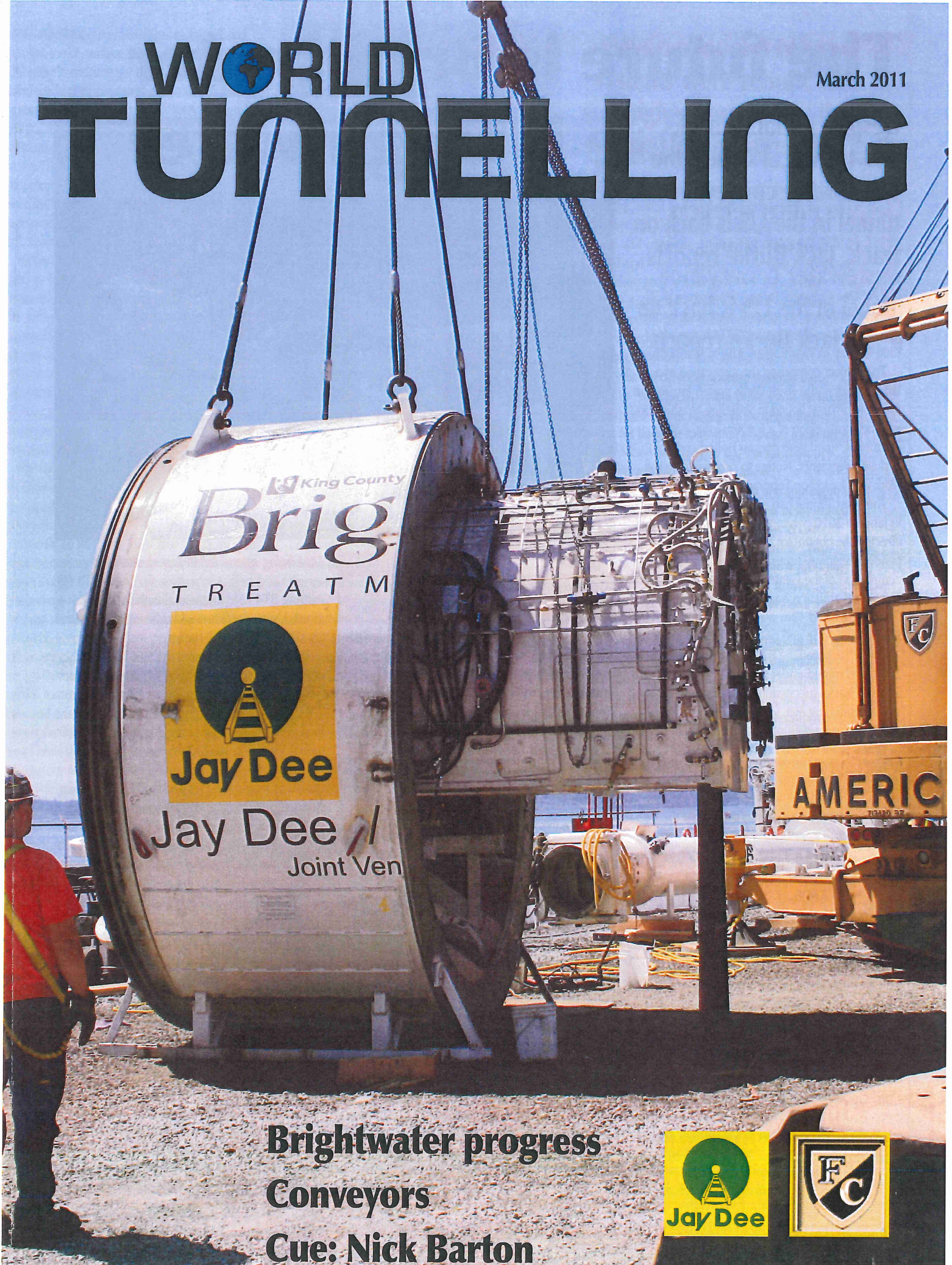


WORLD TUNNELLING

March 2011



**Brightwater progress
Conveyors
Cue: Nick Barton**



The future is Brightwater

Despite initial setbacks and technical issues, the wastewater conveyance tunnel in the US is back on track. Jack Burke reports

JAY Dee Coluccio Taisei joint venture (JCT) was employed as general contractor on the Brightwater West project (BT4 tunnel) for King County in Washington, US, in late 2006.

The project comprised the excavation of a launch shaft at the Point Wells portal, located on the shore of Puget Sound in Shoreline, Washington, and the construction of a 6,400m-long, 3.96m i.d. tunnel, lined with precast bolted and gasketed segments. Notice to proceed with the work was issued on February 20, 2007.

The West Tunnel had almost been excavated in January 2010, when the owner, King County, directed the contractor to stop the advance pending ongoing discussions regarding the completion of the Central Contract's BT3 tunnel. The tunnel advance was halted in early February, around 43m west of the Ballinger Way Shaft (BWS) – the end point for the BT4 tunnel.

The JV launched the BT4 TBM on September 8, 2008, and mined under the Burlington Northern Sante Fe tracks successfully, 18m from the tunnel launching eye, with minimal cover and without causing disruption to the tracks.

When work stopped on February 3, 2010, the JV had completed 6,358m of segmentally lined tunnel. The best month achieved 392 rings or 597m, with the best week making 177m and the best day 40m.

The BT3 tunnel was under contract with another joint venture (Central Tunnel Contract). Mining on the BT3 tunnel had been halted since June 2009, due to wear on the rim bar of the TBM. The BT3 tunnel was planned to hole into the BWS from the east side, approaching from the Kenmore Portal. The Central Contract TBM had advanced about half of the length of the 6,100m BT3 tunnel and was then stopped some 3,000m east of the BWS.

As of early 2010, King County was faced with the decision of whether to continue with the original contractor and the BT3 TBM, or to seek



Brightwater BT3 completion contract

General contractor	Jay Dee Coluccio JV
Owner	King County, Washington

an alternative means to complete this section of the BT3 tunnel, now the only portion of the outfall tunnels that was unexcavated. One option was to make the BT4 TBM continue past the BW tunnel, mining from west to east, and complete the BT3 tunnel to the stalled BT3 TBM.

Negotiations between King County and JCT resulted in a cost-plus-fixed-fee type of contract (with incentives), which was substantially below the cost and time that had been estimated to complete the run with the damaged BT3 TBM.

The new BT3 completion contract was finalised between Jay Dee and Coluccio in accordance with prior commitments. Taisei was unable to participate and chose to drop out of the JV that would contract to complete this section of the Brightwater Project. Consequently, the new joint venture, Jay Dee Coluccio (JDC), was given notice to proceed on April 12, 2010, with a contract value of just under US\$69 million.

During the time from early February until April 12, JDC had been engaged with the TBM manufacturer, Lovat (of Toronto, Canada), to devise a plan and cost estimate to adapt the

TBM being assembled in launch shaft

existing BT4 TBM to contend with the higher ground, water pressure and different soil conditions of the BT3 tunnel.

Lovat evaluated the existing BT4 TBM, and developed a suitability report that identified the necessary improvements and revisions to the TBM. JDC was also engaged in freezing the launch eye and starter tunnel for the new BT3 C tunnel for a distance of 30m east of the BWS. Previously, the hole-in eye to the west of the shaft was frozen for 15m and the TBM had been stopped prior to entering this zone.

Following notice to proceed in April, JDC and Lovat began to modify the TBM and trailing gear to allow the machine to excavate the BT3 tunnel. Modifications included the addition of three sections of trailing gear gantries to accommodate an additional transformer, sump and discharge pumps, cable tray and other gear for the BT3 C tunnel, which would now be driven downhill from the BWS in a west-to-east direction. This differed from the original design of the central section.

JDC also installed an additional California switch just west of the BWS, and proceeded with the refurbishment of the rolling stock and conveyors at the Point Wells Portal.

The freeze for the launch eye and starter tunnel to the east of BWS was completed in early June, and the TBM was advanced into the BWS, holing out on June 18. The freezing system was in place and continued to freeze the ground to the east, →

“The West Tunnel had almost been excavated in January 2010, when the owner, King County, directed the contractor to stop the advance”

→ while the TBM cutterhead was removed and brought to the surface. Over the next four weeks JDC rebuilt and strengthened the cutterhead to stand the higher pressures of the BT3 C tunnel.

For the west contract, the TBM had been designed in anticipation of ground and water pressure to a maximum of 5bar (about 72.5psi). As the TBM had been designed to withstand a maximum pressure of 6bar (87psi), to address the conditions expected in the BT3 tunnel, it had to be rerated and certified to operate at up to 7.3bar (106psi).

At the same time, the hydraulics and other systems were rebuilt to suit higher pressures and generally repaired after the initial 6,400m run. The rolling stock was rebuilt. Additional locomotives were purchased from Obayashi in Atlanta and shipped for rebuilding. While the cutterhead was being rebuilt, the bearing seals were removed and checked for wear. Three of the four seals in both the inner and outer race of the bearing were replaced; minimum wear was detected in the first of each seal group.

The cutterhead was replaced on July 30, and the TBM was pushed ahead into the launch ring by August 5, to allow for the replacement of the articulation joint seals.

In order to push the TBM into the launch seal, it was necessary to decommission the freezing system on the BT3 side of the shaft as of August 2. At the same time, JDC added an additional 6m-long section of screw conveyor and an extra guillotine gate on the TBM; again to counter the higher anticipated pressure. After the forward articulation seal was replaced, the TBM was pushed further to the east, and the stabiliser fin seals and passive articulation joint seal were also replaced. The TBM was once again pushed ahead until the tail can was exposed in the shaft.

Once the tail can was in the shaft, the segments and existing tail seal brushes were removed, and the tail can itself was extended another 300mm to allow a fourth row of tail seal brushes to be installed. All of the grout and tail seal grease tubes had to be extended and the new tail seal brushes were welded into place. All of this was accomplished by early September, along with upgrading the shaft conveyors at Point Wells and bracing the segments through the BWS.

By September 13, JDC was making the final adjustments to the computer and guidance system in anticipation of mining by September 20. The JV was also chasing a minor leak in the cutterhead centre swivel, which appeared to be a loose fitting or some such minor issue.

By September 17, it became apparent that the minor issue of a leaking fitting on the swivel was



Muck hopper

much more serious. As a result, the centre swivel was removed and sent to Lovat in Toronto for rebuilding. This became even more serious after the manufacturer disassembled the swivel in the shop and found serious wear that required its complete rebuild. Through tremendous efforts on the part of Lovat working round the clock, the swivel was returned to Seattle late on the night of September 29. It was installed and tested the following day to allow JDC to start mining and remove the TBM from the BWS.

Having mined out of the BWS on September 30, JDC had achieved Milestone 1 under the contract and earned the incentive payment. On October 1 and 2, JDC replaced the full face of cutters with a new dressing as the old, worn

“Hydraulics and other systems were rebuilt to suit higher pressures... the rolling stock was rebuilt”

ones had been used to go through the seal and mine the initial few sets east of the shaft. In addition, the shaft seal was grouted solid.

JDC will continue mining out of the frozen ground and move forwards to the east until all of the trailing gear is past the BWS. When that occurs – expected in mid-October – JDC will move the ventilation system up to the BWS to provide fresh air to the heading, which will also blow back towards Point Wells. All of the muck will continue to be transported through the tunnel to Point Wells. From there it will be taken to the muck bin for storage prior to loading on barges for haulage to its final disposal location at the MatsMats quarry of Cal Portland on the Kitsap Peninsula, near Port Ludlow.

By clearing the frozen section and mining full bore, more than 305m of tunnel has been mined and supported, as of the writer’s visit in late November. The reception area where the two tunnels will meet will be frozen from within the mined and supported section of BT3, the cutterhead removed from the stalled TBM and the inside components salvaged.

A 351kg/cm² (5,000psi) concrete plug will be placed to fill the machine and the annular void when the Lovat TBM mines into the shell, with 75-100mm to spare around the periphery and into the completed tunnel. JDC expects to mine into the BT3 TBM by early September 2011.



Lovat TBM in workshop

The writer wishes to thank Greg Hauser, project manager, for all of his invaluable assistance and for supplying detailed information on this project. The entire crew on the project must be recognised for their help: Tom McMahon (general superintendent); Martin Vales; Eucario Ramirez; Greg Olsen (project engineer); Mina Shinouda (tunnel engineer); Peter Wang and Will Hodder (tunnel engineers); Rick Sutton (safety); Renee Halley (office manager); Bill Austell (Coluccio Construction); Brad Cowles (Jacobs Engineering); Judy Cochran (King County), project representative.