





## LIVING WITH WATER PARTNERSHIP, HULL, UK

### Sector

-  Arts, Entertainment and Recreation
-  Built Environment
-  Coastal Resilience & Climate Adaptation
-  Water

### Highlights

- Biodiversity
- Carbon mitigation
- Community engagement
- Ecological uplift
- Education
- Property protection

### Project owner

Living With Water

### Project start/completion

2020 - Ongoing

### Location

Hull, Northeast England

### Community impacted

Urban, Coastal, Rural

### Hazards mitigated

Water stress, Flooding

### Sharm El-Sheikh Adaptation Agenda

This project addresses outcomes from the Sharm El-Sheikh Adaptation Agenda within the Marrakech Partnership Water and Nature System.

### Number of people made more resilient

# 267,100\*

\*Kingston upon Hull population change, Census 2021 – ONS

[Find out more](#)



**Living With Water is a partnership between Yorkshire Water, Hull City Council, East Riding of Yorkshire Council, the Environmental Agency (EA) and the University of Hull, supported by Stantec. All stakeholders play an essential role in managing water in Hull and East Riding, and are collaborating to build flood resilience, develop innovative water management systems, and highlight the region as a great place to live, work and visit.**

### ABOUT THE PROJECT

Hull and Haltemprice are situated within a bowl-shaped zone with sloping topography leading to a flat, urban area; this causes rainwater to collect, triggering floods, with only 2% of the area considered not to be at risk from flooding. Flood risk is expected to increase as the population grows, urban creep decreases green space, climate change increases rainfall, and tide levels rise. Since 2007, there's been significant investment to reduce these incidents, however, to prepare and adapt to climate change, a collaborative, long-term vision is required. The Hull and Haltemprice Blue-Green Plan was commissioned to look uniquely through a long-term lens, reducing this flood risk. The plan takes shape, building upon Yorkshire Water's published [Drainage and Wastewater Management Plan \(DWMP\)](#), enhancing collaboration across industries and stakeholders. It provides the understanding of integrated sources of flood risk and how working in partnership can alleviate this challenge. The plan describes how blue (waterways) and green (vegetated) infrastructure can work together, improving flood resilience while enabling sustainable and healthy lifestyles and providing attractive places to live and work. Implementation of the plan will decrease flood risk as rainfall is managed at the source and the flow is slowed.

The research team brought in expert knowledge

Case study provided by:



from universities, consultancies, councils, and the Environment Agency (EA). Due to the complex and long-term nature of the plan, a wide range of digital tools were used to capture accurate information, including the [CIRIA BEST estimation tool](#), Light Detection and Ranging (LiDAR), OS Mapping and Sustainable Drainage Systems (SuDS) GIS tools. With a unique opportunistic approach, solutions were developed to be delivered in a phased approach with the ability to adapt as possibilities arise.

One of the primary objectives of the plan is to reduce flood risk by implementing natural flood management techniques. This includes the restoration of floodplains, the creation of wetlands, and the use of sustainable drainage systems to absorb and slow down rainwater runoff. Green infrastructure elements, such as green roofs, permeable pavements, and bioswales mimic natural processes, allowing rainwater to be absorbed into the ground rather than causing surface runoff. This reduces the risk of flooding, improves water quality, and provides additional greenery in the cityscape.

The plan also prioritises the restoration of natural ecosystems, such as wetlands, rivers, and green corridors. This enhances the resilience of these ecosystems by allowing them to function more naturally. Healthy ecosystems can better adapt to environmental changes and provide critical services like water purification and habitat for wildlife.

Climate-resilient planting and landscaping strategies, including drought-tolerant species, have been incorporated to help natural systems withstand the challenges posed by changing climate patterns. A focus on sustainable water management ensures the availability of water resources during periods of drought. This resilience is achieved by recharging aquifers, preventing over-extraction, and preserving water quality through natural filtration processes.

Deep public consultation has been undertaken to understand community needs and increase understanding of the plan. This included involvement with the Youth Parliament to include younger voices and community outreach events. The Hull and

Haltemprice Blue-Green Plan also enables educational programmes and initiatives to raise awareness about the importance of nature in urban living.

Community engagement and participation are key to ensuring that the plan's positive effects are widely distributed and inclusive. Educating residents about the importance of natural systems and involving them in conservation efforts builds a sense of stewardship and pride. Communities that are engaged in the preservation of natural systems are more likely to support and protect these systems in the face of challenges.

Using the CIRIA BEST tool, it has been estimated that there will be 160,182 visits for physical and emotional wellbeing per year to new or improved green spaces. It was assumed that 40% of the local population within the study area will live near or will intentionally pass through these areas. The plan has laid the foundations to be recreated in other areas and Yorkshire Water has planned 10 similar projects due to the results of the Hull Blue-Green Plan.

### INTENDED OUTCOMES

#### Social

By building and improving green spaces, such as parks and waterfronts, residents will benefit from an enhanced quality of life, access to recreational areas for leisure and relaxation, and healthier lifestyles. Moreover, the plan's flood mitigation measures ensure the safety of local residents, reducing the risk of property damage and displacement during extreme weather events and mitigating knock-on health impacts, such as physical and mental trauma, and skin and gut infections. Additionally, the promotion of sustainable transportation options, like cycling and walking paths, fosters healthier lifestyles and reduces traffic congestion and pollution, improving overall wellbeing. Access to green areas also reduces stress and promotes better mental health.

This plan provides learning opportunities for communities to become more familiar and

comfortable with water management. The region has 104 schools averaging 300-400 students each. Based on the data, it has been assumed that a minimum of 500 students will be engaged in school trips or activities related to the new blue-green infrastructure per year.

### Environmental

The plan also contributes significantly to environmental conservation. Through the implementation of green infrastructure and sustainable urban planning, it enhances biodiversity by creating habitats for local wildlife and preserving green corridors, allowing wildlife to move freely within the city. The Blue-Green Plan will achieve biodiversity net gain and designs will be developed to enhance the distinctiveness of areas. The use of sustainable building practices and green roofs helps to mitigate the urban heat island effect, reducing energy consumption for cooling. Moreover, the plan's focus on floodplain restoration and natural water management not only protects against flooding but also improves water quality and promotes sustainable water resource management. Natural

water management techniques, like restoring wetlands and creating floodplains, mitigate flood risk and serve as natural habitats for aquatic and bird species. They enhance water quality and contribute to the overall health of local ecosystems.

Specific attention has been given to designing spaces that cater to wildlife habitats, including incorporating areas for nesting sites for birds, bat boxes, and amphibian-friendly water features. Such elements contribute to the urban ecosystem's diversity and resilience. Incorporating nature into the urban environment in these ways not only enhances the quality of life for residents but also contributes to environmental sustainability and resilience against the impacts of climate change.

Air quality is also improved through green infrastructure and urban forestry elements, reducing pollution and improving the filtration of stormwater. The planting of trees and vegetation in urban areas including streets, pocket parks, and greenery along waterways not only improves air quality and provides shade but also supports wildlife and creates a more visually appealing urban environment.



Types of Source Control. Created for Living with Water by Stantec.

### Economic

The plan will result in 14,000 fewer properties flooding in 2080 and will deliver an expected £2.6bn in potential benefits to the community. It does this by improving the natural environment and making a more appealing area, both of which have a positive impact on property values. In addition, by placing an emphasis on sustainable urban planning, businesses are encouraged to make investments in the neighbourhood, which results in job creation and expansion of the local economy. Flood resilience measures also lower insurance claims and governmental expenditures that are related to flood

damage, which results in a cost-saving not only for residents but also for the government. This strategy promotes long-term economic sustainability for the region.

Other benefits include traffic calming, noise reduction, carbon sequestration, and energy savings through reduced pumping. Increased resilience ensures that communities are better equipped to adapt and recover from these challenges.

### How has carbon mitigation been integrated?

The Hull and Haltemprice Blue-Green Plan includes several carbon mitigation efforts aimed at reducing greenhouse gas emissions and combatting climate change. Expanding cycling infrastructure, creating pedestrian-friendly pathways, and incentivizing the use of electric cars reduce carbon emissions associated with conventional automobiles. Enhancements to public transportation systems, including the development of efficient bus routes and the expansion of public transit networks, encourage residents to choose eco-friendly transportation options, further reducing carbon emissions from individual vehicles.

The plan encourages the adoption of green building practices and standards. This includes energy-efficient building design, the use of renewable energy sources like solar panels, and improved insulation and ventilation systems to reduce energy consumption and carbon emissions from buildings.

Planting trees and increasing urban green spaces helps to absorb carbon dioxide from the atmosphere. Trees act as natural carbon sinks, sequestering carbon and improving air quality in the urban environment. Green infrastructure features like green roofs, permeable pavements, and bioswales also help to manage stormwater




effectively. By reducing the energy required for water treatment and transportation, these features indirectly contribute to carbon mitigation efforts. The plan also supports net-zero carbon targets through improved biodiversity and ecological uplift. Based on initial carbon assessments, the overall scheme's whole-life carbon emissions are less than the cumulative carbon required to recover from flooding without the scheme, i.e., it is carbon neutral in the long term.

Raising awareness about carbon emissions and climate change within the community can foster behaviour change. Educational programmes can encourage residents and businesses to adopt more sustainable practices, such as reducing energy consumption and minimising waste.

The plan's focus on climate resilience helps mitigate the future impacts of climate change, which is essential for reducing carbon emissions associated with climate-related disasters and their aftermath. Overall, the Hull and Haltemprice Blue-Green Plan employs a multifaceted approach to carbon mitigation, addressing various sectors and aspects of urban life to reduce greenhouse gas emissions and contribute to a more sustainable and climate-resilient community.

## CLIFTON WASTEWATER TREATMENT WORKS YORKSHIRE, UK

### Sector

-  Built Environment
-  Coastal Resilience & Climate Adaptation
-  Water

### Highlights

- Biodiversity
- Carbon mitigation
- Community engagement
- Community wellbeing
- Ecological uplift
- Waste reduction

### Project owner

Yorkshire Water

### Project start/completion

July 2020 – September 2021

### Location

Yorkshire, UK

### Community impacted

Urban, Rural

### Hazards mitigated

Flooding

### Sharm El-Sheikh Adaptation Agenda

This project addresses outcomes from the Sharm El-Sheikh Adaptation Agenda within the Marrakech Partnership Water and Nature System.

### Number of people made more resilient

# 180

[Find out more](#)



**Clifton Wastewater Treatment Works (WwTW) is the first nutrient-reduction Integrated Constructed Wetland (ICW) in the UK designed to treat all flows. It was created as an alternative sustainable wastewater treatment works, demonstrating performance and gain against conventional solutions. It has achieved an operational carbon savings of 79%, embodied carbon of 50% and 24,000+ plants used, creating an innovative, low-carbon, ground-breaking nature-based solution.**

### ABOUT THE PROJECT

As part of Yorkshire Water's £700M [Water Industry National Environment Programme \(WINEP\)](#), 80 regional wastewater treatment works require nutrient reduction measures. This is the largest and most complex environmental programme that Yorkshire Water has ever delivered. Yorkshire Water's commitment to achieving net-zero carbon by 2030, coupled with the challenging [Price Determination](#), means that the business cannot rely on traditional, high-carbon, chemical dosing methods to meet the nutrient reduction requirements.

Clifton WwTW ICW is the first nutrient-reduction ICW in the UK designed to treat all flows. The project's ambition was to create an alternative sustainable wastewater treatment works. It demonstrates both performance and gain against more conventional solutions and has made Clifton one of the most environmentally friendly villages in Yorkshire.

The Environment Agency (EA), BarhaleEnpure JV, Stantec, and Yorkshire Water worked together to create a nature-based solution to fully replace the existing conventional treatment process. Working extensively with the EA, Yorkshire Water was granted the first ever constructed wetland Operating Techniques Agreement (OTA) in the UK.

Case study provided by:



The EA and England and Wales Sewerage Undertakers are collaborating to utilise ICWs for wastewater treatment. This is with the aim of achieving water quality objectives, whilst reducing energy use and carbon emissions and obtaining additional benefits associated with nature-based solutions, such as increasing biodiversity and improving natural capital.

The primary aim of the ICW at the WwTW is to reduce phosphorus to achieve the WINEP limit for phosphorus, but there is uncertainty regarding the efficacy of phosphorus treatment provided by ICWs. Therefore, the EA has agreed that ICWs for implementing phosphorus removal should be operated under an OTA, as a flexible approach to utilise ICW technology to achieve WINEP phosphorus targets.

An OTA includes the WINEP target and sets out the monitoring and reporting requirements for the operator to demonstrate if the target has been achieved or not. It sets out the techniques that must be complied with as part of the conditions within the current Environmental Permit for a water discharge activity to discharge sewage and/or trade effluent from the WwTW and applies to the ICW.

Clifton comprises five ponds (over 3,000m<sup>2</sup>), with open water ponds and shallow vegetated marshes, providing aerobic and anaerobic environments sustaining 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 project aimed to achieve the EA phosphorus target of 4mg/l, with current performance on average being 1.8mg/l.

Unlike conventional treatment processes that use pumping and chemicals to treat the wastewater, the ICW is a fully passive process with flows gravitating through the system with no automatic control elements. The treatment process utilises an existing primary tank with an open water deeper pond providing 24 hours of primary settlement, reducing the solids and organics load into the wetland cells by

15-20%. Secondary treatment provided in the next two ponds works in parallel. These are limited to fewer plant species which are more robust and can tolerate higher organic load. These focus on the reduction of Biological Oxygen Demand (BOD) and nitrogen through filtration, sedimentation, and biodegradation processes. The last two ponds incorporate a diverse array of plants to provide tertiary treatment and increase biodiversity. Clay bunds surrounding the ponds are covered with a geojute and planted to create a flower-rich grassland helping to stabilise slopes, creating additional biodiversity and aesthetic appeal. The local clay environment is also harnessed to seal the wastewater activity and topography of the site to naturally aerate the wastewater, avoiding all need for pumping.

Clifton demonstrates that there is an alternative way, which can serve as inspiration for the industry. This ambition is already being embedded in national regulation and guidance and is being used to inform ICW use across the water sector, with lessons being shared with other water companies, regulators, and stakeholders and to help inform Price Review 24 (PR24).

### ACHIEVED OUTCOMES

Clifton has been operational and treating wastewater since November 2021, exceeding performance expectations. An intensive ecology and chemical monitoring programme has commenced, running for three years, enhancing industry knowledge, and informing guidance on new nature-based solution designs.

This project is also being used as a best practice model for the industry, shaping projects, regulation and innovation. These benefits have no bounds when it comes to reach, affecting community members, water companies, consultants, designers, local authorities, The Environment Agency, OFWAT, the UK Government, The Rivers Trust and other industry professionals. Clifton is a flagship project offering opportunities for research across many areas, including climate impact, and evapotranspiration,

and providing environmental, social, and economic benefits through influencing the industry.

Clifton improved the resilience of people through a systems-thinking approach. At its core, the project delivers water treatment naturally, avoiding the need for chemical dosing, while also breaking down matter on-site, mitigating transport measures and decreasing pressure on global supply chains.

At a higher level, Clifton is ensuring wider resilience as it is being replicated all throughout the UK and provides education opportunities through inclusion in [national](#) and [international](#) reports, as well as welcoming visitors from other water companies to the site, who are interested in developing similar solutions.

### Social

Community engagement has been an important aspect of the project; key stakeholders have been engaged with the aim of improving public understanding of the project and the challenges involved in decarbonisation. Letters were sent to properties in the local village outlining information on the project and benefits in comparison to traditional developments, and a tour was hosted for the local Parish Council. Additionally, an open day was attended by the Rivers Trust, local residents and local and national news outlets who promoted the scheme. OFWAT has visited the site and aims to encourage this type of solution in PR24. Water companies have also visited the site to understand how they can apply the solution in their own areas.

Directly, the people of Clifton will benefit from an improved wastewater treatment service, which has less carbon emissions than a conventional plant, provides educational opportunities and blends into the vista. Additionally, no waste was removed from the site, protecting the local community from disruption and carbon emissions, utilising a materials management plan under the [CL:AIRE](#) process.

### Environmental

The project utilises over 24,000 plants, offering biodiversity enhancements and creating resilience against climate change. Clifton enhances the local

natural environment with a BNG of 2.28. This is an improvement compared to a traditional activated sludge plant (ASP). Additionally, an ASP would also include significant amounts of concrete, which has been avoided.

Additionally, an ecological wilding area was created and planted adjacent to the site, using surplus waste materials. The flora and fauna in this area help to create natural climate resilience and have resulted in a second biodiversity net gain (BNG) habitat equal in size to the wetland. This habitat also enhances the climate resilience of local communities through engagement with schools and professionals and through providing educational visits to study wildlife and plant bug houses.

Being a fully 'green' solution and incorporating waste-reduction measures has also enhanced the resilience of the wider natural systems. This is done through promoting the use of nature-positive infrastructure over conventional 'grey' ones. It decreases the amount of power needed, reduces concrete poured, avoids reliance on chemical supply chains and reduces lorry movements.

Almost two years of performance data has shown that the target nutrient reduction concentration is being achieved. There are several academic studies programmed to continue informing the future of more sustainable water treatment. Since Clifton, another eight projects have adopted the nature-based design in Yorkshire Water and there has been interest from academics, regulators, designers, and other water companies. It is envisaged that up to 1,000 ha of wetlands will be created in the next decade, modelled on the Clifton design, and 40 designs are already in progress across the UK.

### Economic

Clifton WwTW ICW has also generated notable economic outcomes. The project was completed within budget, two years ahead of the original plan and with 35% lower costs than conventional building solutions and operational costs 64% lower over its lifetime. This cost-saving boosts economic growth through reinvestment of savings and passing savings onto the customer.

**It is envisaged that up to 1,000 hectares of wetlands will be created in the next decade, modelled on the Clifton design**



Cell 5 of Clifton Integrated Constructed Wetland, October 2023 © Yorkshire Water