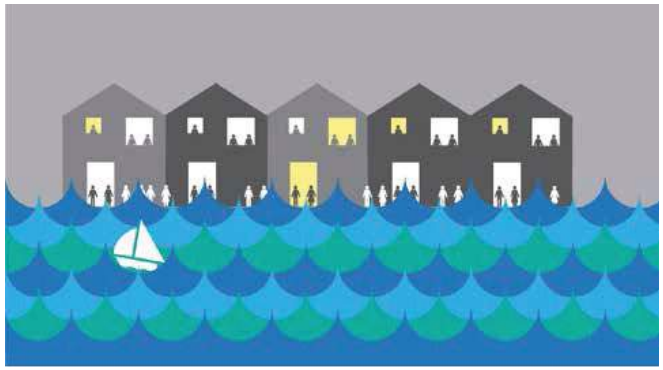
04

DESIGNING SUDS TO RESPOND TO COMMON SITE CONDITIONS

DESIGNING SUDS TO RESPOND TO COMMON SITE CONDITIONS

SuDS can be applied to any site. However, there are a variety of site conditions and constraints which could restrict the types of SuDS that are suitable, or which may trigger the need for bespoke design. Here are a few tips for designers.

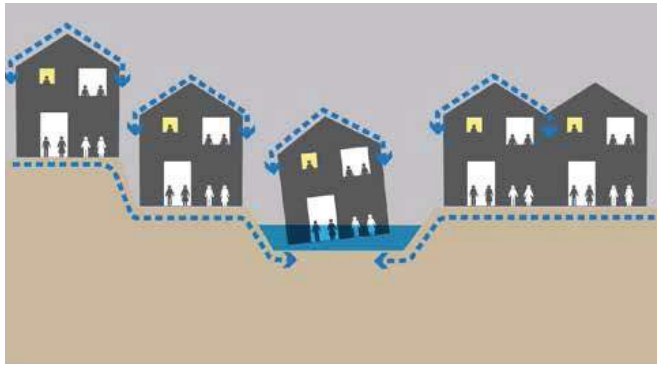
FLOOD CONDITIONS



I would like to include SuDS in the master plan, but how do I...

Design SuDS in a floodplain area?

Floodplains should be used primarily to mitigate flood risk from rivers or tides. During storms and heavy rainfall these areas will naturally flood with river or coastal water, making them ineffective for storing surface water runoff. The presence of a floodplain, however, should not preclude the site from including SuDS as they could still be effective in managing routine rainfall. Given the likely high groundwater table and vulnerability to erosion, floodplain SuDS should be selected and designed accordingly. Design should limit grading and the creation of surface features (such as berms and un-reinforced channels) that could be washed out in a flood. Surface discharge from SuDS should be dispersed (allowed to shed off as sheet flow), and point discharges minimised or eliminated. Attenuation periods for SuDS should be designed so that SuDS empty within 48 hours of any rainfall.



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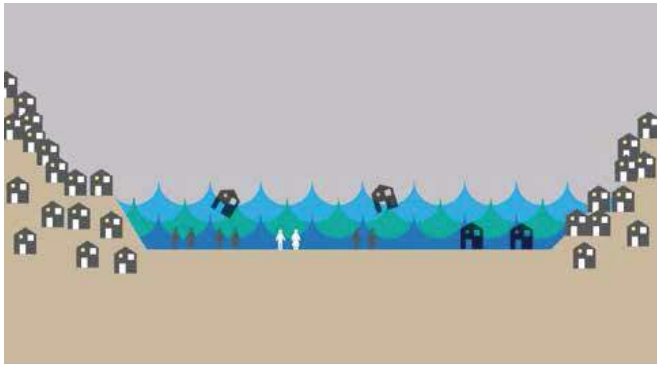
Prevent runoff from neighbouring sites flooding my site?

Some areas will experience existing runoff flows from neighbouring properties. Reducing flood risk requires an understanding of flows from elsewhere, and ensuring that buildings are located outside existing surface water conveyance routes. SuDS such as a swale could be used along the boundary to intercept and divert flows. Minimising flood risk in a wider area requires communication and collaboration among all stakeholders from the beginning of the master planning process with the aim to manage runoff at a catchment scale, rather than solely on individual properties.



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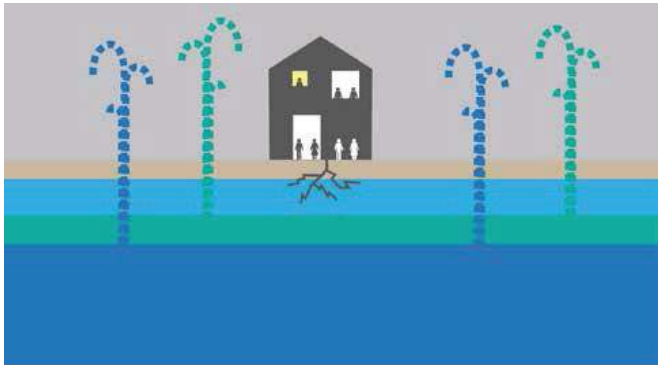
Address local surface water flooding issues?

It is important at the initial design stage to understand if your site is in, or upstream of, local surface water flood risk areas as you may be subject to additional surface water runoff restrictions. This may influence the placement or design criteria for SuDS. Flow and attenuation requirements should be discussed with the Lead Local Flood Authority.

GROUNDWATER



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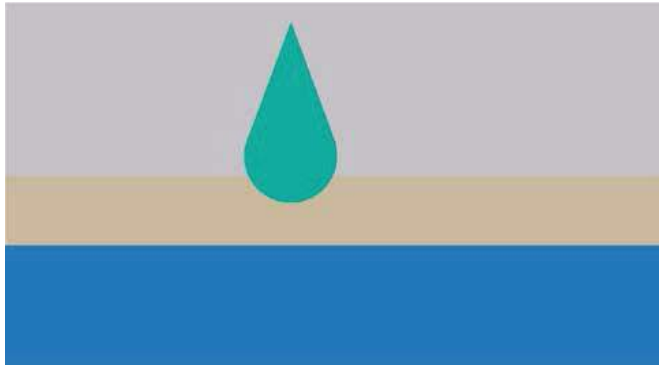
Design SuDS on a site with a high groundwater level?

It is important to determine the depth of the water table below the ground. A water table near to the surface must be protected from contamination and high groundwater may also cause flooding or damage to deep SuDS features. In this instance, SuDS should be selected and designed to be on the surface or shallow in depth and to avoid infiltration. Those SuDS that normally allow infiltration can be lined with an impermeable liner (such as a water proof membrane or compacted native clay) to prevent infiltration.



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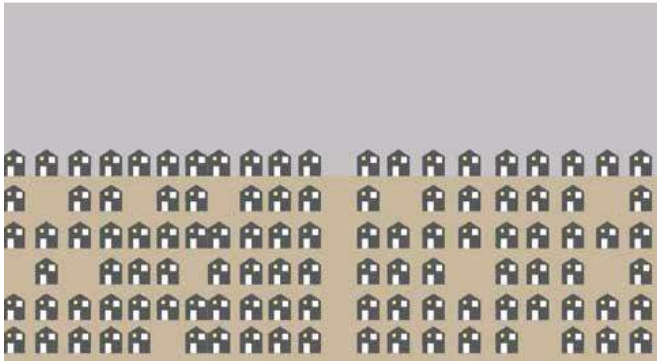
Design SuDS in a Groundwater Protection Zone?

Some areas may be designated as a groundwater protection zone to protect drinking water supply or otherwise. In these areas, SuDS proposals should be discussed with the Environment Agency. If infiltration is not allowed, SuDS can be lined. SuDS can also be used to provide treatment of water before infiltration to ensure contamination is avoided.

TOPOGRAPHY



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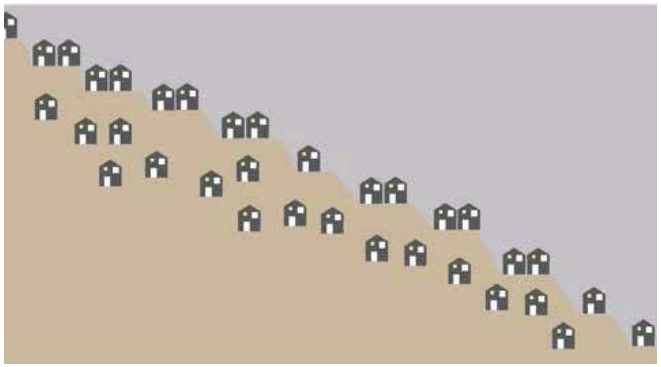
Incorporate SuDS on a flat site?

Managing surface water runoff on flat sites can be a challenge. A moderate slope is advantageous to move water around using gravity. If a piped system is being used to convey surface water on a flat site, downstream SuDS can become deep and unattractive due to the drop required for pipe cover and gradient. The best option on these sites is to keep surface water runoff on the surface as much as possible and to manage runoff close to its source. Water can be conveyed on the surface using roadside kerbs and shallow rills and swales. A designer should consider all alternatives before considering pumping as a last resort.



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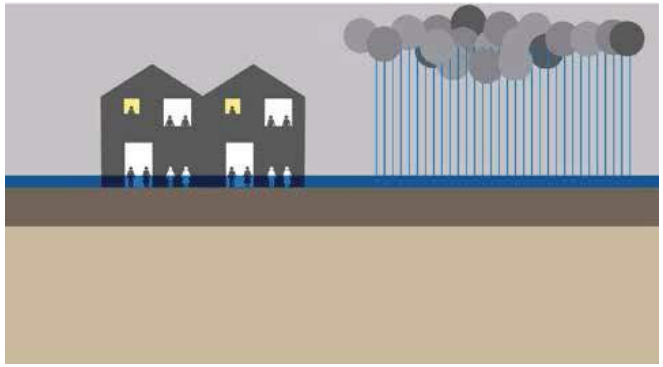
Design SuDS on a site with a steep slope?

As steeper slopes will increase runoff velocity, these sites require additional attention when accommodating SuDS. Infiltration is not recommended near very steep slopes, as it might reduce slope stability. Check dams and staged storage, however, can be used to slow the runoff rates on steeper slopes. Another option is to design the site to convey runoff on platforms in a similar manner to switchback roads on mountainous terrain. Bioretention and wetland features can be staggered in a terraced arrangement on slopes.

SOILS AND GEOLOGY



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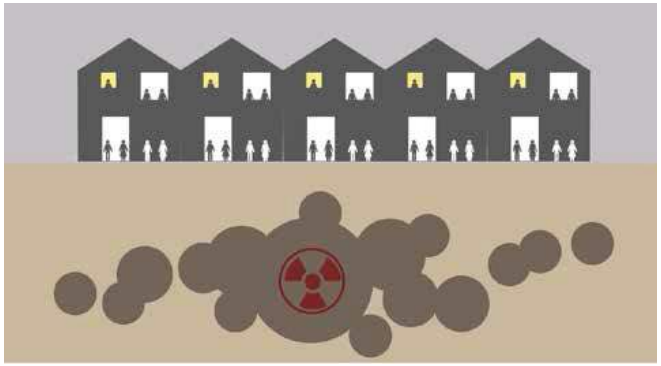
Use SuDS on a site with poor permeability?

Poor permeability is a constraint for SuDS that promote infiltration, but there are still a range of design solutions to be explored. It is firstly worth understanding the vertical geology of an area, as it might be that a more permeable layer exists below shallow impermeable layers, where infiltration could occur at a greater depth. Where infiltration is not possible due to permeability or other ground conditions, SuDS should be designed to provide the required attenuation and treatment above ground or near the surface. In areas of poor permeability, the natural greenfield runoff rates are likely to be high, so requirements for attenuation should be relatively manageable.

CONTAMINATED LAND



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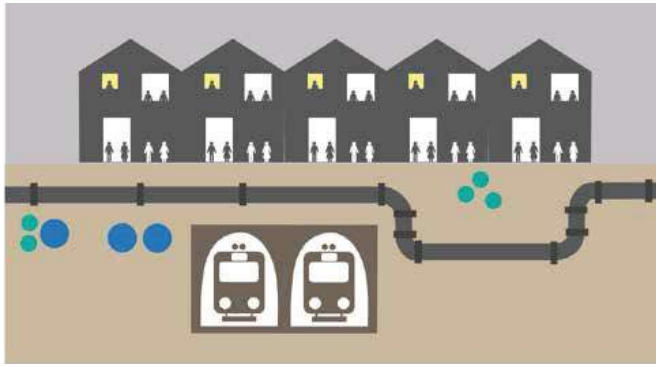
Use SuDS on contaminated land?

Some previously used sites will have contaminated soils. In these cases , SuDS can still be incorporated, although the use of infiltration may not be suitable as concentrated ground flow could lead to water-borne contaminants being transferred to deeper soils or sensitive aquifers. Accordingly, SuDS should be lined and designed to attenuate water on or near the surface.

EXISTING INFRASTRUCTURE



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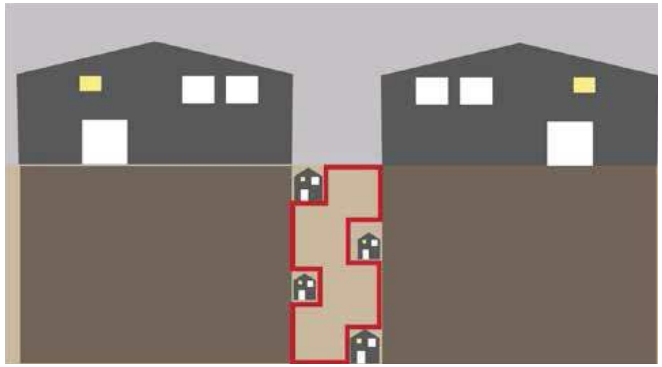
Design SuDS on a site with existing infrastructure?

When building on brownfield or pre-developed sites, existing on-site infrastructure should be considered in SuDS design to find the most cost-effective solution. It will be important to understand the location and capacity of existing drainage to determine what infrastructure should be reused in the SuDS scheme. Other buried infrastructure, such as utilities, will need to be located and considered in SuDS design and construction. Using SuDS such as permeable paving and bioretention should be avoided in major service strips, as access will require disturbance and rebuilding of the SuDS system, but compatibility can be achieved by constructing dedicated and well-marked service strips that are designed with access in mind.

SPACE CONSTRAINTS



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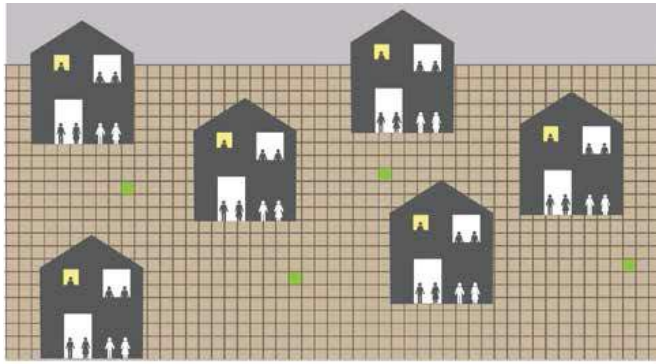
Design for SuDS where space is limited?

SuDS are often associated with large green spaces, however, there are a range of SuDS features which can be easily designed into tight urban settings. Design forethought is required to build SuDS into multi-functional spaces and build up a network of SuDS that manage runoff close to its source to avoid the need for large storage areas. Space efficient SuDS include green roofs, bioretention gardens, permeable paving, rills, rainwater harvesting, hardscape storage, micro-wetlands, and bioretention tree pits.



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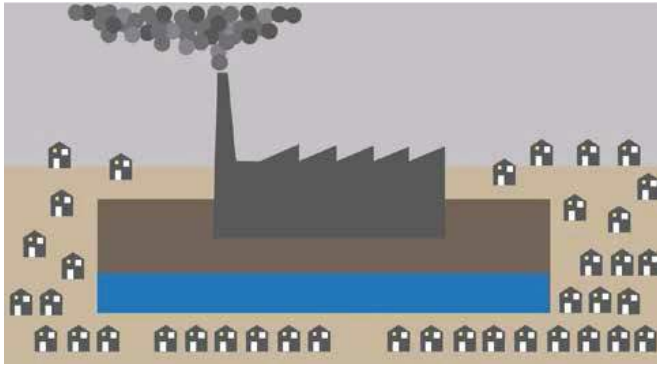
Incorporate SuDS on a site that is mainly paved?

A number of different SuDS options can still be incorporated that will complement paved environments. Permeable paving can be used for part of the paved area to drain a larger area. The areas of permeable paving should be selected to be the least trafficked (e.g. parking and footpaths) and outside of service strips where possible. Hardscape depressions and rills can be used to provide aboveground storage and double as a water feature in courtyard and paved public realm areas. Underground storage is also an option, but one which won't deliver amenity benefits. In areas where neighbourhood character will support additional greenery, bioretention gardens provide a small footprint while doubling as a landscaped area.

RUNOFF CHARACTERISTICS



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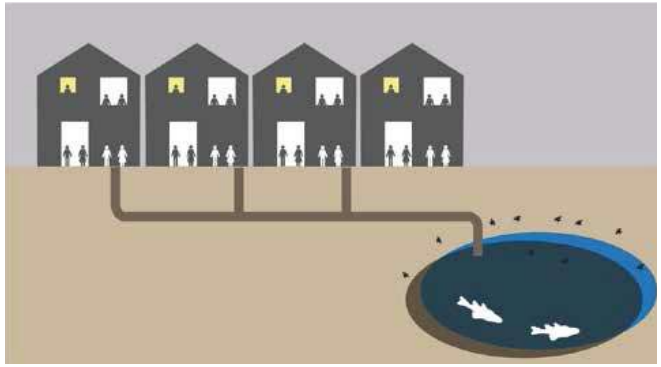
Ensure runoff from industrial sites is not contaminated?

Industrial sites that deal with chemicals, large trucks and machinery and other potential polluting uses need careful consideration in terms of SuDS design. Development of these sites can create surface water runoff with a high contamination risk. Managing runoff from these sites should be done by defining and isolating drainage sub-catchments so that high risk areas drain to separate systems while roofwater and general car park runoff drain to SuDS. Any runoff at high risk of contamination from chemicals or other serious water-borne pollution should be contained and treated as industrial waste.



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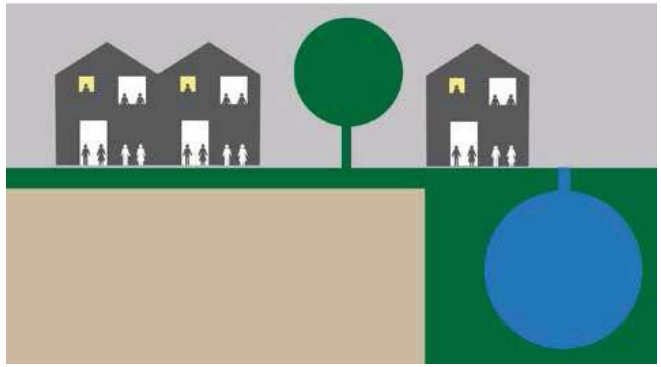
Prevent runoff from reducing the quality of the receiving body of water?

When water is discharged into a water body, the quality of that receiving water needs to be considered. Different SuDS will provide different types of treatment, and a 'treatment train' of SuDS (see chapter 3) should be introduced to ensure water is exposed to a variety of filtration mechanisms and attenuated to allow pollutants to settle out. For example, runoff can be conveyed from permeable paving to a swale, before being treated in a wetland and discharged to provide three stages of treatment. Any water being discharged into a water body should be well treated to remove nutrients and sediments and a greater number of treatment stages is likely to be required when the receiving body quality is high.

PROTECTED SPECIES OR HABITAT



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Design SuDS to integrate with existing ecological areas?

SuDS can include vegetation and surface water that can contribute to biodiversity and enhance ecology in developed areas. However, SuDS are primarily water management features and their design should carefully consider existing ecological conditions. Initial site surveys should identify areas of interest, including designated areas for nature conservation, areas with protected species and locally important habitats. SuDS should be designed to protect or enhance these areas. While SuDS can include areas of habitat, these should be well thought out in terms of long-term maintenance to ensure that habitat is not harmed during maintenance activities.

OWNERSHIP AND MAINTENANCE

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Design SuDS for adoption?

Adoption discussions should be held early in the design process to ensure that SuDS are designed to the standards required by the adoption authority. Depending on the local provisions and context, the adopter could be the SuDS Approval Body (SAB) under the Flood and Water Management Act, a local authority, a highways authority, a land owner or a water company. Where adoption is uncertain, it is beneficial to ensure that design accommodates flexibility and favours simple solutions with low maintenance needs.

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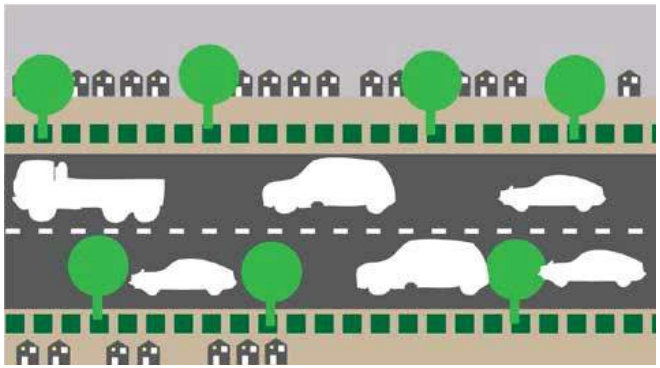
Ensure SuDS costs are viable?

According to Defra[2], the capital costs for SuDS are generally considerably less than traditional drainage systems. By thinking about SuDS early in the design process, there is also a chance to limit long term maintenance costs. For example, developers can:

- Consider early, with all stakeholders, the management of surface water and its integration with the development;
- Maximise the use of simple, surface, vegetated systems, avoiding deep excavation and engineered structures;
- Develop a cost-effective construction programme to protect drainage;
- Design for low ongoing maintenance, integrated with general landscaping work;
- Include green waste and sediment disposal zones on-site; and
- Ensure effective community engagement, with the possibility of involving local people in SuDS maintenance.

Not only that, SuDS also have a number of benefits that can deliver value. This includes attractive views of green and water that people are willing to pay for.



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Manage runoff to/from Adopted Highways?

Specific design requirements and street design guidelines will exist for each authority area, and the local highways authority representative should be engaged early in the master planning process, as there may be potential for an efficient solution which benefits both private property owners and the highways authority. Adoption of SuDS in the roadway should also be discussed at this point.

2. Defra's Water Availability and Quality Evidence Programme

SUDS SELECTION MATRIX FOR SITE CONDITIONS

unsuitable

suitable

		Green Roof	Rainwater Harvesting	Soakaway	Permeable Paving	Filter Strip	Bioretention Area	Swale	Hardscape Storage	Pond	Wetland	Underground Storage
Flood Plain	Located in the floodplain?	●	●	●	●	●	●	●				
Groundwater	Groundwater less than 3 metres below ground surface?	●	●		● With liner and underdrain (no treatment)	●	● With liner and underdrain	● With liner	● If aboveground	● With liner	●	
Topography	Sited on a flat site (<5% gradient)?	● Source control	● Source control	● Source control	● Source control	● Source control	● With short kerb or rill length	● Careful to provide some gradient	●	● Try to keep flow above ground to	● Try to keep flow above ground to	●
	Sited on a steep slope (5-15% gradient)?	●	●		● If terraced		● If terraced	● If installed along contour	● If terraced		● If terraced	●
	Sited on a very steep slope (>15% gradient)?	●	●									●
Soils and Geology	Impermeable soil type (e.g. clay-based type)?	●	●		● With underdrain (no treatment)	●	●	●	●	●	●	●
Contaminated land	Are there contaminated soils on site?	●	●		● With underdrain (no treatment)	● With liner	● With liner and underdrain	● With liner	● With liner	● With liner	● With liner	● With liner
Existing Infrastructure	Are there underground utilities in the SuDS area?	●	●		● If possible relocated into a marked corridor for future maintenance	●	● Possible with structural grid in soil					●
Space constraints	Limited space for SuDS components?	●	●	●	●		●	● Rill or channel more suitable	●		● Micro-wetland	●
Runoff characteristics	Suitable for inclusion in high risk contamination areas?	● Source control	● Source control		● With liner and spill isolation		● With liner and spill isolation	● With liner and spill isolation	● With liner and spill isolation		● If designed for treatment of predicted wastes	● With liner and spill isolation
Protected species or habitat	Proximity to designated sites and priority habitats?	●	●	●	●	●	●	●	●	● If designed and maintained appropriately	● If designed and maintained appropriately	●
Ownership and Maintenance	Can the feature be designed for adoption?	● Dependant on design and local adoption policies										