Clandeboye Rainwater Garden

SuDS used

- *Storm flows are released from a geocellular tank via a valve or high-level overflow. The flows discharge into a 38m-long rill which in turn discharges into two ponds. A bog garden then conveys flows through the substrate to both ponds and finally a swale conveys flows to Clandeboye Stream.*

Benefits

- *Attenuation to reduce water runoff rate*
- *Filtration to improve water quality*
- *Increased biodiversity and habitat creation*
- *Visual amenity and educational opportunities*

1. Location

111 Clandeboye Rd, Bangor BT20 3JW

2. Description

The rainwater garden is located on the grounds of Clandeboye Primary School in Bangor, Co Down, within an existing green space interspaced with mature trees and close to a dense residential area near the town centre. The sustainable urban drainage (SuDs) features were proposed by Northern Ireland Water (NIW) to resolve two surface water management issues: an increase in storm water volume and an existing culvert capacity issue resulting in out of sewer flooding in times of heavy rainfall.

In parallel to the surface water issues in the area, NIW and its parent department, the Department for Infrastructure (DfI) were keen to promote and demonstrate the effectiveness of SuDs within the urban environment. Particularly innovative was the use of "soft SuDs" as a sustainable yet effective tool to manage surface water and reduce both the risk of flooding and carbon footprint. NIW successfully secured funding from the DfI Special Fund for SuDs demonstration projects.

The scheme's location within the grounds of a local primary school added a significant challenge due to concerns about the risk posed to children by the introduction of an open water feature, making stakeholder buy in more difficult. Key to the acceptance of the project was the support by the School Principal and Board of Governors who endorsed the project given its potential not only to help control surface water, but also to provide an additional educational resource, visual amenity and add an element of play and fun to school life.

3. Main SuDS components used

As the scheme was to be used as a pilot project, from an early stage the work scope was defined to include as wide a variety of vegetative surface water management features as feasible within the constraints of the available land, ground conditions and funding.

The raingarden is fed from hardstanding areas around the school building, approx. 300m^2 of which is directed into a storage tank with overflow pipework to a rainwater rill. The tank has a sluice gate which when activates allowing 10l/s to flow into the rill for 20 minutes when the tank is at capacity. The discharge is via a grassed feature mound which is shaped as a turtle with the water discharging from the wooden carved turtles' mouth.

The rill terminates at a circular stone sinkhole which conveys the flow underground via a pipe to facilitate the access path to the school. The pipe terminates at pond A and water then overflows a stone cascade wall to fill pond B. Pond A also receives the overland runoff from the existing school hard surfaces playground area. The overland flow travels first through a bog garden which provides storage in the voids in gravel substrate.

A 1 in 3 gradient swale attenuates the surface water that lands on the access road and limited areas of the pumping station. The swale terminates with a proprietary swale inlet unit connected to a pipe that discharges to the Clandeboye Stream.

A circular economy approach to design and operations has been adopted to help lower the project's carbon footprint. Additional design features have been incorporated in shape of play facilities for the pupils of Clandeboye Primary to add value to the scheme. The additional features included a spiral mound with slide and landscape profiling and serve a dual purpose: to accommodate excavated material from the swale and pond areas, thereby considerably reducing the project's carbon footprint, and to ensure no material required transportation off site.

4. How it works

The drainage strategy involves the interception of overland flows from hardstanding areas around the school and attenuation of these flows before discharging into the Clandeboye Stream. The total area of hardstanding is 2,702m^2 which for a 1 in 100 year return period storm results in a maximum inflow to the ponds of 70l/s. The hardstanding area can be divided into three areas each of which have a different SuDs management train.

The geo-cellular tank was selected as source control for Area A runoff to retain the required volume at the top of a natural slope. The tank is designed so that flows can be released via a valve incorporated into a turtle sculpture to allow the water to discharge from the turtle's mouth into a rill running down the slope. The design of the conveyance system provides amenity value to the school children by a creating play feature where duck races can take place (Fig. 2).

The bog garden collects the runoff from Area B and allows flows to slowly percolate down the natural slope into Pond A. This process filters the runoff removing sediment while also providing 12m^3 of storage in the voids contained in the substrate.

Pond A and Pond B collect the flows from the bog garden and those discharged from the geo-cellular tank. The ponds are designed to have a permanent water depth of 150mm for aesthetic and biodiversity reasons and a maximum water level of 450mm for safety reasons. A low-level overflow is provided to allow attenuated water to slowly drain down to this 150mm depth. A high-level weir ensures that the maximum depth of water in the ponds does not exceed 450mm. The ponds are planted with a mix of aquatic plants to form a boundary to the pond margins. The planting has been selected to ensure that views to the ponds are not obstructed for safety reasons. A dipping platform has also been provided to allow children safe access to the edge of the pond in supervised conditions (Fig.1).

A swale was selected as the most suitable SuDs component for collecting the access road drainage as it can follow the horizontal alignment of the road and collect flows along its length. The swale also provides filtration of the runoff and a small level of infiltration as it conveys flows to the Clandeboye Stream.

5. Specific project details

The raingarden project forms part of a wider drainage area plan (DAP) which involves the closure of unsatisfactory combined sewerage overflows and aims to improve water quality of flows discharging into local water courses and Belfast lough.

The project, comprising of mostly surface water management features, sits in contrast to the more traditional hard engineering solutions used in the rest of the DAP. The added value to the curriculum, alignment with sustainability objectives and benefits through play, combined with the benefits derived from increased biodiversity and visual interest, made this solution ideal from a social and environmental perspective.

The ponds are the main focus of the scheme, providing most of the attenuation, the aesthetic focal point and the primary educational space. The rill and associated underground storage tank provide a safe and fun way for the children to interact with the water as it flows down to the ponds while the swale provides a safe and easy method of drainage adjacent to the access road (Fig. 4).

6. Maintenance & operation

Overall ownership and maintenance of the feature falls to both the School and the Education Authority. As part of a collaborative approach, it was agreed that NI Water will monitor and maintain

certain aspects of the feature over a four-year period following handover. Focus will be given to ensuring vegetation survives the initial planting through to maturity phase, and that suitable design features are in practice. This extended monitoring period was essential to ensure initial buy in, reassure stakeholders of the commitment to make the project a success and guarantee short- to-medium-term overall performance.

Additionally, continued visual inspection of the feature by all stakeholders will ensure maintenance will be carried out as required, as opposed to reactionary maintenance typical of more conventional solutions.

7. Monitoring and evaluation

As a pilot project, the scheme will ensure continued scrutiny over the long term by a variety of stakeholders, including local council, planning departments, schools across the province and developers. Over the extended maintenance period of the feature, pupils, staff and the school maintenance team as well as Education Authority operatives will monitor the performance of the feature, with maintenance as required provided by the constructor.

The effectiveness of the project in reducing the risk of flooding via overland flow in the downstream cul-de-sac is currently being monitored by both NI Water and DfI Roads.

8. Benefits and achievements

The scheme successfully provides attenuation storage before discharging to Clandeboye stream via a high-level overflow. The reduced run-off rate is evidenced in the observed resolution of the flooding in the nearby cul-de-sac. Water quality is addressed at every point of entry into the attenuation system. This includes vegetated slopes entering the swale, the gravel bog garden between the playground and the ponds and gully traps on the pipelines discharging to the geo-cellular tank.

As well as the carbon reduction benefits normally associated with SuDs, the project also delivers a number of benefits related to the additional carbon reduction strategies implemented to reduce the its carbon footprint. These include removing surface water from the combined sewer network, leading to energy savings on treatment, as well as reusing excavation material on site.

The completed project has provided areas of open water and muddy margins planted with aquatic and semi aquatic plants. The planting of flowering perennials through the bog garden as well as the provision of rocks and logs provide a range of habitats that will greatly increase the biodiversity of the area.

The scheme provides proven added value in terms of educational resource, and secondary benefits of creating a safe play environment for the pupils of Clandeboye Primary School. Examples include a substantial lowering of the school's accident rate, with play becoming more focused on the features of the garden and away from the traditional games of "chasing" on hard playground surfaces, as well a noticeable reduction in playground disagreements. Further work completed by voluntary groups has included an outdoor classroom including a mud kitchen and sandpits which has complemented the learning curriculum.

Clandeboye Primary actively encourage other schools within the area to tour the SuDS and demonstrate the added value provided by the rain garden to the school curriculum. An official video which celebrates the success of the project was also produced and can be found here.

9. Lessons learnt

Key challenges were predominantly linked to health and safety concerns. The Education Authority raised concerns about the of risk to pupils attending the school and the potential of legal action taken against the board should accidents occur. This opposition and challenge was welcomed by the development team as a chance to influence at a strategic level within the Education Authority, with the high level of scrutiny leading to the achievement of the best possible design. Due to the location of the raingarden, community engagement meetings were held to discuss the project and planned works and to address possible concerns.

A visual design proposal of the project was created and shared with the community, along with the results of a detailed risk assessment report carried out by ROSPA. The inclusion of the ROSPA Risk Assessment was critical in allaying valid concerns regarding the inclusion of open water within a school environment, with the third-party independence and objectivity of it adding comfort for decision makers.

Key to the success of the project was the early inclusion, buy in and subsequent advocacy of the school's Board of Governors and in particular the headmistress, whose energy, vision and positive approach to perceived obstacles secured the success of the project.

10. Interaction with local authority

No interaction was required with the Local Authority, Ards and North Down Borough Council as the scheme was constructed on grounds which belonged to the Education Authority. Interactions with the Education Authority are detailed in Section 9.

- Project details

Construction completed: *November 2017*

Cost: *£70,000 Capital Expenditure*

Extent: 3000m^2

11. Project team

Funders	• Department for Infrastructure	
Clients	• Northern Ireland Water	

Designers	• AECOM	
Contractors	• BSG Civil Engineering	
Other	• Education Authority	

Fig 1 - Dipping platform adjacent to the detention pond.

Fig. 2 – The rill transfers flows from the geo-cellular tank to the detention ponds.

Fig. 3- Detention ponds with intermediate cascade.

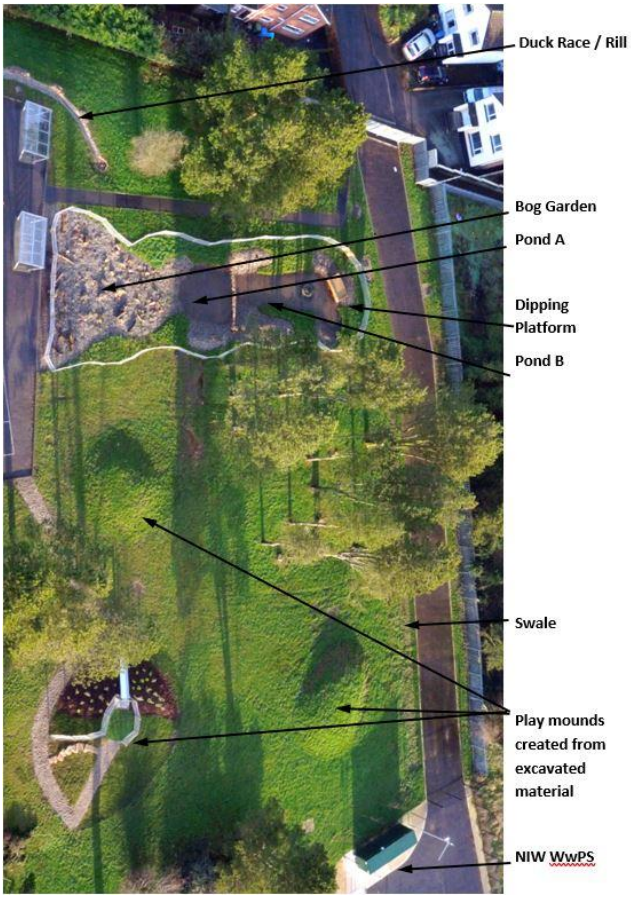

Fig. 4 – Overview of primary SuDs features.