# Tunnelling & Sewer Connection Case Study

Power + Line (P+L) installed a sewage outfall to a housing development in Purley, Surrey. This outfall was unconventional due to the position of the existing main foul sewer, which ran under a busy bus route. Undertaking the work required driving a hand-dug tunnel / heading of 15 metres into a chalk embankment at an average depth of 7 metres to connect to the main sewer.

*Service shaft with crash deck*

We began by carrying out a survey of the existing foul sewer below the main road. This involved delivering leaflets to local residents, raising the existing manhole covers with 50 tonne jacks and carrying out an accurate measurement of the inverts in the manholes to establish the fall of the sewer. We then used rod-mounted electronic location sondes and detectors to establish the route of the sewer.

All works in the live sewer were carried out by in-house personnel trained in confined space work with all appropriate PPE and Weil disease certifications.

We calculated the intercept position and depth of the existing sewer from the results of the survey. This provided the information we needed to sink the service shaft in the property adjacent to the road containing the sewer. Initially, a 4 metre x 3 metre shaft was dug by a 6 tonne hydraulic excavator. This machine also assisted in the installation of heavy baulk timbers and a timber shoring box into the excavation.

Due to the loading restrictions on the bank of the excavation the largest allowable machine did not have an arm long enough to fully reach the required depth of the excavation. A crash deck protection landing was fitted to the shoring structure and the excavation was completed by hand, with the spoil lifted out in mini skips by the excavator. Operatives carrying out this work were regularly briefed on the dangers of working in confined spaces and always carried their air monitors and emergency escape kits with them. We also had fans on the surface, mounted near the shaft entrance to force fresh air into the excavation.

Once the required depth had been achieved in the service shaft, a concrete floor with sump was installed and a large opening formed in the shaft wall. This formed the entrance into the chalk face of the horizontal shaft that was to be driven by hand to meet the 9” trunk sewer pipe. Operatives then excavated into the face of the shaft. About every 0.500mm as the shaft progressed a timber bearer was installed on the floor of the tunnel, 2 No 6” x 3” timbers (bites) fixed with timber screws vertically from this and a 6” x 3” timber (head tree) placed on top of these. When two of these structures were constructed the intervening space between the bites was made up

with 6” x 1” timber planks. These were placed behind the bites and the resulting void filled with excavated material and compacted by hand until the ceiling was reached. Similarly, 6” x 1” boards were fitted between the head trees, spanning the roof of the tunnel. The void here was also packed with excavated material to eliminate voids behind the timber tunnel support. These timbers were treated and are guaranteed to last 100 years underground.

*Tunnel formed to access main sewer*

This process was repeated until the 9” main trunk sewer was exposed, with the excavated spoil being removed from the tunnel shaft via a light rail bogey system.

Fresh air was constantly forced into the tunnel. Every morning time was given to ventilate the shaft and tunnel prior to the start of a new shift due to the possibility of carbon dioxide building up in the

enclosed space of the shaft.

Once the 9” trunk sewer was exposed within the tunnel, operatives wearing appropriate PPE cut a section out of the live 9” pipe and quickly fitted a 9” easy Y connection with two Viking Johnson connectors. Once the connection was made the entire connection was dry packed with lean mix concrete and left to stand and cure. Then 6” pipe sections were connected to the Y junction. Lean mix concrete was packed and haunched around each pipe as it was laid. Once this was cured, arisings from the original tunnel excavation were reimported and packed around the 6” pipe, leaving the timber tunnel support frame in place. This was not removed. This process was repeated until the tunnel was completely filled and compacted resulting in the 6” sewer pipe emerging from the wall of the shaft. Operatives then backfilled and compacted the floor of the service shaft and brought it up to just below the level of the new 6” sewer pipe.

Finally, operatives removed the remainder of the shoring and closed off any remaining holes.