

STAFF SUMMARY

TO: Board of Directors
FROM: Frederick A. Laskey, Executive Director
DATE: April 17, 2019
SUBJECT: Metropolitan Tunnel Redundancy Program
Update on Tunnel Hydraulics and Program Support Services Consultant Key Personnel, Contract 7655



COMMITTEE: Water Policy and Oversight

X INFORMATION
 VOTE

Frederick O. Brandon, P.E., Director, Design and Construction
Preparer/Title

Kathleen M. Murtagh, P.E.
Director, Tunnel Redundancy

At the Board of Directors meeting on March 20, 2019, the Board requested a description of the hydraulics for the proposed Metropolitan Redundant Tunnel System and information on the organization and key personnel for the Program Support Services consultant.

RECOMMENDATION:

For information only.

DISCUSSION:

Hydraulics of Proposed Metropolitan Redundant Tunnel System

The proposed Redundant Tunnel System consists of two deep rock tunnels beginning in the vicinity of the MassPike/Route 128 interchange (see Attachment 1). The Northern Tunnel would be approximately 4.5 miles in length and would connect to the mid-point of MWRA's WASM 3 pipeline. The Southern Tunnel would be approximately 9.5 miles in length and would connect to the southern surface mains at Shaft 7C of the Dorchester Tunnel.

The proposed tunnel system will be designed to supply high day demands to the metropolitan Boston area with the existing Metropolitan Tunnel System (City Tunnel, City Tunnel Extension and Dorchester Tunnel) offline. The new tunnel system will enable the Authority to shut down all or portions of the existing tunnel system for maintenance or in an emergency at any time during the year with no interruption of service to customer communities.

The historic high day water use in the metropolitan area is 265 million gallons per day (mgd). More than 60 percent of this flow is currently supplied through the metropolitan tunnel system. The remaining flow is supplied through surface pipelines. In the future, with the existing metropolitan tunnel system shut down, the proposed redundant tunnel system will carry approximately 60 percent of the metropolitan area flow. The remaining flow will be carried by existing surface pipelines.

The hydraulic concept of the proposed redundant tunnel system is described below. Attachment 1 illustrates the flow of water through the proposed redundant tunnel and the existing distribution system with the Metropolitan Tunnel system off line. Attachments 2 and 3 illustrate the hydraulic grade line of the proposed tunnel system with the Metropolitan Tunnel system offline. Staff will provide a detailed presentation of the system hydraulics at the Board meeting.

Staff have begun to update the hydraulic model of the water system that was used to develop the proposed tunnel concept to include currently planned distribution system improvements, and the latest population and employment projections for the service area through the year 2040, as well as available longer term projections. Staff also plan to evaluate other longer term water use scenarios such as potential system expansion and the effect of drought or emergency conditions on local water supplies that are operated by MWRA partial users. While staff have found that recent increases in population and employment in the service area have not increased overall water use due to improved water use efficiency, the new tunnel will have a life span of over 100 years. The results of this evaluation will be used to confirm the size and configuration of the proposed redundant tunnel system and ensure that the new tunnel is either designed to accommodate future potential demands or that a plan is in place to address potential future water use.

The following describes the current status of the hydraulic analysis:

Proposed Northern Tunnel. The proposed Northern Tunnel will begin in the vicinity of the MassPike/Route 128 interchange near Shaft 5 of the City Tunnel and will run approximately 4.5 miles to the north and will connect to the mid-point of MWRA's Weston Aqueduct Supply Main (WASM) 3 pipeline near the Waltham/Belmont border. This tunnel will include an intermediate connection for the Lexington Street Pump Station, which supplies the City of Waltham. With the existing tunnel out of service, the north side of the metropolitan area including Waltham will be supplied through a combination of the proposed Northern Tunnel and existing surface mains. The proposed Northern Tunnel will convey flow from the Hultman Aqueduct and MetroWest Water Supply Tunnel to the WASM 3 pipeline near the Waltham/Belmont border. The WASM 3 pipeline will carry the flow from the new tunnel to the Medford area where it will supply the Northern Low service area through a pressure reducing valve. The Low Service system will convey flow to the Gillis Pumping station in Stoneham, which will pump to the Northern High Service area. Water supply to the Northern Intermediate High system will be supplied from the Spot Pond Pumping station, which will also pump out of the Northern Low system.

Proposed Southern Tunnel. The proposed Southern Tunnel will also begin in the vicinity of the MassPike/Route 128 interchange near Shaft 5 of the City Tunnel and will run approximately 9.5 miles to the south and will connect to the southern spine surface mains at Shaft 7C of the Dorchester Tunnel. With the existing tunnel out of service, the south side of the metropolitan area will be supplied through the Southern Tunnel. This tunnel will include connections to: Section 80, which supplies Needham and Wellesley; the pump stations that supply the Southern Extra High service area (Newton Street and Hyde Park pump stations); and connections to the Southern High service area.

Program Support Services Consultant Organization and Key Personnel

The Board approved the award of Contract No. 7655, Program Support Services for the Metropolitan Tunnel Redundancy Program to JCK Underground, Inc. in March 2019. The purpose of this contract is to assist Tunnel Redundancy Department staff with program-wide activities such as risk management planning, quality management, design criteria and standardization, document management and controls, design and construction package planning, independent technical reviews, field investigation procedures, rock core storage, critical path scheduling, and budget planning.

The selected consultant team consists of senior professionals with significant experience in tunneling and complex underground construction. Key personnel include technical experts in the areas of program management, rock tunneling, geotechnical engineering, structural engineering, risk management/mitigation and cost estimating/scheduling with experience in the planning, design, and construction on similar complex rock tunneling and underground projects including mega projects (greater than \$1.0 billion).

The following is a list of the key personnel on the JCK Underground team with a brief summary of their relevant experience and qualifications. Representatives from JCK Underground will be in attendance at the Board meeting. Most of the key personnel have master's degrees in their respective fields and are registered professional engineers. The project organization chart and full resumes for each of the key personnel are attached.

Rafael Castro, PE, JCK Underground, Inc., Project Director - Mr. Castro has 30 years of tunneling and geotechnical experience, with more than 25 years dedicated to PM/CM for large complex water and wastewater infrastructure involving tunnel systems. His background includes both traditional and alternative contract delivery and all phases of project development from planning to commissioning. He has a thorough understanding of geotechnical engineering, mechanized tunnel excavation (soft ground and rock, small and large diameter), deep excavations and ground improvement. Mr. Castro will provide oversight to Program Support Services activity, mitigate risks through appropriate contractual language and furnish the MWRA Tunnel Redundancy Department with advice.

Joel Kantola, PE, JCK Underground, Inc., Project Manager - Mr. Kantola has 30 years of tunneling and geotechnical experience, including over 27 years on large, complex infrastructure projects with 25 years on tunnel systems. On the MWRA Braintree-Weymouth Tunnels and Shafts project, he was included in the design team due to his invaluable knowledge gained on the Construction Management team for the Boston Harbor Project. He then returned to construct the project as the contractor's project and geologic engineer, remaining on the job until close-out. Mr. Kantola's experience on large infrastructure programs includes leadership roles on the Construction Management team for both the \$14B Central Artery Project and the \$3.5B Boston Harbor Project. Mr. Kantola will manage all Program Support Services activity.

Jennifer Jordan, PE, JCK Underground, Inc., Geotechnical Engineer - Ms. Jordan has 25 years of experience in geotechnical and tunnel engineering, with over 17 years of experience related to large complex water and wastewater infrastructure including MWRA's MetroWest Water Supply Tunnel. Ms. Jordan will incorporate lessons learned from other large tunnel

programs into geotechnical standards and data management for the MWRA's Metropolitan Tunnel Redundancy Program.

Rosa Castro-Krawiec, PE, JCK Underground, Inc., Structural Engineer - Ms. Castro-Krawiec has 34 years of experience in structural engineering, with over 24 years on complex underground infrastructure projects and 15 years on water/wastewater projects. Her expertise includes design of shafts and underground structures in both soft ground and rock, and tunnel design for water/wastewater and other infrastructure projects. Ms. Castro-Krawiec will assist with development of design criteria for the MWRA Metropolitan Tunnel Redundancy Program and will review Design Engineer submittals.

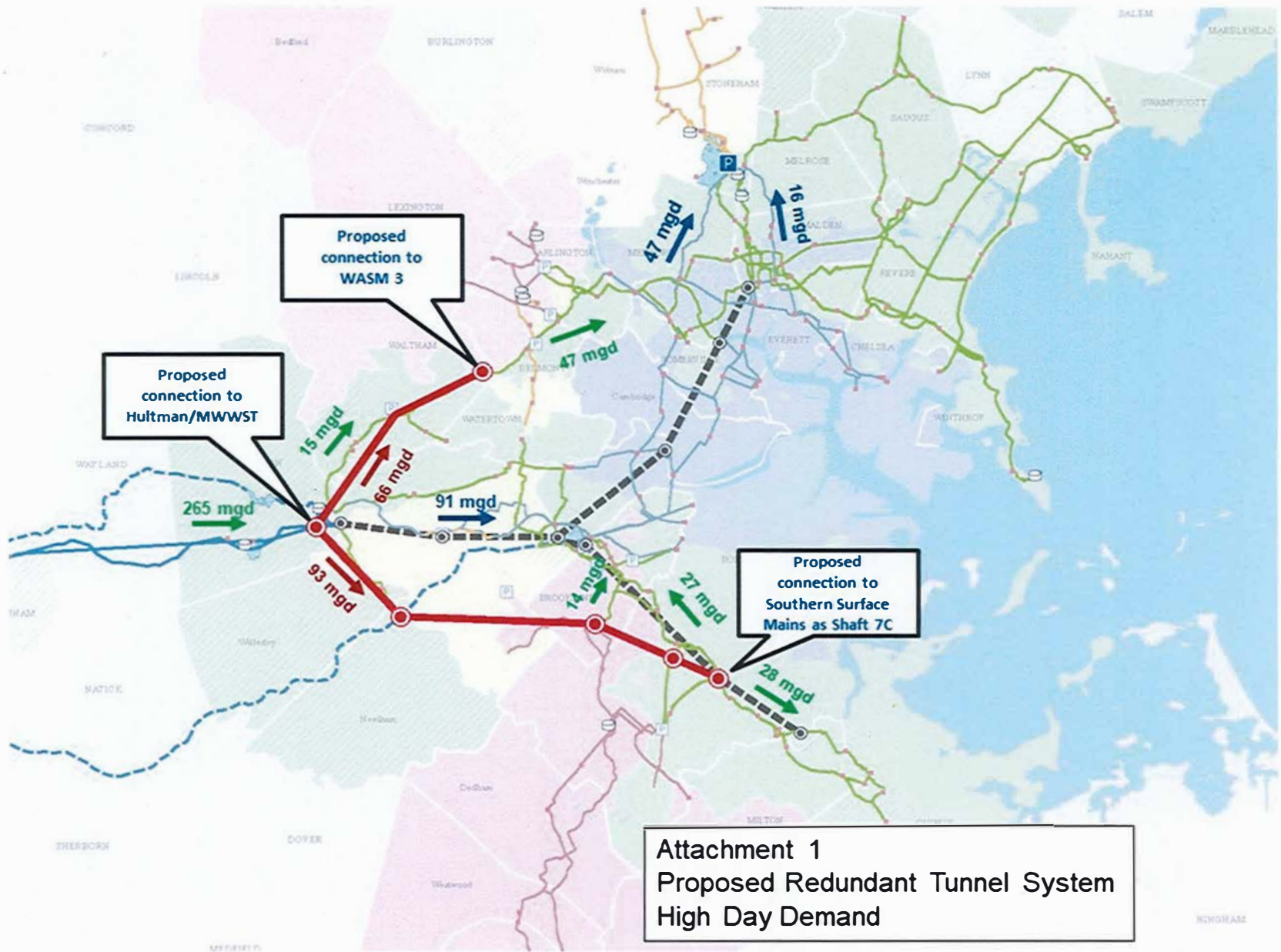
Robert Goodfellow, PE, Aldea Services, Inc., Rock Tunnel Engineer - Mr. Goodfellow has 27 years of tunneling and geotechnical experience, with over 16 years on deep rock pressure tunnels for water and wastewater systems. He has led the design and construction of numerous pressurized rock tunnel system projects in New York, Washington DC, Texas and Ohio. His experience extends to all types of tunneling, leakage control & waterproofing, instrumentation, and rehabilitation of underground structures. He is also a recognized industry-leader in risk management. Mr. Goodfellow will bring his experience in rock tunnel design to help mitigate risk on the MWRA Tunnel Redundancy Program.

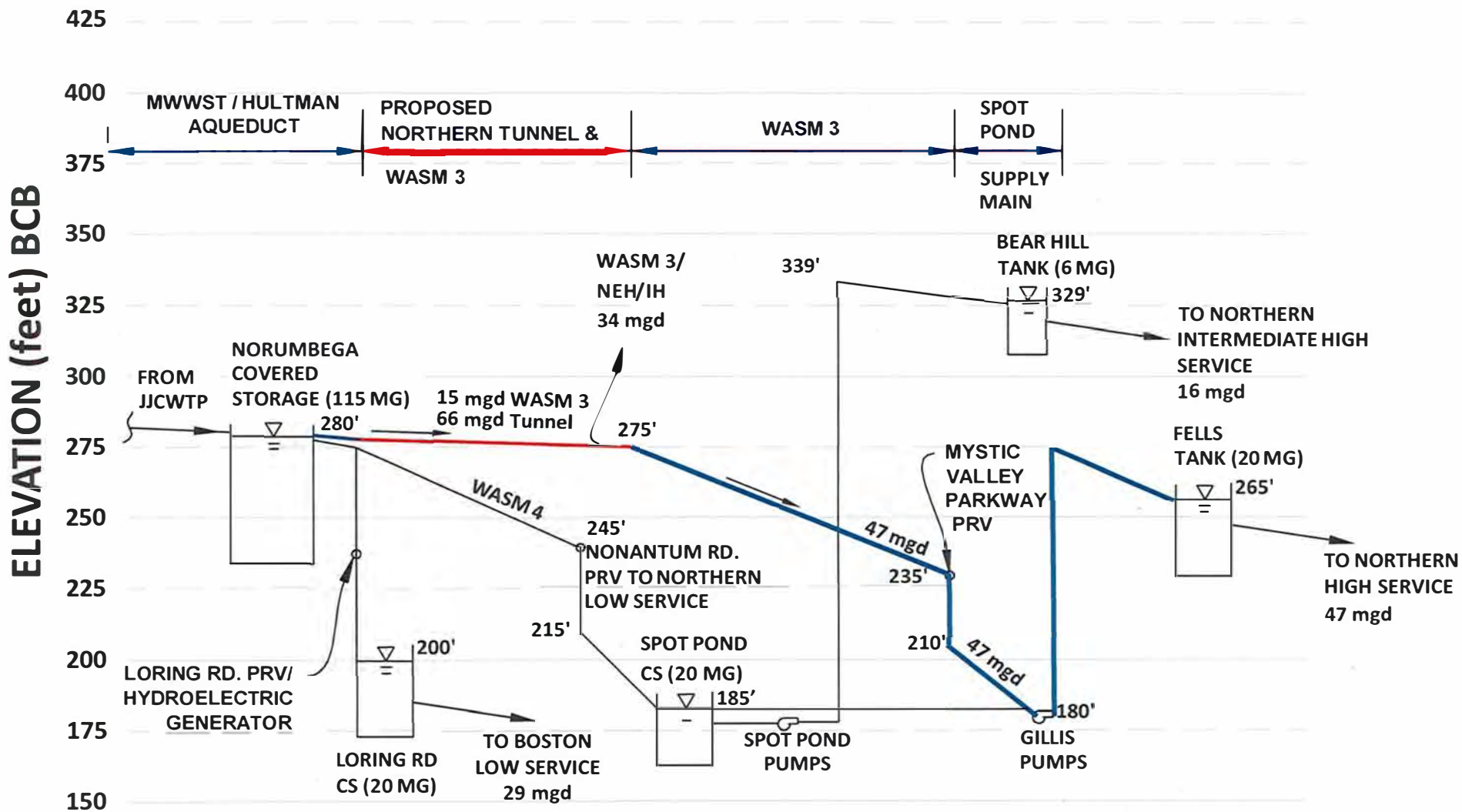
Adam Wirthlin, PE, Wirthlin Consulting Group, LLC, Construction Estimator Mr. Wirthlin has 19 years of experience in construction and design, with 17 years estimating and scheduling large complex water and wastewater infrastructure projects with significant tunnel components. Having worked for both contractors and engineers, his estimating skills are versatile and have been used to estimate projects including tunnels, shafts, trenchless construction, underground utilities, pipelines, ground improvement, sitework, and mechanical/Electrical/Plumbing. Mr. Wirthlin's estimating experience and knowledge base will be used to predict and control construction cost on the MWRA's Metropolitan Tunnel Redundancy Program.

Wayne Beauregard, PSP, PMA Consultants, LLC, Construction Scheduler Mr. Beauregard has 40 years of experience in cost and schedule management with over 15 years of experience on complex billion dollar and multi-million-dollar water/wastewater infrastructure projects. He has extensive expertise in the development, implementation, and updating of schedules using leading industry software. Mr. Beauregard will provide program level schedule support, oversee all schedule related efforts and provide the MWRA with timely schedule information to facilitate decision making to advance the program.

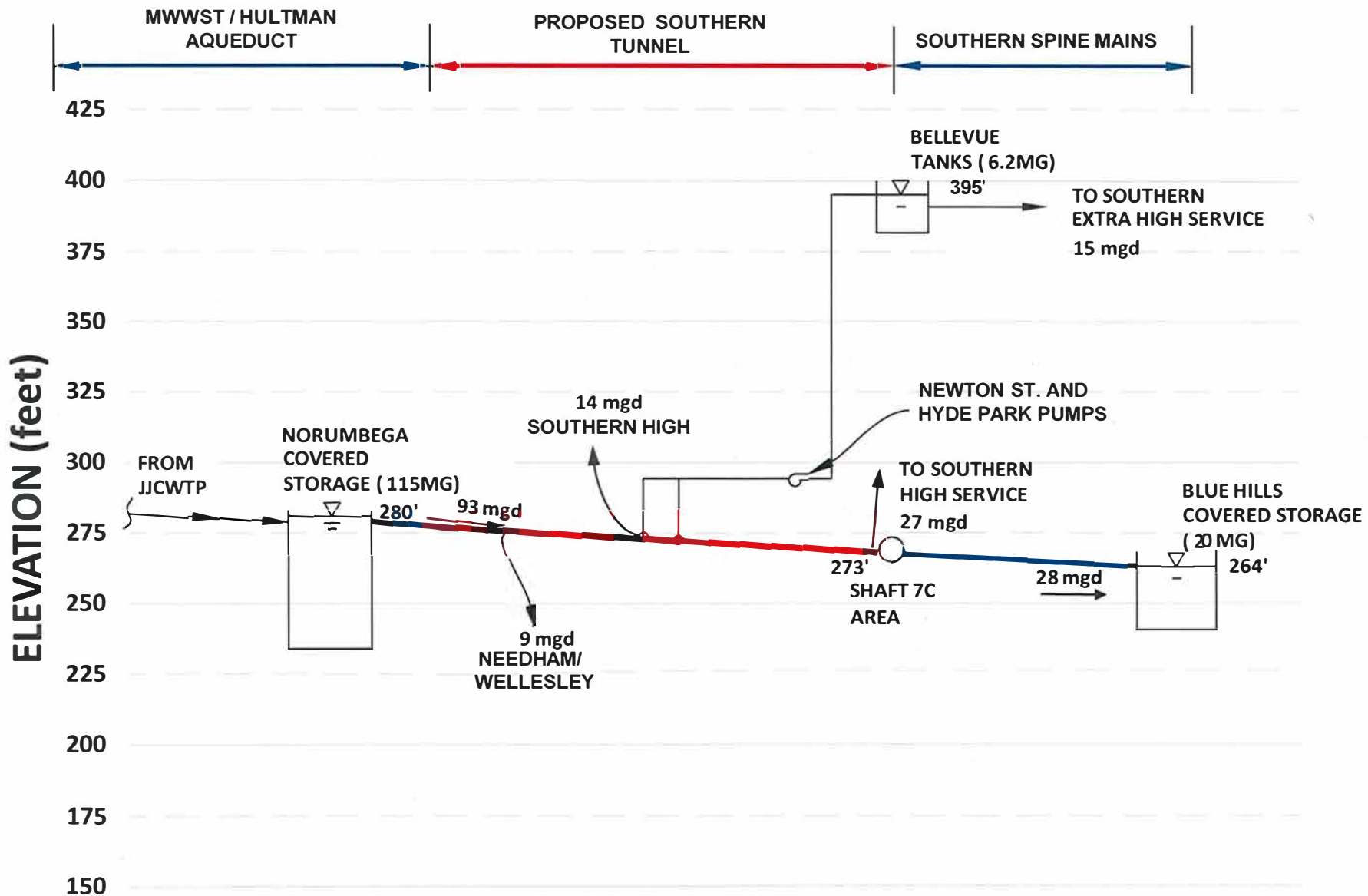
ATTACHMENTS:

- Attachment 1 - Proposed Redundant Tunnel System - High Day Demand
- Attachment 2 - Hydraulic Profile - Proposed Northern Tunnel
- Attachment 3 - Hydraulic Profile - Proposed Southern Tunnel
- Attachment 4 - JCK Underground Team, Organization Chart - Key Personnel
- Attachment 5 - JCK Team - Key Personnel





ATTACHMENT 2
HYDRAULIC PROFILE
METROPOLITAN TUNNEL REDUNDANCY
PROPOSED NORTHERN TUNNEL

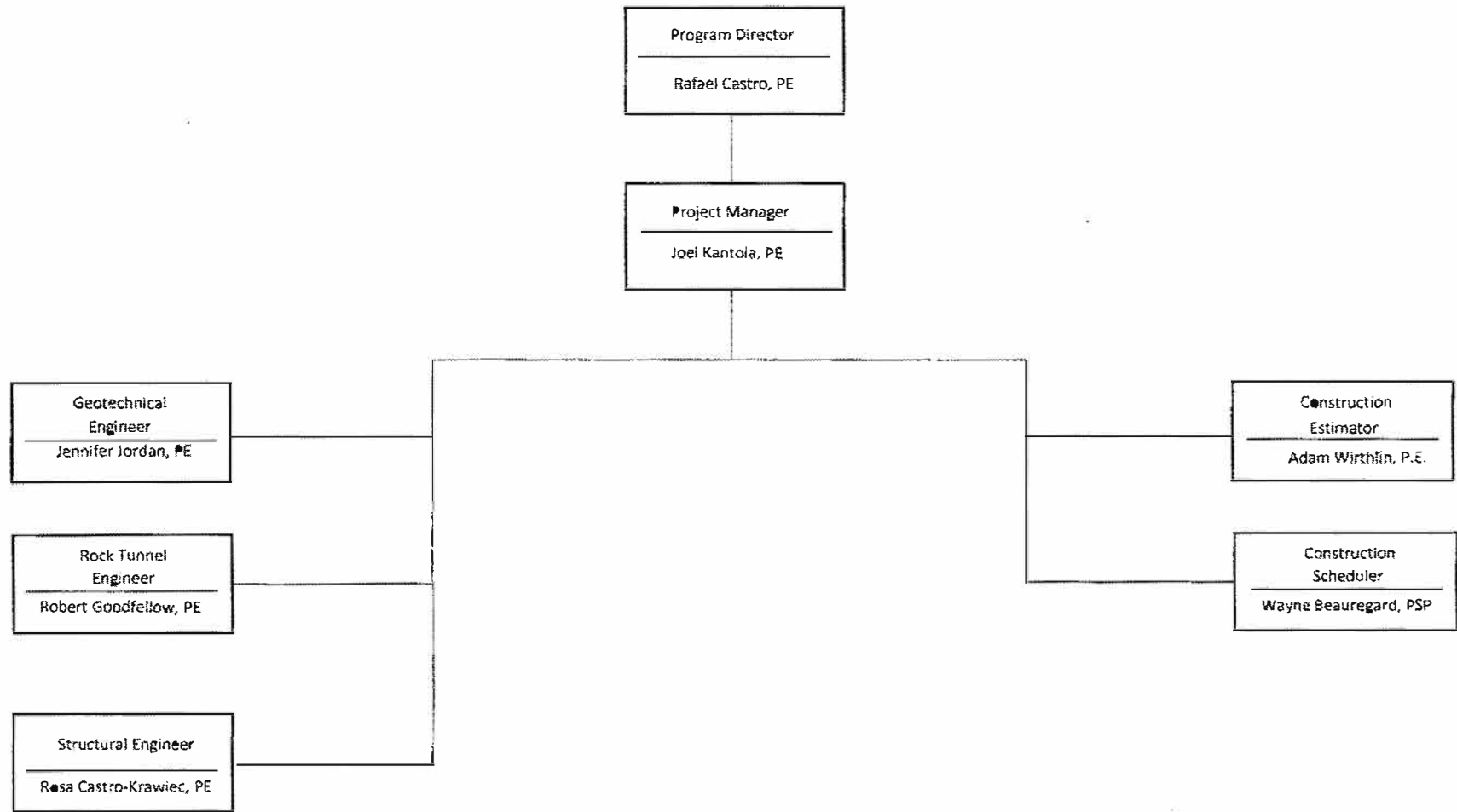


ATTACHMENT 3
HYDRAULIC PROFILE
METROPOLITAN TUNNEL REDUNDANCY
PROPOSED SOUTHERN TUNNEL

JCK Underground Team
Program Support Services Consultant
for the
Metropolitan Tunnel Redundancy Program

Organizational Chart - Key Personnel

April 17, 2019



Attachment 4

JCK Team -Key Personnel

Rafael Castro, PE, Project Director



Mr. Castro has 30 years of tunneling and geotechnical experience, with more than 25 years dedicated to PM/CM for large complex water and wastewater infrastructure involving tunnel systems. Using traditional and alternative contract delivery, his diverse background

includes all phases of project development from planning to commissioning. He has a thorough understanding of geotechnical engineering, mechanized tunnel excavation (soft ground & rock, small & large diameter), deep excavations and ground improvement. From this diverse knowledge base, he provides his clients with practical, proven approaches to manage technical and commercial risks. Having spent more than a decade in leadership roles in the Program Consultant Organization for the \$2.7B District of Columbia Clean Rivers (DCCR) project he has become a trusted advisor to DCCR's executive team. He also participates on advisory boards providing high level technical, commercial and procurement consultation to the Virginia Department of Transportation (VDOT) \$3.2B Hampton Roads Bridge and Tunnel (HRBT) project and the Alexandria Renew Enterprises (AlexRenew) \$345 M RiverRenew CSO tunnel project. Mr. Castro will provide oversight to PSS activity, mitigate risks through appropriate contractual language and furnish the Department with sage advice.

Jennifer Jordan, PE, Geotechnical Engineer



Ms. Jordan has 25 years of experience in geotechnical and tunnel engineering, with over 17 years experience related to large complex water and wastewater infrastructure including NBC's \$1.4B CSO Program, the \$2.7B DCCR program, and ALCOSAN's \$3.6B Program. Having

planned and executed investigations for deep rock tunnels at NBC, Allegheny County Sanitary Authority (ALCOSAN) and MetroWest Water Supply Tunnel (MWWST), she is currently responsible for geotechnical investigations and engineering at the RiverRenew CSO Program in Alexandria VA. Ms. Jordan will incorporate lessons learned from ALCOSAN and RiverRenew into geotechnical standards and data management for the MTRP.

Joel Kantola, PE, Project Manager



Mr. Kantola has 30 years of tunneling and geotechnical experience, including over 27 years on large, complex infrastructure projects with 25 years on tunnel systems. On the \$2.7B DCCR program he managed a large unified multi-firm team located in eight

regions across the country to plan, design, collaborate, procure, and award over \$1.2B in four major DB CSO tunnel contracts (three have been completed under budget and on time and the fourth is under construction). On the \$490 M Silicon Valley Clean Water (SVCW) project he has advised the owner throughout the collaborative Progressive DB Procurement process, which has successfully entered the "Final Design and Construction" stage. On the \$76M MWRA Braintree-Weymouth Tunnels and Shafts (BWTS) project, he was included in the design team due to his invaluable knowledge gained while building tunnels on the BHP. He then returned to construct the BWTS as the contractor's project and geologic engineer, remaining on the job until close-out. Mr. Kantola's experience on large infrastructure programs includes consulting for the Hong Kong Drainage Department, geotechnical engineer for the Comanche Peak Nuclear Power Plant as well as leadership roles on the CM team for both the \$14B Central Artery Project (CA/T) and the \$3.5B Boston Harbor Project (BHP). As well as making his technical insight available to the Department, Mr. Kantola will manage all PSS activity to build a unified team focused on MTRP goals.

Rosa Castro-Krawiec, PE, Structural Engineer



Ms. Castro-Krawiec has 34 years of experience in structural engineering, with over 24 years on complex underground infrastructure projects and 15 years on water/wastewater projects. She has worked on NBC's \$1.4B CSO Program,

the \$2.7B DCCR program, and the \$3.5B BHP. Her expertise includes design of shafts and underground structures in both soft ground and rock and tunnel design for water/wastewater and other infrastructure projects. Ms. Castro-Krawiec will bring her extensive experience in structural design of environmental facilities to assist with development of design criteria for the MTRP as well to the review of Design Engineer submittals.

Robert Goodfellow, PE, Rock Tunnel Engineer



Mr. Goodfellow has 27 years of tunneling and geotechnical experience, with over 16 years on deep, rock pressure tunnels for water and wastewater systems. He has led the design and construction of numerous pressurized rock tunnel system projects

in New York, District of Columbia (DC), Texas and Ohio. His experience extends to all types of tunneling, leakage control & waterproofing, instrumentation, and rehabilitation of underground structures. He is also a recognized industry-leader in risk management with leading roles on mega-projects such as the \$16.7B California Water Fix and the \$2B Alto Maipo, Chile. Mr. Goodfellow will bring his experience in rock tunnel design to help mitigate risk on most critical element of the MTRP.

Wayne Beauregard, PSP, Construction Scheduler



Mr. Beauregard has 40 years of experience in cost and schedule management with over 15 years of experience on complex billion dollar and multi-million-dollar water/wastewater infrastructure projects, including the \$3B Newtown Creek Water Pollution Control

Plant in New York and the \$130M Upper Blackstone Water Pollution Plant in Massachusetts. He has extensive expertise in the development, implementation, and updating of schedules using leading industry software. He has also provided claim support and delay and entitlement analysis for numerous projects. Mr. Beauregard will provide program level schedule support, oversee all schedule related efforts and provide the MWRA with timely schedule information to facilitate decision making to advance the program.

Adam Wirthlin, PE, Construction Estimator



Mr. Wirthlin has 19 years of experience in construction and design, with 17 years estimating and scheduling large complex water and wastewater infrastructure projects with significant tunnel components. Having worked for both contractors and

engineers, his estimating skills are highly versatile and have been used to estimate projects including tunnels, shafts, trenchless construction, underground utilities, pipelines, ground improvement, sitework, and Mechanical/Electrical/Plumbing. He has also provided detailed schedule estimates, cost-benefit analyses of different project alternatives, VE, and cost feasibility reviews for the \$2.7B DCCR, the \$490M SVCW and the \$345M RiverRenew programs. Mr. Wirthlin's estimating experience and knowledge base will be used to predict and control the critical element of construction cost on the MTRP.



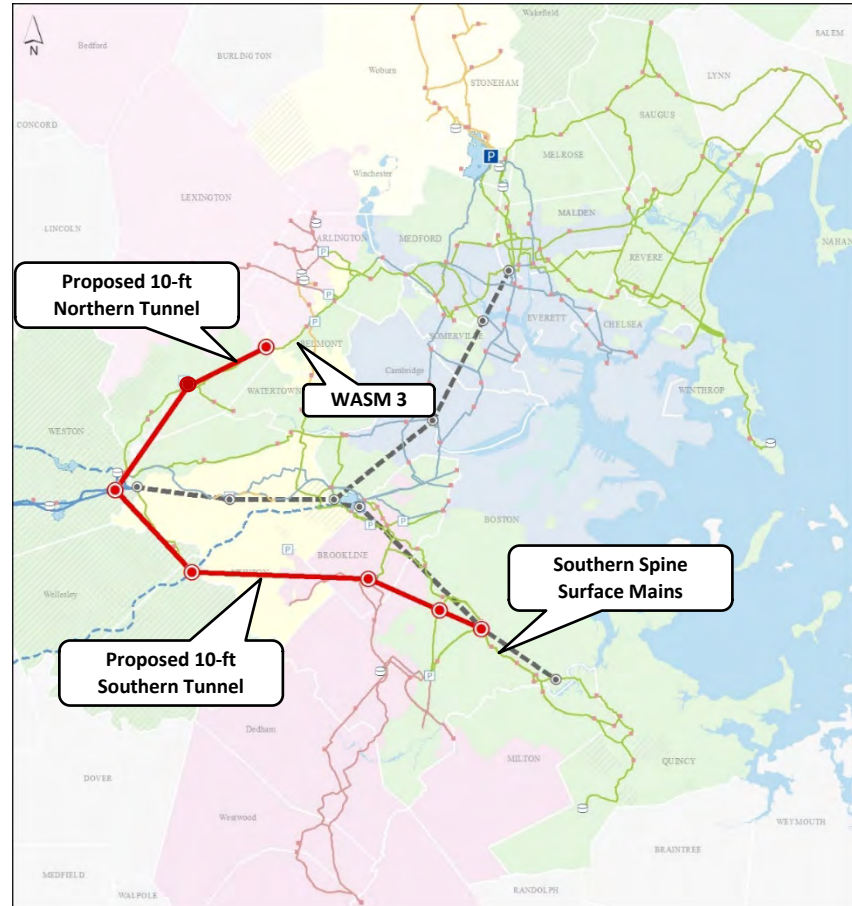
***Metropolitan Tunnel Redundancy Program Update
Hydraulics
and
Program Support Services Organization***

April 17, 2019



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!



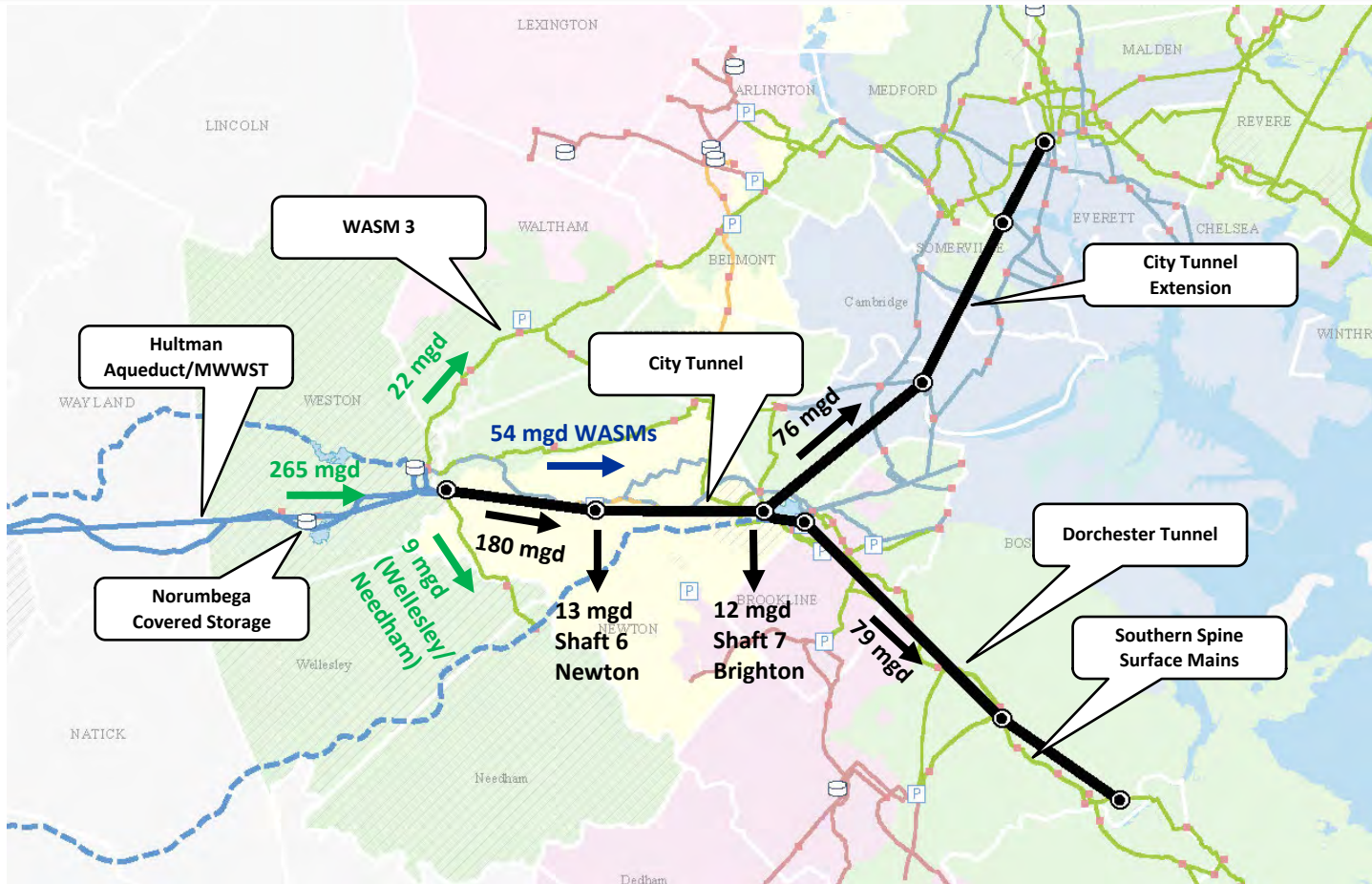


Hydraulic Model Update

- 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

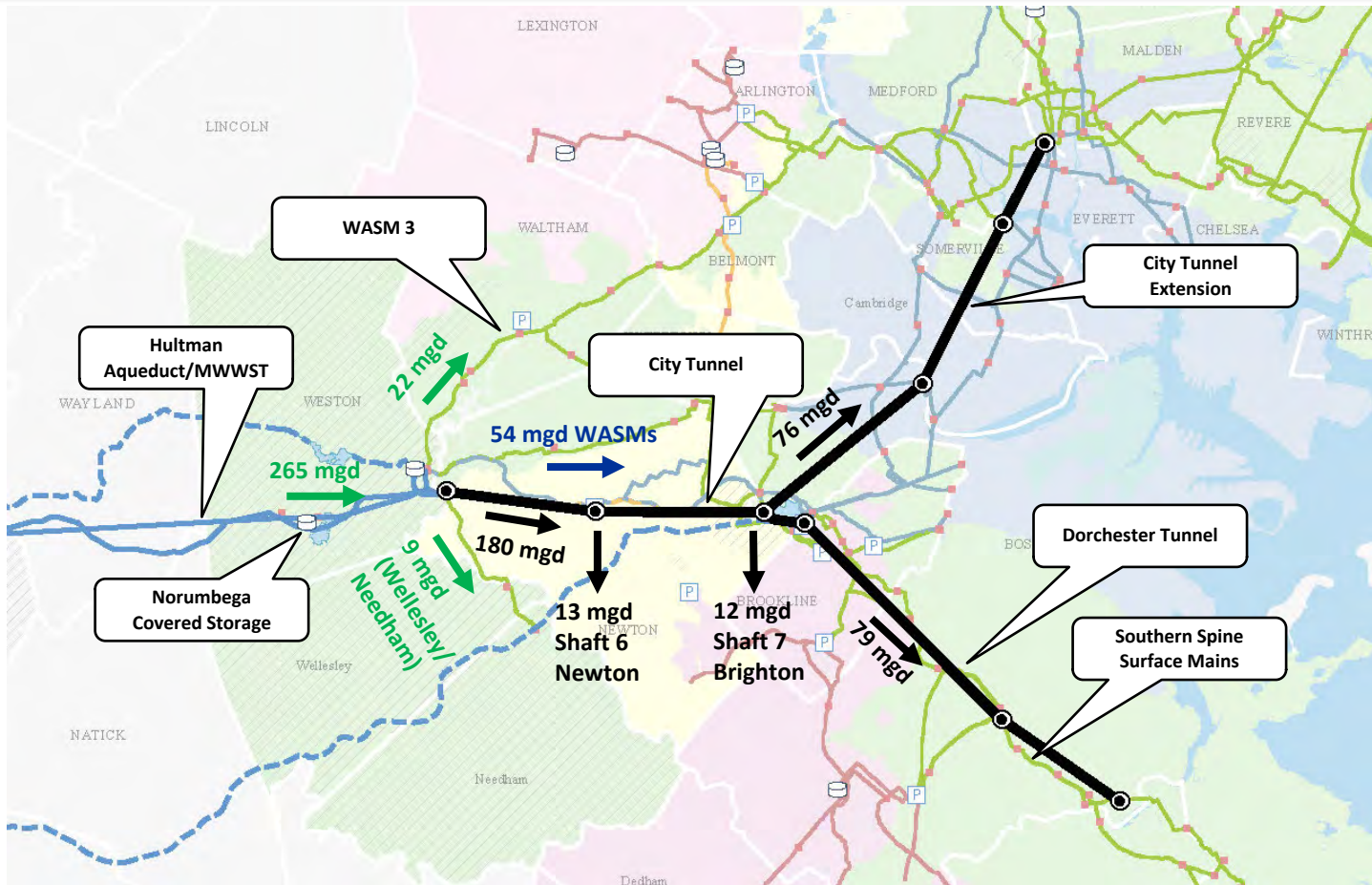


Existing System – High Day Demand 265 mgd East of Norumbega



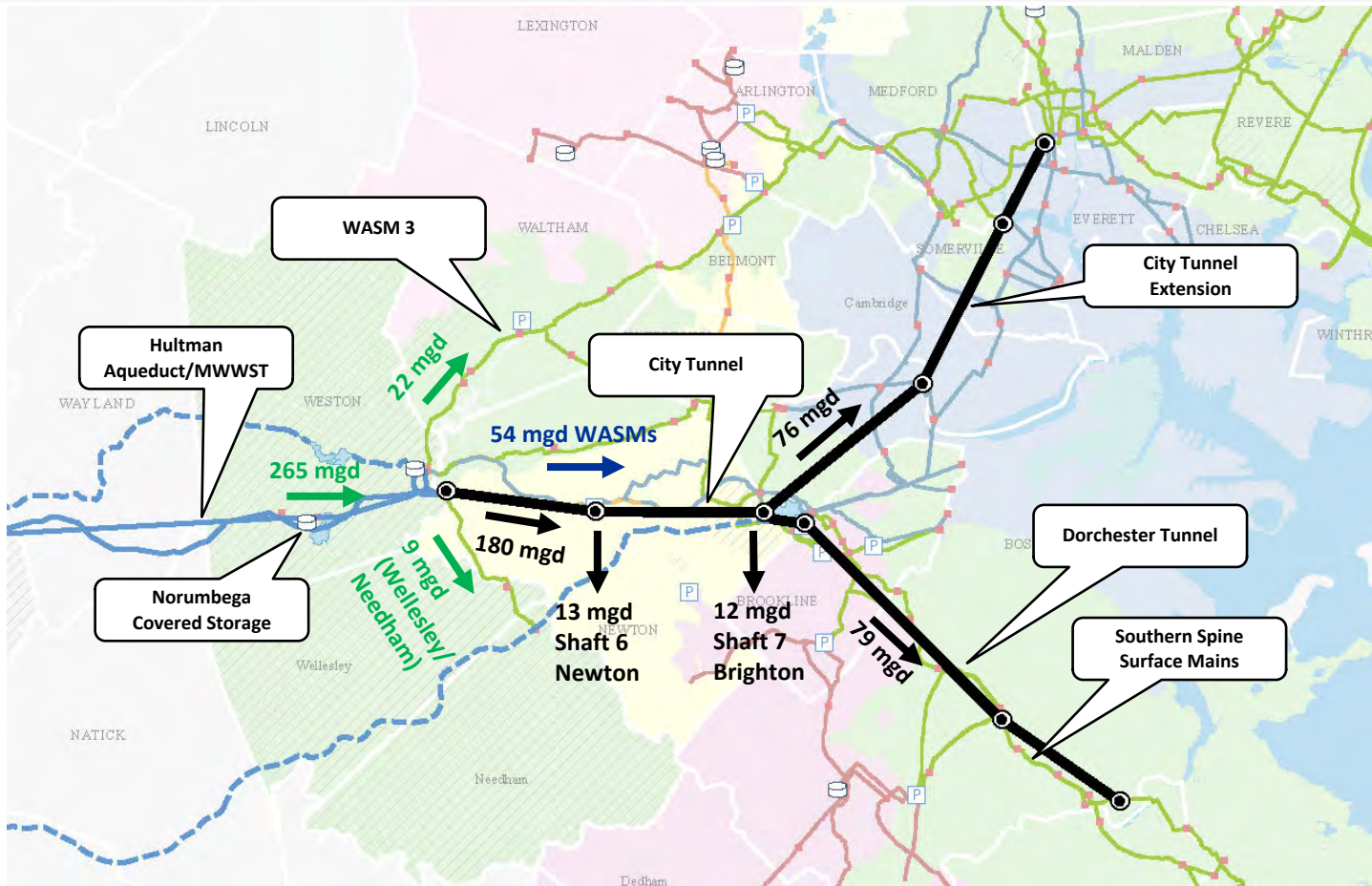


Existing System – High Day Demand 265 mgd East of Norumbega





Existing System – High Day Demand 265 mgd East of Norumbega





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





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



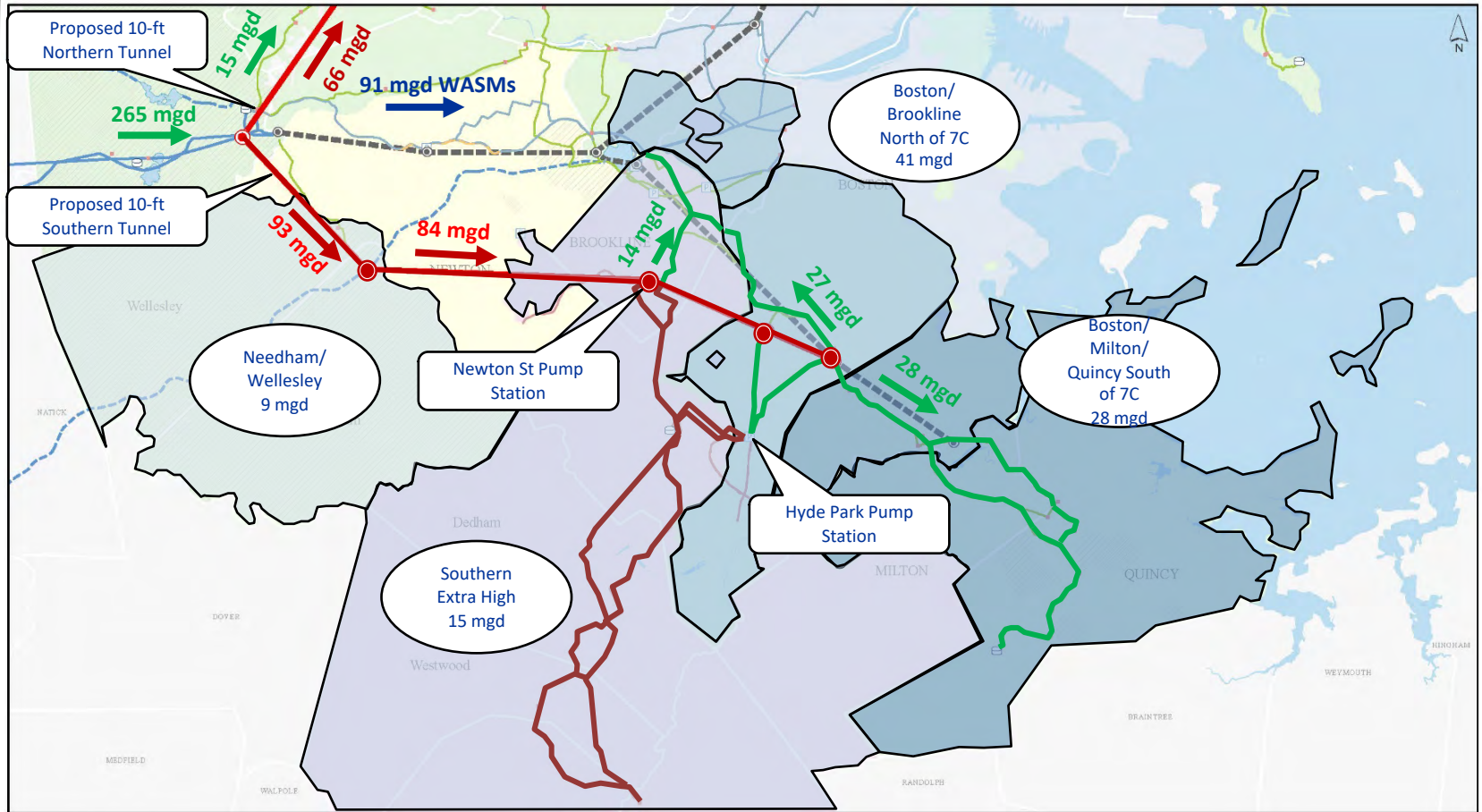


Redundant Tunnel – Existing Tunnel Offline – High Day 265 mgd East of Norumbega



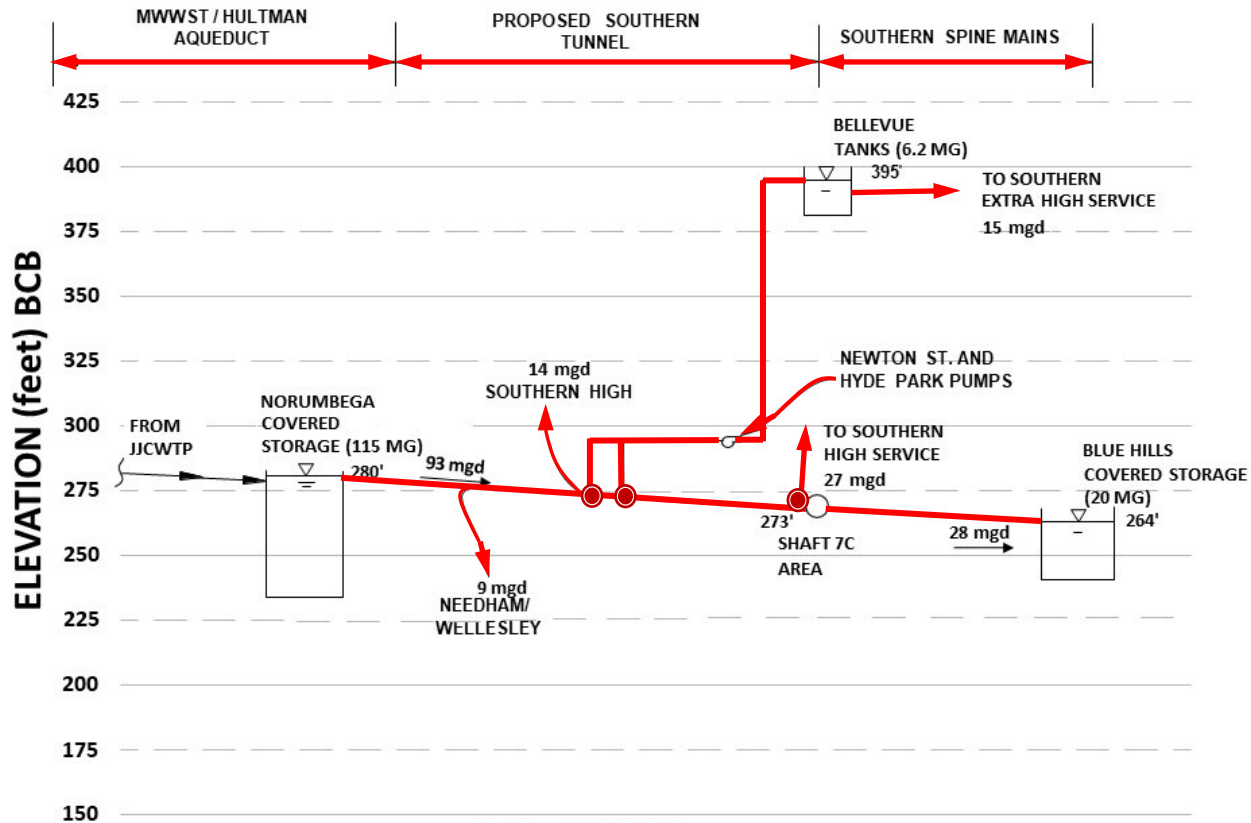


Redundant Tunnel Supply to the South – Existing Tunnel Off Line



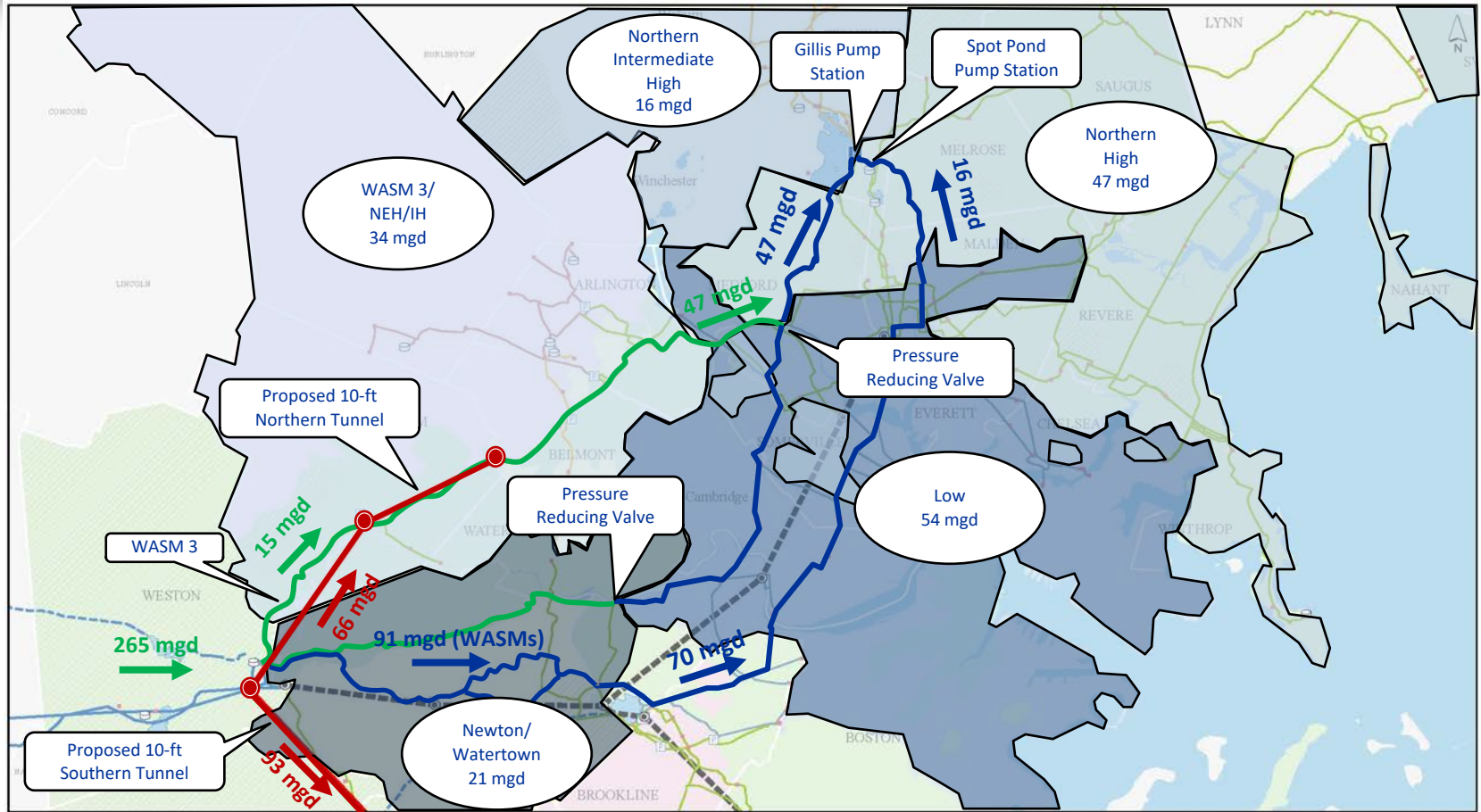


Hydraulic Profile – Southern Tunnel



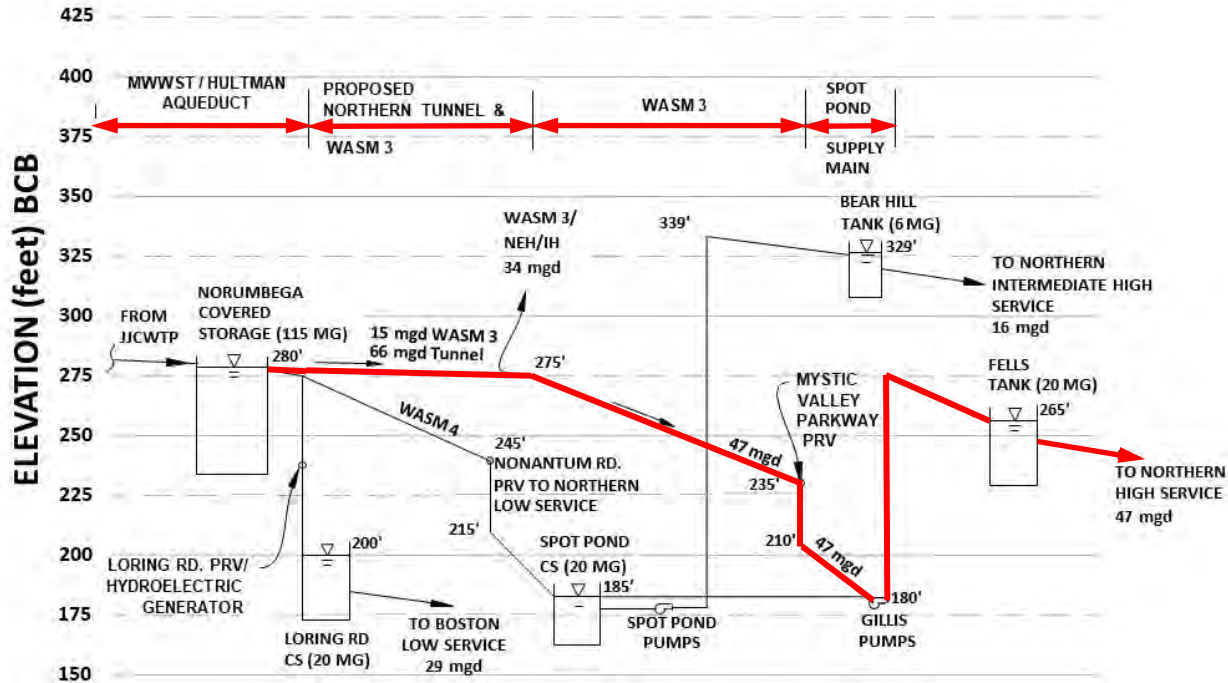


Redundant Tunnel Supply to the North – Existing Tunnel Off Line



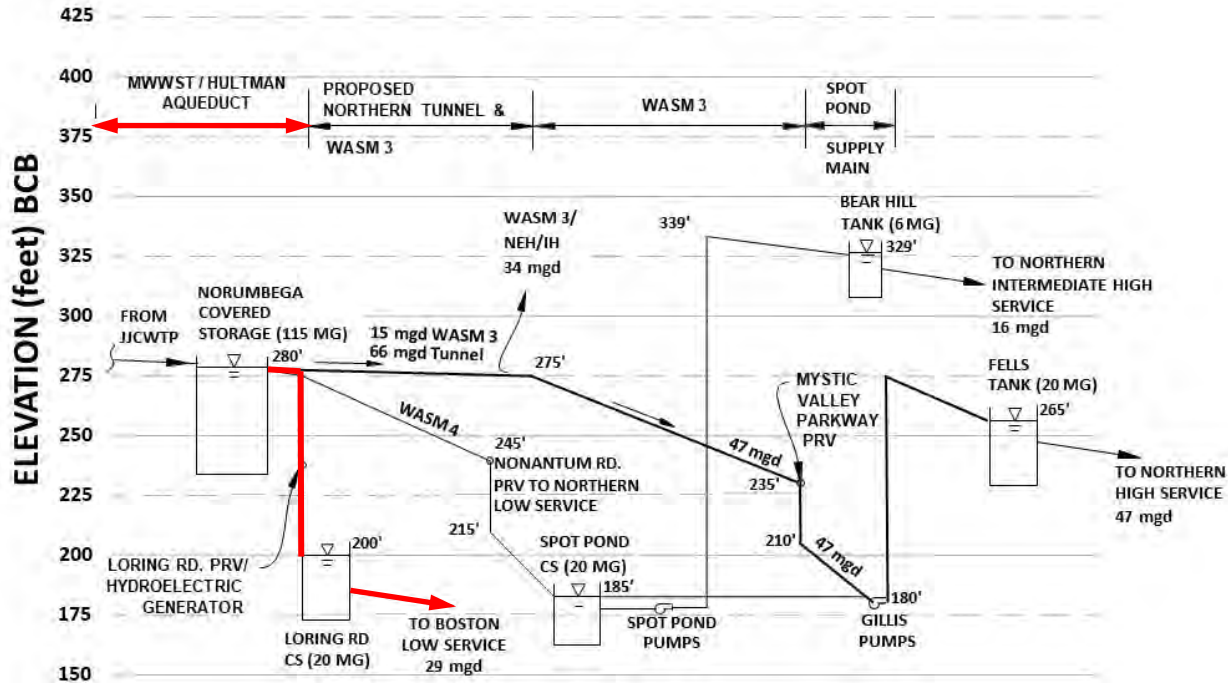


Hydraulic Profile – Northern Tunnel



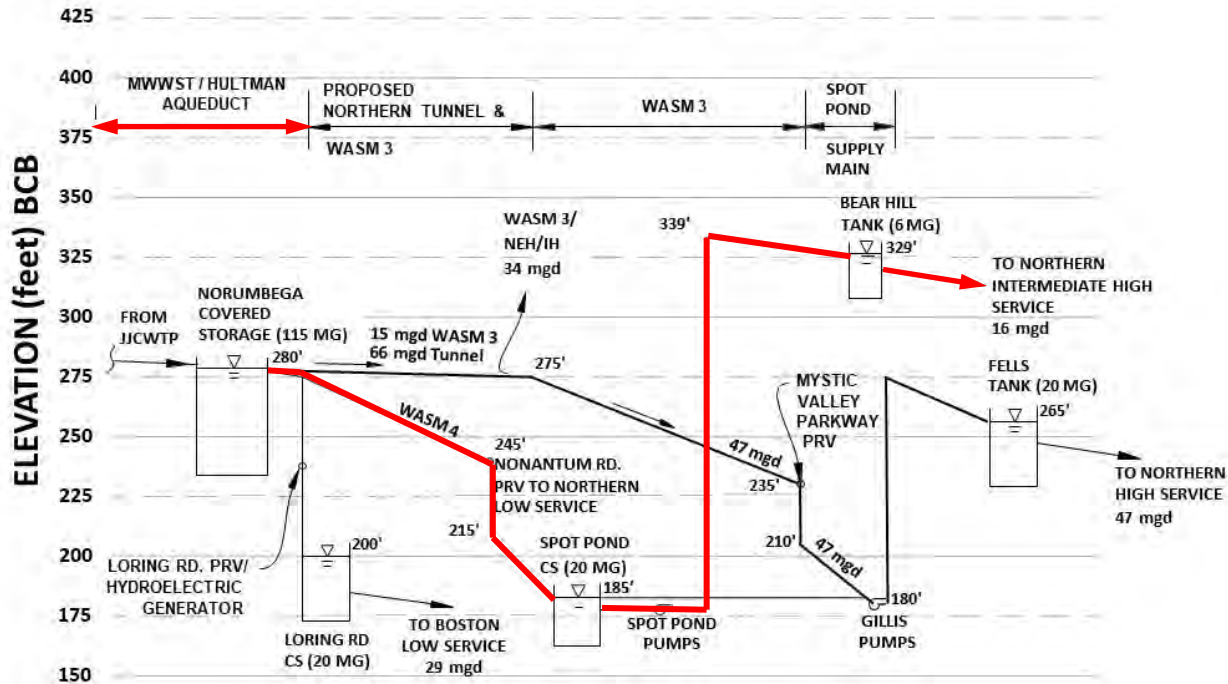


Hydraulic Profile – Northern Tunnel





Hydraulic Profile – Northern Tunnel



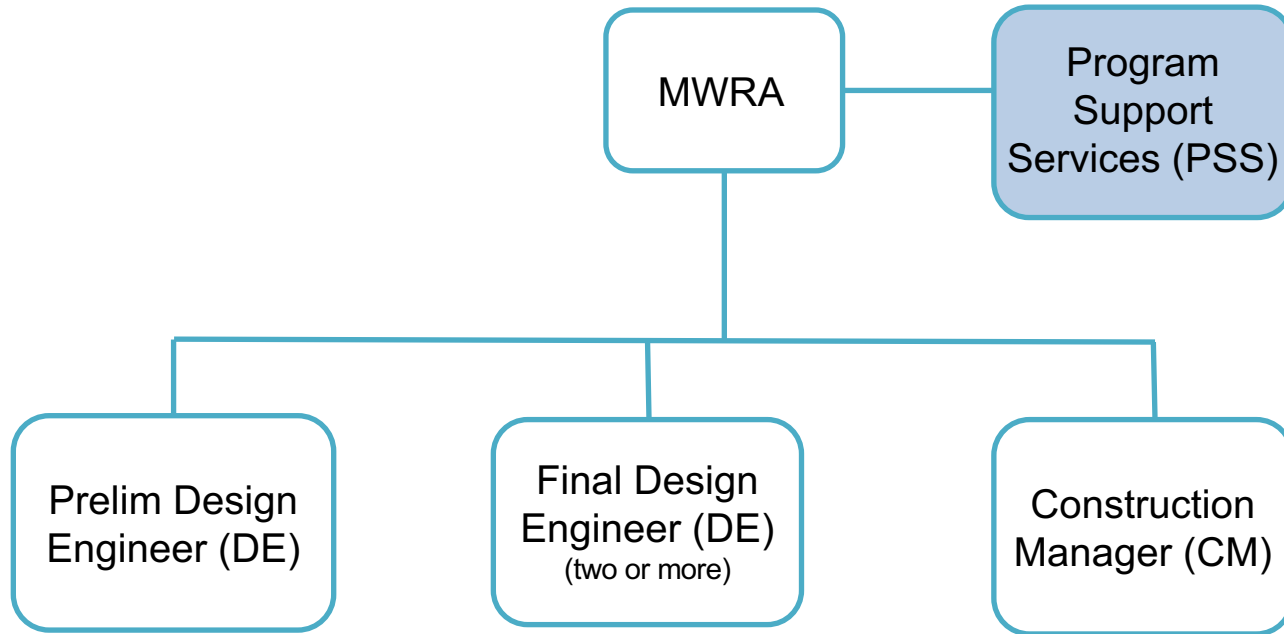


Next Steps – Preliminary Design Phase

- Evaluate future demands and drought/emergency scenarios
- Determine potential refinements to tunnel concept
 - Diameter
 - Connection Points
- Evaluate future improvements to accommodate potential demands



Program Support Services Contract Organization





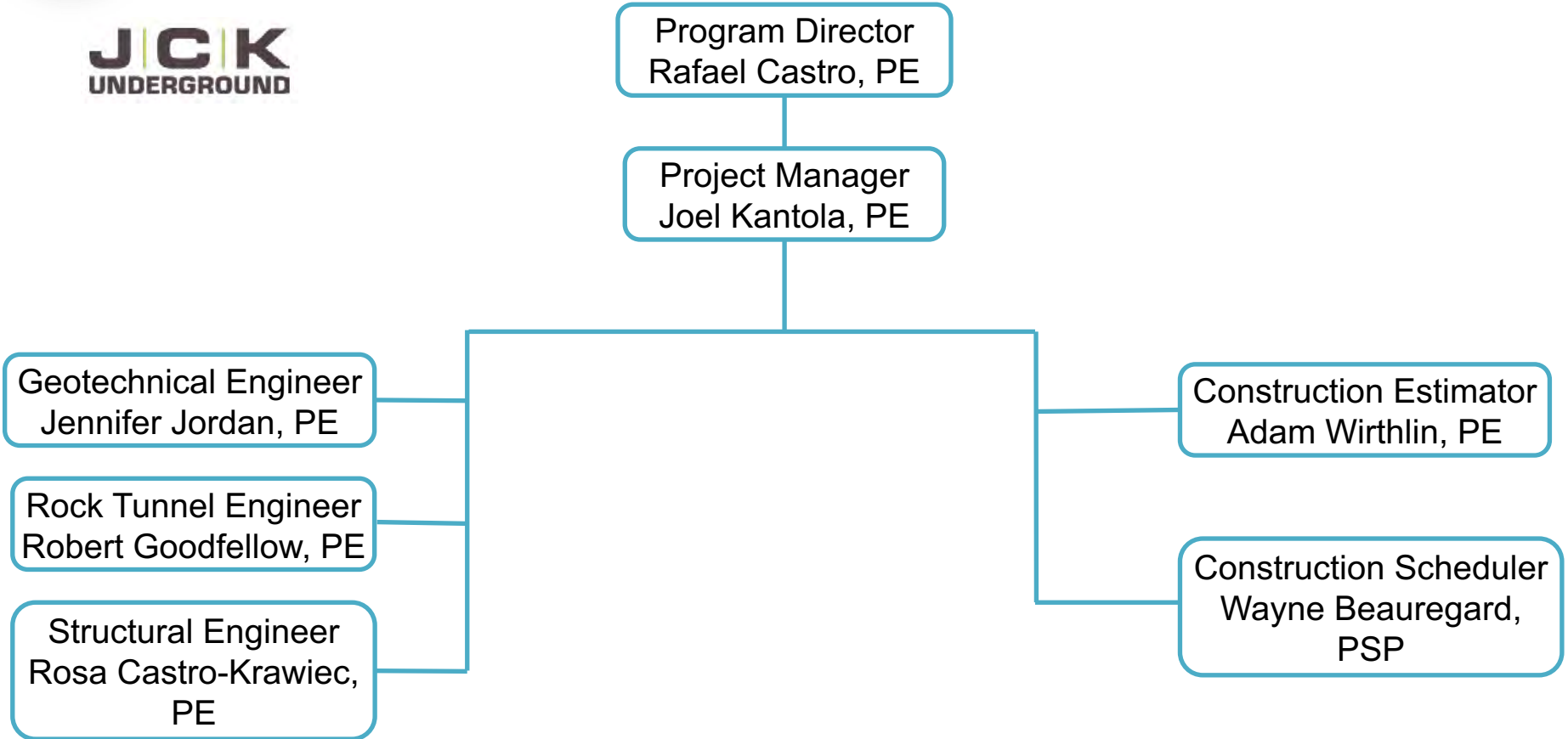
Program-Wide Support Services

- 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 Support Services Contract Organization





Key Personnel

- Industry leaders in....
 - Risk management
 - Project delivery for large complex tunnel programs
- Most have over 25 years of experience and master's degrees
- Locally based
- Past MWRA Tunnel experience includes...
 - Boston Harbor Project
 - MetroWest Water Supply Tunnel
 - Braintree-Weymouth Tunnel