Bewsey Bridge Wastewater Pumping Station

£9.5m new build to replace an outdated last-in-line wastewater pumping station on a disused 1970s landfill site near Warrington, Cheshire

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Bewsey Bridge Pumping Station is a last-in-line wastewater pumping station that discharges 1,890l/s pass forward flow to Warrington North WwTW. Operated by United Utilities, the pumping station is beyond its useful asset life and was performing poorly in terms of reliability and consent compliance causing upstream flooding and contributing to pollution of the nearby Sankey Brook. United Utilities took the decision to rebuild the pumping station on a disused landfill site adjacent to the existing pumping station. To protect the environment and drive down costs, an intricate remediation strategy (approved by the Environment Agency) was implemented during construction to allow reuse of all excavated materials on site.

Aerial view of the 4 pumpsets (No.) arrangement (partially installed) in the dry well - Courtesy of DCT Civil Engineering Ltd

The existing Bewsey Bridge Pumping Station

Bewsey Bridge Pumping Station was originally built in the 1950s to serve the Dallam and Bewsey areas of Warrington transferring wastewater to Warrington North WwTW via an 830mm diameter cast iron rising main. The pumping station was upgraded in the mid-1970s to take flows from Newton-le-Willows with additional pumping capacity and a second 1,200mm diameter steel rising main. In 1992/1993 a major refurbishment of the pumping station was undertaken with construction of 2 (No.) new wet well/dry well pumping stations. Each pumping station has 3 (No.) pump sets which deliver wastewater to a common manifold pipe that bifurcates into the 830mm and 1,200mm diameter rising mains. The pumps in each wet well are protected by rotating bar interceptors (RBIs) at the sewer portals into the wet wells.

The pumping station has a consented pass forward flow of 1,890l/s which was intended to be achieved with 5 (No.) of the 6 (No.) pumps operating at duty.

Due to its age, the pumping station is costly to run, difficult to operate and unsafe to maintain. Pump blockages and failure of the control system cause upstream flooding and contribute to pollution of the nearby Sankey Brook.

Special health and safety measures were implemented due to concerns about the existing methods of accessing, lifting and unblocking pumps. The RBIs at the inlet are normally inoperable and rag-balls form in the shallow sump which regularly block the pumps during storm events. Accessing blockages inside the

suction pipework within the shafts is difficult and hazardous. No lifting facilities are available on the site and hired lifting equipment is used each time the pumps are accessed.

The 1.5m diameter inlet sewer into the station is laid at a very flat gradient which results in the inlet being submerged during normal operating conditions. This has resulted in high siltation levels within the incoming sewer and inlet pipework to the station.

Proposed scope of work at Bewsey Bridge Pumping Station

All activities of the Project Concept and Definition Phase (Conceptual Design phase) have been delivered using United Utilities engineering and project management in-house capabilities.

The adopted solution to meet all maintenance needs of the Bewsey Bridge Pumping Station was to build a new pumping station next to the existing asset and abandon the existing station on completion of the project.

Key features of the new pumping station:

- A new shaft (design internal dimensions: 25m diameter, 15m deep) divided into twin compartments dry well/wet well.
- The pumping capacity is provided by 4 (No.) dry well pumps with variable speed drives (duty/duty/assist/standby arrangement) capable of delivering the maximum consented pass forward flow of 1,890l/s.
- New ancillary buildings including:
  - Control building (20m x 10m).
  - Ventilation and access building (14m x 7m).
  - Emergency egress building (5m x 5m) including associated electrical equipment.
- New rising main (1,200mm diameter, 150m long), with an air valve chamber, a flow-meter chamber and connection into the existing rising main.
- Two new power supply transformers.
- New 160m long access road, hard-standing areas and footpaths.

Associated upstream combined sewer overflows

Two combined sewer overflows (CSOs) are located 1.5km directly upstream of Bewsey Bridge Pumping Station. These CSOs were highlighted by the Environmental Agency as unsatisfactory intermittent discharges (UIDs) with a water quality impact driver. The sewer between these CSOs and the pumping station is a 1.5m diameter concrete pipe which is 8 to 9m below ground level with very few access manholes.

Due to the hydraulic inter-connections between the 2 (No.) CSOs and the pumping station, the two needs have been merged into the same project.

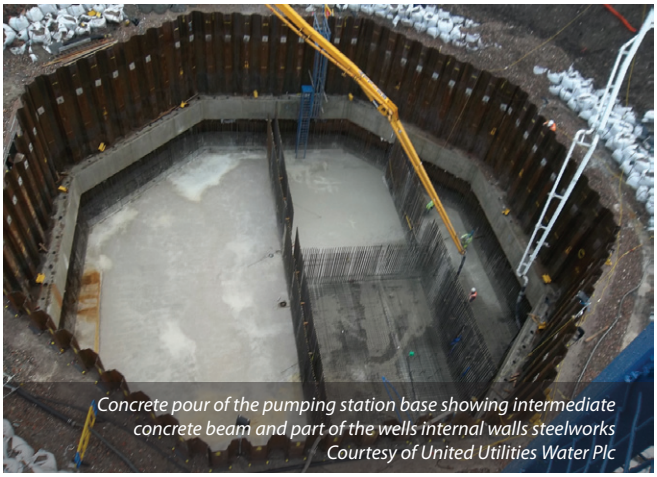
Original scope of work and approved scope of work at the CSOs

The initial solution for the UID issues was to provide a detention tank (internal volume in excess of 2,000m^3) at the UID's location. However, the decision to rebuild the Bewsey Bridge Pumping Station would provide the opportunity to have a free discharge at the Bewsey Bridge wet well inlet. The resulting hydraulic modelling of the catchment demonstrated that if the 1.5km of incoming sewer between the UIDs and the Bewsey Bridge Pumping Station was fully de-silted, only minor works on the sewer were required at the UID's location (new static screens, weir plates level modifications, minor pipe upsizing etc).

During the investigations carried out while planning of the desilting activities, which included a full internal ultrasonic survey of the sewer, it became apparent that the characteristics of this sewer (diameters, profile, restrictions, materials etc) used in building the catchment hydraulic model were incorrect.

Shaft excavation showing the hydraulic shores installation (Intermediate beam level) - Courtesy of DCT Civil Engineering Ltd


Concrete pour of the pumping station base Courtesy of United Utilities Water Plc


Concrete pour of the pumping station base showing intermediate concrete beam and part of the wells internal walls steelworks Courtesy of United Utilities Water Plc


Control building steel frame Courtesy of United Utilities Water Plc

New control building & pumping station inlet manhole and the existing pumping station building - Courtesy of DCT Civil Engineering Ltd

View of the pumping station shaft and new control building Courtesy of DCT Civil Engineering Ltd

General overview of the construction site also showing the temporary site access bridge - Courtesy of DCT Civil Engineering Ltd

View of the pumping station and the area used to remediate excavated materials (top right corner) - Courtesy of DCT Civil Engineering Ltd

Subsequently, the updated model demonstrated that desilting the incoming sewer was not needed to achieve the required performances of the CSOs. However, the minor works on the sewer were still required at the UIDs location. The revised solution has been approved by the Environmental Agency and a regulatory date for delivery agreed for 30 September 2013.

Remediation scheme

The new Bewsey Bridge Pumping Station is being constructed in an area of local authority owned public open space (POS) formally used as a landfill facility. It was estimated at conceptual design stage that the works would generate approximately 18,500m^3 excavated soils (landfill waste).

In pursuit of United Utilities's commitment to divert waste from landfill (to reduce the carbon footprint and the social impacts that vehicles would have generated by hauling contaminated soil from the site) and to reduce project costs, the scheme included at conceptual design stage 100% reuse of excavated materials during construction, as backfill to structures and in a proposed landscaping scheme.

The proposed control building and landscaping scheme at the site, is subject to planning approval. Warrington Borough Council (WBC) approved the development proposal by United Utilities on land off Lilford Avenue, Bewsey. However, planning was granted subject to pre-commencement and post construction contaminated land planning conditions.

For developments on brownfield land, a risk assessment was prepared in order to meet the requirements set out in the National Planning Policy Framework (NPPF). Risk assessments are also required to address waste management responsibilities. The remediation of contaminated land through the planning process is designed to secure the removal of unacceptable risk from pollution and make the site suitable for its intended use.

During conceptual design a risk-based remediation strategy was developed, in consultation with the local planning authority and the Environment Agency, to enable excavated materials to be reused as backfill and within landscaping, using the CL:AIRE Development Industry Definition of Waste: Code of Practice (CL:AIRE Materials Management Plan (MMP)). The remediation strategy included measures that would demonstrably break the contaminant-pathway-receptor linkages identified within landscaping area.

To allow the discharge of pre-commencement planning conditions and to mitigate any impacts on human health and the wider environment, arising during construction/remediation, DCT Civil Engineering Ltd, the principal contractor for the project, developed implementation proposals, to the satisfaction of both United Utilities and the relevant authorities. Reports included a remediation implementation plan, stockpile management plan (required due to the confined nature of the site and close proximity to sensitive surface watercourses) and other air quality control plans.

A final validation report is currently in development by DCT Civil Engineering Ltd, which will demonstrate the objectives of the remediation strategy and subsequent MMP have been achieved following completion of the works.

Construction method

DCT Civil Engineering Ltd, opted to construct the pumping station as an octagonal cast in-situ reinforced concrete structure. The excavation for the structure was undertaken in three stages.

Stage1: The contaminated material was removed to the on-site deposition area and a battered excavation was formed to a depth of approximately 5m below ground level.

Stage 2: The second stage of the excavation was through approximately 5m of stiff clay. Permanent sheet piles were installed on the line of the external face of the octagonal structure. A concrete ring beam was then cast at the top of, and to the rear of the piles. During the excavation the piles were supported by a series of octagonal hydraulic shores.

Upon completion of this phase a permanent in-situ reinforced concrete ring beam (intermediate beam) was constructed at the base of the piles. This beam was designed to be part of the final structure and therefore proprietary rebar connectors were cast into the upper and lower faces into which the wall reinforcement could be connected. This then enabled the temporary hydraulic shores to be removed. It was essential that the temporary works and permanent works designs were coordinated to ensure that the selected method was successful.

Stage 3: The final stage of the excavation was through approximately 5m of self-supporting rock and therefore this was cut neatly to the external face of the structure. Upon reaching formation level the rock was cut beyond the rear face at a depth of 1.2m to construct an under-ream beam, as part of the base slab, in order to assist with anti-floatation measures.

Once the reinforced concrete base had been cast the external walls to the structure were constructed by the use of a single sided shutter system and pouring the concrete back to the rock face and permanent sheet piles. These external walls incorporated the concrete ring beam that had been constructed previously. The reinforced concrete internal walls were then cast.

The structure will be completed by the fixing of a precast concrete cover slab consisting of reinforced concrete beams spanning between the external and internal walls, with infill slabs between the beams.

Construction constraints

The site conditions presented several difficulties in determining the most appropriate and cost effective method of construction. The main considerations were how to deal with the high level of contaminated ground on the site whilst adhering to the remediation strategy prepared by United Utilities and agreed with the various stakeholders. The construction method also had to ensure that any contaminated water was not/did not affect the aquifer running through the site. Good liaison between the geotechnical advisers and remediation specialists from DCT Civil Engineering Ltd and United Utilities was essential to ensure that the works were constructed without impacted on any third party interests.

Conclusion

Construction started on site in August 2012 following approval by the Environment Agency of the remediation implementation plan developed by DCT Civil Engineering Ltd. Despite encountering very complex technical and environmental challenges, the project is on track to be fully commissioned in August 2013, one month ahead of the regulatory date for delivery of 30 September 2013.

At the time of writing (June 2013), construction is 80% complete and the latest best estimate for the project out-turn cost is £9.5m, which is some £1m under budget. Success of the project so far can be attributed to the excellent working relationship fostered between United Utilities and DCT Civil Engineering Ltd, the contractor responsible for the detailed design, construction and commissioning of all work packages.

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