Devon County Council

Sustainable Drainage Systems
Guidance for Devon

Version 1.6 (January 2017)

Sustainable Drainage Systems: Guidance for Devon Version 1.6 (January 2017)

Cover photograph courtesy of Susdrain (2016).

Revision Schedule

Version	Prepared By	Reviewed By	Approved By	Date	Status
1.1	Matthew Beddow	Martin Hutchings	Martin Hutchings	October 2012	Superseded
1.2	Mark Fox	Martin Hutchings	-	September 2014	Superseded
1.3	Mark Fox	Martin Hutchings	-	April 2015	Superseded
1.4	Mark Fox	Martin Hutchings	-	May 2015	Superseded
1.5	Mark Fox	Martin Hutchings	Martin Hutchings	July 2015	Superseded
1.6	**Christopher Perrott**	**Richard Rainbow**	**Martin Hutchings**	**January 2017**	**Current**

We advise that frequent checks are made to determine whether updated versions of this Guidance have been uploaded to our website:

https://new.devon.gov.uk/floodriskmanagement/sustainable-drainage/

Devon County Council's Flood and Coastal Risk Management Team welcome feedback on this Guidance, and can be contacted via:

floodrisk@devon.gov.uk

We would like to thank both CIRIA and Susdrain for their kind permission to use a variety of their published graphics and images in this Guidance

Using this Guidance Electronically

This Guidance contains various interactive hyperlinks which direct the reader to relevant information published by other organisations:

Graphic	Function
www.	Opens your web browser and automatically navigates to a website which will provide further information on the subject matter
CIRIA C753 Ch. 11	Opens your web browser and automatically navigates to the relevant downloadable chapter of CIRIA's SuDS Manual (C753) (2015) You must create a free online account with CIRIA in order to access this content electronically
N-STSfSuDS Sn. 1	Opens your web browser and automatically navigates to DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems document

Contents

1. Introduction

Following the widespread flooding of 55,000 homes and businesses across England and Wales in June and July of 2007, the Pitt Review was published, making 92 recommendations for effective and integrated flood risk management. These recommendations were the main driver of the measures contained within the Flood and Water Management Act (2010), which, combined with the Flood Risk Regulations (2009), placed greater responsibilities on Local Authorities to manage flood risk.

The Flood Risk Regulations (2009) transposed the European Union Floods Directive (2007) into UK law and established upper tier and unitary local authorities as Lead Local Flood Authorities (LLFAs). Devon County Council is therefore the LLFA for its administrative area (Figure 1), with the Flood and Water Management Act (2010) setting out its responsibilities to include managing local flood risk from surface water and groundwater, and consenting and enforcement on ordinary watercourses.

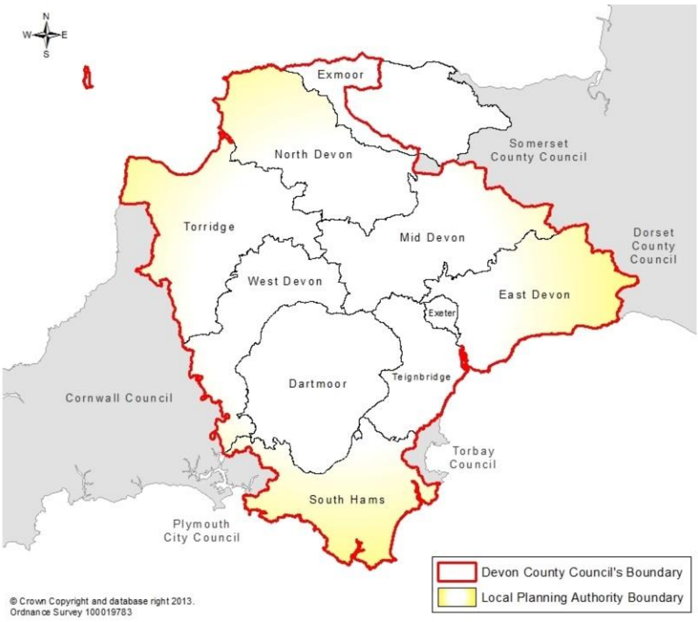

Figure 1: Devon County Council's administrative area does not include the unitary authorities of Torbay Council or Plymouth City Council, which are two separate Lead Local Flood Authorities in their own right. Credit: Devon County Council (2017).

In accordance with the Development Management Procedure Order (2015), each LLFA is now also a statutory consultee for all major planning applications within its area. This role took effect on 6th April 2015, when the Environment Agency handed over the responsibility, and ensures that technical surface water drainage advice is available to Local Planning Authorities (LPAs) when determining planning applications. Our advice is based on various statutory, non-statutory and industry best-practice guidance documents which provide a wealth of information in relation to the management of surface water, in accordance with the principles of Sustainable Drainage Systems (SuDS).

Consequently, this Guidance does not attempt to rewrite existing documents; it provides a summary of relevant information and signposts the reader to useful documents, whilst providing a local context. This Guidance is therefore intended for use by applicants, developers, architects, engineers and other professionals alike who are seeking advice on the standards and information required by the LLFA when reviewing planning applications.

2. Legislative and Policy Background

The **Water Framework Directive (2000)** is a piece of European Union legislation which was introduced to improve and protect the quality of water bodies. It should ensure that water is more effectively and sustainably managed for the benefit of both society and the environment.

The **Flood and Water Management Act (2010)** was introduced in response to the concerns raised in the **Pitt Review (2008)** following the floods across the United Kingdom in 2007. The Act makes LLFAs responsible for coordinating flood risk management within their areas.

The **National Flood and Coastal Erosion Risk Management Strategy (2011)** was published by the Environment Agency under the above Act and should ensure that flood and coastal erosion risk is properly managed and coordinated. Importantly, the Strategy recommends the use of SuDS on development sites as an end to managing surface water flood risk.

The **National Planning Policy Framework (2012)** states that developments should give priority to the use of SuDS in order to ensure that surface water flood risk is not increased. Consequently, all planning applications must be accompanied by a surface water drainage management plan which demonstrates how the surface water runoff from the proposed development will be managed and disposed of, in a manner that does not increase flood risk elsewhere, in accordance with the principles of SuDS.

Devon County Council's Local Flood Risk Management Strategy (2014-2020) specifically focuses on local flood issues in Devon. Importantly, the Strategy recommends that all new developments should have an effective and robust surface water drainage management system, designed in accordance with the most recent SuDS principles, with the aim of reducing on-site flood risk, whilst also avoiding increasing flood risk elsewhere.

The **National Planning Practice Guidance (2015)** contains a Flood Risk and Coastal Change section which advises on how the planning and design process can take account of the risks associated with flooding and coastal change.

The **Non-Statutory Technical Standards for Sustainable Drainage Systems (2015)** outline the basic principles of sustainable drainage, and should be read in conjunction with the National Planning Policy Framework (2012), in addition to this Guidance.

The **Devon Green Infrastructure Strategy (2015)** was published in response to Paragraph 99 of the National Planning Policy Framework (2012) which requires green infrastructure to be incorporated into new developments if they are located in areas vulnerable to flooding. The Strategy provides guidance on how to successfully incorporate green infrastructure into new developments, and shows green infrastructure opportunities and deficiencies across Devon.

3. What are SuDS?

CIRIA C753
Ch. 1

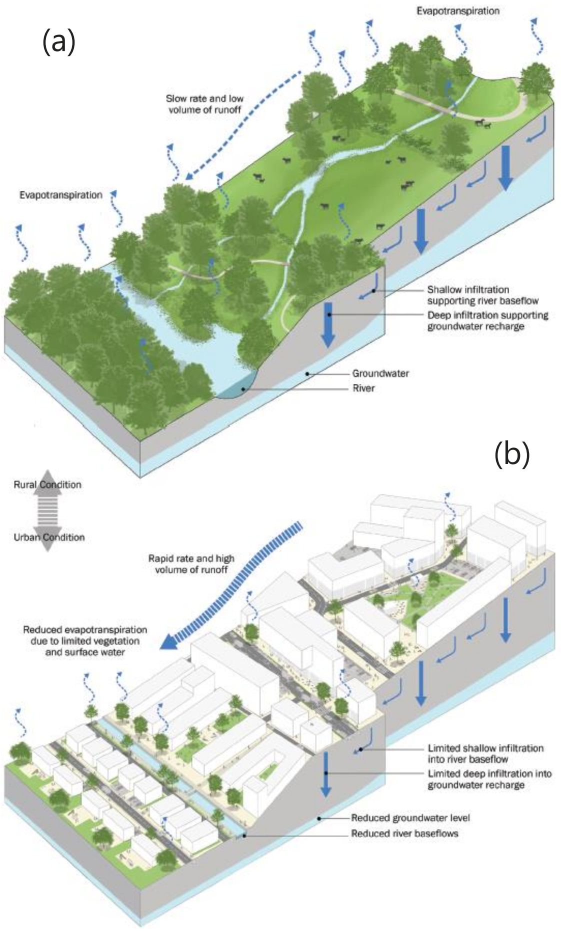

Figure 2: when a natural catchment (a) is subject to development, the hydrological impacts can be mitigated through the use of a variety of SuDS components which manage water quantity, water quality, visual amenity, and biodiversity (b). Credit: CIRIA C753 (2015), p. 22.

When rain falls on greenfield sites, the water may be intercepted by vegetation, evaporate, infiltrate into the ground, or flow overland to enter water bodies (Figure 2a). However, the way in which these sites hydrologically respond to rainfall is significantly modified when they are developed. Most notably, the introduction of impermeable surfaces results in a significant increase in the rates and volumes of surface water runoff from such sites (Figure 2b).

Traditionally, this surface water runoff has been managed in subterranean piped systems which are designed to prevent localised flooding by conveying surface water runoff downstream as rapidly as possible. An inherent disadvantage of these systems is the risk of downstream flooding resulting from the concentration of flows within a confined area, and the absence of control measures to manage exceedance events. Furthermore, sediment-associated pollutants and contaminants are not naturally managed within these traditional drainage systems, and nor do they provide aesthetically-pleasing visual amenity or biodiversity benefits.

CIRIA C753
Ch. 2

In contrast to these traditional subterranean systems, sustainable drainage systems (SuDS) manage surface water on, or as is practicably close to, the ground surface, in a way that mimics natural hydrological processes. Managing surface water in this way controls the rate and quantity of surface water runoff, improves its quality, and also provides visual amenity and biodiversity benefits (Figure 3).

Generally, the use of a variety of above-ground SuDS components, which manage rainfall close to where it falls, provide the greatest environmental benefits, and often cost less than traditional piped systems.

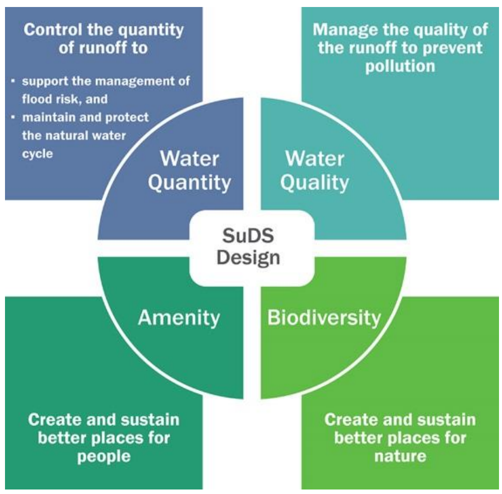

Figure 3: the four pillars of SuDS design describe the underpinning principles of sustainable drainage, namely: water quantity, water quality, visual amenity and biodiversity. Credit: CIRIA C753 (2015), p. 6.

4. Selecting SuDS Components

CIRIA C753
Ch. 7-10

An early assessment of a proposed development site is essential to identify what can and cannot be accommodated within the proposed layout, in addition to any environmental constraints which may preclude the use of particular SuDS components.

Drainage engineers must therefore work alongside architects and landscape architects to identify a range of SuDS components, such as those outlined below, which together will provide a surface water drainage management system which comprehensively addresses water quantity, water quality, visual amenity and biodiversity issues.

CIRIA C753
Ch. 11

Rainwater harvesting systems collect and store surface water runoff from roofs or paved surfaces, prior to use on-site, typically for vegetation irrigation and toilet flushing.

CIRIA C753
Ch. 12

Green roofs are planted soil layers on the roofs of buildings which are irrigated by rainfall and therefore reduce the rate and volume of surface water runoff.

CIRIA C753
Ch. 13

Infiltration systems (including soakaways and basins) collect, store, and dispose of surface water runoff using overlying vegetation, underlying soils, and/or cellular structures.

CIRIA C753
Ch. 15

Filter strips allow surface water runoff to flow across a densely vegetated surface and infiltrate into the ground, whilst also encouraging the natural removal of sediment-associated pollutants and contaminants.

CIRIA C753
Ch. 16

Filter drains allow surface water runoff to be temporarily stored below the surface in a shallow gravel-filled trench, providing attenuation, conveyance and water treatment benefits.

CIRIA C753
Ch. 17

Swales are shallow, open, vegetated channels which are used to convey and treat surface water runoff, whilst also providing a useable public space with biodiversity benefits.

CIRIA C753
Ch. 18

Bioretention systems (including rain gardens) are shallow landscaped depressions which allow surface water runoff to temporarily pond on the surface, before filtering through overlying vegetation and underlying soils prior to collection or infiltration.

CIRIA C753
Ch. 19

Trees can be used within formalised soil-filled pits to complement a range of infiltration SuDS components by collecting, storing and treating surface water runoff by filtration.

CIRIA C753
Ch. 20

Pervious pavements allow surface water runoff to soak through structural paving to enable storage in the sub-base, or infiltration directly into the ground surface.

CIRIA C753
Ch. 21

Attenuation storage systems are below-ground structures which can be used to temporarily store surface water runoff before controlled release or re-use.

CIRIA C753
Ch. 23

Ponds, wetlands and detention basins are features with permanent pools of water, the levels of which increase following rainfall, enabling the attenuation and treatment of surface water runoff.

5. General Requirements for SuDS in Devon

CIRIA C753
Ch. 4

5.1 Providing a SuDS Management Train

The SuDS Management Train (Figure 4) describes the use of a sequence of SuDS components across a development site to control the rate and volume of surface water runoff, reduce the concentrations of sediment-associated pollutants and contaminants to acceptable levels, and provide visual amenity and biodiversity benefits. This method ensures that natural hydrological processes are mimicked by managing surface water runoff at source (i.e. close to where the rain falls), with residual flows conveyed downstream to larger SuDS components:

- **Prevention**: good housekeeping and site design should be employed to manage and reduce surface water runoff and pollution;
- **Source control**: rainfall should be managed in above-ground SuDS components as close as possible to where it falls to the ground surface;
- **Site control**: residual flows from source control components should be managed in larger above-ground SuDS components;
- **Regional control**: surface water runoff from several sites can be managed downstream in large above-ground SuDS components.

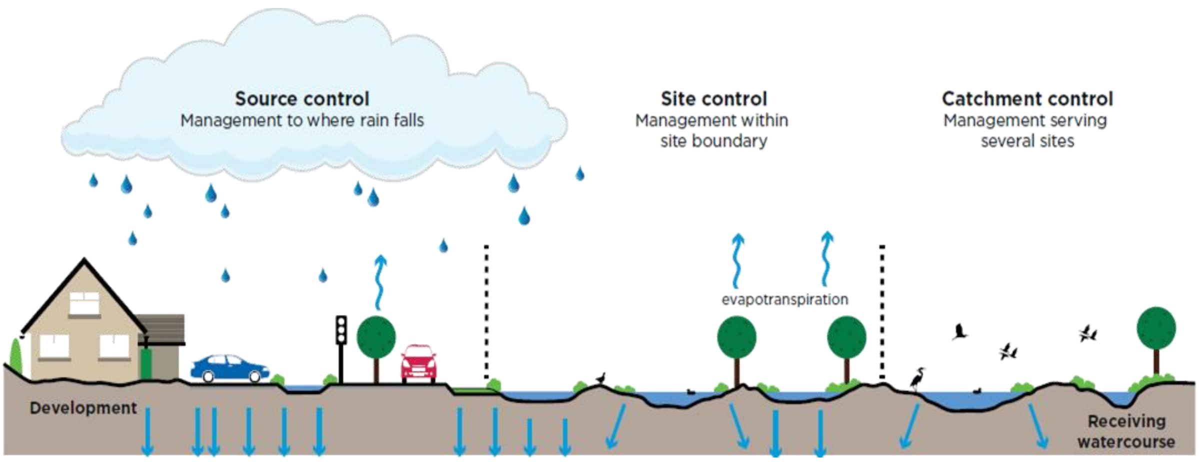

Figure 4: in order to reduce the concentrations of sediment-associated pollutants and contaminants within surface water runoff, the surface water drainage management systems provided on new development sites must comply with the SuDS Management Train. Credit: West of England Sustainable Drainage Developer Guide (2015), p.18.

CIRIA C753
Ch. 26.7.1

Devon County Council's Flood and Coastal Risk Management Team therefore requires all new surface water drainage management systems to provide a comprehensive SuDS Management Train. These systems should ensure that a development site's surface water runoff is passed between a variety of source control, and site control, SuDS components, rather than being directly conveyed to one concentrated point (e.g. to one large attenuation pond).

CIRIA C753
Ch. 1.6

5.2 Prioritising Above-Ground SuDS

Devon County Council's Flood and Coastal Risk Management Team do not consider underground attenuation systems to be truly sustainable components within surface water drainage management systems because they do not inherently and naturally provide water quality, visual amenity and biodiversity benefits.

Figure 5: well-designed attenuation ponds and wetlands, complemented by other above-ground SuDS components, are able to satisfy the four pillars of SuDS design, and can be effectively used on residential, commercial and school sites alike. Credit: Susdrain (2016).

Consequently, development sites must consider the use of a variety of above-ground SuDS components, and these must be incorporated into surface water drainage management systems wherever possible (Figure 5). This will ensure that all surface water drainage management systems within Devon County Council's administrative area are both sustainable and easily maintainable.

Underground attenuation systems will therefore only be permitted once robust evidence has been submitted which demonstrates that it is not viable to incorporate any above-ground SuDS components into the surface water drainage management plan. This evidence should be in the form of written statements which clearly justify the necessity to provide underground components, accompanied by sketches, drawings, or constraint plans, where the LLFA deems it necessary.

Figure 6: this linear rain garden receives surface water runoff from the adjacent footpaths, and is only approximately one metre wide; the land take and cost of such SuDS components can be minimal. Credit: Susdrain (2016).

Despite the fact that underground attenuation systems may be the most suitable solution for sites where significant constraints exist, it is almost always feasible to incorporate some above-ground SuDS components into the surface water drainage management system in order to complement the other components (Figure 6).

CIRIA C753
Ch. 1.4

5.3 Integrating SuDS into Green Infrastructure

Figure 7: the surface water drainage management system for this development in Bordeaux was designed by a team of drainage engineers, landscape architects, ecologists and planners. This approach produced an effective surface water drainage management system which also enhanced biodiversity and ecosystem services, whilst aiming to improve public health and well-being. Credit: Sarah Foqué (2014).

The use of SuDS components to manage surface water runoff represents an important opportunity to improve both urban and rural environments, and help to meet the growing demands to deliver green infrastructure by creating open green spaces which encourage habitat creation (Figure 7).

Due to the fact that SuDS should exploit both green and blue corridor networks, above-ground components can significantly contribute to creating and maintaining biodiversity, in addition to providing public amenity, public health, education, and economic benefits.

It is therefore essential to consider SuDS as part of an integral part of the broad network of green infrastructure on developments, rather than stand-alone, bolt-on features (Figure 8).

Devon County Council's Flood and Coastal Risk Management Team therefore strongly advises drainage engineers to work alongside architects and landscape architects when designing surface water drainage management systems.

This collaborative working will ensure that SuDS will not only provide flood risk benefits; they will be fully integrated into green infrastructure networks and contribute to safeguarding the local landscape character and distinctiveness.

Figure 8: this well-planted attenuation pond serves the University of Exeter's Forum building by collecting, attenuating and treating the surface water runoff from the roof, whilst also providing a biodiversity and amenity benefit to the users of the area. Credit: Christopher Perrott (2016).

6. Technical Requirements for SuDS in Devon

6.1 Technical Documents

Devon County Council's Flood and Coastal Risk Management Team requires surface water drainage management systems for new developments to be designed in accordance with the following technical documents:

- This Sustainable Drainage Systems: Guidance for Devon document (Version 1.6) (January, 2017);
- DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems (March, 2015);
- The Building Regulations Part H (Drainage and Waste Disposal) (2010);
- The Code of Practice for Surface Water Management for Development Sites (BS 8582) (2016);
- Where infiltration is proposed, Building Research Establishment Digest 365 Soakaway Design (2016);
- Natural England's Green Infrastructure Guidance (NE176) (January, 2009);
- CIRIA's SuDS Manual (C753) (2015);
- Those sections of CIRIA's SuDS Manual (C697) (2007) not superseded by C753 (2015);
- CIRIA's Site Handbook for the Construction of SuDS (C698) (2007).

N-STSfSuDS Sn. 1

6.2 Managing Flood Risk Outside of the Development

The introduction of impermeable surfaces onto greenfield sites will significantly increase the rates and volumes of surface water runoff. Consequently, significant changes to the natural hydrological regime must be mitigated.

When designing surface water drainage management systems, robust evidence must be submitted in order to demonstrate that flood risk will not be increased either upstream or downstream of the development site and, wherever practicable, betterment should be achieved.

Where the surface water drainage management system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea), the peak flow control standards (section 6.3) and volume control standards (section 6.4) need not apply.

If an applicant seeking planning permission believes that this exception applies to their development site, they must approach Devon County Council's Flood and Coastal Risk Management Team with the relevant evidence before the surface water drainage management system is designed. The Team will then review the submitted evidence in order to determine whether an exception can be made, and will formally confirm the result of this in writing to both the applicant and Local Planning Authority.

Where formal approval for uncontrolled surface water discharges from a proposed development site is granted by Devon County Council's Flood and Coastal Risk Management Team, the surface water drainage management system must still incorporate a variety of above-ground SuDS components, in accordance with the SuDS Management Train, to provide benefits to the quality of the surface water runoff discharged off-site (Figure 9).

Figure 9: this green roof on a building in Salcombe manages the quality of the surface water runoff from the site before it is discharged, without attenuation, directly into Salcombe Harbour. Credit: Christopher Perrott (2016).

N-STSfSuDS
Sn. 2-3

6.3 Managing Peak Flow Control

Where not collected for re-use, surface water runoff should be discharged as high up the hierarchy of discharge solutions as is practicable:

1. Discharge into the ground (infiltration);
2. Discharge to a surface water body (with written permission from the riparian owner);
3. Discharge to a surface water sewer, highway drain, or other drainage system (with written permission from South West Water Ltd., Devon County Council Highways, or the riparian owner, respectively);
4. Discharge to a combined sewer (with written permission from South West Water Ltd.).

Discharge into the ground (infiltration) must therefore be explored as the primary method of surface water disposal from all development sites in the first instance (Figure 10).

However, if this, or any other method, is discounted when the surface water drainage management system is being designed, robust evidence must be submitted to justify moving down the hierarchy (e.g. detailed results of infiltration testing undertaken in strict accordance with Building Research Establishment Digest 365 Soakaway Design (2016)).

For developments on greenfield sites, the peak surface water runoff rate for the 1 in 1 year rainfall event, up to and including the 1 in 100 year rainfall event, must never exceed the peak greenfield runoff rate for the same event. This will ensure that the surface water runoff rate from developed areas matches greenfield conditions.

Figure 10: rather than attenuating the surface water runoff generated from this car park in Devon, a reinforced permeable surface has been used to allow infiltration into the ground. This method not only manages water quantity and quality, but also supports soil moisture levels and promotes vegetation growth. Credit: Christopher Perrott (2016).

CIRIA C753
Ch. 24.2

Devon County Council's Flood and Coastal Risk Management Team only accept greenfield runoff rates calculated in accordance with the methodologies outlined in CIRIA's SuDS Manual (C753). Furthermore, the runoff areas used in any of these methodologies must be consistent. Consequently, only the area being drained to the proposed surface water drainage management system should be represented in the greenfield runoff rate calculations. For example, if the surface water runoff from a landscaped area does not contribute to the drainage system, this must be excluded from the greenfield runoff rate calculations.

For developments on brownfield sites, peak flow control must still match the greenfield runoff rate. However, if this is robustly demonstrated as being unfeasible, the applicant must work backwards to achieve a betterment, with a surface water runoff rate as close to the greenfield conditions as possible, providing robust evidence of the calculations undertaken.

On development sites where the greenfield runoff rates are low, off-site discharge rates must still be as close as possible to the greenfield performance; the 5 l/s minimum discharge rate recommendation is no longer acceptable because well-maintained modern flow control structures can now facilitate lower discharge rates.

For these development sites, Devon County Council's Flood and Coastal Risk Management Team will formally agree minimum off-site discharge rates on a site-by-site basis to ensure that any proposed flow control structure will remain fully operational and maintainable for the lifetime of the development. This will require applicants to submit evidence in order to demonstrate that the proposed off-site discharge rate and flow control structure design is as reasonable as is practicable.

N-STSfSuDS
Sn. 4-6

6.4 Managing Volume Control

For developments on greenfield sites, the volume of surface water runoff discharged off-site in the 1 in 100 year, 6 hour rainfall event, must never exceed the greenfield runoff volume for the same event.

For developments on brownfield sites, the volume of surface water runoff discharged off-site must still match the greenfield runoff volume. However, if this is robustly demonstrated as unfeasible, the applicant must work backwards to achieve a betterment, with a surface water runoff volume as close to the greenfield conditions as possible, providing robust evidence of the calculations undertaken.

CIRIA C753
Ch. 3.3

www.

Where infiltration is not used to dispose of surface water from a development site, long term storage must be provided to store the additional volume of surface water runoff generated by the increase in impermeable area, which is in addition to the attenuation storage required to address the greenfield runoff rates. The incorporation of long term storage into surface water drainage management systems will ensure that each SuDS component is appropriately sized, and must discharge at a rate not exceeding 2 litres/second/hectare.

www.

6.5 Managing Climate Change Pressures

In the United Kingdom, the prevalence of summer and winter precipitation events is increasing and it is likely that the intensity of these events will increase in the future. The Environment Agency has therefore issued advice which outlines the allowances for climate change which are to be used in the production of Flood Risk Assessments and surface water drainage management plans (Figure 11).

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Figure 11: the Environment Agency's climate change allowances for peak rainfall intensity calculations will ensure that surface water drainage management systems are adequately designed to manage increasing rainfall intensity in the future. Credit: Environment Agency (2016).

The advice is based on different climate change projections and carbon dioxide emissions scenarios, with allowances for various periods of time over the next century.

In order to ensure that surface water drainage management systems on new development sites across Devon are designed to manage increasing rainfall intensity in the future, Devon County Council's Flood and Coastal Risk Management Team requires the upper end climate change allowance for the '2080s' epoch to be used when calculating peak rainfall intensity.

N-STSfSuDS
Sn. 7-9

6.6 Managing Flood Risk within the Development

Consideration must be given to surface water exceedance routes to ensure that life and property are not put at risk in the event of a surface water drainage management system failing, or during storms in excess of the design standard of such systems.

Consequently, unless an area is designed to hold or convey water, flooding within a development site should not occur:

- On any part of the development for a 1 in 30 year rainfall event;
- In any part of a building or any utility plant susceptible to water for a 1 in 100 year rainfall event.

Figure 12: temporary ponding in car parks can manage surface water during extreme rainfall events, without placing the critical site infrastructure at risk. Credit: Susdrain (2016).

CIRIA C753
Ch. 24.12

Where surface water drainage management systems are designed to flood above the 1 in 30 year rainfall event, the depth of any standing water along access and egress routes must be demonstrated as being safe. Overland flows must also be managed by unobstructed exceedance routes which minimise the risk to life and property (Figure 12).

Dividing developments sites into sub-catchments to manage surface water runoff in smaller systems closer to the source of rainfall, in accordance with the SuDS Management Train, will ensure that the surface water drainage management system is more resilient to failure.

www.

6.7 Critical Drainage Areas

Several Flood Zone 1 areas across Devon have been identified by the Environment Agency as having critical drainage issues. These Critical Drainage Areas have stringent surface water drainage design standards which all new minor and major developments must adhere to:

- The rates and volumes of surface water runoff must be safely managed on-site up to, and including, the 1 in 100 year (+40% allowance for climate change) rainfall event;
- The rates and volumes of surface water runoff discharged off-site must mimic greenfield performance, up to a maximum of the 1 in 10 year greenfield runoff rate and volume.

To satisfy these standards, additional surface water attenuation storage areas will be required within the development site in order to contribute to a reduction in downstream flood risk.

7. Constructing SuDS in Devon

N-STSfSuDS
Sn. 10-12

All components of a development site's surface water drainage management system must be designed to ensure the structural integrity of the entire system, as well as any adjacent structures or infrastructure, over the design life of the development, taking into account the requirement for reasonable levels of maintenance.

N-STSfSuDS
Sn. 13-14

For all new major developments, a temporary surface water drainage management plan must be submitted to demonstrate how surface water runoff generated during the construction period will be managed. This plan, which may form part of a Construction Environmental Management Plan, must be approved and constructed before any other works are commenced. However, on large sites, phased construction may be requested and the temporary SuDS may be incorporated into the permanent surface water drainage management system.

CIRIA C753
Ch. 31

In addition to surface water runoff, these temporary surface water drainage management systems must also manage any eroded sediment, preventing it from entering the permanent surface water drainage management system during the construction phase (Figure 13). On sites where the use of underground attenuation systems has been approved, this is particularly important because these systems are difficult to comprehensively clean prior to the developer leaving the site, which may compromise the efficiency of the whole system.

The submission of this information is required to ensure that:

- The receiving environment is protected from surface water runoff during the construction phase;
- Each component of the permanent surface water drainage management system is protected from damage during the construction phase;
- The natural infiltration characteristics of the site soils and subsoils are protected;

Figure 13: care needs to be taken during the construction of SuDS to ensure that the receiving environment is protected from sediment-laden surface water runoff. Credit: Susdrain (2016).

- A permanent surface water management system where runoff is conveyed and stored, as designed, without causing unacceptable erosion, channelling or sedimentation, is delivered;
- Native vegetation and diverse habitats can be established;
- Appropriate inspections, as required by the relevant authorities during the construction period, can be accommodated.

8. Adopting and Maintaining SuDS in Devon

CIRIA C753
Ch. 33-34

The adoption and maintenance requirements of SuDS components are an important consideration during the design process, and it is the responsibility of developers to put in place suitable arrangements for the lifetime of the development.

Figure 14: the maintenance of many SuDS components typically involves only a small amount of additional work (if any) over and above what is necessary for standard public open space. Credit: CIRIA C753 (2015), p. 328.

Typically, SuDS components will either be maintained solely by the landowner, or by private companies which will maintain the surface water drainage management system alongside the site's general landscape maintenance regime (Figure 14). This is possible because maintaining almost all SuDS components does not require specialist knowledge.

On occasion, developers may wish Devon County Council, as Highway Authority, to adopt part of a development site's surface water drainage management system. The decision to adopt these systems is made on a site-by-site basis by Highway Development Management Officers who work outside of the Flood and Coastal Risk Management Team. Nonetheless, the design standard of these systems must at least meet the standards outlined in this Guidance, as well as any other requirements specified by the Highway Authority.

Developers may also wish South West Water to adopt part of a development's surface water drainage management system, in accordance with Section 104 of the Water Industry Act (1991). Written evidence must be provided from South West Water's Developer Services Planning Team to confirm that this is acceptable, and to satisfy their adoption criteria, these systems must be underground, sealed, and designed to the 1 in 30 year rainfall event.

Consequently, a separate surface water drainage management system must also be provided to manage the surface water runoff generated from rainfall in excess of this return period, up to the 1 in 100 year (+40% allowance for climate change) rainfall event, and this system must prioritise the use of above-ground SuDS components.

Where surface water drainage management systems are not proposed for adoption by the Highway Authority or South West Water, an operation and maintenance plan and timetable must be submitted to explain:

- **What** needs maintaining, and the management aims for the site;
- **Who** will be responsible for maintaining each component part;
- **How** each component part will be accessed, and the scope of the activities required;
- **When** each component part needs maintaining.

9. Our Role in the Planning Process

As a statutory consultee in the planning process, it is inherently important that Devon County Council's Flood and Coastal Risk Management Team ensures that all information concerning the surface water drainage aspects of each planning application under consideration is shared with all concerned parties.

Consequently, if additional surface water drainage information is requested from an applicant, the Flood and Coastal Risk Management Team cannot provide a formal substantive response to the Local Planning Authority until the information has been submitted directly to the Planning Case Officer (Figure 15). This ensures that at all times, the Planning Case Officer is fully aware of any additional surface water drainage information submitted, which may impact other aspects of the application. Once any such additional information is submitted, the Planning Case Officer will be able to formally re-consult the relevant statutory consultees to provide another substantive response, usually within 14 days.

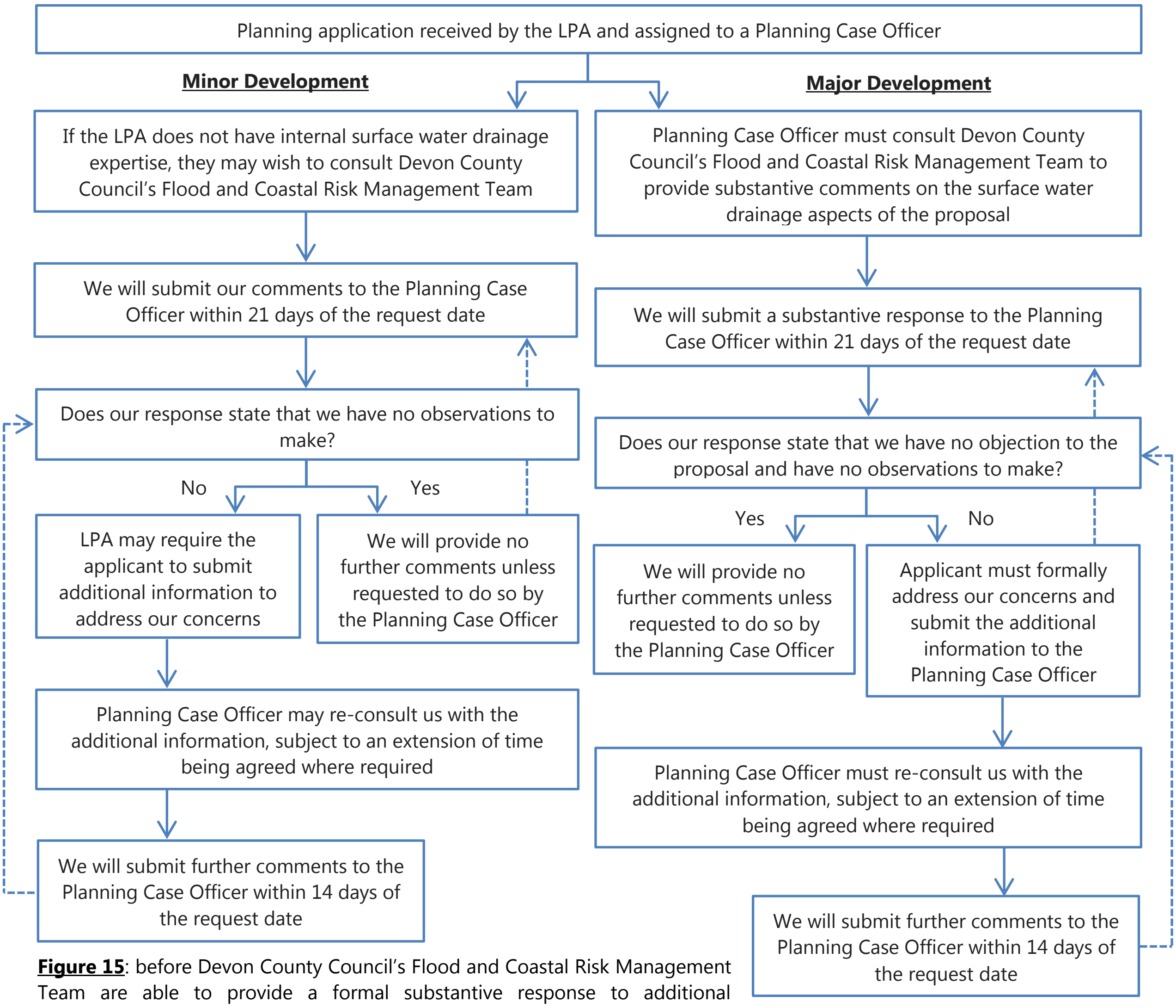

Figure 15: before Devon County Council's Flood and Coastal Risk Management Team are able to provide a formal substantive response to additional information submitted by an applicant or their agent, the Planning Case Officer must be in receipt of all the relevant documentation.

10. Surface Water Drainage Information Required for Planning Applications

The surface water drainage management plan for any development site must be considered at the earliest possible stage; it is now not acceptable for applicants to address the surface water drainage aspects of development sites in discharge of conditions or reserved matters applications.

The level of information relating to surface water drainage management that must be submitted in support of planning applications should be proportional to both the scale of development and level of flood risk. Although not exhaustive, the lists contained within this section provide a guide as to the level of information required by the Lead Local Flood Authority when assessing the surface water drainage management aspects of most planning applications.

10.1 Information Required for Outline Planning Applications

- ☐ Description of the **type of development**;
- ☐ **Location plan** at an appropriate scale with a grid reference, showing geographical features, street names, watercourses, or other water bodies in the vicinity;
- ☐ **Site plan** showing the red line boundary and any land under the applicants' control;
- ☐ **Site survey** showing the existing topography;
- ☐ Assessment of **all existing flood risks** to the site, including from sewer networks, groundwater, overland surface water flows, reservoirs, ponds, canals, and other watercourses;
- ☐ Calculations of the **current surface water runoff rates and volumes** for the site;
- ☐ Calculations of the **proposed surface water runoff rates and volumes** for the site;
- ☐ Calculations of the **surface water attenuation storage volume** required for the 1 in 100 (+40% allowance for climate change) year rainfall event;
- ☐ Calculations of the **long term storage volume** required to store the additional volume of surface water runoff caused by any increase in the site's impermeable area;
- ☐ Evidence that the site has an **agreed point of discharge**;
- ☐ Evidence that the **hierarchy of drainage solutions** has been followed, providing robust evidence as to the viability or otherwise of:
  1. Discharge into the ground (infiltration);
  2. Discharge to a surface water body (with written permission from the riparian owner);
  3. Discharge to a surface water sewer, highway drain, or other drainage system (with written permission from South West Water Ltd., Devon County Council Highways, or the riparian owner, respectively);
  4. Discharge to a combined sewer (with written permission from the riparian owner).
- ☐ Evidence that the **capacity of any receiving watercourse** is sufficient to receive concentrated flows from the site;
- ☐ Explanations of the **proposed flood risk mitigation measures**;
- ☐ **Non-technical summary** of the proposed surface water drainage management system;
- ☐ Plans of the **proposed surface water drainage management system**, demonstrating that it fits within the proposed site layout, and is practical and sustainable;
- ☐ **Outline operation and maintenance plan and timetable** for the proposed surface water drainage management system over the entire lifetime of the development.

10. Surface Water Drainage Information Required for Planning Applications

10.2 Information Required for Full, Reserved Matters, or Discharge of Conditions Planning Applications

- ☐ Description of the **type of development**;
- ☐ **Location plan** at an appropriate scale with a grid reference, showing geographical features, street names, watercourses, or other water bodies in the vicinity;
- ☐ **Site plan** showing the red line boundary and any land under the applicants' control;
- ☐ **Detailed site survey** showing the existing topography;
- ☐ Assessment of **all existing flood risks** to the site, including from sewer networks, groundwater, overland surface water flows, reservoirs, ponds, canals, and other watercourses;
- ☐ Calculations of the **current surface water runoff rates and volumes** for the site;
- ☐ Calculations of the **proposed surface water runoff rates and volumes** for the site;
- ☐ Calculations of the **surface water attenuation storage volume** required for the 1 in 100 (+40% allowance for climate change) year rainfall event;
- ☐ Calculations of the **long term storage volume** required to store the additional volume of surface water runoff caused by any increase in the site's impermeable area;
- ☐ Evidence that the site has an **agreed point of discharge**;
- ☐ Evidence that the **hierarchy of drainage solutions** has been followed, providing robust explanations as to the viability or otherwise of:
    1. Discharge into the ground (infiltration);
    2. Discharge to a surface water body (with written permission from the riparian owner);
    3. Discharge to a surface water sewer, highway drain, or other drainage system (with written permission from South West Water Ltd., Devon County Council Highways, or the riparian owner, respectively);
    4. Discharge to a combined sewer (with written permission from the riparian owner).
- ☐ **Infiltration testing results** at the location and depth of each proposed infiltration system;
- ☐ **Groundwater monitoring** over a 12 month period, taking account of seasonal variations, to demonstrate that the base of any infiltration component is at least 1 metre above the maximum anticipated groundwater level;
- ☐ Evidence that the **capacity of any receiving watercourse** is sufficient to receive concentrated flows from the site;
- ☐ Detailed explanations and plans of **flood risk mitigation measures**;
- ☐ **Technical summary** of the proposed surface water drainage management system;
- ☐ Detailed plans of the **proposed surface water drainage management system**, demonstrating that it fits within the proposed site layout, and is practical and sustainable;
- ☐ **Residual risk assessment** to account for a failure of any part of the proposed surface water drainage management system;
- ☐ **Detailed exceedance route plans** to demonstrate that there is no residual risk of property flooding during events in excess of the return period for which the surface water drainage management system is designed;
- ☐ **Detailed operation and maintenance plan and timetable** for the proposed surface water drainage management system over the entire lifetime of the development;
- ☐ Details of the proposed **community signage and engagement activities** for each component of the proposed surface water drainage management system.

10.3 Flood Risk Assessments

Site-specific Flood Risk Assessments are required for proposals:

- In Flood Zone 2 or 3, including minor development and change of use;
- Of more than 1 hectare in Flood Zone 1;
- Of less than 1 hectare in Flood Zone 1, including a change of use in development type to a more vulnerable class (e.g. from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water);
- In an area within Flood Zone 1 which has been designated a Critical Drainage Area by the Environment Agency.

Some of the information outlined in Sections 10.1 and 10.2 may be presented in a Flood Risk Assessment, and the National Planning Practice Guidance website contains detailed information, and a useful checklist, to aid in preparing these documents.

11. Additional Information

11.1 Designation of Flood Risk Features and the Asset Register

Under the Flood and Water Management Act (2010), LLFAs have the power to designate any feature which could have an impact on the flow or storage of water as a Flood Risk Asset. Surface water drainage management systems could be subject to this classification, and where one is designated as an Asset, permission must be sought from the LLFA to undertake any works to it.

The LLFA will inform the relevant LPA when it intends to formally designate a feature, and in the case of surface water drainage management systems, the following information could be requested as part of the designation process:

- Permitted plans and drawings of all SuDS components;
- As-built plans and drawings of all SuDS components;
- Owners of each SuDS component;
- Person or company responsible for the maintenance of each SuDS component.

11.2 Works within the Vicinity of Ordinary Watercourses

An Ordinary Watercourse is defined as any watercourse that is not designated as a Main River by the Environment Agency.

In accordance with the Land Drainage Act (1991), if any temporary or permanent works need to take place within such watercourses to facilitate any part of a development (e.g. an access culvert or bridge), Land Drainage Consent must be obtained from Devon County Council's Flood and Coastal Risk Management Team prior to any works commencing.

11.3 Works in the Vicinity of Main Rivers or any Flood/Sea Defence

Applicants must contact the Environment Agency to enquire about, and where necessary apply for, an Environmental Permit for flood risk activities if works are proposed:

- In, under, over or near a Main River (including where the river is in a culvert);
- On or near a flood defence on a Main River;
- In the floodplain of a Main River;
- On or near a sea defence.

12. Appendix A: Design Considerations for SuDS Components

SuDS Component	Design Considerations
Rainwater Harvesting Systems	• Water butts do not guarantee that storage will always be available unless the system is designed so that any water stored above a set threshold drains slowly to the downstream drainage system; • Contributing roof area should be calculated in plan because it may not be possible to capture all of the surface water runoff from a roof due to the pitch arrangements; • Projected water use requirements must be considered when sizing the system; • Geotechnical investigation should be undertaken to ensure the suitability of the soils for the foundation of the system, particularly where installation is proposed close to buildings and where groundwater levels are close to the finished ground surface.
Green Roofs	• Hydraulic performance should consider how the roof is likely to behave during extreme storms in both the summer and winter; • Where the design of the downstream attenuation system is linked to green roof performance, the benefits should be explicitly determined; • Minimum finished roof fall of 1 in 80, and a maximum of 1 in 3; • Use a low density growing medium with good water retention, reasonable fertility, mixtures of organic and mineral material, and a depth of between 80-450mm, with variations across the roof area to provide a range of habitats; • Seed and plug-plant with native drought-tolerant wild flowers of local or UK provenance, with consideration given to shading from other buildings and the orientation to the sun; • Shallow layer of gravel over a width of 300-400mm from the outside perimeter of the roof to provide vegetation and soil compaction protection; • Waterproofing layer may need to be anchored to resist wind uplift, be root resistant, and protected from temperature changes and mechanical damage; • Multiple outlets to reduce the risk of blockages and easily accessible for seasonal cleaning, and separated from the growing medium.
Infiltration Systems	• Testing must be carried out in accordance with Building Research Establishment Digest 365 Soakaway Design (2016) standards, with test pits draining beyond the 25% effective depth; • Minimum of 5m away from any building foundation, retaining structure, or highway, unless a suitably qualified geotechnical engineer or engineering geologist can demonstrate otherwise; • Maximum depth of 3m to enable maintenance, with monitoring points to enable the water level in the system to be observed or measured; • Base should be flat to provide uniform ponding and infiltration across the surface; • Base must be at least 1m above the groundwater level to protect the functionality of the infiltration process; • Fill material should provide >30% of void space; • Half-drain within a reasonable time (e.g. 24 hours) so that the risk of the system not being able to manage a subsequent rainfall event is minimised; • System should be of sufficient strength to cater for the loads imposed on them during construction and during their service life; • Where root intrusion has the potential to be vigorous, root protection barriers should be used.
Filter Strips	• Strip should extend the entire length of the area being drained; • Minimum width of 6m; • Minimum longitudinal slope of 1% to prevent ponding, and a maximum of 5% to prevent erosion; • Where filter strip slopes are in excess of 5%, a series of level spreaders constructed of durable, non-toxic material graded into the soil can be used to maintain sheet flow; • Base must be at least 1 metre above the groundwater level to protect the functionality of the infiltration process; • Time of travel of runoff across the filter strip should be at least 9 minutes; • Maximum flow velocities should be 1.5 m/s, although this should be lower than 0.3 m/s for effective treatment; • Where soils are compacted, 300mm of soil should be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth; • Use dense, soil-binding, deep routed vegetation (with a salt tolerance where necessary) which should be planted in the spring, and maintained at lengths of 75-150mm to ensure effective filtration performance; • Where adjacent to a highway or car park, a low-level inconspicuous barrier (e.g. trees, slotted kerbs, or intermittently placed boulders) should be installed to prevent unauthorised vehicular access onto the strip; • Drop of between 50-100mm from the edge of any hard surface to the filter strip to prevent the formation of a sediment lip.

12. Appendix A: Design Considerations for SuDS Components

SuDS Component	Design Considerations
Filter Drains	• Longitudinal slope should not exceed 2% because low flow velocities are required for stable conveyance through the filter medium; • Base must be at least 1 metre above the groundwater level to protect the functionality of the infiltration process; • Suitable for areas with high groundwater pollution risks when lined; • Provide an upper sacrificial stone layer to aid in the removal of fine sediments; • Void ratio and permeability of granular fill should be sufficiently high to allow adequate percolation and to control the risk of blockage; • Most effective pre-treatment option is for runoff to flow over a small filter strip (~0.5m wide) between the edge of the drained area and the trench; • Perforated pipe should be provided near the base to collect and convey water to other downstream SuDS components; • Any lengths of perforated pipes that are more than 10m should be spaced between access sumps so that the pipes can be cleaned by jetting or rodding.
Swales	• Maximum side slopes of 1 in 3, but 1 in 4 slopes are preferred because this makes maintenance easier, although inaccessible swale edges can have steeper, or even vertical, side slopes; • Longitudinal slopes should be between 0.5-6%, with check dams being incorporated on slopes greater than 3% (which allows slopes to increase up to 10%); • Base width of between 0.5-2m to prevent channelling and erosion; • Normal maximum swale depth is 400-600mm; • Maximum flow velocities should be 2.0 m/s, although this should be lower than 0.3 m/s for effective treatment; • Time of travel of runoff along the swale should be at least 9 minutes, or 18 minutes from the top of the swale if there are lateral inflows along its length; • Half-drain within 24 hours so that the risk of the system not being able to manage a subsequent rainfall event is minimised; • Use dense, soil-binding, deep routed vegetation (with a salt tolerance where necessary) which should be planted in the spring, and maintained at lengths of 75-150mm to ensure effective filtration performance; • Where soils are compacted, 300mm of soil should be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth; • Underdrains should use a perforated pipe with a minimum diameter of 100mm, with 150mm of clean gravel above the pipe, enclosed in a geotextile fabric.
Bioretention Systems (Including Rain Gardens)	• Minimum depth of 400mm for the filter medium and 100mm for the transition layer; • Surface area of bioretention system should be a minimum of 2% of the overall site area to be drained to the feature; • Width of system should be greater than 600mm, but less than 20m to ensure easy construction and maintenance; • Maximum length should be 40m to avoid uneven distribution of water over the surface; • Permeability of generic soil filter media should be a minimum of 100mm/h; • Total filter area should not exceed 800m^2; • Maximum depth of attenuated water is 500mm; • In flow velocities should be 0.5 m/s or 1.5m/s for the 1 in 100 year rainfall event; • System should half drain within 24 hours to provide adequate capacity for multi-event scenarios; • Base must be at least 1 metre above the groundwater level to protect the functionality of the infiltration process; • Batters of side slopes should have a minimum of 200mm of topsoil on them; • Use a suitable aerated soil to achieve greater than 50mm/hr filtration rates (soil types with more than 65% sand content and a good proportion of humic material work well); • Dense planting is necessary, with a minimum of 6 plants/m^2, which h are tolerant to periodic waterlogging, and pollution from hydrocarbons and icing salt; • Overflow structure or non-erosive overflow channel should be sized to convey the overflow event.

12. Appendix A: Design Considerations for SuDS Components

SuDS Component	Design Considerations
Tree Pits	• Species and stock size must be selected to fulfil the intended design function, taking into account the prevailing conditions and ongoing maintenance; • Select native species, of local or UK provenance, to support wildlife; • Siting of individual trees must allow sufficient space for the tree crown to grow to a good form; • Allow a sufficient uncompacted soil volume for healthy establishment (mature canopy spread area multiplied by 0.6m); • Ensure compacted ground is ripped to relieve compaction prior to the importation of soils into the tree pits; • Use a suitable soil substrate and avoid placing topsoil lower than 30 centimetres below surface; • Break up the structure of clay soils through the incorporation of granular and humic material; • Soils should be 75-80% of maximum dry density; • Soil permeability should be a minimum of 100mm/h; • Base must be at least 1 metre above the groundwater level to protect the functionality of the infiltration process; • Check for potential conflicts with underground services and ensure that utility cables are segregated using ribbed root barriers as appropriate.
Pervious Pavements	• Pervious sub-base to be structurally designed for the site's purpose; • Calculations for a range of rainfall duration should be carried out to verify the performance of the available storage volume; • Outflow from the sub-base should be via a system of perforated pipes or fin drains that provide a large surface area for water to flow into; • Where slopes are 3% or greater, designers should consider internal terracing or internal check dams in the sub-base to provide a series of compartments; • Temporary sub-surface storage must provide infiltration and/or controlled discharge; • Surface infiltration rate should be an order of magnitude greater than the design rainfall intensity; • Recommended factor of safety of 10 for the surface infiltration rate of all surface types to allow for clogging to affect proportion of the surface water over the pavement design life; • Geotextile may be specified to provide filtration treatment; • Lined and underdrained permeable paving can be used when the water table is within 1m of the sub-base, and/or where the site is contaminated; • Grass reinforcement systems can be used over standard pavement materials, such as open graded, low-fines material; • To accommodate services, an impermeable central carriageway might be employed to contain services, visually differentiated from pervious parking bays; • Bedding and jointing material needs to be free-draining and have sufficient durability to resist wear from small movements between blocks.
Attenuation Storage Systems	• Above-ground SuDS components must be utilised unless the applicant can robustly demonstrate that they are not feasible; even where significant constraints exist, above- and below-ground components can be used in combination; • Effective upstream treatment is an important consideration to control the risk of the system performance being compromised by sediment accumulation; • Structural design should be to relevant standards for the appropriate surface loadings; • Calculations should be carried out to check that the tank will be stable and will not move excessively under the anticipated range of loading conditions during the design life of the tank installation; • Use an appropriate geomembrane; • Horizontal water flow may be substantially restricted or even not possible within honeycomb units, so it is highly inadvisable to connect pipes directly to the side of the tank in the form of inlets or outlets; • Velocity of water entering tanks from larger pipes can be significant, and the internal structure can provide sufficient resistance to cause water to back up in the pipework; • Groundwater pressure significantly increases the lateral loads on the walls of the tanks, so the base of the system must be installed at least 1 metre above the groundwater level; • Maintainability of systems needs careful consideration because any failures or blockages will tend not to be noticed, which may increase the site's flood risk; • It is vital that it is legally clear who is contractually responsible for both the structural and hydraulic design of a system to remove any confusion about who is legally responsible for the design in situations where failures have occurred.

12. Appendix A: Design Considerations for SuDS Components

SuDS Component	Design Considerations
Ponds and Wetlands	• Permanent pool of water for water quality treatment and temporary storage for flow attenuation; • At the water surface, a 1 metre wide muddy aquatic bench should be provided for emergency egress; • Minimum depth for open water areas of 1.2m; • Maximum depth of water should not normally exceed 2m in the most extreme design event; • Maximum side slopes of 1 in 3, with shallower side slopes being better for biodiversity; • Recommended length/width ratio is between 3:1 and 5:1; • Bottom of basin should be fairly flat, with a slope of no more than 1 in 100 towards the outlet, to maximise contact of runoff with the vegetation; • For maximum pollutant removal effectiveness, flows should be distributed across the full width of the basin; • Topography and vegetation should reflect natural forms which fit well with the landscape context, enhancing the character of the area and supporting wildlife; • Should not follow a geometric profile; they should have edges with curves and undulations to produce an aesthetically interesting and natural-looking feature; • Indented shorelines, islands and native vegetation throughout; • Appropriate access to the pond for maintenance activities, and to all inlets, outlets and control structures; • Reinforced grass may be required for maintenance routes where vehicular access is anticipated; • Mowing should ideally retain grass to lengths of 75-150mm across the main treatment surface to assist in filtering pollutants and contaminants and retaining sediments; • Fencing is not desirable as it will reduce the amenity benefits provided by the pond, provide a barrier to easy maintenance and provide a trap where litter and dead vegetation can collect.