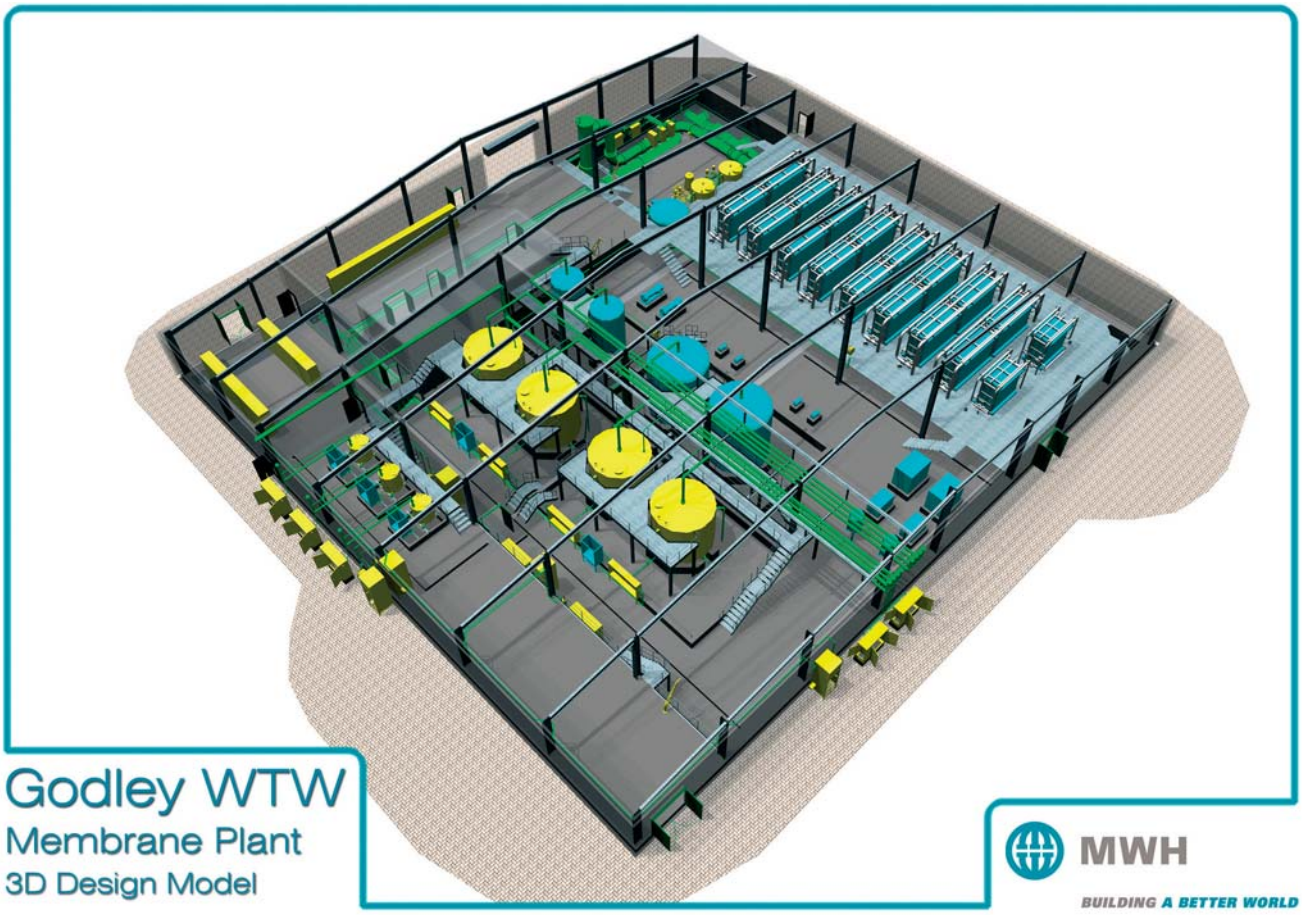
Arnfield and Godley WTW

water quality improvements scheme for United Utilities

by
Martin Clark

Arnfield and Godley WTW's are located in Tameside, south east of Manchester and form part of the Longdendale Valley supply system, United Utilities' (UU) fifth largest source, and are a strategic part of the northwest's water supply network. Raw waters from the five impounding reservoirs in the Longdendale System are delivered by gravity to Arnfield for stage one treatment by coagulation and sludge blanket clarification. Arnfield produces up to 120 Ml/d of partially treated water which then flows some 6.8kms via the Longdendale Aqueduct (LA) to Godley WTW for final stages of treatment. Godley WTW can process up to 90 Ml/d of water through its 20 RGF's which is disinfected and held in the on-site service reservoir before distribution to approximately 72,000 customers. The treatment processes have a high cryptosporidium risk due to poor turbidity removal and inadequate disinfection efficiency. To remove the risk Godley was selected for performance enhancements as part of UU's AMP4 Water Quality Programme.



Optioneering & Process Selection
To meet the regulatory date the project was brought into UU's AMP4 early start programme in January 2005.

Initially, six high level options comprising a total of 17 sub-options were considered.

Due to the expense and risks of sealing the LA (to prevent recontamination of the partially treated waters) and the availability of suitable land it was decided to enhance the process at Godley. Options and outline costs were evaluated and the two most favourable options were taken to a Value Engineering workshop in August 2005. At the workshop an alternative option was identified - to use a pressure membrane plant downstream of the RGF's to act as a cryptosporidium and turbidity barrier.

Following technical feasibility studies, pilot trials and costing, the pressure membrane option was sanctioned in January 2006 on the basis of lowest whole life cost and risk. The option footprint and ground pressure were also significantly reduced, simplifying the layout and avoiding concerns about the adjacent underground service reservoir and M67 motorway cutting.

Tenders were issued and Memcor were appointed in April 2006 to undertake the design of the membrane plant.

Third Party Issues
The main Third Party issue was the presence of a public right of way designated as a Road Used as a Public Path (RUPP) which followed the access road through the site. Due to public safety concerns it was decided to divert the RUPP around the site boundary. A temporary

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diversion prior to the main construction was successfully negotiated with the Planning Authority. Permission was later obtained from Government Office North West for this to become a permanent situation.

Delivery Strategy

To expedite delivery of the project and recover time lost as a result of the solution change, the scope was released to GCA-JV in phased packages.

* Enabling works, including diversion of the RUPP - May 2006.
* Advance works including civil works for pumping station sump, membrane building and electrical equipment buildings - July 2006.
* Full scope release - November 2006.

This enabled early detail design and construction work to commence whilst the details of the M & E work were still being finalised.

United Utilities (UU), MWH, and Galliford Try, Costain and Atkins Joint Venture (GCA-JV) are the three partners in UU's Southern area Integrated Alliance, set up to deliver United Utilities' AMP4 Capital Investment Programme. MWH, as Solution Services Provider (SSP), in association with UU form Solutions and Engineering to take projects through the Solution Identification and Development Phases (SID), culminating in a project Solution Scope Book (SSB), GCA-JV as Process Partner (PP) undertakes detailed design, construction and commissioning. UU undertakes overall Programme and Project Management; input being provided throughout the project lifecycle to ensure a fully integrated team approach.

Scope

The approved solution comprised:

* An interstage pumping station (IPS) downstream of the existing filters/contact tank, from which flows will be pumped to the new membrane treatment facility.
* 8No.Primary membrane units including clean in place (CIP) neutralisation facility and other ancillary systems;
* 2No. Secondary membrane units for treatment of the dirty backwash from the primary membranes.
* 620m pipeline to discharge membrane waste to sewer.
* 2No. 30m^3 sodium hypochlorite storage tanks and dosing system.
* 2No. 30m^3 sodium hydroxide storage tanks and dosing system
* Final pH and disinfection dosing and mixing facility.
* Electrical power, control, software and SCADA system.

The 9m deep sump of the IPS is located just 2.5m away from the existing 4.5m deep filter structure. Early involvement of the construction team, together with piling specialists, was key to the successful investigation and planning of the temporary and permanent works required.

The site of the 50m by 45m membrane building is between the existing Godley service reservoir, the M67 motorway cutting and major electrical and water services. The building, incorporating all the internal plant and equipment, was designed in 3D using AutoCAD 2005 and Bentley Autoplant 2004. An interactive version of the 3D design was utilised in early HAZOP and ALM studies to achieve a design "freeze" in July 2006, prior to release of the Advanced works package.

Detail design

Weekly meetings with MWH ensured detail design of the advance package captured ongoing changes. Early intervention in setting anti-flotation parameters enabled optimisation of the membrane building substructure thicknesses. Atkins Structural engineers refined the base design by using the STAAD software to model the irregular loading on the slab.

Photo inside membrane plant building showing arrangement of membrane units & mezzanine access platform *photo courtesy MWH*

The Site Manager and the Design Team, worked closely to ensure construction could proceed before detail design completion. 'Starterbox' rebar systems were used extensively facilitating safer and easier construction.

Modification of the plan area of the IPS together with a contiguous pile wall design enabled the IPS to be constructed a safe distance away from the adjacent live filter block, ensuring that its structural integrity was not compromised. The design was backed up with a geotechnical model using the Plaxis software. During critical construction sequences stations installed along the filter structure were monitored twice daily for movement.

Construction issues

Site works began in May 2006, with reuse of surplus excavated material to form a landscape mound resulting in savings of over £100,000 compared with off-site disposal.

Access into the membrane building main floor level was provided by designing a temporary 6m gap and access ramp into the north wall. The Membrane units were delivered complete and lifted in through the roof by crane before the roof panelling was completed. The large chemical storage tanks were installed via the above mentioned gap and moved into place using skates.

The 600mm diameter bored concrete piles used to construct the IPS necessitated temporary frames and bracing struts at three levels which restricted working space for excavation. The bottom frame, was removed after the base had been cast, with the middle level removed after the first lift of the internal walls had been cast. The RC roof was formed by GRP permanent formwork panels supported by precast beams, thus removing requirements for falsework.

Hydro-demolition was used to safely remove the 500mm concrete surround on the existing 48 inch steel outlet main in preparation for connecting the new IPS feed pipe work and control valves. The operation involved a 24 hour plant shutdown during which a 15m section of the existing pipe was removed and the four sections of new pipe work, the largest weighing 14 tonnes, were lifted into place. No public health or water supply interruptions were encountered during the operation.

Conclusion

Key to the project's success has been the team working between the three partners throughout the project development, design, construction and commissioning. The £20.8m Arnfield & Godley project is 90% through construction at the time of writing with completion anticipated in August 2008. The project is the largest single water quality improvement scheme in the AMP4 programme in terms of volume of water treated.

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