

Lilleshall Nitrate Improvement Scheme

providing a water treatment plant
at Redhill Reservoir in Telford

by Natasha Kharbanda MEng

The Lilleshall Borehole Nitrate Improvement scheme is a £5.6m project to provide a water treatment plant at Redhill Service Reservoir in Telford, Shropshire. Existing treatment facilities were decommissioned at the three boreholes feeding the reservoir, with nitrate removal, disinfection and plumbosolvency dosing successfully installed within the existing reservoir site boundary. The new plant has been designed to treat 13.8ML/day, supplying water to 22,000 people in Telford. The design and build project has been delivered by Mott MacDonald Bentley (MMB) on behalf of client Severn Trent Water.



Pouring the slab foundation for the new NRP building at Redhill Service Reservoir in Telford - Courtesy of Mott MacDonald Bentley Ltd

Investigation

The site presented significant challenges to the design and build team due to the presence of a Scheduled Ancient Monument (SAM) and Great Crested Newts within the site boundary. Considerable upfront investigative works were coordinated by MMB to obtain the permissions required for working in a Scheduled Ancient Monument Area. MMB and Worcestershire Archaeology undertook a two-phased archaeological investigation to recover the extent of Roman remains which included over 100 pieces of metalwork. The Principal Inspector of Ancient Monuments for English Heritage commented that; *'The investigation was a very good example of archaeological investigation and mitigation required to facilitate the development of a necessary infrastructure project.'*

Project scope

The Lilleshall project incorporated the construction of a new ion exchange nitrate treatment plant, comprising a pre-fabricated process plant within a steel framed building, approximately 30m by 11m and 7m high, with the installation of orthophosphoric acid dosing within a separate kiosk. An access road and concrete turning area, constructed utilising fibre reinforced concrete, was

provided to facilitate chemical delivery. A gabion wall delivered a cost effective solution to the problem of retaining the adjacent steep ground.

A new 450mm delivery main was constructed to connect the borehole rising main to the new plant and an existing resilience connection was used to return flows to the reservoir. As well as the installation of pumps, pipework, tanks and electrical control equipment both within and outside the new building, twin waste disposal pipelines off site, each 150mm in diameter and 800m long were constructed. The works also included installing a new borehole pump at a remote borehole site (Lilleshall) and modifications to the electrical controls at Edgmond Bridge Borehole.

Design

Collaboration between MMB, and their subcontractors, ACWA and IIES in process design was vital to the success of the project. Early design orders in outline design, ensured there was sufficient detail for target costing. Hazard and operability studies (HAZOP) early in the design phase were key to finalising the process, enabling the M&E design to progress on programme.



Erection of the structural steel portal frame building - Courtesy MMB Ltd



Erection of the structural steel portal frame building - Courtesy MMB Ltd



Construction of the new NRP building structure - Courtesy of MMB Ltd



Installation of the south cell inlet pipe works - Courtesy of MMB Ltd

Collaborative design of the building layout was undertaken between MMB and ACWA, utilising 3D modelling technology to determine the optimum layout within the treatment building. The model was instrumental in obtaining stakeholder buy-in to the final solution and ensuring that the Severn Trent wholesale operations team was happy with access to all of the pumps and equipment for future maintenance.

The MMB team programmed the work to ensure that the learning from a previous nitrate removal scheme at Shiffords Bridge was taken forward to the Lilleshall scheme. Crossover in the design team, and the same construction team and site manager, who was awarded the CECA Site Manager of the Year award for his work at Shiffords Bridge, ensured the lessons learned were implemented and many of the difficulties experienced, particularly in commissioning and handover were eliminated through this prior knowledge.

Construction

To facilitate safe access and egress for construction traffic, visibility splays and improved site access were instigated as an early construction activity. A temporary road was successfully accommodated within the site boundary despite initial concerns that a temporary access road would be required through an adjacent field, which would have required further external negotiations with time and cost implications.

It was a particular challenge for the delivery team, given the constraints of the site, to ensure that clear, safe access to the existing processes was available at all times for the Severn Trent operators.

The team created an additional site track to enable site activities to be completed in a safe manner, with the use of the road able to be changed on a daily basis to facilitate varying requirements. This was communicated via signs on gates and a collaborative 'comm cell' board showing how activities will progress over a number of days/months. This practice of mapping out access and forward planning started with the archaeology investigation, and due to its success at maintaining safe access to the site, this continued with other subcontractors as construction progressed.

During this period, main pipework connections to plumb the nitrate plant into the reservoir were undertaken following planned shutdowns, with collaborative agreements into sequencing of connections through diligent risk and contingency planning. Upfront trial holes were used to confirm the complex pipework configuration and enabled a detailed 3D pipework model to be drawn up during detailed design.

The accuracy delivered by the model significantly reduced the risk of dealing with unknown buried services and significantly reduced the required pipework and temporary works requirements, saving money whilst increasing safety on site. Reducing the size of the excavation from the initial estimate of 12m by 6m to just two trenchboxes and a shallow trench was an excellent result.

Another interesting aspect was the use of directional drilling under the Roman road Watling Street to facilitate extension of the waste pipeline to the sewerage system. The dual mains were drilled to prevent damage to the underlying archaeological features and to maintain access for traffic, and no disturbance was caused.

The client was particularly complimentary of the design and commissioning of the SCADA systems and radio communications, adopting this approach as a model for Severn Trent standards for AMP6.

Sustainable urban drainage system

The project also incorporates a sustainable urban drainage system (SUDS), with 65m³ storm attenuation positioned under the new access road to meet requirement for greenfield run off rate. In

In addition to this, approximately 2,000m³ excavated spoil was both reused on site and delivered to local farmers for reuse, with no excavated material sent to landfill, further fulfilling the projects' sustainability credentials.

Archaeology

The archaeological interest on the site relates to the Roman settlement *Uxacona*, and the area of the proposed nitrate removal building was the location of a complex of Roman camps and a civilian settlement. Liaising with English Heritage and Shropshire County Council, MMB designed a Phase 1 trial trenching investigation covering 5% of the land area to be developed to determine its archaeological value. Numerous pieces of high quality Roman metalwork and pottery were located indicating that the whole site, not just the SAM, showed great archaeological potential. The archaeologist commented that the finds were some of the best quality he had encountered.

MMB endeavoured to reduce the impact to the SAM even after permission had been granted for the works to proceed. For example, initially a gabion retaining wall was designed to allow the new access to be constructed; however this was designed out to allow the ground to be sloped to minimise any disturbance. Also, the site compound was to be located on the SAM due to restriction on available land space within the site boundary; however the planned footprint was reduced and the compound was located on the existing car park instead.

MMB and Worcestershire Archaeology collaborated to design and implement the 8 week Phase 2 investigation to remove artefacts and record features of interest prior to the start of construction. The works were sequenced by drawing a series of sketches in a team meeting to reduce impact of the excavator on the archaeological features and avoid disturbance to the 525mm water main delivering supply to Telford. Roman metal work, pottery

and evidence of a potential fort not previously identified were all excavated. All construction work within the SAM was undertaken under an enhanced watching brief, with the archaeologist present for all stages of work.

Third party stakeholders

The team undertook renegotiations with Natural England to utilise an open cut solution rather than directional drill the dual waste pipeline through the adjacent field, significantly reducing the risk of damage to the land drains which was a significant concern to the landowner. The success of the renegotiations was based on the fact that no newts were found when newt trapping in the site boundary was initiated. Regular consultation was established with the farmer to design jetting and rodding points in his field to minimise the disruption to his ploughing activities.

To add to the many stakeholders, the site is also directly adjacent to a crematorium. Consideration had to be given to visual aspect of site set up (not in direct view) and noise surveys were undertaken to understand how intrusive the site activities were. In addition to this, our site foreman visited the crematorium manager daily to understand service times so as not to create unnecessary noise that would disrupt the sensitive facility.

Conclusion

The efforts of the combined delivery team ensured that the December 2014 DWI Regulatory was achieved on time and the project has been delivered within the agreed target price. The project presented a number of significant challenges to the team, all of which were overcome to successfully deliver this strategically important project for the area of Telford.

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Completed new water treatment facility - Courtesy of Mott MacDonald Bentley Ltd