

Suffolk

Flood Risk
Management Partnership

Sustainable Drainage Systems (SuDS) a Local Design Guide

Appendix A to the Suffolk Flood Risk Management Strategy



May 2018

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Flood & Water Management Act 2010 Sustainable Drainage Systems (SuDS) definition:-

“SUSTAINABLE DRAINAGE” means managing rainwater (including snow and other precipitation) with the aim of:

- (a) Reducing damage from flooding,**
- (b) Improving water quality,**
- (c) Protecting and improving the environment,**
- (d) Protecting health and safety, and**
- (e) Ensuring the stability and durability of drainage systems.**

Acknowledgements

- CIRIA Susdrain for permission to use pictures of SuDS from their website.
- Suffolk Flood Risk Management Partnership

1. Introduction

One of the actions in the Suffolk Flood Risk Management Strategy (SFRMS) is to produce this local guide on surface water drainage and Sustainable Drainage Systems (SuDS). Since April 2016, planning applications for all major development should be accompanied by a site-specific drainage strategy that demonstrates that the proposed drainage scheme is compliant with the National Planning Policy Framework, Planning Practice Guidance and DEFRA Technical Standards.

Suffolk County Council, as Lead Local Flood Authority, are the statutory consultee that will provide advice to the Local Planning Authority (LPA) on the suitability of submitted applications.

This document sets the local standards for Suffolk and, together with National Planning Policy, strongly promotes developers to use SuDS to reduce surface water runoff and mitigate flood risk.

The SFRMS states:

The guiding principles for SuDS in Suffolk will be: -

- **Early consideration of sustainable flood and coastal risk management in production of Local Plans and master planning– promoting and protecting ‘blue and green corridors’.**
- **Wherever possible, the use of multifunctional, above ground SuDS that deliver drainage, enhancement of biodiversity, improvements in water quality and amenity benefits.**
- **Ensuring that land owners realise both the importance of reducing flood risk and how properly designed sustainable drainage systems can be an asset to their development.**
- **Ensuring no increase in flood risk from new development wherever possible and contributing to reducing existing risk if feasible.**
- **Ensuring water flows around properties when the design capacity of drainage systems is exceeded by extreme rainfall.**

“Water is an essential part of our natural and built environment. The way we live, work and play to varying degrees are influenced by the availability and quality of water. Increasingly we need to embrace water management as an opportunity rather than a challenge.

Successfully delivered sustainable drainage provides communities and wider society with benefits set within the context of adapting to climate change, development and improving our natural environment.”

Extracted from ‘Planning for SuDS – Making it happen’ (CIRIA report C687, 2010)

1.1 Planning Requirements

Suffolk County Council's (SCC's) Protocol (Appendix C of the SFRMS) provides further information on planning policies, processes and bodies who may potentially be involved with SuDS.

In summary Planning Practice Guidance Paragraph 50 states: "Local authorities and developers should seek opportunities to reduce the overall level of flood risk in the area and beyond. This can be achieved, for instance, through the layout and form of development, including green infrastructure and the appropriate application of sustainable drainage systems, through safeguarding land for flood risk management, or where appropriate, through designing off-site works required to protect and support development in ways that benefit the area more generally."

Furthermore, as of the 15th April 2016 the Written Ministerial Statement (HCWS161) has come into force which requires the provision of SuDS for all major developments unless demonstrated to be inappropriate.

The decision on whether a particular form or type of sustainable drainage system is appropriate for a specific development proposal, is a matter of judgement for the local planning authority, based on advice from SCC. This includes what sustainable drainage system SCC considers to be reasonably practicable.

The judgement of what is reasonably practicable is by reference to the Technical Standards published by the Department for Environment, Food and Rural Affairs and those listed in Section 1.2.

SuDS are one of the main means of achieving improved water quality in watercourses as set by the Water Framework Directive and local River Basin Management Plans. Developments are expected to discharge clean stormwater to rivers and aquifers.

1.2 Purpose of this Guide

The guide is intended for developers, architects, consultants and planners who are seeking direction on the County Council's requirements for the design of sustainable drainage systems on all major developments. The County Council, as LLFA, will refer to this Guide when it is consulted by LPA's.

The main objective of the guide is to steer developments to use high quality SuDS that will offer benefits to the community and the environment. It sets out Suffolk County Council's expectations on the provision of SuDS including preferred layout, key design elements and management of SuDS. The information set out in this document should be read in conjunction with the following national best practice documents:-

- Non-statutory technical standards for sustainable drainage systems
- The CIRIA SuDS Manual (C753)
- BS8582 Code of practice for surface water management for development sites
- LASOO – Practice Guidance

It is not the intention that this guide reproduces or replaces the documents above but the users of this guide should familiarise themselves with these documents and incorporate advice from all documents into their SuDS proposals.

Pre-application advice can be sought from the County Council as it is important to consider drainage as early in the process.

1.3 SuDS Philosophy

The current approach to surface water management in England requires outflows + volumes from new developments to be restricted to Greenfield values where appropriate; therefore not worsening flood risk in the downstream catchment (DEFRA, 2015).

SuDS mimic natural drainage processes by slowing, filtering or retaining runoff, and then putting excess water to use near where it lands rather than dispersing it quickly (Everett et al, 2015).

Planning Practice Guidance Paragraph 51 says: "SuDS should be designed to control surface water runoff close to where it falls", they provide opportunities to:

- Reduce causes and impacts of flooding
- Remove pollutants from urban runoff at source,
- Combine water management with green space with benefits for amenity, recreation and wildlife.

SuDS can generally be classed into two groups:-

1. Open or Above-Ground SuDS
2. Closed or Underground SuDS

Closed SuDS resemble traditional drainage infrastructure but incorporate SuDS principles (examples include soakaways, permeable pavements and geo-cellular systems).

Open SuDS such as swales, basins, ponds, and wetlands are above ground and offer multifunctional benefits such as greater amenity, improved water quality and biodiversity. They will be needed to achieve water quality targets where infiltration is not possible.

Open SuDS components are more accessible to inspect and can usually be maintained using

simple, cost beneficial landscaping techniques (Wilson and Davies, 2017).

Open vegetated SuDS will also help us to meet national objectives such as the Water Framework Directive by improving water quality and ecological status in our rivers and streams.

Good quality open SuDS require more design input, however construction costs are lower and SuDS are safer to build and maintain. They also enhance aesthetics of the development and improve biodiversity which can enhance house values. See also:

Kent CCs SuDS Master Planning Process Guide references: "Whitehead, Tim, Simmonds, David and Preston, John (2006) The Effect of Urban Quality Improvements on Economic Activity. Journal of Environmental Management, 80, (1), 1-12"

SuDS Management Train

Open SuDS must be part of a fully integrated approach to urban design, the object of which is good place-making. SuDS should be multifunctional, contributing to landscape design, public open space strategies, and biodiversity enhancement.

Furthermore effective SuDS systems are built as part of a management train (see Figure 1) with each stage having a specific scale and purpose.

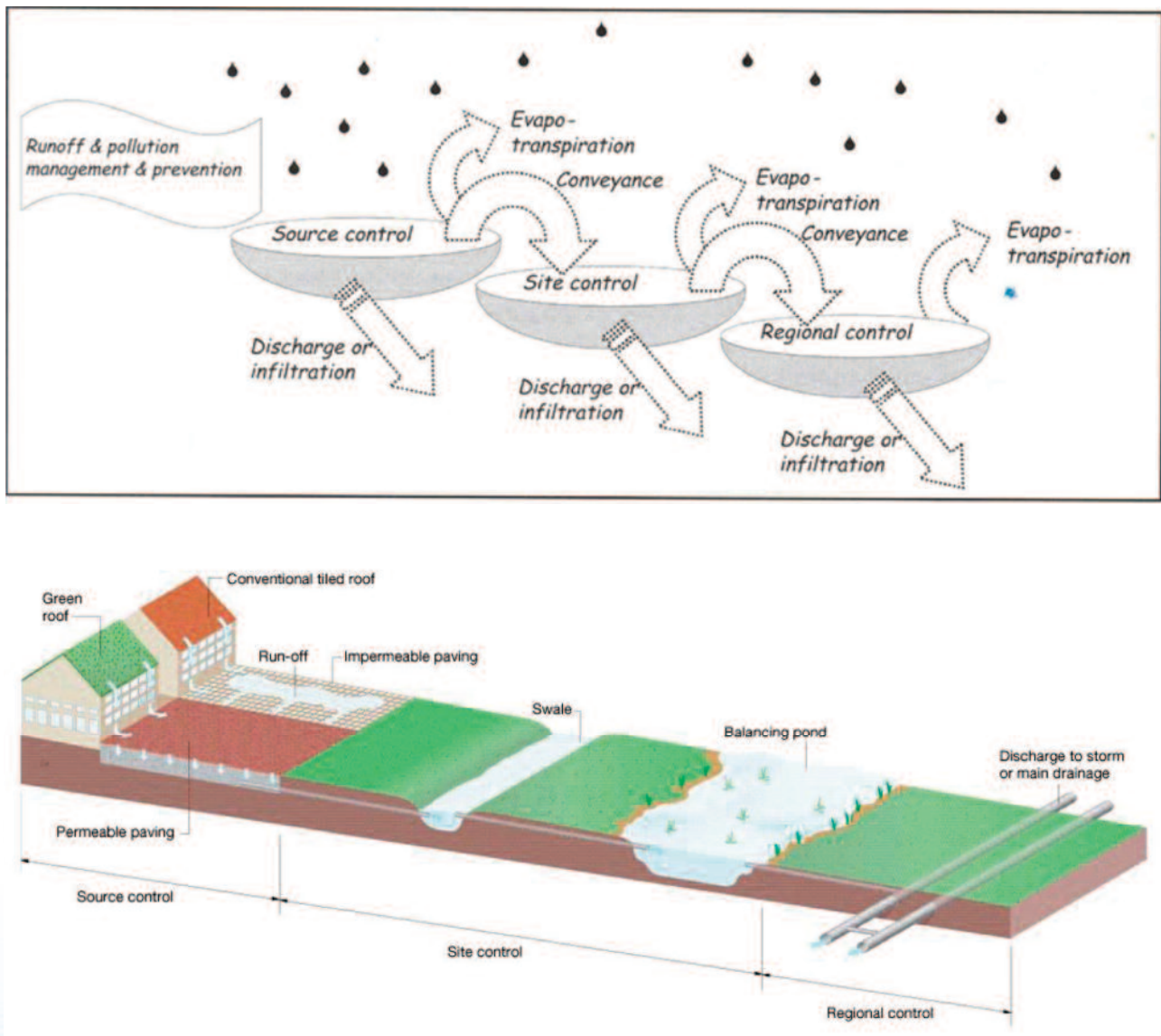
For example 'source control' measures are components designed to capture surface water where it falls, they usually serve individual properties and are relatively small (i.e. rainwater harvesting or green roofs). Generally SuDS increase in size with the amount of catchment area they serve thus 'site control' measures (or even regional control) tend to be much larger components (i.e. detention basins or wetlands). As these types serve more than one property they are usually built as part of the main strategic infrastructure of the site.

An Assessment of the Social Impacts of SuDS in the UK

http://www.susdrain.org/files/resources/evidence/HRW_social_impact_summary.pdf ⁶

found well designed and managed SuDS appear to have a positive effect on house saleability and on house prices. In areas with well-established ponds, there is perceived belief among the residents that their properties would fetch a 10% premium, along with an increase in saleability. Where houses were sited close to poorly designed and / or maintained ponds, it was felt that the saleability and price may be compromised.

Figure 1: - SuDS Management Train



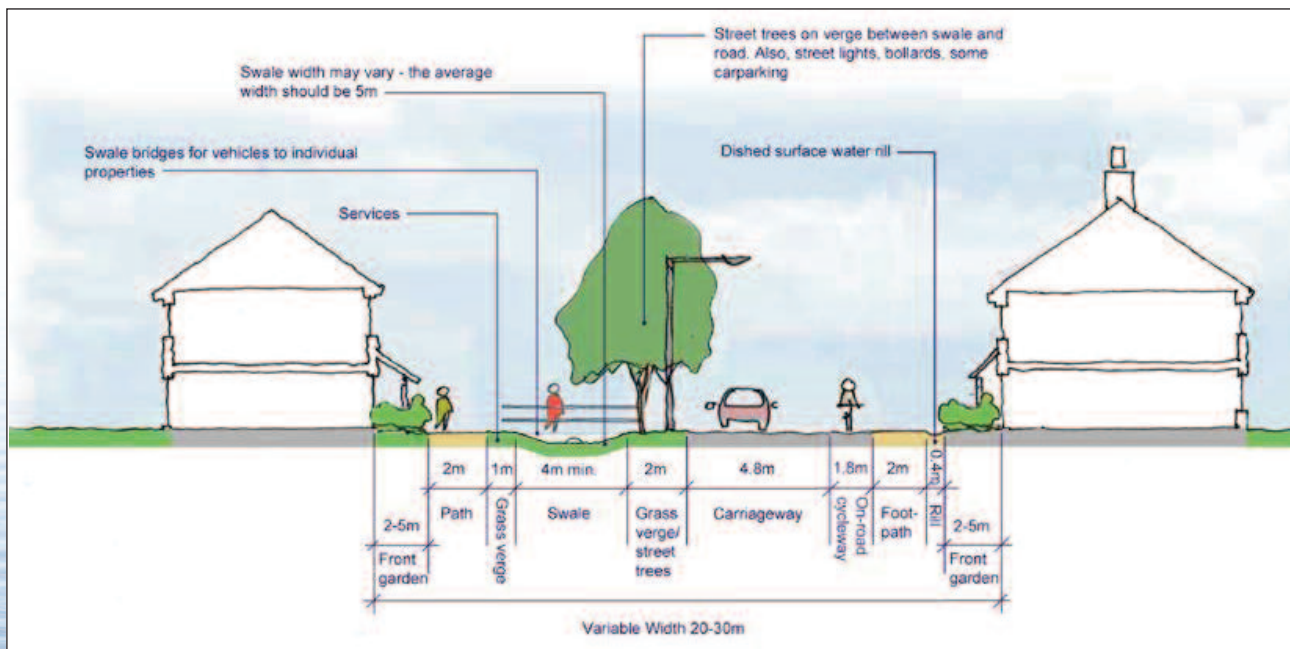
2 Before developing a layout

The key to success is for architects or planners to include SuDS in their earliest layout concepts or sketches. These can be informed by pre-application discussions with SCC drainage engineers.

The following should reduce costs and land take: -

- Contact SCC and adopting bodies as soon as possible to discuss proposals.
- Start with a topographical survey showing contours and existing drainage features such as ponds or watercourses, drainage systems, trees and hedges.
- Topography will dictate location of flood flow paths (exceedance routes) and strategic SuDS.
- Provide appropriate SI Reports and soakage test results.
- Determine site requirements for Public Open Spaces (POS) and whether these may be suitable for open SuDS.
- Avoid siting buildings in low lying areas- as they would be liable to flooding. It will probably be best to site some strategic SuDS in these areas.
- Ensure building thresholds are above surrounding ground. Avoid basements. (Design vision)
- Plan road and housing layouts using contoured plans considering topography & SuDS together – as follows:
- Identify locations for shallow SuDS close to source (e.g. 500mm deep alongside roads).
- Roads can be served by a single swale rather than one each side.

Typical detail of a road served by a single swale.



Surface water runoff, from homes on right hand side, drain to a rill then into the swale. Note there is no gullies or highway drainage. Roads are flush with drainage features and have gentle cross falls.

- If ground conditions are not suited to infiltration, swales should be used to convey flows towards a suitable discharge point. If these swales are vegetated and not too steep they should provide several functions - ie conveyance, interception, infiltration, attenuation and treatment, thus reducing the total SuDS requirement.
- Site SuDS in verges or communal areas, design visual appearance to enhance the development saleability & biodiversity etc.
- Avoid using underground pipes and grates to drain buildings or roads. Use shallow rills/channels or verges to help ensure downstream SuDS are shallow and take up less space. This will also avoid the expense of pipes, manholes and gullies & risks associated with deep excavations & confined spaces. Shallow SuDS are cheaper & safer to build and maintain.
- Wherever possible roads and roadside swales should follow contours. They will be more efficient at storing and treating runoff. On steep sites SuDS need to be carefully planned to avoid erosion and maintain effectiveness.
- Wherever possible avoid having homes lower than adjacent roads. Where land one side of road is lower use excavated material from adjacent swale to build up ground levels.
- Where roads or driveways cross swales, use them as check dams. Use crossing pipes to control flows.
- With road side swales, roads will not need to have conventional longitudinal gradients and this will reduce cut and fill.
- Avoid too much excavation, avoid disposal of excavated material off site - re-use close by or create tumps. Create bunds to hold back water in valley floors rather than excavating deep basins. If material does need to be taken off site, consider ways in which it can be put to beneficial use.
- Plan details such as traffic calming along with SuDS (e.g. site speed humps at high points in roads).

Watercourse at Westerfield.



SuDS design is an iterative process requiring several designs to be produced. The initial preliminary design will determine the approximate size of the SuDS system. This design should aim to overestimate by 10-20% the scale of the likely final SuDS scheme to allow for errors/omissions. The first iteration should identify areas where additional development could be added. (or perhaps areas where insufficient space is provided for SuDS)

Flood storage basin at Ravenswood



Subsequent designs will refine the SuDS design and development potential. The design submitted with a planning application should normally be the final design. For outline applications the initial preliminary design described above may be sufficient.

CIRIA C687 "Planning for SuDS - Making it happen (2010) is free and provides useful and provides useful information on master planning and the incorporation of SuDS through the full development process.

3. What we expect to see

As a minimum, SCC Flood and Water team will require the following information to be submitted for each type of application or stage within the planning process: (Only applies to major development unless stated otherwise)

Document Submitted	Document Description	Pre-App	Outline	Full	Reserved Matter	Discharge Condition
Flood Risk Assessment (FZ3 or Site >1Ha)	Evaluation of flood risk (fluvial, pluvial & groundwater) to the site – will guide layout and location of open spaces. (SCC may require modelling of ordinary watercourse if EA Flood Maps not available)	✓	✓	✓		
Drainage Strategy/Statement (less detail required for Outline)	Document that explains how the site is to be drained using SuDS principles. Shall include information on:- <ul style="list-style-type: none"> Existing drainage (inc adjacent roads) Impermeable Area (Pre and Post Development) Proposed SuDS Hydraulic Calculations (see below) Treatment Design (i.e. interception, pollution indices) Adoption/Maintenance Details Exceedance Paths 		✓	✓		
Contour Plan	Assessment of topography/flow paths/blue corridors	✓	✓	✓		
Impermeable Areas Plan	Plan to illustrate new impervious surfaces		✓	✓		
Preliminary Layout Drawings	Indicative drawings of layout, properties, open space and drainage infrastructure including:- <ul style="list-style-type: none"> Discharge location (outfall) Conveyance network Form of SuDS and location on the site Landscaping Details 	✓	✓	✓		
Preliminary Site Investigation Report	3 or more trial pits to BRE 365 and associated exploratory logs (check for groundwater)	✓	✓	✓		

Preliminary hydraulic calculations (Use of SCC proforma encouraged)	<ul style="list-style-type: none"> Discharge Rates (using suitable method i.e. FEH, IH124 (ICPSUDS) or modified rational method (brownfield sites) Storage Volume Long Term Storage (if required) 	✓	✓	✓		
Evidence of any third party agreements to discharge to their system (i.e. Anglian Water agreement or adjacent landowner)	Evidence of any permissions or permits being obtained.		✓	✓		
Detailed Development Layout and SuDS Provision Plan	Dimensioned plans showing the detailed development layout including SuDS components, open spaces and exceedance corridors.			✓	✓	✓
Full SI Report	Detailed assessment of ground conditions – leading on from initial testing <ul style="list-style-type: none"> Widespread coverage of trial pits to BRE 365 Contamination/Pollution check Groundwater Monitoring 			✓	✓	✓
Detailed Drainage Scheme Plan	Dimensioned plan showing main aspects of the drainage infrastructure. Plans should ref:- <ul style="list-style-type: none"> SuDS details (size/volume) Pipe Numbers/Sizes/Levels Outfall & Permitted Discharge (if applicable) 			✓	✓	✓
Detailed SuDS Drawings (Open SuDS)	Dimensioned plans of proposed SuDS components i.e. scaled cross sections/long sections			✓	✓	✓
Full hydraulic calculations (MicroDrainage "Network" output)	At this stage, SCC require simulations of the drainage network inc SuDS components. MicroDrainage Network should be submitted for 1,30 and 100yr+CC storms. (Source Control files are useful but not enough on their own)			✓	✓	✓
Discharge Agreements	Evidence of any permissions or permits being obtained.					✓
Health and Safety Risk Assessment	Where deep open SuDS (water level >0.5m) are proposed a H&S file will be required.					✓
Surface Water Construction Plan	Plan of how surface water runoff is to be attenuated and treated during the construction phase. Including plans of any temporary drainage.					✓

4. SuDS Adoption & Maintenance

National planning policy requires clear arrangements to be in place for the ongoing maintenance of SuDS over the lifetime of the development. SuDS maintenance and operation requirements must be “economically proportionate” under the same legislation. This could affect layout and succeeding design stages of the development. The LPA will usually ensure these details are in place using planning conditions.

Tip:- Before planning applications are made, as part of the decision process on the form of SuDS, developers should discuss and agree maintenance options and costs with SCC, LPA, Highway Authority, Anglian Water, Internal Drainage Board or other potential adopting bodies.

The new regime for approval of surface water drainage from 6 April 2015 allows a range of bodies to adopt and maintain surface water drainage systems. The following table outlines SCC preferred arrangements.

SCC Preferred Adoption Arrangements

For SuDS serving one property.

Adopting Body	Type and Location	Notes
Individual property owners (residential and commercial)	SuDS sited within the property it serves. (e.g. source control components such as rain gardens, water butts and soakaways).	Default responsibility by law is the individual property owner, thus it is reasonable to expect that private property owner would maintain SuDS to benefit their property. Future maintenance required by planning conditions and enforced via LPA. These can be designated under the Flood & Water Management Act.

For SuDS serving one or more properties.

Adopting Body	Type and Location	Notes
Local Authority (Parks Team) *Currently only in St Edmundsbury BC, Forest Heath DC and Ipswich BC	By agreement, LA's maintain open SuDS sited within or adjacent to public open space.	A common approach is for the LA to combine public open-space and SuDS maintenance activities. LA will require a commuted sum via s.106 agreement and/or CIL usually over the lifetime of the development.
Internal Drainage Board (IDB)	Where sites are in a IDB District, and the SuDS are granted IDB consent, the IDB may adopt SuDS following payment of commuted or infrastructure charge. Under the Land Drainage Act 1991 IDB have a general supervision over all matters relating to water level management within its district	Early discussions should be had with the IDB, as different boards may have specific requirements and may only adopt a certain SuDS types.
Water and Sewerage Companies (WaSC)	The Developer and Anglian Water enter into an adoption agreement via s.104 of the Water Industry Act. Normally for pipes under public highways or SuDS in public open spaces.	If an underground surface water system serves several properties it would normally need to comply with Sewers for Adoption 7th edition (SfA7). Anglian Water would need easements and adequate clearance from buildings, trees and bushes is required as laid out in SfA7.

Continued

Local Highways Authority	For SuDS serving publicly maintained highway only. Discussions with highways should be sought over what types of SuDS are acceptable.	Suffolk Highways will entertain developers seeking the adoption of SuDS serving the highway by voluntarily entering into agreement under Section 38 of the Highways Act 1980, financed by a commuted sum.
Private Maintenance Company	Householders pay annual service charge or commuted sum paid by the developer to the Maintenance Company. Asset is not adopted.	This is the least preferred option as SCC has concerns over long term viability, financial risks and enforcement action in relation to private maintenance companies.

- It is common on single sites to have a combination of adoption bodies, for example AWS may adopt sewers draining to a SuDS basin adopted by the Local Authority or Private Management Company.
- In general, where SuDS receive runoff directly from public highway, SCC Highways may require measures to keep vehicles out of SuDS, including knee rails and channel blocks that support the edge of the highway. Highways will also clear sediment traps & flow controls, de-silt and repair erosion damage.
- Different adopting bodies may have slightly differing standards for access, slopes or depths which ultimately affect spatial requirements.
- SCC expects that developers to undertake maintenance until SuDS are adopted. Examples of previous model adoption agreements can be found: <http://www.susdrain.org/resources/ciria-guidance.html>

High maintenance and replacement costs (e.g. for schemes involving underground structures with limited lives) are likely to result in such options being unviable.

SuDS Maintenance

- Maintenance plans will normally be a planning requirement. Plans should include schedules which specify when maintenance items are due. Owners & maintainers of SuDS should record when these actions are undertaken
- SCC will request the LPA to include planning conditions which prevent occupation until the County Council have received and approved a completed electronic copy of the asset register template. (appended to back of this document)
- Information supplied must include location, ownership and maintenance agreement details of surface water drainage including SuDS basins, swales, soakaways, pipes carrying surface water or ground water and exceedance paths
- SCC will add SuDS records to its Asset Register in order to assist with its duty to investigate and report flooding instances. If necessary, maintenance records / plans will be investigated and enforcement action by the LPA may be required.

5. Suffolk Design Principles

As at April 2017 for major developments; national standards and guidance state that SuDS should:

1. Not increase flood risk off site (in all events up to 100 year return period);
2. Provide adequate standards of flood protection on site - in most cases no flooding inside buildings in events up to a 100 year return period and no flooding in other areas (apart from designated flood paths /storage areas) in events up to 30 year return period
3. Take account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any personnel, vehicle or machinery access required to undertake this work.
4. Make allowances for climate change for all return periods.

SuDS for improving water quality in downstream watercourses are required when runoff from developments drain to freshwater watercourses. The requirement may depend on environmental impact assessments (EIA) and the River Basin Management Plan.

It is good practice to maximise treatment, amenity and biodiversity potential by using multi- functional open SuDS close to source. These will also reduce capacities needed for attenuation, downstream conveyance and volume control.

The UK SuDS tools website: <http://www.uksuds.com/> includes tools for surface water storage requirements, rain water harvesting tank sizing (and capability for flood management), site evaluation, SuDS costs estimator, joint probability analysis (for drainage with tidal or fluvial outfalls), soakaway design and a water quality calculator.

Runoff Destination

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

1. into the ground (*infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer.

Particular types of sustainable drainage systems may not be practicable in all locations.

(*Deep Borehole Soakaways (>2mbgl) are considered not viable by SCC and will only be considered as a last resort)

Paragraph 080 of
NPPG and Part H3 of
Building regulations

Continued

<p>Contact SCC and / or see SFRA for further advice. It may be possible to drain sites close to large estuaries or the coast directly to those water bodies</p> <p>Developers should consider collection and reuse of surface water or ground water as a first choice.</p>	SCC																
<p>Soakage rates need to be above about 5-10 mm/ hr for infiltration to be the sole means of drainage</p> <p>CIRIA C753 – Chapter 25 describes requirements for soakage tests – large scale test pits similar in size /proportion and depths to proposals, following BRE365.</p> <p>SCC or District/Borough Council SFRA maps may indicate where infiltration drainage is likely to be possible.</p>	SCC - full details of soakage tests																
<p>Soakage rates for design will need to be reduced by an appropriate factor as set out in CIRIA Report 156 –table 4.6, reproduced below:</p> <p>Consequences of failure</p> <table><tr><th>Area drained (sq m)</th><th>No damage or inconvenience</th><th>Minor inconvenience – eg: flooding of car park</th><th>Damage to buildings structures or major inconvenience eg roads</th></tr><tr><td><100</td><td>1.5</td><td>2</td><td>10</td></tr><tr><td>100 -1000</td><td>1.5</td><td>3</td><td>10</td></tr><tr><td>>1000</td><td>1.5</td><td>5</td><td>10</td></tr></table>	Area drained (sq m)	No damage or inconvenience	Minor inconvenience – eg: flooding of car park	Damage to buildings structures or major inconvenience eg roads	<100	1.5	2	10	100 -1000	1.5	3	10	>1000	1.5	5	10	
Area drained (sq m)	No damage or inconvenience	Minor inconvenience – eg: flooding of car park	Damage to buildings structures or major inconvenience eg roads														
<100	1.5	2	10														
100 -1000	1.5	3	10														
>1000	1.5	5	10														
<p>Suffolk County Council will not normally permit surface water discharges from developments into existing land drains, highway drains or piped watercourses unless they have been constructed to an acceptable standard, have proven adequate capacity and clearly defined maintenance responsibilities. Owners of such drainage will need to agree to connections</p>																	
<p>Where a site discharges to a watercourse that is within or flows through an IDB District, the developer will need to obtain permission from the IDB and will need to pay a Surface Water Developer Contribution. For more info:- http://www.wlma.org.uk/uploads/WMA_Planning_and_Byelaw_Policy.pdf</p> <p>Land Drainage Act consent should be sort where any works within to a watercourse are to commence. Please contact the relevant drainage authority.</p>	SCC																

Flood risk outside the development

See paragraph 103 - flood risk not be increased elsewhere...	NPPF, Local Planning policies & Suffolk Flood Risk Management Strategy 20
See S1 - no need to control peak flows or volumes discharged to the sea or large estuary.	
Suffolk County Council expects drainage designs to take account of tidal or fluvial water levels where appropriate in designs. The UK SuDS Tools Web site - HR Wallingford http://www.ukSuDS.com/ joint probability analysis tool will assist.	

Peak Flow Control

See S2 and S3 ...Greenfield or reduced previously developed rates	DEFRA Technical Standard
<p>Discharge Rates <u>Greenfield Sites: -</u></p> <p>SCC expects green field runoff to be determined as described in the Environment Agency document SC030219, "Preliminary rainfall runoff Management for Developments", (2013) and the SuDS Manual. See: https://www.gov.uk/government/publications/rainfall-runoff-management-for-developments</p> <p>SCC recommends that discharge is restricted to Q_{bar} or 2l/s/ha (whichever is higher) for all events up to the critical 100yr+CC.</p> <p>(Where discharging to public sewer Anglian Water policy takes precedence i.e. 1 in 1yr greenfield flow rate for all events) http://www.anglianwater.co.uk/_assets/media/Surface-Water-Drainage_Policy-November_2017.pdf</p> <p>Alternatively discharge rates can be limited to a range of greenfield rates, based on the 1 in 1, 1 in 30 and 1 in 100 year storm events. However, the use of this method to restrict discharge rates requires inclusion of long-term storage, sized to take account of the increased post development volumes, discharging at no greater than 2l/s/ha. See volume control below</p> <p>Green field rates should not include an allowance for climate change. Rainfall used to design the SuDS will need to be increased to allow for climate change.</p> <p>Impermeable areas to include allowances for future added paving, extensions or verge hardening. SCC will accept a figure of 10% for urban creep</p>	CIRIA SuDS Manual C754

Peak Flow Control Continued

Previously Developed (Brownfield) Sites:-

Overall where a site is previously developed, SCC will expect discharge rates to be restricted as close to greenfield rates as reasonable practical. Alternatively, the brownfield 1yr, 30yr and 100yr peak runoff rates are be used with a betterment of at least 30% – as per section 3.2.2 in Ciria SuDS Manual C753.

For calculation of Brownfield Runoff Rates, SCC follow guidance in BS8582

A) If the existing drainage network is known then it shall be modelled using best practice simulation modelling, to determine the 1yr, 30yr and 100yr peak flow rates at discharge points (without allowing surcharge of the system above cover levels to drive great flows through the discharge points).

*SCC will require evidence that drainage network information has been obtained.

B) If the system is not known then: -

the brownfield run-off rate should be calculated using the greenfield runoff models (i.e. IH124 or FEH) but with SOIL Type 5 (or equivalent HOST class).

Or

Appropriate average rainfall intensities can be calculated from FEH Rainfall Data and used in the Modified Rational Method – again the 1yr, 30yr and 100yr peak flows will be required.

Checks should also be made where a system has a surcharged outfall – as above, designs will need to take account of high tidal or fluvial water levels where appropriate in designs.

Volume control

See S4,S5, S6 ... volume discharged in 100 year Return period, 6 hour duration events to highway drains, sewers or SW bodies not to be increased.....

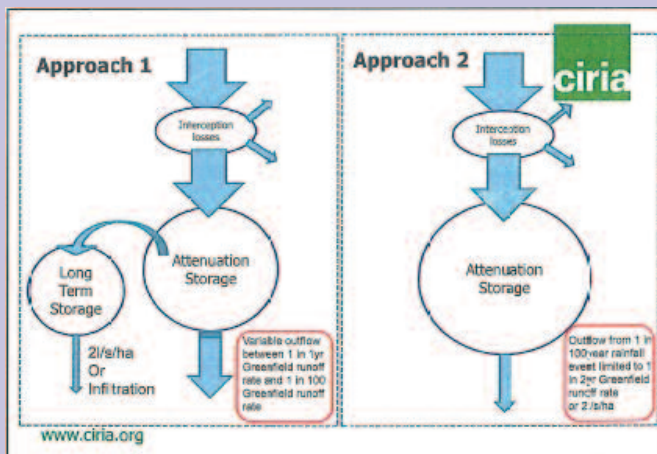
*Volume Control is not required when using infiltration as main drainage approach.

DEFRA Technical Standard

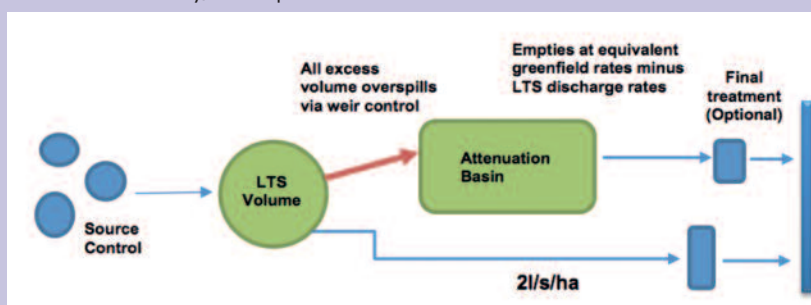
SCC will not normally accept flow control throttles with less than a 100mm opening. However, smaller apertures may be accepted for carefully designed outlets from beneath permeable pavements or if special measures are in place to help prevent blockage. Where volume control requires a smaller throttle, then the volume control requirement may be waived.

Where the proposed discharge rate is greater than 2l/s/ha or Q_{bar} for peak flow control, there must be a separate area for volume control. Also known as Long Term Storage (LTS) this must be provided on the site to counter the excess volume created by new impermeable surfaces. Volume control or Long Term Storage must be discharged from the site at 2l/s/ha even if a higher rate is permitted for peak flow control See Approach 1 below.

SCC recommend that for all sites discharging to a watercourse, the final permitted discharge rate for the entire site is 2l/s/ha or Q_{bar} for all events up to the 1 in 100+CC event (Approach 2) – this then accounts for any volume control needed as per section 3.2 in EA document.



The above is the general principles behind LTS, but the general layout and form of Approach 1 can vary, SCC prefer:-



Flood risk within the development

See S7, S8 & S9 No flooding apart from designated areas in 30 year return period rainfall event. No flooding inside buildings in 100 year return period, exceedance flows to be managed/routed as far as reasonably practical

DEFRA Technical Standard

Where appropriate, (especially when designing SuDS for developments behind tidal defences), rising sea levels over the life of the development need to be taken into account. Sea levels should be set out in SFRAs available on LPA web sites and annual allowances for sea level rise in the Technical Guidance to the NPPF

SCC

SuDS shall be sized to accommodate 100yr+CC runoff volumes and be able to accept any potential exceedance volumes from the upstream network.

Climate Change Factors: - Design at 20% and then sensitivity check at 40% to see wider flood risk.

Developers should also demonstrate flow paths and the potential effects of flooding resulting from blockages, pumping station failure or surcharging in downstream combined sewers, by checking the ground levels around the likely points that flow would flood from the system to identify the flood routes.

SCC only allow pumped networks as a last resort. Where these are necessary SCC will require a 24hr 100yr+CC storm capacity for the system in the case of pump(s) failure + duty/standby arrangement. Similar to requirements in Building Reg Part H for foul pumping stations. Alarms and signboards with emergency telephone details should also be provided.

Water quality

One of the guiding principles for SuDS in Suffolk is

NPPF

"Wherever possible multifunctional above ground SuDS that deliver drainage, enhancement of biodiversity, improvements in water quality and amenity benefits" should be used.

Wherever SuDS drain to a watercourse (including via a SW sewer or highway drain) open vegetated SuDS and/or permeable paving plus permanent wet pond(s) will be required to improve the quality of water discharged. A SuDS train should be designed in accordance with the CIRIA SuDS Manual's 'Simple Index Method'.

Surface runoff should be managed on the surface where it is reasonably practicable to do so and as close to its source as is reasonably practicable.

The drainage system should be designed and constructed so surface water discharged does not adversely impact the water quality of receiving water bodies, both during construction and when operational.

Water Quality Continued

<p>Legislation:-</p> <p>Para 109: planning system to contribute to and enhance local environment...</p> <p>..minimise impacts on biodiversity, preventing development from contributing to unacceptable risk of water pollution....</p> <p>Para 120: effects (including cumulative) of pollution to be taken into account</p> <p>See Paragraph 001,</p> <p>Paragraphs 10, 11, River Basin Management plans, WFD</p> <p>Paragraphs 16-18 -19..... Early engagement with LPA and EA to establish if WQ is a significant planning issue... assessing impacts ... environmental statement... ..good status .. water framework directive etc.</p>	
<p>Guidance on avoiding pollution and compliance with the law can be found on a range of Pollution Prevention Guidance (PPG) notes originally produced by the EA. The EA may take enforcement action against polluters, which could include prosecution...</p> <p>SCC will also refer to the EA's groundwater protection policy (GP3) for infiltration SuDS.</p> <p>Topics include basic good environmental practices, oil separators, works nears or in watercourses, vehicle washing and cleaning.</p>	<p>Pollution prevention guidance</p> <p>Planning Practice Guidance</p> <p>Planning Practice Guidance 10</p> <p>Planning Practice Guidance 16-19</p>
<p>Deliverables:-</p> <p>Pollution risk assessment - Ciria SuDS Manual C753 indices approach is acceptable.</p> <p>Details of any site investigations and the corresponding remediation strategy by a certified geotechnical specialist.</p>	<p>Suffolk Flood Risk Management Strategy 2016</p>
<p>Water quality treatment components should be designed to ensure that they function effectively during rainfall events more frequent than the 1 in 1 year rainfall event.</p> <p>The National SuDS tools web site, CIRIA C753 and Interim Non-Statutory Standards for Sustainable Drainage (SuDS) in Wales (consultation 12 Feb-30 April 2015) provide guidance on treatment.</p>	<p>SCC</p>

Water Quality Continued

1. **Interception storage** should be provided to trap the first 5mm of rainfall (CIRIA C753 para 4.3.1). This can take the form of initial losses into the ground, vegetated surfaces or long term storage (semi-permanent pools).-

2. **Treatment storage** in the form of a pond which retains water during dry weather should provide a volume (Vt) from at least 15mm of rainfall over the site.

Various numbers of treatment stages are required depending on pollution risk.

See <http://www.ukSuDS.com/Conveyance> Swales can be assumed to be a treatment stage if velocities are <0.3m/s in a 1 year RP event. (usually flatter than a 1/100 longitudinal gradient). Swales might include semi or permanent pools providing some interception.

Interim guidance:

Green roofs assumed to absorb 5mm

Vegetated surfaces which are normally dry but receive runoff can be assumed to absorb up to 125 mm depth of water depending on permeability and steepness:

Bases of swales flatter than 1 /100, where soil permeability $k < 1 \times 10^{-6}$ m/sec can absorb 25mm

Bases of swales flatter than 1 /100, where soil permeability $k > 1 \times 10^{-6}$ m/sec can absorb 125mm

Flat parts of detention basins absorb 25mm or 125mm depths dependent on permeability.

Interception volumes might be slightly increased by raising the level of the outlet subject to basin size, vegetation type and permeability.

Interception can reduce volumes needed for controlling peak flows and volumes where absorption is allowed.

Suffolk Flood Risk Management Strategy 2016

Structural integrity

See S10 & S11 - components designed for anticipated loading over design life taking into account requirement for reasonable levels of maintenance.

Materials, products components etc. to be suitable nature and quality....

DEFRA Technical Standard

Structural Integrity Continued

<p>SCC suggests Sewers for Adoption 7th Edition provides suitable standards for most materials/workmanship.</p> <p>SCC is unlikely to accept plastic geo-cellular storage units where vehicle loads may be applied (this includes tractors/grass cutters) or where trees are planned above or within 5m. Details for any submission including geo-cells need to include the manufacturers assurances regarding life expectancy and structural design calculation for the geo-cells and surrounding geotextile fabric. See CIRIA Guide C680 –Structural design of modular geocellular tanks.</p> <p>Erosion protection measures must be included where flow velocities exceed 1 m/s in a 100 year event and at any locations where turbulence is likely such as inlets, weirs etc</p> <p>Side slopes of swales, basins ponds etc. to remain stable (and safe) –see details in section 4.</p>	SCC
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Designing for maintenance considerations

See paragraph 085 designs need to take account of construction and maintenance....access, climate change, increasing impermeable area maintenance and operation requirements.... economically proportionate.	Paragraph 085 of NPPG
See S12 regarding Pumping.	DEFRA Technical Standard
<p>SCC will not accept underground storage which cannot be cleaned using standard jetting /vacuum equipment and will not normally accept confined spaces which require man entry and pose potential risks to operatives.</p> <p>For all applications SCC will require a copy of the CDM Health and Safety Plan including risk assessments.</p>	SCC

Construction

See S13 and S14 ... connection to drainage systems... damage to drainage resulting from construction to be rectified.	
<p>See site handbook for the construction of SuDS (CIRIA C698)</p> <p>Site management plans will need to address issues such as protection of infiltration basins from compaction by construction traffic, need to ensure vegetation is established in open SuDS before water is allowed in, keeping sediments/mud out of SuDS – especially soakaways and permeable paving etc.</p>	DEFRA Technical Standard

6. Key details for SuDS Components

The following are SCC's preferred design criteria, different adopting bodies may have slightly varying standards for details and should be consulted independently.

Open SuDS:-

1. Open Basins (Detention Basins, Ponds, Wetlands, Bioretention areas)

Side slopes of open SuDS must be stable and allow safe maintenance, access and escape. The slope will normally also depend on the maximum depth of water in a 100 year return period (RP):

- Water 0.5m – 0.3m deep - slope no steeper than 1 in 4
- Water 0.3m - 0.2m deep - slopes 1 in 4 to 1 in 2 may be acceptable
- Water <0.2m deep. Vertical -e.g. kerb face of car park allowed to flood.

The maximum depth of water in publicly accessible SuDS, which are normally dry, is 500mm in a 100 year return period event - typically this equates to about 300mm in a 10 year RP event.

Site control basins with a permanent water level, also in publicly accessible areas, can have a max depth of water of 1.5m. However these basins will require a 1.5m wide level bench at 600mm (also known as wet bench).

For all SuDS basins with permanent water, a 3m dry bench around the perimeter of the basin is required, this should be designed with a reverse slope to stop anyone slipping or riding unhindered into the water.

All basins deeper than 1.5m will need to be fenced off appropriately.

Reason: The Flood Risks to People Report FD2321 EA/DEFRA (March 2006) classified flood hazards in terms of flood depth and velocity and Debris Factor. In an Urban setting, static water between 0.25m deep and 0.5m deep is classed as a "danger to some" (e.g. children).

See also CIRIA RP992 paper RP992/17 Nov 2013 - "Health and Safety principles for SuDS Framework and Checklists" – this describes needs for risk assessments for permanent or deeper water as part of the Design process. The adopting body will need to approve these

Access to all SuDS to enable maintenance, repairs or replacement – minimum 3.5m wide from adopted highway to SuDS; suitable for access by tanker/jetting machine, excavator or dumper as appropriate. See CIRIA C793 for further guidance. Sufficient headroom under trees or bridges needs to be provided.

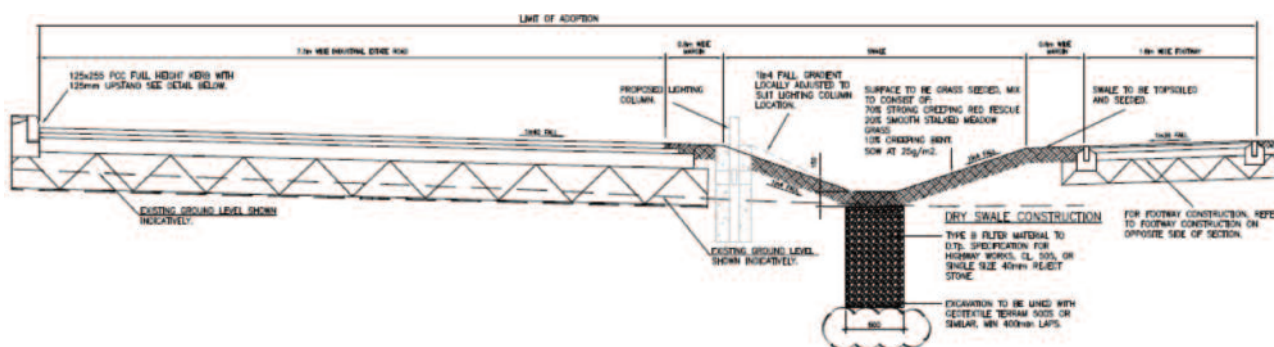
2. Swales

Generally swales should only be used on flat slopes (follow contours) to maximize treatment retention time and minimise erosion.

The above maximum allowable depths of water may be reduced if velocities are high - For a 0.5-2 m/sec velocity a depth of only 0.25m represents a "danger to some". However velocities should be reduced to allow swales to function as treatment or infiltration devices and to prevent erosion.

Side slopes may need to be flatter to avoid erosion where paved areas drain directly down grassed slopes or where the slope is intended to act as a filter strip. Large trees are not normally acceptable where sheet flows enter swales (i.e. in filter strips) but may be acceptable on other side slopes.

Where appropriate SCC encourage the use of swales instead of conventional road drainage, swales can be flush with the highway. Concentrated flows down side slopes must be avoided to prevent erosion. The crossfall on the road must be greater than the long fall to promote egress into the swale. Wet or dry swales can be used in this manner – the figure below illustrates a dry swale configuration.



Note: Not to Scale – Side Slopes not representative of 1:4 batter (Richard Jackson Ltd, 2017)

3. Infiltration Basins

Similar in form to open basins (i.e. Shallow with 1:4 side slopes)

These should be carefully excavated to avoid compacting the base (this would reduce permeability).

As per Ciria SuDS Manual (C753) there should be a minimum 300mm thick, dense vegetated bioremediation layer on the base of the infiltration basin. Layer can be engineered soil or manufactured material such as Remedi[®]. Vegetation should be established before water is allowed in.

SCC discourage direct discharge to chalk bedrock in groundwater protection zones (SPZ) and especially where chalk is structured. Where reasonably practical drainage should discharge to superficial layers in SPZ. Storm water must go through appropriate treatment as to not pose any risks to controlled waters. For areas outside SPZ's appropriate measures shall be put in place to make sure groundwater is also not polluted.

A settling pond or vegetated forebay within the main basin should be included to trap sediments and prevent clogging of the main basin.

Closed (Underground) SuDS

The most common situation where underground SuDS are likely to be accepted is where underground domestic soakaways serve conventional residential development denser than about 30 units per Ha (subject to local ground conditions, satisfactory design standards and sufficient space being available). Residential gardens usually need to be a minimum of 9m long to provide the normal 5m clearance between soakaways and buildings.

For very dense development in urban areas or other development on steep slopes it may also be obvious that open SuDS are not viable. However, if such a development drains to a watercourse then water quality objectives would probably only be achieved through the use of some open SuDS.

Even if open SuDS are used it will be acceptable to use some pipes where necessary. e.g. where roads or driveways cross.

4. Soakaways

SCC discourage direct discharge to chalk bedrock in groundwater protection zones (SPZ). Where reasonably practical the base of infiltration devices should be with upper superficial geology.

Soakaways to be > 5m from highway kerbs and >5m from buildings.

Soakaways (both concrete ring and geocellular crates) are not normally permitted under public highways.

Geocellular Crates

Where reasonably practicable Open SuDS should be used rather than crates.

Where crates are to be used the following criteria must be met: -

1. Provide upstream silt prevention at every location;
2. Provision of an approved access system; main channel(s)/pipe(s) through the base of the geocellular storage with observation/maintenance manholes at each end;
3. Ensure that observation/maintenance manholes are accessible by tanker for jetting and suction;
4. No more than a 2 cell block width from a main channel as a rule of thumb;
5. Provide 10% additional capacity for silt not possible to remove at every location.
6. Consideration of maintenance and replacement costs

Permeable Paving

Attenuation - sub-base storage to have a minimal slope. Infiltration types should have no slope.

Top surface should gently slope towards a centre point. Areas designated for permeable paving should be protected against compaction during construction phase. Maximum acceptable surface gradient for permeable paving is 1:20 (5% slope).

5. Flow Controls

The minimum aperture on a flow control should normally be 100mm, however this may be reduced if there is low risk of blockage – e.g. a flow control for the outlet from beneath permeable paving.

Strategic flow controls should also normally include a bypass valve that can be opened to lower the retained water level and enable the blockage to be easily removed. A high level overflow is normally required to ensure a blockage does not result in flooding of buildings and help cater for exceedance flows. If controls are small SCC will allow a standard outlet of 5l/s

Landscaping

Planting around underground SuDS with connected pipework (i.e. spreader drains) should follow guidance set out by Sewers for Adoption 6 and 7. Generally trees to be at least 3 m or > maximum canopy radius from any underground drainage.

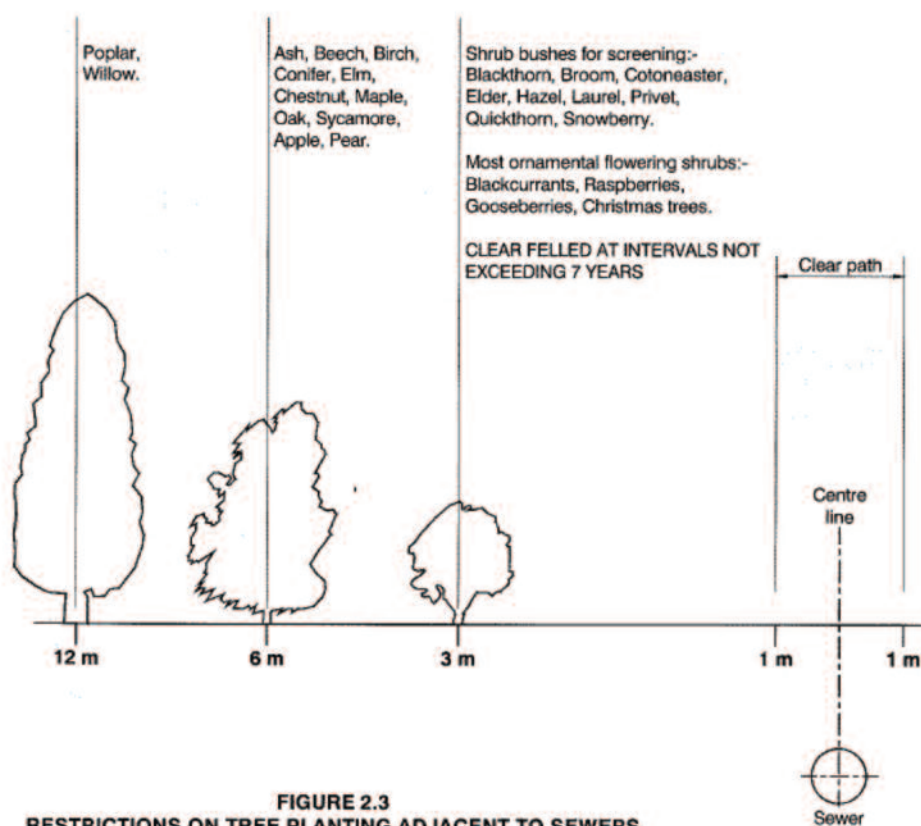


FIGURE 2.3
RESTRICTIONS ON TREE PLANTING ADJACENT TO SEWERS

Where SuDS have to cross under highways, pipes should be used with the minimum acceptable cover. Multiple small pipes will be shallower than a single large pipe.

Alternatively, it might be possible to provide shallower pipes or culverts in conjunction with traffic calming rumble strips, with flood exceedance routes on the surface across the road.



SuDs crossing under a road at Upton, Northampton (picture from CIRIA Susdrain).

7. Local flooding information, planning policies and processes

SCC's Protocol for advising Local Planning Authorities LPA's on surface water drainage aspects of planning and development control (Appendix C of Suffolk Flood Risk Management Strategy) includes relevant policies and describes useful information that can be supplied by SCC, such as flood records and maps as well as guidance on

drainage information that needs to be included in planning applications. It also describes the planning process for SuDS.

Strategic Flood Risk Assessments produced by LPAs will often provide information that needs to be considered when designing SuDS

8. Design tools and guidance in other publications

This guide has been kept brief by avoiding repeating additional guidance listed in the following table.

Document Title	Publisher & Date of latest revision
National Planning Policy Framework.	Communities and Local Government (March,2012)
Planning Practice Guidance to the National Planning Policy Framework.	Communities and Local Government (March,2014)
Technical Guidance to the National Planning Policy Framework (now withdrawn)	Communities and Local Government (March,2012)
Flood and Water Management Act 2010	
Suffolk Local Flood Risk Management Strategy 2016	Suffolk County Council www.suffolk.gov.uk/flooding
SCC Protocol for Advising LPAs on Surface Water Flood Risk Aspects of Planning & Development Control	Suffolk County Council www.suffolk.gov.uk/flooding
Suffolk Local SuDS Guide	Suffolk County Council www.suffolk.gov.uk/flooding
"Preliminary rainfall runoff Management for Developments" SC030219	Kellagher, R. (2013) Publisher:- Environment Agency
UK SuDS Tools Web site - HR Wallingford	http://www.ukSuDS.com/

Continued

Planning for SuDS – Making it Happen	CIRIA C687
SuDS Manual	CIRIA C793
Site handbook for the construction of SuDS	Ciria C698
Managing urban flooding from heavy rainfall - encouraging the uptake of designing for exceedance - Case studies	Ciria C738c
Designing for exceedance in urban drainage: Good practice	CIRIA (C635)
Model agreements for sustainable drainage systems	CIRIA (C625)
DEFRA report WT1505 SuDS Nov 2013 This compares construction, maintenance and lost opportunity costs of underground and open SuDS	Kellagher, R., Wilson, S. and Thomson, R. J.C. (2013)
Health and safety principles for SuDS: framework and checklists	CIRIA RP992-17
Source Control Using Constructed Pervious Surfaces.	CIRIA C582 (2002)
SuSDrain - Using SuDS Close to Buildings	Wilson, S. (2013)
Infiltration Drainage – Manual of Good Practice	CIRIA Report 156
BRE Digest Soakaway Design	Garven, S. (2016) DG 365. Building Research Establishment,
Ground Water Protection: Principles and Practice	Environment Agency (2012).

Towards Sustainable Water Stewardship – SuDS Adoption Manual	Anglian Water 2011
Anglian Water Surface Water Drainage Policy 2017	Anglian Water http://www.anglianwater.co.uk/developers/SuDS.aspx
Building Regulations Part H	
Sewers for Adoption 6th and 7th Editions	Water UK/WRc plc 2012
Anglian River Basin Management Plan	Environment Agency (2015)
Guidance on the permeable surfacing of front gardens	Department for Communities and Local Government (2009)
The Town and Country Planning (Development Management Procedure) (England) Order 2010	
Climate Change Toolkit: Designing for Flood risk	RIBA (2009)
Flood Risks to People Phase 2 - FD2312 TR2.	DEFRA and Environment Agency (March 2006)
Flood Risks to People Phase 1 - FD2317 TR1	DEFRA and Environment Agency (March 2005)

9. SuDS Gallery and Lessons



BEFORE: Newly completed Retrofit SuDS at Heath Rd, Ipswich. Shallow basins were rutted and damaged in wet weather by cars parking on new verges.



AFTER: Heath Road, Ipswich with deterrent posts and planting. Timber posts have been utilised on the carriageway side along with deterrent planting on the footway side. A small gravel trench was constructed to provide additional storage and soakage.



Poor inlet design causes erosion and deposition of sediment and a reduction in infiltration capacity.



The failure of a plastic geocellular tank under a car park in August 2012. The cause of the failure is not currently known.



An infiltration basin at Ravenswood, Ipswich is being used as a BMX track. A small reduction in infiltration capacity has occurred due to compaction. Bunds or dividing walls need to be robust to continue to function. Consider “desire lines” when planning.



Planting in swales prevents parking; however, erosion control would be necessary due to the steep side slopes in this example.



A good example of SuDs: No road gullies (verge drainage or filter strip) - gentle side slope to avoid erosion and deposition of silt in infiltration basin. Grass was established before allowing runoff into basin – temporary drainage, provided by a shallow trench at road side, was filled and turfed once remainder of grass was established.

Basins at least 5m from buildings. Shallow rills or channels could have been used to carry roof drainage into basin.

Posts or post & rail fence is expensive but required to keep vehicles out – which cause rutting in.



Poor inlet design and planting: Swale taking flow from a car park during a storm event. Erosion likely due to the concentration of flow at the inlet from the car park. Bark chips float away and block grates. Runoff should not have been permitted to enter the swale until planting was established.



Good detail for draining roof water to swale but swale is too close to building. Rills / channels need to have flexible joints, especially in clay or mixed soils



Wooden check dam across a swale: These are likely to quickly rot and become ineffective, causing unnecessary maintenance requirements in the future and possibly flooding should it collapse.



This swale is too small to be effective in severe events, but some flooding of road edge may be acceptable in major events.

Works well on inside of bends where roads are super elevated. Need to keep vehicles out of swale if a residential area.

For swale to convey water at low velocities, it needs a relatively flat longitudinal fall. This also reduces the required land take and excavation and so reduces the overall cost.

House roof water could drain in from right hand side but need for rills or pipes to cross footway and driveways to cross-swales. Driveways could be used as check dams if slope is steep.



Stones can be used to reduce erosion risk. Stones should not be at a higher level than the surface of the car park as the voids are likely to quickly block with weeds and debris.



Example above is from Ravenswood, Ipswich no road gullies required as runoff flows from edge of road into shallow basins. Posts prevent cars from parking in the basins. Timber posts will rot and can be broken or stolen.



Large rill or footway perhaps for excessive flows.



A permeable car park at Lovetofts Drive, Ipswich. This has been in position for many years with no issues and minimal maintenance. The paving is on clay and so there is no infiltration. Surface water is stored in the permeable sub base under the blocks. Discharge to the combined sewer, from under the blocks is controlled by a very small orifice (20mm).

Care needs to be taken with sub base specification, and surface gradients. A thicker sub base is required for steeper slopes, or to allow for low infiltration or allowable discharges. See CIRIA guide.



Long vegetation can be beneficial within damp/boggy basins, provides areas for habitat creation.



Shallow water, gentle side slopes for safety. Could look good but problems keeping shallow water clear of excessive weed – regular maintenance needed, and a minimum water level will need to be maintained. Water quality needs to be good – this should be at the end of train, possibly only roof water.



Multifunctional shallow basin at Ravenswood, Ipswich provides capacity for exceedance flows and is a play area. Soakaways under the surface store runoff from storms up to a 30-year return period. The basin is dry most of the time.



Sloping permeable paving on clay. Normally permeable paving should be flat or gently sloped towards centre to contain runoff when maintenance is needed.



Shingle driveway on sandy soil. 50mm of pea shingle on 225mm of type 2 material. The type2 sub base is impervious. It's vital to use correct sub base material.

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