



**ONE HORTON HEATH: WATER QUALITY
OUTLINE MONITORING AND MANAGEMENT PLAN**



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Figure 1 Landscape Strategy Plan Showing SuDS Ponds





1. OUTLINE MONITORING PROTOCOL

1.1 Monitoring Locations

Water quality (to include both water, sediment and aquatic macro-invertebrates)

1.1.1 Example Riverine sampling locations

Sampling locations on Main River and Ordinary Water Courses, will be located to enable assessment of flows entering watercourse reaches associated with and receiving discharges from One Horton Heath, above confluences and also downstream of One Horton Heath discharges. This is illustrated by Figure 2, showing 10 fluvial monitoring sites (green circles with red border).





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1.1.2 Example SuDS sampling locations

Sampling locations on the formal treatment SuDS, will be located to enable assessment of flows exiting these features into watercourse associated with and receiving discharges from One Horton Heath, This is illustrated by Figure 3 which shows 17 SuDS monitoring sites denoted by the green circles with red border.



1.2 Outline Monitoring Specification – Pre-construction Baseline

Subject to agreement with Eastleigh Borough Council, Environment Agency and Natural England.

The following parameters will be measured in water at all locations on a weekly basis over a 4-week period during typical flows and also over 24 hours during storm flows using a hand held GPS enabled multiparameter water quality meter:

- Dissolved oxygen
- Oxidation reduction potential
- Temperature
- pH
- Electrical Conductivity
- Turbidity
- Total dissolved solids
- Ammonium nitrogen
- Nitrate nitrogen
- Chloride
- Atmospheric pressure
- Fixed point photography
- Flow

The following will be measured once each during spring and autumn from the riverine locations:

Aquatic macro-invertebrates: using a combined 3-minute kick sample and 1 minute sweep sample, preserved in 70% Industrial Methylated Spirit, and identified to family and species level to provide suitable indices of pollution and flow e.g. Average Score Per Taxa (ASPT), Biological Monitoring Working Party (BMWP), Lotic Invertebrate Flow Index (LIFE) as well as other indices that help indicate e.g. acidification, siltation, morphology and salinity or reflecting community conservation importance.

Suspended solids: Using an automatic sampler taking multiple samples using a time composite method to sample different flow condition e.g. one sample every 7 hours, over a weekly period, before being relocated. Samples to be laboratory analysed to provide a particle size distribution to evaluate dominance of silt, and sand fractions in the flow. This procedure will also be repeated during high flow events where up to 90% of the sediment mass is transported within 10% of the time during storm flows.

Water samples will be obtained from each riverine location and sent for laboratory testing to confirm baseline total nitrogen levels. The specification will be agreed in advance with Eastleigh Borough Council, the Environment Agency and Natural England.

1.3 Outline Monitoring Specification – Construction Phase

Subject to agreement with Eastleigh Borough Council, Environment Agency and Natural England.

The spot samples highlighted above will be monitored at all locations on a regular basis during construction throughout the multiphase development.

The macro-invertebrate assessment will be carried out at the riverine locations every 3 years during construction and 3 years post-construction. The suspended solids assessment will be repeated at the riverine locations on a basis agreed with Eastleigh Borough Council and the Environment Agency during construction.

Each phase will also be subject to a detailed Construction Environmental Management Plan that will address all identified forms of pollution prevention, response and clean-up including sediments and water runoff, hydrocarbons, concrete, paints and other contaminants. Specific monitoring measures for these will be defined and agreed in advance with Eastleigh Borough Council and the Environment Agency.

Water samples will be obtained from each completed SuDS and riverine locations and sent for laboratory testing to confirm total nitrogen levels. The specification will be agreed in advance with Eastleigh Borough Council, the Environment Agency and Natural England.

1.4 Outline Monitoring Specification – Post-Construction Phase

Subject to agreement with Eastleigh Borough Council, Environment Agency and Natural England.

The spot samples highlighted above will be monitored at all locations on a regular basis during construction throughout the multiphase development.

The macro-invertebrate assessment will be carried out at the riverine locations every 3 years during construction and 3 years post-construction. The suspended solids assessment will be repeated on at the riverine locations on a basis agreed with Eastleigh Borough Council and the Environment Agency during construction.

Water samples will be obtained from each completed SuDS and riverine locations and sent for laboratory testing to confirm total nitrogen levels. The specification will be agreed in advance with Eastleigh Borough Council, the Environment Agency and Natural England.

2. OUTLINE SuDS MANAGEMENT PROTOCOL

Subject to agreement with Eastleigh Borough Council, Environment Agency and Natural England.

Best practice will be adopted when defining and implementing the regular management of SuDS to respond to identified water quality incidents, poor performance of SuDS (notably with respect of nutrients and fine sediment).

An example of an approach to regular SuDS maintenance inspections is set out in the following pages, based on Appendix B of CIRIA document C753. The SuDS Manual.

Please refer to Annex A for an example of good practice for the ongoing management of SuDS , which will be reviewed, discussed and agreed in advance with Eastleigh Borough Council, the Environment Agency and Natural England.

Table B.25 SuDS maintenance inspection checklist			
General information			
Site ID			
Site location and co-ordinates (GIS if appropriate)			
Elements forming the SuDS scheme		Approved drawing reference(s)	
Inspection frequency		Approved specification reference	
Type of development		Specific purpose of any parts of the scheme (eg biodiversity, wildlife and visual aspects)	

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
General inspection items								
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?								
Is there any evidence of accidental spillages, oils, poor water quality, odours or nuisance insects?								
Have any health and safety risks been identified to either the public or maintenance operatives?								
Is there any deterioration in the surface of permeable or porous surfaces (eg rutting, spreading of blocks or signs of ponding water)?								



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Silt/sediment accumulation								
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If yes, state depth (mm) and extent. Is removal required? If yes, state waste disposal requirements and confirm that all waste management requirements have been complied with (consult environmental regulator)								
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (eg underdrained swale or infiltration basin)?)								
Does permeable or porous surfacing require sweeping to remove silt?								
System blockages and litter build-up								
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?								
Is there any evidence of any other clogging or blockage of outlets or drainage paths?								
Vegetation								
Is the vegetation condition satisfactory (density, weed growth, coverage etc)? (Check against approved planting regime.)								
Does any part of the system require weeding, pruning or mowing? (Check against maintenance frequency stated in approved design.)								



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Is there any evidence of invasive species becoming established? If yes, state action required								
Infrastructure								
Are any check dams or weirs in good condition?								
Is there evidence of any accidental damage to the system (eg wheel ruts?)								
Is there any evidence of cross connections or other unauthorised inflows?								
Is there any evidence of tampering with the flow controls?								
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)								
Other observations								
Information appended (eg photos)								
Suitability of current maintenance regime								

Annex A – Example Best Practice SuDS Management Measures

Management and maintenance of Sustainable Drainage Systems (SuDS) landscapes

**Interim Technical Guidance Note 01/2014
March 2014**

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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	
Design considerations (to facilitate management)		
Use suitably contained lightweight soil medium.		<i>Chapter 6</i>
Incorporate drainage layer to allow flow to prevent ponding yet hold some water during drought.		<i>Source control</i>
Waterproofing layer – anchored; root resistant.		
Incorporate multiple outlets to reduce risks from blockages.		<i>Section 6.4.6</i>
Allow access for repair to waterproof membrane/liner.		
Appropriate vegetation:		<i>Table 6.4</i>
- 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.		<i>Green roof planting</i>
Management and maintenance techniques/considerations		
Establishment period – irrigation requirement.		<i>Table 6.5</i>
Inspect for bare patches and replacement of plants, litter removal.		<i>Management and maintenance requirement</i>
OIL INTERCEPTORS		
Significant plant element	Potential for effects on plant health	
No	Yes	
Design considerations (to facilitate management)		
Select type and sizing based on treatment objectives using site specific risk assessment of pollution to receiving waters.		
Management and maintenance techniques/considerations		
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.		

HYDRODYNAMIC/ VORTEX SEPARATORS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
No	Yes	
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		Potential for effects on plant health	2007 C697 SuDS Manual references
No	Possible		
Design considerations (to facilitate management) Pre-treatment to prevent clogging. Provide adequate vehicle access.			<i>Chapter 6</i> <i>Source control</i> <i>Section 6.5</i> <i>Soakaways</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.			

RAINWATER HARVESTING/DISCONNECTING DOWNSPOUTS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
No	Yes	
Design considerations (to facilitate management) Ensure sufficient outdoor space and planting to take runoff.		<i>Chapter 6</i> <i>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</i> <i>6.7 Rainwater harvesting</i>

FILTER STRIPS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
No	Yes	
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</i> <i>Filter strips</i> <i>Table 8.2</i> <i>Filter strips operation and maintenance</i>
Management and maintenance techniques/considerations Maintenance plan to incorporate regular inspections, mowing and litter and debris removal.		

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>
Management and maintenance techniques/considerations Regular inspections; litter, debris, weed and root removal to prevent blockages.		<i>Table 9.2 Trenches operation and maintenance requirements</i>

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: - 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.		

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
No	n/a	

RAIN GARDENS/BIORETENTION

Significant plant element	Potential for effects on plant health	2007 C697 SuDS
Yes	n/a	Manual references

SWALES

Significant plant element	Potential for effects on plant health	2007 C697 SuDS
Yes	n/a	Manual references

Significant plant element	Potential for effects on plant health	2007 C697 SuDS
Possible	Yes	Manual references

DETENTION BASINS

Significant plant element	Potential for effects on plant health	2007 C697 SuDS Manual references
Yes	n/a	

PONDS

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

WETLANDS

Significant plant element Yes	Potential for effects on plant health n/a	2007 C697 SuDS Manual references
Design considerations (to facilitate management) 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. 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. Use shallow side slopes (ideally $\leq 1:4$ or not exceed 1:3 gradient) to allow safe access.		<i>Chapter 20</i> <i>Section 20.4.6 Barrier planting</i> <i>Section 20.4.7 Plant selection</i>
Management and maintenance techniques/considerations Cut back aquatic vegetation after flowering and thin when necessary (7-10 years from September onwards). Inspect quarterly during first two years for nuisance vegetation. 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.		

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