

# Strongford Nitrifying Submerged Aerated Filter

## looking after the past, the present & the future

by  
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**E**nsuring the aquatic environment meets the high standards water companies' customers expect is placing ever greater demands upon the UK's wastewater treatment infrastructure. A series of projects at Severn Trent's Strongford WwTW give an insight into what it takes to ensure existing, large-scale assets will continue to deliver the quality utility customers want. Centre stage in the present programme to ensure Strongford's continued compliance with The Environment Agency's is a new nitrifying submerged aerated filter (NSAF) plant. Dubbed NSAF+ the Strongford process offers reduced energy consumption because it can be operated on a cell by cell arrangement rather than as one whole unit. The new plant is the largest of its kind in the world. The driver for the £11.05m NSAF project is ammonia reduction in order to meet new discharge consents resulting from the EU Fisheries Directive.



Strongford: The site covers a large area - the NSAF structure to the left of the foreground

courtesy Black & Veatch Europe

Strongford serves Stoke-on-Trent, in the Potteries region of the west Midlands. The works treats a mixture of industrial and domestic flows with a population equivalent of 333,000. Final effluent is discharged to the River Trent via Yockerton Brook.

The addition of the NSAF plant provides Strongford with a tertiary biological oxidation step, following the existing activated sludge process. Process design for the NSAF was undertaken in-house by Severn Trent. Grontmij conducted civils design, Black & Veatch (B & V) was responsible for M & E design, construction and commissioning. This created an integrated team approach.

The NSAF plant is a significant reinforced concrete structure consisting of 10 cells, each 6m wide by 22.7m long by 7m deep.

These ten separate reactor cells, with a combined media volume of 5,460m<sup>3</sup>, provide a full flow treatment capacity of 2,738l/s. Additionally, the tertiary treatment project required the construction of a pumping station to screen and forward flows to the NSAF plant. Other associated construction work included new kiosks to house the MCC equipment and three blowers processing air for the treatment process.

The integrated delivery team used a number of strategies to reduce the effect the work had upon the local environment. All excavated material was re-used to form a screening bund which reduced the visual impact of the NSAF structure. This had the dual benefit of cutting the number of HGV movements to remove excavated material, and also reduced landfill requirements.



One arm of a starfish can regenerate into a whole new organism as long as a portion of the central disk is attached.

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Preparing for work on outfall chamber (left) Preparing overpumping system & Pipes suspended allow outfall modifications courtesy Black & Veatch Europe

In addition, base slabs from the sludge press building that formerly occupied the NSAF site were crushed and re-used as piling mats during the construction work. Continuous flight auger piles were used for the NSAF, to lessen the impact of noise upon the site's neighbours.

To further reduce the project's impact upon those living around the site the construction team agreed to redirect HGV through non-residential areas, and restrict the number of trucks.

The most significant issue facing the integrated delivery team was the interface with the live works. This task was at its most difficult when connecting the outfall from the NSAF plant to the existing outfall serving the activated sludge plant. The challenges arose not so much from the nature of the work required, but from the locality in which the work was taking place.

The existing outfall chamber, which had to be modified to receive flows from the NSAF, was flanked by services. To one side was a live overground gas main, to the other was a live vent stack. The presence of the main and stack created hazards for the construction team as well as constraining the working area. The low-lying nature of the area also led to difficult, very damp ground conditions. The task was further complicated because the outfall had been subject to changes over time, which meant the design and construction teams were working with an incomplete idea of the existing structures form. As a result, when this phase of the project began, it was only possible to create an outline design for the new structure. The detailed design was prepared once the construction team had uncovered the pipework and the chamber and was able to better assess what was required.

At this stage of the project the construction team was in daily contact with the designers to find the optimum solution to meet hydraulic, structural, safety and buildability requirements. Discussions addressed the configuration of the existing outfall structure and what would and would not be possible in terms of the modifications to accept the NSAF flows.

This identified the need to underpin the original structure and then extend the chamber. The underpinning operation required excavating around the three existing concrete pipes, then providing temporary support. This work in particular was hampered by the ground conditions.

The temporary works then required a major overpumping operation to bypass the outfall pipes and enable the chamber to remain in service whilst the modification work was undertaken. The overpumping system was capable of handling 3,000l/s and made it

possible to break into the existing pipes and facilitate the connection of new outfall pipework from the NSAF.

The NSAF project is due for completion in October 2008. All the major civil and mechanical elements are complete or well progressed and commissioning is imminent.

In addition to the new tertiary treatment plant at Strongford, there is also extensive capital maintenance work required at the site, to extend the working life of the existing assets by a further 20 years. The detailed requirements were developed jointly between STW and B & V to ensure the work could be done efficiently and safely without compromising the operation of the existing works. This work was awarded to Black & Veatch under Severn Trent AMP4 Non-Infrastructure Framework. Valued at £9.13M, the capital maintenance project covers assets across the site, but is focussed primarily on the civil and M & E refurbishment of aeration lanes on the activated sludge plant.

Looking to the future, the integrated delivery team will continue to make a contribution at Strongford. To ensure the works continues to achieve its environmental protection obligations, it is necessary to increase the storm retention capacity of the works.

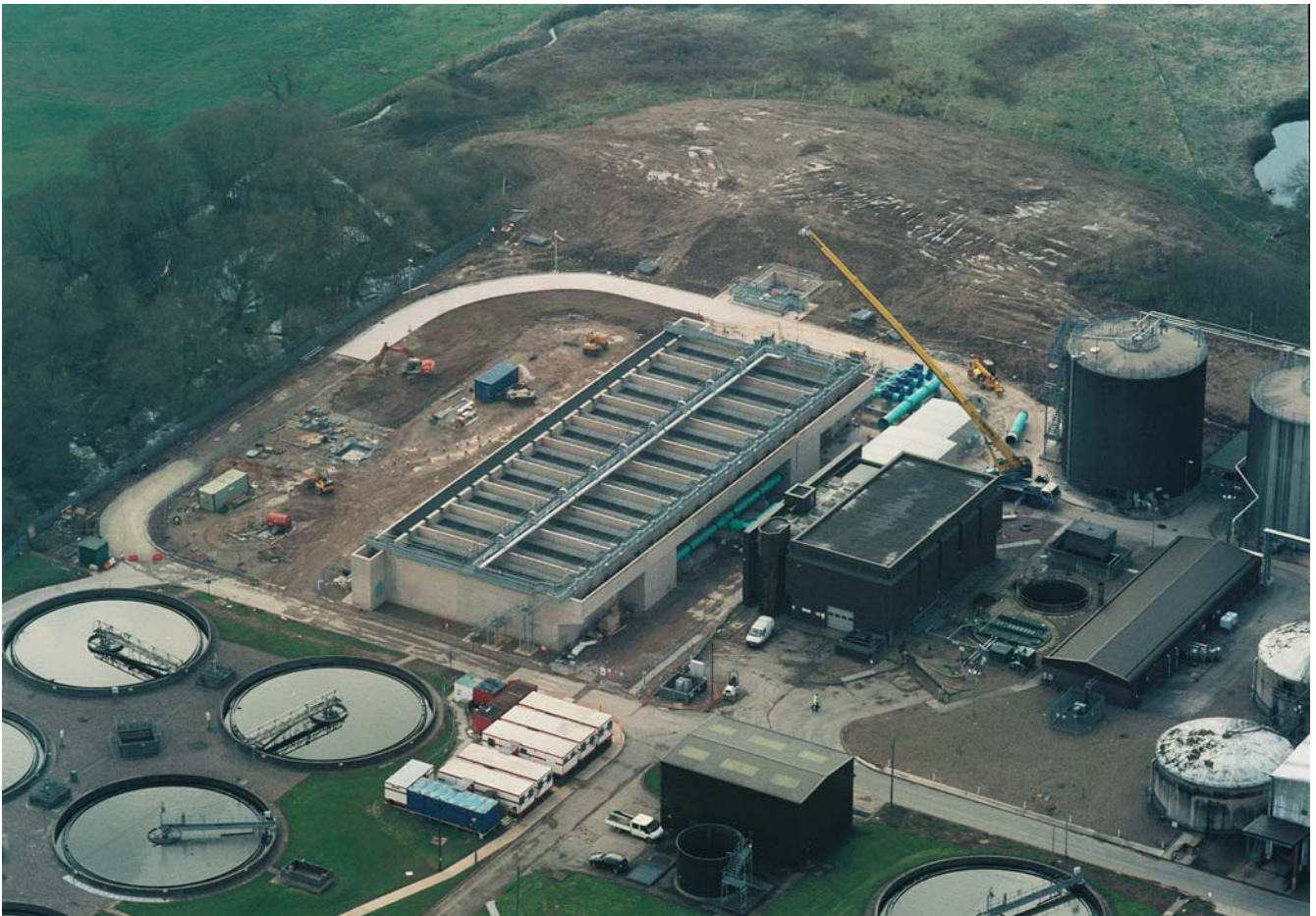
The outline design and scoping was developed by STW and Grontmij with input from contractors to ensure buildability was adequately considered. The project was then tendered as a complete design and build package for all elements of civil and M & E works. Black & Veatch were successful in this tendering process.

This is a project on which Black & Veatch will utilise its integrated design, construction and commissioning resources. The integrated team, with input from STW, further value engineered the original outlined proposal and identified a number of cost saving measures. These included reducing the depth and size of the pipelines, and using a design that needed simpler - and therefore cheaper - construction methods. The combined design and build team was also able to identify ways to cut the amount of temporary works required during the building of new structures.

By contributing to Strongford's capital maintenance, NSAF and storm water projects, the integrated delivery team of STW, Grontmij and Black & Veatch is helping Severn Trent ensure that past, present and future elements of the works will continue to play their role in protecting the environment for the utilities' customers.

**Note** The Editor & Publishers wish to thank Mark Williams, Project Manager, Black & Veatch Water Europe for producing the above article for publication.■





The NSAF unit is the largest of its kind

courtesy Black & Veatch Europe

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