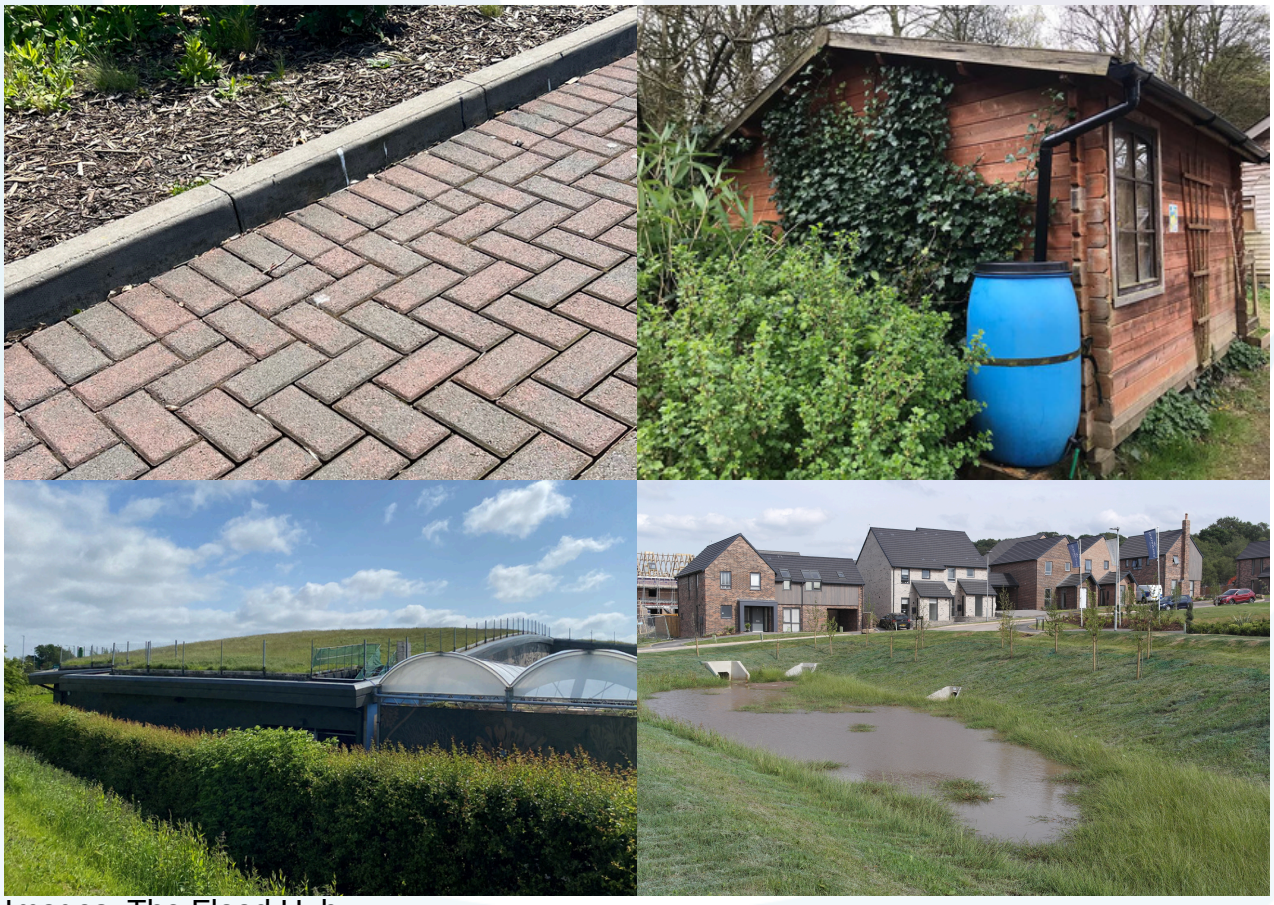
An Introduction to Sustainable Drainage Systems (SuDS)



Images: The Flood Hub

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Introduction

Sustainable drainage systems (SuDS) offer a more natural approach to managing drainage systems in and around properties and developments than traditional drainage systems. They are designed to temporarily store water during storm events, reduce peak flows and reduce surface water runoff, by mimicking the natural cycle of water management by retaining water where it lands.

Types of SuDS

Source Control – This deals with water at the place where it falls (the source), reducing the volume of runoff from a particular site by intercepting water and increasing storage whilst slowing infiltration. By storing water close to the source, the water does not flow to a different area and cause problems elsewhere. There are three types of drainage methods involved in source control, they allow for the interception, infiltration and storage of water and are outlined below:

- **Infiltration –** Source control methods involve the infiltration of the collected runoff into the subsoil layer. Eventually, this water is returned through the subsoil layer to the water table below.

- **Retention –** Retention methods involve permanently or temporarily storing surface water runoff in storage areas at the surface and can be in the form of ponds, underground tanks etc.

- **Conveyance –** These methods involve the transfer of surface water runoff to a point of discharge. There are a number of methods which can be used, for example, underground pipes with no water treatment or through vegetated channels in the surface which allow for some treatment and attenuation. An example of this is the use of swales.

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It is important to think about where the rainwater that falls on your property ends up, as this can have an effect on drainage and potential flood risk. If you have a lot of hard surfaces on your property such as patios and paved driveways, water will run off these and into drains rather than being absorbed into the ground, as would happen in a natural system. This puts additional strain on drainage systems and watercourses, particularly at times of heavy rainfall. Surface water sewers take rainwater from roofs, driveways, roads etc, which are then discharged into local watercourses. This means that more water enters watercourses than through natural drainage, which can increase flood risk.

There are several ways that you can reduce the amount of rainwater that ends up in surface water sewers from your property and reduce your contribution to increased flood risk in your community.

Although it is easier and more effective to implement SuDS during the design stage of a development, there are also some simple ways in which SuDS can be retrofitted into your property, with multiple benefits for you, your community and the local environment.

Image: The Flood Hub

Bioretention Strips

Bioretentions trips are vegetated areas with sand and gravel beneath. They are designed to channel, filter and cleanse runoff vertically. The runoff can either infiltrate into the ground below or drain to a pipe which carries the water elsewhere. Often, they are vegetated areas providing some aesthetic value and can be of varying size. Their surface area is around 5-10% of the drained area with storage below. The storage of runoff and rainwater can reduce peak runoff rates and encourage infiltration which reduces the overall flood risk.

Bioretention strips filter runoff and remove pollutants such as nutrients, metals, suspended solids and bacteria. This will have a positive effect on the overall water quality of the stored water. However, they must be maintained and checked regularly to ensure that there are no blockages from the accumulated sediments and pollutants.

For more information, please visit here.

Bioretention strips have been used in the GrowGreen Manchester project. They have been incorporated with tree pits which absorb the rainwater which falls on the footpath above them. Click here to read the case study.

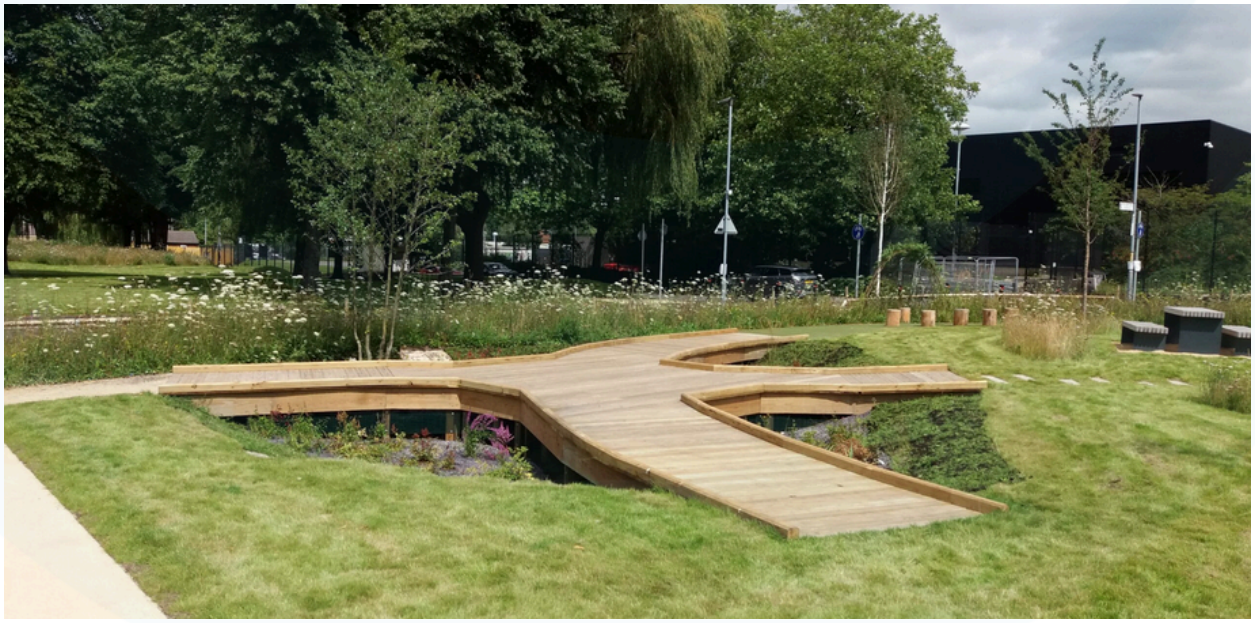


Image: Manchester City Council

Detention Basins

Detention basins are storage basins that control the flow of water and the attenuation of runoff. As a result, they can reduce the local flood risk of an area by storing runoff and rainwater. They also allow for the settlement of some sediment and particulate pollutants.

Detention basins are usually put in place if the treatment of runoff is required, this will improve the overall water quality of the stored water. They can also be used as landscaping and for wildlife habitats.

They can be useful in varying magnitudes of rainfall events and are easy to design and construct. They are easy to maintain and can be used for a number of different purposes not just for drainage and flood risk. Detention basins can serve as both a sustainable drainage system and a recreational area. When wet, they can be used as a pond for wildlife, this will increase the biodiversity of the area and may be useful as an educational resource.

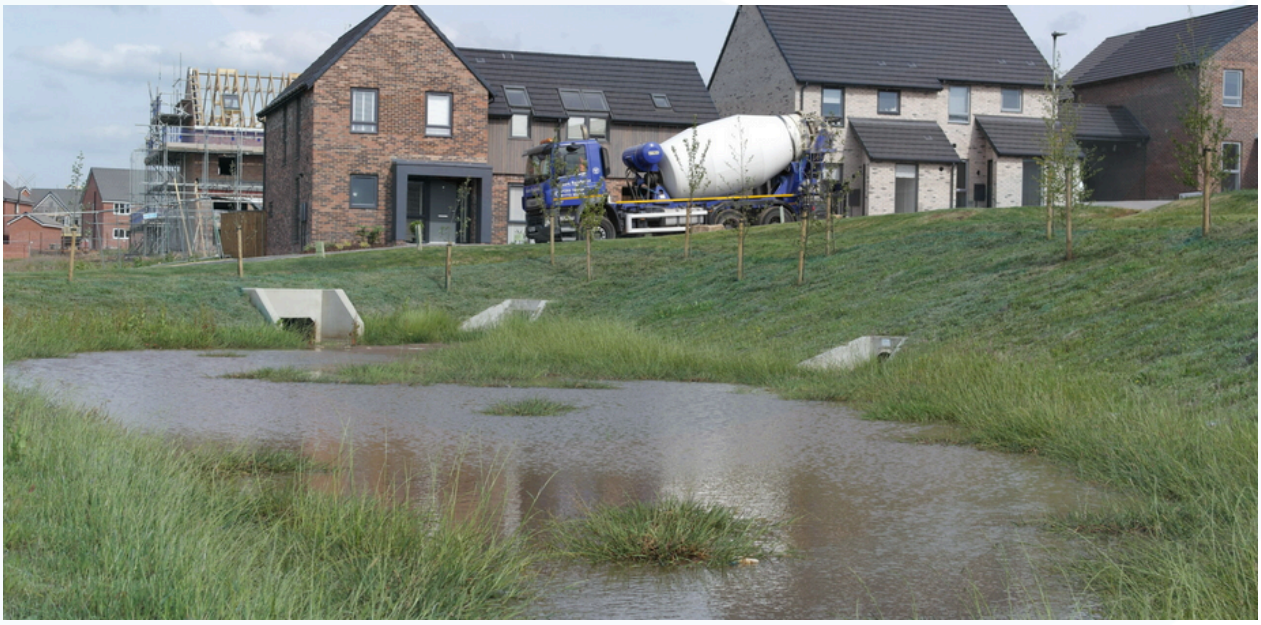


Image: The Flood Hub

Retention Ponds

Ponds can be particularly effective during high intensity rainfall events as they can provide attenuation and treatment for rainwater and runoff. To reduce the risk of flooding in areas, some ponds are designed to slowly release the runoff and rainwater they have collected and stored over time, allowing for controlled flow rates.

This retention method reduces peak flows when an area is at risk from flooding, reducing the overall risk. Retention ponds should function in both dry and wet conditions, and submerged aquatic vegetation should be used. They are only suitable for properties which have enough land available, and this land will most likely need re-landscaping if the retention pond is being retrofitted.

Permanently wet ponds can store water for reuse, and all ponds provide the opportunity to improve habitats and increase biodiversity. Pollution is removed through sedimentation and biological mechanisms to reduce nutrient concentrations. A further benefit of retention ponds is that they can withstand a varying magnitude of rainfall events and can store large volumes of runoff and rainwater that is slowly released, controlling the flow rate. This reduces the flood risk for residents in the area. Furthermore, retention ponds provide amenity which is a benefit for the local community and could be used as an educational resource for local residents and children.

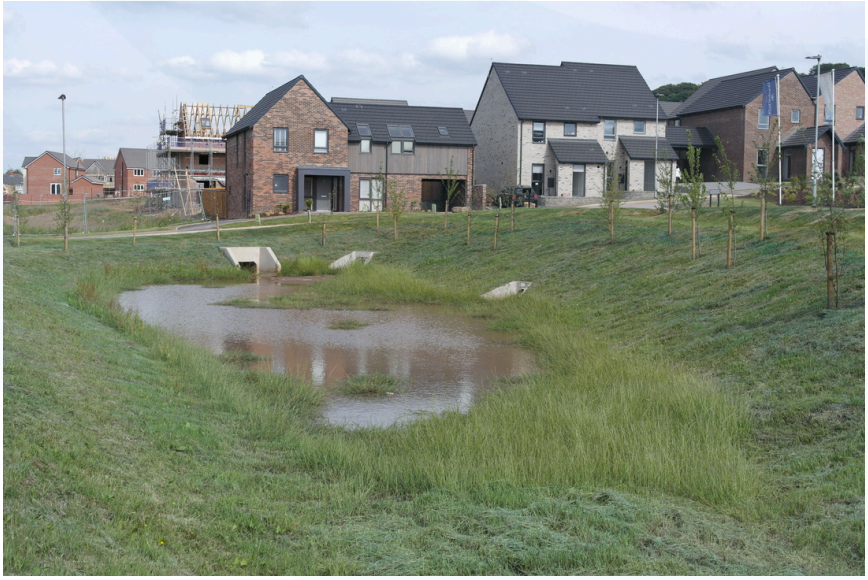


Image: The Flood Hub

For more information on both detention basins and retention ponds, please click here.

Green Roofs

Also known as ‘living roofs’, green roofs have plants growing on them that help to soak up rainfall by increasing infiltration and reducing the amount of runoff. This allows you to incorporate green spaces within your property even with limited space.

Green roofs are a source control method as they store and hold back water, providing interception storage for, on average, the first 5mm of rain. They remain effective during long and intense rainfall events as they still provide a significant reduction in peak runoff rates, retaining between 70-80% of runoff in summer months.

They can be retrofitted to a property, however this does depend on the structural capacity of the existing roof, therefore you should seek professional advice prior to installation.

They not only help to manage flood risk but also provide noise and sound insulation and provide areas to grow vegetation.

For more information please visit: www.livingroofs.org/

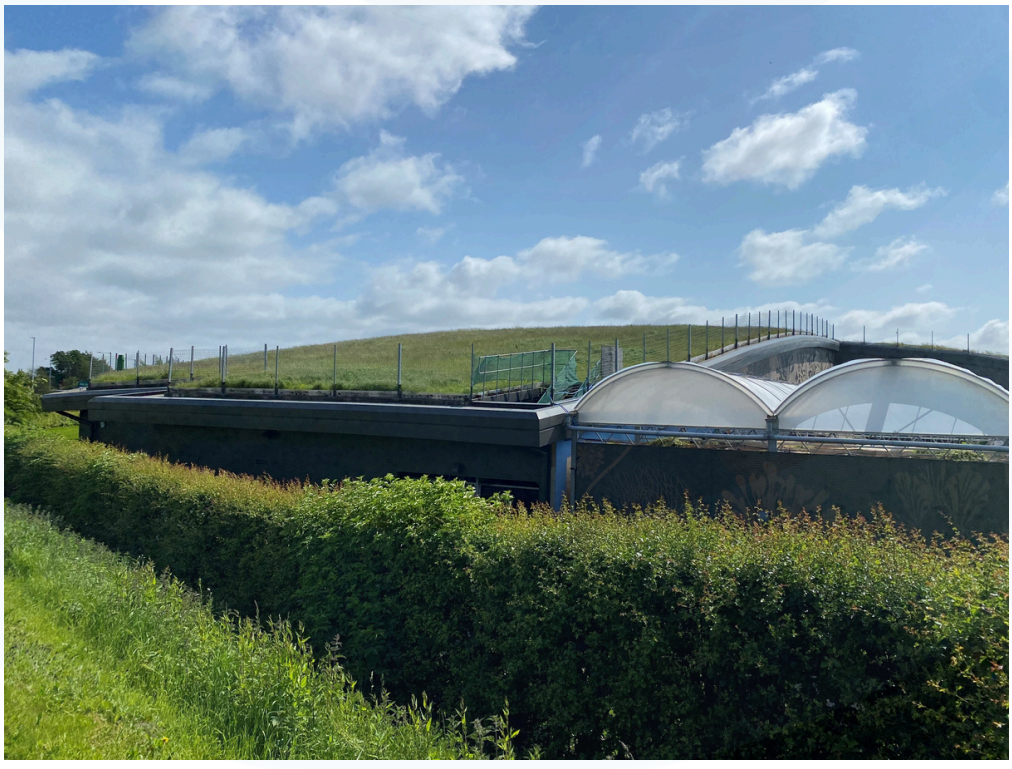


Image: The Flood Hub

Permeable Paving

Permeable paving is not composed of material which is permeable or porous but relies on gaps and voids in the surfacing to allow infiltration. Porous and permeable surfaces allow water to infiltrate through the surface itself, which reduces and delays runoff and peak flows in watercourses.

Image: The Flood Hub

There are also alternatives to paving such as wood chippings or recycled aggregates which also have the same affect.

Most of the water that falls on hard surfaces within your property will run off into drains rather than being absorbed into the ground, which is not the natural cycle of drainage andincreases the risk of flooding elsewhere.

Permeable surfaces can be applied to both front and back gardens in residential areas, as well as in larger, non-residential areas. It is important to note that planning permission is required to pave more than 5 square metres in your front garden with non permeable material, and please be aware that other types of related work may also require planning permission.

An advantage of using permeable surfacing is that it can typically drain double its area, allowing for more water to be stored and infiltrated than directly entering the watercourse. If the surface has a good aggregate sub-base then it can also provide benefits for water quality treatment as well.

Further benefits of installing permeable surfacing are:

- They can be easily applied to properties in both high and low density residential areas.
- SuDS allow for the dual use of space, for example on driveways, and do not require any extra land take.
- They are easy to maintain but can lead to weed growth and clogging if they are poorly maintained.

For more information, please visit here.

Rain Gardens

They help gardens to deal with rainfall more effectively and can be combined with rainwater harvesting measures; they are shallow depressions with absorbent, free draining soil and vegetation that can withstand occasional inundation.

Rain gardens are an infiltration method which increase the amount of water entering the soil and in turn, reduce rates of runoff and volumes of surface water.

Downpipes are often disconnected from sewers and redirected into the garden; they can also be established in planters which are supplied with water by downpipes in properties with limited space.

They do not require changes to the existing drainage system and can be installed virtually anywhere, having significant advantages for surface water quality and habitat creation as well.

For more information please visit: www.raingardens.info

Image: The Flood Hub

Rainwater Harvesting

Rainwater is collected from the roof of a building or paved surface and stored in over or underground tanks for treatment and reuse in toilet flushing, irrigation and gardening. Water butts are the most common measure used for property level SuDS, providing a source control of rainwater, whilst also reducing your properties water usage. However the success of the system is dependent on its design.

To calculate the best size for your water butt and the proportion of storm water it will retain, you should multiply the typical average summer storm rainfall total (mm) by the roof area of your property (m2). For example: 11mm of average rainfall for a summer storm X 70m2 roof area gives a retention volume of 0.77m3.

Water butts can be used to collect rainwater from roofs by connecting them to the properties down pipe. An overflow is required to prevent the water butt from flooding and to create capacity for the next storm event. This is also redirected away from the combined sewer and instead connects a perforated hose to allow slow release of storm water into the ground once a storm event has passed.

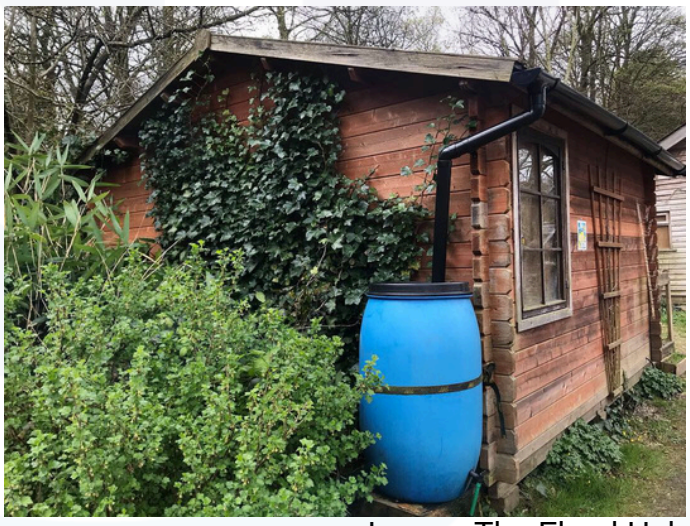


Image: The Flood Hub

As well as reducing flood risk, rainwater harvesting has many other benefits. Firstly, the equipment is easy to maintain and reduces water wastage as the harvested water can be reused again within your property, for example for toilet flushing, irrigation or watering gardens, as rainwater is often free of chemicals so will not harm plants. In turn, this then has a positive effect by reducing water bills as families reuse the harvested water instead of using more. Some maintenance will be required to remove litter and prevent taps becoming blocked. It is also not recommended to depend on rainwater for your water supply, as in some areas, there may be limited rainfall.

Swales

Swales are shallow, broad vegetated channels used to collect and move water to reduce peak flows in rivers. Their sides are slightly sloping and they are flat at the bottom. Ideally, they are better installed in areas which do not have steep slopes.

Swales provide temporary storage and infiltration by storing and conveying storm water runoff. They remove pollutants by encouraging infiltration.

Swales can be ‘wet’ and store water above ground, or, they can be ‘dry'. When they are dry, water collects in a pipe or gravel layer beneath. In wet weather, the rainwater flows down the sloped sides of the swale, along its length and infiltrates through the grass, which acts as a filter, trapping sediment. Some of the runoff is also lost at the surface through evaporation and transpiration.

Swales are easiest to retrofit during landscaping and are relatively inexpensive to install. Their maintenance is minimal and can be carried out alongside general landscape management, any pollution and blockages are easily visible, enabling them to be dealt with when necessary.

Further benefits include the reduction in runoff and discharge into local water bodies which helps to reduce flood risk. Swales are also useful for removing any pollutants from runoff and therefore improve the water quality.

For more information on swales, please visit here.

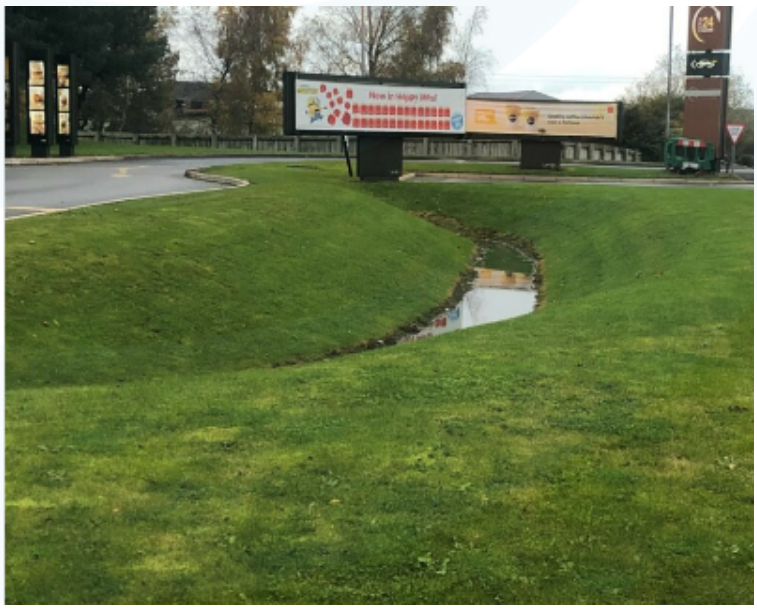


Image: The Flood Hub

Wetlands

Wetlands are quite similar to retention ponds. They are shallow ponds and marshy areas filled mostly with aquatic vegetation. They treat surface water runoff through sedimentation and filtration.

Wetlands slow down the flow of runoff for a period of time to allow for sediment settlement and filtering. Wetlands remove fine sediments, dissolved nutrients, metals and particulates by filtration through vegetation and aerobic decomposition. Overall, they are very useful for the attenuation and treatment of runoff. This will have a positive effect on the water quality of the runoff which will eventually enter local watercourses.

Wetlands can be of great aesthetic value to an area and create an increase in biodiversity. As a result, they can be used as an educational resource and for recreation. Due to the large density of vegetation, often, runoff and rainwater is intercepted and this allows time for evaporation and evapotranspiration. This causes a reduction in the total runoff infiltrating in the ground and entering water courses and reduces the flood risk of an area. Overall, wetlands are relatively similar to retention ponds, however, retention ponds allow a greater volume of water to be stored.

For more information, please visit here and here.

Image: Castle Irwell Flood Plain & Salford Wetlands cc-by-sa/2.0 – © Colin Park – geograph.org.uk/p/6014644

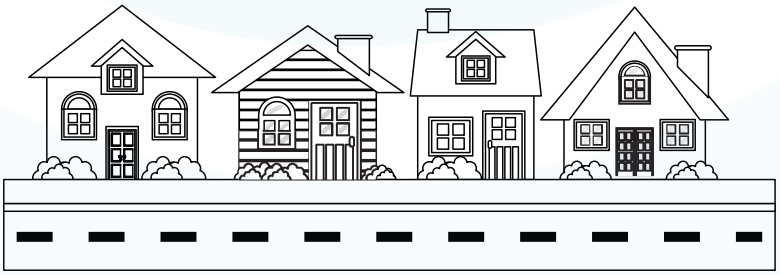
SuDS for Developers

Following new planning policy released in 2015, SuDS should now be provided on ALL developments, particularly major development (these include ten or more dwellings or an equivalent non-residential/mixed development), unless demonstrated to be inappropriate (for example, mineral extraction development) and the techniques used will depend on site-specific characteristics.

The changes also made Lead Local Flood Authorities (LLFA) one of the statutory consultees on planning applications with the aim of reducing the likelihood of surface water flooding and its associated impacts. It is recommended that developers contact the LLFA and appropriate statutory consultees before submitting planning applications to the Local Planning Authority to help identify the most suitable SuDS design options.

Local Planning Authorities (LPA's) are expected to seek information and advice from the LLFA in regards to the management of surface water and implementing SuDS into the planning application. This includes ensuring that the proposed SuDS are fit for purpose, and ensuring that SuDS are continuously maintained for as long as the development exists and their operation.

The Government have produced clear, non-statutory technical standards for SuDS, to ensure that proposed SuDS are affordable, safe, improve water quality and the environment and ultimately, reduce the risk of surface water flooding.



SuDS and Climate Change

With UK climate projections predicting warmer and wetter winters in the years ahead, it is important that drainage systems, including SuDS, are adaptable and can develop and expand their drainage capacity to account for increased rainfall. For example, by 2080, it is predicted that there will be an increase in winter rainfall by around 16% in the North West of England and an increased amount of rain on the wettest days of the year. However, this could be an under or over estimate, depending on the change in global emissions. Therefore it is important to take action to reduce the risk of flooding in the future.

Existing drainage systems are designed to cope with weather conditions in specific areas at the time of being built, therefore they may be outdated and unable to accommodate increased rainfall and changing weather conditions. Considering this, it is important that engineers acknowledge climate change within their drainage designs so the capacity of drainage systems is increased to lower the risk of flooding.

Multiple Benefits of SuDS (Sustainable Drainage Systems)

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SuDS BENEFITS

Rainwater Demand

Water is collected year-round in water butts through rainwater harvesting, which can then be used for gardening. This practice reduces demand on mains supplies and proves especially beneficial during drought conditions.

Biodiversity and Ecology

Habitat maintenance, creation, and linking are essential for supporting both existing and new wildlife. This approach enhances biodiversity and improves the quality of ecosystems in urban environments.

Recreation and Health

Access to open green spaces facilitates activities such as walking, cycling, and organised sports, thereby enhancing the physical and mental health and wellbeing of communities.

Amenity and Economy

Large open spaces and increased use of trees and plants enhance the aesthetic value of an area. This not only attracts tourists but also raises housing and land prices, contributing to economic growth.

Flood Risk Management

SuDS mimic natural drainage patterns & reduce the volume of runoff reaching drains & watercourses. They provide areas to store water & slow the flow of water to reduce flood risk in urban areas.

Water Quality

Sustainable Drainage Systems (SuDS) filter sediment and contaminants from runoff, improving water quality. They intercept rainfall and reduce the volume entering sewers and drains, thereby decreasing combined sewer overflows and the amount that requires treatment.

Climate Resilience

Vegetation and plants, such as those used in green roofs, can capture and store carbon and greenhouse gases, improving air quality. They also help regulate building temperatures and reduce air and water pollution.

Sustainable Drainage Systems (SuDS) offer a more natural approach to managing rainwater drainage. They are designed to temporarily store water during heavy rainfall events, helping to reduce peak flows and surface water runoff by mimicking the natural cycle of water management.

Last reviewed: October 2024

For more information visit:
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For more in depth detail of sustainable drainage systems, you can visit susdrain at: www.susdrain.org and CIRIA at: www.ciria.org. You can also download a free copy of the ciria SuDS Manual (C753) from their website.

Sources: Greening your home Cambridge city council (PDF), livingroofs.org, Suds design guide Cambridge city council, Susdrain, south west water, rain garden guide, geograph, SuDS Wales, unda, Anglian Water, Conserve Energy Future, New Jersey Stormwater Best Management Practices Manual, SuDS Design Guidance.