



# COLLABORATION DELIVERS ONE OF UTILITY'S MOST CHALLENGING REHABILITATIONS

Leading infrastructure partnership John Holland-KBR JV and trenchless delivery partner Interflow have collaborated to deliver one of Melbourne Water's most challenging pipeline rehabilitations. The successful delivery required the project team to adapt its processes, products and technology to cope with confined conditions, the depth of the asset, as well as the presence of bends within the infrastructure.

Constructed in 1932, the North Yarra Deviation is a deep section of sewer located under the Stony Creek Backwash, at the point where the creek meets the Yarra River below the iconic West Gate Bridge. The asset, which transports 15–20 per cent of Melbourne's sewerage, at approximately 1,700 L/s during peak dry weather flows, is managed and operated by Melbourne Water.

The sewer is approximately 573 m long with a diameter of 2.6 m, at a depth of 15–20 m. The deviator was constructed in a tunnel with a triple brickwork bend at each end, 85 m each, and a 407 m concrete conduit in the middle.

As the downstream network has been upgraded, the upstream sewers have been surcharged, causing the North Yarra Deviation's inside layer of brickwork to wear. Over the past two decades CCTV inspection has been carried out on a biennial basis to monitor the condition of the asset.

A 2016 inspection revealed some of the inner layer of bricks at each end had delaminated, and as a result, in January 2018, Melbourne Water awarded a John Holland-KBR Joint Venture (JH-KBR JV) the AU\$14 million contract to restore the asset to full strength.

The design and construct on contract was completed in March this year. It required JH-KBR JV to produce a solution that extended the life of the sewer by at least 50 years. Melbourne Water stipulated a

structural rehabilitation, meaning the solution had to be designed to bear all loads in the event the existing structure failed and was no longer able to support its own weight.

The works had to be undertaken within a specific timeframe to accommodate works required by the West Gate Tunnel project, a largescale transport infrastructure tunnel. It was also stipulated that works could not reduce the sewer's flow capacity and that the sewer system in the region remain in full service during the rehabilitation.

The size, condition, depth, flow capacity and location of the asset, along with its confined nature, made this one of the most challenging projects undertaken by Melbourne Water to date.

## CALLING IN THE EXPERTS

To complete the relining of the sewer and the rehabilitation of associated maintenance holes, JH-KBR JV called in trenchless delivery partner Interflow, a leading provider of customised solutions for water infrastructure networks. The company uses patented technology supported by world-leading products and techniques, that eliminate or minimise the need for excavation.

Interflow assessed suitable technologies capable of delivering the project – including using a cured-in-place pipe liner and segmental slip lining – and concluded the SPR™ PE - Ribline spiral wound lining system, available in Australia and

New Zealand exclusively through Interflow, was the most practical option from an installation and service perspective.

The technology, which results in a structural composite steel reinforced polyethylene spirally wound pipeline, is ideally suited for large diameter pipe renewal as a result of its high strength to weight ratio. In accordance with international standards for sewer relining, calculations, including adjustments based on the verified condition of the asset, confirmed SPR PE – Ribline had sufficient strength to withstand all loads on the sewer in the event the pipeline failed.

Further calculations showed the liner met the design specifications, leading Interflow and JH-KBR JV to produce a plan for Melbourne Water that demonstrated the liner could be installed while meeting all project requirements.

While SPR PE – Ribline can be installed with some flow in the pipeline, bypass pumping was needed on this project to limit these flows to practical levels and maximise working windows to enable works to be undertaken safely. Undertaken by Welltech Total Water Management, it was a challenging procedure due to the volume of sewerage, the depth of the sewer and the above ground location of the project.

**INSPECTION AND CLEANING**

Large volumes of silt and debris needed to be removed from the sewer before the liner installation could commence. Sewer depth, flow conditions and the type of debris – silt mixed with bricks and other large objects – made this a complex process.

Prior to this work commencing, laser and sonar profiling was used to determine the condition of the asset, including the level of deterioration, dimensions and the depth of silt and debris in the invert. Sonar allowed the operators to measure the conditions below water level, without the need to reduce flows or man entry.

The inspection showed the presence of silt and debris up to 500 mm deep, and wall delamination of up to 125 mm. Debris included sheets of bricks that had delaminated from the sewer wall and some large objects that had inexplicably found their way into sewer.

Silt is commonly removed from sewers by

high-pressure water jetting, while for larger sewers, manual methods involving shovels and carts are often used. For this project, Interflow used one of its Kanga excavators, which was adapted to facilitate the safe and efficient removal of silt.

The excavator’s bucket, which is wheeled, open-ended, removable and shaped to match the tunnel invert, was attached to the front of the Kanga and pushed up the sewer collecting silt as it progressed. When at capacity, the bucket was transported back to the access chamber.

The removable container was then lifted to the surface by crane, allowing the silt to be deposited securely in a sealed bin ready for disposal off site. Making safety a key priority, Interflow incorporated a remote-control system into the Kanga, allowing the excavator to be operated from the base of the access chamber without an operator needing to enter the deteriorated sewer.

As well as the safety benefits of less man entry into the dangerous work environment, the innovative choices resulted in major productivity improvements, with up to 22 t of silt and debris able to be removed in an eight hour shift, a four to five fold increase compared to jetting or other available methods.

Elsewhere, maintenance holes and access shafts required cleaning, and coating with calcium aluminate cement. The application of this cementitious material was a major component of the project, with two shafts more than 5 m in diameter and up to 18 m deep requiring it.

**A FLEXIBLE SOLUTION**

While Interflow has a wealth of experience installing SPR PE – Ribline in deep sewers of a similar diameter in live flow conditions, this installation was complicated by the two 45 m sections of the sewer deviating through 80° bends on a 30 m radius. As spiral wound systems are typically designed to be installed in straight lines, the liner profile was adapted to continuously wind through the bends.

SPR PE - Ribline’s lining strip has three ribs over its 126 mm width, with a continuous steel strip is encased in each rib. To enable the liner to navigate the bends, the steel strip was omitted from one of the ribs, which is slit at its base.

As the liner was wound around the bend, the slit rib opened slightly on the outside and

closed on the inside. This allowed the profile to stretch or compress as it passed through the wide side and tight side of a bend, creating a concertina effect.

**BYPASS PIPELINE**

During the relining works, the major environmental consideration that needed to be addressed was the movement of sewerage. There was no alternate route for the flow meaning the pipeline had to remain in service for the duration of the project.

Given that the installation of SPR PE – Ribline does not need to take place in a completely dry pipeline, Interflow’s solution ensured the work could be completed without risk of overflow, spillage or issues with odours.

The JV utilised information from Melbourne Water and studies of flow conditions in the utility’s other sewerage infrastructure to develop a flow management plan. A 570 m bypass pipeline was subsequently installed to move the sewerage around the works from an upstream maintenance hole to a downstream maintenance hole.

**PRIORITISING SAFETY**

Over the course of the project, all stakeholders, demonstrated a high level of maturity through safety leadership, ownership of safety challenges, care for each other and thorough planning and risk mitigation.

The nature of Interflow’s speciality means employees are often involved in work defined as high risk. In order to protect workers – the organisation’s most valuable resource – the company makes safety paramount on a daily basis and is always looking to improve its practices. Interflow has positioned itself as a leader in this space, with the introduction of its Harm 2 Zero (H20) program in 2018, which aims to further enhance the protection of not only workers, but also the general public in proximity to where work is taking place.

According to the company, H20 has transformed the safety culture within the business, as it recognises risks, identifies measures to mitigate those risks and incorporates checking procedures to ensure such measures are properly applied. The relining works were carried out using Interflow’s Safety Management Plan, a 190 page document that was prepared in

accordance with AS/NZS 4801. All of the company’s site management personnel involved in the project were trained in the use of the plan, which addressed:

- identification of hazards generic to Interflow’s sewer rehabilitation tasks and specific to the project
- assessment of risks associated with those hazards
- safety measures and controls for the hazards and risks
- nomination of responsible persons and assignment of roles.

Due to the toxic hydrogen sulphide gas emitted from flowing sewage, which can have a detrimental effect in confined spaces, constant monitoring of the air quality in the sewer was essential. Every team member entering the sewer carried a gas monitor and emergency breathing apparatus that could be used in the

event the gas detectors were activated.

Airflow control curtains were installed in maintenance holes upstream and downstream of the section of pipeline where the work was being carried out. The curtains comprised heavy pieces of artificial turf hinged at the top of a fan, forcing air into the sewer.

At the opening of an upstream maintenance hole, an extraction fan was placed to remove air from the sewer at the downstream manhole.

By taking these steps to prioritise safety, JH-KBR JV and Interflow achieved an excellent result, with no recordable injuries and a zero total recordable injury frequency rate (TRIFR).

**SUCCESSFUL DELIVERY**

Having undergone rigorous testing and meticulous planning, the project is regarded

as one of Melbourne Water’s higher risk and more challenging projects to date and was delivered with no TRIFR, ahead of schedule and on budget. Approximately 75 per cent of the work was completed in confined space, which was successfully navigated safely by an experienced project team, expert subcontractors and best practice processes and systems.

The project also featured the first installation of SPR PE – Ribline around corners and wouldn’t have been possible without the use of the Kanga excavator, customised with a unique and tailored excavation bucket.

Together JH-KBR JV and Interflow look forward to delivering more design and construct pipeline rehabilitation projects for Melbourne Water as part of Melbourne Water’s sewerage strategy. T

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