Cramptons Road WTW

refurbishment of a 1960s water treatment works has provided South East Water with one of its most advanced, fully automated facilities

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Built in 1969, Cramptons Road WTW, 3km north of Sevenoaks, Kent, abstracts aquifer water through on-site and nearby boreholes. After chemical dosing and storage in an underground contact tank, the treated water is pumped to three service reservoirs 7km away. These provide a major water source for 40,000 residents in Sevenoaks, supplying up to 21.4Ml/d. The extensive £4.6m upgrade demanded ten programmed shutdowns of key, live supply pipelines while still ensuring the 45 year old plant remained fully operational. The area's great crested newts and resident bats were carefully protected while over 2km of new pipework was integrated into the original site layout. This re-routes borehole water supplies through the plant's contact storage tank and into existing pipework feeding three nearby service reservoirs.

The new connection, into delivery mains feeding Solefields Reservoir, required insertion of large Y-section pipework - Courtesy J. Murphy & Sons Limited

Background

The WTW is located on a partially wooded 3ha site bordered by housing and a suburban rail line. The site's original buildings housed not only a pumping station and chemical dosing facilities but also headquarter offices for the then owner West Kent Water.

With these offices long empty, and the works' pumping and chemical facilities in need of a considerable upgrade, current owner South East Water decided to replace the old pumps, chemical dosing system and much of the on-site pipework with new facilities and an automated control room. These have been located mainly on a previously under used area of the site, to the north of the old buildings but still close to the original central buried contact storage tank which is being retained.

The water treatment works takes its water from four boreholes, three on site and a fourth a few hundred metres north of the plant. This aquifer supply was originally routed directly into the buried, twin cell contact storage tank before being fed, when needed, to the pumping station.

Here it was dosed with chlorine and pumped into existing on-site water delivery mains feeding to Riverhill, Solefields and Oakbank service reservoirs on the outskirts of Sevenoaks.

By carefully re-routing new supply pipework, about half the original site area is now redundant. Demolition of the old pump station and headquarter offices will free this valuable housing land for development or sale by the water company.

Refurbishment

The £4.6m improvement works, awarded as a design and build contract to J. Murphy & Sons Ltd in October 2011, still centre on the existing 9,500m^3 capacity concrete storage tank. But some 2km of new, mainly ductile iron, pipework, varying from 250mm to 500mm diameter, alters and improves the water flow route around the site.

Pipelines from the four supply boreholes, which originally fed direct into the contact storage tank, have been intercepted and are now routed to a new chemical dosing chamber built immediately alongside this buried concrete reservoir. The four flows combine before entering the chamber where the borehole water is injected with sodium hypochlorite through a series of lances inserted into a single 450mm diameter pipe. The chlorinated water is then routed into both cells of the adjacent contact tank.

When called for, treated water exits the tank cells from the opposite side to immediately enter a second partially buried chemical dosing chamber. Here sodium bisulphite is added to reduce chlorine levels to drinking water standards while injected phosphoric acid protects against possible contamination from domestic lead-lined pipes.

Supplies then enter an adjacent pump room located at the end of the new pump station building. This 28m long rectangular building also houses the new control room, offices and chemical storage facilities.

Two of the four up to 400kw high lift pumps act as standby, while the live pair route treated water out both sides of the building to connect into existing 150mm to 500mm diameter cast iron delivery mains. These feed the three service reservoirs located south of the treatment works.

New surge protection vessels link both exit flows from the pumping station, while a standby generator has been sited nearby.

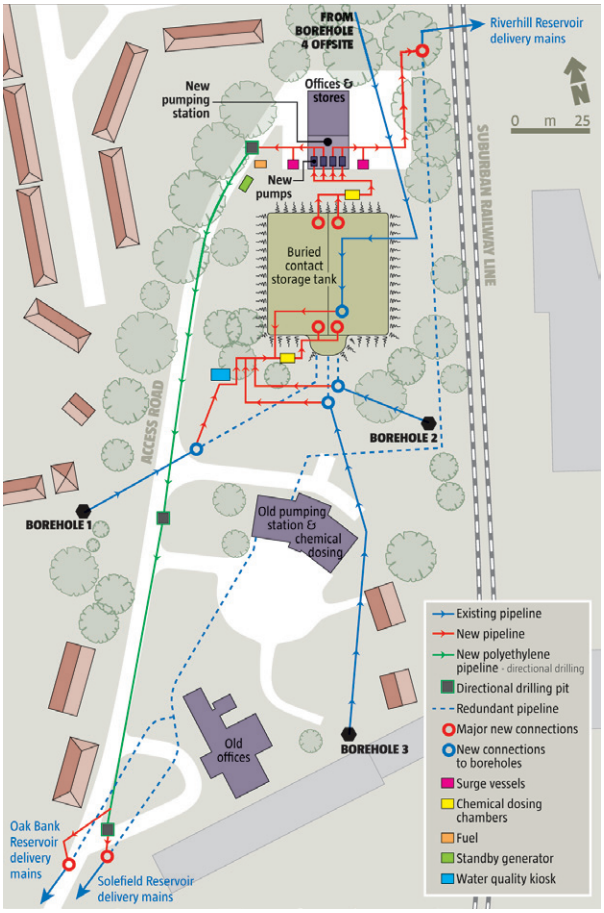
A main driver in the layout of the new pipework, designed by Murphy's consultant, GHA Livigunn, has been to reposition pipelines outside central areas of the site's southern section. This area now contains only the original redundant pumping station and onetime office block. Both are scheduled for demolition, freeing up the area for possible residential development.

Construction challenges

The main construction challenge was the high number of partial or total plant shutdowns needed while installing new pipe connections into the existing mains. Of the total ten shutdowns, four required temporary closure of a borehole supply and three interruption of the delivery main to a service reservoir. But the remaining three demanded a total plant shutdown as new inlet and outlet pipes were installed in the contact storage tank.

Murphy had contractually to give between 6 and 10 weeks notice to SEW to have shutdown dates approved. But in practice, close collaboration, and daily meetings, between contractor and a resident on-site client representative ensured convenient dates were agreed well in advance and constantly reviewed.

Loss of supply averaged between six and eight hours, predominantly during the night. But every shutdown proved a major logistical exercise with Murphy providing South East Water with a detailed



Cramptons Road WTW site layout - Courtesy of J. Murphy & Sons Ltd

New pipework included complex manifold layouts Courtesy of J. Murphy & Sons Limited

New high lift pumps feed treated water to the three service reservoirs Courtesy of J. Murphy & Sons Limited

Connection to Riverhill Reservoir delivery mains was extended 80m to bypass now redundant fragile pipework - Courtesy J. Murphy & Sons Ltd

Some flange connections involved new metric sized pipe bolted to the original imperial pipework - Courtesy J. Murphy & Sons Limited

Directional drilling was used to install pipes running beneath the site's access road, ensuring its uninterrupted use- Courtesy J. Murphy & Sons Ltd

20-page statement setting out precise construction methodology. This outlined procedures ranging from safety risk assessments and plant required, to risk mitigation measures and rescue plans if problems occurred during the connection process.

Exact timelines, flange bolt torque loadings and a list of personal protection equipment to be worn was itemised. Bespoke flange designs were needed as some connections demanded new metric sized T-sections to be bolted into original imperial pipes.

The most crucial shutdowns centred on the existing buried contact storage tank while installing new bellmouth-shaped pipes through 250mm thick reinforced concrete tank walls. These works required an exceptional 7-day shutdown for each of the reservoir's two cells.

Here 500mm diameter angled pipe sections had to be inserted through pre-cored holes close to the tank's underground base. Pipe sections were installed by a five man crew, operating under confined space working conditions from inside a 5m long rectangular excavation 3.8m deep. The crew was located both sides of the enclosed tank and a specialised confined space rescue team was present throughout.

A bespoke C40 concrete mix was designed to ensure rapid but 'watertight' curing around pipe flanges, with formwork stripped after just two days. During this pipe insertion, the empty tank cells were inspected and patch repaired for the first time since commissioning 45 years ago.

All ten shutdowns ran to schedule, with many being completed early, and the water works remained fully operational at all times. Ironically, the very last connection to be tackled, linking treated water supplies into the delivery mains to Riverhill - the largest service reservoir - proved the most difficult and triggered a three week contract extension.

The existing somewhat fragile 500mm diameter pipeline to Riverhill had burst and was repaired immediately before the contract started. This resulted in the new tie-in connection being moved an additional 80m to the north with an extended section of new pipe laid parallel and adjacent to the original mains.

Even though the conventional 4m deep open cut trench for this extended run was dug only in short sections to maintain its stability, the excavation frequently flooded. Water ingress was eventually traced not to the weak adjacent pipe connecting to Riverhill Reservoir but to a rogue uncharted salt-glazed early 1960s pipe that, it is thought, had been used as an overflow or runoff route for one of the nearby boreholes.

Directional drilling

The new pipelines were originally all designed as ductile iron to be placed in open excavation. But where a 430m long section, running from the pumping station to connect with existing delivery mains to Solefields and Oakbank reservoirs, was routed largely beneath the site's only access road, Murphy came up with a less disruptive alternative.

By laying this section using trenchless directional drilling, with more 'flexible' 355mm diameter polyethylene SDR11 pipes being inserted from three drilling pits, the contractor gained uninterrupted use of the access road.

It also eliminated possible access restrictions for local residents who used the lane and it was very important they were not inconvenienced by the project.

Specialist contractor JMH Directional Drilling completed the work in just three days - a saving of at least four weeks over conventional open trenching methods.

To replace pipework into the buried contact storage tank Murphy crews had to work from a cramped inlet chamber classified as a confined space
Courtesy J. Murphy & Sons Limited

Automation

Control of the original water treatment works had been largely manual, demanding permanent on-site staff. This is now no longer needed, with electrical and mechanical subcontractor EPS Ireland installing a state-of-the-art fully automated £250,000 motor control centre.

With only occasional on-site checking required, every operation from recording the levels of boreholes, chemical dosing and pipe flow, to pump outputs and efficiency, is monitored by South East Water engineers from the company's Snodland headquarters 23km away.

Environmental control

Before work started at this semi-rural site, an extensive ecological survey revealed the likely presence of several protected wildlife species. Evidence of great crested newts, slow worms, grass snakes and lizards was identified and it was known Pipistrelle bats frequented several of the site's old buildings. The entire construction area was enclosed by purpose-designed newt fencing and three bat boxes have been built into the new pump station building.

Conclusion

The refurbished Cramptons Road Water Treatment Works became fully operational in October 2013 and is now one of SEW's most technically advanced water treatment works.

It performs a crucial role in ensuring the quality and reliability of the company's supply of 565Ml/d of potable water a day to a population of 2.1 million in surrounding counties.

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