

Basingstoke & Bracknell NVZ Schemes

optimising sustainability in wastewater treatment

by Chris Stanbridge CEng MIMechE

In 2012, legislation came into effect that places restrictions on the agricultural use of fertilisers containing nitrate. Thames Water recycles its sludge for beneficial reuse purposes, the majority of which is used on fields as a nutrient-rich fertiliser – known as biosolids. Major upgrades of sludge treatment facilities at Basingstoke and Bracknell Sewage Treatment Works (STW) provide regulation compliance, reduce the works' impact on the environment and ensure that the works can cope with predicted population growth.



Applying sludge cake to agricultural land as fertiliser will reduce the risk of nitrate pollution run-off - Courtesy of Black & Veatch

Background and need for the scheme

The Nitrogen Pollution Prevention Regulations 2008 (as amended) form part of the Nitrates Directive (1991); an EC law aimed at reducing the amount of nitrogen entering watercourses as a result of agricultural related operations. This limits application of nitrogen (and hence the amount of sludge) to land in designated Nitrate Vulnerable Zones (NVZs). NVZs rules cover about 62% of England and 3% of Wales.

The £12.7m of improvements at Basingstoke, Hampshire, and the £9.3m upgrade at Bracknell, Berkshire, enables sludge to be dewatered so it can be stored as a solid or 'cake'. Applying sludge as cake offers a reduced risk of nitrate pollution from run-off when introduced as a soil improver. Further benefits provided include reducing the volume of sludge requiring on-site storage, which will limit the potential for odour nuisance.

The facilities at Bracknell and Basingstoke comprise two of five NVZ schemes that have been upgraded as part of Thames Water's 25 year sludge management strategy, which considers the sustainable use of sewage; the others being at Camberley, Chertsey and Crawley.

Project delivery

Working closely with Thames Water's Capital Delivery Team, Black & Veatch has undertaken the Basingstoke and Bracknell NVZ schemes in its capacity as an integrated, full service provider. As principal contractor, Black & Veatch's role included enabling works such as planning consent, as well as design, construction supervision and commissioning services. Utilising its global resource centre in Mumbai, an integrated UK/India team was set up to complete design, supported by an experienced local construction and management team. C&M Contracts provided all construction services as main civil contractor.

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*In addition to providing sludge dewatering at Basingstoke, asset improvements will accommodate predicted population growth to 2021
Courtesy of Black & Veatch*

Similarities between the two schemes meant that the same contract team could be deployed on both sites. Integrating the project management teams from the outset provided a seamless link between design and construction. The close collaboration between these teams highlighted several benefits including cost and design efficiencies, explored further in this article.

Project location and overview

Both Basingstoke and Bracknell STW sites are located in rural areas, which are predominantly agricultural in nature. Previous operations at both centres comprised conventional anaerobic sludge digestion processes with treated liquid sludge being recycled to agricultural land. To achieve regulatory compliance, Black & Veatch has provided sludge dewatering and associated sludge cake storage facilities at both sites. Improvements to the electricity supply formed another element of the upgrade at both locations. The scope of works being undertaken at each site is described below.

Basingstoke STW

Basingstoke STW serves a population of 134,816 (PE 138,196). In addition to providing dewatering facilities, asset improvements

were required to the inlet works and up-front sludge treatment facilities to accommodate predicted population growth to 2021. Growth elements included construction of a new chamber for preliminary storm flow split ahead of the inlet works. A control penstock restricts flow at 1,300 litres/second level. Excess flow passes over a weir and through a weir-mounted screen to storm tanks, which have been increased by the addition of a third tank to accommodate the additional load. At the inlet works, primary treatment capacity has been doubled with the addition of 2 (No.) inlet screens and an additional grit trap.

Existing activated sludge treatment has been optimised using a two-point dissolved oxygen control system, which will provide more robust aeration as well as delivering efficiencies in terms of energy usage.

To meet the NVZ Regulations 3 (No.) belt presses were installed to dewater the sludge after it had been through secondary digestion. To enable the STW to treat the liquors from the new dewatering system, chemical assisted precipitation (CAP) was installed consisting of ferric chloride dosing at the inlet to the primary



Used widely as a technique in the construction of shafts, a secant pile method was used to build the 32m by 5m deep storm storage tank at Basingstoke STW. The use of this approach is thought to be a first in its application to a wastewater treatment works - Courtesy of Black & Veatch

settlement tanks. This meant that the additional load was removed in the primary sludge. A second picket fence thickener has been installed to process this additional sludge.

The sludge cake is discharged directly into the newly constructed storage facility, which comprises a dutch-barn style building, designed to reduce visual impact.

Innovative construction

A combination of constrained working area, the presence of overhead power cables and a high groundwater table gave rise to one of the most significant challenges presented at Basingstoke. Evidence of the site team's close collaboration with the client and civil contractor led to innovative construction methods being used to provide an additional storm storage facility.

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The new tank provides additional 5,100m³ storage capacity ahead of the inlet works. The conventional method of construction for a tank of this size would be to put in a cofferdam to prevent water ingress. However, the secant pile method proved the ideal construction solution for working within the constraints encountered at Basingstoke.

A circular wall was formed by installing continuous flight auger (CFA) piles to a depth of 12m. The piles were alternately reinforced (male) and unreinforced (female). The female piles were constructed first and then the male piles driven between them to create a formation that interlocks when set.

Having provided a watertight structure, excavation from the inside was possible in preparation for forming the base slab and lining the tank wall. This provided a much safer method of construction as the need for dewatering was removed. The use of permanent piles served three purposes:

- (i) Act as a cofferdam.
- (ii) Form part of the structure of the tank.
- (iii) Surface friction on the piles acted as anti-flotation.

Further benefits yielded cost savings in terms of reducing time and materials used for tank construction, as well as eliminating the health and safety risks associated with removing the piles at a later stage. The secant pile method also provided an estimated 15% cost saving over applying the traditional cofferdam construction method for the storm tank.

Bracknell STW

Bracknell STW serves a population of 89,646 (PE 90,498). As well as providing sludge dewatering and sludge cake storage facilities, Black & Veatch's scope of works required bringing the site's 4 (No.) existing secondary sludge digesters back on line. No other elements of asset improvement were required since the existing plant had adequate spare capacity to support additional load. A sludge dewatering system has been provided incorporating 2 (No.) belt presses.

Black & Veatch had to overcome essential ecological challenges and comply with strict planning conditions in its design of the new dewatering facility to reduce visual impact on the site's few residential neighbours.

Environmental issues

The presence of great crested newts was the main challenge in obtaining planning permission for the upgrade at Bracknell STW. Surveys revealed the site's disused sludge lagoons were a breeding



ground for the largest population of great crested newts yet to be found on one of Thames Water's sites.

Black & Veatch was required to work with Thames Water's Ecology and Heritage team to move the newts and other creatures from the area before work could commence on site. Fencing was erected around the four-acre working area, with bucket or 'pitfall' traps dug in the ground every two metres. The traps were checked daily and any newts or other animals caught were relocated to a safe location. Overall, 141 animals including toads, frogs, grass snakes and shrews were transferred out of harm's way, to long grass nearer the lagoons.

Sustainable approach yields benefits

In order to comply with environmental legislation, a sludge dewatering building was required at Bracknell for which planning approval was granted subject to strict planning conditions. During the design phase of the project, it became clear that a screening bund would also be required in order to shield a property close to the site from noise and some visual intrusion.

Black & Veatch was able to show both environmental and economical benefits across both schemes by reusing the spoil from the Basingstoke storm tank excavation to construct the earth screening bund at the Bracknell site. Drawings showed that the bund would need to be constructed from approximately 36,000 tonnes of spoil. Mindful of the environmental impact the project team looked for a more sustainable option for obtaining the spoil than using virgin material.

The solution came from the Basingstoke project which required a large excavation for the storm tank, making available spoil potentially suitable for the Bracknell bund. In order to use the Basingstoke spoil an Environmental Permit was required from the Environment Agency (EA). Tests were carried out on the Basingstoke spoil to prove it was fit for purpose and a case was put

forward to show that the bund had a legitimate purpose, planning permission, and was a waste recovery operation. Black & Veatch's Project Manager for Bracknell also attended a course to show he was competent to oversee the recovery operation.

Once the application had been agreed with the EA, 20,000 tonnes of spoil from the Basingstoke site was transported to Bracknell STW. Spoil movements were monitored to ensure compliance with permit requirements. Good communication was also required during meetings and toolbox talks with the main subcontractor to ensure the permit's provisions were understood and adhered to.

Using spoil from the Basingstoke site at Bracknell removed the need to import 20,000 tonnes of virgin material and also prevented the Basingstoke spoil from being taken to landfill. The exercise also saved the projects £80,000. Working with local ecologists, the 8m high earth bund has been planted with indigenous trees, shrubs and plants.

Summary

As well as providing regulatory compliance, the projects have improved the standard of sludge treatment, reduced the sites' carbon footprint by reducing sludge tanker movements and increased the capacity of each to accommodate future population growth. Additionally, the upgrades have yielded environmental benefits as vehicle movements on and off each site have been significantly reduced – 50% less at Basingstoke, and 80% less at Bracknell.

Black & Veatch achieved Thames Water's target date of regulatory compliance in January 2012.

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