

Killingworth & Longbenton Surface Water Management Scheme, North Tyneside



Figure 1: Local primary school helping to plant floating ecosystems to improve water quality, provide new habitats, and enhance biodiversity

SuDS used

- *Surface water ponds, attenuation areas, and two stage channels, wetland areas, floating ecosystems, surface water separation*

Benefits

- *Reduction in flood risk to over 3500 properties*
- *Increased biodiversity with the creation of 1 hectare of new wetland habitat*
- *Improved recreational areas including accessibility that supports healthy activities including a storage area designed to be an amphitheatre in drier conditions*

- *New education opportunities including a viewing platform*
- *Improved water quality due to reduced CSO spills*
- *Reduced flow to wastewater treatment as a result of disconnection of a main river from sewerage system*
- *Improved amenity and visual enhancement to the area*
- *Enables growth by creating capacity within the surface water network*

1. Location

Various sites, North Tyneside, England:

- Longbenton High School, Hailsham Avenue, NE12 8ER
- Killingworth Moor, NE12 6BP
- Killingworth Lake, NE12 6TN

2. Description

Together, Northumbrian Water Group, North Tyneside Council, and the Environment Agency delivered this innovative multi-site partnership project. Esh Stantec designed and constructed the SuDS to manage surface water and provide opportunities for biodiversity, new habitat creation and educational facilities. Over 3500 properties in Killingworth and Longbenton have benefitted from increased flood protection from the sewer network, surface water and river improvements as a result of this scheme.

3. Main SuDS components used

The SuDS components used in this scheme included:

- surface water ponds,
- attenuation areas,
- two stage channels,
- wetland areas,
- floating island ecosystems,
- surface water separation to remove a main river from sewerage system.

Esh Stantec delivered the scheme in a phased approach through a three year construction programme. The scheme has provided opportunities to increase biodiversity through the creation of one hectare of new wetland habitat, five ponds/surface water storage areas including one that doubles an amphitheatre in drier conditions and one that has a raised viewing platform, and three floating ecosystems to provide habitat and maintain and improve the water quality of the lake.

4. How it works

Issues and opportunities to be addressed

The project partners identified that the catchment had the following issues and opportunities:

- Residential, commercial, and highway flooding within the catchment;
- A main river, the Longbenton Letch, into flowed into the combined drainage network until 2018. Killingworth Lake, which attenuates surface water flows from the town of Killingworth (population 7000) and provides a recreational open space in a mainly urban area, spilled into the combined drainage network. These two surface water inflows took up critical downstream capacity, caused increased downstream flood risk to properties and highways, contributed to CSO spills downstream which have a negative impact on water quality, and sent unnecessary flow to be treated at the wastewater treatment facility;
- Growth in the catchment was limited by drainage system capacity;
- Potential for improvements to biodiversity;
- Potential for amenity and recreational improvements; and
- Potential to improve resilience to climate change.

SuDS Approach Adopted

The scheme utilised catchment wide interventions to manage complex network interactions that remove surface water entering the sewer system and create attenuation to balance the flows. This project disconnected the Longbenton Letch from the combined sewer and diverted it north into another main river, Forest Hall Letch. To make space for the incoming watercourse, SuDS attenuation areas were provided upstream on Forest Hall Letch to control flows prior to the confluence of the two watercourses. Additional attenuation areas constructed near the confluence slow flows in the watercourse. The separation of a watercourse from the sewerage network has freed up capacity and reduced flow to treatment, which reduced flood risk and enabled growth and development in the area.

This scheme created attenuation areas along the southern perimeter of the Lake to enable safe spilling of the Lake during large storm events before the overflows are directed into an existing watercourse, the West Moor Tributary. This open green space now floods intentionally rather than allowing properties or transport links to flood. This is shown in Figure 2.

The scheme also lowered the top water level of the lake to create on-surface storage. To help maintain and improve water quality three floating ecosystems were installed – a first for a water company and two submerged marginal planting areas were created. The root-zones help to clean the water as well as providing shelter for fish. The additional 300 m² area of new habitat includes above-ground plants that look great and provide bird nesting habitats. The planting of the floating ecosystems was done with the help of local primary students and is shown in Figure 1.

Solution Delivered

A plan of this multi-site SuDS project is shown in Figure 3. The key elements of the scheme are:

- All of the run-off is managed above ground and totals 22,000m³ volume of new surface water storage. Below ground storage was considered and rejected based on cost and lack of wider benefits.
- The attenuation upstream in the catchment (see Figure 4) allows storage closer to the runoff and slows flows before reaching further down in the catchment.
- The scheme is designed to protect against a 1 in 100 year storm in accordance with EA requirements.
- The removal of the Longbenton Letch watercourse flow from the sewerage network and the removal of the Killingworth Lake spills into the drainage network both result in a reduction of combined sewer overflow (CSO) spills into the Ouseburn watercourse, which results in improved water quality and improved amenity to the Jesmond Dene Park.

In addition to the flooding and drainage benefits, the scheme has provided a wide range of benefits to the local community. The attenuation areas have been designed to provide new wetland areas and enhance biodiversity by working with Council ecologists and landscape architects to provide mixed planting appropriate to the area. The attenuation areas were design and constructed to enhance the amenity of the local area by improving the village green, updating a playing field, re-landscaping the Lakeside Park, and reprofiling farmland near recreational areas. One attenuation area at a school has been designed to be used as an outdoor amphitheatre in dry weather. Another attenuation area is a wetland area with a raised viewing platform that is accessible to the local schools for educational activities.

5. Specific project details

A collaborative approach was key to the project's success

Since 2010, the Risk Management Authorities (RMAs) for the Tyneside drainage catchment have developed and implemented an area-based prioritisation process to identify and investigate those drainage areas at greatest risk of performance failure. The Killingworth, Longbenton and Forest Hall area was one of those areas identified, something supported by the published 2010 Strategic Flood Risk Assessment which identified Longbenton as having the highest risk of flooding. The integrated nature of the drainage system means that it was not practical to assign responsibility for managing the flood risk to a single RMA.

The RMAs Northumbrian Water Group (NWG), North Tyneside Council (NTC), and the Environment Agency (EA) agreed to the joint delivery of an integrated drainage study to fully understand the issues, opportunities and benefits associated with a collaborative approach to risk management in the area. The study concluded that a collaborative approach could deliver significant benefits to both the residents and the environment, particularly in the area of flood risk reduction to over 3,500 properties.

Integrated Catchment Modelling yielded greater visibility of issues to be resolved

The developed areas of the catchment are a mixture of domestic housing, retail businesses, schools, industrial estates and business parks with associated infrastructure. Based on a detailed Integrated Catchment Model (ICM) developed by Esh Stantec, the property flood risk was calculated and validated by historic evidence. Over 500 properties have been formally recorded as affected and, due

to the usual under reporting of flooding, this is considered an underestimation of what has actually occurred. The reports include internal property, curtilage and highway flooding. The problem stems from an overall incapacity within the drainage system resulting in fluvial, highway and sewer flooding. The incapacity occurs when flows are high in the Ouseburn, the main river bounding the study area.

Analysis of costs and benefits demonstrated the value of adopting SuDS

It was not practical, affordable or appropriate for the solution to be delivered by a single RMA with each having a key role in enabling its delivery. Cost estimates indicated that the implementation of traditional underground storage tanks to perform to the same level as the SuDS would be in the order of £4.2million additional cost to the SuDS option without any of the wider recreational, amenity or biodiversity benefits.

Delivery of the option required civil engineering, environmental, landscape, and ecological design, and construction. NWG led the scheme and Esh Stantec designed and built it. Since the bulk of the assets would fall to the EA or NTC, a Legal Agreement was devised and signed by all parties which set out who was responsible for what aspects of the work and ongoing maintenance. The design included input from a range of disciplines including civil engineers, hydraulic modellers, geotechnical engineers, landscape architects, ecologists, 3D graphic specialists, and contractors (civil and landscape). This team worked together to develop effective, attractive attenuation features that complimented the existing areas and provided multiple benefits to the community.

Engaging with the community maximised the project benefits

Delivery was intended to take place starting in 2017. However, it came to light that the school where one of the SuDS ponds was planned was due to undergo a rebuild starting in 2016. Through much stakeholder liaison and many meetings with the contractor for the school rebuild, the project team managed to secure the funding and accelerate this part of the project so that construction works could take place during 2016 to avoid further disruption to the school. Seizing this timing opportunity and not missing it was critical to the success of the project.

As part of this liaison, additional benefits to the scheme were developed. These included the creation of the dual purpose attenuation amphitheatre, the pond with the viewing platform, and the decision to provide the new school's surface water attenuation (See Figure 5) in an above ground storage which would provide a new habitat area rather than as a below ground storage that was originally envisioned by the developer.

Regular updates were provided to the head teachers at the schools during construction on the school sites to ensure safe working conditions and liaise with school activities. Prior to the start, contractors visited the local schools to explain the work and talk about sustainability, engineering, and construction. The school children designed safety signs that were displayed on and around the site during the work (See Figure 6).

During construction around the Lakeside Park, local schoolchildren were invited to a short presentation explaining the role of the floating ecosystems, before helping with planting as shown here: <https://m.youtube.com/watch?v=0hkrpNvnAMI> . The floating ecosystem (See Figure 6) were launched into the lake and have matured into new habitats enhancing the biodiversity and

amenity of the area. The island eco-systems help to clear and clean the lake, provide habitat and protection from predators for fish, wildlife, and nesting birds, and provide shelter for fish from extreme temperatures.

Other improvements at the Lakeside Park as shown in Figure 7 include with shrubs and trees, bat and bird boxes, pathways, and rebuilt fishing jetties. These improvements were led by North Tyneside's ecologist and Esh Stantec's Landscape Architect and made in consultation with the Lakeside Users.

Local environmental groups including the Tyne Rivers Trust, Northumberland Wildlife Trust and the Natural History Society were stakeholders who contributed to the scheme. The Natural History Society were liaised with regarding pass forward flows through Gosforth Lake (SSSI), where the project team committed to ensure the design would take care not to pass forward any issues in terms of quality or quantity.

Children and young people from all nearby schools are able to use these facilities for outdoor learning to improve their knowledge of the environment and changing climate. The team has worked with local groups to enhance the local village green with the planting of a new orchard, installation of accessible raised planters and seating, and the seeding of a wildflower meadow.

There is an open section of the Longbenton Letch that flows through St Bartholomew's Church Cemetery into the combined sewer and work was required to direct flows into a new section of pipe. This worked allowed the opportunity to make improvements creating a series of raised beds to grow flowers and plants for use of the cemetery and chapel. Comments from the cemetery manager included, *"Thanks to all the team, a vast improvement in the aesthetics of the cemetery."*

In addition, the liaison between NWG, NTC, EA, the schools, the village green group, and the lake users groups, community events were held to provide local residents and businesses with information on the scheme and take feedback and questions. These events were co-sponsored and attended by all the project partners. At these community events, residents were encouraged to do local source control, reduce water use, connect downpipes to water butts, reduce hardstanding, and use permeable paving. Northumbrian Water have an active programme to promote these activities called 'Rainwise', which is communicating and enabling this initiative. In addition to these events, a community portal was set up to provide regular updates and allow direct communication between the public and project team. A link to this portal is here:

<https://nwlcommunityportal.co.uk/Projects/killingworth-and-longbenton/Activity>

Stakeholder and community engagement were a key to the success of this partnership project by understanding local issues, concerns, and desired outcomes.

Sensitive Landscape Design enhanced biodiversity

Sustainable drainage is at the core of the design of this project, which reduces flood risk to thousands of properties while also re-landscaping a public open space for the benefit of the local community. The attenuation basins located to the south of Killingworth Lake were designed so that they avoided

existing trees groups and that they would be useable for recreation when not in use as a flood retention scheme.

A key part of the landscape masterplan was to improve connectivity for pedestrians and to provide new recreational opportunities. Increasing the biodiversity of the public open space was also an important component to the design with new native tree and shrub planting and wildflower areas helping to create a landscape that is more resilient to extreme weather events and climate change and requiring less maintenance.

Increasing the biodiversity of the lakes with submerged and aquatic planting was also incorporated into the masterplan. This included the three floating ecosystems within the main Killingworth Lake and two submerged marginal planting groups along the edges of the small lake. Landscape Architects collaborated with Biomatrix, an ecological technology company which specialises in floating technology, and the North Tyneside Ecologist to agree the islands' construction, planting design and locations.

6. Maintenance & operation

Maintenance of new assets has been carefully considered as part of the design and is shared between the Risk Management Authorities: Northumbrian Water Group, North Tyneside Council, and the Environment Agency. The process for agreeing maintenance and operation was not strictly traditional and took the form of a meeting with all contributing parties to discuss, agree and document. A table suggesting possibilities was used to guide these discussions. A Legal Agreement was devised and signed by all parties which set out who was responsible for what aspects of the work and ongoing maintenance. Once the assets are built, the health and safety files are prepared in accordance with the operating authority's requirements. The maintenance of the new assets includes grass cutting, litter picking, and inspection of inlets, outlets, flow controls, overflow weirs, and drainage assets. Cleansing is then carried out when required.

Operation of the SuDS does not require mechanical or electrical systems and uses gravity therefore saving energy and reducing operational costs.

7. Monitoring and evaluation

The project has performed well and monitoring is ongoing. There have been significant environmental improvements following implementation of the scheme including less sewage spill into the Ouseburn main river via Combined Sewer Overflows of up to 81,000m³. The scheme has also enabled new development to go ahead, which adds to the economic growth and prosperity to this region.

The depth gauges have been installed to enable the EA to monitor levels in the watercourses. The flow controls on the watercourses are inspected regularly to ensure the system will operate as designed in a rainfall event.

A flow monitor has been installed on the lake overflow to monitor spill rates and frequency.

The floating ecosystems will be monitored by the council's biodiversity officer. Local groups including the Killingworth Lake Users Group, the Model Boat Club, local anglers, and the RSPB will provide feedback on the impact of these islands to the ecosystem.

There is ongoing liaison with the local school where the attenuation amphitheatre and attenuation area with a viewing platform are located to ensure these provide the benefits envisioned. There is also ongoing liaison with the Village Green Group and Killingworth Lake Users Group.

8. Benefits and achievements

CIRIA's BEST tool (Benefits Estimation Tool) was used to calculate and monetise the benefits of the scheme demonstrating over £30 million benefits. The tool considers amenity value, biodiversity and ecology, flooding, recreation and education among other criteria. Reduction in flood risk generated the majority of this value.

The scheme has maximised the opportunity with the landscaping, planting and soft engineering techniques with multiple benefits to reduce costs saving £4.2 million over a more traditional solution using underground storage tanks. Benefits of the scheme include:

- Flood risk reduction to over 3,500 properties across the catchment;
- Increased amenity and wildlife habitat at Killingworth Lakeside Park;
- Provision of new floating ecosystems to improve water quality and provide new nesting areas;
- Improved water quality in the Ouseburn watercourse as a result of reduced CSO spills;
- Improved amenity to Jesmond Dene park as a result of the Ouseburn's improved water quality;
- New fishing jetties at Killingworth Lakeside Park;
- Improved amenity area at Benton Village Green;
- Educational facilities at Longbenton High School and Benton Dene Primary;
- Reduced treatment of surface water at the wastewater treatment works;
- Reduction in disruption to travel caused by flooding;
- Trust of the local communities;
- Increased awareness of SuDS and flood protection in the local area;
- Working as one team and taking on the challenges brought about by this integrated approach;
- Implementation of a scheme in partnership that could not have been delivered by any one authority on their own;
- Long term relationships and trust built between NWG, NTC, and the EA that are resulting in other sustainable projects progressing.

9. Lessons learnt

The project utilised a new partnership approach and resulted in many lessons learnt including:

- Strong leadership is required to drive a multi-organisational and multi-stakeholder project forward.

- Community engagement results in wider benefits to local residents and asset users.
- Working in collaboration takes longer. This is a result of multiple approval processes, the need to align funding, and the need to put legal agreements in place. The timescales should be discussed and programmed.
- Ongoing liaison and negotiation with landowners are necessary in order to gain trust and help understand SuDS.
- Leadership and the ability to adapt and develop solutions is necessary to meet the expectations of multiple stakeholders with different priorities.
- Operation and maintenance can be agreed to be completed by multiple organisations. Appropriate legal agreements can be put into place. Everyone can 'do their bit'.
- Designs must be completed to meet different authority's standards. At the beginning of the design phase, the design requirements such as design return period, inclusion of climate change uplifts, and flooding threshold levels must be agreed.

10. Interaction with local authority

This scheme was a partnership project between the local authority (North Tyneside Council), the Environment Agency, and Northumbrian Water Group. The key interactions were:

- North Tyneside, the local authority, was a partner on the scheme so has been involved from the start. Initially the funding for the study came from Local Levy which was on the EA's Medium Term Plan and the local authority was the Lead Authority.
- As NWG led the feasibility study, it became clear that the lead role sat better with them. This entailed a process that none of the project partners had undertaken previously – changing of the lead role. This change was based upon trust that NWG could deliver the project – trust gained throughout the feasibility process. The Northumbrian Water Wastewater Director said, *“By working together with Esh Stantec and our partners, we’ve not only been able to reduce flood risk from multiple sources, but we’ve also been able to implement a number of additional recreational and health benefits for both the local community and the wider environment. The project has been a true partnership effort and is a real success story of working together to improve the area.”*
- In support of the project, a Councillor Cabinet Member stated, *“The project complements our Local Plan by facilitating future housing development and managing surface water in the most sustainable way. The other benefits, such as amenity and habitat improvement, provide significant added value and would be most welcome by our local communities.”*
- North Tyneside Council own some of the land where the attenuation basins are being built. Discussions were held with the appropriate departments to reach agreements on the proposed solutions.
- North Tyneside Council aided in the liaison with the schools and the decisions made to do work on the school land.
- Discussions were held with the planners at North Tyneside Council to make them aware of this scheme and the opportunities for surface water separation and drainage for future development in the area.
- The Biodiversity Officer at the council was involved with the development of the scheme, the design of the attenuation basins and floating ecosystems and decisions on planting that enhanced biodiversity and wildlife.

- The EA is responsible for the main rivers included in this scheme and made decisions to improve the fluvial flood risk from these watercourses.
- The EA is also a key project partner having guided NWG and Esh Stantec through the PAR process in a bid to secure the funding towards the project. The EA stated, *“By collaborating in this way with our partners we can combine our resources to ensure we are providing the best possible solution to flooding in the most cost effective way, resulting in better protection for the community.”*
- North Tyneside Council, the EA, and NWG discussed and agreed operation and maintenance of the SuDS assets and agreed this responsibility where appropriate.
- North Tyneside Council, the EA, and NWG contributed to the funding of this scheme.









11. Project details

Construction completed: Construction was completed in July 2019.

Cost: £6,250,000 cost, which was funded by EA: £2,688,000; NWG: £3,058,000; NTC: £434,000; Local Levy: £70,000

Extent: Total of 31,000 m² of SuDS built across a catchment of 1200 hectares for a total of 22,000m³ of surface water attenuation storage.

12. Project team

Funders	<ul style="list-style-type: none"> • Northumbrian Water Group, North Tyneside Council, Environment Agency 	  
Clients	<ul style="list-style-type: none"> • Northumbrian Water Group, North Tyneside Council, Environment Agency 	  
Designers	<ul style="list-style-type: none"> • ESH Stantec 	
Contractors	<ul style="list-style-type: none"> • ESH Stantec 	
Other	<ul style="list-style-type: none"> • Northumberland Wildlife Trust, Tyne Rivers Trust, and Natural History Society 	

13. Site Images and Illustrations



Figure 2: Killingworth Lakeside Park provides flood resilience with an enhanced community space

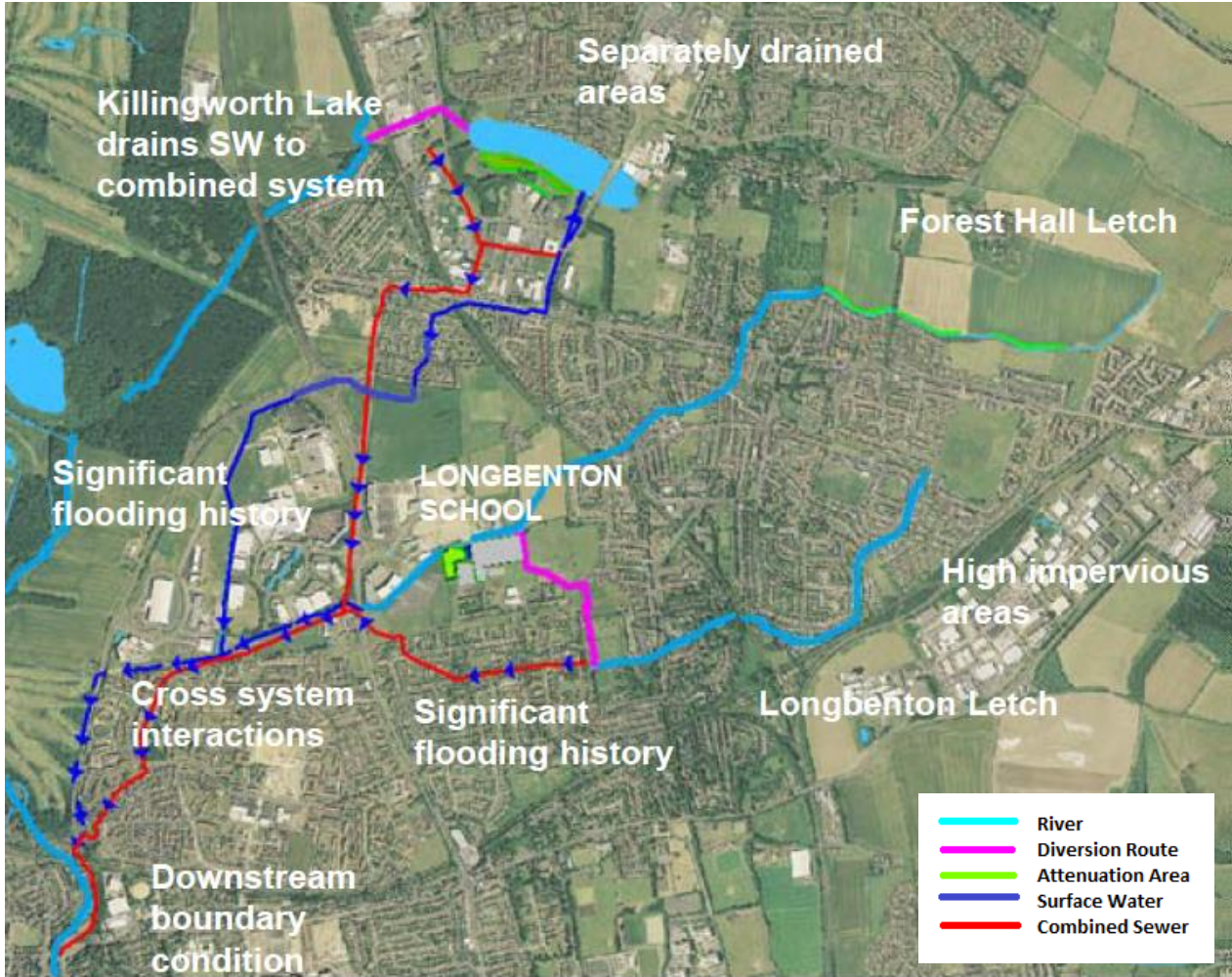


Figure 3: Plan of schematic of system and location of SuDS features



Figure 4: Upstream attenuation along the Forest Hall Letch in a two stage channel, which reduces downstream flooding and provides new habitat and enhances biodiversity in this area



Figure 5: Surface water retention pond at Longbenton High School, which provides habitat, amenity and an educational opportunity

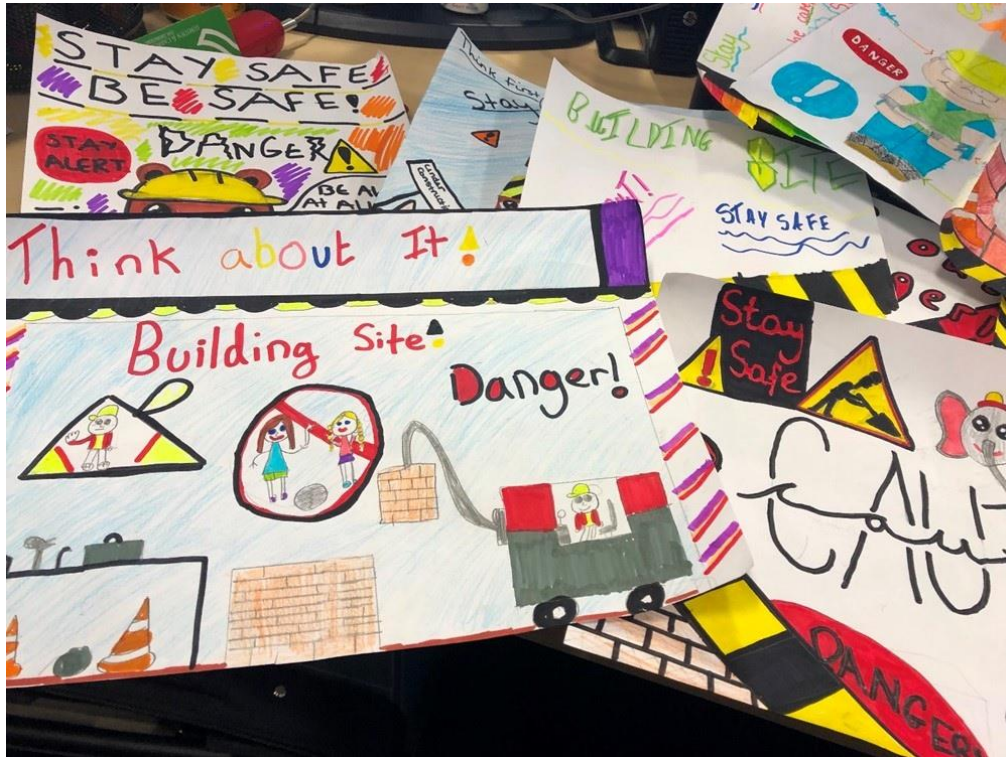


Figure 6: Site safety signs designed by local primary students after an outreach session discussing construction safety and the nearby work. These signs were displayed on fencing around the construction site.



Figure 7: Floating ecosystem on Killingworth Lake, which improves water quality, provides bird nesting habitats, increases biodiversity, and enhances amenity



Figure 8: New pathways and a bridge over the weir are located adjacent to the attenuation area. These are part of an improved pedestrian route, which enhances the recreational opportunities within the Killingworth Lakeside Park.