

# Derringham Aqua Greens Project

## retrofit of SUDs solutions in a residential area of Hull which is susceptible to surface water flooding during storm events

by Fiona Booth & Jade Toulson

The topography in and around the city of Hull makes the city extremely susceptible to flooding. Derringham is a residential suburb to the west of the city, which was heavily impacted by the 2007 floods. Significant flood alleviation works are therefore required in the area to manage stormwater to prevent an event on this scale from having such an impact when it inevitably occurs again in the future. The Derringham Aqua Greens Project has been delivered by the Living With Water Partnership, Stantec and Mott MacDonald Bentley (MMB) to provide flood alleviation in the heavily residential area.



Aerial image of Strensall Road Aqua Green - Courtesy of Mott MacDonald Bentley

### The Living With Water Partnership

The Living With Water (LWW) Partnership was formed following the 2007 floods when 16,000 properties in Hull and East Riding were flooded. It became clear that no single agency accepted any responsibility outside of their own term of reference, but that each had a part to play in maintaining the waterways in the city of Hull which contributed to the floods. The partnership brings together Yorkshire Water, Hull City Council, East Riding of Yorkshire Council, Environment Agency and University of Hull to enable them to collaboratively deliver flood alleviation schemes in the city. The first of its kind in the UK, the partnership aims to reduce flood risk in high-risk areas, while combining blue-green principles to deliver sustainable, low carbon solutions, encouraging knowledge share between all parties, building community resilience, improving local areas by providing biodiversity net gain.

The partnership has proved paramount throughout the design and construction phases as collaboration between all parties has been needed throughout. This included having the expertise of Yorkshire Water on the technical elements of drainage design, discussions with Hull City Council on how highways will be reinstated, proposed planting arrangements and gaining access to council owned green spaces and collaboration with the University of Hull to incorporate the requirements for testing & monitoring equipment within the design from the start.

### Project scope

The principles of the project are to allow exceedance flows from heavy rainfall, for which there is no capacity in the sewer network or nearby watercourses, to flow above ground via existing road accesses between properties, into detention basins retrofitted into existing green spaces in the area. The stormwater can be retained away from properties and returned to the sewer network once there is available capacity and the network is no longer surcharged.

The road access, or '10fts', between properties are lowered to create a channel for stormwater to flow from the highway into the Aqua Green. A headwall and return sewer are installed from the low point of the Aqua Green, connecting into the existing sewer network in the main highway. Flows leave the Aqua Green under gravity, meaning that no mechanical or electrical elements are required for the operation of the solution. The lowering of the 10fts meant that property protection measures were required to the properties adjacent to the 10ft to prevent the solution resulting in them to be at greater risk of flooding. Existing boundary fences were replaced with new fence panels installed on concrete gravel boards to provide a waterproof barrier between the 10ft and the property.

Across the three Aqua Greens, over 1800m<sup>3</sup> of storage has been proved. With a traditional grey infrastructure project, providing the same storage would have had a much higher embedded carbon



measure, could not have been constructed in the small areas that were available and would have required some form of M&E installation with associated ongoing maintenance and running costs.

### Aqua Greens design

The concept design was carried out by Stantec, who produced a full hydraulic model of the whole area to determine where the highest flood levels are seen, to identify the green spaces that would provide the most benefit if they were developed. A total of 11 green spaces in the area were investigated, with cost benefit analysis carried out to establish which of those spaces would provide the most benefit for the community. Three sites were selected to be developed in the first Work Package (WP1) with a further three sites to be developed in Work Package 2 (WP2).

One of the main aims of the detailed design phase was to produce standard details that could be implemented at all Aqua Green sites, to streamline both the design and construction phases. As the return sewers and associated chambers were to be laid in the 10ft between two properties, a standard 1200mm precast concrete manhole could not be installed as there was not space to do so. A 1200mm x 750mm standard product was therefore developed and agreed with Yorkshire Water as it was a much safer and simpler install.

The overall project programme meant that long term groundwater monitoring could not be carried out prior to the design process for WP1. For design calculations, groundwater therefore had to be assumed to be at ground level, which resulted in flotation of the liner and as a result, an additional drainage later needed to be installed below the liner to prevent flotation.

During the construction of WP1, it was observed that the Aqua Greens were retaining water before the liner was installed and that the as clay of very good quality. For WP2, permeability testing and longer-term groundwater monitoring were able to be carried out. This determined that the natural clays were of higher impermeability than the geosynthetic liner and that the groundwater was not as high as was believed during the design phase for WP1. It was therefore discussed and agreed with all relevant parties that the additional geosynthetic liner did not need to be included on site. This saved a total of two weeks on the programme for WP2, approximately 60 tonnes of carbon, material costs of approximately £60,000 and removed the risk of delays associated with the liner install in wet weather.

Construction for WP1 was from October 2023 to December 2024, with works still progressing on the WP2 sites. Sole access to the green spaces via 10ft wide access tracks introduced some difficulties to the construction. Only small plant could be used and the 5m wide liner had to be cut to 2.5m for delivery to the greens. Limited space on site also meant that excavated materials could not be stored at the greens and had to be stockpiled at the site compound, requiring a significant number of dumper loads of materials to be moved on the local road network. The nature of the project and works commencing in winter meant the Aqua Greens frequently flooded during the construction, with water regularly needing to be pumped to the drainage network before further progress could be made.

### Community engagement

Due to the location of the Aqua Greens in such close proximity to residential properties, significant community engagement was needed throughout the project, during both design and construction phases, to ensure that the community were kept up to date with what the project would deliver, how the construction works would impact them and ultimately how the SUDs solution would operate and be maintained into the future. Over 30 engagement sessions have been held with the community to



### Derringham Aqua Greens: Supply chain - key participants

**Client:** Yorkshire Water  
**Principal designer & contractor:** Mott Macdonald Bentley  
**Outline design:** Stantec UK  
**Academic partner:** University of Hull  
**Local Authority:** Hull City Council  
**GCL liner & underdrainage:** SIG Construction Accessories  
**Headwall:** Marshalls Water Management  
**Hinged pole for testing & monitoring:** Fabrikat (Nottingham)  
**Pipework:** John Davidson (Pipes) Ltd  
**Flap valve:** Affco Flow Control (UK) Ltd  
**Surfacing:** Calder CAD Ltd  
**Landscaping:** Craven Forestry Limited



date, from the start of the design development to the end of the construction phase. This has been coupled with regular letters and updates on the LWW website, providing the residents with an opportunity to raise any concerns about the works as well as to help to convey the importance of flood alleviation in the area.

To aid conversations with the local community about the Aqua Green developments, computerised visualisations were produced which showed how the Aqua Greens would look upon completion. While the existing greenspaces were mainly neutral grassland before works commenced, the solution was to plant wildflower seeds in the greenspaces upon completion, to increase biodiversity of the area. To provide habitat for wildlife, wildflower areas are maintained less frequently than grassland spaces and this therefore needs to be portrayed to the residents. The visualisations also helped us to discuss the proposals with the residents to see if there was anything additional, they would like to see of change as part of the design. Some residents told us that they particularly liked the shrubs at the back of one of the green spaces as they provided them some security for their garden, so these were retained as part of the design. Others told us that the proposed parking areas would not be used and that they did not want to encourage parking on the green spaces, so these were reduced in width to just passing places on the narrow roads.

Continued engagement with the community has been needed throughout the construction phase to answer any queries that the residents had about the works and rectify any problems they had been experiencing. Upon completion of the Aqua Greens, permanent notice boards have been installed at each of the sites to inform the residents of the benefits of the Aqua Green.

### Continued testing & monitoring

The University of Hull have installed testing and monitoring equipment at all three of the Aqua Green sites in WP1 to understand how these Aqua Greens perform. The testing and monitoring equipment included soil moisture probes located above and below the liner; conductivity, temperature, and depth (CTD) probes in the return sewer and a weather station at a local school. The aim is that this data will be analysed and used to improve the design to enhance these assets for future installations. The weather station data is also accessible by the local school so that the data can be used for educating the students about the weather and flood risk of their local area and how we can safely live with water.

The intention is that further testing and monitoring equipment will be included on the WP2 sites so that a comparison can be made between the lined and unlined solutions to see if one of them is more effective at providing the required storage or improving the quality of the water that enters the sewer network.

### Summary

Since the installation of the first three Aqua Greens was complete, the benefits provided by the Aqua Greens has been visibly clear during periods of heavy rainfall, with quantitative data expected from the testing and monitoring installations within the next few months. These large-scale SuDS basins have provided flood protection to hundreds of properties in an area which otherwise would be at very high risk. Providing the protection via blue-green methods rather than traditional grey infrastructure has resulted in a solution with a much lower carbon impact, while also providing the areas with an improved biodiversity, making it a much more sustainable solution. The blueprint of this project, along with that of the Living With Water partnership, can be applied to other areas across the UK where properties are at high risk to deliver more types of these projects in the future.

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*Installation of the liner and underdrainage layer  
Courtesy of Mott MacDonald Bentley*



*Retention of water in Aqua Greens seen during construction prior to the installation of the liner - Courtesy of Mott MacDonald Bentley*



*Installation of community noticeboard on site  
Courtesy of Mott MacDonald Bentley*



*Visualisation image used to aid communication with the public  
Courtesy of Mott MacDonald Bentley*



*Testing and monitoring equipment installed at Strensall Road  
Courtesy of Mott MacDonald Bentley*