



Wassara

**STRAIGHT
FORWARD
DRILLING**

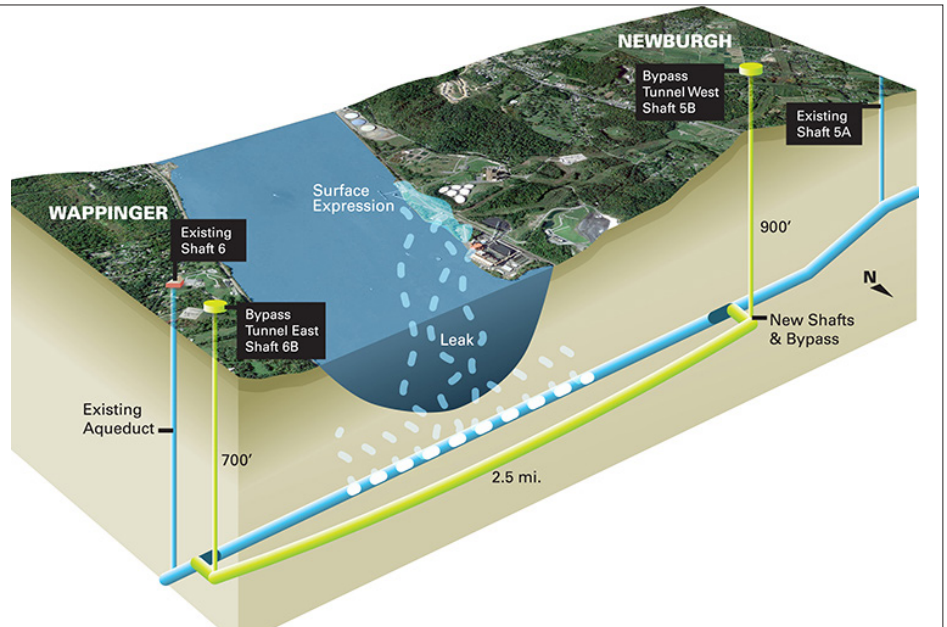


Illustration: www.the Robbins company.com/projects/delaware-aqueduct-repair/

WASSARA GOES UNDER WATER IN NEW YORK

New York City needs a new water supply system. The contractor for this big project decided to use Wassara's W50 hammer on their Robbin's TBM-machine, to get long and straight holes, constant drill rate and a technique that didn't get effected by high water pressure in the formation. All needed to enable high quality exploration drilling while constructing the new Delaware Aqueduct.

Background

The Delaware Aqueduct is an aqueduct in the New York City water supply system. It takes water from the Rondout reservoir on the west bank of the Hudson River through the Chelsea Pump Station, then into the West Branch, ending in at Hillview in Yonkers, New York. The aqueduct was constructed between 1939 and 1945 and carries approximately half of New York City's water supply of 4 900 000 m³ per day.

Over the years, the water system has suffered increasing damages resulting in leakages. The largest of the leakage occurs in a part of the tunnel just when it goes under the Hudson River.

The NYCDEP (New York City Department of Environmental Protection) is therefore building a 4.0 km bypass tunnel beneath the Hudson, which will allow it to bypass the leak. Construction began in November 2013 and was expected to be finished in 2021.

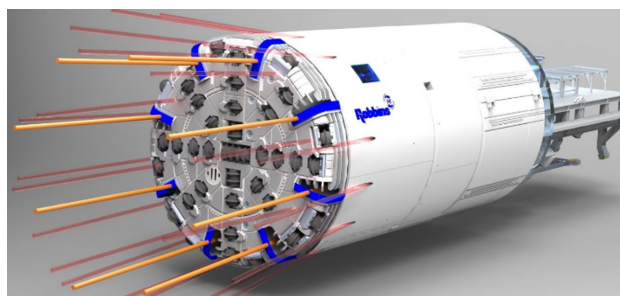
Method

The contractor for the new tunnel was Kiewit - Shea Constructors (KSC) and they decided that the best way to build the tunnel was with a TBM (Tunnel Boring Machine). To drive the tunnel using a TBM, according to experts, is relatively easy in good rock conditions. What can be problematic is when the machine enters areas with loose rock conditions and areas with high water pressures that if it collapses can cause the machine to get stuck.



The TBM used in the project

To know how the rock condition in front of the TBM are at all time, two exploration holes must be drilled continuously in front of the TBM. The holes are specified to be 60-100 meters and depending on the information provided by the drilling, actions can be taken. Actions may be to strengthen and seal the rock. Drilling is done through ports in the cutterhead (four at 0 degrees and twelve at 4 degrees) and at radial ports (fourteen at 7 degrees).



How the exploration holes will be drilled from the TBM

Benefits by using the Wassara technology

Traditionally, exploration drilling is performed with top hammer equipment, but in this case the contractor has chosen to drill with Wassara’s water-powered technology instead. One of the reasons is that the contractor wants to drill longer exploration holes, up to 100 meters, thereby reducing the number of production stops because of probe drilling.

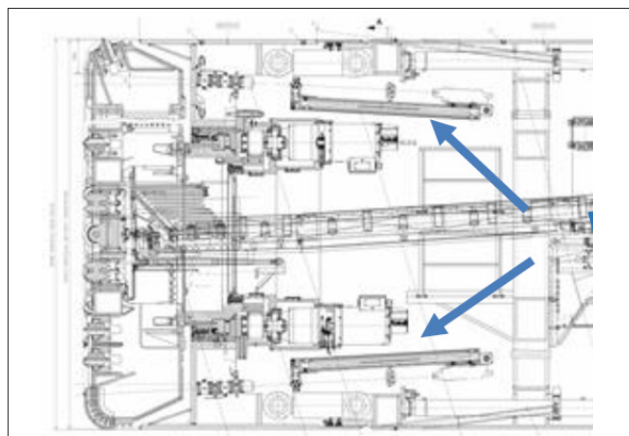
Moreover, Wassara’s technology has a relatively constant rate of penetration, regardless of how long the borehole is, while top hammers drop in drill rate the deeper you go.

Another advantage of Wassara’s water-powered technology is the hole straightness. It increases the likelihood that the exploration hole is within the intended tunnel profile.

In addition, water pressure may occur locally in the formation of up to 27 bar, which can cause major problems for the entire project, but for Wassara’s hammer, which normally works with pressure up to 200 bar, 27 bar is a relatively low pressure.

Equipment

Contractor Keiwit - Shea Constructors chose to equip its TBM with three Wassara systems, each consisting of a high-pressure pump, drill pipes, hammer (W50) and drill bit. The contractor has bought the drill booms from LKAB Wassara’s Italian distributor Ripamonti. In addition to drilling survey holes, the three Wassara systems should also be used to drill for rock reinforcement and for rock sealing.



LKAB Wassara’s W50 hammer systems mounted on the Ripamonti rigs inside the TBM. Two in the front, and a third further back in the TBM.

Used equipment	
DTH hammer	W50
Pump	WASP80
Drill rig	Ripamonti
TBM	Robbins (single shield)
Drill rods	Ø 63,5 mm
Borehole length	Up to 120 m
Scope of drilling	18 500 m
Formation	Limestone, shale and hard rock (up to 370 MPa)
Project time	January 2018 - August 2019