Metropolitan Tunnel Redundancy Program Update

May 14, 2019

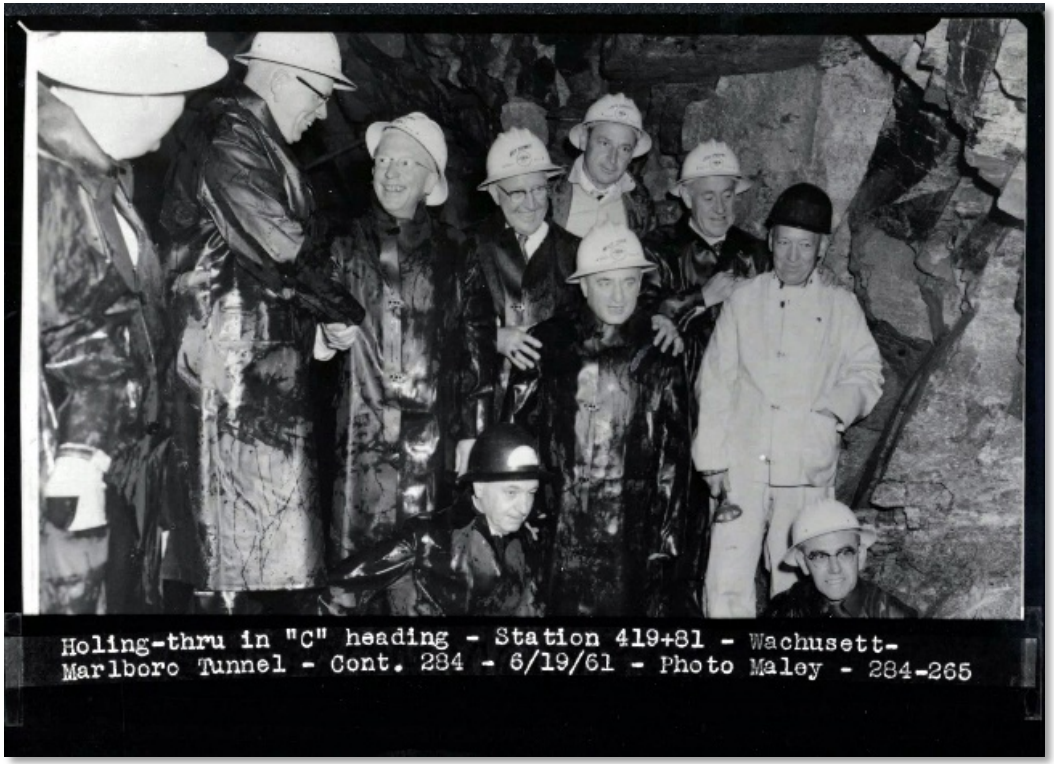
MWRA Water Transmission System

1. Chicopee Valley Aqueduct
2. Quabbin Aqueduct
3. Cosgrove Tunnel / Wachusett Aqueduct
4. MetroWest Tunnel / Hultman Aqueduct
5. Metropolitan Tunnels

MWRA Water Transmission System

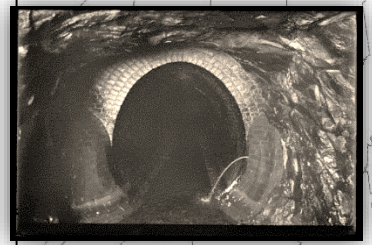
The MWRA has a long history of aqueduct and water tunnel construction as part of our water transmission system

- Cochituate Aqueduct (1840s) - inactive
- Sudbury Aqueduct (1878) - inactive
- Wachusett Aqueduct (1897) - inactive
- Weston Aqueduct (1903) - inactive
- Quabbin Aqueduct (1939)
- Hultman Aqueduct (1940)
  - Southborough Tunnel (1940)
- Chicopee Valley Aqueduct (1949)
- City Tunnel (1950)
- City Tunnel Extension (1963)
- Cosgrove Tunnel (1967)
- Dorchester Tunnel (1976)
- MetroWest Water Supply Tunnel (2003)

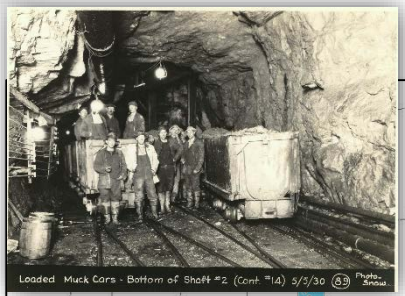


Early Grade Line Aqueducts (1840s - 1903)

- Non-pressurized
- Slope 1 foot per mile



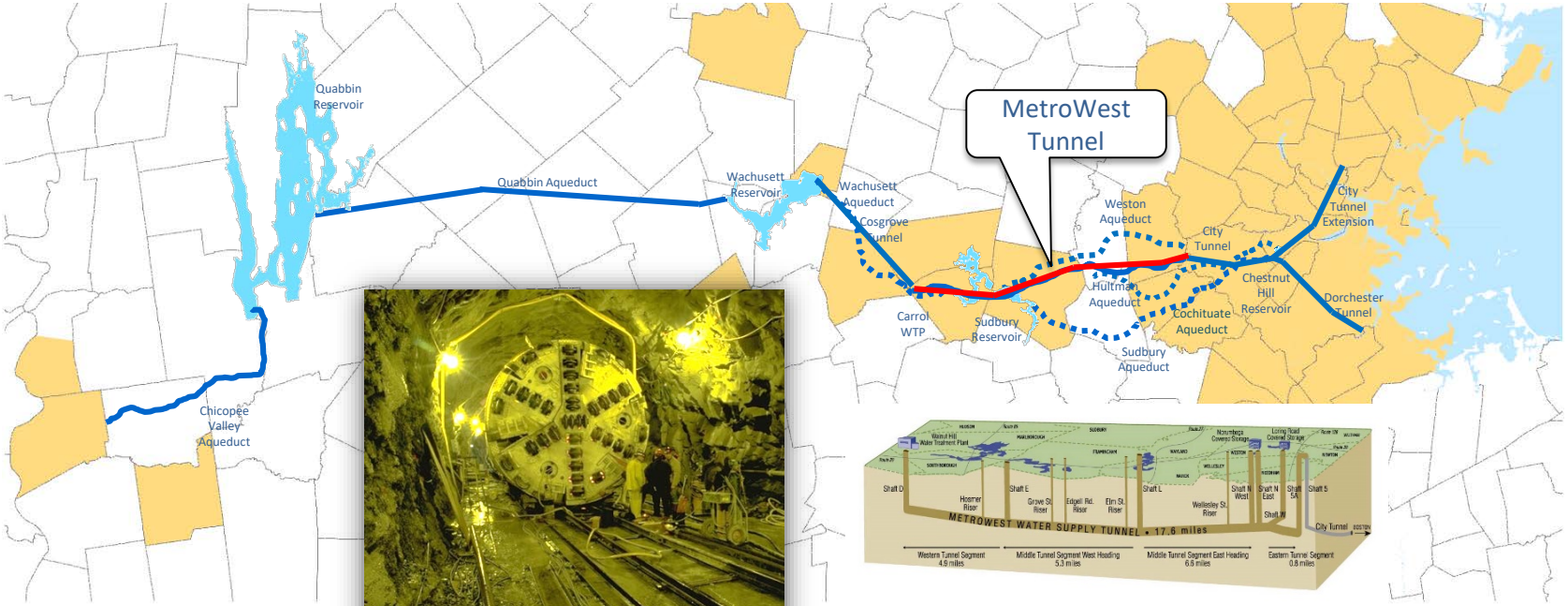
Pressure Aqueduct/Tunnel System (1939- 1976)



MetroWest Water Supply Tunnel (2003)

17.6 mile, 12 to 14 foot diameter, deep rock pressure tunnel was brought on-line in November 2003

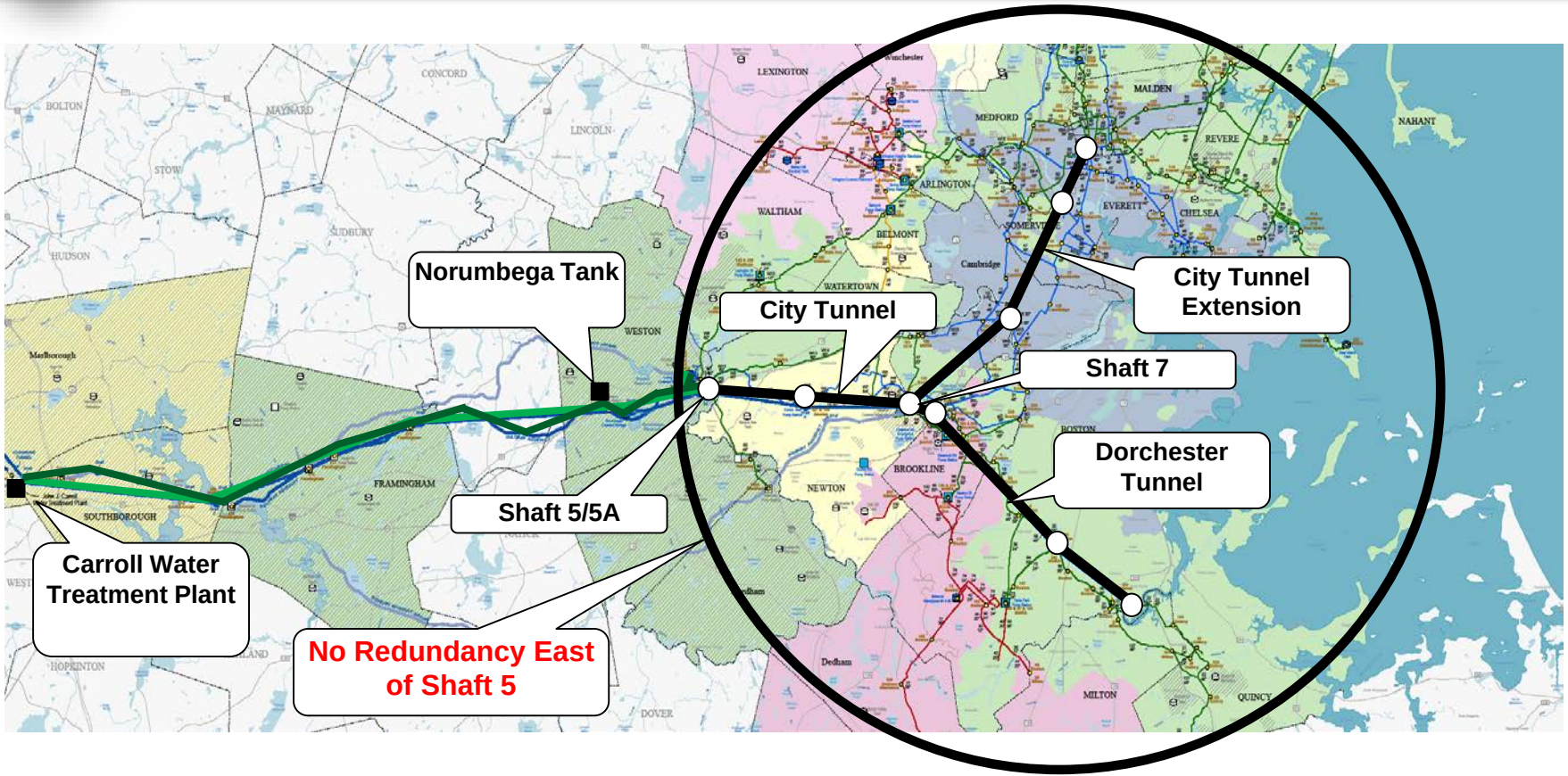
Provides Redundancy to the Hultman Aqueduct



Hultman Aqueduct Rehabilitation (2013)

Once complete in 2013, for the first time since originally planned in the 1930s, the Metropolitan Water System has redundancy from the Carrol WTP to Shaft 5

Metropolitan Tunnel System



Condition of the Metropolitan Tunnel System

- Tunnel system:
  - Concrete-lined deep rock pressure tunnels
  - Steel and concrete lined vertical shafts
  - Surface pipe, valves and appurtenances

- Little maintenance required for tunnels and shafts. Little risk of failure

- Pipe, valves and appurtenances need maintenance, rehabilitation, replacement

Valve Reliability Concern

- Valves that don't work
- Valves we can't operate

Shaft 8 PRV Chamber

Shaft 8

Shaft 8

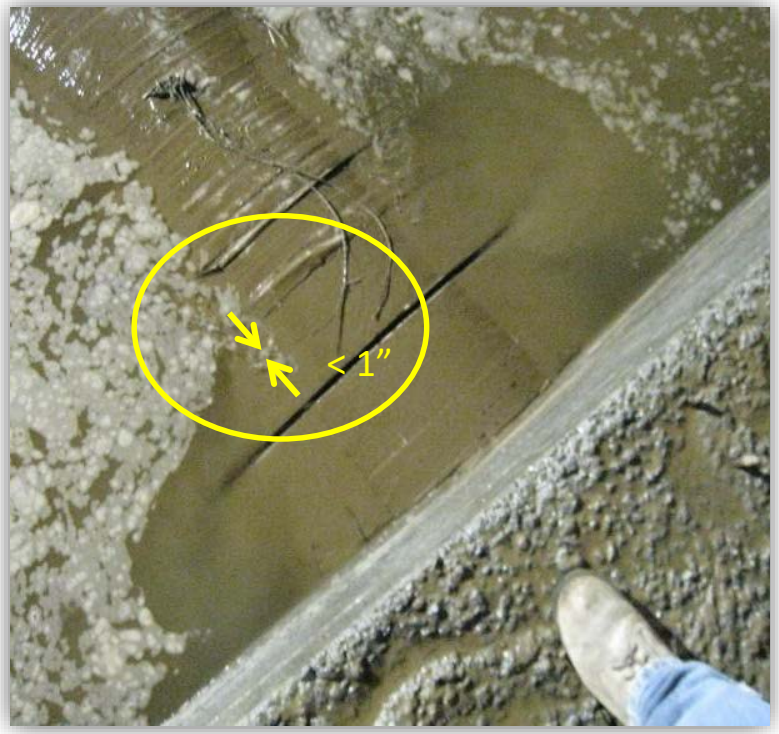
Appurtenances Can Be Liabilities

Small pipe failures can lead to shut downs

The Great Water Main Break of May 2010

Small pipe failures can lead to big problems

250 MGD flow at Shaft 5 break….



…came from a small gap in the pipe

Impact of the 2010 Water Main Break

- A coupling located on 10’ dia surface piping at Shaft 5/5A failed
- The Hultman Aqueduct was off line for rehabilitation and could not provide immediate backup
- Activated emergency supplies (Sudbury Aqueduct and Chestnut Hill Reservoir)
- A state of emergency and a boil water order was issued for ~2 million people located in 30 communities
- MDH issued guidance for…food preparation…health care…hospitals…etc.
- Some major food manufacturers, retailers, and restaurants had to close
- Dunkin & Starbucks had no brewed coffee! **For 2 days**!!!!
- Within 2 days of the initial break, the pipe was repaired, full flow was restored, tested, confirmed safe, and the boil water order was lifted

Economic Impact of Water Supply Loss

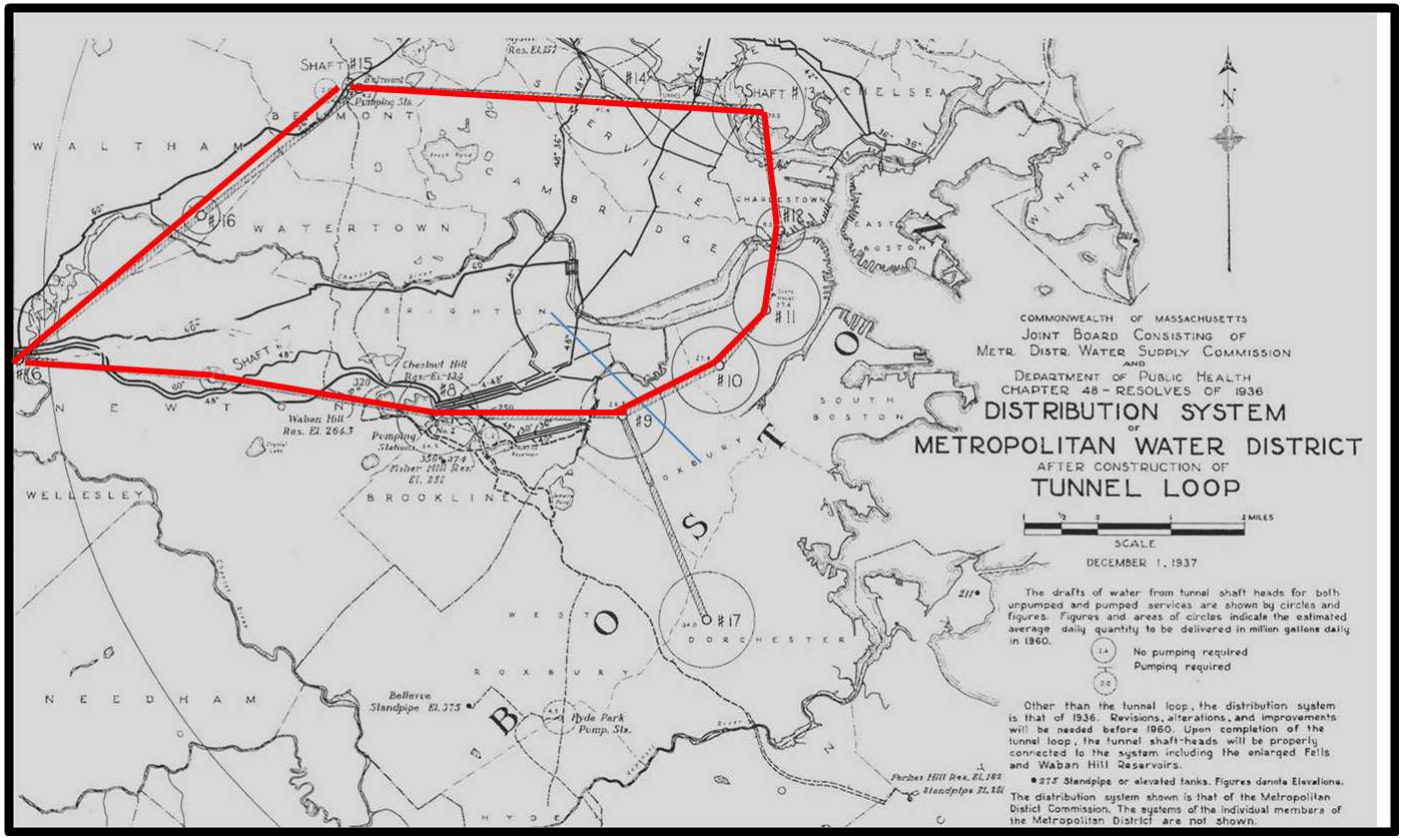
- The estimated economic loss of water supply within the Boston Metropolitan area is:
  - ~$208 million per day to businesses
  - ~$102 million per day residents
  - total economic impact of ~ $310 M per day

We Need Redundancy!

- Why?
  - Valve reliability for the Metropolitan Tunnels is a concern
  - Without the ability to close (and then reopen) valves, there is no way to isolate a portion of the Metropolitan Tunnel System
  - Many valves have reached the end of their useful life but can't be replaced because shutdown of the City Tunnel would be required…which we cannot do
  - Water main break at Shaft 5 in May 2010 put a "sharp point" on the need to operate these valves and have full redundancy

- If we do nothing, another failure will eventually occur

Original 1936 Tunnel Loop Plan



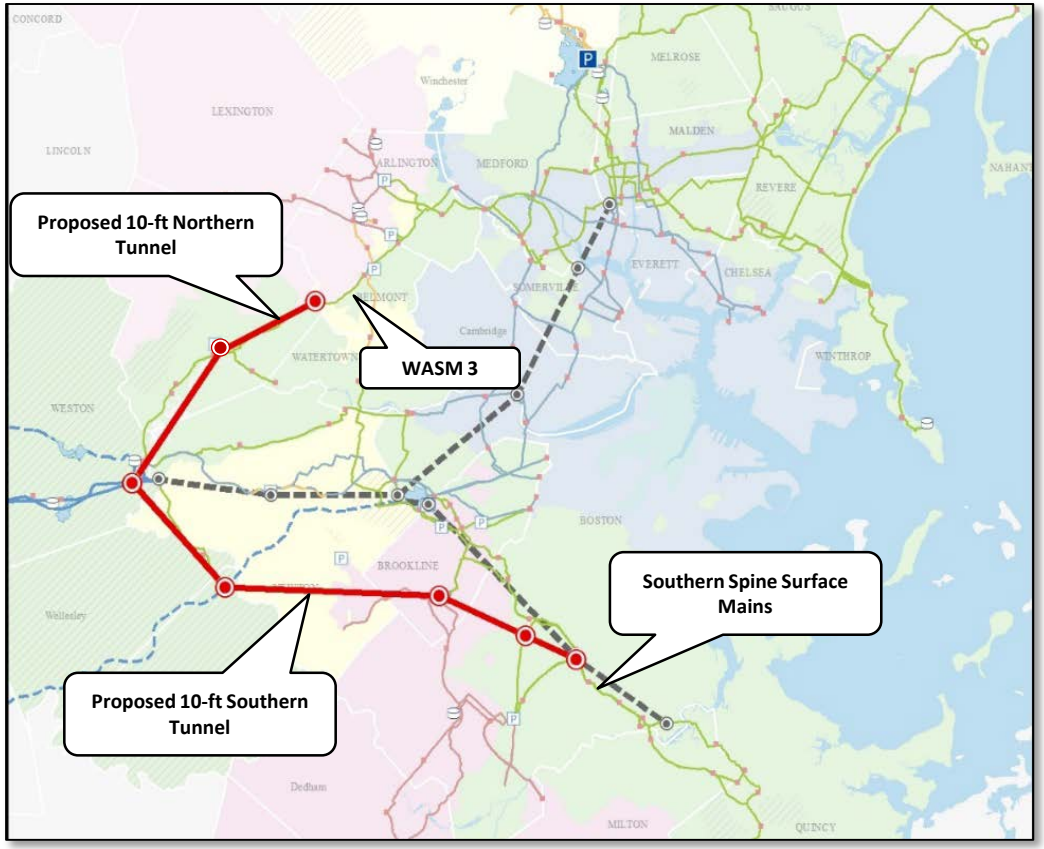
Alternative Analysis

- Many alternatives were evaluated
- Long distance large diameter pipelines are not feasible
- Recommended tunnel alternative meets service objectives and goals
  - Allows planned maintenance of 60+ year old infrastructure that are beyond their useful life
  - Allows emergency response at normal level of service
  - Constructible

Recommended Alternative

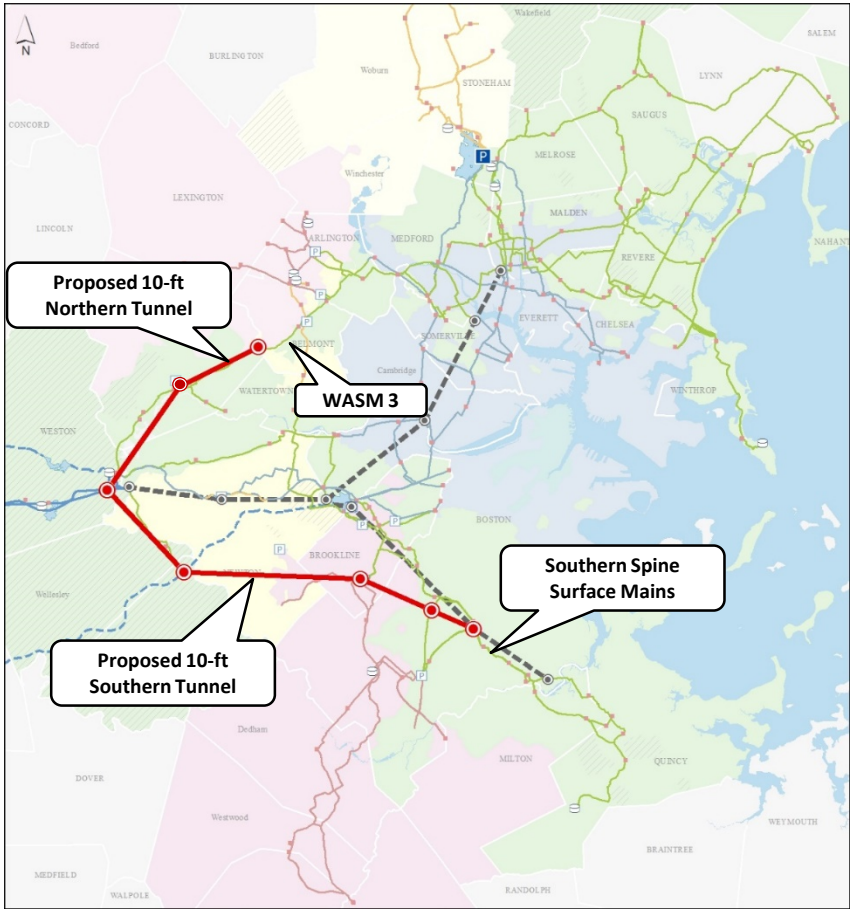
Two Tunnels

- Tunnels begin at Mass Pike/Route 128
  - Northern Tunnel - 4.5 miles, connects to mid-point of WASM 3 in Waltham/Belmont area
  - Southern Tunnel - 9.5 miles, connects to Shaft 7C and southern surface mains
- Time to Complete: 17 - 23 years
- 10’ finished diameter pressure tunnel
- 200’ – 500’ deep (rock)
- Mined using TBMs
- Number and locations of shafts TBD
- No consent decree (this is a water distribution redundancy program)



Hydraulic Objectives for Proposed Tunnel

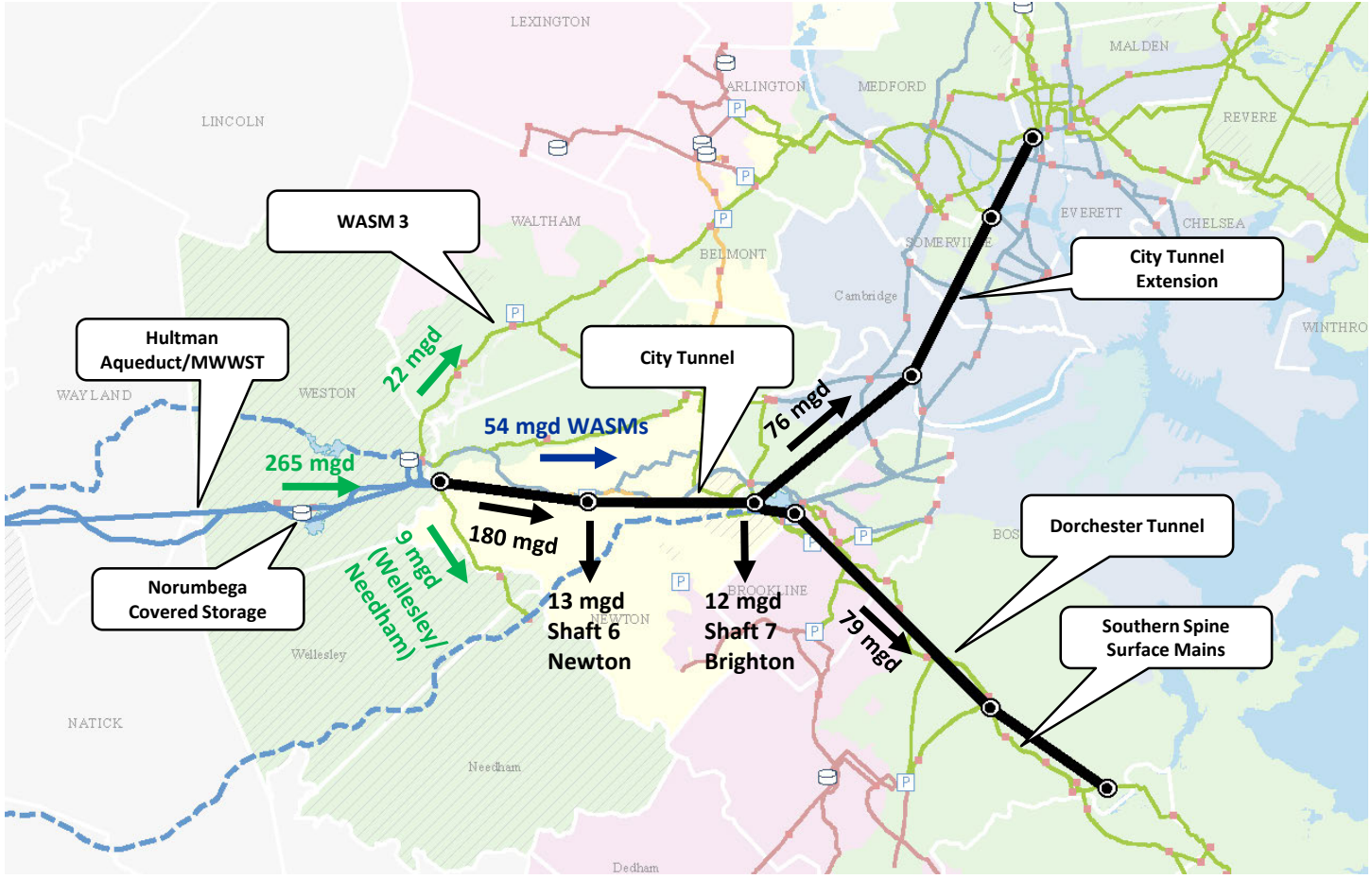
- Provides redundancy for entire metropolitan tunnel system
- Provides normal water service and fire protection if existing tunnel system is out of service
- Designed to meet high day demand. No seasonal restrictions
- Provides ability to perform maintenance on existing tunnels year-round
- Avoids activation of emergency reservoirs
- No boil order!



Hydraulic Model Update

- Adding all proposed CIP Water Projects
  - New pipelines
  - Rehabilitated pipelines
- Population and Employment Projections
  - 2040 and beyond
- Potential System Expansion
- Temporary Loss of Local Sources (Drought/Emergency)
- Water age/quality

Existing System – High Day Demand 265 mgd East of Norumbega



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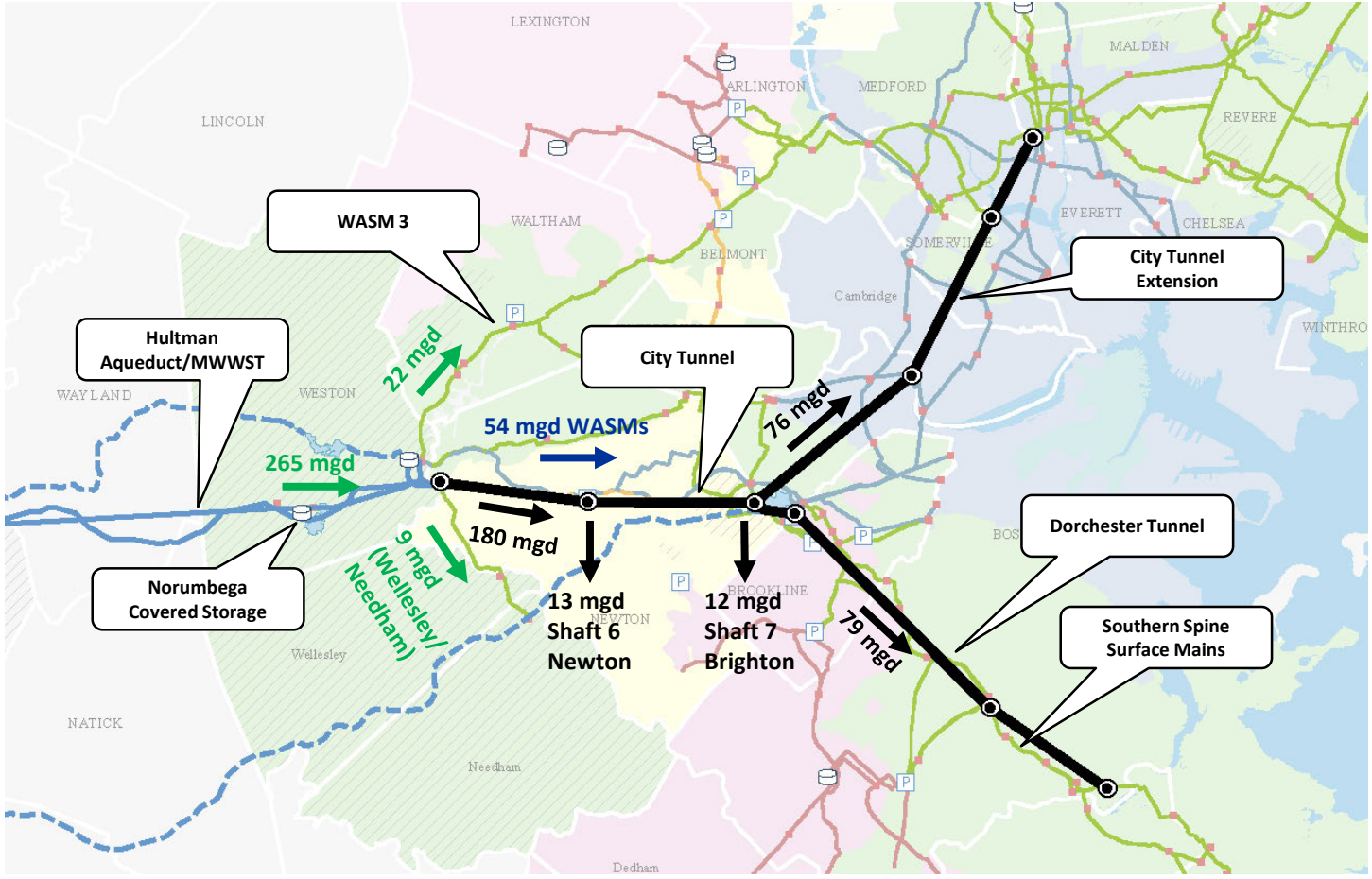

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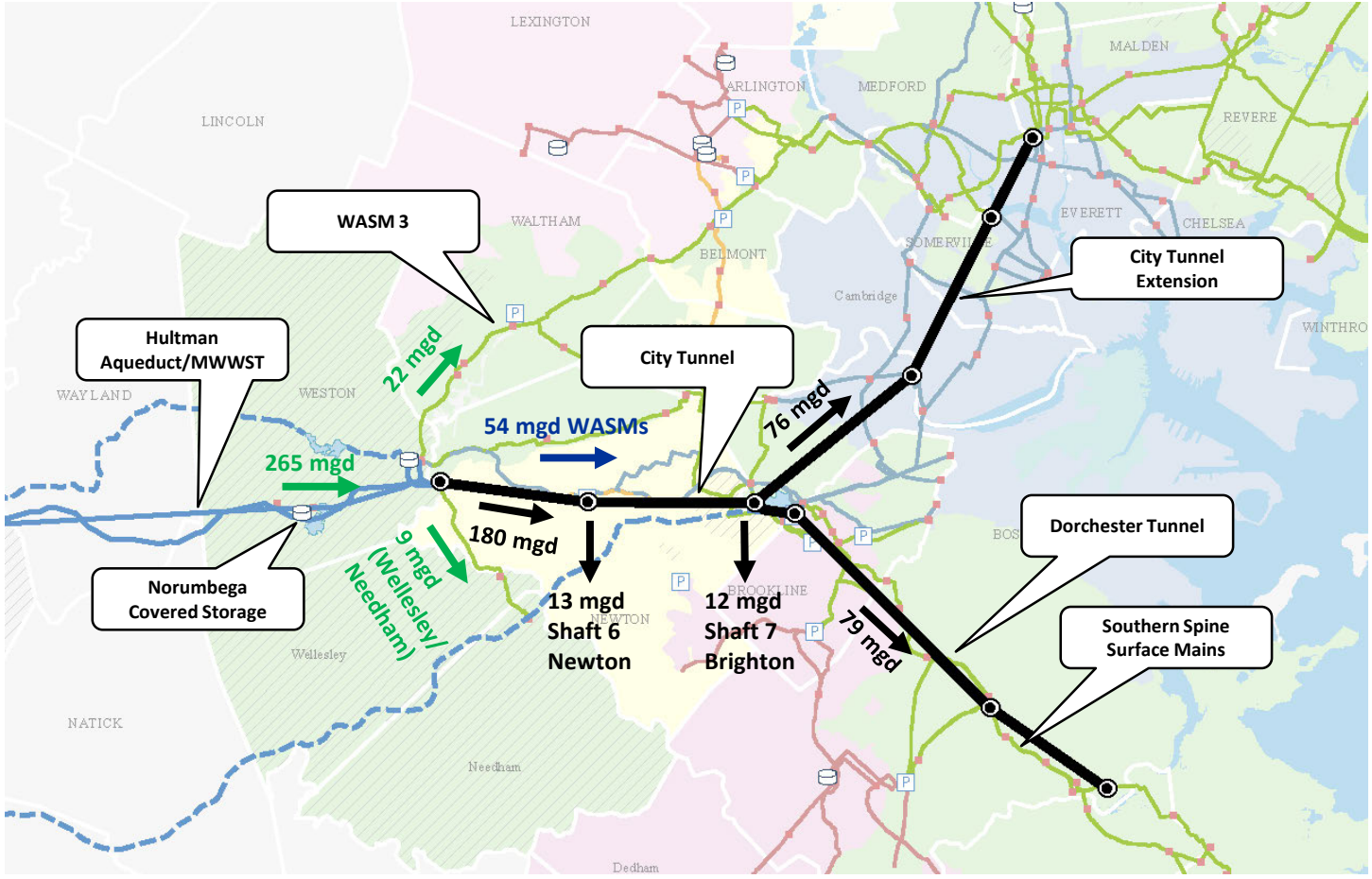
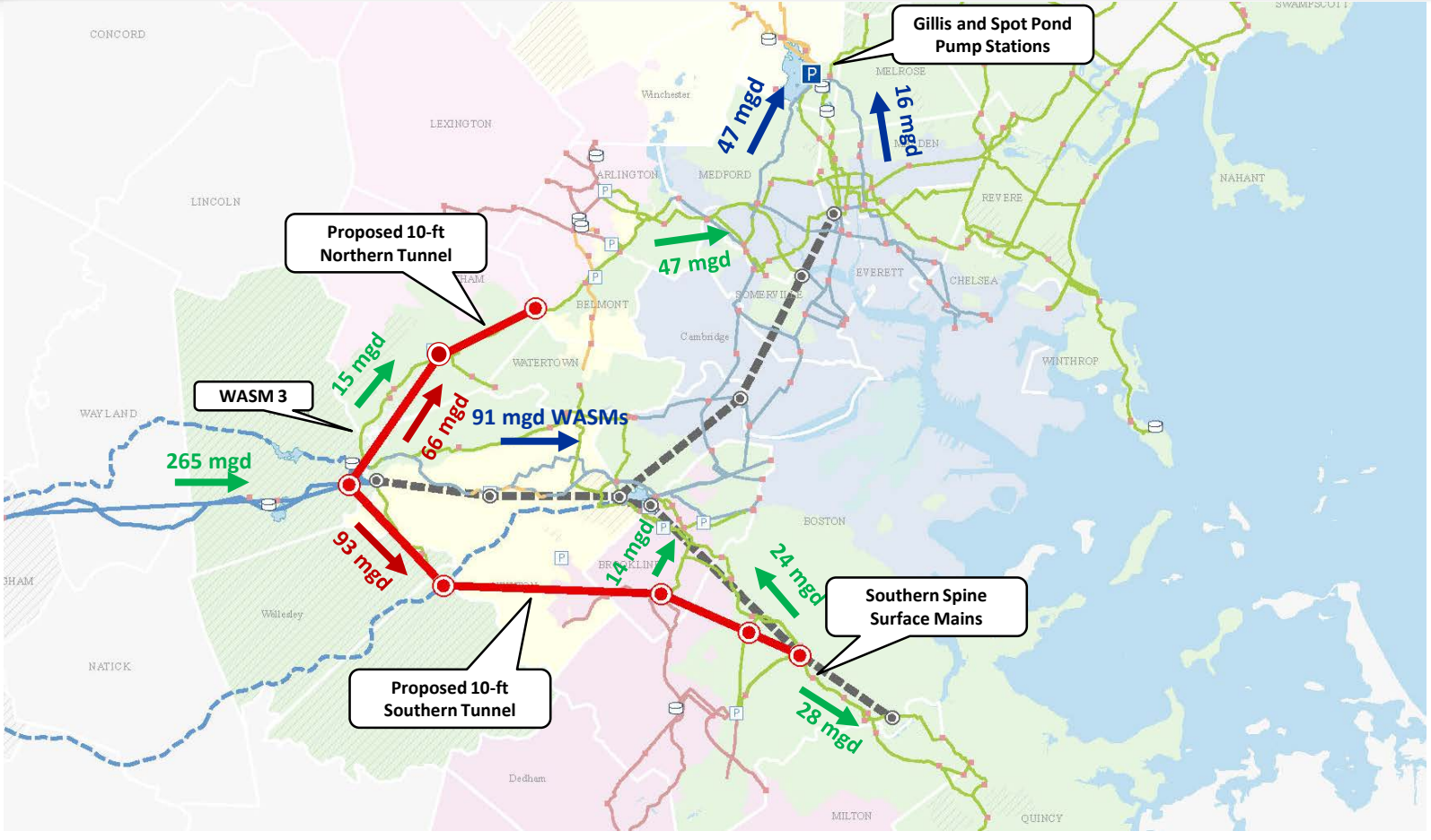


Redundant Tunnel – Existing Tunnel Offline – High Day 265 mgd East of Norumbega



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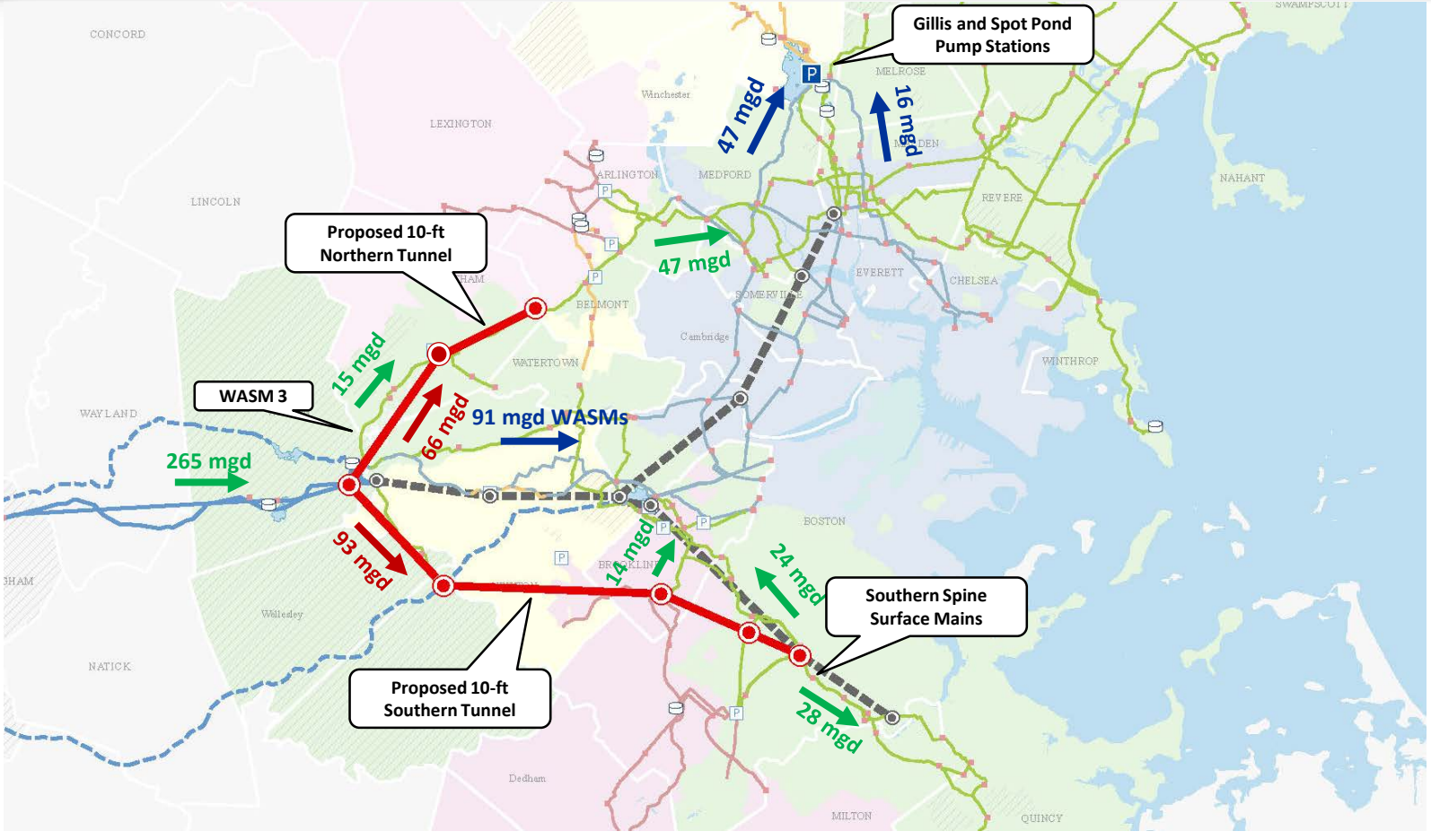

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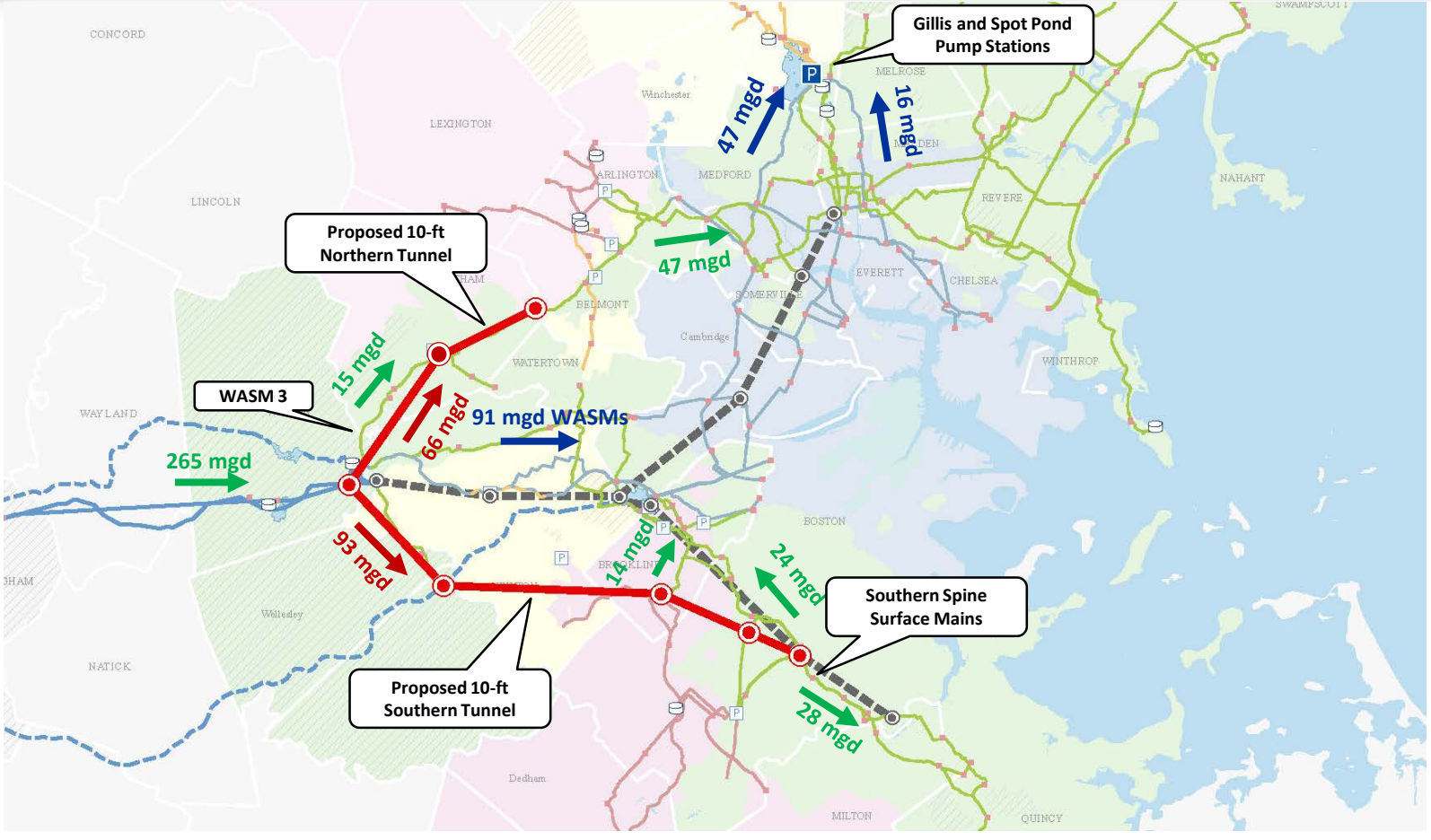
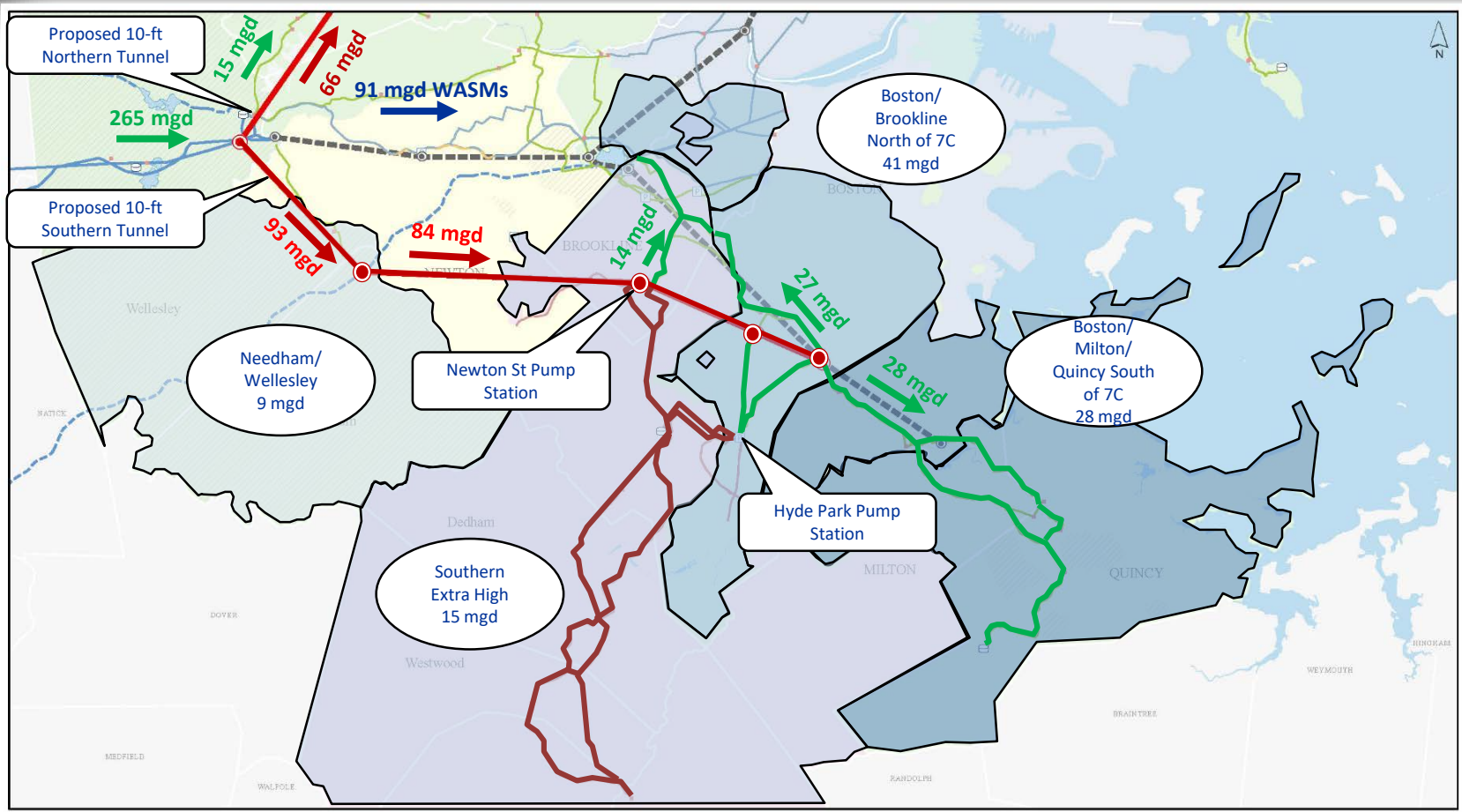
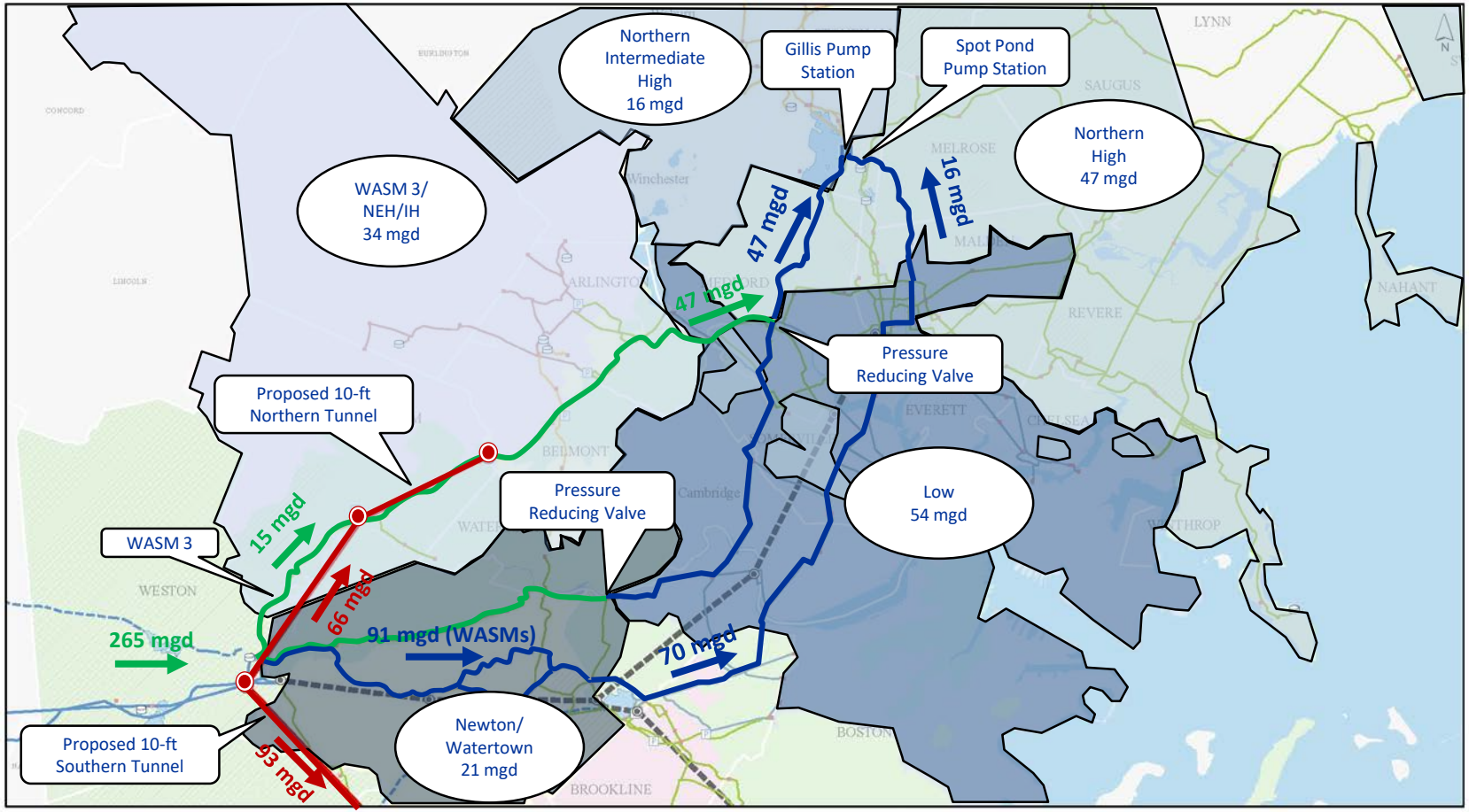


Redundant Tunnel Supply to the South – Existing Tunnel Off Line



Redundant Tunnel Supply to the North – Existing Tunnel Off Line



Project Costs

- Midpoint of construction – Northern Tunnel: $472 million
- Midpoint of construction - Southern Tunnel: $1,003 million
- Midpoint of construction - both tunnels is $1,475 million
- Estimated time to completion of 17 years
- 30% contingency and 4% annual construction cost escalation

Review by MWRA Advisory Board

- Supports the recommended two-tunnel alternative
- Recommended creation of dedicated department to manage the program
- Recommended concurrent construction of both tunnels (save time and $)

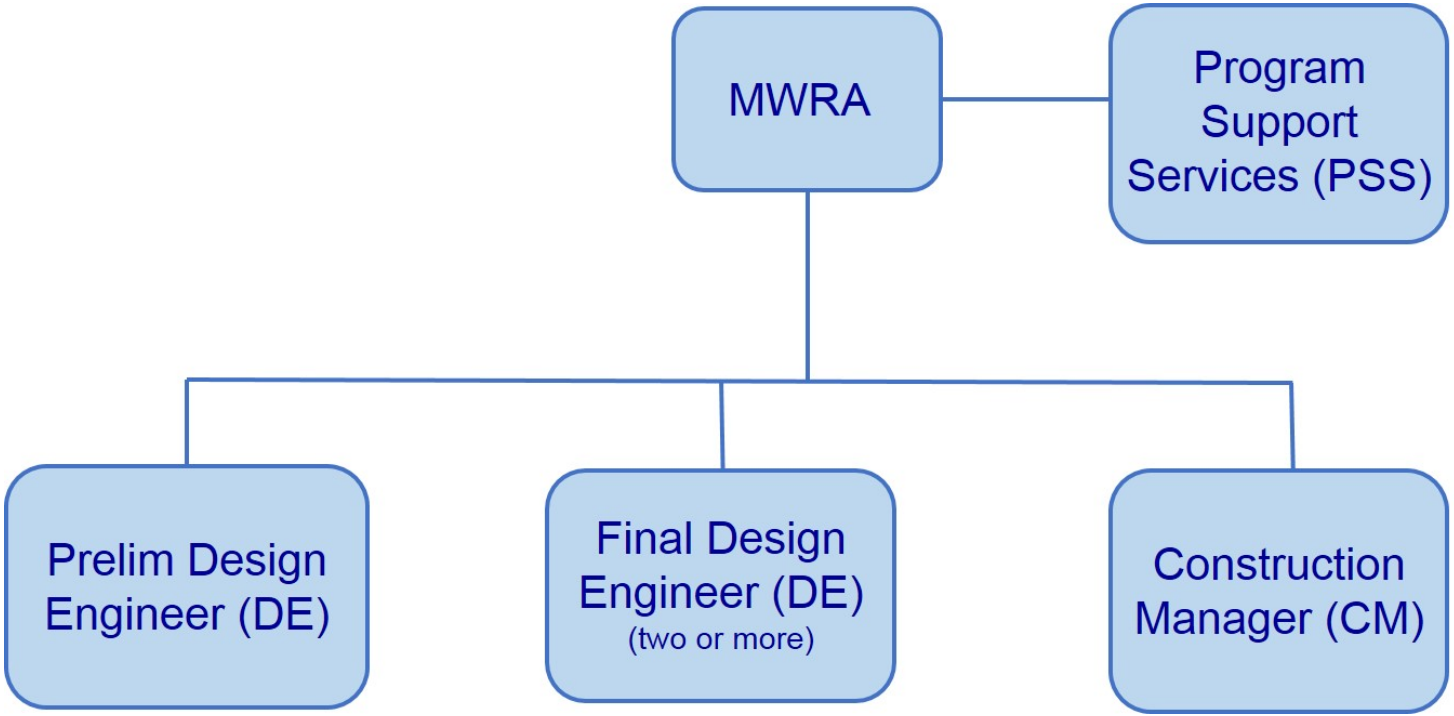
Metropolitan Tunnel Redundancy Program Outlook

- The Program will be managed by the MWRA Tunnel Redundancy Department (similar to PMD for BHP)
- The Program is funded in our Capital Improvement Plan
- DRAFT FY20 CIP Budget
  - Program-Wide Support Services
  - Preliminary Design/Phase 1 Geotech/MEPA Review
  - Final Design(s)
  - Construction Management
  - Tunnel Construction
  - Surface Connections Construction
  - Administration, Legal and Public Outreach

Program-Wide Support Services

- Program-wide planning
- Risk management planning
- Quality management
- Design criteria and standardization
- Independent design review
- Design and Construction package planning
- Critical path scheduling, and
- Budget planning and management

Program Organization

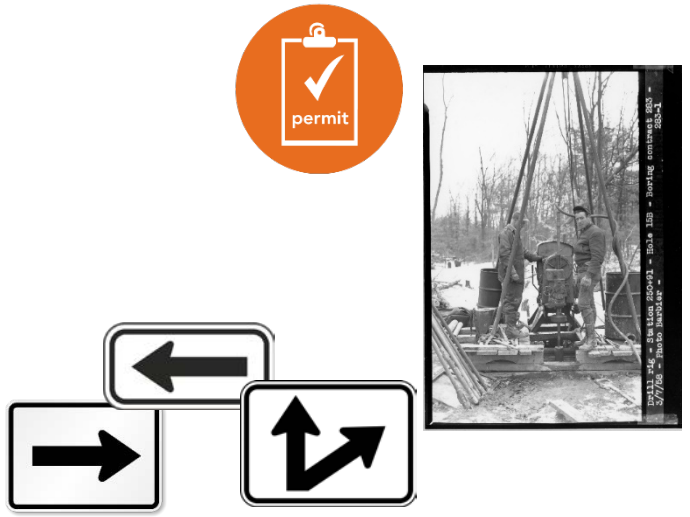


Preliminary Design Engineering

- Preliminary geotechnical investigation, preliminary route and shaft site evaluations, identify environmental permits needed and prepare required the MEPA review

- Produce significant project documents - Preliminary Geotechnical Data & Design Report, Alternatives Evaluation & Preliminary Design Report, Environmental Impact Report and preliminary design drawings

- It is expected this work can be accomplished within 3 years



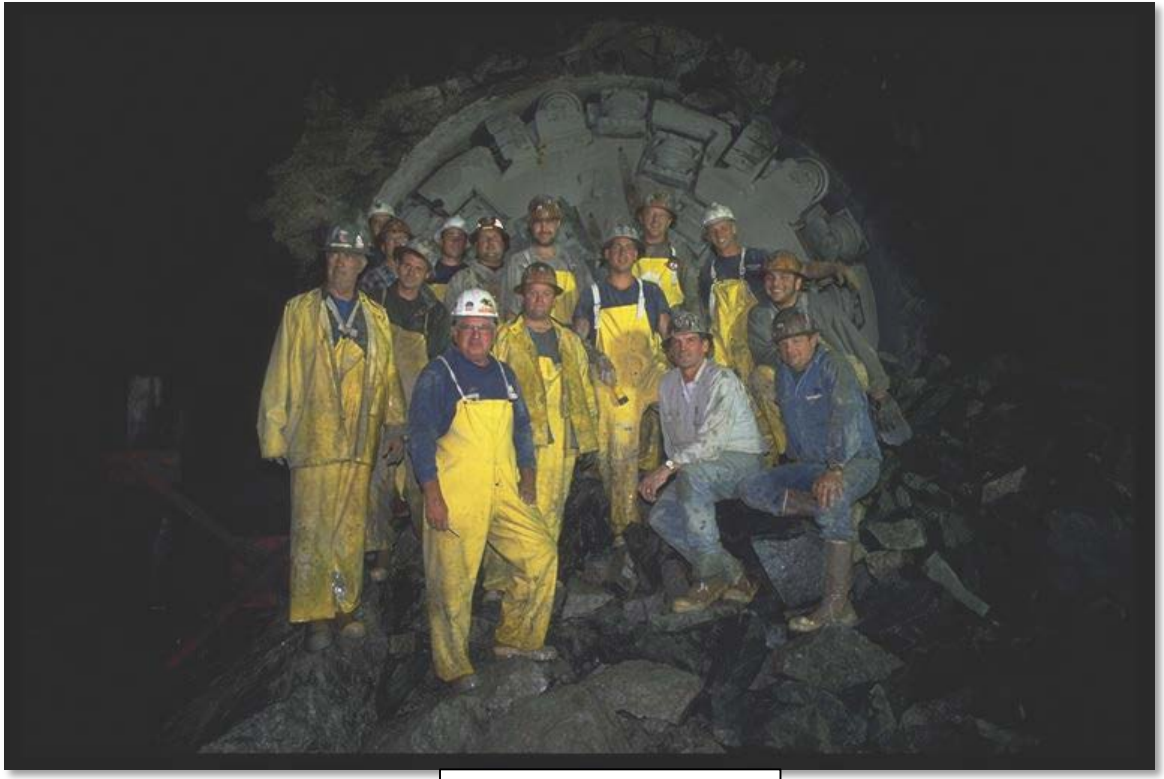
Planned Schedule

- Program Support Services
  - Awarded in March 2019

- Preliminary Design Engineering/MEPA Review
  - Issue RFQ: Summer/Fall 2019
  - Notice to Proceed: early 2020
  - Estimate Completed: 2023

- Final Design
  - Start 2024-ish

The Metropolitan Tunnel Redundancy Program



Thank You!