

Management and maintenance of Sustainable Drainage Systems (SuDS) landscapes

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This Guidance Note aims to provide an accessible summary of current techniques and considerations, at both the design and post-construction stages, for the effective maintenance of SuDS.

1. Introduction

1.1 Sustainable Drainage Systems (SuDS) are a sequence of water management techniques and features designed to drain surface water in a more sustainable manner than that achievable via the conventional practice of routing run-off through pipework alone. The use of SuDS is becoming increasingly promoted by various national policy documents for England, Wales and Northern Ireland and is obligatory for new developments in Scotland. Adoption standards are developing and ongoing management and maintenance of SuDS is an important consideration for the success of a scheme.

1.2 Good SuDS should be able to evolve and improve over time. Landscape architects have the skills not only to understand land and the various disciplines involved in its planning and design, but also to understand how landscapes will behave in the future. A successful scheme is dependent on thinking about longer term maintenance and integrated land management at the outset of a project. It is recognised that long term SuDS management can be a new experience for land managers and that experience in this area is continuing to grow.

1.3 The aim of this Guidance Note is to provide an accessible summary of current techniques and considerations, at both the design and post-construction stages, for the effective maintenance of SuDS. There are a number of other existing guidance documents available, such as those produced by CIRIA and others, and this Note provides signposts to some sources of additional information; this note is therefore not intended to be final.

1.4 This Guidance Note was prepared by members of the Water Sub-Group of the Landscape Institute (LI) Technical Committee, in consultation with LI members and technical experts experienced in the design and maintenance of SuDS and approved by the chair and vice chair on behalf of the Committee. It will be reviewed and updated as necessary to reflect the rapid pace of change in knowledge in this area, as experience of such systems grows.

2. Guiding principles

2.1 Crucial factors to consider when designing SuDS to minimise future maintenance and management issues are:

- how the SuDS will be maintained and by whom
- selection of an appropriate range of SuDS for the site or project area
- effective location, design and construction

2.2 It is essential to involve those ultimately responsible for maintenance to ensure the design can be maintained realistically. It may also be necessary to refer to requirements published in Local Plans and by the forthcoming SuDS Approval Body (SAB) since public bodies have a keen eye to minimising ongoing liabilities. It will be clear from this that SuDS maintenance and management needs to be considered from the outset. The current and/or future land use or function of the site should be considered particularly where SuDS are planned on multifunctional sites. Look to build 'ownership' of the scheme with the local community. This is particularly important with areas of open water to encourage positive attitudes. If there are protected species on site a licence may be required in order to carry out some operations, such as de-silting or vegetation clearance.

2.3 Once soils are exposed during the construction phase of any development there is potential for soil erosion leading to silt-laden runoff which could damage SuDS and pollute watercourses downstream. Temporary treatment systems separate to the main SuDS system should be provided unless it is intended they will be replaced or restored (SEPA, 2006). Upstream pre-treatment features help build resilient downstream SuDS landscapes, reducing maintenance both during construction and operation. Such features are designed to hold back contamination and can include for example swales, detention basins and filters strips or hard infrastructure such as oil interceptors that can capture coarse sediment and oil and contain large spillages. It is imperative to ensure there is a system in place for management of emergency spillages. Measures such as the availability of oil absorbent booms and materials can also be incorporated into management plans and used to contain spills.

2.4 Management and maintenance requirements are specific to each SuDS element although in many cases can easily be aligned with ambient site management programmes and specifications. Indeed the long-term success of schemes is often assured by being pragmatic and accommodating facilities and parks managers' operational patterns.

2.5 It is important to recognise that visible facilities tend to receive more maintenance; resources for maintenance are often limited. This is one reason why, to avoid SuDS failure, both individually and as an approach, above ground and close to source solutions are always to be preferred. However, maintenance should take account of SuDS elements which are not immediately obvious or visible, e.g. manholes, rodding points or pipework.

3. Summary of management and maintenance factors to consider when designing SuDS landscapes

3.1. Effective location: adopt a preference for close to surface, close to source solutions.

3.2 Effective design to facilitate maintenance:

- Use a mix of SuDS techniques selected specifically for the site, considering maintenance aspects of each. Refer to CIRIA C697 SuDS Manual, Chapter 5.
- Select and prepare appropriate soils to suit the preferred maintenance option, e.g. permeable vs. impermeable; scarifying, spiking.
- Use plants appropriate to design characteristics: soil types; drainage; slope and orientation; and available light. Select a mix of species suitable for flow velocities and extremes of weather conditions. Consider how quickly and how large plants will grow and how they are likely to be treated by ambient greenspace management. Refer to CIRIA C697 SuDS Manual, Chapter 20 and local consultation.
- Allow access for management and maintenance, vehicular in public or large spaces.
- Incorporate inspection points which are easy to access.
- Incorporate appropriate pre-treatment structures to prevent clogging and reduce the need for maintenance downstream.

- Incorporate bypass systems or temporary drainage structures for use if required during maintenance/management.
- Consider using geotextiles where necessary to prevent clogging.
- Include gently shelving slopes to allow safe access for maintenance and minimise erosion while allowing people contact with landscape features.
- Consider the availability of disposal areas for organic arisings (green waste) and sediments.
- Appoint an appropriately qualified professional during construction stage to ensure accurate implementation and manage issues such as diversion run off and avoid compaction and clogging.

3.3 Identify appropriate inspection frequency during construction and post-construction which varies dependant on the SuDS element.

3.4 Identify appropriate operations, for example:

Establishment period:

- Plant at appropriate time of year;
- Ideally, stabilise planting before drainage is allowed to enter the system; and
- Maintain harder elements, such as gabions, free from vegetation.

Medium and long term:

- Inspections;
- Mowing frequency (e.g. swales);
- Cutting back of plant growth (removes contaminants);
- Removal of nuisance plants and invasive species management;
- Replacement of dead vegetation;
- Removal of vegetation to ensure appropriate area of open water;
- Mulch replenishment;
- Removal of litter;
- Erosion repair;
- Unclogging of subsurface drains (frequency); and
- Repair of harder elements.

3.5 Health and safety of, for example, users, installers and maintenance personnel of SuDS landscapes need to be considered during the design of such schemes. The requirements of the CDM Regulations (2007) are likely to apply to the design, construction, management and decommissioning of all SuDS projects. Designers should ensure they are competent to prepare or undertake a SuDS design and aware of their duties in relation to the CDM Regulations when undertaking such work.

3.6 Designers and land managers need to be aware of other legislation relating to the protection of certain species and their habitats associated with SuDS features. To ensure that maintenance is undertaken within the law, checks for the presence of these protected species and habitats, by suitably qualified professionals may need to be factored in, such that restrictions as to timing of works and licensing requirements can be determined in advance of such works. Advice from a suitably qualified ecologist may be helpful in such situations.

4. Summary guidance for management and maintenance of SuDS landscapes

4.1 The table below summarises a number of aspects, techniques and considerations relating to the maintenance of SuDS elements. It highlights whether there is a significant soft (planting) element associated with the SuDS features, and whether their function may potentially cause ill-effects on plant health over time. The design considerations and post-construction operations that can influence the success of ongoing maintenance and management are listed and signposts to additional information provided.

GREEN ROOFS		
Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
Yes	n/a	
<p>Design considerations (to facilitate management)</p> <p>Use suitably contained lightweight soil medium.</p> <p>Incorporate drainage layer to allow flow to prevent ponding yet hold some water during drought.</p> <p>Waterproofing layer – anchored; root resistant.</p> <p>Incorporate multiple outlets to reduce risks from blockages.</p> <p>Allow access for repair to waterproof membrane/liner.</p> <p>Appropriate vegetation:</p> <ul style="list-style-type: none"> - Perennial; drought tolerant; rapid colonisation; self-sustaining; withstand extremes of heat, cold and high wind; tolerant of poor mildly acidic soil; preference for well drained soils; low maintenance; fire resistant, e.g. <i>Sedum</i>; <i>Carex</i>; <i>Festuca</i>; <i>Stipa</i> - Alpine or sub-alpine plants: extensive (minimal maintenance): mosses, succulents, herbs or grasses. - Intensive: (regular maintenance – irrigation; feeding; cutting); grasses; ground cover; planters, trees. 		<p><i>Chapter 6</i> <i>Source control</i></p> <p><i>Section 6.4.6</i></p> <p><i>Table 6.4</i> <i>Green roof planting</i></p>
<p>Management and maintenance techniques/considerations</p> <p>Establishment period – irrigation requirement.</p> <p>Inspect for bare patches and replacement of plants, litter removal.</p>		<p><i>Table 6.5</i> <i>Management and maintenance requirement</i></p>
OIL INTERCEPTORS		
Significant plant element	Potential for effects on plant health	
No	Yes	
<p>Design considerations (to facilitate management)</p> <p>Select type and sizing based on treatment objectives using site specific risk assessment of pollution to receiving waters.</p>		
<p>Management and maintenance techniques/considerations</p> <p>Regular inspection (initially monthly) and cleaning to assess sediment and oil levels and prevent accumulated oil and grit from escaping. Cleaning involves a vacuum pump tanker therefore vehicular access necessary.</p>		

HYDRODYNAMIC/ VORTEX SEPARATORS

Significant plant element No	Potential for effects on plant health Yes	2007 C697 SuDS Manual references
Design considerations (to facilitate management) Sizing based on treatment objectives using site-specific risk assessment of pollution to receiving waters. Provide adequate vehicle access.		<i>Section 7.3</i>
Management and maintenance techniques/considerations Regular inspection (initially monthly) and cleaning to assess sediment /pollutant levels and prevent accumulated oil and grit from escaping. Cleaning involves a vacuum pump tanker.		

SOAKAWAYS

Significant plant element No	Potential for effects on plant health Possible	2007 C697 SuDS Manual references
Design considerations (to facilitate management) Pre-treatment to prevent clogging. Provide adequate vehicle access.		<i>Chapter 6 Source control</i>
Management and maintenance techniques/considerations Minimise clogging by sweeping draining area regularly. Regular inspection particularly after heavy rainfall. Regular removal of sediment from pre-treatment device; removal and replacement of sand layers, if present, as necessary to prevent clogging.		<i>Section 6.5 Soakaways</i>

RAINWATER HARVESTING/DISCONNECTING DOWNSPOUTS

Significant plant element No	Potential for effects on plant health Yes	2007 C697 SuDS Manual references
Design considerations (to facilitate management) Ensure sufficient outdoor space and planting to take runoff.		<i>Chapter 6 Source control</i>
Management and maintenance techniques/considerations Regular inspection and cleaning of inlets, outlets of silts and other debris to prevent clogging. Replace filters. Inspect areas receiving overflow for evidence of erosion. Repair erosion damage. Remove tank sediment.		<i>6.6 Water butts 6.7 Rainwater harvesting</i>

FILTER STRIPS

Significant plant element No	Potential for effects on plant health Yes	2007 C697 SuDS Manual references
Design considerations (to facilitate management) Recommended minimum 6m width and sufficient for mowing equipment access. Design to provide a water depth <50mm for the water quality treatment event. Landscape to deter pedestrians, pets and unwanted vehicles. Plant using a mix of dry area and wet area grasses to promote resilience to varying conditions.		<i>Chapter 8 Filter strips</i>
Management and maintenance techniques/considerations Maintenance plan to incorporate regular inspections, mowing and litter and debris removal.		<i>Table 8.2 Filter strips operation and maintenance</i>

INFILTRATION TRENCHES

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
No	Yes	
Design considerations (to facilitate management) Design appropriately to prevent clogging. Can be planted with grass in conjunction with appropriate management.		<i>Chapter 9 Infiltration trenches</i> <i>Table 9.2 Trenches operation and maintenance requirements</i>
Management and maintenance techniques/considerations Regular inspections; litter, debris, weed and root removal to prevent blockages.		

PERMEABLE PAVEMENTS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
No	Yes	
Design considerations (to facilitate management) Soft landscape areas to be 30-50mm below top of kerb adjacent to the permeable pavement. Slope areas of soft landscape away from permeable pavement areas. Soft landscape areas that drain onto permeable pavement areas should be stabilised rapidly to minimise debris migration. Use geotextile where appropriate to prevent clogging.		<i>Table 12.2 Permeable pavement operation and maintenance requirements</i>
Management and maintenance techniques/considerations Initial inspection; monthly for first three months; 48h after large storms and annually. Regular cleaning of silt and other sediment to preserve infiltration capacity and reduce pollutant build up. Clean inlets. Minimum three times per year informed by regular inspection. A brush and suction cleaner or smaller sweeper should be used at a minimum: <ul style="list-style-type: none"> - End of winter (April) to collect winter debris - Mid-summer to collect dust, flower and grass type deposits. - After autumn leaf fall (November) Use an observation well to monitor effectiveness.		

GEOCELLULAR SYSTEMS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
No	Yes	
Design considerations (to facilitate management) As permeable pavements above.		<i>Table 13.2 Operation and maintenance requirements</i>
Management and maintenance techniques/considerations Regular inspection of silt traps, manholes, pipework and pre-treatment devices. Removal of sediment and debris as required.		

SAND FILTERS

Significant plant element No	Potential for effects on plant health n/a	2007 C697 SuDS Manual references
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<p>Design considerations (to facilitate management) Use plants that will not inhibit infiltration, tolerate periods of inundation and drought and are low maintenance. Avoid planting deciduous trees and shrubs in the vicinity to prevent clogging of the structure.</p> <p>Management and maintenance techniques/considerations Inspection frequency. Litter/trash/debris removal. Grass cutting and weeding. Replacement of filter layers.</p>	<p><i>Table 14.4 Operational and maintenance requirements</i></p>
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RAIN GARDENS/BIORETENTION

Significant plant element Yes	Potential for effects on plant health n/a	2007 C697 SuDS Manual references
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<p>Design considerations (to facilitate management) Provide pre-treatment to minimise maintenance. Plant selection for different bioretention zones: grasses vs. woody/herbaceous. Soil type (to infiltrate; clay to absorb hydrocarbons; as planting medium). Soil depth (minimum 1.0m). Mulch layer – max 75mm depth.</p> <p>Management and maintenance techniques/considerations Mowing frequency; height. Timing and frequency of cutting plants back. Dead plant removal. Incorporate observation pipe securely capped to prevent vandalism.</p>	<p><i>Table 11.4 Planting for different bioretention zones</i></p> <p><i>Table 11.5 Bioretention areas operation & maintenance guide</i></p>
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SWALES

Significant plant element Yes	Potential for effects on plant health n/a	2007 C697 SuDS Manual references
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<p>Design considerations (to facilitate management) <1:3 side slopes, ideally 1 in 4-5 to maximise contact with vegetation thus enhance treatment, reduce erosion risk and facilitate mowing. Minimum longitudinal slope of 1 in 300 for conveyance swales prevents ponding; no minimum requirement for under drained swales. Minimum length of 30m (ideally 60m) to maximise treatment and facilitate mowing. Minimise point inflow to prevent erosion (use kerb cuts or low earth weir). Plant selection based on vigorousness; soil type; ability to tolerate silt; available light etc. Do not route water through until grass established.</p> <p>Management and maintenance techniques/considerations Mow in first year to prevent establishment of weeds. Ideal grass height: 100mm.</p>	<p><i>Chapter 10 Swales</i></p>
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INFILTRATION BASINS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
Possible	Yes	
<p>Design considerations (to facilitate management) Ensure appropriate ground characteristics by geotechnical testing. Ensure level basin floor to maximise infiltration. Pre-treatment device(s) recommended to prevent clogging. Can be designed as off line devices to prevent system damage during extreme events. Shallow side slopes ≤ 1 in 4 and benching to allow vegetation to stabilise soils and safe access for maintenance. Design to half empty within 24hrs to accommodate multiple storms and minimise risk of vegetation damage and soil compaction.</p> <p>Management and maintenance techniques/considerations Stabilise the base and sides with a dense turf of water tolerant grass immediately after basin construction. Seed in early spring and during autumn. Additional vegetation recommended to enhance appearance, create habitat, prevent erosion and slow flows enhancing infiltration. Plant with native wildflower mixes to reduce maintenance</p>		<p><i>Chapter 15</i></p> <p><i>Table 15.2 Infiltration basin operation and maintenance requirements</i></p> <p><i>Section 20.4.3 Grass/turf</i></p>

DETENTION BASINS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
Yes	n/a	
<p>Design considerations (to facilitate management) Volumetric allowances for vegetation of up to 25% should be provided to ensure flood control criteria are met. Side slopes no steeper than 1 in 4 gradient for mowing and maintenance with consideration given to changes in slope being suitable for machinery. Minimum length to width ratio of 2:1. Level basin floor to minimise flow velocities. For large developments a sediment forebay will reduce requirement for long term maintenance. Plan area of sediment forebay to be at least 10% of total basin area. In the case of multiple inlets, provide pre-treatment for each inlet. Incorporate benches at edges for maintenance access, stabilise soil & prevent erosion. Bioretention/wetlands/micro pools as outlets desirable to enhance pollution control.</p> <p>Management and maintenance techniques/considerations Inspection frequency - at regular intervals (twice a year) and after severe events (to check bank stability, vegetation growth, debris and erosion). Regular mowing along access and amenity areas. Sediment removal from forebay or micro-pools from September onwards when 50% full or if volume reduced by >25% (3-10 years). Where used for dual purpose, e.g. playground, provide an indication that the area is liable to flooding. If used for temporary storage during construction, reinstate afterwards.</p>		<p><i>Chapter 16 Detention basins</i></p> <p><i>Figure 16.2</i></p> <p><i>Table 16.2 Detention basin operation and maintenance requirements</i></p>

PONDS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
Yes	n/a	
<p>Design considerations (to facilitate management)</p> <p>Incorporate a bypass system offering alternatives for releasing water in storage in case of blockage.</p> <p>Design for maintenance access.</p> <p>Side slopes no steeper than 1 in 3 gradient.</p> <p>Maximum permanent pool depth (2m).</p> <p>Minimum depth for open water areas (1.2m).</p> <p>Use natural forms.</p> <p>Plant to enhance biodiversity.</p> <p>Profile of woodland, shrub, fringing, emergent, floating, submerged. (Introduce adjacent vegetation native to area).</p> <p>Avoid dense planting to allow natural colonisation.</p> <p>Plant to allow visibility of waters edge especially in amenity areas.</p> <p>Develop local (within 30km) plant list excluding invasive species.</p>		<p><i>Section 17.7 Landscaping and vegetation</i></p> <p><i>Figure 17.4 Typical vegetation profile</i></p> <p><i>Section 20.4.6 Barrier planting</i></p> <p><i>Section 20.4.7 Plant selection</i></p>
<p>Management and maintenance techniques/considerations</p> <p>Litter, debris and sediment removal frequencies.</p> <p>Grass cutting.</p> <p>Removal of dead vegetation before start of growing season.</p>		<p><i>Table 17.4 Pond operation and maintenance requirements</i></p>

WETLANDS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
Yes	n/a	
<p>Design considerations (to facilitate management)</p> <p>Incorporation of sediment forebays – eliminate need to dredge main wetland (likely every 25 years or less). Sediment may have to be removed from forebay every 7-10 years or when half full with sediment.</p> <p>Carefully select plants that are not invasive, are capable of pollutant removal, adapted to saturated soils conditions, tolerant of inundation and can withstand dry periods.</p> <p>Use shallow side slopes (ideally $\leq 1:4$ or not exceed 1:3 gradient) to allow safe access.</p>		<p><i>Chapter 20</i></p> <p><i>Section 20.4.6 Barrier planting</i></p> <p><i>Section 20.4.7 Plant selection</i></p>
<p>Management and maintenance techniques/considerations</p> <p>Cut back aquatic vegetation after flowering and thin when necessary (7-10 years from September onwards).</p> <p>Inspect quarterly during first two years for nuisance vegetation.</p> <p>Inspect inlets and outlet quarterly or after large storms for evidence of clogging and accumulation of debris/litter. Inspect also for evidence of erosion and subsidence. Consider context and potential for contamination when identifying disposal options as well as ecological timing (newts, voles, aquatic spawning etc.) as appropriate.</p>		

5. References and sources of information

- Bettess, R. (1996) CIRIA Report R156. *Infiltration drainage: manual of good practice*. London: CIRIA.
- Bray, B., Gedge, D., Grant, G. & Leuthvilay, L. (2012) *Rain garden guide*. London: Reset Development.
- British Standards Institution (2013) BS 8582:2013. *Code of practice for surface water management for development sites*. London: BSI.
- British Standards Institution (2003) BS 6229:2003. *Flat roofs with continuously supported covering: code of practice*. London: BSI.
- British Standards Institution (2009) BS 8515:2009+A1:2013. *Rainwater harvesting systems: code of practice*. London: BSI.
- Building Research Establishment (2007) *Digest 365: Soakaway design*. Watford: BRE.
- Construction (Design and Management) Regulations 2007* (SI 2007/320).
- Construction (Design and Management) Regulations (Northern Ireland) 2007* (SI 2007/ 291).
- Department for Communities and Local Government (2012) *National Planning Policy Framework*. London: DCLG.
- Digman, C., et al (2012). C713. *Retrofitting to manage surface water*. London: CIRIA.
- Dublin City Council et al (2003) *Greater Dublin strategic drainage study: environmental management policy, case studies and SuDS option sheets*.
- Dunnett, N. and Clayden, A. (2007) *Rain gardens: managing water sustainably in the garden and designed landscape*. Portland, OR: Timber Press.
- Dunnett, N. (2003) *Planting green roofs*. Green Roofs for Healthy Cities Conference, University of Sheffield 24 September 2003.
- Groundwork Sheffield [n.d.] *The green roof guide*. <http://www.greenroofguide.co.uk/>
- Hertfordshire County Council (2012) *Interim SuDS policy statement: meeting Sustainable Drainage Systems Standards in Hertfordshire*. <http://www.hertsdirect.org/docs/pdf/s/sabguide.pdf>
- SEPA (2000) *Ponds, pools and lochans: guidance on good practice in the management and creation of small waterbodies in Scotland*. Stirling: Scottish Environment Protection Agency.
- SEPA (2006) *A dos and don'ts guide for planning and designing Sustainable Urban Drainage Systems (SUDS): for developers, landowners, planners, consultants, architects and engineers*. Stirling: Scottish Environment Protection Agency.
- Shaffer, P., et al (2004) CIRIA Report C625. *Model agreements for sustainable water management systems: model agreements for SUDS*. London: CIRIA.
- Woods-Ballard, B. and Kellagher, R. (2007) C697. *The SuDS Manual*. London: CIRIA.
- Woods-Ballard, B. and Kellagher, R. et al (2007) C698. *Site handbook for the construction of SUDS*. London: CIRIA.

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