Hornsey WTW & the New River Bromate Removal Scheme

by
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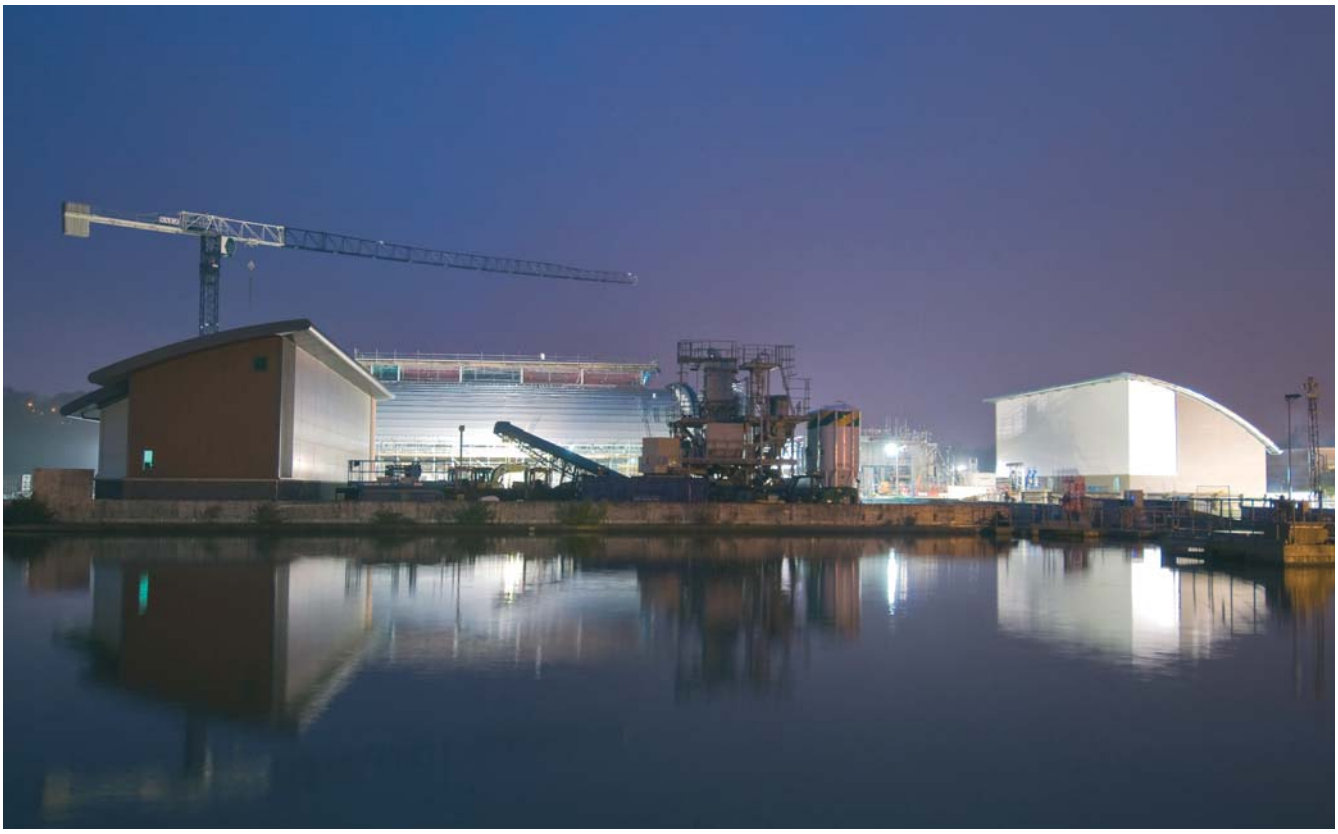
In 2000, the aquifer supplying water to the New River became polluted with bromate. The pollution incident, from a demolished chemical factory near St. Albans, occurred 20 miles away from Hornsey Water Treatment Works (WTW). This WTW is a strategic source of potable water and has been supplying treated water to the area since 1850. It was essential not to lose this extremely important supply and, with the clock ticking, Thames Water embarked on a series of engineering studies and research to solve the issue.



Hornsey WTW under construction *Courtesy of Thames Water Utilities Ltd*

Background

Thames Water's Hornsey Water Treatment Works (WTW) is situated in North London next to Alexandra Palace. The works supplies up to 50Ml/d of water to a population of approximately 350,000 in North London and abstracts its raw water from the historic New River. Constructed in 1613, the New River was built to supply London with drinking water. It is still an important supply of raw water to north London.

Until recently, the treatment provided at the site consisted of slow sand filtration with a Granular Activated Carbon (GAC) sandwich for pesticide control followed by disinfection using super-chlorination and de-chlorination. The first slow sand filters were constructed in the 1850s. Thames Water has now constructed a new 50Ml/d treatment plant consisting of Dissolved Air Flotation (DAF), Rapid Gravity Filtration (RGF) and catalytic Granular Activated Carbon (cGAC) adsorption. The latter process is designed to remove bromate as well as pesticide from the raw water.

Raw Water Source

Raw water for Hornsey WTW is sourced from the River Lee and four abstraction boreholes. The water is pumped, via the New River into a small bank side reservoir and then into the treatment plant.

In the past, Hornsey WTW had always been vulnerable to algal blooms mainly caused by the shallow bank side storage. The algae blocked the slow sand filters and production from the plant would fall dramatically. Hornsey WTW had six slow sand filters and when they became blocked each had to be drained down, skimmed and then run-to-waste for several days before returning to supply. This process was time-consuming and it could take several weeks for the works to fully recover from an algal bloom. To limit the impact of algal blooms ground water from the boreholes are used to dilute the algae present and discourage further growth.

Bromate Contamination

In 2000, routine sampling revealed that the Northern New River boreholes had been contaminated with bromate. An adjacent water company was experiencing a similar problem and further investigation traced the source of the bromate back to a demolished chemical factory near St Albans, Hertfordshire.

The Water Supply (Water Quality) Regulations 2000 set a new Prescribed Concentration or Value (PCV) for bromate limiting its

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concentration to a maximum of 10 µgBrO_3/l. It is very unusual to find high levels of bromate present in raw water. The presence of bromate more usually arises during the water treatment process due to the oxidation of bromide during ozonation.

It was clear that if the northern boreholes were used then the concentration of bromate in the New River would be well in excess of the PCV, causing the works to be shut down in order to prevent excess bromate passing into supply. Slow sand filtration has no impact on bromate and disinfection using sodium hypochlorite will only increase the concentration.

Value Management

To deliver the works in an effective and considerate manner, Thames Water, the Drinking Water Inspector and Haringey Borough Council had an extremely important role to play. Input from all stakeholders resulted in a strategy being developed to combat both the short and long term bromate issue at Hornsey WTW.

The strategy included:

- Providing pre-treatment to reduce the reliance on the abstraction boreholes by maximizing the use of New River water.
- Using the boreholes situated on the New River immediately downstream of the works to provide diluting water.
- Providing a process to remove bromate.
- Minimising water losses through the treatment process by recycling and installing a wash water recovery plant.

Design

Initial work involved establishing the extent of the bromate contamination and determining the future maximum concentration present in the raw water feeding Hornsey WTW. The aquifer was modeled and an extensive sampling and analysis regime put in place. In parallel, research began on the methods available to remove bromate. A wide range of processes were identified and tried on a small scale. From this work, three processes emerged as being viable for application at Hornsey. These were: Ion Exchange, Reverse Osmosis and Catalytic Granular Activated Carbon (cGAC).

After completion of engineering studies and research, cGAC was selected. The main benefit of the cGAC is excellent value for money and whole life operating cost whilst continuing to provide pesticide removal which meant the existing slow sand filtration plant could be decommissioned. A full scale pilot plant was constructed at Hornsey WTW to ratify the research findings.

Construction

The strategy dictated the response to the bromate and the construction was divided into three phases. During construction this was simplified further, to reduce critical path activities, by combining Phases II and III. Construction started on site in March 2007.

Phase I - Two pumping stations were constructed to return the run-to-waste water from the slow sand filters to the reservoir thus reducing the raw water demand. A pipeline was constructed to divert water from three boreholes situated on the New River but downstream of Hornsey WTW to the reservoir. This provided an additional source of water that was bromate free.

Phase II - Construction of a 50 Ml/d pre-treatment plant consisting of dissolved air floatation and rapid gravity filtration. This enabled the works to utilize more river water and therefore deal with algal blooms much more effectively reducing the reliance on the contaminated boreholes.

Phase III - Construction of a 50Ml/d bromate removal plant, consisting of eight cGAC adsorbers. This process enabled the works to remove bromate and use the contaminated boreholes when demand required.

With the emphasis on commissioning to achieve the target date the team focussed on the sequencing of the major civil, mechanical and electrical installation activities to ensure forward flow of water through the plant could be achieved as early as possible.

Constraints
Access to the site for construction activities could not be obtained through the normal site entrance. This problem was overcome by constructing a 700m temporary construction road and two bridges over the New River.

The site itself is extremely compact and it was an operational necessity to maintain up to 30Ml/d from the existing plant whilst constructing the new facilities. The new treatment facilities were constructed on two of the slow sand filters. This is an area equating to the size of a football pitch, which had to contain three DAFs, five RGFs, and eight cGAC adsorbers all capable of delivering 50Mld together with all the ancillaries and a wash water recovery plant.

Health & Safety is the highest priority in Thames Water construction projects. This site presented enormous challenges with over 140 contractors on site at the peak of construction. All activities had to be planned extensively to ensure trades on site could work safely.

In order to satisfy planning requirements, the new treatment works had to be constructed adjacent to the banks of the New River and the Hornsey reservoir. It was absolutely imperative to ensure no damage occurred to these structures as this might have led to extensive flooding of the site and the surrounding area. Extensive temporary works were required particularly around deep excavations and a monitoring regime was agreed with the Statutory Engineer.

Project Team
Hornsey WTW is a business critical treatment facility for Thames Water. With the clock ticking and the bromate level increasing, an integrated team was established to design, construct and commission the project. This included staff from Thames Water, Costain (main Contractor), Black and Veatch (design consultant), Enpure (main process sub-contractor) and Aston Dane (Systems Integrator).

Model of Hornsey WTW *Courtesy of Thames Water Utilities Ltd*

Progress
Despite the technical and construction challenges the project achieved its regulatory target of Water into Supply in January 2009. The plant is currently undergoing final commissioning for handover in September

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