

# Stoke Bardolph STW

a holistic approach to meet future phosphorus consents

by Graham Morris BEng (Hons) MICE & Teresa Jeffcoat MEng Grad MICE

Stoke Bardolph STW serves the majority of the Nottingham catchment and is located adjacent to the River Trent east of the city. The works has suffered from intermittent ammonia and sanitary limit failures and a new P removal consent will be in place from September 2014. A strategic decision for a "Blue Skies" approach was taken by the Severn Trent Water (STW)/NMCNomenca team to look at the need to meet the future phosphorus consent through a holistic investment appraisal, rather than the traditional narrow focus approach given to such projects. The review incorporated the closure of smaller works in the vicinity and the transfer of flows to improve operational efficiency. The design has also ensured the works can be extended to accommodate future population growth for the next 20 years.



Aerial view of Stoke Bardolph STW showing construction of ASP 4 and 8 (No.) FSTs - Courtesy of NMCNomenca

## Project background

Asset Management Programme 2010-2015 (AMP5) expenditure for Stoke Bardolph from the Final Business Plan was identified as £40.44m.

Additionally, a "spend to save" capital allowance of £1.66m was determined to reflect the significant level of OPEX savings that would be realised as a result of the proposed investment using new centrate treatment technology. An extensive course of innovation and rationalisation took place in order to reduce the cost of investment and OPEX and a formulated strategy to drive even further efficiencies.

## Design solution

The project was split into a programme of seven schemes comprising:

• Inlet works	£3,130,000
• SCADA upgrade	£579,000
• ASP 4	£26,156,000
• Centrate treatment	£6,107,000
• ASP 3 modifications	£1,948,000
• PST modifications	£1,709,000
• Site wide works	£812,000

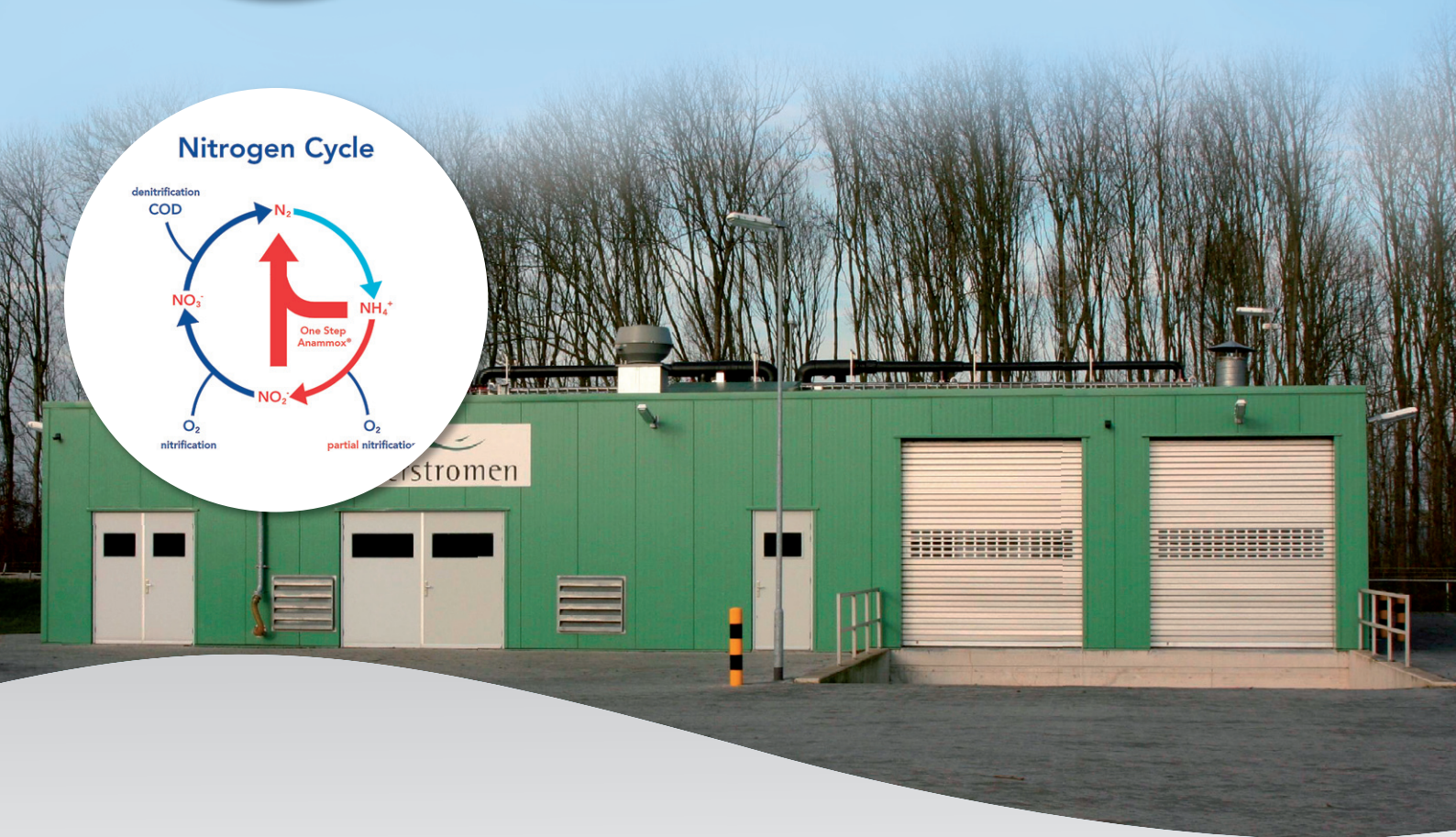
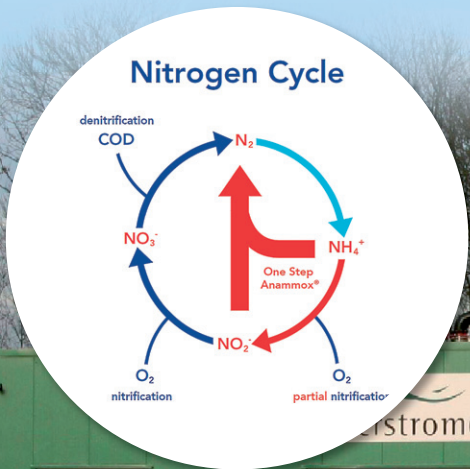




# Revitalizing Resources

Recovery of phosphorus and nitrogen

## PHOSPAQ™ & ANAMMOX®





The target price included client costs and shared savings to incentivise collaboration and innovation.

### Holistic approach

The holistic approach during the feasibility stage ensured that the process units were sized by challenging the STW process design parameters and the use of the first centrate treatment technology plant in the UK contributing to the reduction of the ASP in size by 30%. This was enabled through the close working of NMCNomenca, STW Asset Creation and STW Service Delivery, all of whom were working towards the same goal.

### Inlet works

The original project included the construction of a new inlet works valued at £10m. A physical model at 1/10 scale it was used to prove that the existing asset could be modified rather than construct new saving £6.8m. The model was also used to ensure solids and grit loads distributed evenly to providing reliability and prevent operator interventions.

The completed scheme comprised refurbishing the existing inlet works to upgrade the existing screens with 6mm fine screens, providing an additional tilting screen utilising an existing bypass channel, providing screens handling and washing facilities, whilst addressing the existing hydraulic constraints. The refurbishment of the former PSTs as emergency storm tanks utilised money that was to be spent on costly over-pumping to provide a future asset allowing 10 hour shut downs for civil modifications and providing the client with emergency storage tanks to enhance robustness of the process.

### Activated Sludge Plant 4

The new Activated Sludge Plant (ASP 4) scheme involved the building of a 125m by 73m in-situ concrete tank and 8 (No.) 35m diameter final settlement tanks. The structures were built within

a single open-cut excavation in the Holme Pierrepont sand and gravel overlaying Mercia mudstone. The structure incorporated the extensive use of tension piles to reduce the dependence on self-weight to prevent floatation.

During construction the whole area was dewatered by installing a lateral groundwater cut-off encompassing an area of 35,000m<sup>2</sup> comprising of a single stage array of over 800 (No.) disposable vacuum wellpoints allowing the works to be undertaken in dry, safe and stable working conditions.

### Innovations

A number of other innovations were made during the design and construction phases of this project to ensure value for money. These included the use of AquaSpira pipes as both gravity and siphon pipes for the first time, saving on installation time, material cost, environmental impact and health and safety of installation. Some of the internal baffle walls were designed with a slender section and sloping faces to reduce the volume of concrete challenging the current STW 'standards'

The PST optimisation scheme allowed for the density of sludge from the PST tanks to be increased from 0.5% to 6%. This will make a large saving in OPEX as the sludge can now be pumped directly to the digesters without needing to be thickened. This is the first scheme of this type that STW have carried out and is likely to be further extended.

### Design application

3D modelling was used on the scheme to increase design efficiency, reduce the need for redesign and facilitated end user to 'buy-into' to the proposed solutions more easily. Working with the key supply chain partners the solution was developed to ensure full compliance with the CDM Regulations through the construction, operation, maintenance and demolition of the works.



ASP 4 distribution chamber - Courtesy of NMCNomenca



# Concrete Solutions Reinforced with Quality



Collaborative



Integrated



Productive



Responsible



We are an established water industry leader in the provision of Concrete Structures and Civil Engineering services.

Our reputation, founded upon a culture of partnership and collaboration and our ability to innovate through proactive project involvement, has enabled the successful delivery of major water treatment schemes, throughout the UK.

[www.stamconstruction.com](http://www.stamconstruction.com)

Units 3-4 Nunn Brook Road, Huthwaite, Nottinghamshire NG17 2HU

Tel: 01623 554 320 Fax: 01623 441 785

Email: [info@stamconstruction.com](mailto:info@stamconstruction.com)



NMCNomenca have introduced the 'SAFE' approach (Skilled Assembly Factory Environment) promoting the use of off-site manufacture and modular assembly. An example was the fabrication off-site by NMCNomenca fabrication department of a fully assembled access platform that was lifted and installed without any disruption to the flows. Included in the fabrication were all the pipe supports, pipework runs and cable trays negating the need for others to work at height over the live flows.

The in-situ concrete works were developed in partnership with STAM Construction Ltd to promote constructability and the incorporation of emerging formwork technology. As far as was practicable, the use of stock length reinforcement was used to reduce costs and all the reinforcement was designed to be prefabricated and lifted into place, greatly reducing any work from height.

#### Centrate scheme

The centrate scheme is currently undergoing detailed design in conjunction with Paques, Netherlands. It will be the first plant in the UK to provide a treatment for struvite recovery and ammonia removal. Struvite is a major cause of clogging within the treatment system which will be exacerbated by the biological removal of phosphorus in the ASPs. The recovery system will produce fertilizer and will therefore:

- Conserving phosphate reserves.
- Improve river water quality.
- Recycle materials locally.
- Reduce greenhouse gas emissions.
- Provide a revenue income for STW.
- Severely reduce reactive maintenance by removing the need for unblocking pipes and pumps.

#### Sustainability initiatives

The following initiatives form an integral part of the scheme:



Modular platform installation - Courtesy of NMCNomenca



Modular platform installation - Courtesy of NMCNomenca

- 120,000m<sup>3</sup> of excavated material was retained on site and formed into a landscaping bund to screen the works and provide a habitat for local wildlife following plantings.
- By screening the excavated material 10,000t of fill sand and 4,000t of pipe bedding was created saving 700 lorry movements, and quarrying of raw materials.
- Use of centrate technology and the conversion of ASP 3 has reduced the footprint of the new ASP by 20%.
- Process design for the ASPs challenged the standard further reducing the size of the ASP by a further 10%.
- Reuse of existing/redundant structures to enable conversion of the existing ASP 3 to meet the new consent without having to build new structures.
- Use of stock lengths of reinforcement reducing wastage.
- Use of lightweight AquaSpira pipes with a reduced carbon footprint.
- The phosphorus removal is undertaken using biological methods rather than the use of chemicals to precipitate out the phosphorus.

#### Community initiatives

Every step was taken to minimise disruption to local people. Whilst it was accepted that there would be increased traffic movements the following initiatives were instigated:

- The works were completely contained within the site boundary.
- The excavated material was retained on site.
- Detailed habitat surveys were undertaken, and renewed at regular intervals.
- Liaison with Stoke Bardolph Parish Council with no construction traffic entering or exiting through the village.
- Liaison with the Highways Agency for the erection of signs to direct construction traffic.
- Considerate Constructor Scheme - twice achieving "performance beyond compliance", and a national Considerate Contractors Award - Bronze.
- Use of electric dewatering pumps to reduce noise disruption.
- Sponsorship of a local hockey academy promoting sporting excellence and village Christmas tree.
- Hold local community events to provide information and to answer any questions.
- Guided tours for selected groups including local historical society.

#### Stakeholder management

The major capital schemes within AMP5 saw the creation of a joint initiative between STW Waste Water Services and four contractors including NMCNomenca, Costain, Mott MacDonald Bentley (MMB) and MWH forming the e5 team working across a Midlands-wide programme to maximise efficiency collaboratively.

The project team was augmented with a full time member from the site operations team. His knowledge and expertise of the existing infrastructure was pivotal in the facilitation of efficient shut-downs and the challenge to the proposed design.

The individual projects of the e5 programme were allocated budgets to work within. In addition, a 6% cost reduction stretch target was allocated to provide constructive pressures to find further cost savings.

A model of team working, Stoke Bardolph has provided numerous innovations now being disseminated throughout the region.

*The Editor & Publishers would like to thank Graham Morris, Programme Manager STW e5 Major Projects and Teresa Jeffcoat, Project Manager NMCNomenca, for providing the above article for publication.*