



SuDS and Flood Risk Guidance Document

North Lincolnshire Council

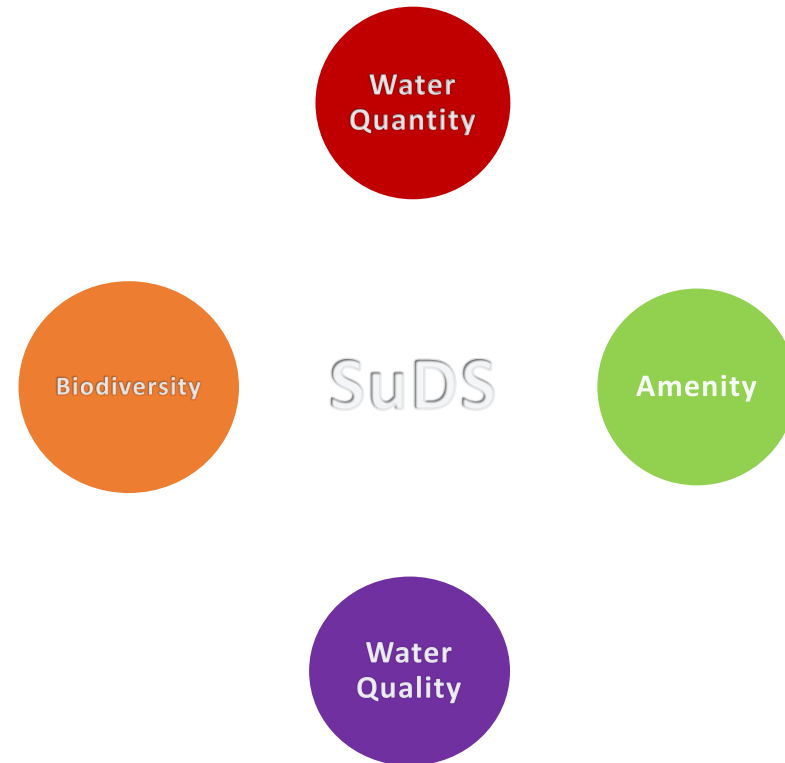
INTRODUCTION

The purpose of this document is to provide developers and designers with guidance on sustainable drainage systems (SuDS) expected to be submitted with planning applications to North Lincolnshire Council (NLC). This guide is based on The SuDS Manual 753 (Ciria, 2016) in conjunction with the National Planning Policy Framework (NPPF)

Flooding is a significant risk throughout the UK, and the risk will continue to increase in the following years with climate change.

Any development needs to be designed and built in a way that avoids increasing the risk of flooding to the site and the surrounding areas. SuDS are a way of managing water quantity (flood risk and controlling surface water run off), water quality (pollution control), biodiversity and amenity.

In this document we aim to provide practical guidance on what type of SuDS are appropriate to the development, depending on the size and location.



It is strongly recommended that developers seek pre-application advice from NLC's flood risk and drainage team **acting as Lead Local Flood Authority (LLFA)**
(LLFAdrainageteam@northlincs.gov.uk)

SuDS REQUIREMENT

In a rural or natural catchment the green spaces allow rain to soak into the ground, and the vegetation intercepts the rain, absorbs water from the soils and evaporates back into the atmosphere. The rain water that infiltrates into the ground will either permeate deeper into the ground and recharge the aquifers, or flow laterally through the soil into the nearest watercourse.

When the catchment is developed and urbanised there is a significant change to where surface water

runoff goes. The buildings and paved areas reduces the permeable surfaces where the rain can infiltrate into the soils, therefore increasing surface water runoff.

Surface water runoff travels quicker than water through the ground, and it enters drainage networks or watercourses faster and in concentrated locations leading to an increase in flood risk.

Minimal vegetation in urban catchments also reduces the amount of evapotranspiration that would usually occur.

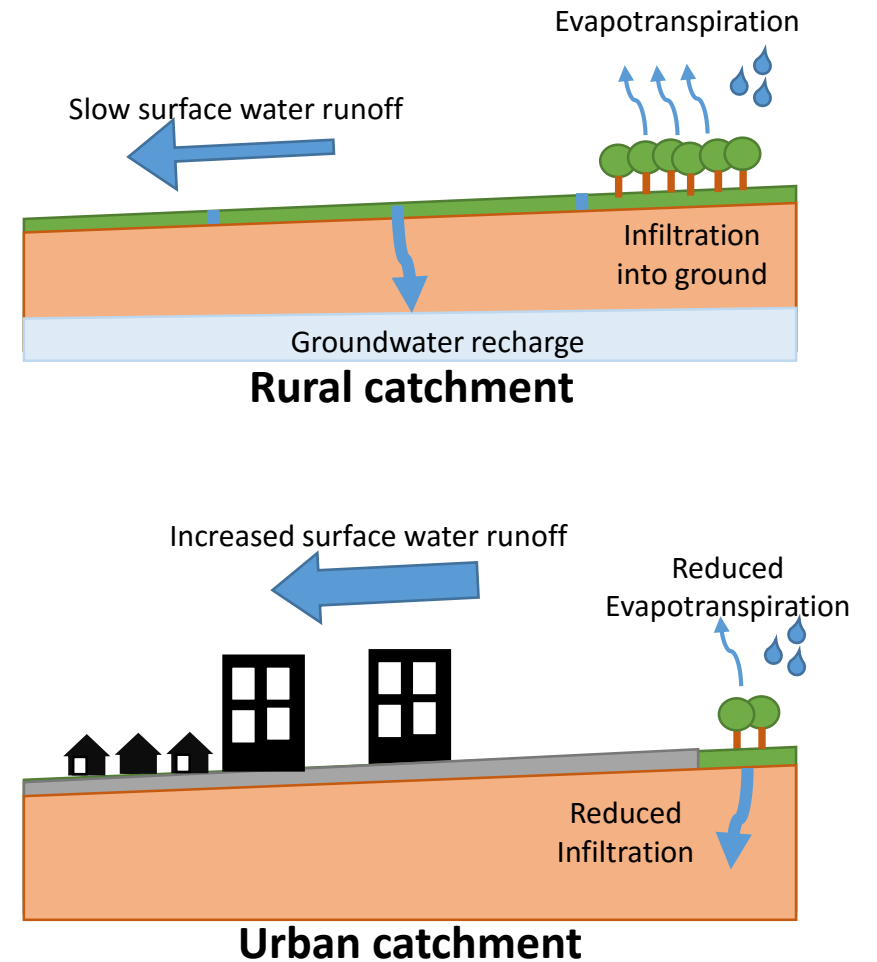


Figure 1 – Rural / Urban Catchments

SuDS MANAGEMENT TRAIN

SuDS attempts to mimic the natural pre development drainage arrangements by providing storage capacity and slowing the runoff rate. The term SuDS does not refer to a single method of controlling surface water but a variety techniques that can be used in conjunction or in isolation through good design at an early stage.

The different SuDS techniques can be classified into 3 categories. The 3 categories also form the *SuDS Management Train*, which is designed to try to match the water cycle of a natural catchment, see figure 2.

Source Control

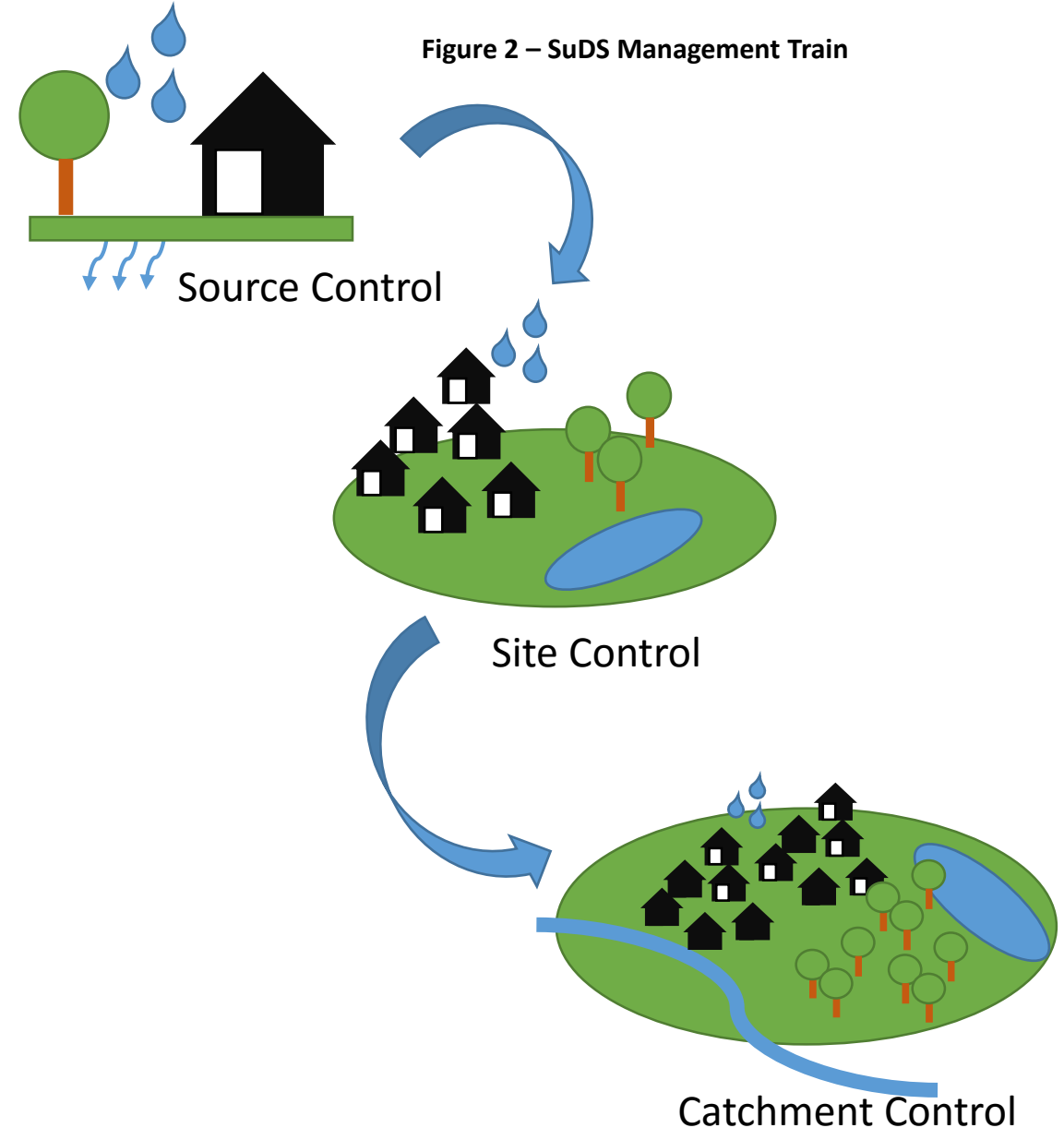
Runoff managed as close to the source as possible e.g. green roofs, rainwater harvesting, pervious paving and filter strips.

Site control

Runoff managed in a network across a site or local area e.g. swales, detention basins, attenuation.

Catchment Control

Downstream management of runoff for a whole site or catchment e.g. retention ponds, wetlands



SOURCE CONTROL

RAINWATER HARVESTING

Rainwater harvesting is the collection of rainwater runoff for further use. Runoff can be collected from roofs and other impermeable areas, subsequently stored, treated and then used as a supply of water for domestic, commercial, industrial and institutional properties.

Where the runoff is from trafficked areas, the potential for harvesting will depend on the proposed use of the water, and the extent of any pollution or treatment required before re-use.

Rainfall runoff can be collected from roofs and stored in water butts. More complex systems divert runoff into larger storage tanks in the roof space or below ground.

Key considerations in rainwater harvesting schemes are:

- structural capacity of the building to store water at a elevated position;
- collection of sufficient water for re-use;
- temperature of stored water

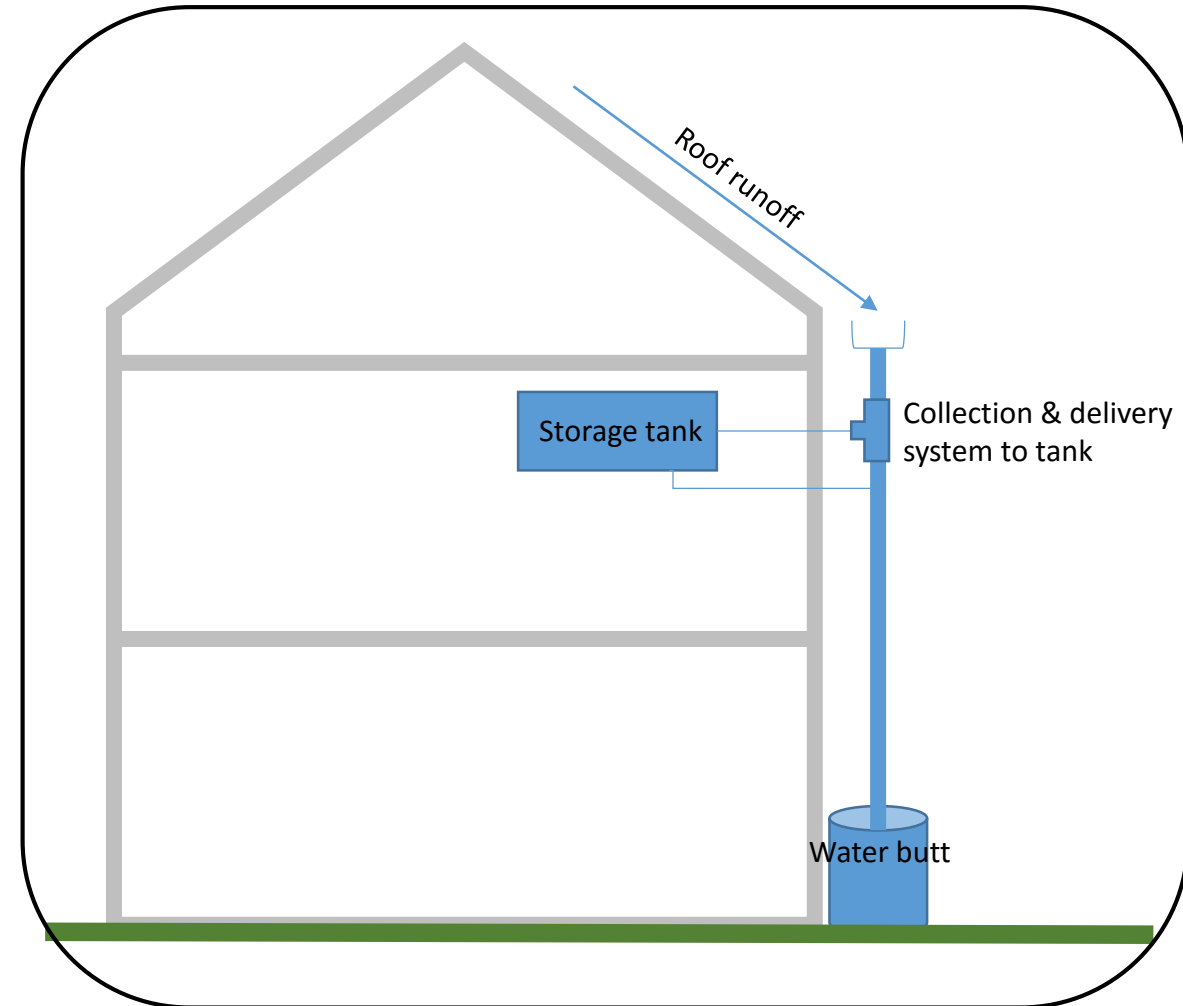


Figure 3 – Rainfall harvesting set up

SOURCE CONTROL

SOAKAWAYS

There are numerous different types of SuDS components that facilitate infiltration, including soakaways.

Soakaways are excavations that are filled with a void-forming material that allows the temporary storage of water before it soaks into the ground. They can range from excavated areas filled with rubble or crushed stone to soakaways formed using perforated precast manhole rings surrounded by granular backfill or using geocellular units wrapped in a geotextile.

The performance of a soakaway is dependant on the infiltration capacity of the surrounding ground. NLC consider infiltration rates of 1×10^{-6} m/s or less unsuitable for soakaways, unless designed for partial infiltration.

Groundwater must be considered when designing soakaways or using other infiltration techniques, and should have a minimum 1 metre clearance from the bottom of a soakaway to the groundwater level, to minimise the risk of groundwater surcharge.

All soakaways should ideally have high level outfalls into a positive drainage system/SuDS feature should they become compromised.

Other considerations include:

- Risk of ground instability;
- Risk of groundwater pollution from polluted surface water runoff or mobilising site containments;
- Risk of groundwater leaking into sewers or basements due to promoting infiltration on the site.

Site investigation is critical to ascertaining soakaway feasibility!

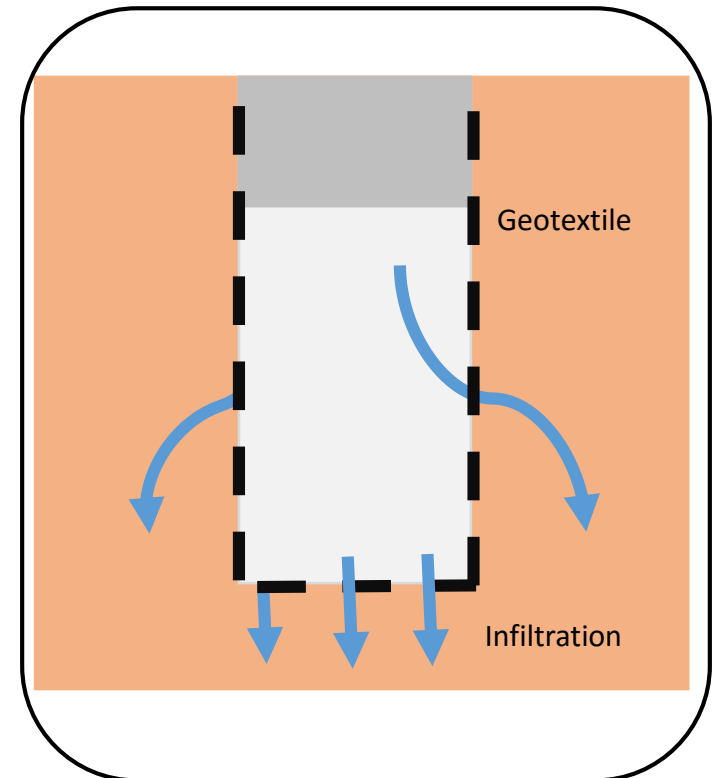


Figure 4 – Simple soakaway

SOURCE CONTROL

PERMEABLE PAVING

The basic principle of permeable paving is to allow surface water to percolate through the surface layers into storage structures below. The storage can be formed using soft ground, granular sub surfaces or holding tanks.

Porous pavements allow water to infiltrate across the whole surface material e.g. reinforced grass, gravel and block paving.

Permeable pavements have surfaces formed of impermeable material

but have void spaces or permeable materials built in to allow water to filter through; e.g. block paving with joints filled with sand, gravel or left empty.

Permeable pavements can be used on most sites but should be avoided where there is high risk of silt loads or heavy vehicle movements on the surface.

They are usually built as an alternative to impermeable surfaces so do not require extra space for construction.

Permeable pavements act as source control, and can be used as part of the treatment train for either full infiltration, partial

infiltration or conveyance into other SuDS components such as detention ponds or wetlands.

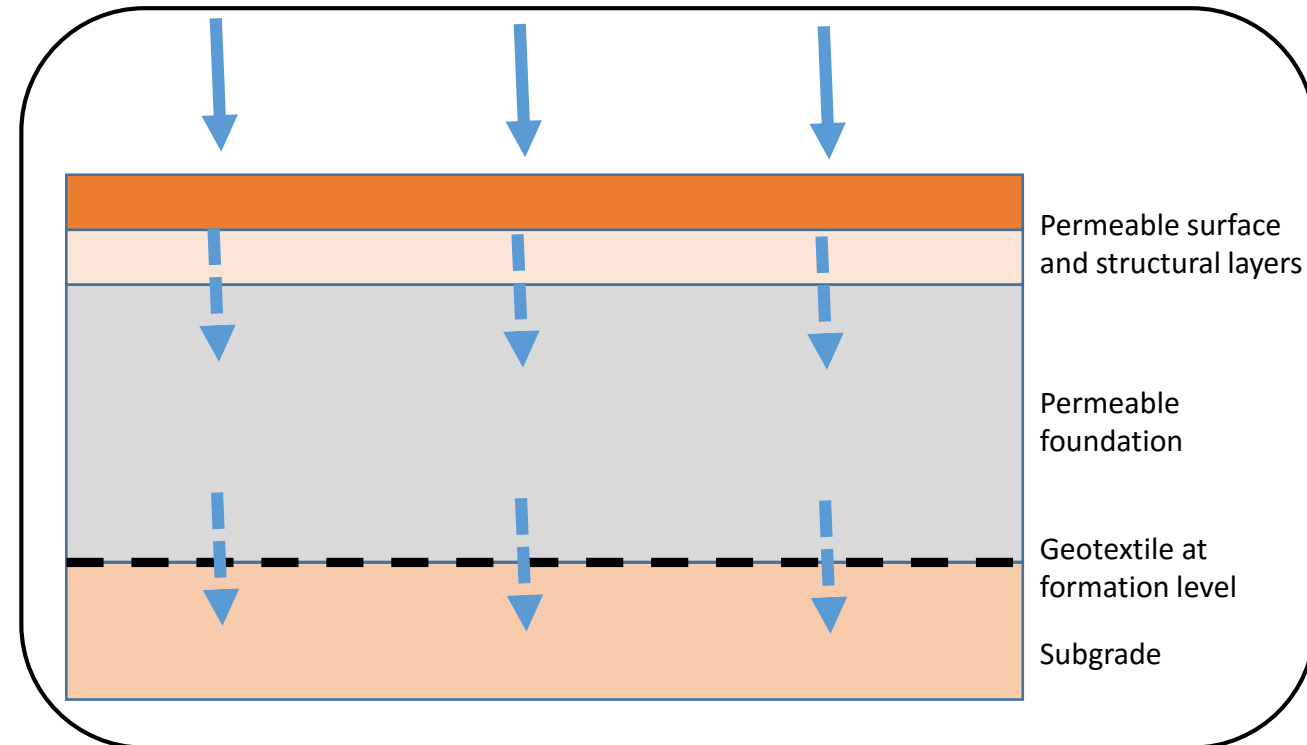


Figure 5 – Typical permeable paving set up

SOURCE CONTROL

GREEN ROOFS

Green roofs are areas of living vegetation, installed on the top of buildings. Green roofs have a number of benefits including ecological value, visual impact, improved thermal performance and reduction in surface water run-off.

Extensive green roofs cover the entire roof area with hardy, slow growing, drought resistances plants. They can be formed on flat or sloping roofs.

Intensive green roofs, or roof gardens are planted with a greater range of plants including grasses, shrubs and trees. Roof gardens require greater maintenance than extensive green roofs and are usually limited to larger flat roofs. Green roofs often lend themselves to industrial/leisure developments, or buildings with large roof space.



Photo – Roof garden



Photo – Extensive green roof

SOURCE CONTROL

TREES

Trees are one of the simplest SuDS measures to install. Trees can help reduce surface water runoff in a number of ways;

- Transpiration
- Interception
- Increased infiltration
- Phytoremediation

Trees are only intended to manage surface water runoff from the localised area, similar to the area drained by one road gully. They are not suitable for draining large areas.

Trees can be installed with other infiltration SuDS components or as standalone features.

Tree pits and planters can be designed to collect and attenuate runoff by installing additional storage within the underlying structure. This can assist in filtering out pollutants in the water.

The maximum likely groundwater level should be at least 1m below the lowest level of the tree pit where infiltration can occur.

It is important to design the tree pit with enough space to allow the tree to grow and thrive and that the catchment

area provides enough runoff to keep the tree hydrated.

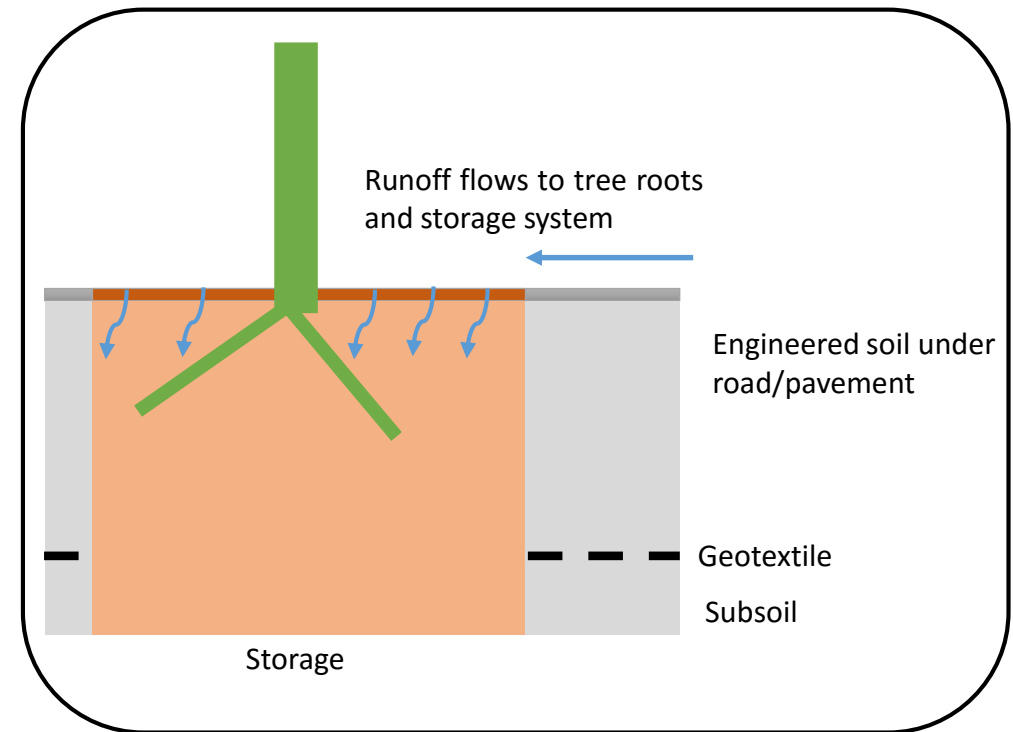


Figure 3 – Typical section through tree pit

SOURCE CONTROL

FILTER STRIPS

Filter strips are uniformly graded and gently sloping strips of grass, dense vegetation or filter material (gravel) designed to slow down the flow of surface water runoff to increase sedimentation, filtration and infiltration.

Filter strips should be designed with a minimum longitudinal slope of 1in100 to avoid ponding and a maximum of 1in20 to prevent flow channelling. Maximum flow velocities across the strips of 1.5m/s are recommended to prevent erosion.

Filter strips can be used in a variety of situations and should be effectively incorporated into landscaping and public open spaces so its function is compromised

Filter strips can be used around the perimeter of new developments to prevent overland flows from or to the area.

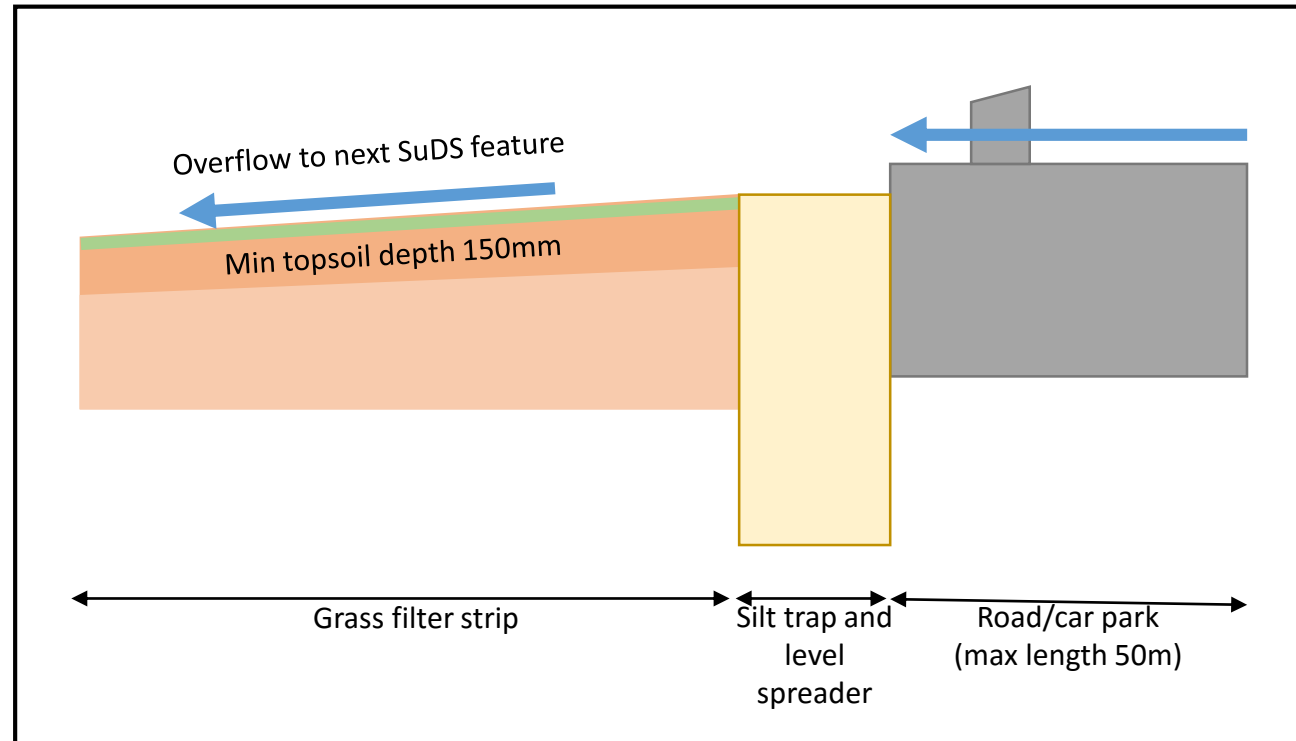


Figure – Filter strip arrangement

SITE CONTROL

SWALES

Swales are shallow, flat bottomed, potentially vegetated channels designed to convey, treat and attenuate surface water runoff. They are similar to filter strips but are generally wider and flatter to allow some attenuation to encourage evapotranspiration as well as infiltration into the ground.

When incorporated into site design swales can be used to enhance the natural landscape and provide visual and biodiversity benefits.

Dry swales are vegetated conveyance channel with a filter bed overlaying an underdrain system. The underdrain provides an additional level of treatment and prevents waterlogging.

Wet swales are designed to be wet and marshy in the base of the swales.

They can be used in very flat areas and soils are poorly drained or to provide biodiversity and amenity areas. Specific wetland planting will be required in the base of a wet swale.

They can typically be constructed alongside a highway, resulting in cost

savings instead of installing conventional drainage systems.

Swales should generally be designed with a base between 0.5 and 2.0m wide, longitudinal slopes between 1in20 and 1in200 and maximum side slopes of 1in4. The typical depth of a swale is between 400 and 600mm.

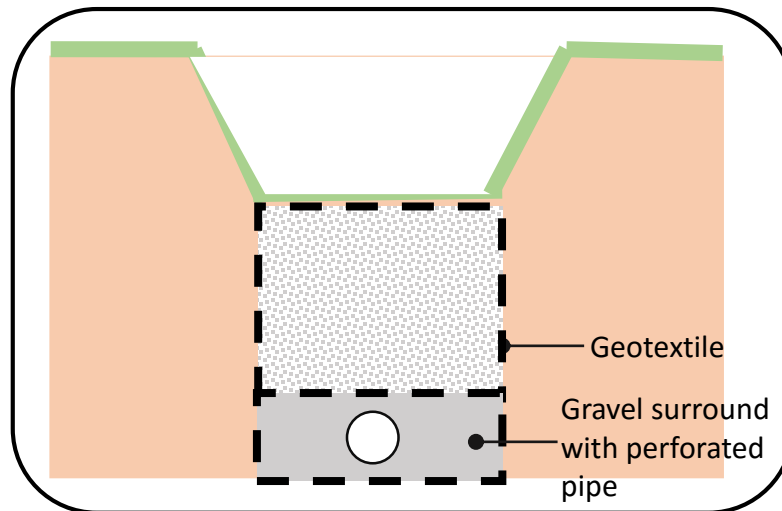


Figure – Dry swale set up

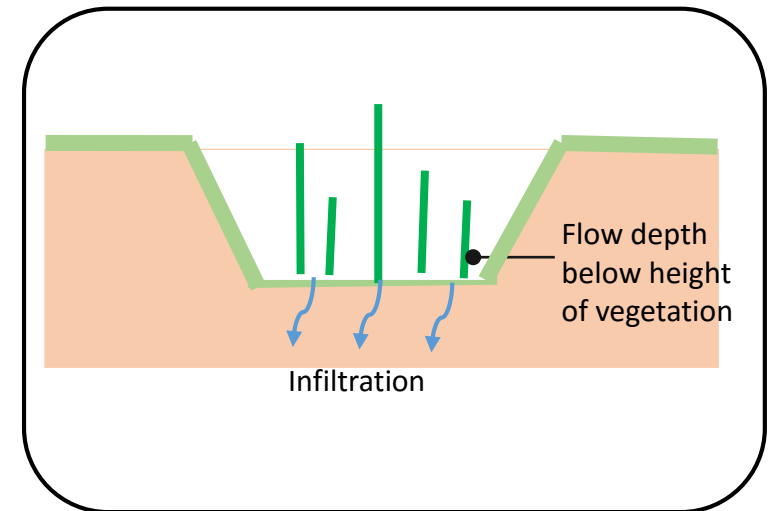


Figure – Wet swale set up

SITE CONTROL

ATTENUATION TANKS

Attenuation storage tanks are used to create below ground void space for the temporary storage of surface water runoff before infiltration, controlled release or use.

Attenuation can be achieved using the following methods:

- Geo-cellular storage system
- Oversized pipes
- Precast or in situ box culvert sections

Attenuation tanks can be used for any site requiring subsurface storage, however this is not considered a preferred option by NLC.

It is recommended tanks are constructed above the groundwater table to minimise lateral loading on the tank.

Effective treatment of runoff is required to control sediment build up. To limit the risk of sedimentation, the drained area should be minimised; therefore a number of smaller tanks is preferred to one larger tank.

Attenuation tanks require regular maintenance and inspection so therefore should not be constructed in private land.

Adoption arrangements should be considered when proposing attenuation tanks as part of an overall SuDS scheme.

It should be noted that underground storage should be used as a last resort, with preference to 'above ground' SuDS systems.



Photo – Pre-cast concrete storage units



Photo – Geo-cellular storage units

REGIONAL CONTROL

DENTENTION BASINS

Detention basins are landscaped depressions that are normally dry, only filling temporarily during storm events and emptying at a controlled rate after. Ponds can be online components, where the surface is discharged into the basin, with a restricted outlet allowing the basin to fill. They can also be offline with surface water runoff being diverted once the flows reach a specified threshold.

Unless used for sports pitches or specific landscaping, detention basins do not need to be a geometric shape.

The maximum depth of water stored during events should not exceed 2m for safety reasons.

The recommended length-width ratio for online basins is between 3:1 and 5:1.

An impermeable liner is required in areas where there is a risk of polluting the underlying aquifers, or high ground water levels.

The base of the basin should have a gentle slope, approximately 1 in 100 towards the outlet, and the side slopes should not exceed 1 in 3.

Any embankments forming part of the basin should be designed and constructed to meet the requirements of the Reservoir Act 1975, even if the basin does not come under the Act.



Photo – Detention pond



Photo – Dry detention pond

REGIONAL CONTROL

PONDS & WETLANDS

Ponds operate in a similar way to detention basins, except they have a permanent pool of water retained. This is achieved by having an outfall arrangement that varies the discharge rate based on the water level in the pond.

Ponds and wetlands can support emergent and submerged aquatic vegetation along the shoreline and in the shallows, which enhances treatment processes and has amenity and biodiversity benefits.

Ponds and wetlands are suitable for most sites.

The geometric limits of a pond, i.e. bed slope, side slopes are the same as detention ponds.

A balance between deep and shallow zones in the pond should be maintained. The maximum depth of permanent waterbody should not exceed 2m.

Keeping the water level shallow allows biodegradation but risk drying out in warm weather so deeper areas should be included.

The maximum depth of storage above the permanent water level should be limited to 0.5m for small and medium sized ponds and deeper for larger ponds if the risks can be managed appropriately.

Safety benches and maintenance access routes should be provided at an appropriate level above the permanent water level.

Like detention basins any pond embankments should be designed in accordance with the Reservoir Act 1975.



Photo – Typical wetland



Photo – Typical pond

SuDS – SELECTION GUIDE

SMALL DEVELOPMENTS

The following options are suitable for developments with 5-15 properties.

- Rainwater Harvesting
- Permeable Paving
- Soakaways
- Propriety Treatment Systems
- Bioretention Systems
- Green Roofs (Industrial/Commercial)

MEDIUM DEVELOPMENTS

The following options are suitable for developments with 15-40 properties.

- Filter Strips
- Swales
- Small Ponds / Wetlands
- Trees
- PLUS ALL OPTIONS IN SMALL DEVELOPMENTS

LARGE DEVELOPMENT

The following options are suitable for developments with more than 40 properties.

- Detention Basins
- Ponds / Wetlands
- PLUS ALL OPTIONS IN SMALL & MEDIUM DEVELOPMENTS

SuDS components should be implemented during the preliminary design stage

SuDS - Adoption and Maintenance

SuDS General Maintenance Plan

Operation

Jetting/Cleansing/De-silting
 Re-Gritting
 Annual Road Sweep
 Grass Cutting (Triple+Strim)
 Grass Cutting (Tractor)
 Herbicide Application
 Shrub Maintenance
 Grill Cleaning
 Inlet / Outlet Inspection
 Removal of Litter and Debris
 Signs/Rescue Equipment Replace

Frequency

Annually
 Once every 10 years
 Annually
 Monthly
 4 times per year
 Annually or 5 yearly
 Annually
 Annually
 4 times per year
 Monthly
 Once every 10 years

Riparian Responsibilities

Please refer to the attached link to document that must be adhered to by developers.
<https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities>



living on the edge



A guide to your rights and responsibilities of riverside ownership

Watercourses enhance our lives in so many ways and yet they can also pose a threat when in flood. They need to be respected, protected and improved for our benefit and for future generations. That is why there is a significant amount of legal safeguards that we all need to comply with.

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NLC REQUIREMENTS

NLC have additional requirements that must be met by the developers:

- The LLFA drainage team should be consulted at pre-planning stage.
- SuDS are required for all developments.
- No water should be stored above ground up to and including the 1in100 year event unless stored in a SuDS component.
- Surface water runoff should be limited for all new developments to greenfield runoff rate.
- Storage components should not be constructed in private land.
- Infiltration should only be viable for areas where the infiltration rate of the soils are above 1×10^{-6} m/s, however filter strips etc. can be used to treat runoff and convey surface water in conjunction with other SuDS components.
- Infiltration testing should be undertaken over a period of time, preferably over various seasons to obtain a range of infiltration rates.
- It is not acceptable to use the roads as flood conduits, formal overland routes should be formed from SuDS techniques if required.
- The level of betterment will be considered on a site by site basis for all brownfield sites.
- Design calculations should been undertaken with industry accepted programs e.g. MicroDrainage. The critical storm period should always be submitted.
- Please refer to document checklist for LLFA requirements to accompany a planning application.

NLC LLFA - DOCUMENT SUBMISSION CHECKLIST

Pre-app	Outline	Full	Reserved	Discharge	Adoption	Documents to be submitted
						Flood Risk Assessment / Statement
						Drainage Strategy incl. adoption and/or maintenance proposals & sketch layout plans
						Preliminary layout drawings
						Preliminary "outline" hydraulic calculations
						Desk top Ground Investigation Report (e.g. for infiltration assessment)
						Outline SuDS scheme proposals including layout and design integration into the master plan of the development
						Detailed development layout drawings showing surface water drainage infrastructure
						Full SuDS scheme proposals including adoption and maintenance arrangements
						Detailed hydraulic calculations
						Geotechnical interpretive reports (e.g. assessment of infiltration & groundwater table levels over seasonal fluctuations)
						Discharge & adoption/maintenance agreements for the full development
						Detailed flood & drainage design drawings
						Structural & ground calculations (e.g. structural design & soils stability)
						Detailed biodiversity and landscaping information
						Development Management & Construction Phasing Plan