Reading STW - a celebration of the art

£80m Thames 'state of the art flagship' commissions in 2004

by

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The Reading Southern Gateway is an area of urban regeneration between the town and the M4 motorway, centred on the A33 relief road - completed by Reading Borough Council in 1999. Several prestigious commercial office developments and the Madejski Stadium have already been completed in the area, but a potential barrier to further development was the existing Manor Farm Sewage Treatment Works, which occupied 25 hectares of land in the new gateway area. This works, built in 1873 - with modifications in 1925 and 1963 - would have required extensive redevelopment to meet new effluent and sludge quality objectives and a conventional approach to this task would have taken many years involving high levels of cost. Unprecedented collaboration between Thames Water, the Borough Council and developers, has led to design and construction of a completely new works on a nearby site and a commitment to regenerate the Manor Farm site with a mix of commercial and residential property. This is a 'flagship' project, demonstrating Thames Water's leading position in process design, engineering and environmental performance.

Reading STW: Site view of digesters with completed insulation and cladding courtesy Thames Water

Site

The new 10-hectare site was owned by the Borough Council and is approximately 400m from the existing Manor Farm Sewage Treatment Works. Up to the 1970s the land was used for sludge disposal in two large lagoons and subsequently for domestic waste disposal. More recently, a demolition company has occupied part of the area for recycling materials. The sludge lagoons rested on a thin layer of river gravels, overlying the relatively impervious clays of the Reading Beds but sand lenses in this strata allowed downward migration of ammonia that was known to be causing contamination of the underlying chalk aquifer. A planning condition required that proposals for remediation of the land should involve removal of the source of pollution.

Land remediation

Land remediation started in May 2001 and involved the excavation of 170,000 tonnes of sludge and 45,000 tonnes of domestic waste. Before this work started a 7 to 11m deep bentonite cement slurry cut-off wall was installed around the perimeter of the site to control groundwater movement and a ring of wells was installed to lower groundwater, permitting excavation down to founding levels for the new works. Approximately 15,000 tonnes of the sludge were retained on site for mixing with sub-soil for use as a topsoil substitute and growing trials were undertaken to ensure that plants used in

Reading: Internal view of inlet works courtesy: Thames Water

landscaping areas would not be adversely affected. High levels of mercury and cadmium were contained in the remaining volume of sludge and this material together with the screened domestic wastes, were disposed of in licensed landfill sites.

Design objectives

The new Reading Sewage Treatment Works has a design population equivalent of 284,000 including trade effluent of 100,000 more than half of which arises from a local brewery. New discharge consent standards must be met by March 2005 and principal design objectives are to treat to a level of 2ppm ammonia and to remove phosphorus to 1 ppm by a biological process. The final sludge will be an enhanced treated product with a 6 log reduction of pathogens, making it suitable to be used for the widest range of agricultural purposes. The odour control system is design to ensure that no receptor outside the boundary of the works is exposed to more than 5 odour units (OU) above background.

Apart from the technical challenges of the design it was also important that the works be seen as an enhancement to the local area – in support of Reading Borough Council's regeneration ambitions.

Environmental management

In view of the high environmental profile and risks associated with this project, a full-time Environmental Manager was employed to develop an environmental management system (EMS) and provide advice and support to the alliance team. The team took the unusual decision at an early stage to obtain certification of the EMS to ISO 14001 and this demonstration of commitment helped to emphasise the importance attached to high environmental standards both to alliance team members and external stakeholders. An early environmental challenge faced by the team was the unexpected discovery of a colony of water voles that had occupied one of the sludge lagoons. Drawing on expertise within Thames Water and Oxford University's WildCru, the voles were captured and successfully relocated at the Barn Elms Wetlands Centre, a former Thames Water reservoir site in London.

The success of the EMS was confirmed in August 2004 when the team received one of the inaugural 'Excellent' category C EEqual (Civil Engineering Environmental Quality) awards.

Design, construction and commissioning of the £80m project is being delivered through an alliance with *Taylor Woodrow* and *Black & Veatch,* which is also setting new standards for collaborative working practices.

Design

An integrated design team was formed by the alliance, drawing resources from all of the alliance members and including civil engineering design input from *Faber Maunsell* and architectural design services by *Broadway Malyan.* A fully equipped design office was established on site, taking as a starting point a concept design prepared by Thames Water in conjunction with *Halcrow.* The design was developed in parallel with land remediation throughout 2001 to enable construction to start early in 2002.

An important element of design was the need for efficient use of space on a site less than half the area of the old works. Underground storm tanks, lamella plate primary settlement and basement tankage for the sludge treatment area all formed a part of this space saving design. Treated and dewatered sludge was originally to be stored on conventional open areas but consideration of odour release and the

need to conserve space for future development resulted in the use of silo storage.

A key feature of the design is the use of a 'signature' curved architectural form of the main buildings that house process equipment. All processes with the exception of final settlement tanks and tertiary filters are in buildings or otherwise covered. Air is extracted from covered process plant and buildings and is treated by *Odorguard* chemical scrubbing plant housed in the Inlet Works and Sludge Treatment Buildings.

Process
A brief description of the process streams is as follow:

Effluent
* preliminary treatment including 6mm screens supplied by *Andritz* and combined removal of grit and grease in aerated channels with equipment supplied by *Vexamus;*
* lamella plate primary settlement, with equipment also supplied by *Vexamus;*
* biological nutrient removal, using the *Bardenpho* activated sludge process;
* final settlement - eight 34m diameter conventional circular tanks;
* tertiary filtration using sand and anthracite in travelling hood type filters supplied by Eimco Dorr Oliver.

Sludge
* separate thickening of primary and surplus activated sludges to approximately 9% dry solids using belt thickeners supplied by *Simon Hartley;*
* pasteurisation at 70˚C for 60 minutes using *Alpha Biotherm* process; the heat to pasteurise the sludge comes first from CHP engines running on biogas from the digesters with additional input from dual fuel boilers;
* anaerobic digestion, the UK's first reinforced concrete egg-shaped digesters which, in addition to operation and maintenance benefits, help to enhance the overall architectural appearance of the new works.;
* dewatering to at least 25% dry solids using centrifuges supplied by *Alfa Laval.*

Construction
Construction of the new sewage treatment works started after completion of the land remediation works and bulk excavation, in March 2002. Approximately 38,000m^3 of structural concrete was produced from site located batching facilities for water retaining structures and foundations to buildings and process plant.

New sewers and pumping mains transfer flow from Manor Farm Sewage Treatment Works as well as effluent and storm discharge pipelines. Crossings of the A33 dual carriageway were facilitated by construction of seven 1.0m or 1.2m diameter microtunnels, excavated by *Johnston Construction* using *Herrenknecht* full-face pressure balance tunnelling machines.

Teamwork has been the key to successful project delivery and key members of the alliance have been drawn from all of the participating organisations. Supply chain partnering has also been a key feature and the alliance has made extensive use of target cost reimbursable sub-contracts to align objectives and integrate key supply chain partners into the team.

The project has now entered the commissioning phase, with transfer of first sewage flows in March 2004. A 20 week full scale trial was underway during the summer of 2004. to be followed by a 28 day reliability testing. Completion of commissioning was targeted before the end of 2004, well ahead of the date required to meet the new discharge consent.

This project has gained a reputation on the international environmental tourism route. The team has become used to entertaining a string of visitors as diverse as the Slovak Environment Agency, groups of Chinese film makers and journalists, Egyptian Generals, and politicians of all shades of opinion. All who visit are impressed by the concept and execution of this most modern of sewage treatment designs.

A true celebration of the art!

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Note on the authors: *Terry Bane is Project Director, Thames Water Engineering; Graham Stanley is Alliance Manager, Taylor Woodrow Black & Veatch Joint Venture.*