

BIG TUNNEL, SMALL CITY

Lorain, Ohio, Embarks on Its Own 'Big Dig'

When it comes to sewer overflows, water does not discriminate. So, big city or small city, infrastructure planners need to deal with overflows just the same.

One common approach to dealing with sewer overflows is by adding capacity through the construction of large-diameter deep tunnels to store excess flows during wet weather events. When the rain stops and flows in the sewers recede, water is then pumped from the storage tunnel back into the system and treated.

Chicago's Tunnel and Reservoir Plan (TARP) pioneered this approach with a deep tunnel system that began construction in the 1970s. One of the most recent adopters of the approach is Lorain, Ohio. With a population of approximately 65,000, Lorain is much smaller than its Great Lakes cousin to the west, but it shares the same need to protect its local waterways from the effects of pollution.

City planners, working with consultants Arcadis and NTH, developed the deep tunnel approach – known locally as the “Big Dig” – to eliminate sanitary overflows to the Black River and Lake Erie. It differs from TARP and other schemes in that it is designed to eliminate inflow-and-infiltration induced sanitary sewer overflows (SSOs) as opposed to combined sewer overflows (CSOs), which comprise a mixture of stormwater and sanitary flows.

PROJECT BACKGROUND

The Lorain Back River Tunnel was the result of an Ohio EPA order in 2000 to address overflows that violated the City's National Pollutant Discharge Elimination System (NPDES) permit. After studying options, including the construction of an equalization basin in downtown Lorain, a deep tunnel option was selected. The tunnel is being constructed with the assistance of loans from the Water Pollution Control Loan Fund through Ohio EPA's Division of Environmental and Financial Assistance.

A joint venture of Walsh, Chicago, and Super Excavators, Menomonee Falls, Wis., was the low bidder for the project with a bid of \$52,000,243. Electrical work bid under a separate contract brings the total construction bid price to \$55.4 million. The major components of the black River Tunnel include the construction of a launch shaft and reception shaft – approximately 36 ft in diameter and 165 ft deep – and a 5,500-ft tunnel with a finished diameter of 19 ft. Ric-Man Construction was subcontracted to build the shafts.

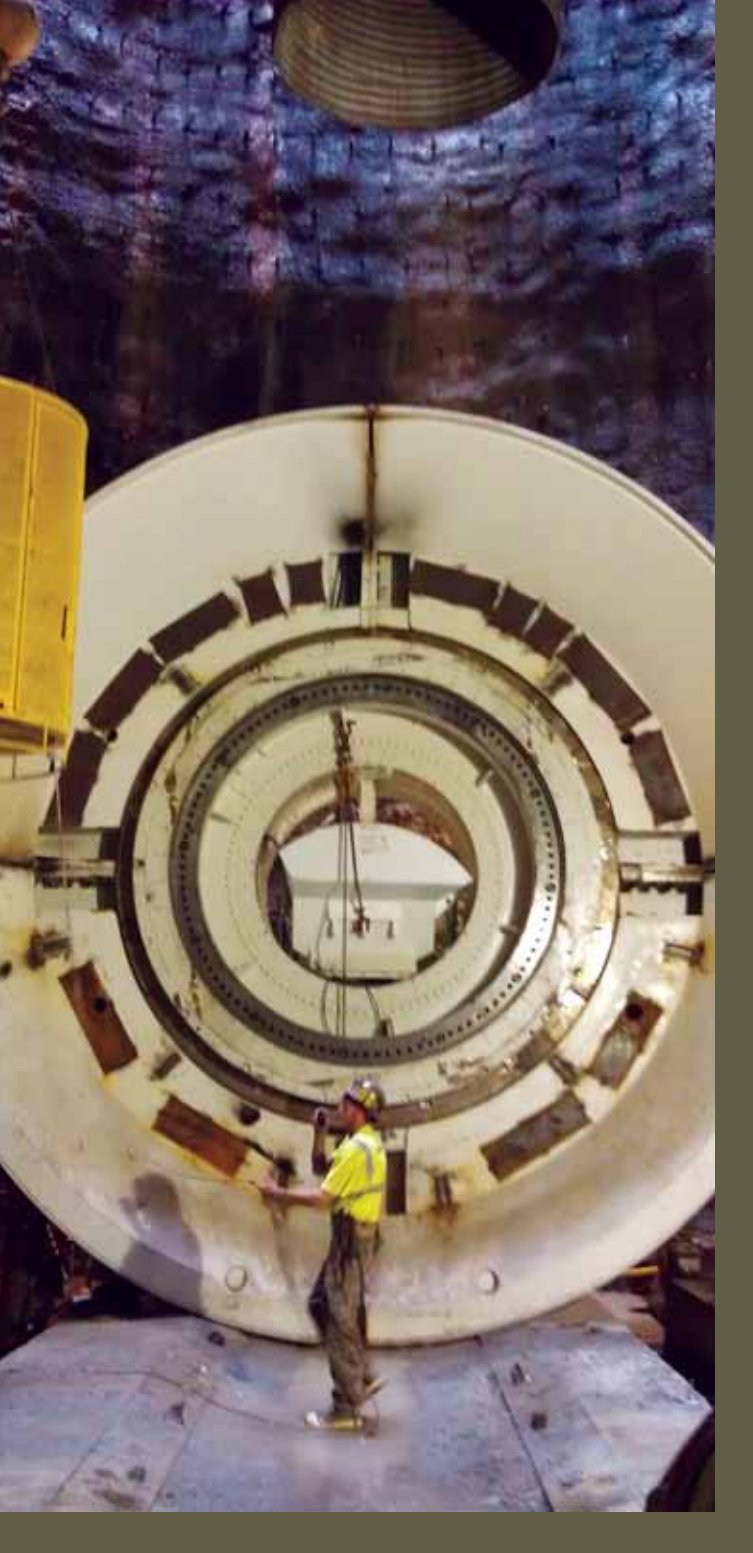


The project route runs along city property roughly parallel to the Black River, beginning at the launch shaft near the Black River Wharf and terminating near the Lorain Black River Wastewater Treatment Plant. A screening facility will be built at one end near the wastewater treatment plant, where water will be diverted into the storage tunnel, and a pump station will be constructed at the launch shaft site. When complete, the pump station will move water from the storage tunnel back into an existing sewer interceptor.

The tunnel will be driven primarily through shale, although a buried valley of soft-ground material is expected near the end of the drive.

TUNNELING THE BRT

Notice to proceed was issued in August 2012. The launch shaft was completed in April 2013 and the starter tunnel completed in August



as crews began preparing for the arrival of the tunnel boring machine. Crews are using a refurbished Robbins double-shield TBM with a new cutterhead.

The machine, which was shipped from Italy, was refurbished and put together using Robbins' "Onsite First Time Assembly (OFTA)" method. By using this approach, as opposed to the more traditional approach of assembling the TBM in the factory and testing prior to shipment, Walsh/Super Excavators was able to save valuable time. According to The Robbins Company, the Black River Tunnel project marks the first use of this approach in the United States, although it has been used elsewhere globally with success. "We are expecting to save at least a few weeks off the schedule by using the OFTA approach," tunnel supervisor Gregg Rehak said.

Using the OFTA approach, individual pieces are tested prior to delivery but the machine is never fully assembled. Onsite, Robbins'


technicians work with the contract to assemble the machine and provide support as needed.

The nearly 200-ft long TBM features a 23-ft ID, 232,000-lb cutterhead that was lowered into the hole on Aug. 20 with the help of a 500-ton crane provided by Capital City Crane just for the occasion. The rib-and-board starter tunnel was built to a length of 200 ft so that mining can begin in full production mode when the machine is assembled, Rehak said. A continuous conveyor will be used to transport the muck.

Crews will install ribs and boards for initial support and a final cast-in-place concrete liner will be poured by subcontractor Headlands Contracting and Tunneling Co., Chardon, Ohio. Jason Edberg of NTH Consultants, which led the tunnel design, discussed the selection of the final lining approach. "We chose the two-pass method because the tunnel was designed before segmented rock tunnels began to be used in the Midwest," he said. "At that time, there were no local segment manufacturers and no local experience to draw upon."

Because of the potentially gassy shale and the rib-and-board initial liner, Trolex gas monitors will be installed every 500 ft to ensure the safety of workers. Crews will also be using a Tacs guidance system to help maintain the 0.2 percent uphill grade.

Given the quality of the rock, Walsh/Super Excavators is expecting good advance rates. "It's going to come down to how fast the crew can stand the sets," Rehak said. "The rock is good and there should be minimal wear on the tooling."

Mining is expected to be completed by spring 2014 final project completion set for 2015. When finished the tunnel will have a storage capacity of 11 mgd, providing a big water quality benefit for a small town. 

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CALIFORNIA

San Francisco Central Subway Tunneling Project – Contract 1252 Barnard/Impregilo/Healy JV

The \$233 million Central Subway Tunnel Project, Phase II of the San Francisco Municipal Transportation Agency's Third Street Light Rail Program, has been designed to expand the City's transportation network and increase public access to San Francisco's Chinatown. This project includes constructing precise, twin, 8,233 lf tunnels to be excavated with two EPB tunnel boring machines (TBMs) and lined with 18-ft diameter precast segments. The work also includes construction of a launch box and portal structure under 4th Street (a city thoroughfare), a retrieval shaft, and headwalls for future stations that the TBMs will mine through prior to station construction.

The first of the two Robbins TBMs, "Mom Chung," has been successfully assembled and launched, and continues excavating the southbound tunnel. The second TBM, "Big Alma," was recently delivered to the site and is currently under assembly.

Subcontractor Condon Johnson-Nicholson JV has recently completed the construction of the Moscone Station headwalls and jet-grouting work. They continue work on the compensation grouting program along various locations of the alignment, and continue with construction of the vertical and battered secant piles and jet grouting which will make up the Union Square/Moscone Station headwalls.

Project Director: Dan Schall; Project Manager: Ben Campbell; Project Superintendent: Mike Hanley; Chief Engineer/DPM: Alessandro Tricamo; Superintendents: Andy Granger, Bill Kiehl, Bob Schaffer, Lynn Twomley, Michael Shough, Eric Smith, Mike Gilbertson and Harlan Davis; Survey Manager: Klaus Herbert; Staff Engineers: Matt Paulisich, Glenn Strid, Jack Sucilsky, Vik Sehdev, Beau Blume, Aaron Abel and Brian Shalk, Safety Manger: Mike Sinon and Quality Manager: Antonio Prado. Information: Ben Campbell, (415) 546-0799, or ben.campbell@barnard-inc.com.

Sunol/Fremont New Irvington Tunnel Southland/Tutor Perini JV

Excavation on the 18,660 ft New Irvington Tunnel for the San Francisco Public Utilities Commission (SFPUC) is almost complete with less than 136 ft remaining to be mined between the Alameda West Portal heading and the Vargas Shaft East Heading. Holetthrough was anticipated for October 2013. The contractor is using conventional tunneling with two Antraquip roadheaders as well as controlled detonations to excavate the two headings. Both headings have been challenging with high groundwater inflows and pressures, some squeezing ground areas and extensive pre-excavation grouting required.

A new portal structure has been completed at the Irvington Portal site located in the City of Fremont and site restoration work has commenced. The site is being reseeded and mulched before the oncoming winter rainy season.

After holetthrough, the installation of the welded steel pipe fabricated by Northwest Pipe will commence on the remaining 14,600 ft of tunnel followed by annulus backfill grouting with low density cellular grout. Project completion is scheduled for mid-2015.

New Irvington Tunnel Project Team: Southland/Tutor Perini Project Manager: Robert Cornish; General Superintendent: Curtis Bahten; Tunnel Superintendents: Jim Mulkey and Jack Bowling; Hatch Mott MacDonald Construction Manager: Daniel McMaster; Lead QA Inspector: Rebecca Fusee; SFPUC Assistant Sunol Regional Project Manager: David Tsztoo, PE. Communications: Maria Le 866-973-1476 or email mle@sfgwater.org.

DISTRICT OF COLUMBIA

Washington Anacostia River Tunnel Impregilo/Healy/Parsons JV

This \$253 million design-build project for DC Water was awarded to Impregilo-Healy-Parsons JV in June 2013. The

work includes six shafts with various configurations, diameters of 27 to 77 ft, depths 113 to 123 ft, 12,500 ft of 23-ft minimum inside diameter CSO tunnel with bolted/gasketed precast liner, excavated by a Herrenknecht EPB TBM, CSO diversion structures, odor control facilities, various SEM adits, and ancillary work. Project design is being performed by Parsons and is under way. Staff and site mobilization are under way with construction to start in fall 2013.

Project Director: Jim McDonald; Project Manager: Mark Rybak; DPM/Design Manager: Phil Colton; Design Manager: Jon Kaneshiro; General Superintendent: Jim Hyatt; Chief Construction Engineer: Daniele Nebbia; TBM Engineer: Chiara di Nauta; Staff Engineer: Jeff Gargoshian; Safety Manager: Barry Jackson; QC Manager: Rick Munzer. For DC Water, Construction Manager: Scott Shylanski. Information: Mark Rybak, (202) 469-6434.

Washington M Street Diversion Sewer- Division E Bradshaw Construction Corp.

Bradshaw Construction Corp. has begun construction on a project for DC Water consisting of two tunnels for sanitary sewers. The first tunnel is 1,014 lf of 72-in. rib-and-board installed by TBM for 48-in. FRP Sewer. The second tunnel is 1,313 lf of 144-in. rib-and-board installed by digger shield for 110-in. FRP Sewer. Information: Mike Wanhatalo, mwanhatalo@bradshawcc.com.

NEVADA

Las Vegas Lake Mead Intake No. 3 Connector Tunnel Renda Pacific

This \$52.5 million project for the Southern Nevada Water Authority was given NTP in May 2009 and is nearing completion. The job consists of 35,000 cu yd surface bulk excavation, grading and rip rap; excavation of a 450-ft deep, 26-ft diameter shaft; excavation of 2,700 ft of up to 20-ft high, 20-ft wide modified horseshoe shaped tun-

nel; and installation of two pre-fabricated steel bulkheads.

Key Project Personnel: Renda Pacific: General Manager: Michael Cash; Renda Project Manager: Joseph Savage; Project Superintendent: Rick Leever; Shift Supervisors: David Prince, Wendell Heeter. SNWA Project Manager: Erika Moonin; SNWA Construction Manager: Jerry Ostberg, SNWA Assistant Construction Manager: Noah Hoefs. Parsons is serving as construction manager. Information: Jerry Ostberg, (702) 567-4925.

Las Vegas Lake Mead Intake No. 3 Shafts and Tunnel Vegas Tunnel Constructors (Impregilo/Healy JV)

This design-build project for the Southern Nevada Water Authority was awarded to Vegas Tunnel Constructors for \$447 million. The work includes an access shaft 600 ft deep and 15,000 ft of rock tunnel to be mined with a convertible 7.2m Herrenknecht TBM, capable of operating as a hard rock machine in open mode and as a full Mixshield in poor rock and/or with high water inflows, and lined with 20-ft diameter precast gasketed segments. Also included is a new Intake Riser structure constructed 350 ft below the surface of Lake Mead, and miscellaneous site and ancillary work.

Project design has been completed by Arup USA in conjunction with Brierley Associates. All underwater excavation and structural work has been completed.

Excavation of the Intake Tunnel is under way, with a long section being excavated in a very complicated geology with large groundwater flows. Closed mode excavation with face pressures of up to 14 bar has been employed in the first 2,800 ft, along with an extensive pre-excavation and ground improvement program. Good progress is being experienced in open mode conditions.

Project Director: Jim McDonald; Project Manager: Jim Nickerson; Construction Manager: Renzo Ceccato; Chief Construction Engineer: Roberto Bono; Senior TBM Engineer: Nicola Donadoni; Staff Engi-

neers: Erik Hornaday, Claudio Cimiotti, Nihad Rajabdeen, Paul Bennett, Joey Cadavid; Tunnel Superintendent: Chris Gomez; Walkers: Mike Revis, Brian Comfort, Willie Flores; Plant Manager: Greg Cook; Safety Manager: Vaughan Hargrave; QC Manager: James Grayson. For SNWA, Construction Manager: Dave Neil. Information: Jim Nickerson, (702) 893-2300.

NEW YORK

New York East Side Access Queens Bored Structures Granite/Taylor Brothers/ Frontier-Kemper JV

All tunnel work is complete, all equipment has demobilized, and all personnel have moved off the site.

The project was awarded in September 2009 with a bid price of \$659 million. Scope of the work included the excavation and the precast concrete lining of four bored tunnels beneath an active rail storage yard. Totalling more than 10,000 lf and approximately 22 ft in diameter, the tunnels were excavated utilizing two tunnel boring machines, each weighing more than 500 tons. The work also included the excavation of three emergency exit structures, underpinning of existing bridges and the demolition of various rail yard buildings.

The Queens Bored Tunnels and Structures contract is part of the Long Island Rail Road's East Side Access project and is the last major link in the tunnels from Queens to Grand Central Terminal in Manhattan. When completed, the East Side Access project will bring Long Island Rail Road service, the busiest commuter railroad in the country, into New York's Grand Central Terminal, providing a direct route between Long Island and eastern Queens to Manhattan's eastside.

New York Harbor Siphons Replacement Tully/OHL JV

Since the announcement by Caterpillar Tunneling Canada Corporation (CTCC) that they

will no longer manufacture tunnel boring machines and that their services are to be scaled-down, the Tully/OHL JV has contracted Robbins to perform repairs to the CTCC TBM that was flooded by Super Storm Sandy. All TBM backup cars have been removed from the tunnel and are now in Ohio at the Robbins facility undergoing repairs. Technicians from Robbins are also on-site supervising the repairs to the TBM underground. Mining is expected to resume in the first quarter of 2014. Land piping work in Brooklyn and Staten Island is ongoing.

Personnel currently assigned to the project are the following: Tully/OHL JV Project Manager: Vincent Sefershayan; Tully/OHL JV Tunnel Project Manager: Josep Juan Rosell; Tully/OHL JV Tunnel Manager: Luis Alonso; LiRo/PB JV CM Project Manager: Tom Bowers; NYCEDC Owner's Representative: Rob Damigella; CDM/HMM JV Design Liaison: David Watson.

New York Second Ave Subway – 86th Street Cavern Skanska/Taylor JV

All underground excavation in the 86th Street station cavern, adits, entrances and deep tunnel cross-overs were completed in July. Concrete operations are well under way with the deep tunnel inverts completed and arches in progress. The cavern drainage and substructures were completed. The cavern reinforced concrete linings are under way with inverts, walls, full wrap waterproofing and Entrance 1 lining in progress. The cavern arch concrete is scheduled to start in November.

The 86th Street open-cut entranceway excavation of soil/rock and including utility support and street decking has been in full swing with a scheduled holethrough to the E2 incline (previously driven from the E2 underground complex) in late October. Then heavy concreting will commence on three fronts in order to bring this community delayed section of the project back to the original contract milestone completion date.

Project personnel: Vice President: Mike Attardo; Project Executives: Gary Almeraris, Tom Maxwell; Technical Director: Lars Jennesmyr; Project Manager: Tom O'Rourke; Production Manager: Scott Hoffman; Underground General Superintendents: John Kiernan, Karl Poss; Surface Superintendent: Frank Spagna; Engineer/Superintendents: Charlie Schock, Mike Stokes, Rob Begonia; Equip Superintendent: Dean Gibbon; Safety Manager: Mike Ceglie; Quality Manager: Ivan Djordjevic.

OHIO

Cleveland Euclid Creek Tunnel McNally/Kiewit ECT JV

This \$198 million project for the Northeast Ohio Regional Sewer District received NTP in April 2011 and is on schedule for an April 2015 completion. The job consists of 18,050 lf of main tunnel mined with a 27-ft diameter new Herrenknecht TBM. The tunnel is approximately 200 ft deep. Breakthrough of the 18,000 ft of tunneling was achieved in August. The project includes the construction of six shafts: three shafts excavated using liner plate and ribs, then blasting through rock; one shaft excavated using secant piles, then blasting through rock; and two shafts excavated using liner plate and ribs, then hammering through rock. Nearly 6,000 lf of additional consolidation and relief sewers (mainly in soft ground) using microtunneling, open-cut, hand-mining and two runs of TBM mining using a refurbished 100-in. Lovat owned by McNally.

Senior Project Manager: Tom Szaraz; Assistant Project Manager: Tom Corry; Project Engineer: Josh Suffel; Tunnel Manager: Jarrett Carlson; General Superintendent: John Herward; Shaft Superintendent: Bill McFadden; Tunnel Superintendent: Danny Smith; Equipment Superintendent: Mark Kaletta; Electrical Superintendent: Troy Porter.

Lorain Black River Tunnel Walsh/Super Excavators JV

In August 2012, the JV partnership received notice to proceed for the Black River Tunnel Project. The project includes a two-pass tunnel with a length of 5,500 ft to be excavated with a 23-ft double-shielded Robbins TBM. The final tunnel liner will be cast-in-place concrete with an ID of 19 ft.

As of September 12, construction of the 200 ft starter tunnel is complete, and the TBM cradle installed. Final concrete liner of the starter tunnel was poured by subcontractor Headlands Contracting and Tunneling Co. Cutterhead assembly is finished, and the 232,000-lb piece was safely lowered into the shaft on Aug. 20. Crews are moving forward with the OFTA (Over-the-hole, first time assembly) process as they continue to advance the machine, and lower and install the backup equipment. Crews have also completed construction of the receiving shaft, and are now in the final stages of assembling the conveyor system that will transport shale to the surface. Tunneling is expected to commence in October 2013.

Project Tunnel Supervisor: Gregg Rehak; Project Managers: Mike Garbeth, Mark Hedrick; Tunnel Superintendent: Jeff Reagan; Project Superintendent: Doug Meyers; Survey Manager: Mike Klement; Safety Managers: Steve Garlock, Anthony Revay Jr. Information: mike@superexcavators.com.

SOUTH CAROLINA

Charleston West Ashley Sewer Tunnel & Influent Pump Station Southland Renda JV

This \$50.7 million project is Phase V of the Charleston Water System (CWS) sewer tunnel improvements program, replacing an existing deep tunnel from the Croghan Spur to the Plum Island Waste Water Treatment Plant (PIWWTP). Other improvements consist of the construction of a new influ-

ent pump station, new pile-supported 48-in. force main, installation of near surface connection at the PIWWTP, two shaft sites and surface collection improvements in the Country Club of Charleston and along Harborview Road. The shafts consist of a 60-ft ID at PIWWTP and 20-ft ID at Croghan, both built using the caisson sinking method, and 30-in. drop pipe at Porter Gaud. The 8,300 ft tunnel will be excavated with an 86-in. diameter single shield tunnel boring machine, manufactured by Southland Contracting, and supported with ribs and lagging boards.

The project is currently about 10 percent complete with the 60-ft ID caisson down 30 ft. The 60-ft ID caisson, with 2-ft thick walls, will reach a depth of 130 ft.

Other parties involved on the project include project designers Black & Veatch, Hanzen and Sawyer, and Hussey, Gay, Bell & DeYoung.

Operations Manager: Kent Vest; Project Manager: Enrique Baez; Superintendent: John Lindsey; Project Engineer: Steven Ricker. Black & Veatch RPR: Keith Fraiser.

Rock Hill
Manchester Creek Outfall
Sewer – Phase II
Bradshaw Construction Corp.

Bradshaw has completed installation of a 265-ft long by 60-in. diameter steel casing under Dave Lyle Blvd. by pipe jacking behind a conventional TBM. The second tunnel under Anderson Road is under way. The first 35 ft was hand mined using 72-in. liner plate supports through unanticipated rock and mixed face. The remaining 120 ft is being completed in the same manner as the previous tunnel though residual soils. The carrier pipe is 42-in. DIP grouted in place. Information: Eric Eisold, eeisold@bradshawcc.com.

VIRGINIA

Richmond
Children’s Hospital of Richmond Pavilion (CHoRP)
Utility Tunnels
Bradshaw Construction Corp.

Bradshaw Construction Corp. is currently constructing two utility tunnels for the extension to the Children’s Hospital of Richmond, owned by Virginia Commonwealth University Health Systems. Excavation for the first tunnel, consisting of 132-in. diameter liner plate, is complete and 96-in. RCP is being installed in the tunnel. The ground conditions were lean clays overlaid with gravelly sand in the crown. Construction of the second tunnel, 96-in. liner plate for 66-in. RCP, was to begin in October. Information: Todd Brown, tbrown@bradshawcc.com.

WASHINGTON

Seattle
SR 99 Tunnel Project
Seattle Tunnel Partners
(Dragados USA/Tutor Perini JV)

After its arrival in Seattle early in April, unloading, transporting, assembling, testing and commissioning of the 57.5-ft Hitachi Zosen TBM continued into July leading to a start of tunneling on July 30, 2013. An ILWU (Longshoremen) picket line on Aug. 20 blocked access to tunnel muck handling facilities on Terminal 46, resulting in a stoppage of tunneling after the TBM had bored 24 ft. The picket line was removed on Sept. 17 and tunneling resumed on Sept. 23. Launching of the TBM, using a launching frame and 13 temporary rings in the launch pit, was completed during the last week of September.

Key project personnel include: Seattle Tunnel Partners Executive Committee: Jack Frost and Alejandro Canga; Project Manager: Chris Dixon; Deputy Project Manager: Greg Hauser; Construction Managers: Mike Kerchner and Juan Luis Magro; General Superin-

tendent: Joel Burch; Tunnel Superintendents: Tom McMahon, Jorge Vazquez and Bill Monahan; Safety Manager: Dan Weathers. Information: Chris Dixon, (206) 971-8215.

Seattle
University Link Light Rail,
Contract U220
Traylor/Frontier-Kemper JV

This job for Sound Transit Achieved substantial completion on June 7, 2013, and consisted of a large slurry wall excavation at the University of Washington Station, from which two side-by-side EPB TBM tunnels were launched. Each tunnel is approximately 11,400 lf, with 16 cross passages connecting the running tunnels. Tunneling was completed in spring 2012 followed by completion of all 16 cross passages, tunnel concrete and permanent electrical and mechanical systems in early 2013. Final shaft concrete work and site demobilization occurred in late spring 2013. Project Director: Dave Ferguson; Project Manager: Matthew Burdick; Information: Matthew Burdick, (206) 285-8888.

structed in a tunnel driven through soil, 35 m underneath the riverbed. The 1000-m (3,280-ft) long, 3.5-m (11.5-ft) diameter tunnel will be excavated under the Fraser River at pressures of up to 6 bar using an earth pressure balanced tunnel boring machine (EPB TBM). The tunnel will be lined with 2.8-m ID precast concrete segments. The next phase of project includes lining the tunnel with 2.1-m water supply carrier steel pipe and tunnel backfill concrete in the annulus. Finally, both shafts will be topped with a valve chamber.

The tunnel will be mined from the South Shaft and will mine the tunnel to the north at a downward gradient. Subsurface conditions range from sand and gravel to silty clays. Hydrogeological conditions at the project area are controlled by the combined influences of local topography and complex geological settings. Artesian piezometric levels were measured at the South Shaft are on the order of 5.1 m above ground surface.

The project is currently 50 percent complete, both shafts have primary ground support completed and base plug installed. Final lining is under way in both shafts. Manufacturing of customized tunnel boring machine (TBM), precast concrete segments and specialized equipment for hyperbaric interventions is complete.

The design was completed by Fraser River Tunnel Group (Ausenco, Jacobs Associates, Golder Associates), with Hatch Mott MacDonald as the project manager. Subcontractors included Bencor Corporation of America (Slurry Walls), Armtec (precast tunnel segments), Lovat/CAT (EPB TBM), Hytec (Hyperbaric Equipment); and Ballard Diving and Salvage (intervention support and equipment).

CANADA

BRITISH COLUMBIA

Vancouver
Port Mann Main Water
Supply Tunnel
McNally/Aecon JV

The \$149.5 million project for the Greater Vancouver Water District was given NTP in May 2011 with final completion estimated for June 2015. The project involves constructing a new water supply main under the Fraser River, just downstream of the Port Mann Bridge. When complete, this new water main will help ensure the continued reliable delivery of clean safe drinking water to the municipalities south of the Fraser River, and will substantially increase the capacity of the existing main.

The water main will be con-

ONTARIO

Brampton
Peel Region Alcoa Feeder-
main and Mississauga Road
Trunk Sanitary Sewer
McNally Construction International

This \$32 million project for the Region of Peel was given NTP in January 2013 with a completion date of Oct. 29,

2014. The project includes the construction of three shafts and mining 7,785 ft of tunnel (4,921 ft of sanitary sewer and 2,864 ft of feedermain) through Queenston shale using a 2.6-m diameter Robbins TBM at depths reaching 225 ft.

Two of the three shafts are complete, and tunneling on the first run of the sanitary sewer is 74 percent complete. Subcontractors include Dom Meridian (open cut, 29 percent complete), Ward and Burke (microtunneling, 55 percent complete), and Subterranean (HDD, 20 percent complete).

Hatch Mott MacDonald, Genivar and Cole Engineering provided design engineering and construction management services. Key project personnel: Project Manager: Adam Stremcha; Chief Surveyor: Nick Dmintonko; Shift Superintendent: Terry Kilbride; Shift Superintendent: Jeremy Knapp; Engineering Technician: Josh VanAndel; Technician Assistant: Parminder Dod.

Mississauga **Twinning of the West Trunk Sanitary Sewer** **McNally Construction Inc.**

This \$71 million project for the Region of Peel was issued NTP on June 6, 2013, with a scheduled completion date of June 30, 2016. The job consists of 9,775 m (6 miles) of 2,400-mm (94.5-in.) diameter trunk sanitary sewer to be constructed by tunneling through rock up to 51 m deep. Additionally, 542 m of 400-mm (15.7-in.) diameter watermain is to be constructed. The caisson wall is completed for the launch shaft and excavation is under way.

Engineering consultants included Genivar (Design/Construction Manager), Golder Associates (Geotechnical Consultant), HC Matcon (Shoring), and Dufferin (Structural Concrete). Key Project Personnel include: Ajay Puri (Region of Peel), Chad Stephen (Genivar) and Jeff Reid (McNally Construction).

Toronto **Billy Bishop Toronto City Airport Pedestrian Tunnel** **Technicore Underground Inc.**

This project for the Toronto Port Authority (TPA) involves 186 linear meters of tunnel, 10 m maximum tunnel diameter, 10 m minimum rock cover and two shafts (mainland and island sides). The tunnel is being constructed in shale rock (Georgian Bay Formation).

The pre-support system for the main tunnel excavation consists of a series of seven 1.8-m diameter horizontal interlocking secant bores (each 186 m in length) using two purpose-built rock TBMs, with each being excavated and backfilled with concrete in a sequential manner. This portion of the work started in December 2012, and was completed in May 2013. This will be followed by conventional rock excavation using a Liebherr 934 excavator with rock breaker attachment and a DOSCO roadheader.

The project reached a key milestone on Friday, Aug. 23, with a ceremony and barbecue at the island shaft to commemorate the breakthrough of the 186-m-long main tunnel excavation under the Toronto Harbor Western Channel. Representatives of the owner, general contractor, tunnel contractor, private partner, design engineer and the local Toronto press were on hand for the event. Shale rock excavation of the central cut underneath the secant bore arch pre-support took approximately two months, with an average advance rate of approximately 5 m per day (two shifts per day, five days a week). The central cut excavation will be followed by sidewall excavation, rockbolting and shotcreting, invert excavation, waterproofing, and permanent lining installation.

Tunnel works, valued at \$82 million, are expected to be complete by December with overall project completion in summer 2014.

Key parties involved in the project include Forum Infrastructure Partners (private partner); PCL Constructors (general contractor), Arup (tunnel design). In addition to serving as the tunnel contractor, Technicore built the TBMs.

Key Project Personnel: Technicore: Tony DiMillo, Gary Benner, David

Marsland, Mike MacFarlane, Joe DiMillo. Design Project Manager: Jon Hurt (Arup); Tunnel Lead: Seth Pollak (Arup); Site Engineer: Andrew Cushing (Arup). Information: jon.hurt@arup.com.

Toronto **Toronto-York Spadina Subway Extension – Southern Tunnels** **McNally-Kiewit-Aecon**

This project \$90 million project for the Toronto Transit Commission was awarded in November 2010 with a completion date of Sept. 30, 2013. The project, to extend an existing subway line northward and into York, included approximately 5,400 m (17,700 ft) of tunnel using two owner-supplied Caterpillar (Lovat) EPB TBMs. The bore diameter was 6.1 m (20 ft) with a finished diameter of 5.4m (17.7 ft). The invert varied from 20 to 30 m below surface. Soils included clay, sand, silts and

mixed face conditions. Also included in the project was four hand-mined cross passages, 4.2 m (14 ft) diameter and approximately 9.1 m (30 ft) long, and three hand-mined connections to EEB shafts, 4.2m (14 ft) diameter, as well as placement of invert and walkway concrete in tunnels. At press time, all excavation was complete with final clean out under way in advance of handover to the owner.

Tunnel Designers/Administrators included Hatch, Delcan and Morrison Herschfield. Armtex served as segment manufacturer. Other subcontractors included Verdi Alliance (Concrete), Smith & Long (Electrical), Groundforce (Tunnel Spoil Removal), Salit Steel (Rebar), and AME (Geotechnical Monitoring).

Key Project Personnel: Project Manager: Jeff Reid; Project Engineer: Adam Gould; General Superintendent: Sean Gamble; HSE Advisor: Steve Brophy; Contract Administrator/Coordinator: Josh Campbell.

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