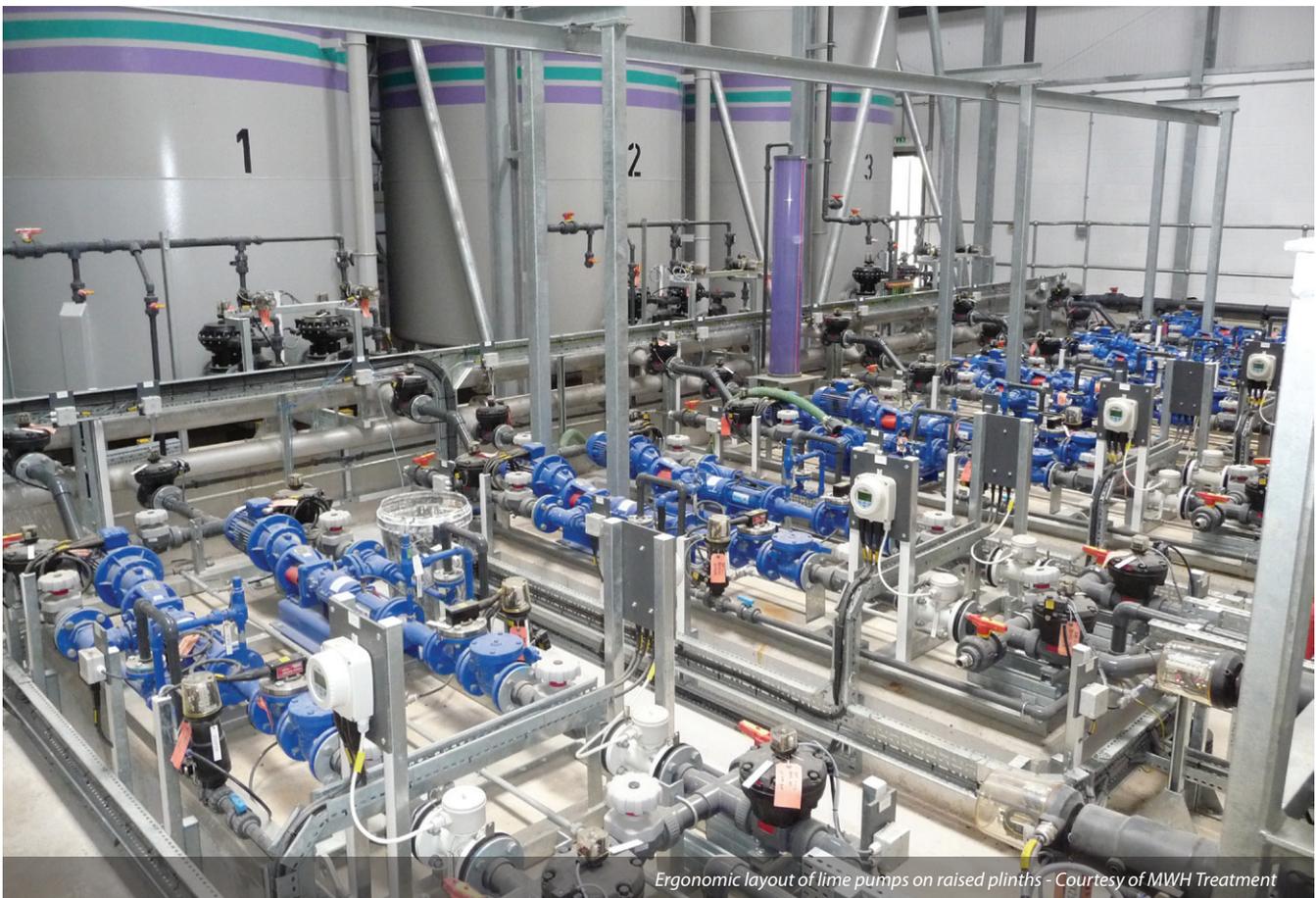


Bamford WTW

an innovative and considerate treatment enhancements project to maintain water quality

by Bill Hinchcliffe BEng MICE, Paul Richardson CEng, and David Bennett

Situated in the Peak District, Bamford Water Treatment Works (WTW) is Severn Trent Water's (STW) third largest treatment works, supplying drinking water to Derby, Nottingham and Leicester. Taking its supply from Ladybower, Derwent and Howden reservoirs, the incoming water is blended and treated in the works before feeding into the Derwent Valley Aqueducts (DVA). There has been a water treatment plant at Bamford since the early 1900s. As water quality standards have improved and demand increased, so the plant has been adapted accordingly. After construction of Ladybower reservoir in 1945, the original slow sand filters were converted to clarifiers and rapid gravity filters. These are more efficient in removing the impurities contained within an upland water supply. Bamford WTW supplies the lowest cost water in the region as it benefits from gravity flows in and out of the works.



Ergonomic layout of lime pumps on raised plinths - Courtesy of MWH Treatment

Updating the works to meet future raw water quality challenges

Increasing raw water colour from the reservoir catchments, associated with higher intensity rainfall events (believed to be linked with global warming), have put the existing clarification processes under increasing challenge. In order to futureproof the works against this, a substantial enhancement project has been undertaken over the past three years (2009 to 2012).

A joint venture between Vinci Construction and MWH has been established to design and construct this £34m scheme in three work packages. Briefly, these are:

- A new disinfection stage contact tank with associated hypochlorite and bisulphite dosing equipment.
- A new lime plant (to control pH throughout the treatment processes) and upgrade of the existing orthophosphoric

acid dosing plant.

- A new dissolved air flotation (DAF) clarification plant and sludge thickeners along with refurbishment/replacement of the associated chemical dosing equipment.

Scope of services

MWH were responsible for the design of the whole works including the hydraulic detailed design, civil design and MEICA. The company also has responsibility for the installation and commissioning of the new works. Vinci were responsible for all aspects of the civil construction. Severn Trent Water are responsible for process design and clarified and final water quality.

Designed to meet the challenge of climate change, the plant will ensure water quality for the future, with a maximum potential output of 202MI/day.



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A full description of each of the three work packages is as follows:

The contact tank

The new 75m x 20m x 6m RC contact tank was built within the footprint of a redundant clear water reservoir, giving a 30 minute contact time. The internal walls are full height RC and the tank contains two compartments to facilitate cleaning and maintenance. It includes an integral valve chamber, which in an emergency is able to draw down into supply via bottom operated penstocks. These can be opened to bypass an existing balance tank which acts as a header tank on the Derwent Valley Aqueduct (DVA).

Other components of the contact tank package included:

- High level outlet weir with associated overflows and under-drainage systems.
- All interconnecting pipework up to 1,800mm dia. to the valve chamber and the DVA.
- Dosing equipment to ensure compliance with disinfection standards.
- Water quality monitoring, SCADA and MCC controls.

The lime plant

The new lime plant will control the pH profile throughout the whole treatment process, replacing the existing lime and Kalic dosing plants. The works packages included the provision of storage silos and mixing tanks giving 28 days storage and providing 27.5m³ working capacity, as well as new duty/standby dosing pumps to dose lime slurry at four different stages.

Other components of the lime plant package included:

- New process water and carrier water systems.
- Construction of a new orthophosphoric acid dosing rig and associated dosing lines.

- Drainage systems to 'Chem e Safe' requirements.
- Systems integration and SCADA.
- MCC and electrical installation.

The DAF plant

The new single DAF plant replaces the clarification stage on the north and south plants, which were built within old slow sand filters 4 and 5. The installation of 2 (No.) raw water inlet mains with chemical mixing connect the existing south plant inlet works to the new DAF Plant.

Clarified water is conveyed via three routes from the DAF building outlet mixing chamber to the following locations: the North Plant Filters 1-6, South Plant Filters 1-16 and 17-22. Two sludge thickening plants and polymer dosing facilities were also constructed to thicken DAF and lamella sludge local to the new DAF plant.

Other components of the DAF plant package included:

- Ferric sulphate dosing facilities for coagulation of raw water.
- Disinfection post DAF plant and an emergency dosing system pre-contact tank.
- Complete electrical installation system, energy metering, control gear, switchgear, instrumentation, systems integration, lighting and lightning protection.

Adding value through innovation

From day one the project team looked to add lasting value to the scheme by introducing cost effective innovation wherever possible.

Through waste minimisation, material selection and design best practice, the carbon savings on the new facilities at Bamford WTW have been independently calculated as 613 tonnes. Some examples of how this has been achieved include:



Precast RC units used for DAF cell internal walls – DAF cells built with integral ladder access – Courtesy of MWH Treatment

- The original clear water reservoir concrete walls were crushed and reused for the new road construction: **Carbon saving 14 tonnes.**
- Used site-derived excavated material as backfill to the contact tank: **Carbon saving 33 tonnes.**
- Pipe bedding material changed from gritstone to limestone reduced transportation from local quarry: **Carbon saving 59 tonnes.**
- Changed pipe material from ductile to coated carbon steel: **Carbon saving 9 tonnes.**
- Contact tank under-tank drainage changed to perimeter drainage: **Carbon saving 59 tonnes.**
- The first use of Weholite pipework on a Severn Trent Water water treatment works instead of ductile pipework for DAF inlet/transfer mains: **Carbon saving 439 tonnes.**

Iterative value engineering process

Focusing on whole life costs, carbon reduction and future maintenance, the design team went through an iterative value engineering process. Some of the many scheme benefits realized at construction include:

- 2,000mm inlet mixers split in two reducing weight for installation/future removal.
- DAF building re-designed with lighter steelwork sections.
- Chemical dosing hoses supported horizontally on cable tray, facilitating lagging and future maintenance.
- Precast concrete units used for DAF cell internal walls.
- Removable spray bar system on DAF cells.
- Sikla modular pipe support system.
- Use of permanent formwork for the contact tank roof providing major health and safety benefits during construction.
- Above ground installation of 1,800mm inlet pipework on precast bases. The pipework was pre-assembled, tested

and disinfected prior to installation.

- Lean construction techniques used, including extensive off site fabrication for items such as skid mounted pumps, precast RC units and 'plug and play' sampling boards.

Considerate Constructors Scheme (CCS)

Given its location in an area of outstanding natural beauty (Peak District National Park), corporate social responsibility has always been a major consideration for the Bamford project. Embracing the ethos of the Considerate Constructors Scheme (CCS), the team's commitment has been formally recognized with two consecutive CCS awards: a silver award, received in 2011 has been followed by a bronze award in 2012. This is a great accolade as awards are rarely presented to the same project in consecutive years. This prompted STW's Programme Manager Bill Hinchliffe to say: "Many congratulations to the whole team for achieving these awards. I know that a lot of hard work has gone into maintaining a good working relationship with our neighbours and the wider community at Bamford. Well done!"

Consideration for local residents and businesses

Some examples of how the project has successfully managed relationships with local stakeholders are shown below:

- A Residents Charter was established and agreed, which outlined the detailed rules to mitigate adverse effects on the immediate site surroundings. This included a vehicle escort system and restricting deliveries to between 08.30 and 17.00 hours.
- The access road to the site is steep, narrow and passes many residential properties. To maintain safety for local residents, a detailed Traffic Management Plan has been devised and successfully implemented during construction. This plan helps to minimise impacts on the character of the road and protect a well-established hedgerow and mature trees.



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Sikla modular pipework support system – simplified installation reduces time and material wastage - Courtesy of MWH Treatment



Sampling equipment on plug and play backboard Courtesy of MWH Treatment

- A permanent acoustic barrier has been constructed to minimise the noise nuisance for residents - weekly noise measurements ensure compliance with agreed levels.
- Regular progress bulletins are issued to residents and local businesses - these show the current status of the works, upcoming activities and early notification of disruptive activities (including advance notice of any road closure or potential increase in traffic movements).
- A compliments and complaints log has been in place since day one of the project to allow local residents to share their views. One resident of Saltergate Lane commented, "In my experience all the traffic marshals and drivers have shown exemplary consideration and are managing what must be a very difficult situation extremely well".
- In addition, the project has contributed to Derbyshire County Council (Highways) by repairing potholes and damage to the highway on Saltergate Lane.

Consideration for the local community

MWH and Vinci have constantly provided community support, raising money for charities and organisations through various initiatives and events. These include:

- Bamford Primary School was presented with a cheque for £500 through a H&S initiative on site. 'Improve It' cards were used extensively by staff to proactively highlight areas for improvement, with MWH and Vinci making a donation for each 'Improve It' raised. The Head Teacher commented:

"gifts of this nature make such a difference to us and enable us to have those much needed extras."

- A charity golf day held in August 2011, raised £1,000 for Help for Heroes and Ashgate Hospice.

Ecological best practice

Bamford WTW is close to a local population of common toads whose spring migratory route is located across the site. To protect the toads, the team worked closely with specialists to collect and translocate them to a nearby lagoon where they can safely spawn.

This process has been repeated during the project life, and is an example of ecological best practice for one of Britain's amphibians.

Progress to date

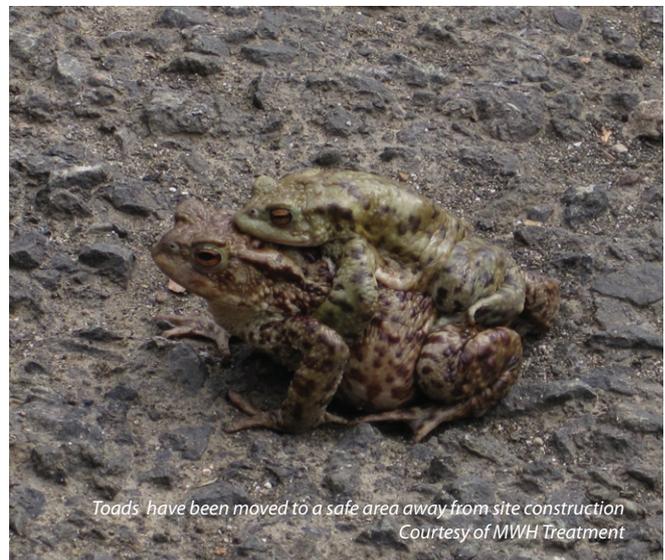
The project is on course to be fully commissioned and operational on time (December 2012) and on budget.

At the time of writing (July 2012), the lime plant is complete and is currently being commissioned, and the DAF Plant is being installed ready for commissioning. The contact tank is complete and was put into supply in April 2011.

The editor & publishers would like to thank Bill Hinchcliffe, Programme Manager with Severn Trent Water, Paul Richardson, Project Manager with MWH Treatment, and David Bennett, Senior Mechanical Engineer with MWH Treatment, for providing the above article for publication.



Pipework supported above ground on precast plinths, with chemical dosing lines (pre-lagging) double-contained and carried on cable tray Courtesy of MWH Treatment



Toads have been moved to a safe area away from site construction Courtesy of MWH Treatment