Coalport STW

primary treatment and activated sludge plant improvements

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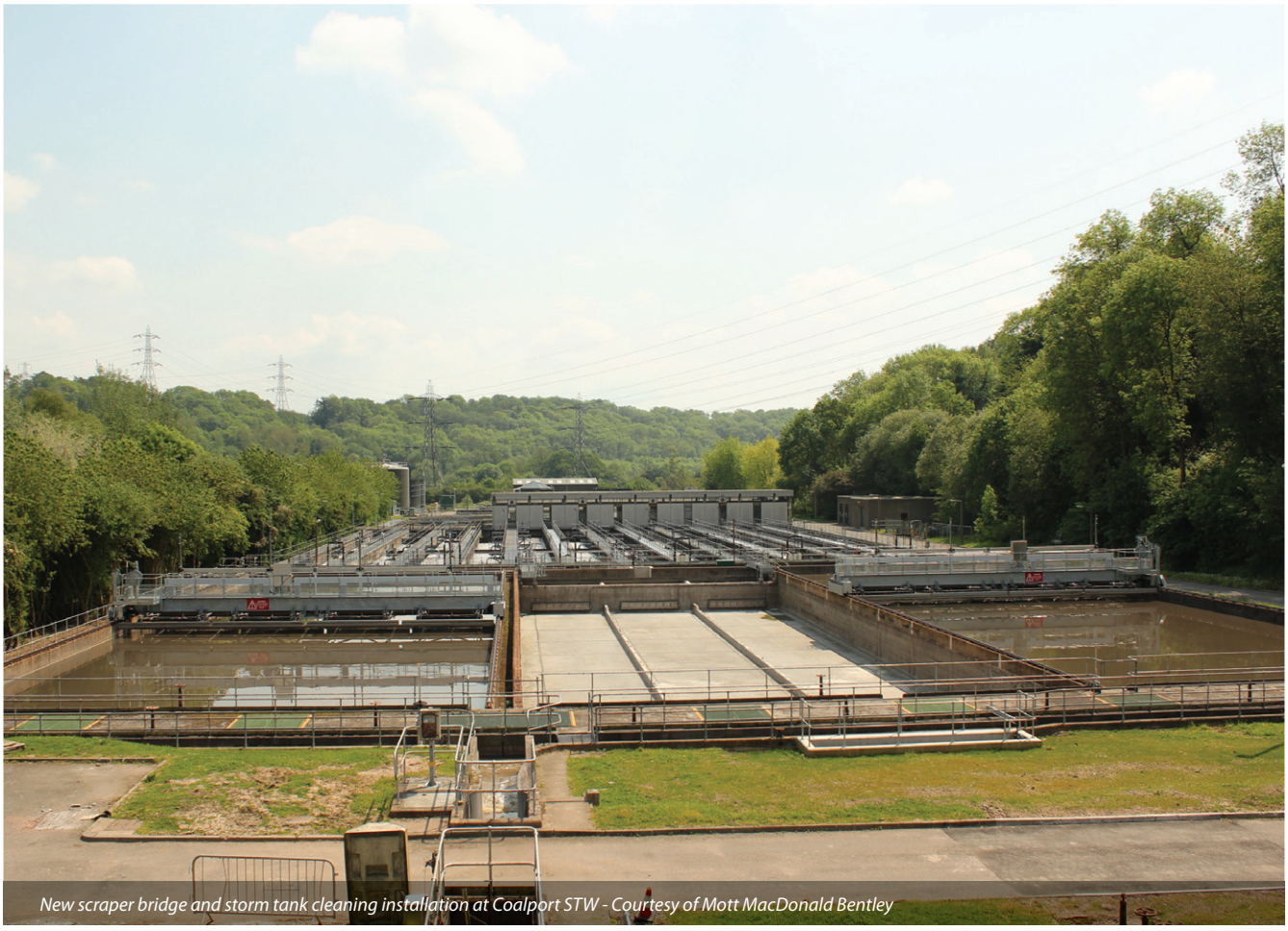
Coalport Sewage Treatment Works (STW) is one of Severn Trent Water's largest works in Shropshire. It is located to the south of Telford, on the banks of the River Severn, and serves a population equivalent of 85,000. The principle features of Coalport STW are 2 (No.) rectangular primary settlement tanks (PST), a 6 (No.) lane activated sludge plant (ASP), 9 (No.) final settlement tanks and 2 (No.) sludge digestion tanks. The key driver for the investment at Coalport STW was the unacceptable risk to discharge consent compliance caused by the poor condition of existing assets.



New scraper bridge and storm tank cleaning installation at Coalport STW - Courtesy of Mott MacDonald Bentley

Background

Two projects were promoted internally by Severn Trent Water to investigate the problems at specific areas of the Coalport site:

- Primary settlement and storm tanks.
- Activated sludge plant.

Mott MacDonald Bentley (MMB) worked with Severn Trent Water during the investigation phase of these two projects and then combined the work into one project for the detailed design and construction phases. This allowed the project to deliver greater efficiency for Severn Trent Water and ensured that a holistic view of the operation of Coalport STW was at the centre of the project.

Primary settlement and storm tanks - the case for change

Coalport STW has 3 (No.) adjacent rectangular tanks each approximately 60m long by 20m wide. Two are used as PSTs, with the third providing storm storage for flows in excess of 3DWF. The two PSTs were served by a single 40m long scraper bridge, with a separate scraper bridge on the storm tank.

The bridge across the two PSTs was installed in the 1980s and in recent years had required approximately 200 hours of maintenance work per annum, an average of half a day per week. Concern was growing that the bridge may catastrophically fail. Every failure of the scraper bridge left the site without effective sludge removal in both PSTs, leading to increased solids carry over into the secondary treatment, putting the discharge consent at risk. An independent scraper bridge for each PST was required to give the site reliable performance and to allow maintenance on one PST without affecting the second PST.

The storm tank scraper bridge was in poor condition and proved ineffective at cleaning settled sewage from the base of the tank

following storm events. A new storm tank cleaning system was required.

Permanent solution

The initial feasibility examined installing new independent scraper bridges on each of the three tanks. However, this proved difficult to achieve for two key reasons:

- The existing PSTs are separated by a narrow wall that could not practically support rails for two scraper bridges.
- Coalport STW requires one fully operational PST and one storm tank to meet its consent, which would not have been possible during replacement of either the PST or storm tank scraper bridge.

The solution was to re-configure the function of the three tanks, such that the central tank became the storm tank, with a PST either side. The storm tank could then be fitted with an appropriate cleaning system, removing the need for a scraper bridge on the central tank.

The whole life cost of different storm tank cleaning systems was considered, alongside the programme and technical risks. This led to the selection of a proprietary flushing gate system to provide an automated storm tank cleaning system.

Project benefits

The improvements had a number of benefits including:

- Greater process flexibility.
- Low impact on works performance during construction.
- Improved storm tank cleansing in line with Environment Agency consent.
- Full support from operational staff.
- Reduced operational saving estimated at £6k per annum.
- Remove the single point of failure risk.

Planned customer interface

A planned site visit to an existing storm tank flushing gate installation at Ray Hall STW and 3-dimensional sketches, were used to articulate design concepts to the operational site staff at Coalport STW, enhance the design process and secure stakeholder support for the recommended solution.

Scraper blade replacement

Replacement of the scraper blades may now be undertaken by lifting the scraper blades above the coping level of the PST and parking the bridge to allow the blades to be withdrawn safely from a new access at the foot of the tank.

Scraper bridge delivery to site

The challenge of delivering a 20m long scraper bridge through the winding roads of the Severn Valley gorge required a well-planned, coordinated approach with local councils, and a test run with a retractable trailer to ensure the low loader would be able to negotiate the steep, tight approach to site. This demonstrated that the bridge could be delivered in one piece.

The activated sludge plant - the case for change

Over a period of 12 years, there have been a catalogue of problems with the aeration system of the ASP at Coalport. These issues have resulted in several schemes being promoted in an attempt to establish the root cause of the problem.

Despite an overall expenditure of approximately £750k during the 12 year period, the site continued to experience poor control of the dissolved oxygen levels in the aeration lanes, and regular failure of the air compressors.

New air compressor units installed at Coalport STW - Courtesy of Mott MacDonald Bentley

This put Coalport STW at significant risk of breaching the discharge consent and required intensive management to control the works' performance. Severn Trent Water needed to know the root cause of the problem and settle on a permanent solution.

Investigation phase

Severn Trent Water and MMB worked closely to conduct a thorough feasibility study, involving detailed analysis of control system data, asset surveys and the use of specialist consultants to test the capacity of the air system

The study concluded that the poor condition of the existing air compressors and control valves caused these two vital components to respond at different rates. This caused frequent surges and stalls of the air compressors and therefore under-aeration of the lanes.

Permanent solution

The proposed permanent solution was to:

- Replace all 4 (No.) existing air compressors with new radial centrifugal compressors, which have a broader operating range and are less prone to surges and stalls.
- Replace all 12 (No.) air control valves with smaller diameter units, to improve air flow control.
- Replace the control system to provide a modern, maintainable asset.

It was a significant challenge to replace the existing equipment and maintain the operation of the activated sludge plant. A phased programme was developed, replacing and commissioning each component of the system in turn, starting with the air compressors, moving onto the air control valves and completing the project by replacing the control system.

This phased approach allowed the delivery team to demonstrate stable operation of the activated sludge plant in between each phase.


Completed installation of new scraper bridges at Coalport STW - Courtesy of Mott MacDonald Bentley

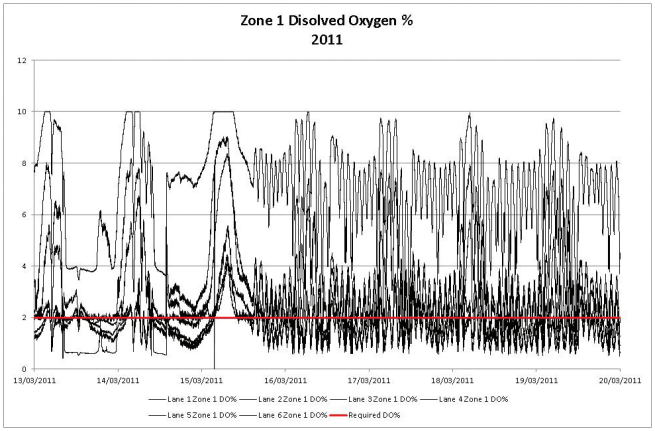


Figure 1. Dissolved Oxygen Levels, ASP, 2011

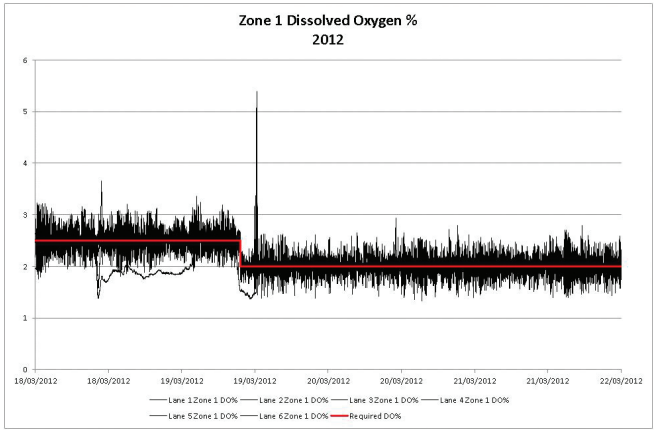


Figure 2. Dissolved Oxygen Levels, ASP, 2012

Process Improvement

The dissolved oxygen levels within the ASP at Coalport have historically been highly unstable, as shown by the graph in Figure 1. The installation of the new equipment has dramatically improved control of the dissolved oxygen levels, as shown in Figure 2.

Project Benefits

The improvements had a number of benefits including:

- Greater reliability and reduced risk of failing works discharge consent.
- Lower operating and maintenance costs.
- Capacity for anticipated growth in the catchment.

Project delivery challenges

There was an opportunity to optimise programme efficiency by delivering these two projects simultaneously, which required a significant effort from a dedicated delivery team to plan and coordinate the phases of the two projects.

The knowledge and cooperation from operational site staff was an important factor in ensuring the impact on the process performance of the works was adequately mitigated throughout the construction period, and to ensure compliance with the discharge consent. The collaboration of the whole project team helped identify process constraints on the phasing; for example the requirement to maintain aeration to all 6 (No.) lanes whilst one of the PSTs was out of service.

The construction and commissioning was further complicated by urgent digester maintenance, undertaken by Severn Trent Water at the mid-point of the contract, which reduced the sludge digestion capacity on site and required greater aeration of the ASP to cope with the additional solids.

Results

Close working relationships on site, with regular communication being maintained between the site operators, and MMB's site agent and commissioning engineer, proved to be key to ensuring the project was successfully delivered ahead of schedule, within budget and achieved the required outputs without compromising the consents standards of the operational site.

The Editor & Publishers would like to thank Ian Johnson, Programme Manager - Waste Water Asset Creation with Severn Trent Water, and Peter Davies, Project Leader - Waste Non-Infrastructure with Mott MacDonald Bentley, for preparing the above article for publication.