Milford & Bednall
iron and Manganese removal scheme

Milford WTW is located on the outskirts of Stafford, on the northern fringe of Cannock Chase, bordering Shugborough Park in the heart of Staffordshire. Milford Borehole pumping station previously consisted of two borehole pumps operating as duty/standby.. The Milford pumps previously pumped water at a reduced rate of 86 l/s to Satnall Reservoir. The abstraction rate had been reduced at Milford due to the high manganese levels in the water. The actual abstraction licence for Milford is 132 l/s. Bednall borehole pumping station is located approximately 5km South of Milford and consists of one borehole pump. Bednall borehole previously pumped water at a rate of 20 l/s straight to Satnall Reservoir.This project will now divert the flow from Bednall and combine it with the flow from Milford, treating the combined flow for Manganese removal prior to supplying Satnall Reservoir.

Milford & Bednall: New filters & high lift pumping station under construction *Photo: courtesy Severn Trent Water*

The reason for the project is so that Severn Trent Water is able to confidently comply with the Water Supply (Water Quality Regulations) level for manganese (50 micro**gramme** per litre) at Satnall Reservoir. The target manganese level output from the manganese removal plant at Milford was set at zero. The target was also to take into account the increase in supply output at Milford from 86 l/s to 132 l/s and combining it with Bednall 20 l/s and hence supplying Satnall Reservoir with 152 l/s in total.

Principal works & Project Team
The principal; works provided under this project are:-
* replacement of existing borehole pumps at both sites;
* provision of new filtration system for combined flows of Milford and Bednall;
* provision of a new backwash tank to filters;
* provision of new high lift pumping station to deliver flows to Satnall Reservoir;
* modifications to existing chlorination system to form prefiltration chlorination;
* provision of post filtration chlorination system;
* provision of new MCC at Milford;
* modifications to existing MCC at Bednall.

The **core project team** consisted of Severn Trent Water (Client), Norwest Holst Ltd (Principal Contractor); and Carl Bro Group (Lead Designer and overall Design Manager). In addition, Pick Everards were the detailed M & E designers, Superior Filtration Ltd., supplied and installed the filters and Severn Trent Services carried out all the chlorination works.

New process
The removal of manganese from groundwater will be carried out by pre-chlorination and filtration of the water through sand filters to achieve the removal of oxidised particulate manganese.

Preliminary chlorination
Once the Bednall flow is diverted to Milford, the two flows combined will pass through the preliminary chlorination plant and then onto a static mixer. The preliminary chlorine dosing is to achieve manganese precipitation which is then removed by gravity sand filters. The existing chlorine dosing plant was modified for this purpose.

Automatic gravity filters

Two automatic gravity filters were installed to filter out the precipitated manganese. The filters are to operate as Duty/Duty in order to achieve the total flow of 152 l/s.However, the system is designed so that one filter can take all of the Milford flow (132 l/s) with little deterioration in output quality. Hence, in the infrequent event, that one filter is required to be taken out of service the output to Satnall Reservoir will only need to be reduced by stopping the Bednall borehole pump.

Main advantage of the Automatic Gravity Sand Filter (AGF) is that once installed the system imposes minimal additional running costs. No power or other external services are required for operation whatsoever and the sand filters are not backwashed using pumps and actuated valves and thus, require no sophisticated control system. Backwashing is performed autonomously under gravity when the head loss across the sand bed reaches a pre-determined level. Each filter stores its own water for backwashing within the filter itself.

Dirty backwash tank

On completion of a backwash, the dirty backwash water is stored in the dirty backwash tank. Two pumps (duty and standby) are located within the high lift pumping station dry well to empty the dirty backwash tank to the sewer at a rate of 5 l/s. This is to minimise the impact of the new plant on an already heavily subscribed sewer. At a rate of 5 l/s it takes the backwash tank approximately 5 hours to empty. However, following a backwash it takes approximately 10 minutes to fill. In order to resolve the sewer limitations, each filter backwashes only once per day and there are 24 hours between backwashes. The backwash tank was sized accordingly with this restriction in mind.

High Lift Pumping Station (HLPS)

Treated water from the filters is conducted to the high lift pumping station where two high lift pumps (duty and standby) pump the water from the high lift pumping station wet well to Satnall service reservoir via a new flowmeter.

Post chlorination

Post chlorination takes place at the outlet of the HLPS. The water is chlorinated at this point for disinfection purposes and then pumped to Satnall Service Reservoir. A new MCC is located within the main building for control and monitoring purposes.

Restrictions & solutions

Major restrictions faced by the project team were the very congested nature of the site and the extremely tight timescales in order to meet the DWI agreed project completion date of 31st March 2006. Due to the restricted access and working area inside the site the following specific sequence of operations was needed to construct the works:

Construction of the filter bases;

* placing the filters onto bases;
* sheet piling and excavating for the HLPS.

The logic behind this was that access onto the HLPS footprint would be needed for the crane to place the filter vessels. Hence, the cofferdam construction could not commence until the craneage work was complete. The critical path for the contract ran through these consecutive activities. In order to reduce construction time it was necessary to reduce the HLPS construction footprint and install the cofferdam and excavate for the HLPS immediately after the filter bases were cast, without waiting for the filters themselves to be installed, using a larger crane to site the filters when the time came.

Other considerations were the fact that the Milford site abuts the Shugborough estate and village properties. In order to minimise local impact and adhere to planning guidelines, the filters were effectively 'hidden' behind the existing pumphouse and the new HLPS was built underground.

Construction

The perimeter sheet piles that formed the cofferdam for the construction of the HLPS were driven to almost the exact footprint of the finished walls. Thus, the walls were cast against the sheet piles with the interposition of sheets of plywood to ease extraction. This allowed the construction time of the HLPS to be reduced, reduced the amount of sheet piling and reduced the quantity of backfill needed. This also allowed the larger crane, referred to above, to be sited to enable the filter installation and HLPS construction to be simultaneous, thus allowing one month to be taken out of the programme in order to meet the required commissioning date.

Conclusion

All parties worked hard to enable the works to be put into operation by the required date, despite the many complexities of the scheme. At the time of writing, May 2006, the works is fully compliant and formal commissioning tests are well advanced. It is envisaged that all works will be complete one month prior to the original end date and on budget A team approach was adopted for the project. This 'open door' policy within the multi-disciplined team allowed a flexible innovative design approach. This approach also enabled close cooperation between all parties, helping to ensure there was no health, safety or environmental issues during the lifetime of the project. The whole project was well planned from concept through to construction.■

Note: *The Editor & Publishers wish to thank Severn Trent Water, Norwest Holst Ltd and Carl Bro Group for preparing the above article.*