Speen WTW Transfer Mains

completion of a 19km pipeline, transferring potable water between two Thames Water Berkshire catchments, safeguards the survival of a rare snail

by David Hayward BSc (Eng) AMICE

A reduction in Thames Water's abstraction licence from raw water supply boreholes was the driver for the construction of a £10.2m water pipeline transferring potable supplies from a Reading reservoir 19.2km west to a similar reservoir near Newbury. This reduction should benefit the Desmoulin's Whorl, one of the world's rarest snails. Increasing flow into the Newbury reservoir by up to 5Ml/d will allow its former main supply source from Speen water treatment works to be shut down. This in turn will let Speen WTW considerably reduce its own raw water abstraction rates from local boreholes, located in the grass-covered wetland floodplain of rivers, where the endangered snail has one of its main European homes.

Murphy's best pipeline completion rate topped 250m a day - Courtesy J. Murphy & Sons Limited

Background

Located near Hermitage 5km north east of Newbury, Cold Ash Reservoir is the major supply source of potable water to some 35,000 local households. This covered reservoir receives its main treated water from Speen WTW, 8km to the south west, via a 200mm diameter pipeline pumping in up to 5Ml/d.

Built in the 1960s, Speen also supplies several other smaller reservoirs, but Cold Ash takes 90% of the water that the treatment works abstracts from five nearby boreholes. This routing works well and would need no technical changes were it not a requirement to reduce borehole abstraction.

The Environment Agency has ordered a reduction in the current 13.6ML/d raw water abstraction licence at Speen. Abstraction rates are being lowered to an average 4ML/d and maximum 5 Ml/d.

The new restriction still allows Thames Water to supply its smaller reservoirs from Speen, but it must find an alternative major water source for Cold Ash. The local Water Resource Zone supplying the

Newbury area is fully committed and Thames Water has turned to the neighbouring eastern zone serving Reading. Here, Tilehurst Reservoir, 3km west of Reading, has been identified as having surplus supplies, triggering the water company's decision to construct transfer mains between the two reservoirs.

Design

In January 2011, Thames Water Utilities awarded a £10.2m design and build contract to Optimise (a joint venture consisting of J. Murphy & Sons Ltd, Clancy Docwra Ltd and Barhale plc, plus designers MWH). Construction was not scheduled to start until January 2013 offering Optimise an unusually generous year-long design period, which it has used well. Thames Water's award was, at the time, a new contract approach setting out only a very broad design brief and allowing Optimise to analyse a wide range of options.

The water company asked the Optimise to identify a 'suitable supply source' within the Tilehurst area and design a transfer pipeline between Reading and Newbury catchments routed somewhere within a 15km wide corridor.

The challenge was to choose a route that avoided the corridor's numerous areas noted for their environmental, ecological, archaeological, heritage or socio-economic value. Much of the landscape between the two reservoirs was rich in local and statutory wildlife sites, ancient woodland, scheduled monuments and even the remnants of an Iron Age fort.

Several rivers, the M4 Motorway, numerous attractive Berkshire villages and even contaminated land complicated the design challenge. Known habitats of badgers, great crested newts, Japanese knotweed and bats added to the obvious no-go areas.

Led by MWH, the design team subjected a dozen possible alignments to a suite of assessments, with the main drivers being hydraulic modelling, topographical and environmental surveys plus stakeholder interests and cost effectiveness.

The result was a route only marginally longer than the 18.5km minimum length suggested in the reference solution by Thames Water and one that succeeded in avoiding all the sensitive areas identified.

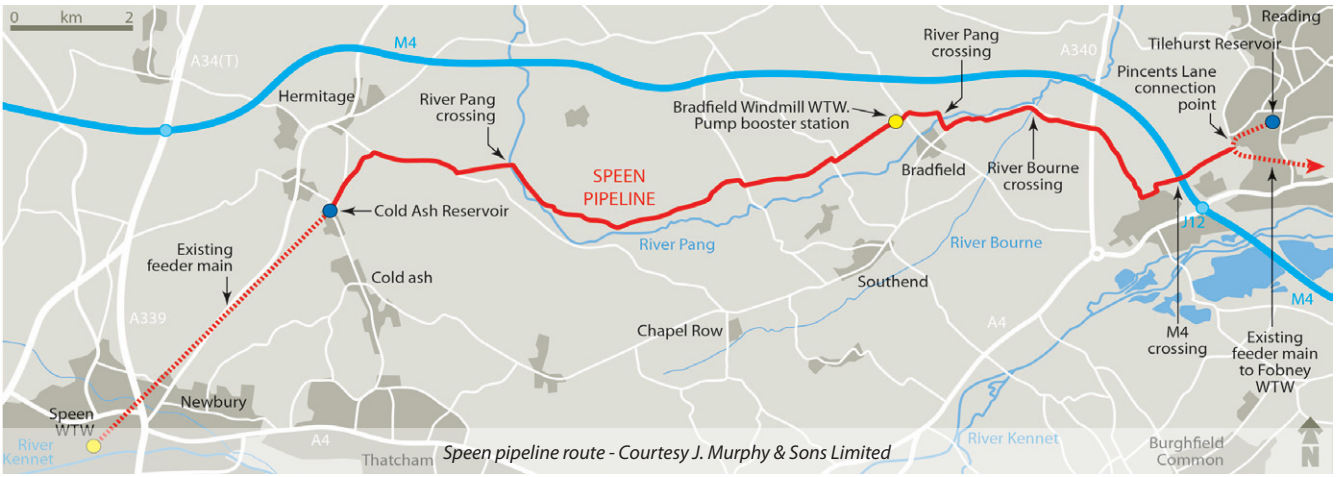
The vast majority of this chosen 19.2km alignment runs beneath privately owned land, with over 80% classified as agricultural. The M4 motorway near Theale has been drilled beneath its carriageway, with the River Pang crossed twice and the River Bourne once.

Murphy has been laying pipelines for over 50 years and, from the start of the route planning process, the design team placed value engineering top if its to-do list. Identifying a suitable intercept

The vast majority of the pipeline was laid in open trench
Courtesy J. Murphy & Sons Limited

A riddler bucket converted excavated clays and gravels into a suitable shingle-like bedding material - Courtesy J. Murphy & Sons Limited

Over 80% of the route lay across agricultural land
Courtesy J. Murphy & Sons Limited



Speen pipeline route - Courtesy J. Murphy & Sons Limited

The pipeline's T-connection into its water supply source near Tilehurst Reservoir - Courtesy J. Murphy & Sons Limited

The pipeline's western end is linked into Cold Ash Reservoir Courtesy J. Murphy & Sons Limited

The pipeline emerges from a directional drilling pit Courtesy J. Murphy & Sons Limited

point into the pipeline's potable water supply at the western start of the route near Tilehurst Reservoir, offered the team its first cost effectiveness exercise.

The reservoir is fed from nearby Fobney WTW through a 710mm medium density polyethylene (MDPE) pipe laid, coincidentally, by Murphy in about 2005. This replaced the original parallel 60 year old 21inch (533mm) cast iron mains, which was capped off but left in situ.

The team decided to connect into the live pipe about 1km from the reservoir, but then immediately insert its new 355mm pipeline into the original redundant cast iron mains lying immediately alongside. It used the old cast iron pipe as an outer sleeve for the first 1km long run of the new pipeline. The net cost saving over conventional trench construction was put at £200,000.

Early ideas were then for the pipeline to continue to flow under gravity a further few hundred metres and be routed into the brownfield site of Thames Water's disused Theale STW. A new pump booster station could be built here allowing the rest of the pipeline to be pumped to Cold Ash Reservoir.

But building a booster station at Theale would have needed full planning permission and denied Thames Water other options for this valuable site.

Instead, said Optimise, why not run the gravity section a further 6km along the route, siting the new pump booster station within Thames Water's existing secluded Bradfield Windmill WTW. It would then lay the remaining 11.9km pumped section direct to Cold Ash.

Even though diverting to Bradfield added about 500m to the route, it eased planning consent and reduced the scope of pumping required. Further advantages were won by siting the transfer main's motor control centre (MCC) also at Bradfield, housed within an existing, though underused, building.

Construction

The vast majority of the high density polyethylene (HDPE) pipeline was laid in conventional open trench at an average depth of 2m. The alignment was unusually flat and, with three excavators plus a specialised trencher on site, the excavation was opened up in maximum 200m lengths. Murphy's best rate was 250m of completed pipeline a day, an achievement helped by a further value-engineered innovation.

Conventional pipe bedding, surround protection and 100mm cover material, would have been imported shingle with the trench then backfilled with the excavated soil. But Murphy decided instead to reuse some of the as-dug gravel, chalk and sandy clay, converting it on site into a shingle substitute.

Pipe strings were laid and butt fusion welded in average 100m lengths - Courtesy J. Murphy & Sons Limited

A trenching machine helps form the rural pipeline route Courtesy J. Murphy & Sons Limited

As-dug material is ground down by the riddler bucket for reuse as pipe protection - Courtesy J. Murphy & Sons Limited

A riddler bucket, equipped with geared spinning wheels, was fitted to a standard excavator arm to cut and grind the mixed ground into shingle-sized rock. Over 100 trial pits were dug along the alignment - double the norm - to confirm the geology was suitable and the replacement bedding material was used for over 70% of the route. This site-won material totalled some 9,400m^3. Faster construction, no imported shingle and hundreds of eliminated lorry journeys totalled a further cost saving of around £700,000.

Subcontractor JMH Directional Drilling was brought in to route the pipeline beneath the M4 near junction 12, and under the Rivers Pang and Bourne. A total 1km of the mains was directionally drilled, with the motorway crossing demanding 12m cover.

The booster station at Bradfield WTW, housing two 50kw high lift pumps, was a small 20m long glass reinforced plastic hut. Alongside it the MCC, installed by E&M contractor Nomenca in an adjacent treatment works building, will record flow rates, pump output and reservoir levels at both ends of the pipeline, when the transfer main is operational this summer. It is to be monitored and controlled remotely from Thames Water's regional headquarters 18km away in Reading.

Conclusion

When fully commissioned this August, and the pipeline is supplying a maximum 5ML/day to Cold Ash Reservoir, the original feed mains from Speen WTW will be shut down. An actuated plug valve, installed in the mains can, when needed, reverse the flow allowing the reservoir itself to boost Speen's water supplies. This will further safeguard the new EA reduced raw water abstraction licence.

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