

PILOT TUBE MICROTUNNELLING

Hybrid techniques restore salmon culverts



A crane lowers the HPD unit into the shaft and the 3m OD x 6m-long pipe for culvert installation arrives on site

A hybrid technique combining pilot tube, auger-bore rig and horizontal pile driving was used to install new culverts that would allow salmon easier passage between habitats. By Laura Anderson

BRITISH Columbia tunnelling contractor Kamloops Augering & Boring is enjoying great success with a distinctive combination of pipe installation methods for quick, accurate and extremely powerful pipejacking.

Kamloop's three-pass process method is a hybrid technique and uniquely its own. Once its current project is complete, it will have installed three culverts (3m OD) using this technique under Highway 1 in Langley, British Columbia (BC).

The scope of work involves replacing the Port Mann Bridge with a 10-lane structure, widening Highway 1, and upgrading the interchanges. The project encompasses a total of 37km of construction. It also forms part of BC's Gateway

Program, which seeks to reduce the area's traffic congestion and improve air quality in the Vancouver area. Construction, which began in the third quarter of 2010, has an anticipated completion in early 2014.

In February, Kamloops began installing the three large-diameter drainage culverts under Highway 1, increasing the diameter of the existing culverts more than two-fold, from 1,397mm to 3,048mm.

The Latimer Creek and Leoran Brook Salmon Habitat Enhancement Culverts project satisfies one of the PMH1's goals to protect and improve fish passage between habitats. The fish have been unable to swim through the existing culverts for the past few decades. The new culverts are the same width as the creek and will be gravel-filled to the halfway point, to fool the salmon and trout into thinking that the culverts are a natural extension of the creek.

Project timing efforts were made to ensure that the native Coho salmon and Cutthroat trout would have already migrated to the ocean and be least likely to be present in the habitat before construction began on the culverts.

The first two culverts were installed from the median of the highway, one pointing northward and one pointing southward alongside Latimer Creek. The culverts crossed two lanes of traffic plus the on/off ramps near 200th Street. The third culvert lies just west of the first site.

Installation of the new replacement culverts via open-cut methods was not a feasible option due to a required depth of 5-6m with strict line and grade tolerances in varied subsurface content. In addition, negative environmental impacts for the salmon habitat also mitigated open-cut as a technique.

Kamloops suggested the use of this three-pass innovation, involving a pilot tube machine, auger-bore rig and horizontal pile driving (HPD) unit, having had success in the past with these systems individually.

The geotechnical reports indicated there was a combination of water, sand, gravel, clay, wood and boulders up to 1.2m in diameter to be anticipated on the project. Pit seals were installed to deter water flow into the launch shaft. Generally, any one of these conditions can create resulting negative scenarios. The combined set of project geological variables, at

Overall project: fast facts

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|-------------------------------------|---|
| Project name | The Port Mann/Highway 1 Improvement Project (PMH1) |
| Owner | The Ministry of Transportation and Infrastructure |
| Project type | Design-build |
| Cost | US\$2.46 billion |
| Construction | 37km |
| Main aims | Mitigate traffic congestion, enhance safety for vehicles and pedestrians, improve environmental habitat, and re-implement public transit in greater Vancouver |
| Main elements of the project | Replacing the Port Mann Bridge with a 10-lane structure, widening Highway 1, and upgrading the interchanges |

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this diameter, presented a major challenge for the contractor.

Pilot Tube Microtunneling (PTMT) has many versatile applications beyond its standard methodology as a stand-alone system. Kamloops owns two Akkerman guided boring machine (GBM) pilot tube systems. The GBM is commonly used to provide auger-bore rig contractors with a means of achieving absolute accuracy in utility-laden soils or as a minimal commitment probing tool for uncharted obstacles.

The GBM jacking frame is mounted on the auger boring rig track, the guidance system is initiated and the pilot tubes establish the drive's line and grade. Akkerman's digital guidance system consists of a theodolite, LED target, camera and tablet PC. It provides accuracy up to 150m, although distances in excess of 183m have been reported.

The LED target is placed in the steering head.

The theodolite's crosshairs are aligned to the drive's line and grade, and the camera relays this data to the tablet PC. The tablet PC is mounted to a GBM frame where the operator assesses the target's position.

If a line and grade adjustment is necessary, the operator turns the pilot tube string in the appropriate direction, which rotates the steering head and the angled steering head displaces the ground until it is back on line and grade. The auger-bore rig then follows with casings and augers and, lastly, installs the final product pipe.

On this project, instead of an auger-bore rig product pipe installation, the contractor used a SCCI S150 HPD unit as the last tool in the sequence for the large-diameter product pipe. Kamloops also used an American Augers 48/900 auger-boring rig, and a 190 Bobcat skid steer loader for spoil removal. A 1,067mm and 3,048mm weld-on reaming head →

“The Latimer Creek and Leoran Brook Salmon Habitat Enhancement Culverts project satisfies one of the PMH1’s goals to protect and improve fish passage between habitats”



Kamloops used a 3,048mm weld-on reaming head to upsize to the 3m OD steel pipe culverts

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→ were upsized to the auger and casing and final product pipe diameters.

Shawn Gaunt, project manager with Kamloops, says: "We've completed tons of projects using pipe ramming with our GBM system and another 16 projects previously with the horizontal pile driving unit. This is the first time we've combined the three methods and are very excited about the possibilities that this melding presents to us for future projects."

The first two drives were initiated from the shaft installed in the highway's median, one pointing north and the other south. The 24m-long by 6m-wide and 5m-deep shaft was sheet-piled and did not require a thrust block.

The GBM jacking frame (mounted to the auger-bore rig) drove the 108mm custom-reinforced pilot tubes to meet the 0.54% grade tolerance for 45m. Next, the 1,067mm weld-on reaming head was welded to the last length of pilot tube to increase the diameter to meet the casings' and augers' diameter.

The GBM was removed from the rig track and auger-bore rig then, in first position, advanced the casings and augers. As sections of pilot tubes, casings and augers were advanced, they were removed simultaneously from the reception area. Spoil was reversed to the launch shaft for dirt bucket removal.

Once the casing and augers travelled the whole length across, the 3,048mm weld-on reaming head was welded into place, which matched the OD of the final product pipe. The reaming head and 6m lengths of product pipe were advanced by the HPD unit with a range of 75,000-100,000kN of jacking pressure per blow, transferring force from the HPD to the pipe segment.

The skid steer loader entered the tunnel and



Kamloops owns two Akkerman guided boring machine (GBM) pilot tube systems

removed the spoil. Once complete, the crew turned all the equipment around to begin the second 52m drive, also with a required 0.54% grade. The general contractor installed a connecting 3.6m OD corrugated steel pipe culvert from the surface that was placed on top of the two drives' launch location.

The third shaft, 4km west of the first shaft, is 30m-long, 6m-wide and 6m-deep. Upon

completion, the final drive, initiated from this final shaft, will extend 81m at a grade of 2.42%.

The geology in this area comprises many boulders, so the crew's progress has been hindered.

At the time of publication, the contractor had just begun on this culvert replacement.

"The crew reported their best daily production rate to-date at 12m"

Two crews of seven staff members each are working 12-hour shifts round the clock. The first 12-hour shift jacks pipe and the second shift welds the next pipe segment in place. They reported their best daily production rate to-date at 12m.

Gaunt said: "The results of these projects were impressive given the geology and working area. We see this simple and cost-effective system as a great solution to large-diameter, on-grade tunnelling in unconsolidated ground."

The greatest project benefit of all remains to be seen for the City of Langley, as it anticipates the return of the Coho salmon and Cutthroat trout to Latimer Creek and Leoran Brook.

Established in 1976, Kamloops Augering and Boring provides a range of tunnelling solutions throughout western Canada.

Akkerman (established in 1973) has developed, manufactured and supported quality pipejacking and tunnelling equipment that can accurately install a variety of underground infrastructure.



The HPD unit delivers 75,000-100,000kN of jacking pressure per blow

Laura Anderson is communications manager at US-based Akkerman