



STAFF SUMMARY

TO: Board of Directors
FROM: Frederick A. Laskey, Executive Director 
DATE: January 16, 2019
SUBJECT: Update on the 2018 MWRA Water and Wastewater Master Plan

COMMITTEE: Administration, Finance & Audit

INFORMATION
 VOTE

Carolyn M. Fiore, Deputy Chief Operating Officer
Stephen Estes-Smargiassi, Director, Planning and Sustainability
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MWRA's water and wastewater systems have an asset value of approximately \$13 billion, split about evenly between the two systems (\$6 to \$7 billion in replacement asset value each). Since its creation (FY86-FY18), the MWRA has invested \$8.3 billion in building new assets and rehabilitating existing ones. MWRA initiated 40-year Master Planning for these systems as a means to identify and prioritize anticipated future water and wastewater investments over a multi-decade horizon. Development of the Master Plan is a collaborative process involving Planning, Operations, Engineering, and Finance staff. This staff summary provides the Board with an update on the development of the 2018 Master Plan, which is a comprehensive update of the 2013 Master Plan. Staff will give a PowerPoint presentation.

RECOMMENDATION:

For information only.

BACKGROUND:

MWRA has initiated a program to update its water and wastewater Master Plan approximately every five years to reflect changing water and wastewater system needs, updated asset conditions, evolving regulatory requirements, required adaptations to climate change and the need to mitigate greenhouse gases, population or system expansion trends, revised or new priorities and other appropriate considerations. The draft 2018 Master Plan was used as a reference to help guide development of the Capital Improvement Program (CIP) spending cap for FY19-23. The Master Plan is intended to be a companion document to the CIP to facilitate staff and Advisory Board recommendations, and allow for comparison of future investment needs between different parts of the water and wastewater systems. The development of the CIP and all system spending is evaluated against the backdrop of rates management.

This update of the Master Plan was developed by MWRA staff during 2017 and 2018, and again takes a 40-year look at potential capital expenditures. The Master Plan lists projects already programmed in the FY19 CIP (approximately \$2.23 billion water and \$1.53 billion wastewater)

and projects recommended for consideration in future CIPs (approximately \$0.35 billion water and \$1.64 billion wastewater). One focus of the Master Plan is on projects proposed to require capital spending during the next two 5-year CIP cap cycles (FY19-23 and FY24-28). For the current cap period, the Master Plan reflects higher priority projects having been incorporated into the CIP during the FY19 budget process. Master Plan recommendations for the FY24-28 time period will be re-evaluated along with existing projects as that cap period approaches. The Master Plan also projects capital spending for an additional 10-year period (FY29-38) and a 20-year period (FY39-58) beyond that. Over the 40-year period, the 2018 Master Plan identifies approximately \$2.58 billion in water system needs and approximately \$3.17 billion in wastewater needs, a total of \$5.75 billion in projected expenditures. A summary table of project costs, by asset type, is provided as Attachment A.

The Master Plan provides a detailed listing, explanation, and prioritization of MWRA's short and long-term water and wastewater projects that impact capital needs over a 40-year period. The Business Plan is a concise listing of MWRA's goals and the objectives and strategies developed to meet the goals over a short (5-year) timeframe. An update on the Business Plan was provided to the Board in October 2018.

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

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

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

Staff are finalizing the document and will be briefing the Advisory Board, the Water Supply Citizens Advisory Committee, and the Wastewater Advisory Committee over the next several weeks.

DISCUSSION:

Summary of the 2018 Water System Master Plan

MWRA's water system includes its source reservoirs, treatment facilities, transmission lines, and distribution system facilities and pipelines; the system (excluding the source reservoirs) has an estimated replacement asset value of approximately \$6.7 billion. Total water system needs identified for the FY2019-58 Master Plan timeframe are approximately \$2.6 billion (in current dollars), including all projects currently in the CIP and those recommended for consideration in future CIPs. Approximately 69% of the total water system need addresses major remaining system redundancy costs including interim and long-term Metropolitan Tunnel Redundancy costs, WASM 3 work and remaining water distribution system storage and pipeline redundancy projects. The remaining 31% includes ongoing asset protection projects for valves, pipelines, pump stations, storage facilities, dams, and treatment facilities. Also included are costs for continuing watershed land acquisition, and replacement and optimization of other smaller yet critical assets such as radio and SCADA equipment, lab equipment and facilities, and metering equipment.

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

- The 300-mgd safe yield of MWRA's water system is sufficient to meet future demand for water both within the service area and additional demand outside the service area.
- Modeling efforts indicate that climate change is not expected to have significant impacts on reservoir yield; in fact, safe yield may increase slightly. Changes in climate may encourage surrounding communities to turn to MWRA for portions of their supply as droughts become more frequent or severe.
- No design and construction funds are included to address the impacts on MWRA's water system of potential changes in federal or state regulations. Staff continue to track potential changes to the Federal Lead and Copper Rule which may cause MWRA to reevaluate corrosion control.
- Water supply redundancy and new storage projects provide for system reliability, operational flexibility, and enhanced security. Planning for redundancy for key elements of both the transmission and distribution systems was a focus of both the 2006 and 2013 Water System Master Plans and continues to be a point of emphasis. Projects to address Metropolitan Tunnel Redundancy have now been incorporated into the CIP as have interim projects to address immediate risk reduction needs in the existing tunnel system prior to the implementation of tunnel redundancy. As a placeholder, the Master Plan includes \$65 million in future funding for repair or rehabilitation needs for the existing Metropolitan Tunnels once the new tunnels are in service. This value will be refined as the redundancy work is completed and a full inspection and assessment can be done. The Master Plan programs these costs in the FY39-58 planning period. Work on redundancy for the Northern Intermediate High and Southern Extra High service areas has progressed significantly during the past five years as well. Approximately \$15 million in new project costs are recommended to enhance redundancy in the Northern Extra High system moving forward.

- Master Plan recommendations include inspections of the Cosgrove Tunnel periodically over the 40-year Master Plan period. The inspection of the Quabbin Tunnel is in the FY19 CIP and is scheduled to begin in FY24. At this time, no funds are included for rehabilitation or repair of those tunnels. However, if inspections of any of the tunnels were to indicate more significant problems, future costs would need to be added.
- The Master Plan again emphasizes the need to continue the systematic cleaning and lining of remaining MWRA-owned, older unlined cast-iron mains to address potential water quality degradation concerns and related health risks. This effort addresses MWRA customer expectations and EPA's anticipated direction for distribution system regulation and reduces pipeline corrosion and leakage. Metropolitan system pipeline expenditures identified in the CIP or recommended in the Master Plan are approximately \$321 million (excludes WASM 3 pipe costs). Additionally, the current CIP includes approximately \$56 million for an expanded cathodic protection program for the metropolitan system.
- The Master Plan recommends a pipeline study in FY25 to help MWRA assess the ongoing need for rehabilitation beyond currently planned work. The study will look at any pipe remaining to be rehabilitated (mostly constructed since 1950), expected replacement cycles for lined pipes, and assess information on corrosion and other factors.
- The Master Plan recommends continuing to systematically address the long-term need to protect and eventually replace other water system assets, including equipment, valves, pump stations, storage facilities, treatment and transmission system buildings and equipment (not including tunnels or piping), dams, and support systems. Including what is already in the CIP as well as recommended asset protection projects, the overall water system master plan total for this category is approximately \$361 million between FY19-58.
- Financial assistance to support member community water system rehabilitation projects to help maintain high quality water is recommended to continue but must be evaluated against competing MWRA CIP needs. Even with the substantial progress made over the last 20 years via MWRA's community water loans, approximately 1,800 miles (27%) of community-owned water mains remain unlined. The Master Plan recommends two additional water loan program phases FY29-48 (each at \$250 million in loans over 10 years) to extend the current program approved through FY30. Since there is no grant component to water financial assistance; the impact to MWRA's CIP is minor compared to the sewer grant/loan program.

Summary of the 2018 Wastewater System Master Plan

The scale and scope of MWRA's wastewater system operation – encompassing collections, pumping, CSO, treatment, effluent discharge, and beneficial reuse of residuals – presents challenges in maintenance, rehabilitation, and replacement. The wastewater infrastructure has an estimated replacement asset value of approximately \$6.8 billion. Deer Island alone has approximately 70,000 pieces of equipment and instrumentation components. Regular maintenance and replacement cycles have become standard plant operating practice, but will become increasingly costly as the plant ages. Total wastewater needs identified for the FY2019-58 Master Plan timeframe are \$3.17 billion (in current dollars), including \$1.53 billion already programmed in the FY19 CIP and \$1.64 billion recommended for consideration in future CIPs. More than 94%, \$2.99 billion of the \$3.17 billion needs estimated for all wastewater projects are rehabilitation or replacement of existing infrastructure assets that are at the end of their useful life. The remaining \$180 million in needs are for projects to optimize existing systems or add capacity, technology

upgrades and new equipment to support automated facility operation, condition assessments, and wastewater modeling.

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

- No new communities are expected to join the wastewater system. Future population and employment growth in the service area is projected to modestly increase. These population and growth increases could result in a projected increase of up to 27 mgd of sanitary wastewater flow through 2040. This potential increase represents a 10% increase over the current 270 mgd average dry day flow (last 20 years). MWRA's continued commitment to invest in community infiltration, inflow, and combined stormwater reductions is expected to offset the increase in new sanitary flows.
- Wastewater quality parameters are not projected to change significantly. The need for capital projects to address wastewater quality will most likely be based on revised NPDES permit limits.
- No significant design and construction funds are included for potential long-term regulatory changes that may impact MWRA based on current Deer Island NPDES permit discussions and the 2017 Clinton permit. Future regulatory issues that may have cost implications for MWRA include more stringent limits on nutrients, conventional pollutants, or emerging contaminants; more stringent biosolids reuse criteria; rapid public notification of CSO discharges (location and volume); a higher level of CSO control; more stringent focus on reduction or elimination of sanitary sewer overflows (SSOs); and expansion of MWRA's role in local stormwater permitting and initiatives for promoting green infrastructure.
- Storm surge, together with anticipated sea level rise resulting from the changing climate, will affect a number of MWRA and communities' coastal collection systems and wastewater facilities. Sea level rise was accounted for during the design and construction of the Deer Island Wastewater Treatment Plant. As climate change projections evolve, projected infrastructure impacts, and identification of appropriate projects to counter negative impacts will become a more critical theme of future MWRA Master Plans. The 2018 Master Plan assumes any significant flood mitigation efforts will be undertaken as each MWRA facility is rehabilitated or upgraded, and that simpler measures will be implemented as maintenance efforts. Rehabilitation projects at the Alewife Brook Pumping Station and the Chelsea Creek headworks have already incorporated anticipated changes in sea level into the design criteria, and other coastal facilities have had flood mitigation measures implemented. Future coastal projects may need to be targeted so that increases in tidal and storm surge inflow do not impact MWRA's ability to provide reliable wastewater collection and treatment.
- Significant asset protection investment at Deer Island will continue, as well as green energy production and energy optimization, with \$660 million programmed in the FY19 CIP over the next 10 years. Three of the most expensive Deer Island projects include:
 - The combined heat and power project to optimize use of methane gas and overall energy efficiency (\$90 million);
 - Rehabilitation of primary and secondary clarifiers (\$134 million); and,
 - A series of odor control and HVAC equipment replacement projects (\$85 million).

- The Pelletizing Plant in Quincy will require large-scale equipment replacement which is included in the FY19 CIP at \$100 million over the next 15 years.
- The cross-harbor tunnels are assumed to be in good condition. A \$1.3 million cross-harbor tunnel shaft study and follow-up \$9.7 million shaft rehabilitation project are programmed in the FY19 CIP during FY19-27. A \$5 million tunnel inspection and condition assessment project is also programmed in the CIP during FY24-28. The condition of the cross-harbor tunnels and potential need for future investment is a significant unknown for MWRA until the inspection/condition assessment project is complete. Included as a Master Plan recommendation is a \$50 million placeholder for future inspection/cleaning/repair of the tunnels in the out years of the planning period (FY46-50).
- Headworks facilities require significant reinvestment that is programmed in the CIP (estimated at over \$240 million over the next 10 years). The Chelsea Creek Headworks Upgrade is well into construction and will be followed by the Columbus Park and Ward Street Headworks Upgrades. Improvements programmed in the CIP for the Nut Island Headworks include odor control, HVAC, mechanical, and electrical system upgrades. Upgrade projects at the headworks must be implemented while systems remain on-line, posing operational challenges.
- MWRA's 20 pump stations and CSO facilities, while generally in good condition, are aging and some are in need of rehabilitation or upgrade. The Master Plan reinvestment strategy for these facilities estimates a \$163 million need over the next 10 years, only 45% of which is currently programmed in the FY19 CIP.
- No significant additional CSO capital costs are included (other than maintenance of existing facilities) beyond the \$2.5 million (through FY21) to complete the 3-year CSO Control Performance Assessment. If regulatory action were to mandate a higher level of CSO control, additional capital needs would be required.
- The average age of MWRA's 226-mile sewer system is approximately 70 years old, with approximately 39% of the sewers more than 100 years old. Overall, the collection system is in reasonably good condition, given its age. MWRA's interceptor renewal program targets the approximate 13 miles (6% of gravity sewers) that have significant physical defects. The sections requiring repair are prioritized based on risk and consequence of failure and are regularly monitored through internal TV inspection. In addition to the gravity sewers and structures, MWRA also maintains 29 miles of force mains, siphons, and CSO/emergency outfalls. The Master Plan reinvestment strategy for all sewer pipelines estimates a \$168 million need over the next 10 years, of which 70% is currently programmed in the FY19 CIP.
- Wastewater metering and supervisory control and data acquisition (SCADA) systems will continue to require upgrades based on assumed useful life/obsolescence of the electronic equipment. Much of this equipment is expected to require replacement every 10 to 20 years (programmed in the FY19 CIP at \$22 million for the next 10 years).
- Financial assistance to support member community projects for sewer system rehabilitation and infiltration/inflow reduction is planned to continue but must be evaluated against competing MWRA CIP needs. Continued investment in rehabilitation of member community sewer systems is key in minimizing the potential for regional wastewater flow increases, which could require additional future transmission and treatment capacity. The Master Plan carries recommended funds for additional community financial assistance beginning in FY24. Staff will continue to work cooperatively with the Advisory Board to identify potential improvements for community financial assistance programs.

Green Power Production and Energy Efficiency

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

Next Steps

Remaining work on the Master Plan includes:

- Presentation to the MWRA Advisory Board;
- Presentation to a joint meeting of the Water System Citizens Advisory Committee and the Wastewater Advisory Committee;
- Finalization of the Master Plan document; and,
- Posting the final version of the 2018 Master Plan on MWRA's website in early 2019.

ATTACHMENT:

Attachment A – 2018 Master Plan Project Cost Summary

2018 MWRA MASTER PLAN PROJECT COST SUMMARY (\$ in thousands)

Asset	FY19-23	FY24-28	FY29-38	FY39-58	SUBTOTAL FY19-58
Water Treatment and Land Acquisition Programmed in FY19 CIP	13,016	18,204	28,500	0	59,720
Future Recommended - Water Treatment and Land Acquisition	0	3,596	15,000	45,000	63,596
Transmission System and Dams Programmed in FY19 CIP	95,455	576,243	826,278	52,862	1,551,838
Future Recommended - Transmission System and Dams	4,050	7,600	10,850	70,500	93,000
Metropolitan System, Lab, SCADA, Metering, Energy and Info Management Programmed in FY19 CIP	235,769	321,531	60,454	0	617,754
Future Recommended - Metropolitan System, Lab, SCADA, Metering, Energy and Info Management	3,575	7,600	33,700	150,400	195,275
SUBTOTAL - Water Projects Programmed in FY19 CIP	345,240	915,978	915,232	52,862	2,229,312
SUBTOTAL - Future Recommended Water Projects	7,625	18,796	59,550	265,900	351,871
TOTAL WATER PROJECTS	352,865	934,774	974,782	318,762	2,581,183
Wastewater Treatment and Residuals Programmed in FY19 CIP	324,596	423,977	68,801	0	817,374
Future Recommended - Wastewater Treatment and Residuals	7,400	49,000	140,750	596,000	793,150
Headworks, Tunnels, Pump Stations, CSO Facilities, Sewers, SCADA and Metering Programmed in FY19 CIP	195,396	287,545	35,215	0	519,156
Future Recommended - Headworks, Tunnels, Pump Stations, CSO Facilities, Sewers, SCADA and Metering	3,000	142,900	204,000	342,400	692,300
Community Financial Assistance Programmed in FY19 CIP	123,200	129,100	-40,500	-13,300	198,400
Future Recommended - Community Financial Assistance	0	106,100	48,000	-4,100	150,000
SUBTOTAL - Wastewater Projects Programmed in FY19 CIP	644,192	840,622	63,416	-13,300	1,534,930
SUBTOTAL - Future Recommended Wastewater Projects	10,400	298,000	392,750	984,300	1,685,450
TOTAL WASTEWATER PROJECTS	654,592	1,138,622	456,166	921,000	3,170,380
TOTAL - Projects Programmed in FY19 CIP	989,432	1,756,500	978,548	39,562	3,764,242
TOTAL - Future Recommended Projects	18,025	316,796	452,300	1,200,200	1,987,321
TOTAL PROJECTS	1,007,457	2,073,396	1,430,948	1,239,762	5,751,563