South Gloucestershire Council

Delivering for you

Sustainable drainage systems (SuDS)

Guidance for new developments

Supplementary Planning Document June 2021

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South Gloucestershire Council
Sustainable Drainage Systems (SuDS): guidance for new developments
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1. KEY POINTS

The purpose of the document is to make developers aware of the council's policies and standards in relation to Sustainable Drainage Systems (SuDS) to ensure that surface water runoff is managed in a sustainable manner, enhancing the overall quality of environment whilst minimising adverse environmental impacts.

- Successful SuDS designs will need to take into account water quality, water quantity, amenity and biodiversity and have a positive impact on each in order to achieve a sustainable design.

- The discharge hierarchy must be followed when considering options to deal with runoff that cannot be used, prevented or dealt with at source. Evidence that the hierarchal approach has been applied must be provided before a SuDS application will be approved.

- Development on Greenfield sites must limit runoff to the Qbar Greenfield rate for all rainfall events up to and including the 1 in 100 year event.

- Development on Brownfield sites must also look to limit runoff to or as close as possible to the Qbar Greenfield runoff rate for all rainfall events up to and including the 1 in 100 year event. Where this is not possible then an allowable discharge rate is to be agreed based on a reasonable reduction from existing rates.

- SuDS should be specifically designed so that:

    - in a 1 in 30 year rainfall event there will be no flooding on site.

    - in a 1 in 100 year rainfall event (plus allowance for climate change), there will be no flooding of any building on the site or any off site flooding; and

    - for any rainfall event above 100 year, the drainage design should demonstrate how exceedance flows generated within the site will be managed including overland flow routes, protection of buildings to prevent entry of water, and protection of access routes.

- An allowance for climate change needs to be incorporated as part of SuDS design, which means adding an extra amount to peak rainfall (20% for commercial development and 40% for residential as per current industry requirements, which may be subject to change in the future).

- SuDS features are expected to be designed in accordance with CIRIA C753 the SuDS Manual and CIRIA C698 Site handbook for the construction of SuDS.

- Swales, infiltration basins, retention and detention basins and ponds must be designed with side slopes with a gradient of 1:3 or less. Basins and ponds must also be designed to incorporate a minimum freeboard of 300mm between the top water level and the top of bank.

- Suitable management arrangements must be put in place for all the SUDS features constructed in South Gloucestershire covering future operation and maintenance. In addition, adequate access must be provided to all SuDS features to allow for the required maintenance and operational activities to be carried out unimpeded.

2. INTRODUCTION

The intention of this document is to ensure an integrated approach to the planning and operation of Sustainable Drainage Systems (SuDS) for new developments across South Gloucestershire. This Supplementary Planning Document (SPD) has been developed to provide further guidance and objectives which support the delivery of the Council's adopted policy framework in line with SuDS planning and industry good practice, contributing to our commitment to achieving sustainable communities and quality of life for all.

This document provides practical guidance and advice for developers, planners, designers and consultants on what is expected of them as they bring sites forward across South Gloucestershire in relation to surface water management and the implementation of SuDS.

It is essential that the management of surface water is considered at the earliest stage of a development. By adopting a sequential approach to development site allocation and integrating SuDS into the site design, the maximum benefits can be achieved, for people and the environment.

The principal objectives of this Supplementary Planning Document are to provide advice and guidance to:

- Make developers aware of the council's policies and standards in relation to SuDS to ensure that surface water runoff is managed in a sustainable manner, enhancing climate change resilience and the overall quality of environment whilst minimising adverse environmental impacts.
- Embed consideration of and support for the use of SuDS for surface water management at the earliest stage of the planning process.
- Make developers aware of the council's Climate Emergency declaration and commitment to provide the leadership for South Gloucestershire to be carbon neutral by 2030 and the need to prioritise design, implementation and operational considerations to deliver this goal for all new development.
- Ensure the management of surface water runoff in new developments does not adversely affect the quality of life of residents, neighbours and other users of the space and that the design and management of the SuDS features conserve and enhance existing ecological habitat and networks.

The SuDS SPD forms one part of a suite of SPDs developed to accord with our Climate Change Emergency Action Plan. The SuDS SPD should be read together with;

- Trees on Development Sites SPD
- Biodiversity and Planning SPD and
- Green Infrastructure (GI) SPD

3. PLANNING POLICY

Links to the following documents are available on Page 9.

South Gloucestershire Core Strategy (adopted December 2013): Policy CS1 – High Quality Design states: 'Development will only be permitted where the highest possible standards of design and site planning are achieved. Information submitted with an application should be proportionate to the scale, significance and impact of the proposal'.

'Development proposals will be required to demonstrate that [they]':

Criteria 11: take account of the South Gloucestershire Strategic Flood Risk Assessments and provide, where appropriate, measures to manage flood risk and prepare surface water management plans.

South Gloucestershire Core Strategy (adopted December 2013): Policy CS2 – Green Infrastructure states: 'The council and its partners will ensure that existing and new Green Infrastructure (GI) is planned, delivered and managed as an integral part of creating sustainable communities and enhancing quality of life, considering the following GI objectives:

Criteria 1: mitigation and adaption to climate change;

Criteria 2: delivering high quality multi-functional and connected open spaces (including Green and Blue Infrastructure)

* Currently under revision and will be replaced by both the West of England Joint Spatial Plan and the South Gloucestershire new Local Plan.

South Gloucestershire Core Strategy (adopted December 2013): Policy CS9 – Managing the Environment and Heritage states: 'The natural and historic environment is a finite and irreplaceable resource. In order to protect and manage South Gloucestershire's environment and its resources in a sustainable way, new development will be expected to':

Criteria 5: reduce and manage the impact of flood risk through location, layout, design, choice of materials and the use of Sustainable Drainage Systems (SuDS);

Criteria 6: protect the quality and quantity of the water environment and its margins;

Criteria 8: utilise natural resources including water in an efficient and sustainable way; and

Criteria 11: protect aqueous environments from pollution.

South Gloucestershire Policies, Sites & Places Plan (adopted November 2017): Policy PSP20 - Flood Risk, Surface Water and Watercourse Management states:

1. Flood risk and surface water management

'All development proposal(s) should follow the sequential approach to flood risk, for all potential flood risk sources. Development proposal(s) will be expected to':

(i) Reduce surface water discharge from the site, wherever practicable and feasible on:

a) previously developed land, by reducing post development runoff rates for events up to and including the 1 in 100 year return period, with an allowance for climate change, to that of a Greenfield condition. Where it can be demonstrated that this is not practical or feasible, a 30% betterment to the existing condition will be required;

b) greenfield sites, by restricting discharge to a watercourse or surface water sewer to the estimated mean Greenfield runoff rate (QBAR) by means of a controlled outflow. The drainage system should be designed so that flooding does not occur on any part of the development for the 3.33% (1 in 30 year) rainfall event other than in those areas/systems designated to store or convey water. Flooding within the development site should not occur in any part of a building or utility plant susceptible to water during a 1% (1 in 100 year) event, with an allowance for climate change; and;

(ii) Incorporate Sustainable Drainage Systems (SuDS) to reduce surface water runoff and minimise the flood risk, supported by an appropriate surface water drainage strategy; and

(iii) Ensure that surface water drainage proposals are designed to not increase off-site flood risk; and

(iv) Wherever practicable achieve the top tier of the following Surface Water Discharge Hierarchy, providing justification where lower tiers are considered appropriate:

1. infiltration
2. surface water body (watercourse/ditch) (non-infiltration)
3. surface water sewer (non-infiltration)
4. combined sewer (non-infiltration)

2. Land drainage and water quality

'Development proposals will be acceptable where':

i) watercourses, ponds and lakes are retained, protected and enhanced as natural landforms, floodplains and wildlife habitats; and

ii) it is designed and located to protect the existing floodplain and enable suitable access for maintenance; and

iii) practicable the water environment is left in its natural state, and designed to avoid engineering activities which would cause harm to the water environment; and

iv) prevention and mitigation measures are sensitively designed to minimise the risk of pollution to the water environment.

3. Operation and maintenance

'Applicants must provide evidence of appropriate arrangements for future ownership, operation and maintenance of new and existing surface water drainage features, including SuDS, for the lifetime of the development proposal(s)'.

LINKS TO SUPPORTING PLANNING POLICY

South Gloucestershire Core Strategy
http://www.southglos.gov.uk/documents/cleanversionforinterimpublication2.pdf

National Planning Policy Framework
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779764/NPPF_Feb_2019_web.pdf

Building Regulations Approved Document H6
https://assets.publishing.service.gov.uk/governmet/uploads/system/uploads/attachment_data/file/442889/BR_PDF_AD_H_2015.pdf

The South Gloucestershire Infrastructure Delivery Plan
www.southglos.gov.uk/environment-and-planning/planning/planning-local-plans/ local-development-framework/infrastructure-delivery-plan

STATUS OF THIS SUPPLEMENTARY PLANNING DOCUMENT (SPD)

The National Planning Policy Framework (NPPF) explains that SPDs are:

'Documents which add further detail to the policies in the development plan. They can be used to provide further guidance for development on specific sites or issues, such as design. Supplementary planning documents are capable of being a material consideration in planning decisions but are not part of the development plan.'

The SPD provides additional explanatory guidance to developers to assist them in making successful planning applications. It supplements and expands on Core Strategy policies CS1 (11), CS2 (1 & 2) and CS9 (5, 6, 8 & 11) and PSP20 (Flood Risk, Surface Water and Watercourse Management) as well as adding local context to the interpretation of the NPPF paragraphs set out above. The guidance within it will form a material consideration of planning applications.

Appropriate weight should therefore be given to the advice set out in this SPD which supports the interpretation and delivery of the council's adopted Local Plan policy.

4. SUSTAINABLE DRAINAGE SYSTEMS (SuDS)

SURFACE WATER AND URBANISATION

When rain falls on a natural landscape it may evaporate or infiltrate into the soil, nourishing our natural habitat by replenishing groundwater or flowing overland into ponds and watercourses. However, in urbanised areas where many surfaces are covered by buildings and impermeable surfaces, natural drainage processes can be impeded.

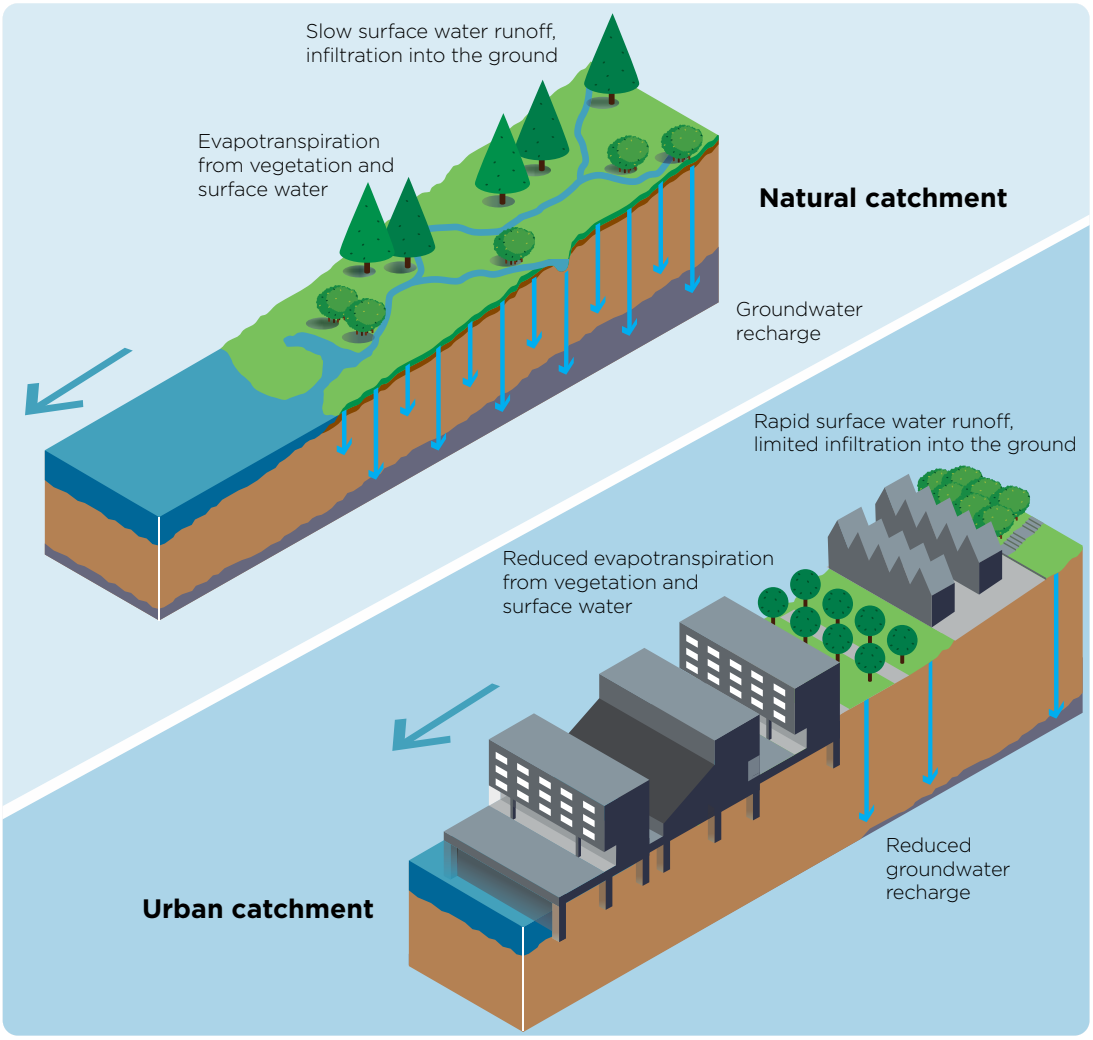

Figure 1: Effects of urbanisation on the water cycle (West of England SuDS Developers Guide)

Urban development can therefore cause a range of adverse impacts on watercourses:

- By diverting rainfall to piped systems the amount of water infiltrating the ground is reduced. This contributes to depletion of ground water and low flows in watercourses;

- Increased runoff as a result of more extensive hard paving and roofing can increase the risk of flooding downstream, as well as give sudden rises in water levels and flow rates as the water is discharged into watercourses; and

- Surface water runoff can contain a wide range of contaminants such as oil, organic matter and toxic metals. Although often at low levels, cumulatively these can result in poor water quality in rivers and streams. After rainfall, the first flush can often be highly polluting. Additionally when combined sewers (which collect surface water runoff and foul waste water) are overwhelmed by surface water they are designed to release diluted sewage into rivers.

The likely impact of climate change of more intense rainfall will only exacerbate the adverse impacts to our watercourses.

What are Sustainable Drainage Systems (SuDS)?

SuDS are physical structures and techniques designed to receive surface water runoff that can be used to replicate natural drainage processes in a built environment. They involve a move away from conventional piped surface water drainage systems that concentrate runoff, cause pollution and/or flooding if their limited capacity is exceeded during storm events.

SuDS can be designed to convey surface water, slow runoff down (through attenuation), provide areas to store water in natural contours, allow water to infiltrate into the ground and also allow surface water to evaporate back into the atmosphere (called evapotranspiration).

Benefits of SuDS?

National and Local policy requires a sustainable approach to drainage, primarily to ensure development does not cause an increased risk of flooding. Well-designed SuDS provide effective surface water drainage that can be used to manage the potential increased surface water flood risk that new development could cause whilst also mitigating many of the adverse effects that storm water run-off has on the environment.

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 LL 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.

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Figure 2: What are the benefits of using SuDS? – WoE SuDS Developer Guide – Part 1 (2015)

5. THE FOUR PILLARS OF SUDS

The SuDS philosophy is to replicate as closely as possible the natural drainage from a site before development. For the success of SuDS it is important that the design takes into account water quality, water quantity, amenity and biodiversity. By considering this set of conditions, SuDS design should attempt to maximise the potential to provide solutions which are:

- water sensitive (i.e. water management close to the natural water cycle and water quality treatment through natural processes inherent in the system);
- functional and easy to maintain;
- aesthetically pleasing (i.e. integrate with the landscape);
- usable and acceptable by local inhabitants; and
- wildlife friendly.

Successful SuDS designs are likely to positively impact water quantity and quality whilst also providing amenity and biodiversity value. When these have been addressed in the design, this will result in a sustainable system design.

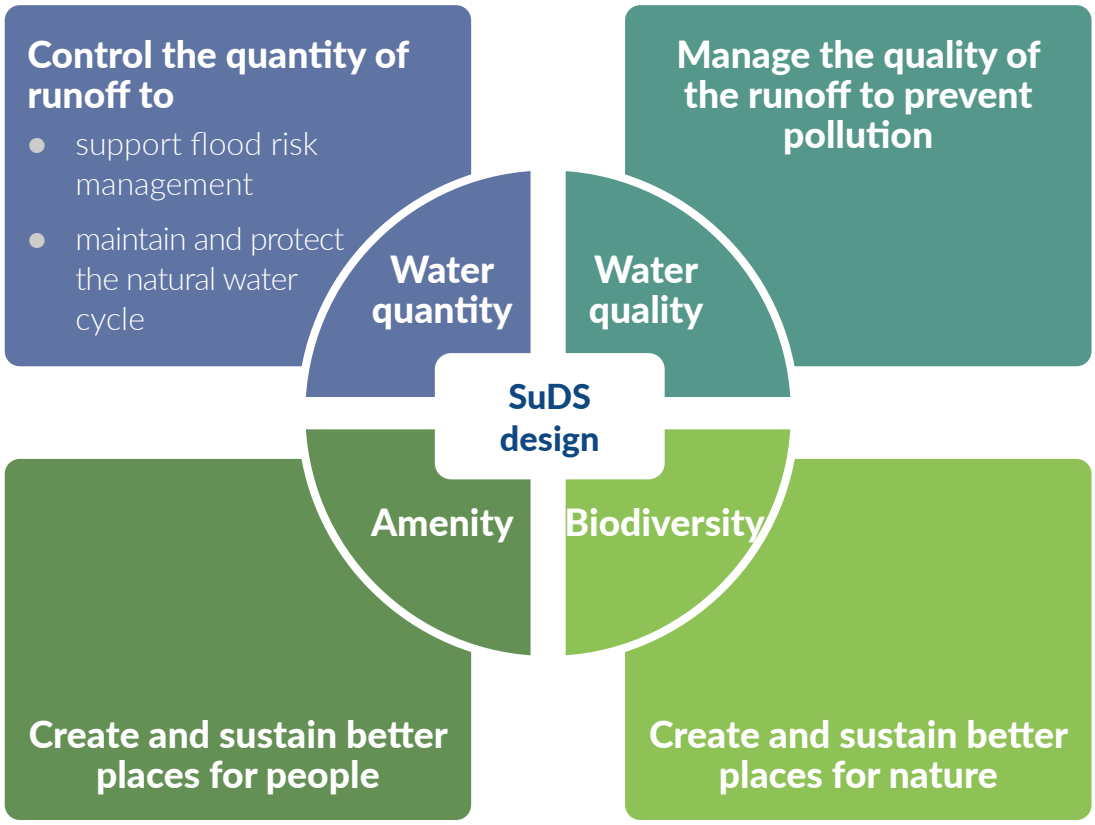

Figure 3: The four pillars of SuDS (CIRIA C753 The SuDS Manual)

WATER QUANTITY

SuDS should use various methods and features to manage the quantity of surface water runoff in order to protect people and property from surface water flooding. Flows, volumes and the frequency of runoff should be controlled such that it mimics natural drainage processes. See Section 8 'SuDS Design' of this SPD for details on surface water runoff discharge rates and volumes.

When designing SuDS, it is also important to consider the receiving watercourses and drainage systems along with overland flows to and from adjacent land. It must be demonstrated that the proposed development will mitigate flood risk from existing adjacent land (if any) and will not increase flood risk at any other points upstream or downstream of the development.

SuDS should be specifically designed so that:

- In a 1 in 30 year rainfall event, there will be no flooding anywhere on the site (winter and summer storm events);
- In a 1 in 100 year rainfall event (plus allowance for climate change), there will be no flooding of any building on the site or any off site flooding (winter and summer storm events);
- For any rainfall event above 100 year, the drainage design should demonstrate how exceedance flows generated within the site will be managed including overland flow routes, protection of buildings to prevent entry of water, and protection of access routes.

For full design criteria and SuDS philosophies and concepts refer to the National Standards for SuDS (2015) and the SuDS Manual (CIRIA C753).

WATER QUALITY

To protect receiving watercourses and groundwater it is vital to capture, control and treat pollution carried by site surface water runoff as close as possible to the source. Passing surface water flows through a series of different types of SuDS (the process known as the 'SuDS Management / Treatment Train') provides a high level of treatment.

South Gloucestershire Council intend that all SuDS installations will provide no deterioration of water quality to surface waters or groundwater from new developments.

Each type of SuDS presents at least one level of treatment. For example, oils and hydrocarbons can be trapped in permeable pavements and broken down by micro-organisms. Using the SuDS treatment train concept will also help mimic the natural drainage regime of an area, thus minimizing impact on receiving watercourses.

The number of treatment stages required is defined in The SuDS Manual (CIRIA C753) and varies with the environmental sensitivity of the receiving waterbody. The following table taken from The SuDS Manual (CIRIA C753) outlines the recommended number of treatment stage components.

	Receiving watercourses sensitivity		
Run off characteristic	Low	Medium	High
Roofs	1	1	1
Residential roads and parking areas	2	2	2
Refuse areas, industrial areas, loading bays and parks, general highways	3	3	4

Figure 4: Recommended SuDS Treatment Stages (The SuDS Manual CIRIA C753)

It is important to highlight that this sets out the minimum number of components required at each site and that each site should be reviewed on a risk assessment basis. One level of treatment can be considered as one SuDS feature.

An increased number of components will generally be required for larger sites to meet all design criteria. It is recommended that sites in excess of 2ha do not drain to a single SuDS component and instead a sub-area SuDS is designed ensuring an effective treatment system.

The processes by which pollutants such as sediments, PAH's and soluble metals can be removed vary from pollutant to pollutant but can include settlement, filtration, uptake by plants, biodegradation, absorption, precipitation and photolysis. The various SuDS techniques also offer different levels of pollution treatment and tackle different contaminants. The table on the following page (see Figure 5) taken from the The SuDS Manual (CIRIA C753) gives an indication of these.

Note: further information on the removal process for pollutants can be found in The SuDS Manual (CIRIA C753).

SuDS Group	Technique	Water quality treatment potential				
		Total suspended solids removal	Heavy metals removal	Nutrient (phosphorus, nitrogen) removal	Bacteria removal	Capacity to treat the suspended sediments and dissolved pollutants
Retention	Retention pond	H	M	M	M	H
	Subsurface storage	L	L	L	L	L
Wetland	Shallow wetland	H	M	H	M	H
	Extended detention wetland	H	M	H	M	H
	Pond/wetland	H	M	H	M	H
	Pocket wetland	H	M	H	M	H
	Submerged gravel wetland	H	M	H	M	H
	Wetland channel	H	M	H	M	H
Infiltration	Infiltration trench	H	H	H	M	H
	Infiltration basin	H	H	H	M	H
	Soakaway	H	H	H	M	H
Filtration	Surface sand filter	H	H	H	M	H
	Subsurface sand filter	H	H	H	M	H
	Perimeter sand filter	H	H	H	M	H
	Bio-retention/filter strips	H	H	H	M	H
	Filter trench	H	H	H	M	H
Detention	Detention basin	M	M	L	L	L
Open channels	Conveyance swale	H	M	M	M	H
	Enhanced dry swale	H	H	H	M	H
	Enhanced wet swale	H	H	M	H	H
Source control	Green roof	n/a	n/a	n/a	n/a	H
	Rain water harvesting	M	L	L	L	n/a
	Permeable pavement	H	H	H	H	H

Figure 5: The water quality performance selection matrix table from The SuDS Manual (CIRIA C753)

AMENITY AND BIODIVERSITY

South Gloucestershire Council expects that all SuDS installations will protect the existing environment and where possible enhance it. This covers both biodiversity in terms of habitats and species, but also amenity value to the owners and occupiers of development sites. The design of SuDS should consider the need to provide aesthetic and social benefits for the community they will serve along with opportunities for biodiversity enhancement.

As an overriding design principle, SuDS features should be kept at or near the surface and be integrated into the local landscape. A high quality mix of engineering and landscape design must be applied throughout the SuDS design process and all SuDS should be adapted to the local conditions. Aesthetic SuDS design will be better received by the public and is likely to increase the overall value of a development.

SuDS features should be safe and easy to maintain and the design must consider the possible need for future adaptation due to potential changing conditions such as climate change or urban creep. To minimise the health and safety risks, SuDS design should use gentle slopes sides and barrier planting to prevent easy access to the water along with shallow water depths and avoidance of sudden depth changes.

Benefits for wildlife can be achieved through the inherent water treatment and providing good ecological design. Ecological value can be achieved by mimicking the natural ecosystems, using native plants, by varying the habitat types and introducing diversity in the design.

Amenity good practice

- SuDS should be integrated into open space to provide amenity benefit to the site and its occupiers. For example, house buyers might benefit from the areas for dog-walking.
- Key considerations to provide amenity benefit are the use of vegetation and landscaping techniques, linking open water areas to recreation sites, setting an appropriate maintenance programme to ensure areas are visually attractive throughout the year.
- It is essential to consider SuDS as part of a broader green infrastructure rather than stand-alone, bolt-on features. SuDS should be an integral part of the landscape, providing amenity space, storing and treating run off, alleviating flooding, and enhancing biodiversity.
- SuDS can be designed to accommodate large volumes of water during heavier rainfall events but remain dry the rest of the time to allow for recreation and events. Ground slopes require particular consideration with regard to health and safety and designs should concentre on shallow gradients. All SuDS systems should also avoid small stagnant pools which could lead to waterborne nuisances such as midges.

- Ensuring that SuDS remain safe and accessible for the life-time of the developments they serve is principal to design. Along with other aspects, health and safety must be considered at the pre-application stage. Shallow water depths, strategically placed vegetation and stable ground around water margins can help to create a safe environment for site users.

- The desire should be to create areas of quality open space which encompass the storage of surface water, amenity and enhancement of biodiversity

Biodiversity good practice

In order to improve the biodiversity value of SuDS systems in South Gloucestershire, a number of general recommendations are set out below. These apply mainly, but not exclusively to ponds and wetland features:

- The wildlife value of existing wetland habitats and surrounding terrestrial areas should be surveyed by suitably qualified ecologists during early planning. Protected species and sites should also be identified around any proposed locations. Hydrological surveys will inform existing surface and ground water flow and are recommended to ensure proposed changes do not affect water quantity or quality.

- Crossovers (bridges, culverts, etc.) should be kept to a minimum and balanced with people access/connectivity between neighbourhoods and places.

- Consider whether planting will rely on natural colonisation or be established with planting regime. This is an important matter to consider as all planting proposed as part of a SuDS system will need to mimic and enhance natural processes along with increasing the resilience of new trees to change (including climate change and other pressures) and disease.

- Use locally appropriate native species where possible when using a planting regime, if possible use plants of regional origin. As per the objectives as set out in the Trees on Development Sites SPD sites should look to procure trees that have been sourced and grown in the UK.

- Any planting regime, should be appropriate for the location and available habitat, relative to top soil present, gradient, water depth and soil moisture and with respect to access and maintenance. For example, a swale may have a very dry soil/moisture profile at the top of the bank, while the bottom of the bank is more likely to be wet. Careful plant choice will ensure planting survives and is self-sustaining.

- Consider planting design and ensure this does not adversely impact highway visibility and safety requirements.

- Provide sufficient treatment upstream of any pond / wetland feature to allow design amenity and biodiversity objectives to be delivered.

- Where possible, create biodiverse/species rich habitats, within ponds / wetlands through the creation of different water depths, deep water, marginal habitat and dry / damp areas. Avoid hard engineered and smoothly finished surfaces they provide less physical habitat diversity for plants and animals.

- Planting designs should avoid need for use of fertilizers. Maintenance should seek to require physical cutting only, with no application of herbicide, fertilizer or other chemical applications, which might pollute water courses.

- During construction, care should be taken in and around SuDS features to avoid compaction of subsoil and topsoil in particular through excessive tracking of machinery. When compaction occurs roots are unable to penetrate the soil

Figure 6: Amenity Pond

6. SUDS PRINCIPLES

GENERAL DESIGN PRINCIPLES

Sustainable drainage is a departure from the traditional approach to draining sites. There are some key principles that influence the planning and design process enabling SuDS to mimic natural drainage by:

- storing runoff and releasing it slowly (attenuation);
- harvesting and using the rain close to where it falls (source control);
- allowing water to soak into the ground (infiltration);
- slowly conveying water on the surface;
- filtering out pollutants; and
- allowing sediments to settle out by controlling the flow of the water.

Surface water is a valuable resource and this should be reflected in the way it is managed. It should be considered from the beginning of the development process and throughout, influencing the design and layout of the site. It is important, where appropriate and particularly on larger developments that an interdisciplinary team (planners, engineers, landscape architects) should work together from the outset.

SuDS are very flexible and there are a number of ways that they can be applied to provide great drainage that are both value for money and inspirational. The following are some of the key considerations when approaching the delivery of SuDS as part of a development in South Gloucestershire.

THE SUDS MANAGEMENT TRAIN

The principle behind the SuDS Management Train (also known as the SuDS Treatment Train) is that a series of different SuDS techniques 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.

Prevention measures at source provide the starting point, with control techniques used to manage water as close as possible to where the rain falls. This is called Source Control. Source Control often provides protection against siltation of downstream elements. 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.

The 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. On occasions we can get very heavy storms resulting in 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.

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.

Further guidance on the treatment train process is available in The SuDS Manual (CIRIA C753).

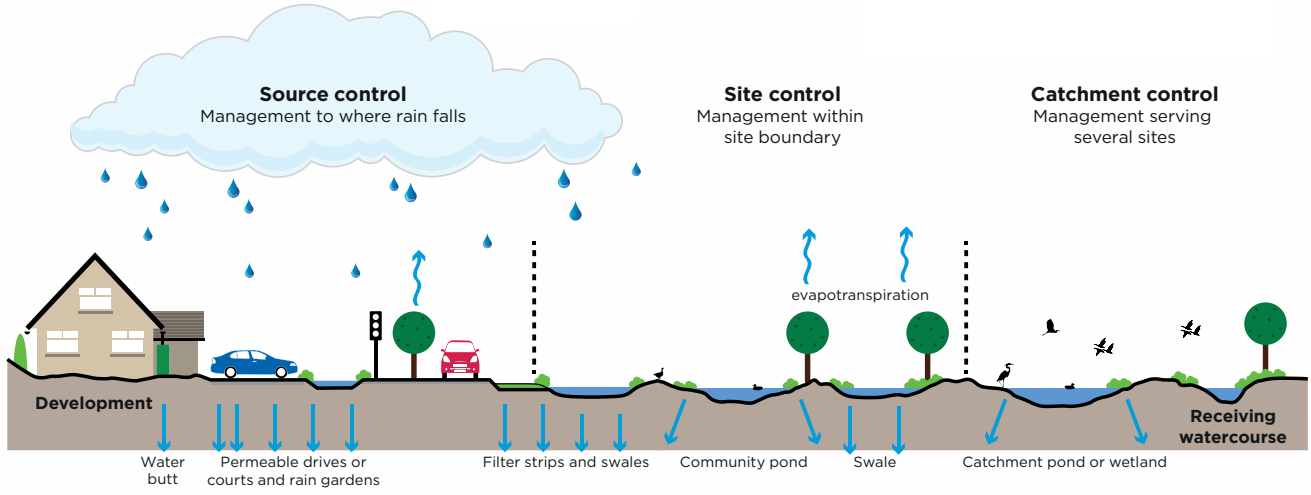

Figure 7: SuDS Management Train (WoE Developers Guide)

Plan in SuDS from the start

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 complement each other. As such SuDS need to be considered at the start of the design process to ensure drainage systems are effectively delivered.

The result of early inclusion of SuDS is a more effective and efficient layout which will avoid the need for abortive work and changes at a later stage which can escalate costs. Integrated design to achieve multi-functional benefits is inherent to the site master-planning and layout process; therefore it is most efficient and cost effective to design SuDS schemes into a site as early as possible.

As set out in Section 7 of this SPD we would recommend that for all major development sites that a Proof of Concept be prepared at the pre-planning stage.

Mimic natural drainage

The topography of an undeveloped site provides a good indication of natural flow routes and can therefore assist in defining appropriate and efficient flow routes through a developed site without relying on additional infrastructure. The most effective and cost efficient designs make use of the local topography, increase landscape permeability, and reduce the amount of surface water flowing off site as much as possible.

Allowing surface water runoff to follow the natural physical geography requires less soil movement and can eliminate the need for additional underground piping and pumping of water. Where the site is suitable for infiltration, opportunities to discharge water to the ground should be taken to mimic natural infiltration and recharge groundwater aquifers.

Source control

Dealing with water when and where it falls (source control) may be the preferred, cheaper and easier option for many developments. By dealing with runoff at source the volume of water and the potential amount of contamination is less, which requires smaller SuDS components further downstream. Often source control components are within the curtilage of properties and maintained by the property owner or manager. In South Gloucestershire we expect that developers look to maximise source control opportunities on their sites.

Managing water on the surface

Where possible runoff from developments should be managed on the surface. This enables their performance to be more easily inspected and managed with pollution incidents and potential flood risk being visible. Any problems with the system are quicker and easier to identify than with a conventional system and are generally cheaper and more straightforward to rectify.

Managing water on the surface can also greatly improve the quality of places by integrating water features into the development either through soft or hard landscaping. This provides an opportunity to create valuable amenity assets and increase the provision of green infrastructure in urban areas enhancing local biodiversity and creating habitat. In this way SuDS can help to produce attractive schemes which enhances both the nature conservation and amenity value of the development improving quality of life as well delivering recreation and education opportunities.

Figure 8: Swale at Abbeywood Community School (Stoke Gifford)

Place-making through SuDS design

When using conventional surface water management systems, water is hidden in pipes underground. By bringing water management to the surface using SuDS, there is an opportunity to enliven public spaces and streetscapes. The presence of water features within the urban environment can promote a strong sense of place, bring an urban space to life and create unique spaces that can be enjoyed by all.

SuDS features such as ponds, wetlands, pools, fountains and planted rills which can be purely aesthetic or interactive in nature, can be integrated into the public realm and open spaces to enrich the area with green infrastructure. Note that interactive SuDS should include an appropriate level of natural pre-treatment upstream before coming into human contact, such as in the case of water play areas.

Landscape-led approach

The selection of SuDS types and the creation of the SuDS network should both respond to and contribute to the surrounding built and natural landscape. A landscape-led approach uses SuDS as a mechanism to create strong green infrastructure networks and is important to increase connectivity to the wider ecosystem and landscape. Effective integration will also require carefully researched and selected plants, which work to improve the local green infrastructure and enhance biodiversity.

Design for wildlife and biodiversity

SuDS can provide the ideal opportunity to bring urban wetlands and other wildlife-friendly green spaces into towns and cities. They can be linked with existing habitats to create blue and green corridors whilst providing an amenity and education resource for the community. Where possible, existing habitats should be retained and incorporated into the landscape design.

SuDS features are likely to have greater species diversity if existing habitats are within dispersal distance for plants, invertebrates and amphibians. It should however be noted that existing wetlands should not be incorporated into SuDS unless there is a guaranteed supply of clean water. An aim should be to create new habitats based on the ecological context and conditions of the site. Habitats and species objectives that contribute to local, regional and national biodiversity targets should be prioritised.

7. PROOF OF CONCEPT

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.

It is important that developers establish the constraints plan for their sites including; overland flow paths, proposed 'blue' corridors, geological and hydrological conditions of their site, any discharge/maintenance requirements, at an early stage through desktop studies and ground investigations, before coming to any conclusions about the suitability of any particular SuDS system.

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

The below diagram shows the proposed design approach sequence, demonstrating how the outline design of SuDS should be undertaken.

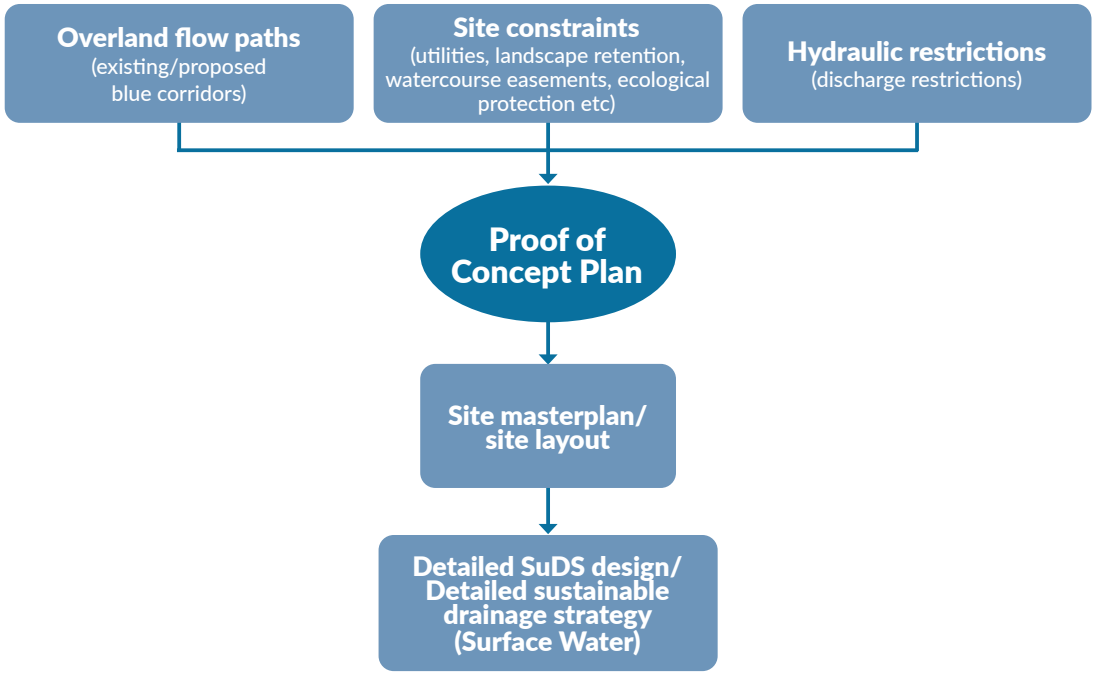

Figure 9: Initial drainage design including proof of concept stage (WoE SuDS Developers Guide)

SITE MASTERPLAN

Once the proof of concept plan has been prepared it can be used to inform the site masterplan, as it will confirm the developable area within the site. When the developable area has been identified, the developer can consider notional layouts that work with the land.

The below diagram is a generic overview of the potential SuDS design process to be followed by design engineers. It should be noted that some of the steps in diagram 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.

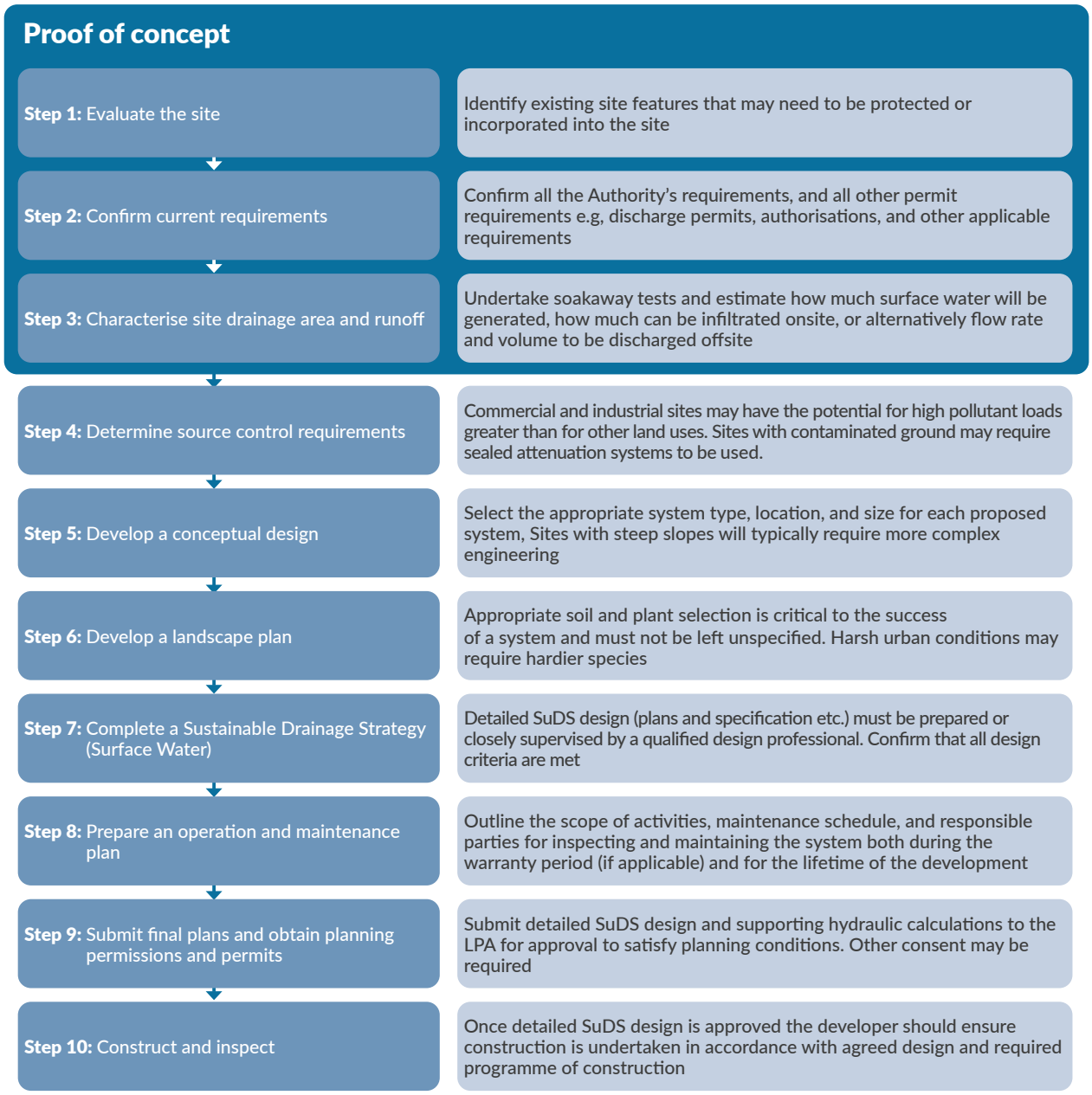

Figure 10: Generic SuDS Design Process (WoE SuDS Developers Guide)

8. SUDS DESIGN

All proposed SuDS should be designed to either maintain or reduce the pre-development run-off rate to mimic a natural drainage response. Natural drainage typically allows rainfall to soak into the ground, where the geology allows. Otherwise, water will naturally follow low points in the topography to create a drainage network linking to streams and wetlands.

Where natural surfaces are replaced, such as often occurs during development, drainage will often connect to artificial pipe networks. These pipe networks are often much more efficient at moving water around, leading to rapid flow to where the pipe network discharges. In these circumstances the aim of SuDS is to reduce the rate of the flow into the pipe network to protect existing drainage systems and provide environmental benefits.

The following section of the SPD outlines the design methodologies that should be followed when designing SuDS for development sites in South Gloucestershire.

MANAGING SURFACE WATER RUNOFF: DISCHARGE HIERARCHY

The destination of surface water 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. In order of preference, surface water runoff should be discharged:

- to the ground via infiltration;
- to a surface water body such as a river, ditch, pond or stream;
- to a surface water sewer; or
- to a combined sewer system (as a last resort when other options higher up the drainage hierarchy are not viable).

Evidence that the hierarchal approach has been applied must be provided before a SuDS application will be approved. Initial source control techniques 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.

Infiltration

When considering infiltration as the method for discharging surface water runoff the soil conditions and infiltration rates of the site need to be established at an early stage. Infiltration testing will need to be undertaken on site in accordance with BRE Digest 365. Note infiltration devices will not normally be permitted in Source Protection Zone 1 (SPZ1).

Evidence of the site investigations and results of the infiltration testing must then be provided for review. If no evidence is presented to secure that way of discharging surface water by infiltration, then an alternative outfall should be identified in case forthcoming tests show inadequate infiltration.

Surface waterbody

If the site is not suitable for infiltration, discharge to a surface water body should be considered next. A suitable outfall location, discharge strategy, rates and consents (where required for some outfall structures) must be agreed with the relevant authorities.

- for discharges into Ordinary Watercourses the agreement should be sought from South Gloucestershire Council (the LLFA);
- for discharges to Main Rivers, agreement is required from the Environment Agency; and
- for discharge into watercourses within the LSIDB area (known as rhines), agreement will need to be sought from the LSIDB.

Sewer systems

If a discharge to the ground or watercourse is not feasible, a surface water connection to a public surface water sewer should be considered. Connection into a public surface water sewer will need to be agreed with the sewerage undertaker, which is Wessex Water. However, the discharge rate from the site into the public surface water sewer will still need to be agreeable to the LLFA. Please note that any proposed connections into public foul sewers for the purpose of discharging surface water runoff from a site is unacceptable.

In some exceptional circumstances, there might be a possibility to connect surface water to the highway drain. However, it should be noted that the main purpose of highway drainage systems is to drain runoff from the adopted highway. The potential to connect into the highway drain will need to be discussed and agreed with the LLFA. In these instances the developer would need to demonstrate that there is adequate capacity in the system down to its outfall.

The developer must have agreements from the relevant authorities in place before concluding a method of surface water discharge. These agreements need to be in place for the planning application submission.

Control of surface water flows: peak flow control

To minimise the impact of development on the environment, surface water discharge from a site should not exceed the current run-off rate from the pre-developed condition. The appropriate method of assessing the predeveloped condition is dependent on whether the site is considered to be Greenfield or Brownfield.

Where run off rates from the proposed development exceed the pre-development rate, attenuation of runoff through the SuDS system shall be incorporated with hydraulic controls used to restrict discharge. A range of storm durations should be used to demonstrate that the system performs appropriately during the design storms.

SuDS should be specifically designed so that:

- In a 1 in 30 year rainfall event, there will be no flooding anywhere on the site (winter and summer storm events);
- In a 1 in 100 year rainfall event (plus allowance for climate change), there will be no flooding of any building on the site or any off site flooding (winter and summer storm events);
- For any rainfall event above 100 year, the drainage design should demonstrate how exceedance flows generated within the site will be managed including overland flow routes, protection of buildings to prevent entry of water, and protection of access routes.

The volume for attenuation storage can be provided after accounting for interception storage and long term storage. In comparison of the pre-development and post-development conditions, consideration of urban creep (such as the installation of patios and drives) must be included in the calculations.

Greenfield sites - runoff rates

The peak runoff rate for all new developments on Greenfield sites within South Gloucestershire must not exceed/be limited to the equivalent **Qbar Greenfield Runoff Rate** for all rainfall events from the 1 in 1 year rainfall event to the 1 in 100 year rainfall event. This is in accordance with Core Strategy Policy PSP20. Greenfield runoff rates are to be calculated using the Interim Code of Practice for Sustainable Drainage Systems method.

Brownfield sites – runoff rates

Brownfield (previously developed land) sites must reduce the existing runoff from the site as part of the redevelopment. Where possible, in order to provide betterment, redevelopments should look to reinstate Greenfield runoff rates. For Brownfield sites in South Gloucestershire we expect that the peak runoff rate from the development to any drain, sewer or surface water body be limited to or as close as possible to the **Qbar Greenfield Runoff Rate** from the 1 in 1 year rainfall event to the 1 in 100 year rainfall event. This is in accordance with Core Strategy Policy PSP20.

Where it is not possible to reduce discharge to or as close to the Qbar Greenfield rate as possible, an allowable discharge is to be agreed 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.

Minimum discharge rates

It is understood that some guidance recommends minimum discharge rates of 5 l/s, to minimise use of small orifice openings that could be at risk of blockages. However, appropriate consideration of filtration features to remove suspended matter and suitable maintenance regimes should minimise this risk and therefore the minimum limit of 5l/s does not apply in South Gloucestershire.

Control of surface water flows: volume control

Uncontrolled discharge volumes on developed sites can be up to 10 times greater than the predevelopment/greenfield equivalent. This additional volume may cause a risk of flooding to the receiving water body. The difference between existing and proposed volumes of water should not be discharged off site i.e. should be infiltrated wherever possible. Where ground conditions do not allow infiltration, the additional volume must be stored on site to be slowly released – this volume is referred to as the Long Term Storage Volume.

Greenfield sites – volume control

In relation to runoff volumes 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.

Brownfield sites – volume control

In terms of volume control where reasonably practicable, for developments on Brownfield sites the runoff volume from the development to any 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.

Flood risk within the development

As per National Standards SuDS 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. 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 above ground SuDS conveyance and attenuation features is required.

Drainage systems must also 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. In addition to the National Standard, adoptable Highways should not to be used to convey exceedance flows from new development unless the highway is a designated flood route that has been agreed with the Highway Authority.

Any infiltration storage features should be capable of half emptying within 24 hours of the rainfall event. This is to ensure capacity for further rainfall events. The risk of high groundwater levels must be accounted for in the design of infiltration drainage. The invert of any infiltration device should be at least 1.0m above the maximum groundwater level recorded.

It should be demonstrated that high water levels at the outfall for the design storm event would not affect the performance of the system. If the outfall of an attenuation facility is likely to be submerged in the design 1 in 100 year rainfall event, then this should be assessed within any hydraulic modelling. Alternatively, within 24 hours of top water level being attained, the regulation facility must be capable of storing 80% of the run-off arising from a 1 in 10 year rainfall event. It should also be demonstrated that any blockage within the system and extreme rainfall volumes can be accommodated through safe overflow routes.

Exceedance

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. Developers must demonstrate they have considered the possibility that their drainage design might fail even if the system is designed for 100 year storms with allowance for climate change.

A backup plan for this eventuality should be developed, which means designing for exceedance. For example overland flow should be routed away from vulnerable areas. This approach should consider the impact of, for example, blockage on outlets, overland flow routes, over-design events and worsening external constraints (such as tidal impacts, failure of any local flood defences etc.).

The drainage system must also be designed to accommodate overland flow from adjacent land if this is likely to be intercepted or affected by the development.

Climate change allowance

The frequency and intensity of rainfall is predicted to increase as a result of climate change and an allowance for how this will affect the proposal will need to be factored into design. An allowance for climate change needs to be incorporated as part of the design, which means adding an extra amount to peak rainfall (20% for commercial development, 40% for residential).

When sizing SUDS features, an allowance should be included for climate change, siltation and vegetation, in accordance with National Standards, CIRIA, Environmental Agency and PPS25 guidelines. The climate change allowance can be adjusted according to the design life of the development.

Urban creep

Urban creep 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. Much research has been carried out in to the effect of urban creep and its effect on the drainage systems which cater for urban areas. It has been shown that, over the lifetime of a development, urban creep can increase impermeable areas by as much as 10%.

Whilst we have always considered the impermeable areas proposed on new development sites and accounted for climate change we have not, previously, accounted for urban creep. Since the 1st of February 2015 an allowance for urban creep is now be required as part of the surface water drainage proposals for new development in South Gloucestershire. The requirements in relation to urban creep is shown in the below table.

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

Figure 11: Requirements for Urban Creep

The consideration of urban creep should be assessed within any hydraulic modelling. Alternatively, within 24 hours of top water level being attained, the regulation facility must be capable of storing 80% of the run-off arising from a 1 in 10 year rainfall event. It should also be demonstrated that any blockage within the system and extreme rainfall volumes can be accommodated through safe overflow routes.

Where the inclusion of the appropriate allowance would increase the total impermeable area to greater than 100%, 100% should be used as the maximum. “Curtilage” means area of land around a building or group of buildings which is for the private use of the occupants of the buildings.

Please note that in South Gloucestershire we discourage the loss of green garden areas to additional hard surfacing (urban creep) as it can have an adverse impact on surface water runoff and carbon storage and we will always look for green garden areas to be retained.

9. SUDS TECHNIQUES

There are a wide range of SuDS that can be included in the design of a scheme each having different approaches to managing flows, volumes, water quality and providing amenity and biodiversity benefits. The application of SuDS is not limited to one technique per site and often a successful SuDS solution will utilise a number of techniques in combination.

It is expected that all SuDS features proposed to be implemented as part of development within South Gloucestershire be designed in accordance with the SuDS Manual (CIRIA C753) and CIRIA C698 Site handbook for the construction of SuDS. Details including construction and maintenance requirements can also be found in these documents.

As such, this section of the SPD does not replicate detailed information and guidance. Instead it provides an overview of the various SuDS techniques that can be included as part of proposed development sites in South Gloucestershire and where applicable sets out specific design requirements in the context of South Gloucestershire.

THE SELECTION PROCESS

When selecting SuDS it is important to consider water quality, water quantity and amenity/biodiversity design criteria equally. There will not be a single "correct" answer. Instead there will be several options that may meet the design criteria, and judgement will be needed. Once an initial assessment of the site has been made and the design strategies for the drainage system have been agreed the drainage components can be selected.

The selection process should be based on the principle of:

- The drainage scheme complements the overall vision for the site and management of surface water;
- Drainage components will be used in series (the SuDS management train) to meet the design criteria for water quantity, quality, amenity and biodiversity;
- Drainage components at the top of the management train are generally to be preferred to those further downstream;
- There is no single correct solution and selection may be the result of site opportunities and constraints;

- Minimise the use of impermeable surfaces wherever possible;
- Maximise opportunity for managing water at or near the surface; and
- Source control is preferred providing more natural drainage and integrating water into the built environment.

The SuDS scheme should be inspired by the original drainage pattern and characteristics of the local area and should also be designed to facilitate maintenance and operation. The selection of individual components and the SuDS scheme will depend on a variety of site attributes and factors including:

- local hydrology and hydrogeology;
- ground contamination;
- depth of/to water table;
- soil permeability;
- ground stability;
- sensitivity of receiving waterbody (either surface water or groundwater);
- size of catchment area;
- development type, density and required layout;
- requirements for local flood risk management;
- other opportunities within the overall site; and
- affordability of scheme (capital and operational).

In assessing SUDS, the Council will consider not just the flood risk management criteria, but also the opportunities to realise other environmental gains and amenity uses. It is important that care be taken when considering using SuDS as not all are suitable in all areas and may affect drainage in other localities. Some development sites may also have challenges to delivering SuDS.

Source control

The inclusion of source control in SuDS schemes is one of the more important principles of SuDS design and source control components should be upstream of any pond, wetland or other SuDS component. Source control can help provide interception storage which can handle and treat some of the more frequent but smaller, polluting events.

Most source control components will be located within the private properties or highway areas. Their purpose is to manage rainfall close to where it falls, not allowing it to become a problem elsewhere. They look to maximise permeability within a site to promote attenuation, treatment and infiltration reducing the need for offsite conveyance.

South Gloucestershire Council requires that developers maximise run-off (source) control opportunities early in the management train.

The main type of source control techniques include:

- Green roofs;
- Rainwater harvesting;
- Permeable paving;
- Other permeable surfaces.

Green roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping. The roof is likely to consist of an impermeable layer, a substrate or growing medium and a drainage layer (although not all green roofs require a drainage layer). Green roofs are designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.

Figure 12: Example of a Green Roof

Rainwater Harvesting

Rainwater from roofs and hard surfaces can be stored and used. If designed appropriately, the systems can also be used to reduce the rates and volumes of runoff. Water butts are the most common means of harvesting rainwater, although they are primarily designed for small scale use such as in gardens. Therefore the relative cost, maintenance and performance of water butts when compared to other larger rainwater harvesting systems are significantly less.

Figure 13: Example of rainwater harvesting

Pervious Paving (surfaces)

Pervious surfaces can be either porous or permeable. The important distinction between the two is:

- Porous surfacing is a surface that infiltrates water across the entire surface.
- Permeable surfacing is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration through the pattern of voids.

Pervious surfaces provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into underlying layers. The water can be temporarily stored before infiltration to the ground, reused, or discharged to a watercourse or other drainage system. Surfaces with an aggregate sub-base can provide good water quality treatment.

In South Gloucestershire we encourage the proposed use of pervious paving for private roads and parking areas. However, please note that we South Gloucestershire Council as the Highway Authority do not formally adopt pervious paving.

Figure 14: Example of Permeable Paving

Other permeable surfaces

Other permeable surfaces can include:

- Grass (if the area will not be trafficked)
- Reinforced grass
- Gravelled areas

The water passes through the surface to the permeable fill. This allows the storage, treatment, transport and infiltration of water.

Swales and conveyance channels

The conveyance of surface water runoff across the site, between SuDS components is essential. There are a variety of approaches that can be used; underground through pipes with little control or water quality treatment, or through vegetated channels on the surface providing some treatment and attenuation and through more engineered canals or rills.

The preference in terms of delivering sustainable drainage objectives is the conveyance of water through vegetated channels or swales. Uncontrolled conveyance to a point of discharge into the environment is discouraged. Overland flow routes will also be required to convey and control floodwater safely during extreme events. In general, the greater the number of components used in series, the better the performance is likely to be, and the lower the risk of overall system failure. Components that can be used for conveyance include:

- Swales; and
- Canals and rills.

Swales

Swales are shallow, broad and vegetated channels designed to store and/or convey runoff and remove pollutants. They may be used as conveyance structures to pass the runoff to the next stage of the treatment train and can be designed to promote infiltration where soil and groundwater conditions allow. The shallow side slopes and flat bottom means that for most of the time water flows in a thin layer, some of them can be under drained with the use of perforated pipe.

Pollution control is achieved in a swale by forcing a reduced speed of flow, allowing fine sediments to settle in the base of the swale, allowing the vegetation to absorb and filter the runoff. Their linear lengths promote natural treatment of the runoff through a combination of settlement, phytolysis, oxygenation and plant uptake.

Figure 15: Example of a swale with walkway beside

The storage aspect of a swale can be increased by the inclusion of small check dam structures, which allow water to pass forward once a certain depth is reached. The use of check dams can increase the moisture gradients provided by the swale, allowing increased biodiversity with wet and dry reaches. It may be that the areas upstream of a check dam are lined with clay to further increase the retention of water.

In South Gloucestershire we expect swales to be designed in accordance with the SuDS Manual (CIRIA C753). This document also includes construction and maintenance requirements. The one specific design requirement we do have in South Gloucestershire is that swales are designed with side slope gradients of 1 in 3 or less, to allow for ease of access. From a maintenance perspective there should also be adequate access to the swale and to all associated components (inlet / outlets and headwalls etc.).

Canals and Rills

Canals and rills are open surface water features with hard edges. They can have a variety of cross sections to suit the urban landscape and can also be planted to provide water treatment. In dense urban developments, or retrofit situations they can be an effective way of providing SuDS and if appropriately designed can also act as pre-treatment to remove silt before water is conveyed into other SuDS components.

Treatment channels collect water, slow it down and can provide storage for silt and oil that is captured. The outlet is designed to act as a mini oil separator and enables the channel to be very effective at treating pollution.

Figure 16: Example of a Typical Rill Channel

Filtration

Filtration and removing sediment or other particles from surface water runoff is one of the main treatment methods for sustainable drainage. This may occur through trapping it within the soil or aggregate, on plants or on geotextile layers within the construction. The location of any filtration will depend upon the structure of the particular SuDS component.

The components that are classified under filtration include:

- Filter strips;
- Filter trenches; and
- Bioretention areas.

Filter Strips & Filter Trenches

Filter strips are gently sloping, vegetated strips of land that provide opportunities for slow conveyance and infiltration (where appropriate). They are designed to accept runoff as overland sheet flow from upstream development and often lie between a hard-surfaced area and a receiving stream, surface water collection, treatment or disposal system.

The main purpose of the filter strip is to remove any silt in the water so that it does not clog up downstream components. They treat runoff by vegetative filtering, and promote settlement of particulate pollutants and infiltration.

Filter trenches provide a similar function to filter strips. They are shallow excavations filled with rubble or stone that create temporary subsurface storage for infiltration or filtration of runoff. These trenches can also be used to filter and convey storm water to downstream SuDS components. Ideally filter trenches should receive lateral inflow from an adjacent impermeable surface, but point source inflows are also acceptable.

Figure 17: Example of a Filter Drain / Strip

Bioretention Areas

Bioretention areas are shallow landscaped depressions which are typically under drained and rely on engineered soils, enhanced vegetation and filtration to remove pollution and reduce runoff downstream. They are aimed at managing and treating runoff from frequent rainfall events.

The filtration layers are usually under drained using a perforated pipe system and where appropriate can allow infiltration. Trees can also be incorporated into bioretention systems and they can therefore be integrated with tree pits in streetscapes and other public realm areas. They have an aesthetic and biodiversity value as they can be planted to enhance local character and are attractive landscape features.

Infiltration

Infiltration components are used to capture surface water runoff and allow it to infiltrate through to the subsoil layer, before returning it to the water table below. Infiltration components can be incorporated into a range of SuDS components. However, there are a number of technical considerations to keep in mind with using infiltration components.

The suitability for infiltration across an area should be based on:

- Existing constraints prior to planning infiltration SuDS;
- Drainage capacity and rate of infiltration into the ground;
- Potential for ground instability when water is infiltrated;
- Impact on groundwater quality as a result of infiltration;
- Development on contaminated land or Source Protection Zones (SPZ) (vulnerable aquifers).

Infiltration should be assessed on-site using infiltration tests that follow the detailed SuDS design principles covered in BRE Digest 365/CIRIA 156 procedure. The maximum acceptable depth for an infiltration device is usually 2.0m below ground level and in addition infiltration components should also be located 1m above seasonal high water table.

In some circumstances, Deep Borehole Soakaways may be considered for a site, which have a depth below ground level greater than 2.0m. In South Gloucestershire there have been a few sites that have proposed this particular method and have been accepted by the LLFA.

Source Protection Zones (SPZ's) should be taken into account when considering infiltration and guidance provided by the Environment Agency should be consulted to determine infiltration constraints and requirements in these areas. A risk assessment should also be undertaken when using infiltration components in areas of contaminated land and not located in areas of impermeable soils.

Investigations should be undertaken on a site by site basis within a development. Just because the ground is not suitable in one area, this does not mean infiltration cannot be used across the entire site. Care also needs to be taken with allowing infiltration components close to the building although this is slightly relaxed for components like permeable surfaces that will behave in much the same way as a lawn.

Infiltration components include:

- Soakaways
- Infiltration trenches
- Infiltration basins
- Rain gardens

Soakaways

Soakaways are the most common type of infiltration device. They store runoff from a single house or from a development and allow its efficient infiltration into the surrounding soil. Soakaways will allow water to soak through the surface into the gravel sub-base below, temporarily holding water before allowing it to either soak into the ground to an outfall. They can be used to provide storm water attenuation, treatment and groundwater recharge.

Soakaways are square or circular excavations either filled with rubble or lined with brickwork, pre-cast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. The supporting structure and backfill can be substituted by modular or geocellular units.

Infiltration trench

Infiltration trenches are shallow excavations with rubble or stone that create temporary subsurface storage of storm water runoff, thereby enhancing the natural capacity of the ground to store and drain water. Infiltration trenches allow water to infiltrate into the surrounding soils from the bottom and sides of the trench. Ideally they should receive lateral inflow from an adjacent impermeable surface, but point source inflows may be acceptable.

Infiltration basin

An infiltration basin is a dry vegetated basin or depression designed to promote the gradual infiltration of surface water runoff into the ground. They are typically dry except in periods of heavy rainfall. Plants in an infiltration basin should be able to withstand periods of ponding and dry periods and, ideally, maintain or enhance the pore space in the underlying soils via deep rooting systems.

Specific design requirement for infiltration basins

In South Gloucestershire we expect infiltration basins to be designed in accordance with CIRIA C753 the SuDS Manual. This document also includes construction and maintenance requirements for these features. However, in South Gloucestershire we have the following additional design requirement;

- Side slopes of an infiltration basin should have a gradient of 1:3 or less steep to allow for ease of access to carry out maintenance activities and for health and safety requirements. This will also help to reduce flow speed of any incoming overland flow and reduce erosion risks around the basin.

- A minimum freeboard of 300mm needs to be provided between the top water level and the top of bank.

- We would expect that basins in terms of their overall depth to not exceed a total depth from top of bank to base of basin of more than 2.5m. If the basin depth exceeds 2.5m then measures such as dry benches should be provided.

- From a maintenance perspective there should be unimpeded access to the entirety of the retention or detention feature and to all associated components.

Rain gardens

Rain gardens are relatively small depressions in the ground that can act as infiltration points for roof water and other 'clean' surface water – i.e. water that is low in contamination levels. Rain gardens are most likely to be implemented on private property close to buildings. In order for roof water to reach a rain garden, property downpipes are often disconnected from the drainage system and redirected. They should be planted up with predominantly native vegetation that is happy with occasional inundations.

Figure 18: Example of a rain garden next to public highway

Retention and detention

These are SuDS components designed to either provide storage, through the retention of surface water runoff, or attenuation through the detention of surface water runoff. Retention is primarily provided on the surface through ponds, and underground through tanks. Detention is often provided by detention basins.

Retention storage within ponds as well as helping manage flood risk is also useful in providing water treatment. However, there should be upstream components or treatment stages before surface water is conveyed to ponds. Detention is often useful in attenuating the peak flow from a rainfall event, but it also allows filtering and sedimentation to take place, which contributes to water quality improvement.

Retention and detention components include:

- Detention basins
- Retention ponds
- Underground storage tanks

A well designed SuDS scheme should have most of the storage and water treatment performed by upstream source control components of the SuDS scheme. These ponds operate optimally when flows are managed and they're providing a final polish to remove any pollution. Silt should also be removed from the runoff before it enters underground storage tanks.

Detention basins

Detention basins are open, usually flat-bottomed areas of grass that are normally dry, except after major storm events. In heavy rainfall they are used to store water for a short time. Water accumulated in the basin is either slowly discharged to the next SuDS component or to a receiving watercourse. Effective operation requires that sediment and debris is removed upstream.

The benefit of a detention basin is the reduction in the flow rate and the volume of water downstream. The inclusion of detention basins in a SuDS installation can provide aesthetic benefit to public areas, visual quality and habitat creation. Detention basins provide a useful stage in pollution control. The slowing of flows allows settlement of suspended solids and allows biological uptake of pollutants by plants, algae, and bacteria.

Figure 19: Detention Basin – Emersons Green

Retention ponds

Retention ponds are open areas of shallow water, designed so they can accommodate rainfall and provide temporary storage for excess water. The water level rises temporarily when it rains, but there is always a permanent pool of water. They are similar to wetlands, but they are more useful for storing excess water. The design of retention ponds permanently storing water is what differentiates from detention basins. They are typically planted with marginal, emergent and aquatic plants and provide an element of water quality treatment (dilution and detention) of the runoff before ultimate discharge.

Retention ponds provide valuable biodegradation of hydrocarbons by allowing microorganisms in the water column to feed and pull in oxygen from shallow water. They should, however, receive free inflow as free as practicable from sediment to minimise deposition and ongoing maintenance issues.

The pond/s should be placed last in the overall SuDS treatment train to ensure they only receive relatively clean water. Ponds should also provide both wet and dry areas with a range of moisture conditions, to store water. This can be achieved by providing a variation in the pond shape and depth – for example by having shallow pools. Sites with high permeability soils may need lining to prevent loss of water through infiltration and thus create a permanent pond area. To this effect, the pond could be lined and reference is always for a natural puddle clay or similar lining. Man-made liners can be used if clay is not a viable option.

Specific design requirement for retention and detention features

In South Gloucestershire we expect both retention and detention features to be designed in accordance with CIRIA C753 the SuDS Manual. This document also includes construction and maintenance requirements for these features. However, in South Gloucestershire we have the following additional design requirement;

- Side slopes of a retention or detention basin should have a gradient of 1:3 or less. This will help to reduce flow speed of any incoming overland flow and reduce erosion risks around the basin.

- A minimum freeboard of 300mm needs to be provided between the top water level and the top of bank.

- We would expect that basins in terms of their overall depth to not exceed a total depth from top of bank to base of basin of more than 2.5m. If the basin depth exceeds 2.5m then measures such as dry benches should be provided.

- From a maintenance perspective there should be unimpeded access to the entirety of the retention or detention feature and to all associated components.

Underground storage

Underground storage features (tanks, oversized pipes etc.) attenuate an agreed volume with a control structure to limit the discharge rate. Geocellular tanks with a high void ratio, have begun to replace underground pipes or concrete tanks that would normally store water. They can also be used to convey or infiltrate surface water runoff into the ground (but they cannot provide water quality treatment).

Structural design for such features must be provided to ensure integrity of the box, pipe or tank under loading (See CIRIA C680). Geocellular storage used on its own is unlikely to be regarded as a SuDS scheme, as it should incorporate source control.

Figure 20: Geocellular Storage Crate System under construction in Yate

Wetlands

Wetlands are densely vegetated water bodies that use sedimentation and filtration to provide treatment of surface water runoff. They generally consist of an inlet zone (sediment basin) a macrophyte zone, which is shallow, densely vegetated area; and a high flow bypass channel, which is typically a wide vegetated swale from the inlet pond around the side of the wetland.

Where possible wetlands should be the last stage of the SuDS management train and should be one of the last treatment stages, otherwise there's a risk of extensive siltation (unless there is upstream treatment). They remove fine sediments, metals and particulates, and dissolved nutrients. Wetlands mainly treat polluted runoff, provide attenuation and deliver biodiversity and amenity.

Wetlands can be constructed on a variety of scales. In highly urbanised areas, wetlands can have a hard edge or be part of the streetscape or other hard landscaping features and furniture. They must be appropriately sized for the catchment to ensure the hydraulics support water treatment.

Upstream components both control the flow and level of siltation allowing wetlands and ponds to polish the runoff. This is achieved by ensuring water flows slowly through the wetland over an extended period of time (known as the residence time). An important mechanism is also the breakdown of oils by natural organisms. They need a good supply of oxygen which means the permanent water must be shallow enough so that oxygen can reach the bottom of the wetland.

Inlets, outlets & control structures

Inlets, outlets and control structures are important components of a well-designed SuDS schemes. As SuDS promote the use of small, cost effective landscape features, on the surface and close to source, the control and conveyance of low flows and velocities are essential.

Inlet and outlet features allow water to flow into and out of features whilst control structures are used to limit the rate at which water flows along and out of the system. There are many different designs and variations, including landscaped pipes, perforated pipes, weirs, orifices, vortex control devices and spillways.

In relation to inlet or outlet structures they should be designed to add interest to the urban landscape, but also consider the implications of maintenance, as regular inspections and cleaning may be required, including in extreme storm event conditions, where safe access to clear blockages must always be available.

Multiple approaches and products are available and they can be easily designed to add interest to the urban landscape. They should be reviewed regarding function, appearance, maintenance, safety and cost. A full range of inlets and outlet structures can be found in the SuDS Manual (CIRIA C753).

10. CONSTRUCTION OF SUDS

Development sites within South Gloucestershire will be designed to incorporate SuDS to attenuate and treat runoff during their operational phase. However, runoff generated during the construction phase of the developments will also need to be managed and treated. Some permanent SuDS features can be used for this and some additional temporary works will also be required.

As with all construction activities there is a risk of poor delivery if workers are not familiar with the necessary techniques for the construction of SuDS features. A lack of attention to detail can reduce or remove the effectiveness of the SuDS.

Figure 21: SuDS attenuation feature under construction

SuDS that are suitable for use during construction, subject to good management practice, are:

- Swales;
- Detention basins;
- Green roofs;
- Rainwater harvesting systems; and
- Online and offline storage.

Construction risks

The main risks to permanent SuDS during the construction phase are caused by:

- Greater sediment volumes during construction than during the operational phase;
- Contaminated silt; and
- Blockages and accumulation of silt causing damage to the permanent SuDS.

The most important aspect to consider during the construction period is the management and control of silt or other pollutants at all stages to prevent blockages and deposition. This is particularly important where SuDS are used to control runoff during construction and are subsequently incorporated in the permanent works.

The protection of SuDS during construction is therefore imperative. For example, permeable paving can easily become blocked by fine sediment eroding from unprotected surrounding areas. Designers should consider the construction sequence with care. Good practice to adopt during the planning and construction should be in accordance with CIRIA C648.

Pre-construction planning can help ensure the successful delivery of SuDS. Key activities before, during and after construction are as follows:

Pre-construction phase

- Plan site set up (control mechanisms, sequencing, and contingency measures);
- Identify potential for pollution from runoff from compound areas, car parks, haul routes and storage areas and other construction activities;
- Apply for discharge consents if site runoff to be discharged to watercourses (not usually required for domestic surface water run off).

Construction phase

- Monitor water quality at several locations in water bodies around and within the site;
- Monitor erosion and sediment runoff.
- Post Construction Phase- Handover
- Clean sediment forebays as required;
- Remove temporary structures used within SuDS;
- Ensure permanent SuDS structures are operational.

Temporary construction sediment and erosion control mechanisms

The design of temporary construction sediment and erosion control mechanisms for a development should be undertaken in accordance with:

- CIRIA C648, which recommends the installation of sediment and erosion control mechanisms as soon as SuDS features are constructed to prevent damage due to siltation;
- CIRIA C532; and
- Environment Agency Pollution Prevention Guidelines 5 and 6, which give particular focus to silt management.

Sediment control mechanisms

Sediment control mechanisms that may be used as temporary works in conjunction with SuDS include:

- **Pumping to grassland and filtration infiltration** – not appropriate for long term use and is only suitable for water that is unpolluted aside from its silt content. Performance depends on the infiltration and permeability of the underlying ground.

- **Settlement Ponds** – have the advantage of being simple and effective and require less maintenance than other sediment control techniques. They can be converted to permanent SuDS features at the completion of works.

- **Filtration** – there are two methods that can be used to remove construction runoff silt prior to discharge. The first method comprises techniques used to trap sediment as water is flowing across site or along channels. The second is filtration by pumping water through steel tanks or skips filled with a suitable filter such as fine single sized aggregate, geotextiles or straw bales.

Erosion control mechanisms

Erosion control mechanisms that may be used as temporary works during construction and in conjunction with SuDS include:

- **Seeding and planting** – to provide temporary stabilisation of soil during construction works to reduce erosion and runoff with high silt content. Care is needed when considering seeding and planting temporary stockpiles as this can attract protected species as they make ideal hibernation sites for reptiles and amphibians.

- **Geotextiles and mats** – use of meshes, netting and sheeting made of natural or synthetic material to stabilise soil temporarily or permanently. They are suited to post construction site stabilisation but may be used for stabilisation of easily eroded soils in sensitive areas including channels and streams where flow may cause erosion.

- **Diversion drains and slope drains** – allow construction run-off to be channelled to appropriate areas on site where it can be controlled and treated. Diversion drains are simple to construct and consist of linear ditches with earth bunds. Slope drains allow runoff flowing directly down a slope by confining all the runoff into an enclosed pipe or channel.

- **Check Dams and sediment traps** - can be constructed across a swale or drainage ditch to reduce the velocity of concentrated runoff thereby reducing the erosion of the swale or ditch and promoting sedimentation. Properly anchored wood, straw bales, hay bales or rock filter bunds may be used.

- **Silt Fence** - comprises of a geotextile filter fabric or straw bales or a combination of both and is installed in the path of sheet flow runoff to filter out heavy sediments. Silt fences may be useful to filter out heavy sediments but will not reduce turbidity.

Some SuDS, such as ponds, can usefully be used to protect watercourses from silt arising during construction. These features used in such a way would then need to be restored to their design capacity at the completion of construction.

Inspections

Inspection during and after the construction of SuDS components and the overall scheme should be carried out to ensure that the system is being constructed correctly and that design assumptions and criteria are not invalidated, for example, by the construction methods used by changes made on site or by variations in ground conditions.

These inspections should be undertaken as necessary and it may be helpful to take photographs. As a minimum inspection could be expected to include the following:

- Pre-excavation inspection to ensure that construction runoff is being adequately dealt with on site and will not cause clogging of the SuDS components;

- Inspections of excavations (for ponds, swales etc.);

- Inspection of manufacturers details of membranes, inlets, outlets and any control structures associated with components;

- Confirmation of sources for materials, i.e. soil, planting lists and material specifications;

Construction method statements

The implementation of a comprehensive quality assurance regime is fundamental to the achievement of a minimum standard of workmanship when constructing SuDS. It is generally accepted that a high proportion of the perceived failures of SuDS components are as a direct result of either poor quality workmanship at the installation stage or damage during construction.

Method statements should be kept simple and emphasise the differences from traditional construction activities, setting out the justification behind the construction programming (in relation to the drainage components), describe important construction processes and specify the installation of critical items.

Common challenges

The majority of challenges can be overcome by a competent and appropriate contractor. There are subtle (but important) differences between a ground worker and landscape contractor. Good communication with simple plans and information is essential. Other key challenges and suggestions include:

Clogging of infiltration systems - If appropriate programming is not possible (i.e. phased developments), careful management of construction runoff and storage of materials should reduce the chances of binding and clogging of infiltration components (permeable pavements, filter drains etc. Rehabilitation may be necessary.

Compaction - careful consideration of the construction process, programme and equipment is required to ensure that the ground and soil is not over-compacted, reducing infiltration.

Communication and understanding - Effective engagement is essential. The designer or contractor should produce a construction method statement for SuDS (dealing with construction runoff, programme etc.). Drawings should be appropriately detailed and provide an explanation of what needs to be done and why. Often a pre-startup meeting with contractors is also helpful.

Levels - Ensuring these are correct and in accordance with the drawings is essential. There also needs to be a recognition that vegetation growth may also change the levels.

Planting - Programme and time of the year will have an impact on vegetation establishment, maintenance and the general aesthetics of SuDS.

All of these challenges can be overcome, but it will save time, effort and money if they are considered from the outset. Guidance on construction standards for components is provided in the SuDS Manual (CIRIA C753).

11. HEALTH & SAFETY

A Health and Safety review of SuDS features involves both a consideration of public acceptance as well as a practical assessment of risk and consequence. The primary risk for SuDS features is the risk of drowning.

All structures associated with SuDS in South Gloucestershire should be evaluated for risk to the public and operatives carrying out maintenance of the SuDS features. The SuDS designer must demonstrate measures taken to reduce the possibility of harm to the public or operatives, which should be agreed with South Gloucestershire Council during the design approval process.

Design

Under the CDM Regulations 2015, the SuDS designer has a responsibility to eliminate hazards by designing them out if possible. Health and Safety issues should be considered throughout the design process with the aim of delivering SuDS that are safe and easy to maintain. All open water features should be carefully assessed, particularly regarding access by young children. Designers must take all reasonable measures to minimise the risk of drowning or harm in any other way and consider all potential liabilities.

There are design risk mitigation measures that can be considered during the design stage so as to limit/design out risk. The following are a list of potential risk mitigation measures to be considered during the design process:

- avoid high vertical drops/headwalls;
- slopes no steeper than 1 in 3 for basins, ponds and swales;
- avoid fast flowing water (prefer maximum velocities of 0.5m/s) and avoid areas that become inundated very quickly;
- marginal planting can create physical protection but should not obstruct visibility of the water from the surrounding area;
- safety grills should be placed on pipes greater than 350mm or greater diameter, with slopes at an angle of 45 degree so that debris is likely to lodge against them yet not block;
- a maximum storage depth of 600mm is acceptable for swales;

- pollution and nutrients should be removed at source by designing the SuDS in accordance with the SuDS management train to avoid contamination and disease;

- a level dry bench at the top of all open structures, 1m minimum wide, allows stationary rest for a person and safe access – i.e. make it easy to exit;

- a wet bench, 1m minimum wide to all water features allows stationary rest for a person and safe access;

- gullies, silt trap pits, catchpits and other sumps should be avoided wherever possible to reduce risk to wildlife and pedestrians and

- danger signs and life-saving equipment for SuDS features should not be necessary where the conditions set out above are followed as SuDS should be considered inherently safe features in the landscape. However, these may be applicable if the conditions as set out above are not followed.

Maintenance

Consideration of the CDM regulations must be made for the long term maintenance of SuDS. In South Gloucestershire we would expect that:

- all SuDS features to afford safe and secure access for maintenance, including emergency access in any storm event;

- any drainage asset that requires maintenance must have suitable vehicular access and the access points should be level, secure and stable;

- access must be available to all parts of a SuDS feature and there be adequate and safe access for machine work;

- any above ground SuDS feature (basin/swale etc.) shall be designed with slopes not exceeding 1 in 3 to allow for maintenance, access and egress; and

- other than for ponds, the maximum depth of standing water should be no more than 600mm.

An appropriate maintenance strategy should be in place. Operatives completing maintenance work should be educated to observe safe systems of work in order to mitigate any remaining risk associated with untreated / polluted water.

Drowning risk

Fear of drowning is a reasonable anxiety in the users of sites with surface water bodies, particularly in residential areas. Young children may not understand the danger of open water so need special consideration. The need for variety within your SuDS installation should be compatible with a safe and easily managed open space. It is a matter of design to ensure that steps, benches and gently sloping banks are included. Measures to ensure reasonable safety should be based on guidance, best practice and judgement.

Trips, slips & falls

Any surface structure will present a hazard to people. There are a number of specific SuDS features that require safety to be considered in their design: inlets and outlets, control structures, inspection chambers, weirs and others. Gully pots, pipes, chambers, vents and other sumps in the landscape can be a hazard to wildlife as well as people, and should be 'designed-out' where possible. They must never be situated within the impact attenuating area of children's play equipment.

Dirty water

One of the aims of SuDS is to remove pollutants from surface water. The risk of mis-connections of waste water, common in traditional piped drainage systems, is removed by using SuDS. Rainwater runoff that has passed through a SuDS system results in clean, low nutrient water that is good for wildlife and which poses minimum risk for people. SuDS management trains that feature multiple treatment stages maximise the quality of surface water for wildlife and people.

12. ADOPTION, MANAGEMENT AND MAINTENANCE OF SUDS

A range of SuDS may be required within new developments in order to produce an effective drainage system. These features have different maintenance requirements and design lives and it is therefore imperative that a suitable management system is put in place for all the SuDS features constructed. An assessment of management requirements should be made at the design stage. South Gloucestershire Council will need to be satisfied that suitable arrangements for future maintenance of SuDS are in place.

MAINTENANCE OF SUDS

Like all drainage systems, SuDS components need to be inspected and maintained to ensure efficient operation and prevent failures. To ensure the success and effective operation of SuDS there needs to be long term maintenance arrangements in place. This is also true for all drainage features including 'traditional' piped systems. The maintenance of SuDS features is no more difficult than maintaining traditional systems but may include a number of different activities or skills.

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 the amenity or biodiversity requirements.

The ongoing management and maintenance of SuDS features should not compromise the biodiversity or other amenity value of the site. Careful consideration should be given to the method and timing of such operations. For example, avoid weed cutting during birds' nesting season. Equally, it should be remembered that the primary purpose of SuDS is sustainable water management.

Wherever possible, SuDS techniques, excluding source control methods such as water butts, should be located in the public realm to facilitate access for maintenance. It is the developer's responsibility in ensuring that effective maintenance arrangements are in place, which will be secured as a requirement of their planning application. CIRIA C753 the SuDS Manual provides further detailed information on maintenance requirements for SuDS features.

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 22: Typical SuDS Inspection and Maintenance Requirements (WoE SuDS Developers Guide)

Adoption of SuDS

The responsibilities for SuDS future maintenance and operation will need to 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 responsible for maintenance and funding provision, and include a defined minimum performance level to which the SuDS must be maintained to. The Local Planning Authority (LPA) 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.

There are a number of different options for maintenance arrangement and this should be considered and discussed with the LPA at the pre-planning stage. It is highly recommended that a statutory organisation takes on the role of maintaining SuDS as this will guarantee maintenance of the drainage system in perpetuity. Statutory organisations in South Gloucestershire include the local authority (South Gloucestershire Council), Wessex Water and the Lower Severn Internal Drainage Board (LSIDB).

However, where this is not possible, alternative bodies may also be able to maintain SuDS, provided that a suitable maintenance plan has been provided and signed off. For SuDS serving the highway these should be discussed with the South Gloucestershire Council to ensure suitability for adoption.

Adoption by the local authority (SGC)

Open space provision within development sites is a normal planning requirement and offers suitable landscaped areas for the inclusion of a wide range of SuDS features (e.g. ponds, basins and swales). These features can enhance the nature conservation and amenity value of the site, although a primary consideration should be the effectiveness and maintenance of the SuDS.

Where South Gloucestershire Council are adopting the open space provision, this could include adoption of the SuDS features located within the open space. In adopting these features, a range of issues will need to be addressed:

- The primary purpose of the SuDS features relate to drainage.
- If the open space is to be used for other purposes, such as nature conservation or as a play area, this must not conflict with the effective working and maintenance of the SuDS.
- Safety issues will come into play if a body of water is involved.
- There is a need to ensure that a long-term, effective maintenance regime is in place along with a long term habitat management plan where appropriate

Where it is being proposed for South Gloucestershire Council to adopt SuDS features developers must enter into early discussions with the council. Where South Gloucestershire Council chooses to adopt SuDS, an agreement under section 106 of the Town and Country Planning Act will be required and ownership of the land in question will have to be transferred to the Council. The section 106 agreement will include provisions regarding the quality of construction and require the developer to carry out maintenance during an interim period before adoption by the Council is completed.

A supervision fee for construction of the SuDS and a maintenance contribution will have to be paid through the section 106 agreement. The agreement may also require a bond to be lodged with the Council in order to guarantee SuDS are constructed and any defects are satisfactory remedied.

Adoption by other statutory organisation (Wessex Water, LSIDB)

The new Sewerage Sector Guidance documentation that came into force in England from the 1st of April 2020 contains new rules on surface water sewers that will apply to all water and sewerage companies. The rules will allow English water and sewerage companies to adopt a wider range of sewer types than they have done to date, including some SuDS. The rules for adoption can be found in the Design and Construction Guidance (DCG) document.

As such if the applicant is minded to choose Wessex Water as the appropriate body for SuDS adoption they should ensure the proposed design meets Wessex Water's adoption criteria, referencing relevant guidance and advice where appropriate. Adoption of SuDS by Wessex Water will be in accordance with section 104 of the Water Industry Act, together with the guidance set out in the current edition of Sewers for Adoption. Further guidance on Wessex Water's SuDS adoption process (including their Sustainable Drainage Systems Adoption Manual) is available on their website.

In some situations, the LSIDB may adopt above ground SuDS features. If this option is pursued, the developer should engage in early discussions with the LSIDB to ensure it meets their criteria. Further guidance is available from the LSIDB.

Private management

SuDS features located within private boundaries will be the responsibility of the site occupier / owner to maintain. It is recommended that details of the management and maintenance requirements are included in the information supplied to the occupier/owner. This is particularly important for permeable paving of private drives, soakaways serving an individual property, green roofs and rainwater harvesting systems.

In circumstances where a maintenance/management company is required to maintain the SuDS, a legal agreement tied to the title of the property will need to be agreed with the LPA (usually via a Section 106 agreement). If this is the case then discussions will need to take place during the pre-application stage of the development so that assurances can be made that this is the correct option for the development. Evidence should also be provided by the applicant on the suitability and experience of the management company during the planning process.

13. SUDS APPROVAL – PLANNING PROCESS

The approval of SuDS proposed as part of a development will be undertaken through the planning process. During this process it will need to be ensured that the design submitted as part of the planning application is robust and contains adequate detail to ensure that the SuDS are appropriate for the development and will be adequately maintained throughout their lifetime.

A surface water drainage strategy is required to be submitted with a planning application, which should contain details of the SuDS. Its scope should be proportionate with the size of development and can range from a paragraph describing the proposed drainage measures with a discharge location for residential extension, to extensive hydrological modelling accompanied by a full report with drawings for a larger site.

Information submitted with planning applications should comply with National & Local validation requirements. These can be found at: www.southglos.gov.uk/planning. For major developments national guidance for SuDS can be found in the PPG, additionally the Non-Statutory Technical Standards for Sustainable Drainage Systems provides the high level principles all SuDS designs must follow.

Masterplanning (conceptual drainage design)

For larger developments a masterplan will be necessary. It is at this stage the SuDS layout (taking into account flow routes, topography, geology and green space) and proposed maintenance of the system should be determined whilst ensuring a safe design and mitigation of flood risk.

Seeking advice at the earliest opportunity from the relevant authorities (SGC LLFA, WW, LSIDB, and EA) will help avoid any costly issues or redesigns at a later stage. Effective master-planning should ensure a robust, viable and cost-effective scheme from the outset, where objectives of the development are informed by the SuDS scheme and vice versa.

Pre-application

The majority of planning applications do not require a masterplan but all applicants should engage in pre-application discussions with the relevant authorities (SGC LLFA, WW, LSIDB, and EA) before developing a surface water drainage strategy. This is the point at which key documents and information should be reviewed including topographic surveys, Strategic Flood Risk Assessments (SFRAs), geological maps, relevant site surveys and Flood Risk Assessments (FRAs) that have already been undertaken.

Outline planning application

When an outline planning application is required the applicant should include an outline drainage strategy with the planning application. It should include enough design information that demonstrates the conceptual surface water drainage design across the site.

The assessment submitted should outline the existing surface water run-off rates from the site and an indication of post development run-off rates with associated storm water storage requirements. SuDS should have been appropriately considered taking into account site specific drainage requirements and constraints and incorporated effectively into the overall masterplan.

Full planning application or reserved matters application

Many developments move straight to a full planning application following pre-application discussions with the relevant authorities (SGC LLFA, WW, LSIDB, and EA). At this stage applicants will also be expected to submit a detailed surface water drainage design with the planning application. Whilst most topics will have been covered to some degree in the outline drainage strategy (if applicable) the applicant will be expected to provide more detail at this stage.

The strategy should demonstrate that opportunities to integrate SuDS have been maximised and where obstacles to their use do persist this should be fully justified within the report. Where proposing to discharge into a third party asset (such as a watercourse or public sewer), appropriate permissions and required consents should have been discussed with the asset owner. Proof of the asset owner's acceptance will need to be provided as part of the application.

The key information a surface water drainage strategy must contain includes:

- How the proposed surface water scheme has been determined following the drainage hierarchy;
- Pre-development runoff rates;
- Post development runoff rates with associated storm water storage calculations
- Discharge location(s);
- Drainage calculations to support the design of the system;
- Drawings of the proposed surface water drainage scheme including sub-catchment breakdown where applicable;
- Maintenance and management plan of surface water drainage system (for the lifetime of the development) including details of future adoption;

Please note that the size and complexity of the site will determine how much information is included within the surface water drainage strategy.

14. OTHER INFORMATION

We are happy to provide pre-planning advice about surface water drainage and the provision of SuDS. If you require advice or clarification about the information in this document, please contact us.

15. CONTACT DETAILS

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