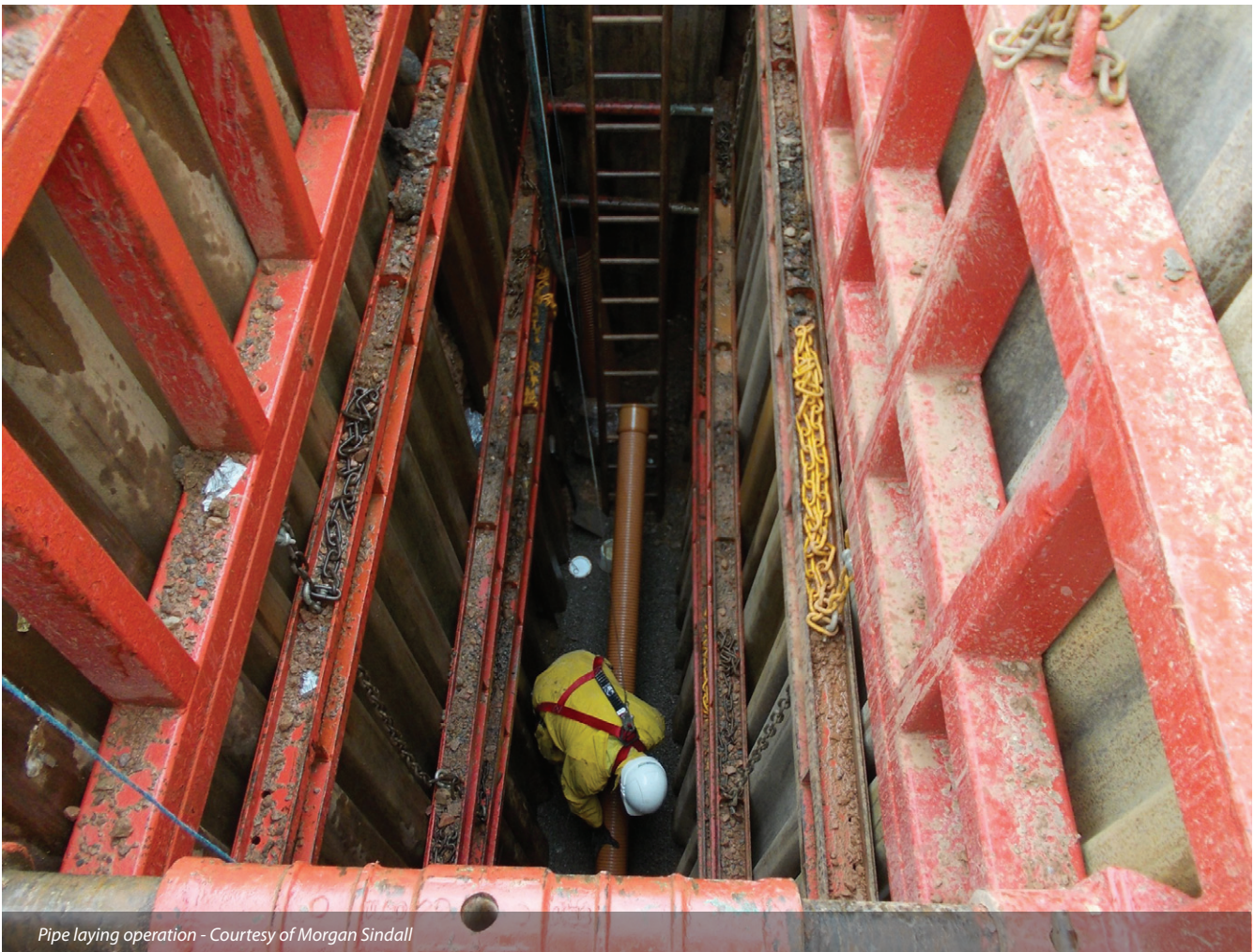


Beachley First Time Sewerage Scheme

provision of a new public sewerage system for 110 properties under Section 101A of the Water Industry Act 1991

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Beachley is located approximately 2.5km south east of Chepstow, on a thin neck of land between the River Wye and River Severn. Residential properties in the area are served by a mains water supply but have a private sewerage system. An application for public sewerage for the properties was made on the basis of repeated blockages of, and flooding from, the private sewerage system together with pollution of the Slimeroad Pill by untreated effluent. Investigations confirmed pollution and the poor state of the existing private sewerage system. Therefore Dŵr Cymru Welsh Water has constructed a new public sewerage system that enables all properties in the area to connect.



Pipe laying operation - Courtesy of Morgan Sindall

Background

When the development of housing commenced in the 1960s, approximately half of the houses opted for a shared septic tank system, which originally served around twenty properties. Over time more houses were built and added to the shared system, bringing the total connected up to forty-five. Problems with blockages started occurring in the 1980s.

The six terraced properties at Buttington Terrace also connect to their own shared system with a septic tank. This shared tank discharges into the outfall from the main shared septic tank.

Investigations by Dŵr Cymru Welsh Water confirmed the presence of pollution in Slimeroad Pill. There was also evidence of further

sewage related pollution around the septic tank itself. Further along and beneath the hedge line in which the tank is situated, the ground was found to be particularly boggy and odorous. There were discarded pipes lying in the field at this location.

The remaining properties located along Beachley Road, Buttington Terrace, Loop Road and Inner Loop Road, not connected to the private sewer, have either their own, or shared (with immediate neighbours), septic tanks and soakaways.

Given the age and type of soakaway that these properties have, combined with the poor suitability of the ground conditions for effective soakaway, it is likely that problems could arise as a result of seasonally high water tables.

Soil percolation tests confirmed that the geology at Loop Road and Inner Loop Road is not suitable for drainage of septic tank effluent via soakaways. Discussions with property owners indicated that a great majority of these septic tanks cause problems and their properties and gardens occasionally become flooded with raw sewage.

Site investigations

Details of the existing private sewerage system were confirmed by carrying out connectivity surveys, manhole surveys and CCTV surveys. The investigations confirmed that properties connected to the communal septic tank have 100mm diameter lateral drains (PVC, vitrified clay or pitch fibre) connecting to 100mm or 150mm diameter pitch fibre collector sewer via branch connections or manholes.

The final sewer, taking combined flows to the private septic tank, is a 150mm diameter pitch fibre pipe. The collector sewers are shallow, with depths varying from 0.23m to 1.50m (in most locations between 0.5m and 0.8m). The pipes were laid with gradients varying from 1 in 50 to 1 in 500, with the majority slacker than 1 in 150. Six properties connect to collector sewers via saddles, the remainder have separate manholes. Twenty-five properties have roof rainwater connections joining the sewer network.

The CCTV survey indicated that the existing collector sewers were in poor condition: some partially blocked (fat deposits and sediments), there were numerous displaced joints (roots ingress) and a number of pipes were deformed.

LiDAR (Light Detection And Ranging) data on a 1m grid was obtained for most of the site, which was used to understand the topography for an initial assessment of possible drainage routes. This data was then confirmed by a topographical survey for the detailed design.

Utility searches were essential to determine the proposed alignment of the new sewer. These were complemented with trial trenches to confirm the positions of services in key locations.

Beachley is within or adjacent to a number of sites of natural beauty and interest. The Severn Estuary is a Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site and Site of Special Scientific Interest (SSSI). The River Wye is a SAC and SSSI and nearby Offa's Dyke is a Scheduled Ancient Monument (SAM). Ecological habitats were identified in the project area alongside the potential for breeding birds, otters and bats. Consultation with the local authority also identified that an area of late iron age/early Roman settlement has been found at Buttington Terrace.

Options

Three options were considered for the collection and disposal of sewage from the Beachley area. These were:

- A gravity system discharging into an existing public sewer.
- A gravity collection system with pumped discharge into an existing public sewer.
- A gravity collection system with a treatment plant discharging into a local watercourse.

The nearest public sewerage network is located in Sedbury approximately 1km to the north. Because of the local topography, it was not possible to provide a new gravity sewer connecting into the existing public system.

Three destinations were considered for a pumped discharge from a gravity collection system:

- The existing public sewerage network at Sedbury.
- The existing sewage pumping station at Sedbury.
- Injection into a foul pumped main west of Beachley.

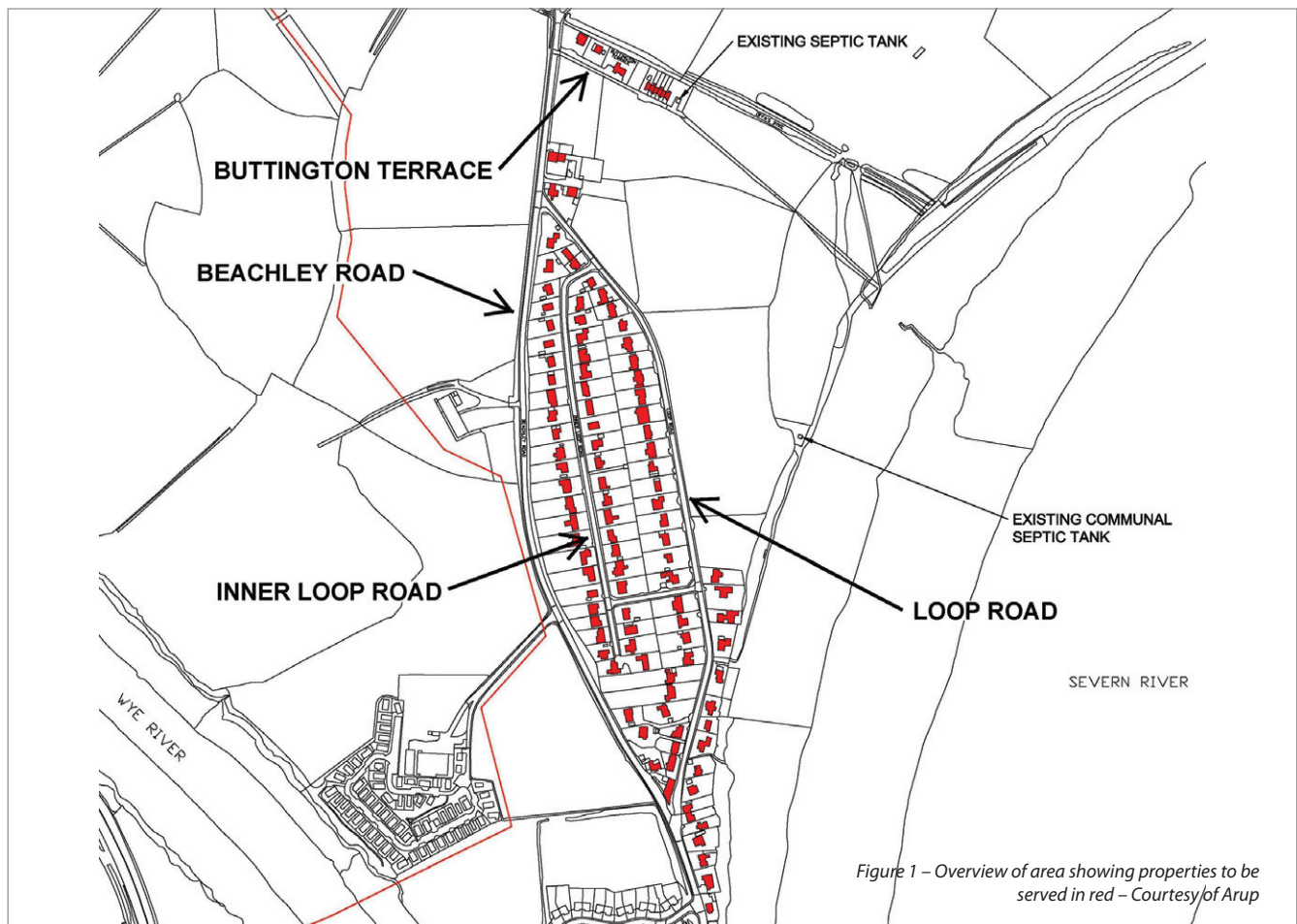


Figure 1 – Overview of area showing properties to be served in red – Courtesy of Arup



Main sewer with Y-junction for lateral connection
Courtesy of Morgan Sindall

Connecting to either the public network or sewage pumping station in Sedbury was ruled out due to the proximity of construction to Offa's Dyke.

The feasibility of pumping into the existing foul pumped main was confirmed in order that this option could be progressed further.

The treatment plant option would use a package plant to treat domestic sewage to the standard required for discharge to a local watercourse. Discharge into the Severn Estuary was unlikely to be permitted due to the sensitivity of the receiving watercourse. Discharge to Slimeroad Pill would require a relatively high standard of treatment. During the design phase the number of properties that would connect was not known and the possibility of low flows presented a high risk to the reliability of the treatment process. Furthermore, the construction of the outfall pipe from the treatment plant could prove problematic due to the steep gradient of the land sloping down to the estuary foreshore.

The solution using a gravity collection system with pumped discharge into an existing foul pumped main was determined to be the preferred solution.

Design

Surveys had shown that the existing private sewer network was in a poor condition and did not conform to Welsh Water's standards for adoption. Adoption of the sewer would require agreement from all forty-five connected properties, which was not guaranteed and presented residents with a *fait accompli* which would not be binding. Properties connecting to the new public sewer would only be permitted to discharge foul flows and therefore a disposal route for surface water would be required. Leaving the existing private sewer in situ provided a double benefit in ensuring that residents had the opportunity to maintain their existing drainage arrangements if they wished and also providing a route for the disposal of surface water for those residents who had decided to connect to the new public sewer.

A number of parameters were used to form the design of the new public sewer. It was determined that the sewer should be used for foul sewage only, that the sewer should be within 25m of all property boundaries (the statutory requirement is 30m but this allows a safe margin for construction), that all properties should be able to connect by gravity and that the requirements of Sewers for Adoption would represent the minimum standard for pipe diameters and gradients.

Challenges were presented by the location of existing private drainage, which was to the rear of many properties and away from the proposed location of the new sewer. This resulted in lowering the sewer in some locations to accommodate gravity connections from the properties.

The route of the new sewer was chosen to be mainly in the highway, although the section from Buttington Terrace to Loop Road passes through fields to avoid working in Beachley Road. The pumping station is situated at the lowest point in the network. Due to the tightly-packed nature of the housing, it was not possible to site the pumping station in the ideal location and this resulted in deeper sewers leading to the chosen site.

The new twin walled plastic gravity sewers comprise a total of 380m of 100mm diameter pipework and 1,180m of 150mm diameter pipework. The pipes are laid at depths between 1.1m and 5.2m with gradients between 1 in 28 and 1 in 130.

The design of the pumping station was based on the use of submersible centrifugal pumps. The pump selection was based on the ability to cope with the range of heads, varying between 10m and 24m, when pumping into the existing foul pumped main.



Completed pumping station compound
Courtesy of Morgan Sindall plc



Deep trench excavation for sewer
Courtesy of Morgan Sindall plc

As a consequence of the depth of the incoming sewer, the 2.4m diameter pumping station wet well is 6.3m deep.

The pumping station was designed without an emergency overflow due to the difficulty associated with construction of an outfall pipe and the fact that a new discharge into the Severn Estuary was unlikely to be permitted. The large storage volume contained within the sewers, manholes and wet well ensures that this is operationally acceptable based on storage time in the event of an emergency.

The rising main was designed as 565m of 110mm outside diameter HPPE pipework from the new pumping station to the existing foul pumped main to the west of the site. Air valves were installed at two high points with a wash-out at the intermediate low point.

Construction phase

The construction of the new sewers was by open cut methods and, due to the depth, comprised a combination of proprietary trench boxes and heavy duty sheet piles and waler frames for the deeper sections. The location of existing services ensured alignment of the new sewer was primarily in the centre of the carriageways which required road closures to be instigated throughout the duration of the construction.

Due to three pipe-laying gangs operating at once, careful planning was paramount to ensure residents' access was maintained at all times. The new rising main pipe was connected into the existing foul pumped main by means of an under pressure tapping, which avoided the necessity for a costly shutdown of the existing main.

Sections of the new sewer leading to Buttington Terrace were in close proximity to Offa's Dyke and as such an archaeological watching brief was required during excavation works. Numerous

pieces of pottery dating back to the 13th century were found along with three small prehistoric punch struck flint blades.

Construction of the pumping station shaft was undertaken as a top down caisson due to the 2.4m diameter, 6.3m depth and close proximity to the site boundary, which proved to be a more cost effective method than installing a sheet piled cofferdam.

This also allowed the excavation of Mercia Mudstone, experienced at a slightly higher level than anticipated, which would have prevented the installation of sheet piles.

Conclusion

The new public sewerage system at Beachley replaces the existing dilapidated private sewerage system and enables all properties to connect by gravity.

A new pumping station pumps collected sewage away for treatment. The construction team found solutions to the challenge of deep excavations and the construction was completed in 32 weeks, exactly on programme.

Key participants:	
Client	Dŵr Cymru Welsh Water
Principal contractor	Morgan Sindall plc
Designer	Arup

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Deep trench in Loop Road - Courtesy of Morgan Sindall



Trench excavation - Courtesy of Morgan Sindall