March 2015 – Issue Version 1

West of England Sustainable Drainage Developer Guide Section 1

Bath & North East Somerset Council

Bristol City Council

North Somerset Council

Somerset County Council

South Gloucestershire Council

Ashley Vale green roof

Wessex Water SuDS system

Aztec West retention pond

Marissal Road attenuation pond

Bristol Airport Car Park permeable paving

Foreword

Through the West of England partnership the Local Authorities of Bath and North East Somerset, Bristol City, North Somerset and South Gloucestershire work together and coordinate high level planning to improve the quality of life of their communities and provide environmental benefits for a growing population.

A sustainable approach to drainage mitigates the impact of new development on flood risk and builds our resilience to flooding. It also provides opportunities to remove pollutants from urban run-off at source, and combines water management with green space with benefits for amenity, recreation and wildlife.

This guide is supported by the Environment Agency, the Lower Severn Internal Drainage Board (IDB), Somerset County Council, North Somerset IDB and Wessex Water who have all been involved in its preparation. Technical assistance has been provided by Ove Arup and Partners Ltd and design by Bristol City Council.

This guide signposts to existing policy and guidance to support the delivery of a sustainable approach to the drainage of new development in our sub-region.

From 6 April 2015 local planning policy and decisions on Major Developments (10 dwellings or more; or equivalent non-residential or mixed development) are expected to ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate.

The current requirement in national policy that all new developments in areas at risk of flooding should give priority to the use of sustainable drainage systems will continue to apply.

Sustainable Drainage

- mitigates the impact of new development on flood risk
- provides opportunities to remove pollutants
- opportunities to combine water management with green space with benefits for amenity, recreation and wildlife.

This document has been endorsed by each Local Authority in February 2015 and ratified by the West of England Planning, Housing and Communities Board on behalf of the West of England Partnership on 20 March 2015.

This is a living document and will be kept under regular review. User feedback is welcomed through: **development.drainage@bristol.gov.uk**

Contents

Other documents:

West of England SuDS Case Studies

Objective

Guide purpose and structure

This guide is primarily intended for use by developers, planners, designers and consultants who are seeking guidance on the requirements for the design and approval of sustainable drainage systems (SuDS) in this sub-region of the West of England and Somerset.
It provides information on the planning, design and delivery of attractive, high quality and well-integrated SuDS schemes which should offer multiple benefits to the environment and community alike. Our aim is to show that meeting these requirements is not an onerous task and can greatly help add to the appeal of your development.

This guide aims to support developers in their understanding of how the current development management process supports the delivery of SuDS.

This guide is structured around the non-statutory Technical Standards for Sustainable Drainage Systems in conjunction with the National Planning Policy Framework and Planning Practice Guidance.

We have created a guide to answer some of the fundamental questions about sustainable drainage for our area, these questions are:

What	is sustainable drainage?
Why	should you use sustainable drainage?
How	do you do sustainable drainage?
When	do you need to do something?

Section 1 provides an overview for the sub-regional approach with an introduction to SuDS, an explanation of the application processes, and, technical assistance signposting to design guidance and practical help with applications.

Section 2 sets out the character of each authority, the authority-specific technical and procedural requirements, and key contacts for each of the four unitary authorities in the West of England sub-region listed below:

- Bath and North East Somerset Council *[To follow]*
- Bristol City Council
- North Somerset Council
- South Gloucestershire Council *[To follow]*
- Somerset County Council and its six Local Planning Authorities *[To follow]*

1. What is sustainable drainage?

A sustainable approach to drainage is to manage the surface water runoff from rainfall near to where it lands, at source, and to consider carefully where excess runoff is discharged by following a hierarchical approach.

A sustainable drainage system (SuDS) is designed to reduce the potential impact of development with respect to surface water drainage discharge. SuDS regards rainwater as a natural resource to control whereas traditional piped surface water sewerage systems regard rainwater as wastewater to convey.

Conventional drainage systems concentrate runoff, causing pollution and/or flooding if their limited capacity is exceeded during storm events. SuDS deliver effective long-term surface water site drainage and can have significant secondary benefits by minimising a development's impact on the receiving environment and where possible deliver additional amenity, environmental and biodiversity benefits.

SuDS philosophy and concepts are not new and over the last twenty years there have been numerous publications on the design and use of SuDS. One document in particular, The SuDS Manual: C697 (CIRIA, 2007), captures current thinking. It is not our intention that this guide provides a general introduction to SuDS and focuses primarily on the sub-regional approach to SuDS and the specific requirements of the contributing authorities.


Stroud Co-housing rills


Bristol Business Park swales


Terrace Theatre, Bristol Zoo Gardens green roof

1 www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

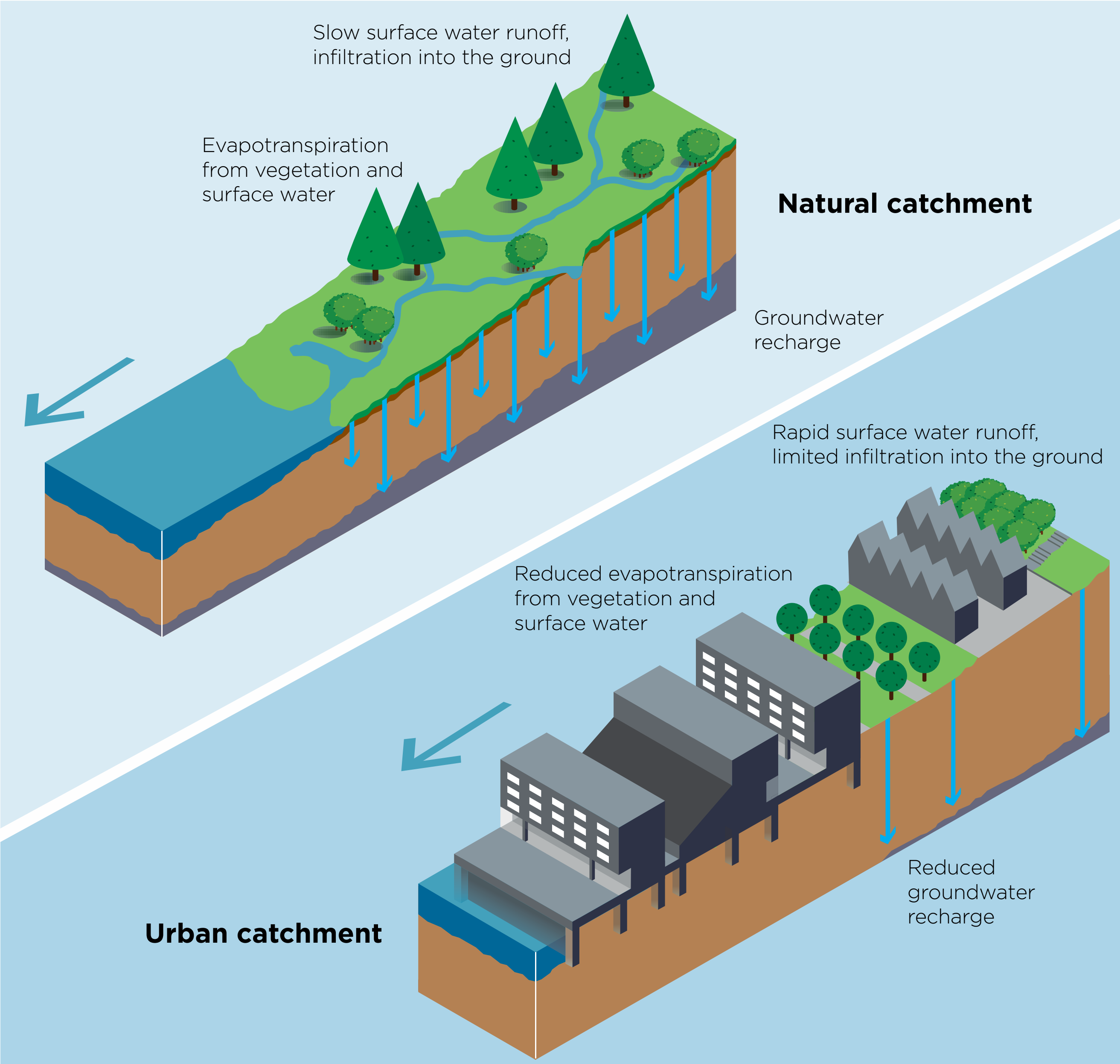


Figure 1: Effects of urbanisation on the water cycle (after CIRIA C687, 2010[2])

1.1 Surface water and urbanisation issues

When rain falls on a natural catchment it may evaporate or infiltrate into the soil, nourishing our natural habitat by replenishing groundwater or flowing overland into ponds and watercourses..

In urbanised areas where many surfaces are covered by buildings and paving, natural infiltration is limited. Instead, conventional drainage networks consisting of pipes and culverts concentrate the direct discharge to specific parts of the local watercourse.

Pipe and culvert networks often increase both the velocity and volume of surface water runoff and can cause flooding downstream. These networks can also cause deterioration in river water quality caused by diffuse pollution[3]. Additionally when combined sewers (which collect surface water runoff and foul waste water) are overwhelmed by surface water they must release polluted water into rivers. The likely impact of climate change of more intense rainfall will only exacerbate this situation further.

2 www.ciria.org/Resources/Free_publications/Planning_for_SuDS_ma.aspx

3 Diffuse pollution is the release of potential pollutants that have no specific point of discharge. Individually they may have no measureable effect on the water environment but at a catchment scale they have a significant impact.

1.2 The SuDS Management Train

SuDS are the preferred method for managing surface water run-off from a development area. In order to reduce development impact on the natural drainage of a site a series of drainage techniques (the "management train") are employed to reduce discharge flow rates and volumes, minimise pollution and so reduce the impact of the quantity of water emitting from a development. These techniques need to be applied progressively from prevention, source control, site control through to catchment control, see Figure 2.

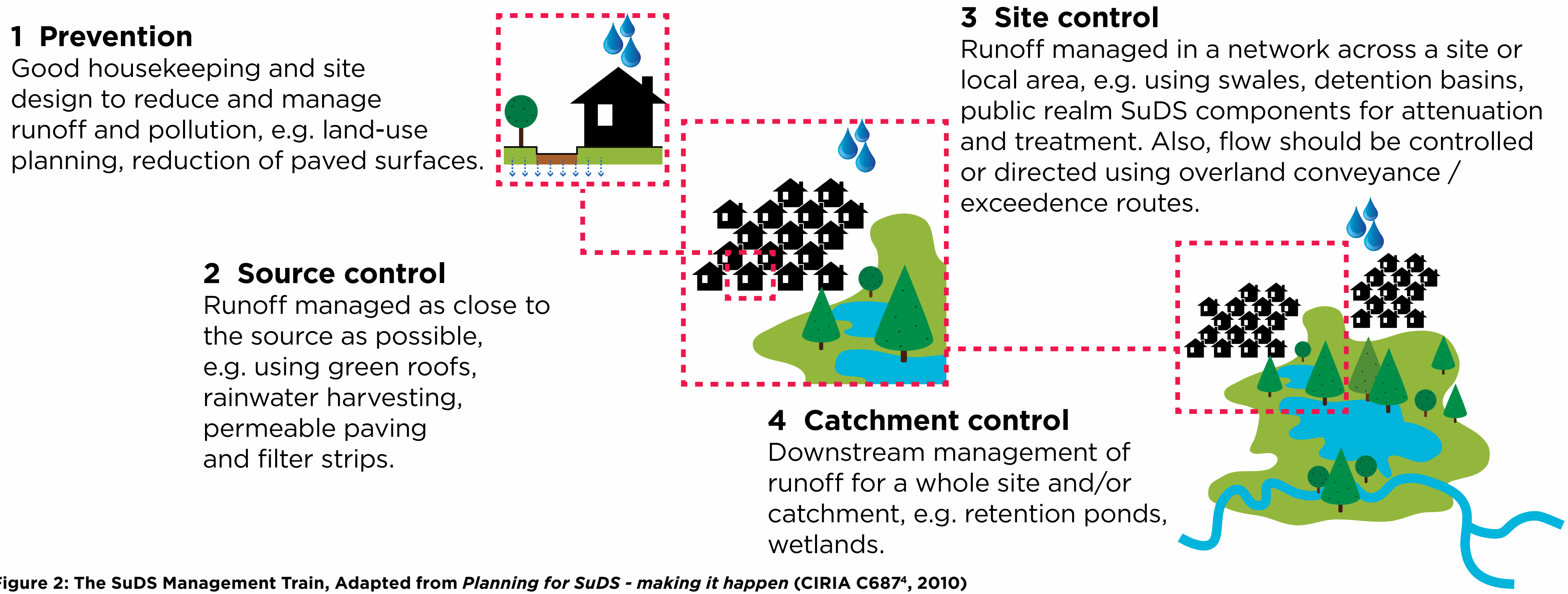


Figure 2: The SuDS Management Train, Adapted from *Planning for SuDS - making it happen* (CIRIA C687[4], 2010)

1.3 Blue (green) Corridors

We advocate the use of blue corridors (overland extreme flow pathways determined from the site topography). They serve as an integral element of the drainage infrastructure by providing flood conveyance during rare (low probability) storm occurrences.

Blue corridors form part of the 'making space for water' approach where urban development accommodates overland flow paths to minimise urban flood risk whilst often enhancing biodiversity and improving access to recreation etc.

Please see page 46 and footnote 5 for further information.

4 www.ciria.org/Resources/Free_publications/Planning_for_SuDS_ma.aspx
5 randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16218

2. Why should you use sustainable drainage?

SuDS manage the potential increased surface water flood risk that new development could cause as well as delivering amenity and environmental benefits.

National and Local policy requires a sustainable approach to drainage, primarily to ensure development does not cause an increased risk of flooding.

The evidence is that in most cases well designed and constructed SuDS reduce costs whilst adding to a development's appeal.

This sub-regional guidance aims to convey how SuDS features can be incorporated into new Greenfield developments and also previously developed sites moving the management of surface water from being considered as an obstacle to development towards being a positive driver to deliver multiple benefits to the developer, residents, the wider community and the environment.

Well-designed SuDS features provide effective surface water drainage and enhance the built environment and the public realm spaces. They can be easily incorporatedinto community open space where they can improve the character and amenity value of the landscape.

SuDS can bring environmental benefits including an improvement in water quality and the creation of habitats to enhance biodiversity.

2.1 Benefits of sustainable drainage

SuDS mitigate many of the adverse effects that storm water run-off has on the environment. However well-designed SuDS provide many additional benefits beyond mitigating local flood risk for the development and wider community which they will serve.

When considered at an early stage, evidence shows that the cost of constructing and maintaining SuDS can work out cheaper than conventional drainage methods[6]. The cost of providing run-off attenuation storage by above-ground SuDS is considerably cheaper than hard-engineering sewers and underground storage when integrated into the urban realm or community open space. Indeed our sub-regional climate makes drainage designs likely to result in larger surface water runoff storage requirements than on average elsewhere in the country and this favours the use of SuDS[7].

When integrated into the urban design and water management is kept above ground where possible, SuDS can create valuable amenity spaces, benefit wildlife, and increase property value. Studies have also found SuDS that integrate greenery or water feature improve the amenity and visual character of a development and this can enhance property values[8].

The benefits of using SuDS are summarised in the table overleaf.

6 www.susdrain.org/delivering-suds/using-suds/the-costs-and-benefits-of-suds/comparison-of-costs-and-benefits.html
7 randd.defra.gov.uk/Document.aspx?Document=11852_FinalIssueSWDReport_November2013.pdf
8 www.sciencedirect.com/science/article/pii/S0301479705001180

What are the benefits of using SuDS?

Managing flood risk

- less surface water entering sewers (freeing capacity and reducing flood risk)
- flow control and dealing with surface water at a catchment level helps manage flood risk
- allows adaption to a changing climate
- making space for SuDS allows overland flow routing and management of flooding from extreme events (drainage exceedance).

Managing water quality

- water quality will be managed to reduce the amount of pollution in runoff
- assists with compliance with the Water Framework Directive.

Amenity and biodiversity

- the use of SuDS can contribute to the quality of the place
- provides opportunities for multifunctional areas
- provides wildlife habitat and ecological benefit.

Water resources

- the use of SuDS can contribute to the quality of the place
- some components can recharge underground aquifers
- harvested rainwater can be used for toilet flushing, garden irrigation etc.

Community and recreation

- SuDS can improve local quality of life
- promotes attractive surroundings to socialise and undertake recreation.

Education

- enables children to improve their understanding of the water and natural environment
- provides attractive environments for education.

Developers

- reduced construction costs
- reduced overall maintenance costs compared to many conventional drainage methods when carried out with landscape maintenance
- increased property values.

2.2 National Legislation and Local Policy

National Flood and Coastal Erosion Risk Management Strategy for England[9]

The National Strategy produced by the Environment Agency in 2011 identified SuDS as being of significant importance in mitigating the potential impacts of flood risk and in helping to provide multiple benefits within catchments.

The National Strategy specifically recommends

Using SuDS in new developments and redevelopments to manage surface water flood risk.

And

Use of public space and the multifunctional use of open space could be considered as part of preparing local flood risk management strategies to reduce the potential land take from SuDS for new developments.

Local Flood Risk Strategy

Each LLFA produces a Local Flood Risk Management Strategy in line with the National Strategy and cover local requirements. SuDS play a significant role in achieving many of the objectives within these local strategies.

9 www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england

Water Framework Directive

The Water Framework Directive requires member states to make plans to protect and improve the water environment. It applies to all surface freshwater bodies, including lakes, streams, rivers and canals; transitional bodies such as estuaries; groundwater; and coastal waters. There are four main aims of the WFD:

- improve and protect inland and coastal waters
- promote the sustainable use of water as a natural resource
- create better habitats for wildlife that live in and around water
- create a better quality of life for everyone

A significant problem is diffuse pollution. SuDS can reduce this and therefore help meet WFD requirements.

National Planning Policy Framework

The National Planning Policy Framework (NPPF) has "presumption in favour of sustainable development."

When determining planning applications, Local Planning Authorities (LPAs) should ensure flood risk is not increased elsewhere and consider carefully the appropriateness of development in areas at risk of flooding.

In December 2014, the Government announced[10] that from 6th April 2015 they will strengthen existing planning policy by also making SuDS a material consideration in planning for Major development.

> "We expect local planning policies and decisions on planning applications relating to major development - developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010) - to ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate"[11].
>
> "The current requirement in national policy that all new developments in areas at risk of flooding should give priority to the use of sustainable drainage systems will continue to apply."

The SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

LPAs will:

- consult relevant LLFA on the management of surface water;
- satisfy themselves that the proposed minimum standards of operation are appropriate
- ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.[12]

The sustainable drainage system should be designed to ensure that the maintenance and operation requirements are economically proportionate.

Flood and Water Management Act[13]

The Flood and Water Management Act (F&WMA) imposes duties on upper tier Councils as the Lead Local Flood Authority (LLFA) including coordinating the flood risk management within its area including smaller 'ordinary' watercourses, surface and ground water. LLFAs provide evidence and consultation comment to LPAs as required.

Some parts of the F&WMA await enabling secondary legislation. Of particular relevance is Schedule 3. **If implemented**, this would introduce the role of the SuDS Approving Body (SAB). The SAB would be responsible for ensuring that all drainage systems for new developments are designed and constructed to agreed National Standards for SuDS. Applications that do

10 www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2014-12-18/HCWS161/

11 http://planningguidance.planningportal.gov.uk/blog/policy/achieving-sustainable-development/delivering-sustainable-development/10-meeting-the-challenge-of-climate-change-flooding-and-coastal-change/#paragraph_103

12 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/the-exception-test/what-is-considered-to-be-the-lifetime-of-development-in-terms-of-flood-risk-and-coastal-change/

13 www.legislation.gov.uk/ukpga/2010/29/contents

not meet the Standards would be refused permission to build and, if necessary, to connect to the public sewer system. The F&WMA also would provide for approved SuDS serving more than one property, constructed in accordance with that approval and not part of an adopted highway, to be adopted by the SAB and thereafter maintained.

Local Policies

The West of England Unitary Authorities and Somerset County Council have policies which encourage flood risk management with multiple benefits. We encourage designs that integrate multiple benefits into the green infrastructure.

SuDS can satisfy key local policies such as: protect and enhance existing open space. Some LPAs are developing or intend to develop Supplementary Planning Guidance or Planning Advice Notes to support this guidance.

Biodiversity

Local authorities have a Duty to have regard to the conservation of biodiversity in exercising their functions. This Duty was introduced by the Natural Environment and Rural Communities Act and came into force on 1 October 2006. The Duty affects all public authorities and aims to raise the profile and visibility of biodiversity, to clarify existing commitments with regard to biodiversity, and to make it a natural and integral part of policy and decision making. (Extract from Defra Guidance for Local Authorities on Implementing the Biodiversity Duty)[14]

14 www.gov.uk/government/publications/guidance-for-local-authorities-on-implementing-the-biodiversity-duty

3. How do you ‘do’ sustainable drainage?

Surface water drainage should be considered at the start of the design process to ensure drainage systems are effectively delivered.

Features should not be shoehorned into a predetermined layout but should be integral to the master-planning design of the development from the outset.This approach should be applied to all sizes of development site.

A ‘proof of concept’ for surface water drainage design at an early pre-planning application stage is recommended to pre-empt or reduce the chance of issues that could later arise and conflict with the ability of development proposals to incorporate SuDS. Development proposals progressed without undertaking this early consultation stage risk the possibility that the proposed layout would not be capable of being drained in a sustainable way to meet national and local policy.

3.1 Approach to Drainage - Planning

As the Pitt Report (2008) noted, care needs to be taken when considering using SuDS as not all SuDS are suitable in all areas and may affect drainage in other localities.

Some development sites may have challenges to delivering SuDS. Sites with low permeability or contaminated soils can be challenging but some SuDS measures are suitable. Be aware that if the site is covered wholly or partially by a ground water protection zone, this may require special consideration and some SuDS elements may be restricted. SuDS techniques can also be adapted to deal with lack of space and poor soil infiltration. Poor soil infiltration can be perceived as an obstacle to SuDS implementation. However, some SuDS techniques do not require infiltration and can be designed accordingly, while still providing effective water treatment and attenuation.

Sustainable drainage design manages surface water run-off at source and reduces conveyance as much as it can. To do this water flow across the site needs to be managed. To allow this to happen, drainage needs to be considered before the building footprints have been finalised. This will allow the buildings and the SuDS to fit together and in many cases complement each other.

Many SuDS components are at ground level, so instead of the drainage ‘serving’ the site, the site is the drainage system.

To allow the early interaction to take place, developers are encouraged to engage with the relevant Flood Risk Management Authorities[15] (FRMAs) and LPA at an early pre-application prior to site layout being finalised as necessary.

3.2 Outline Design including Proof of Concept

We encourage developers to prepare a proof of concept for dealing with the surface water drainage for all major developments as part of a pre-application. A proof of concept approach may also be taken for minor developments as this could assist in producing an acceptable planning application. The proof of concept is to be based on a constraints plan that includes the existing natural flow paths and the proposed Blue Corridors across the site together with any discharge restrictions, maintenance restrictions or access issues that the relevant FRMAs and LPA may require. The diagram overleaf shows the proposed design approach sequence, demonstrating how the outline design of SuDS should be undertaken.

It is recommended that the proof of concept described above is created before considering the development layout, to ensure that the proposed development maximises the development opportunity without having potential adverse effects to the area.

15 Risk management authority such as the Environment Agency, LLFA, IDB, Water Company and local highway authority.

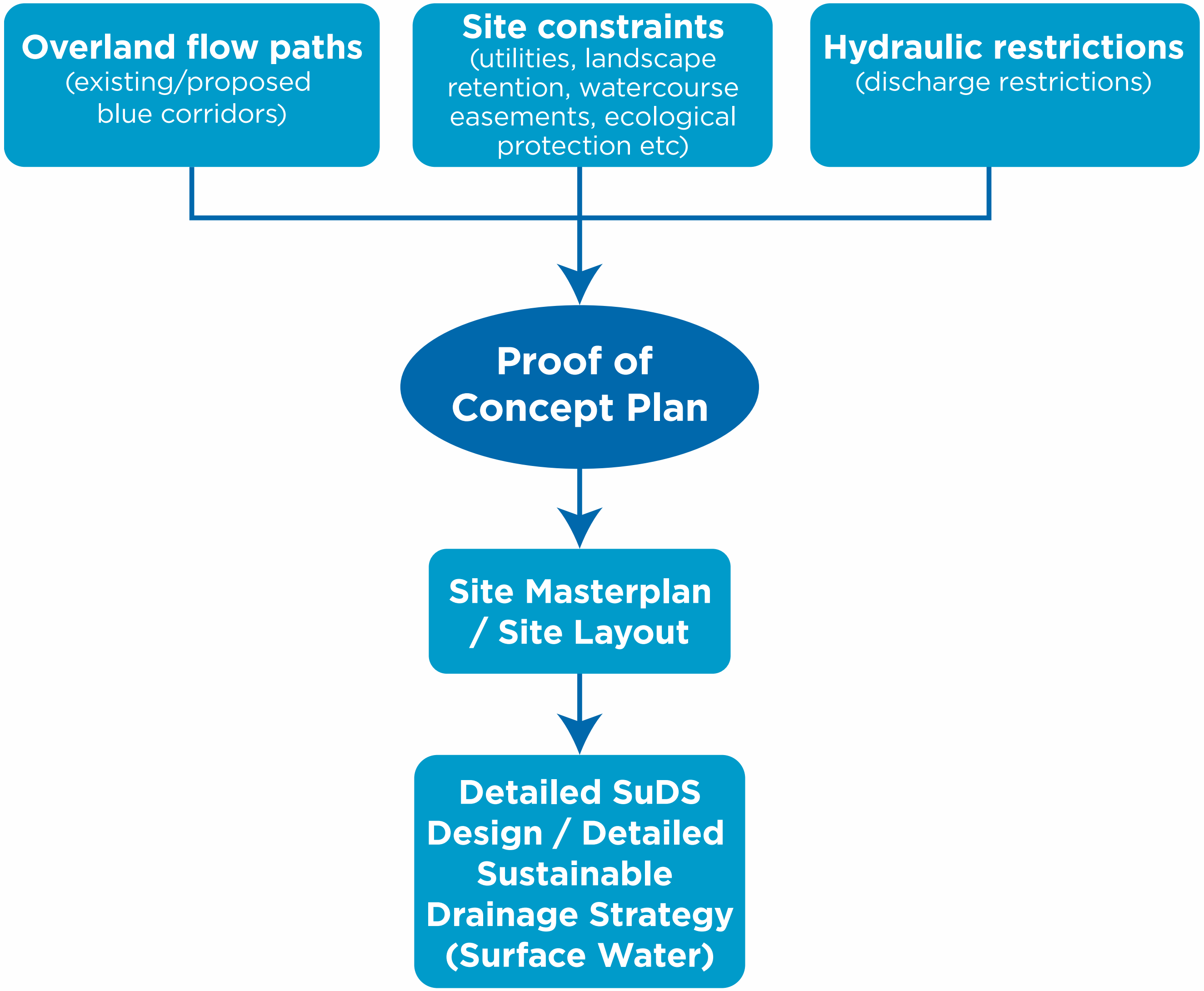


Figure 3: Initial drainage design sequence including proof of concept

The pre-application 'proof of concept' stage should involve the preparation of:

- A location plan identifying existing natural flow paths (blue corridors)
- A site constraints plan identifying potential physical restrictions within the site such as areas of contaminated ground, access issues due to legal easements or existing utility locations.
- An indication of the hydraulic discharge restrictions that will apply to the site that will impact on the sustainable drainage strategy (surface water) for the site. This may include agreed discharge restrictions, infiltration potential and potential maintenance issues. Also, will require an estimate of the surface water attenuation volume.

Once a proof concept has been agreed in principle, it can be used to inform the site masterplan, and once the master plan has been agreed, the detailed SuDS design can commence.

Overland flow paths (blue corridors)

All sites have existing natural flow paths and land drainage features across them, these flow paths are known as the 'blue corridors' within the site. Unless the site topography is radically altered, these blue corridors will continue to be the preferred flow routes for water even when the development has been completed.

Development drainage design will convey flow up to an agreed level, but when a storm event happens that is significantly greater than this agreed level, water will flow overland and the blue corridors will be the routes that this flow will follow.

Constraints plan

The constraints plan identifies areas within the site that will need special consideration. Issues such as 'protected areas' for significant existing infrastructure, existing easements that can impact on maintenance regimes or impose restricted access issues should be included as they can have a significant impact on the drainage feasibility for the development as well as identifying potential issues with the development of the site layout.

Hydraulic discharge restrictions

The third element of the proof of concept is the identification of site restrictions due to the water based impact that the site will have with the 'local' water environment issues such as flood risk zones, contamination potential, surface water discharge restrictions, site permeability and ground water protection zones should be identified and incorporated into the proof of concept.

Some key considerations

There are many potential issues that may have an impact on the proposed development and that need to be considered in compiling the information required and some of the more common considerations are given below:

Site characteristics

- Site layout and optimal use of land - get it right early
- Ground conditions and contamination
- Topography
- Existing land drainage features
- Assessment of existing drainage infrastructure
- Are there are any regulatory requirements
- Environmental Impact
- SSSI (Site of Special Scientific Interest) or SAC (Special Area of Conservation)
- Existing services within the site
- Existing habitats and species

Flood risk

- The volume of attenuation required
- Ground water table
- Overland flood routes
- Effects of all flood risk sources including existing local sources, risk of tidelocking and submerged discharges

Previously developed brownfield sites

- Aim to reduce the discharge to as close to the greenfield rate as possible.
- Seek improvement on pre-development rate
- Peak rate of runoff reduced by 30% of value of pre-development rate
- Discharged volume minimised

Site layout: consider natural flow paths and site dwelling or other vulnerable receptors outside of these corridors. Where possible use community open space within the development to incorporate SuDS to maximise use of land. Limit impermeable surfaces and consider the use of source control measures such as green roofs and permeable paving.

Ground conditions: determine soil type, infiltration potential and depth to groundwater considering seasonal variations. Some ground conditions will mean infiltration is inappropriate, but other SuDS techniques can still be employed even on stiff clay. Previously developed sites may contain contaminated material which could limit the use of some types of SuDS. Consult the local authority and examine historical land uses for an early indication of the likelihood of contamination.

Topography: work with natural site contours and ensure adequate space is allowed for attenuation features such as ponds and basins, including access route provision for maintenance plant and machinery. Steep sites present special difficulties such as high velocities; use the SuDS manual for guidance.

Discharge restrictions: the proof of concept will allow the developer to gain a clear indication of any discharge rate/volume restrictions (discussion needed with LPA, LLFA, EA, IDB and/or Wessex Water as appropriate) and potential issues at an early stage. This will avoid costly design alterations.

The SuDS Manual[16] provides extensive further information on working with the constraints of your site. Susdrain[17] gives good examples and case studies of successful SuDS schemes.

Benefit of a proof of concept

The proof of concept allows the developer to gain a clearer indication of any potential issues that may create significant concerns at an early stage. The proof of concept can help developers to avoid issues that may be very costly to deal with if they are not highlighted until a much later stage in the design process.

The information that is required for drainage approval is detailed design and is often dealt with as a pre-commencement planning condition. However development proposals progressed without early consideration of drainage design risk the possibility that the proposed layout would not be capable of being drained in a sustainable way to meet national and local policy. If the developer chooses to not establish a proof of concept then they will need to accept that they are proceeding at their own risk.

We encourage developers to establish a 'proof of concept' that is acceptable 'in principle' to the RMAs and the LPA. This allows all the requirements of both the drainage and other requirements to be highlighted at an early stage in the design process, which should help avoid abortive design. Having a proof of concept in place will also go some way towards fulfilling the requirements for a flood risk assessment[18] as part of the planning process.

Agree information required for next stage

Having got the proof of concept agreed in principle, it is still important that the remaining steps for the approval procedure and information requirements are discussed and agreed by the developer and the LPA.

Create site masterplan

The proof of concept plan can be used to inform the site masterplan, as it will confirm the developable area within the site.

Once the developable area has been identified, the developer can consider notional layouts that work with the land. Concepts that may help with this are:

If surface water needs to be attenuated on site, aim to incorporate this storage across the slope to minimise excavation costs and try to not convey water directly down steep slopes (in this instance anything steeper than 1 in 200 qualifies as steep). On steep sites, try to meander the flow (within the blue corridors).

Identify potential multi-functional spaces, as SuDS can be incorporated in areas of public realm and can potentially enhance the value of the development by providing amenity/biodiversity and enhanced ecology.

It can be useful to vary property densities on residential developments and the use of clustering can be of great help to create space for SuDS, amenity and biodiversity.

Before proceeding any further with your proposals discuss these provisional

16 www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

17 www.susdrain.org

18 You can find out more about flood risk assessment for planning applications on www.gov.uk/planning-applications-assessing-flood-risk

layouts, proposed maintenance and ownership with the relevant RMAs and LPA.

3.3 SuDS Design Process

Once a proof concept has been agreed and informed the site master plan, the information for the next stage can be agreed and the detailed design process can commence. The following sections provide guidance on the SuDS design process.

It is not the intention of this document to provide detailed design guidance aimed at drainage engineers. However to assist designers with the SuDS design process, we have included a generic overview of the potential design process.

It should be noted that some of the steps in the process chart on the previous page would not be required for smaller sites, but it may still be useful to consider them at a simplified level.

On larger sites it may require steps 1 to 5 to be undertaken to complete a proof of concept.

There are numerous design guides available such as the CIRIA SuDS Manual[19] that can be used to inform detailed design.

The general drainage design process that we expect as a minimum is application

Figure 4: Generic SuDS design process

19 www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

of the SuDS management train, the discharge hierarchy and the proposed National Standards for sustainable drainage systems given below.

SuDS Management Train

This management train approach aims to retain as much rainwater as possible as close to where it falls, as is feasible, which is generally called Source Control. Once this area has taken as much rainwater as it can, any extra water is allowed to spill downstream into areas that can take this flow. This next element of the system is generally called Site Control and this should only operate when there is more rainfall than the Source Control can cope with by itself. We are all aware that on some occasions we can get very heavy storms and on these occasions there may be more rainwater than the Source control and the Site Control can handle. During these events the rainwater will spill from the Site Control into the downstream areas. These downstream areas will be designed to provide Catchment Control to help manage these bigger storms.

This string of cascading controls is what we mean when we refer to the management train.

On rare occasions we can get extreme storm events that the designed system will not be able to handle, which are sometimes known as 'exceedance' events. It is accepted that you cannot design drainage systems that can deal with these 'extreme' events, but you should 'steer' this water away from properties to provide a better level of protection to people during flood events or the failure or blockage of drainage structures.

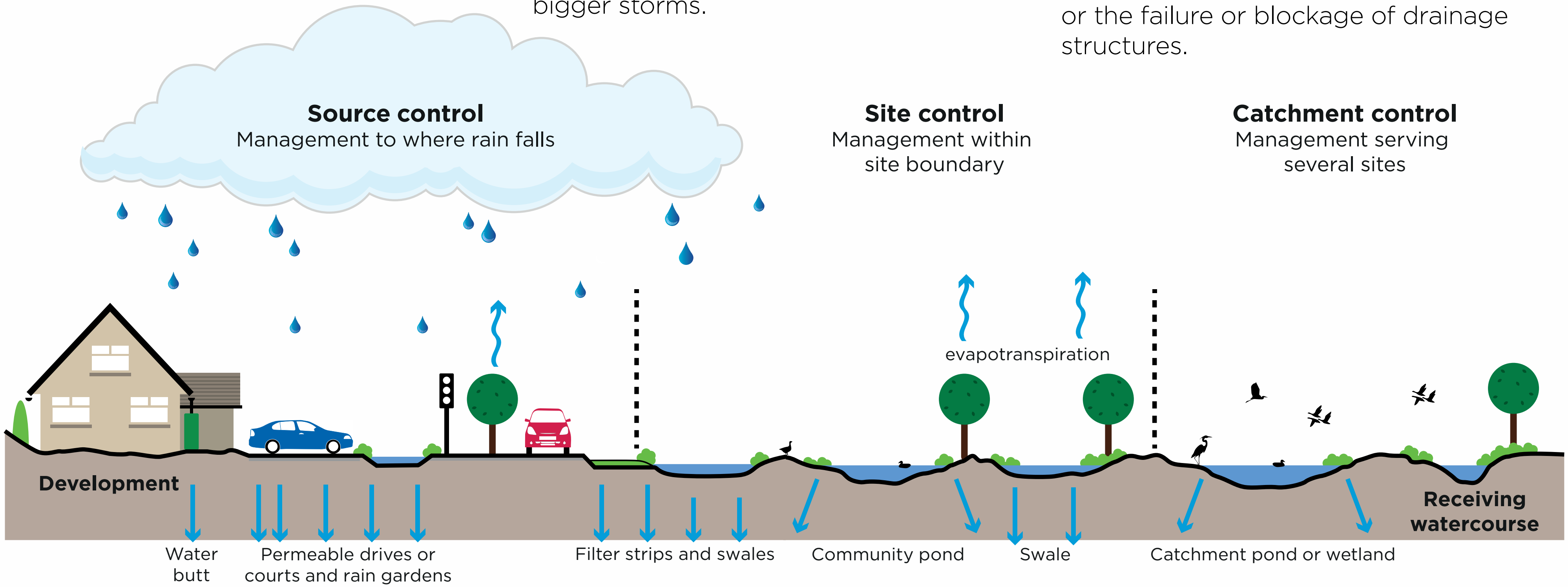


Figure 5: SuDS Management Train (after Sustainable drainage system adoption manual, Anglian Water)[20]

20 www.anglianwater.co.uk/developers/suds.aspx

The Discharge Hierarchy

The destination of runoff that cannot be used, prevented or dealt with at source must always consider the discharge hierarchy. By this we mean that runoff must be discharged in order of priority:

- Into the ground by infiltration
- Into a surface water body such as a river, ditch, pond or stream
- Into a surface water sewer
- Into a combined sewer

Initial source control techniques, such as green roofs, rainwater harvesting, water butts, soakaways, and water gardens will generally be the responsibility of the building owner, however these can often be a key element in SuDS and their inclusion is strongly encouraged.

It is important to note that, even if the whole site cannot be drained by infiltration, this does not exclude the use of partial infiltration, with the remainder of runoff discharged to a destination further down the hierarchy. Surface water drainage with infiltration SuDS techniques and a connection to the public sewer can avoid the risk of groundwater flows entering the sewer through the infiltration system being connected by only an overflow rather than a direct connection.

3.4 SuDS design guides and standards

There is now a wide range of guidance on SuDS. This document focuses on the particular requirements in this sub-region. The principal UK standards and guides are:

non-statutory Technical Standards for Sustainable Drainage

The technical standards provided by government relate to the design, construction, operation and maintenance of sustainable drainage systems and have been published as guidance for those designing schemes.

They should be used in conjunction with the National Planning Policy Framework and Planning Practice Guidance, which includes a hierarchy of drainage options. Generally, the aim should be to discharge surface run off as high up the hierarchy of drainage options as reasonably practicable with infiltration to the ground the most preferred and connection to a combined sewer the least preferred.

The CIRIA SuDS Manual: C697 (2007)

The SuDS Manual[21] – currently being updated (RP992) - provides comprehensive guidance for SuDS design from the introduction to design criteria, through to the detailed hydraulic design methods. The Manual (ibid) then sets out the process by which appropriate SuDS options may be selected for a site, with following sections discussing in great detail these options, their construction, operation and maintenance to facilitate their effective implementation with developments.

In addition, an excellent collection of guidance and information on related issues is provided on the community website **www.susdrain.org** created by CIRIA.

Further details of the character and any local technical and procedural requirements for each authority is provided in Section 2.

21 www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

Sub-regional Requirements for Sustainable Drainage Systems

Each authority in the sub-region has reviewed the appropriateness of the non-statutory technical standards for sustainable drainage systems[22] in conjunction with the National Planning Policy Framework and Planning Practice Guidance. against their individual Local Plans / Core Strategies, Local Flood Risk Management Strategies and supporting evidence bases. A number of common sub-regional requirements for sustainable drainage systems have been identified as necessary. Any authority with an individual variation from the sub-regional requirement is highlighted and aspect covered in their individual Section 2.

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
1. Design **Runoff destinations**			
	Generally, the aim should be to discharge surface[23] 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	As stated. Infiltration testing to be undertaken in accordance with BRE Digest 365. Normally only flows arising from adoptable highway drainage will be allowed to discharge to existing Highway Drains and the developer must demonstrate there is adequate capacity in the system down to its outfall. Local situations where particular sustainable drainage systems are anticipated as not being appropriate as described in the relevant Section 2.	None
Flood risk outside the development			
	When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere[24]	As stated but where necessary and reasonably practicable opportunities will be sought to reduce flood risk outside the development boundary.	None

22 www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

23 planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/#paragraph_080

24 planningguidance.planningportal.gov.uk/blog/policy/achieving-sustainable-development/delivering-sustainable-development/10-meeting-the-challenge-of-climate-change-flooding-and-coastal-change/#paragraph_103

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
S1	Where the drainage 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 or a large estuary) the peak flow control standards (S2 and S3 below) and volume control technical standards (S4 and S6 below) need not apply.	This will not be applicable to most of the surface water bodies in the sub-region (Check with relevant Section 2).	None
Peak flow control			
S2	For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must not exceed the peak greenfield runoff rate for the same event.	As stated. The Greenfield runoff rates are to be calculated using the Interim Code of Practice for Sustainable Drainage Systems method[25].	South Gloucestershire, Somerset
S3	For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but must not exceed the rate of discharge from the development prior to redevelopment for that event.	As stated, the aim should be to reduce the discharge to as close to the greenfield rate as possible. Where this is not possible an allowable discharge is to be agreed with the LPA based on a reasonable reduction from the existing positive connection to the surface water drainage system. A minimum of 30% reduction in flow rate off site will be expected. Consideration is to be given to any existing flow controls or throttles (including pipe capacity) which may have limited the existing Brownfield discharge rate. The maximum allowable discharge will take such restrictions into account.	None

25 www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
Volume control			
S4	Where reasonably practicable, for greenfield developments, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must not exceed the greenfield runoff volume for the same event.	As stated.	Somerset
S5	Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but must not exceed the runoff volume for the development site prior to redevelopment for that event.	As stated.	None
S6	Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.	If S4 or S5 are not met then the allowable discharge rate **for the excess volume** for all events will be QBAR or 2 l/s/ha whichever is the greater. An increase to 5l/s/ha will be accepted where it can be demonstrated that there is capacity in the receiving system to take the discharge without adversely affecting flood risk. Long term storage will be required to meet this standard.	North Somerset

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
Flood risk within the development			
S7	The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the development for a 1 in 30 year rainfall event.	As stated, in addition to the National Standard, a freeboard of 300mm to cover level / top of bank at the design storm (1in30, 1in100 etc rainfall event) for all conveyance / attenuation features is required.	Bristol City, North Somerset
S8	The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.	As stated, in addition to the National Standard, adoptable Highways should not to be used to convey exceedence flows from new development unless the highway is a designated flood route that has been agreed with the Highway Authority.	North Somerset
S9	The design of the drainage system must ensure that so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.	As stated.	None

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
Water Quality			
	The drainage system must 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. The planning system should contribute to and enhance the natural and local environment by...minimising impacts on biodiversity and providing net gains in biodiversity where possible...preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability[26]. See also **planningguidance.planningportal.gov.uk/blog/guidance/water-supply-wastewater-and-water-quality/water-supply-wastewater-and-water-quality-considera-tions-for-planning-applications**	The drainage system must 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.. When 2 or more treatment stages are required, each treatment must be a different type. If the development interacts with a sensitive water body or is in a source protection zone a water quality risk assessment will be required to quantify the potential risk. Where such an assessment is required, the LPA may be prepared to accept an 80/40/40% removal of suspended solids, hydrocarbons and phosphorous in line with CIRIA C609. You will need to discuss with the relevant LPA if this approach is acceptable. The water quality risk assessment could form part of a wider WFD compliance assessment if required at the planning stage	None

26 planningguidance.planningportal.gov.uk/blog/policy/achieving-sustainable-development/delivering-sustain-able-development/11-conserving-and-enhancing-the-natural-environment/#paragraph_109

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
Water Quality			
S10	Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.	As stated.	None
S11	The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.	As stated.	None
Designing for maintenance considerations			
	When planning a sustainable drainage system, developers need to ensure their design takes 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… Whether maintenance and operation requirements are economically proportionate should be considered by reference to the costs that would be incurred by consumers for the use of an effective drainage system connecting directly to a public sewer.[27]	As stated. Operation and maintenance plan must be agreed with the LPA.	None
S12	Pumping must only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.	As stated.	None

27 planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/#paragraph_085

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
	Any sustainable drainage system should be designed so that the capacity takes account of the likely impacts of climate change and likely changes in impermeable area within the development over its lifetime and continues to provide effective drainage for properties.[28]	As stated. Climate change allowance to be made in line with the September 2013 EA "Guidance to support the National Planning Policy Framework"[29] or latest version. Urban creep[30] should be assessed on a site by site basis but is limited to residential development only. The appropriate allowance for urban creep must be included in the design of the drainage system over the lifetime of the proposed development. The allowances set out below must be applied to the impermeable area within the property curtilage:	None

Residential development density Dwellings per hectare	Change allowance % of impermeable area
≤ 25	10
30	8
35	6
45	4
≥ 50	2
Flats & apartments	0

Note where the inclusion of the appropriate allowance would increase the total impermeable to greater than 100%, 100% should be used as the maximum.

28 planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/#paragraph_085

29 www.gov.uk/flood-risk-standing-advice-frsa-for-local-planning-authorities

30 "Urban Creep" This is the conversion of permeable surfaces to impermeable over time e.g. surfacing of front gardens to provide additional parking spaces, extensions to existing buildings, creation of large patio areas.

	Non-statutory technical standards for SuDs in conjunction with NPPF and PPG	West of England Partnership requirement	Authority with local variation
S13	The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.	As stated	None
	In considering a development that includes a sustainable drainage system the local planning authority will want to be satisfied that the proposed minimum standards of operation are appropriate and that there are clear arrangements in place for ongoing maintenance. Information sought by the local planning authority should be no more than necessary, having regard to the nature and scale of the development concerned.[31]	As stated	None
S14	Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.	As stated	None

31 planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/#paragraph_081

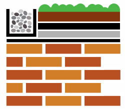
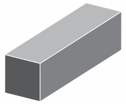
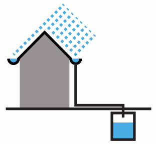
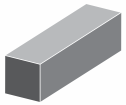
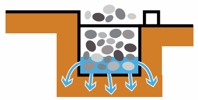
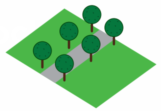
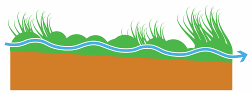
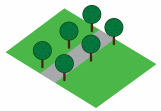
3.5 Selecting SuDS Techniques

SuDS building blocks

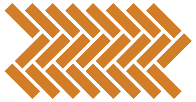
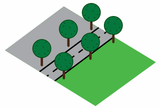
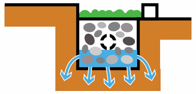
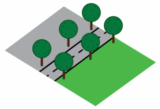
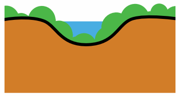
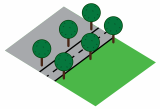
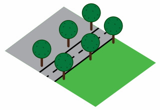
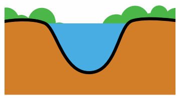
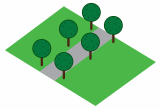
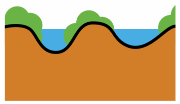
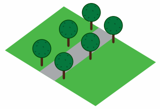
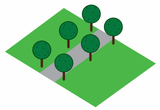
SuDS is not a single technique, it is building a portfolio of techniques across a single system. Potential elements of SuDS are shown below in the diagram taken from ‘Water. People. Places. A guide for master planning sustainable drainage into developments’[32].

These are simply the building blocks that can be put together in a variety of ways in order to capture and manage surface water within your site. The more techniques you use the more benefits they tend to bring but you should be able to make use of some of them on all sites.

Some of these approaches will be better than others for differing site conditions, but this building block or toolbox approach should be adopted if you want to get the best SuDS for your site.

	Description	Setting	Required area
 Green roofs	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	 Building	Bulding integrated
 Rainwater harvesting	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an overground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	 Building	Water storage (underground or above ground)
 Soakaway	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	 Open space	Dependent on runoff volumes, water table and soils
 Filter strip	Filter strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	 Open space	Minimum length 5m

32 Lead Local Flood Authorities of the South East of England. September 2013 www.medway.gov.uk/planningandbuilding/checkifyouneedpermission/managingfloodrisk/sustainabledrainage.aspx

	Description	Setting	Required area
 Permeable paving	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base beneath or allowed to infiltrate into ground below.	 Street/open space	Can typically drain double its area
 Bioretention area	A vegetated area with gravel and sand layers below designated to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	 Street/open space	Typically surface area is 5-10% of drained area with storage below
 Swale	Swales are shallow depressions designed to convoy and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	 Street/open space	Account for width to allow safe maintenance typically 2–3 metres wide
 Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	 Street/open space	Could be above or below ground and sized to storage need
 Pond / Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	 Open space	Dependent on runoff volumes and soils
 Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	 Open space	Typically 5–15% drainage area to provide good treatment
 Underground storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	 Open space	Dependent on runoff volumes and soils

Good SuDS design employs three or four techniques to reduce surface water runoff flow rate and volume whilst improving surface water runoff quality and amenity benefit. Figure 6 below shows a ranked matrix of SuDS techniques.

SuDS Group	Technique	Water quality treatment					Hydraulic control			
		Total suspended solids removal	Heavy metals removal	Nutrient removal	Bacteria removal	Disolved pollutants	Runoff Volume reduction	Flow rate control		
								1-2 yr	10-30yr	100yr
Retention	Retention pond	H	M	M	M	H	L	H	H	H
	Subsurface storage	L	L	L	L	L	L	H	H	H
Wetland	Shallow wetland	H	M	H	M	H	L	H	M	L
	Extended detention wetland	H	M	H	M	H	L	H	M	L
	Pond / wetland	H	M	H	M	H	L	H	M	L
	Pocket wetland	H	M	H	M	H	L	H	M	L
	Submerged gravel wetland	H	M	H	M	H	L	H	M	L
	Wetland channel	H	M	H	M	H	L	H	M	L
Infiltration	Infiltration trench	H	H	H	M	H	H	H	H	L
	Infiltration basin	H	H	H	M	H	H	H	H	H
	Soakaway	H	H	H	M	H	H	H	H	L
Filtration	Surface sand filter	H	H	H	M	H	L	H	H	L
	Sub-surface sand filter	H	H	H	M	H	L	H	H	L
	Perimeter sand filter	H	H	H	M	H	L	H	H	L
	Bioretention/filter strips	H	H	H	M	H	L	H	H	L
	Filter trench	H	H	H	M	H	L	H	H	L
Detention	Detention basin	M	M	L	L	L	L	H	H	H
Open channels	Conveyance swale	H	M	M	M	H	M	H	H	H
	Enhanced dry swale	H	H	H	M	H	M	H	H	H
	Enhanced wet swale	H	H	M	H	H	L	H	H	H
Source control	Green roof	NA	NA	NA	NA	H	H	H	H	L
	Rain water harvesting	M	L	L	L	NA	M	M	H	L
	Permeable pavement	H	H	H	H	H	H	H	H	L

Figure 6: Ranked matrix of SuDS techniques (based on Table 5.7 from CIRIA C697)[33]

33 www.ciria.org/Resources/Free_publications/the_suds_manual_PDF.aspx

The table below gives 3 rankings for SuDS techniques. The first is based both water quality and hydraulic control performance. The second is based on water quality performance alone and the third is based on on hydraulic control performance alone.

	Water quality and hydraulic control combined techniques	Technique (water quality)	Hydraulic control technique
Highest ranking	Infiltration basin	Permeable pavement	Infiltration basin
	Enhanced dry swale	Infiltration trench	Conveyance swale
	Permeable pavement	Infiltration basin	Enhanced dry swale
	Infiltration trench	Soakaway	Retention pond
	Soakaway	Surface sand filter	Subsurface storage
	Enhanced wet swale	Sub-surface sand filter	Infiltration trench
	Conveyance swale	Perimeter sand filter	Soakaway
	Retention pond	Bioretention/filter strips	Detention basin
	Surface sand filter	Filter trench	Enhanced wet swale
	Sub-surface sand filter	Enhanced dry swale	Green roof
	Perimeter sand filter	Enhanced wet swale	Permeable pavement
	Bioretention/filter strips	Shallow wetland	Surface sand filter
	Filter trench	Extended detention wetland	Sub-surface sand filter
	Shallow wetland	Pond/wetland	Perimeter sand filter
	Extended detention wetland	Pocket wetland	Bioretention/filter strips
	Pond/wetland	Submerged gravel wetland	Filter trench
	Pocket wetland	Wetland channel	Rain water harvesting
	Submerged gravel wetland	Retention pond	Shallow wetland
	Wetland channel	Conveyance swale	Extended detention wetland
	Detention basin	Detention basin	Pond/wetland
Lowest ranking or N/A	Subsurface storage	Subsurface storage	Pocket wetland
	Green roof	Rain water harvesting	Submerged gravel wetland
	Rain water harvesting	Green roof	Wetland channel

Figure 7: Ranking of SuDS techniques based on purpose

3.6 Maintenance of SuDS

Like all drainage systems, SuDS components need to be inspected and maintained to ensure efficient operation and prevent failures. DCLG's December 2014 Ministerial Statement stated the SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

SuDS components on the surface are easy to visually inspect and most can be managed using simple landscaping maintenance techniques. Inspection and maintenance requirements will vary depending on the type of SuDS component and scheme, the land use, types of plants as well as amenity/ biodiversity requirements.

Typical requirements are shown in the table and the SuDS Manual provides more information.

Activity	Indicative frequency	Typical tasks
Routine/ regular maintenance	Monthly (for normal care of SuDS)	• litter picking • grass cutting • inspection of inlets, outlets and control structures.
Occasional maintenance	Annually (dependent on the design)	• silt control around components • vegetation management around components • suction sweeping of permeable paving • silt removal from catchpits, soakways and cellular storage.
Remedial maintenance	As required (tasks to repair problems due to damage or vandalism)	• inlet/outlet repair • erosion repairs • reinstatement of edgings • reinstatement following pollution • removal of silt build up.

Figure 8: Typical inspection and maintenance requirements[34]

3.7 Adoption of SuDS

DCLG's December 2014 Ministerial Statement stated that LPAs must satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

The responsibilities for SuDS future maintenance and operation should be agreed during the detailed design stage and presented as a SuDS management and maintenance plan as part of the planning application submission. This should clearly identify who will be respoinsible for maintenance and funding provision, and include a defined minimum performance level to which the SuDS must be maintained to.

LPAs will use planning conditions or legal agreements to secure implementation and maintenance of SuDS to ensure they remain effective for the lifetime of the development.

34 www.susdrain.org/delivering-suds/using-suds/adoption-and-maintenance-of-suds/maintenance/index.html

There are examples where local authorities, water companies, private companies and other organisations have adopted/taken ownership responsibility of SuDS. In our sub-region there are a variety of approaches for shared-SuDS, as described on an individual authority basis in the relevant Section 2. In general:

- Section 104 of the Water Industry Act 1991 makes provision for sewerage undertakers to adopt sewers through a vesting declaration. The vesting of a sewer is normally carried out upon the completion of works in accordance with the terms of an adoption agreement. Wessex Water supports the use of sustainable drainage systems to manage surface water flood risk, sewer flooding and improve water quality. Wessex Water are, at the time of writing, reviewing their policy on the maintenance and adoption of sustainable drainage systems. They are anticipated to approve new connections and adopt sewers downstream of sustainable drainage systems subject to a number of safeguards. They are also anticipated to offer to adopt certain types of sustainable drainage system components, again subject to a number of safeguards. Wessex Water recommend pre-application discussions before any planning submission is made. Further information will be made available on their website.
- Within drainage board areas, surface water management proposals are subject to IDB consent. By agreement and following either payment of a commuted sum or ongoing infrastructure charge, a developer may build (or contribute to) SuDS that IDB subsequently owns and/or maintains.
- Few of the local authorities in the subregion are proposing to actively pursue the adoption of SuDS, although some may wish to take on the responsibility for the maintenance of SuDS in public open space using a model agreement and commuted sum, under a Section 106 Agreement of the Town and Country Planning Act, 1990.
- SuDS serving the public highway may also be adopted as part of a publicly maintainable highway constructed in line with guidelines, following agreement between developer and local authority using a model agreement and commuted sum, under a Section 38 Agreement of the Highways Act 1980.
- Using private management companies that are funded through a private maintenance arrangement such as a commuted sum or service charge.
- Some SuDS serve individual properties and these may remain the responsibility of the individual property owner. It is very important that the purchaser of a property that utilises these these ‘single’ property elements is made aware of their existence and is provided with a ‘Maintenance and Operation Manual’ that explains how to ‘use’ and maintain the assets for the lifetime of the development.

4. When do you need to do something?

Surface water drainage is a material consideration when determining planning applications. Whether or not there is need to incorporate SuDS solutions into a planning application will vary and be dependent on the type and scale of development being proposed. Developers should consider the wider context of their emerging proposal and whether or not it would influence the drainage regime of the site and its surroundings.

If works to the land you are seeking to develop will affect the ability of the land to absorb rainwater and have a material effect on the drainage regime of the site and its immediate surroundings then it is likely that early consideration should be given to a SuDS solution. We would recommend early contact with the planning authority to establish whether a SuDS solution needs to be considered for the works proposed.

Other consents may be required under the Water Resources Act or Land Drainage Act for works in or near a watercourse. See **section 4.6**.
The granting of planning consent does not relieve the applicant of the need to apply for any such consent. For details of consents required contact the Environment Agency (work in or near a main river), internal drainage board (work in or near an ordinary watercourse in a drainage board area) or LLFA (work in or near an ordinary watercourse outside a drainage board area).

Types of work that may change the drainage regime of the site could include:

Type of work	Possible change to drainage regime
Building operations (e.g. construction, demolition & re-development)	Development involving building operations could change the topography or surface water drainage regime of an area.
Temporary use operations	Planning applications for temporary use could have significant yet temporary drainage impacts for the lifetime of the permission.
Engineering operations (e.g. groundworks)	Engineering works that could lead to alterations to the surface water drainage regime of an area.
Storage operations	Open storage that could lead to alterations to the surface water drainage regime of an area.
Change of use operations	Change of use development or refurbishment of existing buildings may have no surface water drainage implications and therefore there will be no need address SuDS matters as part of the planning application. However, some change of use applications could potentially result in alterations to the surface drainage regime of a site.

4.1 Pre-Application Engagement

Drainage related issues should be considered as part of the design process from the earliest stage and directly integrated into the overall site layout and design.

Drainage solutions should be designed in the context of specific site conditions and the nature of the proposed development. Therefore, initial identification and consideration of site specific information such as the hydrology of the site, land and soil condition is important.

Developers are recommended to undertake preapplication consultation with the LPA for the purposes of identifying what supporting information would be appropriate to their emerging development proposals. This is expected to minimise delay in the planning approval process and ensure that the developer fully understands what is expected. Such discussions can occur before land purchase.

We strongly suggest that pre-application discussions should focus on creating a 'proof of concept' in principle agreement, which is discussed in section 3.2.

NPPF footnote 20 explains a site-specific Flood Risk Assessment is required for developments of 1 hectare or greater in Flood Zone 1; all developments in Flood Zones 2 and 3, or in an area within Flood Zone 1 notified as having critical drainage problems; and where development or a change of use to a more vulnerable class may be subject to other sources of flooding. The FRA should, amongst other things, help demonstrate that priority is being given to sustainable drainage systems in areas at risk of flooding.

A Sustainable Drainage Strategy (surface water) is a Local List Planning Application Requirement. It should include the detailed design, management and maintenance of surface water management systems including Sustainable Drainage Systems (SuDS) - see Checklist on page 36 onwards.

4.2 Outline Planning Applications

Outline planning applications are generally used to secure approval in principle for a scheme and identify the quantum for development, before substantial costs are incurred.

This type of application allows for fewer details to be submitted and for full details such as the drainage design to be agreed within a reserved matters application at a later stage.

Drainage systems designed as an item in a reserved matters application will have to comply with the layout, landscaping, scale and access arrangements fixed at the outline stage. These self-imposed constraints could result in challenges to the design and delivery of an effective drainage solution.

An outline planning application should give a level of consideration to SuDS and describe how they have been incorporated into proposals at the concept design stage to align with best practice for SuDS. The information and level of consideration for SuDS should be proportional to the scale and complexity of the proposed development and informed by pre-application discussions on the scheme. Consideration is needed on how the SuDS are intended to be maintained for the lifetime of the development.

As part of large scale planning applications a sustainable drainage strategy (surface water) should outline the principles for the proposed scheme, initial information regarding key drainage features in line with which detailed design should be carried out. This sustainable drainage strategy (surface water) is likely to need to include the provision of hydraulic modelling.

4.3 Full Planning & Reserved Matters Applications

For full planning and reserved matters applications detailed design of proposed SuDS should be provided in support of the proposed development. Full site investigation should be undertaken in advance of full or reserved matters application, for major development, to inform the sustainable drainage strategy (surface water) at an outline application stage.

At the detailed design stage, further site investigations should be conducted providing additional information on site specific ground conditions. The findings of investigations should be used in conjunction with the sustainable drainage strategy (surface water) to develop the detailed design.

The responsibility for its ownership and future maintenance should be identified during the detailed design stage and presented as part of the sustainable drainage strategy (surface water) in the planning application submission.

4.4 Sustainable drainage strategy (surface water): Checklist

Note all levels should relate to Ordnance Survey Datum and coordinates be to National Grid Referencing system. Plans should be at an identified scale with a North reference. Preference for electronic rather than hardcopy. A variety of preferred GIS software packages are used across the West of England (see relevant Section 2).

1. Existing site hydrology and constraints	
Checklist item	**Details**
Topographical survey	Topographical survey of the site, including levels and sections of any adjacent water courses for an appropriate distance upstream and downstream of discharge point, including tidal influence where appropriate.
Overland flow paths	Plan identifying existing overland flow routes and surface water flood risk areas.
Ground investigation and Infiltration potential	Identification of sensitive receptors, including groundwater protection zones, habitat designations or archaeological features Indicative infiltration potential Groundwater depth including an indication of seasonable variation Ground investigation interpretive report, including contaminated land report as appropriate (including extent and types of former landfill sites, mine workings, and shafts, spoil heaps, etc. and any remediation works required or undertaken) Where infiltration forms part of the proposed surface water drainage system add “certified infiltration test results carried out to BRE Digest 365 standard”.
Existing drainage	Review of any existing surface water drainage features (natural and/ or man-made). If appropriate, a clearly labelled existing drainage layout plan showing the existing pipe networks and any SuDS (showing pre-development sub-catchment areas including impermeable areas and permeable areas). Cross-sections and flow capacity estimates of any relevant watercourses should be provided.
Greenfield hydrology and discharge rate	Pre-development runoff rates and volumes (greenfield of brownfield as relevant) for the following return periods: • 1 in 1 year • QBAR • 1 in 30 year • 1 in 100 year • 1 in 100 year +30% (climate change factor)
Site constraints	Utilities, landscape retention, watercourse easements, ecological protection, footpaths, vehicle access routes etc. Identify ownership and maintenance strategy for any existing drainage on site.

The above items are recommended to be used as a basis to produce a Proof of Concept, as described in the West of England Sustainable Drainage Developer Guide.

2. Proposed sustainable drainage strategy (surface water)

Checklist item	Details
SuDS hierarchy application	Statement confirming compliance with the technical standards for sustainable drainage systems. Departures from the technical standards must by justified by sufficiently demonstrating that the most close as reasonably practicable approach has been used.
Site layout	Site layout
Hydraulic report	Design calculations to demonstrate conformity with the design criteria for the site for peak flow, volume control and greenfield runoff, and/or brownfield runoff where appropriate. Based upon the Authorities SuDS guidance showing pre-development (greenfield or brownfield as relevant) and post-development runoff rates, critical storm duration and associated storage estimates to determine the scale (and associated land take) of conveyance and storage structures; • Water levels and discharge rates for flow control devices and outfalls for 1 in 1 year event, the critical storm (1 in 30 return period), and the exceedance event (1 in 100 return period + 30% climate change), including tidal influence and high river levels in receiving watercourses / systems where appropriate • Storage volumes should be determined using the critical duration for the system, including tidal influence and high river levels in receiving watercourses / systems where appropriate • An assessment of the need and opportunity for rainwater harvesting and use. If water butts are utilised, they should be included as 'full' in all design calculations. • Consideration of climate change, future development allowances and quantification of any surface water flows on-site from off-site locations If available, in an electronic format to be specified by the Authority, such as Micro Drainage files (not just hardcopy printouts).
Overland flood flow paths	Plan demonstrating flooded areas and depths for the 1 in 100 year storm when system is at capacity, and demonstrating flow paths for design for exceedance. Details of proposals to manage exceedance (on site and off site)
Water quality	Provide information above the measures taken to prevent pollution of the receiving groundwater and/or surface waters. This should include details of how water quality requirements have been considered and managed, and pollution control methods (both temporary and permanent)
Drainage plan	Plan of proposed SuDS showing the pipe networks and any features with sub-catchment areas including impermeable areas, permeable areas and phasing. Plan should show any pipe node numbers referred to in the drainage calculations and the invert and cover levels of manholes. Flow control devices should be indicated on the plan with the rate of discharge stated.
Drainage drawings: Overall	Long sections and cross sections for the proposed drainage system, as necessary.
Drainage drawings: Features	Detailed design drawings for any attenuation features or flow control features, as necessary.
Drainage drawings: Connections	Details of connections to watercourses, sewers and/or highway drains, as necessary.
Drainage drawings: Access	Details of access arrangements and any easements for all proposed SuDS, as necessary.

2. Proposed sustainable drainage strategy (surface water)	
Vegetated maintenance	Landscape planting scheme, if proposing vegetated SuDS, as necessary.
Mechanical features	Operational details of mechanical features, if any.
Ownership and maintenance responsibility	A management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime. Confirmation that location information of relevant drainage system elements attached to a private property to be included in property deeds. If management payments by householders are required to fund future private maintenance, confirmation these requirements shall be included in property deeds. Blockage scenarios and contingency plans for failure of any part of the drainage system that could present a hazard to people.
Other consents	Confirmation that all other consents and licences have been approved/will be applied for. For example: Discharge Consents (water quality where appropriate); Land Drainage Consent; Approval in Principal (AIP), as necessary.
Offsite works	Details of any offsite works required, together with any necessary consents, as necessary.
Construction programme	A timetable for implementation of the drainage system.

4.5 SuDS Design Goals

Goals for a sustainable drainage system	
Hydraulic	
Protection against flooding	1 in 30 year rainfall event – demonstrate that properties within the development are protected from flooding, and that off-site flood risk is not increased.
	1 in 100 year rainfall event inc. climate change– in situations where volumes cannot be infiltrated or stored, overland flow routes, depths and locations must be illustrated. It must be shown how surface water will be managed to control risk to people and property.
Storage	1 in 30 year rainfall event – permanent surface water storage structures should be sized to contain all surface volumes generated.
	1 in 100 year rainfall event inc. climate change– permanent storage areas should be shown to hold all volumes if possible, although alternative temporary above ground car parks / landscaping etc. storage areas are acceptable if planned and agreed.
Runoff	Infiltration SuDS reducing any runoff from a site should be used as a preference.
	The first 5-10mm rainfall should be contained on site through source control when possible.
	In all other rainfall events the runoff from a site should be restricted restricted to the greenfield runoff rate or Qbar rate as required.
Precautionary approach	The risk of blockage, failure and high ground water levels must be considered in the design of SuDS. A precautionary approach should be taken to ensure the flood risks are reduced.
Water Quality	
Protection against pollution	The first 5-10mm rainfall should be contained on site through source control when possible.
	A series of SuDS to provide treatment stages should be installed on the site. The number of treatment stages required will depend on the nature of the site and source of runoff.
Amenity	
Multiple benefits	SuDS should utilise multi-use land where possible i.e. could be located in public open space.
Community engagement	Aesthetic appeal should be maximised.
	Education advice and information boards should be used to promote understanding and encourage responsibility within communities using SuDS.
Biodiversity	
Maximise ecological value	Selected planting should be of a native variety and create varied habitat types.
	SuDS should be created to be as close a possible to the natural ecosystems.
Health and safety	
Safety by design	CDM regulations will ensure all foreseeable risks are assessed. The Health and Safety file must be presented to the organisation with maintenance responsibility. Where CDM regulations are not applicable, risk assessments should be compiled and presented to the client and adopting organisation.
	Risks to public safety should be managed through design before other measures are considered.

Figure 9: Goals for SuDS techniques (Based on Essex County Council, 2012)[35]

35 www.essex.gov.uk/Environment%20Planning/Environmental-Issues/local-environment/flooding/Pages/Sustainable-drainage-systems.aspx

4.6 Information to be provided to LLFA for Asset Register and Designation

Risk Management Authorities can formally designate a feature on your land as a flood risk management asset, using powers from the Flood and Water Management Act.

Features and structures such as garden walls that were not designed to manage flood risk can still help to do that job.

They will give you at least 28 days notice if they decide to do this. They will also give you details of the feature and explain why they want to designate it. You have a right to challenge any designation if you do not agree with what is proposed.

Features and structures that have been designated as an asset cannot be altered, removed or replaced without the consent of the responsible authority. A designation is a local land charge with Land Registry. (More information: www.gov.uk/government/publications/designation-of-third-party-structures-and-features-for-flood-and-coastal-erosion-risk-management-purposes).

The LLFA will advise the LPA if they consider that an application's SuDS is appropriate to be designated. If so, there is a formal designation process, during which the following information will be required by the LLFA:

- 'As built' survey AutoCAD compatible drawings of all SuDS features and updated detailed asset records
- Details of each owner of each SuDS feature
- Person or organisation responsible for maintenance of each SuDS feature

4.7 Other consents

Other consents may be required under the Water Resources Act or Land Drainage Act for works in or near a watercourse. The granting of planning consent does not relieve the applicant of the need to apply for any such consent. For details of consents required contact the Environment Agency (work in or near a main river), internal drainage board (work in or near an ordinary watercourse in a drainage board area) or LLFA (work in or near an ordinary watercourse outside a drainage board area).

You should discuss your plans to work on or near a watercourse with the appropriate risk management authority as early as possible. This could include new surface water outfalls, attenuation features and flood plain compensation etc. The risk management authority will tell you whether you need its consent before doing the works. Factors taken into account include flood risk, wildlife conservation, fisheries, tidal limits and the reshaping of the river and landscape.

The appropriate risk management authority will need to see detailed proposals for the work and receive your consent application, including the fee, at least 8 weeks before you intend to start work

A consent only covers the impact of the structure on flood risk and the environment. The risk management authority does not assess or approve the design of a structure or check whether your plan complies with other legislation, such as health and safety. It does not allow you to carry out works on land or rivers that you do not own. You must have the landowner's permission as well as the consent.

The type of consent you need will depend on the type of watercourse you want to work in:

1. Flood Defence Consents for works on main rivers The Water Resources Act 1991 and associated byelaws require you to contact your local Environment Agency office to apply for formal consent for works in, over, under or adjacent to main rivers. The Environment Agency will need to see detailed proposals for the work and receive your consent application, including the fee, at least two months before you intend to start work. Main rivers are defined as all watercourses shown as such on the statutory main river maps held by the Environment Agency and Defra

2. Flood Defence Consents for works on ordinary watercourses Under the Land Drainage Act 1991 For further information see www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities

Glossary of terms (See also www.susdrain.org/resources/glossary.html)

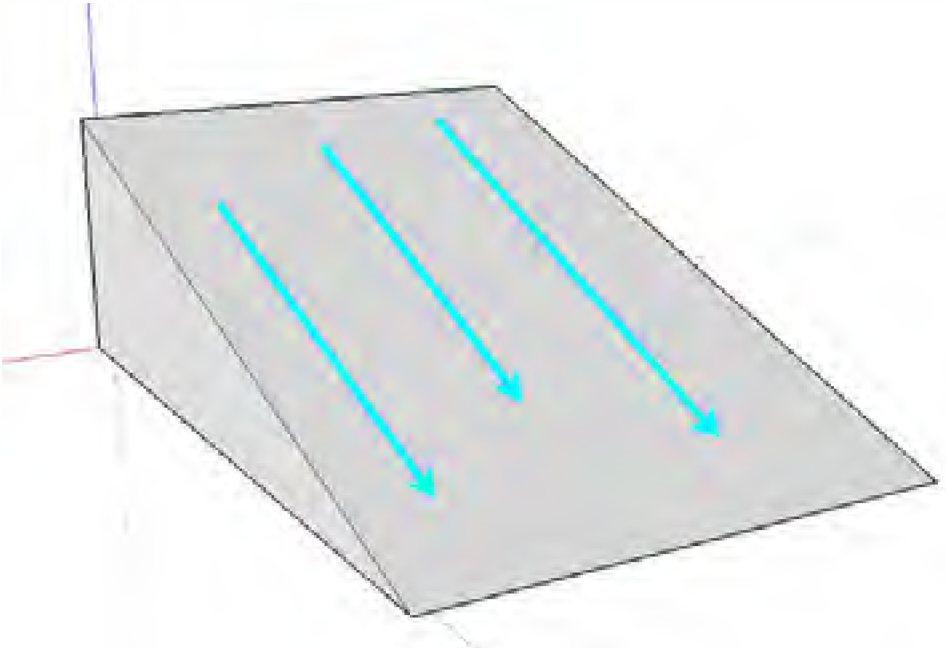
Term	Explanation
Attenuation	Reduction of peak flow and increased duration of a flow event.
Balancing pond	A pond designed to attenuate flows by storing runoff during the storm and releasing it at a controlled rate during and after the storm. The pond always contains water.
Basin	A ground depression acting as a flow control or water treatment structure that is normally dry and has a proper outfall, but is designed to detain stormwater temporarily.
Blue Corridors	These are the natural overland flow pathways determined from the site topography that surface water will take across the site during a significant storm event. They serve as an integral element of the drainage infrastructure by providing flood conveyance during rare (low probability) storm occurrences (See page 46).
Blue roof	A roof design that is explicitly intended to store water, typically rainfall.
Brownfield development	Development of previously developed land which is or was occupied by a permanent structure, including the curtilage of the developed land and any associated fixed surface infrastructure (see planning portal for full definition)
CIRIA	Construction Industry Research and Information Association.
Combined sewer	Sewer that conveys foul and surface water.
Conventional drainage	The traditional method of draining surface water using subsurface pipes and storage tanks.
Culvert	A covered channel or pipe designed to prevent the obstruction of a watercourse of drainage path by an artificial construction
Curtilage Land	Area within property boundaries
Defra	Department for environmental, food & rural affairs
Filter drain	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage.
Filter strip	A vegetated area of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
Freeboard	Distance between the design water level and the top of a structure, provided as a precautionary safety measure against early system failure.
Geocellular structure	Below ground structure, often to attenuate runoff, consisting of modular plastic crates wrapped in a geotextile.
Green roof	A roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane, which contributes to local biodiversity. The vegetated surface provides a degree of retention, attenuation and treatment of rainwater, and promotes evapotranspiration.

Term	Explanation
Greenfield development	Used in construction and development to reference land which has not been previously developed (see planning portal for full definition).
IDB	Internal drainage board
Impermeable	Will not allow water to pass through it.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Infiltration (to a system)	Ground water entering a system through the soil, can also refer to flow into broken or porous pipes, or through defective joints.
Infiltration basin	A dry basin designed to promote infiltration of surface water to the ground.
Infiltration trench	A trench, usually filled with permeable granular material, designed to promote infiltration of surface water to the ground.
LPA	Local Planning Authority
LLFA	Lead Local Flood Authority
Main river	Main rivers are usually larger streams and rivers, but some of them are smaller watercourses of local significance. In England Defra decides which watercourses are the main rivers. Main rivers are marked on an official document called the main river map. Environment Agency local offices have copies of these maps. Main rivers can include any structure that controls or regulates the flow of water in, into or out of the channel.
Major Development	Developments of 10 dwellings or more; a site area of 0.5 hectares or more or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010) including provision of 1,000 sq m floorspace or a site area of 1 hectare or more.
Ordinary Watercourse	An ordinary watercourse is every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows, but which does not form part of a main river. The local authority or Internal Drainage Board has powers on ordinary watercourses similar to the Environment Agency's powers on main rivers.
Orifice plates	Hydraulic control device that throttles the flow.
Permeable pavement	A permeable surface that is paved and drains through voids between solid parts of the pavement.
Permeable surface	A surface that is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration of water to the sub-base through the pattern of voids, for example concrete block paving.
Pervious surface	A surface that allows inflow of rainwater into the underlying construction or soil.
Pond	Permanently wet depression designed to retain stormwater above the permanent pool and permit settlement of suspended solids and biological removal of pollutants.
Porous surface	A surface that infiltrates water to the sub-base across the entire surface of the material forming the surface, for example grass and gravel surfaces, porous concrete and porous asphalt.
Porous paving	A permeable surface that drains through voids that are integral to the pavement.

Term	Explanation
Proof of concept	The proof of concept is similar to a constraints plan. Where it differs from a traditional constraints plan is that it will include the blue corridors and any discharge restrictions that may be required by the LPA or any Risk Management Authority. Agreement in principle cannot guarantee approval will be granted as this will require a full detailed design. It should not be confused with a Sustainable Drainage Design Code, which what has been suggested by Defra to cover large phased developments.
Public sewer	A sewer for the time being vested in a sewerage undertaker etc.
Rainwater harvesting	A system that collects rainwater from where it falls rather than allowing it to drain away. It includes water that is collected within the boundaries of a property, from roofs and surrounding surfaces.
Retention basin	A vegetated depression that is normally dry except following storm events. Constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Risk management authority	Includes the Environment Agency, LLFA, IDB, Water Company and local highway authority.
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or rainfall is particularly intense.
Self actuating variable penstock	Hydraulic control device that throttles flow by reducing the orifice using a float.
Sewer	A pipe or channel taking domestic foul and/or surface water from buildings and associated paths and hardstandings from two or more curtilages and having a proper outfall.
Sewers for Adoption	Document produced by WRc that specifies standards for adoptable sewers.
Site constraints plan	Shows the physical features of the site that will need to be considered within the layout of the development.
Site masterplan	This is a plan that shows the general layout of where the key elements of the site will be located within the site.
Soakaway	A sub-surface structure into which surface water is conveyed, designed to promote infiltration.
Surface water sewer	Sewer that conveys only surface water.
Swale	A shallow vegetated channel designed to conduct and retain water, but may also permit infiltration. The vegetation filters particulate matter.
Unitary Authorities	1st tier local government.
Tanked system	Can be either a storage tank or a large piped system.
Vortex flow control	Hydraulic control device that throttles/restricts the flow by inducing a spiral/vortex in the flow.
Watercourse	Includes all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewer (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows.
Wetland	Flooded land area that is saturated with water, either permanently or seasonally, in which the water is shallow enough to enable the growth of bottom-rooted plants.
Watergarden	A landscape or architectural element whose primarily purpose is to house, display, or propagate aquatic plant.

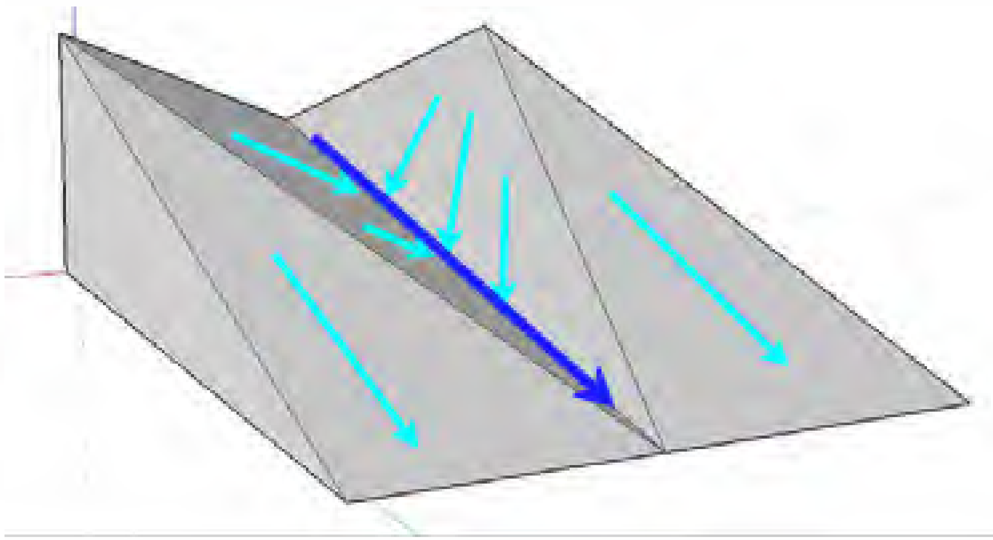
Why Blue Corridors are not the same as flow paths

A flow path is simply the direction across a surface that the flow will take shown by the light blue arrows on the diagram below.



If an obstruction is placed across a flow path, the flow will frequently just flow around the obstruction creating an alternative flow path.

A Blue Corridor is created when the surface diverts multiple flow paths and makes them come together. The diagram below shows flow paths in light blue but the Blue Corridor is shown in dark blue.



Interfering with blue corridors will frequently result in increased flood risk as the water will normally not have an alternative flow path that it can use.

Proof of Concept Template

The objective of the proof of concept procedure is to highlight potential issues that need to be considered at the earliest stages of master planning a development site. The following requirements will satisfy the proof of concept for major developments. For minor developments, not all of the requirements may be necessary. Consult the LPA prior to commencing this phase.

Site Boundary
Insert plan indicating site boundary and state the area within the boundary.

Topographical survey
Insert topographical survey of the site. Include indication of surrounding topography.

Flood Zones
Insert plan indicating site boundary and state the area within the boundary.

Existing blue corridors and drainage features
Insert plan identifying blue corridors using site and surrounding topography. Identify existing drainage features (watercourses, culverts etc).

Ground Conditions
Include appropriate level of ground investigation highlighting factors such as contamination, soil type, groundwater level, bedrock .

Infiltration rate
Insert evidence of infiltration rate based on BRE365, include plan of trial pit locations. If ground investigation has not yet been undertaken, insert an estimated range of likely infiltration rates based on desk top information.

Site constraints
- Existing utility information
- Environmental restrictions (e.g. easements, tree protection orders, protected habitats etc.)

Hydraulic considerations
- Populate below table and provide supporting calculations

Annual probability	Greenfield peak discharge (l/s)	Existing peak discharge (l/s)
1 in 1		
1 in 30		
1 in 100		
Greenfield runoff volume (1 in 100 annual probability, 6 hour duration)	m^3	

- Agreed discharge restrictions (with Risk Management Authorities such as Wessex Water)

Example of Proof of Concept 1

The following is a worked example of a proof of concept plan for a site in Bristol. The site chosen is, at the time of writing, allocated for residential development under the Bristol Local Plan Site Allocations.

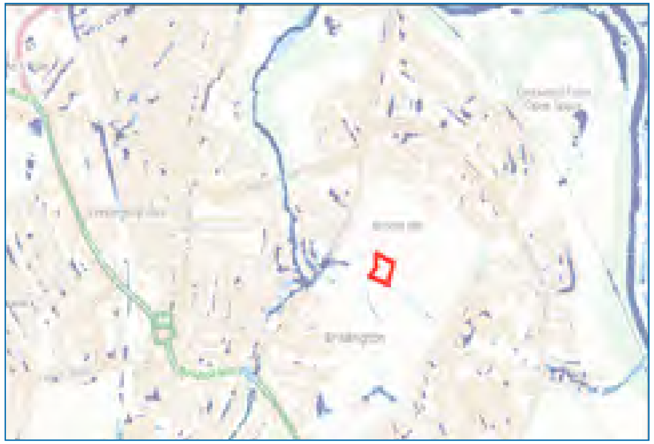
This example proof of concept is intended to provide an indication of the level of detail preferred by the Local Planning Authority to satisfy the proof of concept plan.

Site Boundary

Flood Zones

Plan showing Flood Zones, available from EA website.

Flood Zones (Cont'd)



Plan showing surface water flood map, available from EA website.

Topographical survey

Note that a detailed topographic plan would be expected for a live planning application. The plan below shows 1m contour lines based on LiDAR level data.

Existing blue corridors

The site lies on one side of a natural valley; the existing natural drainage pattern therefore consists of broadly sheet runoff with no well-defined channels. The general direction of overland flow is shown by the blue arrows in the figure below.

Modelling software can also be used to quickly identify blue corridors. On this site, due to the uniform nature of the slope, it is apparent that no distinguishable blue corridors exist and overland flow would be distributed evenly. Water is shown to accumulate at the low spot in the south west corner of the site. The figure below is an extract from Microdrainage modelling software demonstrating that no distinguishable blue corridors exist on this site (the coloured squares in the south west corner show water of depths > 100mm).

Ground Conditions

Note that the following information is based on desk top information only and should be verified on site if used to support a proof of concept plan for a live planning application.

No significant contamination issues are known to exist on site which has historically been used as grazing land and more recently as allotments.

The soil type is sandy clay loam, and bedrock is thought to be free draining. The groundwater level is thought to be more than 5m below the ground surface.

Infiltration rate

The infiltration rate is thought to be approximately 1.1×10^{-5}m/s .

Site constraints

There are Western Power high voltage overhead cables to the north of the site. The culverted watercourse immediately downstream of the site is in the ownership of Wessex Water and is classified as a public surface water sewer. There are no other utility assets within the confines of the site boundary. There are no tree preservation orders on the site. There is an ordinary watercourse that lies along the southern boundary of the site, which discharges in to a culverted watercourse at the south west corner of the site. Access for maintenance will be required.

Hydraulic considerations

Annual probability	Greenfield peak discharge (l/s)	Existing peak discharge (l/s)
1 in 1	1.0	1.0
1 in 30	2.4	2.4
1 in 100	3.0	3.0
Greenfield runoff volume (1 in 100 annual probability, 6 hour duration)	$48.2m^3$	

As the site is entirely Greenfield, existing peak discharge rates are equal to peak Greenfield rates. For a brownfield site, these values would not be equal and would need to reflect site layout and existing drainage capacity.

Because the site is Greenfield, in accordance with the peak flow control standards, peak flow from the developed site would be required to be limited to the Greenfield 1 in 1 and 1 in 100 year peak discharge rates.

For a previously developed site, peak discharge from the proposed development would be required to be as close as reasonably practicable to the Greenfield 1 in 1 and 1 in 100 year peak discharge rates. This should be agreed with the Local Planning Authority before detailed SuDS design.

Example of Proof of Concept 2

The following is a worked example of a proof of concept plan for a site in Bath and North East Somerset Council. The site chosen is, at the time of writing, allocated for residential development under the Bath and North East Somerset (B&NES) Place Making Plan.

This example proof of concept is intended to provide an indication of the level of detail preferred by the Local Planning Authority to satisfy the proof of concept plan.

The desktop studies information can be obtained from the following sources:

Flood Risk Information	**Lead Local Flood Authority, Local Planning Authority, Environment Agency, GIS Teams, Water and Sewage Companies ,Envirocheck Services, Other**
Geological data	British Geological Survey, GI reports
Topographical Information	Ordinance Survey, LIDAR, Topographical Surveys
Infiltration	BGS, Infiltration Testing, GI reports
Sites constrains	Utility Searches, sites walkovers

Site Boundary

Site area: 0.49ha

Flood Risk Information

Flood risk information can be obtained from various sources including Lead local Flood Authority or Environment Agency. The developer shall use the most up to date information while assessing flood risk from various sources.

River Flooding

Plan showing Flood Zones, available from B&NES GIS TEAM

Surface Water Flooding

Plan showing Flood Zones, available from B&NES GIS TEAM

Topographical survey

Note that a detailed topographic plan would be expected for a live planning application. The plan below shows 5m contour lines based on GIS data.

Existing Surface Water Runoff

The existing natural drainage pattern consists of broadly sheet runoff with no well-defined channels. The general direction of overland flow is shown by the blue arrows in the figure below.

Modelling software called Microdrainage FloodFlow is an advanced 2D analysis engine that can be used for calculating flow paths across a digital terrain model. The program enables the 'blue corridors' to be identified across the catchment. The program will identify depth, direction and velocity of the overland flood flow routes.

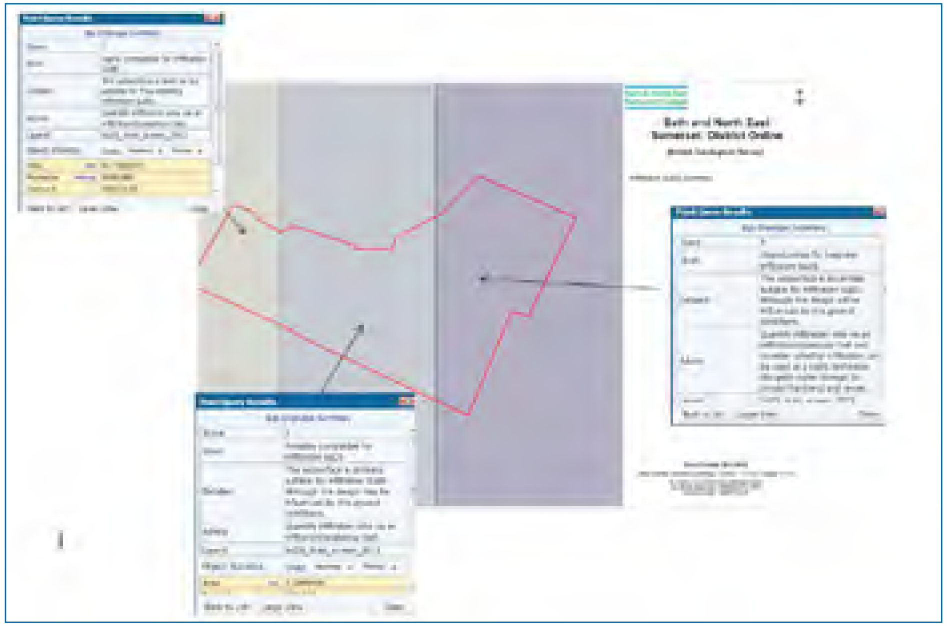
Ground Conditions

Note that the following information is based on desk top information only and should be verified on site if used to support a proof of concept plan for a live planning application.

No significant contamination issues are known to exist on site which has historically been used as grazing land

The soil type is Pink cong with limestone clasts.

Review of the British Geological Survey Maps for the area indicates that the site is divided into three different infiltrations zones.



Infiltration rate

The infiltration rate is thought to be approximately 6.7x10^{-5}m/s (indicative value only)

Soakaway testing in accordance with the BRE Digest 365 should be undertaken to determine the feasibility of the soakaway drainage for the site.

Infiltration rate

There is a culverted ordinary watercourse located 84m away from the eastern site boundary. This watercourse is under the riparian owner responsibilities. Access for maintenance will be required. Utility search will need to be undertaken to identify other site constrains.

Hydraulic considerations

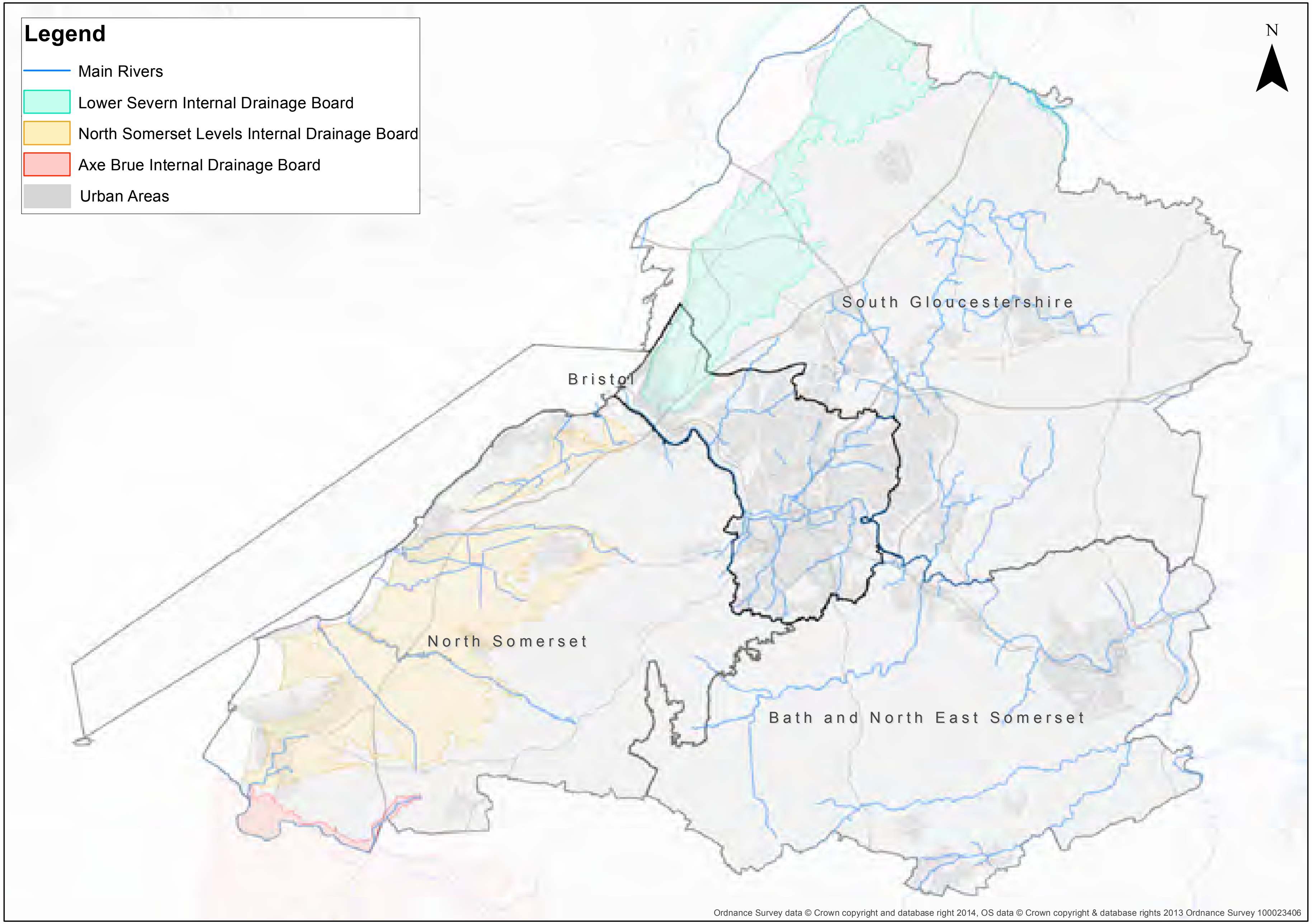
Annual probability	Greenfield peak discharge (l/s)	Existing peak discharge (l/s)
1 in 1	2.8	2.8
1 in 30	6.3	6.3
1 in 100	8.0	8.0
Greenfield runoff volume (1 in 100 annual probability, 6 hour duration)	178m^3	

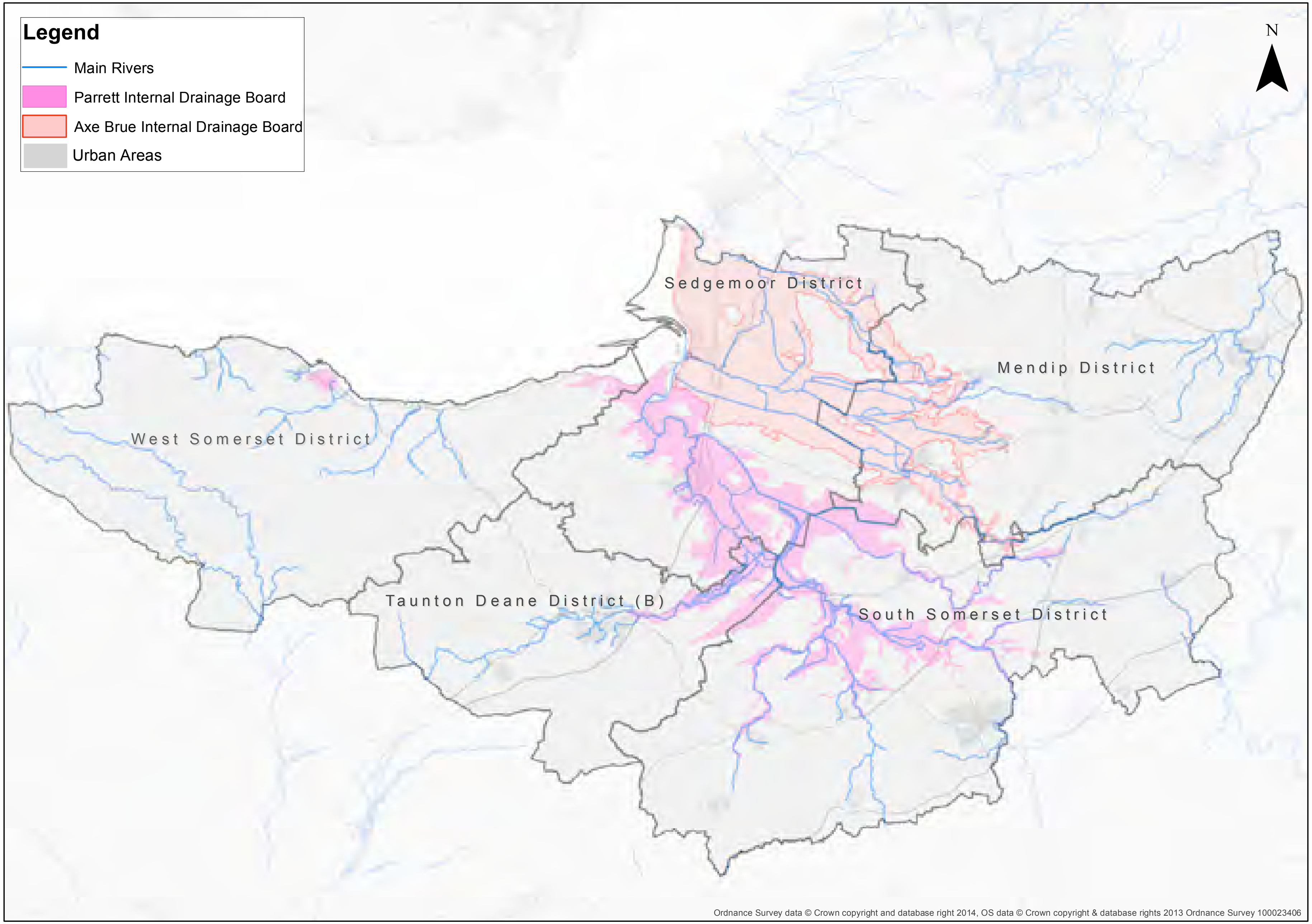
As the site is entirely Greenfield, existing peak discharge rates are equal to peak Greenfield rates. For a brownfield site, these values would not be equal and would need to reflect site layout and existing drainage capacity.

Because the site is Greenfield, in accordance with the peak flow control standards, peak flow from the developed site would be required to be limited to the Greenfield 1 in 1 and 1 in 100 year peak discharge rates.

For a previously developed site, peak discharge from the proposed development would be required to be as close as reasonably practicable to the Greenfield 1 in 1 and 1 in 100 year peak discharge rates. This should be agreed with the Local Planning Authority before detailed SuDS design.

Maps of subregion showing LPA/LLFA and IDB boundaries




Legend
Main Rivers
Parrett Internal Drainage Board
Axe Brue Internal Drainage Board
Urban Areas
N
Sedgemoor District
Mendip District
West Somerset District
Taunton Deane District (B)
South Somerset District
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Notes

BD6457 Designed by Bristol Design, Bristol City Council, March 2015