Troqueer WwTW

£10m scheme to deliver capital maintenance, growth and odour control

by
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Troqueer WwTW is located on the banks of the River Nith and serves the market town of Dumfries. The works treats effluent from a population equivalent of around 35,000 as well as providing the sludge treatment and disposal for a large numbers of satellite sites throughout Dumfries and Galloway. The existing works was built in the 1950s and was extended in the 1970s. Scottish Water raised the need for investment in the works relating to concerns with (i) the age and condition of the existing assets, (ii) the restriction on growth development within the catchment, particularly relating to the construction of the new Dumfries college, (iii) odour complaints from local residents, (iv) the current hydraulic capacity, and (v) the reliability of consistently meeting the discharge consent of 20mg/l BOD_5.

Troqueer Wastewater Treatment Works *Courtesy of Gary Sweeney, Carillion plc*

Project Delivery

Troqueer WwTW is being delivered by Scottish Water Solutions (SWS) as part of Scottish Waters Q&SIIIa Capital Investment Programme and was one of the largest projects in the South East Delivery Area. The scheme was designed using secondees from Scottish Water and Framework Consultants including MWH, Mott MacDonald, AECOM and Mouchel Parkman, highlighting several of the key benefits of joint venture partnerships including co-location, knowledge transfer and access to a large pool of resources. The works is currently being constructed by SWS in-house Delivery Partner, Carillion plc, and is due for completion in October 2010.

Project Background / Drivers

The works receives sewage from three inlet sewers which discharge into an upstream pumping station (PS) approx 250m to the North East of the works. The PS passes forward flows up to Formula A to the inlet works at Troqueer where the flow is screened and de-grited. Flows in excess of Formula A are screened and discharged to the River Nith at the upstream PS. Screened flows are settled in 3 No. primary settlement tanks. Settled sewage then passes through the Flow to Full Treatment (FFT) measuring flume which limits flow to the 4 No. aeration lanes. Activated sewage is settled in 4 No. final settlement tanks (FSTs) before being discharged to the River Nith. Flows in excess of FFT spill over the FFT weir upstream of the aeration lanes and out to the River.

The Sludge Treatment Centre treated indigenous sludges as well as imported sludges from septic tanks and satellite sites within the Dumfries and Galloway area. The sludge is stored in sludge holding tanks before being passed through 2 No. centrifuges. The dewatered cake passed into an elevated silo ready for transport off site via an articulated tanker.

The high odour complaints were primary linked to the use of two aging sludge de-watering centrifuges (located outside on a raised platform), the sludge holding tanks, and the sludge cake silo/loading of the articulated tanker. Previous odour treatment consisted of spraying an odour masking agent which was extremely limited in its effect. The odour scope was initially developed via an odour assessment and the Scottish Odour Steering Group (SOSG). The group's function was to oversee the development and delivery of the solutions to remove the odour issues at SW's top 14 odour generating sites. The final odour scope for Troqueer was reviewed and approved by the group prior to any procurement of plant.

Project Scope / Solution

The SWS project team was tasked with developing the scope and gaining agreement with all project stakeholders including; SW Asset Planner, SW Ops, SEPA and Dumfries and Galloway Planning Department all to an agreed budget and timescales. The design team developed options for consideration and agreed final scope via a solution agreement meeting and compliance with the technical governance gateways through the SWS project delivery lifecycle.

The final solution involved:

- Increasing the Formula A flows fed from the upstream PS from 445l/s to 606l/s;
- Relocating the storm overflow upstream of the primary tanks, thus increasing settlement capacity and retention time;
- Providing 2 hours storm storage for flows > FFT but < Formula A;
- Increasing the flow to full treatment from 185l/s to 291l/s.

The proposed solution also included the delivery of new sludge treatment facilities and new odour control plant

The agreed project scope consisted of the following *(numbers refer to site layout diagram below)*:

GROWTH / CAPITAL MAINTENANCE

1 New Duty/Standby Archimedean Screw Pumps

Archimedean Screw Pumps were required to pass forward the revised design flows, without causing a detrimental effect on the upstream network. They were chosen over submersible pumps due to their reliability, consistency over a range of flows and low power consumption, as well as having a shallower excavation resulting in reduced piling and de-watering activities on site.

2 New FFT Flow Control Flume and Storm Overflow

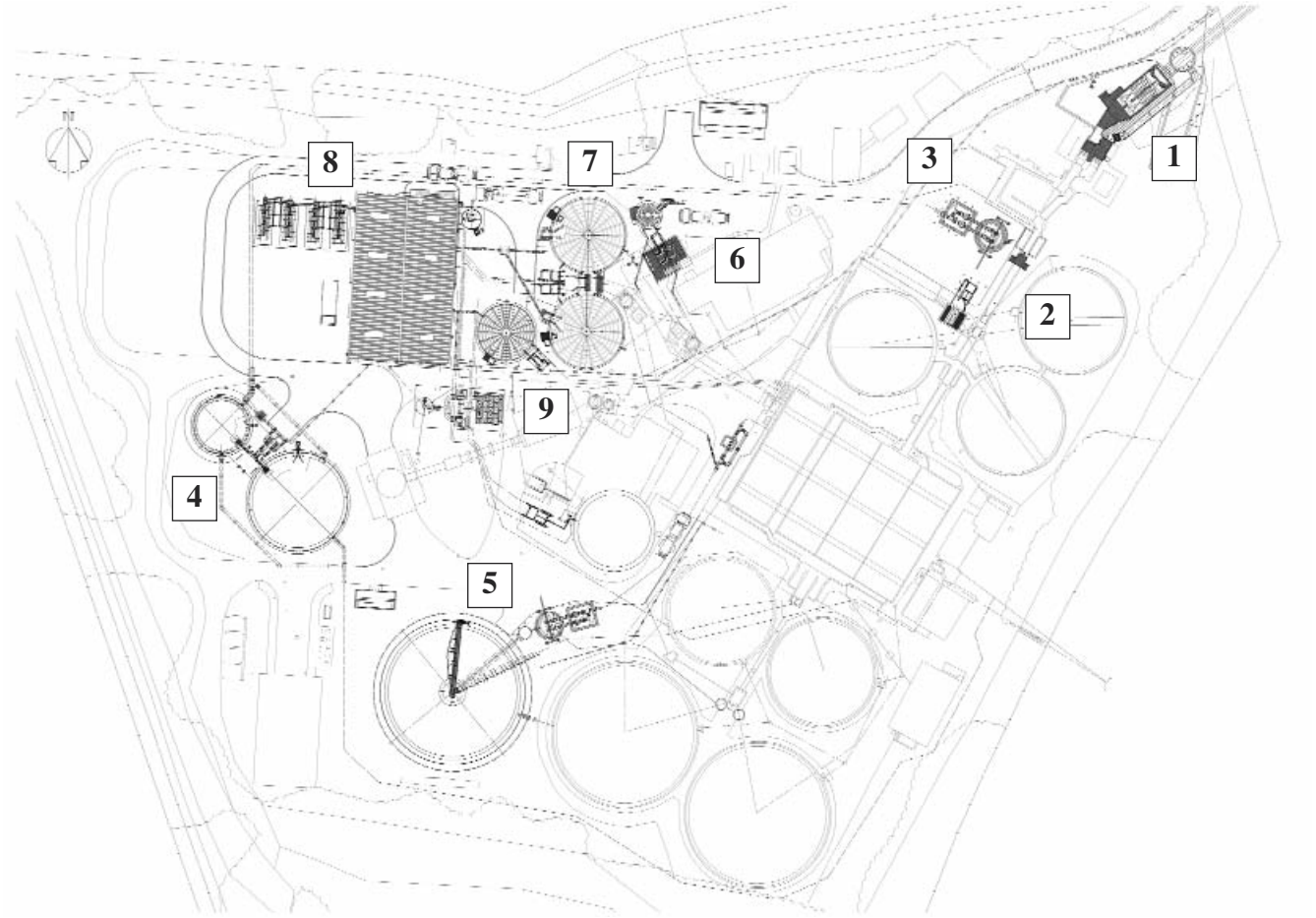
A new flow control flume was installed downstream of the inlet works and upstream of the Primary Settlement Tanks. The flume controls the FFT penstock which will limit the pass forward flow to 291l/s and spill any excess flow over a double sided weir to the storm tank feed pumping station.

3 New Storm Tank Feed Pumping Station

The Storm Tanks were designed above ground which necessitated the need for a lift pumping station to pass forward the storm flows. The major benefits of constructing the tanks above ground were reduced construction costs and significant time savings. Having the tanks above ground also meant it was possible to gravitate the overflow to the river. Duty Standby Pumps were installed in a 4m diameter x 5m deep well constructed with precast concrete manhole rings.

4 New Storm Storage Tanks

The storm storage tanks were designed to store flows of up to 315l/s for 2 hours before overflowing to the watercourse. The tanks were configured with a blind tank – to catch the first flush and retain the high solids concentration – and a dilute tank, larger in diameter to provide increased settlement. The tanks were constructed in Glass Coated steel and were 10m and 18m in diameter by approx 7m tall. The tanks were fitted with external pump type mixers and can part



Troqueer WwTW Extract of Proposed Site Layout ***Courtesy of Scottish Water Solutions***

Construction of New Final Settlement Tank

Courtesy of Gary Sweeney, Carillion plc

empty under gravity with the remainder of the flows being returned by duty standby dry well pumps.

5 New Final Settlement Tank

A new reinforced concrete 24.5m diameter Final Settlement Tank was required to replace two aging flat bottomed tanks which were inefficient at drawing off sludge. The reinforced concrete tank was designed with thick walls and a large concrete toe to prevent the risk of flotation due to the high water table on the site. The works required de-watering during the excavation and construction process which meant an abstraction licence was required, due to the sands/gravel ground conditions and the location of the Permian aquifer.

New sludge draw-off chambers with adjustable bellmouths were installed on the new tank and the remaining two FST's to allow improved control of the RAS return.

A new Submersible RAS Pumping Station was required to return RAS to the aeration lane at the required proportional flow rate. Duty / Standby variable speed pumps were installed in a 4m diameter by 3.5m deep well constructed with precast concrete manhole rings. A bleed off valve from the main RAS rising main feeds into the SAS storage tank for controlled removal of surplus sludge, prior to thickening.

The pipeline from the FST's to the outfall was also upsized to cope with the increase in FFT flow rate.

SLUDGE TREATMENT / ODOUR CONTROL PLANT

6 A new Sludge Reception Centre

The Sludge Reception Centre was designed and constructed to accommodate the large volumes of tanker imports. The process stream consisted of; two inlet connections, a stone trap, a balance tank, strain press feed pumps and duty / standby 6mm strain press sludge screens supplied by Huber.

The reception facility was designed to reduce tanker waiting times and maximise tanker discharge flow rates. A significant challenge with this process stream was the varying solids content of the septic tank loads. The pump selection was critical to minimise the risk of blockages and pump breakdowns.

7 Sludge Holding Tanks

The existing life expired Glass Coated Steel tanks were replaced with new Epoxy coated steel tanks of the same height and diameter, the tanks were fitted with external pump type mixers to ensure the various sludges were homogenous prior to being fed to the dewatering units.

8 New Sludge Treatment Centre

The original sludge treatment for the site consisted of 2 No. centrifuges de-watering sludge to approx 25% DS. The cake was then transferred into a large above ground storage silo. Serious odour problems were created during filling of the articulated tanker due to the high retention time in the silo.

The design team proposed a new sludge treatment building to house the sludge treatment plant in order to minimise any potential odour release. The sludge treatment plant selected by the design team was from Ashbrook Simon Hartley and consisted of 2 No. Klampress Sludge De-Waterers and 2 No. ABCT Gravity Belt Sludge Thickeners.

The proposed solution involved thickening stored SAS to approx 5% DS via the Gravity Belt, which is then transferred to the sludge holding tanks, along with indigenous sludge and screened

Construction of Sludge Treatment Building

Courtesy of Gary Sweeney, Carillion plc

Sludge Screening Problems? HUBER Has The Solution

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Sealed Skips, Conveyors and Weigh Bridges *Courtesy of Mark Davies, Carillion plc*

SAS Thickener Units with Odour Control Ducts *Courtesy of Scottish Water Solutions*

imported sludges where the contents are mixed and transferred onto the Klampress De-waterers. 25% DS Sludge cake from the Klampress is then conveyed via Spirac shaftless screws to sealed skips located outside the building.

The w/w from the units is recycled and topped up using final effluent. The filtrate from the beltpress will be stored in a glass coated steel storage tank before being filtered back to the aeration lane limiting the impact of shock loads on the works. The belt press technology was selected over replacement centrifuges following a whole life cost analysis but primarily due to; lower power consumption, lower polymer usage, ease of operation, smaller footprint and the units are fully enclosed to contain odours. The skips are sealed and are located on weigh bridges to confirm the weight prior to removal. The sealed skips were chosen as the disposal method as part of the odour driver.

Odour Control Plant (Carbon Filter, Stack, Biofilter and Ducting) *Courtesy of Gary Sweeney Carillion plc*

9 New Odour Control Plant

The Odour Control Plant proposed for the site was a biofilter and carbon filter with all associated ducting. The main purpose of the plant is to enclose, capture, transfer and treat the malodorous air relating to the sludge activities on the site prior to discharge to atmosphere.

High odorous air will be extracted from the sludge storage tanks and the sludge dewatering equipment and will be treated in the biofilter. This partially deodorised air will then be mixed with low odorous air extracted from the sludge treatment building and the SAS storage tank. This is then passed through the activated carbon filter before being discharged to the atmosphere via the 15m tall outlet stack. Duty standby fans and an H_2S monitoring system are also provided. The biofilter will contain calcified seaweed and wood chip, both of which are from renewable sources. The odour control equipment was supplied and installed by ERG (Air Pollution Control) Ltd with final commissioning to follow.

Conclusion

At the time of writing (June 2010) the majority of the Civil construction is complete with dry testing and commissioning ongoing. The 14 day performance test and final completion / handover of the project is expected in October 2010.

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