TEES VALLEY AUTHORITIES

LOCAL STANDARDS FOR

SUSTAINABLE

DRAINAGE

VERSION July 15

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Contents

1. Executive Summary

This document has been produced by a working group from the Local Authorities of Hartlepool, Middlesbrough, Redcar and Cleveland, Stockton-on-Tees and Darlington Borough Councils. The Tees Valley Authorities are committed to making our area a place that provides the best possible quality of life for all who live and work here. Making it more sustainable is an important part of supporting this vision and it is therefore implicit that new development should incorporate sustainability measures that help achieve this goal. The Floods and Waters Management Act 2010 (FMWA) stipulates that in designing and implementing SuDS, consideration should be given to ensuring that they: reduce damage from flooding, improve water quality, protect and improve the environment, protect health and safety and ensure stability and durability of drainage

This document forms the local standards for the Local Authorities and, together with the National Standards, strongly promotes the use of Sustainable Drainage Systems (SuDS) which help to reduce surface water runoff and mitigate flood risk.

This document indicates the minimum standards to ensure a satisfactory scheme is constructed under the FWMA, they are not intended to preclude any requirement for a higher standard that may be deemed necessary. Adherence to the standards set out in the document will ensure that the Local Authority is willing to maintain the new systems on completion.

This document is intended to be used by architects, engineers, planners and developers involved in the preparation of schemes for new development. It is not intended to be a prescriptive document, although it does set certain standards which will normally be required as a condition for handover to maintenance of the new systems.

It is further intended that new ideas and approaches to design problems should not be suppressed. Developers and their designers are urged to discuss their ideas with the Local Authority at an early stage in the scheme.

Developers will find it helpful to establish at the outset the relevant policy context for any proposed development as set out in the Local Plan for the area. Similarly, the site may be subject to a development brief, the requirements of which will need to be met.

2. Background and Legislation

The Flood and Water Management Act 2010 (FWMA) was introduced to address the concerns and recommendations raised in the Pitt Report following the 2007 floods.

To aid this the Government are strengthening existing planning policy which will make clear that the Government's expectation is that sustainable drainage systems will be provided in new developments wherever this is appropriate. Local planning policies and decisions on planning applications relating to major development - developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010) - to ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate.

Each Lead Local Flood Authority (LLFA) will become a statutory consultee to the planning authority responsible for approving all surface water drainage systems for new developments in line with a set of national standards set out by government as well as the specific local standards set out later in this document.

The Planning Authority will have to be satisfied that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for on-going maintenance over the lifetime of the development.

This document has been produced as a guide for developers to enable them to submit the appropriate information to the LLFA for approval, handover and maintenance of SuDS schemes. In order to be approved, the proposed drainage system will have to meet the new standards. . It is considered that discussions need to be held at the earliest possible stage with the Planning Authority to discuss the proposals.

The FMWA stipulates that in designing and implementing SuDS, consideration should be given to ensuring that they: reduce damage from flooding, improve water quality, protect and improve the environment, protect health and safety and ensure stability and durability of drainage

3. The Application Processes

The LLFA should be involved in any pre-application discussions relating to a development as it is recognised that the best and most viable SuDS outcomes are achieved if SuDS are considered early on in the formulation of the development design and layout. It would be beneficial for a range of people to be involved at the pre-application stage, including the Local Planning Authority (LPA), LLFA, Environment Agency, sewerage undertakers, the developer, consultants, drainage engineers, landscape architects or urban designers and ecologists.

Pre-application discussions are encouraged as they will help identify the design criteria which apply to your development. No formal submission of information is required at this stage.

Any application should clearly identify who will be responsible for maintaining the sustainable drainage systems and funding for maintenance

3.1 Outline planning approval:

The LLFA will be consulted on outline planning applications. An outline planning application should therefore include a conceptual Drainage Design for the LLFA to provide comments on, otherwise more information may be required at the reserved matters stage and you may discover problems later on that will be harder to resolve.

3.2 Check List

A full checklist of items required for applications can be found in Appendix 1 at the end of this document.

4. Introduction to SuDS

SuDS manage the flooding and pollution aspects of drainage and ensure that the community and wildlife are considered in drainage design. They deliver efficiently and effectively across four key criteria:

- Quantity – SuDS reduce the risk of flooding and erosion by controlling flow volumes and the frequency of surface water runoff.
- Quality – SuDS can assist in the treatment of pollution in surface water runoff.
- Amenity – SuDS provide visual and community benefits for people.
- Biodiversity – SuDS enhance and create habitats for wildlife.

SuDS are a sequence of management practices, control structures and strategies designed to efficiently and sustainably drain surface water, while minimising pollution and managing the impact on water quality of local water bodies. These systems are more sustainable than conventional drainage methods because they:

- Manage runoff volumes and flow rates, reducing the impact of urbanisation on flooding.
- Protect or enhance water quality.
- Are sympathetic to the environmental setting and the needs of the local community.
- Provide a habitat for wildlife alongside urban watercourses.
- Encourage natural groundwater recharge (where appropriate).

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4.1 SuDS Techniques

SUDS use a number of techniques generally based on natural drainage features to collect, treat, store and then release storm water slowly to the environment. The techniques are formulated around Prevention, Source Control, Site Control and Regional Control. These in sequence are normally referred to as a SuDS Management Train.

4.2 SuDS Management Train

The most appropriate method to manage surface water is to implement a management train. Preventing the increase in surface water runoff can be facilitated by controlling surface water at all stages along the source/pathway/receptor model.

Redevelopment within all sites should seek a reduction in surface water peak discharges along the surface water runoff pathway, as close to source as is practicable.

4.3. Education

SuDS present an opportunity to educate and engage communities about water management and to grow a greater appreciation and respect for urban water

SuDS Management Train

What?	How?	Example
Prevention	Good housekeeping and site design to reduce/manage runoff and pollution	 Rain garden
Source Control	Runoff managed as close to source as possible, e.g. green roofs, permeable paving, filter drains and soak ways.	 Green roof
Site Control	Management of water in a local area, e.g. swales, detention basins	 Swale
Regional Control	Management of runoff from a whole site/catchment, e.g. retention ponds, wetlands	 Regional wetland

5. Design Standards

5.1 Local Principles and Requirements

a) Plan for SuDS

SuDS should be incorporated into the early design process (as feasible). Investing in good design and identifying the requirements, issues and opportunities for SuDS at the early stages of a project is likely to be repaid in the long-term.

b) Integrate with public spaces

Where possible SuDS should be combined with public space to create multi-functional use areas and provide amenity. For example SuDS features could be incorporated into traffic calming and parking areas (on street and car parks).

c) Manage rainfall at source

Surface water runoff should be captured as close to where it falls as possible. Management and conveyance of surface runoff should be kept on the surface as far as possible.

d) Mimic natural drainage

SuDS networks will be designed to match natural drainage routes, infiltration rates and discharges as far as possible.

e) Design for water scarcity

New development should consider incorporating rainwater/grey water re-use facilities.

f) Enhance Biodiversity

Consideration for landscape and biodiversity is critical to delivering contextually appropriate SuDS schemes.

g) Link to wider landscape

Opportunities to link SuDS to existing or potential future blue and green infrastructure should be explored. Suds schemes should fit with the local landscape character. Designers should take advantage of local topography and other landscape features such as trees, hedgerows, fence lines and local materials to enhance local character.

h) Design to be maintainable

It is extremely important that from the outset maintenance requirements for SuDS are considered and reflected in the design. Throughout the process, it should be considered how features can be accessed, who will be responsible for maintaining them and how much it is likely to cost. Good management and design go together.

i) Use a precautionary approach

    The natural floodplain must be protected and considered in design. Developments within the fluvial floodplain need to be avoided because SuDS will be ineffective when flooded.

    SuDS should be carefully designed where there is the presence of contaminated soils.

    System components should be designed to maximise their adaptive capacity.

j) Have regard to the historic environment

    SuDS design and construction should be complementary to the heritage of the area

k) Show attention to detail

    SuDS must be carefully designed using attention to detail to ensure they function as intended

l) All SUDs elements should be designed to minimise risk to the general public.

5.2 Exemptions

- form part of the strategic road network (Highways Agency infrastructure)
- form part of the national rail network
- come under 100m2 of permitted development

5.3 Structural Integrity

SuDS need to be designed to mitigate risks of structural failure or unacceptable deformation of drainage system components or other infrastructure over the proposed development design life. The design should also facilitate the replacement/or repair of drainage components, reduce unnecessary maintenance and replacement of drainage or other infrastructure. This statement applies to all elements of the SuDS including green infrastructure.

Any drainage component installed below or adjacent to other infrastructure, such as highways, should have a design life compatible with the adjacent infrastructure. Conversely, any adjacent infrastructure should have a design life compatible with the drainage infrastructure.

Components which need to be replaced or repaired during the design life should be designed to be accessible without undue impact on the adjacent infrastructure or drainage system.

Material must not react and/or degrade over time to the detriment of the system or adjacent infrastructure

The suitability of the material proposed for a particular drainage component should be assessed as fit for purpose.

5.4 Compliance Assessment:

Compliance with structural integrity requirements would be demonstrated by:

- Provision of information relating to the design life of the components and/or adjacent infrastructure. This includes information regarding materials and installation, including any compliance with relevant standards.
- Health and Safety assessment
- Consideration of all relevant infrastructure, and structural calculations if appropriate

For those components which have a shorter design life than the development, then a repair/replacement procedure must be included within the maintenance plan as further discussed in Section 12. With this scenario, a commuted sum will also be requested.

5.5 Health and Safety

The main health and safety concerns regarding SuDS include

- The risk of drowning.
- Waterborne disease.
- The risk of wildfowl strikes to aircraft near airports.

Good design practice that reduces risk includes:

- Fences are generally not required as part of a SUDS scheme, however where toddlers under 5 may have unsupervised access to open SUDS features, a toddler-proof fence 600-750mm high will be appropriate. Fences generally can create their own hazards, prevent rescue and become visually unacceptable.
- A level dry bench at the top of all open structures, minimum of 1.5m wide, allows stationary rest and safe access
- Slopes of 1 in 4 or less allow people to enter and leave SUDS features easily and safely.
- Safe maintenance access is required for appropriate machinery.
- A wet bench, minimum of 2m wide, to all water features allows a stationary rest and safe access at the water's edge.
- A minimum permanent depth of 1.2m for wetlands and ponds is considered acceptable for SUDS and wildlife needs, unless the feature is designed as an amenity lake.
- Unrestricted visibility is required to all accessible water features.
- Dense marginal planting is advised to reduce accidental access to water but should not obscure visibility.

- Minimum freeboard 150mm.
- Headwalls, manholes, inlets, outlets, control structures and other sumps or hard vertical surfaces that can be a trip hazard or create a hard surface near open water should generally be located a safe distance from the water's edge.
- All structures in the SUDS landscape should be assessed for health and safety during the design process.

Wherever possible, surface water runoff from roads and hard standing should pass through a filtering structure like under-drained swales, bioretention and permeable pavement to enhance trapping of potential contamination.

Where ponds and other habitat associated with SUDS are located within eight miles of an airport, guidance provided by the Civil Aviation Authority (CAA) should be followed which minimises the risk of aircraft bird strike. Further information can be found in The SUDS CIRIA C697 Manual 20.3.5.

There is a potential risk of waterborne infection of Weil's disease and Leptospirosis which is transmitted through open cuts through the vector of rat urine, and should be considered in the management of open water features. It is important to recognise that the risk of infection is low.

Where ponds, either singularly or in combination with adjoining SuDS, fall under the Reservoirs Act 1975 or the Flood and Water Management Act 2010, then additional requirements may be needed.

The Construction (Design and Management) Regulations 2007 (CDM) must be applied to the planning, design, construction and long term maintenance of SUDS and a risk assessment undertaken for the design, construction and future maintenance (see The SUDS Manual CIRIA C697), for example:

- All SUDS features must provide safe access for maintenance.
- All SUDS features must provide a safe environment for the general public.
- Access points for vehicles should be level, secure and stable.

As part of the submission to the LLFA it will be a requirement for the risk assessment to be included.

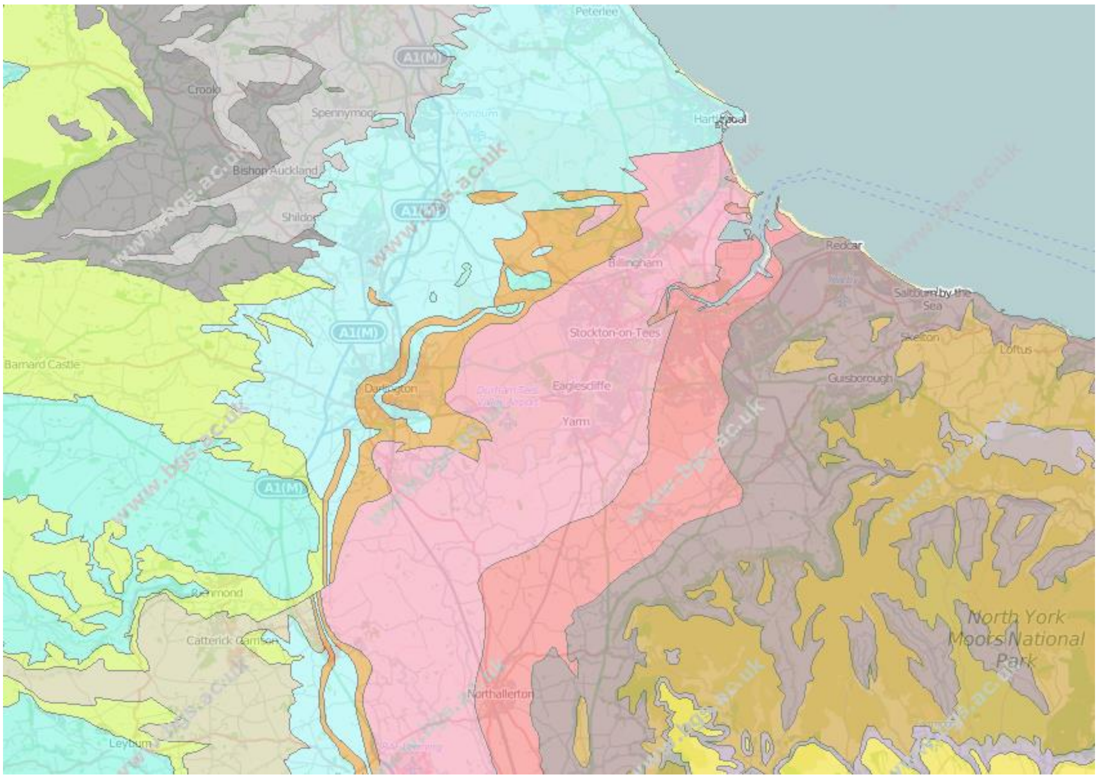
Danger signs and lifesaving equipment should not be necessary where the conditions set out above are followed, as SUDS should be considered inherently safe features in the landscape.

The drainage designer will demonstrate that amenity has been provided in the SUDS design and that all components conform with recognised health and safety best practice as required by the local authority.

6 Design Criteria

6.1 Geology,

The superficial geology, of the area will be an important factor in determining the types of SuDS that can be used at the proposed development sites. The bedrock geology of the upper and middle Tees Valley is largely carboniferous, with alternating limestones, shale, sandstones and thin coal seams and Millstone Grit. Towards the lower reaches of the Tees, the estuarine geology is Triassic marls and sandstones. Strategic scale mapping of the geology and soils in the Tees Valley shows predominant soil type to be slowly permeable, seasonally wet basic loams and clays. There are smaller areas of freely draining loamy soils.



Courtesy of BGS

KELLAWAYS FORMATION AND OXFORD CLAY FORMATION (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE

RAVENSCAR GROUP - SANDSTONE, SILTSTONE AND MUDSTONE

LIAS GROUP - MUDSTONE, SILTSTONE, LIMESTONE AND SANDSTONE

TRIASSIC ROCKS (UNDIFFERENTIATED) - SANDSTONE AND CONGLOMERATE, INTERBEDDED

ZECHSTEIN GROUP - DOLOMITISED LIMESTONE AND DOLOMITE

PERMIAN ROCKS (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE

ERMIAN ROCKS (UNDIFFERENTIATED) - SANDSTONE AND CONGLOMERATE, INTERBEDDED

ENNINE UPPER COAL MEASURES FORMATION - MUDSTONE, SILTSTONE, SANDSTONE, COAL, IRONSTONE AND FERRICRETE

OREDALE GROUP - LIMESTONE WITH SUBORDINATE SANDSTONE AND ARGILLACEOUS ROCKS

6.2 Rainfall

The Tees Valley has an oceanic climate typical for the United Kingdom. Being sheltered by Pennines to the West. The Tees Valley is in one of the relatively drier parts of the country, receiving on average 660 millimeters of rain a year.

10 year average rainfall data for Tees Valley

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation mm	54.3	43.5	40.4	55.7	43.2	64.4	49.5	65.1	62.3	63.7	58.2	59.2

6.3 Infiltration Assessment

The following considerations should be fully evaluated before determining the extent to which infiltration can be used on a site:

- The infiltration capacity of the soil;
- The risk of ground instability or subsidence as a result of infiltration;
- The risk of slope instability or solifluction as a results of infiltration;
- The risk of pollution from mobilising existing contaminants on the site;
- The risk of pollution from infiltrating polluted surface water runoff from the site;
- The risk of groundwater flooding as a result of infiltration;
- The risk of groundwater leakage into the combined sewer as a result of promoting infiltration on the site.

A Ground Investigation should assess the soil infiltration rate, depth to groundwater and, if necessary, note any geotechnical implications.

6.4 Soil Infiltration Rate

The infiltration rate of the ground should be determined within a site specific trial pit(s), ideally in the approximate location of the proposed soak away. For potentially large area soak ways (size??), a trial pit should be dug at intervals of approximately every 10m. Trial pits should be dug to the same depth as that anticipated for the proposed soak away (around 1.0m –1.5m below the anticipated invert level of the pipe discharging to the proposed soak away); be between 0.3m – 1.0m wide; and, approximately 1m – 3m long, with trimmed vertical sides. The trial pit(s) should be rapidly filled three times to its 'effective depth' (i.e. the anticipated soffit level of the soak away structure) within the same, or on consecutive, day(s). The depth of water should be recorded at regular intervals on each occasion, until the trial pit(s) is near empty. The soil infiltration rate should be calculated as prescribed in BRE Digest 365, and is the recommended method that should be adopted for all proposed soak away designs within the Tees Valley area. The average calculated infiltration rate should be used for design purposes.

6.5 Depth to Groundwater

To ensure the adequate performance of a proposed soak away structure and in accordance with the requirements of the Environment Agency, a minimum 1.0m 'buffer' should be ensured between the bottom of a proposed soak away structure and the groundwater table.

6.6 Peak flow control

The drainage design should be tested using 1 in 1, 1 in 2, 1 in 30, 1 in 100 and 1 in 100+ climate change rainfall events to determine the maximum storage volume.

The design rainfall events should be applied for the critical site duration and must include the recommended climate change allowance. The impermeable area of the development must also include an allowance for urban creep. [BS 8582]

Where site run-off is to be discharged to the surface water sewer or combined sewer, the sewerage undertaker should be consulted as to whether any additional or alternative discharge controls are required.

Where site run-off is to be discharged to a highway drainage network, the highway authority should be consulted as to whether any additional or alternative discharge controls are required.

Where run-off rates from the development are greater than the allowable discharge rates from the site, attenuation storage systems should be used that fill and allow events up to the design return period to be adequately controlled.

To meet peak flow rate design criteria for the site, there should be a form of hydraulic control upstream of the point of discharge.

Any minimum requirements for pipe or throttle sizes should be agreed with the LLFA. The risk of blockage from sediment or other debris should be minimized by including mitigation measures in the design.

In order to control flows for both the 1 and 100 year return period events, two or more flow control components or a multi-level system should be included in the design. Achieving multiple level flow control is challenging and therefore reasonable tolerances to achieving the criteria are required.

Surface runoff from previously developed land which has ceased to be in use for a period of time beyond 10 years, may not be able to be accommodated in the downstream surface water system due to recent development in the locality which has taken up the surplus capacity from the site. In these cases the peak runoff rate must be discussed in detail with the approving body to consider the viability of development and other system impacts.

6.7 Volume Control

It will be a requirement for the runoff volume from the developed site to any highway drain, sewer or surface water body in the 1 in 100 year, critical duration rainfall event to not exceed the greenfield runoff volume for the same event.

If this is not reasonably practicable the designer must demonstrate that:

- The volume of storage required would lead to the development becoming unviable
- The volume of storage required could not be accommodated on the development site

6.8 Off-site flood risk

Only coastal or estuarine waters can be deemed sufficient to accommodate uncontrolled surface water discharges. Any discharge to coastal or estuarine waters may require Environment Agency consent in line with Environmental Permitting Regulations for discharge to controlled waters, as well as consent from the Marine Management Organisation for any building of infrastructure within the marine environment.

Flows from exceedances that cannot be contained within the drainage system shall be managed in flood conveyance routes: the primary consideration shall be risks to people and property both on and off site.

If the proposed system connects to an existing drainage system, whether it is a sewer, highway drain, water body or sustainable drainage system, consideration must be given to the operational capacity and functionality of the existing system to ensure that no adverse impacts result or flood risk is increased within the site. For example:

a) Surcharge within an existing system must be prevented from entering the approved drainage system and increasing the flood risk and possible water quality impacts (e.g. connection to a combined sewer must incorporate a non-return valve to prevent contamination of the surface water system)

b) The existing system may be required to be redesigned or resized to accommodate additional flows from an approved system.

6.9 Flood risk within the development

For the design to demonstrate that the drainage system accommodates the 1 in 30 year rain fall event design calculations will be required to be submitted, preferably as mdx files, with any drainage application to support all the design criteria, including, but not limited to, climate change.

Other drawings, plans and specification, as required by the approving body to demonstrate functioning of the drainage system, will also be required.

Flow paths should be clearly shown for the above and below ground drainage system to demonstrate that flooding does not occur in any part of building or utility plant for the design areas. Flow routes should be clearly shown for events that overwhelm the system to demonstrate that conveyance routes minimise risks to people and property on or off site.

6.10 Managing Runoff

Drainage design should always aim to make as much use of the runoff as practicable, discharging the remainder to the ground or surface water bodies in a way that allows for evaporation, evapo-transpiration and further infiltration by managing water at the surface. There may be a number of runoff destinations, flow rate and volume standards that the LLFA are likely to take into account when approving SuDS and drainage plans. There are likely to be four tiers of runoff destination that you should be aware of:

1) into the ground
2) into a surface water body
3) into a surface water sewer
4) into a combined sewer

Depending on conditions, water can drain from a site using a combination of these tiers, although where possible water should be managed at source, on the surface and allowed to infiltrate into the ground. Water should only be discharged to a combined sewer if specific criteria in the National Standards are not met. Runoff should be managed as close to the source as possible, and as many of the SuDS components should be visible on the surface.

It is intended that peak flow rate and volume of runoff only need to be considered if infiltration does not occur. These standards aim to limit the peak flow rates for a range of rainfall events and to return runoff rate to greenfield levels. As infiltration can have significant impact on reducing runoff, peak flow rates and volume of runoff only need to be considered if infiltration does not occur.

The discharge rates from the site will be restricted to the existing greenfield run off rates, (QBAR value) with sufficient storage within the system to accommodate a 1 in 30 year storm. For sites <50ha the method used for calculating existing greenfield run off should be the ICP SUDS method. The design shall also ensure that storm water resulting from a 1 in 100 year event with a 30% increase for climate change and surcharging the drainage system can be stored/attenuated on site without risk to people or property and without overflowing into drains or watercourses.

For previously developed sites, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as the greenfield runoff rate from the site for the same rainfall event. Whilst this may not always be practicable, for any deviation the design must demonstrate that the control to the greenfield rate is not achievable by one or more of the following criteria:

- The volume of storage required would lead to the development becoming unviable
- The volume of storage required could not be accommodated on the development site

6.11 Interaction with utilities

Where ever possible utility apparatus should avoid being placed/routed through any SuDS feature, if this is unavoidable early discussions with the relevant Authority/Engineer should be held. Where SuDS features are adopted as highway, by the Highway Authority, the highway will be designated under section 63 of the New Roads and Street Works Act 1991 as 'Special Engineering Difficulty'.

6.12 Materials

The materials specified for the SuDS components must be fit for purpose. Construction of the drainage system must be in accordance with approved plans Specification sheets for materials used in construction

6.13 Affordability

Where compliance with the Standards would necessitate a drainage system that is more expensive, taking into consideration whole life costs, than an equivalent conventional design then full compliance is not required. Instead the drainage system must comply with the standards to the greatest extent possible, without exceeding the cost of the equivalent conventional design.

Requests for a relaxation of the standards on the grounds of affordability will have to be evidenced and substantiated

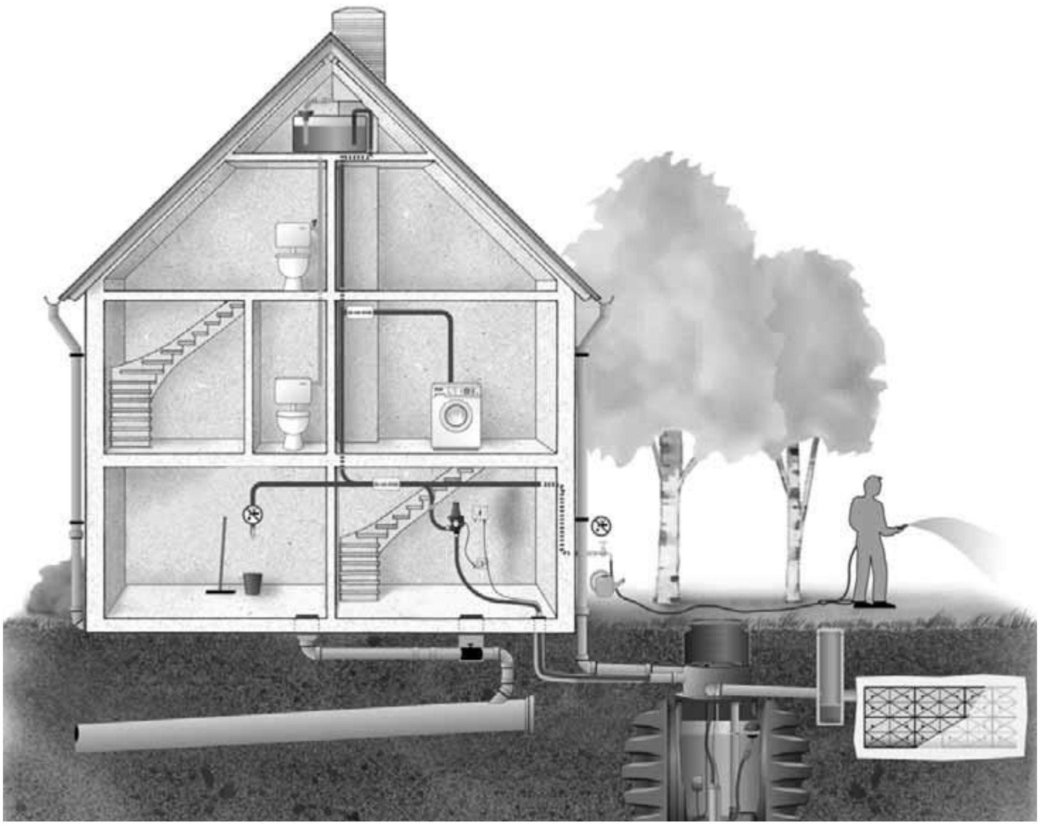
7. SuDS Components

Hydraulic – SuDS must be designed to mitigate the flood risk to the developments and occupants and that off-site flood risk is not increased. Where possible SuDS should aim to reduce the overall risk of flooding off-site and drain via infiltration as a preference.

7.1 Rainwater Harvesting (Ref CIRIA SuDS Manual Chapter 6)

Rainwater harvesting is the process of collecting and using rainwater. If designed appropriately the system can be used to reduce the rates and volumes of runoff

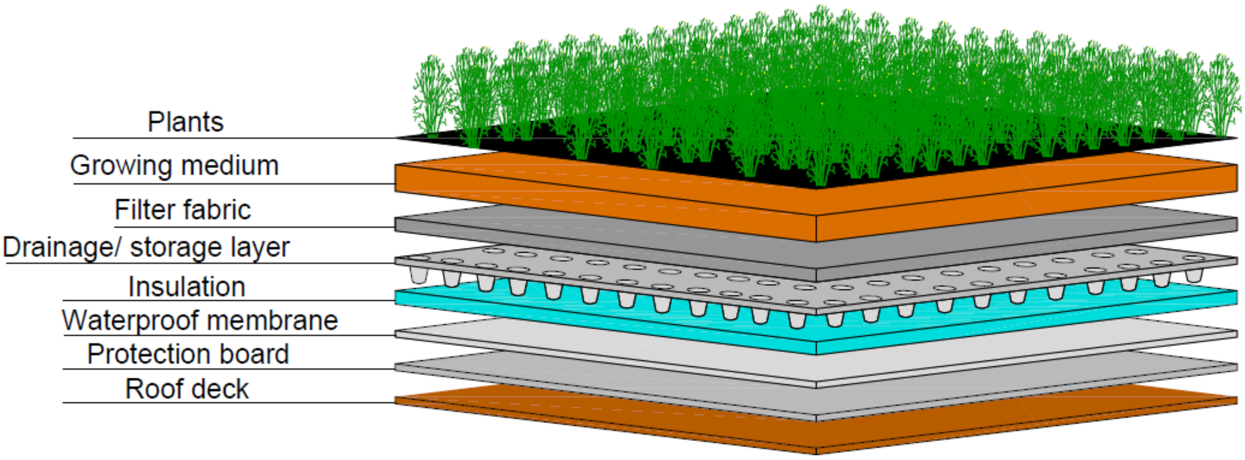
- Can range from complex district-wide systems to simple household systems linked to a water butt
- Most simple rainwater harvesting systems are relatively easy to manage
- Rainwater harvesting system can be combined with grey water recycling systems to form an integrated process



A conceptual rainwater harvesting system

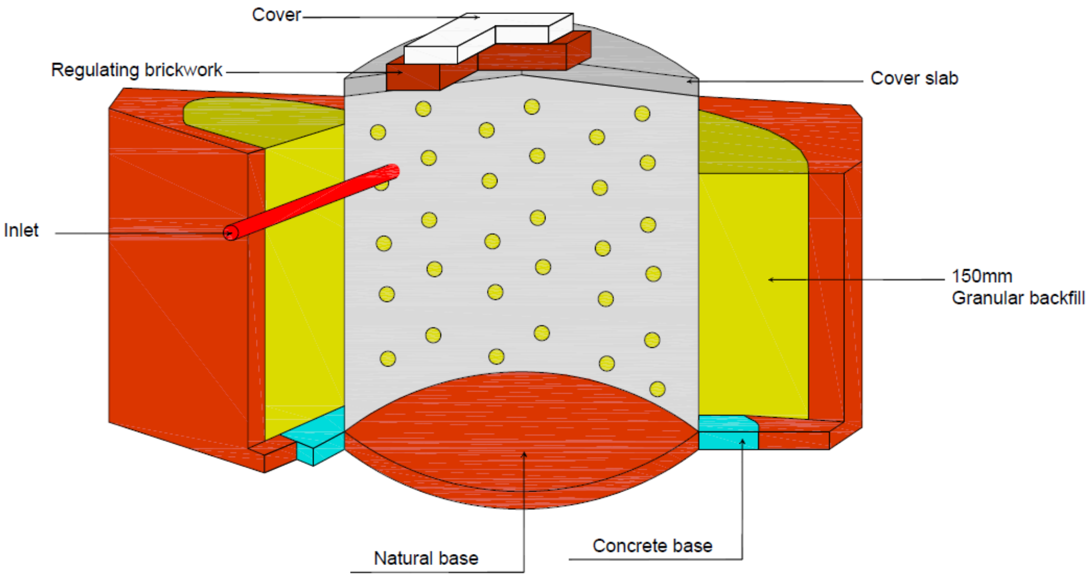
7.1.1 Green roofs are a multi layered system for intercepting and storing rainwater. They often comprise a waterproof membrane overlain with granular material, topped off with low maintenance planting such as sedum to reduce or eliminate run-off from roof areas

They add weight to the structure so should be considered at the construction stage of a new build. For an existing building, an extensive system is recommended as it adds less weight, but you should always consult an engineer to make sure that the structure is safe.

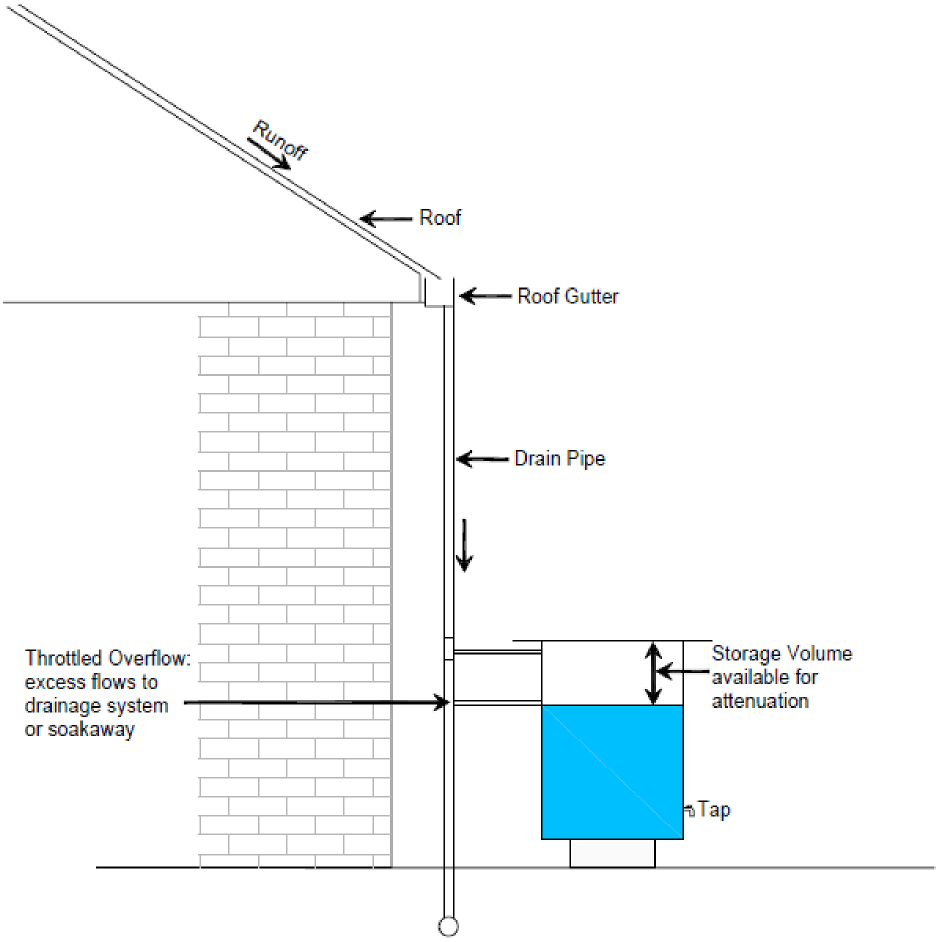


7.1.2 Soakaways can be **s**quare or circular excavation, filled with suitable aggregate or lined with brickwork, or pre-cast storage structures surrounded by granular backfill. They can be located in hard or soft areas and surfaced to match adjacent areas.

- Should be designed for the 1 in 10 year rainfall event as a minimum
- Infiltration testing carried out in accordance with BRE Digest 365
- Filter material should provide >30% void space
- Base of soakaway at least 1m above groundwater level
- Minimum of 5m away from foundations



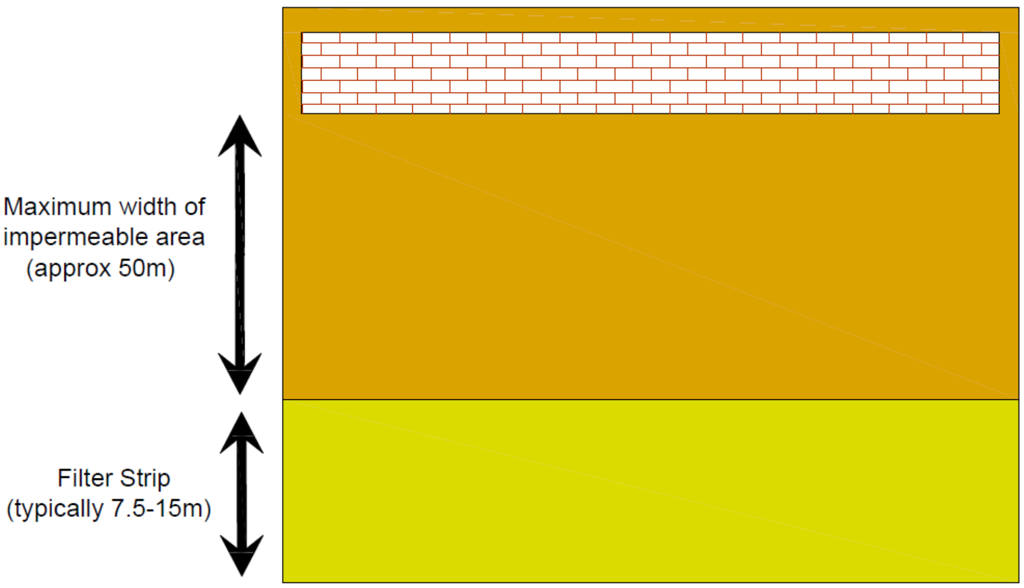
7.1.3 Water butts are the most common means of harvesting rainwater for garden use. They are small, off-line storage devices that are designed to capture and store roof runoff. They should not be taken into consideration when calculating drainage sizes.

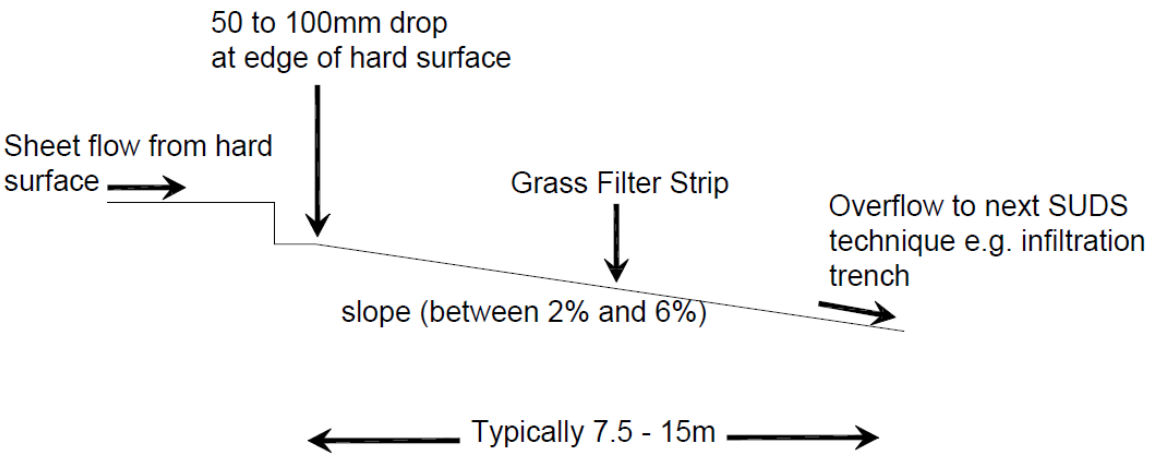


7.2 Filter strips (Ref CIRIA SuDS Manual Chapter 8)

Vegetated strips of land designed to accept overland sheet flow

- Runoff must be evenly distributed across the filter strip
- Gradients not exceeding 1 in 20 and a minimum of 1 in 50

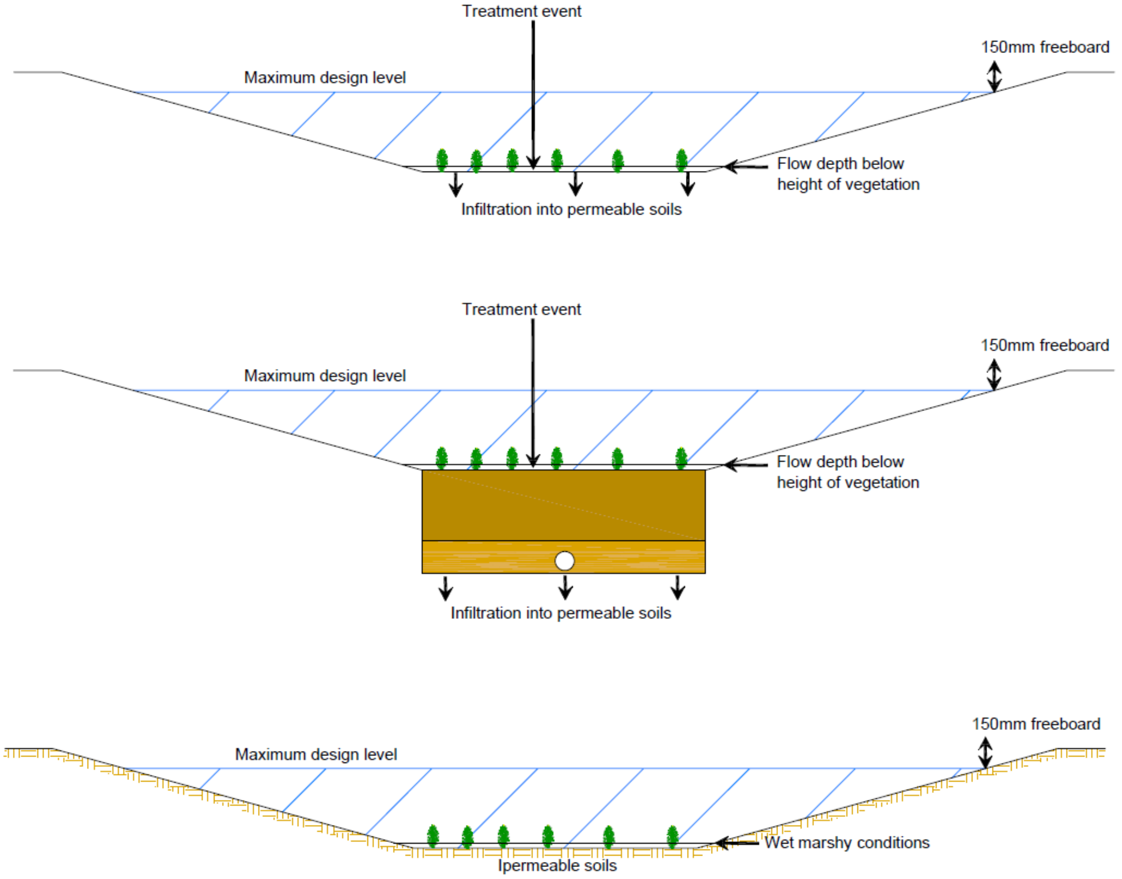

Maximum width of
impermeable area
(approx 50m)
Filter Strip
(typically 7.5-15m)


50 to 100mm drop
at edge of hard surface
Sheet flow from hard
surface
Grass Filter Strip
Overflow to next SUDS
technique e.g. infiltration
trench
slope (between 2% and 6%)
Typically 7.5 - 15m

7.3 Swales (Ref CIRIA SuDS Manual Chapter 10)

Linear vegetated features in which surface water can be stored or conveyed. Can be designed to allow infiltration where appropriate.

- Swales should be shallow with side slopes no more than 1 in 4 to allow flow across the edge, easy maintenance and for safe access.
- Swale depth should not exceed 450mm wherever possible.
- A 100-150mm depth for normal flows uses the vegetation to reduce flow and allow filtration.
- A maximum 300mm storage above normal flow depth, to include freeboard if necessary.
- Flow rate should be restricted to 1-2m/s or 1 in 50 maximum gradient to prevent erosion and ensure effective pollution control. Check dams and other flow restrictions should be used if the layout is steeper
- A minimum base width of 0.5m
- Reasonable access for maintenance by mowers should be provided.



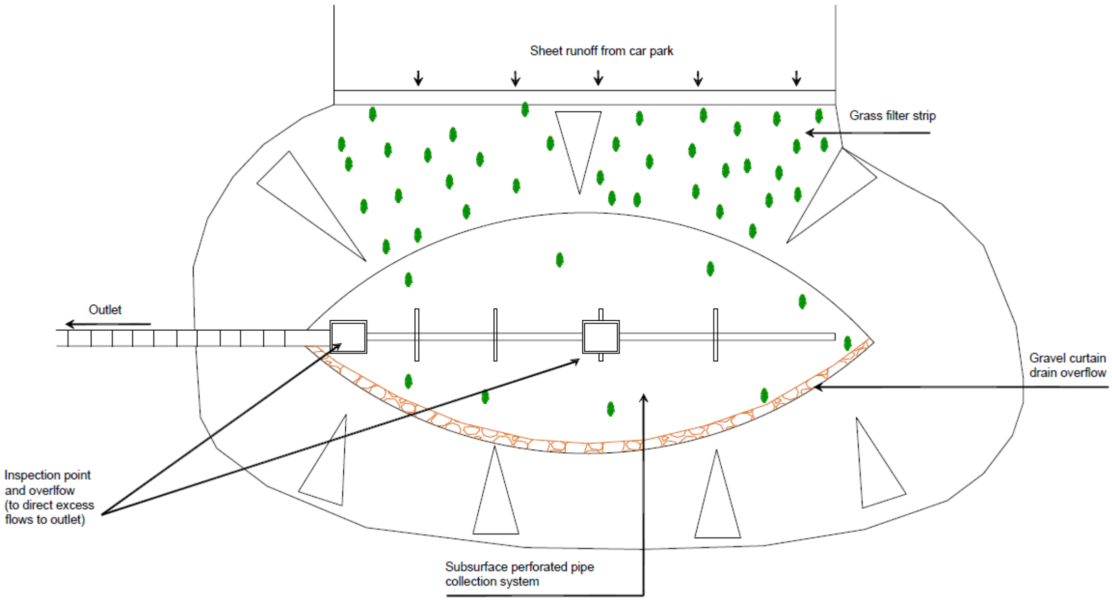
7.4 Bioretention areas and Rain Gardens (Ref CIRIA SuDS Manual Chapter 11)

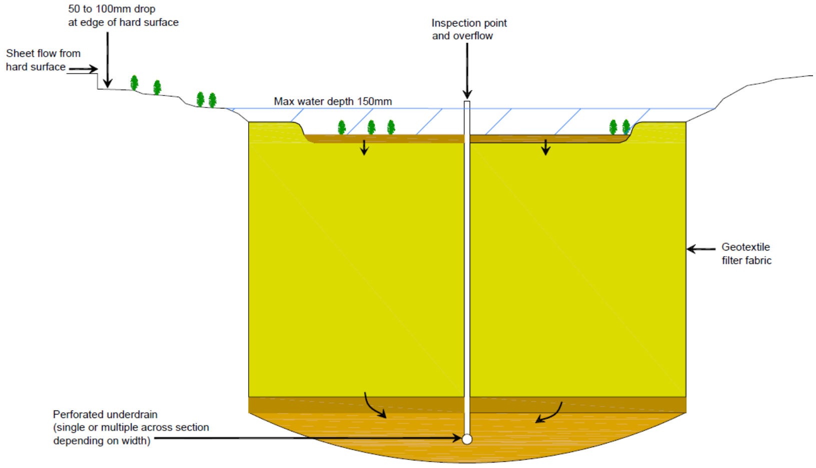
Bioretention areas and raingardens are planted areas that are designed to provide a drainage function as well as contribute to the soft landscape.

They are located where surface water runoff flows from surrounding impermeable hard surfaces and collect the polluted first flush volume in shallow planted basins.

A bioretention area should collect and temporarily store the treatment volume or first flush volume (10-15mm from contributing hard surfaces) at a usual depth of 150mm.

- A grass filter strip or silt forebay for point inlets is required to control siltation and blockage of the basin.
- The water must drain down within 24 hours to anticipate the next storm.
- They should be constructed at least 1m above the groundwater table.
- They usually require a drainage layer with perforated pipe and overflow.
- Should be planted to enhance the local landscape with robust species appropriate to the site and drainage requirements





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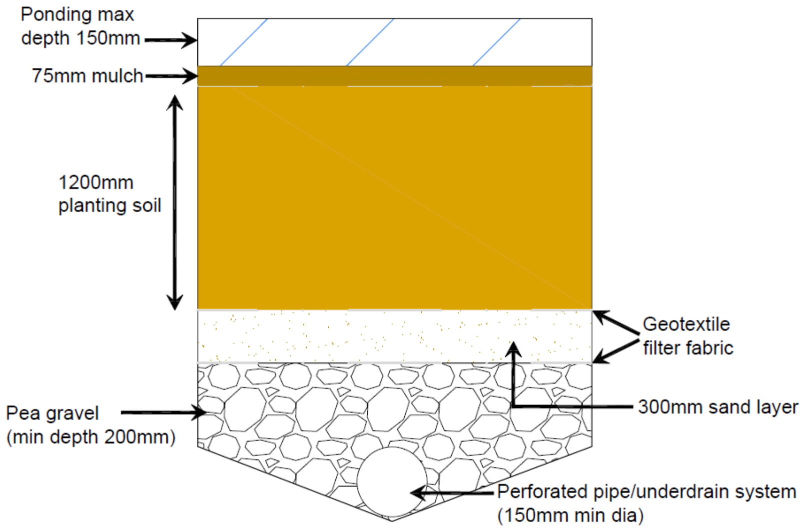
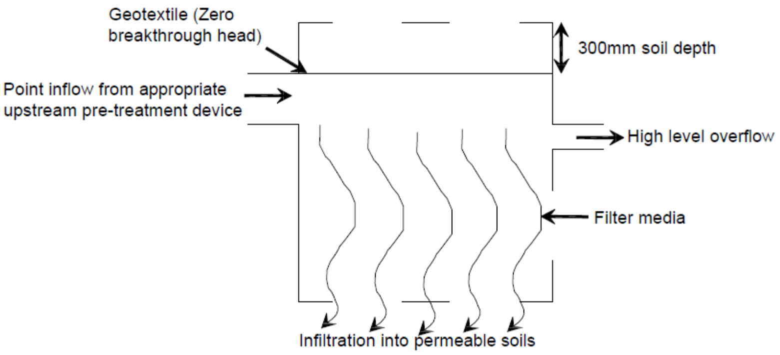


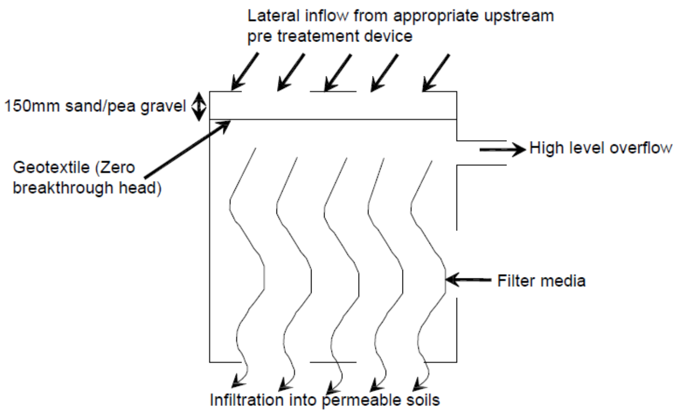
7.5 Filter drains and trenches (Ref CIRIA SuDS Manual Chapter 9)

Filter drains and trenches (often called French drains) are linear excavations filled with a suitable aggregate that ideally collect surface water runoff laterally as sheet flow from impermeable surfaces, although point inlets can be used with care to prevent damage to the structure.

- Effective upstream pre-treatment to remove sediment and fine silts. A perforated pipe may be appropriate to convey water onward from the drain and should include access for rodding or jetting with open outfalls.
- Perforated pipes should normally be provided for the last few metres of the trench to maximise filtration.
- The edge of the drain should be level to encourage sheet flow and prevent gully erosion where taking a lateral flow.



(a) Infiltration trench point inflow



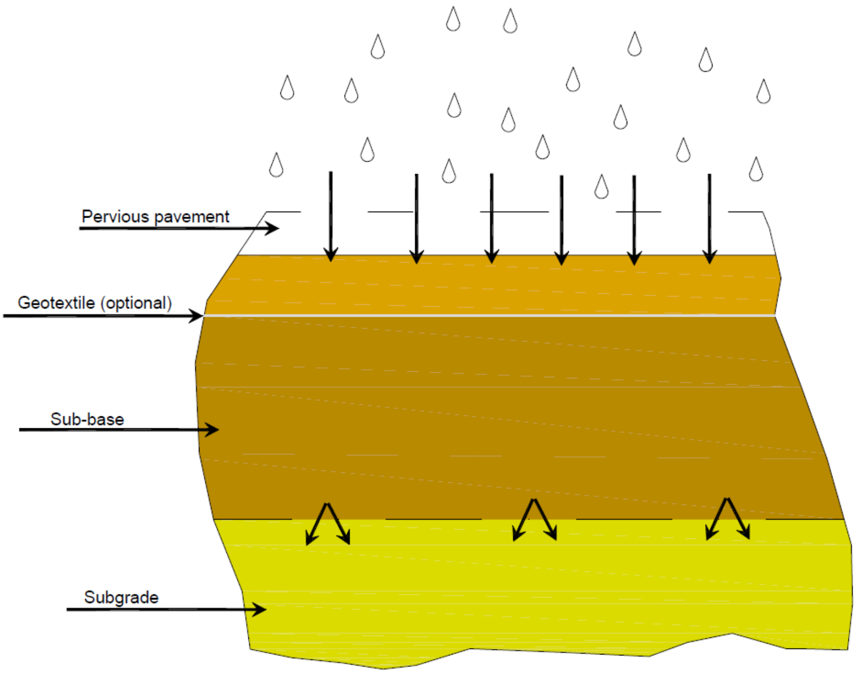
(b) Infiltration trench lateral inflow

7.6 Permeable pavements (Ref CIRIA SuDS Manual Chapter 12)

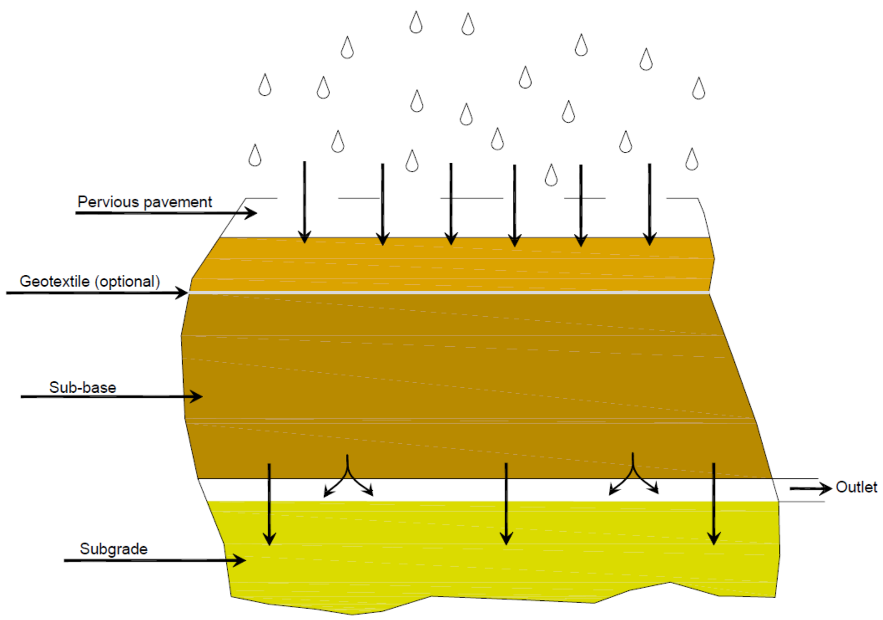
Permeable pavements provide a surface that is suitable for pedestrian or vehicular traffic while allowing surface water runoff to percolate directly through the surface into underlying open stone construction.

- Permeable pavements need to be designed structurally to meet loading and traffic requirements.
- Storage must be sufficient for infiltration rates or to meet attenuation requirements.
- The use of a geotextile as an upper separating or treatment layer may be considered as an option depending on site constraints.
- Pervious surfaces are susceptible to silt blockage and surrounding landscape details, slopes and maintenance plans must take this into account.
- Sub-bases can be augmented with geocellular structures with the advantage that surface water runoff is clean before it enters underground storage.
- Utility apparatus would not be allowed in these areas

Permeable pavements that are adopted as highway, by the Highway Authority, will be designated as 'Special Engineering Difficulty' by the Highway Authority.



Pervious pavement system types: Type A – total infiltration



Pervious pavement system types: Type B – partial infiltration

7.7 Geocellular structures, oversized pipes/ tanks (Ref CIRIA SuDS Manual Chapter 13)

Modular plastic geocellular structures, with a high void ratio, are a below ground storage arrangement that can replace underground pipes or tanks that have been used to store water. These should be designed to the current Sewers for Adoption and manufactures recommendations.

It is important to recognise that all below ground storage structures only provide attenuation of surface water runoff and not treatment. Cleaning of surface water runoff, preferably before entering the structures, is required before release to the environment.

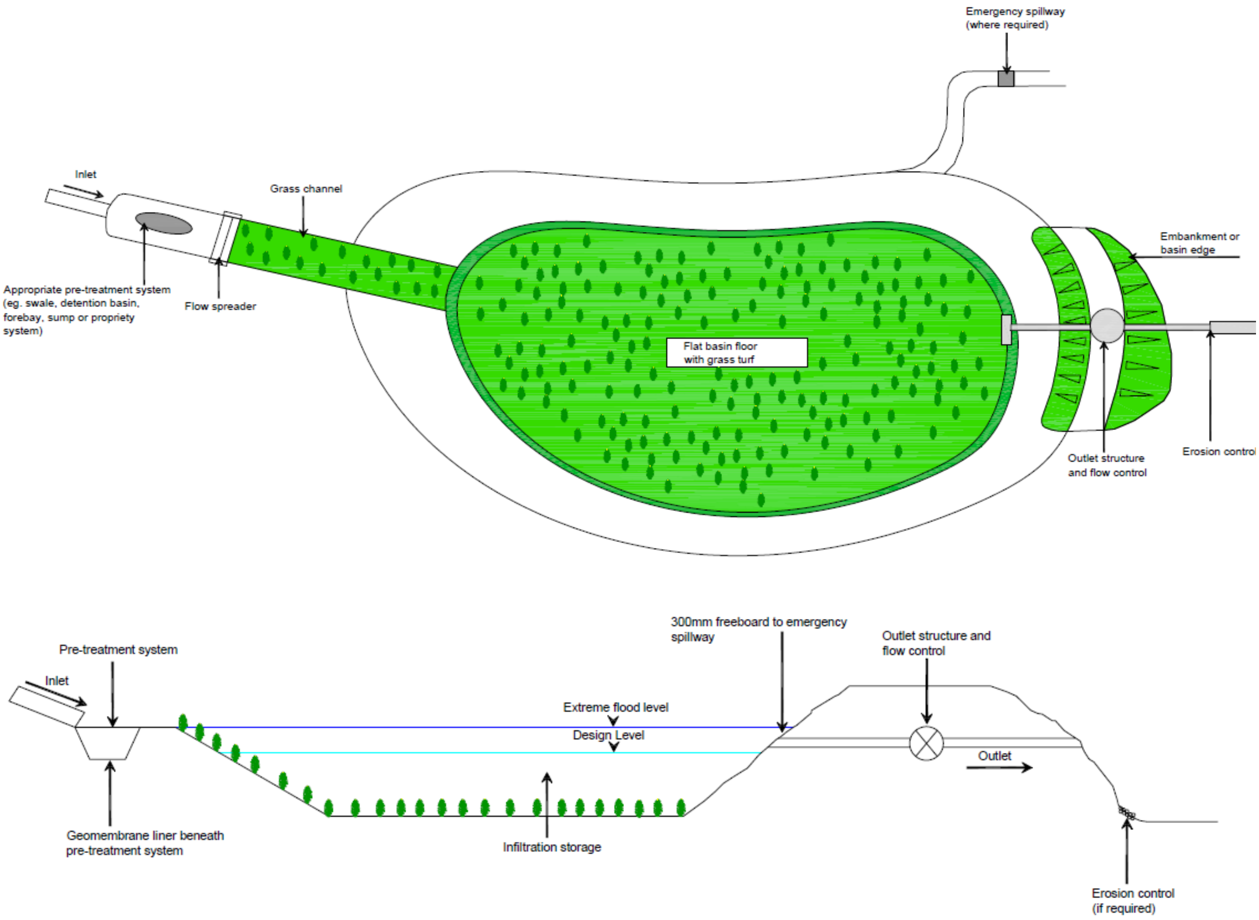
- Structural design must be provided to ensure integrity of the box, pipe or tank under loading.
- Silt interception and management arrangement is critical to long-term effectiveness of these structures and this must be demonstrated at design stage and confirmed for the design life of the development.
- Standard storage design using limiting discharges to determine storage volumes

7.8 Infiltration Basins (Ref CIRIA SuDS Manual Chapter 15)

Infiltration basins are similar to detention basins except that they are designed to allow water to soak into the ground as well as provide storage.

- The infiltration potential of the soil and subsoil must be confirmed by geo-technical tests.

- The stability of the ground must be confirmed and an analysis of likely infiltration pathways and risk to surrounding features undertaken.
- Silt and pollution must be removed upstream in source control features.
- An inlet flow spreader is required to distribute flows across the basin ideally using a widening grass channel inlet.
- The base should be level across the basin to encourage even infiltration with a slight fall of between 1 in 100 and 1 in 200 along the basin to distribute water evenly.
- The water table should be at least 1m below the surface.
- Side slopes to the basin should be 1 in 4 maximum with clear access for maintenance.
- Basins require an overflow to allow for design exceedance or outlet blockage.

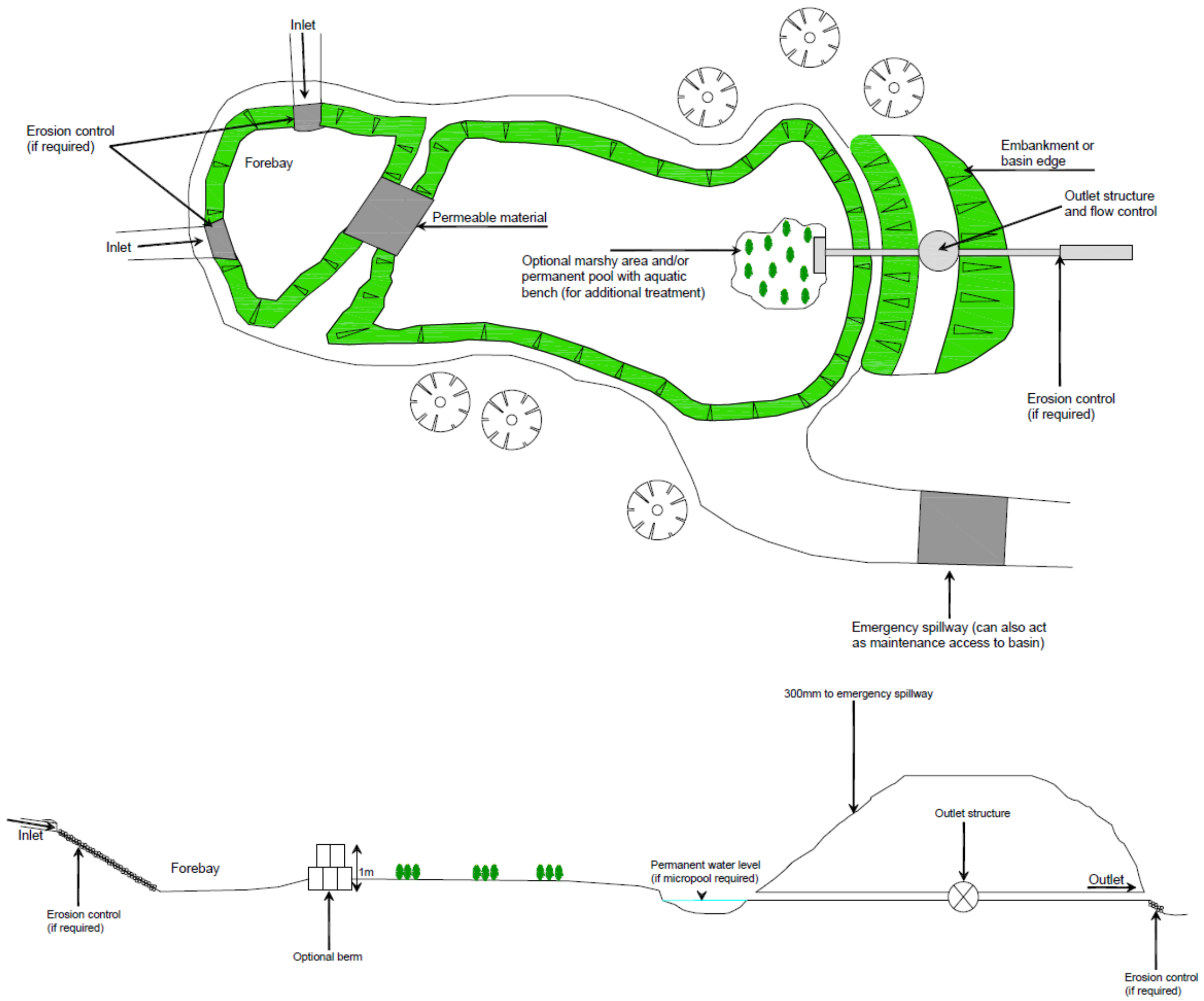


7.9 Detention basins (Ref CIRIA SuDS Manual Chapter 16)

Detention basins are vegetated depressions in the ground designed to store surface water runoff and either allow it to soak into the ground or flow out at a controlled rate.

They should be designed as landscape features that allow other leisure uses when dry, visual enhancement and habitat creation. These opportunities are enhanced when there are source control features upstream that prevent silt and pollution reaching the basin and reduce the frequency at which surface water runoff reaches the basin.

- Silt should be intercepted at source wherever possible or be intercepted in a forebay where surface water runoff enters the basin.
- Surface water runoff should flow into the basin as controlled sheet flow from source control features to reduce the risk of erosion but if entry is uncontrolled through a point inlet then an erosion control structure will be necessary to manage the flow.
- Detention basins should have a 2:1 to 5:1 length to width ratio to provide maximum opportunities for settlement at the inlet and filtration of surface water runoff.
- There should be a gentle fall to the outlet of about 1 in 100 to encourage surface sheet flow by gravity.
- A controlled outfall at or just below ground level is usual to ensure drain down unless preceded by a micro-pool. This ensures a generally dry surface when it is not raining. A micro-pool enhances treatment, avoids a muddy area at the outlet and provides biodiversity interest.
- Side slopes to the basin should be 1 in 4 maximum, with clear access for maintenance.
- Basins require an overflow to allow for design exceedance or outlet blockage.

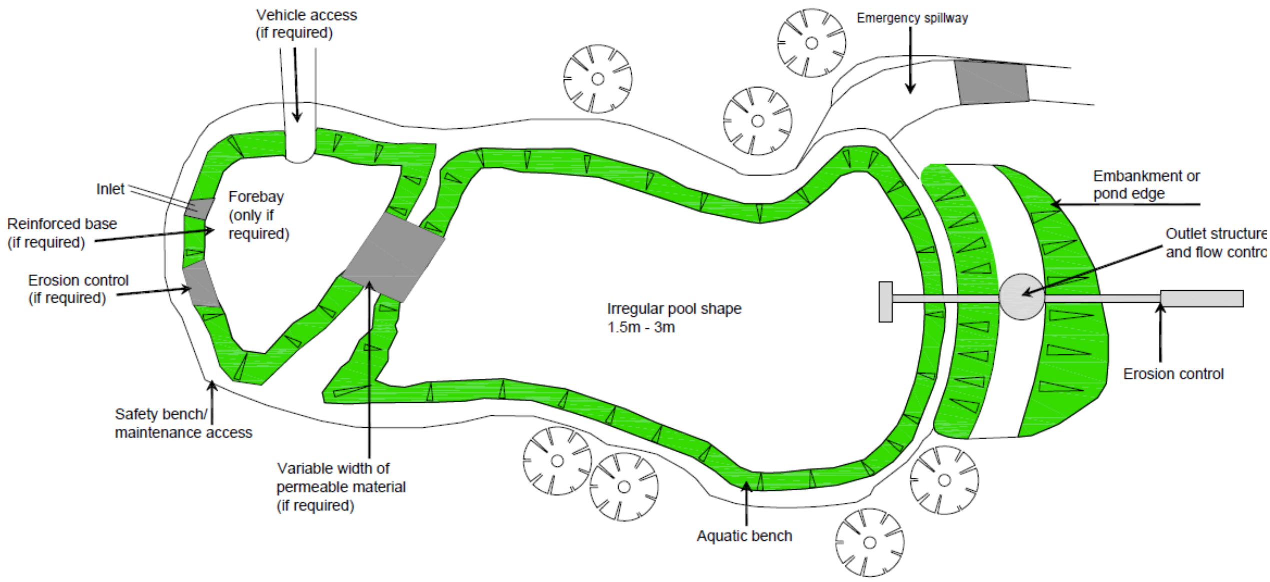


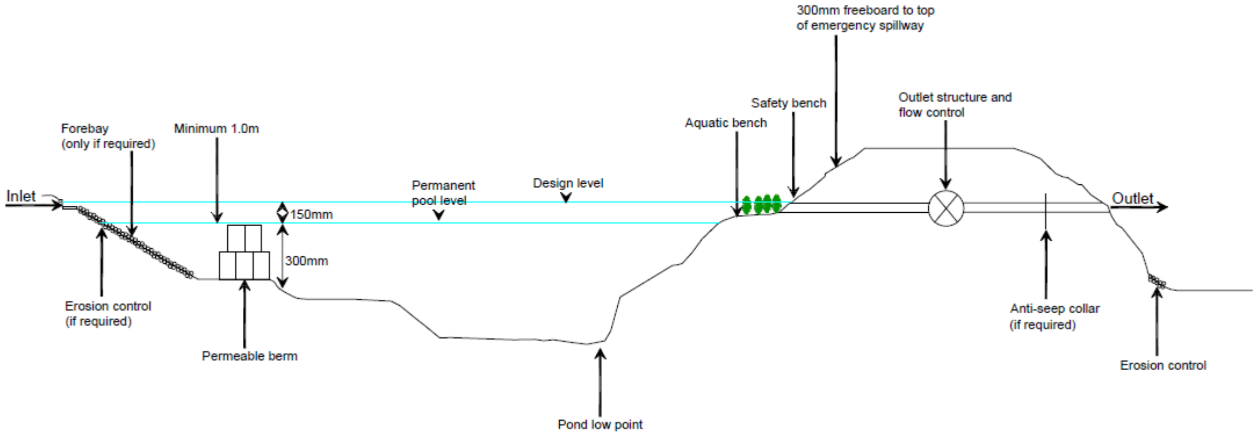
7.10 Ponds (Ref CIRIA SuDS Manual Chapter 17)

SUDS ponds are usually separate structures with a storage capacity above the permanent water volume and a defined edge design to satisfy safety concerns. In all other characteristics they should mimic natural pond systems. Ponds and wetlands should be designed to receive silt-free surface water runoff with light loading of dissolved pollution that can be processed in the water column by microorganisms.

- SUDS ponds should mimic natural ponds wherever possible.
- There should be a dry bench minimum width of 1m, to allow people to stand safely before
- descending towards the pond.
- Slopes down to the ponds and within them should be no more than 1 in 4, both for ease
- of access and maintenance.
- There should be a level wet bench minimum width of 1.5m, unless the pond is very small, to
- allow people to stand safely before the water's edge.

- The storage volume above permanent water level should be 450-600mm deep for safety
- and management reasons with an infiltration option at the pond edge.
- A robust, simple and easily maintained control structure will be necessary to limit flows from
- the pond unless all flows have been controlled further up the management train.
- Basins require an overflow to allow for design exceedance or outlet blockage.



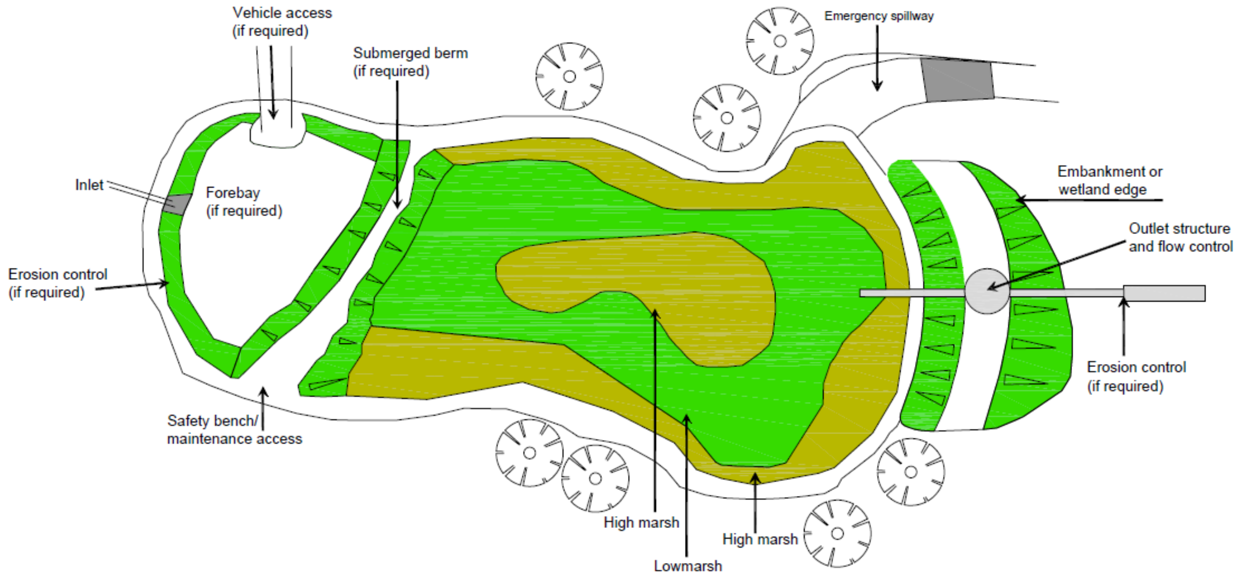


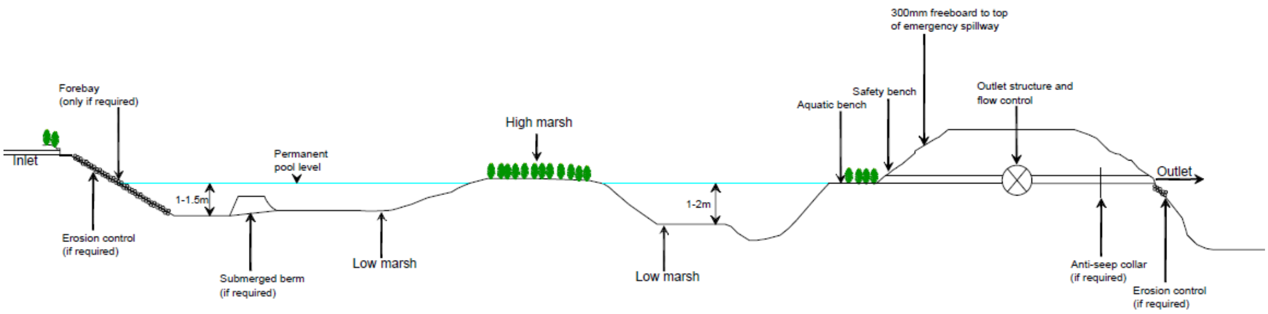
7.11 Wetlands (Ref CIRIA SuDS Manual Chapter 18)

Wetlands are shallow depressions that are nearly or completely covered in marsh vegetation, generally with little open water.

- SUDS wetlands should be longer than wide, with a ratio greater than 3:1.
- A sediment forebay is often recommended to intercept silt but is unnecessary if source control measures are in place higher up the management train.

- A variation in depth is recommended for treatment and ecological reasons but water depths in excess of 600mm are not required for habitat reasons and can affect safety assessments and maintenance operations.
- Basins require an overflow to allow for design exceedance or outlet blockage.





7.12 Maintenance of slopes.

If any gradient which is to be grassed with a slope of more than 1 in 6 discussions are required with the relevant Engineer. A commuted sum may be requested as an abnormal maintenance regime will be required.

Information available on the HSE website provides the following;

- Slopes of up to 1 in 6 managed through normal maintenance methods using ride on mowers with specific risk assessment
- Slopes of 1 in 5 cut using approved pedestrian machines in line with site specific risk assessments
- Slopes of 1 in 4 or 1 in 3 cut with specialist equipment only, pedestrian bank mower, brush cutter & only with a site specific risk assessment
- Slopes of over 1 in 3 to be cut with side-arm flail or remote control mower only no pedestrian based operations.

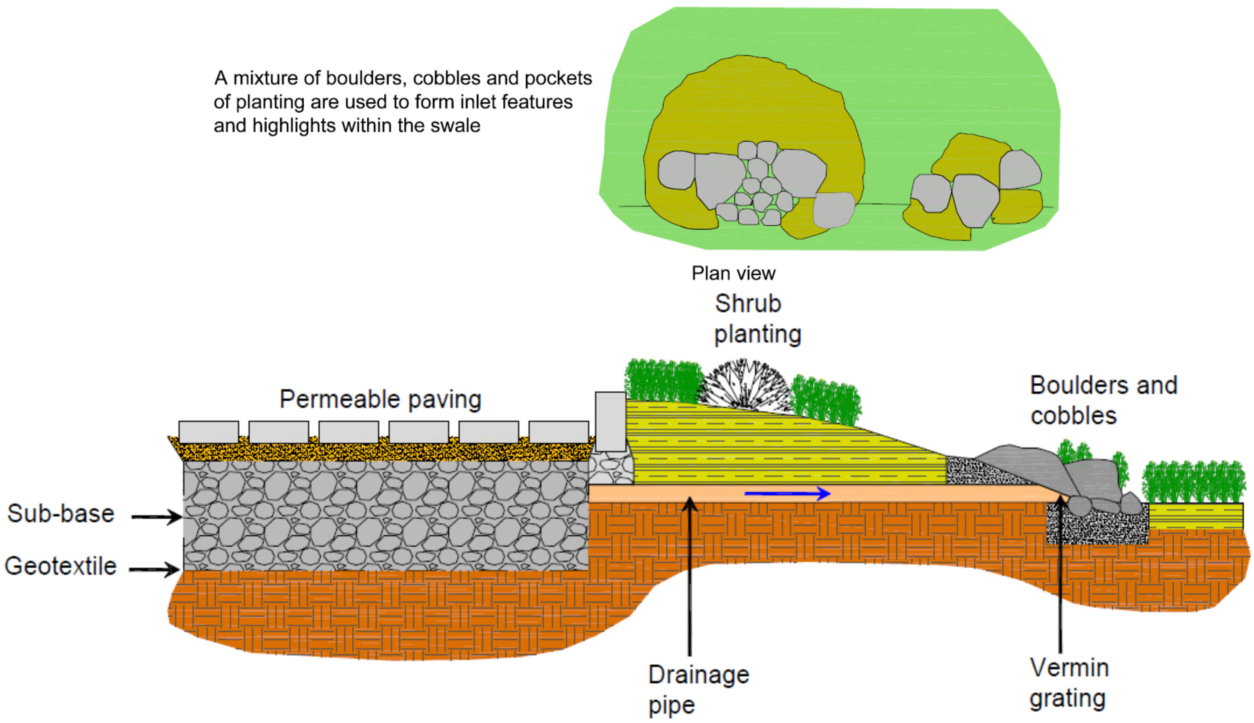
7.13 Inlets, Outlets and control specification and requirements

Inlets, outlets and other control structures are key elements of well-designed SuDS. Inlet and outlet features allow water to flow into and out of features and also limit the rate at which water flows along and out of the system.

There are many different designs and variations, including landscaped pipes, perforated pipes, weirs, orifices, vortex control devices and spillways. Each inlet or outlet structure should be designed specifically for its location to add interest to the urban landscape. All structures should consider the implications of maintenance, as regular inspections and cleaning may be required.

It's preferable for surface water runoff to flow across the surface into a SuDS component but sometimes it is necessary to collect it into a pipe from a grating, channel or chute gully. The collector should not include a silt trap or pot, as in gully pots, as they add to the risk of blockage and maintenance costs. Silt and pollution control is managed within the source control SuDS components.

Surface water runoff collected through permeable surfaces or other filter mechanisms, such as an under-drained swale, will not contain debris so can enter SuDS components through a grille or hidden inlet. The advantage with a covered inlet, particularly in public open space, is that they are difficult to block from the inlet end of the pipe. No orifice should be less than 100mm as this should prevent blockages.



7.13.1 Inlets and outfalls protections

All SuDS inlets and outfalls will require protection to stop debris or animals gaining access to the system. This protection will vary depending upon the system and discussions will be required with the relevant Engineer to ascertain the most appropriate structure.

8. Environmental Design Criteria

8.1 Master planning

Should be undertaken at the beginning to develop an area wide strategy especially where a number of developments could resolve SuDS issues together. This would enable the creation of larger schemes with lakes, ponds, basins etc. including access paths within the green infrastructure area.

When undertaking master planning the following should be taken into consideration

- Natural design criteria – blue corridor analysis of the site
- They should provide real amenity and nature conservation value.
- Landscape character – fit local character, paving and other materials, plant species Take influence from historic water courses
- Use existing topography to develop interesting shapes to the SuDS features
- Use local materials
- Structures should fit into the landscape

8.2 Accreditation of plant sources

Where seeding and planting is considered necessary or beneficial then the source and provenance of seed and plants should be from accredited sources. It is important to ensure fully accredited plant sources to avoid alien species.

Approval of all plant sources will be required before planting takes place. The removal of any alien species will be at the expense of the developer before the site is considered for handover.

8.3 Planting design strategy

Planting as part of a SUDs scheme should be designed specifically for that location. It is preferable that all planting in public open space SUDS features including swales, basins, ponds and wetlands should be native to Great Britain, ideally of local provenance. A list of suitable plants can be found in Appendix 2

The planting objective for most SUDS is to establish a robust native vegetation cover as soon as possible that will assist the drainage function and develop into a biodiversity asset. This is particularly true of grassed surfaces within detention basins and ponds. To achieve a successful planting scheme we recommend developers seek advice from a local ecologist particularly in relation to seed mixes and waters-edge planting that is located within the potential wet or flooded areas of the suds system.

Tall emergent plants such as reeds will be planted in some SuDS schemes to take up pollutants, however much planting of marginal floating-leaved and aquatic plant species in SuDS ponds is unnecessary in terms of function or visual effect and should be avoided.

8.4 Invasive plants

It is important not to plant invasive and vigorous colonising species that will prevent later establishment of a biodiverse wetland community.

Planting proposals should comprise common generalist species that are easily established and give visual interest to local people. Later colonisation by locally occurring species will stabilise the habitat.

8.5 Alien species

Alien species can out-compete and dominate native species and should not be planted where there is any contact with native planting. The Wildlife and Countryside Act 1981 (Variation of Schedule 9) (England and Wales) Order 2010 has an up to date list of plants that cannot be planted.

8.6 Planting requirements

Grass edges in landscape are usually specified at 10-20mm above hard surfaces to allow for mowing. In SUDS where surfaces shed water to grassed areas, it must be 20 to 25mm below the edge of the hard surface, assuming the grass will be cut to a height of 50 to 100mm. Planted areas should also be lower than adjacent hard surfaces.

Subsoil and topsoil should not be compacted by excessive tracking of machinery. Compaction results in roots not being able to penetrate the soil and anaerobic soil conditions. Nutrient rich topsoil should not be used as this can add pollutants to the system.

Planting techniques in SUDS areas should also be varied slightly. Where drainage systems are to be planted the use of grass or a dense ground cover is preferable, without mulch. This avoids soil erosion and prevents soil and mulch washing into the SUDS.

SUDS need rapid establishment of a dense grass/wildflower sward that is self –repairing. If the SuDS are allowed to become established before they become operational then no topsoil is required.

Planting areas should be designed to avoid initial fertilizers. Also ongoing maintenance should require only physical cutting and removal of arisings with no application of herbicide, fertilizer or other chemical applications, which can cause pollution.

8.7 Planting List for SUDS

A list of suitable plants can be found in Appendix 2, it will be a requirement to provide an as constructed drawing listing all plants and positions.

8.8 Contaminated Land

SuDS should be designed taking contamination on site into consideration and need to be factored in when calculating remedial targets and remediation design.

Use of SuDS on brownfield sites is as relevant as it is for greenfield sites. If a site is affected by contamination, SuDS must not mobilise contaminants or act as a preferential flow path to convey such contaminants - SuDS design can be adapted to ensure that this does not occur.

SUDS which use infiltration will not be suitable where infiltration is through land containing contaminants which are likely to be mobilised into surface water or groundwater. This can be overcome by restricting infiltration to areas which are not affected by contamination, or constructing SuDS with an impermeable base layer to separate the surface water drainage system from the contaminated area. SuDS which do not use infiltration are still effective at treating and attenuating surface water.

The introduction of SuDS may provide a pathway along which contaminants in aqueous or non-aqueous liquid phase can migrate and enter groundwater or surface water. The likelihood of this should always be considered and the system and the system located to a different area or redesigned as required. It should be noted however that a traditional piped drainage system is also likely to act as a contaminant conduit in this way.

SuDS can be used during construction to trap and remove contaminants from development. For example, when a site has been cleared runoff can be rapid and may contain high levels of silts, sediments and polluted material.

9. Water Quality

The SUDS design will demonstrate that the Water Quality Criteria set out in The SUDS Manual CIRIA C697 section 3.3 and the requirements of the LLFA and Environment Agency have been considered and incorporated in the SUDS design. An appropriate management train of SUDS components should be implemented to effectively mitigate the pollution risks associated with different site users/activities.

9.1 Protection of the groundwater or receiving watercourse

To remove the major proportion of pollution from surface water runoff, it is necessary to:

- Capture and treat the surface water runoff from frequent, small events.
- Capture and treat a proportion of the initial surface water runoff (the first flush) from larger and rarer events.

9.2 Creating opportunities for wildlife – biodiversity (ecology)

9.2.1 Key principles

- Structural diversity.
- Locate near to existing habitat where possible.
- Good water quality is key to ensuring ecological benefits and is provided by using the SUDS quality concepts of the management train, source control, treatment stages and by intercepting silt and pollution in pre-treatment techniques.

Surface water runoff must pass through source control features before passing onward to conveyance techniques, ideally on the surface in swales or other filtering techniques, before reaching ponds, wetlands or other biodiversity features.

Biodiversity will develop naturally in conveyance structures such as swales, or in open storage structures like basins, ponds and wetlands, providing water quality is good. The design of open landscape structures and the landscape that surrounds SUDS features should be designed and maintained for biodiversity.
Ecological design must take into account that SUDS need to meet drainage functions as a priority. Therefore:

- The management train must remain unobstructed in use at all times.
- All open soft surfaces that receive flows must be protected and remain well vegetated during the lifetime of the system.

- All landscape areas adjacent to SUDS must develop a robust ground vegetation to prevent silt migration.
- Swale, basin, pond and wetland vegetation will be necessary to retain the drainage function but this can easily be compatible with ecological objectives.
- Tree and shrub selection and subsequent care must take into account the requirement of a permanent ground vegetation cover.
- Planting must not compromise future access.

Good ecological practice includes:

- Creating ecologically designed corridors between habitat areas.
- Avoiding the use of pesticides, herbicides and fertilizers.
- Using accredited suppliers of native plants to ensure UK or local provenance and avoid alien species.
- Using local plant material and allowing natural colonisation of SUDS features.
- Reduced maintenance intensity with 25-30% maximum vegetation removal at any one time.
- Retaining and enhancing natural drainage features.
- Including shallow aquatic edges to 450mm max depth and 1m minimum width to ponds and wetlands.
- Increasing vertical and horizontal structural diversity in open SUDS features.

10 Green Infrastructure

Green Infrastructure includes all green spaces, blue spaces and other environmental features that occur in and around the built environment linking urban areas to the wider rural hinterland. This includes parks, commons, open land, woodland, private gardens, street trees and green roofs, as well as areas of water such as rivers, streams, wetlands, swales, ponds and temporary flood storage areas. Green Infrastructure should be strategically planned and delivered on a range of scales to provide usable space with support for natural and ecological processes. It should provide a network of spaces for recreation, habitat creation/preservation, climate change adaptation (flood protection and microclimate control), cultural and spiritual wellbeing, and should be capable of delivering ecosystem functions such as provisioning, regulating and supporting services. By considering different development layouts and densities, GI can be used to deliver multiple functions to help achieve sustainable communities.

Green infrastructure should be planned and managed in ways which make space for water. For example, urban green spaces can reduce run-off and increase natural infiltration, helping to reduce flood risk and improve water quality. SUDs should be seen as part of that 'multi-functional' green infrastructure network, delivering multiple amenity, landscape and biodiversity benefits, alongside their primary function to deliver sustainable water management. This will influence their detailed design and layout; for example, wherever possible they should help to link together existing or new wildlife habitats and be integrated with path networks and open space to provide attractive areas for recreation and play.

10.1 Open space

Designing green space and public realm with SuDS that work well when both wet and dry can provide valuable community recreational space as well as important environmental infrastructure. Sports pitches, squares, courtyards, playgrounds, landscapes around buildings, urban parks, green corridors and woodlands are all popular types of open space which can be integrated with SuDS. SuDS can also contribute to development targets for open space where they are designed to be multi-functional.

SuDS Technique	Brief Description	Water Quantity	Water Quality	Biodiversity	Amenity
Permeable Pavings	Infiltration through the surface into the underlying layer	✓	✓	X	X
Filter Drains	Drain filled with permeable material with a perforated pipe along the base	✓	✓	X	X
Infiltration Trenches	Similar to filter drains but allows infiltration through the sides and base	✓	✓	X	X
Soakaways	Underground structure used for store and infiltration	✓	✓	X	X
Detention Basins	Dry depressions outside of storm periods, provides temporary attenuation, treatment and possibly infiltration	✓	✓	✓	✓
Retention Ponds	Designed to accommodate water at all times, provides attenuation, treatment and enhances site amenity value	✓	✓	✓	✓
Wetlands	Similar to Retention Ponds but are designed to provide continuous flow through vegetation	✓	✓	✓	✓
Rainwater Harvesting	Capturing and reusing water for domestic or irrigation uses	✓	X	X	X
Green Roofs	Layer of vegetation or gravel on roof areas providing absorption and storage	✓	✓	✓	✓
Tanks/ Oversized Pipes	Below ground storage arrangement	✓	X	X	X

11. Construction

Once the design process and SuDS design has been submitted, evaluated and confirmed as acceptable then the construction phase will follow to realise the SuDS proposal. The authority needs to ensure that all SuDS features are constructed as designed so that they perform as intended are easy to maintain and have a long design life.

The developer during the construction phase of a SUDS scheme must demonstrate that the installation of the SUDS scheme has been carried out competently and will be required to verify that the correct materials have been used.

During all stages of construction, the relevant officers should be provided with access for inspection. Any work that cannot be inspected due to insufficient notice being provided will be required to be re-opened for inspection and reinstated at the Developer's expense.

It is vital that the developer contacts the Council before construction commences so that a pre-construction meeting can be held. During this meeting the following will be required

- Method statement of construction and of protection of the SuDS during the construction phase
- An inspection sequence for use during construction.
- Post-construction maintenance.

The impact of ongoing construction works on SuDS features should be minimised therefore it is important that the SuDS is protected from construction traffic during construction of the development

11.1 Pollution and sediment control

Runoff from the construction site must not be allowed to enter SuDS drainage systems unless it has been allowed for in the design and specification. Construction runoff is heavily laden with silt which can clog infiltration systems, build up in storage systems and pollute receiving waters. No traffic should be allowed to run on permeable surface components if it is likely to introduce sediments onto the pavement surface from dusty or muddy areas, or result in over compaction. Discharge of contaminated or nutrient rich water must be positively treated to reduce the impact on the receiving watercourse.
It is essential during the SuDS establishment phase that run off from bare soils be minimised,

- green cover on slopes should be rapidly established
- base of slope trenches should be used to intercept run off and sediments
- construction should be timed to avoid high run off rates

12 Handover Process

The SuDS scheme will only be handed over when **ALL** the parties are satisfied that the scheme is performing satisfactorily and has been built in accordance with the agreed design and specification.

12.1 Maintenance

The design process should consider the maintenance of the components (access, waste management etc.) It will also be necessary for a SuDS management plan for the maintenance of SuDS to be prepared Like all drainage systems, SuDS components should be inspected and maintained. This ensures efficient operation and prevents failure. Usually SuDS components are on or near the surface and most can be managed using landscape maintenance techniques.

For below-ground SuDS such as permeable paving and modular geocellular storage the manufacturer or designer should provide maintenance advice. This should include routine and long-term actions that can be incorporated into the maintenance plan. The level of inspection and maintenance will vary depending on the type of SuDS component and scheme, the land use, types of plants as well as biodiversity and amenity requirements.

The SuDS scheme is unlikely to be handed over for maintenance until all parties are confident that the scheme is constructed and performs as designed. An interim maintenance plan can be incorporated on larger schemes.

One of the key objectives of the process is to ensure that the SuDS installation can be maintained easily over the lifetime of the development. Like all drainage systems SuDS components should be regularly inspected and maintained to ensure efficient operation and prevent failure.

Usually SuDS components are near the surface and can be managed using landscape and watercourse management techniques. Inlets, outlets, control structures or other below ground features should be shallow to allow easy access for maintenance and to reduce safety risks.

The SUDS Management/Maintenance Plan include:

- A description of the SuDS scheme, how it works and a general explanation of how it should be managed in the future.
- A Schedule of Work to set out the tasks required to maintain the site and the frequency necessary to achieve an acceptable standard of work. A spillage control procedure should also be included.

- A Site Plan (Drawing) – showing maintenance areas, access routes, inlets, outlets and control structure positions, location of any other chambers, gratings, overflows and exceedance routes.
- Health and safety issues.

12.2 Highway Drainage

SUDS features within highways would be adopted by the Local Authority and maintained as part of the wider highways maintenance programme. The incorporation of SuDS that involves road drainage usually requires the developer either to enter into an agreement under Section 38 of the Highways Act, if involving new development, or an agreement under Section 278 of the Act, if existing highway arrangements are to be modified.

12.3 SUDS in private property (serving more than one property)

It is reasonable to expect the owners/occupiers of properties drained by sustainable drainage systems that do not also drain other properties to maintain their own sustainable drainage system. The developer would need to provide the owner or owners with full instructions on the maintenance of the sustainable drainage systems including repair and replacement requirements. The developer should also inform all purchasers of their responsibilities in regards to the SuDS management Train.

Source control SuDS components within private property is the responsibility of the landowner or property manager.

SuDS will be designated as a flood risk management asset by the LLFA.

If a SuDS needs to cross adjoining land, not owned by the developer, it will be a requirement that the developer negotiates Easements directly with the landowner.

Appendix 1 Check Lists

Pre-development Advice

1. Pre design discussion with LLFA advised prior to any submission.

    a. Site assessments including the existing drainage characteristics, geology and topography.

    b. Existing flood risks.

    c. Identification of any water courses running through the site.

    d. Identification of any designated sites within a 5km radius.

    e. Potential SUDS locations.

    f. Flow rates and source control.

    g. Evidence of discussions with NWL and the EA.

Outline Drainage Proposals

2. Following pre design discussion with LLFA it is recommended that the following be submitted prior to submitting the application in order to obtain an 'agreement in principle';

    a. Detailed Flood Risk Assessment.

    b. Existing utilities plan (if applicable).

    c. Impermeable areas estimate.

    d. Storage volume estimate.

    e. Storage location(s).

    f. Flow control(s).

    g. Areas where SUDS will form recreational features.

    h. Public health and safety consideration.

    i. Identification of maintenance liabilities.

    j. Ecology and water quality implications.

Detailed Design

To complete the application the following needs to be submitted to the LLFA;

a. Detailed Flood Risk Assessment.
b. Detailed design.
c. Specification of materials.
d. Flow calculations (.mdx files where possible).
e. Details of inlets and outlets and flow controls
f. Construction details.
g. Phasing of development including Construction Management Plan
h. Cross sections including design levels.
i. SuDS Design Statement.
j. Operation and Maintenance Plan.
k. Health and Safety Risk Assessment.

Appendix 2 Plants suitable for SuDS in the Tees Valley

Plants should be locally native species, preferably of local origin. The plants listed below are all common in the five Tees Valley local authority areas.

Any nursery supplied plants must be ensured that they are 'clean' and free of invasive species. A good guide to invasive species is in the INNS site: http://www.nonnativespecies.org/index.cfm?sectionid=47

Suitable species for the water's edge

Veronica beccabunga – brooklime

Mentha aquatica– water mint

Filipendula ulmaria – meadowsweet

Lychnis floc-cuculi - ragged robin

Caltha palustris – marsh marigold

Juncus inflexus – hard rush

Juncus effusus – soft rush

Myosotis scorpioides – water forget-me –not

Eleocharis palustris –common spike rush

Suitable aquatic plants for standing water

Phalaris arundinacea – reed canary grass

Iris psuedacorus – yellow flag

Carex riparia greater pond sedge

Carex acutiformis – lesser pond sedge

Glyceria maxima – sweet reed grass

Sparganium erectum – branched burr-reed (this can be invasive)

Native Tree and shrub species

Tolerant of more winter flooding –

Salix cinerea -grey willow

Salix caprea – goat willow

Less tolerant of flooding –

Betula pendula - downy birch.

AVOID

Phragmites australis – common reed - too invasive

Typha latifolia – reedmace sometimes called bulrush – too invasive

Also avoid all species mentioned in the list on the INNS site at the address above which includes:

- *Elodea canadensis* - Canadian Pondweed
- *Elodea nuttallii* - Nuttalls Pondweed
- *Azolla filiculoides* - Water Fern
- *Crassula helmsii* - New Zealand Swamp-stonecrop
- *Lagarosiphon major* - Curly Waterweed
- *Hydrocotyle ranunculoides* - Floating Pennywort
- *Myriophyllum aquaticum* - Parrots-feather

SuDS Glossary of Terms

Amenity

The quality of place being pleasant or attractive i.e. agreeableness. A feature that increases attractiveness or value, especially of a piece of real estate or a geographic locations

Attenuation

The reduction of peak water flow by spreading it over a longer time period. This is done by providing storage in sewers, tanks or soft SuDS structures. The principle of SuDS is to provide flow attenuation in order to manage surface water effectively. Any form of flow attenuation is a form of SuDS

Base-flow

The sustained flow in a channel or drainage system

Basin

A ground depression that acts as a flow control or water treatment structure that is normally dry and has a proper outfall, but is designed to detain storm water temporarily. These types of structures include flood plains and detention basins.

Biodiversity

The diversity of plant and animal life in a particular habitat

Bioretention area

A depressed landscaping area that is allowed to collect runoff so it percolates through the soil below the area into an under drain, thereby promoting pollutant removal.

Catchment

The area contributing surface water flow to a point on a drainage or river system.

Combined sewer

A sewer designed to carry foul sewage and surface runoff in the same pipe.

Combined Sewer Overflow

Heavy or prolonged rainfall can rapidly increase the flow in a combined sewer until the volume becomes too much for the sewer to carry and excess storm sewage is discharged to river or sea via relief “valves” known as combined sewer overflows (CSO’s).

Conventional drainage

The traditional method of draining surface water using subsurface pipes and storage tanks

Conveyance

The movement of water from one location to another

CSO

See definition for Combined Sewer Overflow

Culvert

A closed channel carrying a watercourse beneath an obstruction such as a road, railway or canal

Curtilage

Land area within property boundaries

Design criteria

A set of standards agreed by the developer, planners and regulators that the proposed system should satisfy.

Designing for Exceedance

An approach that aims to manage exceedance flows during rainfall events such as using car parks during extreme events.

Diffuse pollution

Pollution that comes from non-point source contamination in urban and rural land-use activities spread out across a catchment or sub-catchment. significant.

Ecology

All living things, such as trees, flowering plants, insects, birds and mammals, and their habitats

Environment

Both the natural environment (air, land water resources, plant and animal life) and habitats

Evapotranspiration

The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.

FEH

Flood Estimation Handbook (FEH), produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology) to aid calculation of the possible severity of flooding.

Filtration

The act of removing sediment or other particles from a fluid by passing it through a filter

First flush

The initial runoff from a site or catchment following the start of a rainfall event and as runoff travels over a catchment it will pick up or dissolve pollutants and the "first flush" portion of the flow may be the most contaminated as a result.

Flood frequency

The probability of a flow rate being equalled or exceeded in any year

Flood Routeing

Design and consideration of above-ground areas that act as pathways permitting water to run safely over land to minimise the adverse effect of flooding.

Floodplain

Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions.

Flora

The plants found in a particular physical environment.

Flow control device

A device used to manage the movement of surface water into and out of an attenuation facility, for example a weir.

Forebay

A small basin or pond upstream of the main drainage component with the function of trapping sediment

Greenfield runoff

This is the surface water runoff regime from a site before development,

Greywater

Wastewater from sinks, baths, showers and domestic appliances this water before it reaches the sewer (or septic tank system).

Groundwater

Water that is below the surface of ground in the saturation zone

Highway Authority

A local authority with responsibility for the maintenance and drainage of highways maintainable at public expense

Highway drain

A conduit draining the highway.

HOST

Hydrology of Soil Types (HOST). A classification used to indicate the permeability of the soil and the percentage runoff from a particular area.

Hydrograph

A graph illustrating changes in the rate of flow from a catchment with time

Impermeable surface

An artificial non- porous surface that generates a surface water runoff after rainfall

Infiltration device

A device specifically designed to aid infiltration of surface water into the ground.

Lateral drain

a) That part of a drain which runs from the curtilage of a building (or buildings or yards within the same curtilage) to the sewer with which the drain communicates or is to communicate

Model agreement

A legal document that can be completed to form the basis of an agreement between two or more parties regarding the maintenance and operation of sustainable water management systems.

Nutrient

A substance (such as nitrogen or phosphorus) that provides nourishment for living organisms

Off Stream

Dry weather flow bypasses the storage area.

On Stream

Dry weather flow passes through the storage area.

Orifice plate

Structure with a fixed aperture to control the flow of water

Passive treatment

Natural processes used to remove and break down pollutants from surface water runoff.

Pathway

The route by which potential contaminants may reach targets

Permeability

A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.

Permeable pavement

A paved surface that allows the passage of water through voids between the paving blocks/slabs.

Pervious surface

A surface that allows inflow of rainwater into the underlying construction or soil

Pitt Review

Sir Michael Pitt was asked by Ministers to conduct an independent review of the flooding emergency that took place in June and July 2007..

Piped system

Conduits generally located below ground to conduct water to a suitable location for treatment and/or disposal.

Private Sewer

Private sewers are those owned by either the owner of the land it runs through,

Public sewer

A sewer that is vested in and maintained by a sewerage undertaker

Recharge

The addition of water to the groundwater system by natural or artificial processes

Recurrence interval

The average time between runoff events that have a certain flow rate, e.g. a flow of 2 m/s might have a recurrence interval of two years in a particular catchment.

Rill

Open surface water channels with hard edges.

Runoff

The amount of water from precipitation, which flows from a catchment area past a given point over a certain time period.

Section 102 or 104

Section within the Water Industry Act 1991 permitting the adoption of a sewer, lateral drain or sewage disposal works by the sewerage undertaker. Sometimes referred to as S102 or S104.

Section 106 (Water Industry Act 1991)

A key section of the Water Industry Act 1991, relating to the right of connection to a public sewer

Site and regional controls

Manage runoff drained from several sub-catchments. The controls deal with runoff on a catchment scale rather than at source.

Source control

The control of runoff or pollution at or near its source, the principles of SuDS are to mimic as far as possible the natural drainage characteristics of a site to maintain the drainage regime. By returning water to the natural drainage system as close to where it falls as possible represents effective management of surface water. Source control devices include Soakaways, Permeable surfaces, Infiltration basins and Swales.

Sub-catchment

A division of a catchment, allowing runoff management as near to the source as is reasonable.

Surface Water

Water that appears on the land surface, i.e. lakes, rivers, streams, standing water and ponds.

Transpiration

The loss of water vapour through plant leaves.

Treatment volume

The volume of surface runoff containing the most polluted portion of the flow from a rainfall event.

UKCIP

The UK Climate Impacts Programme (UKCIP) has developed the UK Climate Projections (UKCP09). These projections of our changing climate provide information for the UK up to the end of this century. Sea levels will also rise partly due to melting of polar ice caps. Drier summers will cause pollution problems in watercourses with reduced flow and increased periodic liberation of pollutants that have gathered during extended drier periods.

Water Cycle

The continuous circulation of water in systems throughout the planet, involving condensation, precipitation, runoff, evaporation and transpiration. It is also known as the hydrological cycle.

Water Table

The point where the surface of groundwater can be detected. The water table may change with the seasons and the annual rainfall.

Water Framework Directive

The Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) is a European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015. It is a framework in the sense that it prescribes steps to reach the common goal rather than adopting the more traditional limit value approach.

Water Resource Act

This Act aims to prevent and minimise pollution of water. The policing of this act is the responsibility of the Environment Agency. Under the act it is an offence to cause or knowingly permit any poisonous, noxious or polluting material, or any solid waste to enter any controlled water. Silt and soil from eroded areas are included in the definition of polluting material. If eroded soil is found to be polluting a water body or watercourse, the Environment Agency may prevent or clear up the pollution, and recover the damages from the landowner or responsible person.