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Trenchless TECHNOLOGY 2024 NEW INSTALL PROJECT of the YEAR™

TRANS MOUNTAIN EXPANSION PROJECT

– MAJOR TRENCHLESS CROSSINGS

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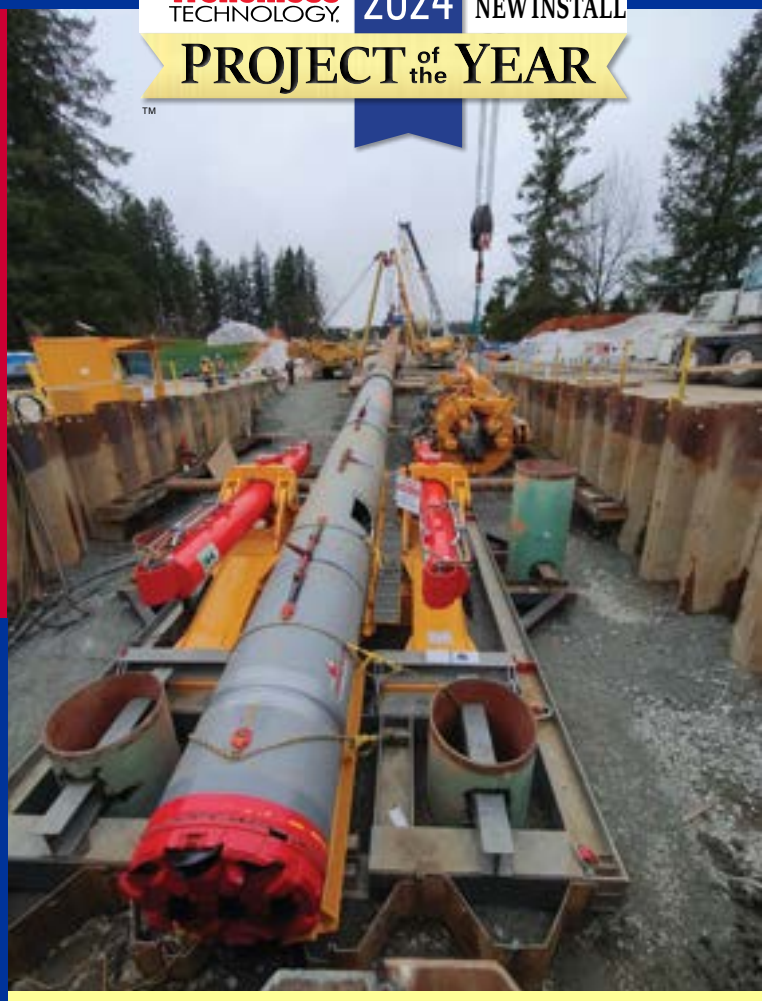
Trans Mountain Expansion Project – Major Trenchless Crossings



When it comes to *Trenchless Technology*'s New Installation Project of the Year, the winning project might be a single complex horizontal directional drill (HDD) crossing, a challenging microtunnel drive, or an outstanding Direct Pipe Installation (DPI).

By Mike Kezdi

For 2024, the *Trenchless Technology* Project of the Year incorporates all of these and more, making it standout not only for its technical achievements but also for its importance to the economies of Alberta, British Columbia and Canada.

The Trans Mountain Expansion Project (TMEP) faced many hurdles during its more than a decade of planning and four years of construction. If it were not for the successful construction of its major (and minor) trenchless crossings, the project could not have been completed.

In many cases, just one of the project's major trenchless crossings would have qualified it for the Project of the Year recipient. For this reason and many others, the New Installation Project of the Year steering committee selected the TMEP as the 2024 *Trenchless Technology* Project of the Year for New Installation.

What Is TMEP?

The TMEP is one of the largest and most technically challenging pipeline projects constructed in North America. The entire scope of work included 988 km of NPS 36-in. and NPS 42-in. pipeline, 193 km of NPS 24-in. reactivated pipeline, 12 new pump stations, 19 new tanks at existing terminals and three new shipping berths at the Westridge Marine Terminal in the Port of Vancouver.

By way of background, the TMEP was the expansion, via twinning of the existing NPS 24-in. Trans Mountain Pipeline (TMPL) that extends 1,181 km from Strathcona County (near Edmonton, Alberta) to Burnaby, British Columbia.

The original pipeline entered service in 1953 to transport petroleum products from the Alberta oilsands to the west coast of North America. It is the only pipeline that transports liquid petroleum from the basin to the west coast of Canada and is the only pipeline that gives Canadian oil producers access to export markets through a Canadian port. While not the first expansion of the TMPL, the TMEP was the largest, increasing capacity of the pipeline from 300,000 to 890,000 barrels per day.

Initially proposed in 2012 by Kinder Morgan Canada — and after several years of intense scrutiny — the TMEP commenced construction in 2018 under the ownership of Trans Mountain Corp., a Federal Crown Corp. Kinder Morgan Canada Ltd.'s U.S.-based parent company, Kinder Morgan Inc., sold its Trans Mountain operations to the Canadian government in 2018.

Since the inception of the TMEP in 2012, UniversalPegasus International (UPI) has served as the lead engineering consultant for the entire pipeline portion of the TMEP. Integral members of the UPI team since 2012 are Rob Brown,

P.Eng., project director, engineering; Jim Murphy, P.Eng., lead engineer and subject matter expert, trenchless; and Manjiri Khare, P.Eng., project manager and lead engineer.

"In 1953, which predates the completion of the TransCanada Highway, the pipeline was a real pioneering work across a lot of new territory," Brown says. "In the intervening years, huge amounts of infrastructure, industry, cities and towns have been developed around the pipeline corridor."

Identifying Major Trenchless Crossings

Based on these challenges, the UPI team knew trenchless crossings, both big and small, would play a critical role in the completion of the expansion work. But it wouldn't be easy work as the pipeline made its way west from Edmonton, where workers would be staging at roughly 700 m above sea level, through the Rocky Mountains, where they staged at a peak elevation of about 1,300 m above sea level to 0 m at the Westridge Marine Terminal on the Burrard Inlet.

Murphy was brought onboard in 2012 to assist UPI's routing team in determining where the project needed trenchless crossing. It's important to note that because the project was trying to stay as close to the original corridor as possible, this task wasn't like a typical greenfield pipeline project.

"Initially, we knew going from Edmonton to the coast there are major water crossings, but that was really the only indication at that point," says Murphy. "Crossings such as the North Saskatchewan River, Thompson River and Fraser River were classified as major trenchless HDD crossings."

In the early stages of routing, 25 crossings were proposed to be completed as HDD crossings. At that time, few DPI projects had been completed

worldwide and, as such, were not generally considered for this project.

By the time the TMEP completed the regulatory process through the National Energy Board (NEB) and later the Canada Energy Regulator (CER), construction was contingent on 156 conditions, many of which impacted the proposed construction methodologies.

In total, at completion of construction there were 75 major trenchless crossings: 35 water crossings, 24 road/highway crossings, three major railway crossings and 13 that fall under the "other" category. These crossings were completed using HDD, DPI, microtunnel and conventional tunneling. There were also three drill-and blast tunnels in Spread 5B near Hope, British Columbia. In addition to the major trenchless crossings, the project executed an additional 557 minor trenchless crossings.

As is common on most large, long-distance pipeline projects, the construction work was divided into spreads. The TMEP was divided into seven spreads with Spreads 4, 5, 6 and 7 further divided into sub-spreads.

Project Owner: Trans Mountain Pipeline Corp.

Engineer: Universal Pegasus International (pipeline and trenchless); BGC Engineering, Stantec, Thurber Geotechnical Engineering and Wood Group (geotechnical)

Contractors: Multiple trenchless contractors were utilized on the project

Value of Trenchless Project (US$): $34 billion (total project cost)

"I've always described it this way: a large pipeline project in North America has one or two major crossings," says-Sam Wilson, P.Eng, Trans Mountain Corp. "We had 75 of them, and they were all challenging in their own way."

Wilson (who joined the TMEP in 2022) was director of Trans Mountain's Trenchless Crossings Group, which oversaw all the trenchless construction work on the project. He notes that the group was formed after Spreads 1 and 2 were substantially complete and the project moved into Spreads 3 to 7, which were considered the more challenging areas of work.

Tackling the overall project management of the trenchless construction allowed for an efficient management

of schedules and resource supplies while still meeting critical construction milestones, Wilson noted.

"At our peak, we had 14 major trenchless crossings in active construction at one time," says Wilson. "And if you include the setup and demobilization, we had 19 open at one time across the whole project."

He adds that 20 percent of the crossings were in densely populated areas, meaning there were strict requirements for noise abatement, ground monitoring and restricted work hours.

Crossings of Note

While each of the 75 trenchless major crossings had its own challenges, Wilson refers to six crossings that were particularly challenging for the construction contractors and the UPI engineers working on the TMEP.

- **Fraser River Crossing** – The 1.4-km crossing via HDD, drilled by Michels Canada, took five months to install due to sub-surface conditions. The alignment was constrained as it was adjacent to the Port Mann Bridge, a critical thoroughfare spanning the river between Coquitlam and Surrey, British Columbia. This crossing was particularly challenging as an HDD was the only viable crossing method.
- **Mountain 3 Crossing** – The 2.3-km HDD crossing through excessively hard bedrock was the longest completed on the project and took two years to complete. This crossing was drilled by Direct Horizontal Drilling.
- **Dry Gulch Crossing** – This 1.8-km HDD crossing through bedrock - on the same spread as Mountain 3 - took 1.5 years to complete. The

Fibre Optic Technology

An additional component of the TMEP that added some complexity to the trenchless works was the installation of a fibre optic cable, which forms part of the pipeline leak detection system, providing an additional tool for the pipeline's safety management system.

The fiber-optic cable along the newly installed pipeline and a portion of the existing pipeline measures vibration, temperature and pipe movement, continuously and accurately.

This system helps to quickly detect very small potential leaks, identify areas where the pipe is influenced by ground movement or where the pipe has become exposed and identify external activity around the pipeline. This allows Trans Mountain to proactively address any potential threats to the pipeline

entire crossing was in an avalanche zone. The crossing was also the deepest HDD crossing on the project at almost 200 m below the exit point. This crossing was drilled by Direct Horizontal Drilling.

- **Jacko Lake Area Microtunnels** – Located near Kamloops, British Columbia, the area was identified by Indigenous groups as a spiritual and sacred location. To minimize surface disturbance, three consecutive 2.5 m outside diameter reinforced concrete jacking pipe microtunnels and one HDD were completed. The 3.4-km crossing was constructed through sand, gravel and bedrock. The crossings were drilled by the Bothar Group and The Trenchless Company.
- **Albreda Triple** – This crossing required a DPI under a highway, railroad and a river in one pass. This crossing was drilled by the Bothar Group.
- **Burnaby to Westridge Tunnel** – This 2.6-km stretch of the project took nearly 1.5 years to complete. The 4.2-m tunnel moved through clay, till and sand, conglomerate and sandstone. It has a lined inner diameter of 3.7 m and houses three NPS 30-in. pipes stacked vertically. The tunnel was engineered by Hatch, the portals were engineered by Mott MacDonald and both the portals and tunnel were constructed by McNally under contract to Kiewit-Ledcor Partnership. The pipeline installation within the tunnel was designed by UPI and completed by Kiewit-Ledcor.

With all this trenchless work on one project, coordination and teamwork were key, highlighting the importance of Trans Mountain establishing its Trenchless Crossings Group.

Of the major trenchless crossings, there were 52 HDD crossings totaling 45 km of installation, 14 DPI crossings totaling 5.8 km of installation, and approximately 3.7 km of microtunnel work. The minor trenchless crossings included smaller HDDs (referred to as HD bores), auger boring and pipe ramming and jacking techniques. These included 190 highway and 50 railway crossings, as well as other crossings of roads, utilities, watercourses and sensitive areas.

"Virtually all major trenchless methodologies were utilized on the Trans Mountain Expansion Project to deal with the myriad of geotechnical, constructability, land and environmental challenges," said Murphy. "The successful completion of the Trans Mountain Expansion Project represents not only a critical achievement of the Canadian energy industry, but also a milestone for trenchless construction in North America."

On May 1, 2024, the expanded pipeline system commenced commercial service. Right-of-way restoration work is ongoing.

The estimated project cost is $34 billion. At peak construction, there were 15,000 workers on the project. Over the 12-year span from 2012 to 2024, 35,300 workers were hired to support engineering and construction on this technically challenging project. That amounts to more than 108 million hours worked during construction.

Mike Kezdi is managing editor of *Trenchless Technology*.