

Weald Road Tunnelling Works

carried out underneath active residential properties

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Burgess Hill is a town in West Sussex, located 10 miles north of Brighton. In the 1950s the picturesque former parish - which contains two nature reserves - underwent a period of rapid expansion, earning it the temporary title of the 'fastest growing town in South East England'. At the last census Burgess Hill had a population of more than 28,000. However, the peaceful idyll was shattered last year when several properties reported extensive foul flooding to Southern Water. The foul flooding was first reported in February 2006, following a period of wet weather, when driveways and gardens of houses at the low lying end of Poveys Close suffered severe sewerage inundation due to the surcharging of the local sewer network. In some cases the effluent entered properties through air bricks and there was concern that the flooding would threaten a neighbouring junior school, a local pond and a natural water course. Southern Water quickly responded by carrying out an investigation, anticipating the cause to be a simple blocked sewer. However, when jetting of the local sewer pipe resulted in damage to one of the Supa-Sucka rigs, all the evidence pointed to a more serious cause of the flooding.



Weald Road - Timber heading works in progress

courtesy Ross Fisher - Mouchel Parkman

Cause of the damage

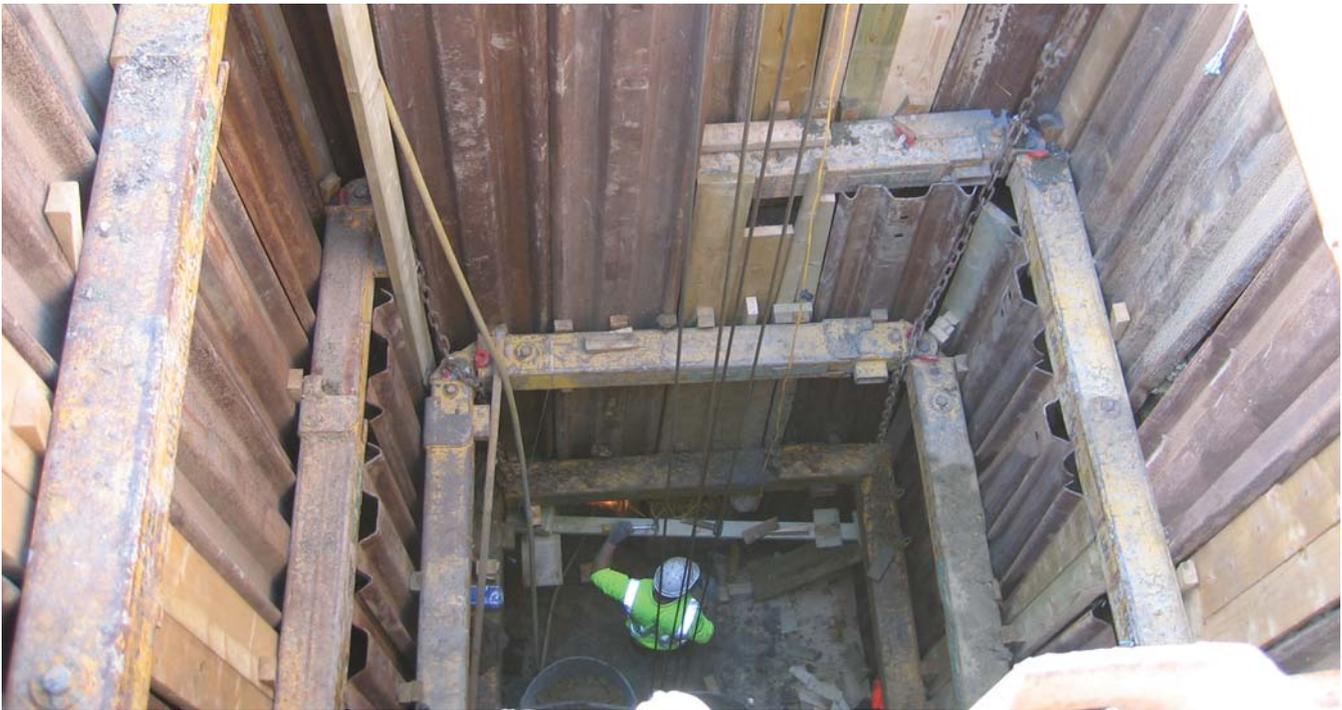
Southern Water's subsequent survey soon identified that **part of the downstream sewer pipe, located 100 metres from the area of foul flooding was blocked with structural concrete, situated immediately below a semi-detached family home.**

The sewer had been damaged by a third party building contractor during the installation of pile foundations for a small house extension, carried out four months before the first reports of flooding. The piles had breached the sewer pipe, located seven metres below ground level, resulting in the 450mm diameter sewer pipe being in-filled with

concrete. Small gaps within the sewer pipe had become blocked during the winter months, resulting in wastewater flows surcharging from the lowest lying upstream properties.

Remedial options

Southern Water asked Holleran Mouchel Parkman Joint Venture to carry out a remedial investigation. A temporary pumping station and rising main were promptly installed to maintain flows and minimise ongoing flooding. The temporary pumping station was installed in the upstream manhole nearest to the blockage, in a residents back garden, to help maintain suitable levels of service. Sewerage flows



An eight-metre deep drive pit approaching full depth

courtesy Ross Fisher - Mouchel Parkman

were then diverted via a shallow rising main, which discharged into the nearest downstream manhole from the blockage. The pumping station was supported by two tankers, which were on standby in case of a pump failure and on hand to support the pumping during periods of heavy rainfall.

A number of options for a permanent solution were identified and evaluated. These included building a new sewer network, which would cause major disruption to the local community, and in-situ dig-down repair requiring the sensitive compulsory purchase and subsequent demolition and rebuild of four properties. Another option involved up-sizing the temporary pump-station set-up into a permanent fixture. However, to install a permanent pumping station at eight metres in depth in a residential area would have been costly and extremely disruptive to local residents.

A fourth option involved the in-situ repair of the sewer via a timber heading. Although this option was not a conventional sewerage design solution and was initially identified as being 'high risk', a fuller evaluation showed it to have a number of key benefits. These included minimal disruption to the residents, least capital cost and the most cost effective long term solution. It also offered the shortest programme duration which would result in the earliest re-instatement of the sewerage network. Following site investigations to confirm ground conditions, this was selected as the preferred option.

The in-situ repair solution involved sinking a seven and a half metre deep drive pit located 20 metres from the blockage and adjacent properties. From this shaft a timber heading could be driven beneath a private garden to the blocked sewer beneath the domestic property. This posed a significant challenge given that tunnelling would be required directly below the inhabited residential properties, while constantly paying close attention to the health and safety of the public and the on-site team.

Excavation

At the end of the summer, open excavation started with the support of specialist deep shaft and tunnelling contractor *Chardan Contracts*. The in-situ repair works, located at the end of a cul-de-sac, caused minor disruption to four houses, one of which was the property with the erroneous piled extension. However, with power cables immediately overlying the site, just two items of mechanical

equipment could be used throughout the entire works - a compressor powered jackhammer and a small crane.

For safety reasons, the initial three-by-three metre drive pit had to be located at least 20 metres from all four properties. Working between 8 a.m. and 4 p.m. to avoid the school rush hour and unsociable evening hours, this took just over three weeks, requiring steel sheeting to be put in place for support and using timber for support areas around smaller sewerage pipes. The dense clay to a depth of five metres overlying mudstone to a depth of eight metres, was self supporting enough to be stable during the heading works while not requiring significant manual effort to excavate.

The tunnel undermined two properties as it reached the sewer pipe. The heading was then driven down in both directions along the line of the sewer, breaking out the concrete and damaged pipe. The erroneous pile foundation was then trimmed back and supported with a steel bridge, which diverted its point load to below the invert of the sewer. Following the removal of the blockage, a 6 m length of 450mm diameter sewer was re-laid and the surrounding void packed with lean-mix concrete. The entire length of the sewer between manholes was then structurally re-lined, increasing the lifespan of the sewer by at least a further 50 years.

All permanent remedial works were completed in November 2006, with contractors and residents celebrating the success of the scheme by holding a street barbecue.

Reflection on engineering solutions

Excavating underneath fully habitable residential properties was a challenge, and extensive geotechnical consultation was required at every stage. Intriguingly, despite all the technology at our disposal, age old tunnelling techniques were identified as the preferred remedial option when considering health, safety, speed, cost and overall disruption to the local community. The residents had been through a very stressful period, but the simplified methods used during the works were clearly a complete success. ■

Note: *The Editor & Publishers wish to thank the authors of the above article Ross Fisher, Project Manager & Mike Kay, a design manager, both with Mouchel Parkman plc, as part of the Holleran Mouchel Parkman Joint Venture.*