

# Mogden STW

## extension and refurbishment project for Thames Water as part of the London Tideway Improvements

by Richard Green BSc CEng MICE CMgr MCM

Thames Water's Mogden STW in Twickenham, West London, is the UK's third largest, serving around 1.9 million customers in the western third of Greater London. The site covers an area of 120 acres; more than 80 times the size of the famous neighbouring rugby pitch. In 2010, work began on an upgrade and expansion project to increase Mogden's treatment capacity and meet the Environment Agency's new consent standard, due to come into effect on 1 April 2013. The improvements also allow for a 6% population increase until 2021 and increase flow to full treatment capacity to 1,064 million litres per day. The project forms part of Thames Water's London Tideway Improvements programme, comprising five major engineering schemes to help stop sewer overflows and improve water quality in the River Thames.



### Background and need for the scheme

Under moderate rain storms Mogden was unable to fully treat incoming flows. This resulted in more frequent than desirable use of storm tanks and potential discharges of partially treated sewage to the River Thames. Outline design identified that it was essential to increase capacity by approximately 50% to fully treat incoming flows and meet more stringent effluent quality standards. As well as significantly reducing discharges of partially treated sewage, the project has been designed to minimise odour where possible and increase the amount of renewable energy generated by the works.

### Delivery team

Working collaboratively with Thames Water's Capital Delivery and Operations teams Black & Veatch was employed as design and build partner for engineering, procurement and construction of the new works. Embedding members of the end-user client within the project team ensured smooth integration of the new treatment stream with the existing plant. This integrated structure also allowed early input by the end-user to the design of the plant, which was crucial to successful project delivery.

### Constraints

The project was truly multi-disciplinary, with huge challenges posed in several major engineering fields. Although the existing works is

on one of Thames Water's largest sites, there was very little usable room upon which to construct the works. Process design evolved to include deeper than normal treatment vessels to increase capacity within the same footprint. The 10m level difference between the old and new works and limited access made project execution logistics immensely challenging. In addition, a large proportion of the scope required interfacing with the existing plant; with the resulting challenges of integrating old and new equipment whilst maintaining full treatment capacity at all times.

Mogden's location added to the project challenges. The site is bounded by residential and light commercial premises and a public footpath runs beside the Duke of Northumberland River which cuts across the centre of the works and so, from the outset, great emphasis was placed on building relationships with all the project's stakeholders.

### Scope

The Mogden scheme includes construction of a new effluent stream using traditional activated sludge treatment technology and also upgrades to the existing sludge plant. The project involved building 20 (No.) new treatment tanks using 42,000m<sup>3</sup> of concrete, upgrading and covering some of the existing parts of the plant and installing a new primary substation.

# Inspiration & Innovation

**We're building a world of difference. Together.**

Where business solutions begin with a conversation. Fresh insight and endless expertise result in constant innovation. And the complex is always made manageable.

That's the Black & Veatch difference.

Redhill +44(0)1737 774155



**BLACK & VEATCH**  
Building a **world** of difference.®

Mogden consisted of 4 (No.) STWs in one location – referred to as the ‘batteries’. Batteries A and B were opened in 1936, Battery C in the 1960s and Battery D was completed in the late 1990s. The new scope comprises Battery E – a new treatment stream on the western side of the works.

**Effluent scope:** The new inlet works comprises 6 (No.) fine screens. Downstream are 2 (No.) duty standby grit detritors and a crude sewage pumping station that transfers flow to 5 (No.) new rectangular primary settlement tanks (PSTs). Eight existing rectangular PSTs have been refurbished and remodelled. All of the aforementioned structures have been enclosed with new high level GRP covers and ducted to a new odour control plant.

An intermediate pumping station then lifts the flow approximately 10m into 5 (No.) new aeration lanes. To increase capacity whilst keeping the footprint as small as possible, these have been constructed deeper (7.5m) than the existing (4.5m). These incorporate Xylem Gold Series fine bubble diffusers that offer a superior oxygen transfer rate. When combined with high efficiency high-speed blowers, this system has the benefit of lowering the plant’s overall energy consumption. Mogden currently represents the world’s largest installation of these diffusers; the system is set to provide a whole-life cost saving of between £2m and £3m over its design life.

Flow then gravitates from the aeration lanes to 10 (No.) new 38m diameter final settlement tanks (FSTs). A return activated sludge (RAS) pumping station returns around 50-60% of the flow from the FSTs to the aeration lanes to provide stock sludge. The final treated effluent is collected and transferred via an existing final effluent channel for eventual discharge into the River Thames.

**Sludge scope:** Proportionate to boosting the site’s flow treatment, Mogden’s sludge treatment capacity has also been substantially

expanded. Two existing raw sludge storage tanks have been relocated to make space for the new pasteurisation plant extension and sludge screening building. Here, Black & Veatch has applied innovative thinking to increase capacity. Instead of re-siting the glass fused to steel tanks above a concrete base, the team constructed a 4m shaft below each new location and rebuilt the tanks on top – effectively doubling their volume within the same footprint whilst maintaining the existing top water level. A new pumping system then transfers sludge to the new sludge screening building.

The pasteurisation plant extension forms Mogden’s largest sub-contract. Four new sludge pasteurisation streams augment the existing eight and the hot water system has been upgraded to suit. The site of an old redundant building now incorporates a new odour treatment plant that treats raw and surplus activated sludge and pasteurisation odours. As part of the sludge scope Black & Veatch has provided improvements that enable the site’s combined heat and power (CHP) engines to more efficiently capture and burn the methane produced to create renewable energy. This is sufficient to serve around 40% of the site’s energy requirements.

**Earthworks:** The scale of earthworks for this type of project is remarkable. Before construction could begin, the site’s huge 300 metre-long western embankment was moved 100m west to create room to build the new works. In total over 430,000m<sup>3</sup> of material was relocated. Balancing the cost of transport of surplus material off site against pumping costs over the life of the plant resulted in the new works being elevated at up to 10m above the existing. This saved approximately 45,000 lorry movements through the surrounding public road system. It did however result in the logistical challenge of a significant proportion of the project’s 42,000m<sup>3</sup> of concrete being routed up a single track access ramp.



*The extended site can now treat up to 426 Olympic-sized swimming pools of wastewater per day - Courtesy of Thames Water*

# TotalCare services

For secure, optimal operations



Xylem TotalCare is a comprehensive, integrated portfolio of services that ensures your business keeps running at its best. Our portfolio comes backed by deep systems knowledge and expertise in water and wastewater applications. Which gives you the operational security and more time to focus on your core business.

What can Xylem do for you?  
Call 0115 940 0111 or visit  
[www.xylem.com/totalcare](http://www.xylem.com/totalcare)





Final settlement tank base pour  
Courtesy of Thames Water



Through collaborative working the project team has executed an exceptionally challenging scheme to the required time, safety, cost and quality targets - Courtesy of Thames Water

**Electrical works:** The team has also increased the site's resilience against power outages. Working with UK Power Networks, a new 19MVA power supply with associated primary sub-station has been installed; sufficient to support a small town. The high-voltage ring main, which extends 2.5km around the site, had to be threaded around more than 250 services. This complex challenge was successfully managed without incurring any service strikes. The team has also delivered improvements to Mogden's power management system that ensures the plant operates at optimal efficiency.

Supplemental to the above works, Black & Veatch successfully delivered around 15% additional scope to refurbish and improve existing assets within the original target date for delivery.

### Considering the community

Working in tandem with Thames Water, a joint communications strategy was developed to ensure residents were informed of the

project's progress and to provide advance warning of heavy civil engineering activities such as piling. Activities included a regular newsletter to 10,000 residential properties, meetings with local residents' groups and monthly drop-in sessions that provided ready access to the project team.

For the wider community, the objective was to provide a beneficial impact and leave a lasting legacy. The project's landscaping scheme was modified to facilitate an environmental project that culminated with a tree-planting exercise on the site's western embankment. The event provided primary school students an invaluable opportunity to gain learning beyond the classroom. Volunteers from the team also supported environmental groups such as Friends of the River Crane Environment (FORCE) and Thames 21.

### Minimising environmental impact

On the way to the project's successful conclusion the team earned two national Considerate Constructor Scheme awards, in part for the extensive efforts made to minimise the project's impact upon the local community. Examples included adopting specialist piling techniques to reduce noise and vibration; diverting heavy goods vehicles from residential roads; reducing working hours for heavy construction activities and preserving the site's mature oak trees.

Scheme design included measures to support all wildlife, from log-piles for invertebrates to animal bridges over water courses. Special measures were put in place to protect the resident badger population including the provision of a migration corridor around the construction area. The site's 300m embankment has been profiled and planted to provide amenity value to the site's residential neighbours.

### Fostering innovation

Establishing an innovation/challenge process at the project's outset yielded over forty potential improvements that were reviewed for overall benefit. This not only generated capital savings of more than £4m but also reduced construction risk during project delivery.

The adoption of an engineered steep-faced reinforced earth retaining wall was perhaps the most significant idea to come out of the process. This innovation alone retained an additional 7,000m<sup>3</sup> of excavated material on site, avoided the use of over 1,700m<sup>3</sup> of energy intensive reinforced concrete, and saved the equivalent of over 2,250 tonnes of carbon.

### Summary

Over 400 of Mogden's neighbours came to see the team's achievements at an open day held to mark the upgrade's final completion in June 2013. The revamped site can now treat the equivalent of up to 426 Olympic-sized swimming pools of wastewater per day.

In total, the project encompassed more than 1,650,000 construction hours; a team peaking at more than 350 people with approximately 100 sub-contractors contributing to the project scope, a large proportion of which was delivered during England's wettest year on record.

Through collaborative working the project team has executed an exceptionally challenging scheme to the required time, safety, cost and quality targets. Integrating new and existing facilities on a massive scale has been managed with innovation and the utmost consideration for those living close to the site. The result is an energy-efficient plant on a minimal footprint that provides positive and lasting benefits, helping to create a cleaner, healthier River Thames.

*The Editor & Publishers would like to thank Richard Green, Contracts Manager for Mogden STW Expansion Project with Black & Veatch, for providing the above article for publication.*