Massachusetts Water Resources Authority

# *2013 MWRA Master Plan*
# *Water and Wastewater System*

## *Briefing to WSCAC and WAC*

**November 19, 2013**

# Presentation Outline

- **Introduction**
- Water System
- Wastewater System

# MWRA Mission

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

# Water System Goals

Goal 1: Provide reliable water delivery.

Goal 2: Deliver high quality water.

Goal 3: Assure an adequate supply of water.

Goal 4: Manage the system efficiently and effectively.

# Wastewater System Goals

Goal 1: Provide reliable and safe sewer service.

Goal 2: Provide environmentally sound wastewater collection and treatment, pretreatment, 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.

# Master Plan vs Business Plan

Some themes overlap, but target audiences are different

## Master Plan

• Detailed listing, explanation and prioritization of all short and long-term projects that impact capital needs over a 40 year period

• Used by Staff and Advisory Board to develop capital investment priorities during development of annual CIP and to help project long-term rates

## Business Plan

• Concise listing of MWRA goals over a short (5 year) period

• Used to engage Board of Directors and outside agencies in discussion of MWRA's goals and plan to meet them

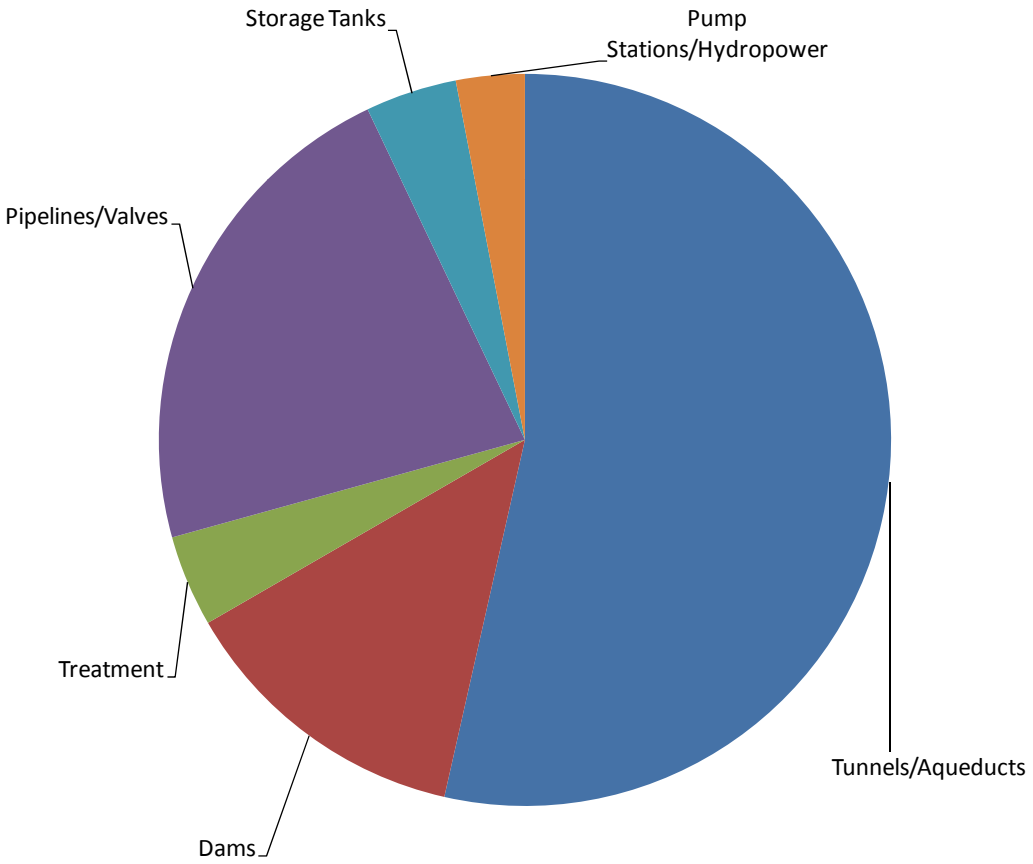
# Background – 28 Years of MWRA Capital Spending

## FY86-13 $7.7 Billion Capital Spending

- 73% on Wastewater - $5.5 Billion
- 25% on Waterworks - $2.0 Billion
- 2% on Business and Operations Support - $200 Million

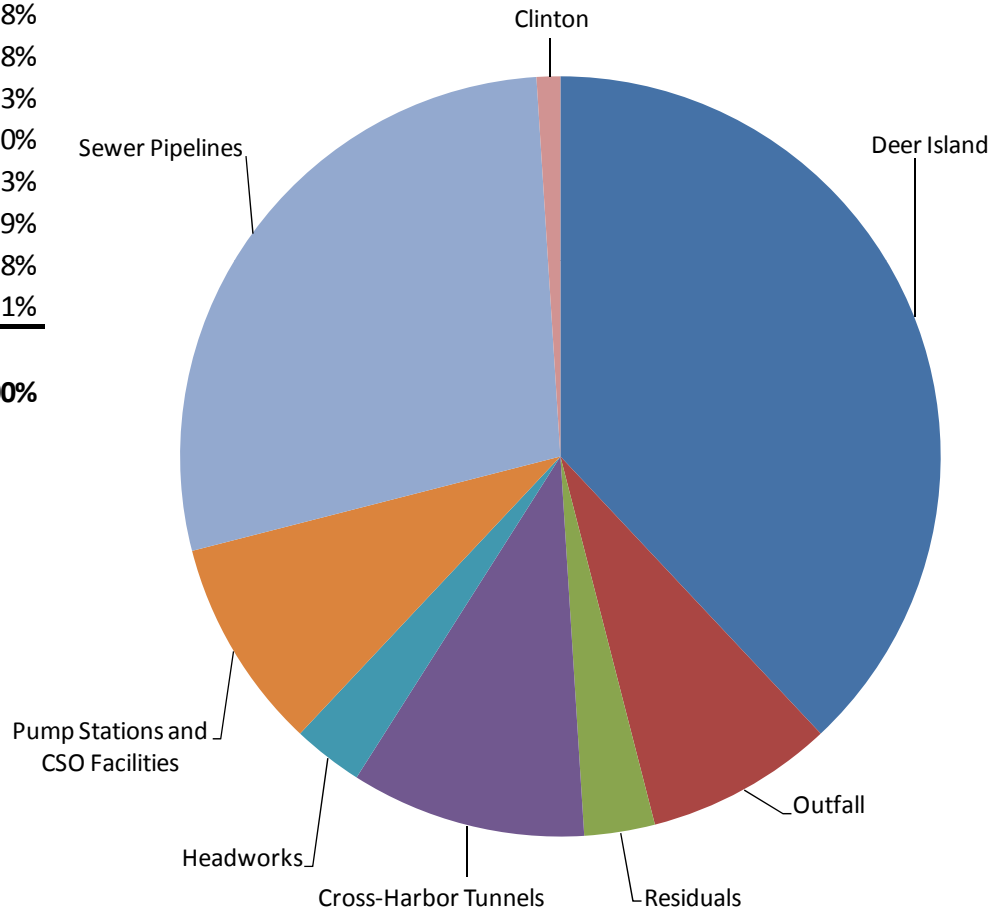
# Water System Infrastructure Replacement Asset Value

| Asset Class | Asset Value in millions | % of Total |
|---|---|---|
| Tunnels/Aqueducts | $3,470 | 53% |
| Dams | $830 | 13% |
| Treatment | $250 | 4% |
| Pipelines/Valves | $1,430 | 22% |
| Storage Tanks | $290 | 4% |
| Pump Stations/Hydropower | $210 | 3% |
| Meters | $30 | <1% |
| **TOTAL** | **$6,510** | **100%** |



# Wastewater System Infrastructure Replacement Asset Value

| Asset Class | Asset Value in millions | % of Total |
|---|---|---|
| Deer Island Treatment Plant | $2,500 | 38% |
| Deer Island Outfall | $530 | 8% |
| Residuals Pelletizing Plant | $200 | 3% |
| Cross-Harbor Tunnels | $660 | 10% |
| Remote Headworks | $190 | 3% |
| Pump Stations and CSO Facilities | $630 | 9% |
| Sewer Pipelines | $1,900 | 28% |
| Clinton Treatment Plant | $50 | 1% |
| **TOTAL** | **$6,660** | **100%** |



# Overview of MWRA Master Planning

- 40-Year Master Plan Developed in 2006 (FY07-48)
- Updates Planned About Every 5 Years
- 2013 Master Plan Includes All Projects in FY14 CIP
- Master Plan Also Includes Additional Projects (System Needs) in 40-Year Planning Period (FY14 through FY53)
- Focus on Next 10 Years – FY14-18 and FY19-23
- Draft Master Plan Used to Help Guide FY14-18 CIP Cap Discussions and Reaffirms CIP Cap Approved by Board of Directors in June 2013

# What the 2013 Master Plan Includes

## System Needs Identified in 2013 Master Plan = $4.0 Billion

| | FY14-18<br>5 years | FY19-23<br>5 years | FY24-33<br>10 years | FY34-53<br>20 years | Total<br>40 years |
|---|---|---|---|---|---|
| Water | $311M | $578M | $398M | $191M | $1.5B |
| Wastewater | $409M | $640M | $541M | $944M | $2.5B |
| Total | $720M | $1,218M | $939M | $1,135M | $4.0B |
| 5 Year Average | $720M | $1,218M | $470M | $284M | $500M |

# Project Prioritization

- 135 Water projects evaluated and prioritized
- 232 Wastewater projects evaluated and prioritized

Priority 1 - Critical
Priority 2 - Essential
Priority 3 - Necessary
Priority 4 - Important
Priority 5 - Desirable

- All projects receive further scrutiny during annual CIP development process

# Presentation Outline

- Introduction
- **Water System**
- Wastewater System

# MWRA Water System Overview

102 miles of active transmission mains and tunnels
43 miles of standby transmission facilities
Water treatment capacity 405 MGD
284 miles of distribution mains
4900 valves
287 MG of covered storage
11 pump stations

# What the Water System Master Plan Includes

## Existing Projects and New Recommendations*

| | FY14-18<br>5 years | FY19-23<br>5 years | FY24-33<br>10 years | FY34-53<br>20 years | Total<br>40 years |
|---|---|---|---|---|---|
| Water Projects Programmed in FY14 CIP | $305M | $538M | $218M | $10M | $1,072M |
| Projects Recommended in Master Plan | $6M | $40M | $180M | $181M | $405M |
| **Total** | **$311M** | **$578M** | **$398M** | **$191M** | **$1,477M** |

## Total Water Needs Identified in Master Plan: $1.5 BILLION

**Local Water System Assistance Program funds not included in calculations*

# Water System Master Plan Themes

## 2006

- Redundancy
  - -Initiate Planning Efforts
  - -Continue Work on NIH/SEH and Lynnfield Projects
  - -Complete Blue Hills
- Continue Pipeline Rehabilitation
- Identify Asset Protection Needs

## 2013

- Redundancy
  - -Implementation Underway
    - Transmission System
    - Distribution System
    - Storage
- Continue Pipeline Rehabilitation
- Increase Asset Protection Funding

# 2013 Master Plan Assumptions - WATER

- 300 mgd safe yield adequate for:
  - Existing service area
  - Potential new users
- No funds for potential changes in federal or state regulations
- 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.

# Major 2013 Master Plan Recommendations - WATER

- Water supply redundancy and new storage projects provide operational flexibility and enhance system security and remain the focus of the 2013 Water System Master Plan.

- Specific projects to address these needs are now programmed in the CIP with implementation ongoing through FY37 (most complete by 2025) and a total remaining cost of approximately $831 million. This includes the rehabilitation/replacement of WASM 3 which will address redundancy for the northern part of the Metropolitan tunnel system.

# Major 2013 Master Plan Recommendations - WATER

- The CIP includes inspection of the Quabbin Tunnel.
- The Master Plan recommends periodic inspection of the Cosgrove Tunnel
- The Master Plan recommends $65 million for design and rehabilitation of the Metropolitan Tunnels
  - Includes access, inspection, initial valve replacement
  - If significant problems found, costs could be higher

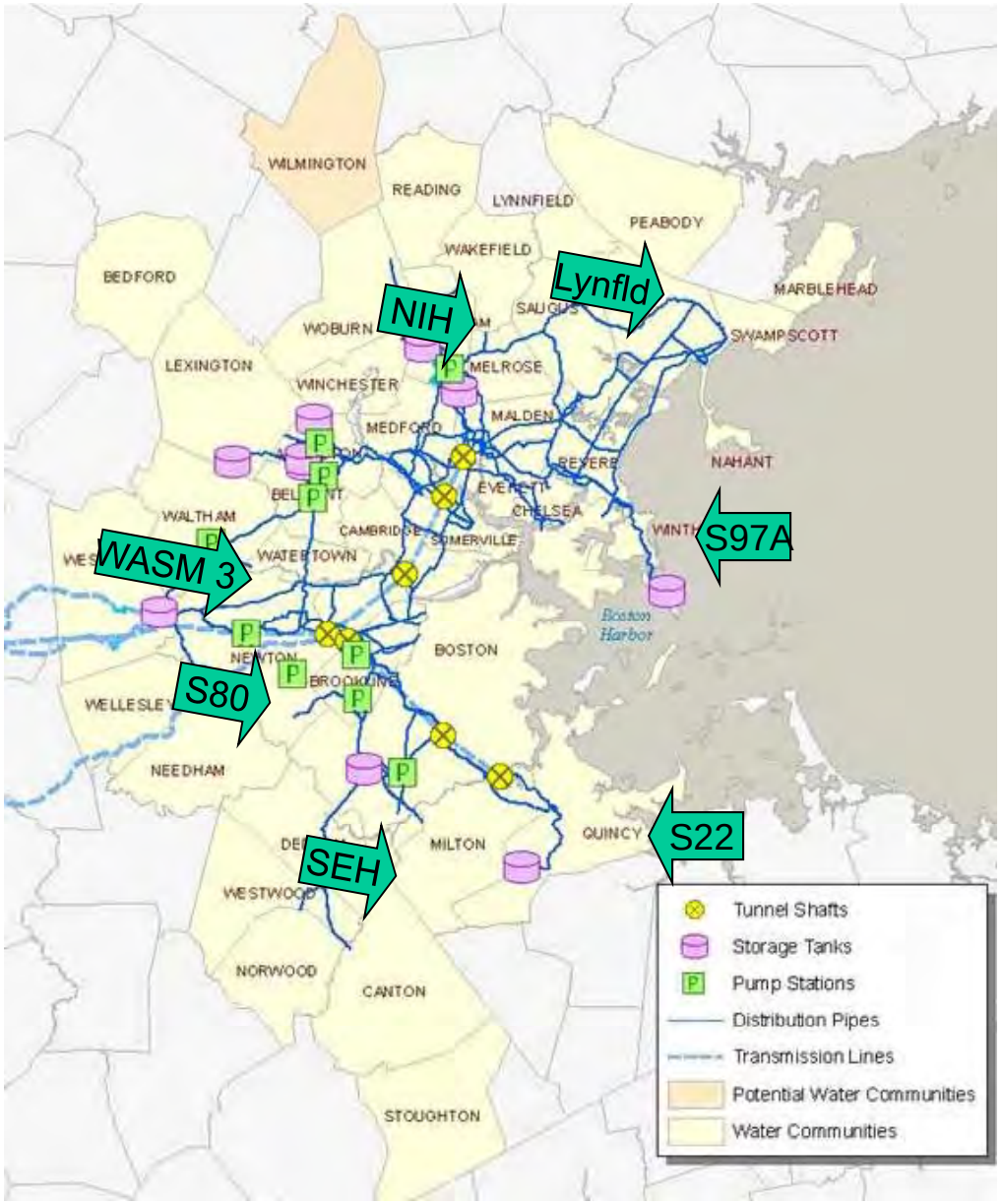
# Redundancy Issues – Single Point of Failure Pipes

## Need for Redundancy

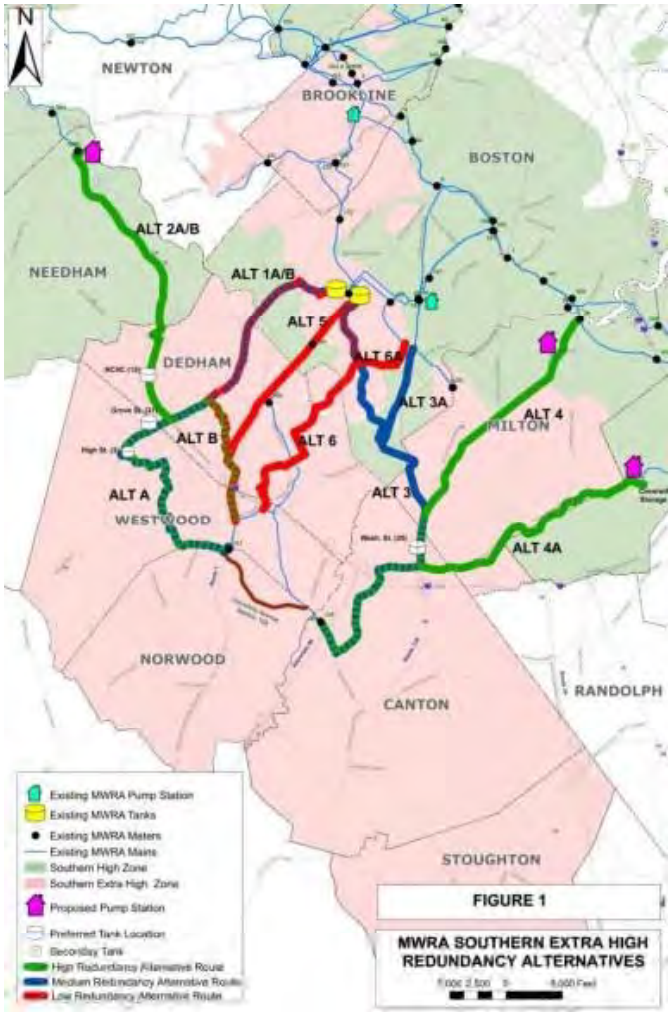
*Single supply line means severe loss of service during breaks.*

## Status

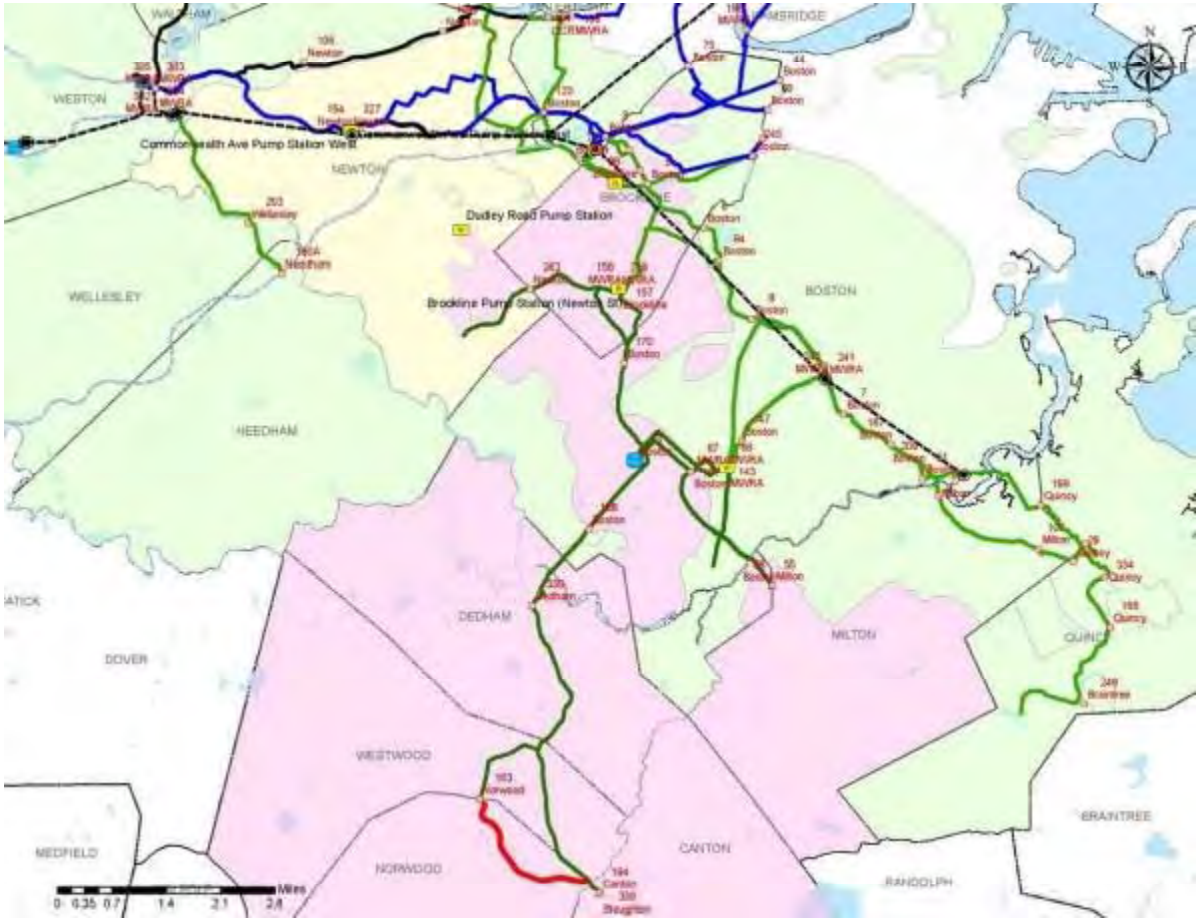
*Problem areas being systematically addressed.*



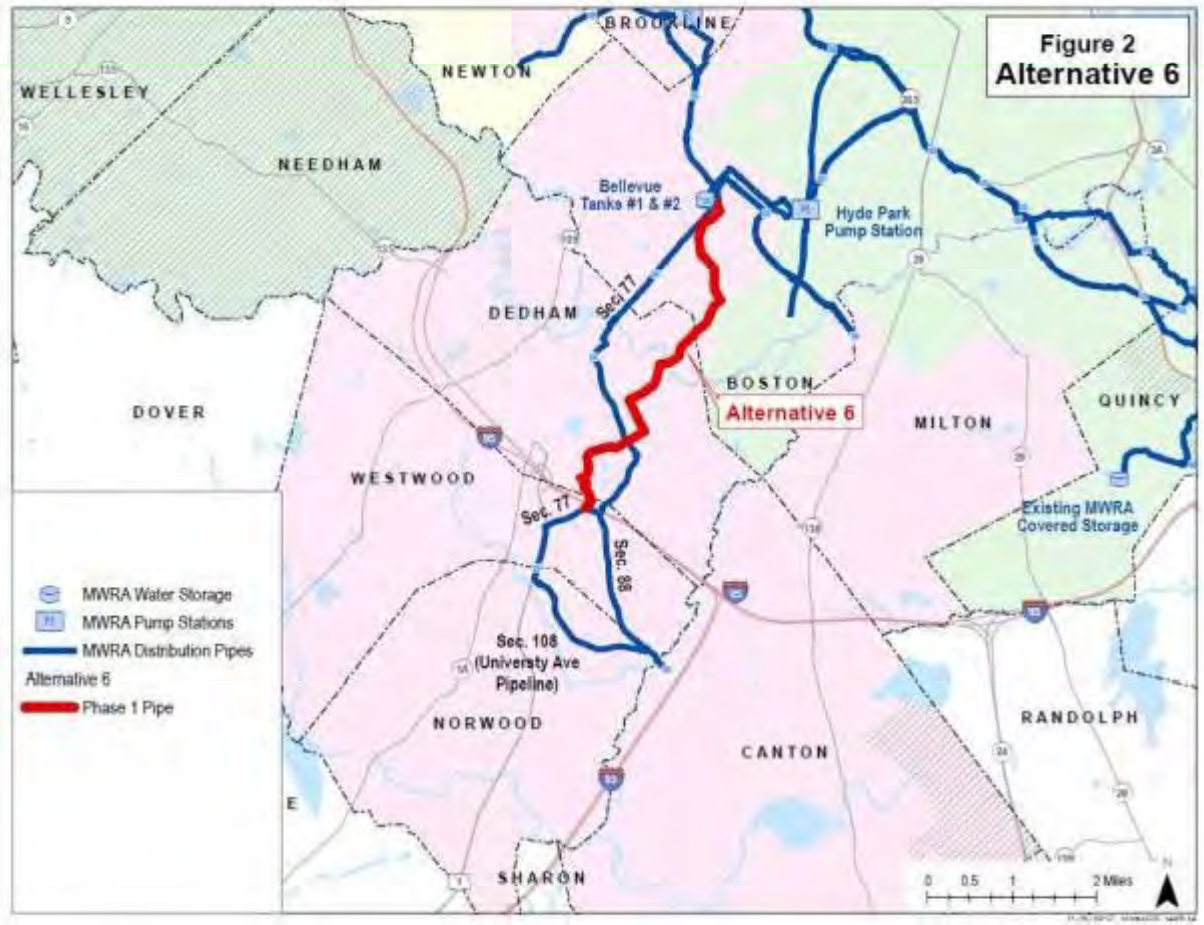
# Southern Extra High Concept Planning



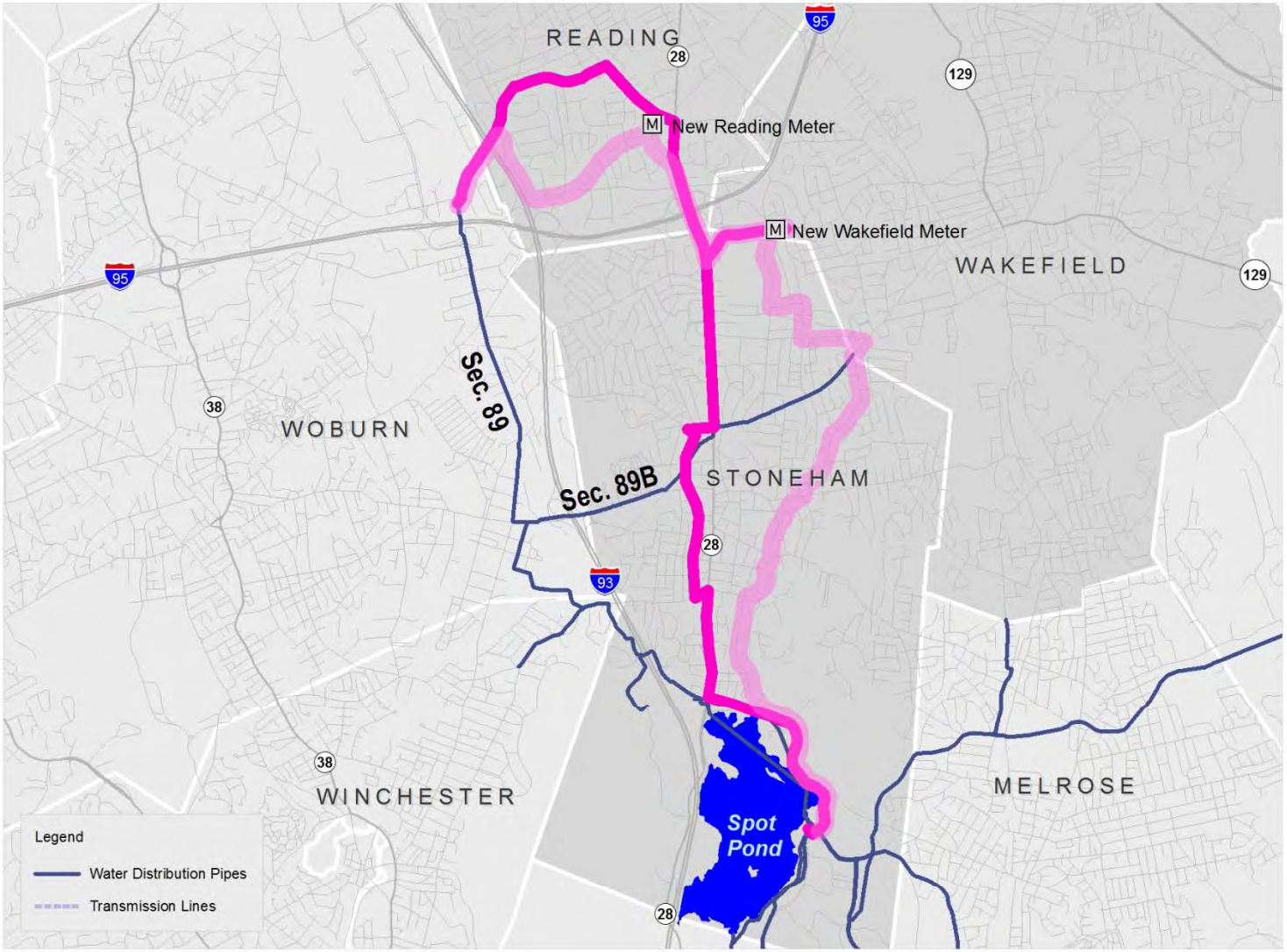
# Short-Term Risk Reduction-University Ave



# Southern Extra High-Recommended Plan



# Northern Intermediate High



# Section 89 at Rt. 128

# NIH-Section 89  Globe Valve Removal

# Metropolitan Tunnels Redundancy

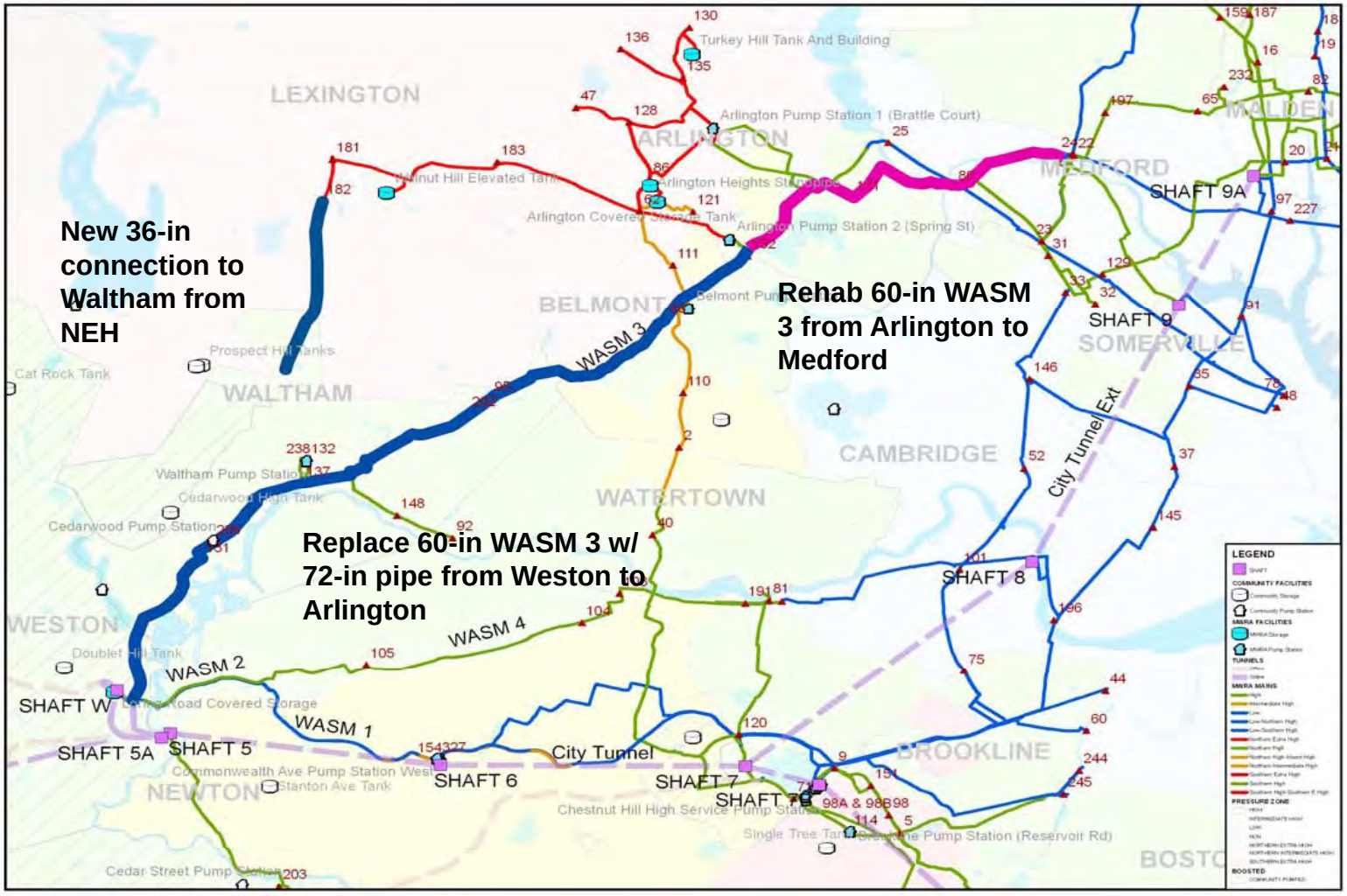

## Redundancy Issue:

Failure of the deep rock tunnels is unlikely but failure of surface connection valves and piping is possible.

Failure of a surface connection at any shaft can require isolation of a large portion of the tunnel system.

The isolation valves at the 3 key shafts are old and needs the kind of maintenance that can only be performed when taken out of service.

# Northern Portion-Metropolitan Redundancy



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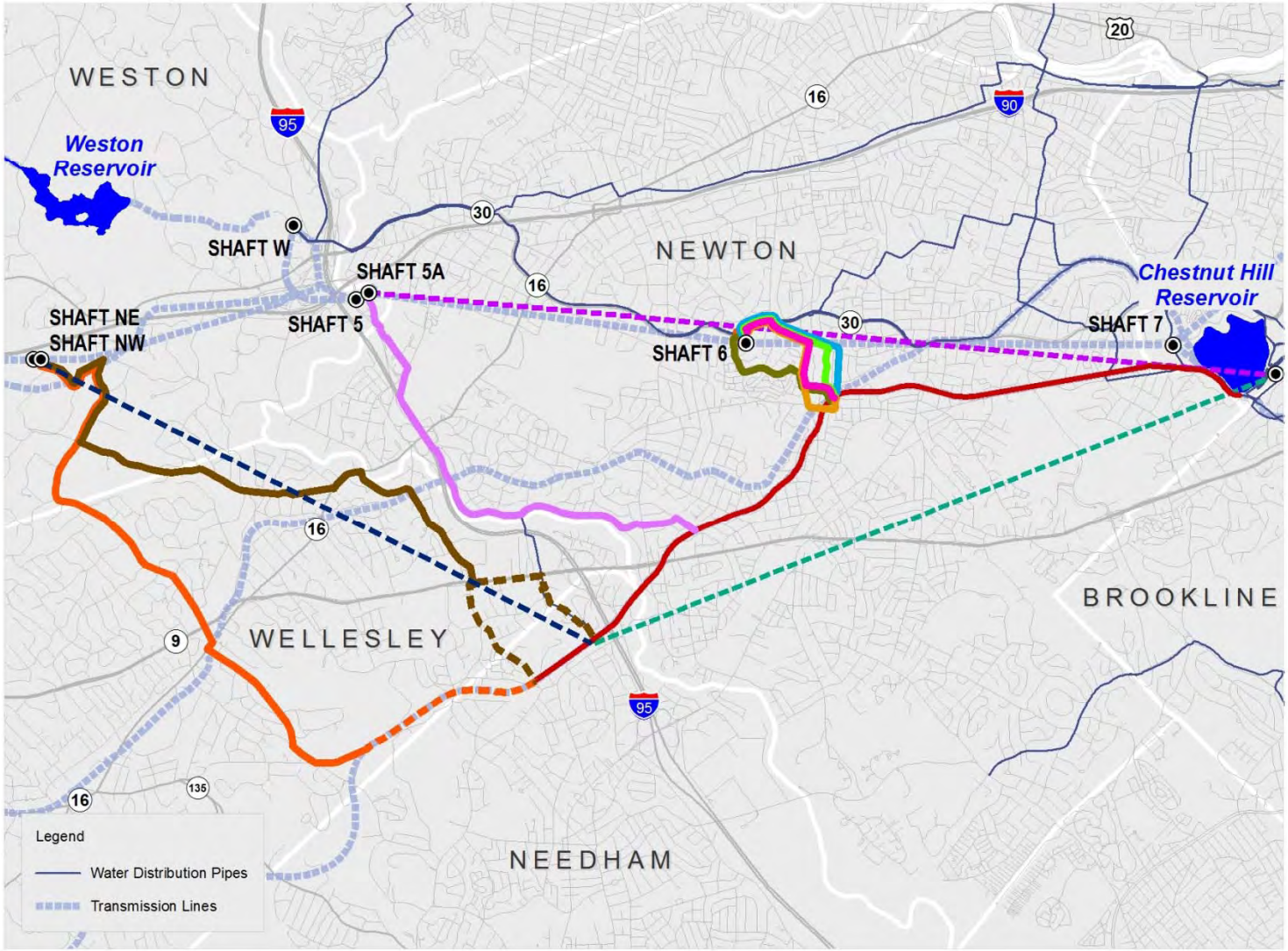
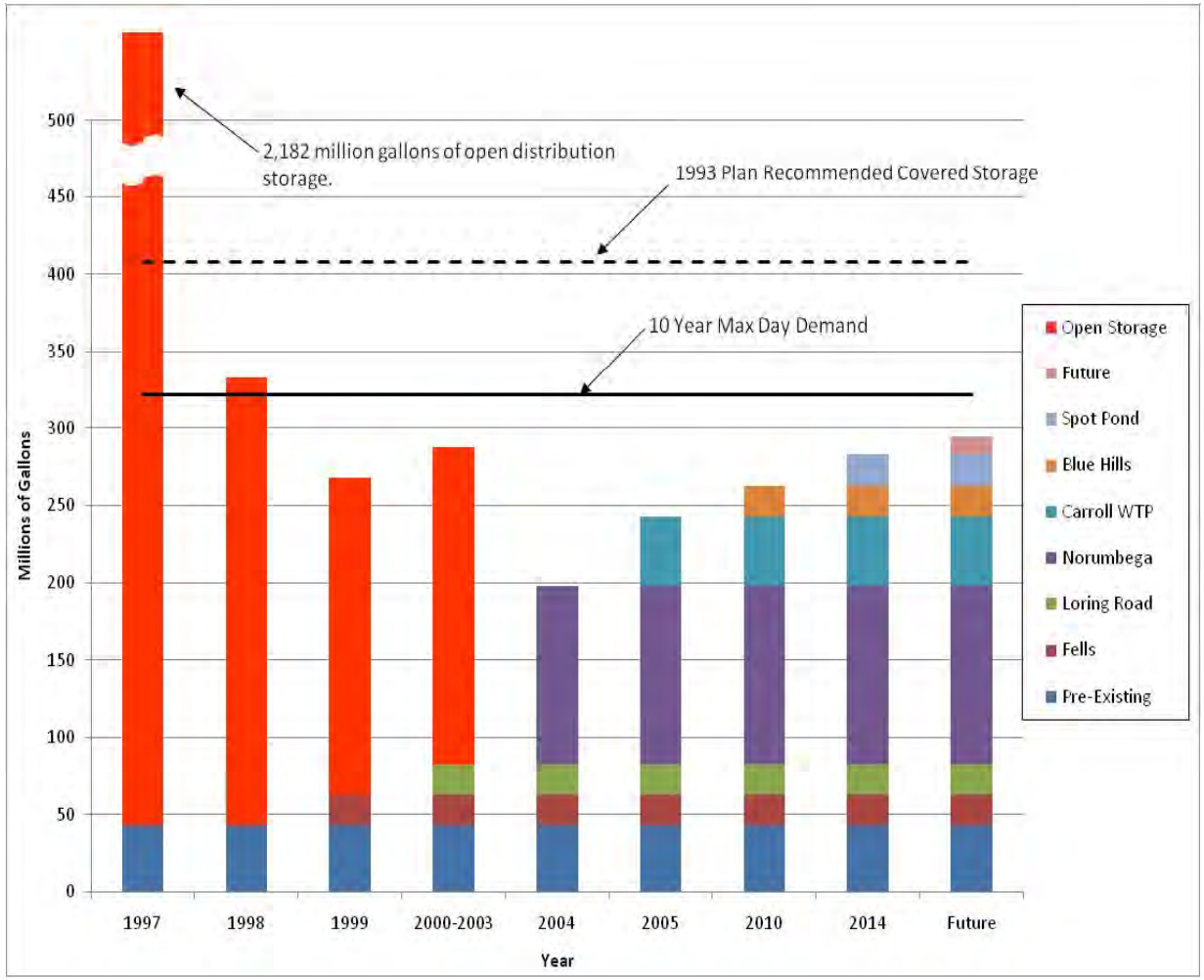


# MWRA Metropolitan Area Storage Capacity Over Time

System-wide evaluation was completed in 1993

- DEP Guidelines and Ten State Standards require at least 1 day of storage
- Industry Practice:
  - Most similar systems have 1 maximum day or more of storage



# Spot Pond Covered Storage Facility

Cell 1 foreground looking north-northwest

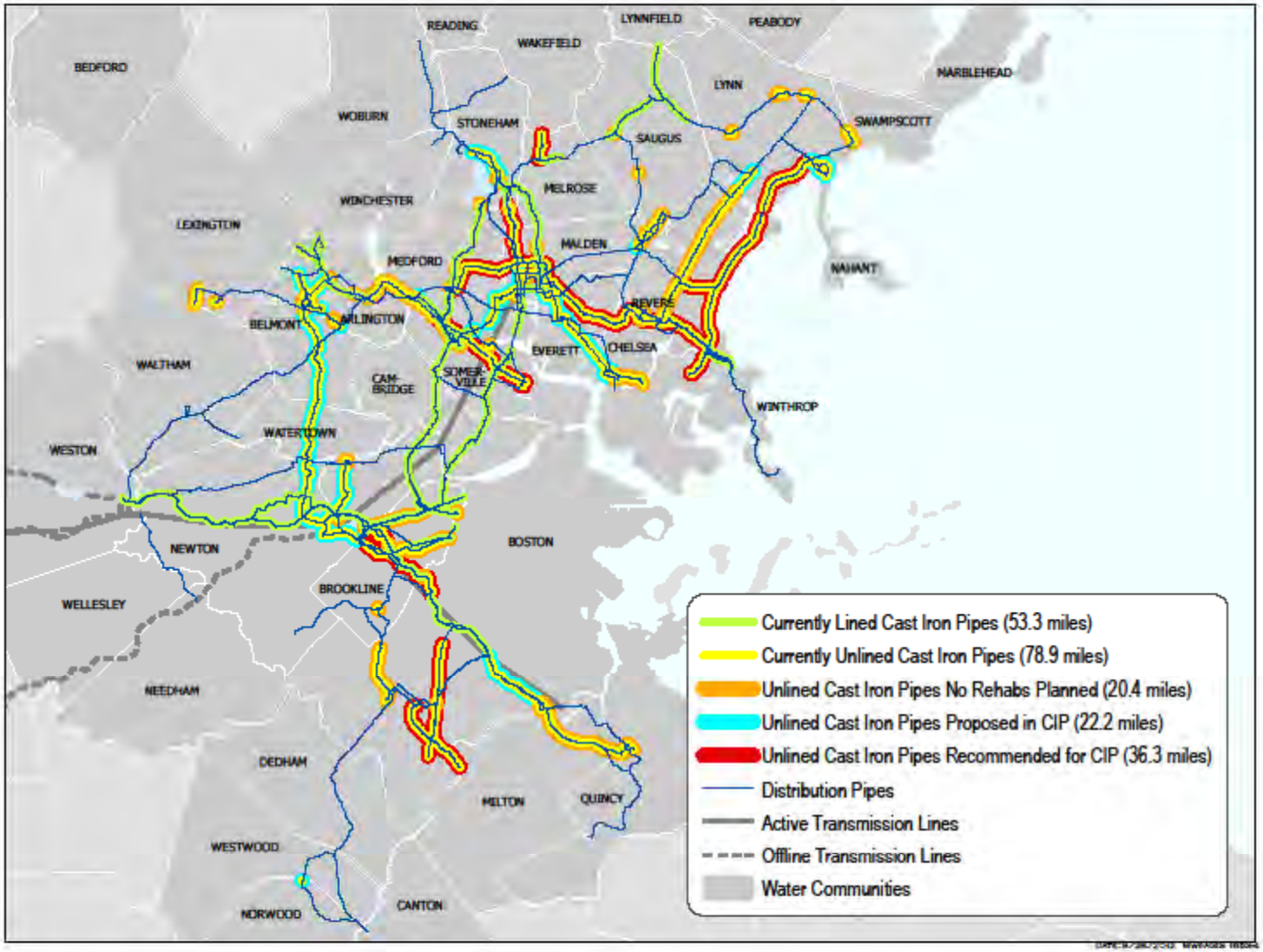
Cell 2 foreground looking northeast

# Metropolitan Pipeline Rehabilitation

Metropolitan system pipeline expenditures identified in the CIP or recommended in the Master Plan are approximately $271 million (excludes WASM3 work) This includes:

- Continuing to systematically line remaining older unlined cast-iron mains (approximately 58 miles) to address potential water quality degradation concerns

# Distribution System Status – Cast Iron Pipe

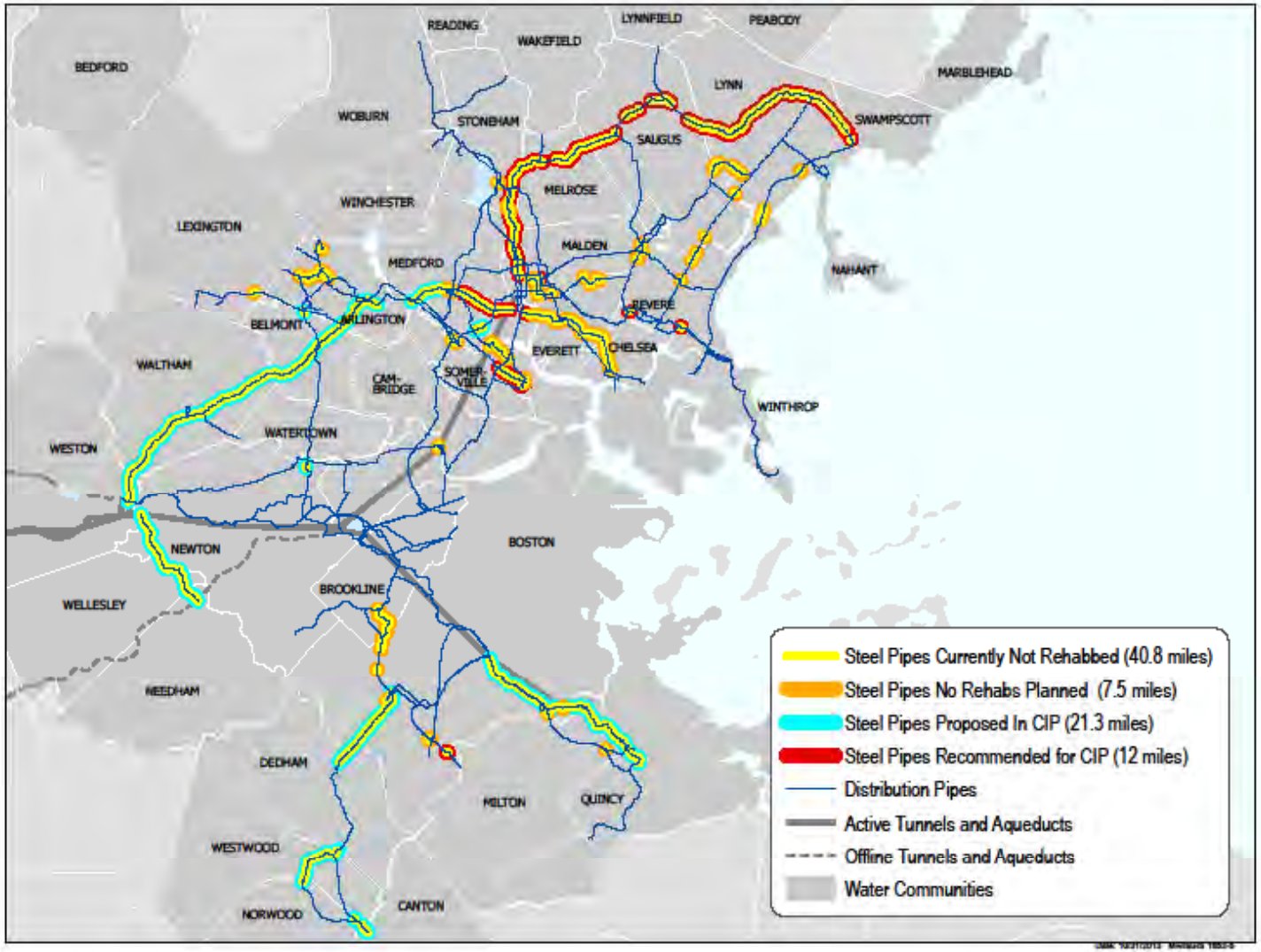


# Metropolitan Pipeline Rehabilitation

- Continuing to replace/rehabilitate more than 21 additional miles of steel pipes prone to corrosion and susceptible to leaks (does not include WASM3 work)

- The Master Plan recommends a pipeline study in FY20 to help MWRA assess the ongoing need for rehabilitation beyond the above work. The study will look at the expected replacement cycles for lined pipes and assess information on corrosion and other factors.

# Distribution System Status - Steel Pipe



# Asset Protection - Water Treatment

## Age and Condition

Carroll Water Treatment Plant has substantial electrical and mechanical systems which are likely to require replacement/upgrades starting at 10 year life.

## Asset Protection Projects

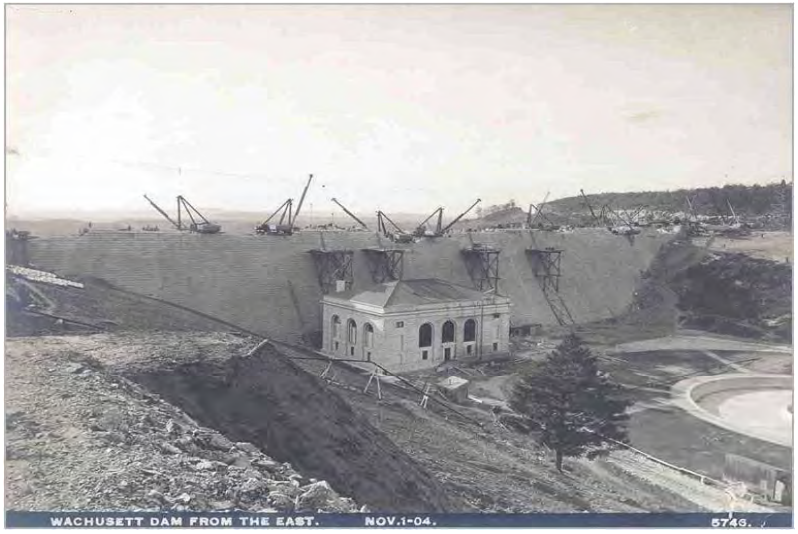
•Carroll Plant, $500,000 Added in FY16-17 Additional funding and projects recommended in FY19-53

•Quabbin Disinfection, $4M Recommended in FY27-33

# Asset Protection - Pump Stations, Valves, Storage, Dams, Buildings and Support Systems

- Besides asset protection at the CWTP and the Quabbin WTP, the 2013 Master Plan reaffirms the need to systematically protect and eventually replace other MWRA water system assets.

- The FY14 CIP and the Master Plan together allocate $272 million for equipment, valves, pump stations, storage facilities, treatment and transmission buildings and equipment, dams and ancillary support systems between FY14-53.




# Quabbin Spillway Masonry Repointing

# Foss Reservoir Spillway and Gatehouse Repointing

# Water System Master Plan - SUMMARY

## Existing Projects and New Recommendations*

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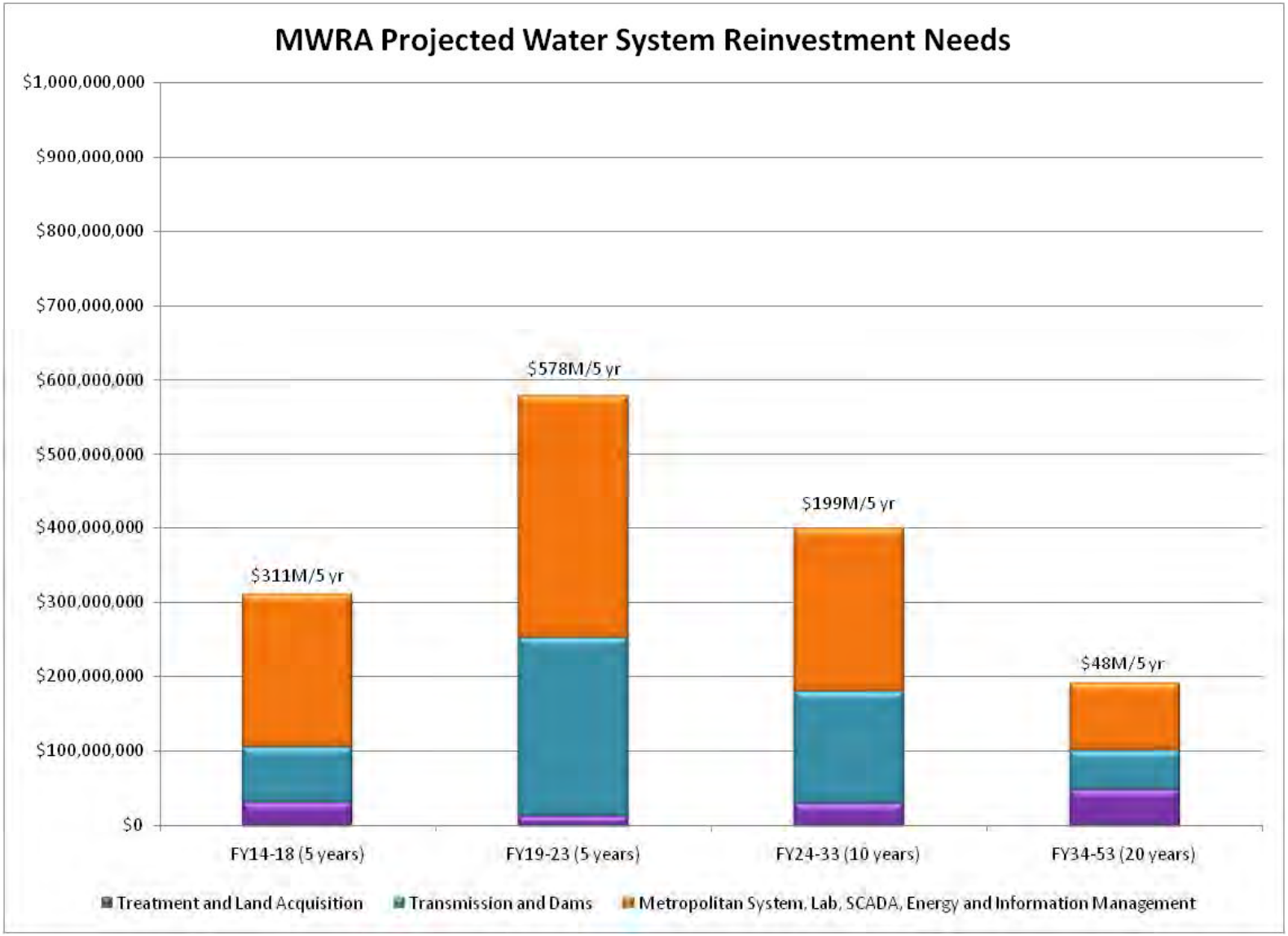
## Total Water Needs Identified in Master Plan: $1.5 BILLION

**Local Water System Assistance Program funds not included in calculations*

# What the 2013 Master Plan Includes



# What the 2013 Master Plan Includes - WATER

**2013 MWRA MASTER PLAN PROJECT COST SUMMARY ($ in millions)**

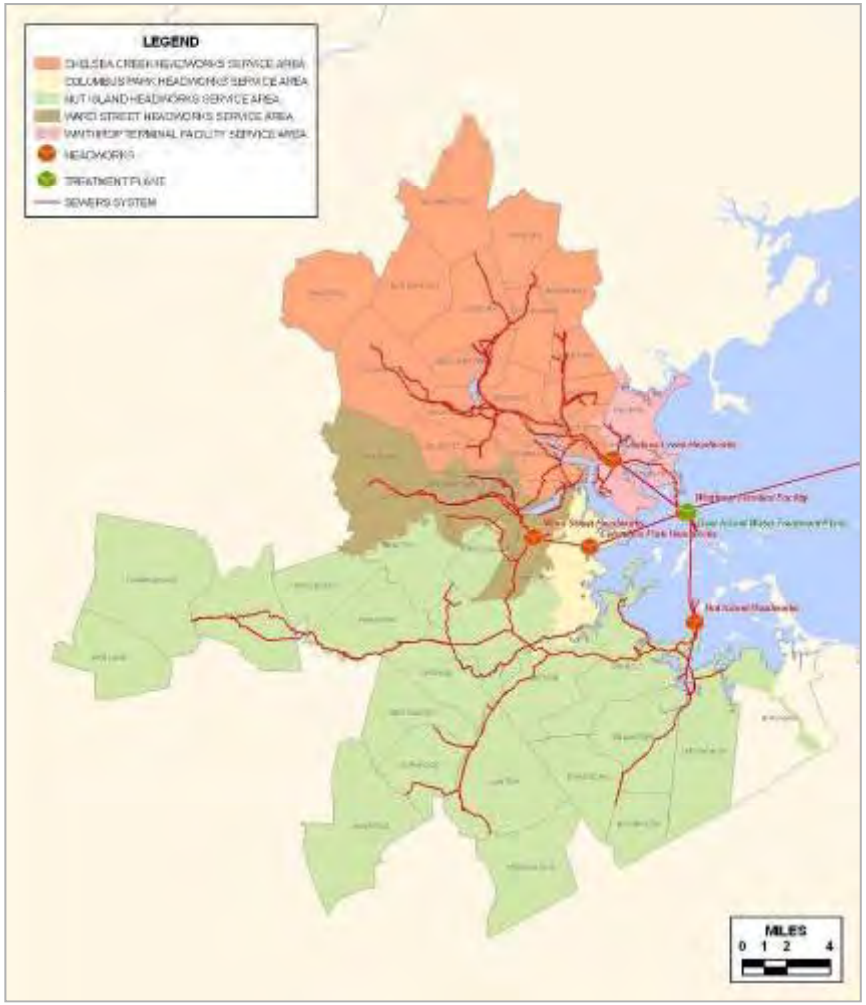
| Asset | FY14-18 | FY19-23 | FY24-33 | FY34-53 | SUBTOTAL FY14-53 |
|---|---|---|---|---|---|
| Water Treatment and Land Acquisition Programmed in FY14 CIP | 31,101 | 79 | 0 | 0 | 31,180 |
| Future Recommended - Water Treatment and Land Acquisition | 0 | 12,500 | 29,000 | 47,000 | 88,500 |
| Transmission System and Dams Programmed in FY14 CIP | 74,135 | 233,502 | 118,738 | 0 | 426,375 |
| Future Recommended - Transmission System and Dams | 0 | 6,100 | 31,725 | 54,000 | 91,825 |
| Metropolitan System, Lab, SCADA, Metering, Energy and Info Management Programmed in FY14 CIP | 200,676 | 304,887 | 99,674 | 9,906 | 615,143 |
| Future Recommended - Metropolitan System, Lab, SCADA, Metering, Energy and Info Management | 5,370 | 20,830 | 118,700 | 80,000 | 224,900 |
| SUBTOTAL - Water Projects Programmed in FY14 CIP | 305,912 | 538,468 | 218,412 | 9,906 | 1,072,698 |
| SUBTOTAL - Future Recommended Water Projects | 5,370 | 39,430 | 179,425 | 181,000 | 405,225 |
| **TOTAL WATER PROJECTS** | **311,282** | **577,898** | **397,837** | **190,906** | **1,477,923** |

# Presentation Outline

- Introduction
- Water System
- **Wastewater System**

# MWRA Sewer System Overview

- Deer Island Treatment Plant
  - 360 Million Gal/Day Average
  - 1,270 Million Gal/Day Peak
  - 9.4 Mile Outfall Tunnel
- Clinton Treatment Plant
- Residuals Plant - for Beneficial Reuse
- 19 miles of Cross-Harbor Tunnels
- 4 Remote Headworks
- 20 Pump Stations and CSO Facilities
- 226 miles of Gravity Sewers
- 29 miles of Force Mains, Siphons, and CSO/Emergency Outfalls



# What the Wastewater System Master Plan Includes

## Existing Projects and New Recommendations

| | FY14-18<br>5 years | FY19-23<br>5 years | FY24-33<br>10 years | FY34-53<br>20 years | Total<br>40 years |
|---|---|---|---|---|---|
| Wastewater Projects Programmed in FY14 CIP | $369M | $500M | $74M | $0M | $944M |
| Projects Recommended in Master Plan | $40M | $140M | $467M | $944M | $1,590M |
| **Total** | **$409M** | **$640M** | **$541M** | **$944M** | **$2,534M** |

**Total Wastewater Needs Identified in Master Plan: $2.5 BILLION**

# Wastewater System Master Plan Themes

## 2006

- Deer Island Asset Protection
  - Identify Increasing Needs as Plant Ages
- Residuals Facilities
  - Develop Long-Term Facilities Plan
- Older Remote Headworks
  - Develop Rehabilitation Plan
- Interceptor Renewal Asset Protection
  - Develop Methodology to Identify Needs
- CSO Control Plan
  - Major Expenditures Required
- Long-Term Regulatory Changes
  - No Significant Spending Planned

## 2013

- Deer Island Asset Protection
  - Continued Long-Term Investments
- Residuals Facilities
  - Timing of Replacement Needs
  - Pilot Co-Digestion and Develop Long-Term Plan
- Older Remote Headworks
  - Design/Construction Projects in Progress
- Interceptor Renewal Asset Protection
  - Reassessment and Timing of Rehabilitation Projects
- CSO Control Plan
  - Ramping Down Expenditures
  - Planning for 3 Year Performance Assessment
- Long-Term Regulatory Changes
  - No Significant Spending Planned

# 2013 Master Plan Assumptions - WASTEWATER

- No new communities are expected to join the wastewater system. No growth in flow or treatment plant loads.

- Only minor funds are included for long-term regulatory changes (Clinton phosphorus removal). Potential changes include more stringent regulation of nutrients, emerging contaminants, SSOs, CSOs, stormwater, and biosolids reuse.

- Flood mitigation for storm surge/sea level rise will be undertaken during upgrades at MWRA's coastal facilities.

# Deer Island Wastewater Treatment Plant

- $2.5 Billion Replacement Asset Value
- $530M Additional Replacement Asset Value for 9.4 mile Outfall Tunnel
- 2nd Largest Wastewater Treatment Plant in the US
- Treatment Capacity
  - Maximum
    - 1.27 Billion Gal/Day
  - Average Daily Flow
    - 360 Million Gal/Day
- 70,000 Pieces of Equipment

- Significant asset protection needs for maintenance, repair, and replacement are increasingly costly. $450M for next 10 years FY14-23 is 40% of wastewater spending.

# Residuals Processing Facility

- $200M Replacement Asset Value
- Contract Operation – NEFCo through 2015
- Full responsibility for O&M ($15M annually)
- Beneficial Reuse of Pellets is Expected to Continue
- Residuals facility needs large-scale equipment replacement. $100M programmed in CIP FY14-23 is 10% of wastewater spending.
- Co-digestion pilot begins in FY14 with future costs expected.

**Upgrade Schedule**

FY14-18 Co-Digestion Pilot and Facilities Planning ($1.3M)
FY18-20 Phase 1 Design & Construction ($12M)
FY19-24 Phase 2 Design & Construction ($90M)

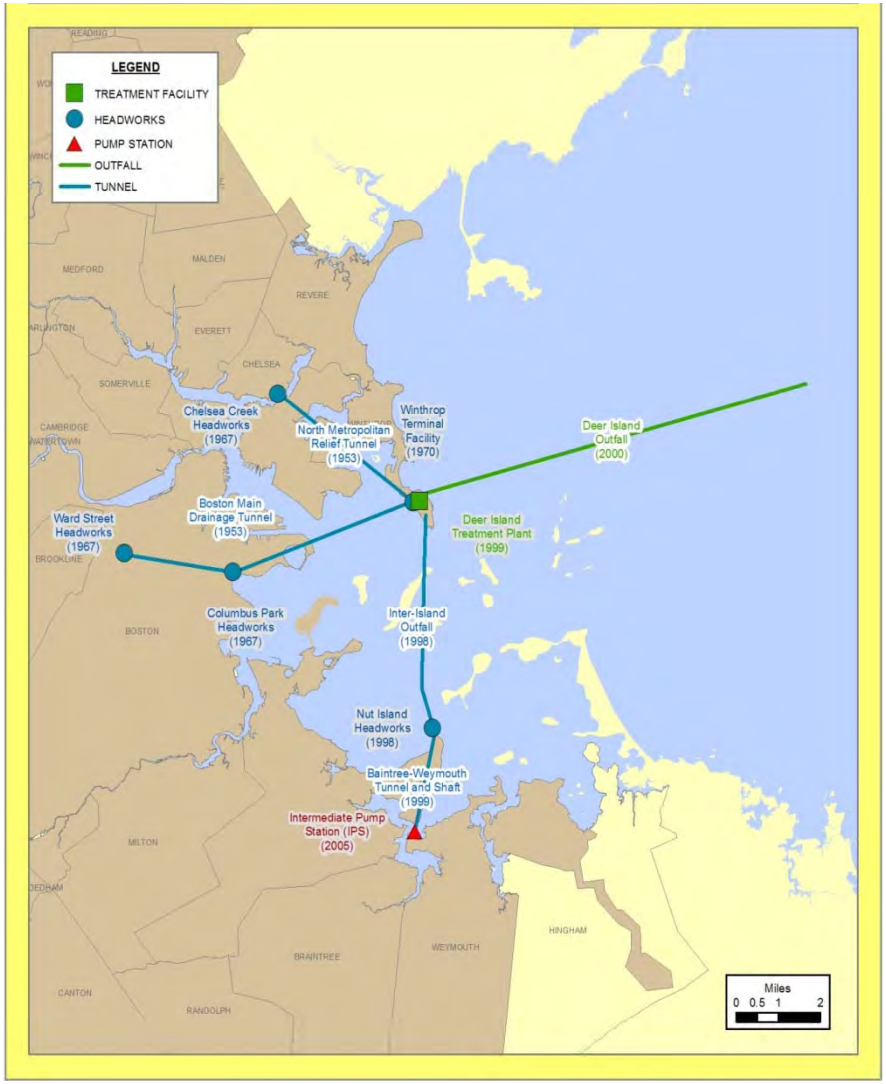
# Clinton Advanced Wastewater Treatment Plant

- $50M Replacement Asset Value
- 3 Million Gal/Day
- Discharges to South Branch of Nashua River

Clinton Plant has $14M programmed in CIP FY14-23 and additional $8M recommended for:

- Phosphorous Removal
- Sludge Digester Cleaning and Rehabilitation
- Concrete Repairs
- Belt Filter Press Replacement
- Grit Removal Facilities
- Closure of Landfill Cell #1

# Cross-Harbor Tunnels

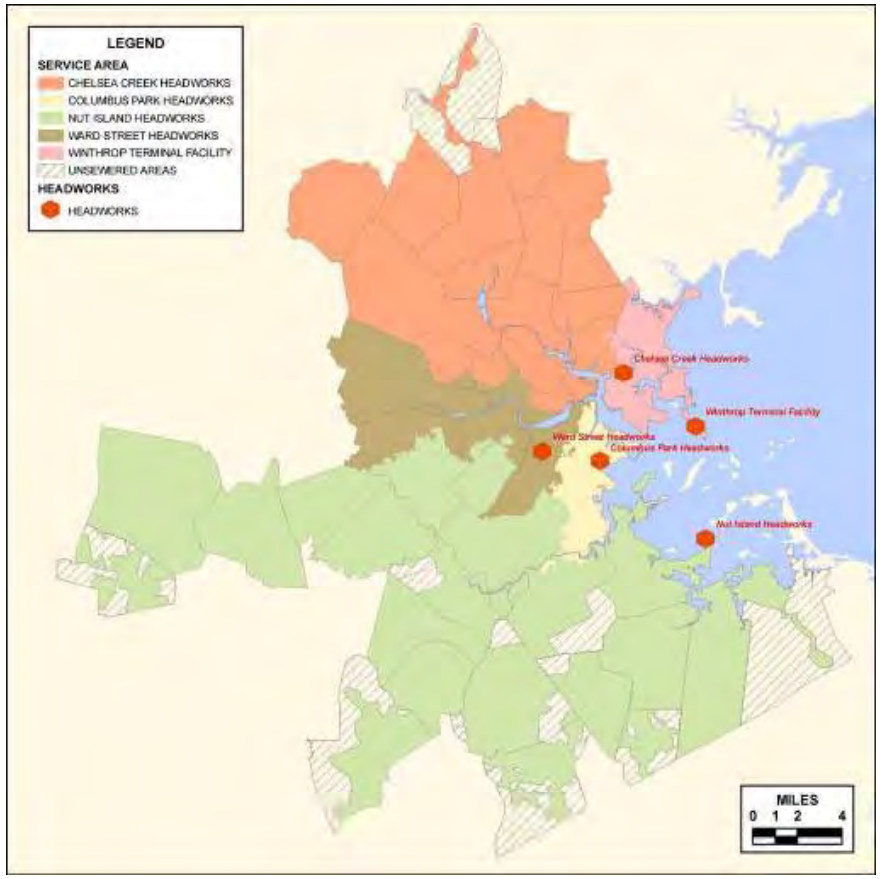



- $660M Replacement Asset Value
- 19 miles – 10/11.5 foot diameter
- 100-120 foot deep shafts
- 2 Older Tunnels – 1953
  - Midway through 100+ year useful life
  - Assumed to be in good condition
  - Inspection is high priority
  - Shaft Repairs Needed
- Inter-Island Tunnel – 1998
  - Inspect with other tunnels to provide baseline
- $5M programmed in CIP FY19-23 for tunnel inspection and shaft repairs
- $50M Recommended for Future Inspection/Cleaning/Repair of Tunnels in FY46-50

# Cross-Harbor Tunnels

Tunnel Shaft Repairs Needed due to $H_2S$ Corrosion


# Remote Headworks




- $190M Replacement Asset Value

| | |
|---|---|
| Chelsea Creek | 1967 |
| Columbus Park | 1967 |
| Ward Street | 1967 |
| Nut Island | 1998 |

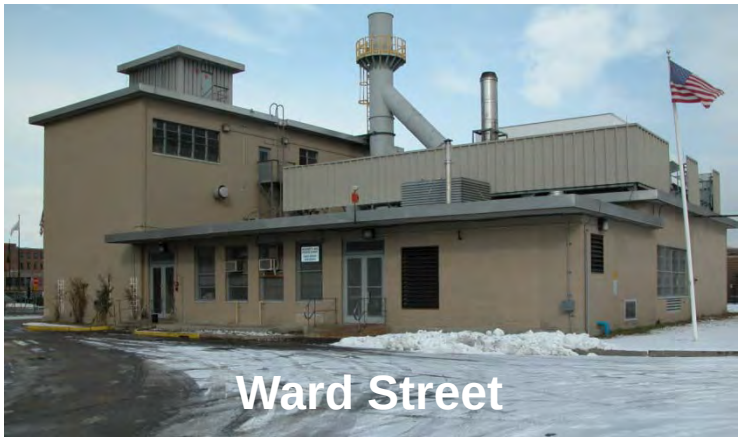
- 3 older Headworks remain operational, but are in only fair condition

- $162M reinvestment has begun (FY14-23)

# Headworks Reinvestment Strategy

## Older Headworks Facilities (1967)

- $162M programmed in CIP is 15% of wastewater spending
  - FY14-19 Chelsea Creek HW Design/Construction ($57M)
  - FY16-22 Ward Street and Columbus Park HW Design/Construction ($105M)


Ward Street

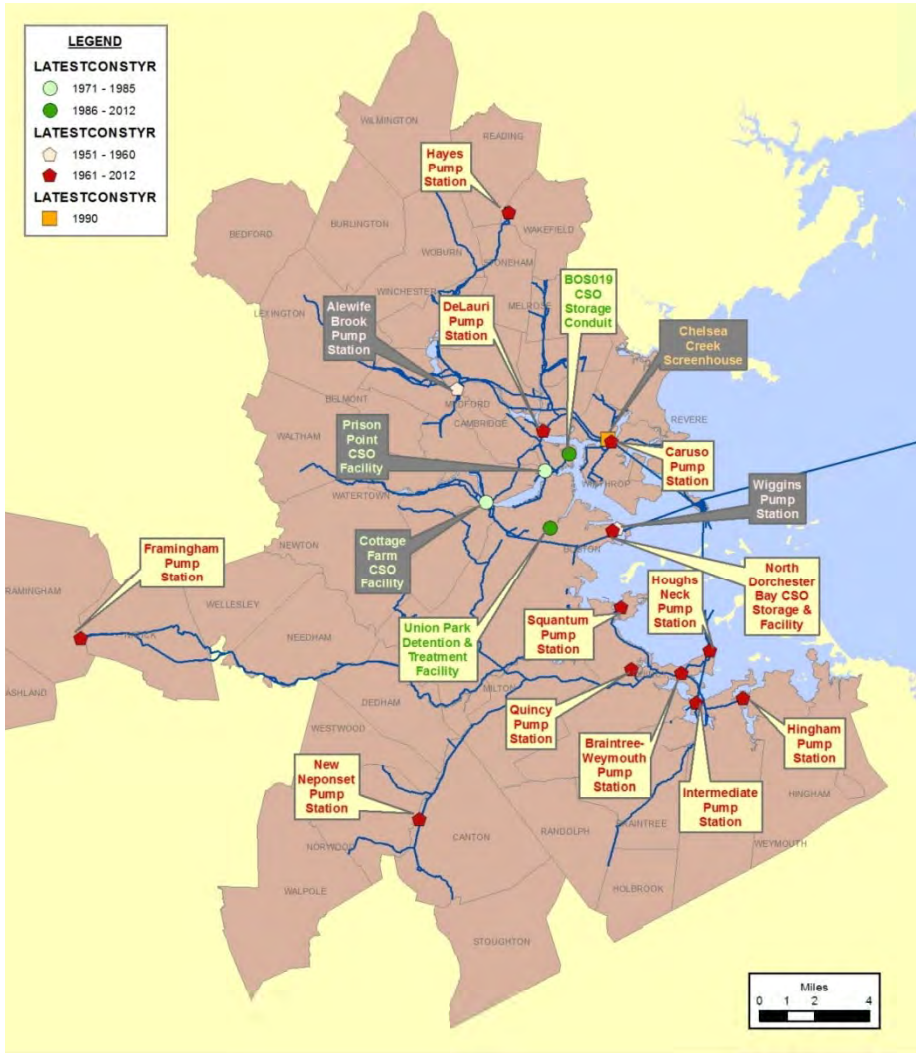

Chelsea Creek


Columbus Park

# Nut Island Headworks (1998)

- Nut Island HW FY14-20 upgrades to mechanical, electrical, grit, screening and odor control systems ($13M)

# 20 Pump Stations and CSO Facilities

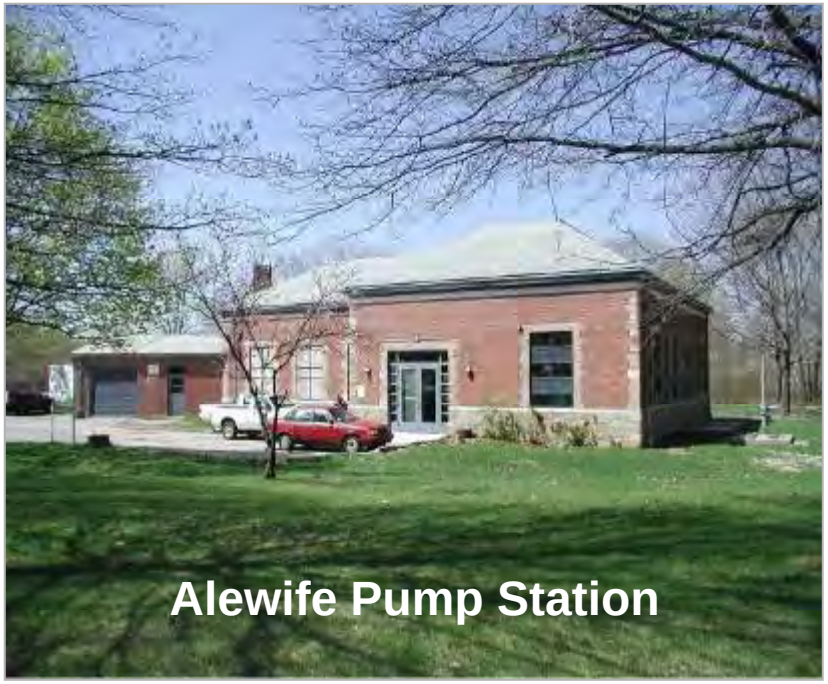



- $630M Replacement Asset Value
- Average Age 21 years - Good to Excellent Condition
- 15 of 20 Facilities Built by MWRA, 1987-2011
- 5 of 20 Facilities Pre-MWRA, 1951-1980

# 20 Pump Stations and CSO Facilities

- Alewife Brook PS 1951
- Wiggins PS 1960
- Cottage Farm CSO 1971
- Somerville Marg CSO 1971
- Prison Point PS/CSO 1980
- Hayes PS 1987
- Chelsea Screen House 1990
- Caruso PS 1991
- Hingham PS 1992
- DeLauri PS 1993
- New Neponset PS 1995
- Framingham PS 1998
- Hough's Neck PS 1999
- Quincy PS 2002
- Squantum PS 2003
- Intermediate PS 2005
- Union Park CSO 2006
- B/W Replacement PS 2007
- BOS019 CSO Storage 2007
- North Dorchester CSO 2011

# 20 Pump Stations and CSO Facilities


Alewife Pump Station

- $28M in Current CIP FY14-21 for Condition Assessment Study and Equipment Rehab/ Replacement Projects at 6 Facilities (Alewife, Caruso, Chelsea Screen House, DeLauri, Prison Point, Cottage Farm)
- $288M Recommended for Future Pump Station and CSO Facilities Upgrades FY19-53

Key Elements to Minimize Risk of Failure

- Operability of Mechanical Equipment
- Maintenance of Electric/Standby Power

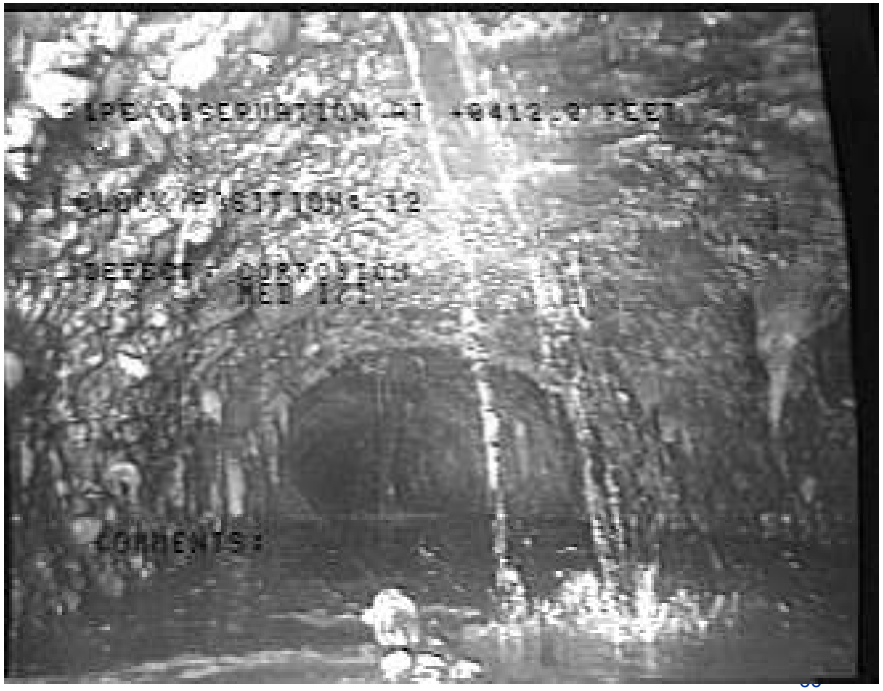
# CSO Control Program


- $888M Total Program Cost
- $839M Previously Invested
- $49M Programmed in CIP FY14-24 to complete 4 of 35 projects and 3-year CSO control performance assessment
- No Additional CSO Control Program funds recommended
- Future CSO Facility costs will be integrated with future pump station upgrades

# Collection System Sewers

- $1.9 Billion Replacement Asset Value
- 226 Miles of Gravity Sewers
- 29 Miles of Force Mains, Siphons and CSO/Emergency Outfalls
- 4,000 Manholes and Structures

- For Gravity Sewers
  - 30% over 100 years old
  - 8% (18 miles) are “C” Rated
  - Sewer Rehabilitation Needed to Address Pipeline Defects
  - TV Inspection Monitored Closely



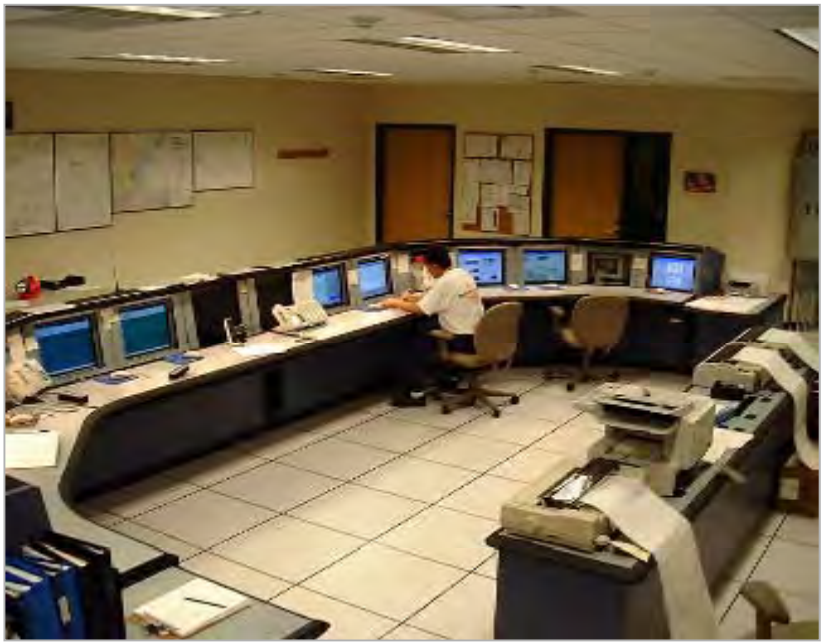
# Interceptor Renewal

- $93M Programmed in CIP (FY14-33) for First 6 of 13 Interceptor Renewal and Other Sewer Pipeline Projects

- $282M Recommended for Remaining 7 of 13 Interceptor Renewal and Other Sewer Pipeline Projects in Later Years (FY24-53)

# Wastewater Metering and SCADA

- Wastewater Metering and Supervisory Control and Data Acquisition (SCADA) for Monitoring and Controlling Facilities
- $21M for Metering System Upgrades Programmed in CIP (FY16-28)
- For SCADA Equipment, $700k Programmed in CIP (FY15-18) and $10M Recommended for Future (FY14-53)



# Community I/I Financial Assistance




# Community I/I Financial Assistance

- Over 5,200 Miles of Community-Owned Sewer Pipes
- $300M Budgeted through FY21
- $256M Distributed through September 2013
- 45% Grant / 55% Interest-free Loan (5 year loan repayment)
- 43 Communities – over 450 Projects Funded

- $6M Net Revenue from Loan Repayments Remaining in FY14 CIP

- Master Plan Includes 5 Additional $40M Funding Rounds Recommended for FY19-FY51

- Additional Community Financial Assistance to be Considered During FY15 CIP Process in Consultation with Advisory Board

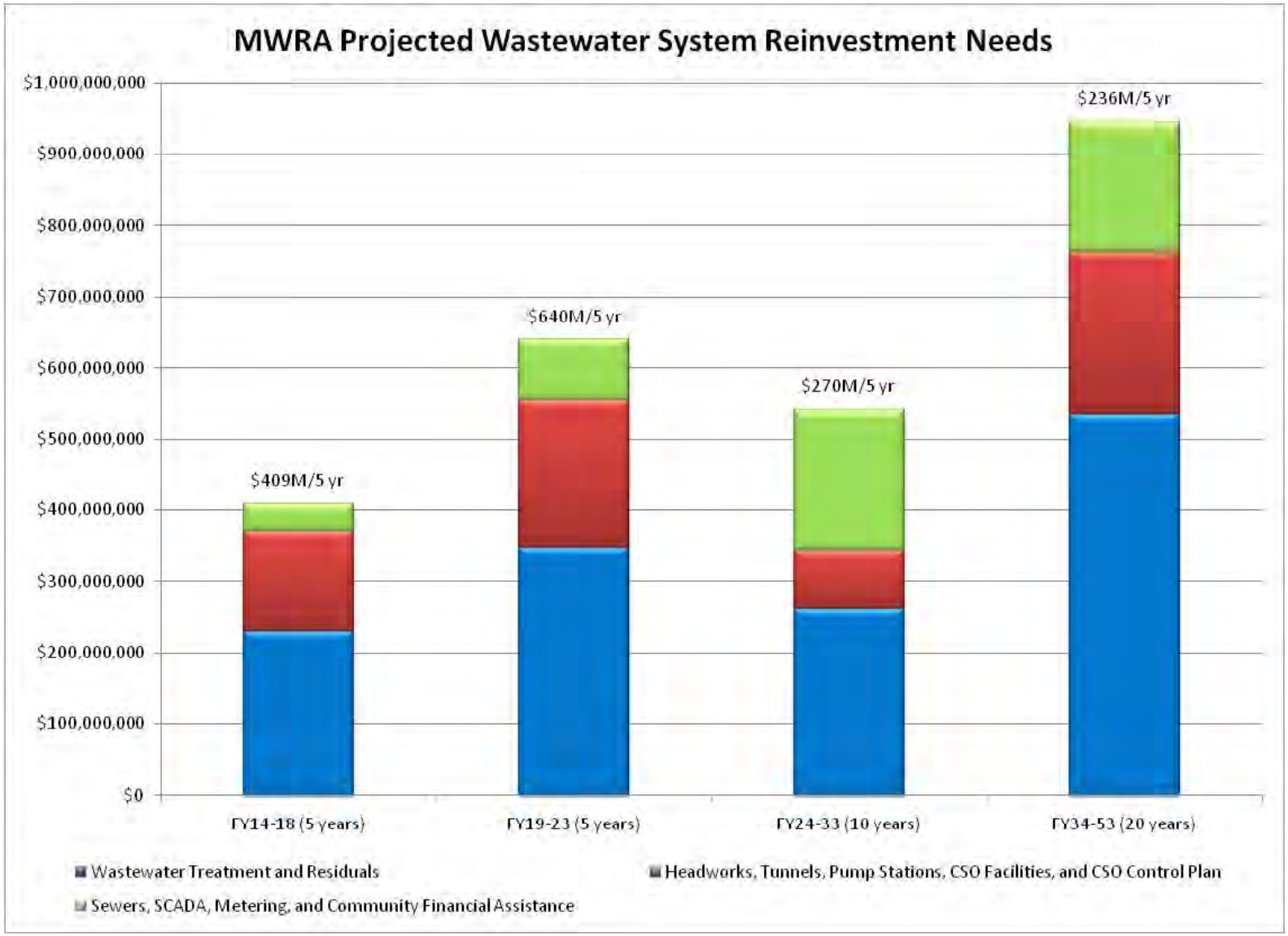
# Wastewater System Master Plan - SUMMARY

## Existing Projects and New Recommendations

| | FY14-18<br>5 years | FY19-23<br>5 years | FY24-33<br>10 years | FY34-53<br>20 years | Total<br>40 years |
|---|---|---|---|---|---|
| Wastewater Projects Programmed in FY14 CIP | $369M | $500M | $74M | $0M | $944M |
| Projects Recommended in Master Plan | $40M | $140M | $467M | $944M | $1,590M |
| **Total** | **$409M** | **$640M** | **$541M** | **$944M** | **$2,534M** |

**Total Wastewater Needs Identified in Master Plan: $2.5 BILLION**

# What the 2013 Master Plan Includes - WASTEWATER



# What the 2013 Master Plan Includes - WASTEWATER

**2013 MWRA MASTER PLAN PROJECT COST SUMMARY ($ in millions)**

| Asset | FY14-18 | FY19-23 | FY24-33 | FY34-53 | SUBTOTAL FY14-53 |
|---|---|---|---|---|---|
| Wastewater Treatment and Residuals Programmed in FY14 CIP | 200,687 | 323,510 | 50,428 | 0 | 574,625 |
| Future Recommended - Wastewater Treatment and Residuals | 29,345 | 22,800 | 211,750 | 535,000 | 798,895 |
| Headworks, Tunnels, Pump Stations, CSO Facilities and CSO Control Plan Programmed in FY14 CIP | 137,943 | 122,176 | 63 | 0 | 260,182 |
| Future Recommended - Headworks, Tunnels, Pump Stations, CSO Facilities and CSO Control Plan | 3,000 | 86,500 | 81,000 | 228,000 | 398,500 |
| Sewers, SCADA, Metering and Community Financial Assistance Programmed in FY14 CIP | 30,480 | 54,521 | 23,817 | 0 | 108,818 |
| Future Recommended - Sewers, SCADA, Metering and Community Financial Assistance | 7,400 | 30,240 | 174,000 | 181,240 | 392,880 |
| SUBTOTAL - Wastewater Projects Programmed in FY14 CIP | 369,110 | 500,207 | 74,308 | 0 | 943,625 |
| SUBTOTAL - Future Recommended Wastewater Projects | 39,745 | 139,540 | 466,750 | 944,240 | 1,590,275 |
| **TOTAL WASTEWATER PROJECTS** | **408,855** | **639,747** | **541,058** | **944,240** | **2,533,900** |