Evaluation is a project to determine the most appropriate action (repair, decommission, or protect) specific sections of piping system on DI, included in the FY07 CIP at $250,000 during the FY09-10 timeframe.

- Pump Packing Replacement project to replace remaining pump packing seals with mechanical seals for SSPS, NMPS, and WTF, included in the FY07 CIP at $200,000 during FY07-08.

- LOCAT Scrubber Replacement Construction (Contract 7056) to replace the Thermal Power Plant’s high-maintenance digester gas wet scrubber system with a dry scrubber system, included in the FY07 CIP at $3.008 million in the FY09-10 timeframe. A $500,000 CEB project was initiated in FY07 to investigate options to upgrade or replace the LOCAT system (the equipment that scrubs hydrogen sulfide and other compounds from the digester gas).

- Grit Blower Replacement Construction (Contract 7052) to replace a high-maintenance grit blower with a dedicated air-handling/compressor system for improved grit handling, included in the FY07 CIP at $335,000 during FY08-09.

- Thickened Primary Sludge Pump Replacement (Contracts 7053 and 7054) to design and construct the replacement of the thickened primary sludge pumps to reduce water use and maintenance costs, included in the FY07 CIP at $5.789 million during the FY08-11 timeframe.

- Centrifuge Back-drive Replacements (Contract 7054) due to equipment obsolescence, included in the FY07 CIP at $2.161 million in FY08-09. These items are expected to need replacing every 7 to 10 years.

- Study/Concept Design – Concrete Repairs (Contract 6727) for protective coatings on concrete below the water line in the secondary clarifiers and disinfection basins, included in the FY07 CIP at $300,000 during the FY07-08 timeframe.

- Expansion Joint Repairs 2 and 3 to continue the ongoing program to periodically replace failed expansion joints in the concrete clarifier decks and/or various retaining walls, included in the FY07 CIP at $312,000 during the FY07-10 timeframe. This project is scheduled to be performed in two phases (2 and 3), estimated at $156,000 each.

- Electrical Equipment Upgrades 2, 3, and 4 is part of DITP's on-going program to replace transformers and bus ducts at the end of their useful lives, included in the FY07 CIP at a total cost of $7.757 million to be completed through FY11.

- VFD Replacements (NMPS, WTF, and miscellaneous other facilities) for installation of variable frequency drives (VFDs) to replace obsolete equipment at the NMPS, WTF, and other facilities throughout DITP, included in the FY07 CIP at $11.029 million to be completed through FY10.

- Power System Improvements Design and Construction (Contracts 7060 and 7061) to design and construct modifications to Deer Island's electrical system as recommended after an FY04 power outage, included in the FY07 CIP at $7.905 million with projects being completed through FY10. This project will help to correct back-up power issues.

- DI Electrical Modifications (Contract 7094) to construct additional modifications to Deer Island's electrical system (not already identified and covered in other projects) recommended after the FY06 outage, included in the FY07 CIP at $2.0 million in FY07-09. This project will help to correct back-up power issues.

- Switchgear Replacements Design and Construction to replace switchgear in the Administration/Lab Building (Contract 6900 in FY08) and all other switchgear on DI that has not been replaced previously (Contracts 7058 and 7059 in FY10), included in the FY07 CIP at a total cost of $4.447 million during the FY08-11 timeframe. This group of projects is an on-going program to sequentially replace obsolete electrical switchgear throughout the plant.

- PICS Replacement Construction (Contract 6884) to replace/upgrade components of the DITP Process Information Control Systems including keypads, consoles, and software due to obsolescence, included in the FY07 CIP at $1.582 million during the FY10-11 timeframe. The backbone of the PICS system (hardware/processing modules, field cabinets, and data transmission loop) is expected to remain viable until at least 2015 to 2020. Staff anticipates routine maintenance of PICS as a major MWRA asset until the 2008 to 2010 timeframe when the operator console portion of the system (which uses computer technology similar to office and desktop uses) will need replacement.

- Sodium Hypochlorite Pipe Replacement Design and Construction (Contracts 6853 and 6854) to replace the PVC piping that transports sodium hypochlorite from the barge to the storage tanks, included in the FY07 CIP at $2.983 million in FY10-12. The pipeline has had joint leakage problems, requiring frequent attention from maintenance staff.

- Pipeline Replacement Design and Construction (Contracts 6851 and 6852) for planned periodic replacement of various chemical pipelines in the disinfection and odor control facilities due to deterioration from corrosion, included in the FY07 CIP at $1.672 million in FY09-11.

- Heat Loop Pipe Replacement Construction 2 (Contract 6883) is the second phase of sequential replacement of heat loop piping, included in the FT07 CIP at $1.26 million in FY07. Sections of heat loop piping that have experienced leaks. Some were previously replaced under Heat Loop Construction 1 (6876, $615,000 completed in December 2005).

- Fuel Transfer Pipe Replacement Design and Construction (Contracts 6969 and 6970) to replace the diesel fuel transfer pipeline from the pier/barge area to the fuel storage tanks at the Thermal Power Plant, included in the FY07 CIP at $1.672 million during the FY12-14 timeframe.

- North Main Pump Station – Motor Control Center (MCC) Design and Construction to replace obsolete MCC equipment and replace cracked end rings in the NMPS motors, included in the FY07 CIP at $3.704 million during the FY07-10 timeframe (Contracts 6971 & 6972).

- Second Deaerator Design and Construction to install a second, small deaerator to supply feed water to one Zurn boiler, included in the FY07 CIP at $353,000 in FY08-10.

- DISC Application is a project to provide the Design Information System Center (DISC) hardware, software, and contract services to implement a plant-wide computerized database of all DITP systems, included in the FY07 CIP at $125,000 in FY07-08.

- Document Format Conversion is a project to convert DI construction documents into electronic format and complete the document-reference database, included in the FY07 CIP at $353,000 during the FY07-12 timeframe.

- Primary Clarifier and Gravity Thickener Rehabilitation Design (Contract 6965) to select a consultant to design the primary clarifier rehabilitation and the gravity thickener improvement projects, included in the FY07 CIP at $1.2 million during the FY07-11 timeframe.

- Gravity Thickener Improvements - Construction (Contract 6966) to install catwalks, remove concrete in the effluent channel, and modify roofing for sludge thickeners to improve staff access and operating efficiency, included in the FY07 CIP at $2.014 million in FY09.

- Sodium Hypochlorite Tank Liner Removal and Repair (Contract 7089 and Contract 6764) to remove the failed lining in one of the four hypochlorite tanks (tank number 1) and repair any wall corrosion prior to tank relining, included in the FY07 CIP at $552,000 in FY07. As of July 2006, tank 3 had also developed a leak and staff are in development of a plan for coordinating this work with the tank 1 work.

- Metals Lab Fume Hood Replacement, included in the FY07 CIP at $134,000 during the FY07-08 timeframe.

- Metals Lab Modifications Construction to construct metals lab improvements (replacement of metal fixtures that may contaminate metals samples, installation of filtered air supply, and reconfiguration of the workspace), included in the FY07 CIP at $919,000 during the FY07-08 timeframe.

- Lab Sample Area Modifications Design and Construction for DI Central Lab improvements in the physical layout for better workflow and to capture fumes from sample containers and bottle wash process, included in the FY07 CIP at $552,000 during the FY08-10 timeframe.

- Clinton Soda Ash Replacement is programmed in the FY07 CIP at $288,000. This one year project will replace all existing equipment, piping, and wiring between the dual discharge bin activator and the existing discharge lines from the slakers to the slurry tanks. The new dry system will provide dual trains from the existing bin activator to the slurry tanks and consist of the following major components: two knife gate valves, two lump breakers, two pre-feeders, two intermediate hoppers, two screw feeders, two solution tanks with electric mixers, one control panel, piping and valves to connect the existing service water piping system, and one new silo air dryer. Discussions were held with the bin activator manufacturer and, based on an assessment of existing equipment, it was determined that the existing soda ash dry delivery system, truck unloading station, silo, and dual discharge bin activator are in good condition and should remain in service as part of a new dry delivery system. The existing slurry tanks and soda ash dosing system in the basement level are also recommended to remain in service as part of this upgrade. This project is recommended to be completed in FY08.

- Clinton Permanent Standby Generator is a project to install a new 350 KW permanent diesel standby generator to provide backup electrical power to the secondary treatment portion of the Clinton Treatment Plant. This one year project is programmed in the FY07 CIP at $259,000 and will replace all secondary system electrical power backup, automatic transfer switches, and concrete pad for permanent generator mount. In addition, a manual transfer switch will be incorporated to allow operators to transfer power from the new backup generator to the primary portion of the plant. The project will provide backup electrical power in the event the utility source is disrupted due to unforeseen circumstance such as severe weather, storm or accident. A permanent standby backup generator for the primary treatment process is already in place. This project is recommended to be completed in FY08.

Projects Recommended for Consideration in the FY08 CIP: There are forty-three Deer Island Treatment Plant projects recommended for consideration in the CIP. The projects are described below and summarized in Table 6-1 (see line numbers 6.38 through 6.80).

- As-Needed Technical Design to continue technical design services and/or construction support for specialized/complex engineering issues, is recommended for consideration in the FY08 CIP at $200,000 for FY13, and $750,000 annually through FY48.

- Equipment Replacement Project to provide a placeholder for future, as needed, equipment replacement, recommended for consideration in the FY08 CIP at a cost of $4 million during FY11-12 and $2 million annually beginning in FY16.

- Future SSPS VFD Replacements to replace obsolete variable frequency drives in the South System Pump Station is recommended for consideration in the FY08 CIP and estimated at $6 million every 10 years beginning in FY16.

- SSPS Pump Lube System Replacement to replace the pump lubrication system, recommended for consideration in the FY08 CIP and estimated at $1.7 million in FY08-09. Once installed, the new system will require only routine maintenance, not replacement. Cost is estimated at $1.7 million in FY08-09.

- Future SSPS shaft and/or Motor Replacements to replace worn shafts and/or obsolete motors in the South System Pump Station, recommended for consideration in the FY08 CIP and estimated at $1.5 million in FY14, and $.5 million every 15 years.

- Future NMPS VFD Replacements to replace obsolete variable frequency drives in the North System Pump Station, recommended for consideration in the FY08 CIP and estimated at $6.5 million every 10 years beginning in FY18.

- North Main Pump Station Motor Control Center Design and Construction to replace the North Main Pump Station MCC equipment as it becomes obsolete/unreliable, recommended for consideration in the FY08 CIP and estimated at $3.5 million in FY28 and 48.

- Future NMPS shaft and/or Motor Replacements to replace worn shafts and/or obsolete motors in the North Main Pump Station, recommended for consideration in the FY08 CIP and estimated at $2.2 million in FY15, and $2.2 million every 15 years.

- Enterprise Engine Removal to remove the diesel engines from the North Main Pump Station building, recommended for consideration in the FY08 CIP and estimated at $600,000 and recommended for FY14.

- Future WTF VFD Replacements to replace obsolete variable frequency drives in the Winthrop Terminal Facility, recommended for consideration in the FY08 CIP and estimated at $ 1.4 million every 10 years beginning in FY19.

- Future WTF shaft and/or Motor Replacements to replace worn shafts and/or obsolete motors in the Winthrop Terminal Facility, recommended for consideration in the FY08 CIP and estimated at $800,000 in FY 16, and $800,000 every 15 years.

- Cryogenics Plant Equipment Replacement to replace equipment, valves, instrumentation, etc. at the Cryogenics Plant, recommended for consideration in the FY08 CIP and estimated at $2 million dollars every 10 years beginning in FY14.

- Cryogenics Plant Cooling Tower and Related Equipment Replacement to replace the cooling towers and related equipment at the Cryogenics Plant, recommended for consideration in the FY08 CIP and estimated at $450,000 every 20 years beginning in FY19.

- Secondary Clarifier Rehabs to replace interim hatches, longitudinal chains, expansion joints, A/B crossover, etc in the secondary clarifiers, recommended for consideration in the FY08 CIP and estimated at $4 million in FY14, and again in FY29 and FY44.

- Secondary Clarifier Drive Chain to replace drive chains in the secondary clarifiers, recommended for consideration in the FY08 CIP and estimated at $250,000 in FY19, and again in FY29 and FY39.

- Sodium Hypochlorite Tank Rehabs to strip and reline sodium hypochlorite tanks is recommended for consideration in the FY08 CIP. Emergency repair of 3 tanks is included in FY07-08. Cost is estimated at $625,000 every 10 years beginning in FY07.

- Sodium Bisulfite Tank Rehabilitation to strip and reline the bisulfite tanks, recommended for consideration in the FY08 CIP and estimated at $1 million every 20 years beginning in FY11.

- Barge Berth and/or Pier Facilities Rehab to maintain the barge berth areas and piers for deliveries of sodium hypochlorite and fuel, recommended for consideration in the FY08 CIP and estimated at $1 million every 20 years beginning in FY11.

- DI Outfall Modifications Construction/REI to re-inspect, clean out and close-off old DITP outfalls, recommended for consideration in the FY08 CIP and estimated at $1.1 million for a

2-year duration (initial project) during the FY14-18 timeframe. Future upgrades are anticipated to cost $150,000 every 10 years after the initial project, for a total estimated cost of $1.55 million.

- Centrifuge Replacements to replace worn centrifuges is recommended for consideration in the FY08 CIP. The cost per centrifuge is estimated at $1.3 million. The program calls for 4 centrifuges to be replaced every 10 years, at a cost of $5.2 million beginning in FY14.

- Digested Sludge Pump Replacements (to FRSA) to replace the pumps that pump sludge to the pellet plant, recommended for consideration in the FY08 CIP and estimated at $2 million in FY10 and again in FY30.

- Dystor Tank Membrane Replacements to replace the gas and sludge storage tank membranes, recommended for consideration in the FY08 CIP and estimated at $750,000 every 10 years, beginning in FY15.

- DI Cross-Harbor Cable Dredging Construction as a contingency for dredging and lowering the harbor cable, place-holder cost recommended for consideration in the FY08 CIP and estimated at $20 million with a duration of 1 year during the FY09-10 timeframe.

- Heat Loop Pipe Replacement Construction phase 3 to replace the heat loop piping, recommended for consideration in the FY08 CIP and estimated at $1.6 million in FY08-09, and $75,000 every 8 years beginning in FY17.

- CTG Rebuilds to rebuild the combustion turbines in the Thermal Plant, recommended for consideration in the FY08 CIP and estimated at $2 million every 15 years beginning in FY15.

- Replace STG at Deer Island to evaluate and install more efficient equipment, recommended for consideration in the FY08 CIP and estimated at $3.5 million for a 2-year project during the FY11-13 timeframe.

- DI Wind Power is a one year study of the feasibility of installing wind power turbines at Deer Island and other MWRA facilities, recommended for consideration in the FY08 CIP and estimated at $150,000 in FY08.

- DI Wind Power Construction is a placeholder for construction to install wind power turbines at Deer Island or other MWRA facilities, to be constructed contingent upon obtaining applicable regulatory permits and approvals, recommended for consideration in the FY08 CIP and estimated at $1.2 million in FY10.

- Future Miscellaneous VFD Replacements to replace obsolete variable frequency drives throughout the DITP Facility, recommended for consideration in the FY08 CIP and estimated at $1.5 million every 15 years beginning in FY19.

- Electrical Equipment Upgrades Phase 5 and Up to replace transformers and bus ducts, recommended for consideration in the FY08 CIP and estimated at $2 million per year for FY11 and FY12, and $500,000 annually through FY48.

- Switchgear Replacements Design and Construction to replace obsolete electrical switchgear through the DI plant, recommended for consideration in the FY08 CIP and estimated at $1.25 million in FY18, and $ 5 million every 10 years through FY48.

- DI Grit and Odor Control Air Handler Replacements to replace corroded air handlers, grit and odor control areas is recommended for consideration in the FY08 CIP. The project has a duration of 2 years, and is expected to cost $1.0 million in FY09, with an additional $1.0 million needed every 15 years (FY24 and 39).

- Pipeline Replacement/Upgrades to periodically replace chemical pipelines throughout the Deer Island Treatment Plant, recommended for consideration in the FY08 CIP and estimated at $250,000 in FY26 and again in FY41.

- PICS Distributed Processing Units (DPU) Replacements to replace the distributed processing unit cabinets and internal components of the PICS system, recommended for consideration in the FY08 CIP and estimated at $4 million in FY15, and again in FY35.

- PICS Replacement Construction to replace obsolete hardware components of the Process Information Control System, recommended for consideration in the FY08 CIP and estimated at $1.8 million in FY15, and an additional $1.8 million every 15 years.

- HVAC Control System to upgrade/replace the HVAC control system at the DI plant, recommended for consideration in the FY08 CIP and estimated at $1 million every 15 years beginning in FY10.

- HVAC Fan Coil Replacements to replace fan coils in the Admin/Lab HVAC system, recommended for consideration in the FY08 CIP and estimated at $1 million in FY09, and again in FY24 and FY39.

- Fire Alarm System to upgrade/replace the fire alarm system at the DI plant, recommended for consideration in the FY08 CIP and estimated at $1.7 million every 15 years beginning in FY10.

- Leak Protection System Upgrade to upgrade the leak protection system, recommended for consideration in the FY08 CIP and estimated at $300,000 every 15 years beginning in FY11.

- DI Eastern Seawall Repairs Design and Construction to repair the eroded concrete seawall at Deer Island, recommended for consideration in the FY08 CIP and estimated at $1.7 million for a 2-year project during the FY11-13 timeframe.

- DI Seawall Refurbishment Design and Construction to repair southern seawall erosion and damage, recommended for consideration in the FY08 CIP and estimated at $500,000 with a duration of 2 years during FY11. An additional $1 million is needed every 12 years (FY23, 35, and 47).

- DI Personnel Dock Rehabilitation Construction to repair the floats, ladders and aluminum grating of the personnel dock is recommended for consideration in the FY08 CIP. The project is expected to last 1 year during the FY09-13 timeframe and cost $1.0 million. An additional $1 million is scheduled every 12 years.

- Cathodic Protection Testing to assess the condition of the cathodic protection stations, recommended for consideration in the FY08 CIP and estimated at $120,000 and recommended for FY08.

Table 6-1

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Future Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		DEER ISLAND TREATMENT PLANT											
		Plant Optimization Program											
6.1	**1**	**As-Needed Design Phases 4-1 & 4-2**	**Opti**	**in**	**2 years**	**1,134**	**now-FY07**	**1,134**					**1,134**
6.2	**1**	**As-Needed Design Phases 5-1 & 5-2**	**Opti**	**in**	**2 years**	**1,800**	**FY07-09**	**1,050**	**750**				**1,800**
6.3	**1**	**Long-Term As-Needed Design 1 & 2**	**Opti**	**in**	**4 years**	**3,200**	**FY09-13**		**3,200**				**3,200**
6.4	**1**	**Ancillary Modifications Design (ESDC/REI) and Construction 2-2**	**Opti**	**in**	**4 years**	**3,574**	**now-FY08**	**3,574**					**3,574**
6.5	**2**	**Ancillary Modifications Preliminary Design, Final Design, and Construction 4**	**Opti**	**in**	**5 years**	**4,783**	**FY08-12**	**360**	**4,423**				**4,783**
		SUBTOTAL - Deer Island Plant Optimization				**14,491**		**6,118**	**8,373**				**14,491**
		Asset Protection Program - *Equipment Replacement Category:*											
6.6	**1**	**Equipment Replacement Project**	**AP**	**in**	**N/A**	**18,653**	**now-FY16**	**300**	**4,900**	**13,453**			**18,653**
6.7	**1**	**Primary Clarifier Rehab Construction**	**AP**	**in**	**3 years**	**6,041**	**FY09-11**		**6,041**				**6,041**
6.8	**2**	**Cathodic Protection Evaluation**	**AP**	**in**	**2 years**	**250**	**FY09-10**		**250**				**250**
6.9	**3**	**Pump Packing Replacement**	**AP**	**in**	**2 years**	**200**	**FY07-08**	**200**					**200**
6.10	**2**	**LOCAT Scrubber Replacement Construction**	**AP**	**in**	**1 year**	**3,008**	**FY09-10**		**3,008**				**3,008**
6.11	**3**	**Grit Blower Replacement Construction**	**AP**	**in**	**1 year**	**335**	**FY08-09**		**335**				**335**
6.12	**2**	**Thickened Primary Sludge Pump Replacement**	**AP**	**in**	**3 years**	**5,789**	**FY08-11**	**210**	**5,579**				**5,789**
6.13	**1**	**Centrifuge Back-drive Replacements**	**AP**	**in**	**2 years**	**2,161**	**FY08-09**	**900**	**1,261**				**2,161**
		CATEGORY SUBTOTAL				**36,437**		**1,610**	**21,374**	**13,453**	**0**	**0**	**36,437**

Table 6-1 (continued)

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Future Projects

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		Asset Protection Program - *Architectural Category:*											
6.14	**3**	**Study/Concept Design- Concrete Repairs**	**AP**	**in**	**1 year**	**300**	**FY07-08**	**300**					**300**
6.15	**1**	**Expansion Joint Repairs 2 & 3**	**AP**	**in**	**6 months ea.**	**312**	**FY07-10**	**156**	**156**				**312**
		CATEGORY SUBTOTAL				**612**		**456**	**156**	**0**	**0**	**0**	**612**
		Asset Protection Program - *Utilities Category:*											
6.16	**1**	**Electrical Equipment Upgrades 2, 3, 4**	**AP**	**in**	**avg. 2 years**	**7,757**	**now–FY11**	**3,610**	**4,147**				**7,757**
6.17	**1**	**VFD Replacements (NMPS, WTF, Misc.)**	**AP**	**in**	**avg. 2.5 years**	**11,029**	**now-FY10**	**3,214**	**7,815**				**11,029**
6.18	**1**	**Power System Improvement Design and Construction**	**AP**	**in**	**4 years**	**7,905**	**now-FY10**	**2,401**	**5,504**				**7,905**
6.19	**1**	**DI Electrical Modifications**	**AP**	**in**	**1.5 years**	**2,000**	**FY07-09**	**1,777**	**223**				**2,000**
6.20	**1**	**Switchgear Replacements Design & Construction (Admin/Whse, All other DITP)**	**AP**	**in**	**avg. 1 yr each**	**4,447**	**FY08-11**	**1,009**	**3,438**				**4,447**
6.21	**1**	**PICS Replacement Construction**	**AP**	**in**	**1 year**	**1,582**	**FY10-11**		**1,582**				**1,582**
6.22	**2**	**Sodium Hypochlorite Pipe Replacement Design & Construction**	**AP**	**in**	**1 year**	**2,983**	**FY10-12**		**2,983**				**2,983**
6.23	**3**	**Pipeline Replacement Design and Constr 2**	**AP**	**in**	**2 years**	**1,672**	**FY09-11**		**1,672**				**1,672**
6.24	**1**	**Heat Loop Pipe Replacement Construction 2**	**AP**	**in**	**0.5 years**	**1,260**	**FY07**	**1,260**					**1,260**
6.25	**3**	**Fuel Transfer Pipe Replacement Design & Construction**	**AP**	**in**	**3 years**	**1,672**	**FY12-14**		**308**	**1,364**			**1,672**
6.26	**1**	**North Main Pump Station - Motor Control Center Design & Construction**	**AP**	**in**	**3 years**	**3,704**	**FY07-10**	**309**	**3,395**				**3,704**
6.27	**3**	**Second Deaerator Design and Construction**	**AP**	**in**	**3 years**	**353**	**FY08-10**	**12**	**341**				**353**
		CATEGORY SUBTOTAL				**46,364**		**13,592**	**31,408**	**1,364**	**0**	**0**	**46,364**

Table 6-1 (continued)

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Future Projects

Last revision 12/15/2006

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		Asset Protection Program - *Support Category:*											
6.28	**4**	**DISC Application**	**AP**	**in**	**2 years**	**125**	**FY07-08**	**125**					**125**
6.29	**3**	**Document Format Conversion**	**AP**	**in**	**5 years**	**353**	**FY07-12**	**116**	**237**				**353**
		CATEGORY SUBTOTAL				**478**		**241**	**237**	**0**	**0**	**0**	**478**
		Asset Protection Program - *Specialties Category:*											
6.30	**1**	**Primary Clarifier & Gravity Thickener Rehab - Design**	**AP**	**in**	**4 years**	**1,200**	**FY07-11**	**600**	**600**				**1,200**
6.31	**4**	**Gravity Thickener Improvements - Construction**	**AP**	**in**	**1 year**	**2,014**	**FY09**		**2,014**				**2,014**
6.32	**1**	**Sodium Hypochlorite Tank Liner Removal & Repair**	**AP**	**in**	**1 year**	**552**	**FY07**	**552**					**552**
6.33	**3**	**Metals Lab Fume Hood Replacement**	**AP**	**in**	**1 year**	**134**	**FY07-08**	**134**					**134**
6.34	**3**	**Metals Lab Modification Construction**	**AP**	**in**	**2 years**	**919**	**FY07-08**	**919**					**919**
6.35	**5**	**Lab Sample Area Modifications Design and Construction**	**AP**	**in**	**3 years**	**552**	**FY08-10**	**55**	**497**				**552**
6.36	**1**	**Clinton Soda Ash Replacement**	**AP**	**in**	**1 year**	**288**	**FY07-08**	**288**					**288**
6.37	**2**	**Clinton Permanent Standby Generator**	**AP**	**in**	**1 year**	**259**	**FY07-08**	**259**					**259**
		CATEGORY SUBTOTAL				**5,918**		**2,807**	**3,111**	**0**	**0**	**0**	**5,918**
		SUBTOTAL - Deer Island Asset Protection				**89,809**		**18,706**	**56,286**	**14,817**	**0**	**0**	**89,809**
		SUBTOTAL - Existing Projects - Deer Island				**104,300**		**24,824**	**64,659**	**14,817**	**0**	**0**	**104,300**

Table 6-1 (continued)

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Future Projects

Last revision 12/15/2006

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Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		Recommended Projects - Deer Island											
6.38	1	As-Needed Technical Design $200k for FY13, $750K annually	AP	new	Annual	26,450	Annually beginning FY13		200	3,750	7,500	15,000	26,450
6.39	2	Equipment Replacement Project	AP	new	Annual $2M expense	70,000	FY11-12, then yearly FY16-48		4,000	6,000	20,000	40,000	70,000
6.40	1	Future SSPS VFD Replacements, $6M each	AP	new	3 years	24,000	FY16, 26, 36, 46			6,000	6,000	12,000	24,000
6.41	2	SSPS Pump Lube System Replacement	AP	new	2 years	1,700	FY08-09	700	1,000				1,700
6.42	3	Future SSPS shaft &/or Motor Replacements ($1.5M each)	AP	new	2 years	4,500	FY14, 29, 44			1,500		3,000	4,500
6.43	1	Future NMPS VFD Replacements, $6.5M each	AP	new	3 years	22,100	FY18, 28, 38, 48			2,600	6,500	13,000	22,100
6.44	1	North Main Pump Sta. Motor Control Ctr. Design & Constr. ($3.5M each)	AP	new	3 years	7,000	FY28, 48				3,500	3,500	7,000
6.45	3	Future NMPS shaft &/or Motor Replacements ($2.2M each)	AP	new	2 years	6,600	FY15, 30, 45			2,200		4,400	6,600
6.46	5	Enterprise Engine Removal	AP	new	1 year	600	FY14			600			600
6.47	1	Future WTF VFD Replacements, $1.4M each	AP	new	1 year	4,200	FY19, 29, 39				1,400	2,800	4,200
6.48	3	Future WTF shaft &/or Motor Replacements ($800k each)	AP	new	2 years	2,400	FY16, 31, 46			800		1,600	2,400
6.49	1	Cryogenics Plant Equipment Replacement - valves, instruments, etc. ($2M each time)	AP	new	1 year	8,000	FY14, 24, 34, 44			2,000	2,000	4,000	8,000
6.50	2	Cryogenics Plant – Cooling Towers & Related Equipment Replacement ($450k each time)	AP	new	1 year	900	FY19, 29				450	450	900
6.51	3	Secondary Clarifier Rehabs ($4M each time)	AP	new	2 years	12,000	FY14, 29, 44			4,000		8,000	12,000
6.52	1	Secondary Clarifier Drive Chain ($250k each time)	AP	new	1 year	750	FY19, 29, 39				250	500	750
6.53	1	Sodium Hypochlorite Tank Rehabs ($625k/tank). Includes tank 3 emergency repair in FY07/08	AP	new	3 years	11,875	FY07-09; 17, 27, 37, 47	625	1,250	2,500	2,500	5,000	11,875
6.54	4	Sodium Bisulfite Tank Rehabs ($500k/tank)	AP	new	3 years	3,000	FY15, 30, 45			1,000		2,000	3,000
6.55	2	Barge Berth and/or Pier Facilities Rehab ($1M each time)	AP	new	1 year	2,000	FY11, 31, 51		1,000			1,000	2,000
6.56	4	DI Outfall Modifications Construction/REI	AP	prev	2 years	1,550	FY14-15, 25, 35, 45			1,100	150	300	1,550

Wastewater Master Plan - Deer Island Treatment Plant

Existing and Future Projects

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new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
6.57	1	Centrifuge Replacements (cost is $1.3M per centrifuge; replace 4 every 10 years).	AP	new	1 year	20,800	FY14, 24, 34, 44			5,200	5,200	10,400	20,800
6.58	1	Digested Sludge Pump Replacements (to FRSA)	AP	new	1 year	4,000	FY10, 30		2,000			2,000	4,000
6.59	1	Dystor Tank Membrane Replacements ($750k for both tanks)	AP	new	1 year	3,000	FY15, 25, 35, 45			750	750	1,500	3,000
6.60	5	DI Cross-Harbor Cable Dredging Construction	AP	new	1 year	20,000	FY09-10		20,000				20,000
6.61	1	Heat Loop Pipe Replacement Construction phase 3 ($1.6M FY08-09, then $75 every 8 yrs)	AP	new	1 year	1,900	FY08/09; FY17, 25, 33, 41	800	800	75	75	150	1,900
6.62	1	CTG Rebuilds ($2M each time)	AP	new	2 years	6,000	FY15, 30, 45			2,000		4,000	6,000
6.63	3	Replace STG at Deer Island	Opti	new	2 years	3,500	FY11-13		3,500				3,500
6.64	5	DI Wind Power	Plan	prev	1 year	150	FY08	150					150
6.65	5	DI Wind Power Construction	NF	prev	1 year	1,200	FY10		1,200				1,200
6.66	1	Future Misc. VFD Replacements, $2M each	AP	new	3 years	6,667	FY18, 28, 38, 48			667	2,000	4,000	6,667
6.67	1	Electrical Equipment Upgrades Phase 5 and up ($2M for FY11 & 12, then $500k per yr)	AP	new	2 years	20,000	FY11-48		2,500	2,500	5,000	10,000	20,000
6.68	1	Switchgear Replacements Design & Construction (all DITP areas - $5M each)	AP	new	4 years	16,250	FY18, 28, 38, 48			1,250	5,000	10,000	16,250
6.69	3	DI Grit & Odor Ctrl Air Handler Replacements	AP	new	2 years	3,000	FY09, 24, 39		1,000		1,000	1,000	3,000
6.70	2	Pipeline Replacement/Upgrades	AP	new	1 year	500	FY26, 41				250	250	500
6.71	2	PICS Distributed Processing Units (DPU) Replacements ($4M each time)	AP	new	2 years	8,000	FY15, 35			4,000		4,000	8,000
6.72	1	PICS Replacement Construction ($1.8M each)	AP	new	1 year	5,400	FY15, 30, 45			1,800		3,600	5,400
6.73	2	HVAC Control System	AP	new	1 year	3,000	FY10, 25, 40		1,000		1,000	1,000	3,000
6.74	3	HVAC Fan Coil Replacement ($1M each)	AP	new	2 years	3,000	FY09, 24, 39		1,000		1,000	1,000	3,000
6.75	2	Fire Alarm System	AP	new	1 year	5,100	FY10, 25, 40		1,700		1,700	1,700	5,100
6.76	2	Leak Protection System Upgrade ($300k each)	AP	new	1 year	900	FY11, 26, 41		300		300	300	900
6.77	4	DI Eastern Seawall Repairs Design & Construction	AP	prev	2 years	1,700	FY11-13		1,700				1,700
6.78	3	DI Seawall Refurbishment Design/Construction	AP	new	2 years	3,500	FY11, 23, 35, 47		500		1,000	2,000	3,500

Table 6-1 (continued)
Wastewater Master Plan - Deer Island Treatment Plant
Existing and Future Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in included in FY07 CIP (bold)
new new project, not previously in CIP
prev included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
6.79	5	DI Personnel Dock Rehab Construction	AP	prev/new	1 year	4,000	FY10, 22, 34, 46		1,000		1,000	2,000	4,000
6.80	4	Cathodic Protection Testing	AP	new	FY08	120	FY08	120					120
		SUBTOTAL - Recommended - Deer Island				351,312		2,395	45,650	52,292	75,525	175,450	351,312
		SUBTOTAL - Existing and Recommended - Deer Island				455,612		27,219	110,309	67,109	75,525	175,450	455,612

Chapter 7
RESIDUALS PROCESSING AND DISPOSAL (OFF-ISLAND)

7.1 Chapter Summary

At MWRA's Fore River Residuals Processing Facility in Quincy, digested wastewater sludge (biosolids) from the Deer Island Treatment Plant (DITP) is converted into pellets for beneficial reuse. The off-island residuals facility is officially named the Biosolids Processing Facility, but is commonly referred to as the Residuals Pellet Plant. The Pellet Plant is operated and maintained under a long-term contract (March 2001 through December 2015) with a private firm (the New England Fertilizer Company). This arrangement is detailed in this Chapter, but due to the nature of the agreement, planning for future MWRA current expense budget (CEB) and capital improvement program (CIP) needs is treated differently than other facilities. Since the private firm is responsible for all operations, maintenance and capital improvements for the term of the contract (December 2015), the Authority has not, as yet, planned for any major expenditures in the CIP. The annual operating cost is a function of biosolids production and various contractual inflationary indices and has been in the range of $13 to $15 million per year. The replacement asset value of the Pellet Plant Facility is $200 million (3% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.7.

In FY07, MWRA is undertaking a reliability assessment of utilities that support the Pellet Plant. This assessment may lead to recommendations for additional expenditures on the infrastructure. In addition, beginning in FY08, the Authority will initiate its assessment of long-term options for biosolids processing and disposal beyond 2015.

MWRA's Pellet Plant was built in 1991 and expanded in 2001. In 2015, the facility equipment will be an average of 20 years old. The facility is currently in good condition, but significant reinvestment is anticipated in the FY14-18 timeframe. For residuals facilities, operability of mechanical equipment and maintenance of 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; future uncertainties include long-term energy costs and supply.

A comprehensive Residuals Condition Assessment/Facility Plan project is recommended for the FY09-10 timeframe. This project will review the adequacy of existing facility components and processes and provide replacement recommendations based upon the latest/alternative technology. Information developed by this project will be used by MWRA to produce a prioritized list of recommended design/construction projects that will be scheduled over an 8 year period (FY11-18). Scheduling of upgrade projects will be based on equipment failure risk, construction sequencing to maintain facility operations, and capital expenditure planning.

For off-island residuals processing and disposal facilities, $180.32 million in projects is identified in the 40 year master plan timeframe (FY07-48). There are no projects currently programmed in the FY07 CIP. Eighteen projects ($180.32 million) are recommended for inclusion in the FY08 CIP. Section 7.6 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $6.32 million in needs is identified for FY08-13 and recommended for inclusion in the FY08 CIP:
  - $620,000 for electrical system reliability (design/construction) project.
  - $700,000 for study, design and rehabilitation (or demolition) of piers.
  - $1 million for a Residuals Condition Assessment/Facilities Plan project.
  - $4 million for design services for residuals upgrades.

Mid-term (FY14-18):

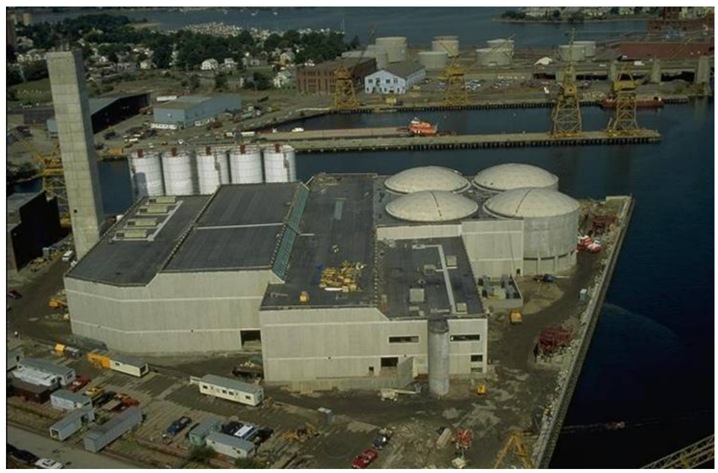
- $71 million in needs is identified for FY14-18 and recommended for inclusion in the FY08 CIP:
  - $4 million for engineering services during construction and resident inspection services for residuals upgrades.
  - $20 million to replace 6 rotary sludge dryers.
  - $18 million to replace 12 centrifuges.
  - $2 million to replace/rehabilitate sludge, centrate, and chemical pumps.
  - $1 million to replace the sludge feed conveyors and weigh scales.
  - $1 million to rehabilitate the sludge storage tanks and related valves.
  - $3 million to replace 6 air scrubbers/packed towers.
  - $2 million to replace 9 pellet storage silos.
  - $1.5 million to replace the main control console (MCC) equipment.
  - $1 million to rehabilitate portions of the rail system.
  - $2 million to upgrade the water, sewer, electrical, and telephone systems.
  - $1 million to replace components of the polymer make-up and pumping system.
  - $12 million to overhaul/replace the 4 thermal oxidizers.
  - $2 million to rehabilitate the building envelope.
  - $0.5 million to replace the pipelines and odor control equipment for the sludge storage tanks.

Long-term (FY19-28 and FY29-48):

- $103 million in needs is identified for FY29-48 and recommended for inclusion in the FY08 CIP:
  - $40 million to replace 6 rotary sludge dryers in FY29 and FY44.
  - $18 million to replace 12 centrifuges in FY33.
  - $4 million to replace/rehabilitate sludge, centrate, and chemical pumps in FY30 and FY45.
  - $2 million to replace the sludge feed conveyors and weigh scales in FY30 and FY45.
  - $2 million to rehabilitate the sludge storage tanks and related valves in FY31 and FY46.
  - $6 million to replace 6 air scrubbers/packed towers in FY31 and FY46.

- $4 million to replace 9 pellet storage silos in FY31 and FY46.
- $3 million to replace the main control console (MCC) equipment in FY32 and FY47.
- $2 million to rehabilitate portions of the rail system in FY32 and FY47.
- $4 million to upgrade the water, sewer, electrical, and telephone systems in FY32 and FY47.
- $2 million to replace components of the polymer make-up and pumping system in FY32 and FY47.
- $12 million to overhaul/replace the 4 thermal oxidizers in FY35.
- $3 million to rehabilitate the building envelope in FY33 and FY48.
- $1 million to replace the pipelines and odor control equipment for the sludge storage tanks in FY33 and FY48.

7.2 Facilities Overview



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 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. A 23 acre portion of the 180 acre FRSA site was set-aside for long-term MWRA use, which included approximately 8 acres for construction of a biosolids processing facility. Subsequently, MWRA constructed and contracted for the operation of the Pellet Plant.

Prior to December 1991 MWRA discharged digested biosolids from the DITP and Nut Island Treatment Plant (NITP) into Boston Harbor during outgoing tide cycles. As of December 24, 1991, the Authority ceased this biosolids discharge and began the transport of liquid biosolids (at 2-6% solids) from DITP and NITP to the Pellet Plant at the FRSA in Quincy. The transport system used specially designed barges to carry biosolids and/or filtrate between DITP, NITP and FRSA. The interim facility was designed to serve the MWRA's processing needs through 1996 (subsequently extended through August 1997). Expansion of the interim facility to the current Pellet Plant was completed in 2001. In 2005, MWRA began pumping digested wastewater sludge from DITP to the Pellet Plant via two 14-inch force mains located within the Inter-Island and Braintree-Weymouth Tunnels. The sludge pumping process eliminated the need to barge sludge between Deer Island and the Pellet Plant.

Residuals Management Program: The Residuals Management Program is a component of the Wastewater Treatment Division, which is headed by the Director of Wastewater Treatment. The Residuals Department is headed by a Manager on Deer Island, who in turn has an on-site Operations Manager reporting to him from the Pellet Plant in Quincy. The Wastewater Treatment Division reports to the Chief Operating Officer.

Contract Operations and Management: The Pellet Plant is operated and maintained under a contract with the New England Fertilizer Company (NEFCo). The contract term is March 2001 to December 2015. NEFCo is responsible for all operation and maintenance and employs approximately 35 staff at the facility. Facility personnel use a computerized maintenance management system with features similar to MWRA's MAXIMO work order software system that is in use at DITP. 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 on monthly basis along with a list of anticipated major repairs. In addition, NEFCo produces an executive summary maintenance report on a quarterly basis for MWRA and DEP review.

Plant Capacity/Design Criteria: The facility is rated to handle up to 180 dry tons per day of biosolids with four of the six operational trains running. Current processing levels are on the order of 100 to 110 dry tons per day, on an average annual basis. 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. At the Pellet Plant, biosolids are converted to pellets that are either shipped or trucked off-site for beneficial re-use. The pellet market is seasonal so there are large variances in quantities leaving the site.

Permitting: Beneficial re-use and disposal of wastewater biosolids are regulated by the EPA under 40 CFR part 503 (503s). The Massachusetts DEP is promulgated to authorize biosolids re-use and disposal under an Approval of Suitability permitting program. MWRA's Pellet Plant maintains an Approval of Suitability from MA DEP and staff report to EPA pursuant to the 503s. A Conditional Approval also governs the Pellet Plant for Air Pollution Control. In addition, biosolids reporting to EPA and MA DEP is also required under the MWRA's NPDES permit.

Biosolids Pumping and Storage: Until the Braintree-Weymouth Tunnel was completed in April 2005, digested biosolids from DITP were barged to the Pellet Plant for processing. Since April 2005, all biosolids have been pumped directly from DITP to the Pellet Plant at Fore River via a series of pipelines. During normal operation, three interconnected million gallon tanks receive incoming liquid biosolids from DITP via the pipelines. There is a fourth million gallon tank available for backup liquid biosolids storage. Centrate (generated from the dewatering process) is pumped back to the new MWRA Intermediate Pump Station (IPS) in Weymouth, where it enters the MWRA wastewater collection system.

Unit Process Description: Liquid biosolids are pumped to the Pellet Plant from DITP and held in storage tanks for processing. The liquid biosolids are pumped from the storage tanks to one of twelve centrifuges located on the second floor within the dewatering area. Eight new centrifugal pumps were installed by NEFCo to increase both pumping capacity and efficiency. The solid material exiting the centrifuges is known as "wet cake", which runs through screw conveyors to pug mills. In the pug mills, dried solids are mixed with the wet cake to form small pellets. The wet pellets are conveyed through rotary dryers, which remove the remaining moisture. The dried pellets are then passed through sieve classifiers and are blown into silos at out-loading facilities. The dried pellet product can be transported by rail or truck to locations where they are used as fertilizer.

Utilities: 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 some degree of emergency generator power on-site that can accommodate basic building needs during a power outage. The emergency generator can not power the biosolids processing operation. The facility's water is provided through a local Quincy connection. Sanitary sewer discharges are pumped directly to the MWRA collection system at the Intermediate Pump Station in Weymouth.

7.3 Detail on Facility Operations

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

Biosolids Dewatering Using Centrifuges: The purpose of each centrifuge is to concentrate the liquid biosolids 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. The centrifuge units have a conservative solids loading rate of 8 pounds digested biosolids per hour per 1,000 gallons or about 2,200 pounds digested biosolids per hour. Solids loading rates as high as 4,000 pounds per hour are possible. There is a 300 HP main bowl drive motor, a 100 HP regenerative DC back drive motor, and a 1/3 HP blower motor.

Each biosolids dewatering centrifuge consists of a high speed, rotating cylinder that receives biosolids through an injection tube located along its axis of rotation. The centrifuge configuration uses a counter-current flow pattern in which the solids and liquid (called centrate) are discharged from opposite ends of the cylinder. A weir at the centrate discharge end controls the depth of material held against the side of the cylinder. The solids discharge end has a gradual taper or cone section to retain solids within the unit. An axially oriented screw conveyor is set to rotate slightly slower than the bowl. Centrifugal force pushes solids towards the discharge port resulting in separation of solids from the liquid centrate. Polymer is added to the liquid biosolids to aid the dewatering process.

Pelletization and Drying: The FBPF houses six similar pelletizing trains. Dewatered biosolids are deposited in the wet cake storage bins and conveyed to mixing screws where it is combined with a dry (96 percent solids) recycle material (small pellets). The recycle 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 pug mill mixer is provided for each dryer train.

The pug mills perform final mixing and help shape the pellets prior to feeding biosolids to 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). The mixers have the capacity to mix and convey 25,000 pounds of material per hour of biosolids cake at 25 to 30 percent solids with 55,000 pounds per hour dry recycle material.

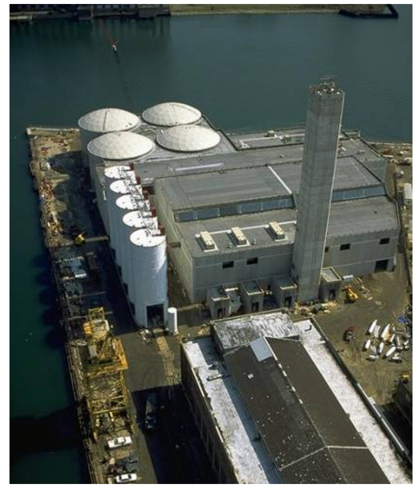
A natural gas burner, manufactured by Peabody Engineering, produces hot air to dry biosolids in a Baker-Rullman rotary drum dryer. The burner is a direct end-fired forced draft burner, sized to operate with natural gas supply. The burner system is a semi-automatic system featuring throttling fuel valves, safety shut-off solenoid valves, manual shut-off valves, pressure gauges, and a throttling air valve. A 7.5 HP blower provides combustion air to the burner.

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. The screener separates the pellets by size. Pellets that are too small fall through the screens to 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 wait to begin the process again. Pellets that are the correct size are cooled in 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.

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. Each pelletizing train has an individual dust collector and fan. 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 are designed to achieve outlet emissions of 0.009 or less grains per dry standard cubic foot. The venturi scrubber and packed tower are connected in series. 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 new biosolids 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 new 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 to capture dust in the air exhausted from the silo. Also on the deck of each silo are two 3-inch pneumatic conveying 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 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. These doors are 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.

Shipping/Distribution of Final Pellet Product: Pellets are stored in the silos until ready for distribution to a customer. 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 use is lower due to their larger capacity. In general, 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.

To support beneficial re-use of biosolids, 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 biosolids cake and/or biosolids pellet disposal. Until April 2005, MWRA was under Court obligation to provide a second layer of emergency backup. To meet this obligation, MWRA had contracted with the East Carbon Development Company in Utah to utilize their landfill for emergency disposal (with two other possible sites in Georgia and South Carolina). For simplicity, NEFCo also was allowed to use this same site in the event of an emergency. Extensive use of the landfill contract had not been needed since 1998, with only sporadic use needed in 2001/2002. The last time the landfill was used was 2002. In late 2005, the MWRA petitioned the Court to be relieved of the need for the second layer of emergency back-up landfill capability. Based on the demonstrated long-term reliability of biosolids re-use, the request was granted and MWRA terminated their contract with the East Carbon Development Company effective March 2006. Since NEFCo still had their contractual obligation for emergency backup landfill, they contracted with New England Organics to provide backup space at a number of sites throughout New England and New York.

7.4 Facility Maintenance and Ongoing Upgrades

NEFCo is responsible for any capital improvements that are needed to maintain the facility operation for the 15 year contract term. Their original contract outlined a tentative project list for each of the 15 years; 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. Below is a representative list of recently completed or on-going upgrades:

- Replacement of all three cooling towers;
- Installation of 8 new centrifugal process pumps;
- Major overhaul of 4 centrifuges;
- Replacement of all 12 polymer pumps;
- Replacement of all 6 shaftless jockey conveyors with shafted conveyors;
- Installation of a new spare polymer make-up system;
- Major overhaul of all 6 biosolids dryer trains;
- Overhaul of silo 6 through 9 rail scale and pneumatic transport system;
- Replacement of media and refractory repairs in three RTOs; and,
- Inspection of fire protection system.

7.5 MWRA Planning for Future Upgrades

In FY07, MWRA is issuing a CEB contract for a Plant System Reliability Study estimated at $620,000. The project will use an independent contractor to assess all major facility support systems, including: power, water, sanitary, and drainage. The contractor will identify needed repairs and/or recommended redundancy. NEFCo will be involved in this effort as well, with the goal to continue to maintain reliable operations. The project will be followed by design and construction contracts to implement the recommendations.

A $700,000 CIP project to demolish the pier adjacent to the plant is recommended. This project will cover the contingency that the work may need to be completed and funded by MWRA to protect the structural integrity of the Pellet Plant.

MWRA expects to issue a CIP contract in FY09 to have a consultant evaluate the condition of the entire facility and determine what equipment needs replacement or rehabilitation at the end of the current contract (December 2015). The facilities planning project will also assess what other technology options exist for biosolids management and processing. This project is estimated to cost $1 million during the FY09-10 timeframe. The Facilities Plan/Condition Assessment project will be followed by a design contract in FY11-12 and a construction services contract in FY14-18, with the combined cost estimated to be $8 million. To project residuals CIP costs for the Master Plan, MWRA is assuming that all major residuals equipment will be replaced in approximate 15 year cycles during the 40 year master plan period. The first round of equipment replacements are estimated to be needed during the FY14-18 timeframe at a total cost of $67 million.

7.6 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to off-island residuals processing and disposal are summarized in this Section. Table 7-1 lists each project, its priority ranking, and proposed expenditure schedule. A detailed description and needs justification for each project is listed in bullet format.

Projects in the Existing FY07 CIP: There are no residuals processing and disposal (off-island) related projects programmed in the FY07 CIP.

Projects Recommended for Consideration in the FY08 CIP: There are 18 residuals processing and disposal (off-island) related projects recommended for consideration in the FY08 CIP. The projects are described below and summarized in Table 7-1 (see line numbers 7.1 through 7.18).

- Pellet Plant Electrical System Reliability (design/construction) project for improvements to the plant electrical, water, sanitary, and drainage systems. The study phase of this project is included in the FY07 CEB. Design/construction cost is estimated at $620,000 with a 1-year duration during FY08.

- Study, design and rehabilitation (or demolition) of piers at the Pellet Plant at an estimated cost of $700,000 with a 2-year duration during FY08-09. MWRA does not own Pier 2; however, it may need to be demolished at some point.

- Residuals Condition Assessment/Facilities Plan to evaluate the condition of the entire Pellet Plant prior to the end of the NEFCo contract (December 2015) and assess various technology options. Cost is estimated at $1 million with a duration of 2-years during the FY09-10 timeframe.

- Design and construction services for residuals upgrades to implement all required equipment/process replacements at the end of the NEFCo contract. The project is estimated at $8 million and will be performed in two phases: $4 million for design is estimated during the FY11-12 timeframe and $4 million is estimated for engineering services during construction and resident inspection during the FY14-18 timeframe.

- Replace 6 rotary sludge dryers at the end of their expected useful lives (15 years) is estimated at $20 million with a duration of 3-years beginning in FY14. Staff anticipate the dryers will need to be replaced again in FY29 and FY44.

- Replace 12 centrifuges at the end of their expected useful lives (18 years) is estimated at $18 million with a duration of 2-years beginning in FY15. Staff anticipate the centrifuges will need to be replaced again in FY33.

- Replace/rehabilitate sludge, centrate, and chemical pumps is estimated at $2 million with a duration of 2-years beginning in FY15. Staff anticipate the pumps will need to be replaced again in FY30 and FY45.

- Replace the sludge feed conveyors and weigh scales (from the centrifuges to the rotary dryers) is estimated at $1 million with a duration of 1-year beginning in FY15. Staff anticipate the conveyors and weigh scales will need to be replaced again in FY30 and FY45.

- Rehabilitate the sludge storage tanks and related valves is estimated at $1 million with a duration of 1-year beginning in FY16. Staff anticipate rehabilitating the tanks again in FY31 and FY46.

- Replace 6 air scrubbers/packed towers is estimated at $3 million with a duration of 2-years beginning in FY16. Staff anticipate replacing the air scrubbers/packed towers again in FY31 and FY46.

- Replace 9 pellet storage silos at the end of their expected useful lives (15 years) is estimated at $2 million with a duration of 2-years beginning in FY16. Staff anticipate replacing the silos again in FY31 and FY46.

- Replace the main control console (MCC) equipment is estimated at $1.5 million with a duration of 2-years beginning in FY17. Staff anticipate replacing the MCC equipment again, as new technology emerges, in FY32 and FY47.

- Rehabilitate portions of the rail system is estimated at $1 million with a duration of 2-years beginning in FY17. Staff anticipate other portions of the rail system may need to be replaced periodically and recommend funds for projects in FY32 and FY47.

- Upgrading the water, sewer, electrical, and telephone systems is estimated at $2 million with a duration of 2-years beginning in FY17. Staff anticipate periodic upgrades and recommend additional funds in FY32 and FY47.

- Replace components of the polymer make-up and pumping system is estimated at $1 million with a duration of 1-year beginning in FY17. Staff anticipates replacing components again, as new technology emerges, in FY32 and FY47.

- Overhaul/replace the 4 thermal oxidizers is estimated at $12 million with a duration of 3-years beginning in FY17. Staff anticipate rehabilitating the oxidizers again in FY35.

- Rehabilitate the building envelope is estimated at $2 million with a duration of 2-years beginning in FY17. Staff anticipate periodic rehabilitation of doors, windows, siding, etc. and recommend projected expenditures in FY33 and FY48.

- Replace the pipelines and odor control equipment for the sludge storage tanks is estimated at $500,000 with a duration of 1-year beginning in FY18. Staff anticipate periodic rehabilitation and recommend projected expenditures in FY33 and FY48.

Table 7-1
Wastewater Master Plan - Residuals (Off-Island)
Recommended Projects
Last revision 12/15/2006

Prioritization	Project Types		FY07 CIP Notes	
1 Critical	NF	New Facility/System	in	included in FY07 CIP (bold)
2 Essential	RF/IC	Replacement Facility/Increase Capacity	new	new project, not previously in CIP
3 Necessary	Opti	Optimization	prev	included in prior CIP, but deleted
4 Important	AP	Asset Protection		
5 Desirable	Plan	Planning/Study		

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		RESIDUALS											
7.1	1	Residuals Plant Electric System Reliability Design/Construct	AP	new	1 year	620	FY08	620					620
7.2	2	FRSA Pier Rehabilitation	AP	new	2 years	700	FY08-09	350	350				700
7.3	1	Residuals Condition Assessment and Facilities Plan	Plan	new	2 years	1,000	FY09-10		1,000				1,000
7.4	1	Residual Upgrades - Design & Constr Services (50% of cost for design, 50% is for ESDC/REI)	AP	new	Des FY11-12, Cons FY14-18	8,000	Des FY11-12, Cons FY14-18		4,000	4,000			8,000
7.5	1	6 Rotary Dryer Replacements	AP	new	3 years	60,000	FY14, 29, 44			20,000		40,000	60,000
7.6	2	12 Centrifuge Replacements (avg. 18 yr life)	AP	new	2 years	36,000	FY15, 33			18,000		18,000	36,000
7.7	2	Pumping Systems Upgrade	AP	new	2 years	6,000	FY15, 30, 45			2,000		4,000	6,000
7.8	2	Sludge Feed Conveyor Replacements	AP	new	1 year	3,000	FY15, 30, 45			1,000		2,000	3,000
7.9	2	Sludge Storage Tank Rehabilitation	AP	new	1 year	3,000	FY16, 31, 46			1,000		2,000	3,000
7.10	1	6 Air Scrubber Replacements	AP	new	2 years	9,000	FY16, 31, 46			3,000		6,000	9,000
7.11	2	Replace 9 Pellet Storage Silos	AP	new	2 years	6,000	FY16, 31, 46			2,000		4,000	6,000
7.12	1	Plant MCC Replacements	AP	new	2 years	4,500	FY17, 32, 47			1,500		3,000	4,500
7.13	2	Rail System Rehabilitation	AP	new	2 years	3,000	FY17, 32, 47			1,000		2,000	3,000
7.14	2	Utility Upgrades	AP	new	2 years	6,000	FY17, 32, 47			2,000		4,000	6,000
7.15	3	Polymer System Upgrade	AP	new	1 year	3,000	FY17, 32, 47			1,000		2,000	3,000
7.16	3	Thermal Oxidizer Rehabilitation (avg. 18 yr life)	AP	new	3 years	24,000	FY17, 35			12,000		12,000	24,000
7.17	3	Building Envelope Rehabilitation	AP	new	2 years	5,000	FY17, 33, 48			2,000		3,000	5,000
7.18	2	Odor Control System Rehabilitation	AP	new	1 year	1,500	FY18, 33, 48			500		1,000	1,500
		SUBTOTAL - Recommended - Residuals				180,320		970	5,350	71,000	0	103,000	180,320

CHAPTER 8
COLLECTION SYSTEM REMOTE HEADWORKS AND CROSS-HARBOR TUNNELS

8.1 Chapter Summary

The MWRA's wastewater collection system is a complex network of conduits and facilities that is strongly influenced by seasonal and wet weather conditions. The system average daily flow is approximately 360 mgd, minimum dry weather flow is approximately 260 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 275.5 miles of sewer pipelines (18.1 miles of cross-harbor tunnels, 227 miles of gravity sewers, 20 miles of force mains, 7 miles of siphons, and 3.4 miles of CSO and emergency outfalls); 13 pump stations; one screening facility; six CSO treatment 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 18 miles of cross-harbor tunnels are detailed. The 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 to remove grit and screen out debris from the wastewater flow to minimize solids accumulation in the cross-harbor tunnels and protect the downstream pump facilities at 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 $190 million (3% of wastewater system asset value) and the cross-harbor tunnels is $660 million (11% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.7. The facilities are detailed within the Chapter Section noted below:

8.3 Chelsea Creek Headworks
8.4 Columbus Park Headworks
8.5 Ward Street Headworks
8.6 Nut Island Headworks
8.7 Intermediate Pump Station
8.8 Winthrop Terminal Headworks
8.9 Boston Main Drainage Tunnel
8.10 North Metropolitan Relief Tunnel
8.11 Inter-Island Tunnel
8.12 Braintree-Weymouth Tunnel

The Chelsea Creek, Columbus Park, and Ward Street Headworks were all built in 1967 and are almost 40 years old. Equipment at the headworks was upgraded by MWRA in 1987 and is now almost 20 years old. These three older facilities remain operational, but, largely due to age and equipment obsolescence, are in only fair condition and in need of significant reinvestment in the immediate future. The Nut Island Headworks, built in 1998, is relatively new and is in very good condition. Some minor equipment rehabilitation and replacement projects are recommended, however, significant 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 which 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 the future energy/chemical costs.

A comprehensive Headworks Condition Assessment/Facility Plan project has been approved in the FY07 CIP and will begin in 2007. This project will review the adequacy of existing headworks components and processes and provide replacement recommendations based upon the latest/alternative technology. Information developed by this project will be used by MWRA to produce a prioritized list of recommended design/construction projects that will be scheduled over a 20-year period (FY09-28). Scheduling of upgrade projects will be based on equipment failure risk, construction sequencing to maintain facility operations, and capital expenditure planning.

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 all wastewater facilities (headworks, pump stations, and CSO facilities) is recommended. This asset protection project is included in Chapter 10 – Collection System Pump Station and CSO Facilities rather than in this Chapter.

With respect to the cross-harbor tunnels, the North Metropolitan Relief Tunnel and Boston Main Drainage Tunnel were built in 1953 and are more than 50 years old. The Inter-Island Tunnel (1995) 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. Since the cross-harbor tunnels are critical facilities, an inspection and condition assessment project is recommended as a high priority. 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. No tunnel repair/rehabilitation costs are recommended in the Master Plan. Some deterioration of concrete in the tunnel shafts has been documented and attributed to hydrogen sulfide corrosion. Funds to repair the tunnel shafts are recommended as a high priority.

For the remote headworks and cross-harbor tunnels, $84.5 million in projects is identified in the 40-year master plan timeframe (FY07-48). Two projects ($7 million) are currently programmed in the FY07 CIP. Seven additional projects ($77.5 million) are recommended for inclusion in the FY08 CIP. Section 8.14 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $7 million is currently programmed in the CIP (FY07-13):
  - $2 million to complete the Headworks Condition Assessment/Facility Plan.
  - $5 million to replace headworks screens.

- $17 million in needs is identified for FY09-13 and recommended for inclusion in the FY08 CIP:
  - $10 million for design/construction of headworks upgrades during the first 5-years of the 20-year program.
  - $4 million for two equipment replacement projects at the Nut Island Headworks ($200,000 for fire alarm and wiring conduit and $3.8 million for mechanical systems).
  - $3 million for a Cross-Harbor Tunnel Inspection and Condition Assessment project.

Mid-term (FY14-18):

- $20.5 million in needs is identified for FY14-18 and recommended for inclusion in the FY08 CIP:
  - $15 million for design/construction of headworks upgrades during years 6 through 10 of the 20-year program.
  - $500,000 for pier rehabilitation at the Nut Island Headworks.
  - $5 million for cross-harbor tunnel shaft repairs.

Long-term (FY19-28 and FY29-48):

- $40 million in needs is identified for FY19-28 and recommended for inclusion in the FY08 CIP:
  - $10 million for design/construction of headworks upgrades during the last 10-years of the 20-year program.
  - $30 million for long-term equipment replacement at the Nut Island Headworks.

8.2 Facilities Overview

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. Key information on each headwork facility is provided in Table 8-1.

Management of headworks facilities is the responsibility of the Field Operations Department. The Field Operations Department is a subset of the Operations Division under the oversight of the Chief Operating Officer. Key supervisory staff reporting to the Director, Field Operations include: Director, Wastewater Operations and Maintenance; Manager, Wastewater Operations; Senior Program Manager, Metro Trades; and Manager, Headworks.

Table 8-1

MWRA Headworks

Facility/Location	Average Daily Flow (MGD)	Peak Capacity (MGD)	Year Built	Flow Received From
Chelsea Creek Headworks Chelsea	135	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	40	182	1967 upgrade 1987	Columbus Park Connection, New Boston Main Interceptor, Dorchester Interceptor and South Boston Interceptor
Intermediate Pump Station (IPS) North Weymouth	14.8	45	2005	Braintree-Weymouth Extension Sewer, Randolph Trunk Sewer & Holbrook Extension Sewer
Nut Island Headworks Quincy	125	400	1998	High Level Sewer
Ward Street Headworks Roxbury	90	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	14	64	1970	North Metropolitan Trunk Sewer

<u>Operation and Maintenance</u>: Each remote headworks has dedicated staff that operate the facility 24-hours per day. A total of about 39 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 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 via mini computer at the headworks and downloaded to a central computer. All system scans that produce abnormal readings are checked

Figure 8-1:

MWRA Headworks & Cross Harbor Tunnels Location Plan

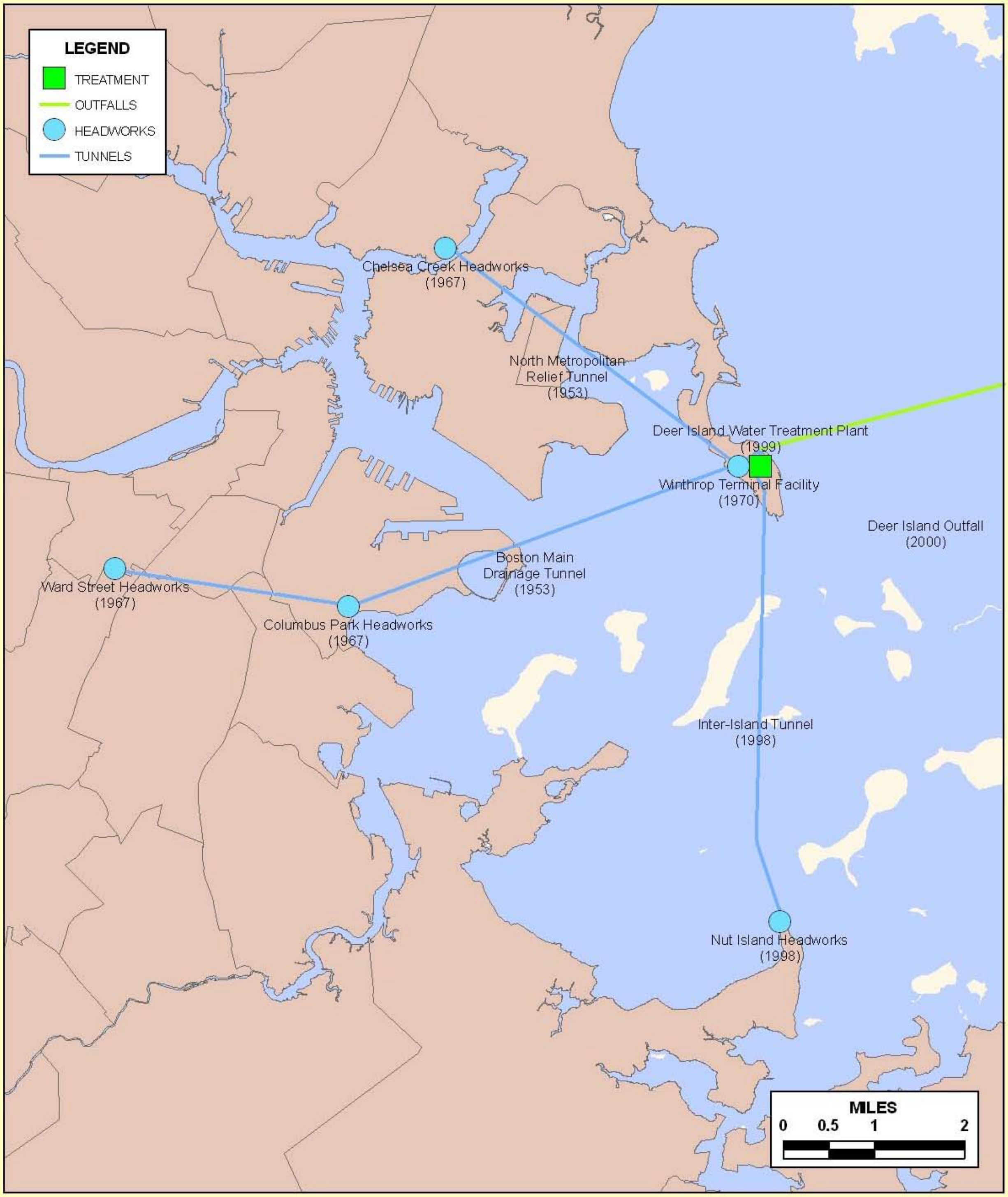
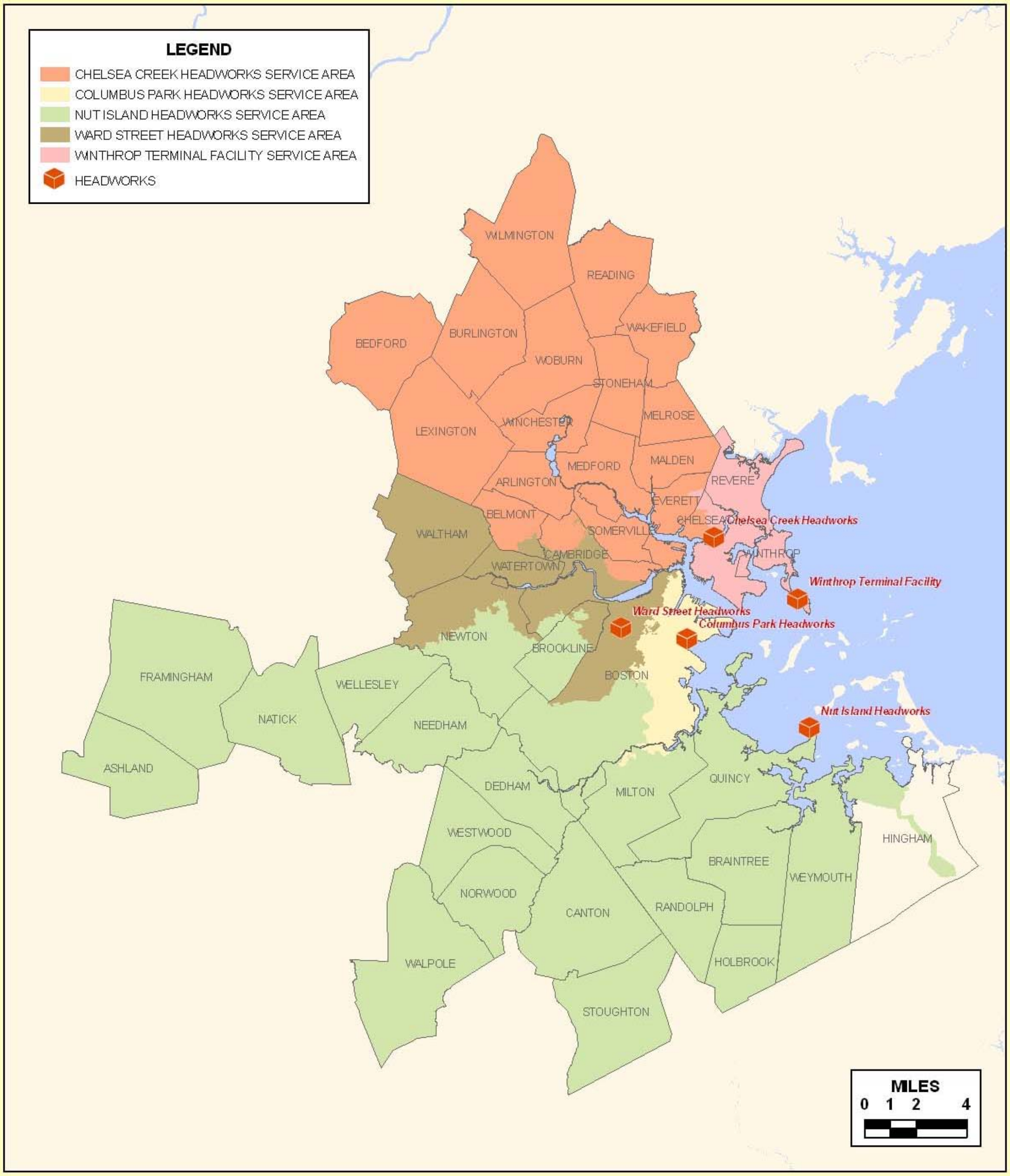


Figure 8-2:

MWRA Headworks Service Areas



by area 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 Field Operations Department provides scheduling and job planning at all wastewater facilities. All maintenance is scheduled through the MAXIMO system (see detail below).

<u>Facility Operation</u>: Influent gates at headworks facilities are used to control flow to the facility. Bar screens remove large debris. Screenings are transferred to a screenings dumpster for disposal at an off-site landfill. Grit is allowed to settle out of the flow in the grit channels and is also 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.

<u>Facility Maintenance</u>: Preventative maintenance is a primary focus of MWRA staff. Tasks performed by operational staff are generally defined as light maintenance duties that increase the number of work hours dedicated to preventative maintenance activities. Dedicated staff at the headworks use a handheld monitoring device to perform daily checks of equipment. This information is integrated in a database for use with MWRA's MAXIMO work order system. The MAXIMO computerized maintenance management system captures 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 equipment. Abnormal conditions are noted and forwarded to planner/schedulers for work order processing and further action by the Equipment Maintenance section. Maintenance backlog varies from as low as two weeks, for essential work orders, and up to six months for low priority work. Backlog levels depend on resources available, 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.

<u>MWRA In-House Tasks</u>: There are two in-house tasks related to the headworks facilities recommended to be completed by MWRA staff:

- Staff should review/update SOPs for all headworks facilities.
- 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;
- High voltage maintenance;
- HVAC pneumatic controls maintenance;

- Hydraulics maintenance;
- Instrumentation maintenance;
- Nut Island landscape maintenance;
- Overhead door maintenance; and,
- Pump variable frequency drive maintenance.

Headworks Condition Assessment/Facility Plan Project: The Headworks Condition Assessment/ Facilities Plan project will provide professional engineering services including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for three remote headwork facilities (Chelsea Creek, Columbus Park, and Ward Street). This study has a $2 million budget and is scheduled to be performed in FY07-08. This project is a priority based on the age and obsolescence of most equipment within the three older remote headworks facilities. Separate capital projects have been previously proposed in the CIP to replace major portions of the headworks equipment (including screens, odor control, grit collection, and grit and screenings removal). The Headworks Condition Assessment/Facilities Plan project will be a comprehensive review and evaluation of the three older remote headworks. A consultant will review the adequacy of existing components and processes and provide recommendations based upon the latest/alternative technology. Information developed by this project will be used by MWRA to produce a prioritized list of recommended design/construction projects that will be scheduled over the 20-year master planning period FY09-28. The Headworks Condition Assessment/ Facilities Plan contract will begin in 2007 and be completed over a period of 2-years.

8.3 Chelsea Creek Headworks

- Address: Eastern and Marginal Streets, Chelsea
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 135 mgd
- Peak Capacity: 350 mgd


Chelsea Creek Headworks

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 Siphons. 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, and odor control equipment.

Hydraulic Performance: Four channels are available for use at the Chelsea Creek Headworks. Typically, two channels are used during normal (dry weather) flow conditions and three 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 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 will initially divert excess flow to the Chelsea Screen House, which is tributary to the Caruso Pump Station. Once Caruso Pump Station reaches its peak capacity, the hydraulic grade line will increase in the North Metropolitan System to a point where it will activate the upstream CSO outfalls.

Facility Power: The primary electrical feed is from commercial service. A diesel generator (200 KW) provides backup power.

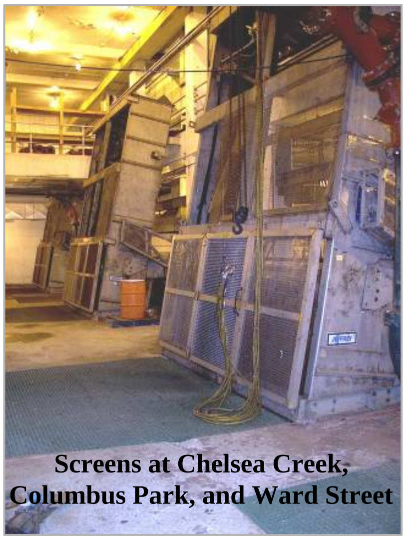
Standard Operating Procedures (SOPs): The facility SOP was developed in 1987 and has received periodic updates.

Record Plans: Record Drawings for the 1987 upgrades for the 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.

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 in need of significant reinvestment in the immediate future. The facility structure is 40 years old and most equipment is 20 years old. Based on the industry useful life benchmark of 20 years for equipment and 50 years for structures, a comprehensive review and evaluation is warranted. A Condition Assessment/Facilities Plan project is included in the FY07 CIP and will be conducted in FY07-08. This project will recommend significant future upgrades; no upgrades are ongoing.

Projects in the Existing FY07 CIP:

- The Headworks Condition Assessment/Facilities Plan project will begin in 2007 (see Section 8.2); $2 million is included in the FY07 CIP for expenditure in FY07-08.
- Remote headworks (Chelsea Creek, Columbus Park, and Ward Street) screen replacement construction, $5 million in FY09-12. It is anticipated that replacement of screens will be the most critical and highest priority recommendation from the Headworks Condition Assessment/Facilities Plan project.


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.

Projects Recommended for Consideration in the FY08 CIP:

- Rehabilitation, replacement and upgrades recommended in the Headworks Condition Assessment / Facilities Plan at three remote headworks (Chelsea Creek, Columbus Park, and Ward Street); $35 million in FY09-28. These recommendations are expected to be spread over a 20-year period and will incorporate previous CIP project recommendations for headworks improvements (including odor control system replacement at $1.5 million; grit collection system replacement at $6.1 million; and grit/screenings ejection system replacement at $6.0 million).
- A long-term Wastewater Facilities Asset Protection Project is recommended (see Section 8.13); a portion of these funds would be used for rehabilitation/replacement needs at the Chelsea Creek Headworks.

8.4 Columbus Park Headworks


Columbus Park Headworks

- Address: Columbus Road and Day Boulevard, South Boston
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 40 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 potion of Boston and a 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, and odor control equipment.

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 used during peak flow (wet weather) conditions, with one channel held in reserve. 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 Power: The primary electrical feed is from commercial service. A diesel generator (200 KW) provides backup power.

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 in need of significant reinvestment in the immediate future. The facility structure is 40 years old and most equipment is 20 years old. Based on the industry useful life benchmark of 20 years for equipment and 50 years for structures, a comprehensive review and evaluation is warranted. A Condition Assessment/Facilities Plan project is included in the FY07 CIP and will be conducted in FY07-08. This project will recommend significant future upgrades; no upgrades are ongoing.

Projects in the Existing FY07 CIP:

- The Headworks Condition Assessment/Facilities Plan project will begin 2007 (see Section 8.2); $2 million is included in the FY07 CIP for expenditure in FY07-08.
- Remote headworks (Chelsea Creek, Columbus Park, and Ward Street) screen replacement construction, $5 million, FY09-12. It is anticipated that replacement of screens will be the most critical and highest priority recommendation from the Headworks Condition Assessment/Facilities Plan project.

<u>Projects Recommended for Consideration in the FY08 CIP</u>:

- Rehabilitation, replacement and upgrades recommended in the Headworks Condition Assessment / Facilities Plan at three remote headworks (Chelsea Creek, Columbus Park, and Ward Street); $35 million in FY09-28. These recommendations are expected to be spread over a 20-year period and will incorporate previous CIP project recommendations for headworks improvements (including odor control system replacement at $1.5 million; grit collection system replacement at $6.1 million; and grit/screenings ejection system replacement at $6.0 million).
- A long-term Wastewater Facilities Asset Protection Project is recommended (see Section 8.13); a portion of these funds would be used for rehabilitation/replacement needs at the Columbus Park Headworks.

Photos above show grit pipling 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.

8.5 Ward Street Headworks

- Address: Ward Street, Roxbury
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 90 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 hydraulic effluent sluice gates, and odor control equipment.

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 used during peak flow (wet weather) conditions, with one channel held in reserve. 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 Power: The primary electrical feed is from commercial service. A diesel generator (820 KW) provides backup power.

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 in need of significant reinvestment in the immediate future. The facility structure is 40 years old and most equipment is 20 years old. Based on the industry useful life benchmark of 20 years for equipment and 50 years for structures, a comprehensive review and evaluation is warranted. A Condition Assessment/Facilities Plan project is included in the FY07 CIP and will be conducted in FY07-08. This project will recommend significant future upgrades; no upgrades are ongoing.

Projects in the Existing FY07 CIP:

- The Headworks Condition Assessment/Facilities Plan project will begin in 2007 (see Section 8.2); $2 million is included in the FY07 CIP for expenditure in FY07-08.
- Remote headworks (Chelsea Creek, Columbus Park, and Ward Street) screen replacement construction, $5 million, FY09-12. It is anticipated that replacement of screens will be the most critical and highest priority recommendation from the Headworks Condition Assessment/Facilities Plan project.

Projects Recommended for Consideration in the FY08 CIP:

- Rehabilitation, replacement and upgrades recommended in the Headworks Condition Assessment / Facilities Plan at three remote headworks (Chelsea Creek, Columbus Park, and Ward Street); $35 million in FY09-28. These recommendations are expected to be spread over a 20-year period and will incorporate previous CIP project recommendations for headworks improvements (including odor control system replacement at $1.5 million; grit collection system replacement at $6.1 million; and grit/screenings ejection system replacement at $6.0 million).
- A long-term Wastewater Facilities Asset Protection Project is recommended (see Section 8.13); a portion of these funds would be used for rehabilitation/replacement needs at the Ward Street Headworks.

8.6 Nut Island Headworks


Nut Island Headworks

- Address: 147 Sea Avenue, Quincy
- Location Map: See Figure 8-1
- Tributary Area Map: See Figure 8-2
- Average Daily Flow: 125 mgd
- Peak Capacity: 400 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 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 two 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 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, two motorized emergency spillway sluice gates, and bubbler tube level sensor in the effluent drop shaft.

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. The Nut Island Treatment Plant served all of the south collection system providing preliminary and primary treatment and chlorination prior to discharge through the 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 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 headworks is operating at maximum capacity, or if the headworks had to be isolated for an emergency condition (such as a sewer system pump station failure).


Nut Island Headworks

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.

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 Power: The primary electrical feed is from commercial service. A diesel generator (820 KW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 1998.

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 in very good condition. Some minor repair work to maintain system/equipment operation is recommended. A preliminary study planned for the Nut Island Headworks grit conveyor system may result in a longer-term rehabilitation or replacement project.

Projects in the Existing FY07 CIP: None

Projects Recommended for Consideration in the FY08 CIP:

- Future rehabilitation, replacement and upgrades recommended in the Headworks Condition Assessment/Facilities Plan. Although the Nut Island Headworks is not included in the general scope of the project, a separate task-order portion of the Facilities Plan may provide recommendations for upgrades at the Nut Island Headworks. No funds are recommended to be added for this project. If needs arise, these projects will be funded via the Long-Term Wastewater Facilities Asset Protection Project.
- A long-term Wastewater Facilities Asset Protection Project is recommended (see Section 8.13); a portion of these funds would be used for rehabilitation/replacement needs at the Nut Island Headworks.
- In recent years, portions of the fire alarm and wiring conduit have deteriorated due to salt water corrosion. Replacement of the conduit is estimated by staff at $200,000 with a project duration of 1-year. This project is recommended during the FY09-13 timeframe.
- In recent years, portions of the Nut Island Headworks mechanical systems have failed to operate properly, including the hydraulic accumulator, sluice gates, and conveyor system. A planning, design, construction project to replace the mechanical systems at Nut Island is recommended for the FY09-13 timeframe at an estimated cost of $3.8 million with a project duration of 3-years.
- The Nut Island Pier is anticipated to require rehabilitation during the FY14-18 time frame. A $500,000 planning, design, construction project is recommended with a project duration of 2-years.

- 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 FY19-28 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 over time utilizing the Long-Term Wastewater Facilities Asset Protection Project funds. 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, no expenditures are anticipated for structural type components at the Nut Island Headworks during the 40 year planning period of the Wastewater Master Plan.

8.7 Intermediate Pump Station

The Intermediate Pump Station (IPS) is located 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) is 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 at the Fore River Staging Area in Quincy. The Braintree-Weymouth Tunnel is detailed in Section 8.13.

8.8 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 included within Chapter 6 - Deer Island Treatment Plant.

8.9 Boston Main Drainage Tunnel

<u>Function and Operation</u>: The Boston Main Drainage Tunnel was constructed in 1953. The tunnel location is shown on Figure 8-1 and on the MWRA Sewer System Location Plan, Figure A (included as Appendix A). 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 37586 feet (about 7.1 miles) from the Ward Street Headworks shaft to Shaft "C". The portion from the Ward Street to Columbus Park Headworks is 10-foot diameter and 13,763 feet long. The portion from the Columbus Park Headworks to Shaft "C" 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.

<u>Hydraulic Performance</u>: 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 (closing of influent gates) at the Ward Street and Columbus Park Headworks.

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

<u>Condition Assessment and Ongoing Upgrades</u>: 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. A condition assessment project is recommended. No upgrades are ongoing.

<u>Projects Recommended for Consideration in the FY08 CIP</u>:

- A Cross-Harbor Tunnel Inspection and Condition Assessment project is recommended ($3 million recommended in prior CIP). The project should include evaluation of three cross-harbor tunnels: the Boston Main Drainage Tunnel, the North Metropolitan Relief Tunnel, and the Inter-Island Tunnel. Inspection and assessment of the condition of the headworks drop shafts ($2 million recommended in prior CIP) at the beginning of the tunnels and the pump shafts at Deer Island should be included in this project. Staff estimate a $3 million project cost and 1-year project duration. The project is recommended for the FY09-13 timeframe.
- 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. Staff recommend a planning/design/construction project to rehabilitate and repair the drop shafts. This project is estimated at $5 million with a 3-year duration and is recommended for the FY14-18 timeframe.

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.

8.10 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 and on the MWRA Sewer System Location Plan, Figure A (included as Appendix A). 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 (closing 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. A condition assessment project is recommended. No upgrades are ongoing.

Projects Recommended for Consideration in the FY08 CIP:

- A Cross-Harbor Tunnel Inspection and Condition Assessment project is recommended ($3 million recommended in prior CIP). The project should include evaluation of three cross-harbor tunnels: the Boston Main Drainage Tunnel, the North Metropolitan Relief Tunnel, and the Inter-Island Tunnel. Inspection and assessment of the condition of the headworks drop shafts ($2 million recommended in prior CIP) at the beginning of the tunnels and the pump shafts at Deer Island should be included in this project. Staff estimate $3 million project cost and a 1-year project duration. The project is recommended for the FY09-13 timeframe.
- 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. Staff recommend a planning/design/construction project to rehabilitate and repair the drop shafts. This project is estimated at $5 million with a 3-year duration and is recommended for the FY14-18 timeframe.


Shaft Corrosion

8.11 Inter-Island Tunnel

Function and Operation: Construction for the Inter-Island Tunnel began in 1995 and it was placed into operation in July 1998. The tunnel's location is shown on Figure 8-1 and on the MWRA Sewer System Location Plan, Figure A (included as Appendix A). 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 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 at Nut Island 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 less that 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. A condition assessment project is recommended. No upgrades are ongoing.

Projects Recommended for Consideration in the FY08 CIP:

- A Cross-Harbor Tunnel Inspection and Condition Assessment project is recommended ($3 million recommended in prior CIP). The project should include evaluation of three cross-harbor tunnels: the Boston Main Drainage Tunnel, the North Metropolitan Relief Tunnel, and the Inter-Island Tunnel. Inspection and assessment of the condition of the headworks drop shafts ($2 million recommended in prior CIP) at the beginning of the tunnels and the pump shafts at Deer Island should be included in this project. Staff estimate a $3 million project cost and 1-year project duration. The project is recommended for the FY09-13 timeframe.

8.12 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 at the Fore River Staging Area in Quincy. The location of the tunnel is shown on Figure 8-1 and on the MWRA Sewer System Location Plan, Figure A (included as Appendix A). 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 at the Fore River Staging Area in Quincy. The Braintree-Weymouth Tunnel contains:

- 2 - 14-inch ductile iron sludge force mains from Nut Island in Quincy to the Residuals Processing Facility in Quincy, a distance of 2.5 miles;
- 2 - 12-inch ductile iron centrate force mains from the Residuals Processing Facility in Quincy to the IPS in Weymouth, a distance of 0.5 mile;
- 1 - 12-inch ductile iron potable water line from the Residuals Processing Facility 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 will be completed in 2006/07.

Condition Assessment and Ongoing Upgrades: The Braintree-Weymouth Tunnel is new. No upgrades are ongoing and no future work is recommended.

Projects Recommended for Consideration in the FY08 CIP: 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 9.9).

8.13 Reinvestment Needs Based on Estimated Replacement Asset Value

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. Staff estimate that MWRA's headworks facilities have a replacement asset value of $190 million in 2006 dollars. 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 the headworks, 60 percent of the asset value was allocated as a 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 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 the headworks, staff recommend allocating $1.5 million per year (about 25 percent of the headworks overall estimated reinvestment need) to a long-term Wastewater Facilities Asset Protection Project. Based on other recommendations made in this chapter, the need for a long-term asset protection funds for the headworks will begin in FY14. The long-term Wastewater Facilities Asset Protection Project is recommended as a consolidated project for rehabilitation/replacement tasks for all (non-treatment) wastewater facilities (including headworks, pump stations and CSO facilities). This project is recommended here, as well as, in Chapter 10 – Collection System Pump Stations and CSO Facilities (see Section 10.29). The recommended CIP funds are carried forward as a Chapter 10 recommendation. Asset protection for Sewers (all wastewater pipelines) is handled separately in Chapter 9.

Staff estimate that MWRA's 16 miles of Cross-Harbor Tunnels have a replacement asset value of $655 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 approximately half of their estimated useful lives. The Inter-Island Tunnel has only recently (1998) come into service. The expected useful life of the cross-harbor tunnels extends well beyond the 40 year planning period of the Wastewater Master Plan. Based on this, a long-term asset protection project is not recommended for the Cross-Harbor Tunnels. However, projects to inspect/assess the tunnels, as well as to repair concrete corrosion in the tunnel shafts, are recommended as future capital improvement projects.

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. A detailed 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 FY07 CIP</u>: MWRA's ongoing Wastewater Central Monitoring - SCADA project includes work at the remote headworks. The SCADA project is detailed in Chapter 12. There are three separate SCADA construction contracts that will be completed during FY07-09 with additional expenditures of over $15 million during the 3-year period. There are two new headworks related projects programmed in the FY07 CIP. The projects are described below and summarized in Table 8-2 (see line numbers 8.1 and 8.2).

- The Headworks Condition Assessment / Facilities Plan project will begin in 2007 (see description in Section 8.2), $2 million is included in the FY07 CIP for expenditure in FY07-08.

- Remote headworks (Chelsea Creek, Columbus Park, and Ward Street) screen replacement construction, $5 million in FY09-12.

<u>Projects Recommended for Consideration in the FY08 CIP</u>: There are five headworks and two cross-harbor tunnel related projects recommended for consideration in the CIP. The projects are described below and summarized in Table 8-2 (see line numbers 8.3 through 8.9).

- Rehabilitation, replacement and upgrade (design and construction) projects as recommended in the Headworks Condition Assessment / Facilities Plan at three remote headworks (Chelsea Creek, Columbus Park, and Ward Street), $35 million in FY09-28. These recommendations are expected to be spread over a 20-year period from FY09 through FY28. Design and construction project costs are estimated at a total of $40 million, with $5 million in the existing FY07 CIP (screens project) and $35 million recommended for new funding.

- A project to replace deteriorated portions of the fire alarm and wiring conduit at Nut Island Headworks is recommended at an estimated construction cost of $200,000 with a project duration of 1-year. This project is recommended during the FY09-13 timeframe.

- Replacement of failing Nut Island Headworks mechanical systems (including the hydraulic accumulator, sluice gates, and conveyor system). Planning, design, and construction project phases are estimated at $3.8 million with a project duration of 3-years. The project is recommended for the FY09-13 timeframe.

- The Nut Island Pier is anticipated to require rehabilitation during the FY14-18 time frame with an estimated cost of $500,000 for planning, design, and construction with a project duration of 2-years.

- Staff recommend an anticipated expenditure of $30 million over a 10-year duration during the FY19-28 time frame for equipment replacement at the Nut Island Headworks. It is assumed that some of the Nut Island equipment will be rehabilitated/replaced over time utilizing the long-term Wastewater Facilities Asset Protection Project funds.

- A Cross-Harbor Tunnel Inspection and Condition Assessment project is recommended to include evaluation of three cross-harbor tunnels: the Boston Main Drainage Tunnel, the Inter-Island Tunnel, and the North Metropolitan Relief Tunnel. Inspection and assessment of the condition of the headworks drop shafts at the beginning of the tunnels and the pump shafts at Deer Island should be included in this project. Staff estimate a $3 million project cost and 1-year project duration. The project is recommended for the FY09-13 timeframe.

- A planning/design/construction project to rehabilitate and repair concrete corrosion (due to hydrogen sulfide) in the three cross-harbor tunnel drop shafts at the Chelsea Creek, Columbus Park, and Ward Street Headworks. This project is estimated at $5 million with a 3-year duration and is recommended for the FY14-18 time frame.

- A long-term Wastewater Facilities Asset Protection Project is recommended. This project will provide annual baseline target expenditures for asset protection projects for all wastewater facilities (headworks, pump stations, and CSO facilities. As specific projects are identified, they will become sub-phases within the target expenditure. For the headworks facilities, the annual baseline expenditure for long-term asset protection is recommended at $1.5 million per year. This target expenditure has been combined with the target expenditure for pump stations and CSO facilities (developed in Chapter 10) to produce one recommended asset protection project for all wastewater facilities. Costs for the consolidated long-term Wastewater Facilities Asset Protection Project are not included within this Chapter or in Table 8-1. The costs are included in Chapter 10 and in Table 10-1.

Table 8-2

Wastewater Master Plan - Remote Headworks and Cross-Harbor Tunnels

Existing and Recommended Projects

Last revision 12/15/2006

Prioritization		**Project Types**		**FY07 CIP Notes**	
1	Critical	NF	New Facility/System	in	included in FY07 CIP (bold)
2	Essential	RF/IC	Replacement Facility/Increase Capacity	new	new project, not previously in CIP
3	Necessary	Opti	Optimization	prev	included in prior CIP, but deleted
4	Important	AP	Asset Protection		
5	Desirable	Plan	Planning/Study		

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		REMOTE HEADWORKS AND CROSS-HARBOR TUNNELS											
8.1	**1**	**HW Condition Assessment and Facility Plan for 3 Older Remote Headworks**	**AP**	**in S10399**	**2 years**	**2,000**	**FY07-08**	**2,000**					**2,000**
8.2	**1**	**HW Screen Replacement for 3 Older Remote Headworks**	**AP**	**in S10387**	**3 years**	**5,000**	**FY09-12**		**5,000**				**5,000**
		SUBTOTAL - Existing - Headworks and Tunnels				**7,000**		**2,000**	**5,000**				**7,000**
8.3	1	HW Facility Plan Upgrades for 3 Older Remote Headworks	AP	new	20 years	35,000	FY09-28		10,000	15,000	10,000		35,000
8.4	3	Nut Island HW Fire Alarm & Wiring Conduit Replacement	AP	prev	1 year	200	FY09-13		200				200
8.5	3	Nut Island HW Mechanical Systems	AP	new	3 years	3,800	FY09-13		3,800				3,800
8.6	4	Nut Island Pier Rehabilitation Plan/Design/Construction	AP	new	2 years	500	FY14-18			500			500
8.7	3	Nut Island HW Future Equipment Replacement	AP	new	10 years	30,000	FY19-28				30,000		30,000
8.8	1	Cross-Harbor Tunnel Inspection/Assessment	Plan	prev	1 year	3,000	FY09-13		3,000				3,000
8.9	2	Cross-Harbor Tunnel Shaft Repairs Plan/Design/Construction	AP	new	3 years	5,000	FY14-18			5,000			5,000
		SUBTOTAL - Recommended - Headworks and Tunnels				77,500			17,000	20,500	40,000		77,500
		SUBTOTAL - Existing and Recommended - Headworks and Tunnels				84,500		2,000	22,000	20,500	40,000		84,500

CHAPTER 9
COLLECTION SYSTEM SEWERS

9.1 Chapter Summary

The MWRA's wastewater collection system is a complex network of conduits and facilities that is strongly influenced by seasonal and wet weather conditions. The system average daily flow is approximately 360 mgd, minimum dry weather flow is approximately 260 mgd, and peak wet weather capacity to the Deer Island Treatment Plant is 1,270 mgd with additional system capacity available at combined sewer overflow (CSO) outfalls. The MWRA collection system includes a network of 275.5 miles of sewer pipelines (18.1 miles of cross-harbor tunnels, 227 miles of gravity sewers, 20 miles of force mains, 7 miles of siphons, and 3.4 miles of CSO and emergency outfalls); 13 pump stations; one screening facility; six CSO treatment 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, 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 (through over 1800 community connection points) to MWRA headworks facilities. 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 piping 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 $1,750 million (28% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.7. The facilities are detailed within the Chapter Section noted below:

- 9.3 Sewer Age and Construction Materials;
- 9.4 Gravity Sewers;
- 9.5 Sewer System Capacity Related Projects;
- 9.6 Gravity Sewer Manholes and Related Structures;
- 9.7 Force Mains and Related Valves;
- 9.8 Siphons and Siphon Headhouse Structures;
- 9.9 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 33 percent of sewers are over 100 years old and another 25 percent are between 51 to 100 years old. Overall, the collection system is in reasonably good condition, given its average age. Based on internal TV inspection ratings for gravity sewer pipe, approximately 18 miles (8 percent) of interceptors are severely damaged (C-rated), 139 miles (61 percent) are in fair to good condition with some damage (B-rated), and 52 miles (23 percent) are in very good condition (A-rated). An additional 18 miles (8 percent) of gravity sewer, mostly newly constructed interceptors, were unrated at the time of the analysis. 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.

The majority of MWRA's past CIP funds spent on sewer interceptor projects have constructed new facilities, some 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 structural deficiencies. High priority rehabilitation projects include the West Roxbury Tunnel and Sewer Section 624 in North Weymouth. In addition to prioritizing rehabilitation construction, as part of the Master Plan process, staff have developed an interceptor renewal methodology to identify and plan/design/construct sewer repair/rehabilitation projects to facilitate long-term sewer asset protection. A prioritized list of interceptor renewal projects totaling $79 million are recommended over the first 20 years of the Master Plan (FY09-28). An additional $100 million placeholder is recommended for future projects during FY29-48. Other high priority collection system needs include a system-wide study to address odor/hydrogen sulfide problems, as well as, specific projects to rehabilitate pipelines with known hydrogen sulfide deterioration. The highest priority need for sewer structures is rehabilitation design/construction of siphon headhouse chambers due to physical defects and access issues as identified in a 1996 siphon structure needs assessment. 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 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, $415.551 million in projects is identified in the 40 year master plan timeframe (FY07-48). Seven projects ($45.171 million) are currently programmed in the FY07 CIP. Thirty-two additional projects ($370.38 million) are recommended for inclusion in the FY08 CIP. Section 9.11 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $45.171 million is currently programmed in the CIP (FY07-13):
  - $0.578 million to complete an interceptor asset protection/rehabilitation project for Sewer Sections 80/83 in Arlington.

- $3.389 million to complete an interceptor asset protection/rehabilitation project for Sewer Section 160 in Winchester and Medford.
- $2.041 million to complete the Cummingsville Replacement Sewer Project.
- $36.377 million to complete the Upper Neponset Valley Relief Sewer Project.
- $1.136 million to complete design/construction of the Somerville Sewer Connection as recommended in the Wastewater Process Optimization project.
- $150,000 to develop a plan for relief of the Cambridge Branch Sewer and DeLauri Siphon as recommended in the Wastewater Process Optimization project.
- $1.5 million to complete structural improvements to Outfall MWR023 (to the Charles River) located in the Fenway section of Boston.

- $35.58 million in needs is identified for FY07-08 and FY09-13 and recommended for inclusion in the FY08 CIP:
  - $12 million for the first 5 years of the Interceptor Asset Protection/Interceptor Renewal Program; these funds cover the first three priority projects (#1, #2, and #3).
  - $5 million for redesign/construction to rehabilitate, due to severe hydrogen sulfide corrosion, Sewer Section 624 in North Weymouth.
  - $5 million to design/construct biofilters for the FES/FERS system to reduce corrosion and control odors.
  - $1 million for a System-Wide Odor Control Study.
  - $5 million for the first 3 years (design portion) of the 8 year West Roxbury Tunnel corrosion rehabilitation design/construction project.
  - $0.75 million to study relief alternatives for the Randolph Trunk Sewer.
  - $200,000 for a North System Hydraulic Capacity Study.
  - $500,000 for the first 5 years of the annual manhole rehabilitation program with a target of 20 manholes at $100,000 per year.
  - $1 million for construction of improvements to the Woburn Sandcatcher.
  - $130,000 for purchase of new sonar inspection equipment to inspect siphons.
  - $5 million for design/construction of siphon structure rehabilitation during the first 5 years of the 8 year program.

Mid-term (FY14-18):

- $126 million in needs is identified for FY14-18 and recommended for inclusion in the FY08 CIP:
  - $24 million for years 6 through 10 of the Interceptor Asset Protection/Interceptor Renewal Program; these funds cover the fourth through seventh priority projects (#4, #5, #6, and #7).
  - $15 million for the first 5 years of the 9 year Wellesley Extension Replacement Sewer rehabilitation design/construction project.
  - $8.5 million for design/construction of the FES Tunnel Rehabilitation Project.
  - $75 million for the last 5 years (construction portion) of the 8 year West Roxbury Tunnel corrosion rehabilitation design/construction project.
  - $500,000 for the second 5 years of the annual manhole rehabilitation program with a target of 20 manholes at $100,000 per year.
  - $3 million for design/construction of Siphon Structure Rehabilitation during the last 3 years of the 8 year program.

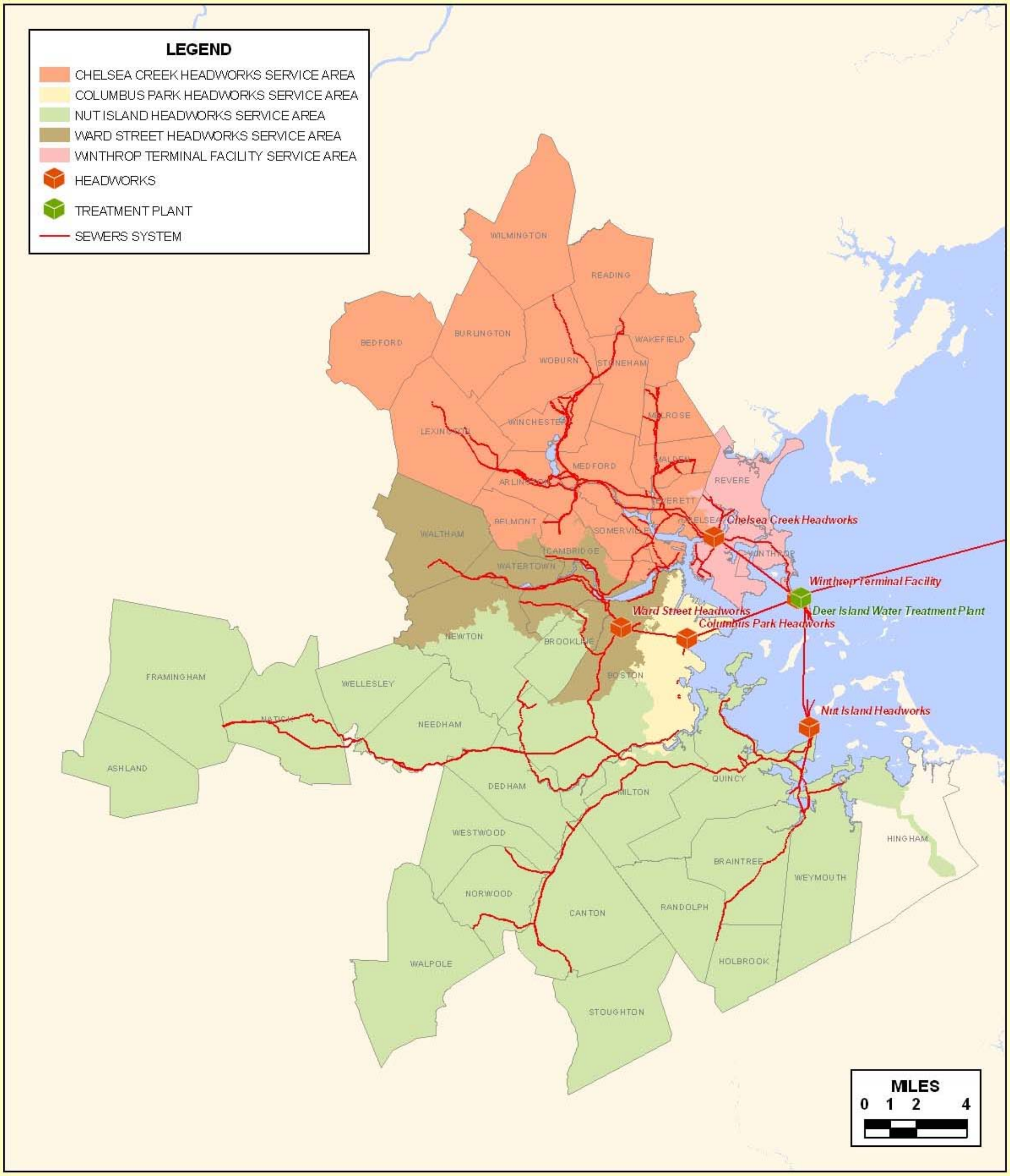
Long-term (FY19-28 and FY29-48):

- $208.8 million in needs is identified for FY19-28 and FY29-48 and recommended for inclusion in the FY08 CIP:
  - $43 million for FY19-28 for years 11 through 20 of the Interceptor Asset Protection/Interceptor Renewal program; these funds cover the eighth through twelfth priority projects (#8, #9, #10, #11, and #12) and $100 million for FY29-48 for future interceptor renewal program funding (project #13) estimated at $5 million per year.
  - $9 million for the last 4 years of the 9 year Wellesley Extension Replacement Sewer rehabilitation design/construction project.
  - $23 million for design/construction for relief of the Cambridge Branch Sewer and DeLauri Siphon as recommended in the Wastewater Process Optimization Project.
  - $12 million for Neponset Valley Relief Sewer planning, design, and construction.
  - $1 million for planning (feasibility study) and design for the Ashland Extension Sewer.
  - $1 million for FY19-28 and $2 million for FY29-48 for the annual manhole rehabilitation program with a target of 20 manholes at $100,000 per year.
  - $5 million for force main asset protection to provide a place holder for projects likely to be identified in the future.
  - $5 million for siphon asset protection to provide a place holder for projects likely to be identified in the future.
  - $7 million for design/construction for sliplining of Section 652 Fore River Siphon.
  - $800,000 for inspection and assessment of CSO and Nut Island Emergency Outfalls.

9.2 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 population of over 2 million in a service area of about 518 square miles. The general layout of the collection system is shown on Figure 9-1. Each community owns and operates its local collection system. Approximately 10 percent of the regional system contains combined sewers that are designed to receive both sanitary and storm water flow. Approximately 90 percent of the collection system area contains separate sanitary and storm water collection systems. All flow from the service area is conveyed to the Deer Island Wastewater Treatment Plant. The history and growth of the wastewater service area is presented in Chapter 3. The regional collection system encompasses about 275.5 miles of MWRA-owned sewers and over 5,000 miles of publicly-owned community sewers connected to MWRA interceptors at over 1,800 connections. There are also over 5,000 miles of sewer service laterals that connect building plumbing to the community-owned sewers. An overview of community collection systems is provided in Chapter 15.

Figure 9-1:
MWRA Sewer System Location Plan



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	227	82.4 %
Cross-Harbor Tunnels	18.1	6.6 %
Force Mains	20	7.3 %
Siphons	7	2.5 %
CSO and Emergency Outfalls	3.4	1.2 %
Total	275.5	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 over the last 125 years. MWRA sewers 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 Field Operations Department under the supervision of the Director of Field Operations. The Field Operations Department is a subset of the Operations Division under the oversight of the Chief Operating Officer. Key supervisory staff reporting to the Director, Field Operations include: Director, Wastewater Operation and Maintenance; Manager, Wastewater Operations; Senior Program Manager, Pipelines; and Senior Program Manager, Metro Trades.

Operation and Maintenance: A total of about 30 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 via MWRA’s MAXIMO maintenance work order system. Field Operation's Pipeline Maintenance Unit is responsible for maintenance activities include: bucketing, hydraulic jetting, porcupining, etc.

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, and help define rehabilitation projects. During each inspection, a log is maintained detailing all pipeline 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.

Figure 9-2:

MWRA Sewers By Type

HIGHLIGHTS

TYPE	*MILES*	*PERCENTAGE*
GRAVITY SEWERS & OTHER TUNNELS	*227*	*82.4%*
CROSS HARBOR TUNNELS	*18.1*	*6.6%*
FORCE MAIN	*20*	*7.3%*
SIPHON	*7*	*2.5%*
CSO, EMERGANCE, & NUT ISLAND OUTFALLS	*3.4*	*1.2%*
TOTALS	*275.5*	*100%*

(In addition to the 275.5 miles of collection system sewers, there are 10 miles of outfall at Deer Island.)

Figure 9-3:

MWRA Sewers By Size

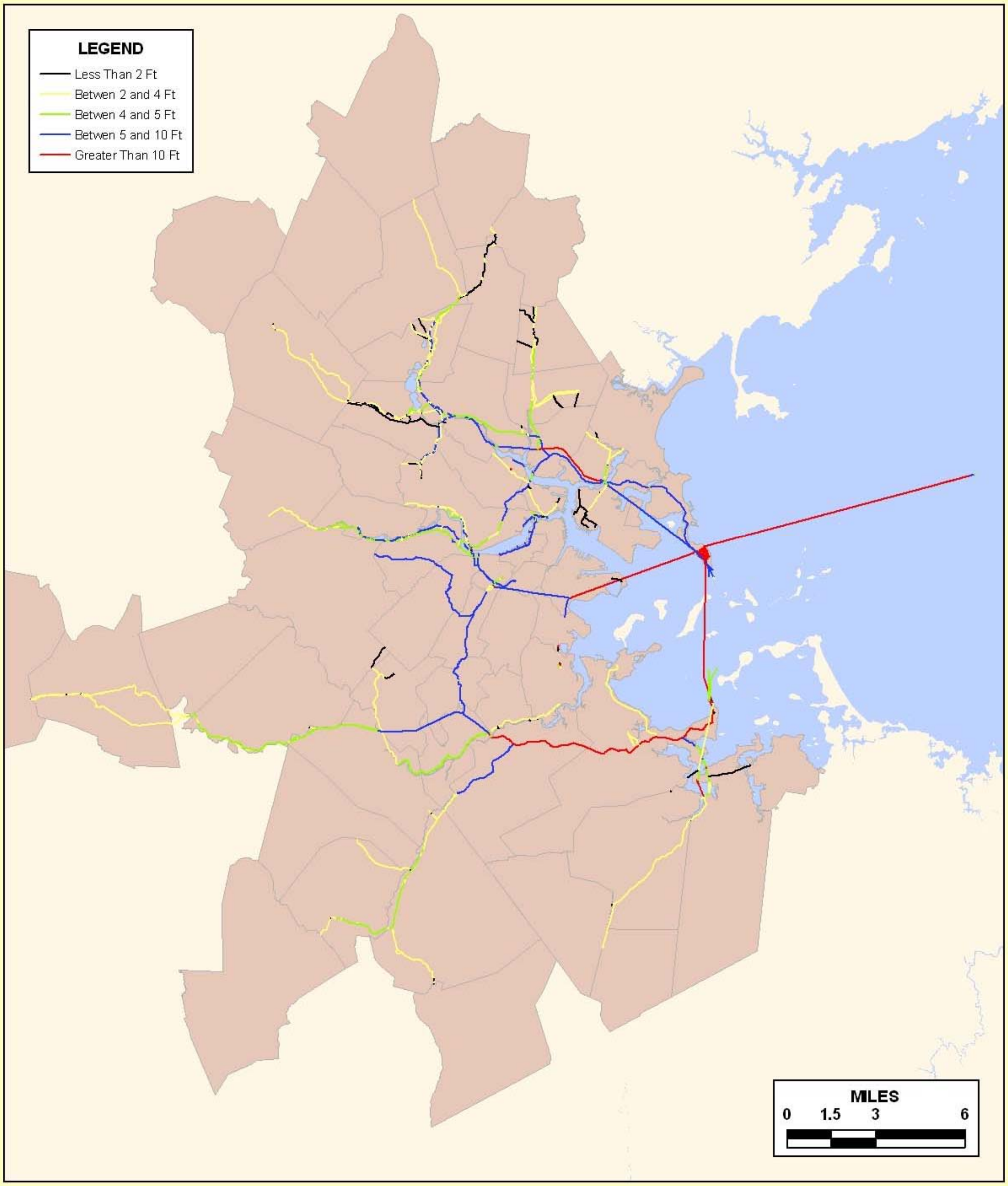


Figure 9-4:

MWRA Sewers By Material

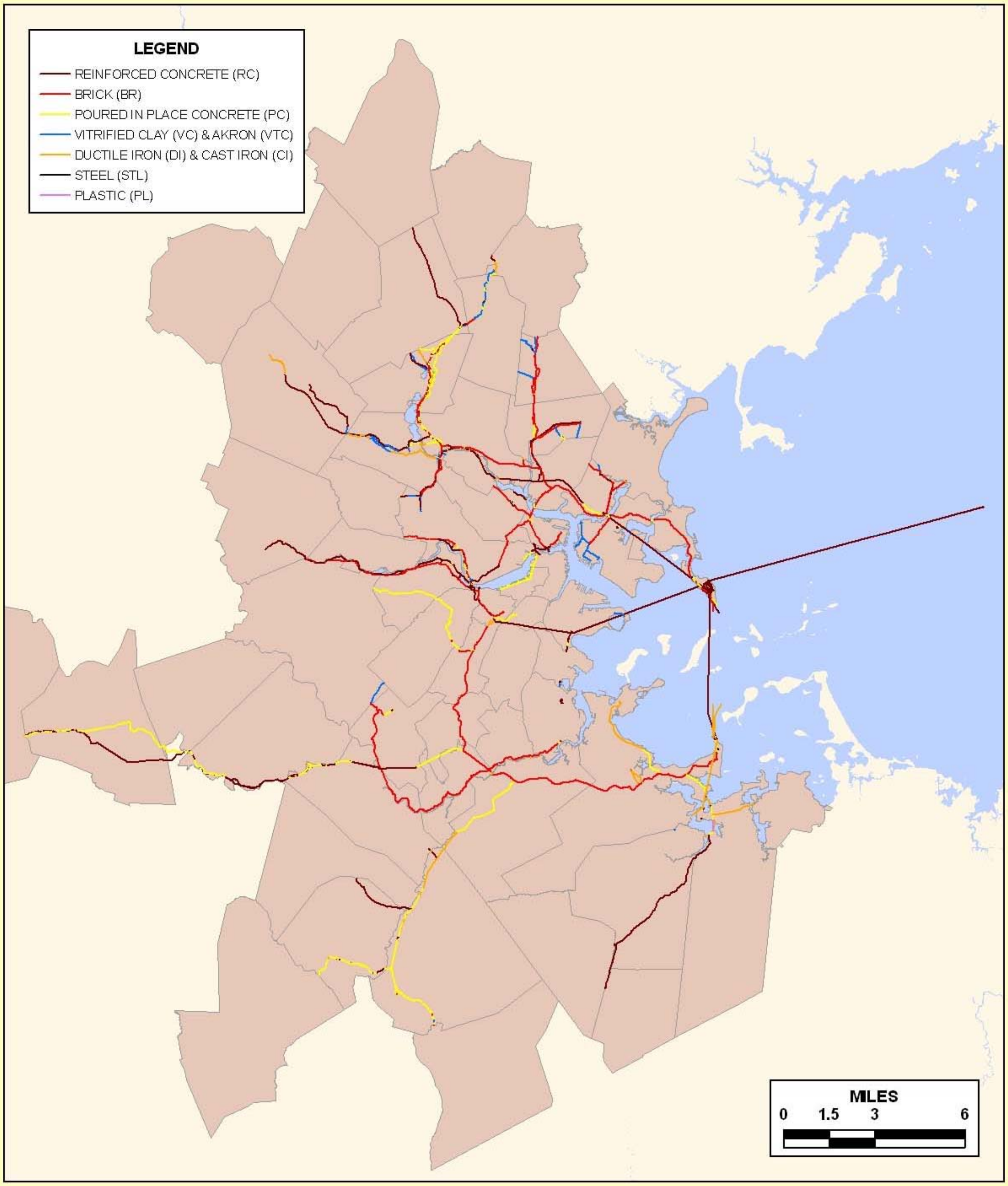
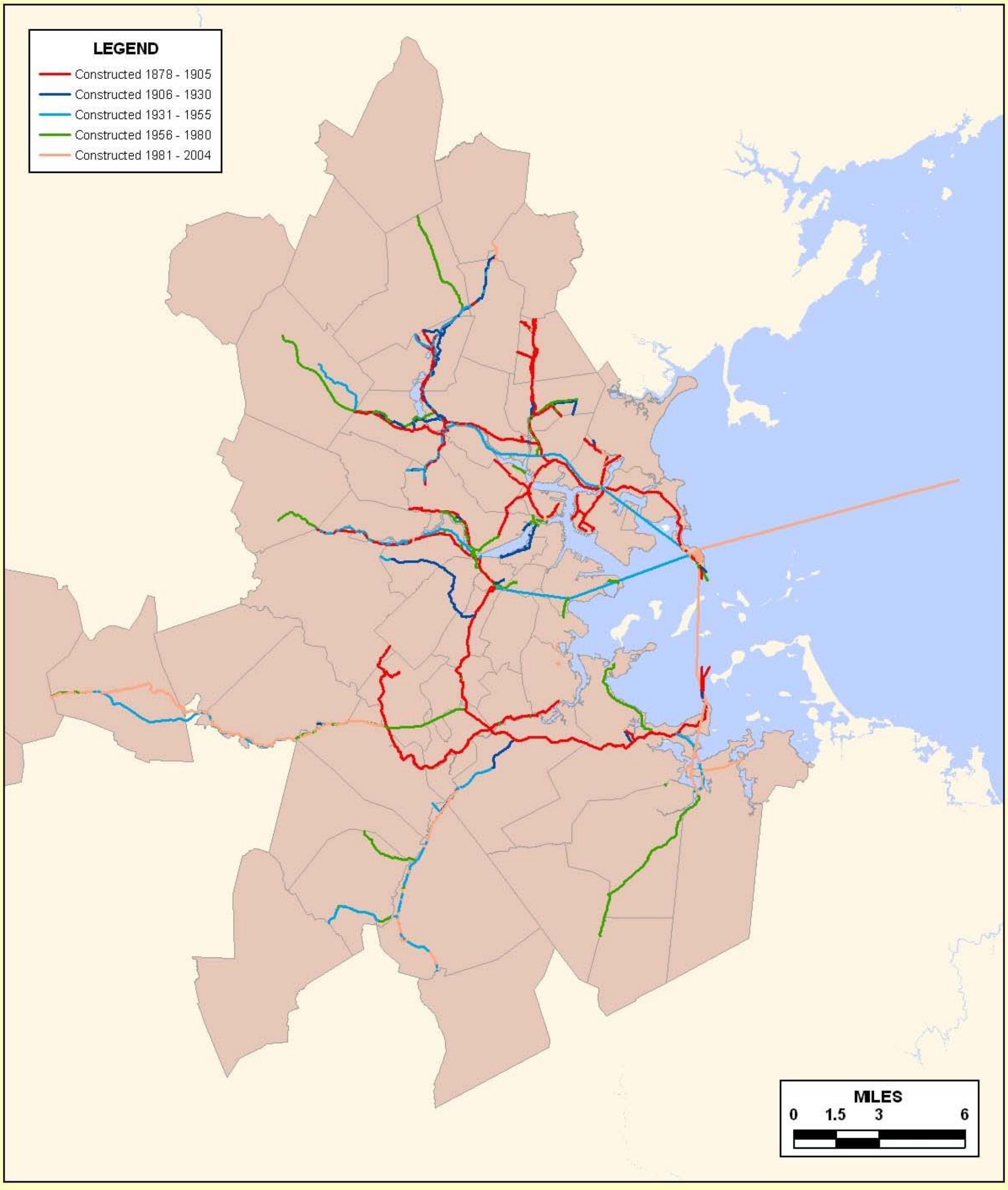


Figure 9-5:

MWRA Sewers By Year Constructed



MWRA In-House Tasks: There are five in-house tasks related to the collection system sewers recommended to be completed by MWRA staff:

- There are 12 C-rated interceptor renewal projects recommended (see Section 9.4) to be rehabilitated over an extended period (20 years) due to budget and staffing considerations. It is recommended that MWRA staff periodically review updated sewer TV inspection tapes of all C-rated pipe and adjust the priority of projects planned in the CIP to ensure the most critical sewer sections receive the highest priority ranking. In addition, staff should conduct future iterations of the interceptor renewal methodology (recommended to be performed every 3-5 years) as updated sewer inspection rating information is incorporated into the electronic database. The analysis presented in this Chapter used sewer inspection rating data through approximately 2004. Significant staff time was consumed in downloading historical data and developing the risk and consequence of failure methodology. Future iterations should be less time consuming. Timely processing of new rating information will help ensure that the most critical projects are assigned the highest priority ranking.
- Staff should review the Interceptor Asset Protection/Interceptor Renewal Program (as presented later in this Chapter) to determine which projects are most appropriate for in-house staff versus procurement of consultant services for planning/design. This review will require a comprehensive evaluation of staffing requirements for all projects recommended in the Master Plan with consideration of scheduling decisions likely to be made during the annual CIP process. Individual interceptor renewal projects with estimated costs of less than about $5 million are good candidates for MWRA's in-house 4-step pipeline rehabilitation process that is conducted by the Wastewater Engineering Department: (1) development of a conceptual design report; (2) preparation of a preliminary design report; (3) preparation of final design plans and specifications; and (4) procurement/bidding for contractor services.
- 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. The Woburn Sandcatcher project is intended to optimize flow through the division structure, provide appropriate access for system maintenance, and improve debris removal.
- Staff should conduct an evaluation of MWRA's sewer force mains and air valves. The task will evaluate age and material related factors and expand on the work being performed under the Water Master Plan for water main piping. This analysis may help predict force mains that may be susceptible to failure.
- Staff should update the 2001 Collection System O&M Manual.

9.3 Sewer Age and Construction Materials

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. For the MWRA sewer system, approximately 33 percent of sewers are over 100 years old and another 29 percent are 51 to 100 years old. The average age of all pipelines in the sewer system is about 70 years old; Figure 9-6 provides the age breakdown of the system. Approximately 57% of the system is concrete (34 percent reinforce concrete and 23 percent poured in place concrete) and 30 percent is brick. Figure 9-7 provides the construction material breakdown of the system.

Figure 9-6 Sewer System Age

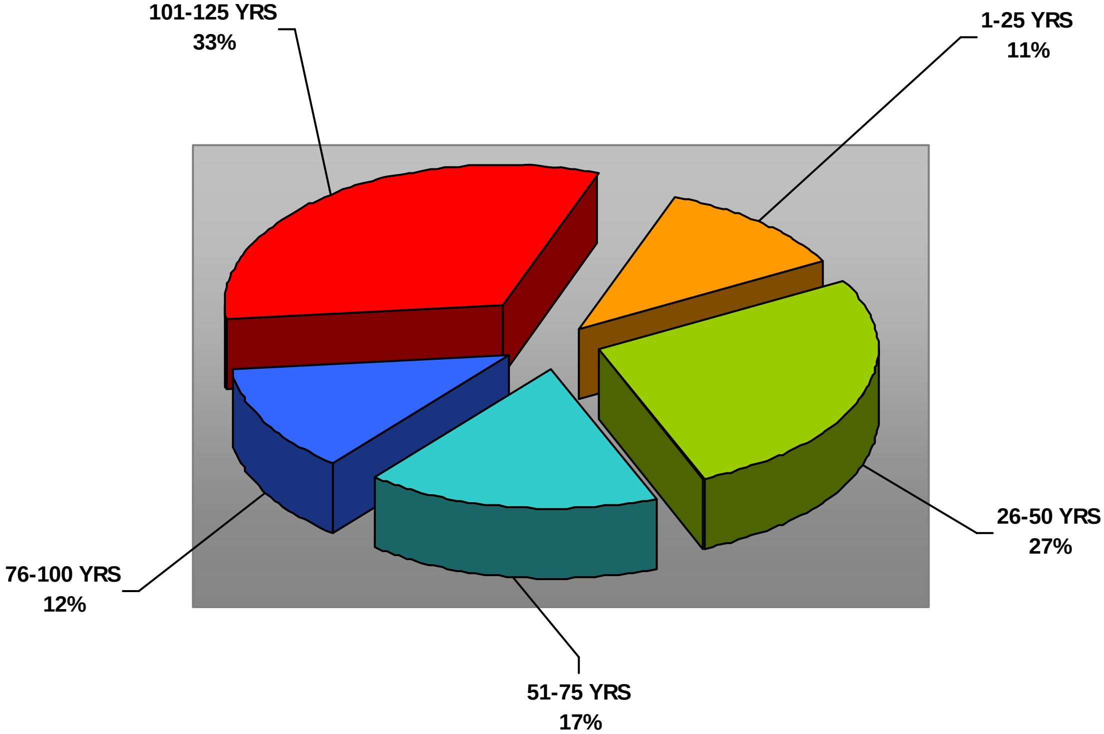
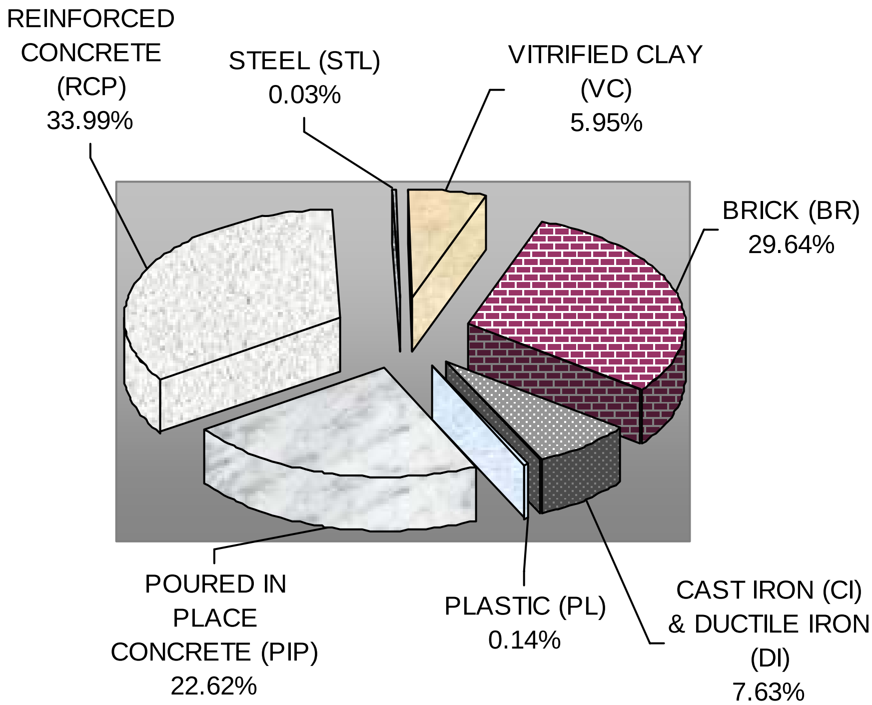


Figure 9-7 Sewer System Material



9.4 Gravity Sewers

There are about 227 miles of gravity sewers in the MWRA collection system, accounting for about 82 percent of the system. 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 every 300 feet±. These manholes provide access for operation and maintenance activities. Access to tunnel sections is dependent on individual site conditions. MWRA's West Roxbury Tunnel (Section 637/638) is a 2.8 mile long gravity tunnel that requires special operation and maintenance considerations. Key information on MWRA Interceptors is provided in Table 9-2.

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	RC, PIPC	3-10	1948-1950	16,329
Belmont Extension Sewer	063	Cambridge	BR, CI	2-3	1904	6,358
Belmont Relief Sewer	081	Belmont/Cambridge	RC	3	1927	3,467
Boston Main Drain Relief Sewer	201	Roxbury	PIPC	7	1961	4,818
Boston Marginal Conduit	222	Boston Main, Roxbury	RC, PIPC, CI	5-14	1910	10,043
Braintree-Weymouth Interceptor	622-625	Braintree, Quincy & Weymouth	RC, PIPC, CI, HDPE	1-5	1933-1934, 1982, 2002	9,679
Brighton Branch Sewer	580-587	Brighton, Brookline, Newton, & Roxbury	BR, PIPC, CI	5-7	1907-1909, 1933	26,753
Bryant St Sewer	195, 196	Malden	VC	2	1967	2,638
Cambridge Branch Sewer	023-024, 026-028, 154	Cambridge, Charlestown, Everett, & Somerville	BR	3-7	1892-1895	15,819
Cambridge Marginal Conduit	229	Cambridge	PIPC	6-8	1910	1,965
Castle Island & Connoly Terminal Sewer	252	South Boston	VC	1	1960	2,265
Charles River Marginal Conduit	198	Charlestown	RC	2-10	1974, 1979	2,360
Charles River Valley Sewer	162-165, 190-192, 202-203	Brighton, Brookline, Newton, Roxbury, & Watertown	BR, RC, PIPC, CI	3-7	1891-1892, 1906, 1954, 1963	44,154
Charlestown Branch Sewer	031-032	Charlestown	BR, RC	3	1895, 1989	10,442
Chelsea Branch Relief Sewer	250	Chelsea	BR, RC	4-6	2001	7,513
Chelsea Branch Sewer	056-057	Chelsea, Everett	BR, PIPC, RC	2-4	1901, 1999	8,314
Cummingsville Branch Relief Sewer	086	Winchester, Woburn	RC, PIPC	2-3	1952	5,005
Cummingsville Branch Sewer	047	Winchester, Woburn	VC	1-2	1894, 1904	4,593
Dedham Branch Sewer	532	Canton/Dedham	RC	2	1950	2,145
Dorchester Intercepting Sewer	240-242	Dorchester	BR, PIPC, CI, VTC	3	1895-1897	6,775
East Boston Branch Sewer	036-039, 206-208	East Boston	BR, PIPC, RC, VC	1-6	1894-1895	20,382
Edgeworth Branch Sewer	020	Malden, Medford	BR, DI	2	1893, 1987	1,599
Everett Branch Sewer	055	Malden	PIPC	1	1898	1,548
Extension to Everett in Broadway	066	Malden	VC	1	1911	2,623

Table 9-2 (continued)
MWRA Interceptors

Name	Section #	Community	Material	Approximate Diamter (ft)	Year Built	Length (ft)
Framingham Extension Relief Sewer	678	Dover, Natick & Wellesley	PIPC	3-5	1999	9,773
Framingham Extension Sewer	632, 634, 657	Dover, Framingham & Natick	RC, PIPC	4-5	1955	30,973
High Level Sewer	545-575	Hyde Park, Milton, Quincy & Roxbury	BR, PIPC, RC, CI	3-12	1900-1904, 1958, 2000	74,768
Holbrook Extension Sewer	656	Braintree, Holbrook, & Randolph	RC	2-4	1967	8,262
Lexington Branch Sewer	053	Arlington	CI, VC	1-2	1899	4,511
Main Street Branch Sewer	031	Charlestown	CI, PIPC	1-2	1895	660
Malden Extension Sewer	064	Malden	BR, PIPC, RC, CI	3-6	1907	3,143
Malden Relief Sewer	087	Everett	BR, RC	4-5	1959, 1969	8,501
Melrose Highlands Trunk Sewer	049	Melrose	BR	1-2	1896	3,888
Metropolitan Sewer	010, 012, 014-017, 020-022, 029, 030, 040-046, 048, 052, 054, 058-060, 065, 150, 155, 156, 175, 187-189, 227,654	Arlington, Boston, Braintree, Cambridge, Chelsea, Dorchester, East Boston, Everett, Malden, Medford, Melrose, Somerville Stoneham, Winchester & Woburn	BR, PIPC, DI, CI, RC, VC, VTC	1-9	1957	151,945
Millbrook Valley Relief Sewer	092-093, 151-152, 172-173	Arlington, Lexington, & Medford	RC, DI	1-6	1965-1967, 1972	33,666
Millbrook Valley Sewer	077-080, 082-085	Arlington, Lexington, & Medford	BR, PIPC, RC, CI, VC, VTC	1-4	1899, 1925-1934, 1948, 1953, 1967	33,869
Mystic Valley Sewer	153, 160	Medford, Winchester, & Woburn	BR< PIPC, CI, VC	1	1878-1879, 1950	14,324
Neponset Valley Relief Sewer	531	Hyde Park, Milton	BR, PIPC	5-6	1935	173
Neponset Valley Sewer	243-246, 515-525	Dedham, Dorchester, Hyde Park & Milton	BR, PIPC, RC, CI, VC	1-5	1896-1897, 1963, 1972	36,036
New Mystic Valley Sewer	067-072, 109-110	Medford, Winchester, & Woburn	BR, PIPC, CI, VC	2-6	1913-1914, 1924, 1929, 1937	31,308
New Neponset Valley Relief Sewer	671	Canton	PIPC	5	1992	5,058
New Neponset Valley Sewer	607-615, 619	Canton, Milton	PIPC, CI, PL	1-6	1930-1932, 1992	45,941
New Neponset Valley Sewer Replacement	614	Canton	RC	5	1964	1,075
North Charles Relief Sewer	181-184	Cambridge	PIPC, RC, VC	2-7	1968, 1971-1972, 1976	18,363
North Charles Relief Sewer, Charles River Sewer Crossing	180	Brighton, Cambridge	RC	3-9	1965, 1968	2,856
North Metro Relief Sewer	102-103, 105-108, 111-114, 158, 168-169, 193-194	Chelsea, Everett, Medford, Stoneham, Winchester & Woburn	BR, PIPC, RC, VC	3-11	1936-1943, 1950, 1965-1968	67,742
North Metropolitan Trunk Sewer	003-006, 008-009, 186	East Boston, Winthrop	BR, PIPC, STL	4-15	1891-1894, 1960, 1989, 1993	24,707
North Metropolitan Trunk Sewer, Belle Isle Inlet	007	East Boston, Winthrop	BR	9	1895	513
North Weymouth Relief Interceptor	639	Weymouth	CCFP	5	2004	1,653
Old High Level Sewer	247	Roxbury	BR	7	1903	446
Randolph Trunk Sewer	626-628, 655	Braintree, Randolph, & Weymouth	RC	2-4	1972-1973	26,481
Reading Extension Relief Sewer	204-205	Stoneham, Wakefield	RC, PIPC	2-3	1921, 1984	4,063
Reading Extension Sewer	073-075	Stoneham, Wakefield, & Woburn	RC, CI, VC	1-2	1919, 1921	12,210

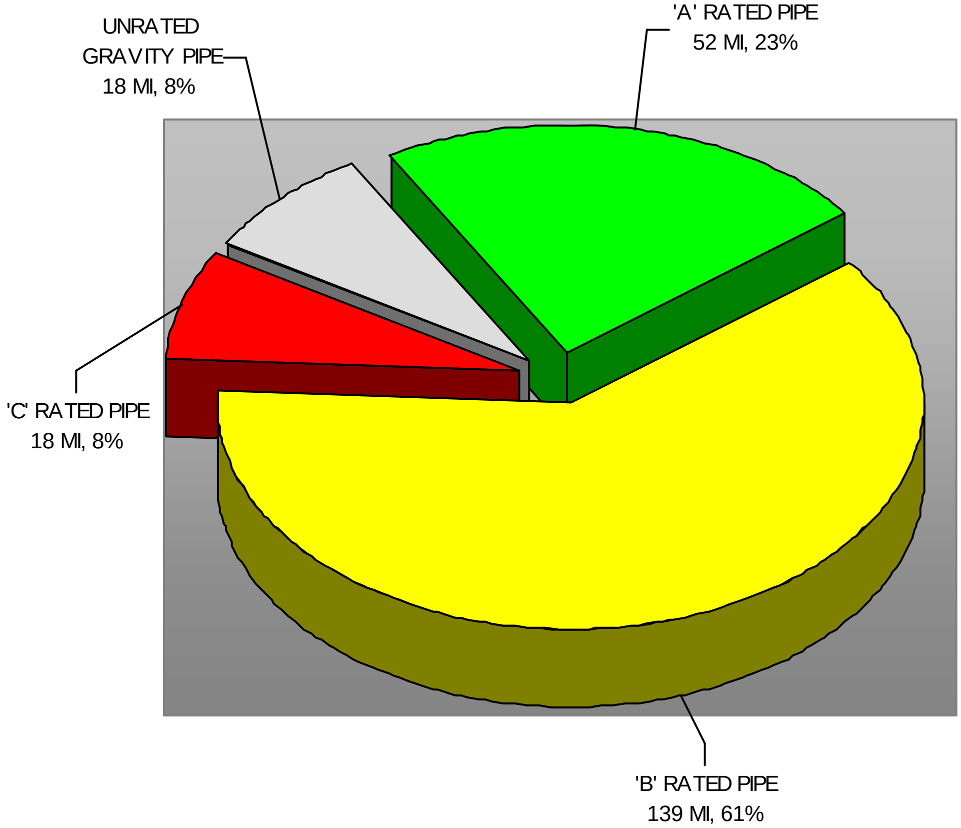
Table 9-2 (continued)
MWRA Interceptors

Name	Section #	Community	Material	Approximate Diamter (ft)	Year Built	Length (ft)
Revere Extension Sewer	061, 062, 159	Chelsea, Revere	BR, CI, VC, VTC	1-4	1904, 1914	8,440
Saugus Branch Brook Flood Control Project, Malden Relief Sewer	95	Malden	BR, PIPC, RC	3	1969	8,988
Somerville Marginal Conduit	230	Somerville	RC	7	1971	2,522
Somerville-Medford Branch Sewer	035	Charlestown, Medford & Somerville	BR, RC, VC	2-4	1895-1896	8,806
South Charles Relief Sewer	001-002, 212, 218-220	Brighton, Brookline, Cambridge, newton, Roxbury, Waltham, & Watertown	BR, PIPC, RC, CI	3-13	1892, 1903, 1954-1958, 1967	51,201
Stoneham Branch Sewer	051	Melrose	RC, VC	1	1897, 2001	4,026
Stoughton Ext Relief Sewer	670	Canton	BR, PIPC, DI	2-3	1992	9,609
Stoughton Extension Sewer	620-621	Canton, Stoughton	BR, PIPC, VC, VTC	2-3	1931-1932	6,556
Upper Neponset Valley Sewer	526-530	Dedham, Newton, & West Roxbury	BR, PIPC, RC, CI, VC	1-4	1897-1898, 1902	23,526
Wakefield Branch Sewer	050	Melrose	BR, VC	1-2	1897	4,665
Walpole Ext Relief Sewer	669	Norwood	BR, PIPC, RC, VC	3-4	1992	6,901
Walpole Extension Sewer	616-618	Canton, Norwood	PIPC, RC, CI	3-5	1931, 1964	15,664
Wellesley Ext Sewer Replacement	664-668	Dedham, Dover, Needham, & Wellesley	PIPC, RC, DI	3-7	1989-1991	38,518
Wellesley Extension Relief Sewer	629-631, 638	Dedham, Dover, Needham, Wellesley, & West Roxbury	PIPC, RC	4	1951-1952, 1956, 1963	37,649
Wellesley Extension Sewer	601	Dedham	PIPC	3	1921	1,179
Westwood Extension Sewer	635-636	Canton, Norwood, & Westwood	RC	2-3	1961	11,979
Wilmington Trunk Sewer	088-090	Wilmington, Woburn	RC	3-4	1959, 1972, 1974	20,444

Overall, MWRA's gravity sewers (interceptors) appear to be in reasonably good condition given their age. Based on internal TV inspection ratings for gravity sewer pipe, approximately 18 miles (8 percent) of interceptors are in poor condition - severely damaged (C-rated), 139 miles (61 percent) are in fair to good condition with some damage (B-rated), and 52 miles (23 percent) are in very good condition (A-rated). An additional 18 miles (8 percent) of gravity sewer, mostly newly constructed interceptors, were unrated at the time of the analysis. Figure 9-8 provides the system breakdown for gravity sewer inspection A/B/C ratings.

<u>Sewer System Capacity Issues</u>: The majority of MWRA's past CIP funds spent on sewer interceptor projects have been 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 some 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. Due to the significant degree of study capacity issues have received in previous reports, a comprehensive review of system capacity issues has not been made a part of the Wastewater Master Plan. Existing CIP projects and future projects recommended for consideration in the CIP that address sewer capacity issues are presented in Section 9.5 and are based on recommendations from previous studies.

Figure 9-8 Interceptor Condition Ratings



TV Inspection Crew

Inside of TV Inspection Truck

Examples of C-Rated Pipe

Interceptor Renewal Methodology: While MWRA's CIP has traditionally funded interceptor projects based on capacity recommendations, staff recognize the need for a planning process that provides a systematic, phased program to address interceptor renewal needs. 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 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 condition (C rated) and pipe age and construction material. Nearly two-thirds (65 percent) of C-rated pipe is over 100 years old and an additional 24 percent is 50 to 100 years old. In terms of construction materials, 54 percent of the C-rated pipe is constructed of brick. The analysis also indicated a higher than expected percentage of poured-in-place concrete that is 51 to 75 years old was in poor condition, perhaps reflecting a poorer quality of materials used during a certain timeframe.

Figure 9-9

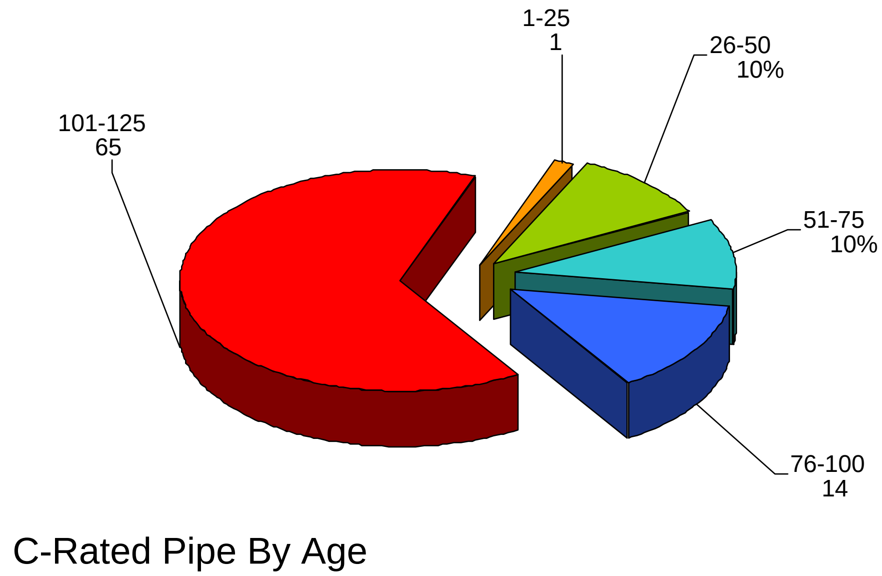
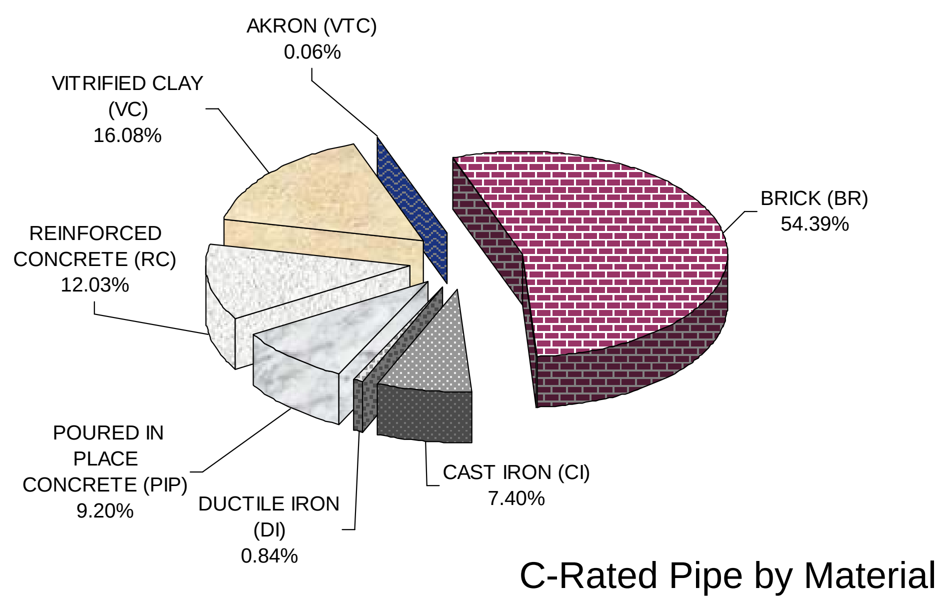


Figure 9-10



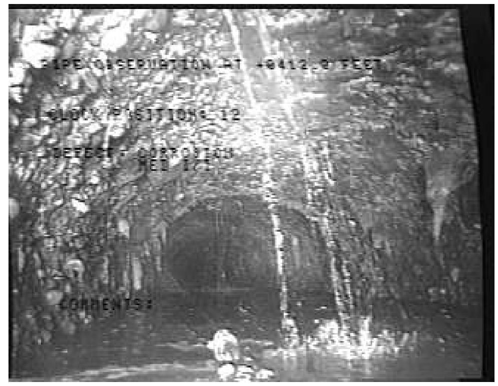
Based on these results, staff selected a two-pronged approach focusing on risk and consequence of sewer failure to develop a methodology to prioritize sewer sections for future rehabilitation/replacement. To assign points to pipe sections based on their risk of failure, staff developed a weighted scoring 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 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 the risk 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 and consequence of failure methodology. 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 are 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). 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

The outcome of the interceptor renewal methodology is a prioritized list of sewer sections to be considered for future rehabilitation/replacement. The analysis was completed using pre-2004 internal TV inspection data. Periodic updates of the analysis, incorporating the most recent internal inspection data, are required. As anticipated, some of the high priority sewer sections identified from the interceptor renewal methodology are included within ongoing (or recently complete) rehabilitation construction projects, or are already programmed into the CIP.

Some examples include: Sewer Sections 37, 39, 208 in East Boston (included in the East Boston CSO Project); Sewer Sections 526, 527, 528 in West Roxbury (included in the Upper Neponset Valley Relief Sewer Project); Sewer Sections 80, 83 in Arlington (project ongoing); Sewer Section 172 in Lexington (project complete); Sewer Section 160 in Winchester/Medford (project ongoing); Sewer Section 637 in Hyde Park/West Roxbury (included in recommended West Roxbury Tunnel project); Sewer Section 624 in Weymouth (formerly part of the Braintree/Weymouth project and included in separately recommended Section 624 project).

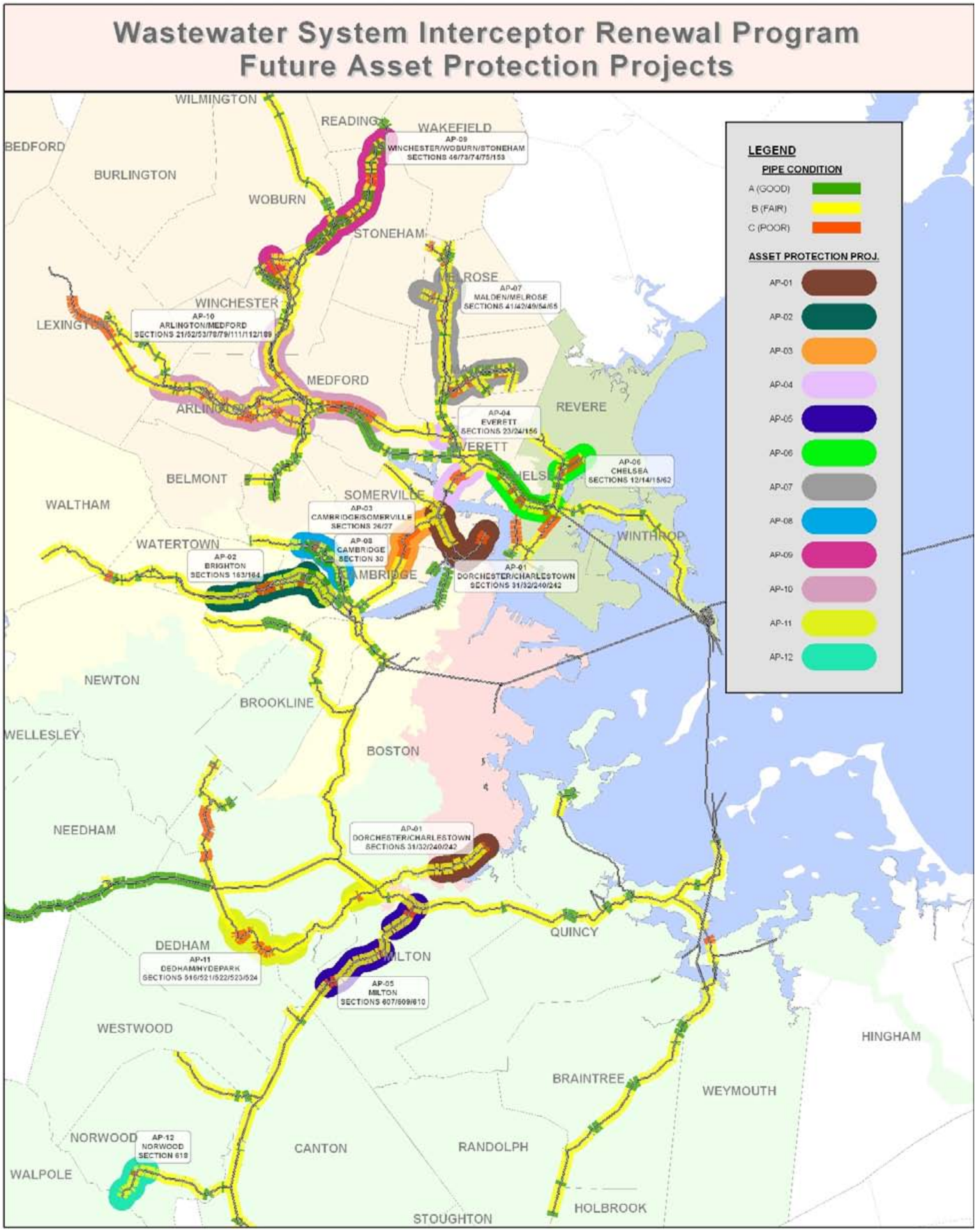


Section 624, Weymouth

The interceptor renewal project team's work resulted in the identification of 13 new interceptor asset protection projects recommended for future consideration in the CIP. The first 12 projects (totaling $79 million) are prioritized based on interceptor renewal methodology for all C-rated sewer sections that are not included in a separate CIP project. The location of the 12 Interceptor Renewal Projects are shown on Figure 9-11. These projects require more detailed engineering evaluation to determine the most appropriate sewer rehabilitation strategy. Completion of the 12 projects and expenditure of the $79 million is recommended over a 20 year period (FY09-28). Each of the projects is detailed in the bullet summary list of projects recommended for consideration in the FY08 CIP (see page 9-22). The rehabilitation projects will help ensure that the 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 due attention to preserving and extending the useful life of the pipeline assets.

Projects with estimated costs of less than $5 million are good candidates for MWRA's in-house pipeline rehabilitation process that is conducted by the Wastewater Engineering Department. This 4-step process includes: (1) development of a conceptual design report; (2) preparation of a preliminary design report; (3) preparation of final design plans and specifications; and (4) procurement/bidding for contractor services. The MWRA's in-house pipeline rehabilitation process has been used successfully to initiate rehabilitation of Sewer Sections 79/92 in Arlington and Sewer Sections 172/173 in Lexington. In addition, ongoing projects including the rehabilitation of Sewer Sections 80/83 in Arlington and Sewer Section 160 in Winchester and Medford were planned/designed using MWRA staff resources. Projects with estimated costs of more than about $5 million are more appropriate candidates for planning/design services using outside engineering consultant services. The 12 C-rated interceptor renewal projects are recommended to be constructed over an extended period (20 years) due to budget and staffing considerations. It is recommended that MWRA staff periodically review updated sewer TV inspection tapes of all C-rated pipe and adjust the priority of projects planned in the CIP to ensure the most critical sewer sections receive the highest priority ranking. The 13th interceptor renewal project is a place-holder for future interceptor asset protection funding in the out years (FY29-48) of the Master Plan. The project is estimated at $5 million per year ($100 million for 20 years). Future projects will be identified through subsequent iterations of the interceptor renewal methodology (recommended to be performed by in-house staff every 3-5 years) as updated sewer inspection rating information is incorporated into the electronic database.

Figure 9-11

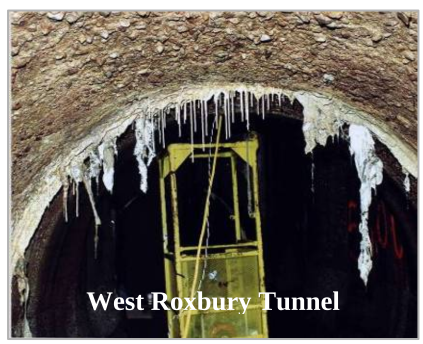

Wastewater System Interceptor Renewal Program
Future Asset Protection Projects
LEGEND
PIPE CONDITION
A (GOOD)
B (FAIR)
C (POOR)
ASSET PROTECTION PROJ.
AP-01
AP-02
AP-03
AP-04
AP-05
AP-06
AP-07
AP-08
AP-09
AP-10
AP-11
AP-12
AP-09 WINCHESTER/WOBURN/STONEHAM SECTIONS 46/73/74/75/153
AP-07 MALDEN/MELROSE SECTIONS 41/42/49/54/65
AP-10 ARLINGTON/MEDFORD SECTIONS 21/52/53/78/79/111/112/189
AP-04 EVERETT SECTIONS 23/24/156
AP-06 CHELSEA SECTIONS 12/14/15/62
AP-03 CAMBRIDGE/SOMERVILLE SECTIONS 26/27
AP-08 CAMBRIDGE SECTION 30
AP-02 BRIGHTON SECTIONS 163/164
AP-01 DORCHESTER/CHARLESTOWN SECTIONS 31/32/240/242
AP-11 DEDHAM/HYDEPARK SECTIONS 516/521/522/523/524
AP-05 MILTON SECTIONS 607/609/610
AP-12 NORWOOD SECTION 618
WILMINGTON
READING
WAKEFIELD
BEDFORD
BURLINGTON
WOBURN
STONEHAM
WINCHESTER
LEXINGTON
MEDFORD
REVERE
BELMONT
SOMERVILLE
WALTHAM
WATERTOWN
WINTHROP
NEWTON
BROOKLINE
WELLESLEY
BOSTON
NEEDHAM
QUINCY
DEDHAM
WESTWOOD
HINGHAM
BRAINTREE
WEYMOUTH
NORWOOD
CANTON
RANDOLPH
WALPOLE
HOLBROOK
STOUGHTON

Example of sewer needing rehabilitation

Example of sewer rehabilitated with cured-in-place 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 – Framingham Extension Relief Sewer, Wellesley Extension Relief Sewer – 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 were 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.

Some of MWRA's previously planned capital projects to address hydrogen sulfide corrosion and odor issues in the collection system have been delayed due to CIP adjustments. A series of projects to address hydrogen sulfide corrosion and odor control are recommended in this Section for inclusion in the CIP. These projects are detailed in bullet format below (see page 9-23) and include construction of in-system biofilters, lining and/or rehabilitation of deteriorated sewers, and additional system-wide study.


West Roxbury Tunnel

West Roxbury Tunnel Rehabilitation Project: The West Roxbury Tunnel (MWRA Sewer Section 637/638) is a 2.8 mile long gravity tunnel with limited access. Due to its significant length and limited access, this tunnel section requires special operation and maintenance considerations. Previous MWRA internal inspections of the West Roxbury Tunnel have determined that approximately 12,000 feet of Section 637 requires rehabilitation due to severe hydrogen sulfide corrosion. Two related MWRA construction projects have been previously completed: (1) rehabilitation of 1,000 feet of Section 638 (upstream) 84-inch sewer (Contract 6569) between the Neponset Valley Connection Chamber and the New Haven Street Drop Shaft and (2) the New Haven Street Drop Shaft Rehabilitation. The West Roxbury Tunnel Rehabilitation Project will complete the rehabilitation of Sections 637/638 and is recommended for consideration in the CIP (see projects described in bullets format below).

Projects in the Existing FY07 CIP:

- Evaluation, design, and construction of structural repairs to portions of MWRA Sewer Sections 80/83 in Arlington as detailed in MWRA's preliminary design report, $578,000 included in the FY07 CIP for expenditure in FY07-08.
- Evaluation, design, and construction of structural repairs to portions of MWRA sewer Section 160 - Mystic Valley Sewer in Winchester and Medford as detailed in MWRA's preliminary design report, $3.389 million included in the FY07 CIP for expenditure in FY07-09.

Projects Recommended for Consideration in the FY08 CIP: The following interceptor renewal and sewer asset protection projects are recommended based on the results of the Interceptor Renewal Program and/or previous MWRA studies:

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #1 – A project to rehabilitate approximately 1,900 feet of Sections 240 and 242 in Dorchester and Sections 31 and 32 in Charlestown is recommended in the FY09-13 timeframe. The project is estimated at $2 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #2 – A project to rehabilitate approximately 4,900 feet of Sections 163 and 164 in Brighton is recommended in the FY09-13 timeframe. The project is estimated at $5 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #3 – A project to rehabilitate approximately 4,400 feet of Sections 26 and 27 in Cambridge and Somerville is recommended in the FY09-13 timeframe. The project is estimated at $5 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #4 – A project to rehabilitate approximately 3,100 feet of Sections 23, 24 and 156 in Everett is recommended in the FY14-18 timeframe. The project is estimated at $3 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #5 – A project to rehabilitate approximately 3,800 feet of Sections 607, 609 and 610 in Milton is recommended in the FY14-18 timeframe. The project is estimated at $4 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #6 – A project to rehabilitate approximately 6,000 feet of Sections 12, 14, 15 and 62 in Chelsea is recommended in the FY14-18 timeframe. The project is estimated at $7 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #7 – A project to rehabilitate approximately 10,000 feet of Sections 41, 42, 49, 54 and 65 in Malden and Melrose is recommended in the FY14-18 timeframe. The project is estimated at $10 million with a duration of 4 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #8 – A project to rehabilitate approximately 2,000 feet of Section 30 in Cambridge is recommended in the FY19-28 timeframe. The project is estimated at $2 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #9 – A project to rehabilitate approximately 9,000 feet of Sections 46, 47, 73, 74, 75 and 153 in

Winchester, Woburn and Stoneham is recommended in the FY19-28 timeframe. The project is estimated at $9 million with a duration of 4 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #10 – A project to rehabilitate approximately 24,000 feet of Sections 21, 52, 53, 78, 79, 111, 112 and 189 in Arlington and Medford is recommended in the FY19-28 timeframe. The project is estimated at $24 million with a duration of 5 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #11 – A project to rehabilitate approximately 7,200 feet of Sections 516, 521, 522, 523, and 524 in Dedham and Hyde Park is recommended in the FY19-28 timeframe. The project is estimated at $7 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #12 – A project to rehabilitate approximately 700 feet of Section 618 in Norwood is recommended in the FY19-28 timeframe. The project is estimated at $1 million, with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #13 – A long-term Interceptor Renewal Program is recommended. This project is a CIP placeholder to provide an annual baseline target expenditure of $5 million for interceptor asset protection/interceptor renewal. As specific projects are identified, they will become sub-phases within the target expenditure. The annual baseline expenditure for long-term asset protection is recommended at $5 million per year beginning in FY29 and continuing through FY48.
- Re-evaluation, re-design, and construction of structural repairs to 2,000 feet of MWRA Section 624 in North Weymouth is recommended due to extensive deterioration caused by hydrogen sulfide corrosion from the Hingham Pump Station force main discharge. This project was previously a component of the Braintree/Weymouth Project with an estimated construction cost of $5 million ($4 million in previous CIP). The project duration is 3 years and is recommended in the FY09-11 timeframe.
- FES/FERS Corrosion and Odor Control (biofilters) is a design and construction project to make improvements at the MWRA Framingham Pump Station and related sewers. Three air treatment systems (biofilters) are recommended to remove and treat hydrogen sulfide in the FES, FERS, WESR, WERS, and WRT sewer systems. Rehabilitation of hydrogen sulfide meters will be included. Design and construction is estimated at $5 million ($4.8 million in previous CIP) with a project duration of 5 years. The project is recommended during the FY09-13 timeframe. This project is a critical component of MWRA's overall hydrogen sulfide corrosion and odor control program. Construction of the biofilters will allow reduced chemical addition at the Framingham Pump Station resulting in O&M cost savings. This project is directly linked to the two asset protection projects that follow: WERS lining and FES tunnel rehabilitation. Depending on implementation scheduling, it may be less expensive to design all three projects together.
- Re-evaluation, design, and construction of replacement lining of 29,000 feet of the Wellesley Extension Sewer Replacement (WESR) due to deterioration of the existing liner is recommended. Project cost is estimated at $24 million ($23.2 million in previous CIP) with a project duration of 9 years. The project is recommended in the FY14-22 timeframe.
- Design and construction to rehabilitate the Framingham Extension Sewer (FES) tunnel due to deterioration from hydrogen sulfide is recommended. The project is estimated at $8.5 million with a 2 year duration [$8.5 million was recommended in previous CIP for

construction portion only, design was previously included in the FES/FERS Corrosion and Odor Control (biofilters) project]. The project is recommended in the FY14-18 timeframe.

- Odor Control Study (system-wide) is a planning project to study odor control comprehensively for the entire collection system. The project is estimated at $1 million with a 3 year duration and is recommended in the FY09-13 timeframe. This project is a critical component of MWRA's overall hydrogen sulfide corrosion and odor control program.
- Re-evaluation, design, and construction of structural repairs to 12,000 feet of MWRA sewer Sections 637, West Roxbury Tunnel located in West Roxbury; $80 million is recommended in the FY11-18 timeframe ($73.5 million recommended in previous CIP). This project has an 8 year duration.

9.5 Sewer System Capacity Related Projects

Sewer capacity issues are generally addressed through some combination of sewer replacement and relief sewer construction. Many of MWRA's projects to increase sewer capacity have been recommended in previous planning studies. A new planning study is recommended by staff to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Chelsea Creek Headworks to determine the feasibility of increasing system capacity. Existing sewer system capacity related projects included in the FY07 CIP and future sewer system capacity related projects recommended for consideration in the CIP are presented below.

<u>Projects in the Existing FY07 CIP</u>:

- Construction of the Cummingsville Replacement Sewer as detailed in MWRA's Facilities Plan. This ongoing construction project has $2.041 million remaining to be expended through FY08.
- Construction of the Upper Neponset Valley Relief Sewer as detailed in MWRA's Facilities Plan. This ongoing construction project has $36.377 million remaining to be expended through FY09.
- As an outcome of the Wastewater Process Optimization Study, design and 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 is recommended. This project will increase/optimize system capacity during peak flow conditions. This 4 year project is estimated at $1.136 million and included in the FY07 CIP for expenditure in FY09-12.
- 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 is recommended. This project will increase/optimize system capacity during peak flow conditions. This 2 year planning project is estimated at $150,000 and included in the FY07 CIP for expenditure in FY12-13.

<u>Projects Recommended for Consideration in the FY08 CIP:</u>

- The Randolph Trunk Sewer Relief Study is recommended to identify system improvements to reduce sanitary sewer overflows that occur at MWRA's Sewer Section

628 - Pearl Street Siphon. This 2 year duration study is estimated at $750,000 and is recommended for the FY08-09 time frame.

- As a follow-up to the Cambridge Branch Sewer/DeLauri Pump Station Siphon planning project (in the FY07 CIP), a design/construction project to rehabilitate the Cambridge Branch Sewer and DeLauri Siphon is recommended. The project is estimated at $23 million (previous CIP recommendation) and is recommended during the FY19-28 timeframe. The project duration is estimated at 5 years.
- Neponset Valley Relief Sewer planning, design, and construction is recommended as a follow-up to a recommendation from the 1994 Final CSO Conceptual Plan and System Master Plan. The 3-mile long Neponset Valley Sewer was constructed between 1895-1898. The project is estimated at $12 million (previous CIP recommendation) and is recommended during the FY19-28 timeframe. The project duration is estimated at 10 years.
- Ashland Extension Sewer planning and design is recommended to study the feasibility and design of the extension of the Framingham Relief Sewer to Ashland. The project is estimated at $1 million (previous CIP recommendation) and is recommended during the FY19-28 timeframe. The project duration is estimated at 2 years.
- A North System Hydraulic Capacity Study is recommended to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Chelsea Creek Headworks and to determine the feasibility of increasing system capacity. This project could help identify options to mitigate occasional SSOs in the North System during extreme storm events. The project is estimated at $200,000 with a 2 year duration and is recommended during the FY09-13 timeframe.

9.6 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 9.8. CSO and emergency outfalls are discussed in Section 9.9. Manholes and related structures require the same attention as any other component of the collection system. The Technical Inspection Unit performs visual inspections of manholes and assigns structural and infiltration ratings and also maintains a 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 the annual CEB. In addition, manholes and structures along the route of sewer rehabilitation projects are reviewed and rehabilitated, as appropriate, within the project. For master planning purposes, staff recommend a project to target rehabilitation of at least 20 manholes per year (based on condition priority ranking) providing for the rehabilitation of 2,000 manholes/structures (half the system) over 100 years. The remaining manholes/structures (half of the system) will be rehabilitated through inclusion within sewer rehabilitation projects. 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>Projects Recommended for Consideration in the FY08 CIP:</u>

- An annual manhole and special structure rehabilitation project is recommended at a cost of $100,000 per year (based on estimate of $5000 per manhole at 20 manholes per year) for a total estimated cost of $4 million for the FY09-48 timeframe. Due to the annual need and relative low cost of this project, it may be a candidate for CEB funding.
- A construction project to rehabilitate the Woburn Sandcatcher is recommended at an estimated cost of $1 million for the FY09-13 time frame. This project has a duration of 1 year. The project will optimize flow through the division structure, provide appropriate access for system maintenance, and improve debris removal. In-house planning and design will be required prior to implementation of this construction project.

9.7 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. There are approximately 20 miles of force main piping in the MWRA collection system. Approximately 15.5 miles of force main are located outside the facilities they serve. The remaining 4.5 miles of force main piping is integral to the individual facilities. Key information on MWRA force mains is provided in Table 9-3.

MWRA has historically evaluated force mains for replacement/rehabilitation as an integral part of larger pump station replacement projects. The recent Mill Brook Valley Sewer Rehabilitation project (Sections 79 and 92) led to the identification that an upstream force main (Section 93A in Lexington) that also required replacement due to hydrogen sulfide corrosion. The identification of this problem demonstrates the need for asset protection planning specifically for MWRA's force mains. An in-house force main evaluation project is recommended below.

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 the system where the air will accumulate. Serious flow restrictions or even blockage can result from the air pockets that form in the force main. Also, these 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. An in-house task is recommended to review the performance of MWRA's force mains and evaluate age and material related factors. This force main task would expand on work being performed under the Water Master Plan for water main piping. This analysis may help predict force mains susceptible to failure. In addition, 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.

Table 9-3
MWRA Force Mains

Facility/Location	Section	Size	Material*	Length (ft)	Date
Alewife Brook Pump Station/Somerville	155	24-inch	CI	168	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	677	36-inch	PCCP	23,661	1999
Hayes Pump Station/Wakefield	205	20-inch	DI	2,329	1984
Hingham Pump Station/Hingham-Weymouth	661/662	20-inch	DI	7,923	1984/1990
Hough's Neck Pump Station/Quincy	588	10-inch	DI	40	1998
Intermediate Pump Station (IPS)/North Weymouth	642A	42-inch	DI	152	2000
New Neponset Valley Sewer/Canton-Milton	675/676	48-inch	DI	21,406	1992
Prison Point Pump Station and Pumped CSO Facility/Cambridge	198 (dry weather)	18-inch	RC	2,322	1974-1977
	199 (dry weather)	96-inch	RC	2,208	1973-1974
Quincy Pump Station/Quincy	660	30-inch	CI - cement lined 1999	2,754	1923
Squantum Pump Station/Quincy	659	24-inch	DI - cement lined 1995	4,583	1969
	659A	30-inch	DI - cement lined 1999	8,111	1969-1970
	659B	30-inch	PCCP	6,307	1970

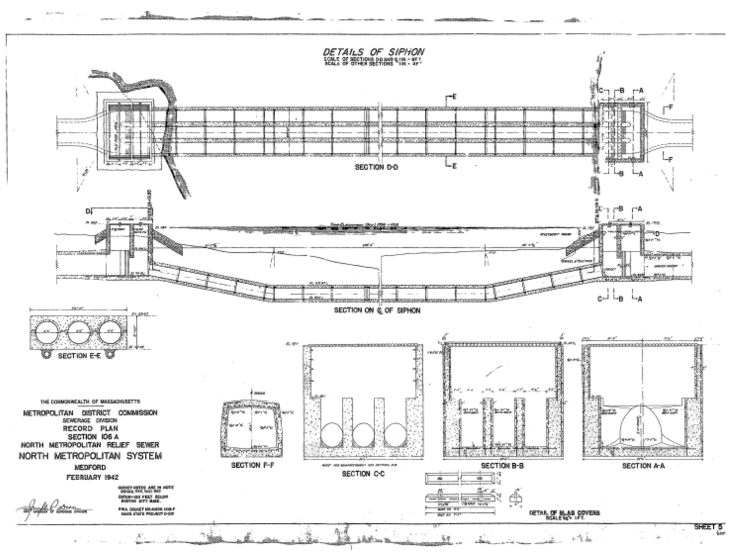
*Notes for materials: CI - cast iron; DI - ductile iron; PCCP - prestressed concrete cylinder pipe; PICP - poured-in-place conrete pipe; RC - reinforced concrete

Projects Recommended for Consideration in the FY08 CIP:

- For Master Planning purposes, a force main asset protection project is recommended to provide a place holder for possible future recommendations from an in-house force main and related structure evaluation. This project is estimated at $5 million with a duration of 5-years and is recommended in the FY19-28 time frame. 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).

9.8 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 gradeline of the sewer. It is constructed with special inlet and outlet chambers (headhouses) to facilitate cleaning. Siphons may have one, two or three 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 high likelihood of debris and grease build-up that can lead to blockage and sanitary sewer overflows. The MWRA collection system has 7 miles of siphons at 24 separate siphon locations. These include 61separate siphon barrels and 114 separate siphon headhouse structures. Key information on MWRA siphons is provided in Table 9-4.



Example of three barrel siphon

MWRA's operation and maintenance practices for siphon barrels relies in large part on use of a relatively new technology - 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 reinspection are scheduled based on the results of sonar inspections. Advances in sonar scanner camera equipment technology have been made over the equipment MWRA currently owns. MWRA staff recommend the Authority purchase new sonar inspection equipment to provide the highest level of technology to optimize preventative maintenance planning. A project to purchase new sonar inspection equipment is recommended.

Table 9-4
MWRA Siphons

Name	Section #	Community	Material	Approximate Diameter (ft)	Year Built	Length (ft)	# of Barrels
Alewife Brook Conduit	176	Medford	RC	5,6	1948	225	1
Alewife Brook Conduit	177	Arlington/Cambridge	RC	5,6	1948	589	1
Alewife Brook Conduit	178	Cambridge	RC	4	1948	223	1
Alewife Brook Conduit	179	Cambridge	RC	3	1948	73	1
Belmont Relief Sewer	081	Cambridge	CI	1	1927	23	3
Braintree-Weymouth Interceptor	623	Quincy/Weymouth	DI/RC	5,10	1982	1711	2
Braintree-Weymouth Interceptor	624/625	Weymouth	CI	4	1933	1597	1
Braintree-Weymouth Interceptor	625	Braintree/Weymouth	CI	3	1933	743	1
Braintree-Weymouth Interceptor Emergency Mill Cove Relief Siphon	624A	Weymouth	PL/PIPC	4	1998	1949	1
Cambridge Marginal Conduit	229	Cambridge	CI	4	1910	201	2
Charles River Marginal Conduit	216	Boston/Cambridge	RC	3	1979	1112	1
Charles River Marginal Conduit	217	Boston	RC	7	1979	398	1
Chelsea Creek Siphon	101	Chelsea/East Boston	PIPC	5	1942	911	2
Dedham Branch Sewer	532	Canton/Dedham	CI	1	1950	112	2
Deer Island Miscellaneous Facilities	225	East Boston	RC	10	1952	145	1
DeLauri Pump Station	025	Charlestown	PIPC/RC	5, 10	1989	628	2
Fore River Siphon	640	Weymouth	HDPE-ST	3,36	2002	3656	2
Framingham Extension Relief Sewer	678	Dover/Wellesley	PIPC	2	1999	194	2
Framingham Trunk Interceptor, Framingham Extension Sewer	632	Natick	RC	2	1955	226	2
Framingham Trunk Interceptor, Framingham Extension Sewer	634	Natick	RC	2	1954	54	2
High Level Sewer	564	Hyde Park/Milton	CI	5	1902	159	3
Metropolitan Sewer	059	Melrose	PIPC, CI	4	1901	79	2
Metropolitan Sewer	150	Winchester	Brick/VC	2,3	1894	56	1
Metropolitan Sewer	155	Medford/Somerville	Brick/CI	2,3	1894	96	1
Metropolitan Sewer, Cambridge Branch Sewer/DeLauri PS	025	Charlestown	Brick	5	1895	1197	1
Metropolitan Sewer, Cummingsville Branch Sewer	047	Winchester	VC	1,2	1894	45	1
Metropolitan Sewer, East Boston Branch Sewer	038	East Boston	DI, RC	1,2	1895	165	2
Metropolitan Sewer, New Malden River Siphon	019	Everett/Medford	Brick	4	1916	345	1

Table 9-4 (continued)
MWRA Siphons

Name	Section #	Community	Material	Approximate Diameter (ft)	Year Built	Length (ft)	# of Barrels
Millbrook Valley Relief Sewer	152	Arlington/Medford	RC	3,4	1966	577	2
Millbrook Valley Sewer	078	Arlington/Medford	CI	1,2	1926	182	2
Millbrook Valley Sewer	084	Lexington	VC	2	1948	113	3
Mystic Valley Sewer	160	Winchester	CI	2	1878/1950	205	1
Neponset Valley Relief Sewer	531	Hyde Park/Milton	CI	3	1935	154	2
Neponset Valley Sewer	243	Dorchester/Milton	DI	1	1972	156	2
Neponset Valley Sewer	245	Dorchester/Milton	CI	1	1963	152	2
New Mystic Valley Sewer	067	Winchester	CI	5	1937	68	1
New Mystic Valley Sewer	069	Winchester	CI	2	1913	64	2
New Mystic Valley Sewer	109	Medford	CI, PIPC	4,6	1929	53	2
North Metro Relief Sewer	105	Everett/Medford	RC	5	1940	425	2
North Metro Relief Sewer	107	Medford	CI	5	1938	247	3
North Metro Relief Sewer	113	Winchester	CI, PIPC	3,5	1937	118	2
North Metro Relief Sewer	158	Medford	CI	5	1942	358	3
North Metropolitan Trunk Sewer, Belle Isle Inlet	007	East Boston/Winthrop	PIPC	5	1895	233	3
Randolph Trunk Sewer	626	Braintree/Weymouth	RC	2,3	1973	83	3
Randolph Trunk Sewer	628	Braintree	RC	2	1972	57	2
Randolph Trunk Sewer	655	Braintree/Randolph	RC	1,2	1972	86	2
Walpole Ext Relief Sewer	669	Norwood	DI	3	1992	116	1
Walpole Ext Relief Sewer	669	Canton/Norwood	DI	3	1992	145	1
Walpole Extension Sewer	616	Canton/Norwood	CI	3	1931	52	2
Walpole Extension Sewer	617	Norwood	CI	3	1931	101	1
Walpole Extension Sewer	618	Norwood	CI,/RC	2,3	1957	145	2
Watertown Coll System Improvements, East End Replacement Siphon	211	Brighton/Watertown	DI/RC	1	1984	254	2
Wellesley Ext Relief Sewer	629	Dedham/Needham	RC	3	1956	169	2
Wellesley Ext Relief Sewer	630	Dover/Needham	RC	2	1952	430	2
Wellesley Ext Sewer Replacement	666	Dedham/Needham	DI/RC	2	1990	249	3
Wellesley Ext Sewer Replacement	668	Dover/Wellesley	PIPC	3,4,5	1989	119	3
Wellesley Extension Sewer	601	Dedham/Needham	CI	1	1921	161	2
Westwood Interceptor, Westwood Extension Sewer	635	Canton/Westwood	RC	1	1961	320	3

MWRA's siphon inspection work has identified that all MWRA siphons are currently in good condition. No siphon rehabilitation or replacement projects are recommended based on poor physical condition. 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 652, the Fore River Siphon 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 feet long twin 54-inch diameter Fore River Siphons by inserting a 28-inch liner into the existing siphon. Reduction in siphon size is needed due to the rerouting of significant flows to the Intermediate Pump Station.

Inspection and maintenance of siphon headhouse structures is a regular part of MWRA's O&M 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, has been in previous CIPs and continues to be recommended by staff. The project will address capacity issues, detention time and odor issues, structural repairs, flow diversion using stop planks, structure accessibility, and easements issues.

<u>Projects Recommended for Consideration in the FY08 CIP:</u>

- Purchase of new Sonar Inspection Equipment is recommended at $130,000 with a project duration of 1 year during the FY09-13 timeframe. Due to the relative low cost of this project (purchase), it may be a candidate for CEB funding.
- A Siphon Asset Protection project is recommended to provide a placeholder for possible recommendations from the ongoing in-house siphon inspection and maintenance program. This project is estimated at $5 million with a duration of 5 years and is recommended for the FY19-28 time frame.
- Sliplining design and construction of Section 652 Fore River Siphon to reduce the size of one of the existing 1,700 feet long twin 54-inch Fore River Siphons by inserting a 28-inch liner into the existing siphon is recommended. Reduction in size is needed due to the rerouting of significant flows to the Intermediate Pump Station. The project is estimated at $7 million and has a project duration of 2 year. The project is recommended during the FY19-28 timeframe. This project was previously a component of the Braintree – Weymouth Project with a $10.6 million cost estimate in previous CIP for both this project and the rehabilitation of Sewer Section 624. These projects are now recommended separately in the Master Plan.

- A Siphon Structure Rehabilitation design and construction project is recommended for improvements to 127 siphon headhouses and/or diversion structures. 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 to allow for proper maintenance. The project cost is estimated at $8 million with a project duration of 8 years. The project is recommended in the FY09-16 timeframe ($7.7 million recommended in a previous CIP).

9.9 CSO and Nut Island Emergency Outfalls

Some of MWRA's member communities' wastewater collection systems were originally constructed as combined sewers 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, the excess flows can 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, other are not. 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 in an emergency. Outfalls at the Deer Island Treatment Plant are discussed in Chapter 6.

The MWRA collection system includes 14 CSO and 3 Nut Island emergency outfalls. The total length of outfall pipe is 3.4 miles. Key information on these structures is provided in Table 9-5. Under MWRA's CSO Control Plan, some of the MWRA-owned CSO outfalls have been closed, some will be closed when future projects are completed, and some will remain active. The Nut Island outfalls will remain active for emergency purposes. The Nut Island outfalls were inspected in 2005 and found to be in good condition. A future inspection project is recommended as a follow-up to the 2005 Nut Island Emergency outfall work and will also include inspection of all MWRA CSO outfalls. Project scheduling should be coordinated with outfall closings planned under CSO Control Plan projects. This recommended future project is included below. In addition, the existing FY07 CIP includes one CSO outfall related project (Outfall MWR023 Structural Improvements). 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. This work is scheduled to begin in FY08.

Projects in the Existing FY07 CIP:

- Outfall MWR023 Structural Improvements is a construction project included in the FY07 CIP at a cost of $1.5 million and is scheduled to be performed during a 3 year project duration from FY08-10.

Projects Recommended for Consideration in the FY08 CIP:

- A future Outfall Inspection and 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. This project has an estimated cost of $800,000 (based on a previous Nut Island Outfall inspection) and a project duration of 2 years. It is recommended for the FY19-28 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
MWRA003/CAM003	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	Boston Marginal 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	Active	7	100	Reinforced Concrete	1971	Upper Mystic
MWR207	N/A	Decommissioned Constitution Beach	Closed 9/00					Constitution Beach
MWR209/BOS088/089	N/A	Fox Point to be decommissioned in 2008	Active					South Dorchester Bay
MWR211/BOS090	N/A	Commercial Point to be decommissioned in 2008	Active					South Dorchester Bay

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 community flow-based rate assessments and data for 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 detailed 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.

Projects in the Existing FY07 CIP: There are seven ongoing collection system sewer related projects in the FY07 CIP. The projects are described below and summarized in Table 9-6 (see line numbers 9.1 through 9.7).

- Evaluation, design, and construction of structural repairs to portions of MWRA Sewer Sections 80/83 in Arlington as detailed in MWRA's preliminary design report; $578,000 included in the FY07 CIP for expenditure in FY07-08.

- Evaluation, design, and construction of structural repairs to portions of MWRA Sewer Section 160 - Mystic Valley Sewer in Winchester and Medford as detailed in MWRA's preliminary design report; $3.389 million included in the FY07 CIP for expenditure in FY07-09.

- Construction of the Cummingsville Replacement Sewer as detailed in MWRA's Facilities Plan. This ongoing construction project has $2.041 million remaining to be expended through FY08.

- Construction of the Upper Neponset Valley Relief Sewer as detailed in MWRA's Facilities Plan. This ongoing construction project has $36.377 million remaining to be expended through FY09.

- As an outcome of the Wastewater Process Optimization Study, design and 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 is recommended. This project will increase/optimize system capacity during peak flow conditions. This 4 year project is estimated at $1.136 million and included in the FY07 CIP for expenditure in FY09-12.

- 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 is recommended. This project will increase/optimize system capacity during peak flow conditions. This 2 year planning project is estimated at $150,000 and included in the FY07 CIP for expenditure in FY12-13.

- Outfall MWR023 Structural Improvements in the Fenway area of Boston is a construction project included in the FY07 CIP at a cost of $1.5 million and is scheduled to be performed during a 3 year project duration from FY08-10.

Projects Recommended for Consideration in the FY08 CIP: There are thirty-two collection system sewer related projects recommended for consideration in the CIP. These projects are described below and summarized in Table 9-6 (see line numbers 9.8 through 9.39).

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #1 – A project to rehabilitate approximately 1,900 feet of Sections 240 and 242 in Dorchester and Sections

31 and 32 in Charlestown is recommended in the FY09-13 timeframe. The project is estimated at $2 million with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #2 – A project to rehabilitate approximately 4,900 feet of Sections 163 and 164 in Brighton is recommended in the FY09-13 timeframe. The project is estimated at $5 million with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #3 – A project to rehabilitate approximately 4,400 feet of Sections 26 and 27 in Cambridge and Somerville is recommended in the FY09-13 timeframe. The project is estimated at $5 million with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #4 – A project to rehabilitate approximately 3,100 feet of Sections 23, 24 and 156 in Everett is recommended in the FY14-18 timeframe. The project is estimated at $3 million with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #5 – A project to rehabilitate approximately 3,800 feet of Sections 607, 609 and 610 in Milton is recommended in the FY14-18 timeframe. The project is estimated at $4 million with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #6 – A project to rehabilitate approximately 6,000 feet of Sections 12, 14, 15 and 62 in Chelsea is recommended in the FY14-18 timeframe. The project is estimated at $7 million with a duration of 3 years.
- Interceptor Asset Protection (AP)/Interceptor Renewal Project #7 – A project to rehabilitate approximately 10,000 feet of Sections 41, 42, 49, 54 and 65 in Malden and Melrose is recommended in the FY14-18 timeframe. The project is estimated at $10 million with a duration of 4 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #8 – A project to rehabilitate approximately 2,000 feet of Section 30 in Cambridge is recommended in the FY19-28 timeframe. The project is estimated at $2 million with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #9 – A project to rehabilitate approximately 9,000 feet of Sections 46, 47, 73, 74, 75 and 153 in Winchester, Woburn and Stoneham is recommended in the FY19-28 timeframe. The project is estimated at $9 million with a duration of 4 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #10 – A project to rehabilitate approximately 24,000 feet of Sections 21, 52, 53, 78, 79, 111, 112 and 189 in Arlington and Medford is recommended in the FY19-28 timeframe. The project is estimated at $24 million with a duration of 5 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #11 – A project to rehabilitate approximately 7,200 feet of Sections 516, 521, 522, 523, and 524 in Dedham and Hyde Park is recommended in the FY19-28 timeframe. The project is estimated at $7 million with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #12 – A project to rehabilitate approximately 700 feet of Section 618 in Norwood is recommended in the FY19-28 timeframe. The project is estimated at $1 million, with a duration of 3 years.

- Interceptor Asset Protection (AP)/Interceptor Renewal Project #13 – A long-term Interceptor Renewal Program is recommended as a CIP placeholder to provide an annual baseline target expenditure of $5 million for interceptor asset protection/interceptor renewal. As specific projects are identified, they will become sub-phases within the target expenditure. The annual baseline expenditure for long-term asset protection is recommended at $5 million per year beginning in FY29 and continuing through FY48.

- Re-evaluation, re-design, and construction of structural repairs to 2,000 feet of MWRA Section 624 in North Weymouth is recommended due to extensive deterioration caused by hydrogen sulfide corrosion from the Hingham Pump Station force main discharge. This project was previously a component of the Braintree/Weymouth Project with an estimated construction cost of $5 million ($4 million in previous CIP). The project duration is 3 years and is recommended for the FY09-11 timeframe.

- FES/FERS Corrosion and Odor Control (biofilters) is a design and construction project to improve the MWRA Framingham Pump Station and related sewers. Three air treatment systems (biofilters) are recommended to remove and treat hydrogen sulfide in the FES, FERS, WESR, WERS, and WRT sewer systems. Rehabilitation of hydrogen sulfide meters will be included. Design and construction is estimated at $5 million ($4.8 million in previous CIP) with a project duration of 5 years. The project is recommended during the FY09-13 timeframe. This project is a critical component of MWRA’s overall hydrogen sulfide corrosion and odor control program. Construction of the biofilters will allow reduced chemical addition at the Framingham Pump Station resulting in O&M cost savings. This project is directly linked to the two asset protection projects that follow: WERS lining and FES tunnel rehabilitation. Depending on implementation scheduling, it may be less expensive to design all three projects together.

- Re-evaluation, design, and construction of replacement lining of 29,000 feet of the Wellesley Extension Sewer Replacement (WESR) due to deterioration of the existing liner. Project cost is estimated at $24 million with a project duration of 9 years ($23.2 million in previous CIP). The project is recommended in the FY14-22 timeframe.

- Design and construction to rehabilitate the Framingham Extension Sewer (FES) tunnel due to hydrogen sulfide deterioration. The project is estimated at $8.5 million with a 2 year duration [$8.5 million was recommended in previous CIP for construction portion only, design was previously included in the FES/FERS Corrosion and Odor Control (biofilters) project]. The project is recommended during the FY14-18 timeframe.

- Odor Control Study (system-wide) is a planning project to study odor control comprehensively for the entire collection system. The project is estimated at $1 million with a 3 year duration and is recommended for the FY09-13 timeframe. This project is a critical component of MWRA's overall hydrogen sulfide corrosion and odor control program.

- Re-evaluation, design, and construction of structural repairs to 12,000 feet of MWRA Sewer Sections 637, West Roxbury Tunnel located in West Roxbury, $80 million is recommended for expenditure in the FY11-18 time frame ($73.5 million recommended in previous CIP). This project has an 8 year duration.

- Randolph Trunk Sewer Relief Study is recommended to identify system improvements to reduce sanitary sewer overflows that occur at MWRA's Sewer Section 628 - Pearl Street Siphon. This 2 year duration study is estimated at $750,000 and is recommended for the FY08-09 timeframe.

- As a follow-up to the Cambridge Branch Sewer/DeLauri Pump Station Siphon planning project (in the FY07 CIP), a design/construction project to rehabilitate the Cambridge Branch Sewer and DeLauri Siphon is recommended. The project is estimated at $23 million (previous CIP recommendation) and is recommended during the FY19-28 timeframe. The project duration is estimated at 5 years.

- Neponset Valley Relief Sewer planning, design, and construction is recommended as a follow-up to a recommendation from the 1994 Final CSO Conceptual Plan and System Master Plan. The 3 mile long Neponset Valley Sewer was constructed from 1895-1898. The project is estimated at $12 million (previous CIP recommendation) and is recommended during the FY19-28 timeframe. The project duration is estimated at 10 years.

- Ashland Extension Sewer Feasibility planning and design project to extend the Framingham Relief Sewer to Ashland. The project is estimated at $1 million (previous CIP recommendation) and is recommended during the FY19-28 timeframe. The project duration is estimated at 2 years.

- A North System Hydraulic Capacity Study is recommended to evaluate the tributary flows and hydraulic capacity of the North Sewer System tributary to Chelsea Creek Headworks and determine the feasibility of increasing system capacity. This project could help identify options to mitigate occasional SSOs in the North System during extreme storm events. The project is estimated at $200,000 with a 2 year duration and is recommended during the FY09-13 timeframe.

- An annual manhole and special structure rehabilitation project is recommended at a cost of $100,000 per year (based on estimate of $5000 per manhole at 20 manholes per year) for a total estimated cost of $4 million during the FY09-48 timeframe.

- A construction project to rehabilitate the Woburn Sandcatcher is recommended at an estimated cost of $1 million in the FY09-13 timeframe. This project has a duration of 1 year. The project will optimize flow through the division structure and provide appropriate access for system maintenance and debris removal. In-house planning and design will be required prior to implementation of this construction project.

- A Force Main Asset Protection project is recommended to provide a placeholder for possible recommendations from an in-house force main and related structure evaluation. This project is estimated at $5 million with a duration of 5 years and is recommended in the FY19-28 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).

- Purchase of new Sonar Inspection Equipment is recommended at $130,000 with a project duration of 1 year during the FY09-13 timeframe.

- A Siphon Asset Protection project is recommended to provide a placeholder for possible recommendations from an ongoing in-house inspection and maintenance program. This project is estimated at $5 million with a duration of 5 years and is recommended for the FY19-28 timeframe.

- Sliplining design and construction of Section 652 Fore River Siphon to reduce the size of one of the existing 1,700 feet long twin 54-inch Fore River Siphons by inserting a 28-inch liner into the existing siphon. Reduction in size is needed due to rerouting of significant flows to the Intermediate Pump Station. The project is estimated at $7 million and has a project duration of 2 year. The project is recommended during the FY19-28 timeframe. This project was previously a component of the Braintree/Weymouth Project with a $10.6 million cost estimate in previous CIP for both this project and the rehabilitation of Sewer Section 624. These projects are now recommended separately in the Master Plan.

- Siphon Structure Rehabilitation design and construction project to make improvements to 127 siphon headhouses and/or diversion structures. 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 to allow for proper maintenance. The project cost is estimated at $8 million with a project duration of 8 years. The project is recommended for the FY09-16 timeframe ($7.7 million recommended in a previous CIP).

- A future Outfall Inspection and 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. This project has an estimated cost of $800,000 (based on a previous Nut Island Outfall inspection) and a project duration of 2 years. It is recommended for the FY19-28 timeframe.

Table 9-6
Wastewater Master Plan - Collection System Sewers
Existing and Recommended Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		COLLECTION SYSTEM SEWERS											
9.1	1	**Interceptor AP - existing Arlington Sections 80/83 Rehab**	AP	in S145	2 years	578	now-FY08	578					578
9.2	1	**Interceptor AP - existing Winchester/Medford Section 160 Rehab**	AP	in S145	3 years	3,389	now-FY09	2,344	1,045				3,389
9.3	1	**Cummingsville Replacement Sewer**	RF/IC	in S127	2 years	2,041	now-FY08	2,041					2,041
9.4	1	**Upper Neponset Valley Relief Sewer**	RF/IC	in S131	3 years	36,377	now-FY09	35,825	552				36,377
9.5	3	**Wastewater Process Opti/Somerville Sewer Connection Design/Construct**	Opti/IC	in S141	4 years	1,136	FY09-12		1,136				1,136
9.6	2	**Wastewater Process Opti/Cambridge Branch Sewer/DeLauri Siphon Plan**	Plan	in S141	2 years	150	FY12-13		150				150
9.7	2	**Outfall 023 Structural Improvements**	AP	in S139	3 years	1,500	FY08-10	800	700				1,500
		SUBTOTAL - Existing - Sewers				45,171		41,588	3,583				45,171

Table 9-6 (continued)
Wastewater Master Plan - Collection System Sewers
Existing and Recommended Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
9.8	2	Interceptor AP - interceptor renewal #1 Charlestown/Dorchester Sections 31/32/240/242	AP	new	3 years	2,000	FY09-13		2,000				2,000
9.9	2	Interceptor AP - interceptor renewal #2 Brighton Sections 163/164	AP	new	3 years	5,000	FY09-13		5,000				5,000
9.10	2	Interceptor AP - interceptor renewal # 3 Cambridge/Somerville Sections 26/27	AP	new	3 years	5,000	FY09-13		5,000				5,000
9.11	2	Interceptor AP - interceptor renewal #4 Everett Sections 23/24/156	AP	new	3 years	3,000	FY14-18			3,000			3,000
9.12	2	Interceptor AP - interceptor renewal #5 Milton Sections 607/609/610	AP	new	3 years	4,000	FY14-18			4,000			4,000
9.13	2	Interceptor AP - interceptor renewal #6 Chelsea Sections 12/14/15/62	AP	new	3 years	7,000	FY14-18			7,000			7,000
9.14	2	Interceptor AP - interceptor renewal #7 Malden/Melrose Sections 41/42/49/54/65	AP	new	4 years	10,000	FY14-18			10,000			10,000
9.15	3	Interceptor AP -interceptor renewal #8 Cambridge Section 30	AP	new	3 years	2,000	FY19-28				2,000		2,000
9.16	3	Interceptor AP - interceptor renewal #9 Winchester/Woburn/Stoneham Sections 46/47/73/74/75/153	AP	new	4 years	9,000	FY19-28				9,000		9,000
9.17	3	Interceptor AP - interceptor renewal #10 Arlington/Medford Sections 21/52/53/78/79/111/112/189	AP	new	5 years	24,000	FY19-28				24,000		24,000
9.18	3	Interceptor AP - interceptor renewal #11 Dedham/Hyde Park Sections 516/521/522/523/524	AP	new	3 years	7,000	FY19-28				7,000		7,000
9.19	3	Interceptor AP - interceptor renewal #12 Norwood Section 618	AP	new	3 years	1,000	FY19-28				1,000		1,000
9.20	3	Interceptor AP - interceptor renewal #13 Future @ $5 mil/year	AP	new	annual	100,000	FY29-48					100,000	100,000
9.21	1	B/W Rehabilitation of Section 624 Construction	AP	prev	3 years	5,000	FY09-11		5,000				5,000
9.22	3	FES/FERS Corrosion and Odor Control (biofilters) Design/Construct	AP	prev	5 years	5,000	FY09-13		5,000				5,000
9.23	3	Wellesley Extension Replacement Sewer Rehab Design/Construction/CS/RI	AP	prev	9 years	24,000	FY14-22			15,000	9,000		24,000
9.24	2	FES Tunnel Rehab Design/Construct	AP	prev	2 years	8,500	FY14-18			8,500			8,500

Table 9-6 (continued)
Wastewater Master Plan - Collection System Sewers
Existing and Recommended Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in included in FY07 CIP (bold)
new new project, not previously in CIP
prev included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
9.25	2	Odor Control Study (systemwide)	Plan	new	3 years	1,000	FY09-13		1,000				1,000
9.26	1	West Roxbury Tunnel Corrosion Rehab	AP	prev	8 years	80,000	FY11-18		5,000	75,000			80,000
9.27	3	Randolph Trunk Sewer Relief Study	Plan	new	2 years	750	FY08-09	250	500				750
9.28	3	Cambridge Branch Sewer/DeLauri Siphon Design/Construct	IC/Opti	prev	5 years	23,000	FY19-28				23,000		23,000
9.29	4	Neponset Valley Relief Sewer Plan/Design/Construct	RF/IC	prev	10 years	12,000	FY19-28				12,000		12,000
9.30	5	Ashland Extension Sewer Planning/Design	Plan/NF	prev	2 years	1,000	FY19-28				1,000		1,000
9.31	5	North System Hydraulic Capacity Study	Plan	new	2 years	200	FY09-13		200				200
9.32	4	Manhole Rehabilitation @ $100k/year	AP	new	annual	4,000	FY09-FY48		500	500	1,000	2,000	4,000
9.33	4	Woburn Sandcatcher Construction	AP/Opti	new	1 year	1,000	FY09-13		1,000				1,000
9.34	4	Force Main Asset Protection	AP	new	5 years	5,000	FY19-28				5,000		5,000
9.35	3	New Sonar Inspection Equipment	NF	new	1 year	130	FY09-13		130				130
9.36	4	Siphon Asset Protection	AP	new	5 years	5,000	FY19-28				5,000		5,000
9.37	4	B/W Sliplining of Section 652 Fore River Siphon Design/Construction	AP/Opti	prev	2 years	7,000	FY19-28				7,000		7,000
9.38	2	Siphon Structure Rehab Design/Construct	AP	prev	8 years	8,000	FY09-16		5,000	3,000			8,000
9.39	4	Outfall Asset Protection	AP	new	2 years	800	FY19-28				800		800
		SUBTOTAL - Recommended - Sewers				370,380		250	35,330	126,000	106,800	102,000	370,380
		SUBTOTAL - Existing and Recommended - Sewers				415,551		41,838	38,913	126,000	106,800	102,000	415,551

CHAPTER 10
COLLECTION SYSTEM
PUMP STATIONS AND CSO FACILITIES

10.1 Chapter Summary

The MWRA's wastewater collection system is a complex network of conduits and facilities that is strongly influenced by seasonal and wet weather conditions. The system average daily flow is approximately 360 mgd, minimum dry weather flow is approximately 260 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 275.5 miles of sewer pipelines (18.1 miles of cross-harbor tunnels, 227 miles of gravity sewers, 20 miles of force mains, 7 miles of siphons, and 3.4 miles of CSO and emergency outfalls); 13 pump stations; one screening facility; six CSO treatment facilities; and four remote headworks facilities.

In this Chapter, MWRA's 20 collection system pump stations and CSO facilities are detailed. Two additional MWRA CSO facilities (under construction) are not included in the 2006 Wastewater Master Plan, these include: (1) CSO MWR019 Storage Conduit and Dewatering Pump Station and (2) North Dorchester Bay CSO Storage and Pump Facilities. These facilities should be added in a future update.

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. The primary function of a combined sewer overflow (CSO) facility is to treat 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. 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. CSO facilities also operate only during wet weather. 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 replacement asset value of the pump stations and CSO facilities is $370 million (6% of wastewater system asset value). See detail on Wastewater Infrastructure Replacement Asset Value in Section 3.7. The facilities are detailed within the Chapter Section noted below:

10.3 Alewife Brook Pump Station
10.4 Braintree/Weymouth Replacement Pump Station
10.5 Caruso Pump Station
10.6 Chelsea Screen House
10.7 DeLauri Pump Station
10.8 Framingham Pump Station
10.9 Hayes Pump Station
10.10 Hingham Pump Station

10.11 Hough's Neck Pump Station
10.12 Intermediate Pump Station
10.13 New Neponset Valley Sewer Pump Station
10.14 Prison Point Pump Station and Pumped CSO Facility
10.15 Quincy Pump Station
10.16 Squantum Pump Station
10.17 Wiggins - Castle Island Terminal Pump Station
10.18 Commercial Point Gravity CSO Facility
10.19 Cottage Farm Pumped CSO Facility
10.20 Fox Point Gravity CSO Facility
10.21 Somerville Marginal Gravity CSO Facility
10.22 Union Park CSO Facility
10.23 Braintree Howard Street Pump Station

The average age of MWRA's 20 collection system facilities is 17 years. Only five of the 20 facilities are more than 20 years old. The oldest pump station, Alewife Brook in Somerville, is 55 years old. Two of MWRA's CSO facilities are 35 years old: the Cottage Farm Pumped CSO Facility and the Somerville Marginal Gravity CSO Facility. MWRA's newest facilities include two that are in the final stages of construction: the Braintree/Weymouth Replacement Pump Station in Quincy and the Union Park CSO Facility in Boston. Three facilities have come on-line in the last five years: Intermediate Pump Station (2005) in Weymouth, Squantum Pump Station (2003) in Quincy, and Quincy Pump Station (2002) in Quincy.

Overall, the 20 collection system facilities are in very good condition. Significant automation upgrades are being implemented under MWRA's Wastewater Central Monitoring/SCADA Implementation Project (see Chapter 12). The CSO facilities have undergone upgrades under the CSO Control Plan and two of the stations (Commercial Point and Fox Point) are scheduled to be decommissioned in 2008 following completion of sewer separation projects. The highest priority immediate needs for wastewater pump stations and CSO facilities are small scale equipment rehabilitation/replacement projects being implemented under the existing CIP asset protection project and recommended additions to this project for improvements at Alewife and Framingham Pump Stations and the Chelsea Screen House. Also a high priority is the creation of annual baseline target expenditures for asset protection projects for all wastewater facilities (headworks, pump stations, and CSOs). As specific small scale rehabilitation/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.

Similar to the Headworks Condition Assessment/Facilities Plan project, a Pump Station and CSO Condition Assessment/Facilities Plan project for the ten older facilities is recommended for the FY10-12 timeframe. This planning project is recommended to be completed within the same timeframe as the small scale/high priority facility projects. The Facility Plan project will review the adequacy of existing equipment and facility systems (electrical, HVAC, etc.) and provide recommendations based upon the latest/alternative technology to produce a prioritized list of design/construction projects that will be scheduled over the next 15 year period (FY14-28).

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, $343.6 million in projects is identified in the 40-year master plan timeframe (FY07-48). Two projects ($17.45 million) are currently programmed in the FY07 CIP. Ten additional projects ($326.15 million) are recommended for inclusion in the FY08 CIP. Section 10.26 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $17.45 million is currently programmed in the CIP (FY07-11):
  - $13.745 million to complete the Braintree-Weymouth Relief Facilities Project.
  - $3.705 million to complete asset protection projects at seven facilities: Alewife Brook (pumps and screens replacement), Caruso (generator and shaft replacement), Chelsea Screen House (sluice gate study), Cottage Farm (HVAC upgrades and pipe improvements), Framingham (sluice gate assessment), Hingham (isolation gate construction), and Prison Point (HVAC upgrades and pipe improvements).
- $13.15 million in needs is identified for FY09-13 and recommended for inclusion in the FY08 CIP:
  - $2 million for additional costs for the Alewife Brook Pump Station pump improvements to augment the funds already in the FY07 CIP.
  - $100,000 for design of Chelsea Screen House sluice gate rehabilitation.
  - $2.05 million for improvements at the Framingham Pump Station including $1.5 million for force main corrosion and odor control improvements, $500,000 for sluice gate replacement, and $50,000 to automate the screenings process.
  - $3 million for a condition assessment/facilities plan contract for the 10 older pump stations and CSO facilities.
  - $6 million to begin (first three years at $2 million per year for FY11-13) a systematic annual asset protection program for equipment rehabilitation/replacement at all wastewater facilities.

Mid-term (FY14-18):

- $78 million in needs is identified for FY14-18 and recommended for inclusion in the FY08 CIP:
  - $400,000 for construction of Chelsea Screen House sluice gate rehabilitation.
  - $100,000 to automate the screenings process at the Framingham Pump Station.
  - $60 million to design and construct the first half of upgrades to the 10 older wastewater pump station and CSO facilities as recommended from the Condition Assessment/Facilities Plan project.

  - $17.5 million to continue a systematic annual asset protection program for equipment rehabilitation/replacement at all wastewater facilities (five years at $3.5 million per year for FY14-18).

Long-term (FY19-28 and FY29-48):

- $235 million in needs is identified for FY19-28 and FY29-48 and recommended for inclusion in the FY08 CIP:
  - $60 million for FY19-28 to design and construct the second half of upgrades to the 10 older wastewater pump station and CSO facilities as recommended from the Condition Assessment/Facilities Plan project.
  - $35 million for FY19-28 and $70 million for FY29-48 to continue ($3.5 million per year) a systematic annual asset protection program for equipment rehabilitation/replacement at all wastewater facilities.
  - $70 million for FY29-48 to plan, design and construct future upgrades to the 8 newer wastewater pump station and CSO facilities.

10.2 Facilities Overview

The MWRA wastewater collection system includes 13 pump stations, one screening facility, and six CSO treatment facilities. The location of each facility is shown on Figure 10-1. The service area tributary to each pump station is shown on Figure 10-2. Key information on each pump station and CSO facility is provided in Table 10-1.

Management of pump stations and CSO facilities is the responsibility of the Field Operations Department. The Field Operations Department is a subset of the Operations Division under the oversight of the Chief Operating Officer. Key collection system supervisory staff reporting to the Director, Field Operations include: Director, Wastewater Operations and Maintenance; Manager, Wastewater Operations; and Senior Program Manager, Metro Trades.

<u>Operation and Maintenance</u>: There is no dedicated staff at any MWRA pump stations or CSO facilities. A total of about 38 staff are employed in roving crews for operation and maintenance. Operations data are scanned via mini computer at facilities and downloaded to a central computer. All system scans that produce abnormal readings are checked by area 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 Field Operations 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. During the day shift (7 am – 3 pm) the facilities are split into two areas. Area 1 consists of the following facilities: Alewife Brook PS, Caruso PS, Chelsea Screen House, Cottage Farm Pumped CSO Facility, DeLauri PS, Hayes PS, Prison Point PS and Pumped CSO

Figure 10-1:

MWRA Pump Stations, CSO Facilities & Screen House By Year Constructed

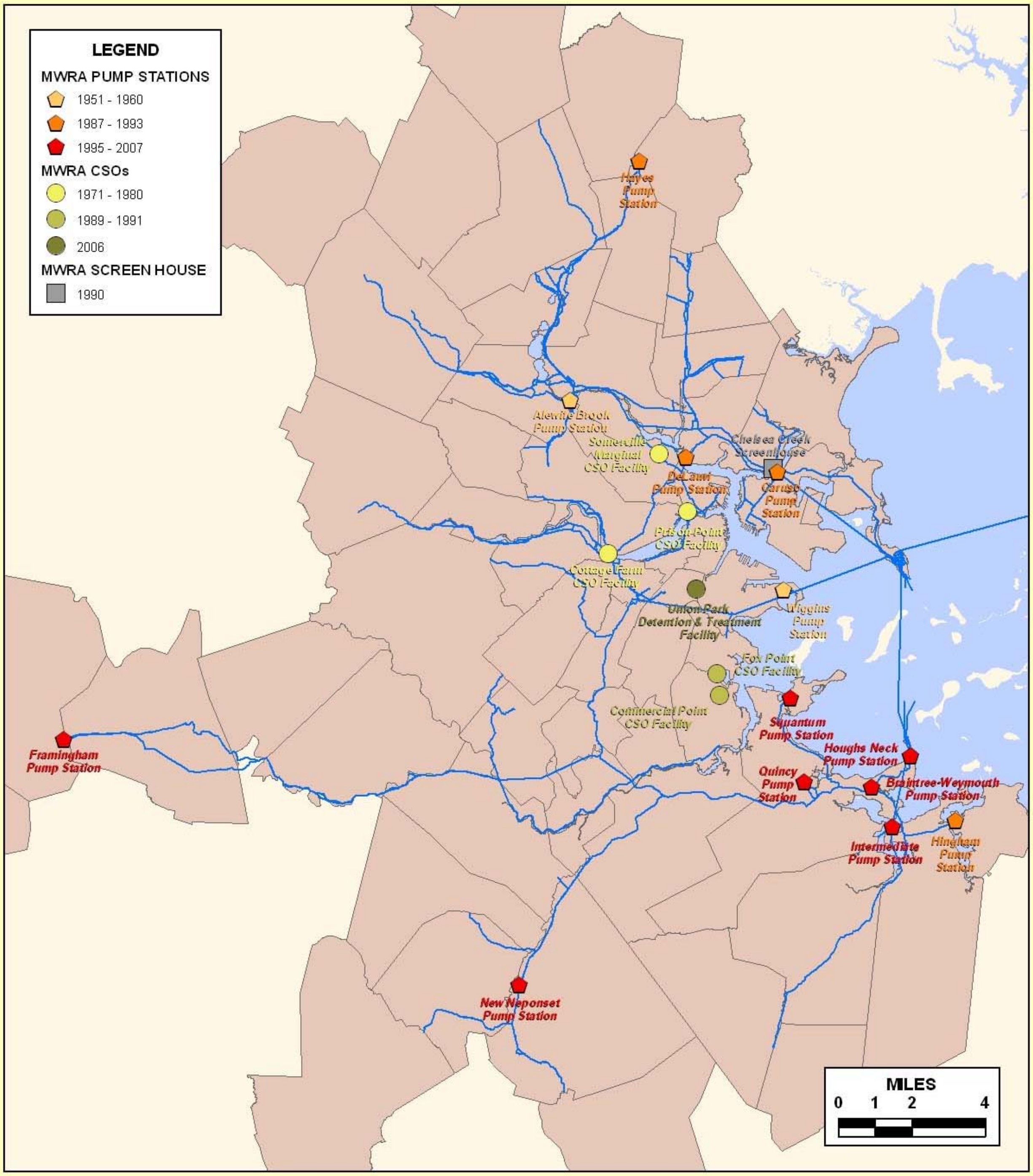


Figure 10-2:

Pump Station Service Areas

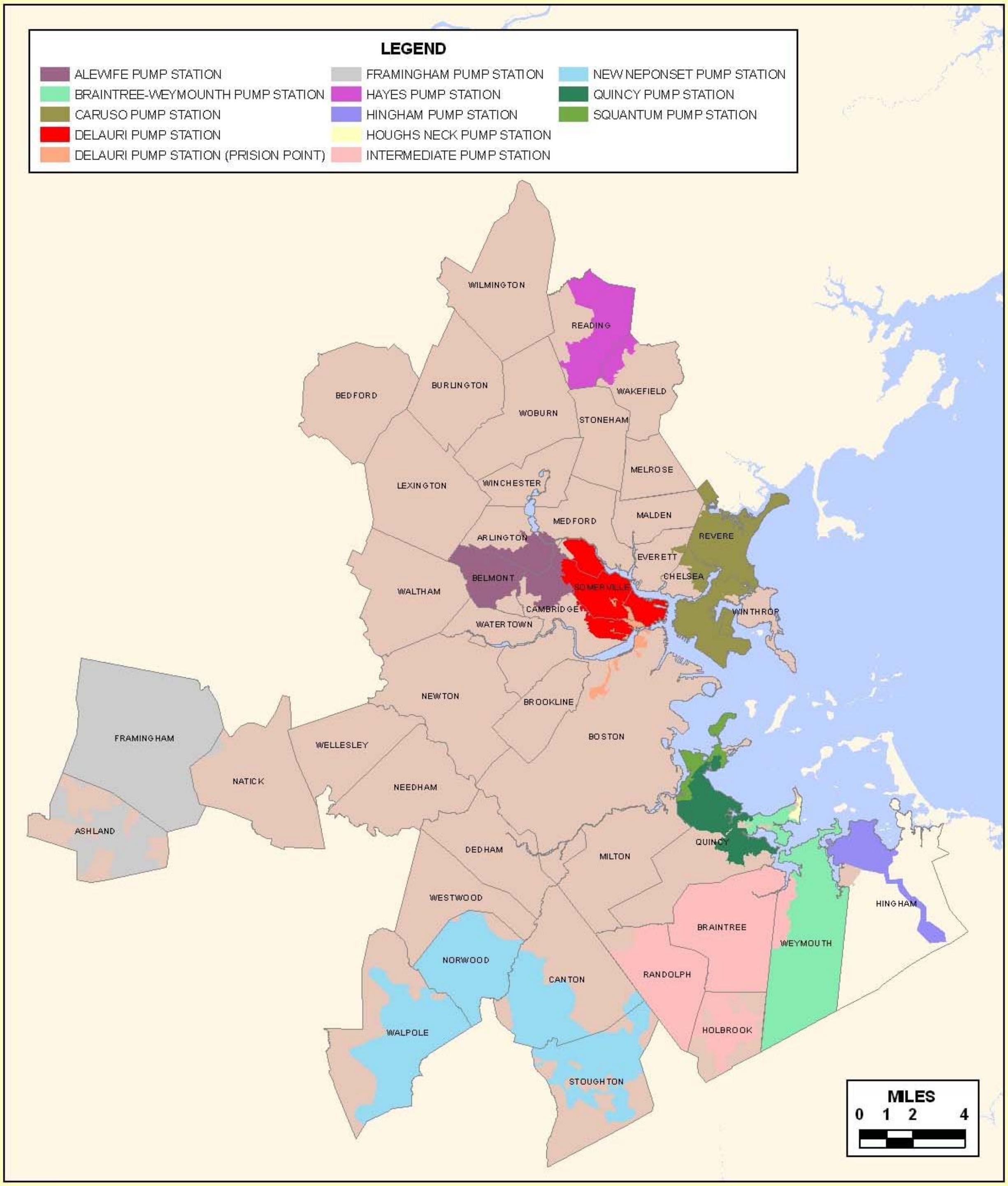


Table 10-1

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	9.8	60	1951	Alewife Brook Sewer & Conduit, Belmont & Lexington Branch Sewers, Millbrook Valley & Relief Sewers, Mystic Valley Sewer & North Metro & Cummingsville Branch Reflief Sewers & Reading & Wilmington Relief Sewers
Braintree/Weymouth Replacement Pump Station Quincy	8.5	28	2007 (1937)	Braintree-Weymouth Extension Sewer & Hingham Pump Station
Caruso Pump Station East Boston	18	80-125	1991	Revere Extension Sewer, Chelsea Branch Sewer, East Boston Branch Sewer & East Boston Local Sewers
Chelsea Screen House Chelsea	12	32	1990	Revere Extension Sewer & Chelsea Branch Sewer
DeLauri Pump Station Charlestown	31	93	1993	Somerville/Medford Branch Sewer, Cambridge Branch Sewer & North Charles Relief Sewer
Framingham Pump Station Framingham	N/A	28	1998	Ashland & Framingham Local Sewers
Hayes Pump Station Wakefield	3	9	1987 (1921)	Reading & Wakefield Local Sewers
Hingham Pump Station Hingham	3.5	7	1992 (1957)	Hingham Local Sewers
Hough's Neck Pump Station Quincy	0.5	1.3	1999 (1942)	Quincy Local Sewers
Intermediate Pump Station (IPS) North Weymouth	14.8	45	2005	Braintree-Weymouth Extension Sewer, Randolph Trunk Sewer & Holbrook Extension Sewer
New Neponset Valley Sewer Pump Station Canton	N/A	46	1995	New Neponset Valley Sewer, Stoughton Extension Sewer & Walpole Extension Sewer
Prison Point Pump Station and Pumped CSO Facility Cambridge	PS - 2.5 CSO - N/A	PS - 5 CSO - 323	1980	Cambridge Marginal Conduit, Boston Marginal Conduit, CSO from Charlestown Branch Sewer
Quincy Pump Station Quincy	6	22	2002 (1908)	Quincy Local Sewers
Squantum Pump Station Quincy	1.2	7.5	2003 (1930)	Quincy Local Sewers
Wiggins-Castle Island Terminal Pump Station South Boston	0.1	0.5	1960	Castle Island and Connolly Terminal Sewers

Table 10-1 continued

MWRA Pump Stations and CSO Facilities

Facility/Location	Average Daily Flow (MGD)	Peak Capacity (MGD)	Year Built (Original)	Flow Received From
Commercial Point Gravity CSO Facility Dorchester	N/A	195	1991	Dorchester Local Combined Sewers
Cottage Farm Pumped CSO Facility Cambridge	N/A	233	1971	North and South Charles Relief Sewers
Fox Point Gravity CSO Facility Dorchester	N/A	129	1989	Dorchester Local Combined Sewers
Somerville Marginal Gravity CSO Facility Somerville	N/A	145	1971	Somerville-Medford Branch Sewer and Somerville Local Combined Sewers
Union Park CSO Facility South End, Boston	N/A	300 (BWSC PS)	2007	South End Local Combined Sewers

Facility, and Somerville Marginal Gravity CSO Facility. Area 2 includes: Commercial Point Gravity CSO Facility, Fox Point Gravity CSO Facility, Framingham PS, Hingham PS, IPS, New Neponset Valley Sewer PS, Quincy PS, and Squantum PS. The staff is split into four teams, with two teams per area. Teams rotate every two weeks. Staff rove through Area facilities 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.

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.).

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 a nearby receiving water. 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 facilities are designed to treat these overflows by screening out debris (for floatables control), providing disinfection to destroy pathogens, and dechlorinating the flow before it enters the receiving water. The gravity CSO facilities are designed for unattended, automatic start-up when the wastewater flow reaches a preset level. When a storm event is over and flow into the gravity CSO facility has ended, the facility automatically shuts down and resets itself to await the next storm. If staffing allows, CSO facilities are often manned during activations. There are two pumped CSO facilities: Prison Point and Cottage Farm. Both facilities need to be staffed and manually activated during a wet weather event

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. 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. 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 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 work hours dedicated to preventive maintenance activities. Operations roving crews travel from facility to facility using a handheld monitoring device to perform daily checks of equipment. This information is integrated into a database for use with MWRA's MAXIMO work order system. The MAXIMO computerized maintenance management system captures 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. Maintenance backlog varies from as low as two weeks for essential work orders and up to six months for low priority work. 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: There are three ongoing in-house tasks related to the pump station and CSO facilities being performed by MWRA staff:

- For the Alewife Pump Station, new screen parts have been purchased and are scheduled to be installed by MWRA crews.
- For the DeLauri Pump Station, butterfly valve replacement is being performed by MWRA crews.
- For the Hayes Pump Station, pumps are being replaced during FY06-07 by MWRA crews.

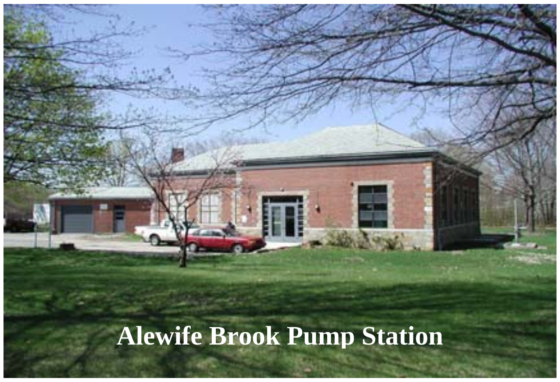
There are four additional in-house tasks related to the pump station and CSO facilities recommended to be completed by MWRA staff:

- Staff should review/update SOPs, as needed, for all facilities.
- Staff should update the 2002 Equipment and Operational Summary for Wastewater Transport Facilities.
- The 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 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.
- Staff should implement an in-house task to evaluate/assess all decommissioned facilities and all facilities that may have historical significance. A prioritized list of action items and schedule required for facility reuse or surplus to DCAM should be developed. This project may require use of as-needed consultants.

Service Contracts: 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;
- High voltage maintenance;
- HVAC pneumatic controls maintenance;
- Hydraulics maintenance;
- Instrumentation maintenance;
- Overhead door maintenance; and,
- Pump variable frequency drive maintenance.

10.3 Alewife Brook Pump Station


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: 9.8 mgd
- Peak Capacity: 60 mgd

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 Alewife Brook Pump Station is served by both combined and separate sewers. Continued sewer separation in Somerville and Cambridge should reduce the amount of stormwater 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 (VFD) on pump 2, 3, and 4. This work was accomplished under Contract 5302 in 1992. The second upgrade was the replacement of the mechanical bar screen system, update of the HVAC system, and replacement of the facility's windows and doors under contract 5330, all completed in 1996. A third facility upgrade was the replacement of the transformer station, completed in 2001.

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 12 mgd), four electric motors, two electric sluice gates (downstream of the bar screens), wet well bubbletube depth meter, wet well ultrasonic level indicator, effluent flow meter 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 gradeline 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 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 the Alewife Brook. MWRA's CSO Control Plan addresses these CSO discharges (see Chapter 11).

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.

Standard Operating Procedures (SOPs): The Station SOP was developed in 1992 and updated in 2002.

Force Main: Section 155, 24-inch diameter cast iron pipe, 168 feet long, built in 1948.

Record Drawings: Accession Numbers 200260-200272, 52452, 200440-200465, 603437.

Condition Assessment and Ongoing Upgrades: The Alewife Brook Pump Station (1951) is the oldest of the 20 MWRA facilities reviewed in this Chapter. The station is in fair condition with the most urgent equipment upgrades being addressed in projects programmed in the FY07 CIP (detail below). The station structure is outdated and could be reconfigured for more efficient operation and maintenance. New screen parts have been purchased and are planned to be installed by MWRA crews during fall 2006. The goal of this upgrade is to keep the existing screens running until they are replaced. MWRA's Wastewater Engineering Department has recently completed (August 2006) a Draft Conceptual Design Report for Pump and Screen Replacement. The final version of the report will be the basis for a professional design services contract procurement. The schedule for this project calls for design services to begin in July 2007 and construction to begin in 2008/9. Also, the station's number 4 (dry weather flow) pump is being replaced under the SCADA Facility Upgrade Pump 4 Contract 6355. The Pump 4 upgrade is currently planned for July 2007.

Projects in the Existing FY07 CIP:

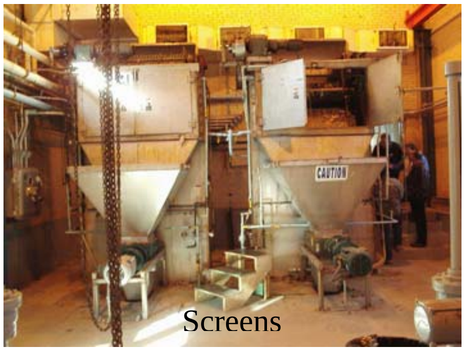
- The Interceptor and Pumping Facility Asset Protection Project includes the following subphases:
  - Alewife Pump Station design of pump replacement, $150,000, FY08-10;
  - Alewife Pump Station construction of pump replacement, $450,000, FY09-10;
  - Alewife Pump Station design of screen replacement, $100,000, FY07-09; and,
  - Alewife Pump Station construction of screen replacement, $400,000, FY08-09.


Pump

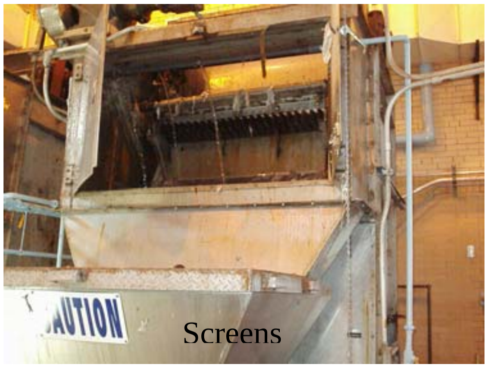

Motor

Projects Recommended for Consideration in the FY08 CIP:

- Existing upgrades to the Alewife Brook Pump Station being implemented under the asset protection project are estimated to require an additional $2 million. These funds are recommended to be added to the CIP during the FY09-13 timeframe with a 4 year project duration.
- The Alewife Brook Pump Station should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: replace influent and effluent sluice gates at $250,000; replace pumps and motors at $1 million; replace 5 ton bridge crane; replace generator; evaluate existing HVAC; and replace doors/windows/roof.



Screens


Screens

10.4 Braintree/Weymouth Replacement Pump Station

- Address: 27 Kilby St., Quincy, MA
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 8.5 mgd
- Peak Capacity: 28 mgd

Facility Function and Operation: The Braintree/Weymouth Replacement Pump Station is currently under construction and is scheduled to be completed in 2007. This facility replaces the original Braintree/Weymouth Pump Station built in 1937. The facility 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, North Weymouth, and all of Hingham. The entire tributary area consists of separate sanitary sewers. Wastewater flow to the upstream Intermediate Pump Station (IPS) can be diverted to flow to the Braintree/Weymouth Pump Station.

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 Power: The primary electrical power is from local commercial service. A diesel generator (750 KW) provides backup power.

Standard Operating Procedures (SOPs): To be prepared in 2007/2008.

Force Main: Section 622, 36-inch diameter ductile iron pipe, 34 feet long, constructed in 2007.

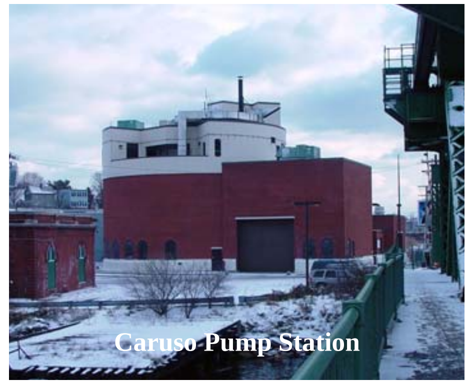
Record Drawings: To be prepared in 2007/2008.

Condition Assessment and Ongoing Upgrades: The Braintree/Weymouth Replacement Pump Station is scheduled to be complete in 2007. No immediate upgrades are anticipated.

Projects Recommended for Consideration in the FY08 CIP:

- The Braintree/Weymouth Replacement Pump Station should be included in a project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.5 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: 18 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 portions of Chelsea, Everett, Revere and East Boston. The majority of the tributary area is comprised of separate sanitary sewer systems, but approximately 12 percent of the tributary sewers carry combined sanitary and stormwater flows. The pump station receives flow from the East Boston Branch Sewer and Low Level Sewer. It is designed to receive flow from the Chelsea Branch Sewer and the Revere Extension Sewer via the Chelsea Screen House and Dry Weather Siphon. In addition, the station is designed to receive overflow from the Chelsea Creek Headworks via the Wet Weather Siphon. 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.

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. If the 50 mgd pumps are required (only during very large storm events) they are brought on-line manually.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (800 KW) provides backup power.

Standard Operating Procedures (SOPs): An O&M manual was prepared in 1991.

Force Main: Section 223, 84-inch diameter reinforced concrete pipe, 227 feet long, constructed in 1985.

Record Drawings: Accession Numbers 201,921 through 201,935 and 227,193 through 227,212.

Condition Assessment and Ongoing Upgrades: The Caruso Pump Station (1991) is near average age for MWRA facilities and is approaching the 20 year old milestone. The station is in good condition with no major operational problems and no ongoing upgrades. It is anticipated that equipment may begin to have operational problems after the 20 year useful life span is passed. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe.

Projects in the Existing FY07 CIP:

- The Interceptor and Pumping Facility Asset Protection Project includes the following subphases:
  - Caruso Pump Station construction of generator replacement, $250,000, FY10; and,
  - Caruso Pump Station construction of shaft replacement, $425,000, FY10-11.

Projects Recommended for Consideration in the FY08 CIP:

- The Caruso Pump Station should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: replace doors/windows/roof and replace pumps.

10.6 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. The facility screens sewage before it flows to the Chelsea Creek Siphons, which transport sewage to the Caruso Pumping Station. Screening removes large debris that could damage Caruso Station pumps or accumulate and plug 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 and Revere Extension Sewers and discharges into the Chelsea Creek Siphon for transport to Caruso Pump Station. During peak flow (wet weather) operation, flow diverted from the Chelsea Creek Headworks is transported to the Chelsea Screen House, where it is screened and discharged into the Chelsea Creek Siphon for transport to the Caruso Pumping Station.

Facility Components: Major facility components include: seven hydraulic sluice gates and four mechanical bar screens.

Hydraulic Performance: No problems.
Facility Power: The primary electrical power is from local commercial service. No backup power exists.

Standard Operating Procedures (SOPs): An SOP should be developed.

Record Drawings: Accession Numbers 9740-9783, 600968-9.

Condition Assessment and Ongoing Upgrades: The Chelsea Screen House (1990) is near average age for MWRA facilities and is approaching the 20 year old milestone. The station is in good condition with the no major operational problems other than the sluice gates, which are being reviewed under an ongoing study. The Chelsea Screen House Energy Study is also being conducted. It is anticipated that equipment will begin to have operational problems after the 20 year useful life span is passed. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe.

Projects in the Existing FY07 CIP:

- The Interceptor and Pumping Facility Asset Protection Project includes the following subphase:
  - Chelsea Screen House sluice gate study, $43,000, FY07.

Projects Recommended for Consideration in the FY08 CIP:

- The Chelsea Screen House should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: evaluate existing HVAC; replace screens; replace doors/windows/roof; and provide backup power.
- A design/construction project to rehabilitate the sluice gates at the Chelsea Screen House is recommended at an estimated cost of $500,000 with a project duration of 3 years. The project is recommended for the FY09-18 timeframe.

10.7 DeLauri Pump Station

- Address: 172 Alford Street, Charlestown
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 31 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, one automatic bar screen, one venturi meter, and one wet well bubbletube depth meter.

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. In the event that the Chelsea Creek Headworks is required to choke flows, coordination with the DeLauri Pump Station is necessary. Pump throttling may be required to prevent excessive pressure surges in the downstream gravity system that could cause surcharging. 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. This project is a $150,000 2 year planning study to evaluate increasing and optimizing system capacity during peak flow conditions and is included in the FY07 CIP (see Chapter 9).

Facility Power: The primary electrical power is from local commercial service. A diesel generator (600 KW) provides backup power.

Standard Operating Procedures (SOPs): An O&M manual was prepared in 1993.

Force Main: Section 25, 60-inch diameter poured-in-place concrete pipe, 285 feet long, built in 1989.

Record Plans: Accession Numbers: 9,785 through 9,844.

Condition Assessment and Ongoing Upgrades: The DeLauri Pump Station (1993) is below average age for MWRA facilities and is will be approaching the 20 year old milestone in a few years. The station is in good condition with the no major operational problems. It is anticipated that equipment will begin to have operational problems after the 20 year useful life span is passed. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe. The following upgrades are ongoing:

- Under the Transport SCADA Implementation project, instrumentation and electrical upgrades are planned and the facility VFD will be evaluated and, if appropriate, replaced. Screenings grinders will also be evaluated and installed, if appropriate.

- Replacement of butterfly valves is ongoing as an in-house task.

Projects Recommended for Consideration in the FY08 CIP:

- The DeLauri Pump Station should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: evaluate existing HVAC; replace screens; replace sluice gates; replace pumps and motors; and replace doors/windows/roof.

10.8 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 facility pumps wastewater from upstream community-owned sewers to the FERS that connects to the Wellesley Extension Sewer and the High Level Sewer and ultimately flows to the Nut Island Headworks. The tributary area includes all of Framingham and Ashland and is served by a separate sanitary sewer system. 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: two diversion chamber influent automatic sluice gates, two mechanical bar screens, three pumps, three electric motors, one diversion chamber outlet automatic sluice gate, two influent flow meters (a Palmer-Bowlus Flume meter located at the influent diversion chamber and a sonic flow meter located in the influent channel), a wet well bubbletube depth meter, an effluent flow meter, a surge arrestor 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, 23,661 feet of 36-inch diameter pre-cast concrete cylinder pipe with embedded T-Lock lining, constructed in 1999.

Record Drawings: Accession Numbers 200,854 through 200,911.

Condition Assessment and Ongoing Upgrades: The Framingham Pump Station (1998) is less than 10 years old and is in good to excellent 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 are scheduled to be constructed under the Transport SCADA Implementation project.

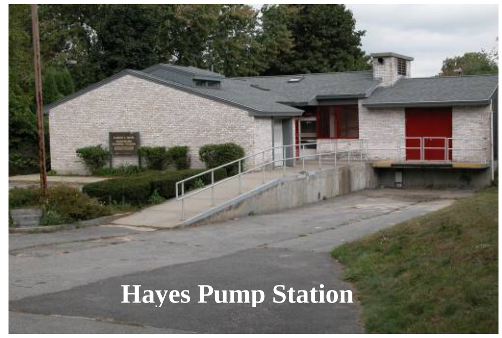
Projects in the Existing FY07 CIP:

- The Interceptor and Pumping Facility Asset Protection Project includes the following subphase:
  - Framingham Pump Station sluice gate assessment, $43,000, FY07.

Projects Recommended for Consideration in the FY08 CIP:

- Modifications at the Framingham Pump Station for force main corrosion and odor improvements (previously under the proposed Odor and Corrosion Control Contract) include pump station automation and optimization improvements, FES flow meter modifications, automation of the force main filling, and modifications to the chemical feed facilities. This planning/design/construction project is estimated at $1.5 million with a 3 year project duration. The project is recommended for the FY09-13 timeframe.
- Framingham Pump Station design/construction for replacement of three 48-inch sluice gates due to excessive hydrogen sulfide corrosion, estimated at $500,000 with a 2 year project duration. The project is recommended for the FY09-13 timeframe.
- Framingham Pump Station study/design/construction for automation of the screenings process, estimated at $150,000 with a 3 year project duration. The project is recommended for the FY09-18 timeframe.
- The Framingham Pump Station should be included in a project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.9 Hayes Pump Station



- Address: 100 Redfield Road, Wakefield
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 3.0 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 upstream community-owned sewers to 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 entire 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 effluent electric sluice gates, a wet well bubbletube depth meter, and an effluent flow meter.

Hydraulic Performance: 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.

Facility Power: 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.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 1987.

Force Main: Section 205, 2329 feet of 20-inch diameter ductile iron pipe, constructed in 1984.

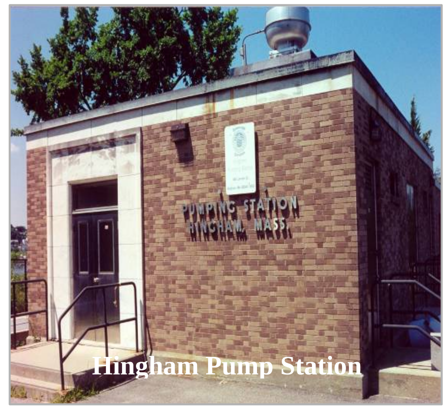
Record Drawings: Accession numbers 9,535 through 9,552 and 200,428 through 200,429.

Condition Assessment and Ongoing Upgrades: The Hayes Pump Station (1987) is near average age for MWRA facilities and is approaching the 20 year old milestone. The station is in good condition with no major operational problems. Ongoing upgrades include the replacement of the three station pumps by MWRA crews using CEB funds. One pump was replaced during FY06, one has been replaced in FY07, and the third pump will be replaced in the future. It is anticipated that other station equipment will begin to have operational problems after the 20 year useful life span is passed. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe.

Projects Recommended for Consideration in the FY08 CIP:

- The Hayes Pump Station should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: replace sluice gates; replace screens; replace pumps and motors; and replace doors/windows/roof.

10.10 Hingham Pump Station



Hingham Pump Station

- Address: 463 Lincoln Street, Hingham
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 3.5 mgd
- Peak Capacity: 7 mgd

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 entirely 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: two comminutors, three 4.85 mgd pumps, three electric motors, a wet well bubble tube depth meter, and an effluent flow meter.

Hydraulic Performance: No problems. Currently, only a stop log chamber is available to isolate the station. Construction of an influent isolation gate is planned to allow the station to be shut down during maintenance.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (200 KW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 1992.

Force Main: Section 661 and 662, 7923 feet of 20-inch diameter ductile iron force main, constructed under two separate contracts in 1984 and 1990.

Record Plans: Accession Numbers 9,586 through 9,604b.

Condition Assessment and Ongoing Upgrades: The Hingham Pump Station (1992) is near average age for MWRA facilities and is approaching the 20 year old milestone. The station is in good condition with no major operational problems and no ongoing upgrades. It is anticipated that equipment will begin to have operational problems after the 20 year useful life span is passed. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe. Although the station structure is relatively new, cracks in the facility may indicate a foundation problem. This situation is being monitored by Field Operations staff and should be highlighted in the proposed condition assessment study. Construction of an influent isolation gate is planned to allow the station to be shut down during maintenance. Currently, only a stop log chamber is available to isolate the station.

Projects in the Existing FY07 CIP:

- The Interceptor and Pumping Facility Asset Protection Project includes the following subphase:
  - Hingham Pump Station construction of isolation gate, $350,000, FY08.

Projects Recommended for Consideration in the FY08 CIP:

- The Hingham Pump Station should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: replace doors/windows/roof and pumps.

10.11 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: 0.5 mgd
- Peak Capacity: 1.3 mgd


Hough's Neck Pump Station

Facility Function and Operation: The Hough's Neck Pump Station was originally built in 1942 and completely rebuilt by MWRA in 1999. This facility lifts wastewater from upstream community-owned sewers in 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 manual sluice gate, one automatic grinder unit, one backup manual bar screen, two submersible pumps, a wet well ultrasonic depth meter, and an effluent flow meter.

Hydraulic Performance: No problems.

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, 40-feet of 10-inch diameter ductile iron pipe, constructed in 1998.

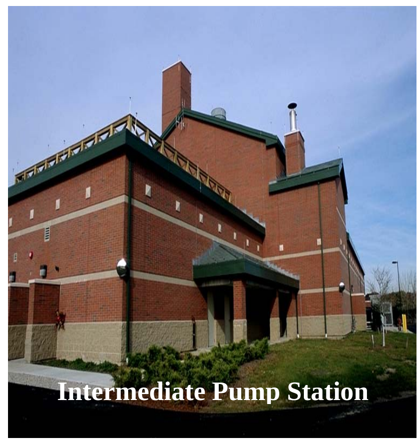
Record Drawings: Accession Numbers 202474-202499.

Condition Assessment and Ongoing Upgrades: The Hough's Neck Pump Station (1999) is less than 10 years old and is in excellent condition. There are no operational problems with no immediate upgrades anticipated.

Projects Recommended for Consideration in the FY08 CIP:

- The Hough's Neck Pump Station should be included in a project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.12 Intermediate Pump Station (IPS)



- Address: 50 Bridge Street, North Weymouth
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 14.8 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 Weymouth, Braintree, Holbrook, Randolph and a small portion of Quincy via a 60-inch interceptor in North Weymouth, and through two 36-inch siphons (across the Fore River). The tributary area is served by separate sanitary sewers. 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, 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, and the 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 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. In the Braintree/Weymouth Tunnel, the 42-inch force main continues for approximately 2 miles and discharges into the Inter-Island Tunnel.

Record Drawings: To be completed in 2006/2007.

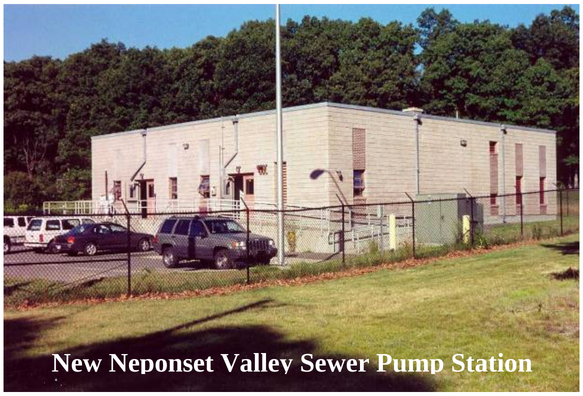
Condition Assessment and Ongoing Upgrades: The Intermediate Pump Station (2005) is new and is in excellent condition. There are no operational problems with no immediate upgrades anticipated.

Projects Recommended for Consideration in the FY08 CIP:

- The Intermediate Pump Station should be included in the project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.13 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 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, one strap-on polysonics ultrasonic flow meter, one ultrasonic diversion chamber level sensor, and one differential pressure 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 discharges to the lower reaches of the New Neponset Valley Sewer near the connection to the High Level Sewer. 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.

Standard Operating Procedures (SOPs): An O&M manual was prepared in 1995.

Force Main: Sections 675, 676, and 676A, 21,406 feet of 48-inch diameter ductile iron pipe, constructed in 1992.

Record Drawings: Accession Numbers 200,587 through 200,635.

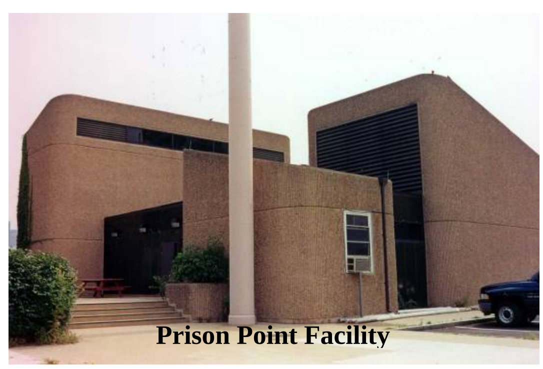
Condition Assessment and Ongoing Upgrades: The New Neponset Valley Sewer Pump Station (1995) is 11 years old and in good to excellent condition. There are no operational problems and no ongoing upgrades.

Projects Recommended for Consideration in the FY08 CIP:

- The New Neponset Valley Sewer Pump Station should be included in the project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.14 Prison Point Pump Station and Pumped CSO Facility

- Address: 1 Monsignor O'Brien Highway, Cambridge
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 2.5 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



Prison Point Facility

Facility Function and Operation: The Prison Point Pump Station and Pumped CSO Facility was built in 1980 and a major upgrade of the facility was completed by MWRA in 1999. During normal (dry weather) flow conditions, wastewater collected in the Cambridge Marginal Conduit and Boston Marginal Conduit is pumped from the facility into the Charlestown Branch Sewer via an 18-inch force main 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 the Cambridge Marginal Conduit and Boston Marginal Conduit, as well as overflow from a regulator on the Charlestown Branch Sewer (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 and grinders, six 200,000 gallon sedimentation/detention tanks, two 2.5 mgd dry weather flow pumps, four 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 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.

Dry Weather Force Main: Section 198, 2,322 feet of mostly 18-inch diameter reinforced concrete pipe, constructed in 1974-1977.

Wet Weather Force Main: Section 199, 2,208 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 Ongoing Upgrades: The Prison Point Pump Station and Pumped CSO Facility (1980) is about seven years older than the average age for MWRA facilities and is beyond the 20 year old milestone for equipment useful life. The station is in fair to good condition. Some of the Station’s equipment has been upgraded and there are no major operational problems other than HVAC and piping defects that are scheduled for upgrade in the FY07 CIP. It is anticipated that other station equipment will begin to have operational problems. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe.

Projects in the Existing FY07 CIP:

- The Interceptor and Pumping Facility Asset Protection Project includes the following subphases:
  - Prison Point Pump Station and Pumped CSO Facility design of HVAC upgrades, $150,000, FY08-10;
  - Prison Point Pump Station and Pumped CSO Facility construction of HVAC upgrades, $694,000, FY09-10;
  - Prison Point Pump Station and Pumped CSO Facility/Cottage Farm CSO Facility design of pipe improvements, $150,000, FY08-09; and,
  - Prison Point Pump Station and Pumped CSO Facility/Cottage Farm CSO Facility construction of pipe improvements, $500,000, FY09.

Projects Recommended for Consideration in the FY08 CIP:

- The Prison Point Pump Station should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: replace pumps.

10.15 Quincy Pump Station

- Address: 41 Fenno St. Quincy
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 6 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 Power: The primary electrical power is from local commercial service. A diesel generator (500KW) provides backup power.

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 - 600,766.

Condition Assessment and Ongoing Upgrades: The Quincy Pump Station (2002) is new and is in excellent condition. There are no operational problems with no immediate upgrades anticipated.

Projects Recommended for Consideration in the FY08 CIP:

- The Quincy Pump Station should be included in the project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.16 Squantum Pump Station

- Address: 36 Newland Street, North Quincy
- Location Map: See Figure 10-1
- Tributary Area Map: See Figure 10-2
- Average Daily Flow: 1.2 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 500 acre tributary area 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 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; 4,583 feet of 24-inch diameter ductile iron pipe, constructed in 1969 and rehabilitated with cured-in-place liner in 1995; 8,111 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 most corroded sections; 6,307 feet of 30-inch diameter prestressed concrete cylinder pipe, constructed in 1970. Cathodic protection was installed on the 8,111 foot portion of ductile iron pipe in 2002/2003.

Record Drawings: Accession Numbers 203,154 through 203,205.

Condition Assessment and Ongoing Upgrades: The Squantum Pump Station (2003) is new and is in excellent condition. There are no operational problems with no immediate upgrades anticipated.

Projects Recommended for Consideration in the FY08 CIP:

- The Squantum Pump Station should be included in the project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.17 Wiggins - Castle Island Terminal Pump Station

- Address: Connoly 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 Connoly Terminal Sewer and discharges flow to a local BWSC sewer on Day Boulevard. Wastewater from this station is tributary to the Columbus Park Headworks. The tributary area is a small portion of South Boston that includes Department of Conservation and Recreation facilities on Castle Island and Massport facilities at Connoly Terminal.
Facility Components: Major facility components include: two 350 gpm pumps and a manual screen.

Hydraulic Performance: No problems.

Facility Power: The primary electrical power is from local commercial service. No backup power is provided.

Standard Operating Procedures (SOPs): There is no written SOP for this facility.

Force Main: The 8-inch diameter force main is relatively short and connects to a local BWSC sewer.

Record Drawings: Accession numbers 201,668 and 42,260 through 42,263.

Condition Assessment and Ongoing 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 most urgent problem is pumps in need of replacement, which may be performed as an in-house CEB project during FY07 or FY08. The station structure is very small and outdated. The entire facility should be evaluated for upgrade or replacement.

Projects Recommended for Consideration in the FY08 CIP:

- The Wiggins - Castle Island Terminal Pump Station should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project.

10.18 Commercial Point Gravity CSO Facility

- Address: 50 Park St., Dorchester
- Location Map: See Figure 10-1
- Average Daily Flow: N/A – only operated during peak (wet weather) flow
- Peak Capacity: 195 mgd

Facility Function & Operation: The Commercial Point Gravity CSO Facility was built in 1991. The facility is designed to provide screening and disinfection to combined sewer overflows prior to discharge to the Commercial Point Outfall (permitted outfall BOS090). The facility currently services approximately 880 acres of combined and separate sanitary sewer. BWSC is in the process of performing sewer separation within the tributary area. Design and operation of this facility is similar to the Fox Point Gravity CSO facility. The facility has been designed for unattended, automatic start-up when storm events cause flow to enter the facility and exceed a predetermined minimum flow (15 mgd). When the storm is over and inflow into the CSO facility drops below 5 mgd, the facility is designed to automatically shutdown and reset to await the next storm. Sewer separation in Dorchester, being implemented by BWSC under MWRA's long-term CSO Control Plan, will allow MWRA to decommission the Commercial Point Gravity CSO Facility and the associated remote sodium bisulfite facility in 2008.

Facility Components: Major facility components include: a diversion stop log chamber, two (influent and effluent) electric screen channel sluice gates, one automatic bar screen, three 3000 gallon hypochlorite storage tanks, two 2,000 gallon sodium bisulfite storage tanks, a chemical feed system, two 450 gpm submersible dewatering pumps, and one ultrasonic flow meter.

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 tributary to BWSC's Dorchester Interceptor under dry weather conditions. Choking at the Columbus Park Headworks may cause backwater conditions that result in a reduction in the Dorchester Interceptor's capacity, which can increase overflow to the Commercial Point Gravity CSO Facility. Upstream of the facility, a local area near Park Street has experienced flooding in the past. Tidal conditions at the outfall discharge can increase or decrease the facility's available hydraulic capacity.

Facility Power: The primary electrical power is from local commercial service. A diesel generator (200 KW) provides backup power.

Standard Operating Procedures (SOPs): The facility SOP was last updated in 1991.

Force Main: N/A – Commercial Point Gravity CSO is a gravity facility.

Record Drawings: Accession Numbers 10673 – 10701.

Condition Assessment and Ongoing Upgrades: The Commercial Point Gravity CSO Facility (1991) is in good to excellent condition. There are no onging upgrades.

Projects Recommended for Consideration in the FY08 CIP:

- None. The Commercial Point Gravity CSO Facility will be decommissioned in 2008.

10.19 Cottage Farm Pumped CSO Facility


Cottage Farm

- 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)

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 combined sewer overflows 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 (Brookline Overflow) was constructed but never connected to the Charles River Valley Sewer as designed. After 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 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 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 one flow meter.

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 due to limited capacity in the Boston Main Drainage Tunnel or pumping problems at Deer Island Treatment Plant results in increased overflow to the Cottage Farm Pumped CSO Facility.

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 2001.

Force Main: N/A 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 24-inch diameter detention tank drains are gravity flow to the North/South Charles Relief Sewer.

Record Drawings: Accession Numbers 54,813 through 54,886, 203,308 through 203,393, and 601,860 through 601,866.

Condition Assessment and Ongoing Upgrades: The Cottage Farm Pumped CSO Facility (1971) is almost twice the average age for MWRA facilities and is well beyond the 20 year old milestone. The station remains in good condition, much of the stations equipment has been upgraded and there are no major operational problems and no ongoing upgrades. Piping problems are scheduled for upgrade in the FY07 CIP. It is anticipated that other station equipment will begin to have operational problems as it continues to age. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe.

Projects in the Existing FY07 CIP:

- The Interceptor and Pumping Facility Asset Protection Project includes the following subphases:
  - Prison Point/Cottage Farm Pumped CSO design of pipe improvements, $150,000, FY08-10; and,
  - Prison Point/Cottage Farm Pumped CSO construction of pipe improvements, $500,000, FY09.

Projects Recommended for Consideration in the FY08 CIP:

- The Cottage Farm Pumped CSO Facility should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's ten older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project.

10.20 Fox Point Gravity CSO Facility

- Address: 170 Freeport St., Dorchester
- Location Map: See Figure 10-1
- Average Daily Flow: N/A – only operated during peak (wet weather) flow
- Peak Capacity: 129 mgd

Facility Function and Operation: The Fox Point Gravity CSO Facility was built in 1989. The facility is designed to provide screening and disinfection to combined sewage and stormwater runoff prior to discharge to the Fox Point Outfall (primary discharge - permitted outfall BOS089) or the Malibu Beach Outfall (secondary discharge – permitted outfall BOS088). The facility currently services approximately 385 acres of combined and separate sanitary sewer area. BWSC is in the process of performing sewer separation within the tributary area. Design and operation of this facility is similar to the Commercial Point Gravity CSO Facility. The facility has been designed for unattended, automatic start-up when rainstorms cause flow to enter the facility and exceed a predetermined minimum flow (15 mgd). When the storm is over and inflow into the CSO facility drops below 5 mgd, the facility is designed to automatically shutdown and reset to await the next storm. Sewer separation in Dorchester, being implemented by BWSC under MWRA's long-term CSO Control Plan, will allow MWRA to decommission the Fox Point Gravity CSO Facility and the associated remote residual chlorine sampling and control facility in 2008.

Facility Components: Major facility components include: a diversion stop log chamber, two (influent and effluent) electric screen channel sluice gates, one automatic bar screen, two 4000 gallon hypochlorite storage tanks, two 2000 gallon sodium bisulfite storage tanks, chemical feed system, two 375 gpm submersible dewatering pumps, and one ultrasonic flow meter.
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 tributary to BWSC's Dorchester Interceptor under dry weather conditions. Choking at the Columbus Park Headworks may cause backwater conditions that result in a reduction in the Dorchester Interceptor's capacity, which can increase overflow to the Fox Point CSO Facility.

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 2002.

Force Main: N/A – Fox Point Gravity CSO is a gravity facility.

Record Drawings: Accession Numbers 10299 – 10317.

Condition Assessment and Ongoing Upgrades: The Fox Point Gravity CSO Facility (1989) is in good to excellent condition. There are no ongoing upgrades.

Projects Recommended for Consideration in the FY08 CIP:

- None. The Fox Point Gravity CSO Facility will be decommissioned in 2008.

10.21 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. The facility is designed to provide screening and disinfection to combined sewer overflows prior to discharge to the Mystic River via outfall MWR205. The facility serves to prevent excessive surcharge and possible flooding in the upstream East Somerville community system. The tributary area is approximately 700 acres of combined and separate sanitary sewers (about 50 percent of each). The station is activated when the hydraulic gradeline at the McGrath Highway overflow weir is exceeded. Flow entering the CSO facility receive screening and disinfection (chlorination and dechlorination) prior to being discharged by gravity to the 7.5x10-foot outfall conduit that receives additional stormwater from downstream systems. CSO discharges either occur downstream of the Amelia Earhart Dam, through permitted outfall MWR205, during low tides; or upstream of the dam (outfall MWR205A) during high tide. The facility is deactivated when the depth of flow entering the facility falls below elevation 104.5 feet.

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, and one effluent flow meter.

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 outfall MWR205 (downstream of the Earhart Dam) under mid to low tides, or through outfall MWR205A (upstream of the Earhart Dam) under mid to high tides. Mean high water downstream of the dam is approximately 110 feet, but can rise to approximately 115 feet during extreme tides or storm surges. The normal elevation of the Mystic River Basin is approximately 107-feet. The two CSO outfall discharges provide operational flexibility and allow the gravity facility to continue to function under high tides.

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 2003.

Force Main: N/A – Somerville Marginal Gravity CSO is a gravity facility.

Record Drawings: Accession Numbers 10280 – 10295.

Condition Assessment and Ongoing Upgrades: The Somerville Marginal Gravity CSO Facility (1971) is almost twice the average age for MWRA facilities and is well beyond the 20-year old milestone. The main station building remains in fair to good condition. There are no major operational problems and no ongoing upgrades. The separate chemical storage and remote sampling buildings are new and in excellent condition. Piping problems are scheduled for upgrade in the FY07 CIP. It is anticipated that other station equipment will begin to have operational problems due to the age of the facility. The station should be included in a project to assess equipment replacement and upgrades during the FY09-13 timeframe.

Projects Recommended for Consideration in the FY08 CIP:

- The Somerville Marginal Gravity CSO Facility should be included within the Pump Station and CSO Condition Assessment/Facilities Plan project recommended for the FY09-13 timeframe. This project would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for MWRA's older pump stations and CSO facilities. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. The assessment should include items recommended for replacement in the 1997 Sewerage Division Plan: replace screens and doors/roof. Also the project should ensure that river water backflow problem noted in 2002 report has been corrected.

10.22 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

Facility Function and Operation: The Union Park CSO Facility is currently under construction and will be completed 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. Flows will pass through the new CSO treatment facility before entering the existing pumping station wet well. The new CSO facility is designed to run automatically and will include coarse screens, fine screens, chlorination with sodium hypochlorite, dechlorination with sodium bisulfite and odor control equipment. A new building will be constructed adjacent to the existing BWSC Union Park Pump Station to house the new CSO treatment equipment. New underground detention basins, which will have a combined storage capacity of 2.2 million gallons, are intended to reduce the number of pumping station discharges to the Fort Point Channel, detain flows that exceed the storage capacity in larger storms, and allow a level of solids removal. Flows retained in the detention basin will be pumped to an existing BWSC sewer in Malden Street when capacity becomes available after a storm event.

Facility Components: Major facility components include: six detension basins, two coarse screens, four fine screens, six 250 gpm dewatering pumps, odor control equipment, and flushing gates.

Hydraulic Performance: N/A, The facility is under construction.

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 will be developed in 2007/8.

Force Main: The 10-inch diameter ductile iron pipe is 22 feet long and connects to an existing BWSC sewer on Malden Street. The discharge line will be owned and maintained by BWSC.

Record Drawings: To be completed in 2007/2008.

Condition Assessment and Ongoing Upgrades: The Union Park CSO Facility is under construction and should be complete in 2007. This is a new facility and no immediate upgrades are anticipated.

Projects Recommended for Consideration in the FY08 CIP:

- The Union Park CSO Facility should be included in a project to assess equipment replacement and upgrades during the second 20 years of the Master Plan (FY29-48).

10.23 Braintree Howard Street Pump Station

MWRA, through agreement with the Town of Braintree, 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 the Braintree 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 are 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 have negotiated and drafted a successor Agreement to the 1990 Agreement; however, as of December 2006, the draft successor agreement remained in review by the Town of Braintree.

MWRA In-House Task:

- The 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 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 Historical Structures

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 historical significance of older structures may impact MWRA's decision making. A summary is provided in this section.

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.

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. The property was surplused to DCAM in June 2002.

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. The building is national register eligible. The property was surplused to DCAM in 2004. Easement rights were retained for MWRA Sewer Section 37.5 in East Boston.

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 Pump Station. The building is on the National Register. MWRA's future need and use of this property is uncertain and should be determined.

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 surplused 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.

MWRA In-House Task:

- The MWRA should implement an in-house task to evaluate/assess all decommissioned facilities and all facilities that may have historical significance. A prioritized list of action items and schedule required for facility reuse or surplus to DCAM should be developed. This task may require use of as-needed consultants.

10.25 Reinvestment Needs Based on Estimated Replacement Asset Value

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. Staff estimate that MWRA's eighteen pump stations and CSO facilities have a replacement asset value of $366 million in 2006 dollars. Note that the Commercial Point and Fox Point CSO Facilities have been eliminated from this analysis because they are scheduled to be decommissioned in 2008. 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 $12 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 the pump stations and CSO facilities, staff recommend allocating $2.0 million per year (about 17 percent of the pump station and CSO facility overall estimated reinvestment need) to a long-term Sewerage Facilities Asset Protection Project. Based on other recommendations made in this Chapter, the need for long-term asset protection funds for the pump stations and CSO facilities will begin in FY11. The long-term Sewerage Facilities Asset Protection Project is recommended as a consolidated project for rehabilitation/replacement tasks for all (non-treatment) wastewater facilities (including headworks, pump stations and CSO facilities). This project is recommended here, as well as, in Chapter 8 – Collection System Remote Headworks and Cross-Harbor Tunnels (see Section 8.13). The recommended CIP funds are carried forward as a Chapter 10 recommendation. Asset protection for sewers is handled as a separate recommended project (see Chapter 9).

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 detailed 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.

Projects in the Existing FY07 CIP:
There are two pump station and CSO facility related projects programmed in the FY07 CIP. The projects are described below and summarized in Table 10-2 (see line numbers 10.1 and 10.2).

- Completion of the Braintree/Weymouth Relief Facilities project is included in the FY07 CIP at $13.745 million for expenditure through FY08.

- The following projects are in the FY07 CIP, all as subphases under the existing Interceptor and Pumping Facility Asset Protection Project (total of $3.705 million):
  - Alewife Pump Station design of pump replacement, $150,000, FY08-10;
  - Alewife Pump Station construction of pump replacement, $450,000, FY09-10;
  - Alewife Pump Station design of screen replacement, $100,000, FY07-09;
  - Alewife Pump Station construction of screen replacement, $400,000, FY08-09;
  - Caruso Pump Station construction of generator replacement, $250,000, FY10;
  - Caruso Pump Station construction of shaft replacement, $425,000, FY10-11;
  - Chelsea Screen House sluice gate study, $43,000, FY07;
  - Framingham Pump Station sluice gate assessment, $43,000, FY07;
  - Hingham Pump Station construction of isolation gate, $350,000, FY08;
  - Prison Point Pump Station and Pumped CSO Facility design of HVAC upgrades, $150,000, FY08-10;
  - Prison Point Pump Station and Pumped CSO Facility construction of HVAC upgrades, $694,000, FY09-10;
  - Prison Point Pump Station and Pumped CSO Facility/Cottage Farm CSO Facility design of pipe improvements, $150,000, FY08-09; and,
  - Prison Point Pump Station and Pumped CSO Facility/Cottage Farm CSO Facility construction of pipe improvements, $500,000, FY09.

MWRA's ongoing Wastewater Central Monitoring - SCADA project includes work at some of the pump stations and CSO facilities. The SCADA project is detailed in Chapter 12. There are three separate SCADA construction contracts that will be completed during FY07-09 with additional expenditures of over $15 million during the 3 year period. Additional upgrades at some of the pump station and CSO facilities are being performed as part of the SCADA project, these include:

- For the Alewife Pump Station, installation of one new pump under the SCADA Facility Upgrade Pump 4 Contract 6355, currently planned for July 2007.

- For the DeLauri Pump Station, instrumentation and electrical upgrades are ongoing and evaluation of the facility's variable frequency drive and screenings grinders is planned.

- For the Framingham Pump Station, instrument automation improvements are planned.

<u>Projects Recommended for Consideration in the FY08 CIP:</u> There are ten pump station and CSO facility related projects recommended for consideration in the CIP. These projects are described below and summarized in Table 10-2 (see line numbers 10.3 to 10.11).

- Existing upgrades to the Alewife Brook Pump Station being implemented under the asset protection project are estimated to require an additional $2 million. These funds are recommended to be added to the CIP during the FY09-13 timeframe with a 4 year project duration.

- A design/construction project to rehabilitate the sluice gates at the Chelsea Screen House is recommended at an estimated cost of $500,000 with a project duration of 3 years. The project is recommended for the FY09-18 timeframe.

- Modifications at the Framingham Pump Station for force main corrosion and odor improvements (previously under the proposed Odor and Corrosion Control Contract) include pump station automation and optimization improvements, FES flow meter modifications, automation of the force main filling, and modifications to the chemical feed facilities. This planning/design/construction project is estimated at $1.5 million with a 3 year project duration. The project is recommended for the FY09-13 timeframe.

- Framingham Pump Station design/construction for replacement of three 48-inch sluice gates due to excessive hydrogen sulfide corrosion, estimated at $500,000 with a 2 year project duration. The project is recommended for the FY09-13 timeframe.

- Framingham Pump Station study/design/construction for automation of the screenings process, estimated at $150,000 with a 3 year project duration. The project is recommended for the FY09-18 timeframe.

- A Pump Station and CSO Condition Assessment/Facilities Plan project is recommended at an estimated cost of $3 million and a 3 year duration. This project is recommended for the FY10-12 timeframe. This project would be similar to the Headworks Condition Assessment/Facilities Plan project. It would provide professional engineering services (via an RFQ/P process) including facilities planning, design review, inventory, evaluation, identification and prioritization of rehabilitation/replacement projects and operational processes for ten older pump stations and CSO facilities. The ten older pump station and CSO facilities to be included in the condition assessment/facilities plan are: Alewife Brook, Caruso, Chelsea Screen House, DeLauri, Hayes, Hingham, Prison Point, Wiggins - Castle Island Terminal, Cottage Farm, and Somerville Marginal. The consultant will review the adequacy of existing components and processes and provide recommendations based upon the latest/alternative technology. Information developed by this project will be used by MWRA to produce a list of recommended projects by facility, priority and fiscal year. The eight newer pump station and CSO facilities excluded from the condition assessment/facilities plan are: Braintree/Weymouth Replacement, Framingham, Hough's Neck, IPS, New Neponset Valley, Quincy, Squantum, and Union Park. The Commercial Point and Fox Point CSO Facilities are also excluded because they are scheduled to be decommissioned in 2008.

- Design/construction of upgrades for ten older facilities from recommendations in the Pump Station and CSO Condition Assessment/Facilities Plan project. This project is estimated at $120 million and a 15 year duration during the FY14-28 timeframe. The older pump station and CSO facilities to be included for upgrades are: Alewife Brook, Caruso, Chelsea Screen House, DeLauri, Hayes, Hingham, Prison Point, Wiggins-Castle Island Terminal, Cottage Farm, and Somerville Marginal. The $120 million estimate is based upon: (1) an estimated total replacement asset value of $203 million in 2006 dollars for the ten older pump stations and CSO facilities, (2) 40 percent of the asset value ($82 million) was allocated as equipment (20 year useful life) components and assumed to need replacement during the FY 14-28 time frame, and (3) 60 percent of the asset value ($121 million) was allocated as structural (50 year useful life) components, but only a portion of this total ($38 million) was assumed to need replacement during the FY14-28 timeframe.

- A long-term Wastewater Facilities Asset Protection Project is recommended. This project will provide annual baseline target expenditures for asset protection projects for all wastewater facilities (headworks, pump stations, and CSO facilities). As specific projects are identified, they will become sub-phases within the target expenditure. For the pump station and CSO facilities, the annual baseline expenditure for long-term asset protection is recommended at $2 million per year beginning in FY11. This target expenditure has been combined with the target expenditure for headworks facilities ($1.5 million per year developed in Chapter 8) to produce one recommended asset protection project for all sewerage facilities at $2 million per year for FY11-13 and $3.5 million per year for FY14 and beyond. Costs for the consolidated long-term Wastewater Facilities Asset Protection Project are included within this Chapter and Table 10-2. The costs are not included in Chapter 8 or Table 8-2. Asset protection projects for interceptors and other sewer pipelines are recommended independently of the facilities (see Chapter 9).

- Staff recommend a future anticipated expenditure (budget place holder) of $70 million during the FY29-48 timeframe (20-year duration) for equipment replacement and upgrades at the eight newer facilities not included in initial Pump Station and CSO Condition Assessment/Facilities Plan project. The eight pump station and CSO facilities to be included within this project are: Braintree/Weymouth Replacement, Framingham, Hough's Neck, IPS, New Neponset Valley Sewer, Quincy, Squantum, and Union Park. It is assumed that some of the equipment at the eight newer facilities will be rehabilitated/replaced over time, utilizing funds from the long-term Wastewater Facility Asset Protection Project. The $70 million estimate is based on: (1) an estimated total replacement asset value of $163 million (in 2006 dollars) for the eight newer pump stations and CSO facilities, (2) 40 percent of the asset value ($66 million) was allocated as equipment (20 year useful life) components and assumed to need replacement during the FY 29-48 timeframe, (3) 60 percent of the asset value ($97 million) was allocated as structural (50 year useful life) components, but were assumed to not need replacement during the FY29-48 timeframe (no cost included), and (4) $4 million was estimated for a future facilities plan.

Table 10-2

Wastewater Master Plan - Pump Stations and CSO Facilities

Existing and Recommended Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		WASTEWATER PUMP STATIONS AND CSO FACILITIES											
10.1	**1**	**B/W Relief Facility Completion**	**NF**	**in S104**	**2 years**	**13,745**	**now-FY08**	**13,745**					**13,745**
10.2	**1**	**PS and CSO Facility AP - existing projects at 7 facilities - Alewife Brook, Caruso, Chelsea Screen House, Cottage Farm, Framingham, Hingham, and Prison Point**	**AP**	**in S145**	**5 years**	**3,705**	**now-FY11**	**976**	**2,729**				**3,705**
		SUBTOTAL - Existing - Pump Stations and CSO Facilities				**17,450**		**14,721**	**2,729**				**17,450**
10.3	2	Alewife PS Improvements-Additional Costs to Existing AP Project	AP	new	2 years	2,000	FY09-13		2,000				2,000
10.4	2	Chelsea Screen House Sluice Gate Rehabilitation Design/Construct	AP	new	3 years	500	FY09-18		100	400			500
10.5	3	Framingham PS -Force Main Corrosion and Odor Improvements	NF/AP	new	3 years	1,500	FY09-13		1,500				1,500
10.6	2	Framingham PS Sluice Gate Replacement Design/Construct	AP	new	2 years	500	FY09-13		500				500
10.7	3	Framingham PS Screening Automation Study/Design/Construct	Plan/NF	new	3 years	150	FY09-18		50	100			150
10.8	2	PS and CSO Condition Assessment/Facilities Plan for 10 Older Facilities	Plan	new	3 years	3,000	FY10-12		3,000				3,000
10.9	3	PS and CSO Condition Assessment Facilities Plan Upgrades for 10 Older Facilities Design/Construct	AP	new	10 years	120,000	FY14-23			60,000	60,000		120,000
10.10	3	Long-term Wastewater Facility Asset Protection (for HW, PS & CSO Facilities) \$2.0M per year for FY11-13, \$3.5M per year for FY14-48	AP	new	annual	128,500	FY11-48		6,000	17,500	35,000	70,000	128,500
10.11	4	PS and CSO Future Plan/Upgrades for 8 Newer Facilities	AP	new	20 years	70,000	FY29-48					70,000	70,000
		SUBTOTAL - Recommended - Pump Stations and CSO Facilities				326,150			13,150	78,000	95,000	140,000	326,150
		SUBTOTAL - Existing and Recommended - Pump Stations and CSO Facilities				343,600		14,721	15,879	78,000	95,000	140,000	343,600

CHAPTER 11
COMBINED SEWER OVERFLOW CONTROL PLAN

11.1 Chapter Summary

This chapter reviews the regulatory background and history of MWRA's recommendations for system optimization improvements and a long term control plan to bring Combined Sewer Overflow (CSO) discharges in the metropolitan Boston area into compliance with the Federal Clean Water Act and Massachusetts Water Quality Standards. The recommended plans are described, including project engineering and construction requirements, schedules and required CSO discharge goals. The chapter then reviews the status of work to implement these plans, describes the benefits achieved to date, and discusses future needs. Recommended projects and costs for upgrading existing CSO Facilities are included in Chapter 10 – Collection System Pump Station and CSO Facilities, not in this Chapter.

There are no future MWRA or community managed CSO Control Plan projects recommended for consideration in the CIP. Included within the existing FY07 CIP is a total cost of $460,793,000 for the CSO Control Plan. This total includes existing MWRA managed CSO Control projects ($312,271,000), as well as existing community managed CSO Control projects ($148,522,000). Detail on MWRA and community managed CSO control projects is provided within this chapter. Section 11.9 – Summary of Existing and Recommended Capital Projects includes a consolidated listing of all projects recommended in this chapter.

11.2 Overview of Combined Sewer Overflow (CSO) Control Plan

In 1987, MWRA entered a 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 the communities of Boston, Cambridge, Chelsea and Somerville (the "CSO communities"). Since then, MWRA has conducted site-specific and watershed based planning to meet short-term control requirements pursuant to federal regulations (including EPA Nine Minimum Controls) and to develop a long-term control plan to bring the Boston area CSOs into compliance with the Federal Clean Water Act and State Water Quality Standards. MWRA developed these plans in conformance with federal and state CSO policies and associated guidance documents, which evolved during the nearly 20-year planning period.

EPA's National CSO Policy (effective April 1994) requires CSO permitees to develop and implement a series of system optimization and reporting measures intended to minimize and quantify CSO discharges in the short term with detailed system characterization, easily implemented and less expensive system improvements, and optimized operations and maintenance. In compliance with the policy, MWRA submitted its Nine Minimum Controls compliance documentation by January 1, 1997. While most of the reported compliance measures involve operations, maintenance and regulator functions of MWRA that are funded through the Current Expense Budget, system characterization and hydraulic optimization measures described below were funded through the CIP.

The National Policy also requires permitees to develop and implement a long-term control plan, in accordance with the provisions of the policy. In the CIP, MWRA undertook two major planning efforts: one in the period 1986 through 1990, which produced the 1990 CSO Facilities Plan primarily in accordance with the EPA CSO Strategy of 1989, and a second and final planning effort in 1992-1997, which produced a revised plan for CSO control that conformed to the 1994 Policy.

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 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 incorporated 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. Together with MWRA's and the CSO communities' efforts in the late 1980s and the 1990s to operate and maintain their respective systems more efficiently, these improvements were shown to effectively maximize the system's capacity to control wet weather flows and markedly reduce CSO discharges system-wide. In the period 1988 through 1992, total annual CSO discharge predicted for a typical rain year dropped from 3.3 billion gallons to 1.5 billion gallons, with approximately 51% of the remaining discharge treated at five MWRA CSO screening and disinfection facilities. The Charles River especially benefited from these improvements.

- In 1993-4, MWRA presented a System Optimization Plan ("SOP"), which recommended approximately 160 low cost, easily implemented system modifications 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 about 20 percent.

- MWRA recommended a large set of projects covering a range of control technologies to achieve site-specific CSO control goals based on site-specific and watershed based technology assessments and receiving water impacts and uses. MWRA recommended 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 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. These adjustments and additions responded to regulatory inquiries seeking higher levels of control (i.e. Charles River) or to new information that raised concerns about construction requirements, cost or CSO control performance. A final, comprehensive long-term plan, presented in Table 11-1 and Figure 11-1, was approved by EPA and DEP and accepted by the Federal Court in 2006. MWRA predicts that the long-term plan will further reduce total annual CSO discharge in a typical rain year to 0.5 million gallons (an 85% reduction from the 1988 level), with 94% of the remaining discharge to be treated at four MWRA screening and disinfection facilities.

The CSO project schedules are driven by milestones for design and construction in Schedule Seven of the Federal Court order. Updated project schedules are presented in Table 11-2. The schedules are aggressive and account for project-specific design, permitting and construction requirements. In addition, the program continues to face cost and schedule challenges, including the general uncertainty associated with construction of large tunnels, such as the North Dorchester Bay storage tunnel, and the difficulty in obtaining the necessary wetlands permits to construct a stormwater detention basin that is critical to the implementation of the Alewife Brook CSO plan. Notwithstanding these challenges, MWRA, working in cooperation with the Boston Water and Sewer Commission (BWSC), the Town of Brookline and the City of Cambridge, will continue to manage the CSO program with the goal of controlling project costs and improving upon established schedules where possible.

MWRA commenced implementation of the long-term CSO control plan in 1996. By June 2006, MWRA had completed fifteen of the 35 projects in the plan, and an additional eight projects were in construction. With this level of completion, MWRA achieved significant progress in reducing CSO discharges to Boston Harbor and its tributaries. Together with improvements to MWRA's wastewater system, including the upgraded Deer Island Treatment Plant and associated pump stations, the completed CSO projects have reduced the total annual volume of CSO discharge in a typical rainfall year from 3.3 billion gallons in 1988 to 0.8 billion gallons, a 76% reduction. In addition, 64% of the remaining overflow receives treatment at MWRA's five CSO treatment facilities. While 2015 is the end date for the final component of MWRA's long-term CSO control plan, the bulk of the remaining work is scheduled to be completed well in advance of that date. For example, the North Dorchester Bay CSO project, which is the largest single component of MWRA's CSO program and comprises over half of the remaining budget to be expended is scheduled for completion by May 2011.

The performance of the sewerage system is constantly improving as CSO and non-CSO projects are completed. Updated assessments of the system's hydraulic performance and estimates of CSO discharges based on actual field data are essential to verify the predicted benefits of various CSO-related improvements, to recalibrate the system hydraulic model to reflect updated conditions, and to provide up-to-date information to support continuing CSO design efforts and long-term goal tracking. 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 storms events on an annual basis. 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 other CSO outfalls. The Federal Court schedule requires MWRA to conduct a three-year performance assessment after completing implementation of the CSO plan in 2015 and submit an assessment report by 2020. 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 rain year) Activations	Volume (million gallons)	Projects*	MWRA FY07 Capital Budget ($ million)
Alewife Brook	7	7.29	• Cambridge/Alewife Sewer Separation • MWR003 Gate and Rindge Siphon Relief • Interceptor Connection Upgrades	55.0
Mystic River	1 39 treated @ Somerville Marginal	0.02 64.1	• Somerville Marginal Facility Upgrade • Somerville Baffle Manhole Separation • Hydraulic Relief at BOS017	5.1
Charles River (including Stony Brook and Back Bay Fens)	2 2 treated @ Cottage Farm	6.8 6.3	• Cottage Farm Facility Upgrade • Stony Brook Sewer Separation • Hydraulic Relief at CAM005 • Cottage Farm Brookline Connection and Inflow Controls • Charles River Interceptor Gate Controls • Brookline Sewer Separation • Bulfinch Sewer Separation • MWRA Outfall Closings and Floatables Control	71.6
Inner Harbor (including Chelsea Creek)	6 30 treated @ Prison Point	10.2 335.0	• Prison Point Facility Upgrade Chelsea Trunk Sewer Replacement • Chelsea Branch Sewer Relief • CHE008 Outfall Repairs • BOS019 Storage Conduit • E. Boston Branch Sewer Relief	120.7
Constitution Beach	Eliminated		• Constitution Beach Sewer Separation	3.8
Fort Point Channel	2 17 treated @ Union Park	2.5 71.4	• Union Park Detention/ Treatment Facility • BOS072-073 Sewer Separation and System Optimization	57.3
Reserved Channel	3	1.5	• Reserved Channel Sewer Separation	57.4
North Dorchester Bay	Eliminated		• N. Dorchester Bay Storage Tunnel and Related Facilities • Pleasure Bay Storm Drain Improvements • Morrissey Blvd Storm Drain	262.0
South Dorchester Bay	Eliminated		• Fox Point Facility Upgrade (interim improvement) • Commercial Pt. Facility Upgrade (interim improvement) • South Dorchester Bay Sewer Separation	124.8
Neponset River	Eliminated		• Neponset River Sewer Separation	2.7
Regional			Planning, Technical Support and Land Acquisition	51.4
TOTAL		**505.1**		**811.8**

*Floatables controls are also recommended at all remaining outfalls and are included in the listed projects and capital budget.

Figure 11-1 MWRA Recommended CSO Control Plan and Status of Implementation

Table 11-2 CSO Project Schedules

Project		Commence Design	Commence Construction	Complete Construction
North Dorchester Bay Storage Tunnel and Related Facilities		Aug 97	Aug 06	May 11
Pleasure Bay Storm Drain Improvements		Sep 04	Sep 05	May 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	Jun 10
BOS019 CSO Storage Conduit		Jul 02	Mar 05	Mar 07
Chelsea Relief Sewers	Chelsea Trunk Sewer Relief	Jun 97	Aug 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	Dec 06
CSO Facility Upgrades and MWRA Floatables	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 and Outfall Closings	Jun 96	Mar 99	Mar 00
Brookline Connection and Cottage Farm Overflow Interconn. and Gate		Sep 06	Jun 08	Jun 09
Charles River Interceptor Gate Controls and Additional Connections		Jan 08	Jan 10	Jan 11
Optimization Study of Prison Point CSO Facility		Mar 06	Mar 07	
South Dorchester Bay Sewer Separation		Jun 96	Apr 99	Nov 08
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	Jun 09
Reserved Channel Consolidation Conduit > Sewer Separation		Jul 06	May 09	Dec 15
Bulfinch Triangle Sewer Separation		Nov 06	Nov 08	Jul 13
Brookline Sewer Separation		Nov 06	Nov 08	Jul 13
Somerville Baffle Manhole Separation			Apr 96	Dec 96
Cambridge/Alewife Brook Sewer Separation	CAM004 Outfall and Detention Basin		Oct 07	Oct 09
	CAM004 Sewer Separation	Jan 97	Jul 98	Jan 13
	CAM400 Manhole Separation	Oct 06	Oct 07	Oct 08
	Interceptor Connection Relief/Floatables	Oct 06	Apr 08	Mar 09
	MWR003 Gate and Rindge Ave. Siphon	Jul 09	Nov 10	Jan 12
Region-wide Floatables Control and Outfall Closings		Sep 96	Mar 99	Dec 07

11.3 2006 Federal Court Decision

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 that provides a comprehensive resolution of outstanding issues related to MWRA's CSO program. Under the motion, MWRA will implement its recommended plans for Alewife Brook/Upper Mystic River and East Boston on a defined schedule. MWRA will also undertake limited additional work to further reduce CSO discharges to the Charles River from its Cottage Farm CSO Facility, which was the subject of discussions between EPA and MWRA and related investigations by MWRA since MWRA first issued its long-term control plan in 1997. The estimated cost of this additional Charles River work is approximately $20 million, and it is expected to reduce CSO discharges from Cottage Farm to 2 activations and 6.3 million gallons in a typical rain year, from the previous goal of 6 activations and 23.6 million gallons. The scope, milestones and performance goals of other CSO projects remain unchanged.

The Federal Court ordered schedule contained three unmet milestones related to completion of the CSO control plans for Alewife Brook/Upper Mystic River, East Boston, and region-wide floatables control and outfall closings. The accepted joint motion and the Schedule Seven it created replaces these with new milestones and adds milestones for the revised Charles River CSO control plan. The revised milestones extend the completion date for the Alewife Brook/Upper Mystic River CSO control plan from January 2000 to January 2013 and the completion date for the East Boston CSO control plan from September 2005 to June 2010. The recommended CSO control plan for the Charles River would be completed in July 2013.

In exchange for agreeing to implement its revised long-term control plan, MWRA will be issued a series of five (5), three-year water quality variances for the Charles River and Alewife Brook/Upper Mystic River through 2020. As it relates to MWRA, the terms and conditions of all the variances will be limited to the requirements of the Court Order (i.e. that MWRA's responsibility is to implement the long-term control plan contained in the revised Schedule Seven). Finally, along with the joint motion, EPA, DOJ and MWRA filed a second stipulation on responsibility and legal liability for combined sewer overflow control. This stipulation replaces the stipulation entered in 1987 which established MWRA's responsibility to develop and implement a region-wide CSO long-term control plan. The second stipulation states that, once MWRA has implemented the recommended plan and demonstrated that it meets the specified goals for activation frequency and discharge volumes each CSO community will be solely responsible for the CSO outfalls they own and operate. These important conditions provide much greater certainty to the MWRA and its ratepayers relative to the scope and cost of the CSO program through 2020.

11.4 Completed Projects

Somerville Baffle Manhole Separation

The City of Somerville completed this project in 1996 under a financial assistance agreement with MWRA (SOP Agreement), at a total MWRA capital cost of $0.6 million. It involved the replacement of common storm drain and sewer manholes tributary to CSO outfall SOM001 on the Alewife Brook and CSO outfalls SOM006 and SOM007 on the Mystic River. By separating the City's storm drain and sewer systems in these areas, CSO discharges were eliminated at the three outfalls.

CSO Upgrades at Five Facilities: Cottage Farm, Prison Point, Somerville Marginal, Commercial Point, Fox Point and MWRA Floatables Controls and Outfall Closings

MWRA completed these six projects by 2001, at a total capital cost of $22.4 million.

- CSO Facility Upgrades

The facility upgrades involved replacement of the disinfection (sodium hypochlorite) systems, the addition of dechlorination (sodium bisulfite) systems and other facility improvements related to performance, reliability or safety. The Commercial Point and Fox Point upgrades are interim improvements pending completion of the South Dorchester Bay Sewer Separation project in 2008, which will allow MWRA to decommission these two facilities.

- MWRA Floatables Controls and Outfall Closings

In 2000, MWRA closed outfall BOS028 (that discharged to the Charles River via the Millers River), closed outfalls MWR021 and MWR022 (that discharged to the Lower Charles Basin at the Esplanade), and completed floatables controls associated with outfalls MWR018, 019 and 020 (also Lower Charles Basin at the Esplanade).

Constitution Beach Sewer Separation

This project involved sewer separation in a section of East Boston near Constitution Beach, to eliminate CSO discharges at MWRA's Constitution Beach CSO facility (outfall BOS002/ MWR207). The separation work included construction of approximately 14,000 feet of new storm drain. BWSC performed the work with MWRA funding, under the terms of the CSO Memorandum of Understanding and Financial Assistance Agreement (the "MOU and FAA"). Total MWRA capital cost was $3.8 million.

BWSC completed storm drain construction and closed the last remaining CSO regulator in September 2000. MWRA decommissioned the Constitution Beach CSO Facility soon after, and has transferred the site to the control of the Division of Capital Asset Management.

Neponset River Sewer Separation

This project involved sewer separation in the Neponset section of Dorchester, to eliminate CSO discharges to the Neponset River at outfalls BOS093 and BOS095. The separation work included construction of approximately 10,000 feet of new storm drain. BWSC performed the work with MWRA funding, under the MOU and FAA.

BWSC completed storm drain construction and closed the last remaining CSO outfall to the Neponset River in June 2000. BWSC continues to perform downspout disconnections and other work to remove additional stormwater inflow from the sewer system, in order to minimize the risk of surcharging and flooding. MWRA funded the eligible costs of the work completed and continues to fund the remaining inflow removal work, which is scheduled to be completed in FY07. Total MWRA capital cost is $2.7 million.

Hydraulic Relief at CAM005 and Hydraulic Relief at BOS017

MWRA completed construction of these two projects in 2000, at a total capital cost of $2.3 million. These localized hydraulic relief projects reduced CSO discharges at outfall CAM005, which discharges to the Charles River Basin, and at outfall BOS017, which discharges to the Lower Mystic River in Charlestown.

In Cambridge, the 24-inch, 40-foot long dry weather connection between the CAM005 regulator and MWRA's North Charles Metropolitan Sewer, adjacent to Mt. Auburn Hospital, was relieved with a new 54-inch connection. An underflow baffle was installed in the CSO regulator for floatables control.

In Charlestown, 190 feet of 36-inch pipe was installed in Sullivan Square to provide a more direct and larger connection between two BWSC combined sewers and MWRA's Cambridge Branch Sewer, thereby relieving the original dry weather connection and reducing overflows. Floatables control was provided with the installation of an underflow baffle in the CSO regulator. In addition, a 10-foot long restriction between the Charlestown and Cambridge Branch Sewers, adjacent to Sullivan Square, was removed, with the intent of lowering hydraulic grade lines in the Charlestown Branch Sewer during wet weather and possibly relieving CSO overflow conditions upstream, at outfall BOS019.

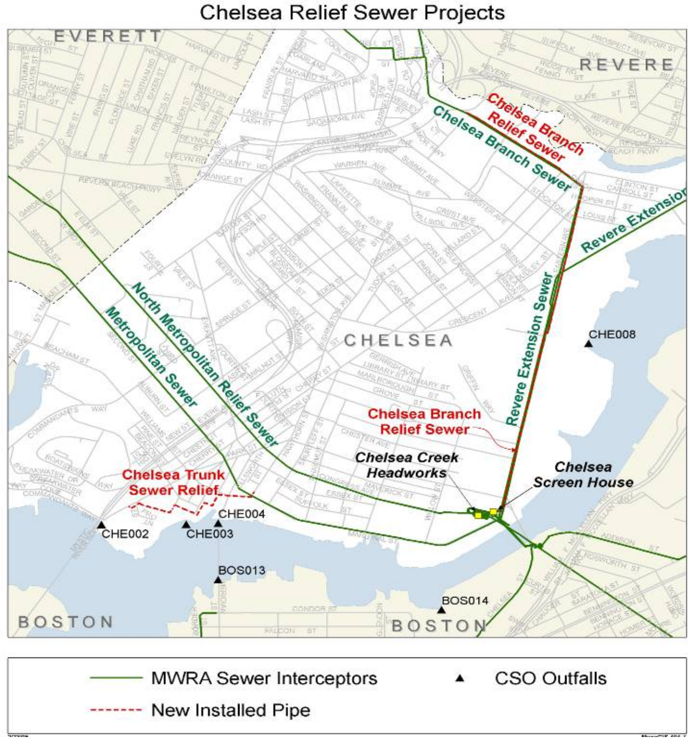
Chelsea Relief Sewers Including Chelsea Trunk Sewer Replacement, Chelsea Branch Sewer Relief, and CHE008 Outfall Repairs

MWRA completed these projects (see Figure 11-2) in 2001, at a total capital cost of $29.8 million.

- Chelsea Trunk Sewer Replacement

MWRA completed this project in 2000. It involved replacing a city-owned trunk sewer in Chelsea with larger pipe, to minimize CSO discharges to the Inner Harbor at outfalls CHE002, CHE003 and CHE004. The existing Chelsea Trunk Sewer, which varied in diameter from 8 to 15 inches, was replaced with 2,300 feet of 30-inch diameter pipe. MWRA also replaced or rehabilitated sections of the CHE002 and CHE003 outfalls. MWRA managed the construction, but the City of Chelsea retains ownership and responsibility for operation and

Figure 11-2
Chelsea Relief Sewer Projects



maintenance of the trunk sewer and the three outfalls.

- Chelsea Branch Sewer Relief

MWRA completed this project in 2001. It involved relieving MWRA's Chelsea Branch Sewer to minimize CSO discharges to Chelsea Creek at outfall CHE008 and reduce surcharging in the upstream transport system. The construction contract also included repairs to the existing CSO outfall at CHE008. MWRA installed 4,200 feet of 42-inch pipe and 3,500 feet of 66-inch pipe along Cabot Street and Eastern Avenue, to replace or relieve MWRA's Chelsea Branch Sewer and Revere Extension Sewer, which lie parallel along Eastern Avenue. The new pipes were constructed primarily using microtunneling methods.

- CHE008 Floatables Control and Outfall Repairs

This project was completed in 2001. The outfall repairs included relining approximately 540 feet of the existing 42-inch outfall pipe, replacing 35 feet of the pipe at its downstream end, replacing the headwall and laying new riprap shore protection. An underflow baffle was installed at the regulator structure associated with this outfall, to provide floatables control.

Pleasure Bay Storm Drain Improvements

MWRA completed this project in March 2006, at a total capital cost of $3.2 million. Shown in Figure 11-3, the construction contract (North Dorchester Bay CP-1) included installation of a new storm drain system surrounding the perimeter of Pleasure Bay and the removal of the old storm drain outfall pipes which discharged to the Pleasure Bay beach area. The new storm drain system redirects stormwater discharges to the Reserved Channel (outfall BOS080) and to a North Dorchester Bay outfall (BOS081) which will eventually be connected to the proposed North Dorchester Bay CSO storage tunnel.

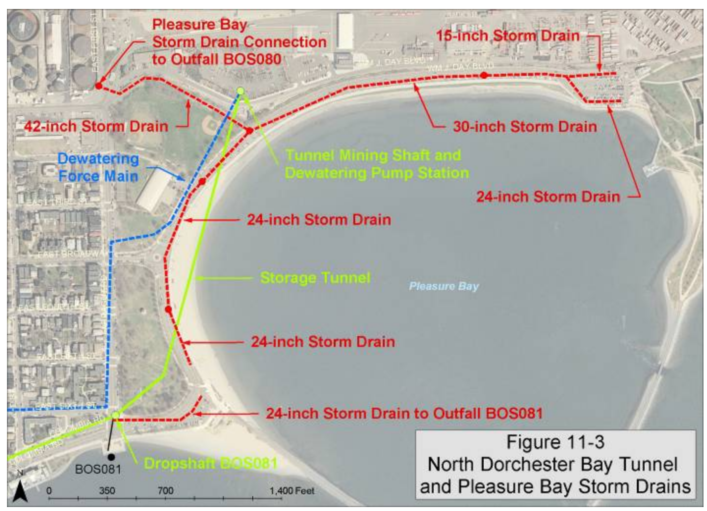


Figure 11-3
North Dorchester Bay Tunnel and Pleasure Bay Storm Drains

MWRA designed and constructed the new drainage system for the Department of Conservation and Recreation. With these improvements, all stormwater discharges to Pleasure Bay beach have been eliminated. The improvements also addressed chronic flooding along parts of Day Boulevard in the Pleasure Bay area. These benefits were the first to be realized by ongoing implementation of MWRA's long-term CSO control plan for the South Boston beaches.

11.5 Ongoing Projects

North Dorchester Bay CSO Storage Tunnel and Related Facilities and Morrissey Boulevard Storm Drain

In April 2004, the MWRA Board of Directors voted to approve a revised recommended plan for CSO control for North Dorchester Bay, and MWRA filed the Supplemental Facilities Plan and Environmental Impact Report ("SFP/EIR") presenting the revised plan. The recommended plan calls for a 25-year-storm level of CSO control (essentially elimination) and a 5-year-storm level of separate stormwater control for the North Dorchester Bay beaches; elimination of stormwater discharges to Pleasure Bay by redirecting them to the Reserved Channel; and a large reduction in CSO discharges to the Reserved Channel, in line with the B(cso) water quality standards designation for the Channel. Components of the recommended plan and MWRA's project schedule are described in Table 11-3 and shown in Figure 11-4.

Table 11-3 Project Elements of North Dorchester Bay CSO Control Plan

COMPONENT	DESCRIPTION	PROJECT SCHEDULE		
		Commence Design	Commence Construction	Complete Construction
North Dorchester Bay Storage Tunnel	11,000-ft. long, 17-ft. diameter soft-ground tunnel with mining shaft and equipment removal shaft Drop shafts, diversion structures and associated piping at CSO outfalls BOS081 to BOS086, including gates to control stormwater	Sep 04	Jul 06	Dec 09
North Dorchester Bay Facilities	15 mgd dewatering pump station at Conley Terminal and 24-inch force main Odor control facility at upstream end of tunnel, near Bayside Exposition Center	Nov 06	Apr 09	May 11
Pleasure Bay Drainage Improvements	Stormwater piping and appurtenances to relocate stormwater discharges from Pleasure Bay to the Reserved Channel	Sep 04	Sep 05	May 06
Morrissey Boulevard Storm Drain	2,900-foot long, 12x12 foot box conduit for stormwater conveyance to Savin Hill Cove/South Dorchester Bay Gated connection to CSO Storage tunnel	Jun 05	Dec 06	Jun 09

Once completed, the project is expected to virtually do away with beach closings resulting from sources associated with the North Dorchester Bay outfalls. These sources are CSO, separate stormwater and illegal sanitary connections to drainage pipes. The project will eliminate CSO discharges except in catastrophic storms (greater than 25-year storm), compared to 21 discharges per year on average today.

With the participation of BWSC and the Department of Conservation and Recreation (DCR), the project includes components to minimize these agencies' separate stormwater discharges to the South Boston beaches. Overall, separate stormwater from BWSC and DCR drainage systems will be discharged only in storms greater than the 5-year design storm, compared to current discharges during every rainstorm (about 100 times per year on average). Stormwater now discharging to the beaches will be tied into the CSO tunnel, and stormwater tributary to Pleasure Bay will be relocated to the less sensitive Reserved Channel. BWSC stormwater discharges from the BOS087 area to Carson Beach will be minimized by redirecting stormwater from larger storms, via a new Morrissey Boulevard drainage conduit, to a non-swimming area of South Dorchester Bay (Savin Hill Cove). It is important to note that MWRA has no statutory or regulatory responsibility for managing separate stormwater and that this project does not set any precedent for MWRA to adopt such responsibilities.

Figure 11-4
North Dorchester Bay and Reserved Channel
Recommended CSO Control Plans

By tying much of the stormwater flows proposed to be diverted from outfall BOS087 at the North Dorchester Bay beaches to the new CSO storage tunnel, this plan minimizes the frequency and volume of new stormwater discharges to Savin Hill Cove, compared to an earlier BWSC/DCR Morrissey Boulevard drainage proposal. Under MWRA's plan, stormwater from the BOS087 outfall area will be captured in the tunnel up to the 1-year design storm, resulting in one diversion discharge per year to Savin Hill Cove, on average, rather than every time it rains, as in the previous proposal.

The estimated capital cost of the recommended plan for North Dorchester Bay, including the tunnel, tunnel-related facilities, Pleasure Bay storm drain improvements and Morrissey Boulevard storm drain, but not including permit, land and easement acquisition costs, is $262 million (FY07 CIP), of which $240 million is for the tunnel and related facilities alone. Permit, land and easement costs for the North Dorchester Bay projects are estimated to total $11 million, which is included in the FY07 CIP budget under CSO Planning and Support.

On June 30, 2005, the Federal District Court accepted a MWRA motion to add several milestones to Schedule Seven for design and construction of the North Dorchester Bay tunnel and facilities, Pleasure Bay storm drain improvements and the Morrissey Boulevard storm drain. The project schedules shown in the table above are consistent with these new milestones. MWRA completed the Pleasure Bay storm drain improvements in March 2006 (see "Completed Projects," above) and issued notice to proceed with construction of the North Dorchester Bay storage tunnel in July 2006.

Under the CSO MOU and FAA, BWSC is implementing the Morrissey Boulevard storm drain project, and MWRA is funding eligible capital costs, which are estimated to be $19.4 million. BWSC plans to commence construction of this project in December 2006.

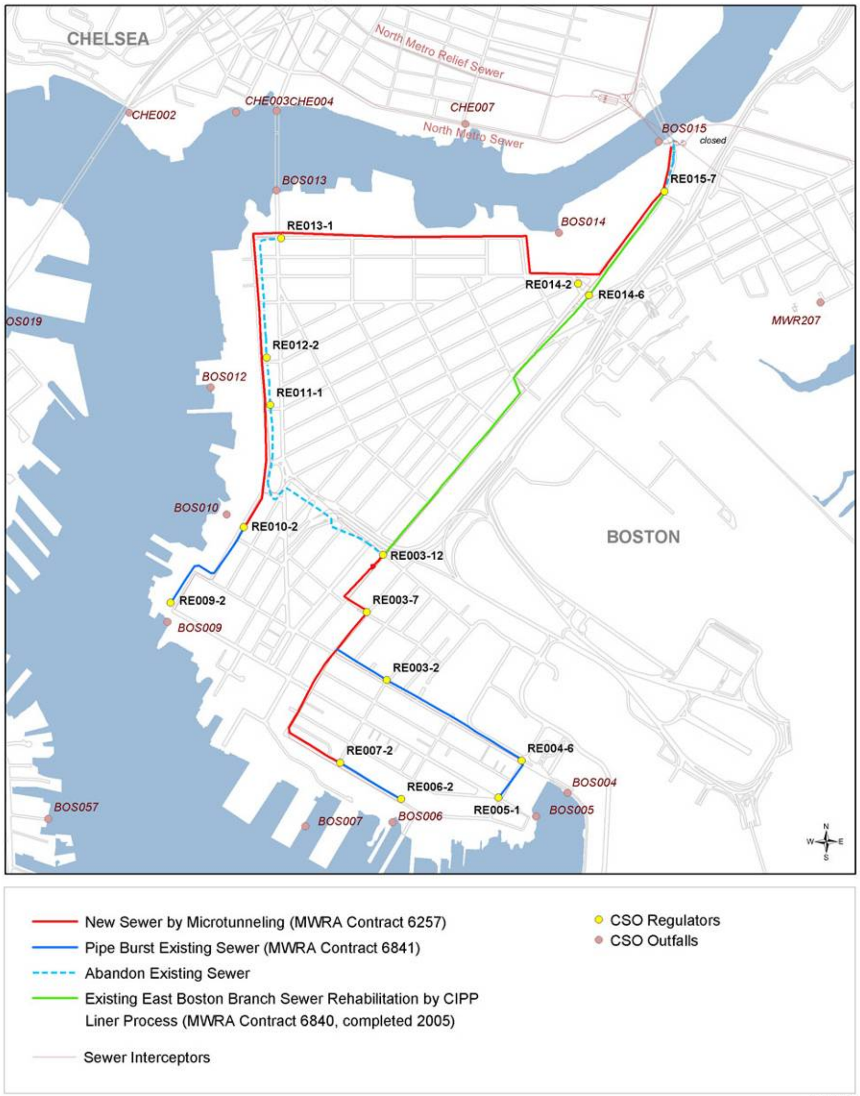
East Boston Branch Sewer Relief

This project (see Figure 11-5, below) calls for relief of the MWRA interceptor system serving most of East Boston, to minimize CSO discharges to Boston Harbor and Chelsea Creek through outfalls BOS003-014. The recommended plan consists of replacing, relieving or rehabilitating approximately 4.5 miles of existing interceptor sewers using a combination of construction methods including microtunneling, pipe bursting, open cut and pipe relining. MWRA issued a Notice to Proceed for design services in March 2000, in compliance with Schedule Seven. Design plans call for three construction contracts to complete the project. MWRA has completed one of the construction contracts, but suspended design work on the other two, when it determined that the original plan would cost twice as much as the estimate in the 1997 Facilities Plan/EIR and would not fully attain the recommended level of CSO control. The reassessment, conducted in 2003 and 2004, involved reevaluating the cost effectiveness of the plan against alternatives that might provide higher benefit and/or cost less.

MWRA completed its reassessment in early 2004. The results confirmed that the current interceptor relief project, at a total estimated capital cost of $72 million, more than twice the cost estimate in the 1997 Facilities Plan/EIR, would reduce CSO discharges from 31 to 6 in a typical year and reduce annual discharge volume from 41 million gallons to 8.6 million gallons, compared to the 1997 plan goals of 5 activations and 4.0 million gallons.

MWRA commenced the first construction contract in March 2003, in accordance with Schedule Seven, and completed the contract in June 2004. This work involved rehabilitating portions of

Figure 11-5 East Boston Branch Sewer Relief Hydraulic Relief Plan



the existing East Boston Branch Sewer with cured-in-place pipe lining to extend the useful life of the sewer and improve its hydraulic capacity. The second construction contract involves installation of a new sewer interceptor along Border, Condor, East Eagle and Chelsea Streets and along Marginal, Orleans and Bremen Streets primarily using microtunneling methods, and the third contract replaces and upgrades interceptors in upstream areas using “pipe bursting” methods, whereby a new, larger pipe is installed in the same place as the smaller existing pipe by pushing through and breaking up the old pipe.

MWRA issued a notice to proceed with final design services on June 15, 2006, in compliance with Schedule Seven. Schedule Seven also requires MWRA to commence the remaining construction work by June 2008 and complete all construction by June 2010.

BOS019 Storage Conduit

MWRA is constructing two 380-foot long, 10'x17' box conduits adjacent to the Tobin Bridge and Chelsea Street in Charlestown to store most of the CSO flows that discharge through outfall BOS019 (see Figure 11-6). The stored flows will be pumped back to the Deer Island transport system after each storm passes and system capacity becomes available.
An aboveground building will house the dewatering equipment and the activated carbon odor control systems which will treat the air that is displaced when the conduit fills with combined sewage. During larger storms that cause overflows that exceed the storage volume of each conduit, system relief will continue to be provided through the existing outfall. For this reason, underflow baffles are being installed within the existing and proposed regulators to provide floatables control.

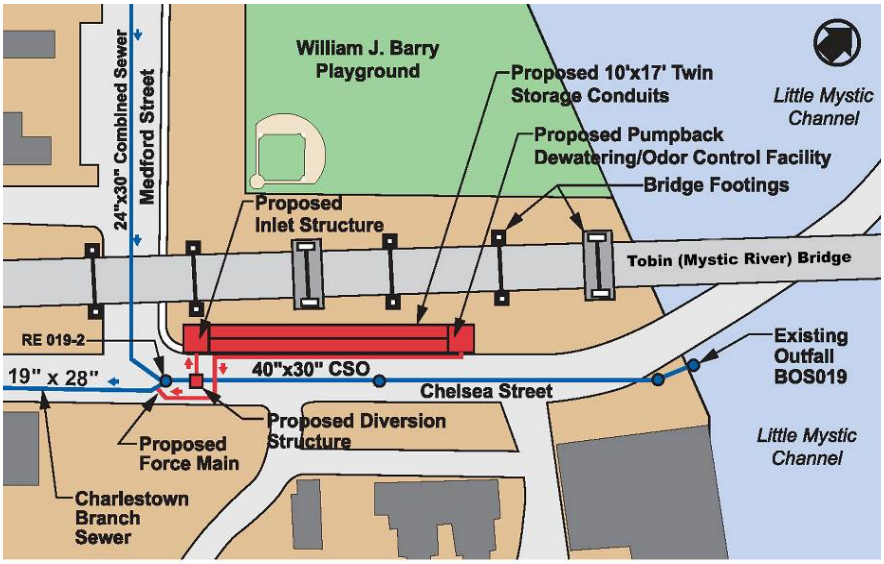


Figure 11-6 BOD019 CSO Storage Conduit

MWRA issued the notice to proceed with construction of the BOS019 storage conduit in March 2005, in compliance with Schedule Seven. In June 2006, construction was approximately 60% complete. The project is on schedule for completion by March 2007, as reported to the Federal Court prior to contract award.

Union Park Detention/Treatment Facility

The Union Park Detention/ Treatment Facility (Figure 11-7) is intended to improve water quality in the Fort Point Channel by providing treatment to CSO flows that are discharged through BWSC's Union Park Pump Station. The existing pumping station, constructed in 1976, provides flood control for the South End neighborhood of Boston. Flows will pass through the new treatment facility before entering the existing pumping station wet well.


Figure 11-7 Artist Rendering of Proposed Union Park Detention/Treatment Facility

The new facility will include coarse screens, fine screens, chlorination with sodium hypochlorite, dechlorination with sodium bisulfite and odor control equipment. A new building will be constructed adjacent to the existing pumping station to house the new treatment equipment.

New underground detention basins, which will have a combined storage capacity of 2.2 million gallons, are intended to reduce the average annual number of pumping station discharges to the Fort Point Channel (from 25 to 17 per year) and to detain flows that exceed the storage capacity in larger storms, to allow a level of solids removal.

Construction commenced in March 2003. By June 2006, construction was 93% complete. Although Schedule Seven required construction to be complete by September 2005, unforeseen conditions, including the extent of contaminated and unsuitable soils, and other problems have increased the construction duration. MWRA expects to extend the construction contract duration into 2007, but plans to begin to bring the treatment facility on-line by December 31, 2006.

South Dorchester Bay Sewer Separation

This project is intended to eliminate CSO discharges to South Dorchester Bay by separating combined sewer systems in Dorchester. The separation work primarily involves the construction of new storm drains and appurtenant structures, relocation of storm runoff connections from existing combined sewers to the new storm drains. The plan calls for approximately 136,000 linear feet of new storm drains. BWSC is implementing the project with MWRA funds.

Figuer 11-8
South Dorchester Bay Sewer Separation

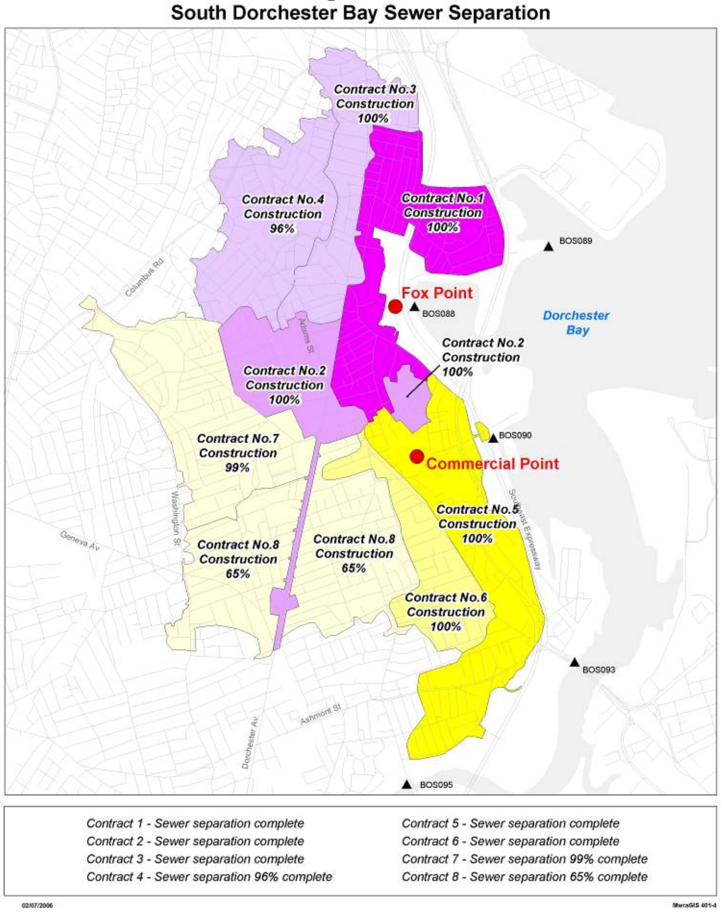
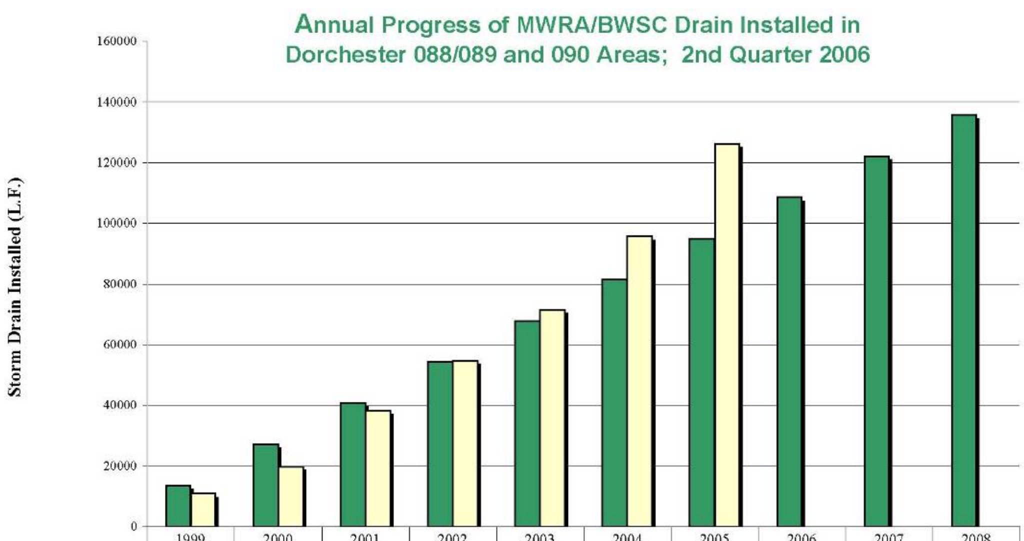


Figure 11-8 and 11-9 show the project's design and construction progress. Schedule Seven requires a construction progress rate of 10% per year from the commencement of construction in April 1999. As of June 2006, construction was 93% complete, measured as linear feet of installed storm drain. BWSC plans to complete the installation of new storm drainage before the end of 2006. This project comprises eight major sewer separation construction contracts. Five have been completed, and three are ongoing. All of the ongoing contracts were awarded by BWSC in 2004.

Disconnection of downspouts from the combined sewer systems is necessary to remove enough stormwater from the sewers to meet CSO control goals, in this case elimination. The initial downspout disconnection contract for Dorchester, which also included downspout disconnection work in other CSO project areas, such as Jamaica Plain (Stony Brook project), Neponset and East Boston (Constitution Beach), was completed in 2004. The second downspout disconnection contract for the Dorchester area was awarded in late 2004 and continued through 2005. Also, BWSC has completed two of the three project-related street paving contracts.

BWSC plans to award a total of 16 construction contracts (sewer separation, downspout removal and paving) to complete the South Dorchester Bay sewer separation project. Once these contracts are complete and the CSO regulators are closed, MWRA plans to decommission the Commercial Point and Fox Point CSO treatment facilities.

FIGURE 11-9



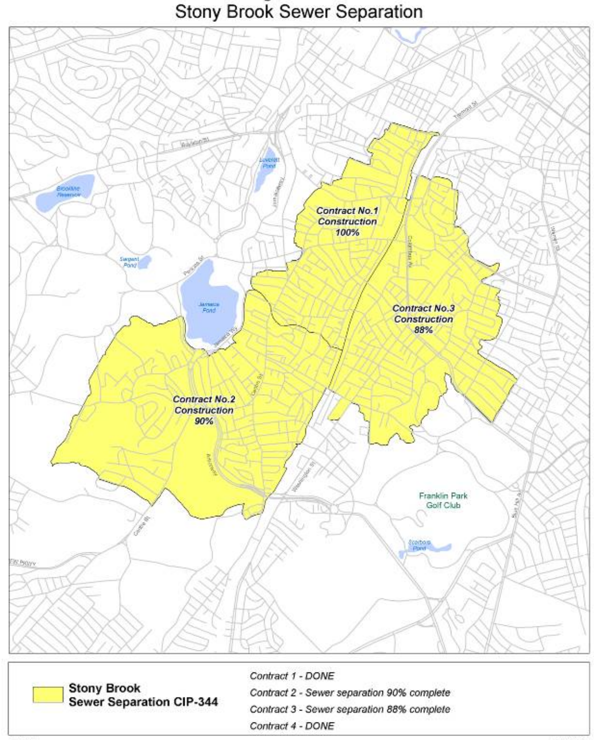
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10% TARGET PROGRESS	13569.8	27139.6	40709.4	54279.2	67849	81418.8	94988.6	108558.4	122128.2	135698
ACTUAL PROGRESS	10882	19833	38160	54694	71585	95659.15	126300			

Stony Brook Sewer Separation

This project is intended to minimize CSO discharges to the Stony Brook Conduit and the Back Bay Fens, both of which drain to the Charles River, by separating combined sewers in parts of Roxbury and Jamaica Plain. The separation work involves the installation of approximately 73,300 linear feet of new storm drain. BWSC is implementing the project with MWRA funds under the MOU/FAA. Total estimated MWRA cost is $44.3 million.

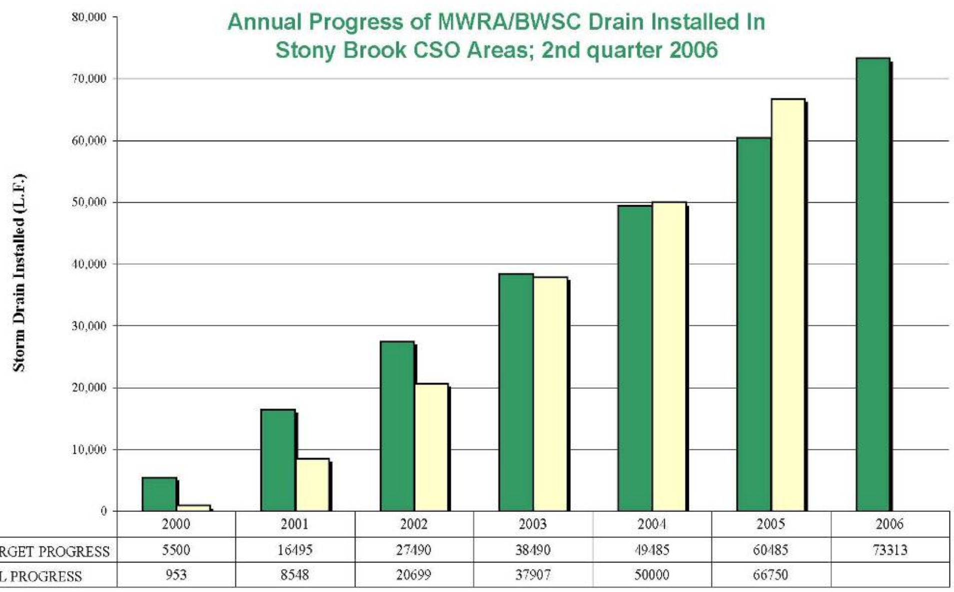
Figure 11-10 and 11-11 show the project's design and construction progress. Schedule Seven requires a construction progress rate of 15% per year from the commencement of construction in July 2000. As of June 2006, construction was 96% complete, measured as linear feet of installed storm drain. BWSC plans to complete the installation of new storm

Figure 11-10
Stony Brook Sewer Separation



drainage by September 2006, in compliance with Schedule Seven.

FIGURE 11-11

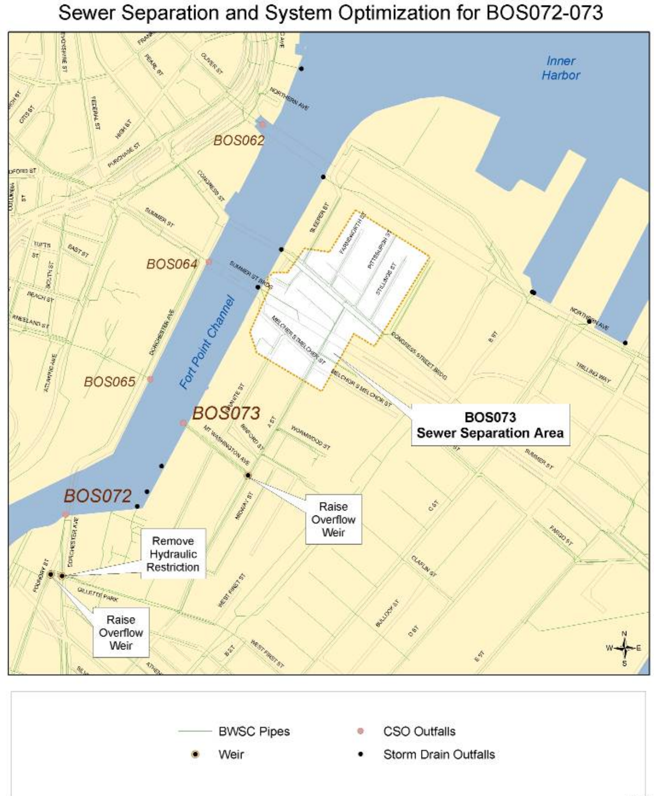


	2000	2001	2002	2003	2004	2005	2006
15% TARGET PROGRESS	5500	16495	27490	38490	49485	60485	73313
ACTUAL PROGRESS	953	8548	20699	37907	50000	66750	

Fort Point Channel BOS072-073 Sewer Separation

This project is intended to eliminate CSO discharges in a typical year at outfalls BOS072 and BOS073. The separation work primarily involves the construction of new storm drains and appurtenant structures, relocation of storm runoff connections from the existing combined sewer to the new storm drains, and rehabilitation of the existing combined sewers for use as sanitary sewers. The plan calls for approximately 5,150 linear feet of new storm drains in a 10 acre area adjacent to the Fort Point Channel tributary to outfall BOS073 (see Figure 11-12). BWSC is implementing the project with MWRA funds.

Figure 11-12
Sewer Separation and System Optimization for BOS072-073



BWSC commenced construction of a portion of the sewer separation work in March 2005, in compliance with the milestone in Schedule Seven. In September 2005, BWSC commenced a second contract involving the bulk of the project work. By June 2006, construction was approximately 17% complete. Construction is scheduled to be completed by March 2007, in compliance with Schedule Seven.

The work to install the new storm drains in the narrow, busy commercial streets adjacent to Fort Point Channel is more difficult and more costly than originally expected, due in part to the need for extensive and difficult utility relocation and related traffic management. For these reasons, the estimated cost of this project has risen from $4.8 million when it was incorporated into Schedule Seven in 2004 to $8 million today.

<u>Reserved Channel Sewer Separation</u>

The Reserved Channel sewer separation project is intended to help protect recreational and fishing uses in the Reserved Channel by greatly reducing CSO discharges in compliance with the Channel's Class B(cso) water quality classification. The project is predicted to reduce CSO discharges to the Channel from 37 activations to 3 activations in a typical year and reduce average annual CSO discharge volume from 41.3 million gallons to 1.5 million gallons. The project involves separation of combined sewers in a 355-acre area along and near the Reserved Channel in South Boston (see Figure 11-4 on page 11-12). Under the CSO MOU and FAA, BWSC is implementing the project, and MWRA is funding eligible costs, estimated to total $57.4 million. BWSC commenced design in July 2006, in compliance with Schedule Seven. Other milestones require commencement of construction by May 2009 and substantial completion of the project by December 2015.

<u>Alewife Brook CSO Control Plan Including: CAM004 Outfall and Detention Basin, CAM004 Sewer Separation, CAM400 Manhole Separation, Interceptor Connection Relief/Floatables, and MWR003 Gate and Rindge Avenue Siphon</u>

These projects, shown in Figure 11-13, are intended to minimize CSO flows to Alewife Brook, primarily by separating combined sewer systems in parts of Cambridge. With the exception of the MWR003 Gate and Rindge Ave. Siphon project, the projects are being implemented by the City of Cambridge with MWRA funding under a CSO Memorandum of Understanding and Financial Assistance Agreement. In July 1998, Cambridge began construction of the CAM004 sewer separation project recommended in the 1997 Facilities Plan/EIR. The work already completed has significantly reduced CSO discharges to Alewife Brook. Hydraulic model simulations show that CSO discharges have been reduced from 63 times per year on average with 50 million gallons annual volume to 25 times per year on average with 33 million gallons annual volume. But the discovery in 2000 of previously-unknown system conditions necessitated a reevaluation of CSO control options for this area. MWRA and the City of Cambridge developed a revised control

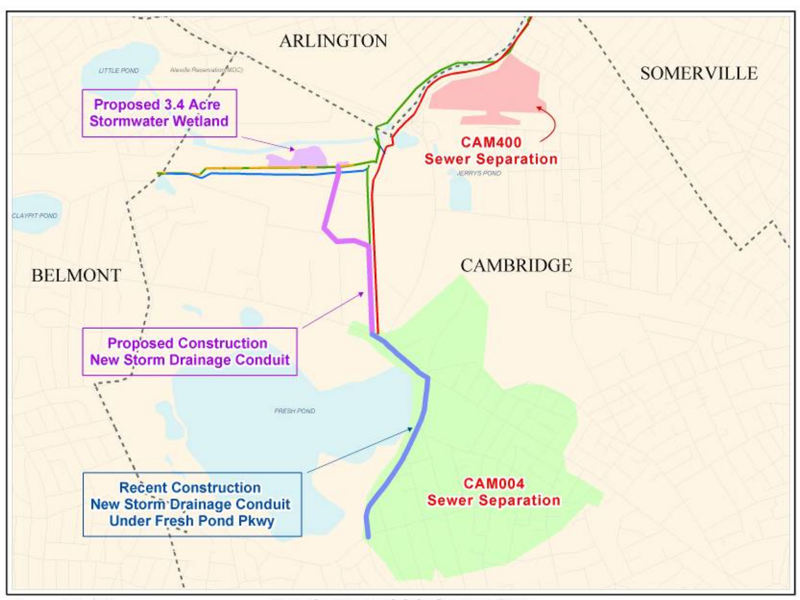


Figure 11-13 Alewife Brook CSO Control Plan

plan for Alewife Brook, which was presented in MWRA's Final Variance Report for Alewife Brook and the Upper Mystic River, dated July 2003.

The revised long-term CSO control plan for Alewife Brook includes sewer separation to close outfalls CAM400 and CAM004, construction of a new storm drain outfall and wetland detention basin to manage the separated stormwater flows; relief of interceptor connections, floatables controls, construction of an overflow control gate at outfall MWR003, and relief of MWRA's Rindge Ave. Siphon. Completion of these projects will reduce the frequency of CSO discharges to Alewife Brook in a typical rain year from 25 activations today to seven activations, and will reduce total annual volume of CSO discharge to Alewife Brook from 34 million gallons to 7.3 million gallons. The total estimated cost to complete the projects is $102 million, including escalation and contingency. Funding will be shared by MWRA and the City of Cambridge. The FY07 CIP budget for MWRA's cost share is $53 million.

Schedule Seven requires MWRA, with the cooperation of the City of Cambridge, to complete construction of the Alewife Brook projects by January 2013. Design and construction of the remaining work is dependent on Cambridge's progress in constructing the CAM004 storm drain outfall and wetland detention basin, which has been delayed by a citizens' appeal of DEP's Order of Conditions for work in wetlands.

- MWRA Improvements at Outfall MWR003 and Rindge Avenue Siphon

While most the revised Alewife Brook CSO control plan is being implemented by the City of Cambridge with MWRA financial assistance, a portion of the plan dealing directly with MWRA sewers and an MWRA CSO outfall will be designed and constructed by MWRA. This work, shown in Figure 11-14, involves installing an automated hydraulic relief gate and associated controls at the overflow weir associated with outfall MWR003; installing floatables control for this outfall, consisting of an in-line netting structure; and relieving a 30-inch MWRA siphon that interconnects the two MWRA interceptors (the Alewife Brook Sewer and the Alewife Brook Conduit) that parallel Alewife Brook and convey wastewater from parts of Belmont, Arlington, Cambridge and Somerville.

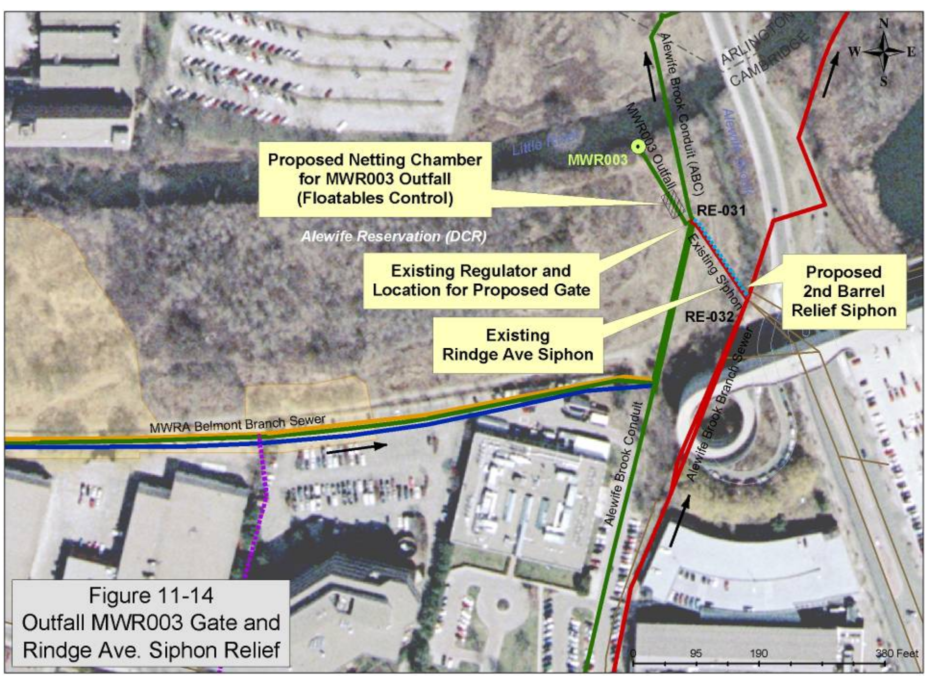


Figure 11-14
Outfall MWR003 Gate and Rindge Ave. Siphon Relief

MWRA's FY07 CIP budget for this project is $1.96 million. Schedule Seven requires MWRA to commence design of the MWR003 gate and Rindge Ave. siphon project by April 2009 and complete construction by January 2012. Like the other Alewife Brook projects, however, this project is dependent on Cambridge's ability to construct the CAM004 storm drain outfall and wetland detention basin.

Optimization of Prison Point CSO Facility

In March 2006, MWRA commenced a study to optimize the operating procedures of the Prison Point combined sewer overflow ("CSO") facility and related structures, in compliance with Schedule Seven. The goal of the study is to identify and implement operating procedures that will minimize the frequency and volume of treated discharges at the Prison Point facility. The investigations are proceeding in three key areas: critical review of current operations, consideration of already planned improvements and their effects on Prison Point operations and discharges, and identification and evaluation of additional operational improvements that may further reduce treated discharges from the facility to the Inner Harbor.

MWRA will investigate fine tuning the operation of the influent gates to maximize in-system storage benefit and minimize discharges at Prison Point. Potential improvements may involve better forecasting and expanded or modified operational strategies based on forecasting, improved use of remote depth sensors to monitor system conditions during filling and to control gate functions, and use of these controls to optimize the closing of the gates near the end of a storm, in addition to the current early storm storage.

Work previously planned by MWRA to optimize operations at the Prison Point Facility involves implementation of supervisory control and data acquisition (SCADA) measures (see Chapter 12). When applied to Prison Point, these systems will allow remote manual operation or semi-automatic operation of the facility or other control structure with real-time data on system conditions at the facility/structure and at remote locations, such as upstream critical overflow points. For instance, SCADA integration will better alert operational staff when water elevations approach the crest of weirs along the Cambridge Marginal Conduit and the Boston Marginal Conduit, which could result in an untreated overflow to the Lower Charles River Basin.

In addition to integrating existing depth sensors in these conduits, the program includes installing a third level sensor, in the Charlestown Branch Sewer at the BOS019 regulator, and new influent flow monitors in the three of the six inlet storm channels at the Prison Point facility, just downstream of the wet weather bar screens. The BOS019 depth sensor will assist MWRA in optimizing operation of the dry weather pumps at Prison Point, which discharge to the Charlestown Branch Sewer and can reduce the amount of flow directed to the wet side (treatment side) of the Prison Point facility. Careful operation of the dry weather pumps is necessary to avoid contributing to surcharge in the Charlestown Branch Sewer and aggravating overflows at outfall BOS019. The new influent flow monitors at Prison Point will provide a major advantage in determining the flow rate for throttling or closing the influent gates and allow a more precise application of sodium hypochlorite (the disinfection agent) for discharge permit compliance and health and safety protection for the operators. MWRA plans to complete construction of these SCADA improvements by 2009.

Schedule Seven requires MWRA to submit a report by April 1, 2007, recommending measures to optimize the hydraulic performance of the Prison Point facility.

11.6 New Projects

The following CSO projects are included in the FY07 CIP and will commencement in FY07.

<u>Charles River CSO Controls Including: Cottage Farm Brookline Connection and Inflow Controls and Charles River Interceptor Gate Controls</u>

In response to the long-term CSO control plan MWRA recommended in 1997, DEP and EPA issued variances to water quality standards for the Charles River. With the variance, DEP approved and required MWRA to implement its plan for the Charles River Basin, and also required MWRA to identify and evaluate additional measures that could further reduce CSO discharges to the Basin. In August 2005, MWRA recommended a series of optimization measures and investigations to further lower CSO discharges.

Figure 11-15 Cottage Farm Brookline Connection and Inflow Controls

One set of these improvements includes measures to reduce treated discharges at the Cottage Farm CSO Facility by controlling overflows into the facility by increasing flow conveyance to the Ward St. Headworks and by taking advantage of upstream storage capacity in the North Charles Metropolitan and Metropolitan Relief Sewers, in Cambridge. These measures, shown in Figure 11-15, include: bringing into operation the historically un-utilized 54-inch "Brookline Connection" that crosses beneath the Charles River from the Cottage Farm influent chamber (on the Cambridge side of the Charles River) to an improved connection with the South Charles Relief Sewer (on the Boston side); developing gate controls and a control system to optimize and potentially automate the operation of the existing Cottage Farm influent gates; providing a piped interconnection between the two overflow chambers outside the Cottage Farm facility; and optimizing the overflow weir settings within the chambers.

MWRA plans to commence design of these improvements under one contract in September 2006, in compliance with Schedule Seven. Schedule Seven also requires MWRA to commence construction by June 2008 and complete construction by June 2009.

Another set of improvements includes measures to optimize flows among the four interceptors upstream of the Cottage Farm facility and Ward St. Headworks. The measures include developing an operational strategy for optimizing the transfer of flows between the Charles River Valley Sewer and the South Charles Relief Sewer using existing gates located at three connections between these interceptors. MWRA will also evaluate the feasibility of improving hydraulic performance along the North Charles Metropolitan Sewer and the North Charles Relief Sewer by creating new connections or modifying existing connections between these interceptors and by adjusting overflow regulators along these interceptors.

The design of the gate controls and the evaluation of additional interceptor connections will commence under one contract in January 2008, in compliance with Schedule Seven. Schedule Seven also requires MWRA to submit a report on the additional connections evaluation by January 2009, commence construction of the interceptor gate controls by January 2010, and complete construction of the gate controls by January 2011.

<u>Bulfinch Triangle Sewer Separation</u>

The Bulfinch Triangle sewer separation project (Figure 11-16), is intended to help reduce CSO discharges to the Charles River at MWRA's Cottage Farm facility. It will allow the closing of

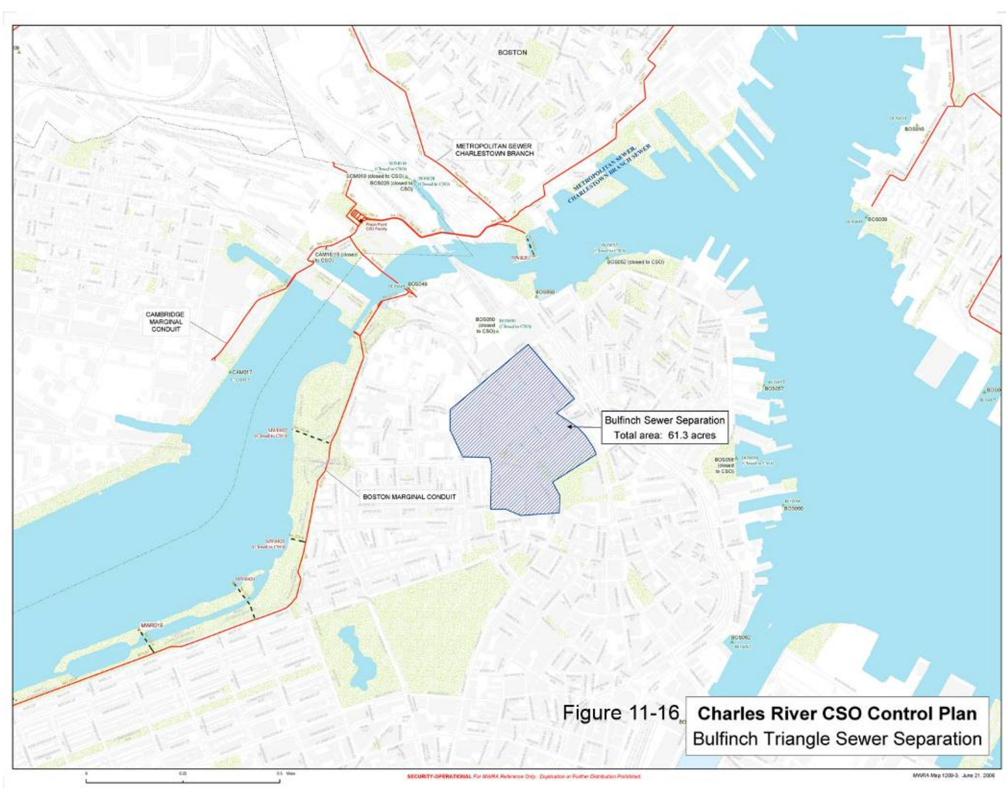


Figure 11-16 **Charles River CSO Control Plan**
Bulfinch Triangle Sewer Separation

CSO outfall BOS049, and will reduce CSO discharges along the Boston Marginal Conduit and at the Prison Point CSO Facility. The project involves the separation of combined sewers in a 61 acre area bordered by Haymarket Square, North Station and Cambridge St. in Boston. Under the CSO MOU and FAA, BWSC will implement the project, and MWRA will fund eligible capital costs, estimated to be $4 million. BWSC issued notice to proceed with the design contract in August 2006, in advance of the November 2006 milestone in Schedule Seven. Schedule Seven also requires commencement of construction by July 2008 and substantial completion of the project by July 2013.

Brookline Sewer Separation

The Brookline sewer separation project (Figure 11-17) is also intended to help reduce CSO discharges to the Charles River at MWRA's Cottage Farm facility. The project involves the separation of sewers in several areas of Brookline, totaling 72 acres, where there are remaining combined sewers tributary to MWRA's Charles River Valley Sewer. Under a CSO MOU and FAA between the Town of Brookline and MWRA, Brookline will implement the project, and MWRA will fund eligible capital costs, estimated to be $9 million. Brookline plans to commence design work in November 2006, in compliance with Schedule Seven. Schedule Seven also requires commencement of construction by July 2008 and substantial completion of the project by July 2013.

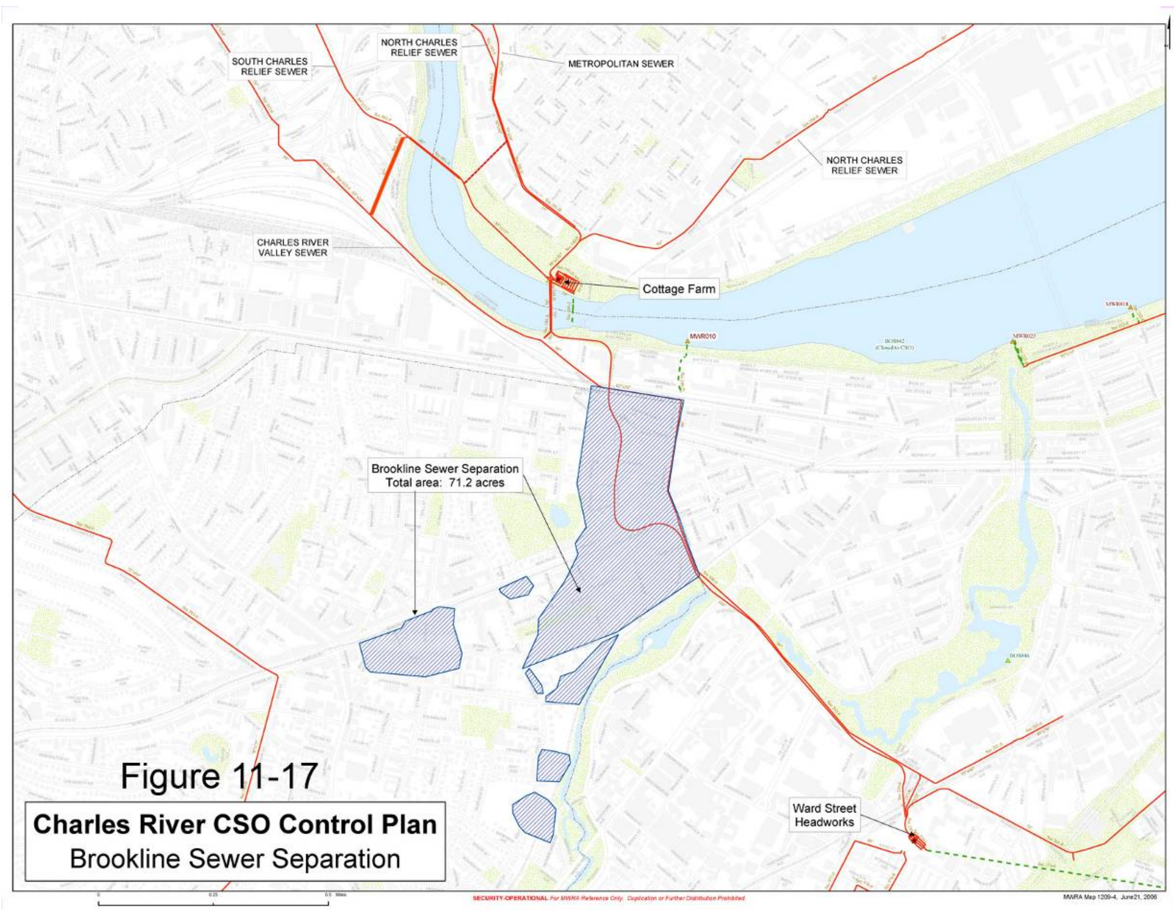


Figure 11-17
Charles River CSO Control Plan
Brookline Sewer Separation

11.7 Future Staffing and O&M Cost Impacts

Continued implementation of MWRA managed projects within the long-term CSO control plan will have incremental staffing and annual O&M cost impacts, as presented in Table 11-4, below. All staffing and O&M cost impacts associated with any community implemented CSO project will be borne by the respective community, i.e. BWSC or the City of Cambridge.

Table 11-4 Staffing and O&M Cost Impacts of Existing CSO Projects

CSO Project	Startup	Staffing Impact (FTE)	Annual O&M Cost (including staffing)
Union Park Detention/Treatment Facility	Dec 06	0*	$ 897,000
Prison Point CSO Facility Optimization	Mar 07	0	0
BOS019 CSO Storage Conduit	Mar 07	0	50,000
Brookline Connection and Cottage Farm Overflow Interconnection/Gate	Jun 09	0	0
East Boston Branch Sewer Relief	Jun 10	0	0
Charles River Interceptor Gate Controls	Jan 11	0	0
North Dorchester Bay Storage Tunnel and Related Facilities	May 11	0	400,000
TOTAL		0	$1,347,000

* MWRA and BWSC to jointly contract operations and maintenance services for Union Park Detention/Treatment Facility.

11.8 Future Capital Improvement Project Needs

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, MWRA may be obligated to develop and implement additional capital improvements to further control CSO discharges, but <u>only for outfalls it owns and operates</u>.

This outlook assumes that the required CSO control performance levels recommended in the long-term plan are met with the recommended projects described above. If, in 2020, when MWRA completes the required CSO performance assessment, MWRA determines that the goals have not been met, it may be obligated and may be required to implement additional controls to bring the discharges into conformance with the plan goals at MWRA and community outfalls.

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.

DEP is required to review water quality standards every three years. Its reviews 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.

11.9 Summary of Existing and Recommended Capital Projects

There are no future MWRA or community managed CSO Control Plan projects recommended for consideration in the CIP. The existing MWRA Managed CSO Control projects ($312,271,000), existing Community Managed CSO Control projects ($148,522,000) and future CSO Control projects ($0) are summarized in Table 11-5.

There are seven existing MWRA managed CSO Control Plan projects in the FY07 CIP with a total cost of $312,271,000. The projects are described below and summarized in Table 11-6.

- North Dorchester Bay, $218,042,000 is included in the FY07 CIP and will be completed in FY12.

- East Boston Branch Relief Sewer, $63,033,000 is included in the FY07 CIP and will be completed in FY11.

- BOS019 CSO Storage Conduit, $5,832,000 is included in the FY07 CIP and will be completed in FY08.

- Union Park Detention/Treatment Facility, $4,695,000 is included in the FY07 CIP and will be completed in FY08.

- MWR003 Gate and Siphon, $1,960,000 is included in the FY07 CIP and will be completed in FY13.

- Charles River CSO Controls, $6,000,000 is included in the FY07 CIP and will be completed in FY12.

- CSO Planning and Support Services, $12,709,000 is included in the FY07 CIP and will be completed in FY20.

There are ten existing community managed CSO Control Plan projects in the FY07 CIP with a total cost of $148,522,000. The projects are described below and summarized in Table 11-7.

- Dorchester Sewer Separation (Fox Point), $1,899,000 is included in the FY07 CIP and will be completed in FY10.

- Dorchester Sewer Separation (Commercial Point), $13,457,000 is included in the FY07 CIP and will be completed in FY10.

- Stony Brook Sewer Separation, $3,120,000 is included in the FY07 CIP and will be completed in FY07.

- Cambridge 02-04 Sewer Separation, $33,235,000 is included in the FY07 CIP and will be completed in FY14.

- Cambridge Floatables Control, $1,869,000 is included in the FY07 CIP and will be completed in FY10.

- Fort Point Channel Sewer Separation, $5,534,000 is included in the FY07 CIP and will be completed in FY08.

- Morrissey Boulevard Drain, $19,015,000 is included in the FY07 CIP and will be completed in FY10.

- Reserved Channel Sewer Separation, $57,393,000 is included in the FY07 CIP and will be completed in FY17.

- Brookline Sewer Separation, $9,000,000 is included in the FY07 CIP and will be completed in FY15.

- Bulfinch Triangle Sewer Separation, $4,000,000 is included in the FY07 CIP and will be completed in FY15.

Table 11-5

Wastewater Master Plan - CSO Control Plan Projects

Existing and Recommended Projects Summary

Last revision 11/30/2006

Line No	Project	Cost ($1000)	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
			2 years	5 years	5 years	10 years	20 years	
1	**SUBTOTAL - MWRA-Managed Projects (see Table 11-2)**	312,271	126,051	185,782	195	243	0	312,271
2	**SUBTOTAL - Community-Managed Projects (see Table 11-3)**	148,522	40,246	87,702	20,574	0	0	148,522
3	**SUBTOTAL - Recommended Projects**	0	0	0	0	0	0	0
	TOTAL CSO Control Plan	**460,793**	**166,297**	**273,484**	**20,769**	**243**	**0**	**460,793**

Table 11-6
Wastewater Master Plan - CSO Control Plan - MWRA Managed Projects
Existing Projects

Last revision 11/30/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		CSO CONTROL PLAN - MWRA managed projects											
11.1	1	**North Dorchester Bay**	NF	in S339	6 years	218,042	FY07-12	103,646	114,396				218,042
11.2	1	**East Boston Branch Sewer Relief**	RF/IC	in S347	5 years	63,033	FY07-11	4,104	58,929				63,033
11.3	1	**BOS019 CSO Storage Conduit**	NF	in S348	2 years	5,832	FY07-08	5,832					5,832
11.4	1	**Union Park Detention/Treatment Facility**	NF	in S350	2 years	4,695	FY07-08	4,695					4,695
11.5	1	**MWRA003 Gate & Siphon**	NF/IC	in S355	5 years	1,960	FY09-13		1,960				1,960
11.6	1	**Charles River CSO Controls**	Opti	in S357	6 years	6,000	FY07-12	850	5,150				6,000
11.7	1	**CSO Support**	Plan	in S324	15 years	12,709	FY07-21	6,924	5,347	195	243		12,709
		SUBTOTAL - CSO Control Plan (MWRA Managed)				312,271		126,051	185,782	195	243		312,271

Table 11-7

Wastewater Master Plan - CSO Control Plan - Community Managed Projects

Existing Projects

Last revision 11/30/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in included in FY07 CIP (bold)
new new project, not previously in CIP
prev included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		CSO CONTROL PLAN (Community managed projects)											
11.8	**1**	**Dorchester Sewer Separation (Fox Point)**	**NF**	**in S340**	**4 years**	**1,899**	**FY07-10**	**1,568**	**331**				**1,899**
11.9	**1**	**Dorchester Sewer Separation (Commercial Point)**	**NF**	**in S341**	**4 years**	**13,457**	**FY07-10**	**9,143**	**4,314**				**13,457**
11.10	**1**	**Stony Brook Sewer Separation**	**NF**	**in S344**	**1 year**	**3,120**	**FY07**	**3,120**					**3,120**
11.11	**1**	**Cambridge 02-04 Sewer Separation (Alewife)**	**NF**	**in S346**	**8 years**	**33,235**	**FY07-14**	**4,021**	**29,202**	**12**			**33,235**
11.12	**1**	**Cambridge Floatables Control**	**NF**	**in S352**	**3 years**	**1,869**	**FY07-09**	**1,625**	**244**				**1,869**
11.13	**1**	**Fort Point Channel Sewer Separation**	**NF**	**in S356**	**2 years**	**5,534**	**FY07-08**	**5,534**					**5,534**
11.14	**1**	**Morrissey Boulevard Drain**	**NF**	**in S358**	**4 years**	**19,015**	**FY07-10**	**11,575**	**7,440**				**19,015**
11.15	**1**	**Reserved Channel Sewer Separation**	**NF**	**in S359**	**11 years**	**57,393**	**FY07-17**	**3,035**	**34,426**	**19,932**			**57,393**
11.16	**1**	**Brookline Sewer Separation**	**NF**	**in S360**	**9 years**	**9,000**	**FY07-15**	**400**	**8,145**	**455**			**9,000**
11.17	**1**	**Bulfinch Triangle Sewer Separation**	**NF**	**in S361**	**9 years**	**4,000**	**FY07-15**	**225**	**3,600**	**175**			**4,000**
		SUBTOTAL - CSO Control Plan (Comm Managed)				148,522		40,246	87,702	20,574			148,522

CHAPTER 12
SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) AND WASTEWATER METERING SYSTEM

12.1 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 is undergoing a major upgrade over the next two years as part of the current Wastewater Central Monitoring/SCADA Implementation Project. This contract will create a unified SCADA system covering all significant wastewater facilities. Future facilities such as the North Dorchester Bay CSO will be incorporated into the system as they are completed. Monitoring and control will be performed at the Chelsea Operations Control Center.

MWRA's wastewater metering system provides community flow-based rate assessments and data for modeling, engineering studies, infiltration/inflow estimates, and operational support. Upgrades to the system under the Wastewater Metering System Equipment Replacement Project are scheduled to continue through FY16.

Existing MWRA SCADA and wastewater metering equipment are relatively new and in very good condition. Both SCADA and metering systems are operating well. Future needs identified in the Master Plan are based on assumed useful life/obsolescence of the electronic equipment. Wastewater SCADA related PC upgrades are expected every 5-years so that the PCs will continue to be able to support the desired operating systems. Wastewater SCADA equipment (PLC's) and data radios are expected to need replacement or upgrade every 15-years or when a significant enhancement in security architecture is released. Wastewater metering system equipment is expected to need replacement every 10-years.

For SCADA improvements and wastewater metering system upgrades, $42.96 million in projects is identified in the 40-year master plan timeframe (FY07-48). Near-term, mid-term and long-term costs are detailed below. Section 12.8 - Summary of Existing and Recommended Capital Projects includes a consolidated listing of all projects recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $16.26 million is currently programmed in the CIP (FY07-13):
  - $15.873 million for SCADA improvements.
  - $387,000 for wastewater metering system upgrades.

- $50,000 in needs for SCADA related PC upgrades is identified for FY09-13 and recommended for inclusion in the FY08 CIP.

Mid-term (FY14-18):

- $1.2 million is currently programmed in the CIP (FY14-18) for Phase 2 wastewater meter system upgrades.
- $5.05 million in needs is identified for FY14-18 and recommended for inclusion in the FY08 CIP:
    - $50,000 for SCADA related PC upgrades.
    - $5 million for wastewater metering system asset protection/equipment replacement.

Long-term (FY19-28 and FY29-48):

- $20.4 million in needs is identified for FY19-28 and FY29-48 and recommended for inclusion in the FY08 CIP:
    - $100,000 for FY19-28 and $200,000 for FY29-48 for SCADA related PC upgrades.
    - $2 million for FY19-28 and $3 million for FY29-48 for SCADA equipment replacement/upgrades.
    - $50,000 for FY19-28 and $50,000 for FY29-48 for wastewater data radio replacements.
    - $5 million for FY19-28 and $10 million for FY29-48 ($5 million every 10 years) for wastewater metering system asset protection/equipment replacement.

12.2 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, or “PLCs,” which handle data and command signals to and from field equipment);

- Communication devices and media (e.g., telephone lines, radio links); and,

- Host computer (e.g., personal computers that support the data management and user interface software know has as a Human Machine Interface or HMI).

12.3 Previous SCADA Master Plan and Extent of the Current System

The goals established in the 1999 SCADA Master Plan are still relevant. They include the following primary and secondary goals:

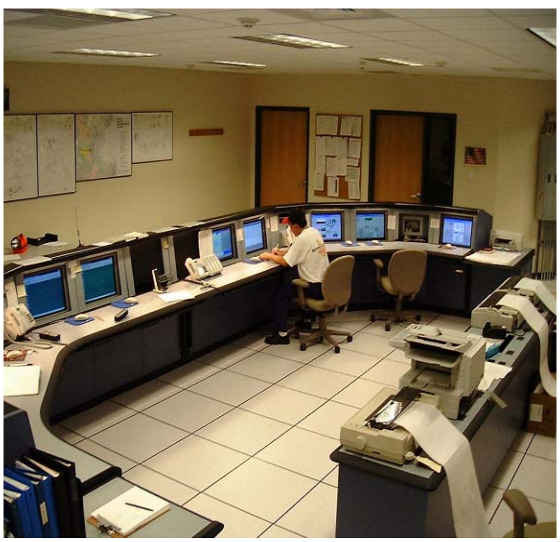
Primary Goals

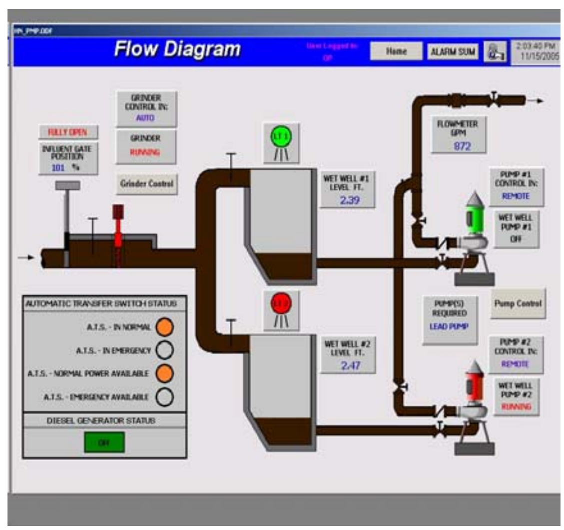
- Reduce Transport Operations and Maintenance Costs;
- Operate the Transport System More Efficiently;
- Enhance the Reliability and Performance of Transport System Operations; and,
- Improve Customer Service in the Sewerage Division;

Secondary Goals
- Facilitate Information Access Throughout the Sewerage Division;
- Optimize Transport System Performance Through Computerized Decision Support; and,
- Improve Facilities Planning Decision Making Throughout the Sewerage Division.

The current Transport SCADA system (in existence prior to construction of the Wastewater Central Monitoring/SCADA Implementation Project) is an amalgamation of past projects from a variety of contracts. While in-house staff have upgraded and unified alarm handling, security and home pages, each facility's SCADA system has its own look and feel. Different brands of hardware and software as well as different versions of software exist throughout the system. As of 2006, there are currently eleven facilities that have some form of a SCADA system: Caruso Pump Station, Commercial Point Gravity CSO, Cottage Farm Pumped CSO, Fox Point Gravity CSO, Houghs Neck Pump Station, Intermediate Pump Station, Nut Island Headworks, Prison Point Pump Station and Pumped CSO, Quincy Pump Station, Somerville Marginal Gravity CSO, and Squantum Pump Station. Of these, all but Caruso Pump Station and Nut Island Headworks have varying levels of remote control from the Chelsea Operations Control Center.

The existing Wastewater SCADA system is maintained by MWRA staff. A staff increase of two SCADA technicians is expected to meet the maintenance needs of the additional SCADA installations identified in this document.


MWRA Operation Control Center



Sample SCADA Screen

12.4 Wastewater Central Monitoring/SCADA Implementation Project

The Wastewater Central Monitoring/SCADA Implementation Project, currently programmed in the FY07 CIP, is budgeted at $15.873 million during the FY07-09 time frame and is divided into the following three construction contracts:

CP-1 (Contract 6533) Design Period: 8/02 – 8/04 Construction/Implementation: 3/06 – 8/07	**CP-2 (Contract 6534)** Design Period: 6/04 – 3/06 Construction/Implementation: 12/06 – 12/07	**CP-3 (Contract 6657)** Design Period: 7/06 - 2/07 Construction/Implementation: 9/07 – 3/08
• Most Pump Stations: Alewife Brook, Caruso DeLauri, Hayes Hingham, Houghs Neck New Neponset • CSO Facilities: Cottage Farm, Prison Point Somerville Marginal • Chelsea Screenhouse • Supporting Communications Infrastructure, including extending MWRA's microwave system to Nut Island via DI's water tower. • OCC improvements to support additional facilities	• All Headworks Facilities: Nut Island Headworks Columbus Park Headworks Ward Street Headworks Chelsea Creek Headworks • Supporting Communications Infrastructure • OCC improvements to support additional facilities	• Remaining Pump Stations: Quincy Replacement Squantum Replacement Intermediate Arthur Street • Powering of up to 36 remote Non-Facility Monitoring Stations and 5 H_2S Monitoring Sites • OCC improvements to support additional facilities

Notes: 1. Commercial Point and Fox Point CSO facilities are being decommissioned; minor programming improvements may be necessary.

2. Construction of the Braintree/Weymouth Relief Pump Station and BOS019 Conduit are being performed under separate ongoing construction contracts. Integration work for these facilities will be performed under the SCADA Implementation project. MWRA staff have reviewed the design of SCADA components to establish consistency with other wastewater facilities.

Construction Package-1 (CP-1) is the most significant of the three construction packages, addressing SCADA needs in 13 of the 21 existing wastewater facilities. These facilities will also require the greatest amount of instrumentation and control, and automation improvements prior to being incorporated into the final SCADA system. The unique configuration, age and existing equipment in each wastewater facility has required CP-1's design effort to consider individual facility requirements for SCADA implementation. This has not only required the need to design the installation and/or replacement of instrumentation, but also to evaluate and if warranted, design replacements to the process equipment and facility support systems to ensure their ability to function in an automatic mode. Therefore, some facility process equipment and support system improvements were necessary (e.g., Alewife's Pump 4 replacement, Chelsea Screen House's generator installation, Prison Point's fuel oil system, VFD replacements at three facilities, etc.) to meet the objective of automatic operations at some facilities.

CP-2 will provide SCADA needs at four remote headworks facilities. These SCADA improvements will include remote monitoring of grit and screening processes and implementation of automatic operation of the influent gates at the three older remote headworks facilities (Chelsea Creek, Columbus Park, and Ward Street). This project will be integrated with the Headworks Condition Assessment/Facilities Plan Project, detailed in Section 8.3. At Nut Island, there will be improved remote monitoring and control of various processes and system conditions, replacement of instrumentation that has exceeded its useful life or is inconsistent with other wastewater facilities, and new remote control capabilities of the odor control system.

The primary goal of CP-3 is the installation of electrical power at approximately 36 remote, non-facility monitoring sites. This will enable staff to continually monitor key locations within the collection system that are impacted by facility operations or prone to flooding. SCADA upgrades being performed under CP-1 and CP-2 will also be implemented at the Arthur Street Pump Station under CP-3. Minor instrumentation improvements will also be made in newer facilities (i.e., Squantum, Quincy, IPS) to ensure consistent data collection from all wastewater facilities. Although, these newly commissioned facilities were designed with the intent of being fully incorporated into the SCADA system, some programming adjustments may be necessary to provide consistency with other facilities currently being upgraded. However, MWRA staff believe these facilities are mostly consistent with the monitoring and control functionality being implemented throughout the wastewater facilities.

The existing 3-phase project is described in the bullet below and listed in the Project Summary Table 12-1 in Section 12.8.

- The existing Wastewater Central Monitoring/SCADA Project includes planning, design, and construction for SCADA upgrades throughout the collection system. The total project cost is $15.873 million during the FY07-09 time frame.

12.5 Other Existing Projects with SCADA Components

The Braintree-Weymouth Replacement Pump Station and the BOS019 CSO Storage Conduit are currently under construction. MWRA staff participated in facility design to help provide consistency with monitoring and control functionality being implemented at other wastewater and water facilities. Programming of these facilities will be performed under Transport SCADA Implementation to ensure consistency with other facilities.

The North Dorchester Bay CSO Storage Tunnel and Dewatering Pump Station will require the implementation of SCADA technology to maximize the facility's storage capabilities without causing surge or overfilling which could lead to flooding or discharge of CSO to the receiving water. This will require the remote monitoring of the tunnel and remote monitoring and control of several tunnel CSO and Stormwater influent structures. Current plans are to have these remote monitoring and flow control structures communicate through redundant means (radio and phone) back to the Dewatering Pump Station. The Dewatering Pump Station will house a master PLC with programmed logic to automatically control gates based on data from various field measurements and rainfall prediction entered by operational staff. SCADA will also be used to monitor and control the Dewatering Pump Station on a day-to-day basis as well as after a storm has ended to maximize the upstream tunnels storage capability. As with other wastewater facilities, monitoring and control of these facilities will be enabled locally or from the MWRA's primary or backup Operations Control Centers. The North Dorchester Bay CSO Storage Tunnel and Dewatering Pump Station project, as detailed in Chapter 11, will be completed in five years.

12.6 Recommended SCADA Capital Projects

There are three SCADA related projects recommended for consideration in the CIP. The projects are described below and listed in the Project Summary Table 12-1 in Section 12.8. Other future Wastewater SCADA system enhancements will be based on recommendations derived from future modeling and system optimization studies. Upgrades to the MWRA's microwave system are included in the Water Master Plan at about $1 million; no additional funds are recommended (and have not been included) for microwave upgrades within the Wastewater Master Plan. While there are no plans to install a SCADA system at the Clinton Wastewater Treatment Plant, it may be desirable to include data collection and monitoring systems as part of future facility upgrades (see Chapter 14).

- Staff estimate that a Wastewater SCADA Related PC Upgrades project will be required every 5 years so that the PCs will continue to be able to support the desired operating systems. The estimated cost is $50,000 per 5-year timeframe for a total 40-year cost of $400,000. This cost may be included within the MIS current expense budget, however, for planning purposes it is presented here as a future CIP recommendation.
- Staff estimate that a Wastewater SCADA Equipment (PLC's) Replacement/Upgrade project will be required every 15 years or when a significant enhancement in security architecture is released. Replacement/upgrade costs with depend on the level of reconfiguration and reprogramming required. For planning purposes, an equipment upgrade cost of $2 million during the FY19-28 time frame and a cost of $3 million during the FY29-48 timeframe have been recommended. Each project would have a 3-year project duration.
- Staff estimate that a Wastewater Data Radio Replacement project will be required every 15 years at cost of $50,000 during the FY19-28 time frame and a cost of $50,000 during the FY29-48 timeframe. Each project would have a 3-year project duration.

12.7 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 issued a Notice to Proceed to RJN Group for a contract to replace the wastewater metering equipment (Contract No. 6793). This contract was completed in 2005.

The replacement metering system is comprised of the following:

- 134 Marsh McBirney Flo-Dar - Radar Based/Area Velocity Flow Meters;
- 53 MGD ADFM – Acoustic Doppler Flow Meters;
- 26 Facility RTU – Remote Terminal Units;
- 5 Marsh McBirney FloTote 3 – Electromagnetic Flow Meters; and,
- 3 Flume RTUs with depth sensors.

The Marsh McBirney Flo-Dar utilizes ultrasonic depth and radar velocity as primary means of measuring flow. The MGD ADFM utilizes submerged ultrasonic depth and velocity as primary means of measuring flow. The Facility RTU captures, stores and transmits the signal/data from the respective facility's primary wastewater flow meter. The Marsh McBirney FloTote 3 utilizes submerged pressure depth and electromagnetic velocity as primary means of measuring flow. The Flume RTU 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 the new metering system.

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 above photo is a close-up of the depth/velocity sensor mounted near the wastewater flow.

Under the first phase of the Wastewater Metering System Equipment Replacement Project, a total of $287,000 exists in the FY07 CIP and is projected to be spent in the FY07-09 time frame. The second phase of the metering system upgrade (Contract No. 6928) will supply power and enhanced wireless communications to approximately half of the wastewater metering sites. The schedule for this portion of the project was moved out from an original Notice to Proceed date of June 2008 to July 2013. For the second phase, a total of $1.3 million exists in the FY07 CIP and is projected to be spent in the FY013-16 time frame. The existing Wastewater Metering System Equipment Replacement Project is described in the bullet below and listed in the Project Summary Table 12-1 in Section 12.8.

- The existing Wastewater Metering System Equipment Replacement Project (the remainder of Phase 1 and all of Phase 2) includes planning, design, and construction for replacement/upgrade of all permanent wastewater metering equipment, communications hardware and system software. The total project cost is $1.587 million; Phase 1 is ongoing and will be completed in FY09. Phase 2 ($1.3 million) is scheduled for FY13-16.

At this time, there are no plans to incorporate SCADA control or monitoring of the collection system as part of the Wastewater Metering System planned upgrades. Under the SCADA CP-3 (see Section 12.4) up to 36 non-facility sites may be included for SCADA monitoring. Some wastewater metering system sites may be included in that upgrade. In addition, there are specific sites already monitored through the Event Notification System (ENS) that monitors key trouble spots throughout the MWRA service area.

There is also one Wastewater Metering System related future project recommended for consideration in the CIP. The project is described in the bullet below and listed in the Project Summary Table 12-1 in Section 12.8.

- Future Wastewater Metering System Asset Protection includes the rehabilitation, replacement and upgrades (planning, design and construction) for the Wastewater Metering System estimated at $5 million and projected to be required every 10-years for a total of $20 million over the 40-year planning period. For planning purposes, funds for metering equipment asset protection have been estimated to be needed once during FY14-18, once during FY19-28, and twice during FY29-48. Each of these projects will have a duration of about 3-years.

12.8 Summary of Existing and Recommended Capital Projects

There are two ongoing capital improvement projects for SCADA and Wastewater Metering System related facilities in the FY07 CIP. These projects are described below and summarized in Table 12.1 (see line numbers 12.1 and 12.2):

- Wastewater Central Monitoring/SCADA; $15.873 million during FY07-09.

- Wastewater Metering System Equipment Replacement Project; $1.587 million during FY07-16.

There are four future capital improvement projects for SCADA and Wastewater Metering System related facilities recommended for consideration in CIP. These projects are described below and summarized in Table 12.1 (see line numbers 12.3 and 12.6):

- Wastewater SCADA Related PC Upgrades; $50,000 every 5 years for a total 40-year cost of $400,000 during FY09-48.

- Wastewater SCADA Equipment (PLC's) Replacement/Upgrade; $2 million during FY19-28 and $3 million during FY29-48 for a total cost of $5 million during FY19-48.

- Wastewater Data Radio Replacement; $50,000 during FY19-28 and $50,000 during FY29-48 for a total cost of $100,000 during FY19-48.

- Wastewater Metering System Asset Protection; $5 million every 10 years for a total of $20 million over the 40-year planning period (FY14-48).

Table 12-1
Wastewater Master Plan - SCADA and Wastewater Metering System
Existing and Recommended Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		SCADA & WASTEWATER METERING											
12.1	**1**	**Wastewater Central Monitoring/SCADA**	**AP/Opti**	**in S137**	**3 years**	**15,873**	**FY07-09**	**15,246**	**627**				**15,873**
12.2	**1**	**Wastewater Metering System Equipment Replacement**	**RF**	**in S142**	**phase 2 - 3 years**	**1,587**	**now-FY16**	**265**	**122**	**1,200**			**1,587**
		SUBTOTAL - Existing - SCADA and Metering				**17,460**		**15,511**	**749**	**1,200**			**17,460**
12.3	2	Wastewater SCADA Related PC Upgrades, $50k every 5 years	AP	new	1 year	400	FY09-48		50	50	100	200	400
12.4	3	Wastewater SCADA Equipment (PLC) Replacement/Upgrade	AP	new	3 years	5,000	FY19-48				2,000	3,000	5,000
12.5	3	Wastewater Data Radio Replacement	AP	new	3 years	100	FY19-48				50	50	100
12.6	2	Wastewater Metering System Asset Protection Plan/Design/Construct $5M every 10 years	AP	new	3 years	20,000	FY14-48			5,000	5,000	10,000	20,000
		SUBTOTAL - Recommended - SCADA and Metering				25,500			50	5,050	7,150	13,250	25,500
		SUBTOTAL - Existing and Recommended - SCADA and Metering				42,960		15,511	799	6,250	7,150	13,250	42,960

CHAPTER 13
ENERGY MANAGEMENT AND ANCILLARY SERVICES

13.1 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, three specific support areas are detailed: (1) energy management, (2) laboratory services, and (3) information management. The current conditions and needs of each are discussed below along with corresponding recommendations. Since the three support areas apply to both the water and wastewater systems, the discussion and recommendations have been included in both the Wastewater Master Plan and the Water System Master Plan.

13.2 Energy Management

The Energy Management Section presented here is also presented as Chapter 10 of the Water System Master Plan. Utility costs are the second largest component of MWRA's direct expense budget, exceeded only by labor costs. In FY07, the MWRA budgeted approximately $23.1 million for electricity, $4.0 million for diesel fuel and $1.1 million for natural gas. These represent about 13.3 percent of total FY07 direct expenses. As MWRA has placed new facilities into service, demand for energy has grown. Growth in demand, coupled with the sharp rise in the cost of energy in recent years, has made energy management an increasingly important element of MWRA's overall rates management strategy. The key energy management strategies for the Authority should be to diversify its energy sources, include renewable energy in its portfolio, and reduce energy use whenever possible. Strategies are broken into demand-side strategies and supply-side strategies for the purpose of the Energy Management discussion in this Section. Demand-side strategies focus on opportunities to implement additional energy conservation measures as well as to 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 focus on the operational and economic feasibility of enrolling additional back-up generation assets in load reduction programs and evaluating opportunities to shave peak demand thereby reducing demand charges. If a capital project identified in this Section is associated with a particular facility (e.g. Deer Island or Winsor Power Station), cost and schedule information for that project can be found in the respective Chapter of the Water System or Wastewater Master Plan. For projects not identified with specific facilities, please see Table 9-1 of the Water System Master Plan.

Energy Use

Collectively, MWRA facilities use approximately 185.5 million kilowatt hours (kWh) of electricity each year which translates into an average load of approximately 21,700 kW. The bulk of MWRA energy consumption is used for the pumping and treatment of wastewater. Energy consumption within the water system is much less since over 80% of the water supplied by MWRA to its customer communities is delivered by gravity. The Carroll Water Treatment

Plant, however, is a significant electrical load requiring 15.5 million kWh per year, largely consumed in the generation of ozone which is the plant's primary water disinfectant. Electricity consumption within the MWRA system by asset class is presented in Table 13-1.

Table 13-1
Summary of MWRA Electricity Demand

Asset Class	Annual Consumption (kWh)	Percent Share
Wastewater Treatment	130,815,000	70.5%
Wastewater Pump Stations	7,617,000	4.1%
Headworks	9,442,000	5.1%
CSO Facilities	2,895,000	1.6%
Subtotal – Wastewater	*150,768,000*	*81.3%*
Water Treatment	15,448,000	8.1%
Water Pump Stations	12,314,000	6.6%
Storage/Transmission	3,093,00	1.7%
Subtotal Water	*30,856,000*	*16.6%*
Support Facilities	3,898,000	2.1
Total	**185,523,000**	**100.0%**

MWRA's eight largest accounts, presented in Table 10-2, account for almost 90 percent of demand for purchased electricity. The Deer Island Treatment Plant is, by far, the largest consumer of energy resources within the MWRA system, accounting for over 69 percent of Authority-wide demand for purchased electricity (128.7 million kWh).

Table 10-2
Largest MWRA Electric Accounts

Facility	Annual Consumption (kWh)	Percent Share
Deer Island Treatment Plant	128,716,000	69.4%
Carroll Water Treatment Plant	15,448,000	8.1%
Nut Island Headworks	5,294,000	2.9%
Chelsea Maintenance Facility	3,534,000	1.9%
Newton St. Water Pump Station	3,247,000	1.8%
Braintree/Weymouth Intermediate Wastewater Pump Station	3,000,000	1.6%
Spring St. Water Pump Station	2,321,000	1.3%
Clinton Treatment Plant	2,099,000	1.7%
Subtotal	*163,659,000*	*88.2%*
Other Facilities	21,864,000	11.8%
Total	**185,523,000**	**100.0%**

Energy Management Strategy

MWRA's approach to managing energy costs consists of both demand-side management (strategies to reduce the quantity of purchased power) and supply-side management (strategies to reduce the cost of purchased power).

Demand-side Management

MWRA has implemented a wide-range of projects and operational changes to reduce energy consumption at its facilities. For example, MWRA has made extensive use of energy efficient variable frequency drives ("VFDs") to control the operation of pumps and other large equipment at its water and wastewater facilities. The continuing rise in energy costs will reduce payback periods and enhance the economic feasibility of further investment in energy conservation measures. Therefore, MWRA should pursue the following recommendations:

- Undertake new audits and revisit old audits to identify cost effective energy conservation strategies. The cost of energy audits may be subsidized by Local Distribution Companies (NSTAR and NGrid). This initiative would also include other energy conservation efforts such as optimizing operation of HVAC systems in MWRA headworks facilities.
- Examine the benefits of using performance contracting for the implementation of demand-side management projects (MGL Chapter 25A Section 11C Contracts for Procurement of Energy Management Services).
- Prioritize energy conservation during the design of new facilities and rehabilitation of existing facilities, including installation of VFDs to control pumps and other large equipment.

In pursuing demand-side management strategies, it is important to recognize that MWRA manages large, complex industrial process facilities which involve a wide range of operational considerations, including worker health and safety, security, system reliability and environmental compliance. These issues must be carefully considered when evaluating energy conservation measures.

The second element of MWRA's demand-side management approach is to maximize the use of existing base-load self-generation assets and promote the development of new base-load self-generation assets to reduce or offset MWRA's need for purchased energy. MWRA has five principal base-load self-generation assets which are summarized in Table 10-3.

The Deer Island Steam Turbine Generator (STG) is the MWRA's most significant base-load self-generation asset. It generates the largest amount of electricity; the electricity generated is "behind the meter" (i.e. the power generated is consumed on-site thus avoiding not only the cost of electric energy but the transmission and distribution charges assessed by NSTAR to deliver the energy to Deer Island); and it is a renewable energy source (the STG is fueled by digester gas) making it eligible for renewable energy credits which provide approximately $1.0 million in annual revenue to MWRA. The Deer Island thermal plant and the STG are, however, oversized relative to the thermal load of the treatment plant (see detail on Deer Island STG in Section

6.11). As a result, the STG operates at a fraction of its rated capacity and is relatively inefficient, particularly in summer, when excess steam which could be used to generate electricity is dumped into the outfall tunnel. Therefore, MWRA should undertake the following:

- Evaluate the economic and engineering feasibility of replacing the existing steam turbine generator with a smaller more efficient design to maximize electricity production from Deer Island digester gas output. A $3.5 million CIP project is recommended in Section 6.11 for Deer Island STG replacement.

Table 10-3
MWRA Base-load Self-Generation Assets

Asset	Rated Capacity (kW)	Annual Output (kWh)	Comment
Cosgrove Hydroplant	2,500	7,000,000	Portion of output is behind the meter – offsets Western Operations demand. Balance of output is sold into the ISO-NE grid at real time prices
DITP Hydroplant	2,500	4,380,000	Behind the meter – offsets DITP demand
DITP Steam Turbine Generator	18,500	26,280,000	Behind the meter – offsets DITP demand. Renewal assets receives RPS credits
Oakdale Hydroplant	3,500	10,000,000	Operates seasonally based on transfer of flow from Quabbin to Wachusett. Output sold to West Boylston with revenue offsetting DCR watershed management costs
Winsor Dam Hydroplant		-	Not in service

The Cosgrove, Deer Island and Oakdale hydroplants are also important self-generation assets and MWRA should seek to optimize their operation to the extent permitted by operational consideration (see detail on the Deer Island hydroturbine generators in Section 6.11). Therefore, MWRA should:

- Seek to optimize performance of its existing hydroplants by insuring that equipment is adequately maintained to insure operational availability, and that flow through the facilities is maximized to the extent feasible without compromising other critical operational criteria.

The Winsor Dam hydroplant is inoperative due to a fire in 1991 that destroyed the electrical switchgear. At the time the fire occurred, hydropower re-development was not a priority given the low price for which electricity from the hydroplant could be sold into the regulated utility market and the capital costs of station rehabilitation (in addition to switchgear replacement, turbine/generator repairs were also required). Another factor that forestalled repair of the hydroplant was concern over potential licensing/permitting issues that could severely limit electricity output and adversely affect MWRA's ability to perform its key mission of supplying water. However, the need for valving and electrical work at Winsor Power Station is moving forward and this initial work will examine the feasibility of installing a smaller turbine in the hydroplant. Assuming such work is feasible, MWRA expects to initiate any required permitting with the goal of resuming hydropower production at the station.

In addition to hydropower already being produced at Cosgrove, Oakdale, and Deer Island; there is a new technology that uses the water pressure present in water pipes to produce energy. Gravity fed water systems use pressure release valves to reduce pressure resulting from the change in elevation between the water source and the customer. This new technology puts a micro hydroturbine onto these pressure release valves to harness the energy that would otherwise be lost when it dissipates through the friction of the valves. This energy is then sold back into the grid. Initial installations of this technology reveal that a typical system can generate around $25,000 per year in energy. Therefore, the MWRA should:

- Evaluate the feasibility of installing micro hydroturbines on pressure reducing valves in MWRA's water transmission system, and if applicable, install a micro hydroturbine at a test location in MWRA's water system to determine the applicability and reliability of these types of turbines.

MWRA's most significant demand-side management initiative is the development of new large-scale on-site self-generation assets to further reduce the demand for purchased electricity. Specifically, MWRA is evaluating the economic and engineering feasibility of installing wind turbines at MWRA sites. Wind turbines have several key features which make them attractive: they are a proven, cost-effective technology capable of generating significant amounts of electricity; they are quiet, safe and avoid production of greenhouse gases; and wind turbines are classified as a renewable energy source and, therefore, eligible to receive renewable energy credits.

As discussed above, it will generally be most advantageous for MWRA to site wind turbines in locations with large, steady electricity loads (e.g. Deer Island Treatment Plant, Carroll Water Treatment Plant, and Nut Island Headworks) so the power can be consumed on-site and thereby avoid not only the cost of the electricity itself but the transmission and distribution charges assessed by the Local Distribution Companies (NSTAR and NGrid) to deliver the electricity as well. These transmission and distribution charges account for a significant share of the delivered cost of electricity; and thus, behind the meter applications generally have more attractive economics. As a result, these are the sites where MWRA will focus its efforts, plus possibly sites where multiple turbines could be installed and generate sufficient electricity to make it cost effective to sell into the grid. Therefore, MWRA should undertake the following:

- Continue pursuing development of wind turbines on Deer Island and undertake studies to determine the economic, engineering and environmental feasibility of siting wind turbines at other MWRA facilities with a focus on those facilities with large loads and high load factors which could consume the generated power on site. This effort should also seek to maximize use of MTC's Large On-Site Renewables Initiative (LORI) program to provide funding for a portion of project implementation. A $150,000 study and $1.2 million construction placeholder are recommended as wind power CIP projects in Section 6.11.

Supply-side Management

The bulk of MWRA demand for purchased electricity is addressed through the procurement of competitive supply agreements in which the pricing for a portion of total demand is fixed and the balance is purchased in the hourly variable rate market at market clearing prices. This approach, coupled with the structure of MWRA fixed-price contracts, result in MWRA consistently purchasing electric power at rates below those charged by Local Distribution Companies under Basic Service. MWRA has been purchasing competitive supply for the Deer Island Treatment Plant since November 2001. MWRA plans to continue this approach for procuring electric power for the foreseeable future.

While this approach results in lower average electricity costs, it does expose MWRA to greater price volatility. An important strategy used to limit this volatility on Deer Island is to enroll the plant's significant back-up generation assets (Combustion Turbine Generators or CTGs) in load reduction (Price Response) programs managed by ISO-New England (operator of the regional electric grid). Under this program, Deer Island self-generates electricity and removes itself from the grid when ISO-New England declares a Price Response event. MWRA then receives a payment from ISO-New England based on the market price of power and avoids the high cost of peak market rate electricity as well as NSTAR transmission and distribution changes. These revenues and savings are partially offset by the cost of operating the CTGs (primarily diesel fuel), but the net result is significant economic benefit to MWRA while operating the CTGs on a fairly limited basis (e.g. less than 300 hours per year). Additionally, participation in these programs can result in significant reductions or elimination of capacity charges assessed by ISO New England on all customers and these charges are expected to increase over time.

Almost all MWRA operating facilities have back-up generating capability which could similarly be enrolled in load reduction programs. In particular, the John Carroll Water Treatment Plant has significant back-up generation capability, already permitted for non-emergency operation that could be utilized in this manner. Additionally, DEP has relaxed some restrictions on non-emergency operation of back-up generators to allow participation in these programs. Therefore, MWRA should undertake the following:

- Evaluate the operational and economic feasibility of enrolling the John Carroll Water Treatment Plant and other MWRA facilities with back-up generation capacity in ISO-New England load reduction programs.

Similarly, these self-generation assets could also be used for "peak shaving" to reduce transmission and distribution charges paid to Local Distribution Companies. These charges are generally calculated based on the total amount of electricity consumed (in kilowatt hours) and the monthly peak demand for electricity (in kilowatts). The latter "demand charges" can significantly increase the unit cost of electricity for facilities that may have relatively low average consumption, but whose demand can peak sharply, such as wastewater pump stations during a wet weather event. To potentially minimize these costs, MWRA should undertake the following:

- Evaluate the operational and economic feasibility of utilizing back-up generation capacity at MWRA facilities to shave peak demand and reduce demand charges. Also, review schedules for pump testing and other routine test procedures and evaluate the feasibility of performing testing during off-peak periods and modifying test procedures to limit peaks in demand.

Finally, certain MWRA facilities, such as water pump stations, have some degree of operating flexibility which may be used to smooth demand and shift electricity consumption to lower cost off-peak hours. To potentially reduce electricity costs, MWRA should undertake the following:

- Evaluate the operational and economic feasibility of modifying operation of water pump stations and other facilities to smooth electric demand, improve load factors, and shift electricity consumption to off-peak periods.

Summary of Energy Management Recommendations

All Master Plan projects related to Energy Management are summarized in this Section.

- Undertake new audits and revisit old audits to identify cost effective energy conservation strategies. The cost of energy audits may be subsidized by Local Distribution Companies (NSTAR and NGrid). This initiative would also include other energy conservation efforts such as optimizing operation of HVAC systems in MWRA headworks facilities.

- Examine the benefits of using performance contracting for the implementation of demand-side management projects (MGL Chapter 25A Section 11C Contracts for Procurement of Energy Management Services).

- Prioritize energy conservation during the design of new facilities and rehabilitation of existing facilities, including installation of VFDs to control pumps and other large equipment.

- Evaluate the economic and engineering feasibility of replacing the existing steam turbine generator with a smaller more efficient design to maximize electricity production from Deer Island digester gas output. A $3.5 million CIP project is recommended in Section 6.11 for Deer Island STG replacement.

- Seek to optimize performance of its existing hydroplants by insuring that equipment is adequately maintained to insure operational availability and that flow through the facilities is maximized to the extent feasible without compromising other critical operational criteria. Move forward with evaluation and rehabilitation of the hydroplant at Winsor Power Station.

- Evaluate the feasibility of installing a micro hydroturbine at a test location in MWRA's water system to determine the applicability and reliability of these types of turbines.

- Continue pursuing development of wind turbines on Deer Island and undertake studies to determine the economic, engineering and environmental feasibility of siting wind turbines at other MWRA facilities with a focus on those facilities with large loads and high load factors which could consume the generated power on site. This effort should also seek to maximize use of MTC's Large On-Site Renewables Initiative (LORI) program to provide funding for a portion of project implementation. A $150,000 study and $1.2 million construction placeholder are recommended as wind power CIP projects in Section 6.11.

- Evaluate the operational and economic feasibility of enrolling the John Carroll Water Treatment Plant and other MWRA facilities with back-up generation capacity in ISO-New England load reduction programs.

- Evaluate the operational and economic feasibility of utilizing back-up generation capacity at MWRA facilities to shave peak demand and reduce demand charges.

- Review schedules for pump testing and other routine test procedures and evaluate the feasibility of performing testing during off-peak periods and modifying test procedures to limit peaks in demand.

- Evaluate the operational and economic feasibility of modifying operation of water pump stations and other facilities to smooth electric demand, improve load factors, and shift electricity consumption to off-peak periods.

- Assess how energy related projects get prioritized, especially in relation to construction or engineering projects. These types of project could improve the efficiency of our facilities and save significant dollars in the long term, but whose immediate, tangible benefits are less obvious.

13.3 Laboratory Services

The Laboratory Services Section presented here is also presented in Chapter 9 of the Water System Master Plan. MWRA's laboratory services are client based. Clients include Deer Island, ENQUAD, TRAC and Drinking Water Programs (including MWRA communities). To accommodate the range of program needs, the geographic range of the MWRA system and types of samples to be analyzed requires multiple facilities and MWRA operates laboratory facilities in Chelsea, Clinton, Quabbin, Southborough and the Central Lab, located on Deer Island.

Samples are generally taken by staff within various programs and submitted to the appropriate lab for analyses in compliance with a range of regulatory requirements. For example, TRAC staff sample industrial discharges for permit compliance and 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, the Central Lab analyzes more than 300,000 samples per year and the Chelsea Lab analyzes approximately 2,000 total coliform samples per month for 37 MWRA communities. This latter work, for communities, allows MWRA to both ensure sampling consistency and to be in a position to recognize patterns of bacterial contamination that could potentially occur in the water distribution system. Overall, 85 percent of the analyses conducted in the Chelsea Lab are done for communities. The Lab also analyzes all DCR's samples in accordance with the MOU between MWRA and DCR.

Given the magnitude of the work effort, the master planning related challenges faced by Laboratory Services are significant. Staff safety while handling and analyzing samples must be protected through training and maintenance of laboratory equipment. Staff resources must be allocated efficiently to ongoing work while thinking ahead to potential regulatory changes that may occur, particularly the identification of emerging contaminants. The lab 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 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 lab services 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 lab work load and significant advances in technology. Projects identified for Laboratory Services address these challenges.

Facility needs generally include the need to periodically reconfigure space for gains in efficiency or to adapt to new test and/or equipment requirements. This is of particular importance at the Central Lab. An ongoing means to accomplish such reconfigurations should be addressed jointly by Laboratory Services, appropriate Deer Island Managers, Operations, and Finance.

Laboratory facilities at Quabbin Reservoir are currently housed in DCR facilities at the Reservoir. As part of the Concept Design for future improvements at the Ware Disinfection Facility, the plan includes construction of new laboratory facilities to replace the facilities used by MWRA staff at Quabbin.

In addition, periodic replacement of analytical or safety equipment is necessary. Ventilation equipment is particularly critical in this regard. Fume hoods at the Central Lab are now recommended for replacement both to address worker safety and to preserve sensitive analytical equipment. The fume hoods in the metals lab need to be replaced because they have corroded due to acid used in the test. This is a recurring expense approximately every 15 years.

Data management needs are being addressed in the short-term through the replacement of the Laboratory Information Management System (LIMS). This system has not been upgraded since 1993 and significant improvements in software options and functionality have occurred since then. A competitive bid is expected to be released in FY07 with an award recommendation to the Board in early FY08. The benefits of a new LIM System are more automation, consolidation of data, and the ability to automate responses to DEP regarding reporting requirements. There will likely be a need for reprogramming of other linked in-house databases once a new LIMS system is selected. This work will be addressed by MIS. Any additional data management tools necessary to more fully utilize and interface with an updated LIMS system will be identified and coordinated between MIS and laboratory staff and identified as part of the LIMS procurement or as a subsequent capital project.

Summary of Laboratory Services Recommendations

All Master Plan projects related to Laboratory Services are summarized in this Section. Projects programmed in the FY07 CIP under Deer Island are specifically noted below. Estimated costs associated with new projects recommended for consideration in the FY08 CIP are included in Chapter 9 of the Water System Master Plan (see Table 9-1 of the Water System Master Plan).

- Move forward as planned in 2007 with the LIMS upgrade and any ancillary in-house data management improvements. Discuss with MIS how the proposed purchase of a Chromatography Data Management Server, or a more global instrument data management system (which could include a server-based approach to managing instrument data and interfacing with LIMS), fits into the LIMS procurement. Laboratory Services has identified a need for this type of system at an estimated cost of $250,000 to be spent in FY09.

- Replace the fume hoods at the Central Lab at a cost of $270,000. A $134,000 project for Metals Lab Fume Hood Replacement is programmed in the FY07 CIP and included in the existing projects in Section 6.13 for Deer Island Additional Support Systems.

- Operations staff including Lab Services, Deer Island and Chelsea facilities staff and Operation Administration should develop an ongoing means to efficiently and quickly reconfigure laboratory space to accommodate new sampling requirements or new equipment. This will allow the lab to maintain high levels of efficiency with minimum disruptions to ongoing work by staff. As part of this effort, Laboratory Services staff should identify any technological changes or equipment that will assist in improving staff efficiency. A $919,000 project for Metals Lab Modification Construction and a $552,000 project for Lab Sample Area Modifications Design and Construction are programmed in the FY07 CIP and included in the existing projects in Section 6.13 for Deer Island Additional Support Systems.

- Purchase major laboratory instrumentation, such as high resolution GC-MS (gas chromatography-mass spectrometry) or LC-MS (liquid chromatography-mass spectrometry) to facilitate laboratory operations at a cost of $1 million in FY09-10.

13.4 Information Management

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.

Record drawings are the major category of information maintained by MWRA and these also provide the basis for MWRA's GIS-based mapping and modeling systems. In addition, MWRA uses MAXIMO as a work order-based maintenance system which can provide useful information on asset condition and the need to plan for rehabilitation or replacement of equipment. Individual facility sites often have specific facility handbooks on site and this type of information should also be kept up to date as facility changes are made. Each type of information resource is discussed below and recommendations focus on ways to improve the access to and accuracy of key MWRA asset and facility information to ensure its availability when needed. In contrast to other sections of the Master Plan, while there may be need for consultant support to facilitate initial document control system improvements, the recommendations below focus on the need to develop and use standard procedures both for information provided by consultants and for information obtained by in-house staff. At the start of FY07, MIS initiated a MWRA-wide steering committee to address GIS priorities and data related improvements. The goal is to develop an Information Management Business Plan by staff representing Planning, Field Operations, Water and Wastewater Engineering and MIS. This Data Resources committee will be expanded to include records drawing data standards, priorities, and plans in late FY07.

Record Drawing Management

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 45,000 of those drawings has been electronically scanned to the network. Record drawings at these locations vary from complete sets on recent contracts, to incomplete sets on pre-MWRA contracts, and partial sets for others. Design Information Systems Center (DISC) staff in Wastewater Engineering 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, 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. Minor changes will be made in FY07 by MIS to expand the capability to address waterworks drawings but this is only a short-term solution.

InfoStar requires replacement since the product is obsolete and there is no vendor support. Newer technology would provide improved efficiency and management control.

- The Data Resources committee will develop plans, process improvements, data standards and recommendations to address a number of needed changes, work backlog and system replacement. The committee will make specific recommendations that may lead to CIP projects, CEB spending, and/or in-house staff tasks. These plans will also be included in the MIS Master Plan.

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 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.

In considering mapping and modeling information, the flow of information is as follows:

Project →Project doc. mgmt. →Digital doc. Mgmt. →Digital info. mgmt. →Info. surfing
(hardcopy) (electronic copy)

The digital information management includes both a spatial and a non-spatial component. The spatial component includes the GIS information such as pipes, parcels, manholes, etc. and the non-spatial component is the connection to programs such as MAXIMO and LIMS. There, the Data Resources committee will address needed improvements. Examples include:

1) Standardizing nomenclature (e.g. W12 or 12W, Spring Street P.S. or Arlington P.S.), data formats (e.g. Excel vs. Access, upper case vs. lower case) and data to be collected across all projects.

2) Data maintenance and version control (e.g. to ensure intermediate, final and official Authority versions are delineated for all to use).

<u>Recommendations for Records Management and Mapping and Modeling</u>: Estimated costs associated with new projects recommended for consideration in the FY08 CIP are included in Chapter 9 of the Water System Master Plan (see Table 9-1 of the Water System Master Plan).

- As previously indicated, the Data Resources committee will identify recommendations and additional CIP budget needed to evolve records management, mapping and modeling into a more integrated resource. For Master Planning purposes, staff has included $930,000 in Table 9-1 of the Water System Master Plan for the planning and implementation of these improvements. Additionally, the committee will consider enhancements to MWRA's data use, such as new potential applications and consider pilot projects to demonstrate them (e.g. pollution tracing, call center, etc.). Over the longer term, expansion of modeling efforts beyond hydraulic modeling to encompass other types of modeling would appear to be beneficial. Examples include water quality modeling, modeling of the behavior of water and wastewater while in the pipes, and modeling of potential releases to the wastewater or water system. No funds are proposed at this time for system enhancements.

- The Committee should also provide guidance on the Distribution Systems Facilities Mapping-Records Development. This project will create record drawings and detail records for high priority areas of the water distribution system where such records do not currently exist. Funds are programmed in the FY07 CIP with expected costs of $1.268 million in the FY07-13 time period.

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 regularly 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. Some next steps for wider use of MAXIMO include how to better schedule staff activities based on time they've spent on those activities in the past, prioritizing work and assigning criticality, and using it more to support proactive asset management. For example, MWRA can use MAXIMO to better track equipment use as well as the occurrence of problems with each piece of equipment in order to optimize our assets. In addition, MAXIMO could be the repository for condition information that then could be used to provide critical information to other programs, such as GIS, SAMS, and the hydraulic modeling program. For example, the hydraulic model could obtain from MAXIMO the current position and operability of valves.

<u>Recommendations for Work Order Management</u>:

- Establish a project manager position to manage the preventative maintenance and asset management piece and to provide QA/QC support to the program. In addition, this staff person could function as the asset manager in the Work Coordination Center using MAXIMO to produce reports and analyze data concerning equipment use and failure, frequency and types of maintenance performed, and infrastructure behavior. The creation of this position was recommended by an internal audit done in September 2005.

- Integrate MAXIMO with other programs such as GIS, SAMS, and the hydraulic model to assist in the management and operation of the water and sewer system.

- Implement the use of wireless handheld devices so information can be made readily available in the field.

CHAPTER 14
CLINTON ADVANCED WASTEWATER TREATMENT PLANT

14.1 Chapter Summary

The Clinton Wastewater Treatment Plant (CLTP) provides advanced sewage treatment services to the Town of Clinton and a portion of Lancaster, the Lancaster Sewer District. Since assuming formal operational responsibility for the plant in 1987, MWRA has designed and constructed new primary and secondary treatment facilities that incorporate rehabilitated portions of the existing plant with new construction. 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 CLTP is $50 million (1% of wastewater system asset value).

The Clinton Wastewater Treatment Plant is less than 15 years old and in generally good condition. Some minor equipment rehabilitation and replacement projects are recommended, however, significant reinvestment is not required in the short-term. Operability of mechanical equipment and maintenance of electric/standby power systems are key elements to minimize risk of component failure. Malfunction of mechanical equipment may impact wastewater treatment, particularly during large storm events that stress the hydraulic capacity of the facility. 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 CLTP uncertainties include technology upgrades to meet future regulatory requirements.

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 $300,000 per year beginning in FY14 is recommended as a place-holder to fund smaller scale Clinton projects that, individually, may not be seen as high priority.

For the Clinton Wastewater Treatment Plant, $24.525 million in projects is identified in the 40-year master plan timeframe (FY07-48). Two projects are currently programmed in the FY07 CIP, but these projects are carried under the Deer Island Treatment Plant budget, not under the Clinton budget. Seventeen additional projects ($24.525 million) are recommended for inclusion in the FY08 CIP. Section 14.6 – Summary of Existing and Recommended Capital Projects includes a consolidated list of all projects recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $975,000 in needs identified for FY09-13 and recommended for the FY08 CIP:
  - $200,000 to plan and implement the closure of Landfill Cell #1.
  - $150,000 to rehabilitation the rubber roofing on all buildings.
  - $350,000 to internally inspect, clean, and rehabilitate two digesters.
  - $175,000 to replace/rehabilitation 4 process water pumps.
  - $100,000 to upgrade security at the treatment plant and the landfill.

Mid-term (FY14-18):

- $9.55 million in needs identified for FY14-18 and recommended for the FY08 CIP:
  - $1.5 million for a long-term asset protection program (first 5 years at $300,000 per year).
  - $3 million to improve plant processes technology.
  - $2 million to upgrade technology to meet future regulatory requirements.
  - $750,000 to replace 3 influent and 3 intermediate lift pumps.
  - $100,000 to repair/seal the plant roadway.
  - $700,000 to rehabilitate or replace grit removal facilities.
  - $1.5 million to replace the belt filter press with emerging technology.

Long-term (FY19-28 and FY29-48):

- $14 million in needs is identified for FY19-28 and FY29-48 and recommended for inclusion in the FY08 CIP:
  - $3 million in FY19-28 and $6 million in FY29-48 to continue a long-term asset protection program (at $300,000 per year).
  - $1 million to expand the landfill and add a fourth cell.
  - $1 million to add a fourth tank to the secondary clariflocculator.
  - $3 million to add a UV disinfection system.

14.2 Facilities Overview

The Clinton Wastewater Treatment Plant provides advanced sewage treatment services to the Town of Clinton and a portion of Lancaster, the Lancaster Sewer District. The location of the CLTP and the sludge landfill are shown on Figure 14-1, and an aerial photograph of the plant is show in Figure 14-2. Since assuming formal operational responsibility for the plant in 1987, MWRA has designed and constructed new primary and secondary treatment facilities that incorporate rehabilitated portions of the existing plant with new construction. The new facilities, completed in 1992, provide secondary treatment using an activated sludge process in combination with advanced nutrient removal and dechlorination. The major facilities include a headworks, primary settling tanks, digesters, sludge processor, trickling filters, aeration tanks, secondary tanks, and a chemical addition building. 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.

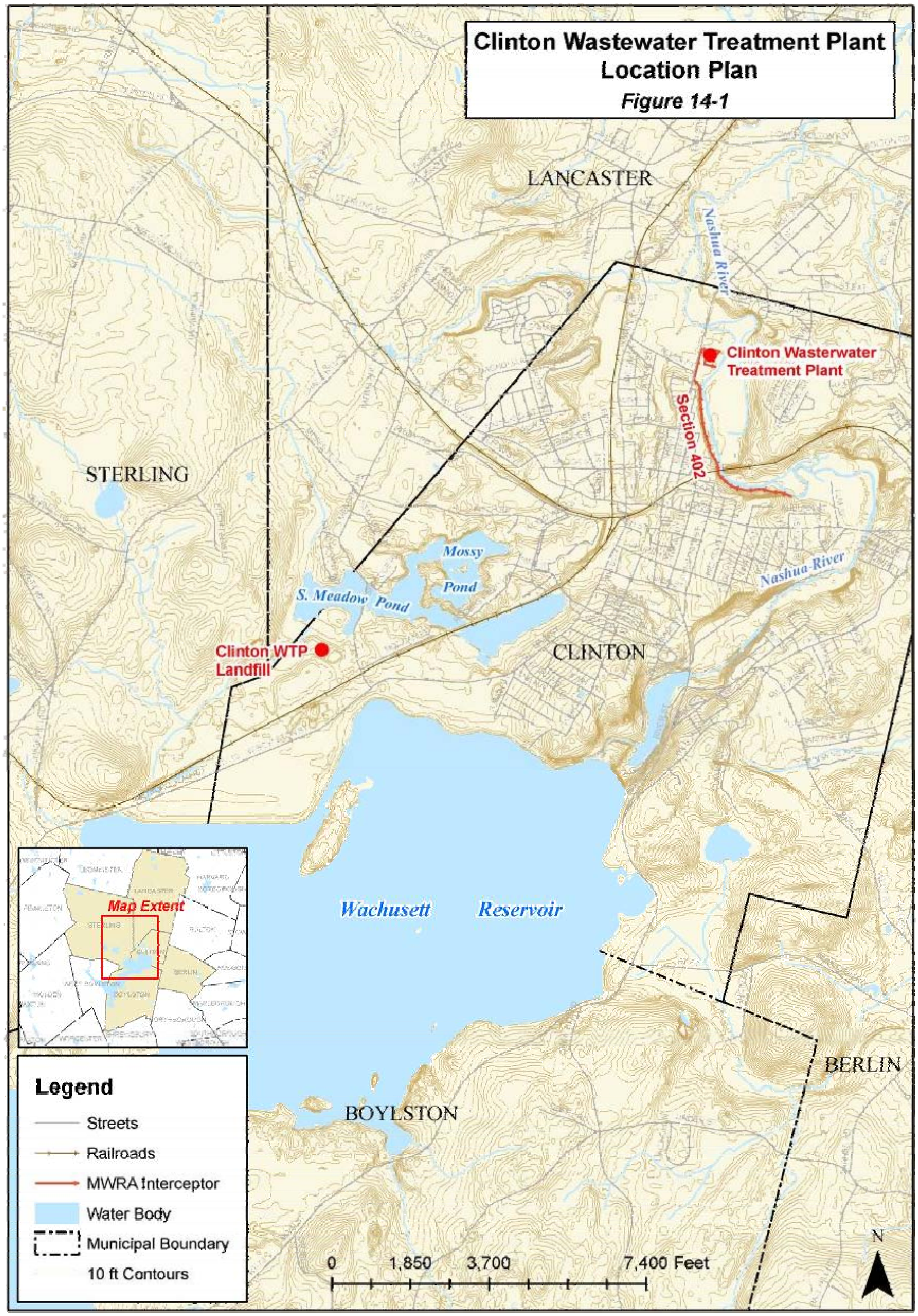

Clinton Wastewater Treatment Plant
Location Plan
Figure 14-1
LANCASTER
Nashua River
Clinton Wasterwater
Treatment Plant
Section 402
STERLING
Mossy
Pond
S. Meadow Pond
Nashua River
Clinton WTP
Landfill
CLINTON
Map Extent
Wachusett Reservoir
BERLIN
BOYLSTON
Legend
Streets
Railroads
MWRA Interceptor
Water Body
Municipal Boundary
10 ft Contours
0
1,850
3,700
7,400 Feet
N

Figure 14-2

Residual materials are dewatered (pressed) and transported to an MWRA-owned landfill for disposal. Staff also perform regular monitoring of the landfill site. 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 Wastewater Treatment Plant is the responsibility of the Superintendent under the supervision of the Director of Wastewater Treatment. The Wastewater Treatment Division 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, Area Supervisor, and Maintenance and Operations Specialist. A total of about 7 employees are responsible for the operation and maintenance of the CLTP. Two Laboratory Services staff (Chemist II, and Chemist III) are also located at the CLTP.

<u>Operation and Maintenance:</u> 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.

<u>Plant History</u>: In 1898, MWRA's predecessor, the Metropolitan Water District [which was later reorganized into the Metropolitan District Commission (MDC)], entered into an agreement with the Town of Clinton to provide wastewater treatment and water services in return for land used to build the Wachusett Dam and Reservoir. The original Clinton Wastewater Treatment Plant was built in 1955 by the MDC. In 1987, the responsibility of operating and maintaining the CLTP was transferred from the MDC to MWRA by the Massachusetts Legislature.

<u>Clinton National Pollutant Discharge Elimination System (NPDES) Permit</u>: Plant performance has dramatically improved since construction of the advanced wastewater facility in 1992. Prior to its completion, the plant periodically exceeded permit limits for conventional pollutants including pH, dissolved oxygen, BOD, and TSS. The new plant has never exceeded these parameters and only rarely exceeds biotoxicity tests. The current NPDES Permit for the CLTP limits effluent flow to 3.01 mgd (annual average using the reporting month and monthly averages for the preceding 11 months). The CY 05 effluent flow has exceeded the NPDES limit with an annual average daily flow of 3.34 mgd. The CY06 effluent flows continue to exceed the NPDES limit through November with an average daily flow of 3.51 mgd. The Authority has been reporting this exceedance each month since the first occurrence in March 2005. The facility's flow is calculated using a 12-month running average and it is believed that the exceedance is directly attributed to the wet weather impact of groundwater infiltration and stormwater inflow on the local collection systems. The Town of Clinton and the Lancaster Sewer District are co-permittees on two sections of the plants NPDES permit. The two sections address conditions regarding the operation and maintenance of the local collection systems owned and operated by the Towns.

As of December 2006, MWRA is awaiting a new NPDES permit for the CLTP. The current permit expired in 2005, but remains in force until EPA issues a new permit. MWRA's application for renewal of the NPDES Permit was submitted in May 2005. Future regulatory requirements and potential changes to the NPDES Permit may impact MWRA's recommended capital projects (see more detail in Chapter 4). Staff recommend two projects in the FY14-18 timeframe to improve plant process technology and upgrade technology to meet future regulatory requirements. The recommended projects are detailed in Section 14.6. Potential impacts on CLTP due to regulatory issues include:

- Effluent phosphorus: Draft state water quality standards include more stringent phosphorus criteria. CLTP may be required to change its existing seasonal phosphorus treatment to year-round nutrient removal or new nutrient removal technologies.

- Effluent copper: EPA copper criteria have been a persistent problem state-wide because of relatively high natural background levels. CLTP has received interim permit limits as part of a 2002 EPA-imposed Administrative Order. If Clinton has to meet the current or more stringent limits, it is likely that MWRA would do a site-specific study of the effect of Clinton copper discharges on the river. Copper limits are not expected to become more stringent, but until DEP finalizes proposed Water Quality Standards, MWRA must be prepared to address the issue.

14.3 MWRA and Local Collection Systems

MWRA owns and maintains approximately one mile of 20-inch, 24-inch and 30-inch interceptor that parallels the South Branch of the Nashua River between High and Williams Streets. The interceptor is constructed of vitrified clay and brick pipe and serves primarily residential areas. During the late 1980's, internal TV inspection of the MWRA-owned interceptor resulted in concern regarding the structural integrity of the pipeline. In 1992, MWRA installed approximately 2500 linear feet (phase 1 lining) of cured-in-place pipe (CIPP) in the MWRA-owned interceptor. The remaining 3000 linear feet was lined using CIPP during the fall of 1999 to spring of 2000 (phase 2 lining). The relined interceptor is essential in new condition. Post construction internal inspection showed no I/I within the MWRA-owned interceptor. In addition to the pipeline rehabilitation, the interior of every MWRA-owned manhole was coated with an epoxy lining to eliminate infiltration and extend the useful life of the existing brick. MWRA Field Operation staff periodically re-inspect the MWRA-owned interceptor and manholes.

<u>Clinton Collection System</u>: The Clinton wastewater collection system includes approximately 40 miles of sewers ranging in diameter from 8 to 30 inches. Parts of the sewer system date back to the mid-1880's when the development of the textile industry and related population increase encouraged sewer construction. Wastewater flows from various sections of Clinton are collected by two circular brick interceptors. A 30-inch interceptor, known as the Counterpane Brook Interceptor, parallels Counterpane Brook. It originally discharged into the South Branch of the Nashua River at the intersection of High and Allen Streets. It conveys about 70 percent of flow to the CLTP. The second major Town-owned sewer connects to the upstream end of the 20-inch MWRA interceptor. This line serves primarily residential areas. Most of the Clinton collection system is gravity flow; however, there are four small package pump stations. Three of these pump stations, located on the northeast side of the Nashua River, are required to convey flow across the river's flood plain to the treatment plant. A majority of the lateral sewers in the highly developed downtown section of Clinton are vitrified clay pipe constructed between 1885 and 1910. Very little sewer construction was undertaken between 1910 and 1960. Since that time,

substantial additions to the Town's wastewater collection system have been made. The primary focus of the sewer construction has been in three areas: (1) the residential area of Clinton between Coachlace Pond and Park Street, (2) the northwest section of town in the vicinity of Clinton Hospital, and (3) the northeast section of town between the South Branch of the Nashua River and the Towns of Lancaster and Bolton. These new sewers are primarily 8-inch diameter clay and asbestos cement pipe with rubber O-ring joints.

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 three small pump stations and approximately nine miles of pipeline, primarily 8, 10, and 12-inch diameter lateral sewers. The Town's one main interceptor (15 to 36-inch diameter) collects flow from the lateral sewers and connects to the Clinton collection system on High Street.

14.4 Wastewater Flows and Loads

Wastewater Flow: CLTP influent and effluent flow data are part of monthly NPDES reporting. MWRA also submits an annual wastewater flow report to US EPA and MA DEP annually (prior to February 28) as required under the NPDES Permit. The report provides an analysis of infiltration and inflow (I/I) trends. Under the Permit, each permitee (MWRA, the Town of Clinton, and the Town of Lancaster Sewer District) shall eliminate excessive I/I to the sewer collection system which it owns and operates. The CLTP effluent average daily flow (ADF) for six calendar years (2000 through 2005) and corresponding annual rainfall are provided in Table 14-1, below.

Table 14-1

Calendar Year	Effluent Average Daily Flow (mgd)	Annual (inches)
CY00	2.54	50.3
CY01	2.55	36.6
CY02	2.27	45.6
CY03	2.90	44.4
CY04	2.82	49.2
CY05	3.34	43.7
Six Year Average	2.74	45.0

The Clinton NPDES Permit limit for effluent flow is 3.01 mgd (annual average using the reporting month and monthly averages for the preceding 11 months). The CY05 effluent flow has exceeded the NPDES limit with an annual average daily flow of 3.34 mgd. The 12 month running average flow through November 2006 was 3.51 mgd. The Authority has been reporting this exceedance each month since the first occurrence in March 2005. If, in the future, the

Authority decides to increase releases from the Wachusett Reservoir to the Nashua River, a higher flow limit may be negotiated based on increased dilution.

Wastewater flow increases over the last four years may be attributed to a combination of higher sanitary flows and infiltration/inflow from the local collection systems. The relined MWRA-owned interceptor is essentially in new condition and post construction internal inspection showed no I/I. For the Master Plan, no capital projects are recommended for the MWRA-owned interceptor. Using current expense budget funds, MWRA Field Operation staff should continue to periodically re-inspect the MWRA-owned interceptor and manholes.

Analysis of CLTP influent wastewater flow (from the annual wastewater flow reports) estimates Clinton and Lancaster sanitary flows at approximately 1.25 mgd, groundwater infiltration ranging from approximately 1.0 mgd in low groundwater to 2.0 mgd in high (spring) groundwater; and stormwater inflow (from a 1.7-inch DEP design storm) at approximately 1.7 mgd. Since the annual flow analysis performed by MWRA staff is not highly detailed, a portion of the wastewater flow estimated to be groundwater infiltration may actually be industrial flow contributed from 24-hour process operations. Given the uncertainty of the I/I analysis, it is fair to say that influent wastewater flow to the CLTP is significantly influenced by I/I entering the local collection systems. Due to these significant I/I flows, DEP (per DEP Administrative Consent Order) currently requires developers proposing to add new sanitary flows in Clinton to offset the proposed new sanitary flows by removing twice the volume of I/I from the local sewer system.

Since each of the upstream co-permitee communities (Town of Clinton and Town of Lancaster Sewer District) are responsible for eliminate excessive I/I to the sewer collection system which it owns and operates, no Master Plan capital projects are recommended for the locally-owned collection system.

Wastewater Loads: MWRA submits monthly effluent sampling records to EPA and MA DEP for the following wastewater load parameters: Biological Oxygen Demand (5-day), Total Suspended Solids, Fecal Coliform, Total Residual Chlorine, Total Copper, Total Phosphorus, Total Ammonia Nitrogen, Dissolved Oxygen, and pH. From January 2005 through November 2006, only the total residual chlorine levels have exceeded the NPDES permit limits. Both occurrences were due to minor maintenance issues. Sampling frequencies and discharge monitoring limits are presented in Table 14-2. None of the wastewater load parameters are anticipated to change significantly over time. The need for capital projects to address wastewater loads will most likely be based on revised NPDES permit limits, as previously noted in Section 14.2.

14.5 Detail on Facility Operations

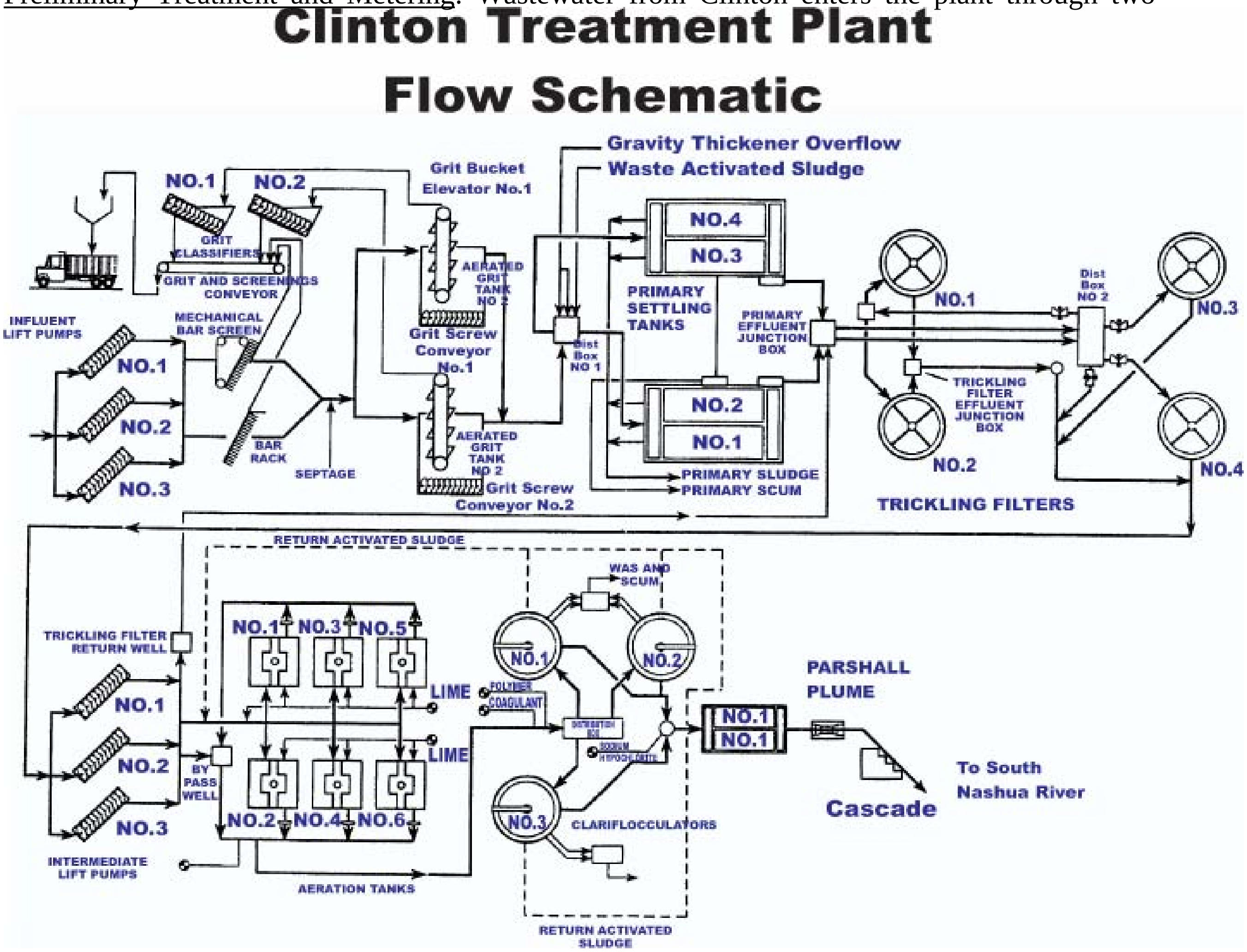
Major CLTP processes include a preliminary treatment, primary treatment, secondary treatment, effluent disinfection and dechlorination, and residuals processing. The plant effluent is discharged into the South Nashua River in accordance with the discharge limits of the facility's NPDES permit. Residual materials are digested, dewatered (pressed), and transported to an MWRA-owned dedicated landfill for disposal. The CLTP process flow schematic is presented as Figure 14-4.

Table 14-2

Effluent Characteristic	Units	Monthly Average	Discharge Limit Weekly Average	Daily Maximum	Monitoring Requirement Measurement Frequency	Sample Type
Flow	mgd	3.01	---	Report	Continuous	Recorder
BOD_5	mg/L lbs/day	20 500	20	Report	3/Week	24-Hour Composite
TSS	mg/L lbs/day	20 500	20	Report	3/Week	24-Hour Composite
Fecal Coliform	#/100 mL	200	---	400	3/Day	Grab
Total Residual Chlorine	ug/L	50	---	50	3/Day	Grab
Copper, Total	ug/L	20	---	---	1/Month	Grab
Total Phosphorus (5/1-10/31)	mg/L	1	---	Report	1/Week	24-Hour Composite
Total Ammonia Nitrogen (4/1-4/30)	mg/L	10	---	Report	1/Two Weeks	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	---	3	3/Week	24-Hour Composite
Total Ammonia Nitrogen (11/1-3/31)	mg/L	10	---	35.2	1/Month	24-Hour Composite
Dissolved Oxygen	mg/L	6 mg/L daily minimum			1/Day	Grab
pH	SU	6.5-8.3			1/Day	Grab

Figure 14-4

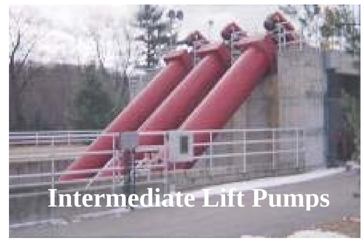
<u>Preliminary Treatment and Metering</u>: Wastewater from Clinton enters the plant through two



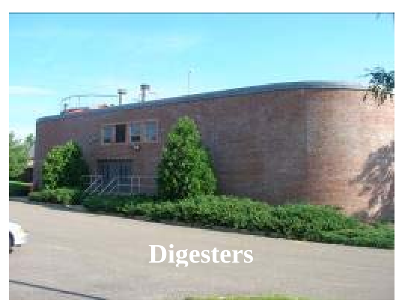
connections: (1) a 24-inch diameter reinforced concrete sewer connected to the MWRA 30-inch diameter interceptor in High Street (contributing almost all of Clinton's flow), and (2) an 18-inch diameter reinforced concrete sewer connected to the Lancaster interceptor in High Street. Wastewater flow is conveyed into the facility by three influent lift pumps. Flow passes through a metering station, then through 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. Looking ahead, staff recommend two projects for asset replacement in the FY14-18 timeframe. The projects include $750,000 for replacement of three influent and three intermediate lift pumps and $700,000 to rehabilitate or replace grit removal facilities with updated equipment (see project detail in Section 14.6).

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.

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 (new construction 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-feet by 50-feet by 17-feet). From the aeration tanks, wastewater is conveyed to three 80.25-foot diameter clariflocculators. Nitrification at the CLTP is accomplished in the activated sludge tanks. Nitrogen removal takes place in the activated sludge process at the aeration basins. Nitrogen removal is desirable to reduce nutrient levels to the receiving water thereby inhibiting algae growth and reducing oxygen demand on the river. Nitrification 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. Phosphorous removal is accomplished by the addition of aluminum sulfate in the return line of the aeration tanks. The alum precipitates phosphate at the final clarifiers (clariflocculators), settling it out with the sludge. Alum has an additional advantage of coagulating suspended solids to achieve a high effluent quality. Under normal and peak flow conditions, most of the equipment works well and there are no performance problems. An existing project programmed in the FY07 CIP at $288,000 will replace the soda ash (dry lime) addition system in the aeration process (see project detail in Section 14.6). In the FY19-28 period of the Master Plan, staff recommend a project to add a fourth clariflocculator tank at an estimated cost of $1 million (see project detail in Section 14.6).


Intermediate Lift Pumps

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 one Parshall flume and one step 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 FY19-28 period of the Master Plan, staff recommend a project to add an ultraviolet (UV) disinfection system at an estimated cost of $3 million (see project detail in Section 14.6).


Digesters

Residuals Process: 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 residuals landfill located in Clinton. The sludge landfill is lined and includes a leachate collection system that pumps leachate to the Clinton sewer system. The residuals process equipment works well and there are no performance problems. Staff recommend two residuals projects be undertaken during the FY09-13 timeframe. First, a project to internally inspect, clean and rehabilitate the two sludge digesters at an estimated cost of $375,000; and second, a project to plan and implement the closure of cell #1 at the Clinton residuals landfill at an estimated cost of $200,000. A project to replace the two belt filter presses with updated equipment is recommended for the FY14-18 timeframe at an estimated cost of $1.5 million. In the FY19-28 period of the Master Plan, staff recommend a project to expand the Clinton residuals landfill and add a fourth cell at an estimated cost of $1 million. Each of the four recommended residuals projects are detailed in Section 14.6.

Utilities and Plant Components: The primary electric feed to the CLTP is from local commercial service. The plant experienced a catastrophic loss of power in 2005 when a truck struck a utility pole just outside the plant. The only source of power into the plant was out-of-service for an extended period (six hours). The plant has existing backup diesel generator power for only the primary portion of the plant, including: influent pumping, primary sedimentation tanks, primary sludge pumping, and disinfection. The secondary portion of the treatment process does not currently have a dedicated backup diesel generator power, but can be supplied with emergency power using portable generators from off-site. Historically, utility power interruptions are relatively short-lived (less than 2 hours in duration), which would generally not caused NPDES violations if backup power was not provided. As part of an agency-wide effort to ensure power reliability at all critical facilities, a project to install a new 350 KW permanent diesel standby generator to provide backup electrical power to the secondary treatment portion of the CLTP is programmed in the FY07 CIP at $259,000 (see project detail in Section 14.6).

Four additional projects recommended to maintain operability of additional plant components include: (1) replace/rehabilitation four process water pumps at an estimated cost of $175,000; (2) upgrade security at the CLTP and Clinton residuals landfill at an estimated cost of $100,000; (3) rehabilitate the rubber roofing on all buildings at an estimated cost of $150,000; and (4) repair/seal the CLTP roadway at an estimated cost of $100,000. Each of the four recommended utility/component projects are detailed in Section 14.6.

14.6 Summary of Existing and Recommended Capital Projects

All Master Plan projects related to the Clinton Wastewater Treatment Plant are summarized in this Section. Table 14-3 lists each project, its priority ranking, and the proposed expenditure schedule. A detailed description and needs justification for each project is listed in bullet format.

Projects in the Existing FY07 CIP: There are two new projects for the Clinton Wastewater Treatment Plant programmed in the FY07 CIP. The projects are described below and summarized in Table 14-3 (see line numbers 14.1 and 14.2).


Soda Ash Delivery Machine

- A project to replace the Clinton soda ash system is programmed in the FY07 CIP at $288,000. This one year project will replace all existing equipment, piping, and wiring between the dual discharge bin activator and the existing discharge lines from the slakers to the slurry tanks. The new dry system would provide dual trains from the existing bin activator to the slurry tanks and consist of the following major components: two knife gate valves, two lump breakers, two pre-feeders, two intermediate hoppers, two screw feeders, two solution tanks with electric mixers, one control panel, piping and valves to connect the existing service water piping system, and one new silo air dryer. Discussions were held with the bin activator manufacturer and, based on an assessment of existing equipment, it was determined that the existing soda ash dry delivery system, truck unloading station, silo, and dual discharge bin activator are in good condition and should remain in service as part of a new dry delivery system. The existing slurry tanks and soda ash dosing system in the basement level are also recommended to remain in service as part of this upgrade. This project is recommended to be completed in FY08.

- A project to install a new 350 KW permanent diesel standby generator to provide backup electrical power to the secondary treatment portion of the Clinton Treatment Plant is programmed in the FY07 CIP at $259,000. This one year project will replace all secondary system electrical power backup, automatic transfer switches, and concrete pad for permanent generator mount. In addition, a manual transfer switch will be incorporated to allow operators to transfer power from the new backup generator to the primary portion of the plant. The project will provide backup electrical power in the event the utility source is disrupted due to unforeseen circumstance such as severe weather, storm or accident. A permanent standby backup generator for the primary treatment process is already in place. This project is recommended to be completed in FY08.

Projects Recommended for Consideration in the FY08 CIP: There are 15 new projects for the Clinton Wastewater Treatment Plant recommended for consideration in the CIP. The projects are described below and summarized in Table 14-3 (see line numbers 14.3 through 14.17).

- A long-term asset protection project is recommended at $300,000 per year beginning in FY14. This project 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 herein for the FY09-13 timeframe.

- A project to replace/rehabilitation four CLTP process water pumps is recommended at an estimated cost of $175,000. This project has a 2 year duration and is recommended for the FY09-13 timeframe. Due to the relatively low cost of this project, it may be a candidate for CEB funding.
- A project to internally inspect, clean and rehabilitate two CLTP sludge digesters is recommended at an estimated cost of $375,000. This project has a 2 year duration and is recommended for the FY09-13 timeframe. Due to the relatively low cost of this project, it may be a candidate for CEB funding.

- A project to plan and implement the closure of Clinton residuals landfill cell #1 is recommended at an estimated cost of $200,000. This project has a 2 year duration and is recommended for the FY09-13 timeframe. Due to the relatively low cost of this project, it may be a candidate for CEB funding.
- A project to upgrade security at the CLTP and Clinton residuals landfill is recommended at an estimated cost of $100,000. This project has a 2 year duration, is recommended for the FY09-13 timeframe, and would include automatic fencing, identification card building access, identification card gate access, etc. Due to the relatively low cost of this project, it may be a candidate for CEB funding.
- A project to rehabilitation the rubber roofing on all buildings at CLTP is recommended at an estimated cost of $150,000. This project has a 1 year duration and is recommended for the FY09-13 timeframe. Due to the relatively low cost of this project, it may be a candidate for CEB funding.
- A project to replace three influent and three intermediate lift pumps at CLTP is recommended due to wear on the internal pump vanes that reduces pumping efficiency. The project may include replacement or rehabilitation of pump cover plates and automatic oil injection system. The project has an estimated cost of $750,000, with a 5 year duration and is recommended for the FY14-18 timeframe.
- A project to rehabilitate or replace CLTP grit removal facilities with updated/emerging technology equipment is recommended at an estimated cost of $700,000. This project has a 5 year duration and is recommended for the FY14-18 timeframe.
- A project to replace the two belt filter presses at CLTP with updated/emerging technology is recommended at an estimated cost of $1.5 million. This project has a 5 year duration and is recommended for the FY14-18 timeframe.
- A project to repair/seal the CLTP roadway is recommended at an estimated cost of $100,000. This project has a 1 year duration and is recommended for the FY14-18

timeframe. Due to the relatively low cost of this project, it may be a candidate for CEB funding.

- A project to improve plant processes technology (including sludge pressing, phosphorous, UV disinfection, etc.). is recommended at an estimated cost of $3 million. This project has a 5 year duration and is recommended for the FY14-18 timeframe.

- A project to upgrade technology to meet future regulatory requirements is recommended at an estimated cost of $2 million. This project has a 5 year duration and is recommended for the FY14-18 timeframe.

- A project to add a fourth tank to the secondary clariflocculator at the CLTP is recommended at an estimated cost of $1 million. This project has a 5 year duration and is recommended for the FY19-28 timeframe.

- A project to add an ultraviolet (UV) disinfection system to the CLTP is recommended at an estimated cost of $3 million. This project has a 5 year duration and is recommended for the FY19-28 timeframe.

- A project to expand the Clinton residuals landfill and add a fourth cell is recommended at an estimated cost of $1 million. This project has a 5 year duration and is recommended for the FY19-28 timeframe.

Table 14-3

Wastewater Master Plan - Clinton Advanced Wastewater Treatment Plant

Existing and Recommended Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

*existing project funding carried under DITP, see chapter 6

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		CLINTON WASTEWATER TREATMENT PLANT											
14.1	**1**	**Clinton Soda Ash Replacement**	**AP**	**in S19302**	**1 year**	**0**	**FY08**	**0***					**0**
14.2	**2**	**Clinton Permanent Standby Generator**	**AP**	**in S19308**	**0.3 years**	**0**	**FY08**	**0***					**0**
		SUBTOTAL - Existing - Clinton						**0**					**0**
14.3	3	Long-term Asset Protection @ $300k/yr for FY14-48	AP	new	annual	10,500	FY14-48			1,500	3,000	6,000	10,500
14.4	3	Landfill Cell #1 Closure Plan/Implementation	AP	new	2 years	200	FY09-13		200				200
14.5	3	Rubber Roofing Rehab	AP	new	1 year	150	FY09-13		150				150
14.6	3	2 Digesters - Internal Inspection Cleaning & Rehab	AP	new	2 years	350	FY09-13		350				350
14.7	3	Process Water Pumps (4) System Replacement/Rehabilitation	AP	new	2 years	175	FY09-13		175				175
14.8	4	Security Upgrades for Plant/Landfill	NF	new	2 years	100	FY09-13		100				100
14.9	3	Plant Processes Technology Improvements	Opti	new	5 years	3,000	FY14-18			3,000			3,000
14.10	3	Technology Upgrades to Meet Future Regulatory Requirements	NF	new	5 years	2,000	FY14-18			2,000			2,000
14.11	3	Influent (3) and Intermediate (3) Lift Pump Replacement	AP	new	5 years	750	FY14-18			750			750
14.12	4	Repair/Sealing of Plant Roadway	AP	new	1 year	100	FY14-18			100			100
14.13	3	Grit Removal Facilities Rehab/Replacement	AP	new	5 years	700	FY14-18			700			700
14.14	3	Belt Filter Press Replacement	AP	new	5 years	1,500	FY14-18			1,500			1,500
14.15	4	Landfill Expansion - Fourth Cell	NF	new	5 years	1,000	FY19-28				1,000		1,000
14.16	4	Secondary Clariflocculator - Fourth Tank	NF	new	5 years	1,000	FY19-28				1,000		1,000
14.17	4	UV Disinfection System	NF	new	5 years	3,000	FY19-28				3,000		3,000
		SUBTOTAL - Recommended - Clinton				24,525		0	975	9,550	8,000	6,000	24,525
		SUBTOTAL - Existing and Recommended - Clinton				24,525		0	975	9,550	8,000	6,000	24,525

CHAPTER 15
MWRA FINANCIAL ASSISTANCE FOR COMMUNITY-OWNED COLLECTION SYSTEMS

15.1 Chapter Summary

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. More than half of the annual flow treated at DITP enters the regional sewer system from infiltration (groundwater) and inflow (stormwater). High levels of infiltration and inflow (I/I) consume capacity in the collection system that would otherwise be available to transport sanitary flow. During periods of high groundwater and extreme storm events, I/I entering the system cause sewer surcharging, wastewater backups into homes, local overflows of untreated sewage, 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 in that MWRA directly passes on the cost of running its operations to its member cities and towns. 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 coordination between MWRA and its member communities is in place. Financial Assistance programs administered by MWRA for its member communities have been shaped through recommendations from the Advisory Board.

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 system rehabilitation/replacement are key elements to minimize risk of sewer plugging or structural failure within community-owned collection 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 to operate and maintain their local collection systems to provide uninterrupted service in a safe, cost-effective and environmentally sound manner.

Under MWRA's I/I Local Financial Assistance Program, $50 million in funding for community-owned collection systems rehabilitation projects is identified in the 40 year master plan timeframe (FY07-48). The existing I/I Local Financial Assistance Program ($14 million through Phase 6) is currently programmed in the FY07 CIP. Two additional program Phases ($36 million for Phases 7 and 8 of the I/I Local Financial Assistance Program) are recommended for inclusion in the FY08 CIP. The costs noted here represent the net cost of MWRA grants and loans, as well as, loan repayments from communities to MWRA. Section 15.4 – I/I Local Financial Assistance Program includes a list of all funding phases recommended in this Chapter.

Near-term (FY07-08 and FY09-13):

- $18.6 million is currently programmed in the CIP (FY07-13) for the I/I Local Financial Assistance Program (through Phase 6). $3 million in needs is identified for FY09-13 and recommended for inclusion in the FY08 CIP for the I/I Local Financial Assistance Program (Phase 7). The net cost for the FY07-13 timeframe to provide the existing and recommended I/I Local Financial Assistance for community-owned collection systems is $21.6 million.

Mid-term (FY14-18):

- $1.1 million in revenue is currently programmed in the CIP (FY14-18) for I/I Local Financial Assistance Program (through Phase 6) community loan repayments to MWRA. $13 million in needs is identified for FY14-18 and recommended for inclusion in the FY08 CIP for the I/I Local Financial Assistance Program (Phases 7 and 8). The net cost for the FY14-18 timeframe to provide the existing and recommended I/I Local Financial Assistance for community-owned collection systems is $11.9 million.

Long-term (FY19-28 and FY29-48):

- $3.5 million in revenue is currently programmed in the CIP (FY19-28) for I/I Local Financial Assistance Program (through Phase 6) community loan repayments to MWRA. $20 million in needs is identified for FY19-28 and recommended for inclusion in the FY08 CIP for the I/I Local Financial Assistance Program (Phases 7 and 8). The net cost for the FY19-28 timeframe to provide the existing and recommended I/I Local Financial Assistance for community-owned collection systems is $16.5 million.

15.2 Overview of Infiltration/Inflow Impact on the Regional Collection System

The MWRA's regional interceptor system receives flow from 43 member sewer communities (locally-owned collection systems) covering an area of over 500 square miles. The regional system serves about 2.1 million people, including the City of Boston and the surrounding metropolitan area. About 95 percent of the service area is sewered. All flow from the service area is tributary to MWRA’s Deer Island Treatment Plant. The regional collection system encompasses about 240 miles of MWRA-owned interceptors, 5100 miles of publicly-owned community sewers, and 5000+ miles of private sewer service connections. Most of the service area is served by separate sanitary and storm drainage systems. However, portions of five communities (Boston, Brookline, Cambridge, Chelsea, and Somerville) utilize combined sewers.

Community-owned sewer systems discharge wastewater to the MWRA 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 system average daily flow is approximately 360 mgd; minimum dry weather flow is approximately 260 mgd; peak wet weather capacity to the Deer Island Treatment Plant is 1,270 mgd, with additional system capacity is available at combined sewer overflow (CSO) outfalls. The average annual wastewater flow contributed from the entire MWRA collection system varies, depending on annual precipitation, from about 335 to 425 mgd. More than half of the annual flow treated at DITP enters the sewer system from infiltration (groundwater) and inflow (stormwater). Infiltration and inflow (I/I) enter the sewer systems of both MWRA and its member communities through a variety of defects. High levels of I/I consume capacity in the collection system that would otherwise be available to transport sanitary flow. During periods of high groundwater and extreme storm events, I/I entering the system may cause sewer surcharging, wastewater backups into homes, local overflows of untreated sewage, as well as increased operating costs.

Infiltration and inflow are highest in the spring when: rainfall is high; the groundwater table is high; 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 of surface and groundwater is high. Infiltration tends to increase and decrease gradually over the course of the year. Conversely, inflow causes a rapid increase in wastewater flow during and after storms leading to sewer system surcharging and sanitary sewer overflows (SSOs). The volume of inflow that enters the collection system typically depends on the magnitude and duration of a storm event, as well as related impacts such as snowmelt and storm tides. Few problems exist within MWRA and local systems during dry weather or as a result of small and medium storm events (those below the DEP designated 1.7 inch – six hour "design" storm level). Wastewater backups into homes and SSOs generally only occur during extreme storm events.

The Enabling Act (Chapter 372, Acts of 1984) establishes as a goal of the 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 Rules and Regulations (360 CMR 10.000) which govern the discharge of sewage, drainage, substances, and wastes into any sewer under the control of the MWRA, or into any sewer tributary thereto. MWRA's Sewer Use Rules and 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 Authority Sewerage System. The Sewer Rules 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 Rules 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 Rules 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 construction site dewatering permit in a CSO area), non-contact cooling or industrial process waters, and uncontaminated contact cooling or industrial process waters. MWRA's Sewer Use Rules and Regulations are available on-line on MWRA's web site (mwra.com).

15.3 MWRA Regional I/I Reduction Plan

The August 2000 NPDES Permit 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 DEP as required under MWRA's NPDES Permit. The Plan was submitted to EPA and DEP in June 2001. DEP approved the Plan in a letter dated November 19, 2002.

The Regional I/I Reduction Plan (dated September 2002) 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, DEP, 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 community retains full legal and fiscal responsibility for implementation of operation, maintenance and I/I reduction programs for community-owned sewers. MWRA will provide technical and financial assistance to member communities and work cooperatively with DEP, 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, DEP 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, DEP 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 DEP regulations or guidance documents.

4. MWRA will work cooperatively with member communities, DEP 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, DEP 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 per its NPDES Permit, MWRA is required to submit an annual I/I report to EPA and DEP (prior to September 1 of each year). The MWRA's annual I/I reduction reports are available on-line on MWRA's web site (mwra.com).

15.4 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 assure 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 approved a total program budget of $220.75 million. The funds have been allocated among the 43 MWRA sewer communities based on respective shares of overall MWRA wholesale sewer charges. Financial assistance for Phases 1 and 2 (total of $63.75 million) was distributed for approved projects as a 25 percent grant and a 75 percent interest-free loan. The grant/loan split was revised for distribution of the Phase 3, 4, 5, and 6 funds (total of $157 million) to a 45 percent grant and a 55 percent interest-free loan. All loans are repaid to MWRA over a five-year period beginning one year after the funds are distributed.

Through December 2006, $139 million has been distributed to fund local I/I reduction and sewer system rehabilitation projects. The projects generally take one to three years to complete. Distribution of the remaining $82 million in funds has been approved through FY15. A summary table of the financial assistance allocations, distributions, and funds remaining for each community is updated periodically and is available on-line on MWRA's web site (mwra.com).

Table 15-1 lists the existing and recommended Phases of the I/I Local Financial Assistance Program and the proposed expenditure schedule.

<u>Projects in the Existing FY07 CIP</u>:

- I/I Local Financial Assistance Program (through Phase 6) is programmed in the FY07 CIP at a net cost of $14 million in the FY07 through FY22 timeframe. The net cost of the program includes grants, interest-free loans, and community loan repayments.

<u>Projects Recommended for Consideration in the FY08 CIP</u>:

- For Master Planning purposes, two additional ($40 million each) I/I Local Financial Assistance Program phases (Phases 7 and 8) are recommended to provide a placeholder for future funding consideration. Both Phase 7 and 8 funding are recommended at $18 million in grants, $22 million in interest-free loans, and $22 million in community loan repayments over ten years. The net capital cost of each recommended I/I Local Financial Assistance Phase is $18 million. Phase 7 is recommended for the FY12-24 timeframe and Phase 8 is recommended for the FY17-28 timeframe. Prior to expansion of the current program, coordination with the MWRA Advisory Board to develop a recommendation for Board of Directors consideration would be required.

Table 15-1

Wastewater Master Plan - Community-Owned Systems/Community Support

Existing and Recommended Projects

Last revision 12/15/2006

Prioritization

1 Critical
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

FY07 CIP Notes

in	included in FY07 CIP (bold)
new	new project, not previously in CIP
prev	included in prior CIP, but deleted

Line No	Priority	Project	Project Type	FY07 CIP	Project Duration	Cost ($1000)	Schedule	FY07-08	FY09-13	FY14-18	FY19-28	FY29-48	Total Cost ($1000)
								2 years	5 years	5 years	10 years	20 years	
		COMMUNITY-OWNED SYSTEMS/COMMUNITY SUPPORT - SEWER											
15.1	**3**	**I/I Financial Assistance (phases 1-6)**	**AP**	**in S128**	**14 years**	**14,000**	**now-FY20**	**3,600**	**15,000**	**(1,100)**	**(3,500)**		**14,000**
		SUBTOTAL - Existing - Community Support				**14,000**		**3,600**	**15,000**	**(1,100)**	**(3,500)**		**14,000**
15.2	3	I/I Financial Assistance (phase7) $18 mil grants/$22 mil loans	AP	new	13 years	18,000	FY12-24		3,000	10,000	5,000		18,000
15.3	3	I/I Financial Assistance (phase 8) $18 mil grants/$22 mil loans	AP	new	12 years	18,000	FY17-28			3,000	15,000		18,000
		SUBTOTAL - Recommended - Community Support				36,000			3,000	13,000	20,000		36,000
		SUBTOTAL - Existing and Recommended - Community Support				50,000		3,600	18,000	11,900	16,500		50,000

CHAPTER 16
RUTLAND-HOLDEN SEWERS

16.1 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 Wachusett Reservoir), and the Ware River. The sewers convey wastewater from the service area to the Upper Blackstone Treatment Plant 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 Department of Public Works is the permitting authority for the Trunk Spur Sewers. By agreement 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 the CIP. 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.

16.2 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 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 Rutland State Hospital in Rutland, and conveyed the wastewater to the Worcester sewer system for treatment and disposal at the Upper Blackstone Treatment Plant. In 2003, West Boylston began to convey wastewater flows from newly completed sewers to the Rutland-Holden Trunk Sewer via a connection in Holden.

When constructed, the trunk sewer was to be turned over to the MDC and maintained by it as part of the metropolitan water system.[2] Local public sewers and private connections from

[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. The MDC was abolished and its powers and duties transferred to the Department of Conservation and Recreation (DCR) in 2004.

[2] Legislation in 1939 authorized the 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 the MDC "its proportionate share of the cost to the commission of receiving, caring for and disposing of said sewage," referencing the 1938 agreements.

factories or institutions within Rutland and Holden could be connected to the trunk sewer under the control of the 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, leading to construction of the Rutland-Holden Relief Trunk Sewer in the 1980's. Construction was authorized under the Acts of 1979.

16.3 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 the MWRA) and the watershed system (to be managed by the 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 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 the MDC was abolished, its former functions related to the Rutland-Holden Sewers transferred to the DCR Division of Water Supply Protection. MWRA and DCR entered into a revised MOU dated April 27, 2004 which continued the prior understanding of the joint and separate responsibilities of each agency relative to the Rutland-Holden Sewers.

16.4 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 a match-line connects the two figures). 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 treatment plant in Millbury, MA. The treated effluent is discharged to the Blackstone River.

<u>Rutland-Holden Trunk and Trunk Relief Sewers:</u> 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. 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.

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 2006, the average daily wastewater flow was 0.34 mgd. The Rutland 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.

Holden Sewer System: The Holden municipal sewer system consists of approximately 25 miles of Town-owned gravity collection sewers averaging 8-inched in diameter, 16 miles of individual 6-inch service connections, plus approximately 40 miles of newer sewers, constructed in 1998 to 2003, under the MDC's Holden-West Boylston sewer project in the Wachusett Reservoir watershed. In 2006, the average daily wastewater flow was 0.88 mgd. These municipal sewers discharge to the Rutland-Holden Trunk and Trunk Relief Sewers in Holden proper.

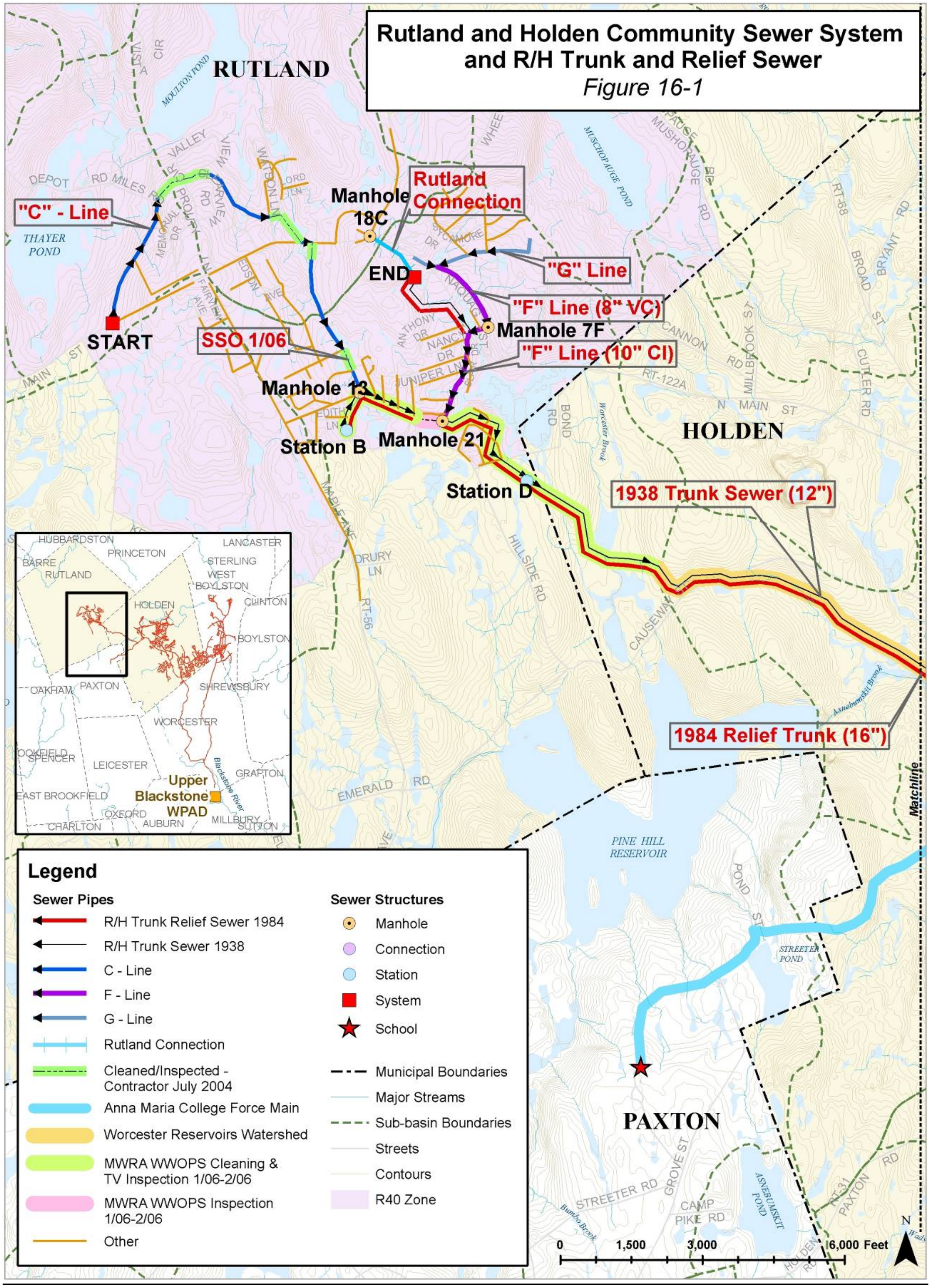
16.5 Flow Allocation, Sewer Billing, Operation and Maintenance

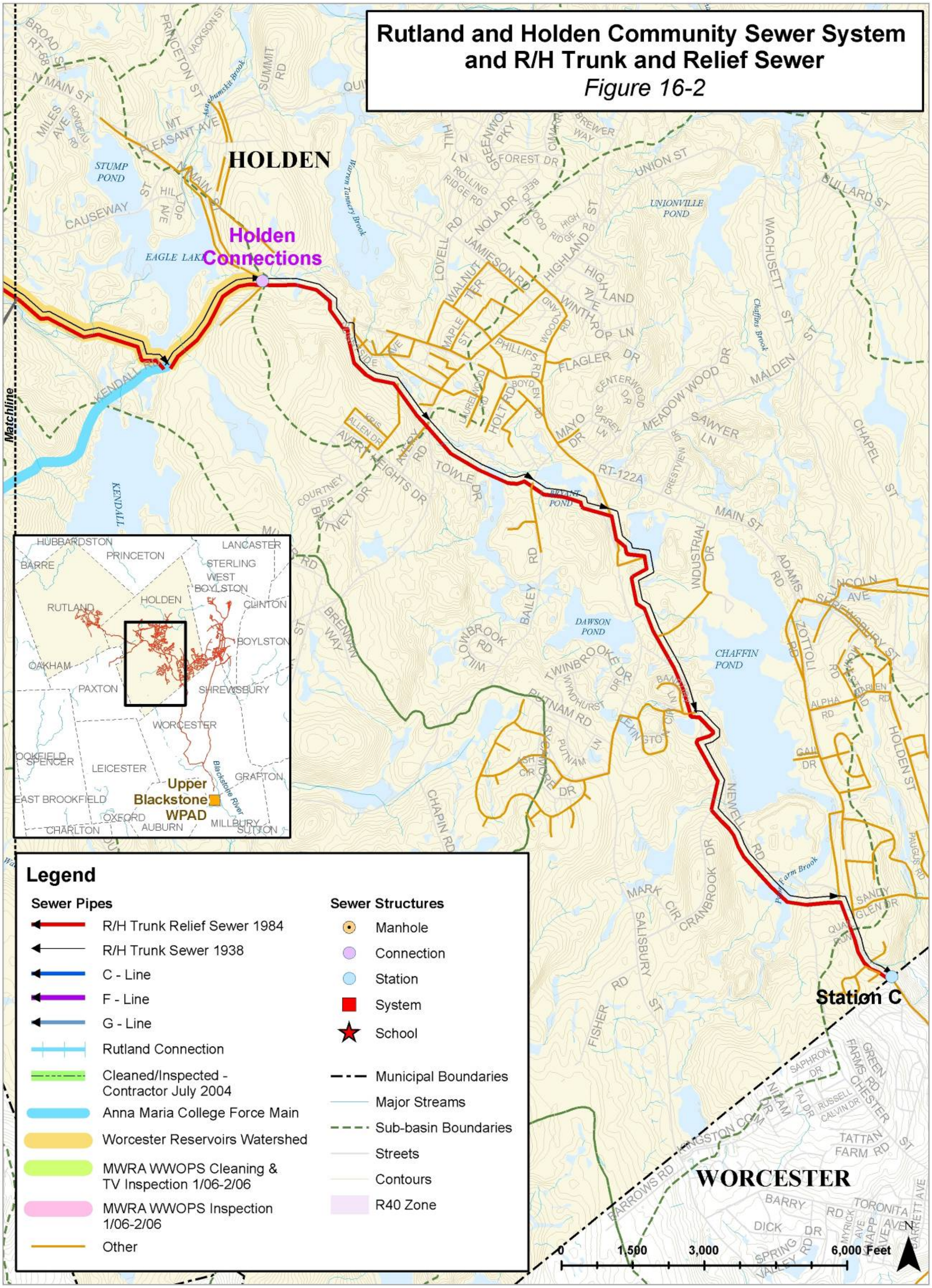
As of 2006, there are five entities that discharge wastewater into the Rutland-Holden Sewers and are charged for wastewater treatment and sewer system operations and maintenance: (1) Town of Rutland, (2) Town of Holden, (3) Town of West Boylston, and (4) DCAM property (former Rutland State Hospital), and (5) Anna Maria College in Paxton connected by a new cross-country force main.

Flow Allocation: 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 2.67 mgd annual average daily flow and 8.55 mgd peak flow for contribution into the Worcester Interceptor System. DCR has allocated the 2.67 mgd flow to the communities as follows: Rutland – 0.55 mgd; Holden – 1.53 mgd; and West Boylston – 0.59 mgd. 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.

Treatment Costs: The formula for wastewater treatment billing is administered by DCR. The formula is applied on a proportional basis depending on flows measured at monitoring stations, meters at West Boylston pump stations, and calculations performed by DCR. Generally, the total wastewater flow transported through Worcester to the Upper Blackstone Treatment Plant can be apportioned as follows: (1) Town of Rutland at approximately 25 percent, (2) Town of Holden at approximately 62 percent, (3) Town of West Boylston at approximately 12 percent, and (4) DCAM property/ former Rutland State Hospital at approximately 1 percent. The Anna Maria College system is designed for up to 60,000 gpd of wastewater flow to the TRS, however, as of December 2006, quantification of annual flows had not been made. The DCR issues bills to the Towns (billing entities) which are to be made payable to the City of Worcester.

Operation and Maintenance Costs: Per the existing MOU, 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 Holden, West Boylston, and Rutland 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.


Rutland and Holden Community Sewer System
and R/H Trunk and Relief Sewer
Figure 16-1
RUTLAND
HOLDEN
PAXTON
"C" - Line
START
SSO 1/06
Manhole 18C
Rutland Connection
END
"G" Line
"F" Line (8" VC)
Manhole 7F
"F" Line (10" CI)
Manhole 13
Station B
Manhole 21
Station D
1938 Trunk Sewer (12")
1984 Relief Trunk (16")
Matchline
PINE HILL RESERVOIR
Upper Blackstone WPAD
Legend
Sewer Pipes
R/H Trunk Relief Sewer 1984
R/H Trunk Sewer 1938
C - Line
F - Line
G - Line
Rutland Connection
Cleaned/Inspected - Contractor July 2004
Anna Maria College Force Main
Worcester Reservoirs Watershed
MWRA WWOPS Cleaning & TV Inspection 1/06-2/06
MWRA WWOPS Inspection 1/06-2/06
Other
Sewer Structures
Manhole
Connection
Station
System
School
Municipal Boundaries
Major Streams
Sub-basin Boundaries
Streets
Contours
R40 Zone
0 1,500 3,000 6,000 Feet
N



Rutland and Holden Community Sewer System
and R/H Trunk and Relief Sewer
Figure 16-2
HOLDEN
Holden Connections
WORCESTER
Station C
Matchline
Legend
Sewer Pipes
R/H Trunk Relief Sewer 1984
R/H Trunk Sewer 1938
C - Line
F - Line
G - Line
Rutland Connection
Cleaned/Inspected - Contractor July 2004
Anna Maria College Force Main
Worcester Reservoirs Watershed
MWRA WWOPS Cleaning & TV Inspection 1/06-2/06
MWRA WWOPS Inspection 1/06-2/06
Other
Sewer Structures
Manhole
Connection
Station
System
School
Municipal Boundaries
Major Streams
Sub-basin Boundaries
Streets
Contours
R40 Zone
0
1,500
3,000
6,000 Feet
Upper Blackstone WPAD

This system tracks the cost associated with labor, equipment, and materials. MWRA summarizes the annual operation and maintenance costs each January in preparation for submittal of an operation and maintenance bill to DCR. DCR then apportions the MWRA operation and maintenance charge to each Town (billing entity) based upon flow and requires the bills to be made payable to MWRA.

Sewer Cleaning and Inspection Project: In 2005, MWRA embarked on a special project utilizing MWRA Wastewater Field Operations staff to clean, televise and inspect the Rutland-Holden Trunk and Trunk Relief Sewers scheduled over a four year period. This special project is in addition to routine operation and maintenance performed by MWRA Western Operations staff. The Towns were briefed on the proposed project and agreed with the billing scheme that spread the project cost over four years. No capital costs are recommended for this project; first year costs were included in MWRA's FY07 Current Expense Budget. Future costs will be included in future annual Current Expense Budgets.

Wastewater Metering Project: In 2006, MWRA began a project to perform sewer flow metering at specific locations to better understand wastewater flow contributions in the Rutland Trunk C spur sewer line. No capital costs are recommended for this project; the costs were included in MWRA's FY07 Current Expense Budget.

Easement Project: Over the last several decades, development has increased in the Rutland-Holden area. This has led to a number of encroachments by abutters along the sewer easement, particularly on the Rutland Trunk C spur sewer line. Easement encroachments include fences, trees, swimming pools, porches, 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 is to keep the easement open for operation and maintenance operations. The strategy is 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 explaining the easement conditions, and any existing encroachments, with a copy of their plot plan identifying the encroachment and sewer easement. No capital costs are recommended for this project; the costs were included in MWRA's FY07 Current Expense Budget.

16.6 Summary of Existing and Recommended Capital Projects

There are no existing or recommended MWRA capital projects associated with the Rutland-Holden Trunk Sewers proposed for consideration in the CIP. 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.