Chellow Heights WTW

modifications for THM removal

by

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Chellow Heights Water Treatment Works, constructed in the late 1960s, occupies a 44acre site situated on the northwest side of Bradford, West Yorkshire. It serves the conurbation of Bradford, a Grid Link to Leeds and a number of outages to the Halifax water supply area. In all, some 500,0000 customers rely on this works for their supply of potable water. Currently, the works is a two stage treatment plant designed for a reliable output of 175Ml/day.

Chellow: construction of manganese superstructure with curved profile. *(photo: Brown & Root in association with Scott Wilson, courtesy: Yorkshire Water)*

Raw water is supplied to the WTW from three main sources:

* Angram and Scar House impounding reservoirs;
* River Wharfe water via the Chelker pumping station;
* Thornton Moor and Stubden impounding reservoirs.

These sources provide Chellow Heights WTW with greatly varying raw water qualities from the soft, acidic, Nidd water to the hard, alkaline River Wharfe source. Such variation causes problems at the works in terms of greater formation potential for trihalomethanes, concentrations of manganese giving a continued risk of regulatory failure and continuous monitoring at three points on the works for *cryptosporidium.*

More significant problems occur in the distribution system where THMs take time to form after chlorination and manganese precipitates out of solution as oxides.

A major capital expenditure to the extent of £30m is also being directed towards the renovation of trunk mains within the distribution system in general and the Bradford Intermediate Ring Main in particular. Besides the regulatory drivers for the water treatment works target dates, the reduction of manganese in the works output is a requirement from the milestones set within that rehabilitation programme.

Flexibility

The solution formulated to overcome these problems involves modifying Chellow Heights to a 3-stage process that mirrors the successful approach Yorkshire Water have made to the treatment

of this type of highly coloured water at other treatment plants throughout their region. The process described below gives maximum flexibility to meet all the requirements of colour, improve the removal of THM precursors and fully optimise the process in maintaining other water quality standards across the wide range of water quality experienced from this mixed moorland water/river water supply.

Both Gravity and pumped raw water supplies converge at the works at a mixing/blending chamber situated downstream of a detritor stage. Enhanced coagulation is afforded at this stage of the process by improved control of coagulation pH where lime is dosed into the Nidd bellmouths and acid is dosed into the Chelker main. Improved blending of the raw waters with the Chelker supply is provided within a structurally modified blending chamber. The lime and acid is dosed on a flow proportional basis with residual trim prior to and after the clarifiers for cascade control.

Aluminium sulphate and powdered activated carbon (PAC) are also to be added at the new blending chamber on a flow proportional basis equal to the summated raw water inflow. Refurbishment improvements are to be undertaken to the existing PAC facility to accommodate the coagulation requirements.

The mixed "dosed" water is then distributed to six clarification tanks via three feed channels. Polymer is added at the inlet to each tank and will be dosed proportional to flow. New inlet flow measurement to each tank is to be installed as well as a new sludge blanket detection and turbidity monitors at the outlet of each clarifier. The coagulated material within the clarifiers forms a sludge blanket and the settled sludge is bled off for further thickening.

A settled water ring main feeds separate banks of rapid gravity filters to both the east and west sides of the site. The addition of lime dosing before the rapid gravity filters optimises aluminium removal.

There are ten filters on the east feeding a single compartment clean water tank whilst 4 filters on the west feed a dual compartment clean water tank. The 150 Ml storage of each tank provides the works with approximately 30 hours of strategic storage.

***Cryptosporidium* barrier**

A second stage of filtration is to be installed downstream of the rapid gravity filtration and prior to the clean water storage, where soluble manganese is precipitated and removed by eight manganese contactors. These filters, giving an added barrier to *cryptosporidium,* are to be housed within an enclosure that has been designed,in accordance with certain planning constraints, to match existing architecture. The building will then enclose interstage pumping, inlet and outlet channels, backwash, forward rinse, air scour and drainage pipework for each contactor, a washwater tank and a machinery room containing backwash pumps, air blowers, water quality monitoring equipment and MCC panels.

Five lamella settlement tanks for treatment of washwater generated from the rapid gravity filters, manganese contactors and supernatant from existing sludge tanks are to be installed in close proximity to the filtration stages. Supernatant water from the lamellas will gravitate to the inlet works whereas the sludge will gravitate to a site pumping station from where it will be pumped to sewer.

A sodium hypochlorite storage and dosing facility is to be accommodated within the new manganese contactor building that will replace the current regime of gaseous disinfection and is dosed into the filtered water leaving the contactors before distribution to the east and west clean water tanks.

Extensive reconfiguration of site pipework has had to be effected and hydraulic considerations given to the manner of maintaining flow split between the two tanks. Disinfection, with adequate contact time, takes place in these two storage structures. The outlets of the reservoirs are de-chlorinated by the use of sodium bisulphite.
Due to the complex nature of the Chellow site in terms of the operation of the treatment processes and numerous site services, a contract strategy was adopted to involve the resources and contribution of *three Yorkshire Water Framework contractors* at an early stage of development of the project. In this manner, early identification of any problematic interfaces on live assets could be addressed.

Start of the construction process commenced on site in September 2001. An intermediate milestone date for the reduction of manganese production is targeted for 15 July 2002 with further target dates of Beneficial Completion by end of December 2002 and Scheme Completion by 31 March 2003. ■

Note: *The author of this article, Peter J Corrigan is Capital Solutions Manager with Yorkshire Water Services.*