Nut Island Headworks
Odor Control and HVAC Improvements
Contract 7548

January 15, 2020
• Replace and rehabilitate odor control system
  Carbon adsorbers, wet scrubber components, fans, ductwork, dampers, pumps, tanks, instrumentation
• New stairhouse and access hatches into odor control room
• Replace HVAC system
  Air handling units, boilers, building management system, unit heaters
• Replace underground fuel storage tanks
• Replace emergency spillway gates
Access Into Odor Control Room

Opening Made into Odor Control Room During Fire

Locations of New Hatches and Stairway to Odor Control Room
Current Odor Control System

Nut Island Headworks Odor Control Facility

- Grit Facility Exhaust
- Tunnel Shaft & Arterated Channels Exhaust
- New 60"x60" ductwork with dampers
- Junction Chamber Exhaust
- Truck Bay & Screening Exhaust

Wet Scrubbers

Fan #1
Fan #2
Fan #3

Carbon Adsorber Vessels

Exhaust Stack

Recirculation Pumps
Chemical Feed Pumps

Sodium Hydroxide Tanks
Tank #1
Tank #2

Sodium Hypochlorite Tanks
Tank #1
Tank #2
Future Odor Control System

- Wet Scrubbers (3)
- Bypass Duct
- Carbon Adsorbers (10)
- Discharge Stack

Odor Control System – Future Configuration, Showing New Ductwork and Vertical Carbon Adsorbers
HVAC Equipment Replacement

Replace
- Building management system
- 16 air handling units
- 11 exhaust fans
- 211 air volume dampers
- 3 boilers
- 18 unit heaters
- 3 air conditioning units
## Procurement Process

<table>
<thead>
<tr>
<th>Bids Opened October 8, 2019</th>
<th>Bid Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Engineer’s Estimate</em></td>
<td>$52,672,000</td>
</tr>
<tr>
<td>Walsh Construction Company II, LLC</td>
<td>$57,565,399</td>
</tr>
<tr>
<td>Daniel O’Connell’s Sons, Inc.</td>
<td>$57,725,000</td>
</tr>
<tr>
<td>Barletta Heavy Division, Inc.</td>
<td>$57,763,000</td>
</tr>
</tbody>
</table>

Construction duration 34 months
Nut Island Headworks
Odor Control and HVAC Improvements

Contract 7517, Amendment 1

January 15, 2020
Additional Time Request of 23 Months

- Extension of 13 months to design services
  - Design required more time than provided for in contract

- Extension of 10 months to ESDC services
  - Construction is 34 months; contract includes 24 months ESDC
Proposed Amendment 1

Out of Scope Services

- Resident Engineering $893,000
- Additional ESDC Services $357,308
- Orion E-Construction $247,617
- High Performance SCADA HMI Graphics $45,000

Total: $1,542,925
Remote Headworks and Deer Island Shafts Study

Amendment 2

January 15, 2020
Overview of North and South System Tunnels/Shafts

- SHAFT A: Ward Street Headworks
- SHAFT B: Columbus Park Headworks
- SHAFT C: Deer Island Wastewater Treatment Plant
- SHAFT 1: Inter-Island Tunnel
- SHAFT 2: North Metropolitan Tunnel
- NORTH SHAFT
- SOUTH SHAFT
Shaft Study Project

- Contract 7237 awarded in September 2018
- Includes headworks and Deer Island shaft/effluent channel inspections, evaluations and assessments

<table>
<thead>
<tr>
<th>Consultant</th>
<th>Budget</th>
<th>Terms</th>
<th>Spent to Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mott MacDonald</td>
<td>$1,372,000</td>
<td>*16-months</td>
<td>$525,388</td>
</tr>
</tbody>
</table>

*Contract was extended from 10 months to 16 months under Delegated Authority (Amendment 1)
Project Work

- Entry, visual inspection, hammer sounding, and extraction of concrete cores for laboratory testing of effluent channels and shafts
- 3D scans of all shafts
- Sonar inspections
- Ventilation study for effluent structures
- Final Study Report
• Cleaning grease layer in Deer Island shafts
• Unable to inspect during wet weather or high flow condition
• Enhanced safety requirements
• Remote headworks’ shafts grating/supports prohibiting diver’s inspection
• 6-7 weeks to receive results from samples sent for laboratory testing
• This amendment
  – Five month extension to complete lab tests and finalize recommendations
  – Minor modifications to scope of work, sub-consultant payment items
  – No increased cost
Section 22 Rehabilitation Alternatives Analysis and Environmental Permitting  
Contract 7155 - Quarterly Update  

January 15, 2020
Distinct Project Segments

Section 22 – Upland Area
- 8,000 feet of steel pipe
- 70 years old
- Multiple cross country easements

Section 21
- 5,000 feet of cast iron pipe
- 100 years old
- Urban Streets

Section 22 – ACEC Area
- 8,000 feet of steel pipe encased in 6” (min) of reinforced concrete
- 2,000 feet of piles
- 70 years old
- Neponset River Marsh
Sections 21 and 22

Section 22 – Neponset River Estuary

Section 22 – Forbes Hill Road, Quincy

Section 22 – Neponset River Estuary

Section 21 – Adams Street, Milton
Current Work - 3 months

- Review of existing information
- Review leak history; 14 leaks
- Perform leak detection by MWRA – No active leaks December 2019
- Develop Phase 1 test pit program
- Develop Phase 1 boring program (if required)
- Permit applications for Phase 1 program
- Develop hydraulic model runs
Test Pits and Borings in ACEC Area

11 Borings (if required)
Total Length - 7,450'

Section 22
Test Pits and Borings in Upland Area – Section 22

12 Borings (if required)
Total Length - 8,500'

Section 22
Condition Assessment Flow Chart

Phase 1

Substantial Pipe Corrosion?

Yes

No Additional Condition Assessment
Replace / Slipline

~ $900-1100/linear foot

No

Confirm Remaining Pipe Section is Structurally Sound
Clean and Line

~ $400/linear foot

• Test Pits (approx. 50%)
• Borings (approx. 33% if required)
• Pipe condition assessment, including soil corrosivity and hazardous materials testing

• Additional condition assessment (if necessary)
Next 4-6 months

- Complete phase 1 test pit and borings (if required)
- Complete permit process
- Review results of pipe condition assessment, soil corrosivity, soil hazardous materials
- Complete hydraulic model runs
- Determine additional condition assessment, if necessary
- Begin preparation of Environmental Notification Form
Wachusett Dam Bastion Improvements Design and Engineering Services During Construction Contract 7333

January 15, 2020
• Bastion improvements required due to structural deficiencies/leaks in roof
Scope of Work
• Design
  – New roof structure, including waterproofing and drainage system
  – Demolish top 3’ of walls to sound concrete and rebuild with reinforced concrete doweled into existing concrete
  – Rebuild arched doorway and stairs
  – Rout and seal existing cracks in walls and floor
  – Remove and reinstall granite parapet blocks/stone façade
  – Design shoring to support existing walls during roof removal
• Engineering Services During Construction
### Procurement Process and Project Cost

<table>
<thead>
<tr>
<th>Proposer</th>
<th>Cost</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kleinfelder</td>
<td>$768,274</td>
<td>5,118</td>
</tr>
<tr>
<td>Engineer’s Estimate</td>
<td>$798,500</td>
<td>4,490</td>
</tr>
<tr>
<td>Simpson, Gumpertz &amp; Heger</td>
<td>$1,063,682</td>
<td>6,317</td>
</tr>
</tbody>
</table>

- One step RFQ/P
- Selection Committee recommends Kleinfelder
<table>
<thead>
<tr>
<th>Item</th>
<th>Start Date</th>
<th>Duration</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>February 2020</td>
<td>18 Months</td>
<td>August 2021</td>
</tr>
<tr>
<td>Construction</td>
<td>September 2021</td>
<td>15 Months</td>
<td>December 2022</td>
</tr>
<tr>
<td>Warranty</td>
<td>January 2023</td>
<td>12 Months</td>
<td>January 2024</td>
</tr>
</tbody>
</table>
FY21 Proposed Capital Improvement Program

January 15, 2020
• FY21 Proposed CIP complies with the Cap requirements

• Focus on Asset Protection and Long-Term Redundancy

• Metropolitan Tunnel Redundancy
FY20 – Beyond Program
$4.1B

FY19-FY23
5yr Cap Period
$983.3M

FY21
$256.3M
<table>
<thead>
<tr>
<th>FY21 Proposed CIP - FY19-23 vs. Base-Line Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FY19-23 Base-Line Cap</strong></td>
</tr>
<tr>
<td>Projected Expenditures</td>
</tr>
<tr>
<td>(in millions)</td>
</tr>
<tr>
<td>I/I Program</td>
</tr>
<tr>
<td>Water Loan Program</td>
</tr>
<tr>
<td><strong>MWRA Spending</strong></td>
</tr>
<tr>
<td>Projected Expenditures</td>
</tr>
<tr>
<td>I/I Program</td>
</tr>
<tr>
<td>Water Loan Program</td>
</tr>
<tr>
<td>Contingency</td>
</tr>
<tr>
<td>Inflation on Unawarded Construction</td>
</tr>
<tr>
<td>Chicopee Valley Aqueduct Projects</td>
</tr>
<tr>
<td><strong>FY19 Final FY19-23 Spending</strong></td>
</tr>
<tr>
<td>(in millions)</td>
</tr>
<tr>
<td><strong>FY21 Proposed</strong></td>
</tr>
<tr>
<td>Projected Expenditures</td>
</tr>
<tr>
<td>I/I Program</td>
</tr>
<tr>
<td>Water Loan Program</td>
</tr>
<tr>
<td><strong>MWRA Spending</strong></td>
</tr>
<tr>
<td>Projected Expenditures</td>
</tr>
<tr>
<td>I/I Program</td>
</tr>
<tr>
<td>Water Loan Program</td>
</tr>
<tr>
<td>Contingency</td>
</tr>
<tr>
<td>Inflation on Unawarded Construction</td>
</tr>
<tr>
<td>Chicopee Valley Aqueduct Projects</td>
</tr>
<tr>
<td><strong>FY21 Proposed FY19-23 Spending</strong></td>
</tr>
</tbody>
</table>
## FY21 Proposed CIP – Top Projects Excluding Loans FY19-23 Cap Period Spending

<table>
<thead>
<tr>
<th>Project</th>
<th>Subphase</th>
<th>FY19-23 Spending ($000)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DI Treatment Plant Asset Protection</td>
<td>Clarifier Rehab Phase 2 - Construction</td>
<td>$111,900</td>
<td>10.3%</td>
</tr>
<tr>
<td>I&amp;P Facility Asset Protection</td>
<td>Chelsea Creek Upgrades - Construction</td>
<td>$51,381</td>
<td>4.7%</td>
</tr>
<tr>
<td>Corrosion &amp; Odor Control</td>
<td>NI Odor Control HVAC Improvement Construction</td>
<td>$49,563</td>
<td>4.6%</td>
</tr>
<tr>
<td>I&amp;P Facility Asset Protection</td>
<td>Prison Point Rehabilitation - Construction</td>
<td>$36,143</td>
<td>3.3%</td>
</tr>
<tr>
<td>NIH Redundancy &amp; Storage</td>
<td>Section 89 &amp; 29 Replacement - Construction</td>
<td>$21,300</td>
<td>2.0%</td>
</tr>
<tr>
<td>NIH Redundancy &amp; Storage</td>
<td>Section 89 &amp; 29 Redundancy Construction Phase 2</td>
<td>$19,776</td>
<td>1.8%</td>
</tr>
<tr>
<td>SEH Redundancy &amp; Storage</td>
<td>Redundancy Pipeline Sect 111 - Construction 3</td>
<td>$19,325</td>
<td>1.8%</td>
</tr>
<tr>
<td>DI Treatment Plant Asset Protection</td>
<td>Gravity Thickener Rehabilitation</td>
<td>$19,275</td>
<td>1.8%</td>
</tr>
<tr>
<td>DI Treatment Plant Asset Protection</td>
<td>Fire Alarm System Replacement - Construction</td>
<td>$15,857</td>
<td>1.5%</td>
</tr>
<tr>
<td>New Connect Mains-Shaft 7</td>
<td>CP3-Sect 23,24,47, Rehabilitation</td>
<td>$14,700</td>
<td>1.4%</td>
</tr>
<tr>
<td>Metro Tunnel Redundancy</td>
<td>Preliminary Design &amp; MEPA Review</td>
<td>$14,166</td>
<td>1.3%</td>
</tr>
<tr>
<td>SEH Redundancy &amp; Storage</td>
<td>Redundancy Pipeline Sect 111 - Construction 2</td>
<td>$14,120</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

**Total FY19-23 Spending Suphases**  
$387,506  
35.6%

**Other Changes**  
$701,371  
64.4%

**Total FY19-23 Spending**  
$1,088,877  
100.0%
<table>
<thead>
<tr>
<th>Project</th>
<th>Subphase</th>
<th>FY21 ($000)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DI Treatment Plant Asset Protection</td>
<td>Clarifier Rehabilitation Phase 2 - Construction</td>
<td>$34,475</td>
<td>13.4%</td>
</tr>
<tr>
<td>I&amp;P Facility Asset Protection</td>
<td>Chelsea Creek Upgrades - Construction</td>
<td>$16,091</td>
<td>6.3%</td>
</tr>
<tr>
<td>I&amp;P Facility Asset Protection</td>
<td>Prison Point Rehabilitation - Construction</td>
<td>$15,490</td>
<td>6.0%</td>
</tr>
<tr>
<td>Corrosion &amp; Odor Control</td>
<td>NI Odor Control HVAC Improvement Construction Phase 2</td>
<td>$14,854</td>
<td>5.8%</td>
</tr>
<tr>
<td>NIH Redundancy &amp; Storage</td>
<td>Section 89 &amp; 29 Repl - Construction</td>
<td>$9,150</td>
<td>3.6%</td>
</tr>
<tr>
<td>DI Treatment Plant Asset Protection</td>
<td>Gravity Thickener Rehabilitation</td>
<td>$6,444</td>
<td>2.5%</td>
</tr>
<tr>
<td>Central Monitoring System</td>
<td>CWTP SCADA Upgrade Construction</td>
<td>$5,000</td>
<td>2.0%</td>
</tr>
<tr>
<td><strong>Top FY21 Spending Subphases</strong></td>
<td></td>
<td><strong>$101,504</strong></td>
<td><strong>39.6%</strong></td>
</tr>
<tr>
<td><strong>Other Changes</strong></td>
<td></td>
<td><strong>$154,824</strong></td>
<td><strong>60.4%</strong></td>
</tr>
<tr>
<td><strong>Total FY21 Spending</strong></td>
<td></td>
<td><strong>$256,328</strong></td>
<td><strong>100.0%</strong></td>
</tr>
<tr>
<td>Spending Composition</td>
<td>Amount</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ongoing Awarded Contracts</td>
<td>$140.9M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed Contract Awards</td>
<td>$82.5M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budgeted Loan Programs</td>
<td>$32.9M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Proposed Expenditures</td>
<td>$256.3M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FY21 Proposed CIP – Proposed FY21 Contract Awards

Contract Value

- Waterworks: $79.1 million, 45%
- Business and Ops: $17.6 million, 10%
- Wastewater: $78.0 million, 45%

Contract Awards

- Waterworks: 44%
- Business and Ops: 19%
- Wastewater: 37%

$ in millions
Total Proposed FY21 Expenditures: $256.3 million

$ in millions
14 New Projects Added in FY21: $57.0 million

- Waterworks: $50.3 million
- Wastewater: $6.7 million
• Water Tank Painting Bellevue 1 & 2, Park Circle, Walnut Hill, DI - $27.9 million
• Cosgrove Tunnel Rehab. Design - $10.0 million
• Beacon Street Line Rehabilitation - $9.3 million
• Deer Island Roof Replacement: $2.0 million
• CSO Study/Prel. Design Alewife Brook and Lower Charles River Basin: $1.5 million
• Clinton Landfill Cell #1 Closure: $1.0 million
<table>
<thead>
<tr>
<th>Project Category</th>
<th>FY14-18</th>
<th>FY19-23</th>
<th>FY24-28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset Protection</td>
<td>$222.8</td>
<td>$607.7</td>
<td>$1,209.3</td>
</tr>
<tr>
<td>Water Redundancy</td>
<td>$174.6</td>
<td>$232.8</td>
<td>$376.9</td>
</tr>
<tr>
<td>CSO</td>
<td>$64.7</td>
<td>$10.6</td>
<td>$0.1</td>
</tr>
<tr>
<td>Other</td>
<td>$123.5</td>
<td>$237.7</td>
<td>$235.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$585.6</strong></td>
<td><strong>$1,088.9</strong></td>
<td><strong>$1,821.6</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>FY14-18</th>
<th>FY19-23</th>
<th>FY24-28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset Protection</td>
<td>38.0%</td>
<td>55.8%</td>
<td>66.4%</td>
</tr>
<tr>
<td>Water Redundancy</td>
<td>29.8%</td>
<td>21.4%</td>
<td>20.7%</td>
</tr>
<tr>
<td>CSO</td>
<td>11.0%</td>
<td>1.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Other</td>
<td>21.1%</td>
<td>21.8%</td>
<td>12.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

- Asset Protection and Water Redundancy including Deer Island and water tunnel redundancy projects are the principal drivers of future capital expenditures.
Clarifier Rehabilitation Phase 2 Construction

FY 21 Budget: $34.5M
Total Contract: $148.9M
NTP: May 2020
SC: May 2024
Chelsea Creek Headworks Upgrade Construction

FY21 Budget: $16.1M
Total Contract: $82.9M
NTP: November 2016
SC: November 2020
Prison Point Rehabilitation Construction

FY 21 Budget:

Total Contract:

NTP: June 2020
SC: June 2022
Nut Island Odor Control & HVAC Improvements Construction

FY 21 Budget: $14.9M
Total Contract: $57.6M
NTP: January 2020
SC: November 2022
Northern Intermediate High Redundancy Section 89 and 29 Replacement Constr.

FY 21 Budget: $9.2M
Total Contract: $21.3M
NTP: July 2020
SC: July 2022
Gravity Thickener Rehabilitation

FY 21 Budget: $6.4M
Total Contract: $19.7M
NTP: May 2018
SC: February 2021
Carroll Water Treatment Plant SCADA Upgrade Construction

FY 21 Budget: $5.0M
Total Contract: $9.9M
NTP: July 2020
SC: July 2022
Historic and Projected Capital Improvement Spending

Actual
FY90-19 Average
$273M/year

Projected
FY20-23 Average
$237/year
Level of MWRA Indebtedness

Outstanding Debt on June 30 by Fiscal Year
FY12-FY23

<table>
<thead>
<tr>
<th>Year</th>
<th>Debt Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$5,948,000,000</td>
</tr>
<tr>
<td>2013</td>
<td>$5,858,000,000</td>
</tr>
<tr>
<td>2014</td>
<td>$5,738,000,000</td>
</tr>
<tr>
<td>2015</td>
<td>$5,608,000,000</td>
</tr>
<tr>
<td>2016</td>
<td>$5,398,000,000</td>
</tr>
<tr>
<td>2017</td>
<td>$5,218,000,000</td>
</tr>
<tr>
<td>2018</td>
<td>$5,118,000,000</td>
</tr>
<tr>
<td>2019</td>
<td>$5,078,000,000</td>
</tr>
<tr>
<td>2020</td>
<td>$5,058,000,000</td>
</tr>
<tr>
<td>2021</td>
<td>$5,038,000,000</td>
</tr>
<tr>
<td>2022</td>
<td>$4,988,000,000</td>
</tr>
<tr>
<td>2023</td>
<td>$4,908,000,000</td>
</tr>
</tbody>
</table>

$2,000,000,000 to $6,500,000,000
As of December 31, 2019, the total Indebtedness is $4.9 billion.
• Lessons learned from Chelsea Headworks Upgrades
• Continue Asset Protection
• Metropolitan Tunnel Redundancy
FY19-23 Projected Expenditures

<table>
<thead>
<tr>
<th>Contract Name</th>
<th>Start/Duration (years)</th>
<th>Contract Budget (millions)</th>
<th>FY19-23 Spending (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Support Services Awarded</td>
<td>FY19/9</td>
<td>$17.5</td>
<td>$8.3</td>
</tr>
<tr>
<td>Preliminary Design/MEPA Review Anticipated award April 2020</td>
<td>FY20/3.5</td>
<td>$16.0</td>
<td>$14.2</td>
</tr>
<tr>
<td>Technical Assistance Anticipated Award January 2022</td>
<td>FY22/6</td>
<td>$4.1</td>
<td>$1.2</td>
</tr>
</tbody>
</table>
Review of Tunnel Program CIP

• October 2016 Special Board Meeting on Metropolitan Tunnel Redundancy
  – Staff Presented Preferred Two-Tunnel Alternative
  – 14 miles (4.5 miles North, 9.5 miles South) of 10-ft diameter deep rock tunnel

• Estimated midpoint of construction cost: $1.47 - $1.70 billion
  – 17 to 23 year program with preliminary design beginning in 2017 and tunnel construction beginning in 2022
  – Duration depends on program phasing (Advisory Board recommended concurrent construction of north and south tunnels)
  – 30% contingency factor
  – 4% annual escalation

• Current schedule is to begin Preliminary Design in 2020
• Current estimate for tunnel construction start is 2027-ish
Review of Tunnel Program CIP (continued)

• Select key variables affecting Tunnel Program
  – Underground conditions (geology)
  – Selection of shaft sites and tunnel alignment/land acquisition
  – Future water demands (length of tunnel)
  – Schedule (time value of dollars)

• Many variables will be evaluated during preliminary design (2020-2023)

• Key findings will be presented to Board as preliminary design progresses
Next Steps

- Work with the Advisory Board
- Finalize FY21 CIP
- Submit FY21 Final CIP to Board of Directors for approval in June 2020
Christmas Day Water Usage

Year | Water Usage (MGD)
-----|------------------
2003 | 174.05
2004 | 173.11
2005 | 175.28
2006 | 162.86
2007 | 168.70
2008 | 158.42
2009 | 152.87
2010 | 152.65
2011 | 149.87
2012 | 156.68
2013 | 170.83
2014 | 152.56
2015 | 146.41
2016 | 152.84
2017 | 151.20
2018 | 146.45
2019 | 143.66