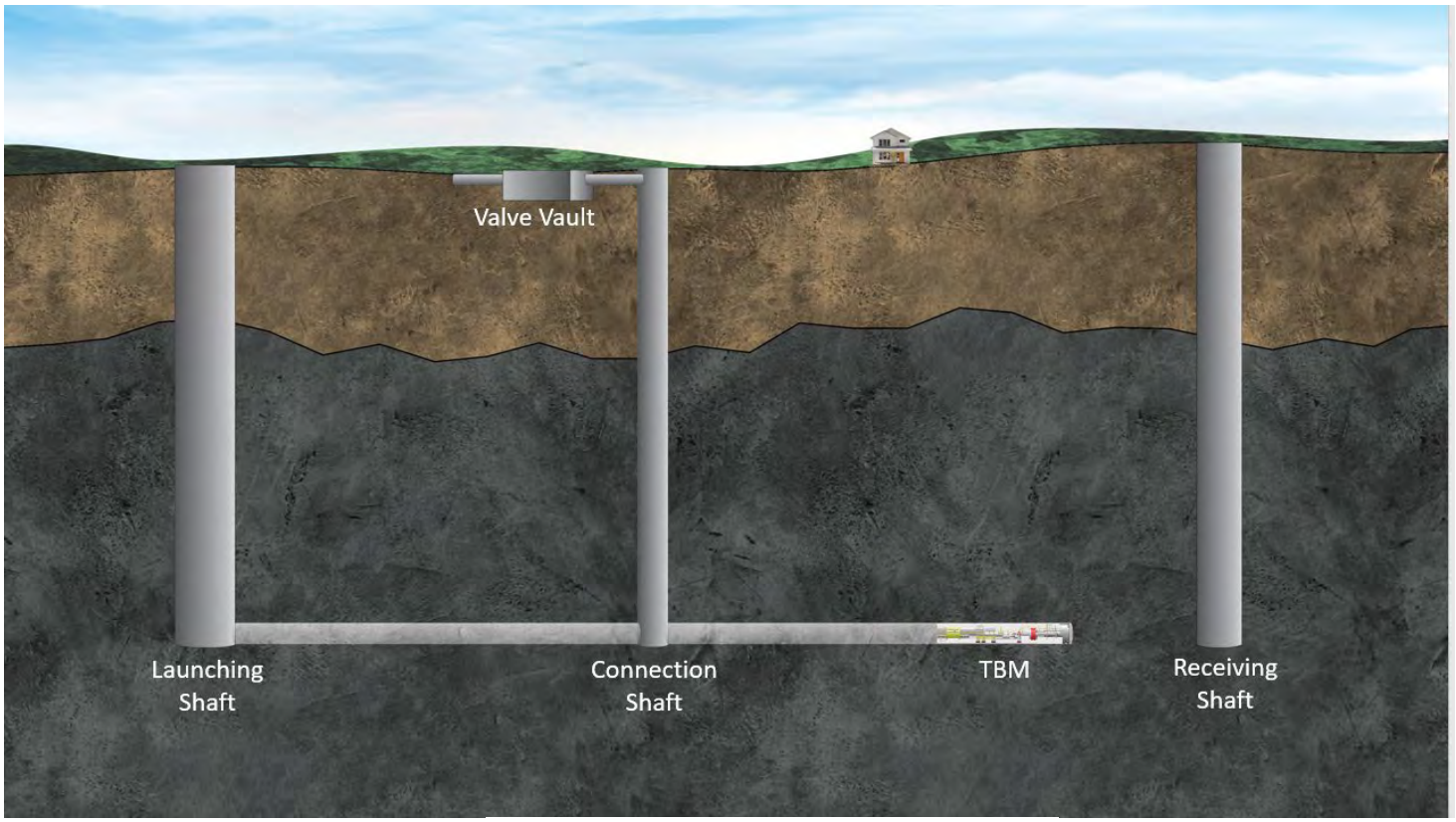
Metropolitan Water Tunnel Program
How Is A Tunnel Constructed?

Through the Metropolitan Water Tunnel Program, the MWRA will construct two new water supply tunnels that will allow our aging existing water tunnel system to be rehabilitated without interrupting service. Implementing the Program will require construction of deep shafts, tunnels, and near surface valve vaults, and pipeline connection facilities. This *Fact Sheet* provides a description of these elements and some typical construction methods that will be used to complete the Program.

Types of Tunnel Shafts

Construction will start at the surface with shaft construction. Shafts provide the vertical connections from the surface to the depth of the tunnel. Three types of shafts will be constructed, each with a different function during construction, comprising launching shafts, connection shafts, and receiving shafts. When the tunnel is in operation, these shafts will provide the connections from the new tunnels to our existing water transmission system and to the local communities that we serve.



Tunnel Construction Components

Launching Shafts are the largest diameter shafts to be constructed for the Program and will provide the primary staging for tunnel construction. A launching shaft will be approximately 40 feet in diameter. Two to three of these types of shafts may be required. A minimum of approximately 5 acres of land surrounding the shaft are required at the surface at each launching shaft site to support tunnel boring machine (TBM) assembly, tunnel excavation, tunnel muck handling, water handling, and tunnel liner installation. A smaller footprint of approximately 1.5 to 2 acres may be needed for the permanent top of the shaft structure, valve vaults, and near surface pipelines which will provide connections to our existing water distribution system.

Connection Shafts are smaller diameter shafts located along the tunnel alignment that are used to make connections between the tunnel and water distribution system pipelines. A connection shaft may be excavated up to 10 feet in diameter. Approximately six of these are currently planned. Approximately ½ to 1 acre is needed for construction depending on the shaft construction method. A smaller footprint is needed for the permanent top of shaft/valve vault and near surface pipelines.

Receiving Shafts are large diameter shafts located at the terminus of the tunnel, used to remove the TBM and also to make a connection to our existing water distribution system. Receiving shafts may be up to 25 feet in diameter. Two to three of these may be required for the Program. Approximately 2 acres are needed at the surface of receiving shafts to support removal of the TBM and construction of permanent connections. A footprint similar to a launching shaft is needed for the permanent structures.

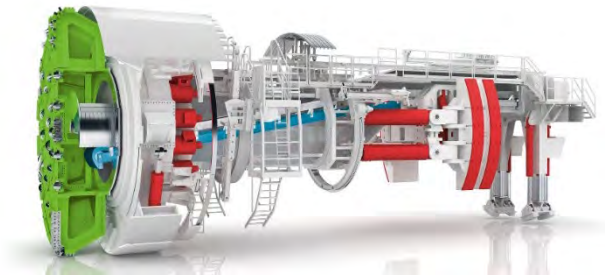
Shaft Construction Methods

Conventional Shaft Construction (also referred to as top-down construction and may be used for Launching and Receiving Shafts). Construction starts at the surface of the shaft by installing secant pile, slurry wall, steel ribs and lagging, or other methods to support the ground down to bedrock. Construction in bedrock requires controlled blasting of the rock. Soil and rock are removed in muck buckets lifted to the surface by a crane and then trucked off the site for reuse or proper disposal.

MWRA's MetroWest Water Supply Tunnel Launch Shaft from Below

Raise Bore Shaft Construction (also referred to as bottom-up construction and may be used for some of the Connection Shafts). An approximately 12-inch pilot hole is drilled from the surface into the already excavated tunnel below. Construction of the shaft then continues predominantly from within the previously excavated tunnel using a raise bore cutterhead which bores the shaft from the bottom up and drops the shaft cuttings down to the tunnel where the material is hauled underground back to the tunnel launching shaft for removal. This shaft construction method requires the least amount of space on the surface, typically no more than ½ an acre.

Tunnel Construction



Components of a Gripper TBM
(courtesy of Herrenknect; www.herrenknect.com)

The tunnels will be excavated using Tunnel Boring Machine (TBM) technology. TBMs are electric powered tunnel excavation machines specifically designed for the ground they are anticipated to encounter. The main components for the TBM expected for this program include a cutterhead with disc cutters, propulsion system (grippers and jacks), and muck transport system (conveyors, or muck cars). After the TBM has completed excavating the tunnel and is removed, the tunnel will be lined with concrete (with embedded steel pipe used in certain areas).

What You'll See at the Surface – Launching Shafts

The ideal construction site is big enough for construction, close to major roadways, close to a body of water for discharge of treated water, near MWRA's existing infrastructure so connections with the tunnel are less disruptive, and away from sensitive receptors. The aerial image below shows a launching shaft for the MWRA's MetroWest Water Supply Tunnel (MWWST) in Framingham, MA during construction and presents the types of activities that would take place at a launching shaft site. The insert aerial image shows the same site after construction and after restoration was complete.

Launching Shaft site for the MWWST

Near Surface Valve Vaults and Pipeline Construction

Large subsurface valve vaults and pipelines will be constructed to complete the connections from the top of shafts to MWRA's existing water distribution system. The concrete valve vault structures may be up to 40 by 60 feet in plan, extending up to 25 feet below grade and exposed a few feet above grade at the surface. Pipelines, between 36 inches and 120 inches in diameter and buried approximately 10 to 20 feet deep, will connect shafts to valve vaults and valve vaults to MWRA's existing water distribution pipelines. The valve vaults and pipelines will be constructed within excavations supported using conventional methods including secant pile walls, steel sheeting, soldier piles and lagging, trench boxes, or other methods.

MWWST Valve Vault and Pipeline

MWRA'S NEW DEEP ROCK TUNNEL – AT A GLANCE!

14.5 Miles of New Deep Rock Water Supply Tunnels: to transport potable water to MWRA communities in Metro-Boston. The proposed tunnels provide system redundancy to aging existing water transmission infrastructure.

How: The tunnels will be constructed using specially designed Tunnel Boring Machines (TBMs).

TBMs will excavate rock to at least 14-15 feet in diameter followed by the installation of a concrete liner for a finished diameter of about 10 feet. The tunnel will be between 200-400 feet below the ground surface.

TBMs typically excavate approximately 50-100 feet per day. Tunnel excavation is a 24/7 operation.

MWRA has constructed and put into operation several deep rock tunnels as part of our existing water systems; the most recent is the MetroWest Water Supply Tunnel (MWWST) completed in 2003.

For more information about the Metropolitan Water Tunnel Program please visit www.mwra.com/mwtp.html or contact our Communications Team at tunnels.info@mwra.com