Project of the Year 2017 New Installation Winner: Rebecca Trunk Wastewater Main

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As part of an effort to keep pace with a growing population, Halton Region, located within the Greater Toronto Area (GTA) in southern Ontario, began a program to update its sewer system.

One major component of that program, the Rebecca Trunk Wastewater Main, not only represented a major step in meeting future infrastructure demands for the region, but also for microtunneling in North America.

Project Owner: Halton Region
Trenchless Design Engineer: Aldea Services LLC
Lead Design Engineer: Cole Engineering Group Ltd.
Trenchless Contractor: Ward & Burke Construction Ltd.
General Contractor: Drainstar Contracting Ltd.
Manufacturers/Suppliers: Herrenknecht (MTBM), VMT (guidance systems), Decast (jacking pipe)

The project involved more than 4 km (2.5 miles) of 1,200- and 1,350-mm (48- and 54-in.) microtunnels within Oakville, an urban and affluent town along the shore of Lake Ontario. The project included nine microtunneling drives (eight curved) ranging in length from 180 to 626 m (590 to 2,053 ft), with seven of the drives completed in rock

Due to the length of drives, number of curves, difficult ground conditions and behavior, and congested urban work environment, the project helps raise the bar in what can be accomplished with trenchless technology. As such, it has been selected as the 2017 *Trenchless Technology* Project of the Year for New Installation.

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“The project was completed in a highly congested and affluent area, so digging up roads and taking out large numbers of established trees would have been very difficult to do” said Paul Headland of Aldea Services, the trenchless design consultant for the project. “Trenchless construction was really the only way that we could accomplish the goals of upgrading the infrastructure while minimizing disruption to residents and businesses while accommodating the project specific design constraints.”

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The Project

In addition to the nine tunnel drives, the Rebecca Trunk Wastewater Main Project comprised five jacking pits and six receiving pits. Five of the nine drives exceeded 520 m (1,700 ft) in length. The drives, located at depths up to 14 m (45 ft) below ground surface, were excavated using a Herrenknecht (AVN1200 and AVN1350) slurry microtunnel boring machine (MTBM) on a grade of 0.15%. With the exception of two mixed-face drives, microtunneling was entirely through rock.

The rock drives were located within the Georgian Bay formation comprised of shales with interbedded hard layers of siltstone and limestone. The mixed-face drives comprised Georgian Bay formation and glacial till. All drives were below the water table.

Design considerations included provisions for swelling shale, interbedded limestone and siltstone (hard layers within the softer shale), high horizontal stress, areas of limited ground cover, curved and composite curved alignments (<430 m (1,410 ft) radius), and pipe requirements including provision for grout ports and watertight gaskets.

Construction requirements included a continuous lubrication system, an automated guidance system (supplied by VMT), and an MTBM equipped with rear loading cutters, a crushing chamber and a minimum required overcut to help compensate for swelling ground and curved alignment. Project constraints and key stakeholder concerns included crossing beneath regulated waterways (14 Mile Creek and McCraney Creek), tree protection and noise ordinance, ongoing and future adjacent construction, and permitting and interaction with permitting agencies (Conservation Halton and Ministry of the Environment and Climate Change).

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The project procurement comprised a microtunneling contractor Request for Qualification (RFQ) and a Request for Proposal (RFP). A total of eight contractors submitted an RFQ package and upon review a total of six contractors were prequalified. A total of four contractors submitted bids ($42.58 million, $42.62 million, $46.9 million and $64.03 million).

The project was awarded to Drainstar Contracting Ltd. as the low bidder with Ward and Burke the shaft and microtunnel subcontractor. Construction commenced in December 2015 with preparation of works areas, traffic control, construction of jacking and receiving pits using reinforced concrete caisson shaft construction method, and installation of geotechnical instrumentation. All drives were completed on Oct. 25, 2016, nine weeks ahead of the scheduled construction completion date of Dec. 30, 2016.

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Highlights

The Rebecca Trunk Wastewater Main was successful in helping Halton Region to upgrade its wastewater system while minimizing impact on businesses and residents. In addition to added capacity, the project had the added value of eliminating lift stations. Some of the project highlights included:

Curved Alignments – Due to the limited availability of jacking and receiving pit locations, presence of utilities, limited potential for lane closures and required alignments at creek crossings, curved drive alignments were incorporated into the project design to limit the number of pits, reduce the size and number of easements required, and limit impacts to businesses and residents. The nine tunnel drives included 15 total curves, including four curves on one drive (626 m in length).

Time Dependent Deformation – The injection of bentonite and swell suppressing additives into the annulus during mining operations, and performance of contact grouting using low strength grout following completion of mining operations were developed to prevent development of TDD/swelling and the resulting potential for locking of the jacking pipes in place.

14 Mile Creek Crossing – Due to the limited ground cover and the permitting requirements the pre-engineered solution included localized excavation of the creek bed, installation of a box culvert, backfilling around and over the box culvert with concrete to reinstate creek bed profile, and infilling of box culvert with low strength concrete. This box culvert was tunneled through by the MTBM during mining for Drive 3. Curved segments in the drive were mined before and after the straight section through the box culvert.

Post Award Value Engineering – The original design consisted of seven jacking pits, eight receiving pits and 14 drives. Following award of the contract, Ward & Burke proposed extending five of the drives thereby reducing both the number of pit and drive by five. The design change was approved based upon the Contractors previous performance on curved drives, and the associated benefits include reduced impact and disruption to businesses and residents, fewer expensive utility relocations, and fewer tree removals. There were 15 total curves along the nine alignments, with four curves in a single drive alone.

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Intermediate Jacking Stations (IJS) – IJSs were installed within the pipe string on all drives but no IJSs were used at any time during mining, which has an impact on the development of higher jacking forces. This is particularly impressive as the longest drive was 626 m.

Moving Forward

The Rebecca Trunk Wastewater Main marks a step forward for the microtunneling industry, showcasing the abilities of the method in conjunction with proper planning, design, construction, and management. The longest drive, at 626 m (2,053 ft), incorporated four curves and snaked through the concrete-filled box culvert, while registering a maximum jacking force of 140 tons – well below the capabilities of both the microtunneling equipment and the Decast-supplied reinforced concrete jacking pipe.

"In conjunction with the automated bentonite system and proper mud management, we were able to keep the jacking forces well below the capacity of the pipe and also the jacking force we were capable of applying" Headland said. "Ultimately, the lengths of these projects can be increased significantly. With existing technology, sound engineering, and a good understanding of the ground conditions and ground behavior, I see the industry progressively achieving longer drive lengths in the future."

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The Rebecca Trunk Wastewater Main demonstrates all that is good about the tunnel business, with sound design, open procurement for competitive pricing and intelligent review and acceptance of value engineering proposals for the betterment of the project. This collaboration with the project objectives always in mind produced a facility with a minimum of local impact, within the allocated budget and completed early for the people

of the Region of Halton.

“One of the keys was that the project team worked well together,” said John Grennan of Ward & Burke. “There was a project team workshop right at the beginning of the project where we could get together and express any concerns we had about the project. That help build relationships and set us off on the right foot.”

Jim Rush is editor of *Trenchless Technology*.