



MASSACHUSETTS WATER RESOURCES AUTHORITY

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October 20, 2017

Susan Studlien, Director
Office of Environmental Stewardship
U.S. EPA Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

Susannah King, NPDES
Division of Watershed Management
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

RE: Massachusetts Water Resources Authority
Permit Number MA 0103284
O&M Annual Report

Dear Ms. Studlien and Ms. King:

Attached please find the MWRA's annual status sheets on plant performance and maintenance for the period covering July 2016 – June 2017. This submittal fulfills the requirements of MWRA's NPDES Permit MA0103284 - Section I.18.f and I.18.g that states in part:

“The MWRA shall submit annual status sheets on plant performance, using key indicators for maintenance”.

The Status Sheets will be posted at www.mwra.com.

If you have questions or need additional information, please feel free to call Betsy Reilley at (617) 788-4940.

Sincerely,

Michael J. Hornbrook
Chief Operating Officer

cc: MA DEP, Wilmington
MA DEP, Worcester
K. Brander, DEP
T. Borci, US EPA
C. Vakalopoulos, MA DEP
F. Laskey, MWRA

MWRA Annual Report on Operation & Maintenance

July 2016 – June 2017

This report has been generated to fulfill the requirements of MWRA's NPDES Permit MA0103284 - Section I.18.f that states:

"Within ninety (90) days of the effective date of this permit, the permittee shall develop and implement a long-range operations and maintenance plan that will maximize the life of the treatment facility. The permittee shall report on the plan's implementation and results to EPA and the MADEP on a yearly basis"

Also included with this submittal are the annual status sheets on plant performance and maintenance as required in section I.18.g.

1. SYSTEM OVERVIEW

Deer Island Sewage Treatment Plant

The Deer Island Sewage 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 DITP's purpose is to remove human, household, business, and industrial pollutants from the wastewater that is collected and transported through 5,400 miles of pipes and community owned sewer lines and approximately 228 miles of Authority owned interceptors and tunnels.

DITP is a state of the art wastewater treatment facility and one of the most automated in the country. The MWRA has made a considerable capital investment in the DITP and is fully committed to ensuring that this valuable public asset is cared for in the best possible manner. The MWRA's Board of Directors, Executive Director, management team, and staff are dedicated to providing the highest quality of asset management. The MWRA has assembled a highly skilled and qualified staff that will ensure that the treatment plant is operated and maintained to the satisfaction of the regulatory agencies and the public.

Wastewater Transport System

The Field Operations Department (FOD) operates and maintains MWRA's wastewater transport system, which transports wastewater from MWRA member communities to the Deer Island Treatment Plant. This system includes a network of 240 miles of interceptor sewer lines and related appurtenances, a screen house, 13 pumping stations, 4 remote headwork's facilities, 3 combined sewer overflow (CSO) facilities and 2 combined sewer overflow (CSO) storage facilities. The primary goal is to operate the system in a manner that will provide uninterrupted wastewater transport service in a safe, cost-effective, and environmentally sound manner.

Fore River Pelletizing Plant

The operation and output of the Fore River Pelletizing Plant (FRPP) is regulated, in part, by the terms of the federal NPDES permit, 40 CFR 503 regulations, and state sludge regulations in Massachusetts (310 CMR 32.00) and the states to which the pelletized product is shipped. Other important external factors that influence operation of the FRPP include an extensive residuals management facilities plan developed as part of the permitting process for the FRPP as well as commitments to local communities.

Under the terms of the current operating agreement between New England Fertilizer Company (NEFCo) and MWRA, NEFCo budgets for, and performs all necessary predictive, preventive and routine maintenance at the FRPP. NEFCo's agreement contains a plan for the maintenance, repair and operation of the facility. At this time, NEFCo performance meets the necessary standard for proper operation and maintenance. Since the inception of the agreement in March of 2001, there has not been an incident requiring an interruption in service.

The operating agreement requires NEFCo to provide a letter of credit in the amount of \$1,000,000 (adjusted for inflation) that MWRA may draw on in the event that there is a material breach of the operating agreement, such as failing to adequately maintain the facility.

2. PERMIT VIOLATIONS

There were no violations at MWRA facilities due to inadequate maintenance efforts.

3. FACILITIES ASSET MANAGEMENT PROGRAM (FAMP)

The goals of the MWRA multi-year maintenance plan include coordinated, consistent asset inventory; condition assessment; maintenance scheduling and long-term replacement planning. The MWRA has developed and implemented, the "Facilities Asset Management Program." This asset management program addresses the goal of becoming more efficient by developing consistent, compatible best practices, cost-effective operations and maintenance procedures.

MWRA has been conducting its maintenance on a calendar-based schedule in accordance with the original equipment manufacturers' (OEM) recommendations. This approach to maintenance was primarily driven by contractual obligations of the OEM 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. MWRA management acknowledges the importance of asset management and developed the Facilities Asset Management Program (FAMP) to meet the long-term demands of facility maintenance. The main objective of the FAMP program was to develop a sound maintenance strategy that would ultimately lead to better overall asset management, extended equipment life and increase reliability.

MWRA has expanded its efforts in the areas of condition monitoring; Reliability Centered Maintenance (RCM); asset replacement prioritization and capital improvements; and training of

staff. DITP is continuing to build the program, this year upgrading Maximo to version 7.6, continuing using the methodology of RCM, consolidating the tool data-base into Maximo, expanding condition monitoring oil analyses by using on site testing equipment, and constantly reviewing our metrics to ensure we are at or above industry benchmarks.

4. COMPUTERIZED MAINTENANCE MANAGEMENT SOFTWARE

The maintenance management software used by the Authority is MAXIMO version 7.6. The software includes safety and job plan features that allow users to document hazardous materials and areas around the plant. It has the ability to use lockout/tag-out tasks and generate associated work orders for the field. MAXIMO provides document management capabilities to streamline maintenance and regulatory functions, and workflow capabilities for synchronizing operations. Applications can be fine-tuned to suit specific work processes or integrate with other programs. The software also includes mobile applications for gathering and downloading data and an intuitive interface.

Maintenance staff can prioritize tasks, assign work based on the availability of necessary parts, labor, and analyze equipment failures in order to implement appropriate preventive maintenance measures budgets for asset management..

The MAXIMO maintenance management tool is used to manage all MWRA assets. The software is used for work order management, planning and scheduling, asset management, resource management, recording of maintenance costs, and generation of reports and analyses. The software can store large amounts of data and is equipped with built-in failure analysis programs. In addition, MAXIMO contains the historical record for all maintenance activities, thus allowing staff to better address a problem with a facility, or a specific asset group.

This year, MWRA began a major upgrade to our computerized maintenance management software, Maximo from version 5.2 to version 7.6 (The latest version available). The project team is the consultant group of SHI International Corporation and Total Resource Management Inc. This upgrade has started and will finish in FY18. It tracks material cost, labor cost, actual work performed, spare parts, staff hours and service contract work. MWRA Maximo currently manages more than 120,000 assets.

This upgrade will provide updated technology, increase functionality for maintenance, improves reporting, allow MWRA to combine two separate Maximo instances into a single org, multi-site application resulting in increased productivity. The final phase of the project will incorporate Management Information Systems (MIS) Information Technology (IT) Assets and Asset Management into Maximo further streamlining MWRA's overall Asset management under one software system. Additional Maximo features will be added to increase efficiencies including; Calibration for instruments, Help Desk to support MWRA computer network, Maximo Anywhere using mobile devices, Spatial Asset Management for pipe sections.

NEFCo has computerized maintenance management software – E-maint. E-maint is used for work order management including preventive and corrective maintenance work.

5. SERVICE CONTRACTS

The maintenance program is supplemented by a series of service contracts. These contracts are intended to provide specialized services beyond the resources of the MWRA maintenance staff. Table 1 below shows the service contracts currently used by MWRA.

TABLE 1
DEER ISLAND CURRENT SERVICE CONTRACTS
Laser alignment
Boiler maintenance
CCTV maintenance
Centrifuge maintenance
Combustion Turbine Generator maintenance
Continuous emissions monitoring
Catch Basin Contract
Copier/fax maintenance
Crane maintenance
Cryogenics facility maintenance
Digester Mixer overhauls
Electrical testing
Elevator maintenance
Facilities coatings
HVAC chemical treatment (Legion Ella testing)
Fire Sprinkler Repair Contract
Hydro turbine generator maintenance
Hydraulic maintenance
Janitorial services
Lab hood certification
Locksmith services
Lube oil analysis
Oil separator cleaning
Overhead door maintenance
Pest control
Plant and Public access landscape services
Plant instrumentation and control system (PICs) maintenance
Pratt Whitney Preferred service
Reactor Mixer gearbox rebuild
Recycle contract (Scrap/Paper)
Security
Steam turbine generator maintenance
Trash removal
Vibration analysis

July 2016 - June 2017

Annual Report: Deer Island Maintenance reporting on Key Performance Indicators for FY17.

- Preventive Maintenance Work Orders Completed - Maintenance is working to reach the PM goal of 100%. The average PM % completion rate is 99.9%.
- Work Order Kitting - The first step to increase wrench time is to have all parts available for work orders. Kitting is a task where the maintenance planner identifies the specific parts required for a task on the work order and electronically sends the information to warehouse personnel to assemble the parts in one location (kit) for the technician to pick up and install. Deer Island exceeded its goal of 48% with 51% in FY17.
- Predictive Maintenance - Extending the useful life of equipment and allows for better planning for equipment replacements. 6,453 work orders were completed for vibration, acoustic ultrasonic, ultrasonic thickness, and oil analysis. Deer Island exceeded its FY17 goal of 20%, with 22% of all work orders being predictive maintenance.
- Maintenance Backlog in Hours - Backlog is determined by totaling the planned craft hours on open work orders and comparing them to craft resources which are available. The average backlog for last year was 16,666 hours which constitutes a 5.7 weeks of work for the entire Maintenance workforce. This backlog is within the industry standards of 8,730 hours to 17,460 hours or 4 to 6 weeks. DITP monitors all of our metrics very closely to ensure the backlog is not affecting our availability of equipment.
- Maintenance Overtime - The goal is to maintain maintenance overtime to 5% of total wages and salaries. DITP was above the benchmark with 6%. The increase was due to additional overtime spent during the Eversource cable outage project when staff was required to be on site when running CTG units as our primary source of electricity.

Critical Equipment Availability: 12-Month Average – 99.8%

An equipment availability report is generated daily that details the critical equipment required to treat the maximum flow of approximately 1.3 billion gallons per day. Higher maintenance priority is given to equipment that drops below the number required. No operational impact has occurred in the past year from a 99.8% versus 100% availability because the plant normally operates at approximately one-third the design flow capacity.

Preventive Maintenance (PM):

99.9% of all PMs were completed and 18,536 PM work orders were initiated this year. Incomplete PM's that are not completed in one month are rolled over into the next month's workload and given a high priority to complete first.

Predictive Maintenance (PdM):

6,825 predictive maintenance work orders were completed in the past year. Predictive maintenance work includes vibration, acoustic ultrasonic, ultrasonic thickness and oil analysis

and is proactive maintenance work to extend equipment useful life by monitoring and trending equipment characteristics. It also provides early detection without requiring equipment downtime.

Average Craft Hours per Month:

Preventative Maintenance	3343 hours	25 %
Predictive Maintenance	109 hours	1 %
Corrective Maintenance	8593 hours	65 %
Emergency Maintenance	8 hours	<1 %
Project Work	730 hours	5 %
Other Work	452 hours	3 %
Total	13,235 hours	100.0 %

Total Work Orders:

38,114 work orders initiated this year

35,436 work orders completed/closed status

Maintenance Projects and Equipment Replacement:

- Centrifuges Refurbishment \$300,346

There are twelve waste sludge centrifuges which, due to high speed rotating assembly and critical nature of the process, require maintenance. Centrifuges require refurbishment at regular intervals based upon running hours for normal wear and tear. Due to the intricacy of the equipment all overhauls are sent back to Alfa Laval, the original equipment supplier. In the past year, three waste sludge centrifuges and gearboxes were refurbished.

- Reactor Aerator/Mixer Gearbox Rebuilds \$149,152

The secondary reactor aerators and mixers have large gearboxes that have started to fail. Six gearboxes were refurbished in FY17 with new gears, seals, and bearings.

- Boiler, STG and Hydro Plant Maintenance \$1,697,443

A maintenance contract was put in place to perform annual preventive maintenance and repairs as necessary. This contract was combined with Hydro plant and STG to save money with one contract on like equipment and save on mobilization cost. Maintenance spent additional money on repair work in Hydro.

- Cryogenic Facility Repairs \$650,710

The Cryogenic facility has an annual maintenance contract to handle preventive maintenance and some project maintenance work. The maintenance work includes two shut downs per year and scheduled projects. The scheduled projects completed were installing the Bentley Nevada vibration system and replace all cooling towers (3) internal media.

- Uninterrupted Power Supply Replacements - \$21,000

The Uninterrupted Power Supplies on Deer Island are extremely important which requires constant maintenance and equipment replacements to ensure reliability. These steps are necessary throughout Deer Island to instantaneously continue operation in the case of a power loss. Uninterrupted Power Supply units (UPS) were installed in the North Main Pump Station Switchgear.

- Grinder Rebuilds \$157,104

The Residuals Complex at Deer Island has small Muffin Monster grinders, installed “in-line” to provide continuous grinding of sludge into uniform, homogenized slurry. The sludge, which travels through these in-line grinders, is transported from Primary and Secondary treatment processes. The in-line grinders in Residuals are used after pre-treatment solids and rags are removed. In-line grinders are smaller than the larger channel grinders in size due to the composition of sludge entering them. Normal wear and tear to the grinders caused by constant operation wears the gears and seals requiring periodic service to re-build the grinders or cutter blocks. Staff replaced sixteen in-line grinders this year.

- Roller Gates Rebuilds \$146,048

The primary function of roller gates is to isolate channels or chambers. Isolation of flow is necessary for maintenance tasks to be performed. Stop logs are fabricated of structural steel and have specifically designed rubber fittings on the tops and bottoms that mate with the units above and below them to provide a water-tight seal. As part of the overhaul, the stop logs were dismantled, removing all existing wheels, axles, bushings, retainers and seals. The stop logs were then be cleaned, shop blasted, and repainted to the original specifications. All new wheels, bushings, retainers, and seals, per the original manufacturer’s specifications were installed. Eight (8) stop logs were refurbished in FY17.

- Variable Frequency Drives and Motors \$1,700,000

Deer Island has been updating the Variable Frequency Drives and Motors throughout Deer Island to ensure proper operation of the Raw Wastewater Pumps. These existing Variable Frequency Drives and Motors were encountering an issue with the rotor bars creating unreliability as well as being obsolete. All VFD drives and Motors are now complete in the North Main Pump Station.

- Slide Gates \$29,242

There are forty-eight (48) primary clarifiers on Deer Island that remove floatable scum and settleable solids, or sludge. Each clarifier has a set of eight (8) 14-inch-diameter influent sluice gates that isolate the flow of raw wastewater from the primary influent channel into each clarifier and one (1) 18-inch dewatering sluice gate used to dewater the clarifier through the dewatering system to the Winthrop Terminal Facility. These sluice gates serve to both isolate and dewater the clarifiers

for corrective or preventive maintenance is necessary. The gates operate on a continuous basis in submerged raw wastewater, which contains rags, grit, organic and inorganic solids, and high concentrations of corrosive compounds commonly found in raw wastewater. Over time, these solids and the corrosiveness of wastewater affect the ability of the gates to provide leak-free isolation of the clarifier or a tight seal on the dewatering gates. Staff has replaced five sluice gates in Primaries.

- Electric Vehicles \$131,907

Deer Island Treatment Plant staff perform multiple job-related activities and tasks all around the large expanse of the DITP and its numerous buildings and facilities on a daily basis. The expansive nature of DITP's terrain requires use of electric vehicles to ensure the most efficient transport of staff, tools, equipment, and supplies. Electric Vehicles save countless staff hours throughout the year. Utilizing these smaller electric vehicles is less costly than conventional vehicles, in addition to being significantly more environmentally friendly. Deer Island purchased fifteen new electric vehicles.

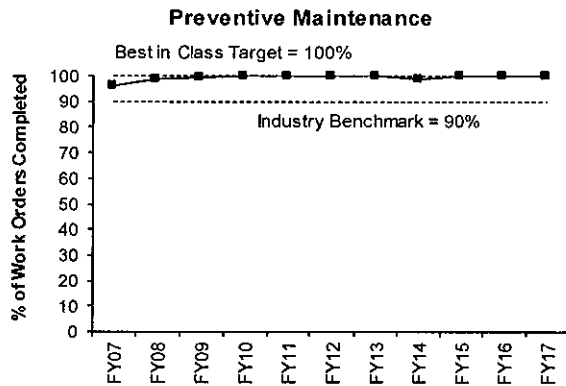
- Centrifugal Compressor \$150,446

The Deer Island Treatment Plant has three centrifugal compressors in the Central Blower Facility that supply and distribute low-pressure air. The low-pressure air system provides channel aeration to the grit chamber influent channels, the primary clarifier influent channels, the primary effluent cross channels, the secondary reactor effluent channels, and the secondary clarifier influent channels. Repair work included complete overhaul of the compressor and gearbox.

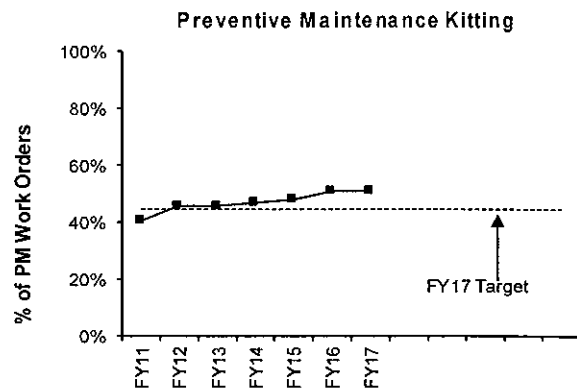
- Rip Rap Project on Shoreline \$227,000

We repaired a section of public access which is eroding due to tidal impact above the seawall, on the constructed slope. We replaced the grassy area with rock (rocks 14-24" in diameter). The rock shoring will stabilize the area and be a better long term solution for the Island. This work is critical for the protection of the Wastewater Treatment Facilities and Water Tank on the land above this area. Some of the segments of this landform have storm damaged ruts as deep as 2-3 feet due to damage from nor'easters.

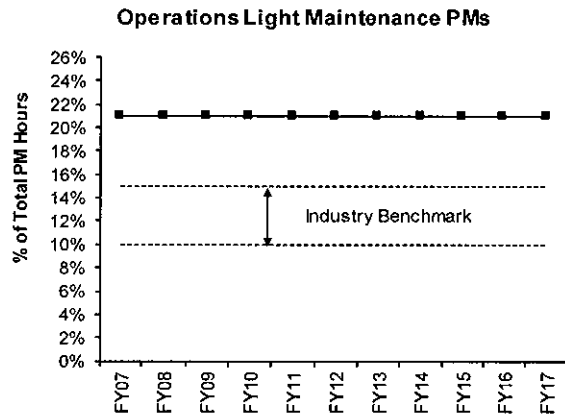
Deer Island Yearly Maintenance Metrics FY17 Proactive and Productivity Measures



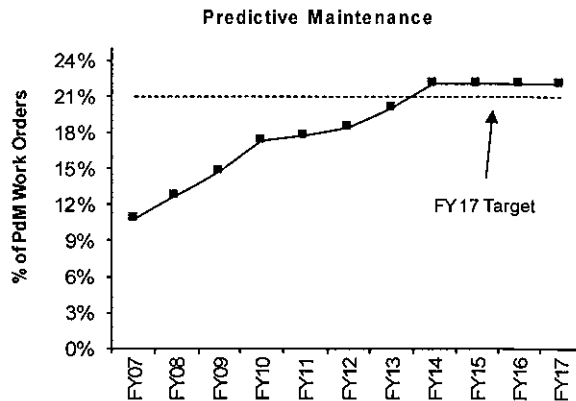
The industry benchmark is 90% for Preventive Maintenance (PM) completion. Upon reaching the 90% goal in FY05, the target goal was increased to the "Best in Class" Target of 100% PM completion. Since then, the percentage of PM work order completion has been at 99% or higher. Reliability-Centered Maintenance (RCM) and PM optimization efforts have continued since FY01. PM completion rate was 99.9% in FY17.



Preventive Maintenance (PM) inventory items were loaded into Maximo to assign spare parts for equipment to PM work orders. DITP reached the PM kitting goal of 100% in FY10. In FY11 a new graph (above) was developed to track kitting of all maintenance work orders in an effort to increase wrench time. Staff continues to fine-tune the process to "kit" all maintenance work orders. Kitting is considered a best practice by maintenance and reliability professionals. It entails staging parts necessary to complete maintenance work. Kitting allows maintenance staff to spend more time "turning the wrench" and less time waiting for parts at the stockroom window. Kitting for FY17 was 51%, surpassing DITP's goal of 48%.



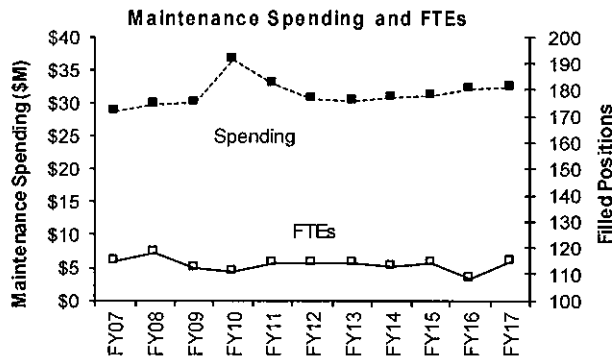
The percentage of preventive maintenance work order hours completed by Operations staff (not maintenance staff) increased from less than 1% in January 2002 to the current level of 21% in FY17. DITP reached the industry benchmark range of 10-15% in April 2003 and has exceeded the goal through FY17. Operations completes approximately 600 PM work orders per month.



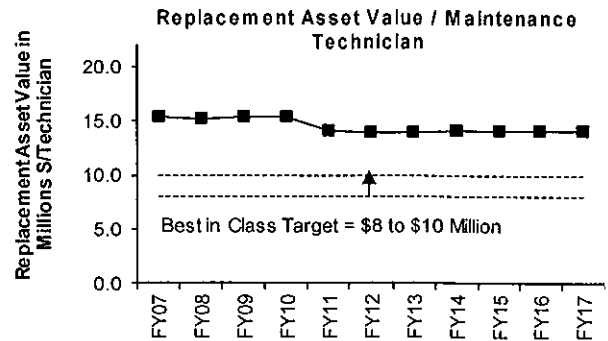
Predictive maintenance has steadily increased from 2% in FY03 to 22% in FY17, surpassing DITP's FY17 goal of 21%. The increase in predictive maintenance was achieved through the expanded use of lubrication, vibration, thermography, and acoustic ultrasonic testing techniques. The Condition Monitoring Group continually reviews and investigates new opportunities and initiatives to expand condition monitoring testing and analysis.

Deer Island Yearly Maintenance Metrics FY17

Overall Maintenance Program Measures

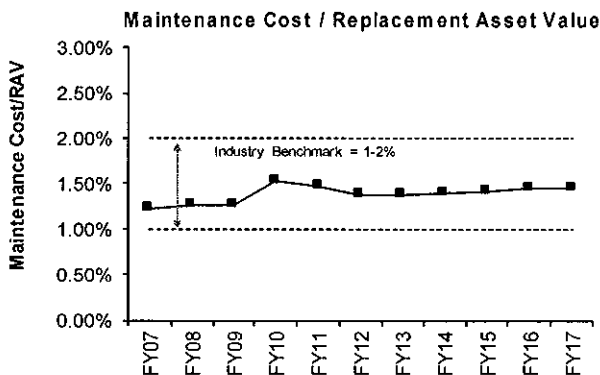


DITP's Maintenance staff is currently at 115 FTEs. Maintenance has been successful in meeting its goals through implementation of numerous maintenance efficiencies including: Operations staff performing light maintenance, cross-functional training and flexibility, and Reliability-Centered Maintenance.

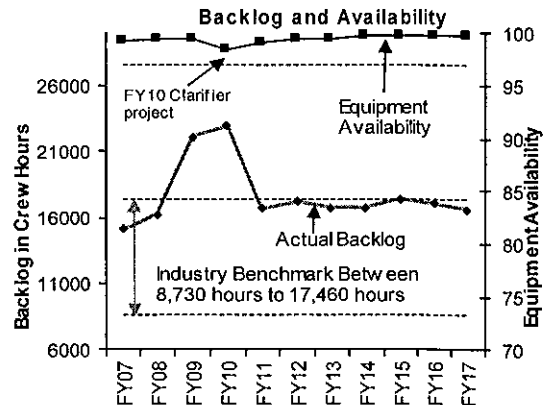


DITP adopted a "best in class" target of \$8-\$10 Million/Technician for maintenance staffing. Even after a period of downward trending, DITP remains above this Best in Class target range. However, as the plant ages and additional equipment replacements are expected, DITP management will reassess staffing as needed.

The Maintenance Spending graph shows actual annual maintenance spending and large CIP asset replacements (equipment costs only). Maintenance budgeting continues to evaluate plant assets and requirements for replacement of obsolete equipment to ensure the plant operates at maximum efficiency. In FY17, overall spending slightly increased from FY16 due to an increase in Maintenance Projects. Scheduled projects during FY17 included: Grit Classifier Cover Rehabilitation Project, East and West Odor Control Acid Wash Piping Prefabrication/Installation, Waste Gas Burners Gas Valve Replacement and the Scum Wet Wells Chopper Pump Replacements. The large spike in FY10 and FY11 is attributed to the Clarifier Rehabilitation Project (\$58M), which was an on-going during that period.



The industry benchmark for annual maintenance spending is between 1% to 2% of replacement asset value, currently DITP is at 1.46%. The plant's replacement asset value is calculated at approximately \$2.4 billion dollars. DITP's current maintenance spending is within the industry benchmark. As the plant ages and equipment replacement is required, spending is expected to increase. DITP Maintenance CEB spending is \$12.5 million coupled with CIP spending which funded Grit Classifier Cover Rehabilitation Project, East and West Odor Control Acid Wash Piping Prefabrication/Installation, Waste Gas Burners Gas Valve Replacement, Pump Stations Valve Replacement Project, and Digester Sludge Pump Replacements.

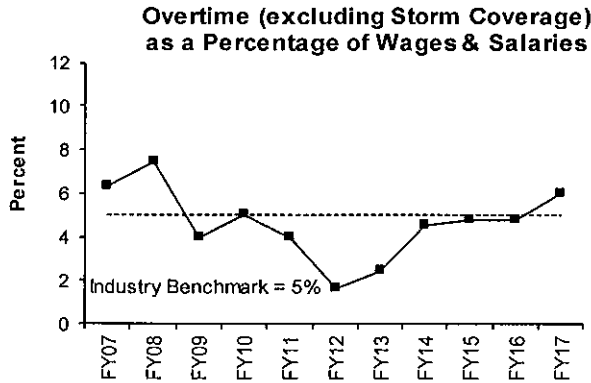


Industry benchmark for Equipment Availability are 97% and over the last ten years, equipment availability has consistently exceeded the benchmark. In FY17 the availability was 99.8%, the highest availability to date. The decrease in Equipment Availability during FY10 was due to the Clarifier Rehabilitation Project.

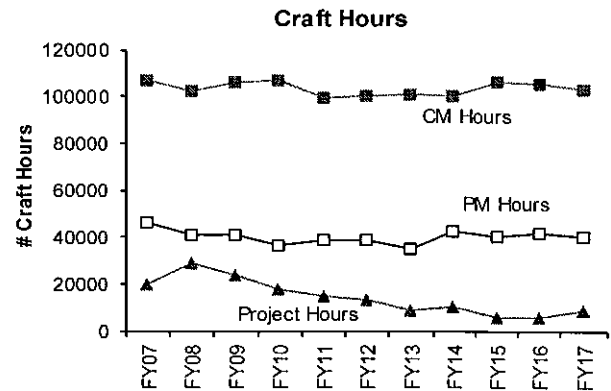
Industry Benchmark for Backlog is between 8,730 to 17,460 hours for maintenance based on current staffing, the total average backlog for FY17 was 16,666 hours, which is slightly below the industry benchmark. The slight decrease in backlog is from utilizing staff during Eversource Cable Outage to perform light maintenance tasks.

Deer Island Yearly Maintenance Metrics FY17

Overall Maintenance Program Measures (cont.)

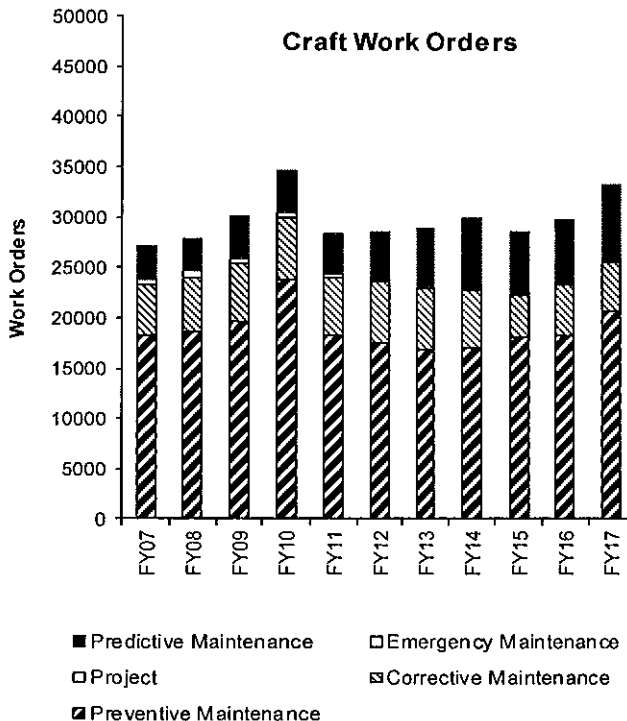


Management continues its effort to keep overtime below the industry benchmark. DITP maintenance overtime was 6% for FY17. Management has taken steps to reduce overtime spending by limiting overtime to repair critical equipment and systems only. DITP has been on or under Industry Benchmark from FY09 through FY16. The increase in overtime in FY17 was due to the Eversource Cable Outage Project.



Continued optimization of the Preventive Maintenance (PM) program through the transfer of some light maintenance tasks from Maintenance to Operations staff (21% of PM hours at the end of FY17), elimination of duplicate work orders, increasing PM frequency due to equipment history and performance. Reliability-Centered Maintenance (RCM) recommendations resulted in a significant decrease of 6,303 hours in maintenance staff PM hours from FY07 to FY17.

Corrective Maintenance (CM) hours decreased from last year due to additional maintenance projects. Project Maintenance hours increased due to large HVAC Equipment Replacement, Grit Classifier Cover Rehabilitation, Upgraded Acid Washing Piping System, New Gas Valves for Gas Burners and Centrifugal Chopper Pump Replacement Projects.



During FY17, the number of work orders increased by 3,391 from the previous year primarily due to the increase in Predictive Maintenance work orders (CBM) associated with the Condition Monitoring Program. The number of Corrective Maintenance (CM) work orders decreased slightly in FY17. Project (PROJ) work orders increased for FY17 due to additional maintenance projects scheduled.

The Planning department is continuously modifying PM, PdM, CM and CBM Job Plans to ensure maintenance is being performed efficiently and effectively, while ensuring reliability and availability of DITP's Assets.

Wastewater Transport System

July 2016 - June 2017

Wastewater Transport System Overview

The Field Operations Department (FOD) operates and maintains MWRA's wastewater transport system, which transports wastewater from MWRA member communities to the Deer Island Treatment Plant. This system includes a network of 240 miles of interceptor sewer lines and related appurtenances, a screen house, 13 pumping stations, 4 remote headwork's facilities, 3 combined sewer overflow treatment (CSO) facilities and 2 combined sewer overflow (CSO) storage facilities. The primary goal is to operate the system in a manner that will provide uninterrupted wastewater transport service in a safe, cost-effective, and environmentally sound manner.

Wastewater Transport Facilities

1. Facilities Operational Statement

During FY17 Wastewater Transport facilities operated at full capacity throughout the year. All required equipment to maintain flow and process of wastewater was available with the following exceptions: Chelsea Screen House: screen #2 was unavailable from July 20, 2016 to August 19, 2016 for screen rehabilitation, screen #3 was unavailable from July 1, 2016 to July 13, 2016 for gate replacement, screen #4 was unavailable from July 27, 2016 to August 11, 2016, for screen & gate replacement. Chelsea Creek Headworks: channel #1 was unavailable from March 17, 2017 to June 9, 2017 for PCB remediation, channel #2 was unavailable from June 12, 2017 to June 30, 2017 for PCB remediation. There were no operational impacts as a result of this work and all required flows were processed through the Chelsea Screen House and Chelsea Creek Headworks during the work associated with these capital improvements. The CSO facilities operated with sufficient chlorination and dechlorination, though some NPDES exceedances were reported. The required number of pumps in each gravity and pumping CSO was available throughout the year.

2. Equipment Availability

The average equipment availability for FY17 was 99.97 %. An equipment availability report is generated daily that details the critical equipment required to collect and transport the wastewater flow at the facility design capacity. Higher maintenance priority is given to equipment that drops below the number required. Because of the high daily equipment availability, no operational impact has occurred in the past year.

3. SCADA Program

The MWRA 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. Although the system is continuously being upgraded through CIP projects and in-house efforts, the SCADA system for all FOD facilities has been in place since FY10.

MWRA SCADA staff performs the required maintenance and upgrades to the majority of the field instrumentation and control panel equipment to ensure accurate measurements and continued operation throughout MWRA's FOD facilities. During FY17, these efforts were supplemented by an Instrumentation Service Contractor who was primarily responsible for performing calibrations and corrective service to the gas monitoring systems within facilities and at H₂S monitoring sites within MWRA interceptors. SCADA staff also maintains, upgrades, programs and patches the computers and hardware used in collecting, controlling, transmitting and displaying facility data. During FY17, continued emphasis was placed on improving MWRA's cyber security posture. This included installation of data diodes between the MIS and SCADA networks, enhancing the network monitoring systems, and making improvements to physical hardening.

Equipment Replacement and Significant Maintenance Projects

Equipment replacement is part of the overall maintenance strategy that ensures compliance with permit requirements. Projects and initiatives are completed during each fiscal year to maintain redundancy and continued reliability. Many projects are extensive, requiring significant in-house resources and use of specialty/service contractors. Some examples of key improvements, equipment replacement, or significant repair work during the past fiscal year include in-house and out-sourced projects:

Headwork's Improvements: Staff continued to work to replace equipment at the headwork's to maintain equipment reliability on an as needed basis. Each year, staff evaluates systems for upgrade. All channels, all dewatering pumps have been replaced or overhauled. Work continues to maintain reliability and availability of the headwork's systems through Preventive Maintenance Practices. The following is a detailed list of work performed at all water and wastewater facilities in Metro East.

- Braintree Weymouth RPS: Maintenance staff removed and replaced pump # 3
- Caruso Pump Station: Electrical staff removed and replaced UPS for control room.
- Braintree Weymouth IPS, Prison Point, and Nut Island : Electrical and SCADA staff install upgraded gas detection system
- Prison Point: Mechanical staff replaced river water strainer that failed
- Braintree Weymouth IPS: Mechanical staff replaced dewatering pump
- Braintree Weymouth IPS: Mechanical staff removed and replaced screening system conveyor belt
- Hayes Pump Station: Mechanical staff removed and replaced pump # 2 rotating assembly

Nut Island Headwork:

- Electrical staff upgraded all non-explosion proof emergency lighting to LED
- Electrical and SCADA staff install upgraded UPS Odor Control
- Plumbing staff replaced ten Emergency Washing Units
- Electrical staff installed and tested Facility Emergency Generator Load Bank
- Mechanical/Machine staff installed Activated Carbon on Shaft inlet, discharge structure and building vents
- Machine and Weld staff fabricate and install new equipment access hatches

Outsourced Projects

- Braintree Weymouth RPS: Pump # 3 pump failed, pump was removed and spare pump installed by in-house mechanical staff, failed pump delivered to vendor to evaluate and overhaul. When overhaul complete pump will be delivered and stored as a spare.
- Hayes Pump Station: Pump # 3 rotating assembly was removed and a spare was installed by in-house mechanical staff, pump rotating assembly delivered to vendor to evaluate and overhaul. when overhaul complete pump will be delivered and stored as spare.

Wastewater Transport Pipelines

1. Manhole Inspection and Rehabilitation Program

The Technical Inspections Unit (TIU), of the FOD conducts manhole inspections. These inspections facilitated the beginning of the manhole rehabilitation program. Specialized equipment and training are the essential elements of the program. Pipeline maintenance crews perform manhole renovations and repairs that result in reduced I/I. The manholes are coated using cementitious material applied with spinning equipment and then covered with special coatings to resist corrosion from hydrogen sulfide.

In FY17 TIU staff inspected a total of **719** manholes. Approximately 115 manholes were rehabilitated utilizing in house staff. The rehabilitation work included frame and cover replacement, external repairs to raised manholes, internal repairs using the spin-cast application, and other miscellaneous repair work.

2. Pipeline Rehabilitation

Pipeline Rehabilitation projects are first identified by the TIU during routine television inspections of the pipelines and interceptors. MWRA Engineers review these projects and perform or coordinate all necessary design and construction contracting. The following is a current pipeline construction/rehabilitation project included in the MWRA Capital Budget.

Phase 8 Sewer Manhole Rehabilitation Contract No. OP-358

Contract OP-358 was designed by MWRA staff. It is the eighth in a series of annual contracts to rehabilitate sewer manholes. The work under this contract consists of internal rehabilitation of 76 sewer manholes at various locations in Boston, Dedham, Somerville, Winchester and Woburn. The interior surfaces of the manholes will be prepared by first cleaning and plugging active water infiltration. A fiber-reinforced, corrosion-resistant mortar will then be applied, which will improve the structural integrity of the manhole and also protect against future corrosion damage.

3. Pipeline Inspection and Cleaning

The Technical Inspection and Wastewater Pipeline Maintenance groups were merged to more efficiently and consistently maintain the wastewater collection system. The work performed by the inspection staff is an important element to the planning and execution of pipeline maintenance work. The inspection tasks are shared by the entire staff and the maintenance workload is prioritized based on inspection data and information.

TIU conducts internal inspections of MWRA structures and pipelines to reveal potential problem areas and identify locations requiring maintenance. Pipeline inspections average about 70% of the workload followed by inspections of other structures and manholes. Approximately 33.17 miles of pipelines were TV inspected in FY17.

Community Assistance was provided to member communities on an as needed basis. This assistance included:

- City of Somerville Assistance. Somerville suspected a possible sewer collapse. MWRA CCTV inspected 287 linear feet of 12" diameter sewer pipe.
- City of Cambridge Assistance. Cambridge requested the CCTV inspection to locate a 6" connection for a CSO evaluation. MWRA CCTV inspected 100 linear feet of 12" diameter sewer pipe.
- City of Malden Assistance. Malden was experiencing a sewer blocked. MWRA cleaned 1,410 linear feet of a 10" diameter sewer pipe.

Pipeline maintenance crews perform a variety of maintenance activities for the MWRA's Wastewater Transport system. The Transport collection system includes 240 miles of interceptor sewer lines. Approximately 35.78 miles of pipeline and 81 siphons were cleaned in FY17.

In addition to general pipeline and manhole repair work performed under this program, the following are other activities pipeline crews perform during the year:

- Pipeline spot repair work in shallow excavations
- Clear obstructions and clean sections in community lines under the Community Assistance Program

- Snow plowing and removal during winter months
- NPDES inspections and best practice management activities
- Emergency pumping activities for communities during major wet weather events
- By-pass pumping for contracted pipeline rehabilitation or repairs
- Emergency response and overflow monitoring during wet weather events
- Response to odor complaints in the system

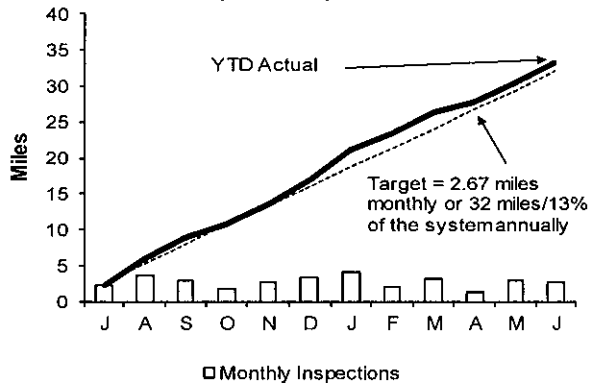
The attached “Maintenance Pipeline and Structure Inspections and Maintenance” page provides a breakdown of the pipeline inspections and maintenance activities for FY17.

Wastewater Pipeline and Structure Inspections and Maintenance

June 2017, FY 17

Inspections

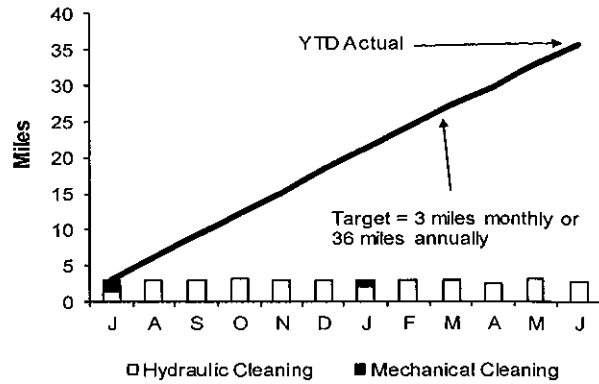
Pipeline Inspections



Staff internally inspected 2.74 miles of MWRA sewer pipeline during the month of June. The year to date total is 33.17 miles. Community Assistance was provided to the city of Somerville (287' of 12" sewer) and Cambridge (100' of 12" sewer) this month.

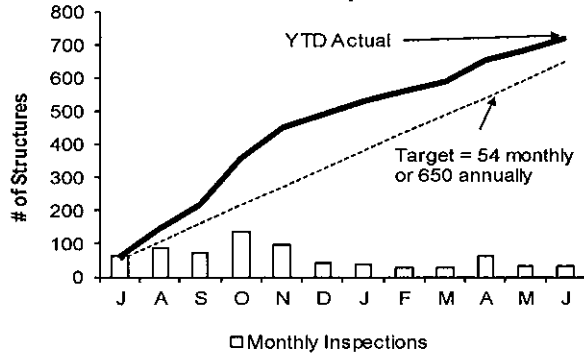
Maintenance

Pipeline Cleaning



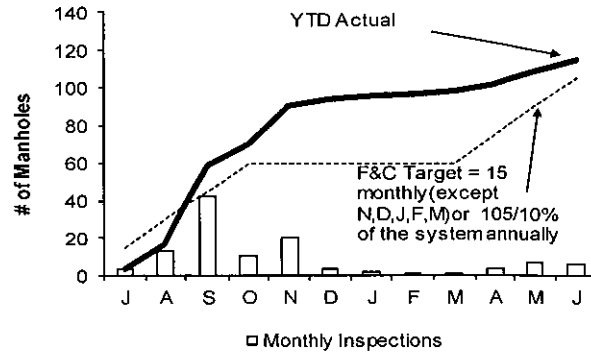
Staff cleaned 2.78 miles of MWRA's sewer system and removed 10 yards of grit and debris during the month of June. The year to date total is 35.78 miles. No Community Assistance was provided this month.

Structure Inspections



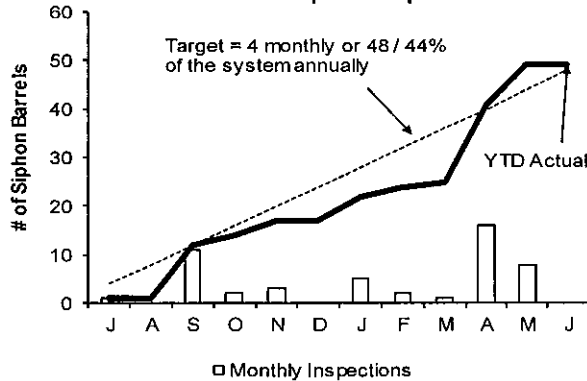
Staff inspected the 12 CSO structures and performed 21 additional manhole/structure inspections during the month of June. The year to date total is 719 inspections.

Manhole Rehabilitation



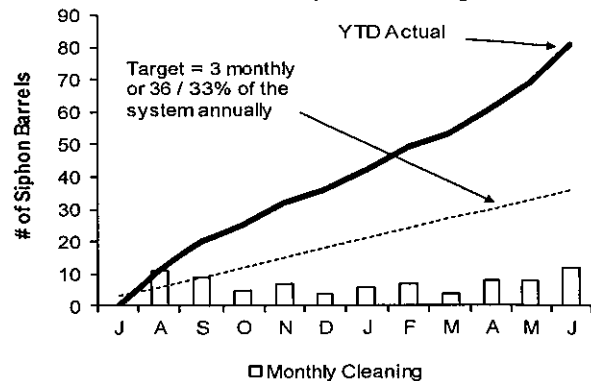
Staff replaced 6 frames & cover during the month of June. The year to date total is 115.

Inverted Siphon Inspections



Staff did not inspect any siphon barrels this month. Year to date total is 49 inspections.

Inverted Siphon Cleaning



Staff cleaned 12 siphon barrels during the month of June. Year to date total is 81.

FY17 Maintenance Program Costs, Staffing and Contracts

1. Budget

FOD has made a significant commitment to the maintenance of its wastewater system. Additional maintenance and improvement projects are included in the MWRA Capital Program and are identified on an annual basis. A Master Plan is ongoing within the Authority to prioritize projects and to determine required funding needs. The budget below includes only the Current Expense Budget (CEB). Maintenance includes protecting the many assets of the MWRA with individual programs that care for facility interior and exterior elements, maintain plant equipment, inspect and clean wastewater pipelines, and structures. Staff plan/schedule and track maintenance activities for each program, supervise staff, and provide adequate administrative support. The table below includes a summary of the approved budget in FY17 for programs within FOD for related maintenance activities.

FY17 APPROVED MAINTENANCE ANNUAL BUDGET

Budget Line Item	Total Funding
Wages and Salaries	\$10,620,474
Overtime	\$662,643
Maintenance (Parts & Supplies)	\$5,248,034
Professional Services	\$83,118
Other Materials	\$293,868
Other Services	\$329,356
Total	\$17,237,493

2. Staffing

A total of 131 employees are included in the chart below. They represent personnel responsible for the maintenance of wastewater transport facilities and pipelines. Unit Supervisors for each trade provide supervision and support in their respective areas: electrical, mechanical, machinists and welding, plumbing, HVAC, painting, and carpentry. 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, painters, and masons). These groups perform maintenance activities at both wastewater and water facilities.

Work Coordination in FOD provides scheduling and job planning at all water and wastewater facilities, water and wastewater pipeline maintenance, and Western Operations. The Wastewater

Pipeline Maintenance and Technical Inspection programs maintain the collections system for the Transport system only. The staffing represents FY17 average levels for employees reporting to the Chelsea Facility. The table below indicates the amount of staffing available and dedicated to maintenance efforts.

MAINTENANCE STAFFING LEVELS

Staffing Categories	No. of Staff
Equipment Maintenance Program	
Maintenance Manager	1
Engineers	0
Program Manager/Area Manager	3
Administration	1
Maintenance Specialists	15
Electrical Specialists	12
Plumber/Pipefitters	9
HVAC Specialists	5
Machinists & Welders	4
	50
Work Coordination Group Program	12
Wastewater Pipeline Inspection and Maintenance Group	25
Building & Grounds Program	14
Facility Maintenance Program (Carpenters, Painters, Masons)	13
SCADA Engineers	2
SCADA Maintenance Technicians	8
Subtotal	77
Total	131

Staffing levels may vary as a result of vacancies, transfers, and other factors. This chart provides a number of available staff during the fiscal year for maintaining the collections system and wastewater facilities. Equipment Maintenance, Building & Grounds, and Facility Maintenance programs perform similar core business functions at Water Pumping Facilities and locations.

3. Service Contracts

The Maintenance Program is supplemented by a series of service contracts. These services are intended to provide resources beyond the in-house capabilities of the Maintenance staff. FOD currently utilizes the following service contracts and services, listed below, to supplement the existing workforce and assist with maintenance projects at water and wastewater facilities.

<u>CURRENT SERVICE CONTRACTS</u>
Elevator Maintenance
Crane Maintenance
Hydraulic Equipment Maintenance
Instrumentation Maintenance
Fuel Storage Tanks
Fire Alarm and Sprinkler
Air Compressor Service
Boiler and Water Heater
Pest Control Services
Trash Removal
Electrical Testing
Groundskeeping
Lube Oil Analysis
Union Park Station Operation and Maintenance
Generator Maintenance
Overhead Door Maintenance
Vibration Monitoring

Wastewater Transport Equipment Maintenance

1. Annual Report

The Field Operations Department Equipment Maintenance page for key indicators of performance for FY17 is attached. Monthly maintenance data is shown under six headings.

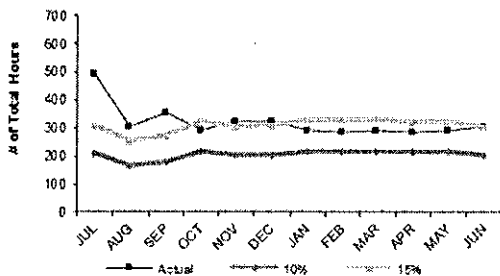
- Operations Light Maintenance (PM) Hours – In an effort to free up Maintenance staff to complete more detailed and complex maintenance, Operations staff have been committed to completing a number of the routine monthly preventative maintenance tasks. These tasks generally consist of observation and light maintenance tasks. The industry benchmark is 10% - 15% of the total preventative maintenance hours. In FY17, Operations staff completed an average of 310 hours per month which accounted for 15% of the total preventative maintenance hours.
- Overall Preventive Maintenance – The preventive maintenance work orders are completed by both operation and maintenance staff. The goal for FY17 was to complete 100% of all preventative maintenance work orders. The average PM completion for FY17 was 100%.
- Items Kitted Utilizing Maximo – In an effort to more efficiently complete work, maintenance staff and work coordination center staff have utilized the Lawson/Maximo interface to better kit stock and non-stock material. The goal is to kit at least 50 items per month. The average for FY17 was 233 items per month.
- Operations Light Maintenance % PM Completion – In an effort to free up Maintenance staff to complete more detailed and complex maintenance, Operations staff have been committed to completing a number of the routine monthly preventative maintenance duties. The goal for Operations staff is to complete 100% of the preventative maintenance work orders. In FY17 Operations staff completed an average of 100% of the work orders.
- Maintenance Backlog in Crew Hours - Backlog is determined by totaling the planned craft hours in open work orders and comparing them to craft resources available. The FY17 backlog average was 10,787 hours which remains within the industry standard of 6,626 to 13,275 hours.
- Overtime Spending – Maintenance overtime spending was \$233,014 over budget for FY17. The overtime was used to support call ins for emergency maintenance and planned overtime. It was also used for emergency coverage and maintenance coverage related to weather events.

Field Operations' Metropolitan Equipment & Facility Maintenance

June 2017 - FY17

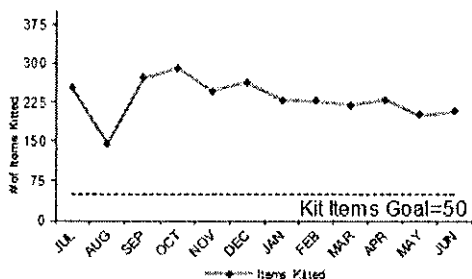
Several maintenance and productivity initiatives are in progress. The goal for the Overall PM completion and the Operator PM completion was raised to 100% in Fiscal Year 2010. The Operator PM and kitting initiatives frees up maintenance staff to perform corrective maintenance and project work, thus reducing maintenance spending. Backlog and overtime metrics monitor the success of these maintenance initiatives.

Operations Light Maintenance PM Hours



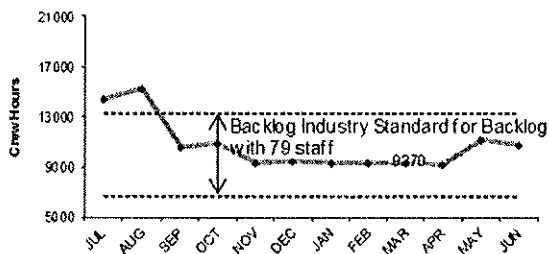
As part of efforts to improve efficiency, Operation staff completed 305 hours of preventive maintenance in June, about 15% of the total PM hours, which is within the industry benchmark of 10% to 15%. Operators completed 100% of the Ops PMs scheduled.

Items Kitted Utilizing Maximo



In an effort to more efficiently complete work, maintenance staff and work coordination staff have utilized the Lawson/Maximo interface to better kit stock and non stock material. The goal for FY 17 is to "kit" 50 stock and non stock items total per month. 207 items were kitted during the month of June.

Maintenance Backlog in Crew Hours



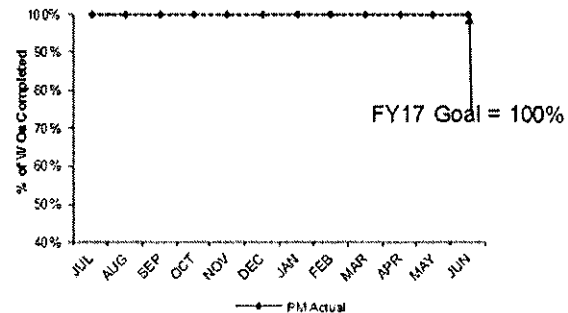
Current backlog is at 10815 hours while overtime spending was 31k over budget for June. The industry standard for maintenance backlog with 79 staff is between 6,636 and 13,275 hours. There are currently eight vacant positions, one Plumbing Supervisor, three Facility Foreman and one Facility Specialist, one HVAC Technician and two M & O Specialists.

Overall Preventive Maintenance



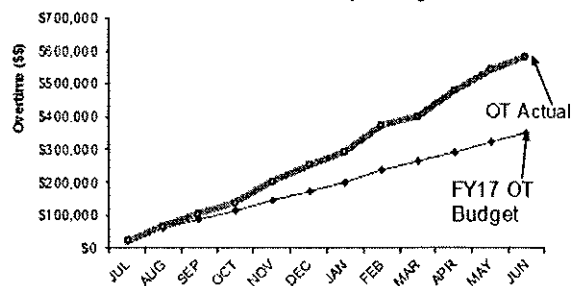
In June, Field Ops completed 100% of all PMs. Maintenance staff completed 100% of their assigned PMs and Operations staff completed 100% of their PMs.

Operations Light Maintenance % PM Completion



Operations' PM goal is the completion of 100% of all PMs each month; Operations completed 100% in June.

Overtime Spending



Maintenance overtime was \$14k over budget for June and is currently \$233k over budget for FY 17. Overtime in June was used for critical maintenance repairs and wet weather events.

2. Critical Equipment Availability

The average equipment availability for FY17 was 99.97 %. An equipment availability report is generated daily that details the critical equipment required to collect and transport the wastewater flow at the facility design capacity. Higher maintenance priority is given to equipment that drops below the number required. Because of the high daily equipment availability, no operational impact has occurred in the past year.

Annual Status Sheets – Fore River Pelletizing Plant

July 2016 – June 2017

Critical Equipment Availability: 93.65%

Operating logs indicate that of the 2,190 machine days in the fiscal year 2016, centrifuges were available for 2,051 days for an availability of 93.65%. The centrifuges and ancillary equipment make up the critical components at the Pelletizing Plant because dewatered sludge can be processed through the dryers or it can be sent through a bypass system to trucks and taken to a landfill. The primary driver of downtime was the factory reconditioning of two complete rotating assemblies, which reduces capacity while those machines are off site. At the present time, all 12 centrifuges are available giving the Plant more than enough capacity to process flows from Deer Island. The facility is currently operated on a 5-day workweek ceasing operations on most weekends.

Backlog:

The current maintenance monitoring software does not track craft hours, but at fiscal year-end, there were 68 outstanding work orders. Of the 68, 31 are PM's, 12 are corrective and 25 are listed as other.

Maintenance Work Orders:

In FY2017, there were 1,002 work orders generated in the CMMS. Of those 996 were completed during the fiscal year, equating to a 99.8% completion rate. The new eMaint CMS system has allowed the plant to better track ongoing work orders and the benefits of the upgrade are clear. The Preventative Maintenance system is continuously being modified to include updates for equipment changes, new lubrication schedules and new equipment inspection and cleaning practices. In addition, the operations staff are utilizing the system to track non-routine cleaning tasks to better gauge necessary frequency and to allow these cleanings to be scheduled as preventative rather than corrective actions.

Maintenance:

More than \$1.40 million was spent on replacement parts and maintenance related items in FY2016, including:

- A new VFD was purchased and installed for the Centrifuge 11 main drive motor.
- Replaced ceramic media in two of four RTO's
- Centrifuge repairs – two complete rotating assembly were sent back to the manufacturer and have been overhauled to OEM condition
- Conveyor Repairs – Several small to medium repairs were completed; Major repairs include:
 - Replaced mixer B, screw and liners on Train 1
 - Replaced two of the silo screw conveyors and added UHMW liners to those two and two additional conveyors
- One of the site's main boilers was replaced with a new boiler