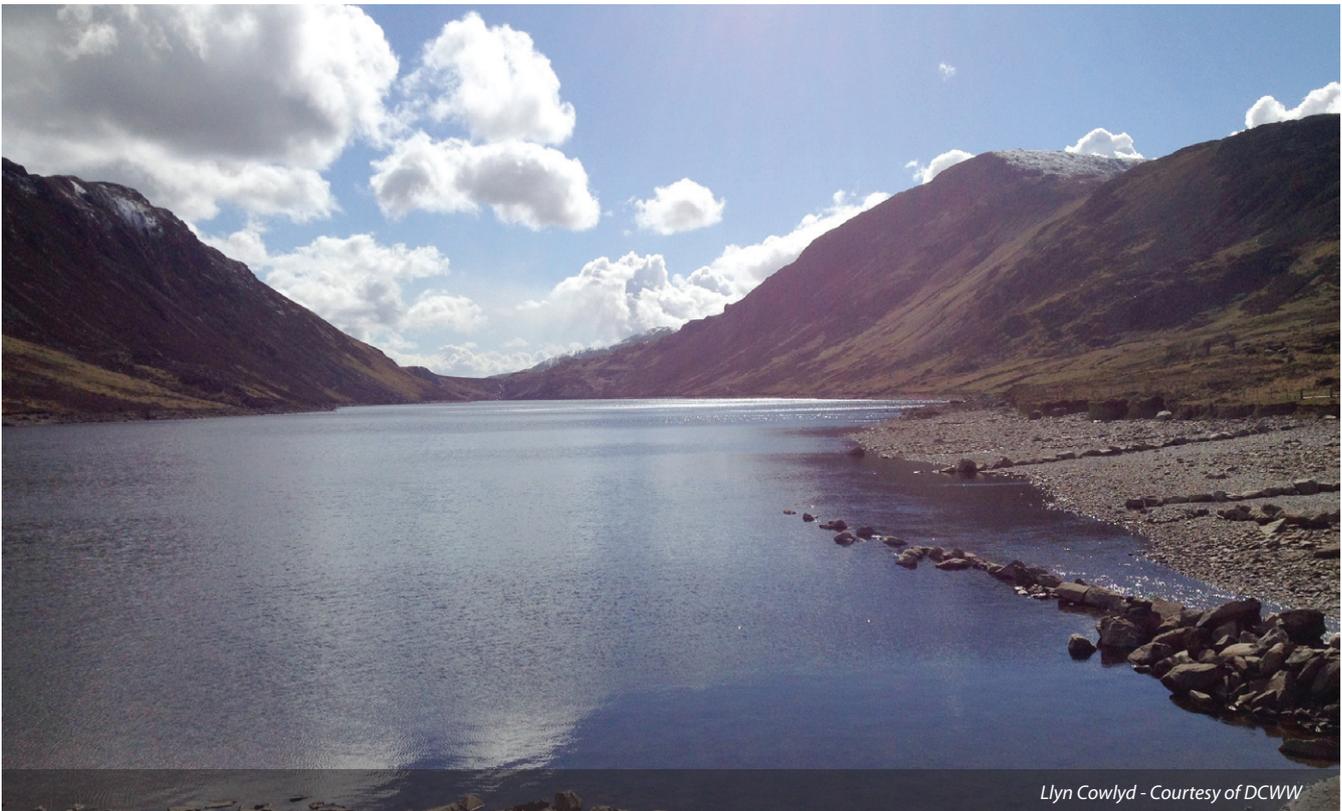


Bryn Cowlyd WTW

Welsh Water's £31m AMP6 investment to improve dissolved organic carbon removal and reduce disinfection by-products

by Rory Jones BEng(Hons) IEng MICE

Welsh Water's Bryn Cowlyd Water Treatment Works (WTW) is located near Dolgarrog village in the Conwy Valley. The site sits on the eastern side of the Carneddau mountain range on the outskirts of Snowdonia National Park. The existing works on the site was commissioned in 1998 and can deliver up to 46MI/d of clean water to nearly 100,000 people in the Conwy Valley and across parts of the north Wales coast. The works is gravity fed with raw water from Llyn Cowlyd, which is located 350m above the works in the Carneddau mountain range. The £31m investment work on the site includes a new coagulation and filtration treatment process to improve dissolved organic carbon (DOC) removal and reduce disinfection by-products (DPBs).



Llyn Cowlyd - Courtesy of DCWW

Existing works

Construction work on the current treatment works started in 1996 with the site commissioned in 1998. At the current works, raw water is fed under high pressure to the granular activated carbon (GAC) filters, with ozone dosing pre GAC filters. Kalic (Lime) is dosed for pH control, UV and chlorination for disinfection, re-carbonation and phosphate dosing is carried out for plumbosolvency control. The treated water is transferred, still under high pressure, to an off-site treated water reservoir on the opposite side of the valley (giving the required contact time) where additional UV reactors de-activate cryptosporidium. Ammonia can also be dosed for chloramination. The original design of ozone and high pressure GAC filtration was selected to eliminate the requirement for costly re-pumping and is unique in Wales.

Design - undertakings

The design of the expansion to Bryn Cowlyd WTW is being carried out by Arcadis (previously Hyder) with some early feasibility studies carried out in partnership with Mott MacDonald Bentley (MMB). The value of the design package is £1.8m and includes the design of all aspects of the project.

Pilot trials

Jar tests were carried out in the spring of 2014 to evaluate the most effective form of coagulation for the new WTW. The jar tests confirmed that ferric sulphate was the most effective coagulant for organics removal, achieving 62% reduction in dissolved organic carbon (DOC) levels.

Following the initial tests, further jar tests and a pilot trial were then carried out up until spring 2015, demonstrating that there could be up to 90% reduction of trihalomethane (THM) precursors, with the ferric sulphate dose and pH conditions observed in the jar test. The pilot plant, showed that although direct pressure flocculation and filtration using ferric sulphate could achieve promising results, it is not sufficiently robust to be progressed any further.

Design details

The new WTW requires an extension to the total footprint by over 100%, with proposed process upgrades including hydrogenation dissolved air filtration (DAF), rapid gravity filter units (RGF), sludge handling, new chlorine drum store, chlorinators, generators and a high lift pumping station. The design team was immediately



The site flooded on Boxing Day of 2015 - Courtesy of DCWW

presented with challenges of how to efficiently utilise this high pressure within the proposed process upgrades while providing the best value to the client. Thus the design also incorporates the use of a 500kW hydro turbine on the inlet to the DAF, ensuring the operational treatment works reduces its carbon impact.

A further challenge to the design team is the location of the existing asset; it is situated on the southern bank of the Afon Ddu, approximately 600m from its confluence with the Afon Conwy and the entire site is located on the tidally influenced flood plains of both rivers. It is imperative that the site is fully secured and protected from flooding, while remaining fully operational during extreme flood events.

These challenges presented potential hold ups to a very tight design programme. The co-located Arcadis-Skanska teams quickly developed, working as a single entity within a BIM environment; utilising innovative approaches, including the latest 360 immersive technologies and virtual solutions to mitigate any risk and improve value whilst offering a flexible resource to react to changes in scope or programme.

Third party consultations

The project team have been very aware of the fact that two major construction projects have been undertaken in the local area within



Use of the Igloo (360 immersive technology) - Courtesy of DCWW

recent years, which have caused disruption to the local community. As a result of this, the team would like to cause minimal disruption and demonstrate construction best practices.

Welsh Water and the capital delivery alliance team have been proactive in engaging with the community. Together they have issued quarterly update newsletters to residents in the local area, held information meetings with local residents and attended meetings with the local residents association.

The Welsh Water education team has also been into the three local schools to carry out water engineering workshops; this has enabled them to provide as much information as possible on the project to the local community and also listen to feedback and concerns.

Local community councils, County Councillors, the local Assembly Member and Member of Parliament receive regular updates on the work and site visits. The local schools are also kept informed of work on site as well as construction movements.

The main concern of the local residents is the volume of HGV traffic movements and the associated increased safety risk; so the project team has put some stringent control measures in place. The first control measure implemented was a voluntary embargo on mass HGV movements past the local schools, during pupil pick up times.



Overview of site - Courtesy of DCWW



*Cutting the turf on site with the local councillor and MP
Courtesy of DCWW*



*Skanska sub-agent discussing site weekly activities with Welsh
Water operations team - Courtesy of DCWW*

Traffic marshalls were also posted at narrow sections of the road, during mass movements of HGV's to try to alleviate any congestion caused by two HGV's passing in opposite directions at the same time. Speed monitoring equipment has also been used by the site team, to ensure that all HGV movements to and from site are adhering to the highway speed limits. The project team has worked closely with the supply chain (e.g. hauliers), to implement best practice including pre-induction of drivers and numbering of wagons prior to arriving on site; these rules are then enforced, with a no tolerance policy.

The team has also carried out engagement work within the community; one such example was the sale of logs for the charity WaterAid. Logs from the trees cut down as part of the site enabling works were then offered to the local community for a donation to WaterAid.

Construction

The new Bryn Cowlyd WTW project is deploying the latest in new technology and innovative construction methods to deliver £24m of construction activities in a very tight programme and meet the DWI deadline. The Skanska site team is taking the Welsh Water Capital Delivery Alliance ethos and implementing it throughout the project with all subcontract partners, with the aim of making a more collaborative project team. This is done by early engagement with

all subcontract package winners, to try and plan each package of works to a greater level of detail and ensure the transition between packages of work are smooth.

This ethos, combined with the increased use of off-site manufacturing of elements of the works, means there is less time spent on site, meaning reduced risk in terms of health, safety and the environment. It also brings with it an improved level of quality control and reduced level of wastage (LEAN), especially with elements such as the pre-cast concrete units being used throughout the RGF and DAF structures rather than traditional cast-in situ methods.

The project team is faced with huge challenges in terms of the ground conditions on site, with the site being located in the middle of a flood plain, with extremely soft ground, mixed with fluvial/ boulder material. Nearly 1,500 CFA and soil displacement piles are being used for the foundations of the buildings; installation of the continuous flight auger (CFA) piles is presenting some extreme challenges for engineers on site.

Skanska (Civil Engineering) and their sister company Skanska Cementation have worked very closely to overcome these issues and are deploying LEAN techniques on site to reduce the amount of standing time when obstructions are encountered.



Overview of site - Courtesy of DCWW

Poor ground conditions are also creating major challenges for the Skanska temporary works design team, who are in the process of designing the cofferdam for the RGF structure.

The Skanska project team has also engaged with the clients operational teams at an early stage, in order to try and overcome any foreseen issues; working in a more collaborative manner the teams can foresee any access or interface issues between the work on site and the operational treatment works.

Environment

With the site located on the outskirts of Snowdonia National Park, the project team is extremely keen to preserve the beauty of the surrounding area and its wildlife.

Extensive up-front discussions took place with the local planning authority and Natural Resources Wales regarding planning, ecology, biodiversity enhancements, discharging of groundwater, working within the floodplain to ensure compliance with environmental legislation.

Environmental compliance for the project is managed by a comprehensive environmental management system which will support the project's aims of zero environmental incidents and prosecutions. In addition to the high level environmental management plan, the project has bespoke environmental plans which include a flood action plan, bio-security risk assessment for invasive species, dewatering plan, to assist the project with achieving this target.

The team erected bat and bird boxes around the site, and once construction is complete an extensive landscaping scheme using native plants will improve the biodiversity of the area and replace any net loss caused by the felling of trees to facilitate the building of the works.

Logs from the felled trees, were either used to create hibernacula's around the site (to help create a habitat for amphibians and reptiles) or sold to raise money for WaterAid.

Reducing CO₂

In a bid to reduce the amount of CO₂ produced by the project, the project team looked at opportunities to reduce the environmental impact of the project.

A large site set up was required, and it was predicted that over 35,000T of aggregate would be needed to ensure a safe site set up. Instead of using virgin materials, the project team identified that 'quarried slate waste' from the local slate industry would be suitable.

Discussions took place with a local slate quarry, who confirmed that the slate aggregate was appropriately graded (6F5) meaning it would be a suitable material for the application in question. By utilising this Welsh slate waste, the project has significantly reduced its impact on the environment by moving away from unsustainable, finite virgin materials. This decision ensured cost saving of £210,000 and enabled the project to support the local supply chain.

Other CO₂ savings include the design team reusing excavated spoil on site to construct the flood bund, which is needed to surround the site, and the project has worked closely with a local waste contractor to ensure minimal waste is sent to landfill by separating at site predicted waste streams.

Progress

Construction work on the new water treatment works started in January 2016 and is scheduled to be completed by December 2017.

The editor and publishers would like to thank Rory Jones, Sub-Agent with Skanska UK, for providing the above article for publication.



Bat and Bird boxes installed in trees around site - Courtesy of DCWW

*Rory Jones of Skanska (right) transferring the logs to local resident Giovanni Jacovelli (left), with Welsh Water North East Distribution Manager and WaterAid Representative Oliver Malkin (Centre)
Courtesy of DCWW*

