Sustainable Drainage Systems

Good Practice

- New development should provide appropriate sustainable drainage systems (SUDS) for the disposal of surface water
- SUDS should be applied within the curtilage of the development site. If this is not possible, developments should contribute towards the cost of off-site SUDS
- SUDS can be designed to provide multi-use benefits, such as public amenity and wildlife improvements
- Where possible, rainwater should be stored for re-use such as irrigation or toilet flushing (see Water Conservation and Recyling)

Above
Balance ponds can provide important wildlife habitats in the urban area (Hoebrook Close, Westfield).

Background - Climate Change and Drainage

Climate change projections predict a decrease in annual rainfall in the South East of up to 10%, with significantly wetter winters (between 15-20% more winter rain), and an increase in frequency of severe weather. Parts of Woking are already susceptible to flooding, and over 300 properties were flooded in the Hoe Stream and Wey catchments during autumn 2000 following prolonged periods of rainfall. Furthermore, predicted drier summers may also lead to an increased risk in flash flooding when sudden storms cause very rapid run-off over dry, impermeable ground.

Development generally reduces surface permeability by replacing permeable ground with impervious roofs and paved areas. This reduces the amount of water infiltrating into the ground and increases surface run-off. The traditional solution has been to install underground pipe systems designed to convey water as quickly as possible away from the development and prevent flooding locally. However, this increases the speed of run-off and can change the flooding regime of the catchment and may lead to problems elsewhere within the river catchment, particularly flooding downstream.

Increased flow rates can also cause erosion and damage stream and streamside habitats. Water quality issues are also important because pollutants from built up areas are washed into rivers or groundwater, harming fish and wildlife and are difficult to clean up.

In urban areas, localised flooding arises when drains and sewers are overwhelmed by sudden downpours. In addition to flood damage, there is the added risk to health from sewerage mixing with flood waters. Recent research suggests the number of people at risk of localised urban flooding in England could increase four-fold due to climate change. SUDS can make a key contribution to reducing the risk of urban flooding.

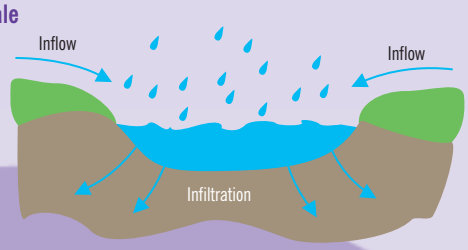
The Benefits of SUDS

PPG25 (Development and Flood Risk, 2001) recognises that flood risk is expected to increase as a result of climate change and advocates the greater use of SUDS as a means of reducing the impact of development on flooding. By mimicking natural drainage patterns, SUDS can also encourage recharge of groundwater, provide significant amenity and wildlife enhancements. SUDS can also protect water quality by employing pollutant trapping and degradation processes.

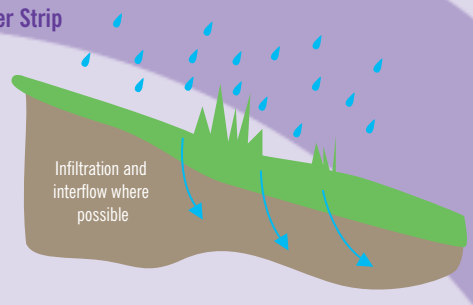
Planning for SUDS early in a project's design is essential to enable integration of sustainable drainage systems into the overall site concept and layout, and agreement on adoption, maintenance and operation of the systems

Right
The market value of properties over-looking water can be significantly enhanced (balance pond collecting the roof water from nine houses, Holmes Close, Westfield).

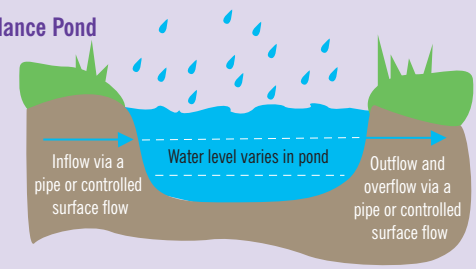
Swale



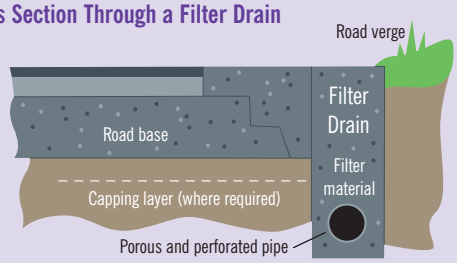
Filter Strip



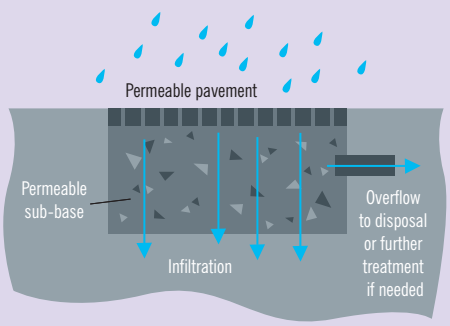
Balance Pond



Cross Section Through a Filter Drain



Permeable pavement used for infiltration



SUDS Techniques

There are a range of SUDS techniques available. These range from soak-aways (at the simplest level) to a range of techniques that are summarised below:

- **Preventive Measures** - rain-water recycling, water butts and storage tanks.
- **Filter strips and Swales** - vegetated landscape features with smooth surfaces and a gentle downhill gradient to drain water evenly off impermeable surfaces.
- **Infiltration devices** - below-ground or surface structures to drain water directly into the ground. Examples include soakaways, infiltration trenches, swales with infiltration and infiltration basins. These may be used at source or the run-off may be conveyed to the infiltration area in a pipe or swale.
- **Filter Drains and permeable and porous pavements** - permeable surfaces to allow rainwater and run-off to infiltrate into permeable material placed below ground to store water prior to discharge.
- **Basins and balance ponds** - structures designed to hold water when it rains; basins are free from water in dry weather, ponds contain water at all times and are designed to hold more when it rains; examples include detention basins, balancing/attenuation ponds, flood storage reservoirs, lagoons, retention ponds and wetlands/reed beds.

Whilst basins and ponds can provide effective SUDS, their value in the wider landscape and for wildlife can differ. If a pond is to be created for drainage, it should be designed to maximise its potential for wildlife and create an attractive landscape.

Selection of the most appropriate SUDS approach should be based on meeting the same principles of hydrology and hydraulics as traditional drainage systems

Selecting the best SUDS approach

Selection of the most appropriate SUDS approach should be based on meeting the same principles of hydrology and hydraulics as traditional drainage systems, but also taking into account the interests of the landscape and the environment. As a general principle, techniques based on the control of run-off near its source are to be preferred to downstream solutions.

Where possible, SUDS should be designed to provide landscaping and/or wildlife benefits, because:

- 90% of ponds have been lost from the urban area in Woking over the last 100 years.
- Ponds can provide a focal point for new development and create a distinctive landmark.
- SUDS can provide valuable wildlife habitats, especially in river corridors.

Further advice on the range of SUDS techniques and their application is provided by CIRIA.

Planning for SUDS

It is important to consider using SUDS early in the design process. Wherever possible, SUDS should be integrated within the layout of the development site. However, it may be appropriate to develop SUDS over a wider area serving a number of sites, each development making a contribution to the implementation and management costs of off-site SUDS.

The land-take implications of SUDS should be identified early in the design of site layout. The SUDS approach adopted will determine the land requirements, although in some cases this may be zero (e.g. use of permeable paving). A simple contribution to SUDS can be provided by the installation of water butts for new dwellings (thought should be given to the positioning of rainwater down pipes to enable water butts to be installed). These are particularly effective in reducing the impact of heavy summer storms which can cause flash floods. The land take of SUDS can also be combined with other land uses, such as amenity areas.

The developer should seek the advice of the Environment Agency and County Engineer on the design criteria and performance parameters at the outset. Submission of a technical appraisal of the proposed SUDS will be required to demonstrate it will meet the agreed criteria.

Left
Perforated kerb edging and grassed infiltration basin (Birtley House apartments, Woking).
Bottom left
Permeable block paving provides an effective solution for sustainable drainage in many areas.

Apartments

- In high density developments there is likely to be insufficient space available for balance ponds or infiltration basins (although balance ponds can make an important contribution to urban wildlife). The most suitable approach may be to use modular cellular storm water tanks that provide large holding capacities for infiltration. These can be located under parking courts, service areas or landscaping and combined with permeable hard surfaces.
- Roof water run off can also be mitigated by the use of rainwater harvesting (which can be stored for uses such as w.c. flushing and irrigation), and by the use of green (vegetated) roofs which can reduce run off by 50% or more.

Medium Sized Housing

- Water butts installed on rain water down pipes provide a simple contribution towards reducing storm-water run-off.
- Where ground conditions are appropriate, surplus water can be directed to soakaways.
- Community SUDS schemes, with run off collected from a number of houses and directed to a basin or balance pond (discharged to a water course or mains drain via a hydrobrake) can provide an attractive landscape and wildlife feature.
- Permeable paving for driveways, access roads and parking areas.

Large Housing

- Water butts should be installed on rain water down pipes.
- In lower density developments there is likely to be more space available for some SUDS features, such as soak-aways, swales and infiltration basins.
- Large driveways and parking areas should be surfaced with permeable paving, or constructed to drain to adjoining soft surfaces. Using permeable paving will benefit the future growth of mature trees by maximising the area of soil moisture re-charge.

Maintenance

The satisfactory performance of SUDS depends not only on good design but also adequate maintenance, and provision for this must be made from the outset. Planned maintenance operations are likely to be more intensive during the early establishment of balance ponds, and may include an initial de-silting on completion of construction (sand, silt and other construction waste may enter the SUDS whilst site construction is ongoing). Vegetated SUDS will require routine maintenance to control growth, ranging from regular grass cutting (swales and filter strips), to annual 'meadow' grass cutting (for basins) or longer term management of the vegetation in ponds.

De-silting and disposal of sediment will be required at some stage to maintain storm water capacity (this may require consents from the Environment Agency and the Council as planning authority). The developer and the Council will need to agree who will be responsible for the on-going maintenance as a condition of planning consent. Responsibility for this may rest with the freeholder or a management company. The Council may be willing to adopt SUDS features if they are located within an open space where the public has access. A S.106 Agreement will be required for the transfer of the SUDS feature to the Council, along with a management plan and an appropriate payment for future maintenance and management responsibilities. A model form of agreement will be provided by the Council.

In some cases, adoption by the statutory sewerage undertaker (Thames Water) may be possible, although it has no duty to accept the land drainage flow.

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Further Information and Advice

Publications

Sustainable Urban Drainage Systems
design manual for England and Wales
(C522, CIRIA 2000)

Sustainable Urban Drainage Systems
best practice manual (C523, CIRIA 2001)

Sustainable Urban Drainage Solutions:
An Introduction (Environment Agency/SEPA)

A Guide to the Design, Construction and Maintenance of Concrete Block Permeable Pavements is available at www.paving.org.uk

General information at
www.ciria.org/suds/index.html

Further advice available from the Environment Agency
(contact Development Control Engineer (01276 454331)

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South East Climate Change Partnership
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