Highwood Bankside Storage Reservoir

Portsmouth Water Ltd's '*dark-side*' solution to reduce the level of THM's at Highwood raw water storage facility near Southampton

by Gary Hynds CEng

The River Itchen is some 28 miles long and runs from mid-Hampshire near Cheriton through Winchester to Southampton at Mansbridge. It is one of the worlds leading chalk streams for fly fishing and is a designated site of Special Scientific Interest (SSI). Portsmouth Water's River Itchen Water Treatment Works (WTW) is located to the east of Southampton Airport near to the picturesque Itchen Valley Country Park and abstracts water directly from the River Itchen. In 1982, as a result of a number of pollution incidents in the River Itchen and elsewhere in the UK, Portsmouth Water constructed the Highwood Bankside Storage Reservoir as a means of supplying the WTW whilst the river intake was unavailable. This paper looks at the measures undertaken to reduce the level of trihalomethanes (THMs) within the supply network.

The large compartment of Highwood Reservoir - Courtesy of Portsmouth Water Ltd

Background

The River Itchen is affected by several influents which lead to elevated levels of ammonia in the river water. The most notable influent originates from the Chickenhall WwTW and consequently the river is enriched in nutrients allowing algae to thrive in the eutrophic water.

Pre-chlorination is utilised to combat ammonia and high levels of bacteria but pre-chlorination usually leads to the generation of trihalomethanes (THMs) within the supply network. The level of these THMs increase when certain algal levels are high in the river, the bankside storage and the upward flow clarifiers at the WTW.

Supporting evidence of the water quality problems at the Itchen WTW were submitted to the DWI in order to gain their support for the scheme during the PR09 period. In order to guard against the risk of this occurrence, it was proposed that the bankside storage reservoir was covered to prevent light from reaching the open water body thereby preventing the growth of algae.

Undertakings

Having entered into a legal undertaking with the DWI, in March 2011 Portsmouth Water's Purchasing Department invited expressions of interest through the European Journal. In April 2011 Portsmouth Water approved the proposals to proceed and invited 6 of the original 177 interested parties to tender for the roofing contract. In October 2011 Clancy Docwra Ltd were appointed as the contractor and were given a completion date of 31 March 2013.

Clancy Docwra Ltd employed John Reid & Sons (Strucsteel) Ltd and Structa Consulting Engineers to design a building structure that completely enclosed the reservoir with no loads transferred to the external walls. The total cost for the structure was estimated at just under £4.5m.

Planning consent and consultations

Eastleigh Borough Council confirmed that planning permission was required for the construction of a roof. The existing concrete reservoir is surrounded by woodland which is designated as a

Site of Importance for Nature Conservation (SINC) and part of the woodland is designated as Ancient Woodland. Vegetation had to be removed at the site in order to provide sufficient access for the contractor to complete the works.

- ***Ecological assessments:*** Funding made available early on in the contract enabled preliminary ecological assessment and site clearance work to commence; thus avoiding delays to start of the construction.
- ***Wildlife:*** Birdwatchers had recorded a surprising variety of wildfowl which used the open water of the reservoir, however many of these sightings related to transient birds that will utilise other sites once the reservoir was covered. The local Airport Authority expressed concerns that once the roof was constructed, roosting, loafing and nesting birds could present a hazard for aircraft. Accordingly, access to the roof was a prerequisite under Portsmouth Water's '*Bird Management Plan*'. and all operators have undertaken training in '*bird control for air safety*' and will ensure the roof is kept clear of congregating birds.
- ***Grassland:*** Ecological reports highlighted a number of valuable grassland areas around the reservoir. It was important that the contractor was excluded from these areas to ensure the SINC was not disturbed. Other grassland areas had to be actively managed in advance of the work to prevent reptiles hibernating on land required for stockpiling materials and welfare facilities.
- ***Site access:*** An environmental audit was not requested by the Council, but comprehensive data on construction plant noise levels and traffic management was required. The access track to the reservoir site was also utilised by local equestrian centres to gain access to a bridleway which circumnavigates the reservoir. Portsmouth Water Ltd liaised with these users both prior to and during the works to ensure the safety of horse riders and staff.
- ***Woodland management strategy:*** To assist with the submission for planning approval, Portsmouth Water undertook a detailed '*Woodland Management Strategy*'. This report included details of how any trees which are diseased, dying or felled shall be replaced and how the woodland will be monitored, to ensure that the existing natural screening of the site is retained.

The collation of data used to compliment the planning application was a combined effort from both client and contractor. However, it soon became evident that the programmed period for the submission was insufficient. As a result the subsequent delay to the start of the construction period resulted in elevated costs to the contract due to the fluctuation of steel prices.

Following the confirmation of a successful planning submission, Portsmouth Water Ltd instructed to the Clancy Docwra Ltd to commence work in March 2012.

Roof construction

The completed structure measures an impressive 195m in length, 128m in width and 12m at its maximum height above ground level.

Portsmouth Water was keen to minimise the impact that the roof would have on the structure of the existing reservoir and so Clancy Docwra ensured that no loads were transmitted to the reservoir walls. To minimise loading on the floor and negate the use of micropiles the contractor designed large column pads, 5m^2 by 0.75m deep, to spread the load from the roof.

The reinforced concrete columns constructed on these pads are 800mm in diameter. Each column varies in height between 5.75m and 6.15m due to the profile of the existing floor slab and is designed to extend above the top water level of the reservoir. These concrete columns provide the support to the steel columns

manufactured by REIDsteel which bear the roof load. Internally there are three rows of 17 (No.) columns (51 (No.) in total), that have a maximum span of 36.5m. In addition there are 64 (No.) steel columns on concrete pad foundations located outside the reservoir which support the edge of the roof.

The main roof structure contains 400 tonnes of galvanised steel sections with an additional 300 tonnes of box section bracing, roof purlins and side rails. Fabrication took place at REIDsteel in Christchurch, and galvanising was undertaken in Hartlepool and Chesterfield due to lack of local capacity. The deliveries were meticulously planned to minimise on site stockpiling and double handling during erection.

Reidsteel intended to use 3 (No.) mobile tower cranes for the erection of the superstructure. Two would be used within the reservoir, the third outside for offloading deliveries. The cranes used were Liebherr 32TT diesel driven cranes on crawler-track undercarriage. Approval by Airport Controllers was required at certain stages of the construction due to the height of the cranes and their proximity to the Airport. Both cranes used within the reservoir had to be bunded when static to prevent potential diesel leaks contaminating the reservoir floor; the provision of electric cranes not being possible at the time.

Cladding

The roof and walls are clad externally with Corus/Tata HPS 200 Ultra coated trapezoidal profiled trough section, with a Corus/Tata Prisma coated internal profile liner. The coating has WRAS approval and was chosen to eliminate the risk of possible contaminants entering the water from condensation. Non-combustible insulation of 180mm thickness was provided in the roof and 140mm in the wall to provide U-Values which complies with Building Regulations and ensures that 'green house' conditions will not develop within the reservoir space.

The roof area covers some 25,000m^2, the walls a further 4,600m^2. This equates to around 220 tonnes of steel cladding used to cover the reservoir. The wall cladding finishes at a 200mm high concrete kerb which is located around the perimeter of the exiting reservoir wall. This kerb is positioned to give a clear space approx 1.5m wide around the reservoir, between the cladding and the reservoir wall. Ground surfaces around the reservoir are composed of compacted recycled Type 1 material.

Maintenance

Ventilation within the reservoir is provided by passive louvres at the gable ends and also by 3 (No.) 21m long ridge vents to provide a safe working environment. Under normal operating conditions this ventilation is sufficient to reduce the effects of condensation on the cladding and steelwork. However the methods used for cleaning and maintenance had to be revisited due to the enclosed nature of the structure and the composition of the sediment from the river source.

At its highest point at the gable ends the roof rises some 9m above the existing reservoir walls. Large doors, over 8m high, at either end of the structure allow heavy cleaning equipment to be lifted into the reservoir via the use of permanent gantry cranes.

Guttering

The gutters around the roof are walkable and constructed from galvanised steel sections. A permanent roof edge protection system was incorporated for safety during construction, future roof maintenance and for bird control.

Guttering and site drainage was sized to accommodate runoff from a 50mm/hr rainfall event. This run-off is directed to the existing drainage system which flows to lagoons near the treatment works and provides some mitigation for the loss of open water at the reservoir. This has potential benefits to species such as amphibians, reed bunting, otter and water vole and will encourage the spread of riparian vegetation.

External view of Highwood Reservoir roof
Courtesy of Portsmouth Water Ltd


The large compartment of Highwood Reservoir
Courtesy of Portsmouth Water Ltd


The large compartment of Highwood Reservoir
Courtesy of Portsmouth Water Ltd

Conclusion

The purpose of the roof is to prevent sunlight reaching the surface of the water and this inherently presents problems for access and lighting. All working areas, walkways and emergency exits required bespoke lighting design but much of the reservoir remained dark. The roof steelwork and cladding was fully installed by 13th February 2013, ahead of the March deadline with only the reinstatement of the access tracks left for Clancy Docwra to complete.

The Editor & Publishers would like to thank Gary Hynds, Project Manager with Portsmouth Capital Delivery, for providing the above article for publication.