Maundown WTW Reconstruction

£25m works rebuild by Wessex Water

by
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Maundown WTW is Wessex Water's largest and most strategic water treatment works serving 15% of the population in the Taunton and West Somerset area. In order to provide an improvement in water quality, as well as an increase in output capacity to the north resource zone, a new Works has been designed for construction adjacent to the existing Treatment Works. The plant is designed to treat licensed abstraction flows from Clatworthy and Wimbleball reservoirs to 82.4Ml/d, giving an increase in output of 16Ml/d. This article principally covers the project design phase, the construction phase will be presented in a future article.

Maundown WTW: Computer model of works *courtesy Enpure Ltd*

Delivery strategy

The delivery strategy adopted by Wessex Water for the project was to identify the key project phases and the necessary resource for successful project delivery using an integrated team of external and in-house resource.

To this end, following a competitive tendering process, *Enpure* were appointed as the Process Contractor responsible for the detailed design of the new works. Wessex Water, using their own in-house resource and expertise have taken responsibility for procurement and construction with all technical documentation prepared by the Designer. The process contract also includes the provision of design support during the construction phase, the procurement and installation of process specific equipment (DAF plant), and the complete wet commissioning and Take Over testing of the completed works.

Design team

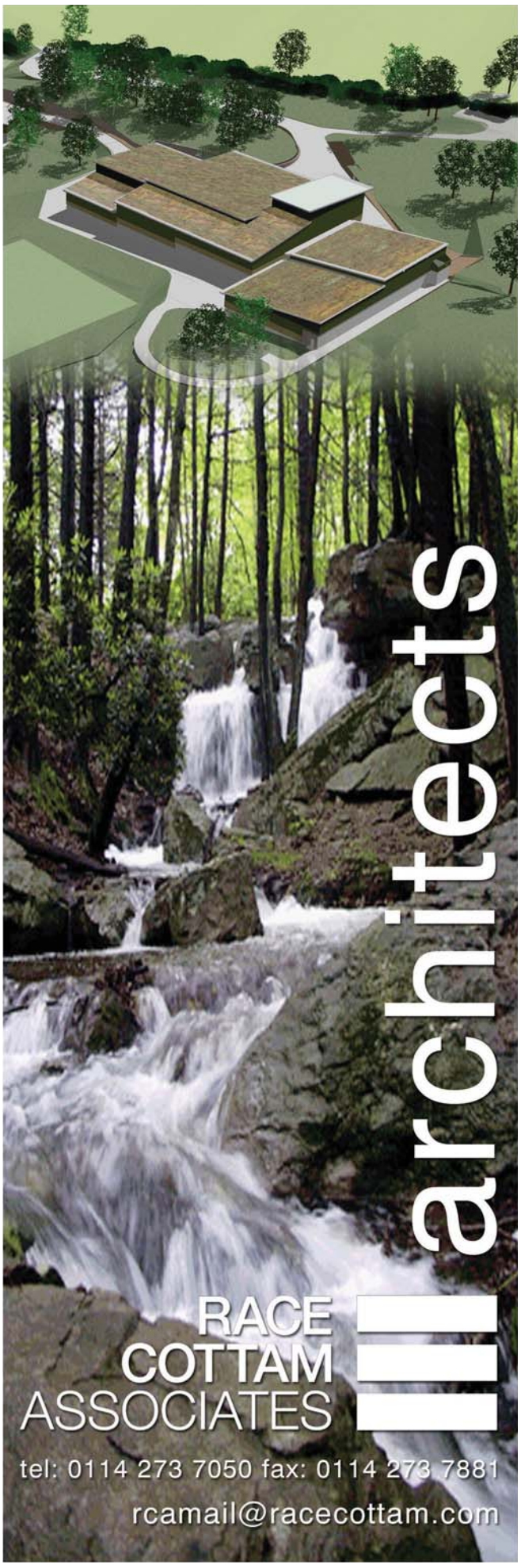
The integrated design team was led by *Enpure*, with a sub-contract placed by them with *Faber Maunsell* for the civil design. The architectural design was undertaken by *Race Cottam Associates,* engaged initially by Wessex Water and then transferred under a novated agreement to *Enpure.*

To provide an integrated design, a core design team was co-located at Wessex Water's head office at Claverton Down. This team was supported by engineering staff from the designers head offices at Kidderminster and Exeter respectively. During the six month period of residence the design was developed, initially by preparing the information required in support of the planning application followed by development of the detailed process, civil and M & E design. The programme was structured to allow areas of design development with an ongoing periodic review incorporating regular meetings with Operations representatives, Value Engineering workshops and a aeries of Hazop studies.

Architectural design

Visual impact was identified as a critical issue and, therefore, a coordinated site layout has been developed with contoured embankments that blend into the existing site topography, including the restoration of those areas following demolition of the existing works and final landscaping.

During the early stages of design development the decision was made to separate the DAF and Main Treatment areas into two buildings, with a third smaller building for dirty washwater and sludge treatment. This layout did away with the need for an access road around the West side of the DAF building, enabling the service areas of each section to be concentrated into the 'gap' between the buildings, screening them from key public viewpoints.



The requirement to set the DAF and Main Treatment buildings at the levels determined by the hydraulic profile meant that part of the building had to be set into the ground, and also orientated so that different sections and steps in building follow the contours of the valley. The key views into the site are generally from an elevated position, and with no public viewpoints close to the building the roof forms became a key consideration. To this end, a design approach was adopted where the roof planes were kept simple, of a low pitch and 'clean' form which reflects more closely the slopes of the valley sides and ties the building into the landscape.

The material used for the roof finish in this design becomes critical and the design team decided on the option of using a 'green' roof finish to blend the buildings even further into the landscape with long term sustainability taken into consideration.

The use of an extensive green 'sedum' roof provides increased heat insulation in the main building together with absorbing CO2 through photosynthesis. In addition, the green roof reduces peak storm water run off volumes. It uses a mix of alpine 'sedum' species which are low maintenance, wind, frost and drought resistant. It also offers an immediate non-reflective roof that has colours and textures that will blend into the existing landscape.

Solar water heating panels will be installed on part of the roof of the Main Treatment building to generate a renewable hot water supply for the accommodation block. Also, in-line with the Clients' sustainable energy philosophy is the installation of a wood pellet burning boiler, which will provide the heating requirements for both the chemical storage areas and accommodation block.

Planning approval for the new works was received in May '06 following a four months consultation and notice period.

Process selection
Pilot plant trials and treatability studies undertaken by Wessex Water had confirmed the preferred treatment process:

* clarification using Dissolved Air Flotation (DAF) for algae removal;
* rapid gravity filtration (RGF) for turbidity and manganese removal;
* taste & odour control caused by geosmin using Powdered (PAC) & granular activated carbon (GAC);
* disinfection by means of chlorination.

The process train and key design parameters having been established initially by Wessex Water for the purpose of tender were refined during the course of the tendering process to yield the optimum number of process units and plant configuration up to the point of contract award. Key to this was the selection of Enpure''s DAFRapide® which is designed to operate at higher surface loading rates than the other conventional forms of DAF treatment. During the course of detail design further process evaluation was undertaken in order to optimise the number, size and configuration of the process units and systems.

The completed design comprises:
* receipt of raw water flows to the inlet works from Wimbleball reservoir;
* fine screening to 5mm prior to discharge to inlet flash mixer where there are chemical additions of aluminium sulphate and sulphuric acid for optimum coagulation;
* provision has been made for seasonal dosing of powdered activated carbon for taste and odour peak lopping;
* clarification stage consisting of four parallel streams of two stage flocculation and Dissolved Air Flotation cells;

* provision for downstream dosing of chlorine and lime to assist manganese removal in the rapid gravity filters;
* eight rapid gravity filters for removal of residual aluminium, each containing a dual media fill of 600mm of 16/30 silica sand and 400mm of grade 2 anthracite;
* the dual bed media is supported on a Leopold floor;
* gravity feed to six granular activated carbon (GAC) contactors for removal of taste & odour compounds, each containing 2000mm of carbon supported on a Leopold floor;
* disinfection in two chlorine contact tanks, each providing the requisite ct value;
* dechlorination & pH correction of treated water using sulphur dioxide and 0.15% lime respectively before exiting to two on site treated water reservoirs;
* sodium silicate dosing for control of discolouration;
* dirty washwater and DAF sludge is blended, thickened and stored for tankering off site;
* supernatant returned to head of works.

Computer modelling

Design of the two chlorine contact tanks was undertaken with the aid of a Computational Fluid Dynamics (CFD) model utilising Fluent 6.3.21 software. The purpose of the model was to ensure that the required ct value would be achieved with the optimum hydraulic design in terms of flow split, inlet and outlet pipework configuration and internal baffling. Construction of the two tanks is an integral part of the main treatment building, each being located beneath the two streams of rapid gravity filters.

The application of modelling was further utilised in the design of the clean backwash water holding tank where, due to building constraints, it was necessary to use the tank as a source for backwash supply, but also to provide compartments within the tank to act as sources for carrier water and service water supplied. Clean backwash water is drawn by canister pumps located within the tank and borehole pumps have been selected for service and carrier water duties.

The design output also required the production of a walk-through 3D computer model of the works in order to maximise the use of space without risk of equipment clashing, in particular the large bore pipework layout within the Main Treatment Building.

The model has been used to generate isometric drawings of the large bore pipework along with other 2D assembly drawings and the facility is provided within the model to navigate any route and view any aspect of the design in detail. The software packages utilised included Solidworks, 3D+ by CSC and Navisworks.

Implementation

At the time of writing (May 07), the principal civil construction works is eight months into its programme, having commenced in August 06. Delivery and installation of process equipment is scheduled to commence March 07 and M & E installation works programmed for completion February 08.

Commissioning is programmed to commence from January 08 and Operational Use forecast for June 08. All within the constraints of the programme.■

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