Clifton Wastewater Treatment Works (WwTW) Integrated Constructed Wetland
Clifton Sewage Treatment Works, Off Common Lane, Clifton, South Yorkshire S66 7RF
Yorkshire Water, Stantec, Barhale Doosan JV

BIG Biodiversity Challenge Award Category: *Innovation Award*

Project overview

Clifton WwTW Integrated Constructed Wetland, a low energy, environmentally friendly method of wastewater treatment – the first in England to treat all flows and the first ever Biodiversity Net Gain positive WwTW. Operational carbon saving 79%, embodied carbon saving 50%. 24,000+ plants used to create an innovative, low carbon, nature-based solution.

What were the biodiversity conditions on site, prior to the enhancement?

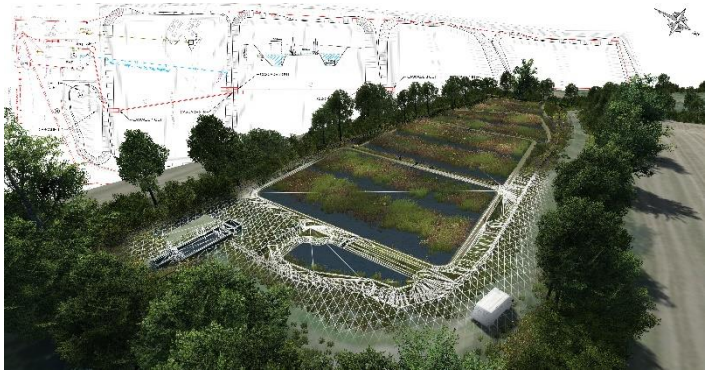
This project forms part of Yorkshire Water's (YW) £900M 5-year Asset Management Plan (AMP7) to deliver nutrient reduction (Phosphorus) measures at 80 regional wastewater treatment works.

YW, strategic solutions partner, Stantec and the Environment Agency (EA), with contractors Barhale-Doosan JV, created a Nature Based Solution (NBS) to replace an existing conventional wastewater treatment process, serving the village of Clifton, south Yorkshire.

The 4000m2 site had a natural fall towards the beck. Ground conditions consisted approx. 0.5-1m of boggy, nutrient rich topsoil overlying 4-5m of clay.

The EA granted the first ever constructed wetland Operating Techniques Agreement (OTA) in the UK.

Aerial View of Clifton WwTW Site before construction



Clifton integrated constructed wetland concept design

What were the reasons behind this project ?

Clifton WwTW integrated constructed wetland (ICW): a low energy and environmentally friendly method of wastewater treatment -the first of its type in England treating all flows.

This project has demonstrated both performance and gain, adjacent a more conventional solution. It brought together international expertise to deliver one of the first Biodiversity Net Gain (BNG) positive WwTW. Impressive operational carbon saving of 79% and embodied carbon saving of 50%.

No chemicals are used on site and solar energy is used to power flow monitoring devices. The surplus construction area has been transformed into an adjoining ecological habitat.

Clifton WwTW Integrated Constructed Wetland - Planting completion

What were the biodiversity measures taken? (Cont. overleaf)

The ICW comprises of open water ponds and shallow vegetated marshes providing a complex mixture of aerobic and anaerobic environments to sustain a diverse population of microbial activity and plant life.

Wastewater treatment within ICWs is achieved by a combination of filtration, biological treatment, sedimentation, plant absorption, and adsorption to sediment and plant surfaces. The ICW is a fully passive process with flows gravitating through the system with no automatic control elements.

Clifton ICW sequence consists of 5 № ponds and an existing primary settlement tank. Treatment process utilises an existing primary tank together with an open water deeper pond providing 24hrs of primary settlement, reducing the solids and organics load into the wetland cells by 15-20%.

Clifton WwTW Integrated Constructed Wetland - Spring 2022

What were the biodiversity measures taken? (Cont.)

Secondary treatment provided in the next two ponds work in parallel. Plant species in these are limited to fewer species which are more robust and can tolerate higher organic load. These focus on removal of Biological Oxygen Demand and nitrogen through filtration, sedimentation, and biodegradation processes.

The last two ponds incorporate a diverse array of plants chosen to provide tertiary treatment while also increasing biodiversity.

Clay bunds surrounding the ponds are covered with a geojute and planted to create a flower rich grassland helping stabilise slopes, creating additional biodiversity and aesthetic appeal.

The project achieved over an 80% reduction in operational emissions compared to chemical dosing and a 40% carbon reduction vs. traditional solutions. It lowers the amount of power needed, reduces "concrete" poured, avoids reliance on chemical supply chain and reduces lorry movements.

No waste was removed from site during construction, protecting local community from disruption and carbon emissions. An ecological wilding area was created and planted out, adjacent to site using surplus waste materials, bringing opportunity to engage with local schools, providing educational visits, to study wildlife and plant bug houses.

Creation of Ecological Natural Habitat Area adjacent to Clifton Integrated Constructed Wetland

Ecological Habitat Creation Area adjacent to Clifton Integrated Constructed Wetland

Further information

To create the complex biochemistry required for the wastewater treatment a team of geotechnical, ecologists, hydraulic and process engineers worked together to select the plants, determine hydraulic retention times, and engineered the ponds to achieve the maximum amount of contact between the wastewater and the wetlands.

Planted with over 24,000 wetland plants, the interconnected ponds stimulate wildlife diversity, achieving biodiversity net gain. The passive operation and use of nature-based treatment eliminates the need for energy-heavy chemical treatment processes.

The Environment Agency worked extensively with Yorkshire Water (YW) and Stantec supporting the use of clay as a natural barrier, encouraged the reuse of the nutrient rich topsoil for offsite habitat creation and most importantly, granted a flexible permitting condition for this site. A condition of the flexible permitting condition is that data is collected and used to inform designs of ICWs in the future.

The Clifton ICW project enhances its local natural environment and creates engagement opportunities for YW and the community.

The Clifton project enhances its local natural environment with a Biodiversity net gain of 2.28.

The Don Rivers Catchment Trust and the Local Parish Council have visited the site to find out more about the benefits it will deliver. Severn Trent Water and other water companies are visiting to see how they could apply the solution in their own areas. The site has also featured on BBC breakfast news and ITV's Calendar.

Planting 24k+wetland plants, the interconnected ponds stimulate wildlife diversity, achieving biodiversity net gain

Clifton WwTW Integrated Constructed Wetland - ponds engineered to achieve the maximum amount of contact between the wastewater and the wetlands

Project Team

- Client / funders: **Yorkshire Water**
- Other design team members: **Stantec, Barhale Doosan JV (Contractors)**
- Volunteer organisations: **Don Rivers Catchment Trust, Parish Council**

What was the motivation for carrying out the enhancement?

YW committed to achieve Net Zero carbon by 2030. They cannot rely on traditional, high carbon, chemical dosing methods to meet nutrient reduction requirements.

The Clifton ICW project enhances its local natural environment with a Biodiversity net gain of 2.28. Brings opportunity to engage local community, providing educational visits, to study wildlife and plant bug houses.

Created interest from academy to regulator designers to other water companies.

An intensive ecology and chemical monitoring programme will run for 3 years to enhance industry knowledge. Data is informing guidance on new NBS designs of which all collaborative project partners are extremely proud.

Visulisation of Clifton Integrated Constructed Wetland Scheme

Clifton Integrated Constructed Wetland Spring 2022