

Weelsby WTW Refurbishment

includes development of three new on-site boreholes

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Weelsby Water Treatment Works and Pumping Station lies close to the Humber Estuary, near to Cleethorpes and supplies water to Cleethorpes and surrounding areas. The water is drawn from a chalk aquifer directly beneath the site, and also from a nearby chalk spring source. The project brief included development of three new on-site boreholes, major improvements to the disinfection process, provision of additional treated water storage and complete refurbishment and modelling of the high-lift pumping station and site wide control. The original pumping station was nearing the end of its life, evident in reliability problems and poor efficiency. Raw water quality and available site storage were also of concern.



Weelsby WTW: Overall 3D Site view

photo courtesy Halcrow Water Services

Longer term planning identified the need for increased treated water storage on site but at this stage, only limited provision had been made which, together with re-zoning a part of the network, has allowed adequate balance of supply and demand to be achieved for the foreseeable future.

Halcrow, were commissioned under the AMP3 Partnering Framework Agreement to work closely with Anglian Water and Laing O'Rourke, one of their partner contractors, to plan and design the red-modelling of the site.

The following describes some of the challenges faced during the design and construction phases, and how the framework partners successfully overcame them

Challenges

Some of the main challenges that had to be overcome were:

- * the presence of overhead 132kV power lines severely limited the opportunity for development & construction of new facilities;
- * the elevation of the existing service reservoir required additional process units to be located at a higher level in order to avoid inter-stage pumping;

- * the existing pumping station that was to be re-used had very limited space, with no scope for locating pumps below floor level; this exacerbated the hydraulic design problems & required careful design & equipment selection in order to maximise use of available space.

The project had to be constructed and commissioned whilst maintaining full output from the site. This required an innovative design, which was developed around a complicated commissioning strategy formulated in partnership between Anglian Water, Laing O'Rourke and Halcrow at the early stages of design.

Solution

The Solution included the following features which were designed by the Halcrow multi-disciplinary design team:

- * development of 3 new boreholes on site with associated headworks, pipework & kiosk arrangements, plus new raw water mains & diversion of existing pipework to a new chlorine tank;
- * fixed speed borehole pumps replaced with variable speed units driven by 6-pulse VSDs with G5/4 compliant Harmonic Filters;
- * new 2 section, baffled, reinforced concrete contact tank/pump sump and associated pipework located on highest part of site.



3D view inside the pumphouse

photo courtesy Halcrow Water Services

the top of the contact tank was constructed at a higher elevation than the existing storage reservoir. This required careful geotechnical assessment to ensure the structure would remain stable under different operating conditions and with minimal ground works in order to maintain an economical design;

- * mechanical limiters fitted to heavy plant to enable safe working under overhead transmission lines;
- * installation of five new booster pumps, together with suction and delivery pipework and all controls within the existing pump room. This required very detailed pipework design to ensure the arrangement could be accommodated within the existing structure and floor trenches.
- * much research was also carried out into options for the switchgear and control system which led to the specification of the latest 'state of the art' variable speed regenerative drive design, not previously used in the UK;
- * conversion of the old generator room into a new power distribution & ICA room;
- * second power supply provided by common-on-site transformer to allow greater flexibility when replacing motor switchgear;
- * phased replacement of existing MCC & ICA panels. With the use of temporary starters and allocation of new ICA panels in the existing standby generator, greater flexibility was created allowing the new MCC, incorporating 6 pulse and regenerative VSDs to be positioned in place of the old MCC;
- * phased commissioning of MCC & ICA panels to allow integration of old and new systems during MCC replacement;
- * temporary electrical distribution to supply essential and non-essential loads during MCC replacement;
- * installation of a new, larger standby generator in a redundant pump room;
- * a new surge suppression system.

Halcrow provided a fully detailed civil, structural and MEICA design and associated contract documentation for the works, which were then built and commissioned by Laing O'Rourke with direct labour and sub-contracts. *Laing O'Rourke*, Anglian Water (represented by the treatment manager, the design team leader, and the construction team leader), and *Halcrow's* MEICA staff were involved throughout all stages of the design, construction and commissioning stages to ensure a fully integrated approach. Anglian Water also provided network modelling inputs to the project which

included analysing the distribution system under different proposed operational arrangements. This led to splitting the distribution into two sub-zones which improved management and provided a more efficient system. Anglian Water's network modelling staff worked closely with the *Halcrow's* mechanical engineer and surge analysis expert in developing pump specifications.

From the outset, the over-riding challenge which touched all aspects of the design was the lack of space both on site and within the buildings. To successfully overcome this, it was necessary to pay special attention to design detail in order to maximise the use of space without risk of equipment clashes during the construction stage - whilst still affording good access for operation and maintenance. For this reason, design was undertaken in a 3-dimensional 'virtual reality' environment. A virtual scale model of the site was produced and then all 2-dimensional construction drawings were produced automatically from the model. This ensured that if the design worked in the model, it would work in reality on site.

This approach also further benefited the design process as follows:

- * by making design revisions easier, all drawings could be updated by just one change in the model;
- * all design presentations were carried out in 3D virtual reality, where the design team could navigate the model in real time and view any aspect in detail;
- * final presentations to Anglian Water operations staff were carried out using the 3D model;
- * 3D virtual reality pictures were used in the planning application process;
- * Laing O'Rourke was able to use the model on site to complement two dimensional drawings in order to visualise complex areas of the design.

It was also necessary to very carefully consider the methodology for commissioning the new works to ensure production could be maintained.

Halcrow's commissioning engineers developed a detailed implementation programme in consultation with the Anglian Water treatment manager, which was incorporated into the contract specifications. ■

Note: *The authors of the above article, Alex Beere & Paul Hammond are both with Halcrow Water Services.*