Wanlip STW - Inlet Works

replacement of two existing inlet works with a single new process to improve the reliably, operability and effectiveness of preliminary treatment

by Naomi Dickens & Mark Tootell

Wanlip STW is Severn Trent Water's third largest wastewater treatment facility and currently serves a population equivalent of 582,800 from Leicester and the surrounding areas. Incoming flows to Wanlip STW are split between two independent process streams; the 1960s built 'Old Works' treats two thirds of the flows whilst the remaining third is treated by the 1990s built 'New Works'. Both the 'Old' and 'New' works comprise their own inlet works, storm tanks, primary settlement tanks, activated sludge plant and final settlement tanks. There is a single sludge treatment process at Wanlip STW which includes thickening, anaerobic digestion, dewatering and on-site sludge cake storage. A separate scheme is underway to improve and increase the capacity of sludge treatment at Wanlip which is detailed in a separate article within this publication.

Storm pumping station with band screens complete and metalwork being installed - Courtesy of Costain Limited

Project need

The Wanlip Inlet Works Project is being delivered to replace the existing 'Old' and 'New' inlet works at Wanlip STW with one single process which will handle all flows arriving at the site. The delivery of this project will complete the first phase of the Wanlip STW twenty-five year strategy. Following historic piecemeal development across the site the strategy has been produced to provide a coordinated plan for future work; this will facilitate the development of a more efficient site, with an overarching aim to create a single process stream. The strategy also considers the limited space available on the site and promotes a sequence of work that will ensure the required development can be accommodated.

Completion of the inlet works will considerably improve the reliability and effectiveness of the preliminary treatment process at Wanlip STW. Both the existing inlet works are in a poor condition and unreliable. There is currently a high level of rag and grit carry over which results in downstream manual interventions with associated health and safety risks for site operators and maintainers, as well as a reduction in overall site efficiency.

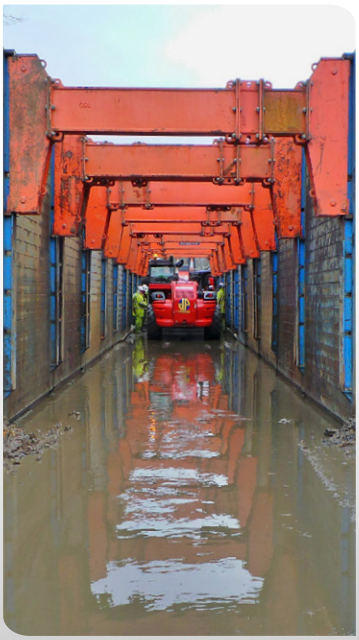
The scope of the project includes the provision of a new pumping station for storm flows, new inlet channels and screens for flows to full treatment (FFT), refurbished grit removal and replacement of FFT pumps. The project also includes approximately 300m of large diameter pipework across the existing site.

Delivery of the project

The Wanlip Inlet Works Project forms part of Severn Trent Water's (STWL) Major Projects programme of work and is being delivered by e5, a joint venture of four framework partners (Costain Ltd, Mott MacDonald Bentley, MWH Treatment and North Midland Construction) working collaboratively with STWL.

The commercial arrangements under e5 are such that each project is being delivered by an individual contractor, with all partners sharing in the pain or gain of each of the projects. This promotes close collaboration and drives all partners to support each other by actively sharing innovations and lessons learnt; additional benefits are also being realised through sharing resources and procurement at a programme level.

Mabey Hire. The answer to all your Groundworks requirements.



- Trench Boxes
- Excavation Bracing Systems
- Sheeting, Light Piling & Accessories
- Temporary Roadways
- Auxiliary Products
- Mabey ShoreSafe

www.mabeyhire.co.uk

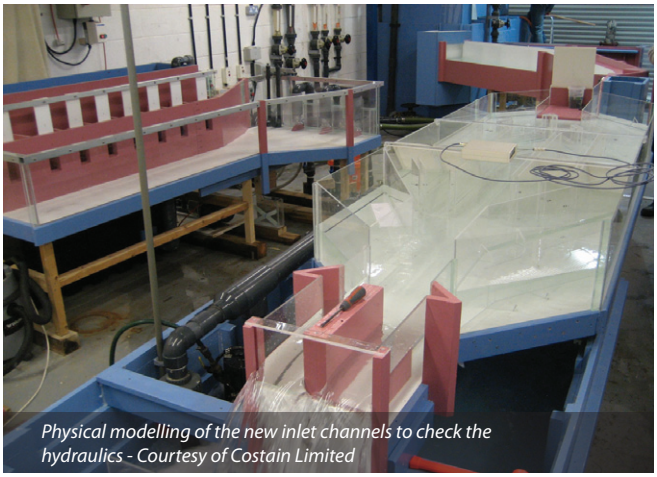
0845 741 3040

mabey hire

part of the mabey family

The shaft for the storm pumping station under construction Courtesy of Costain Limited

The initial ring of the shaft being built - Courtesy of Costain Limited



Physical modelling of the new inlet channels to check the hydraulics - Courtesy of Costain Limited

Start of construction of new inlet channels - Courtesy of Costain Limited

Storm pumping station

Currently at Wanlip STW all flows enter a main channel. FFT (flows up to 3,600l/s) and storm flows (an additional 3,600l/s, taking incoming flows upto 7,200l/s) are split between the 'Old' and 'New' works; all flows greater than 7,200l/s are discharged directly to the River Soar via an 8ft storm sewer. Combined FFT and storm flows are passed through the inlet screens and grit removal process before being separated between the primary treatment and storm tanks.

As part of the Inlet Works Project the storm flows will be separated from FFT upon entry of the flows to the site and taken to a new storm pumping station. 2 (No.) 1,750 x 700mm culverts connect into the existing 8ft storm sewer and divert consented storm flows into the new pumping station.

A 15m diameter, 8m deep shaft was constructed using the caisson jacking method. Upon entering the pumping station flows pass through 6mm, 2D band screens before reaching 7 (No.) submersible pumps; 4 (No.) of the pumps are dedicated to the 'Old' works and 3 (No.) to the 'New' works, with both sets operating on a duty/assist/(assist)/standby arrangement.

Through reviewing the hydraulic modelling undertaken for the project the design of the pumping station was optimised. By creating baffle walls within the shaft the layout of the pumps was able to be adjusted and the overall size of the shaft was reduced from 18m to 15m in diameter. The benefits of the reduced shaft size included reduced construction costs (of approximately £180,000) and a better overall site layout with increased operational space around the pumping station.

Inlet channels and FFT screening

By separating the storm flows at an earlier stage in the treatment process the inlet channels and screens can be designed purely for FFT resulting in a more optimised installation.

4 (No.) new 25m long, 3m deep concrete inlet channels with a central by-pass have been constructed to improve the hydraulics and allow better treatment to be achieved. During the construction of the channels unexpected ground conditions were encountered; the ground was found to be disturbed sandy gravel, backfilled around footings from previous construction work. The solution was to install 26 (No.) 9m deep mini-piles.

4 (No.) 2-D escalator screens are housed within the new inlet channels. The screens will operate in a duty/assist/assist/assist configuration controlled by the differential level across them. To increase the robustness of the installation the screens have been sized to allow FFT to be treated by three of the four screens.

3 (No.) screenings handling equipment units will treat the captured screenings and operate in a duty/assist/standby arrangement. 3 (No.) launder channels will feed each of the screenings handling units with screenings from both the inlet and storm screens.

The design of screenings handling area between the inlet channels and storm pumping station has allowed the single installation to be utilised by both sets of screens resulting in a more efficient overall design.

Grit removal

An opportunity was identified early in the project to reuse some of the existing grit removal structures. The 'Old' works grit process is being utilised and a complete mechanical and electrical refurbishment will be undertaken on two of three detritors.

The third detritor is larger than the original two and was added in the 1980s, but it has since been mothballed as the hydraulics are poor resulting in grit settling in the approach channel rather than the detritor itself. This third detritor will be utilised during the

construction phase; once the storm pumping station is completed, the third detritor will take the FFT flows allowing detritors 1 and 2 to be refurbished in a safer and more efficient way.

Pipework

Within the project approximately 300m length of large diameter pipework has been required to integrate the new inlet works into the existing site. There have been a number of challenges associated with this element of work, including significant uncharted underground services and obstructions. Carbon steel pipework has been used throughout the project; this material was chosen over ductile iron due to the following advantages:

- Shorter procurement periods.
- A material saving of £100k.
- A reduced number of joints below ground by fabricating custom pieces.
- Ability to fabricate in situ to meet complex existing pipework.

FFT pumping

Existing wet and dry wells are being utilised to accommodate 8 (No.) new FFT dry-well pumps with a duty of 600l/s. 5 (No.) of the pumps will transfer flows to the 'Old' works primary settlement tanks and 3 (No.) pumps will transfer flows to the 'New' works. These pumps will replace 6 (No.) existing dry-well pumps and 3 (No.) screw pumps. The operation of the pumps will be controlled by the measured flows coming into the site and will maintain the two third/one third split between the 'Old' and 'New' works respectively.

The original dry well was successfully surveyed using 3D laser scanning technology to accurately plan and design the connections in such a tight space.

Delivering a safe solution to operate and maintain

Throughout the design and construction of the Wanlip Inlet Works the project team has been focused on delivering a solution that will meet the end users needs and be safe to operate and maintain. A 3D model was created for the project and has been particularly valuable for reviewing the proposed design with the end user.

The model allowed operators and maintainers to clearly understand what the design will look like and identify potential issues that the design may cause them. Regular reviews were organised and led to many comments and suggestions being collected and incorporated into the development of the design.

The project team is also currently working on opportunities to utilise the 3D model to improve the user interface for planning and assisting with future operation and maintenance activities. This would allow the benefits associated with using a 3D model to be extended into the project life, beyond the design and build phase.

Project delivery

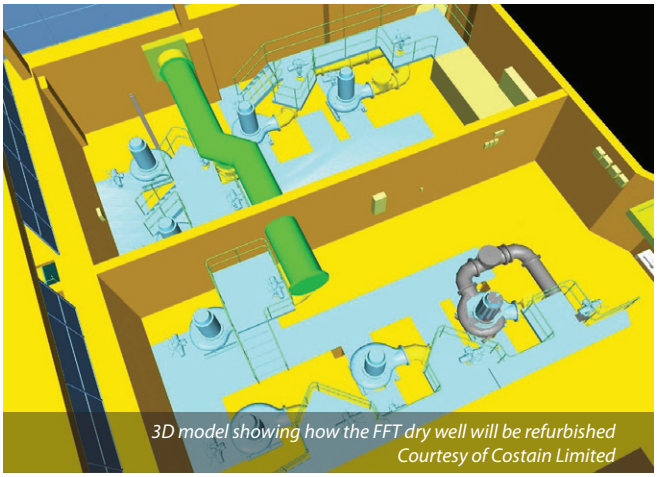
Construction started in September 2012 and handover of the completed works is forecast in January 2015. The storm pumping station and inlet channels have been constructed and will be put into operation in June 2014. Refurbishment of the grit removal process will follow and be completed by August 2014. The FFT pumps will be installed and commissioned in a phased sequence starting in July 2014 and extending until January 2015.

The Principal Contractor for the project is Costain Ltd with the detailed design work being completed by MWH. The agreed target price for is £18.8m and the current forecast cost is £14.1m.

The Editor & Publishers would like to thank Naomi Dickens, Senior Programme Engineer with Severn Trent Water, and Mark Tootell, Project Manager with Costain, for providing the above article for publication.

Construction of new inlet channels completed and escalator screens being installed - Courtesy of Costain Limited

Installation of 1m diameter carbon steel pipework to connect new pumps to existing 'new' works primary treatment and storm tanks Courtesy of Costain Limited



3D model showing how the FFT dry well will be refurbished Courtesy of Costain Limited

Progress of the Wanlip Inlet Works Project (April 2014) Courtesy of Costain Limited