WINEP Durham Transfers

improving water quality in County Durham and providing a resilient sewer network to support catchment growth

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Northumbrian Water

The WINEP Durham Transfers project was designed to improve the quality of the Blackdene Burn, a watercourse located in the north Durham area. During AMP7, sewage treatment works (STW) sites within Northumbrian Water Group (NWG) ownership were identified for improvements in phosphorus concentrations within final effluent discharge to the environment. The scope of this project is to address the improvements at both Plawsworth STW and Pity Me STW, which currently discharge to the Blackdene Burn.

Directional drilling operations by Ken Rodney Construction - Courtesy of Esh-Stantec

Background

Esh-Stantec was appointed by NWG to progress the proposed solution; a phased approach whereby, during AMP7, final effluent from both STWs will be transferred to a discharge point on the River Wear via transfer pumping stations. The transfer of flows will be facilitated via new rising mains and gravity sewerage which will connect immediately upstream of the existing outfall from Brasside STW. In line with the phased approach, planned upgrades to Brasside STW in AMP8 will increase its treatment capacity and allow for the eventual abandonment of Plawsworth and Pity Me STWs along with chemical dosing to meet planned phosphorus limits discharging to the River Wear.

The designed solution allows for projected growth across the Plawsworth and Pity Me catchments (including the completion of the significant Sniperley development) with an AMP8 solution transferring all raw flows from Plawsworth and Pity Me to the upgraded Brasside STW for treatment, with final effluent from Brasside STW ultimately discharging to the River Wear.

The objective of this appointment is to provide the assets required to enable to the transfer of flows from Pity Me and Plawsworth STWs in the AMP7 and AMP8 scenarios. It is anticipated that the project will be completed in December 2024.

New transfer stations

The first stage of the scheme involves the transfer of fully treated, final effluent to the River Wear, meaning that Plawsworth and Pity Me STWs remain fully operational throughout the construction of all assets which will become live prior to the upgrade of Brasside STW.

Plawsworth Transfer Station: The new transfer assets at Plawsworth STW were carefully designed and sequenced around the limited working room in the site and the requirement to maintain treatment operations during construction. The Plawsworth Transfer Pumping Station comprises:

- A 4m diameter, 6m deep wet well shaft (sunk as a caisson).
- MCC and associated kiosk.
- Generator and associated kiosk.
- Above-ground valve arrangement.
- Flow meter chamber and all associated interconnecting pipework and ducting.

WINEP Durham Transfer: Supply chain - key participants

Client: Northumbrian Water
Principal designer & contractor: Esh-Stantec
Structural consultant: James Christopher Consulting Ltd
M&E, including supply & installation of generators, MCCs & pumps to wet wells: Retroflo Ltd
Auger boring under the East Coast Mainline, coordinating with Network Rail, & supply/installation of track monitoring: Terra Solutions Ltd
Directional drilling of 3km of rising main & installation of all AV chambers: Ken Rodney Construction Ltd
Design, manufacture, & installation of pipe bridge: Francis & Lewis International Ltd
Design & sinking of segmental shafts: Active Tunnelling Ltd
Temporary works/shoring: MGF Ltd

Piling operations by Francis & Lewis International Ltd, for the construction of the pipe bridge substructure - Courtesy of Esh-Stantec


Construction of pipe bridge structure by Francis & Lewis International Ltd Courtesy of Esh-Stantec


Active Tunnelling constructing the new wet well shaft at Pity Me STW Courtesy of Esh-Stantec

In AMP7, final effluent flows are intercepted and directed into the new wet well before being pumped to the River Wear. Due to the transfer of final effluent, a reduced emergency storage volume has been provided within the new wet well.

In AMP8, following upgrades to Brasside STW, raw flows will be intercepted upstream of the inlet works and diverted to the new SPS for transfer to Brasside via a new 250mm rising main. As part of the conversion from a treatment works to a terminal pumping station, the existing humus tank will be re-purposed to provide additional emergency storage in line with EA guidelines for the transfer of raw sewage flows and minimise emergency overflow spills to the environment.

In addition to emergency storage, a permanent standby generator has been incorporated into the design which will automatically cut in if there is a loss of power to the site.

The pumping station was designed as a three pump station (duty/assist/standby) to transfer ultimate AMP8 flows up to 32 l/s, however, in the AMP7 scenario, the pumping station will operate as a duty/standby/standby station, with the individual pumps sized to transfer 24 l/s of final effluent to maintain a minimum velocity in the rising main.

Pity Me Transfer Station: The main works at Pity Me STW comprises the following:

- A 6m diameter, 9m deep wet well shaft (sunk as a caisson) with built-in emergency storage volume sized for ultimate raw flows.
- MCC and associated kiosk.
- Generator and associated kiosk.
- Valve chamber.
- Flow meter chamber and all associated interconnecting pipework and ducting.

Similar to Plawsworth, the pumping station was designed as a three pump station to transfer 34 l/s in AMP7, with a duty/standby/standby arrangement, and up to 61 l/s in AMP8, after conversion to a duty/assist/standby arrangement. In both the final effluent and raw flow scenarios, pumped flows will exit the works via a new 280mm rising main.

Transfer rising mains

Approximately 2.1km of 250mm PE rising main and associated air valve/washout chambers has been installed from Plawsworth STW. The rising main pipework was installed predominantly via a trenchless technique, namely horizontal directional drilling (HDD), primarily due to lack of available access from the adjacent A167 highway to facilitate traditional open cut construction, as well as unfavourable ground conditions.

A new 280mm rising main was installed over an 850m length from Pity Me STW. Due to a tight working corridor situated between a garden centre and the Blackdene Burn, as well as the requirement to cross beneath the A167, a highly trafficked highway, the rising mains was also installed via HDD. This use of a trenchless installation technique minimised disruption to local business and removed the requirement for traffic management on a busy commuter route.

eDNA samples taken from ponds adjacent to Pity Me in the feasibility stage confirmed the presents of great crested newts. In lieu of protracted traditional population surveys and subsequent licenced activities to mitigation including fencing and capture to clear the working area, a District Level License (DLL) was secured from Natural England and works were completed under an approved method statement with supervision from a consultant ecologist.

The 280mm and 250mm rising mains from Pity Me and Plawsworth connect to a common chamber located at the high point of the new network, where they will discharge flows to a new DN400 gravity sewer.

New gravity sewerage

2.4km of new DN400 gravity sewerage, with associated manhole chambers, was constructed to receive the pumped flows from both Pity Me and Plawsworth STWs. Careful consideration was given to the design of the new sewerage to ensure capacity (including future growth) and self-cleansing requirements are met in all flow scenarios, including when Pity Me and Plawsworth transfer pumps operate either in isolation or in parallel.

The construction of the new gravity sewer poses some complex crossings and challenging ground conditions. The crossing of Chester Low Road, another busy road for both commuters and customers of a popular local retail park, The Arnison Centre, was originally planned for open cut excavation. However, subsequent on-site observations with regard to topography, a number of high-risk services including high voltage electric cables and a uPVC water main, and running sands within nearby open cut trenches led to the conclusion that it would not be possible to safely support the excavation during construction. Therefore, the road crossing was completed via guided auger bore. Not only did this mitigate the disruption and health and safety risks associated with damaging services, but it also minimised disruption to local businesses and residents as the road remained operational throughout the process.

East Coast Main Line crossing

Further downstream, the new gravity line is also set to cross beneath Network Rail's East Coast Main Line. The proposal is to install a 610mm sacrificial steel sleeve via a guided auger bore beneath the embankment, once complete the 400mm NB gravity pipe will be sleeved and the anulus grouted. Extensive liaison is ongoing with Network Rail in the lead up to the under track crossing (UTX) to gain the necessary approvals and fully understand the constraints which must be met during construction. These constraints include but are not limited to 24/7 working for the duration of the tunnelling works, installation of track monitoring and an approved contractor on standby in case there is a requirement for emergency track repair.

Brasside pipe bridge

Approximately 800m upstream of the Brasside STW outfall connection, the sewer crosses a watercourse located within a steep ravine and dense woodland at the existing Brasside Sewage Pumping Station (SPS).

At the optioneering stage of the project, it was proposed that this crossing would take place via an inverted siphon arrangement. However, subsequent hydraulic modelling deemed that, due to topography constraints, it would not be feasible to achieve sufficient capacity while maintaining self-cleansing velocities in both the AMP7 and AMP8 flow scenarios without connecting to the existing outfall further downstream. This would have required construction works within ancient woodland, imposing the requirement for Environmental Impact Assessment (EIA) and potentially preventing the obtention of a Lawful Development Certificate.

Therefore, to mitigate the risk of repeat maintenance issues and potential asset failure, a pipe bridge was progressed as the preferred option having discounted a further interstage pumping station at the low point due to a lack of space within the existing Brasside SPS site and the associated operational carbon and expenditure.

The route of the pipe bridge was designed to mitigate environmental impact, by including bends within the bridge structure and above ground pipework to take advantage of existing operational land and avoid clearance of significant trees within a conservation area. The interface between the bridge structure and the above ground ductile iron pipework has been carefully modelled and iteratively designed to assess the impact of bridge movement and deflection on the pipe joints and select joints which provide appropriate tolerances for these movements.

Conclusion

The design of the WINEP Durham Transfers Scheme serves to meet regulatory deadlines by achieving a sustainable multi-stage solution which meets the needs of the current and future catchment population.

At the time of writing (July 2024), construction is progressing well, and all rising main pipework and transfer station substructures have been installed. The gravity sewer is predominantly complete with the two key crossings remaining, pending final Network Rail approval to complete the rail crossing and final structural design of the pipe bridge to install the above-ground pipework adjacent to Brasside SPS.

The current construction programme shows that flows will be turned in December 2024, transferring final effluent to the River Wear in the interim and, in AMP8, transferring raw flows to Brasside STW for treatment. This will achieve the removal of treated effluent from the Blackdene Burn, in turn significantly improving water quality while meeting WINEP obligations. Furthermore, the completion of the scheme in AMP8 will serve to rationalise the NWG sewage network in the area and improve the resilience of the network by serving catchment growth and improving treatment capacity.

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Construction of new valve chamber and associated pipework at Pity Me STW Courtesy of Esh-Stantec

Aerial view of working area at Brasside STW - Courtesy of Esh-Stantec