# Camberley, Chertsey & Crawley STWs

## the NVZ dewatering challenge

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Camberley STW, Chertsey STW and Crawley STW all fall within the Thames Water South London Process Area. The Nitrogen Vulnerable Zone (or NVZ) projects were required to comply with EU Nitrogen Directive (91/676/EEC); their purpose to amend the sludge process streams (specifically sludge dewatering and liquor treatment) to produce a dewatered sludge that can be applied to agricultural land. The existing sludge had high levels of ammonia which would oxidise to nitrate and would breach the directive. Therefore the nitrogen based compounds had to be removed. However if the sludge is dewatered the ammonia rich liquors had to be returned to the inlet works after the storm overflow weir. The performance of the existing works had to be evaluated to confirm that the increased load will not affect the discharge consent. The ammonia load was too great for the existing filter plant at Chertsey therefore a liquor treatment plant had to be constructed to reduce the ammonia to an acceptable level.

*Chertsey STW - Belt dewaterers - Courtesy of Courtesy of GBM JV*

### Undertakings

The GBM JV, which comprises Galliford Try, Biwater Treatment (now MWH Treatment) and Mott MacDonald, were awarded the contract in July 2010 as part of the AMP5 Capital Delivery Process Programme of work with Thames Water Utilities Limited (TWUL). The overall value of the contract was £29.2m.

In addition to the NVZ scope, the project addressed catchment area increases and capital maintenance issues on each of the three sites. Each site was treated as an individual project, although the synergy in scope across the scheme was used as a benefit during the design, procurement and commissioning stages.

### Delivery strategy

Due to the extremely tight programme and operational constraints the delivery strategy was collaborative and best practice working with the client, Thames Water. In doing so, GBM were able to identify, eliminate and plan the mitigation of key risks to the programme.

Each element of the scope was challenged to provide best value and fitness for purpose. Key suppliers were identified early and engaged to provide input into the design & build process. Innovations were identified pre-gateway approval and shared to ensure synergy across the sites.

### Key responsibilities

GBM was responsible for stakeholder engagement, planning, design, construction, commissioning, sampling and testing, process guarantees and any works not covered specifically by the project brief to meet the project outputs.

*Camberley STW - Drum Thickener Feed Pumps - Courtesy of GBM JV*

### Constraints
The key project constraints (apart from the tight programme) were issues associated with integrating new plant into existing operational works. To ensure the end product met with the end users needs, GBM JV were awarded early orders to enable the design team to involve the site operators in the early stages of the design process and share best practice.

### Camberley STW
Camberley STW treats and disposes of sewage from the Camberley catchment area that serves a population equivalent of 133,700 increasing to approximately 139,495 by year 2021.

The sewage treatment process at Camberley STW involves the settlement of solids and treatment of the remaining water using a biological process where bacteria breakdown organic matter in the sewage through the activated sludge treatment process. The treated water (effluent) discharges into the River Blackwater located to the south-west of the STW.

In addition to the NVZ requirements, the project scope at Camberley included the refurbishment of the existing fine bubble diffused air (FBDA) system in the existing 3 (No.) aeration lanes, to meet the oxygenation capacity requirement in 2021, and the provision of a fourth aeration lane. The existing aeration lanes were split between 1/3 anoxic and 2/3 aeration capacity. Due to insufficient headroom it was not possible for TWUL Operations to take an ASP lane out of service (except in an emergency) without a fourth lane.

### Camberley STW anoxic tank
During the negotiated tender stage, GBM identified a saving of £950k by the provision of a new anoxic tank in lieu of an additional fourth aeration lane. The tank was less than that of a new ASP lane and (as the depth is not limited to the blower capability) founded at a lower level thereby reducing imported fill.

It was built from reinforced concrete off line with only one live connection into the existing RAS pipe. Process performance exceeds that of the existing ASP plant. The existing aeration lanes were converted to 100% aerated volume.

### Chertsey STW
Chertsey STW treats and disposes of sewage from the Chertsey catchment area that serves a population equivalent of 86,500 in 2006, which is forecast to increase to 92,250 by 2021. The treatment at Chertsey comprises solids settlement, biological filters and humus tanks. Chertsey imports sludge from other sites where it is treated with a thermal hydrolysis plant (THP) and digested.

### Chertsey STW liquor treatment plant
The return of the ammonia rich liquors from the sludge dewatering facility would result in a discharge failure and it was necessary to treat the liquors to achieve a concentration of ammoniacal nitrogen of 20mg/l, BOD of 100mg/l and total suspended solids of 150mg/l under average conditions with a new liquor treatment plant (LTP).

The feed to the LTP included both the liquors from the dewatering of digested sludge and the dewatering of raw sludge. There was 257$m^3$/d of digested liquor and 654$m^3$/d of raw sludge liquor. Consequently the organic carbon concentration was much higher than a LTP treating digested sludge liquors alone.

Four LTP alternatives, SHARON®, Amtreat®, Anammox® and Sequencing Batch Reactor (SBR), were evaluated using the Whole Life Cost technique and it was established that in this instance a SBR was the most cost effective solution. This would not have been the case without the inclusion of the raw sludge liquors

### Crawley STW
Crawley STW treats and disposes of sewage from the Crawley catchment area that serves a population equivalent of 148,600 in

*Chertsey STW - Rainwater attenuation tank - Courtesy of GBM JV*

2008 and is forecast to increase to 169,024 by 2021. The treatment comprises solids settlement, biological treatment using the activated sludge process and final settlement with partial treatment with disc filters to achieve the consent required to discharge into local watercourse.

The existing works had been built in three stages and there was considerable refurbishment requirement in addition to the construction of new primary sludge thickeners. The sludge from the existing digesters was to be dewatered.

### Crawley picket fence thickeners

As part of the improvements to the existing sludge stream, 2 (No.) new picket fence thickeners (PFTs) were provided, which allowed the existing PFT to be converted to a blend tank. The new PFTs provided a more robust sludge treatment on a site where historically the sludge loading is high. In addition the existing SAS thickening belts were refurbished to accommodate the additional loads.

On all three sites there were additional power upgrades, ICA mods and system integration to meet revised asset standards.

### Sludge cake storage buildings

On all three sites the sludge cake was stored on a covered concrete cake pad within a fully enclosed building consisting of *'crinkly metal'* walls, roller door vehicle access and odour control. At Chertsey, due to odour benefits GBM were able to provide a Dutch barn instead, consisting of open fly mesh walls with no ventilation.

The buildings were sized to produce a minimum of 60 day storage of the final sludge, plus a further storage area for 10 days production of non-compliant sludge. The pad includes a cake drop zone, storage, drainage and truck loading/drive through areas. Additionally an automatic drive through wheel washing facility was provided if required.

### Gravity belt dewaterers

Through competitive tendering and historical experience Ashbrook Simon-Hartley was selected as the preferred supplier for the sludge dewatering equipment and poly dosing plant. Duty/standby sludge belt dewaterers were installed on all three sites. The machines were fully enclosed to meet odour standards and located outdoors. The sludge was transferred to the sludge cake storage buildings using enclosed conveyors.

All the equipment was designed and installed to meet the exacting Thames Water Asset Standards.

### Poly dosing

It is necessary to dose polyelectrolyte to the sludge feed to the belt dewaterers to achieve the desired performance. Whole Life Cost studies were undertaken for the type of polyelectrolyte to be used from the Thames Water framework supplier and the storage system to be adopted. Liquid polyelectrolyte was selected at Camberley as the sludge throughput was lower than the other sites.

Powdered polyelectrolyte was selected at Chertsey and Crawley and the storage method was powder. The dose rates required were established following pilot plant trials.

### Planning requirements

There were a number of planning requirements that had to be discharged. These included a no increase in the odour measured at the boundary of the site following the installation of the dewatering facilities. After extensive odour modelling it was established which structures and tanks had to be odour controlled and the location of the odour control system and outlet stack which had to achieve a performance of <1,000ouE/m$^3$ at the stack for each of the three sites.

*Chertsey STW -Construction of the sludge cake storage barn - Courtesy of GBM JV*

Other planning requirements included no increase in noise at the site boundary and no increase in surface water run-off despite the large sludge storage barns and concrete aprons. Due to its location next to Gatwick Airport, the planning authority stipulated that the works would not create a bird hazard or encourage nesting, roosting or loafing. This was incorporated into the design of the new building.

## Delivery dates

The NVZ regulations came into effect on 1 January 2012 at Camberley and Crawley, although they were not implemented until March 2012. At Chertsey STW the implementation date was 1 April 2011.

To achieve this, a temporary dewatering plant (TDP) was engineered, procured and commissioned within 4 months of project award to provide the facility for storage and removal of sludge dewatering liquor off site by tankers for treatment at another Thames Water site. A temporary generator, poly dosing rig, belt conveyor was provided to operate with the centrifuge producing a nominal average sludge dry solids feed of 4% achieving 60m$^3$/hr throughput and 30%DS.

## Conclusion

At the time of writing, all projects are now complete despite a very challenging programme and compliance with exacting standards, and all the projects are now in the final stages of commissioning. The end results meet the client's expectations and deliver the requirements of the EU Directive.

*The Editor & Publishers thank Matthew Laporte, Project Manager with GBM JV, and Martin Hind, Technical Consultant with GBM JV, for providing the above article for publication.*


*Chertsey STW - Sludge odour control unit - Courtesy of GBM JV*

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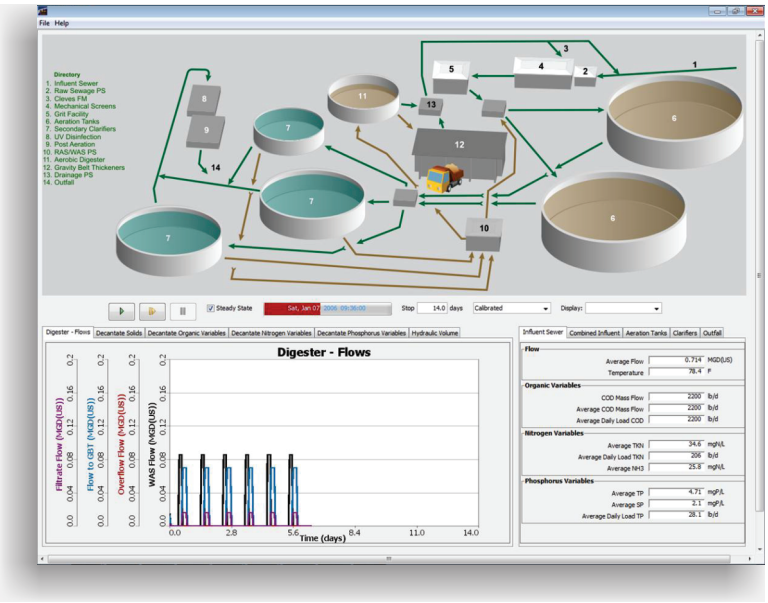


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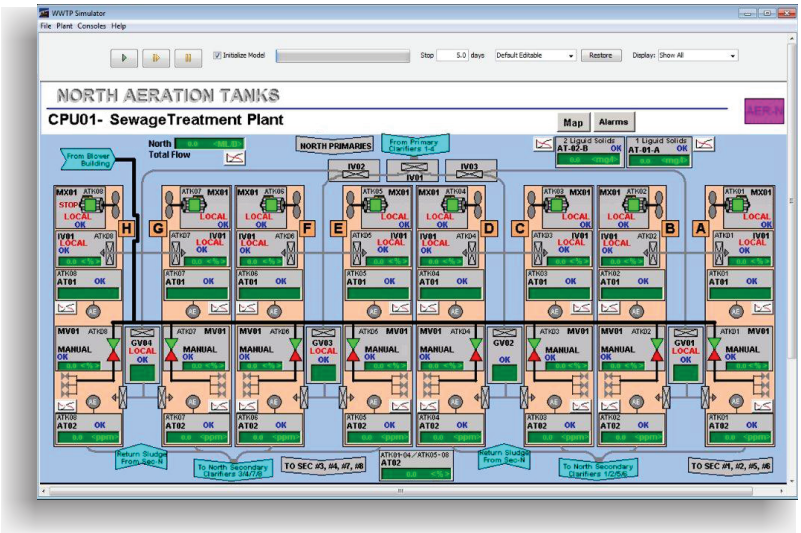


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