

Woodhouse Mill WwTW

refurbishment and asset replacement for FFD compliance

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Woodhouse Mill WwTW serves a population equivalent of 185,556 in the south-east area of Sheffield and treats flows of up to 73,000m³ per day. Constructed in 1930 and having undergone a number of modifications over the years, the plant is undergoing its latest phase of development in order to meet the tighter ammonia consent as required under the Freshwater Fish Directive. In August 2010, ETM, a joint venture company between AECOM Design Build and Galliford Try, were employed by Yorkshire Water to undertake an investigation contract to validate the scope of a proposed extension and refurbishment of Woodhouse Mill WwTW. Following the delivery of a suite of investigation reports and a subsequent tender period, including design rationalisation activities, Yorkshire Water awarded ETM an £18m contract to provide the new works.



Investigation phase

Yorkshire Water identified a number of business risks which affected the plant's operation and reliability. Each business risk was provided with a nominal solution and Yorkshire Water further identified necessary process plant expansion in order to meet the requirements of the Freshwater Fish Directive.

ETM were awarded the investigation phase contract, the aim of which was to validate the business risks and to further identify any other issues on the plant that could affect its long term operability with a view to providing necessary information to allow a scope to be developed.

ETM undertook a full review of the plant and delivered Yorkshire Water a total of 37 reports in order to validate the risks and to fully assess the plant. The reports covered a number of areas including ecology, geotechnical, environmental, nuisance, civil, process, mechanical and electrical aspects. They allowed Yorkshire Water to have a full understanding of the condition of the plant, its operability and the issues surrounding expansion through data such as the ground investigation, high and low voltage studies and hydraulic analyses.

An outline solution was developed in conjunction with Yorkshire Water to satisfy all of the identified business risks and to meet the requirements of the plant expansion as necessary to comply with the Freshwater Fish Directive.

Development of solution and innovation

The notional solution and estimated cost identified at the start of the project to address the business risks was greater than the available budget allocated to the project and therefore innovative solutions needed to be sort. To that end, ETM and Yorkshire Water undertook a number of value engineering exercises to identify possible scope changes that would not only make the project affordable but would still meet all the required project outputs.

The biggest impacts on reducing the cost of the project were the introduction of co-thickening, removal of an interstage pumping station, removal of the need to build a new storm tank, and a reduction in the size of the inlet works.

Co-thickening

The original notional solution was to provide separate thickening streams for primary sludge and SAS. Combining primary sludge

and SAS into common tanks and taking sludge through a common thickening plant resulted in the removal of two sludge holding tanks with associated mixing and two drum thickeners with associated pumps and instrumentation.

Interstage pumping station

The original expansion requirement was to provide a chamber to combine flows from 5 (No.) ASP lanes and then provide even flow split to 6 (No.) FSTs. Due to the tight hydraulics there was insufficient head to drive flows through the flow split chamber and as such an interstage pumping station was required. Whilst a combination of new and existing pipework could be used to stream two sets of aeration lanes to two sets of FSTs, flow balancing problems would exist in the event of taking FSTs out for maintenance.

The introduction of a small overpumping pump station which would be used in the event of FST maintenance removed the need to build a full interstage pumping station. This idea was further refined by Yorkshire Water with calculation by ETM to utilise abandoned pipework to remove the need for the maintenance pumping station.

Storm tank

The original solution for plant expansion was to build a replacement anoxic zone within an existing storm tank and to build a new storm tank elsewhere on the site. An analysis was undertaken of the aeration lane capacity and it was found that there was sufficient aeration capacity within the aeration lanes if the front portion of each of the lanes were to be converted to an anoxic zone. This alleviated the need to provide a conversion of the storm tank and the need to provide a new storm tank.

Inlet works

The original project requirement was to provide a Formula A inlet works (rated at 2,414l/s) with storm tank split after the fine screens. By splitting storm flows before the inlet works through a CSO screen, an FFT inlet works (rated at 842l/s) could be provided with a commensurate reduction in screenings and grit plant.

These value added ideas gave a total reduction of nearly £3 million from the price for the original scope.

Project delivery

The key parameters against which the new plant is being designed are as follows:

Dry Weather Flow	328 l/s
FFT Flow	842 l/s
Formula A Flow	2,414 l/s
Population Equivalent	185,556

ETM were successful in securing the delivery phase of the project and design work started in August 2011. The full scope of the project involves new build and asset replacement throughout as follows:

- Refurbishment of the inlet screw pumps and installation of a new screw.
- New CSO screen to split storm flow above FFT flow.
- New second lift screw pumping station to lift FFT flows.
- New FFT inlet works including coarse screens, grit detritors and fine screens.
- Refurbishment of PSTs and circular storm tank including new half bridge scrapers.
- Refurbishment of fine bubble and surface aeration lanes.
- New fine bubble aeration lane.
- Refurbishment and uprating of RAS screw pumps.
- Refurbishment of FSTs including new half bridge scrapers.
- New final settlement tank.



- New combined primary sludge and SAS storage tanks.
- New combined primary sludge and SAS thickening plant.
- New digested sludge tanks.
- New centrifuge dewatering plant.
- New MCCs, control system, SCADA and telemetry.
- Replacement storm tank cleaning, storm return, SAS, return liquors, top water and final effluent pumps.
- Refurbishment of the administration building.

Challenges

This project poses a number of challenges for construction. The site is quite compact leaving very little space available for construction and laydown areas. The phasing of the work is critical to allow access and as such construction in certain areas has to be delayed to allow movement of plant. The inlet works, for example, is being built with a key section of channel left out to allow access to build the new ASP lane.

The ASP lane itself requires a 7m deep excavation and the removal of in excess of 33,600 tonnes of material. It is in close proximity to the River Roth which requires careful control of groundwater to prevent water ingress into the excavation. The unusually wet weather during March and April has caused a number of delays to the excavation due to the potential of machines slipping on the mainly clay material.

These issues required agility in design and construction methods to minimise programme delays as unexpected events occur.

Collaboration and standardisation

This project is running in parallel with another Yorkshire Water project which is being delivered by a different Yorkshire Water partner contractor. In order to achieve a number of efficiencies and savings in design, a collaborative approach was taken with the establishment of the project teams from both contracting companies within ETM's Tankersley offices. Whilst working with what would traditionally be seen as a competitor could have proved difficult, the reality has been very different. The teams have worked

very well together and a number of savings have been generated. The flows to the inlet works on the two sites were within 5% of each other and due to having the same manufacturer of inlet screens and same manufacturer of grit plant, the inlet works outline design has been developed jointly.

The collaboration continued into the physical model testing where the same contractor was chosen to provide the model for each company. A model was built whereby the screens channels and grit plant were common and the only excess was that two sets of interconnecting channels had to be built. This generated a saving in the region of 15% on the modelling costs.

Part of the development work that ETM have done is the standardisation of the sludge thickening plant for Yorkshire Water. Standard P&IDs have been developed and a concept for the sludge thickening building has been established that provides a repeatable, extendable design which satisfies all Yorkshire Water's maintenance and operational requirements better than previous designs have. In the spirit of partnering and collaboration, these designs have been shared to reduce the design costs for Yorkshire Water on other projects.

Programme & key project participants

Start Date	August 2011
Completion Date	September 2013
Compliance Date	March 2014
Client	Yorkshire Water Services Ltd
Principle Contractor/Designer	ETM
Technical Consultant	MWH
Commercial Consultant	Turner & Townsend

The editor & publishers would like to thank Mark Godfrey, Project Manager (AECOM) for the ETM Joint Venture, for providing the above article for publication.



ASP lane excavation - Courtesy of ETM

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