

Woodhouse Mill WwTW

refurbishment and asset replacement for FFD compliance

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Woodhouse Mill Wastewater Treatment Works (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 required under the Freshwater Fish Directive. In August 2010, ETM, a joint venture between AECOM Design Build and Galliford Try, was employed by Yorkshire Water Services (YWS) 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, YTS awarded ETM an £18m contract to provide the new works and design work commenced in August 2011.



New works under construction at Woodhouse Mill WwTW located to the south east of Sheffield on the banks of the river Rother - Courtesy of ETM

Project delivery

The full scope of the project involves new build and asset replacement throughout the works 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 admin building.

Project challenges and solutions

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

Dry Weather Flow	328l/s	FFT Flow	842l/s
Formula A Flow	2414l/s	Population Equivalent	185,556

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Existing Inlet Screw Pumping Station

As part of the investigation works the inlet screws were inspected. There were 3 (No.) screws at the inlet with a combined capacity of 2,700l/s. As part of the works, two of the existing screws are being replaced due to corrosion and damage. The third screw is being refurbished and a fourth new screw is being provided to provide stand-by capacity.

When the inlet works was first built an empty channel was constructed for the fourth screw but the 10m sloping concrete 'U' profile had to be cast under this scheme. To do this a purpose made steel shutter was built that incorporated an innovative access staircase making the operation safer.

New Inlet Works

The inlet works consists of a connection channel between the inlet screw outlet channel, new storm screens, a new FFT screw pumping station (with duty/assist/standby screws), duty/standby coarse screens, duty/standby detritors and duty/standby fine screens.

The design was developed in collaboration with another YWS asset delivery partner and principle design elements were used on both Woodhouse Mill WwTW and a similar project at Old Whittington WwTW. Before detailed design, this was extensively modelled to ensure that the flow distribution in the screen approach channels was uniform across the full design range.

Construction of the civil works is nearly complete and mechanical and electrical installation has started. The co-ordination of sub-contractor activities is very challenging as many activities overlap with multiple subcontractors working in a small area. After being updated, the site programme is issued to all subcontractors and regular liaison meetings are held to keep all subcontractors informed and to minimize any time buffer between activities reducing programme duration.

Primary Tank Refurbishment

As part of the project, the scraper bridges are being replaced on the 3 (No.) primary settlement tanks. Initially the design criteria for the new bridges was based on five-man loading on the bridge and a theoretical sludge loading of 60kg/m² on the scraper blade.

However, on-site load monitoring on the bridges at Woodhouse Mill showed actual sludge loadings of around 180kg/m² with a peak of up to 250kg/m² on the scraper blade. Following this measurement the bridge decks were strengthened to allow for this loading.

The load measurement at Woodhouse Mill has provided valuable design information that can be used for future bridge design.

Aeration Systems

Originally at Woodhouse Mill there were 2 (No.) lanes of surface aeration and 2 (No.) lanes of fine bubble aeration. As part of the works, the surface aeration systems have been upgraded.

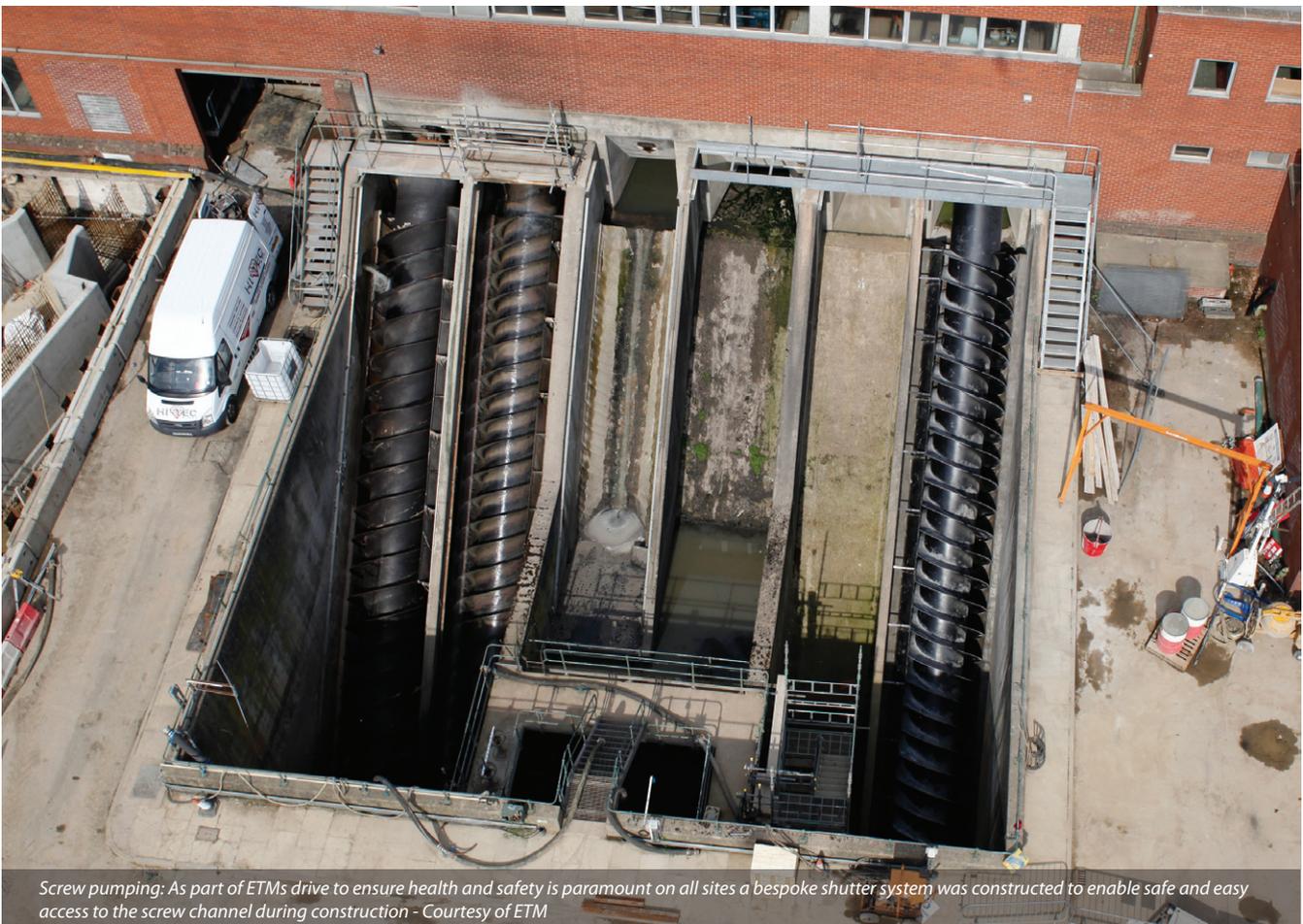
Surface Aeration Lanes

These have been retained and the hand railing and surface aerators replaced. This was carried out while the lanes were kept in service. The control of the surface aerators has been changed to control the DO to a set point at the end of the lane to minimize over aeration and save energy.

Fine Bubble Diffusers

As part of the works, new high efficiency blowers have been provided and the aeration membranes have been replaced with Aquaconsult membranes improving the standard oxygen transfer requirement (SOTR) of the system.

This has allowed the first section of each lane to be converted to an anoxic zone with mixing. Also to provide standby aeration, an extra lane (70m x 15m x 6m deep) has been constructed.



Screw pumping: As part of ETMs drive to ensure health and safety is paramount on all sites a bespoke shutter system was constructed to enable safe and easy access to the screw channel during construction - Courtesy of ETM

The water table in the area of these tanks is high. To protect the existing tanks from flotation there are relief valves in the base of the tank. These are no longer Yorkshire Water's preferred means to protect against flotation. It was therefore decided to adopt tension piles for the new lane. However during construction high aquifer pressure meant these had to be redesigned and the piles shortened.

As the required factor of safety could no longer be achieved with the shortened piles, relief valves had also to be incorporated half way up the walls to provide the required safety factor.

Final Settlement Tanks

There was no final settlement standby capacity at Woodhouse Mill. As part of the scheme a new 32m tank has been constructed. This has allowed the existing tanks to be taken out of service and their bridges and GRP components either replaced or refurbished. Integration of the new tank into the system required significant temporary works/short term shutdowns to connect its pipework to the existing. This involved close cooperative working with Yorkshire Water Operations and careful planning.

As part of the scheme, the existing mechanical components and GRP in the 5 (No.) final settlement tanks has been replaced and a new tank has been constructed.

Sludge Thickening

The existing sludge thickening facility had failed. Under this scheme a new system is being provided, consisting of 2 (No.) storage tanks storing a mixer of primary sludge and SAS. The sludge in these tanks is mixed using pumped mixing. The sludge is then fed to drum thickeners (duty/assist/standby). Drum thickening has been adopted as a standard for thickening sludge by Yorkshire Water.

The design is based on standard P&IDs developed by Yorkshire Water's asset delivery partners 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.

A new polymer dosing and storage system was installed using liquid polymer and new odour control has been provided for the mixed sludge tanks, thickeners and thickened sludge tanks.

The building housing the control MCC, drum thickeners and polymer plant was a pre-fabricated Saredan building. This type of building has been adopted by ETM on a number of sites for this purpose on the grounds of economy and speed of erection.

Sludge Dewatering

At the commencement of the scheme the sludge at Woodhouse Mill was dewatered using belt presses. There were two on site, one was unreliable and rarely used and the second was asset-life expired and again frequently failed. As part of the scheme new duty/standby centrifuges have been provided along with additional sludge storage. For economy, the building of one of the redundant belt presses has been utilized to house the control MCC, polymer make-up and dosing equipment.

The new centrifuges are supported on concrete walls at height to allow the conveyors to discharge over an adjacent push wall. The centrifuges are covered with walk-in acoustic enclosures with steel decking around the enclosure.

Similar to the sludge thickening, the design of the dewatering system is based on standard P&IDs developed by Yorkshire Water's asset delivery partners. The design adopted is now considered to be a Yorkshire Water signature design and was taken from Esholt WwTW and is also being used at Old Whittington and Blackburn Meadows WwTWS.





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We are pleased to be associated with Yorkshire Water and ETM on Woodhouse Mill WwTW and with Northern Ireland Water and Ovivo on Newcastle WwTW

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Interfacing with Digester Construction

In parallel with the Woodhouse Mill FFD scheme there is also a digester replacement scheme being undertaken by ETM on the same site. As the schemes are being commissioned at the same time regular joint commissioning meetings have been taking place. One purpose of the meetings has been to identify any temporary works required due to the timing of the works to ensure one scheme does not delay the other.

Effective Collaboration

On completion of this scheme the majority of all the mechanical and electrical equipment on the site will have been renewed while the treatment process has been 'live'. The works have been phased throughout construction to ensure that final effluent has not been affected by construction activities. This has been achieved by regular interface/commissioning meetings to ensure that all parties were aware of what was happening and ensure effective planning.

Conclusion

At the time of writing (July 2013) there has been over £3m of capital efficiencies identified on Woodhouse Mill. Work started in August 2011 and the forecast completion date is December 2013, ahead of the March 2014 compliance date. The key project participants are:

Client	Yorkshire Water Services Ltd
Principle contractor/designer	ETM
Technical consultant	MWH
Commercial consultant	Turner & Townsend

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New inlet works consisting of flow to full treatment works pumping station, coarse screens, detritors and fine screens - Courtesy of ETM



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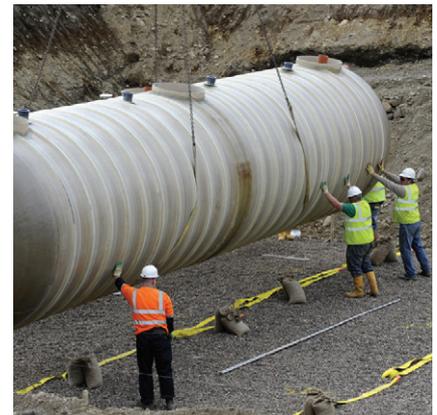
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