

The Birmingham Resilience Project

safeguarding the water supplies to the UK's second city

by Simon Hinsley C Eng MICE

In the late 1880s Sir Thomas Martineau addressed the City of Birmingham Council.

"Gentlemen, there has been yet another outbreak of smallpox and diarrhoea in our city. We need pure water. Our existing supplies are woefully inadequate. We depend on local wells, rivers and streams which cannot meet our current needs, let alone our projected demands. Therefore as Chairman of the City's Water Committee I propose that we undertake a survey of possible sources of supply, initiate the necessary legislation in Parliament and seek the necessary finance to improve the situation for our citizens and industry, for remember fellow councillors, cleanliness is next to godliness."



Supply reservoir and dam - Courtesy of Severn Trent Water

History

Having spoken these words to the City of Birmingham Council in the late 1880s, Sir Thomas Martineau initiated one of the great feats of Victorian municipal engineering; the Elan Valley Reservoirs and aqueduct to Birmingham. Faced with a growing industrial city, serious public health problems and inadequate water supplies, the pioneering engineers and politicians of the day launched a visionary project to bring water to Birmingham.

Commissioned in July 1904, the Elan Valley Aqueduct (EVA) charts a course from the mountains of mid-Wales through to Frankley WTW on the south-western edge of Birmingham. The system functions entirely by gravity and, in its two day journey along the 73 miles of tunnels, conduits and siphons forming the aqueduct, water drops some 52m before reaching Frankley Reservoir.

Today, 111 years after it was first opened, the aqueduct is still providing trouble-free service delivering around 320ML of water into Birmingham each day. The Birmingham Resilience Project will allow Severn Trent Water to safeguard this important asset and secure another century of service.

Background

In July 2007 severe flooding caused the loss of Severn Trent Water's treatment works at Mythe, Tewkesbury, leaving around 350,000 people without a supply of mains water for two weeks.

Tewkesbury, situated toward the edge of Severn Trent's distribution network, had limited options for an alternative piped supply and the consequence was a civil emergency involving a massive exercise in tankering and bottled water distribution. The incident



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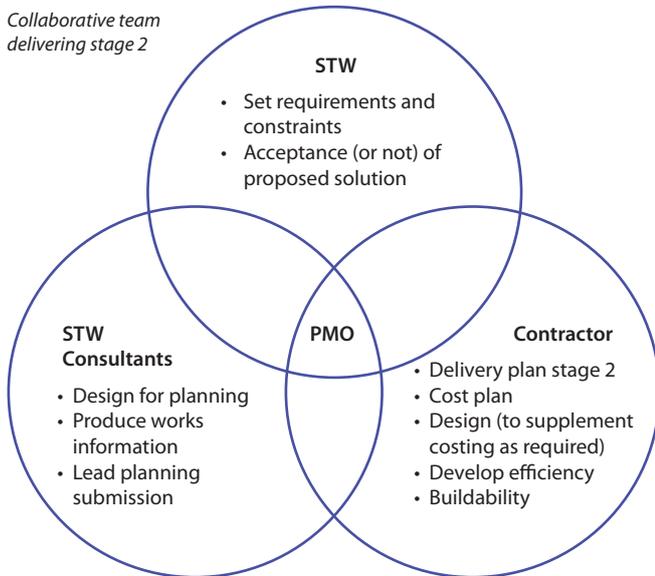
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prompted an industry-wide review of operational resilience. Whilst the EVA is drained annually for maintenance inspections, for Severn Trent Water this triggered a full structural investigation of the entire length of the aqueduct and the subsequent Birmingham Resilience Study to assess potential failure modes, consequences and supply upgrade options.

As a result, several capital projects were developed for inclusion in Severn Trent Water’s AMP6 Business Plan; the Birmingham Resilience Project (to deliver a new water supply into the city from the River Severn) plus associated EVA works (to address various location-specific risk issues). OFWAT’s final determination in December 2014 confirmed AMP6 funding of £242m for the Birmingham Resilience Project, with delivery by March 2020 and significant Outcome Delivery Incentive (ODI) penalties for late completion or shortfalls in available capacity.

Project overview

The Birmingham Resilience Project aims to deliver a new water supply into Birmingham to allow extended planned maintenance shutdowns of the EVA (as well as providing a back-up for any emergency events) and strengthen our treatment processes at Frankley WTW. The new supply would be brought into use every other year, for up to 50 days during the winter months, to allow for planned maintenance on the aqueduct.

In this way, the aqueduct can receive an ongoing programme of more extensive refurbishment and protection and safeguard its operational life. During shut-down periods, Birmingham will continue to receive water from the new River Severn source, as well as other sources local to the city and from Severn Trent’s strategic grid network. The project has a number of key elements:

- A new 130MI/d abstraction site and pumping station on the River Severn.
- A cross-country rising main to Frankley WTW.
- A new, parallel treatment stream at Frankley WTW to accommodate River Severn water as well as various resilience upgrades across the site.
- Securing the necessary alternative sources, grid ‘headroom’ and distribution improvements to deliver the balance of Birmingham demand, without adverse customer impact; this now forms a separate *Operational Readiness* project alongside Birmingham Resilience.

With the Birmingham Resilience Study having identified the strategic option of a new supply from the River Severn as the way forward, early feasibility work on the project began in 2013.

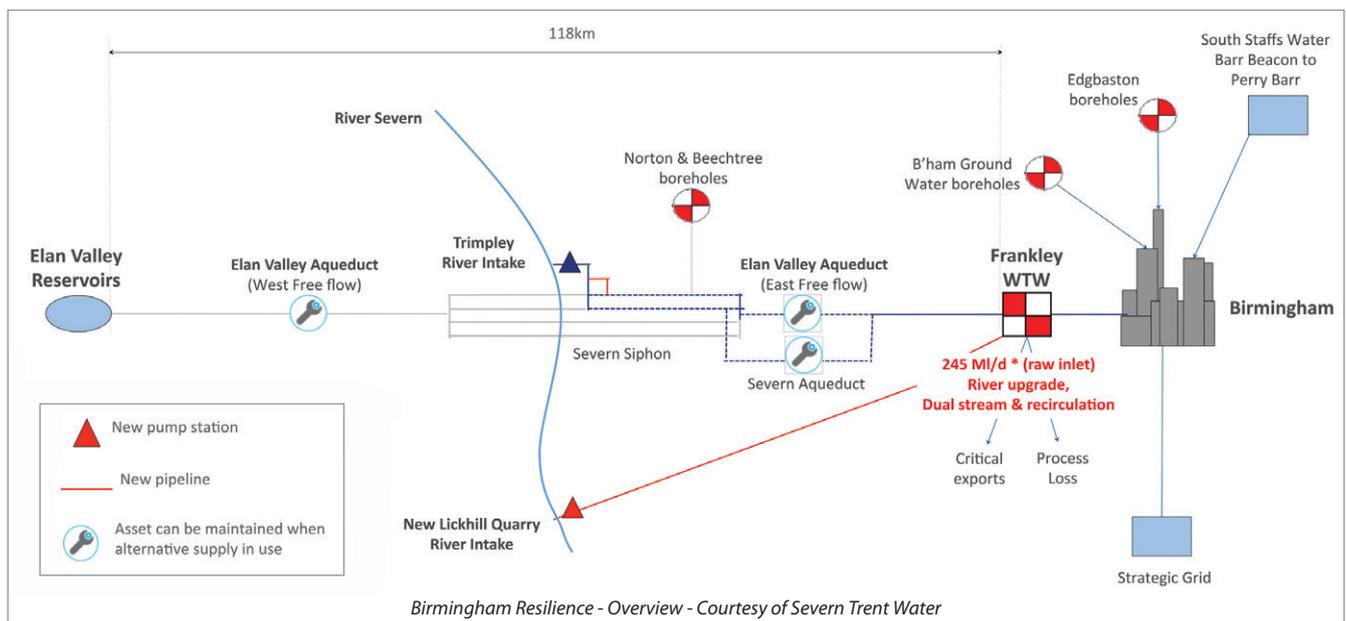
A small team of Severn Trent Water engineers, planners and scientists was supported by external consultants:

- Jacobs (focussing on the raw water transfer aspects).
- MWH (looking after the treated water workstream at Frankley WTW and providing the programme management office function).
- Dalcour Maclaren & Fisher German (land access & planning support).
- PPS Group (stakeholder management and engagement).

The team has recently been bolstered with the appointment of Laing O’Rourke Imtech (LORI) following a short tender process. The integrated project team now comprises three elements, linked by a programme management office. This team will work together to deliver the planning submissions in December of this year and agree a target price for the detailed design and construction phase.

Feasibility work

The scale of the project means it passes the threshold for requiring an environmental statement, so no permitted development rights exist. This means that, whilst statutory powers for access to land remain, planning permission is required for a cross-country pipeline – an unusual situation for Severn Trent Water.



This emphasises the need for strong and positive stakeholder and community engagement to ensure permission is gained without delay.

Twenty-two potential abstraction sites along the River Severn have been appraised in the search for the best location, from Trimpey in the north down to Ombersley in the south. All sites were assessed (through desktop studies and walkover surveys) and ranked against standard environmental statement criteria as well as river flow data. Of these, three sites were selected for further, more detailed assessment, and ground investigation.

Lickhill, near Stourport-on-Severn, was selected from this process. A combination of low visual impact, good river conditions, access and land availability making it the preferred site although a previous use as quarry and domestic landfill site is likely to mean leachate/gas mitigation measures are required. This land has now been acquired by Severn Trent Water. Eight route corridors from Lickhill to Frankley, some 25km away, have also been assessed against similar environmental criteria.

Severn Trent's intent remains to avoid or minimise adverse impact on the public during pipelaying operations and route corridors have been chosen very much with this in mind. A preferred route corridor (1km wide) was presented to local communities in a series of public exhibitions in late 2014. Feedback gathered, as well as data from environmental surveys along the corridor, is being used to refine and confirm the precise pipe alignment.

The route involves laying a 1,000mm diameter rising main to a break pressure tank located at the highest point of the route close to the M5 south-west of Birmingham. From here, water will gravitate downhill to Frankley WTW. Getting water to the break pressure tank from the River Severn requires a pumped lift of close to 300m and will involve up to 6 (No.) multi-stage shaft-driven pumps and lengths of high pressure (>25bar) pipework.

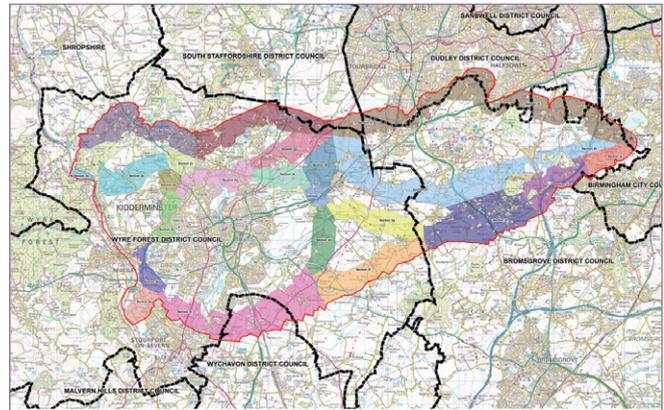
Water from the River Severn is very different to that from the EVA currently being treated at Frankley WTW and requires a totally new process stream to treat to drinking water standards. Severn Trent Water has selected Veolia's *Actiflo* high-rate sand ballasted clarifier in conjunction with rapid gravity filters to treat the river water.

Powdered activated carbon dosing is also being included to remove any pesticides and prevent disinfection bi-products (trihalomethanes, THMs) in the downstream network. An *Actiflo* pilot plant has recently been commissioned at Severn Trent's Trimpey site on the River Severn. Trimpey provides the ideal location for the pilot as it means Severn water can be used for the trial and, as the EVA passes close by, the use of Elan Valley water (either alone or in combination with Severn water) can also be trialled. Results from the pilot plant will be used to inform sizing of the full-scale plant.

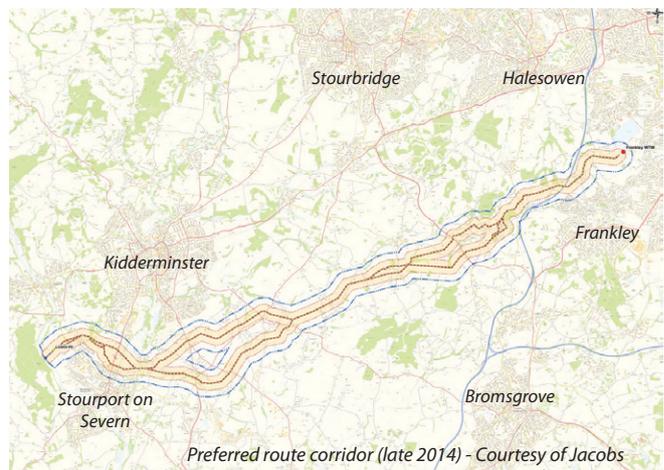
Key risks

Key risks for the project remain a timely planning approval from the four local authorities in whose areas Severn Trent are developing; obtaining an Environment Agency abstraction licence for Lickhill and securing Drinking Water Inspectorate (DWI) approval for the work at Frankley WTW and the use of a new potable water supply. Severn Trent Water is actively engaging with these key stakeholders to ensure approvals will be forthcoming. Delivering such a major undertaking within AMP6 is a huge challenge and the prospect of ODI penalties for late delivery is certainly driving decision making and a desire to *protect the plan*.

Once the new infrastructure is in place, a major risk exists in using the new supply without generating adverse customer reaction. During planned EVA shut-downs, Birmingham will temporarily receive four different sources of water – a large proportion from the



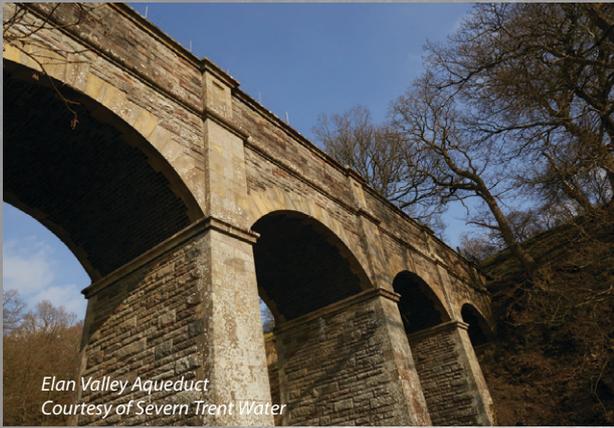
8 potential route corridors were appraised - Courtesy of Jacobs



Preferred route corridor (late 2014) - Courtesy of Jacobs



Elan Valley Aqueduct - showing 4 parallel pipes where the aqueduct crosses a river in siphon - Courtesy of Severn Trent Water



Elan Valley Aqueduct
Courtesy of Severn Trent Water



Pilot plant - Veolia Actiflo plant container
Courtesy of Severn Trent Water



Pilot plant - chemical dosing pipelines
Courtesy of Severn Trent Water



Pilot plant - river intake monitors
Courtesy of Severn Trent Water

new River Severn supply plus smaller amounts from local borehole and reservoir sources as well as the Strategic Grid. Whilst all are treated to the same high drinking water standards, these waters will exhibit a different hardness to EVA water and possibly, to some customers, a slightly different taste. Modelling, understanding and mitigating these effects, together with liaising with affected business and domestic customers, forms part of the associated *Operational Readiness* project and is absolutely key to successful delivery of the overall outcome.

ambitious project the company has undertaken. The department's motto; *'Investing efficiently for our customers, leaving a legacy to be proud of'* is nowhere more in evidence.

The Birmingham Resilience Project team is acutely conscious of both the legacy that will be left and the legacy the team is helping to protect; that of the remarkable pioneering engineers and politicians that had the skill and foresight to create an asset that transformed lives in 1904 and remains vital to this day.

Conclusion

At £242m, the Birmingham Resilience Project is not only the largest project in Severn Trent's AMP6 capital programme but also the most

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