Weston-super-Mare STW

£25m upgrade of major sewage treatment works at coastal town

by Stuart Lewis BEng (Hons) and Nigel Habershon BSc (Hons)

Weston-super-Mare, a large coastal town in the county of Somerset, has a population of around 134,000 and has been a significant tourist attraction since the 19th century. Until 1999, sewage from the town was screened only before being discharged into the Severn Estuary via a sea outfall. In order to comply with the Urban Waste Water Treatment Regulations (UWWTR), a new sewage treatment works was constructed to the south of the town at Brean. However, improvements are now required and the £25m upgrade of the treatment works by Wessex Water has to meet the AMP5 compliance date of 31 March 2013.

Weston-super-Mare STW - Courtesy of Dean & Dyball

Project need

Based on historic sampling results, Bathing Waters at 'Weston Main' and 'Uphill Slipway' would be classified as 'poor' under the revised Bathing Water Directive (revBWD).

In AMP4, investigations carried out by Wessex Water at Weston-super-Mare Black Rock SPS concluded that the continuous discharge from Weston-super-Mare STW and spills from Black Rock SPS were contributing to the poor bathing water quality. AMP5 therefore included outputs for both Weston-super-Mare STW and Black Rock SPS to minimise the impact of wastewater discharges on bathing water quality.

The output for the STW requires improved secondary treatment to improve effluent quality and achieve better microbial reduction from UV disinfection. The specific requirement is for the suspended solids consent to be reduced from 50mg/l to 30mg/l.

Weston-super-Mare STW also exceeds its consented DWF and a revised DWF consent is to be addressed by the scheme. However, improvements over and above those required by the improvements to meet the revBWD are not required as the site is consented primarily to meet UWWTR percentage removal requirements. No change in flow to full treatment is required by the revised DWF consent.

The output related to Black Rock SPS requires a reduction in spill frequency to 3 spills per bathing season (average over 10 years). This is to be partly achieved by the provision of storm storage at the STW itself and partly by a programme of Integrated Urban Drainage Management (IUDM) measures within the catchment to remove surface water inflows into the foul sewerage network. The storm storage component is included within the scope of this project; while IUDM measures will be the completed under a separate scheme.

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View of Weston-super-Mare STW - Courtesy of Dean & Dyball

Scope of Works

The final approved option involves the replacement of the existing submerged biological contactors (SBC) with a more efficient and reliable activated sludge plant (ASP), combined with increased final settlement capacity. The extensions to the STW will be kept within the existing site boundaries and as a result most of the works are being completed as permitted development, with only the standby generators and the GRP kiosks requiring planning approval.

The works have been designed to achieve the following consent requirements: flow to full treatment (FFT) of 1,050l/s; minimum percentage reductions for BOD and COD with upper limits of 25mg/l and 250mg/l respectively; and SS of 30mg/l. DWF at the design horizon of 2032 is forecast to increase by 28% to 24,896m^3/d.

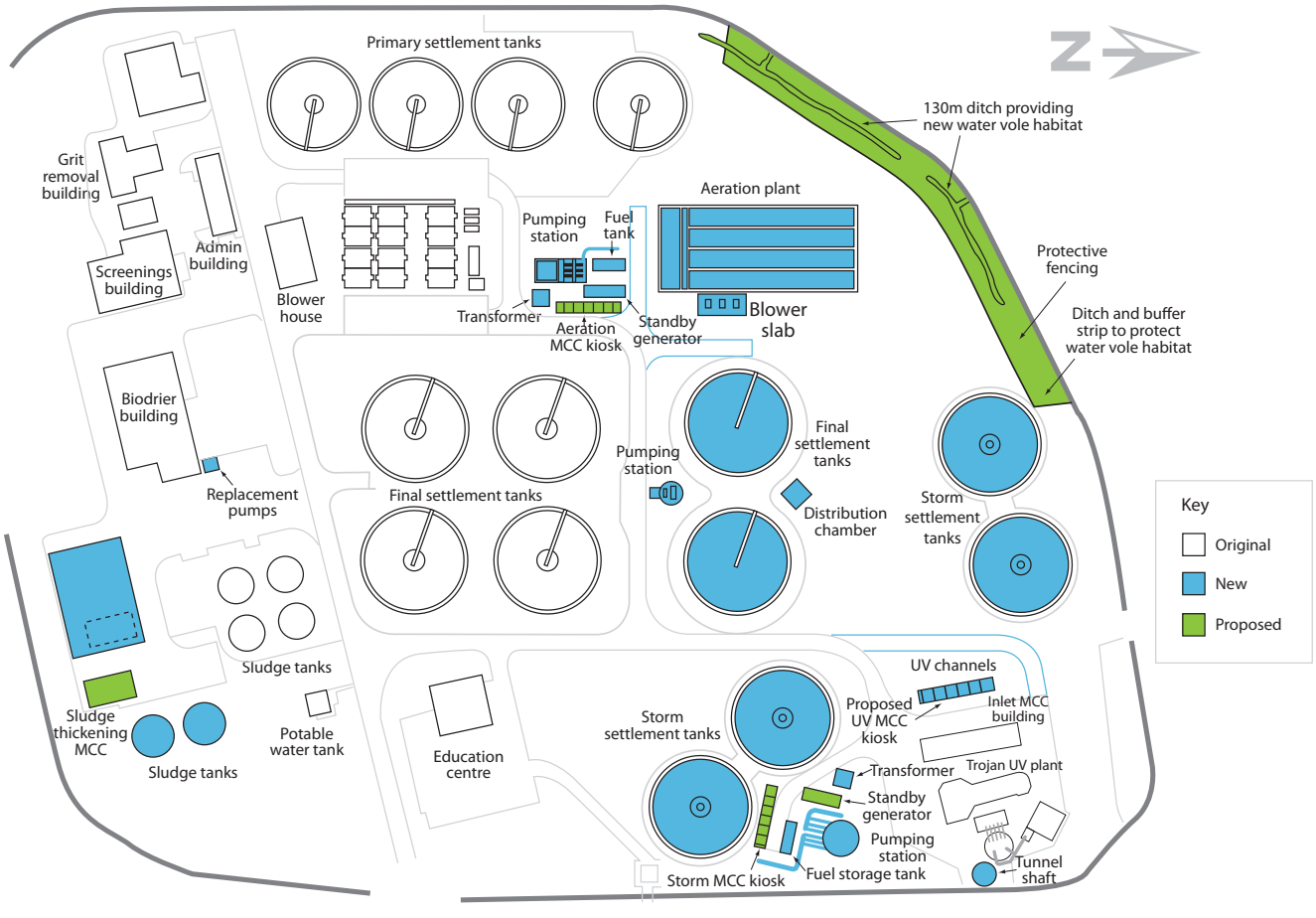
Storm storage is to be provided to limit spills to three per bathing season, averaged over a 10 year period, in conjunction with IUDM improvements in the sewer network. Modelling demonstrated that the provision of 21,000m^3 of storage at the STW, together with the network improvements, would satisfy the criteria.

The opportunity is also being taken to improve the sludge treatment facilities at the STW, including additional storage and enhanced thickening capability.

The new works comprises:

(a) Treatment stream

- Settled sewage pumping station to divert primary settled effluent to a new ASP.
- ASP with anoxic selector - total aerated volume of 7,214m^3 provided in 4 (No.) lanes. Each lane is 50.1m long by 6.0m wide, with a water depth of 6.0m.
- RAS/SAS pumping station.



Schematic of proposed works - Courtesy Wessex Water

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- 2 (No.) new final settlement tanks, 31m diameter with 3m side wall depth.
- Conversion of 4 (No.) existing humus tanks (31m and 1.8m side wall depth) to act as final settlement tanks.
- Replacement UV plant and channel.
- UV control buliding.

(b) Storm System

- Connection to the existing inlet pumping station.
- Tunnel to the storm pumping station.
- Storm pumping station, delivering a peak flow of $2m^3/s$.
- 4 (No.) storm tanks, 5,250m^3 capacity each (generally 8m above ground level and 29m in diameter) arranged in two streams.
- Storm control building.

(c) Sludge System

- Pre-thickened sludge storage.
- 2 (No.) drum thickeners.
- Polymer dosing system ('big bag').
- Thickened sludge storage.
- Sludge pumps.
- Odour control.

Other work undertaken in association with the site infrastructure included pipelines, MCCs, instrumentation and SCADA, standby generation and an uprated HV supply to the site.

CFD modelling

Detailed CFD modelling using a drift flux representation of the activated sludge settlement was carried out by MMI Engineering Ltd to determine the capacity and performance of the final tanks.

This was particularly useful for this site, providing a robust understanding of the flow and load balance between the new settling capacity and the existing converted humus tanks (which have a shallow sidewall depth).

Implementation

Wessex Water has adopted a 'workstream' approach for the delivery of schemes in AMP5, and the overall roles of the partners for this scheme are as follows:

- ***Halcrow Group*** - responsible for detailed design.
- ***Dean & Dyball Civil Engineering*** - responsible for civil engineering construction services. Also principal contractor for the scheme.
- ***Nomenca*** - responsible for M&E procurement and installation.
- ***Wessex Engineering & Construction Services*** - responsible for automation, process commissioning and environmental services.

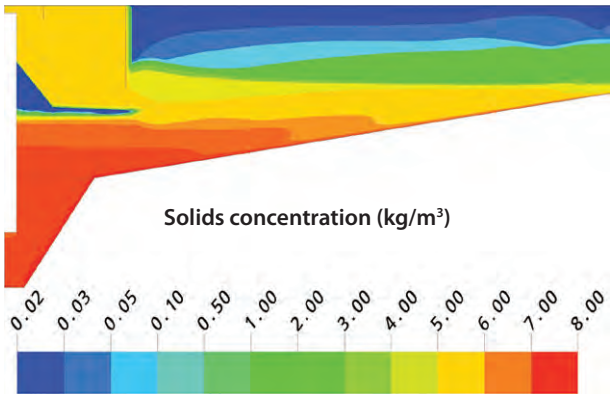
Site location challenges

The scheme presented a number of challenges. For instance, most of the surrounding land is agricultural, but some is also used for leisure purposes with a number of camping sites located just 1.5km east and a hotel located 3km south.

The tidal River Axe runs to the West of the site at close proximity and the site is protected by a 2m high embankment that shelters it from any flooding originated from the river.

The site is within the flood plain of the Severn Estuary. The estuary is also a designated Special Protection Area (SPA), Special Area of Conservation (SAC), Site of Special Scientific Interest (SSSI) and a County Wildlife Site (CWS).

Within the site boundary there are three designated areas: the operational works, the wildfowl lagoons, and the redundant UV



Converted humus tank - Courtesy MMI Engineering Ltd

Settled Sewage PS - Courtesy of Dean & Dyball

Fine bubble diffusers - Courtesy of Dean & Dyball

Tunnelling operations - Courtesy of Dean & Dyball

lagoons. The operational works is fenced and gated with no access to the public. The wildfowl and redundant UV lagoons attract a large number of common and rare water birds; hides are located around the site to accommodate birdwatchers.

Meeting the early completion date

Work commenced on site in April 2011 and completion is expected in December 2012.

As a result of the relatively early AMP5 target date for completion, Wessex Water actually commenced optioneering and outline design of the scheme in 2009, and subsequently handed over to the workstream to complete detail design and implement construction.

The construction programme was influenced by the constrained nature of the site and the fact that operation of the existing facilities had to be maintained.

The following gives some idea of the scale of the scheme:

- Expected manhours on site to completion - 250,000.
- 1,150 precast concrete piles placed.
- 12,000m^3 of structural concrete poured.
- 2,000 tonnes of steel reinforcement fixed.
- 1.2km of pipelines laid (250mm to 1,200mm in diameter).

Progress

The design and installation of the process plant has been managed by Nomenca, with the aeration equipment for the ASP being sourced from Sanitaire (now part of Xylem Water Solutions) and the UV plant from Wedeco (also now part of Xylem).

One critical element of the scheme was the construction of the storm pumping station, which involved the sinking of a 12.5m diameter precast concrete shaft down to the mudstone bedrock, which was approximately 16m below ground level, and the shaft was sunk into this material by a further 1-2m. Borehole dewatering was employed in order to reduce the groundwater level in the immediate vicinity.

The main ASP and storm tank structures were substantially completed by July 2012 and installation of the process plant and M&E installation commenced in May 2012 – Dean & Dyball and Nomenca have been working closely together in order to coordinate their on-site activities. At times up to 150 people have been working on the site, particularly through the Summer of 2012.

Proposals for habitat enhancement of the site have focused on enhancements of the water vole habitats within the operational area and enhancement of the wildfowl wetland areas.

Unfortunately the original soils investigations showed high moisture content, and this material was unsuitable for reuse on site in its as-dug condition. However, 95% of the inert muck-away was reused in a local landscaping scheme within 0.5 miles of the site.

Conclusion

The scheme has proved to be complex and all parties involved with it have worked well together in order to deliver the improvements within the tight timescale.

Completion by December 2012 will provide ample time for the team to address any snags that remain in time for the regulatory deadline of March 2013.

The Editor and Publishers wish to thank Stuart Lewis, Programme Manager Wessex Water, and Nigel Habershon, Framework Manager Dean & Dyball Civil Engineering, for producing the above article for publication.

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