St Helens WwTW

£20m complex construction project improves effluent quality

by **Ian Clare & Steve Bruffel**

St Helens Wastewater Treatment works serves a population of 138,000 with a consented flow to treatment of 127ml/d or 1.47m³/sThe works is located to the East of St Helens, serving St Helens and the Haydock areas. The improvements undertaken were to improve the effluent quality from 30 BOD, 45 SS to 10Bod 25SS and 5NH4 and this was achieved as required by the end of March 2005. Access around the site is restricted. Sankey Brook flows through the middle of the site, separating some of the final settlement tanks from the rest of the works. The two bridges crossing the Brook have weight restrictions, one bridge is available only for foot traffic and access over the second has been provided by a Bailey Bridge. Soils to the north of the Brook are alluvium overlying boulder clay and to the south of the Brook is a rock outcrop in which there is a disused mine shaft. The site was operational throughout the improvements and together with the access problems and mineshaft, this was a complex construction project.

St Helens WwTW *courtesy: KMI Water & Pell Frischman*

Original works

Originally**,** the plant consisted of a common inlet works that fed two aeration treatment streams using diffused air, known as streams 'A' & 'B' with separate discharges into Sankey Brook.

New works

The new works consists of an improved inlet works , a new inlet pumping station, Stream B primary settlement has been enlarged by the addition of a new primary tank and now provides settlement for all the treated flow. Stream A aeration has been enlarged and new final tanks have been provided. An additional final tank for Stream 'B' has also been constructed. All the flow is now passed through tertiary treatment filters prior to discharge through a common point to Sankey Brook.

Construction & design

MWH is *United Utilities'* engineering service provider, charged with the optioneering process and outline design to achieve the required effluent standard. The work was to be undertaken as two separate contracts, one to improve the inlet works, the other to undertake improvements to the works and achieve compliance.

The appointed framework contractor was *KM I Water* with *Pell Frischmann Consultants* as their designers. An early award for part of the works on the critical path was granted and design for the new final settlement tanks for Stream 'A' and the associated pipework was successfully completed, which enabled construction to start as soon as a possible and the required end date to be achieved. Total value of the contract came to more than £20m.

Inlet works

Refurbishment of the Inlet Works was complicated by the presence of Sankey Brook to one side, sludge lagoons to another and the location of the Haydock sewer. The design required the removal of the three drum screens and their replacement with escalator screens all within the confines of an existing building. A fourth screen was installed outside the building in a purpose made channel. The drum screens were kept operational until replaced by a new screen, also the screenings macerator and compacter remained operational until no longer needed. To enable access to the building, the roof was removed and the MCC room was protected from the elements. This was successfully completed as a separate contract with the same *KMI Water and Pell Frischmann* teams.

Primary pumping station
The Primary pumping station was constructed as a shaft containing submersible pumps, each located in an isolatable well. The flow is then pumped via an over ground steel main to a flow splitting chamber. The influent is then passed to the Primary Settlement tanks.

Primary tanks
Two of these were part of the original Stream 'B' and a third was added to provide settlement capacity for the whole works. The scrapers on the existing tanks were exchanged and the whole desludge sytem was replaced. Settled sewage is then split between the two aeration streams. Stream 'A' receives 60% and Stream 'B' receives 40%. This uses a modulating weir penstock and flow meters to ensure flow proportioning at full range of flows.

Aeration Stream 'A'
Stream 'A' has been enlarged by the addition of three extra lanes and all of the existing lanes have been refurbished with new air distribution systems fed from a new blower house. This was constructed as a separate group of lanes to ensure that the integrity of the existing structures were maintained as they are thin precast post tensioned panels. Some of the connections were made at prepared points but the mixed liquor pipe was connected via a purpose made chamber. This enabled a post tensioned precast channel to be removed later when the final diversions were undertaken. The chamber was located close to the junction of the two sets of aeration lanes and this helped to reduce hydraulic losses to the final settlement tanks.

River crossings
Stream 'A' is arranged on both side of Sankey Brook and has required pipe crossings. In order to comply with EA requirements there are no joints in pipelines over the brook. The mixed liquor feed is a 1.6m diameter steel and the returned activated sludge is a 800mm diamater steel main, both pipes are welded and span approximately 20m. Steel was chosen for its spanning abilities and at these large diameters it is possible to protect the welds after completion of the pipework.

Final tanks Stream 'A'
Stream 'A' originally treated 40% of the flow to treatment, under the new proposals the plant was not only designed to nitrify, but Stream 'A' was required to receive 60% of the flow. This is a considerable increase in flow to the tanks. The intention was to replace the four existing 22m diameter Final Settlement Tanks (FST) with four new 30m diameter Final Settlement Tanks. The area for these tanks was very restricted as Sankey Brook borders one side and other sides were restricted by the mixed liquor channel, the existing outfall and a site road. Whilst difficult to construct it was successfully carried out, the gap between the formwork for one of the FSTs and the mixed liquor channel was only 25mm.

River crossings at footbridge
In addition to the two original concrete bridges a third footbridge and service bridge was required. This carries all the smaller service pipes, settled effluent from stream 'A', the Tertiary Treatment Plant feed and the final treated effluent. The EA not only required pipes over the river to be continuous but also limited their invert levels, this complicated the hydraulics and led to some pipelines operating as 'part full' pipes. This has also resulted in both settled effluent from Stream 'A', and the works treated effluent falling through about two metres, realising a considerable amount of energy that has been mitigated by a stilling chamber.

Aeration Stream 'B'
Stream 'B' blowers are being replaced. Presently the old Stream 'A' blowers are being used to provide air to Stream 'B'.

Final tanks Stream 'B'
Stream 'B' Final Settlement Tank is constructed below the normal water level of Sankey Brook and at risk of flotation. The tank was constructed in a cofferdam and relies upon a combination of a toe and anti flotation valves to provide resistance to flotation. The valves have been positioned above the normal water levels to ensure that the structure can be drained for maintenance.

Tertiary Feed PS
The Tertiary Feed Pumping Station was constructed as a shaft containing mixed bowl axial flow pumps, each located above the well on a reinforced concrete roof slab over the well. The flow is then pumped via a steel main over the brook to the Tertiary Treatment plant.

Tertiary Treatment plant
To achieve overall compliance a Tertiary Treatment Plant has been provided. A high head loss filter by *Severn Trent Water Services* was constructed. The area was known to contain a redundant mine shaft. Despite extensive trenching the shaft was not found so the structure was designed to span over a shaft, this proved unnecessary as during construction the shaft was found and plugged. However, by this approach, construction could proceed confidently knowing that a foreseeable problem had been overcome.

Conclusion
Throughout the construction of this project the approach has been to ensure effluent compliance. This could only be achieved by all involved in the project working closely together, the contributions made by operational staff were essential to its successful completion. ■

Note on the authors:*Ian Clare is with KMI Water & Steve Bruffell, Pell Frischmann*

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