

Blagdon Pumping Station and Intake Upgrade

Victorian pumping station refurbishment within a Site of Special Scientific Interest

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The Blagdon Reservoir is surrounded by the picturesque Mendip Hills, an Area of Outstanding Natural Beauty (AONB). The lake covers over 200 hectares and its long narrow shape with plenty of points and promontories has made it renowned among anglers for the trout fishing. The lake was built at the turn of the last century (1902) to supply water to Bristol and the surrounding area and is classified as a Site of Special Scientific Interest (SSSI) by Natural England for its wildflower meadows and native bird population. The reservoir is key to Bristol's water supply; its location 16km south of Bristol allows it to supply several different treatment facilities, ensuring resilience to the Bristol Network. Each year the pumping station supplies approximately 13,000ML of raw water to the southern treatment plants, which in turn helps supply Bristol Water's 1.1 million customers.



Existing Pumping Station - Courtesy of Bristol Water



Blagdon Reservoir - Courtesy of Bristol Water



Steam beam engine at the Blagdon Visitor Centre
Courtesy of Bristol Water

Existing pumping station

The existing pumping station is housed within the Grade II listed Victorian building. One of the original beam engines remains in working order within an adjacent section of the building and is open to the public on visitor days. The pumping station consists of 3 (No.) (centrifugal split case) fixed speed pumps arranged duty/assist/standby. The pumps deliver a maximum of 40ML/d and are supplied from Blagdon Reservoir by either a siphon system or a gravity fed tunnel.

The station is over 60 years old and as a result, the pumps have reached the end of their operational life by some margin. When a repair is required there are long lead times and high costs involved as the pumps are obsolete and consequently spares are

unavailable. Replacing the pumps was not an option as the position of the existing pumps above the suction pipework puts the pumps at risk of cavitation at high flows. Further to this there were some fundamental health and safety upgrades required particularly with the control switchgear and the confined spaces areas around the pump suction pipework.

New pumping station design

It was imperative to find a design solution that did not impinge on the site's current operation as a pumping station, visitor centre and fishery. Atkins engineering, environmental and planning teams worked closely with Bristol Water to develop an outline design and programme that was sensitive to the historical and environmental nature of the site without compromising on engineering.

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During the project's feasibility stage, several options were assessed based on environmental and economic criteria. Converting a section of the existing Victorian building, once used as coal store was chosen for its limited impact on the environment and existing site.

Parsons Brinckerhoff completed the structural design for the conversion of the old coal store to facilitate the installation of 3 (No.) 355kW SPP (duty/assist/standby) split case vertical pumps at basement level with sufficient ventilation to allow full access without confined space restrictions. The pumps will have variable speed drives capable of delivering a maximum flow of 45ML/d. The new control system will give a much greater flexibility and enable a tariff control regime to increase energy efficiency and reduce operational costs.

The new pumping station will provide greater supply resilience by allowing the pumping station to accept water directly from two springs (up to 20ML/d) and also boost water between raw water facilities up to 90ML/d west to east.

The raw water network consists of large sections of c.100 year old cast iron main that are sensitive to pressure fluctuations and overpressure which in the past has resulted in catastrophic longitudinal bursts. Black & Veatch carried out the surge analysis and provided recommendations for surge suppression and safe working pressures within in these mains.

Quantum Engineering Developments (QED) will supply and install 2 (No.) new surge vessels (suction and delivery). The installation will have sufficient control and adaptability to ensure the system and alarm set points can be altered as pipework is replaced to accept higher pressures, and the pumping station delivery pressures are subsequently increased.

New intake design

During summer months, algae blooms occur causing water quality to drop to untreatable levels. The new siphon system will have three intakes positioned at different levels within the reservoir for greater flexibility and resilience as well as reduced treatment costs.

Due to an Environment Agency requirement for the protection of eels, 2.0mm static screens will be installed to prevent eels being drawn into the intakes. To prevent the screens binding a *Hydroburst* air scour system by Johnson Screens has been selected to scour residue from the screens.

On start up the priming system will lift water up to 7.5m to establish the siphon, then at full flow (45ML/d) the priming system will need to establish -8.5mH₂O to account for static and dynamic losses through the pipework and eel screen. The priming system will consist of vacuum pumps and eductor (duty/standby) with priming vessels to allow entrained air to be released from the system without breaking the siphon.

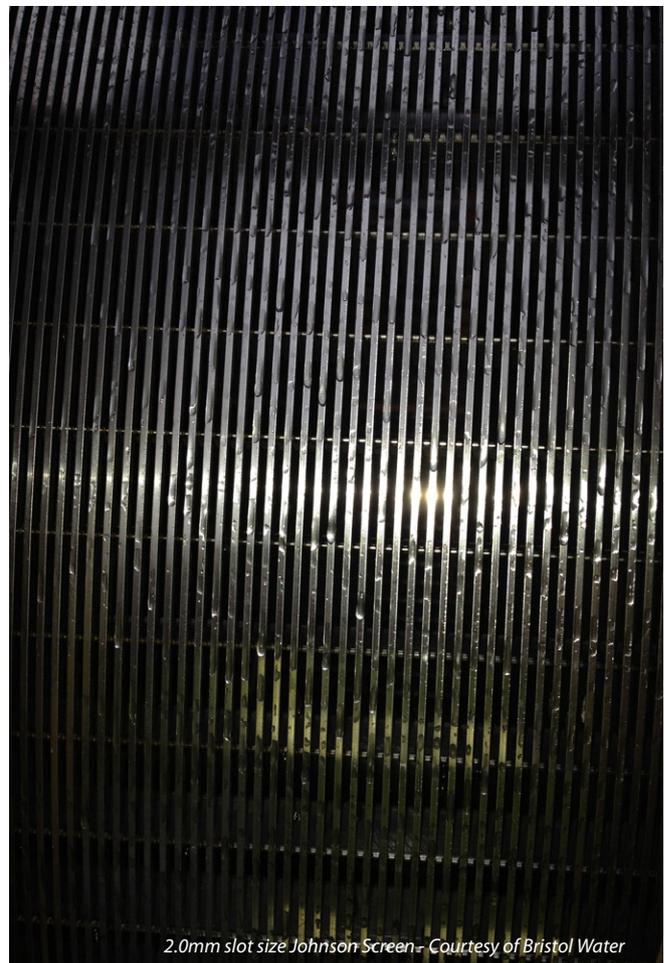
The high-pressure motive water passing through the eductor will be taken from the new pump's delivery discharge. Although the vacuum pumps and eductor will perform the same duty, the eductor system will be used preferentially due to the relatively low maintenance and running costs.

The pumping station will retain the facility to draw water from the reservoir via the existing tunnel outlet. The tunnel outlet will be used as a standby system should the siphon intake be out of operation due to routine maintenance or low reservoir levels.

Within AMP6 there is scope to replace the tunnel with a draw off tower. This makes operation of the new siphon system at the lowest water levels in the reservoir imperative to the operation during its construction phase.



*SPP split case pump during factory acceptance testing
Courtesy of Bristol Water*



2.0mm slot size Johnson Screen - Courtesy of Bristol Water



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Blagdon is an Environmentally Sensitive Site
Courtesy of Bristol Water



Structural beams removed allowing access to basement for the new pumps - Courtesy of Bristol Water



Existing delivery surge vessel to be decommissioned
Courtesy of Bristol Water



Existing Blagdon Pumping Station - Courtesy of Bristol Water

Undertakings

Balfour Beatty Regional Civil Engineering (BBRCEL) is the principal contractor for the project with Balfour Beatty Solutions contracted as the detailed design consultant.

Bridges Electrical Engineering Ltd is the principle sub-contractor for the design of the electrical, ICA and HVAC systems as well as carrying out the M&E fit out of the equipment in the new pumping station with the exception of the pumps, which are to be installed by their respective manufacturer SPP Pumps.

Environmental and architectural issues

Any changes to the external appearance of the buildings require planning approval and Natural England has strict criteria in place for the construction programme to ensure native flora and fauna are not disturbed as well as local wildlife.

The Blagdon site is an environmentally sensitive site with sections of the grassland recently displayed at the Chelsea flower show. Consequently special construction techniques have been developed to preserve the species rich grassland and their root systems.

The methodology to preserve this grassland is for 300mm grass and sub-soil sections to be lifted and placed onto teram covered pallets. While the 300mm grass sections are out the ground they are to be watered and frequently checked to ensure that they will not die.

Project process

The project to date has seen a lengthy detailed design phase, due to the complexity of the design and number of stakeholders. As the works being carried out are on a raised reservoir and its embankment an independent panel engineer from MWH was used to approve the design with a supporting engineer from HR Wallingford and in doing so, ensure reservoir safety throughout the design phase.

With the rain over the winter months filling Bristol's reservoirs, it has significantly increased the amount of works that will be to be completed by divers and barges. Parsons Brinkerhoff has completed the siphon pipe work design.

A concrete mattress is to be laid onto the existing reservoir granite setts to ensure that the pipework supports will have firm foundations to which concrete filled bags will be used as pipework supports.

Once the construction phase is complete, the environmental action plan will be started to ensure no lasting effects of the construction activities remain, most notably a major tree planting programme.

Programme

The detailed design is in the final stage with much of the preparatory construction works already in place with all structural modifications to the existing Victorian building completed with the pumps and pipework ready to be installed.

The new suction and delivery pipework will be laid over the next month and siphon building will commence late June.

Commissioning

Commissioning period is scheduled to start in late August with the completion of the whole project including decommission of the existing station set for late 2014.

The Editor & Publishers would like to thank Matthew King, Project Mechanical Engineer with Atkins (seconded to Bristol Water), Andrew Fenwick, Senior Mechanical Engineer, and Ben Davis, Senior M&E Project Manager, both with Bristol Water, for providing the above article for publication.

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