Metropolitan Water Tunnel Program

Tunnel Program Update

Presented to MWRA Advisory Board

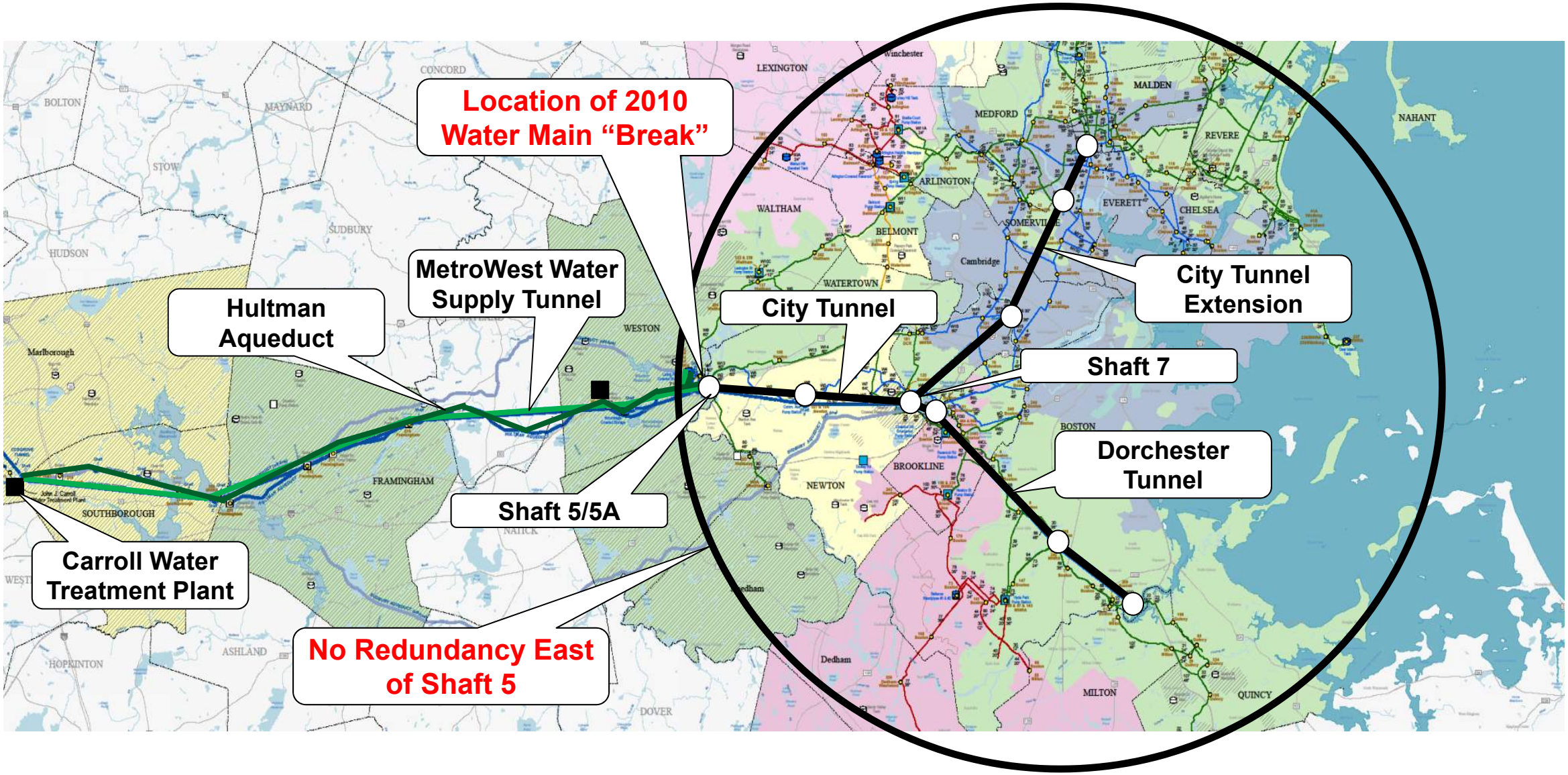
July 18, 2024

Agenda

- Advisory Board Operations Committee Business
- Introductions
- Safety Minute
- Tunnel Program Needs and Overview
- Metropolitan Redundancy Interim Improvements Projects Update
- Preliminary Design and Environmental Impact Report
- Tunnel Program Look Ahead
- Break
- Shaft Site Figures
- Core Storage Tour
- Q&A/Closing

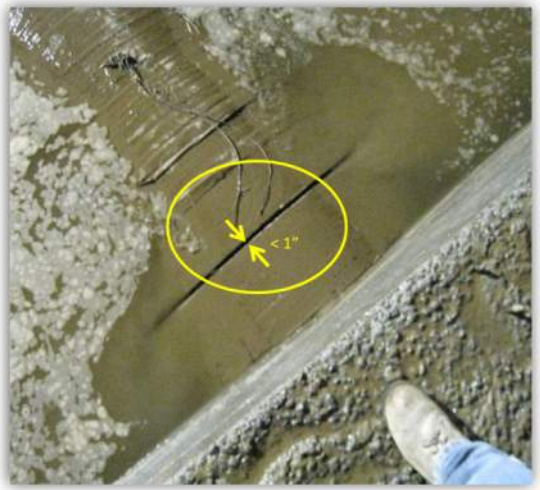
Tunnel Program Needs and Overview

Metropolitan Tunnel System Serves About 60 Percent of Water Demand in Metropolitan Area



Metropolitan Water Tunnel Program Purpose

- Our current Metropolitan Tunnel System, servicing the Boston area, is in need of repair
- The tunnels, valves, chambers & pipelines are between 50 – 80 years old

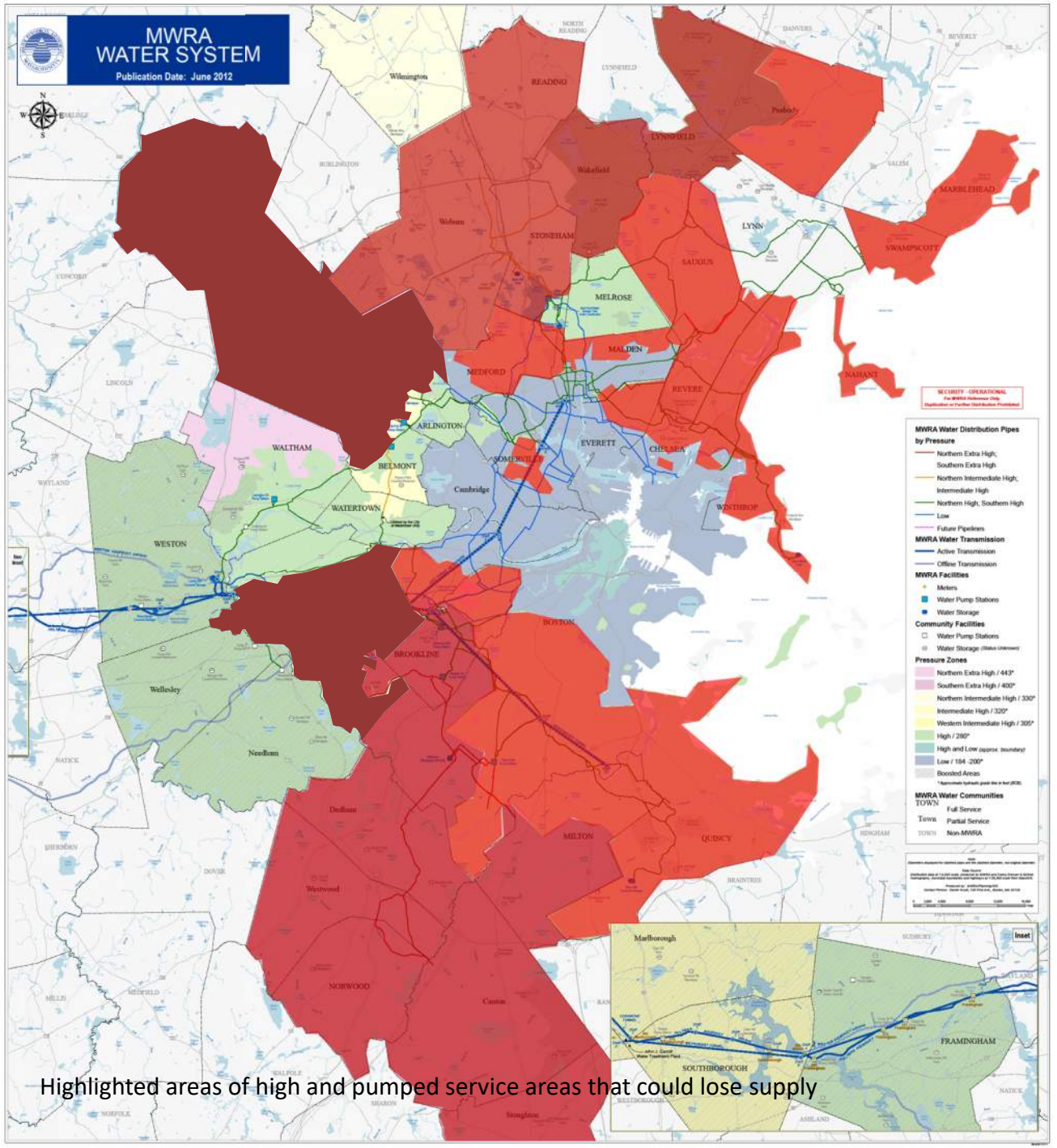


- Currently we cannot maintain our tunnel system east of Shaft 5 in Weston because a shutdown of the entire Metropolitan Tunnel System would be required
- The **Metropolitan Water Tunnel Program** will solve that problem by creating a redundant water tunnel system allowing the old system to be completely taken offline for inspection, maintenance, and repair

Wide-Spread Impact

- Sudden shut down of Metropolitan Tunnel system
- Loss of supply to high service areas
- Pumped Service Areas lose supply as tanks empty
- Whole system would be on boil order

- Economic Impact for Total Water Loss - One Day:
  - $360 million (2024)
- Economic Impact for Total Water Loss - Three Days:
  - $1.1 billion (2024)



Metropolitan Water Tunnel Program Goals

Protect Public Health, Provide Sanitation and Fire Protection

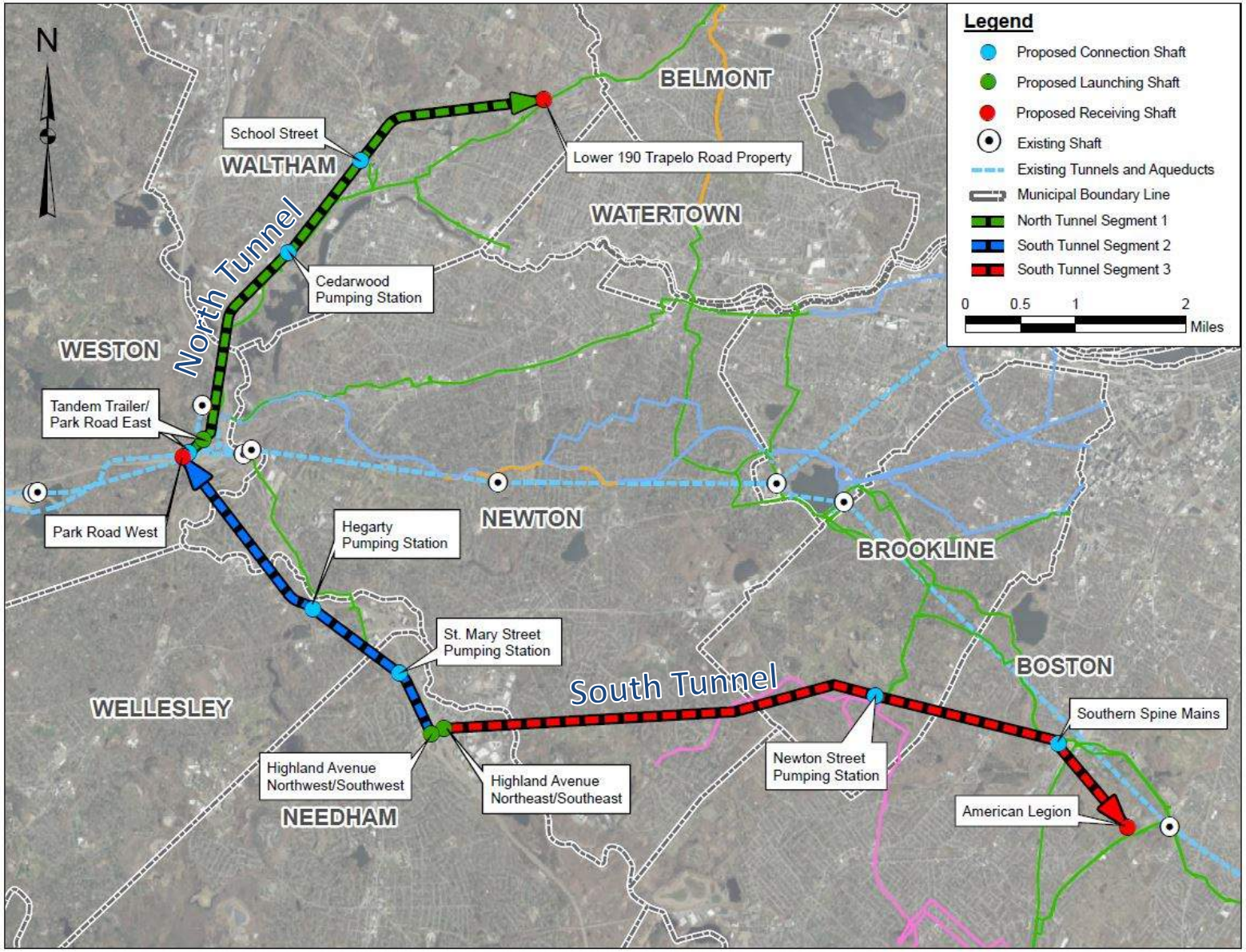
- Provide full redundancy for the Metropolitan Tunnel System:
  - Provide normal water service and fire protection when the existing tunnel system is out of service
  - Provide the ability to perform maintenance on existing tunnels year-round
  - Provide uninterrupted service in the event of an emergency shut down
  - Meet high day demand flow with no seasonal restrictions
  - Avoid activation of emergency reservoirs
  - Meet customer expectations for excellent water quality
- Result in no future boil orders!

Tunnel Program – Since 2017

- 2017 – Board approves Two-Tunnel Concept
- 2018 – Tunnel Department established
- 2019 – PSS consultant and Expert Review Panel
- 2020 – Began preliminary design and environmental review process
- 2021 – Purchased School St property
- 2022 – GSS consultant began an expanded geotechnical program
- 2023 – Completed preliminary design, first bottom-up cost estimate
- 2024 – Completed environmental review process
- 2024 – Begin final design

Metropolitan Water Tunnel Program

- ~15 miles of deep, hard rock, pressure tunnel
- Tunnels will begin in the Weston (I-90/I-95 vicinity)
- Northern Tunnel - ~5 miles, ends in Waltham
- Southern Tunnel - ~10 miles, ends in Mattapan near American Legion Hwy
- Six intermediate connections to existing water infrastructure
- Construction anticipated between 2028 and 2040

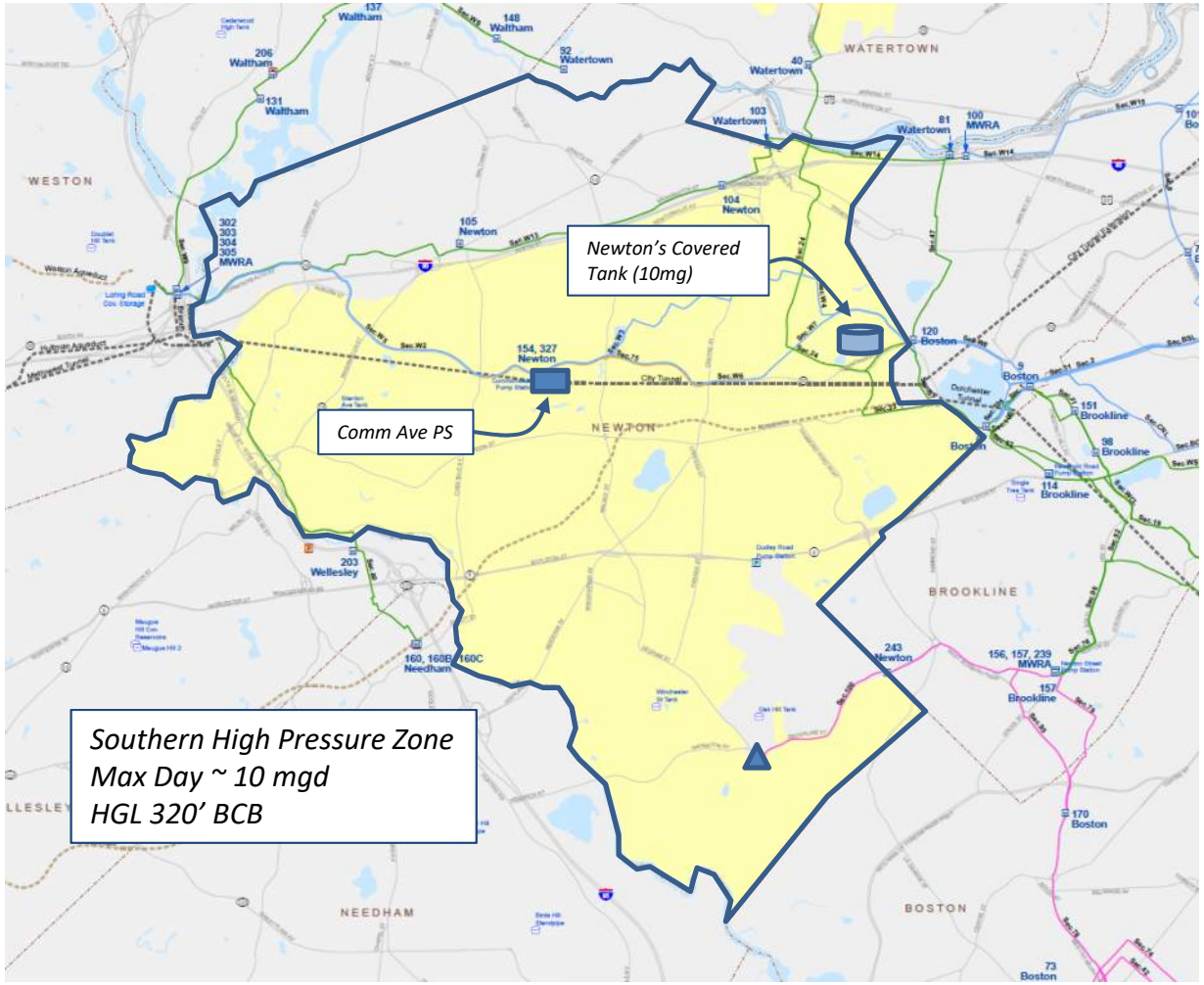


For discussion only

Metropolitan Redundancy Interim Improvements Projects Update

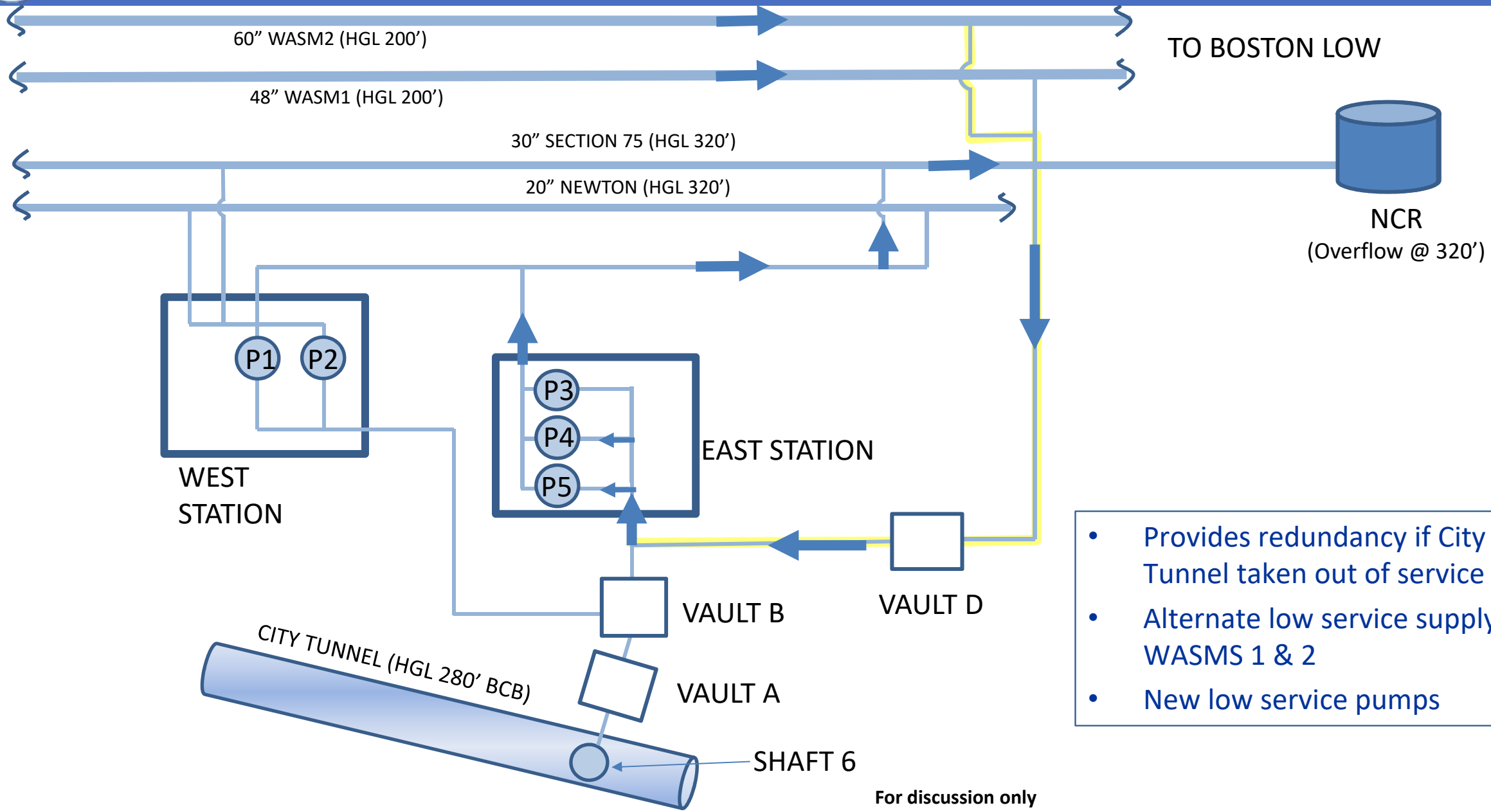
Commonwealth Avenue Pumping Station Modifications

Commonwealth Avenue Pump Station



- Prior to the completion of the project there was a single supply to the pump stations from the City Tunnel at Shaft 6
- Main goal of the project was to provide a redundant supply

Schematic of supply from Low Service (WASM's 1 & 2) to East Station

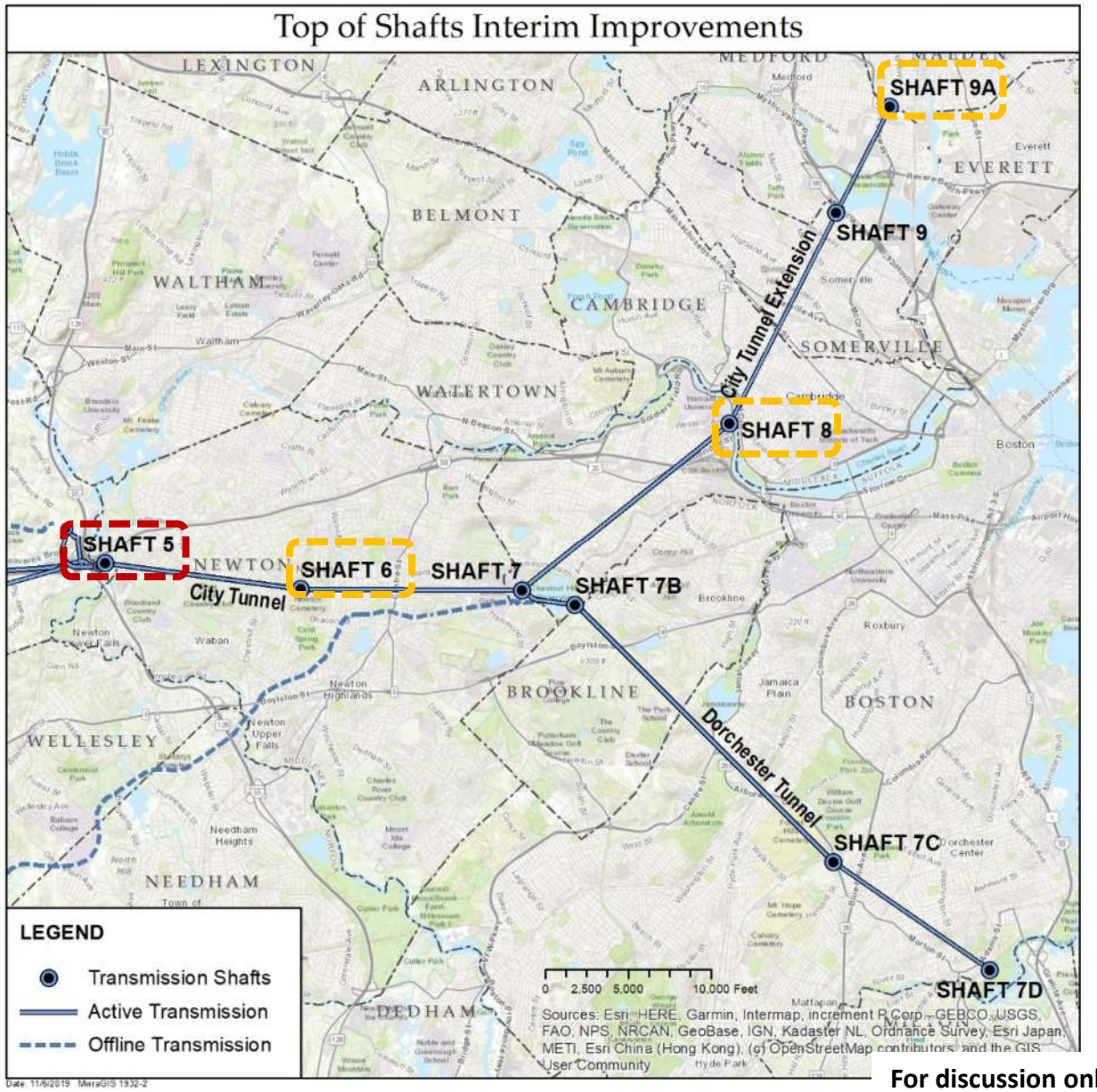


- Provides redundancy if City Tunnel taken out of service
- Alternate low service supply from WASMS 1 & 2
- New low service pumps

New Pumps #4 & #5 with VFDs

For discussion only

Location of Metropolitan Tunnel Shafts



Improve and protect critical facilities related to the existing tunnel system.

7671 Shaft 5 – Under Construction

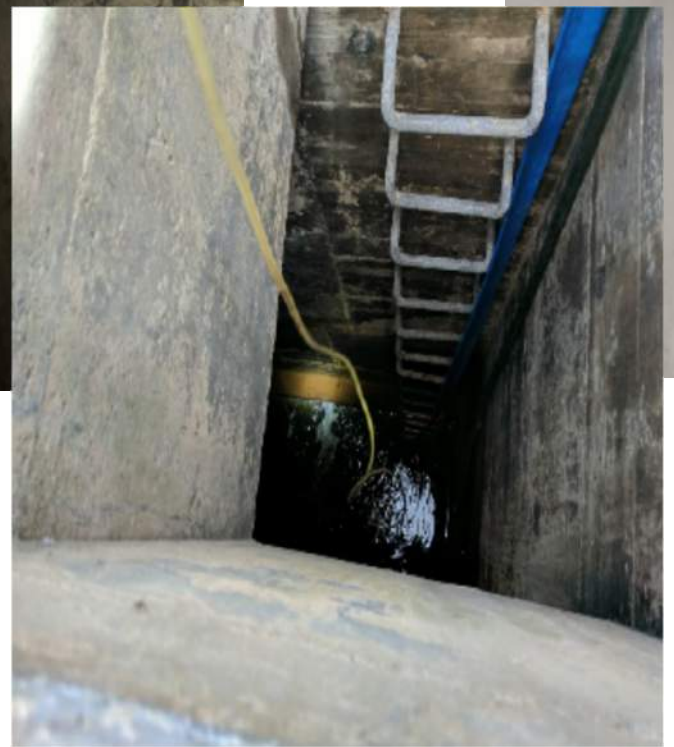
Completed work:

- Shaft 6 – Newton
- Shaft 8 – Brighton
- Shaft 9A – Malden

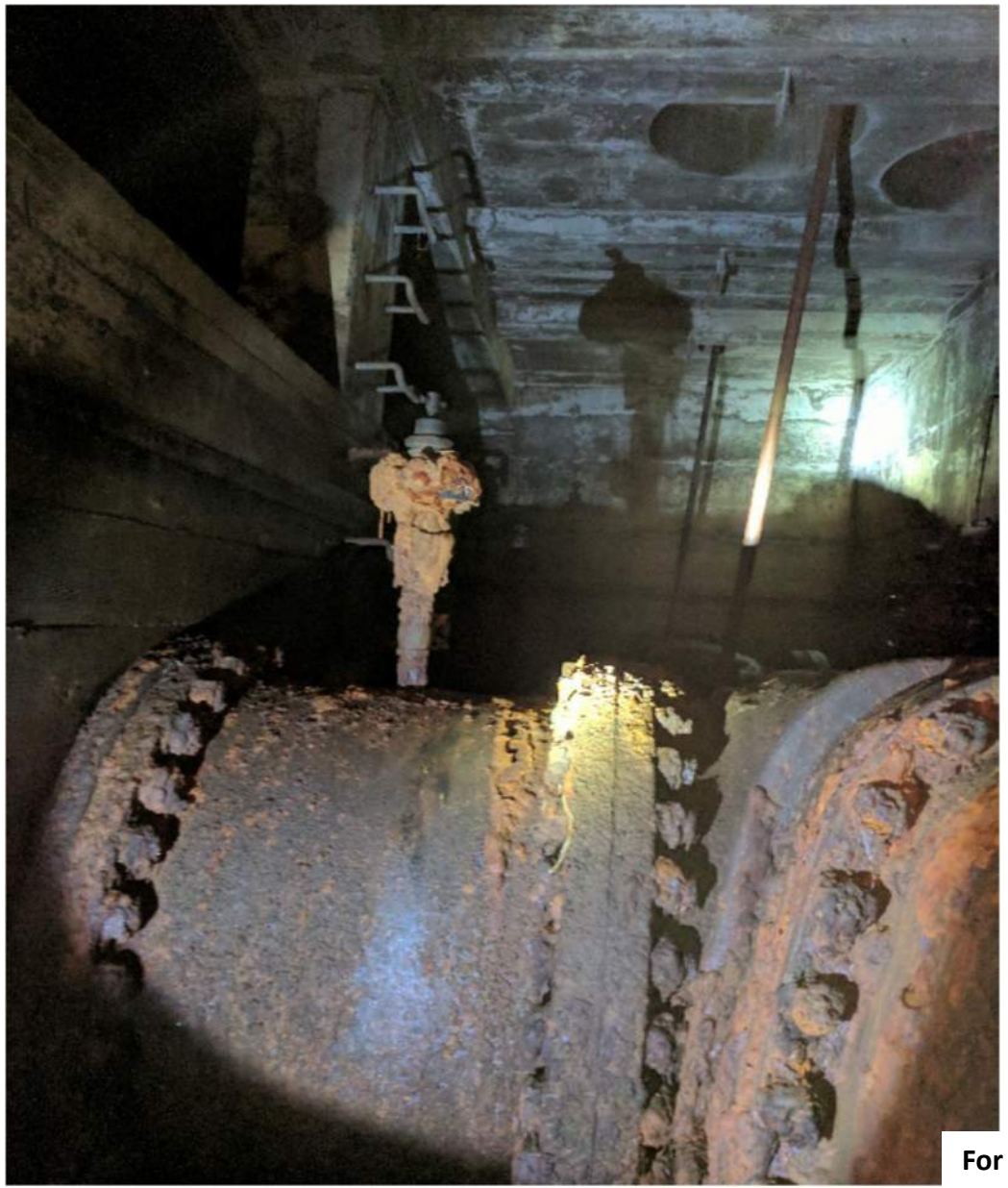
Future work:

- Shaft 7 – Boston College
- Shaft 7B – Chestnut Hill
- Shaft 7C – Dorchester
- Shaft 7D – Dorchester.
- Shaft 9 – Somerville

Shaft 8 Before and After Epoxy Coating



Shaft 9A Air Valve – before and after (installed by Ops)



For discussion only

Contract 7671 Top of Shaft 5 Interim Improvements

Multiple valve vaults (corrosion protection, bolt replacement, and vault waterproofing)

Underground pump room (abandoned with fill)

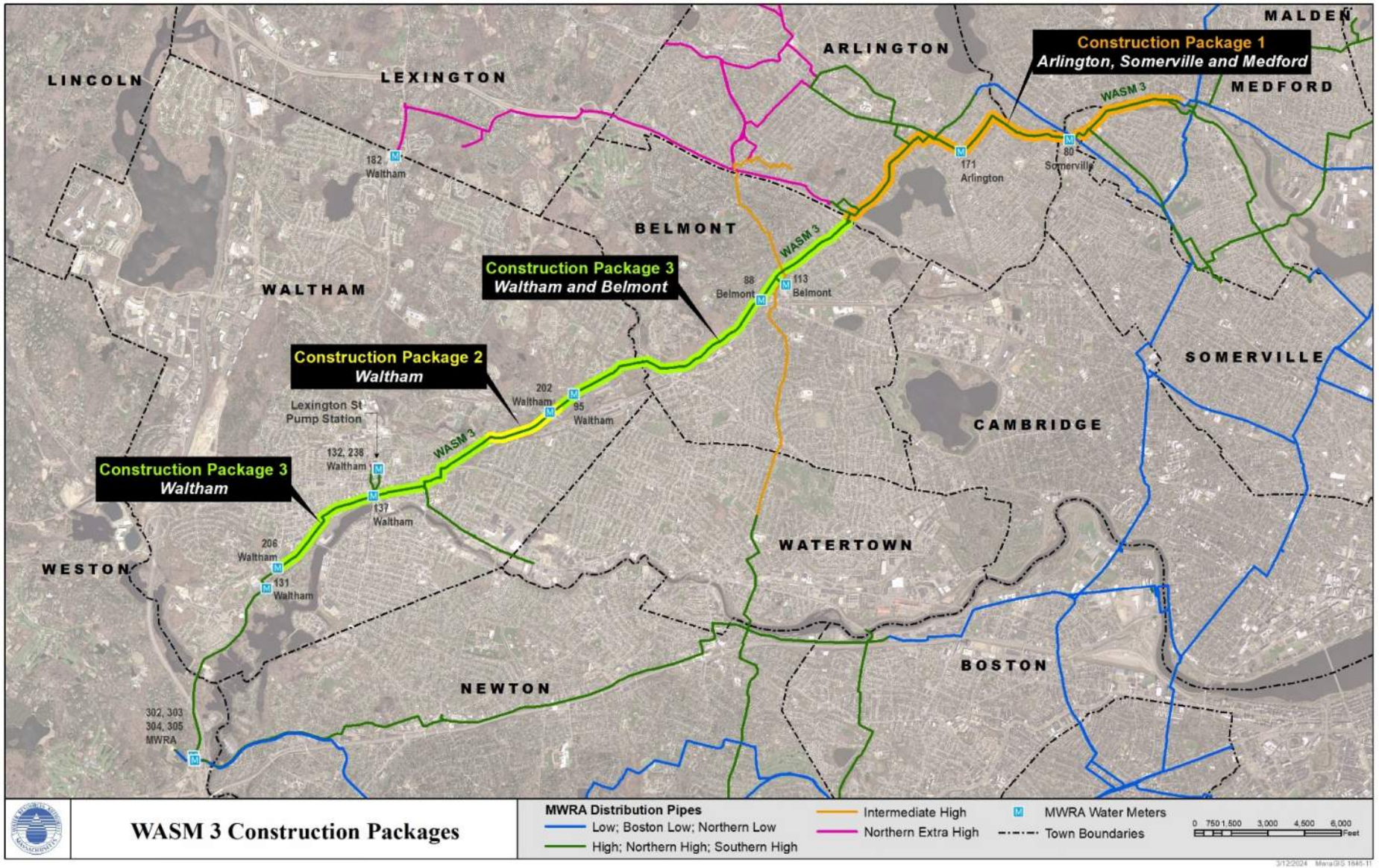
Contract 7599 Shaft 5 Building Improvements-Existing Exterior

Contract 7599 Shaft 5 Building Improvements Equipment Upgrades

Existing Switchgear

Existing Overhead Crane

WASM 3 Rehabilitation



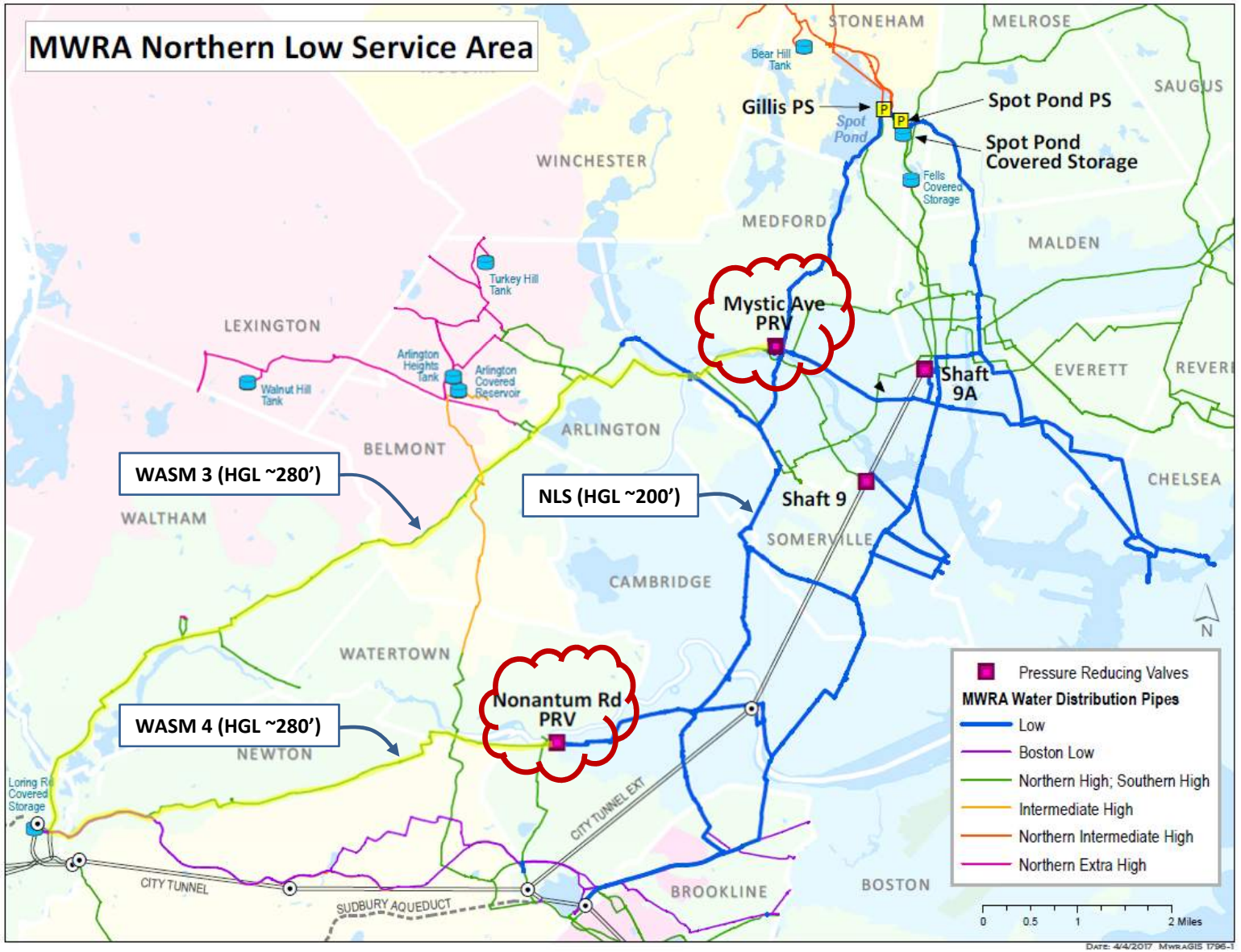
For discussion only

WASM 3 - Existing Pipe, Cleaned Pipe, New Cement Lining

WASM 3 - Installation of New 60” Steel Pipe

For discussion only

Low Service Pressure Reducing Valve Improvements



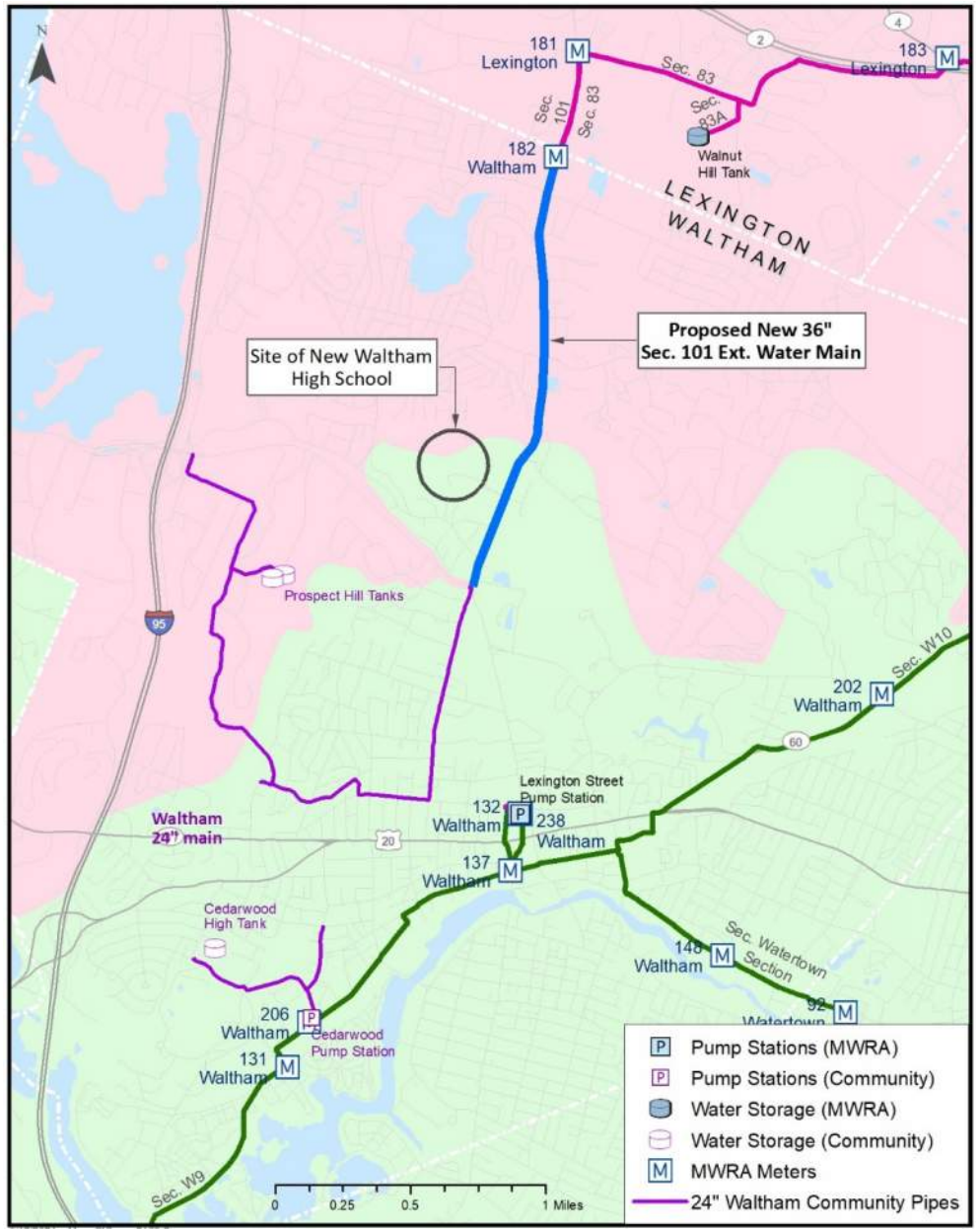
- Increase capacity of water supply via WASM 3 and WASM 4 to Northern Low Service
- Gillis and Spot Pond pumping stations can supply Northern High and Northern Intermediate High services in event of a tunnel failure
- Construction nearing substantial completion, Start-up Summer 2024

For discussion only

W14 Nonantum Road PRV Old vs New

W16 Mystic Valley Parkway PRV Old vs New

Section 101 Extension Waltham – Project Overview



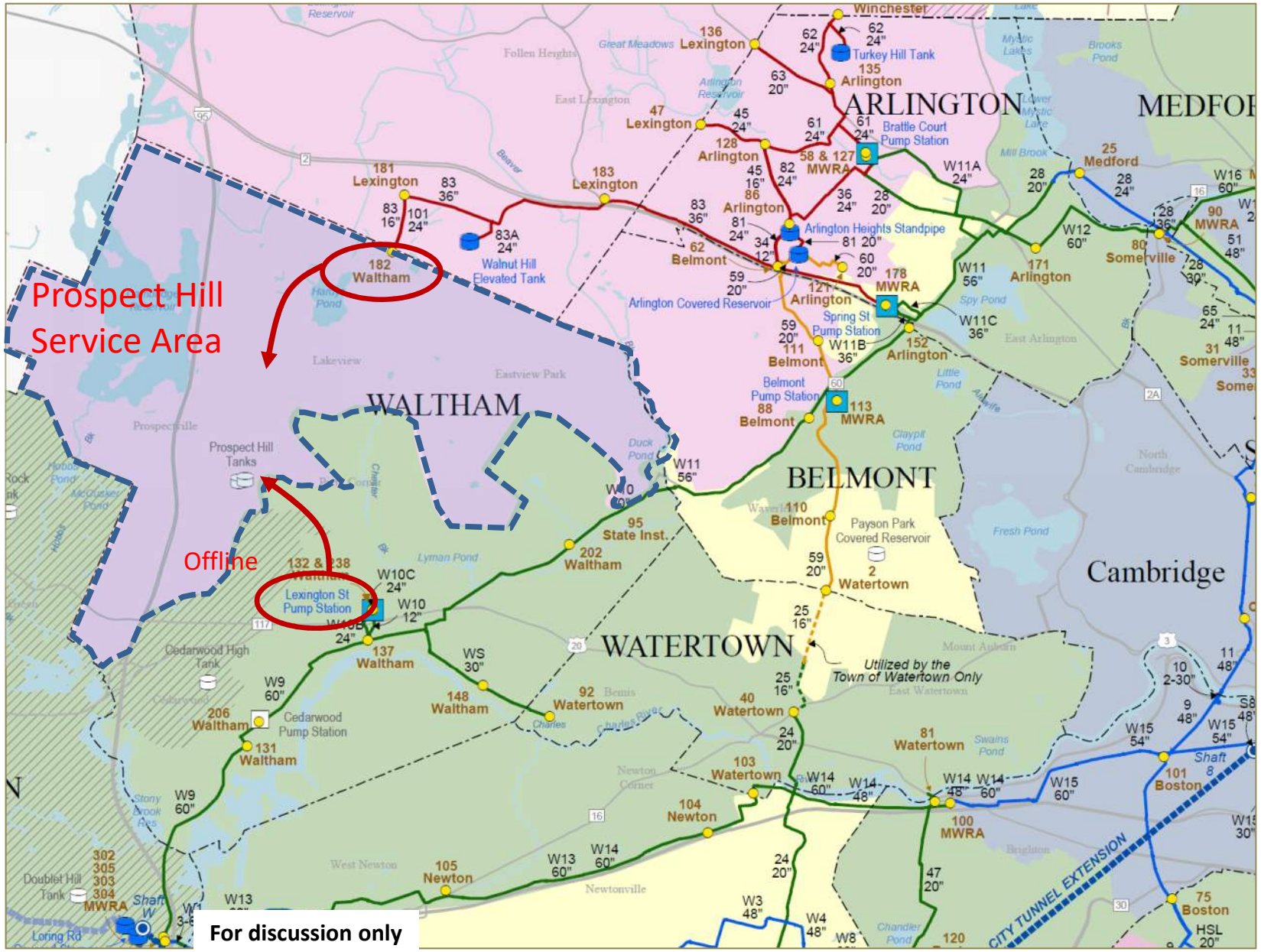
For discussion only

Section 101 Extension Waltham

Prospect Hill Service Area

- 2- 4 MG Tanks – Waltham's Prospect Hill Tanks
- ~75% supply from MWRA's Lexington Street Pump Station
- ~25% of the supply from meter 182 – MWRA's Northern Extra High Service Area
- Max Day Demands ~ 4 mgd

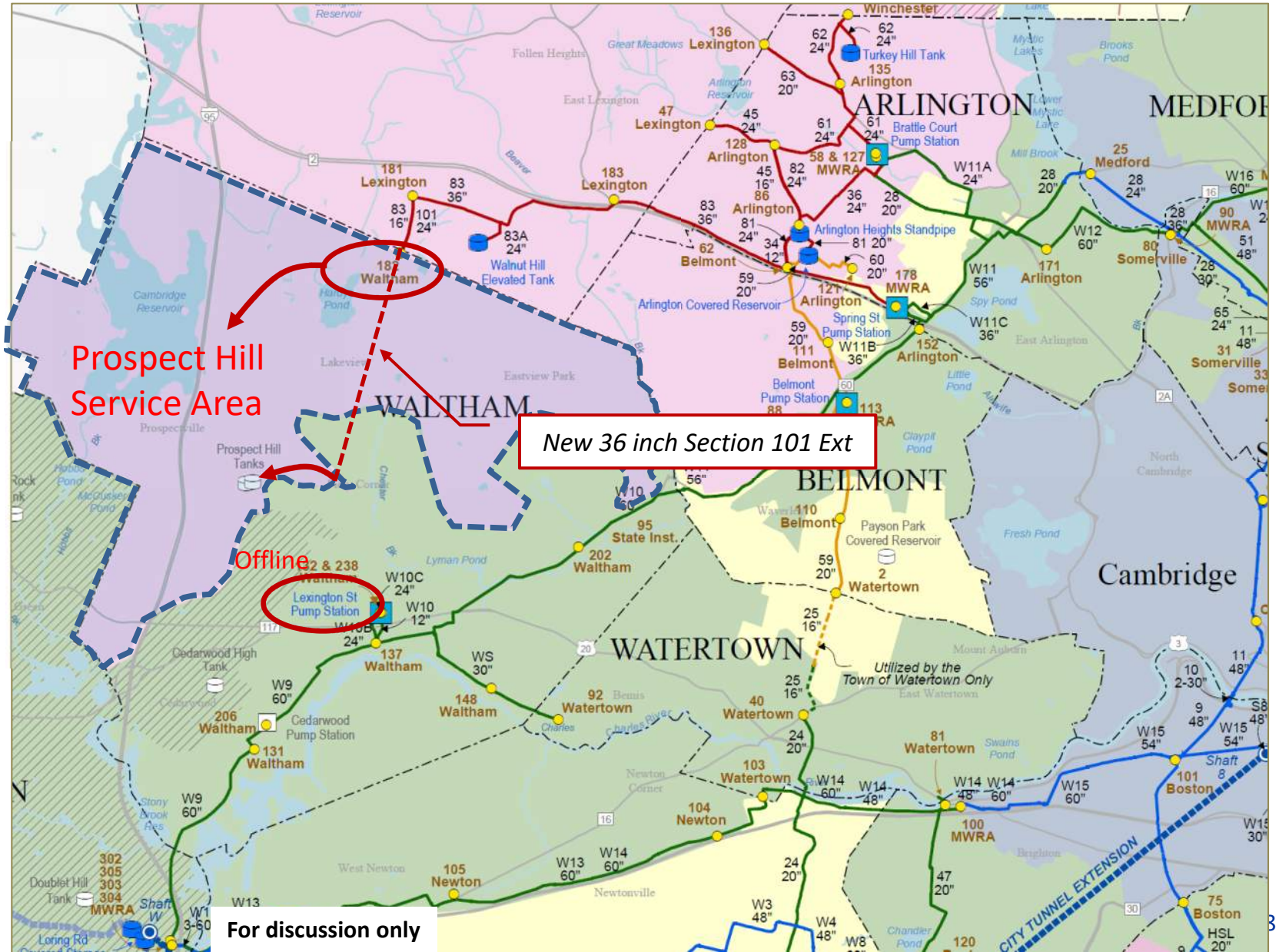
Loss of MWRA's Lexington Street PS requires all of the supply to come from meter 182 – Northern Extra High Service Area



For discussion only

Section 101 Extension – Redundancy for Lexington St Pump Station

New 36 inch pipeline from meter 182 to the heart of Waltham's Prospect Hill Service Area increases the hydraulic capacity from MWRA's Northern Extra High System to Waltham's Prospect Hill tanks



For discussion only

Sect 101 Ext. 36-Inch Valve & Manhole Installation Lexington St.

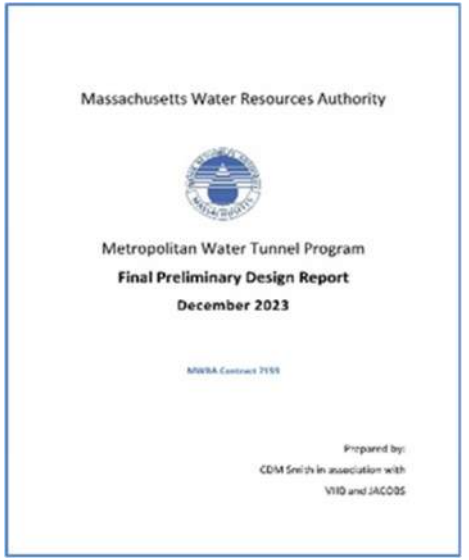
Conclusion

- Tunnel construction is a long term program
- Much work completed since tunnel authorization approved
- Projects reduce risk, improve response capability, resiliency
- Cost of projects in CIP is $120.3M

Preliminary Design and Environmental Impact Report

Preliminary Design and Environmental Impact Report

- Preliminary Design Report
  - 15 miles of deep rock tunnel
  - 100 Year Service Design Life
  - Preliminary tunnel alignment and profile, valve chambers and surface pipeline connections
  - Construction contract packaging and sequence approach
  - Updated construction cost estimate and construction schedule


Massachusetts Water Resources Authority

Metropolitan Water Tunnel Program

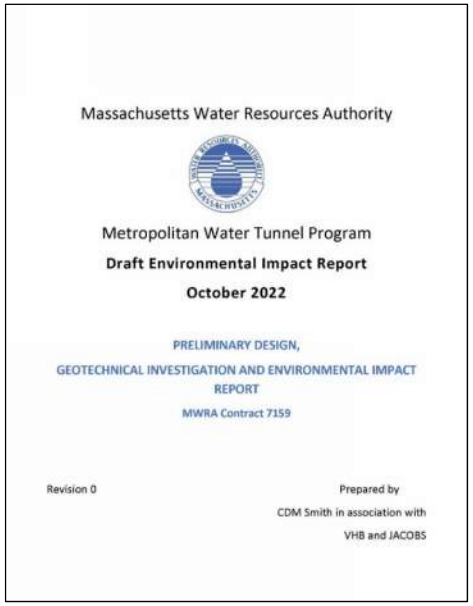
Final Preliminary Design Report

December 2023

MWRA Contract 7159

Prepared by:
CDM Smith in association with
VHB and JACOBS

- MEPA filings and Environmental Impact Reports
  - Environmental Notification Form
  - Draft Environmental Impact Report
  - Supplemental Draft Environmental Impact Report
  - Final Environmental Impact Report
  - FEIR Certificate received April 2024


Massachusetts Water Resources Authority

Metropolitan Water Tunnel Program

Draft Environmental Impact Report

October 2022

PRELIMINARY DESIGN,
GEOTECHNICAL INVESTIGATION AND ENVIRONMENTAL IMPACT REPORT

MWRA Contract 7159

Revision 0

Prepared by
CDM Smith in association with
VHB and JACOBS

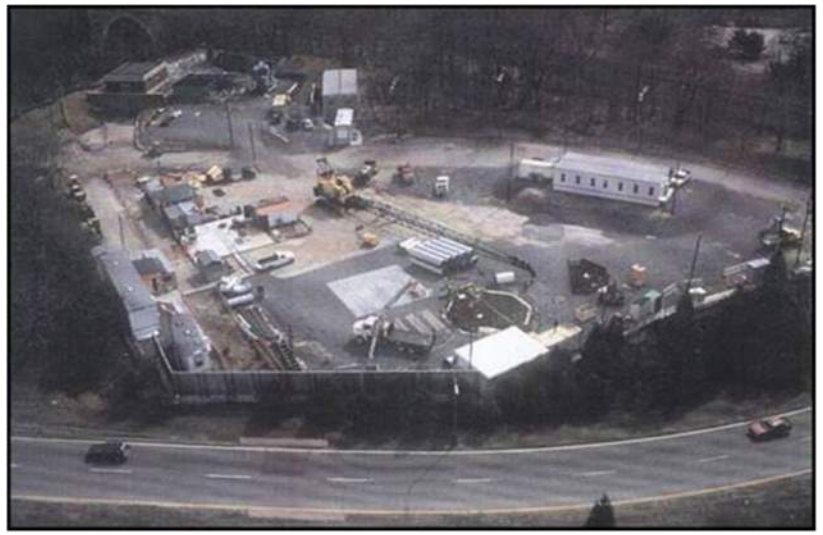
Preliminary Design & EIR – Performed in Parallel

Key Objectives:

- Shaft site selection
  - Meet system hydraulic requirements, provide full redundancy
  - Provide sufficient space for temporary construction staging and permanent infrastructure
- Establish tunnel alignment (both horizontal and vertical)
  - Minimize overall tunnel length
  - Avoid geo-hazards when possible
  - Maximize length of unreinforced concrete liner
  - Establish readily constructible tunnel segment lengths
- Avoid, minimize, and mitigate impacts to the environmental and communities to the maximum extent practicable
- Establish construction sequence and packaging
  - Promote good competition by qualified bidders
  - Balance risks

Shaft Site Selection Objectives

- During Construction
  - Sufficient size for construction
  - Locate away from sensitive receptors and abutters
  - Close to major highway
  - Near receiving water
- After Construction
  - Landscaped and secured
  - Periodic site visits and maintenance
  - Good neighbor



Shaft Site During Construction

Shaft Site After Construction

Shaft Sites

Construction Shaft Sites

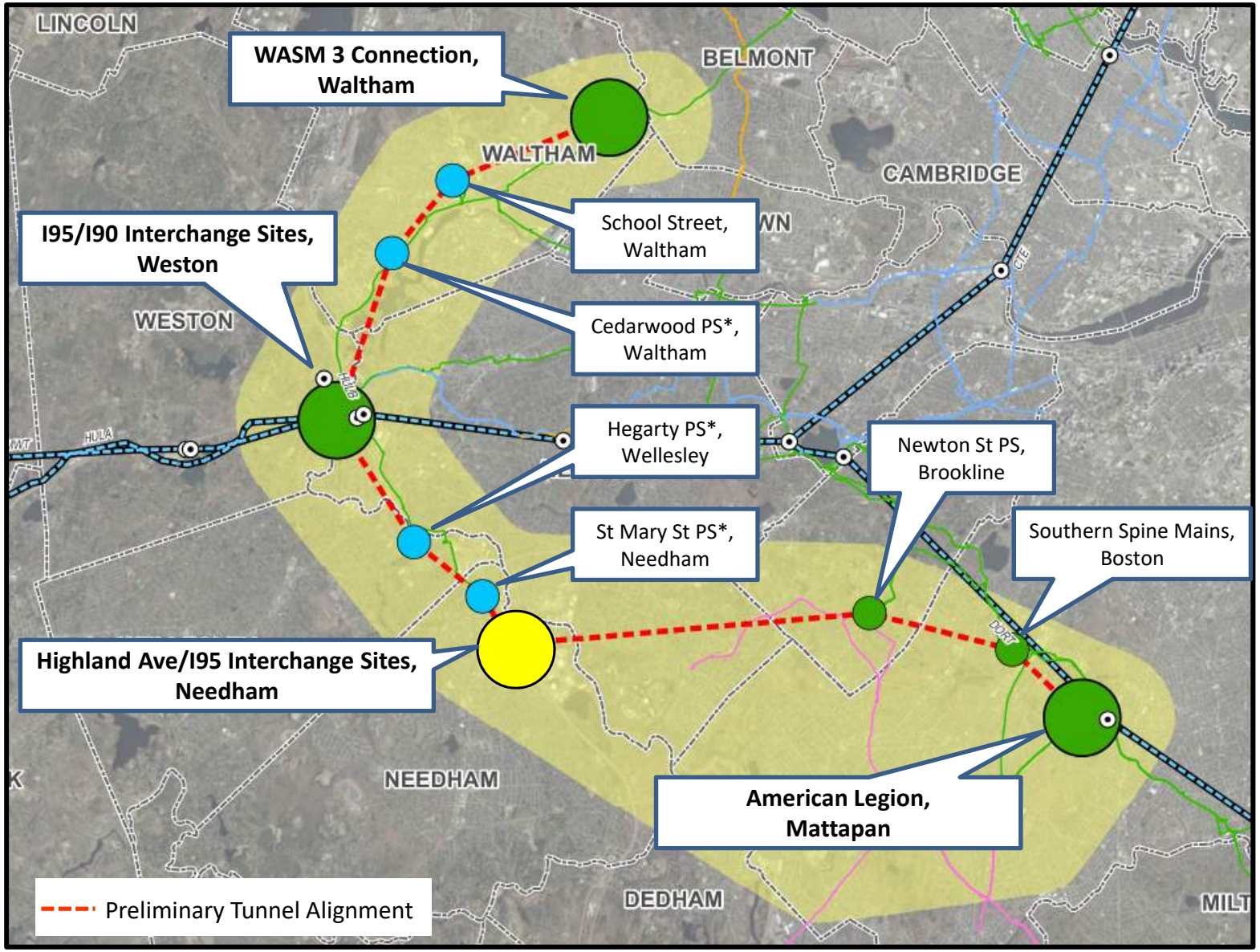
- WASM 3 Connection, Waltham
- I90/I95 Interchange, Weston
- Highland Ave/I95 Interchange, Needham
- American Legion, Mattapan

Connection Shaft Sites

- Lexington St Pump Station, Waltham
- Cedarwood Pump Station, Waltham
- Hegarty Pump Station, Wellesley
- St. Mary Street Pump Station, Needham
- Newton Street Pump Station, Brookline
- Southern Spine Mains, Boston

Final shaft locations subject to permits and real estate acquisition

* Non MWRA Pump Station

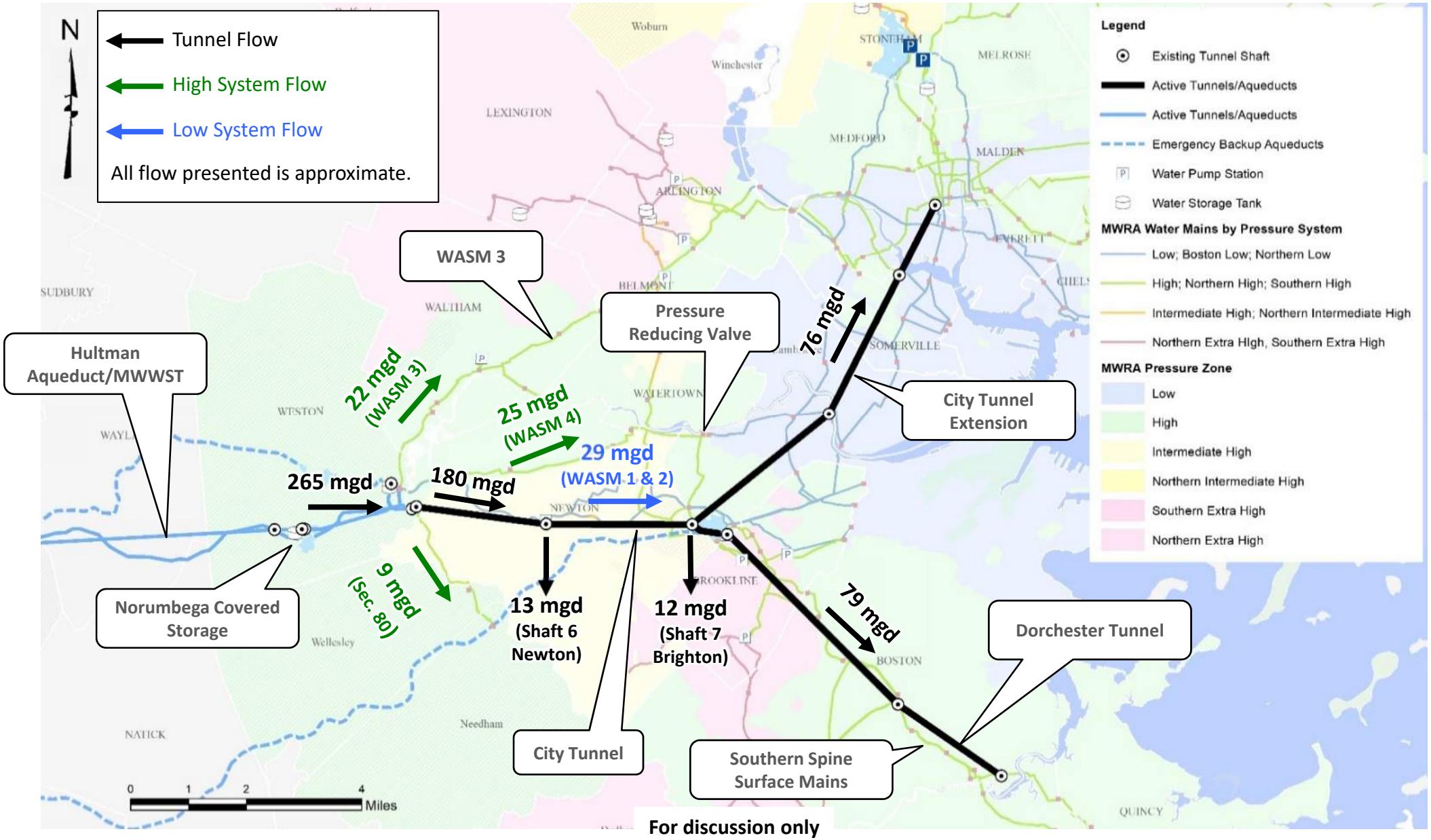


Required Connection (required for system redundancy)
Secondary Connection (provides local benefit)
Construction Shaft (South Tunnel Isolation)

For discussion only

Existing Tunnel System

Current High Day Demand 265 mgd East of Norumbega



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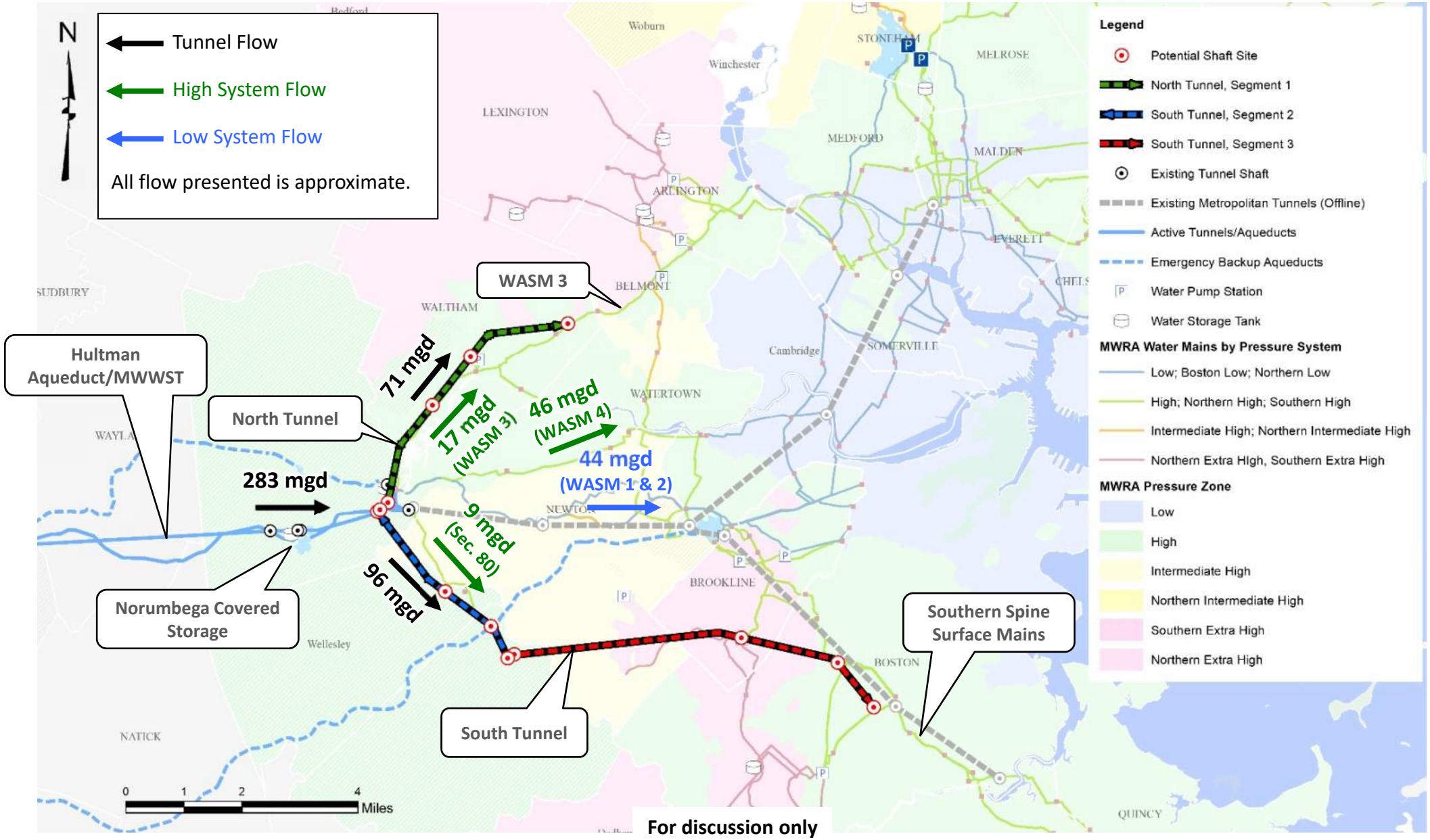
New Tunnel System (Existing Tunnel System Offline)

Projected High Day Demand 283 mgd East of Norumbega



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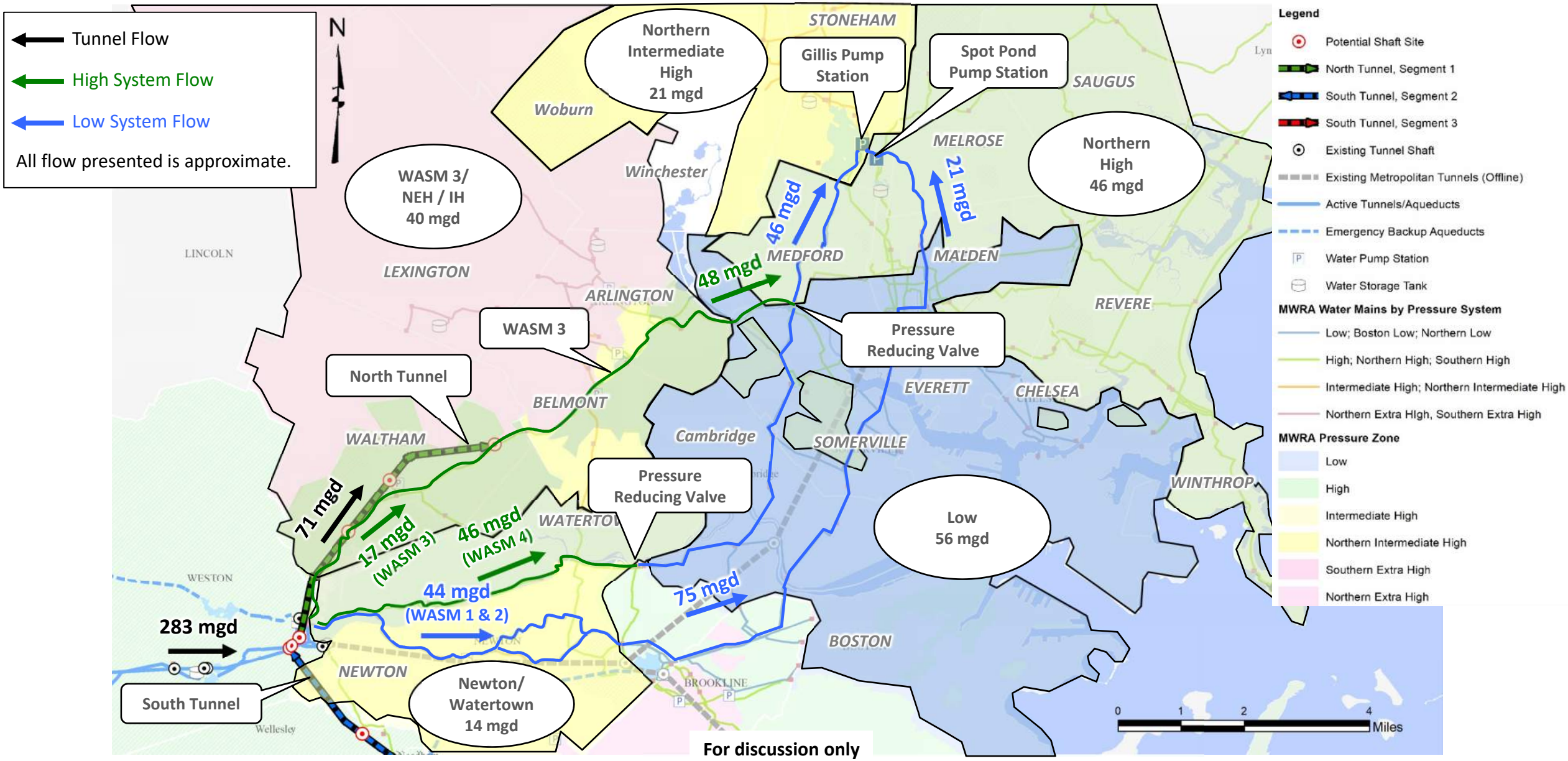
New Tunnel System (Existing Tunnel System Offline) – North

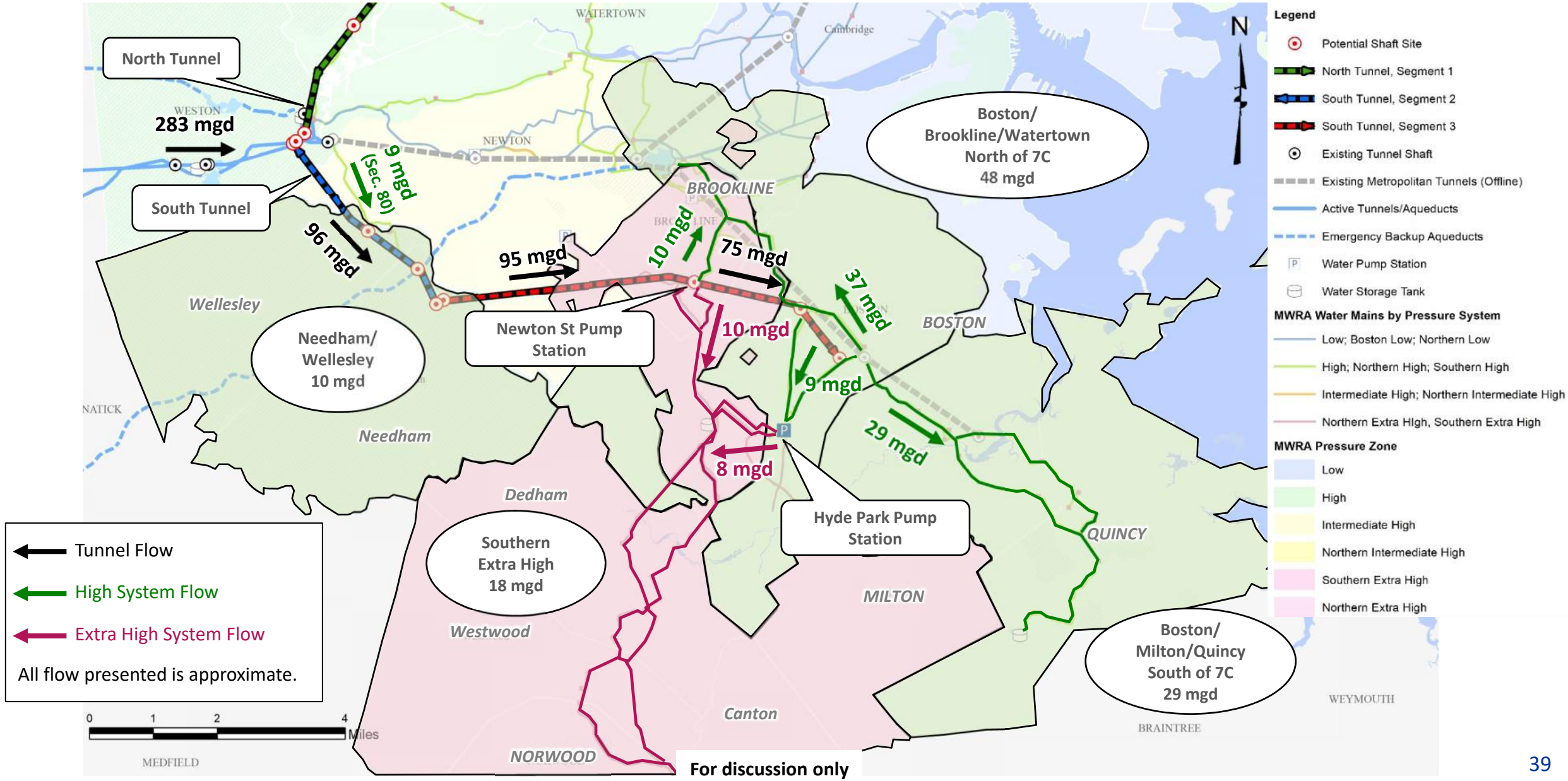
Projected High Day Demand 283 mgd East of Norumbega



For discussion only

New Tunnel System (Existing Tunnel System Offline) – South

Projected High Day Demand 283 mgd East of Norumbega

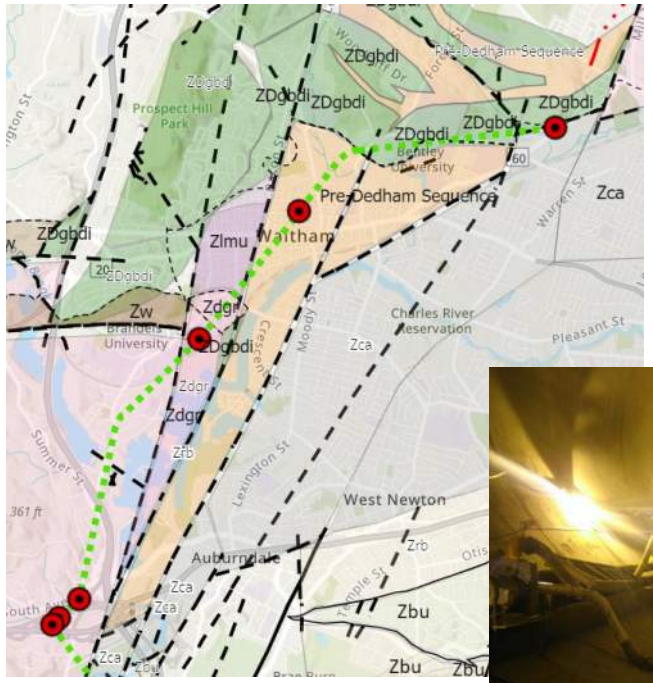


For discussion only

Tunnel Alignment & Segments

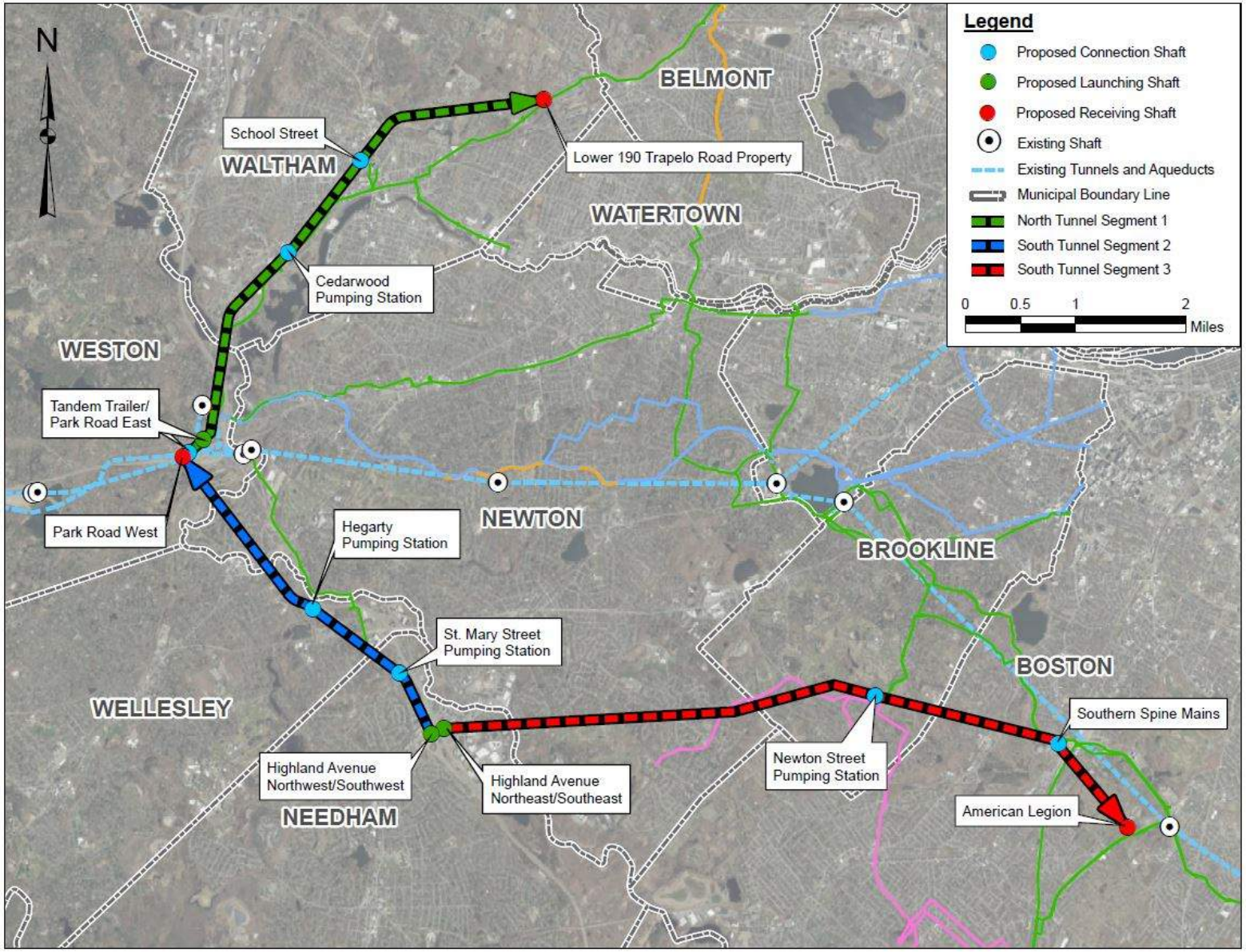
Objective:

- Establish tunnel alignment (both horizontal and vertical) to minimize overall length and maximize unreinforced concrete permanent liner system
- Avoid/minimize mining through difficult ground conditions where possible
- Select segment lengths to shorten overall construction duration and provide added operational flexibility
- Control construction costs by combining tunnel segments into contract packages that minimize contract interfaces and encourage construction flexibility



Tunnel Alignment, Segments, and Contract Packaging

- 15 miles of deep, hard rock, pressure tunnel, 250 to 500 feet deep
- Three launching and three receiving shafts
- Three tunnel segments (4.8, 3.4 and 6.8 miles long)
- Six intermediate connection shafts
- Alignment has been adjusted to avoid known geo-hazards
- Two tunnel construction packages
  - North Tunnel (Segment 1)
  - South Tunnel (Segments 2 & 3)
- Contract package sizes should promote good competition



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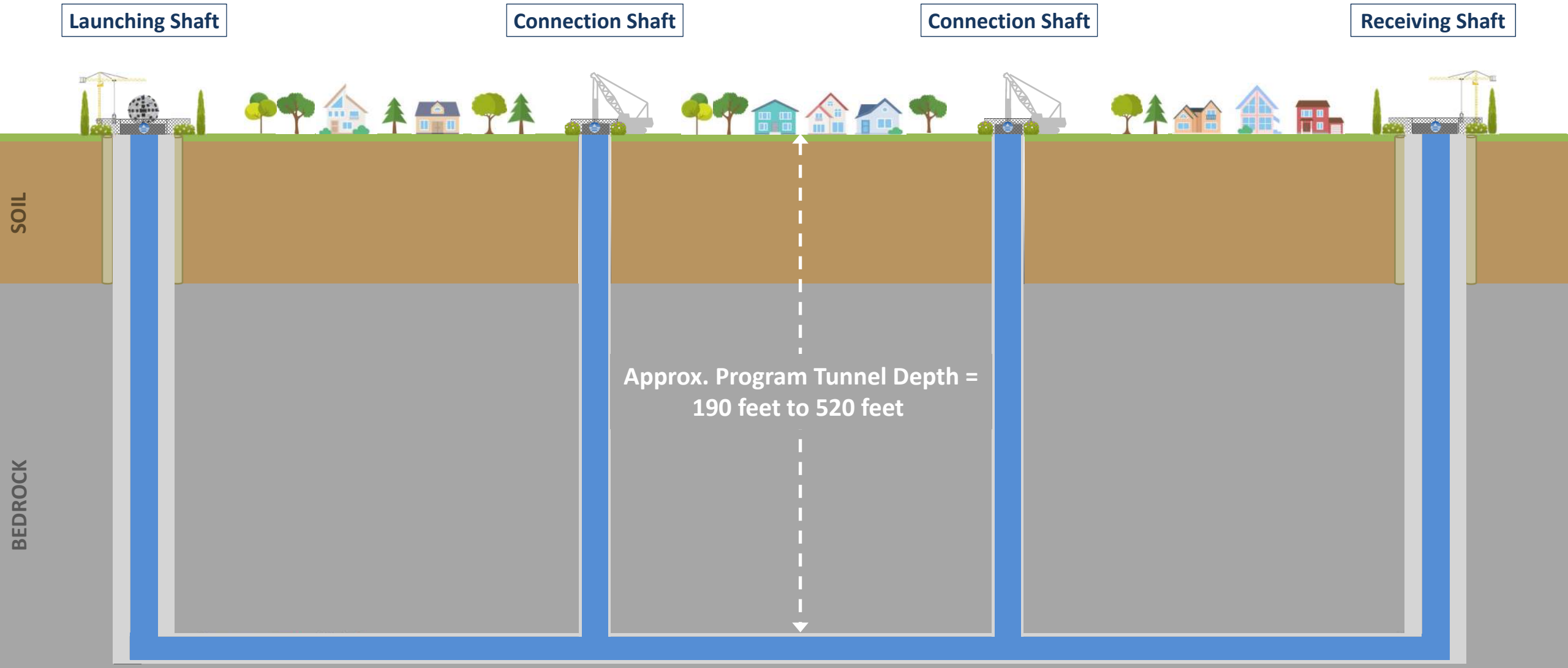
Conceptual Construction



NOT TO SCALE

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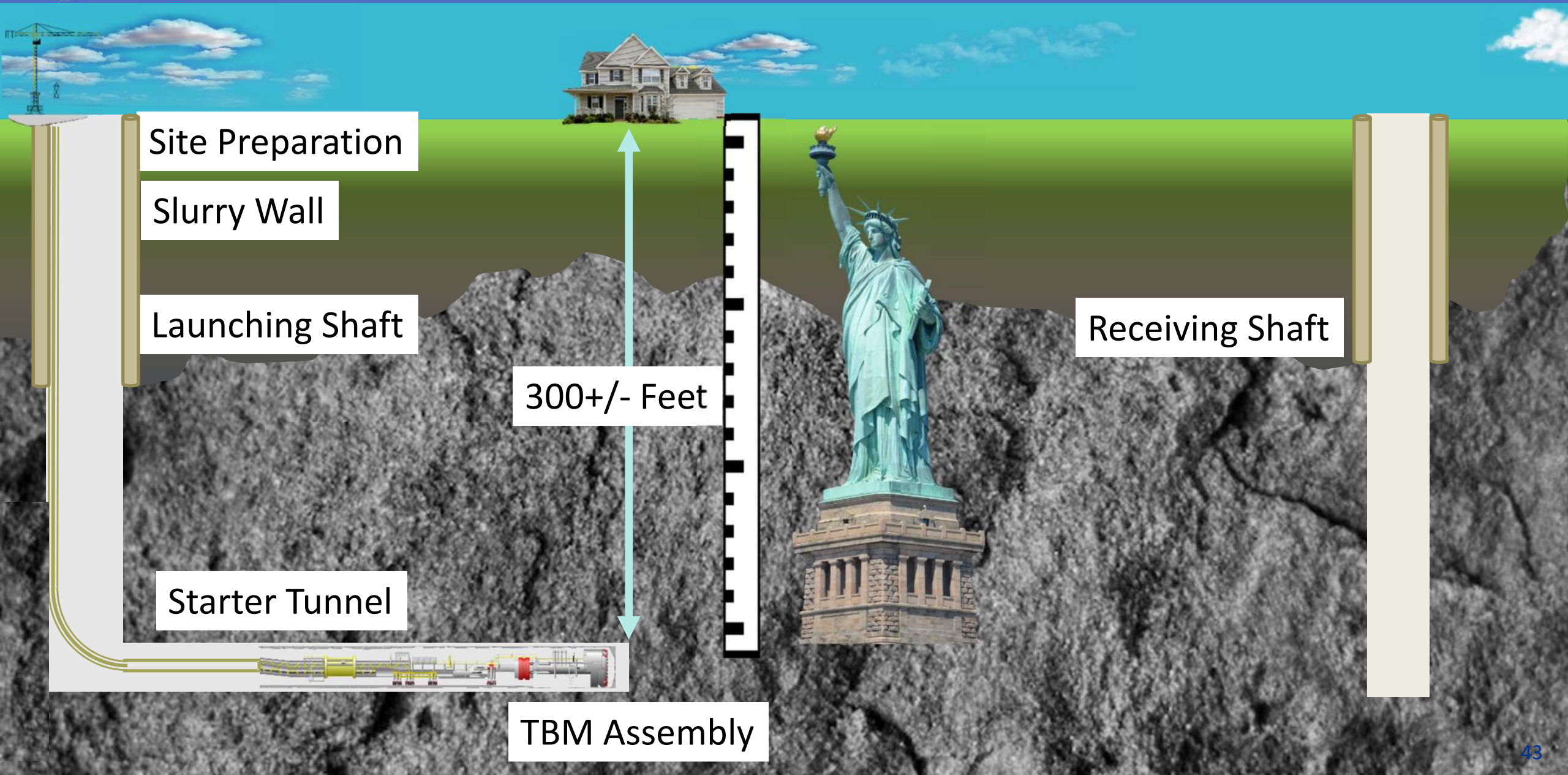
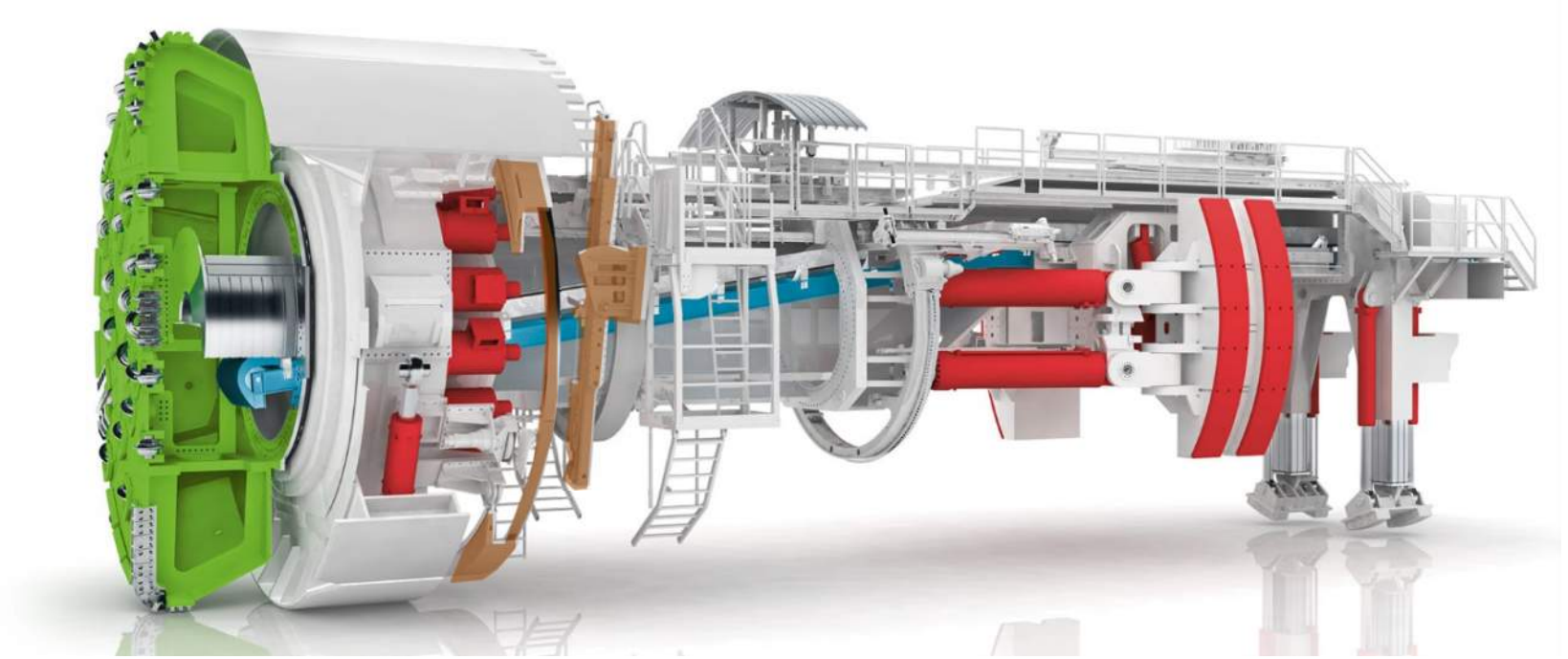
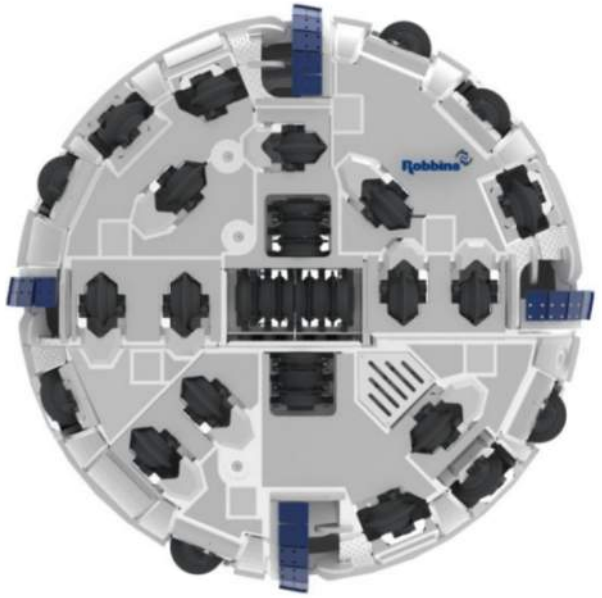
Tunnel Construction



Tunnel Boring Machine

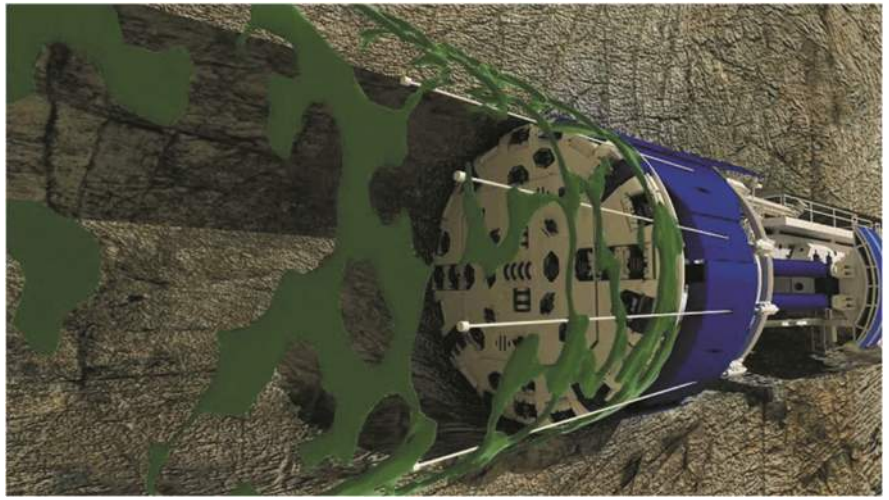


Source: www.herrenknecht.com

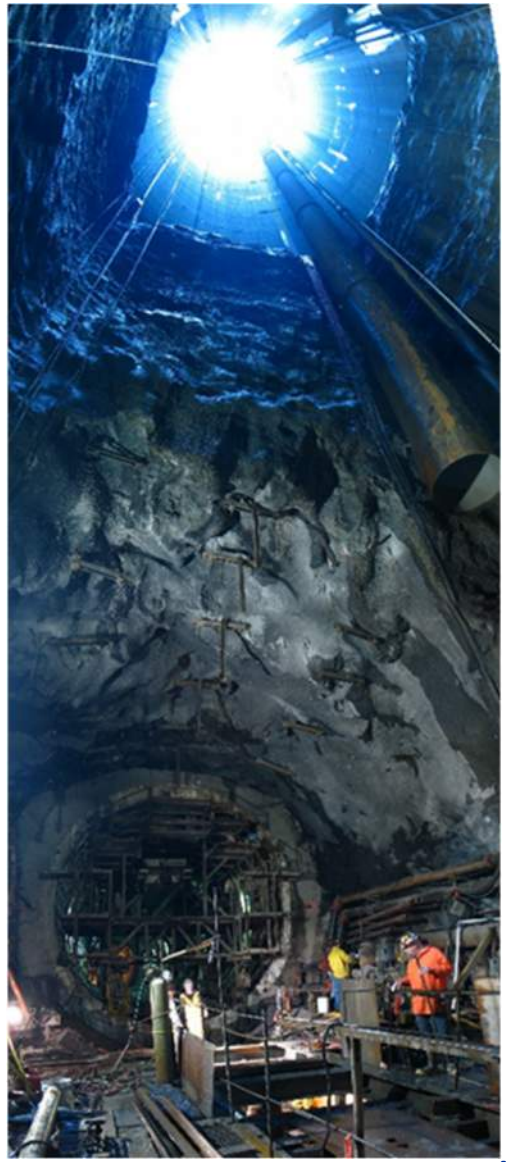


Source: www.robbins.com

- Cutterhead grinds the bedrock into small pieces
- Conveyors move the broken rock to the back of the TBM
- Self propelled grippers push to side of tunnel, jacks propel forward
- Bedrock is self supporting or supported with rib (rib erector), rock bolts (rock drill), and shotcrete
- Probing and grouting is used to control groundwater



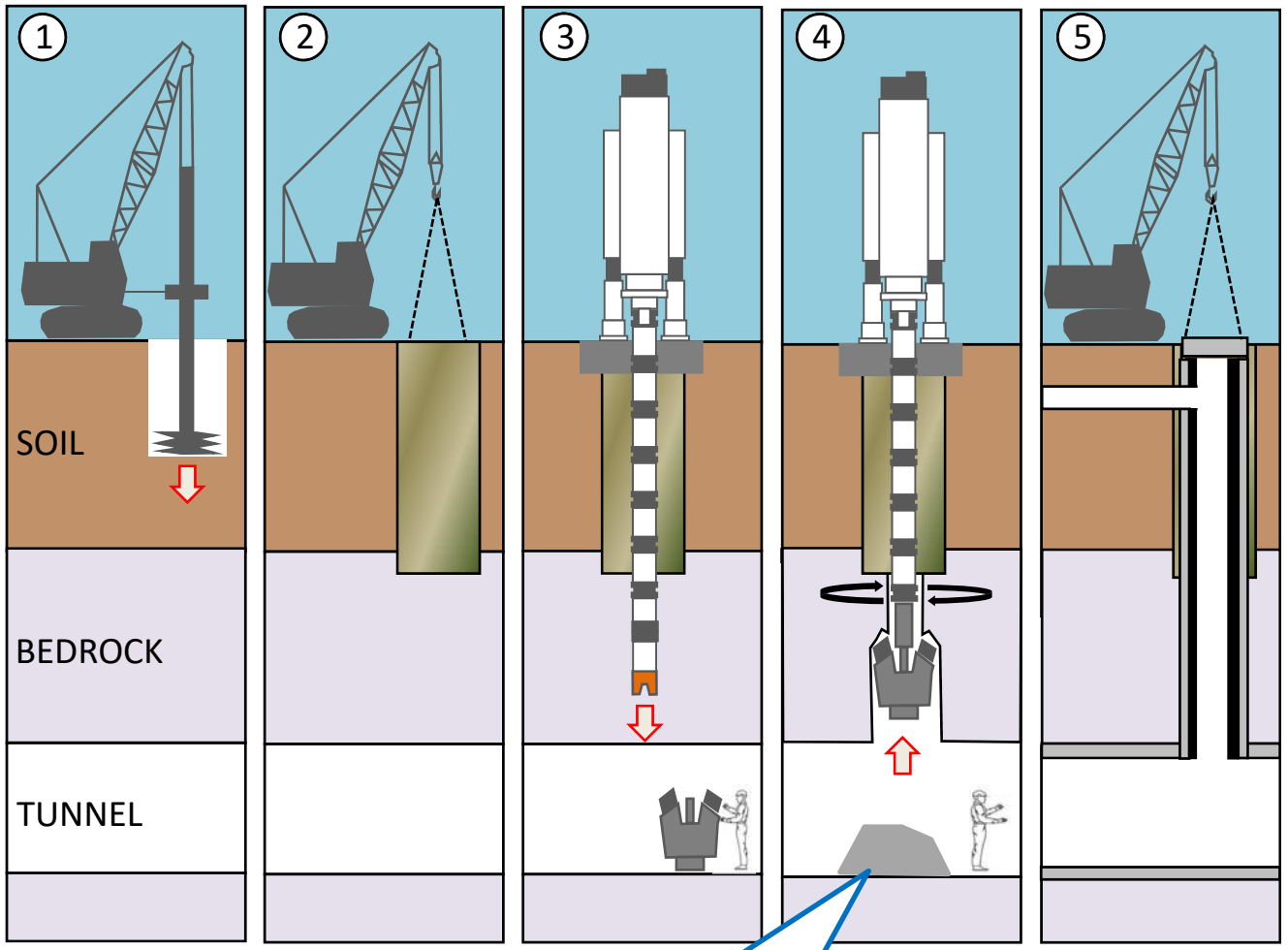
Launching / Receiving Shaft Construction



- ~25’ – 40’ diameter, ~250’ – 400’ deep
- Launching shaft is the only access to the tunnel until breakthrough into the receiving shaft
- Constructed by drill and blast methods
- “Cavern” at the bottom of launching shaft is where TBM will be assembled

Intermediate Shaft Construction

- Intermediate connection shafts are smaller diameter
- Use raised bore shaft construction method where possible
- Sequence of Construction (after tunnel has passed below):
  - (1) Auger drill through soil
  - (2) Install steel casing through soil
  - (3) Drill pilot hole in rock
  - (4) Ream larger hole in rock – **spoil drops into and is removed from the tunnel**
  - (5) Install shaft lining
- Benefits of Raised Bore Shaft Method:
  - Smallest footprint at the surface
  - Most excavate is removed from inside the tunnel which limits hauling from the site
  - No blasting
  - Not 24/7



Potential Permits and Approvals

Federal

- National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP)
- NPDES Dewatering and Remediation General Permit (DRGP), if needed
- Section 404 Department of the Army Permit (General and Preconstruction Notice)

Commonwealth of Massachusetts

- Massachusetts Environmental Policy Act (MEPA) Review
- Massachusetts Historical Commission (Massachusetts General Law Ch. 9, Section 26-27C)
- Highway Access/Construction Access Permits
- MBTA Right of Way Access License Agreement
- Natural Heritage Endangered Species Program
- Water Management Act Permit
- Chapter 91 Licenses
- Superseding Order of Conditions, upon appeal
- Section 401 Water Quality Certificate
- Distribution System Modification
- Land disposition/easements
- Article 97 Land Disposition Legislation

Municipal

- Wetlands Protection Act Order of Conditions
- Roadway Access Permits/Street Opening Permit
- Hydrant Permit
- Drainage Discharge Permit

Environmental and Community Impacts

Avoid, minimize, and mitigate impacts to the environmental and communities to the maximum extent practicable:

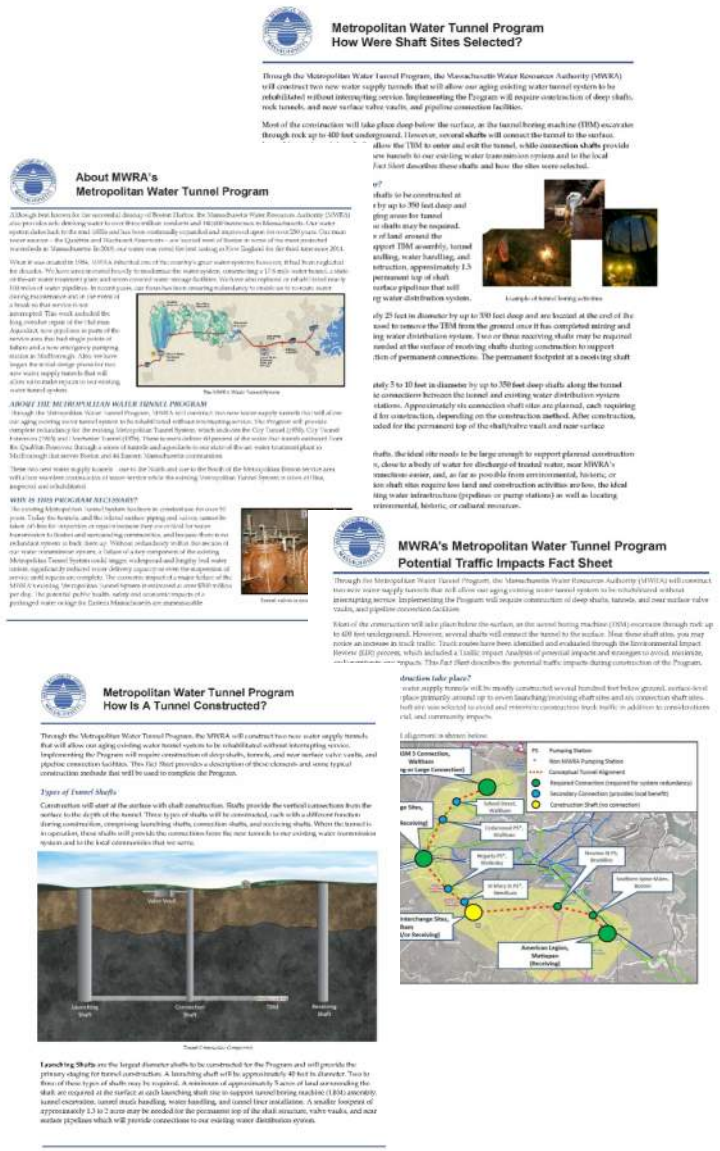
- Shaft site selection considered land use, traffic, noise, hauling routes, proximity to sensitive receptors, EJ communities, etc.
- Prioritized public land (MWRA, DCR, MassDOT) and communities that directly benefit from the Tunnel Program
- Construction methods selected to minimize impacts where possible (e.g., TBM, raise bore shaft construction method)
- Solicited stakeholder input throughout the process to help understand impacts and inform decisions
- Locating launching shaft sites along major highways and near receiving water was key to minimizing impacts
- Shaft sites selected should avoid the need for costly mitigations

Construction impacts are temporary

Redundant water supply is a long-term benefit

Community & Stakeholder Outreach

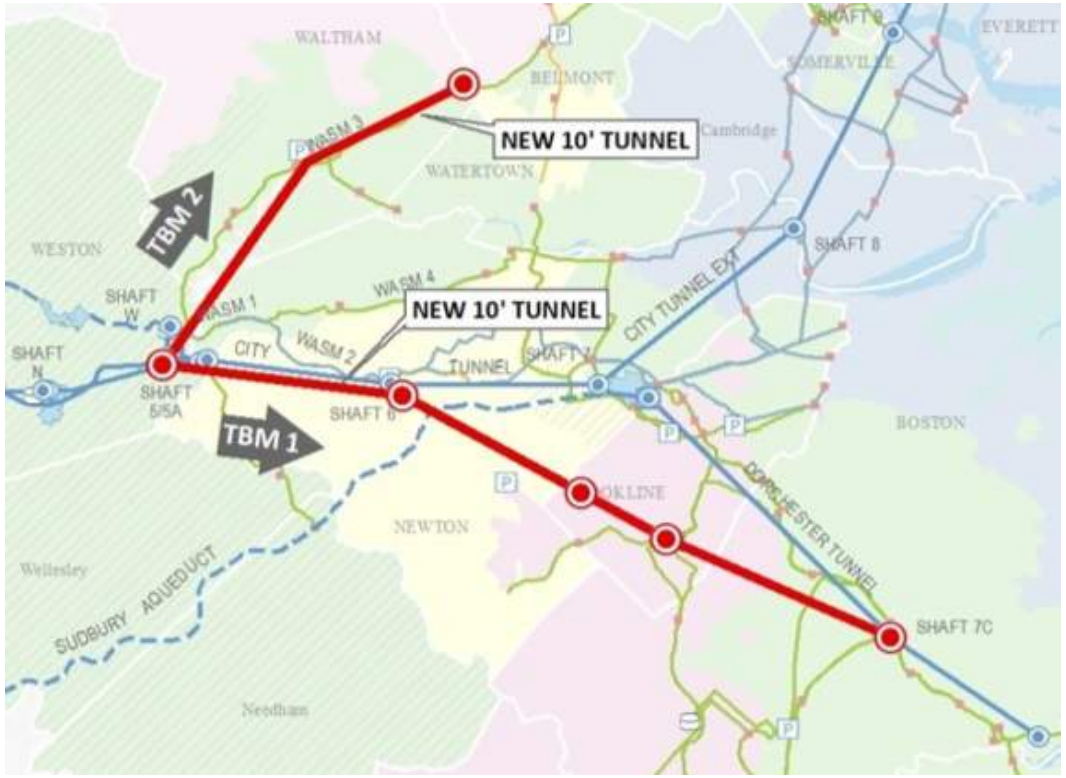
- Met with 10 communities in the study area
- Established a Working Group with representative from each community
- Numerous meetings with the 7 communities in which the tunnel will be constructed:
  - Town Management, Public Works, Public Safety/Fire, Conservation Commission, etc.
- Multiple meetings with key stakeholders and permit agencies:
  - EEA, DEP, MassDOT, DCR, DPH, DYS, UMass and DCAMM
- Met with numerous organizations, businesses & private property owners to coordinate field work
- Met with community interest groups
  - WLT, CRWA, neighborhood groups and others
- Established a Website https://www.mwra.com/mwtp.html and email address (for questions) Tunnels.info@mwra.com
- Created multiple Fact Sheets – available in 4 languages
- Outreach will continue throughout design and construction



Key Characteristics of the 2017 Two-Tunnel Concept Maintained

- Hard rock pressure tunnels
- Two separate tunnels:
  - One begins in Weston and ends in Waltham (North Tunnel)
  - One begins in Weston and ends in Mattapan (South Tunnel)
- TBM excavation with two pass construction method
- Set horizontal and vertical alignment to maximum unreinforced concrete liner, limit steel liner
- Probing and grouting to control ground water
- Buried top of shaft structures and valve vaults
- Meets goal of full redundancy

Key Changes Since 2017 Concept

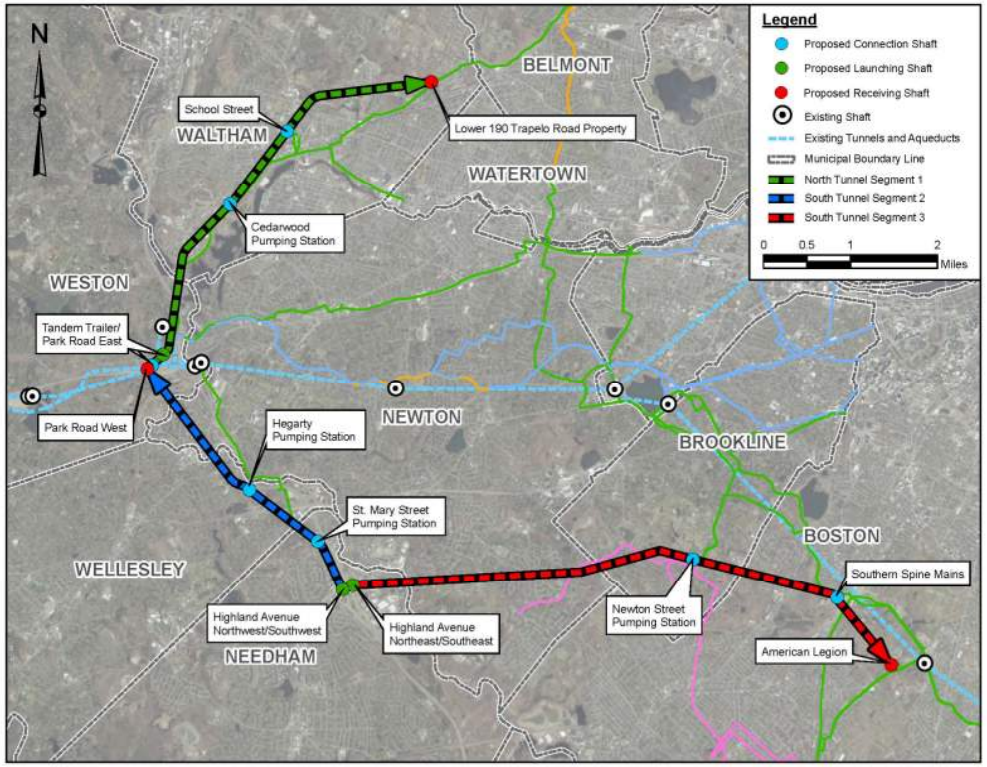


2017 (Two-Tunnel Concept):

- 14 miles, 2 segments, 2 TBM's
- Four intermediate shaft
- One double launching shaft site at I90/I95
- Two receiving shafts (Waltham & Mattapan)

2023 (Preliminary Design / FEIR):

- Accounts for land availability and environmental impacts
- Accounts for geologic conditions
- 15 miles, 3 segments, 2 or 3 TBM's
- Six intermediate shafts, 1 large connection shaft, 2 connector tunnels
- Two launching shaft sites at Highland Ave, one at I90/I95
- Three receiving shafts (Waltham, I90/I95, Mattapan)



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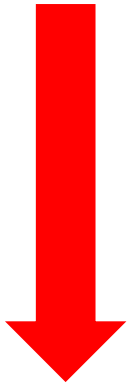
2017 Two-Tunnel Concept vs. 2023 Preliminary Design/FEIR

- Benefits of 2023 Configuration:
  - Improves construction packaging
  - Reduces construction schedule
  - Reduces construction contract interfaces
  - Reduces risks
  - Improves community supply resilience
  - Provides added long-term operations capability
- Accounts for land availability
- Accounts for geologic conditions
- Avoids/minimizes/mitigates environmental and community impacts, to the extent practical
- Prioritizes construction sequence to match largest need for redundancy (South Tunnel first)
- Establishes construction contract packaging that should promote good competition
- Constructible tunnel system that will meet redundancy goals

Tunnel Program Look Ahead

Critical Path Tasks

- Geotechnical Investigations (Core Storage Tour)
- Land Acquisitions
- Community/Stakeholder Agreements (MOU's)
- TBM Power Supply

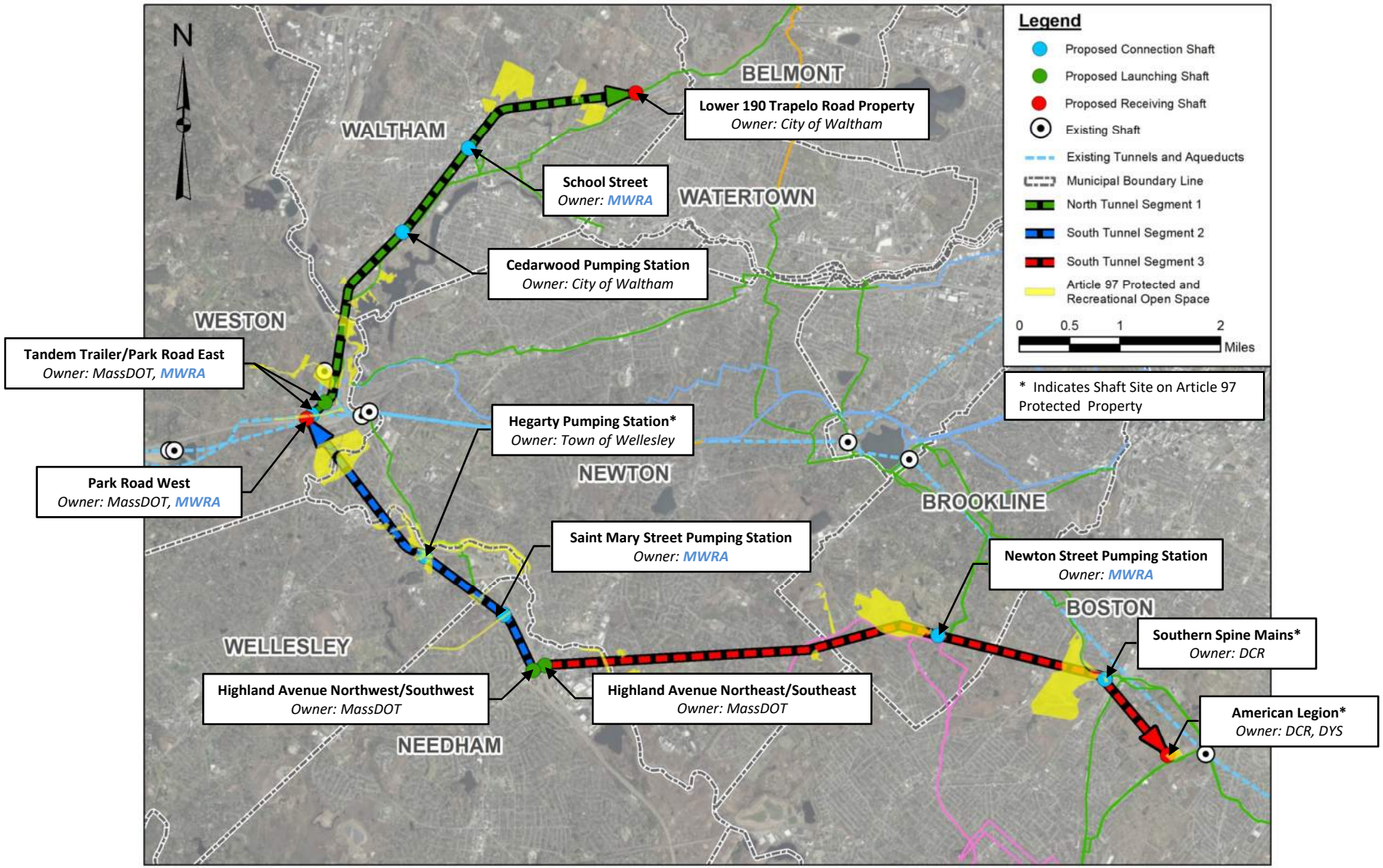


- Tunnel Construction

Land Acquisitions

- 13 shaft sites -
  - Larger temporary staging area and smaller permanent facility footprint
  - MWRA owns 3 shaft sites & has partial control of 2 shaft sites already
- Pipeline easements - ~6,000 ft
- Permanent surface access easements - ~9 sites
- Subterranean easements - ~600 individual properties
- ~3.8 acres of land for permanent facilities will require Article 97 legislation
- Land purchases/easements will be based on appraised value and negotiations
- Own in fee (most sites) or permanent easement (MassDOT)
- Land acquisitions will require MWRA Board approval

Land Acquisitions & Article 97 Properties



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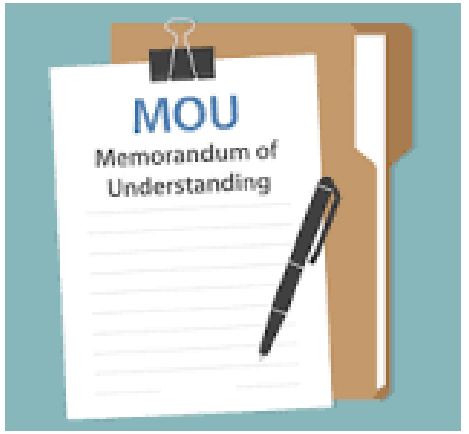
Community/Stakeholder Agreements (MOU's)

Topics may include:

- Land acquisitions
- Permitting and local regulations
- Public safety and emergency response
- Water supply contingency
- Work hours, hauling hours and routes, traffic management
- Dust and noise control, blasting and vibration control
- Connections to community water systems
- Mitigations and final site conditions (fencing, lighting, landscaping, etc.)



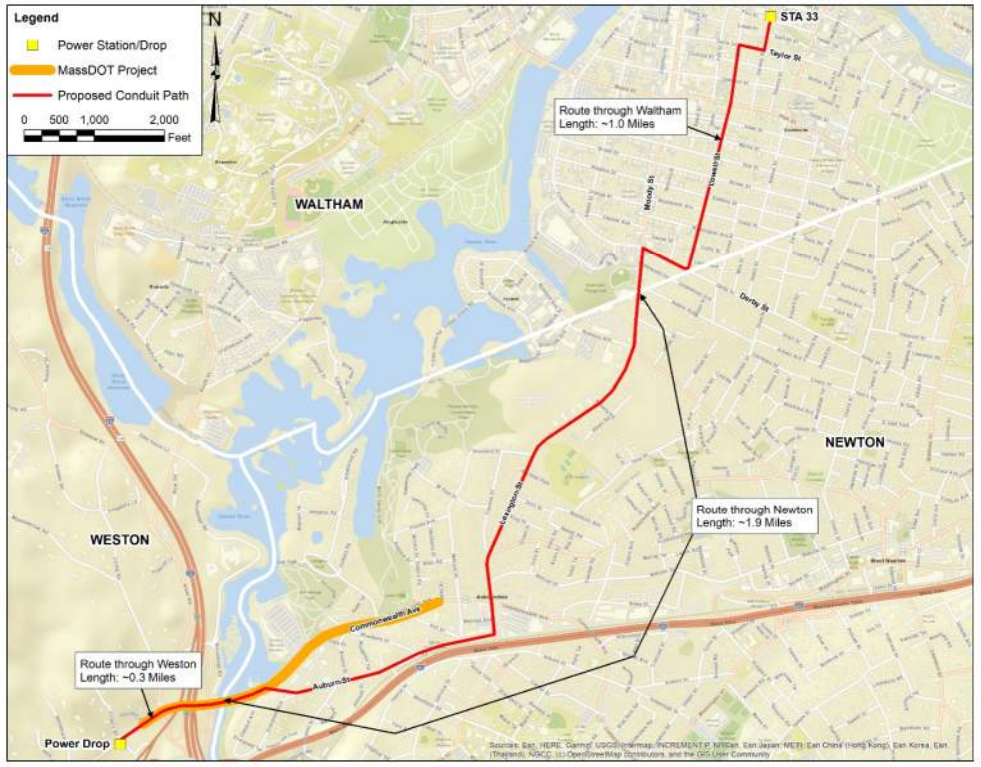
- Expect to execute MOU's with 7 communities (Waltham, Weston, Wellesley, Needham, Newton, Brookline & Boston)
- Expect to have agreements/MOU's (or similar) with DCR, MassDOT, and DYS related to land acquisitions
- All MOU's will be presented to the Board for approval

Emergency Response

- Shafts in six (6) communities, tunnel alignment beneath seven (7) communities
- Advance coordination to ensure coordinated emergency response during construction
- Staff have had three (3) meetings with community Emergency Responders:
  - Uniqueness of the underground construction environment and its hazards
  - Anticipated role and responsibilities of the MWRA tunnel contractors and community Emergency Responders
    - Tunnel Contractors to provide all OSHA required tunnel rescue resources (2 teams)
    - Community Emergency Responders assume incident commend on the surface and, if needed, support underground for extrication and medical care
  - Training and equipment needed by the community Emergency Responders throughout tunnel construction

- Emergency response coordination needs to be tailored to the supporting communities' capabilities and size
- MWRA resources will be needed to ready the community Emergency Responders
- MOU's between MWRA and each community will include emergency response support

TBM Power Supply

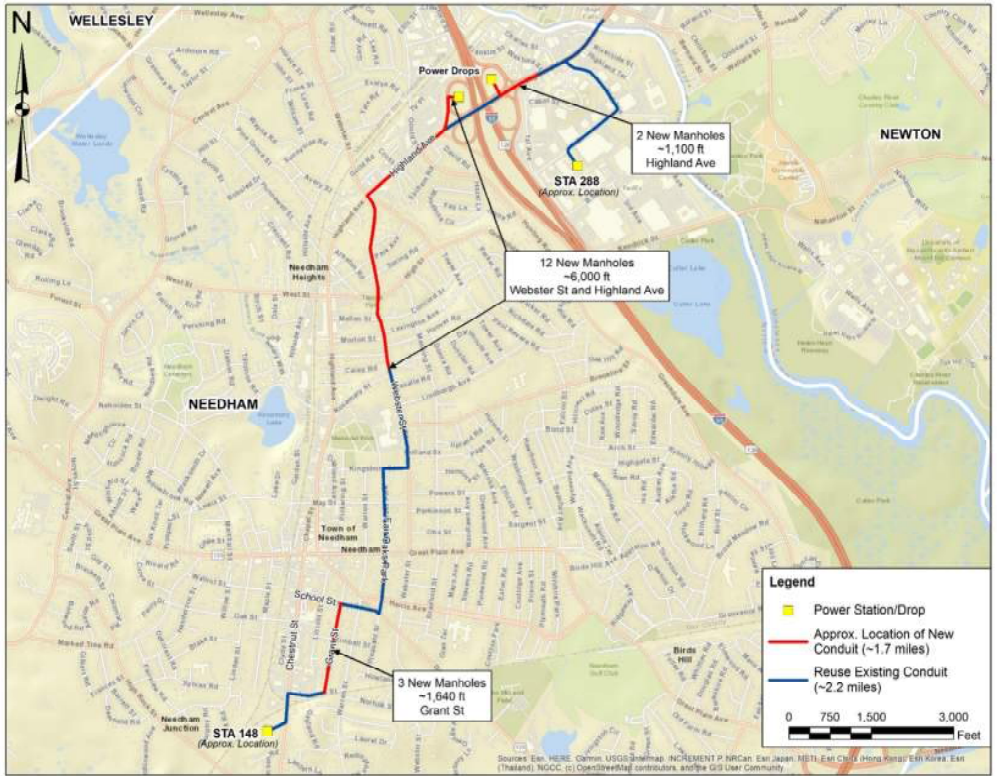


I90/I95 – Tandem Trailer Launching Shaft Site:

- ~3.2 miles of new duct bank & cable
- Coordinating with ongoing MassDOT project along Route 30
- Through Waltham, Newton & Weston

Highland Ave Launching Shaft Sites:

- ~1.7 miles of new duct bank & cable
- ~2.2 miles of reused duct bank & cable
- All within Needham



Eversource will design and install all new duct bank & cable

MWRA and Eversource will enter into an agreement addressing completion schedule and compensation, subject to Board approval

Power supply will remain and provide added resilience to the power grid

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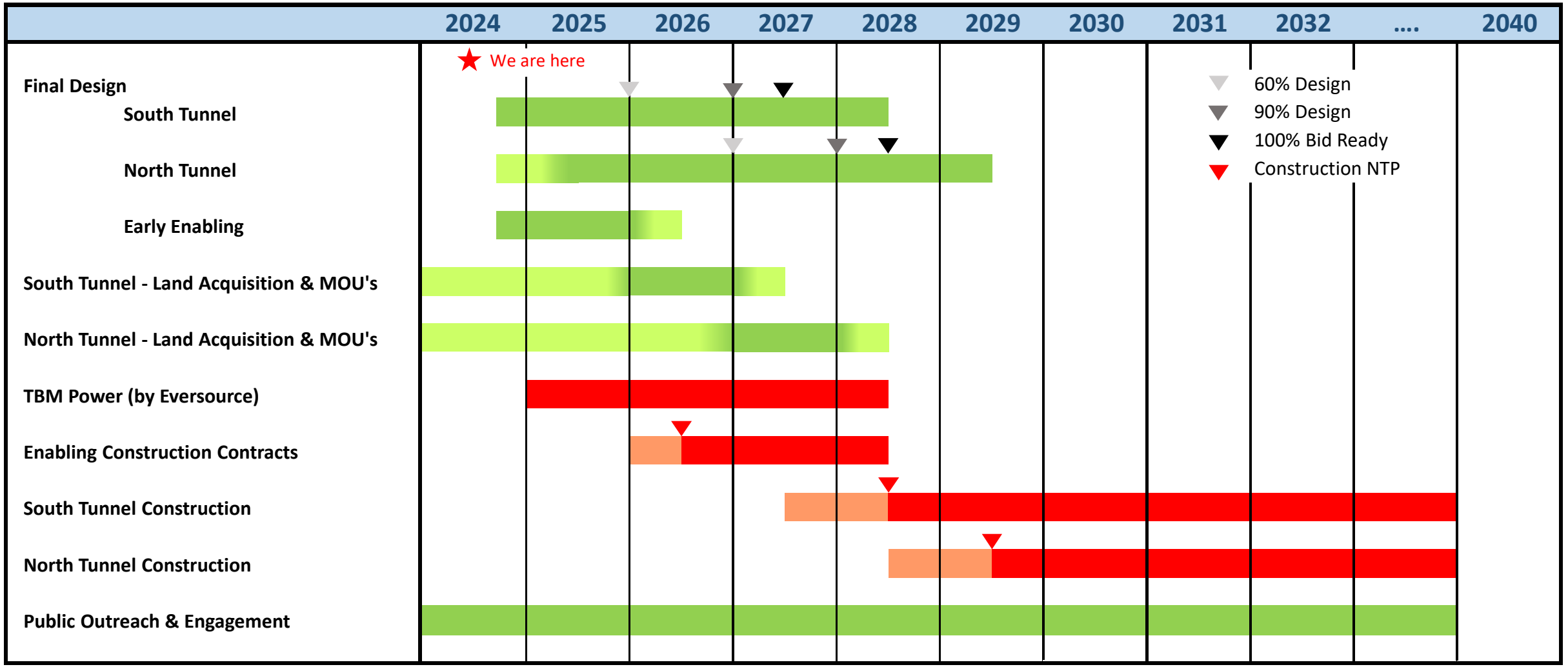
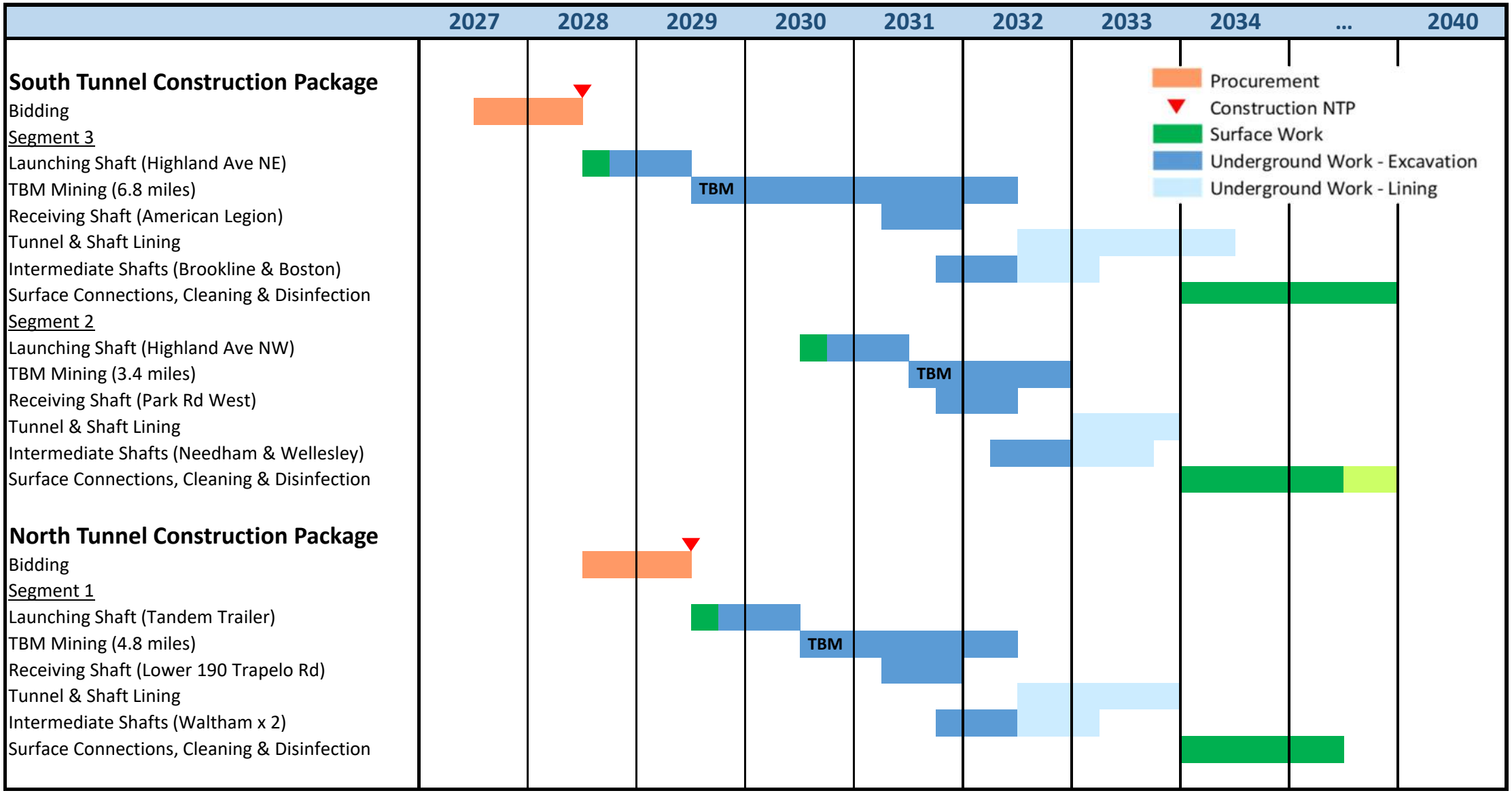
Tunnel Program - Critical Path Schedule



Tunnel System – Construction Schedule Look Ahead



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Break