# Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code")

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# PART C – DESIGN AND CONSTRUCTION OF NEW SURFACE WATER DRAINAGE SYSTEMS

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## C1 INTRODUCTION

1. The purpose of surface water drainage is to carry water away from buildings and yards belonging to buildings in a manner that manages flood risk and water quality. Some types of surface water drainage can also enhance amenity and biodiversity. Local authorities can also require surface water drainage systems to meet requirements for flood risk, water quality, amenity and biodiversity.

2. **Local authorities** have key functions in determining the surface water drainage arrangements as follows:

a) as the local planning authority (LPA). The LPA approves the surface water drainage arrangements for new developments and redevelopments in accordance with the National Planning Policy Framework (NPPF), local policies and any supplementary planning documents;
b) as the lead local flood authority (LLFA). The LLFA provides guidance to the LPA as statutory consultee in all major developments. They may provide advice for other developments;
c) as the local land drainage authority (LDA). The LDA regulates any work carried out in or in proximity to non-main rivers (ordinary watercourses) except in areas where there is an internal drainage board (see C1.5).

In Part C where the term 'local authority' is used in this guidance, it can mean any or all of these roles.

3. In areas where there are both district and county councils, the district council is the LPA and the county council is both the LLFA and the LDA. Note: Some authorities have delegated their LLFA functions to others.

4. The **Environment Agency** provides guidance to the LPA in areas that are designated critical drainage areas and sites within 20 m of a main river as a statutory consultee. It also regulates any work carried out in or in proximity to any main river.

5. In some areas there are **internal drainage boards** which regulate any work carried out in or in proximity to non-main rivers (ordinary watercourses). Where they do not exist, these powers are carried out by the local land drainage authority (see C1.2 c)).

6. The NPPF gives an expectation that sustainable drainage systems (SuDS) should be used as first preference in developments of any size. The Ministry of Housing, Communities and Local Government (MHCLG) has also issued practice guidance to support the NPPF in a number of areas.

7. The Department for Environment, Food and Rural Affairs (Defra) have also issued ‘Non-statutory Technical Standards for Sustainable Drainage Systems’ in England. The Association of SuDS Authorities (formerly called LASOO) has also issued practice guidance in relation to both the NPPF and the non-statutory technical standards.

8. The designer should submit detailed construction drawings and calculations to show how the proposed design meets the requirements of the local authority, with confirmation of the arrangements for the operation and maintenance of the system in perpetuity.

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9. For those parts of England where the sewerage company is one whose area is mainly in Wales[2], other Regulations apply[3].

## C2 SCOPE

1. Part C gives guidance for the design and construction of new surface water drainage systems that are intended for adoption by sewerage companies, in accordance with an agreement under Section 104 of the Water Industry Act 1991.

## C3 GENERAL

1. To be capable of adoption by the sewerage company, a component must come within the meaning of a ”sewer” (see A6.19) or ”lateral drain” (see A6.11) in accordance with the Water Industry Act 1991. Subject to careful assessment of the particular features of the component in each case, the features listed in C7.2 to C7.13 are potentially adoptable as public sewers or lateral drains.

2. This guidance provides the mechanism by which sewerage companies can secure the adoption of a wide range of SuDS components that are compliant with the legal definition of a sewer[4]. This is a significant step change which will deliver better managed and integrated surface water systems, that align more closely with the direction of government and regulatory policy.

3. Providing a route for adoption allows the four pillars of SuDS design to be properly considered and utilised, with the production of resilient surface water systems that integrate all four. This will enable new development to be more sustainable and deliver a wider range of multi-functional benefits.

4. A component is potentially adoptable as a sewer (or lateral drain) if all of the following apply (please note that this is a non-exhaustive list and not all structures that meet the following criteria will be adoptable):

a) it is constructed for the drainage of buildings and yards appurtenant to buildings;
b) it has a channel (a depression between banks or ridges with a definite boundary);
c) it conveys and returns flows to a sewer or to a surface water body or to groundwater; and
d) it has an effective point of discharge, which must have lawful authority to discharge into a watercourse or other water body or onto or into land. As with conventional piped systems, this right to discharge must be secured by the developer and transferred to the sewerage company on adoption.

[2] Currently Dŵr Cymru Welsh Water is currently the only company wholly or mainly in Wales with any part of its operating area in England.

[3] This is likely to change when the relevant provisions of the Wales Act 2017 are commenced.

[4] Water UK has published a brochure "Sewers for Adoption in England – a changed approach to surface water sewers".

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5. The following components are not adoptable as sewers:

a) watercourses as defined in law (these include rivers, streams and can include some ditches)[5];
b) components built primarily for the drainage of surface water from streets or for the drainage of land;
c) components built to manage groundwater;
d) components which are part of the structure of a building or yard (e.g., green roof, pervious driveway or guttering and rainwater pipes attached to the building); and
e) components which are an integral part of the structure of a street (e.g., a pervious street or the channel formed by the kerb of a conventional road or a channel formed by a depression in the centre of a street).

6. Where surface water sewers are to be adopted by the sewerage company, then this may include all surface water sewers and lateral drains (this is different in the area of sewerage companies wholly or mainly in Wales) being connected to the surface water sewer, except any that will be adopted by the highway authority or other bodies. The management of other components can be covered by a separate agreement.

7. Some SuDS are not adoptable by sewerage companies because they are not correctly described as sewers or drains when the physical component is assessed as a whole. These include pervious pavements, green roofs and filter strips. These components may form part of the drainage design as part of a holistic design provided they are upstream of the adoptable components or form an exceedance flood route.

8. The developer should ensure that any components not adopted by the sewerage company are constructed as designed. They should also make arrangements to ensure their future operation and maintenance in perpetuity. These can include adoption by another body. The developer should provide details of these arrangements in their S104 Application.

9. Where the operation and maintenance of a component managed by another body could adversely impact on the sewerage company's system, an agreement should be in place to protect the sewerage company's system.

10. The designer should take account of the cost of future maintenance activities identified in the maintenance plan (see A5.5) as well as the initial capital costs.

11. The local authority can specify requirements for the design of surface water drainage systems that are different to those set out below. The design of the adoptable components should comply with the guidance in this section, in addition to the requirements of the local authority. Where any local authority

[5] Water UK has published a *Protocol for correctly classifying Culverted Watercourses and Sewers* this is available at https://www.water.org.uk/publications/water-industry-guidance/protocol-correctly-classifying-culverted-watercourses-and

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requirements conflict with the guidance in Part C, this should be brought to the attention of the sewerage company at the earliest opportunity.

12. The government guidance to local authorities includes a hierarchy of connection, which can be summarised as follows:

a) surface water runoff is collected for use;
b) discharge into the ground via infiltration;
c) discharge to a watercourse or other surface water body;
d) discharge to a surface water sewer, highway drain or other drainage system, discharging to a watercourse or other surface water body;
e) discharge to a combined sewer.

13. Where a developer proposes to connect surface water to the existing sewer system they should submit evidence to show how the surface water hierarchy has been applied to the site and why the connection to the sewer is the most practical solution. They should also show that this has been accepted by the LPA and in the cases of major developments, they should also show that this has been reviewed by the LLFA.

14. The location of adoptable drainage components should take account of the need to provide appropriate access to each component for maintenance.

15. The health and safety risks associated with any open water should be assessed and managed in accordance with Chapter 36 of CIRIA Report C753 ‘The SuDS Manual’. Where the proposed drainage system incorporates any surface components, the design should be carried out in accordance with Chapter 36 of ‘The SuDS Manual’ and a copy of the principal designer's risk assessment should be submitted to the sewerage company.

16. The developer should submit completed copies of the relevant checklists from Appendix B of the CIRIA Report C753 ‘The SuDS Manual’ with their S104 Application. In all cases this should include CIRIA Report C753 ‘The SuDS Manual’ Tables B.3, B.4, B.5 and B.22. It should also include Tables B.6 to B.21 for each of the components used.

## C4 SEPARATE SYSTEMS

1. Separate foul and surface water systems should be provided.

2. If, subject to the approval of the local authority (see C3.11 and C3.12), surface water sewers are to discharge into an existing combined (single pipe) sewer system, the separate foul and surface water sewers should be combined at locations immediately upstream of the point where they discharge into the existing combined sewer system. Where there is a risk of the combined sewer surcharging and backing up into the proposed surface water system, a non-return valve should be fitted.

3. The sewerage company has no duty to accept runoff from streets. The developer should note that acceptance of this runoff into the works and, ultimately, the public sewer system, is only by agreement which will not be unreasonably withheld (see A8 for further details).

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4. The sewerage company has no duty to accept land drainage runoff, flows from watercourses or groundwater. The developer should note that permission to discharge these flows into the works is not normally given (see A9 for further details).

## C5 LAYOUT PRINCIPLES

1. The layout of the development is fundamental to the performance and affordability of the drainage system as well as the wider urban design, including the character of development, amenity, biodiversity, connectivity and the use of the site. The layout of the whole development, including the drainage layout should, therefore, be considered at the earliest stages of the design of the development. 'Building for Life 12' recommends that designers "Explore how a holistic approach to design can be taken to the design of sustainable urban drainage by exploiting the topography and geology".

2. Holistic design should work with the topography, existing site features and vegetation to create a harmonious and practical physical and visual layout that integrates various types of access and transport modes (including walking and cycling), drainage, public open space, an attractive street scene and biodiversity within a context of safe and practical design.

3. The location of adoptable drainage components within the system should take account of the needs for access for maintenance.

4. Where maintenance could require the use of a tanker, the access should be suitable for a tanker with a capacity equal to the capacity of the component, up to a maximum of 18,000 litres. The access should include appropriate turning facilities, where necessary.

5. Where in accordance with the maintenance plan access is anticipated to be required for tankers or other maintenance vehicles, an access road with an appropriate surface and rights of way should be provided.

6. Surface water systems should not create a raised reservoir (see A6.17) with a capacity in excess of 10,000 $m^3$.

7. The layout of pipe systems should be in accordance with B4 and B5.

8. Surface water pumping stations should only be used where there is no other practicable method of surface water drainage and an adequate exceedance flood route is provided in the event of failure of the pumping station (see C6.3). Where a developer proposes to construct a surface water pumping station, they should have early discussions with the sewerage company.

## C6 HYDRAULIC DESIGN

### C6.1 General

1. The hydraulic design should take account of the requirements of the local authority and the guidance below. The local authority can specify criteria, including design rainfall rates, design flood protection frequencies and allowances, for climate change and urban creep.

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2. The hydraulic design should be carried out in accordance with the CIRIA Report C753 ‘The SuDS Manual’. The hydraulic design of pipelines and other conduits should be designed in accordance with BS EN 16933-2.

3. Surface water sewer systems should be designed to take the runoff from roofs, yards belonging to those buildings and, subject to the agreement of the sewerage company, the runoff from streets (see A8) including any flows through pervious pavements where they discharge into the system. For these areas, an impermeability of 100% should be assumed unless it can be demonstrated that the proposed management arrangements will limit the rate of runoff to a lower level. An impermeability of 100% for the whole site area (including soft landscaped areas) should be used in all cases when determining exceedance flows.

4. The sewerage company is not obliged to accept runoff from land drainage (see A9) or flow from watercourses. In these cases, the developer should agree satisfactory and separate arrangements with the local authority and the sewerage company.

5. An appropriate flow simulation method that can simulate flooding from the drainage system should be used for hydraulic design, unless otherwise agreed with the sewerage company. A simple calculation method is likely to be acceptable in the case of small developments.

6. Where a component is designed to convey or store flows in excess of the 1 in 30 year return period event, the designer should demonstrate that the upstream system (including any inlets such as gullies or pervious paving) has the capacity to allow the flows to reach the component.

7. In some cases it is not practical to design a particular component to convey all of the flows necessary (for example, because the infiltration capacity is limited, or the inlets would not have sufficient capacity). In these cases, the additional capacity required to meet the local authority's requirements may be provided using another component or a designated overland flow route (see CIRIA Report C635 ‘Designing for Exceedance in Urban Drainage - Good Practice’). Where an overland flow route is used, it should not be designed to operate more frequently than in a 1 in 30 year return period design rainfall event.

## C6.2 Control of Surface Water Discharges from the Site

1. The local authority can impose restrictions on the method of discharge of surface water from a development on the rate and volume of discharge. They can also specify the frequency and duration(s) of the design rainfall used to calculate the discharge, including any allowance for climate change and urban creep.

2. Where storage is provided to control surface water discharges from the site, the designer should demonstrate that:

a) the upstream system (including the inlets) has sufficient capacity to deliver the design flows to storage, either in its entirety (see C6.3.1) or in combination with overland flow pathways (see C6.2.2 b);

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b) an overland flow pathway (see C6.5) is provided that will safely manage any exceedance flows.

3. The design of storage should take into account the frequency and extent of any surcharge in the downstream system, including flood levels at any discharge point into a watercourse, lake or pond.

Note: The levels in watercourses and groundwater bodies can vary both seasonally and in response to rainfall. Sewer pipes will typically surcharge (i.e., the water level in manholes will rise above the level of the soffit of the pipe) much more frequently than the design flooding frequency.

## C6.3 Drainage Components on the Surface and Infiltration Systems

1. The capacity of surface level components (e.g., swales, ponds and basins) is not normally constrained by the capacity of the inlet system in the same way as underground components. They may, therefore, be designed to accept higher flow rates than underground drainage systems up to the 1 in 100 year rainfall event plus climate change standard typically required by local authorities.

2. Provided there is provision for the flows to reach a particular feature, surface SuDS features designed to take 1 in 100 year rainfall event plus climate change will normally be adoptable.

3. Components that are designed to be filled with water intermittently (e.g., basins or swales) should be designed so that the water is apparent at least a few times a year to ensure that the public are aware of their function. Where appropriate, signage should be provided to indicate:

a) that the area can be filled with water; and
b) to describe the flood risk management function of the component.

4. Further guidance on the hydraulic design of surface drainage components, including appropriate hydraulic roughness values can be found in Chapters 3 and 24 of the CIRIA Report C753 'The SuDS Manual'.

5. Guidance on the hydraulic design of infiltration drainage components can be found in Chapter 25 of the CIRIA Report C753 'The SuDS Manual'.

6. The infiltration potential of the soil and subsoil used in the hydraulic design of infiltration components should be confirmed by geo-technical tests, taking account of the seasonal variation in groundwater conditions. Guidance on this can be found in Chapter 25 of the CIRIA Report C753 'The SuDS Manual'. The highest groundwater level should be at least 1m below the base of the proposed infiltration component. A completed copy of the infiltration potential checklist (CIRIA 'The SuDS Manual' Table B.6) should be submitted with the S104 Application.

7. On sloping sites, the impact of the infiltration on neighbouring land should be taken into account.

## C6.4 Underground Drainage Components

1. Underground drainage systems include piped sewers and drains, and underground attenuation storage tanks.

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2. The Colebrook-White hydraulic roughness value ($k_s$) for surface water sewer and lateral drain pipe design should be 0.6 mm.

3. Underground drainage pipes should be designed under pipe full conditions to accept the following design rainfall (i.e., without surcharging above pipe soffit):

- sites with average ground slopes greater than 1% 1 year;
- sites with average ground slopes 1% or less 2 year; and
- sites where consequences of flooding are severe 5 year.
  (e.g., existing basement properties adjacent to new development)

4. The capacity of pipe should be increased further where it is necessary to comply with the flooding protection requirements.

5. The capacity of inlets to the systems (e.g., gullies or pervious paving systems) can limit the flows that can enter underground drainage systems. Gully systems designed in accordance with the 'Design Manual for Roads and Bridges' (HA 102/17) will not admit all the flows from streets into an underground system during extreme events (e.g., 1 in 100 years). Where the design of the system requires that flows from rainfall events in excess of the capacity of the gully systems are conveyed or stored in an underground system, the designer should use alternative inlets systems with higher capacity.

### C6.5 Exceedance Flow Management

1. During exceptionally wet weather, in excess of the design conditions specified by the local authority, the capacity of the surface water drainage system can be inadequate and flooding can occur. Surface water drainage system components should be located so as to minimise the risk of damage to buildings or other critical infrastructure in the event of sewer flooding.

2. Flooding can also occur due to blockages, pumping station failure or surcharging in downstream sewers.

3. In designing the site sewerage and layout, developers should identify the flow paths and understand the potential effects of flooding They should then design flood exceedance routes to mitigate its impact, where practicable. Guidance of design of flood exceedance routes can be found in CIRIA Report C635 *'*Designing for Exceedance in Urban Drainage – Good Practice'.

## C7 DETAILED DESIGN OF COMPONENTS

### C7.1 General

#### C7.1.1 Sediment management

1. An effective means of sediment control should be provided within the drainage system and particularly upstream of any attenuation component (e.g., pond, wetland, basin or tank), infiltration component, filtration component or outfall.

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2. The sediment control system should not only capture sediment under low flows but ensure that sediment is not re-entrained and washed out under peak flow conditions.

3. Sediments can be controlled by various means including catch-pits, hydrodynamic vortex separators and (in ponds, wetlands, basins and bio-retention systems) by use of a sediment forebay. An effective means of sediment control should be provided within the drainage system upstream of any attenuation component (e.g., pond, wetland, basin or tank), infiltration component, filtration component or outfall.

4. Sediment management components should incorporate access to and into the component for removal of accumulated sediment. This should include provision of appropriate vehicular access to facilitate removal. The operations and maintenance plan should describe procedures for sediment removal.

5. Where there is any risk of sediment entering an underground tank, provision should be made for removal of the sediment.

### C7.1.2 Infiltration components

1. In almost all cases, infiltration drainage components can be constructed in proximity to buildings without any detrimental impact on building foundations. However, in some ground conditions problems can occur particularly, where the infiltration is concentrated in a small area.

2. Where infiltration is proposed within 5 m of foundations of any buildings or other structures, this should be agreed with a geotechnical specialist who is the designer of the foundations of the building or structure. Details should be submitted to the sewerage company with the S104 Application. Further guidance can be found in Chapter 25 of the CIRIA Report C753 ‘The SuDS Manual’ and 'Using SuDS close to buildings' on the Susdrain Website

3. The local authority can impose requirements to prevent pollution of groundwater from polluted surface water.

## C7.2 Pipe Systems

### C7.2.1 Layout

1. The layout of pipes laid as surface water sewers and lateral drains should be in accordance with B5.1.

2. Surface water sewers and lateral drains should not normally be constructed under any building or any structure except that they may cross under a boundary wall not greater than 1.8 m high. However, for terraced properties it is sometimes necessary to install intermediate rainwater pipes, along the length of the terrace, to take rainwater from more than one property. Where it is not reasonably practicable to route the sewer around the building, surface water sewers with a nominal internal diameter of no more than 100 mm may be laid under a building, provided that the sewer takes the drainage from no more than one rainwater pipe with a nominal internal diameter of no more than DN75, or the equivalent cross-sectional area, provided that the entry point to the rainwater pipe is in the land owned by the building concerned. Where such a solution is proposed for adoption, it should be discussed with the sewerage company at the earliest stage.

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### C7.2.2 Access

1. Access should comply with the requirements of B5.2.

2. Access points, and any inlets to drains or sewers, should be located so as to minimise the risk of damage to buildings or other critical infrastructure in the event of sewer flooding.

### C7.2.3 Reliability

1. The minimum size for a gravity surface water sewer should be 150 mm nominal internal diameter, except where a 100 mm nominal internal diameter is permitted, in accordance with C7.2.1.2.

2. The minimum size for a gravity surface water lateral drain should be 100 mm nominal internal diameter.

3. To provide a self-cleansing regime within surface gravity sewers, the minimum flow velocity should be 1 m per second at pipe full flow. Where this requirement cannot be met, then this criterion would be considered to be satisfied if:

a) a 150 mm nominal internal diameter gravity sewer is laid to a gradient not flatter than 1:150; or
b) a 100 mm nominal internal diameter lateral drain is laid to a gradient not flatter than 1:100.

4. These parameters should not to be taken as a norm when the topography permits steeper gradients. Hydraulic studies indicate that these requirements may not necessarily achieve a self-cleansing regime. When a choice has to be made between gravity sewerage and pumped sewerage, these criteria should not be regarded as inflexible and the developer should consult the sewerage company.

5. Pipe systems should comply with the requirements of B6.3 to B6.8.

### C7.2.4 Structural design and integrity

1. Structural design and integrity of pipe systems should comply with the requirements of B7.

## C7.3 Swales

1. A swale is a shallow, vegetated channel designed to convey and retain water but may also permit infiltration.

2. Where a swale is adopted it will usually include the sides and base of the channel, any vegetation that is part of the function of the swale and any under-drainage including any liner, check dam, flow control or erosion control measure.

3. The design of swales should be carried out in accordance with Chapter 17 of the CIRIA Report C753 ‘The SuDS Manual’.

4. Swales proposed for adoption should typically be located in verges or other public open space or on the boundary between the street and a private garden. Where they are not adjacent to a street, provision should be made for access by maintenance equipment.

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5. A completed copy of the design assessment checklist for swales (CIRIA Report C753 'The SuDS Manual' Table B.13) should be submitted with the S104 Application.

## C7.4 Rills

1. A rill is a small, shallow lined channel through which surface water can flow.

2. Where a rill is adopted it will usually include the material forming the sides and base of the channel and any check dam or flow control device.

3. Rills proposed for adoption should typically be located in verges or other public open space or on the boundary between the street and a private garden. Where they are not adjacent to a street, provision should be made for access by maintenance equipment. Sewerage companies will not adopt rills that are part of the structure of a street (see C3.5 e)).

## C7.5 Bioretention Systems

1. A bioretention system is a shallow planted depression that allows runoff to pond temporarily on the surface, before filtering through vegetation and underlying soil prior to collection or infiltration. In its simplest forms, it can be a tree pit or a rain garden. Engineered soil (gravel and sand layers) and enhanced vegetation can be used to improve treatment performance.

2. The channel is formed by the banks of the depression. The effective point of discharge may take the form of a properly-designed means of infiltrating the water into the ground below or an overflow to another sewer.

3. Where a bioretention system is adopted, it will usually include the whole area used for temporary ponding of water and the inlet and outlet structures and any engineered soil structures, including the vegetation.

4. Detailed design should be carried out in accordance with Chapter 18 of CIRIA Report C753 'The SuDS Manual'.

5. Bioretention systems should be designed to drain down within 24 hours.

6. A completed copy of the design assessment checklist for bioretention systems (CIRIA Report C753 'The SuDS Manual' Table B.15) should be submitted with the S104 Application.

## C7.6 Ponds and Wetlands

1. A pond is a permanently wet depression designed to temporarily store surface water runoff above the permanent pool.

2. A wetland is a type of pond with a high proportion of shallow zones that promote the growth of bottom-rooted plants.

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3. The channel may be considered as being formed by the depression between the banks of the pond or wetland.

4. Where ponds are adopted, this will usually include the inlet and outlet structures (including flow controls) and the entire area of the pond, including any banks that are designed to retain water, any storage below the ground surface, impermeable liners and under drains.

5. The maximum water level in any pond should be at least 500 mm below the lowest floor level of any adjacent properties.

6. The maximum design storage depth should give a freeboard of 600 mm below the top of the banks.

7. Design should be carried out in accordance with Section 23 of the CIRIA Report C753 'The SuDS Manual'.

8. Where wetlands are used for flow attenuation, the depth of temporary storage above the permanent water level should be limited so that the risk to plant damage is low.

9. A completed copy of the design assessment checklist for ponds and wetlands (CIRIA Report C753 'The SuDS Manual' Table B.21) should be submitted with the S104 Application.

## C7.7 Basins

1. A basin is a depression in the ground that is normally dry but is designed to store surface water before infiltration (infiltration basin) and/or to provide attenuation (detention basin).

2. The effective point of discharge can be a properly-designed means of infiltrating the water into the ground. The channel may be considered as being formed by the depression or between the banks of the basin.

3. Where basins are adopted, this should usually include the inlet and outlet structures (including flow controls) and the entire area of the basin including any banks that are designed to retain water, any storage below the ground surface, impermeable liners and under drains.

4. Design should be carried out in accordance with Chapter 22 of the CIRIA Report C753 'The SuDS Manual'.

5. The maximum water level in any basin shall be at least 500 mm below the lowest floor level of any adjacent properties.

6. The maximum design storage depth should give a freeboard of between 400 mm and 600 mm below the top of the banks, depending on the scale of the component.

7. Infiltration basins should be provided with an inlet flow spreader to distribute flows across the basin, ideally using a widening grass channel inlet. The base should be level across the basin to encourage

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even infiltration with a slight fall of between 1 in 100 and 1 in 200 along the basin to distribute water evenly.

8. A completed copy of the design assessment checklist for basins (CIRIA Report C753 'The SuDS Manual' Table B.19) should be submitted with the S104 Application.

## C7.8 Tanks

1. A tank is an underground structure that creates a void space for the temporary storage of surface water before infiltration, controlled release or use.

2. Tanks should have provision for access for inspection and cleaning. This should include a means of removing any sediment and a means of trapping sediment to prevent it from being washed downstream during cleaning operations.

3. The structural design of geocellular tanks should be carried out by a person competent to do so using the guidance, in CIRIA Report C737 'Structural and Geotechnical Design of Modular Geocellular Drainage Systems' or other established engineering principles. Verified product performance data should be used for the engineer to make their assessment (see E2.48).

4. The design of flow attenuation facilities should, wherever practicable, include the following criteria:

a) gravity tank sewers or tanks formed from oversized pipes should be designed as online storage;
b) where parallel pipes are used for attenuation, a minimum of one pipe should act as online storage, the remainder as offline;
c) the design of attenuation facilities should seek to prevent a build-up of silt and other debris (e.g., by use of benching and low-flow channels).

d) where half pipe or arch structures are proposed, the design must (in addition to the above) demonstrate how the system can be cleaned/jetted and done so without damage or erosion of base materials or membrane. Further design evidence should outline how, in areas of a high water table, groundwater is kept out of the system and, when positioned under highways, that the loading criteria is acceptable to both undertaker and adopting Highway Authority (if applicable).

5. Adequate ventilation should be provided to limit pressure build up in the system during filling. The means of ventilation should be agreed with the sewerage company.

6. A completed copy of the design assessment checklist for attenuation storage tanks (CIRIA Report C753 'The SuDS Manual' Table B.17) should be submitted with the S104 Application.

## C7.9 Infiltration Trenches and Filter Drains

1. An infiltration trench is a trench, usually filled with permeable granular material, designed to promote infiltration of surface water to the ground.

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2. A filter drain is a linear drain consisting of a trench filled with a permeable material, normally with a perforated pipe in the base of the trench to assist drainage.

3. Design should be carried out in accordance with Chapter 13 of CIRIA Report C753 'The SuDS Manual'.

4. Infiltration trenches/filter drains should be designed with a perforated pipe (or other suitably-defined inspection channel) along the whole length and adequate access chambers to provide access for inspection and maintenance.

5. A completed copy of the design assessment checklist for filter drains (CIRIA Report C753 'The SuDS Manual' Table B.11) should be submitted with the S104 Application.

## C7.10 Soakaways

1. A soakaway is a subsurface structure for the temporary storage of water before it soaks in to the ground. A soakaway is essentially a point feature; it does not have a channel.

2. To be considered for adoption, a soakaway must be fed by an upstream channel that is legally a sewer or lateral drain that is also proposed for adoption.

3. Where a soakaway is adopted, this will usually include the whole structure up to the external face, including any external rubble fill or membrane.

4. Design should be carried out in accordance with Chapter 13 of the CIRIA Report C753 'The SuDS Manual'.

5. In considering the requirements for access (see C5.3), this should include provision of access for removal and replacement of any fill material.

## C7.11 Outfall Structures

1. Surface water outfalls discharging to watercourses should be fitted with non-return valves, where necessary, to prevent backflow in the event of high water levels in the watercourse.

2. Design should be carried out in accordance with Chapter 28 of the CIRIA Report C753 'The SuDS Manual'.

3. A hinged, lockable safety grille should be fitted to any surface water outfall pipe that is 350 mm diameter or larger. Where necessary, the outfall should be angled to reduce the risk of bank erosion. Typical details of outfalls to a watercourse are shown in

Figure C 1 and Figure C 2 and a typical detail of a grille is shown in Figure C 3. Aspects of the design and configuration of an outfall structure may be regulated by Local Land Drainage Authorities or the Environment Agency and therefore further input into the design may be required by the sewerage company.

4. Access should be provided for cleaning and maintenance of the grille, and for inspection of the outfall.

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5. The design of the outfall can be subject to the approval of the local land drainage authority (see A7).

## C7.12 Flow Control Devices

1. The design and location of flow control devices are to be agreed with the sewerage company.

2. Design should be carried out in accordance with Chapter 28 of the CIRIA Report C753 ‘The SuDS Manual’.

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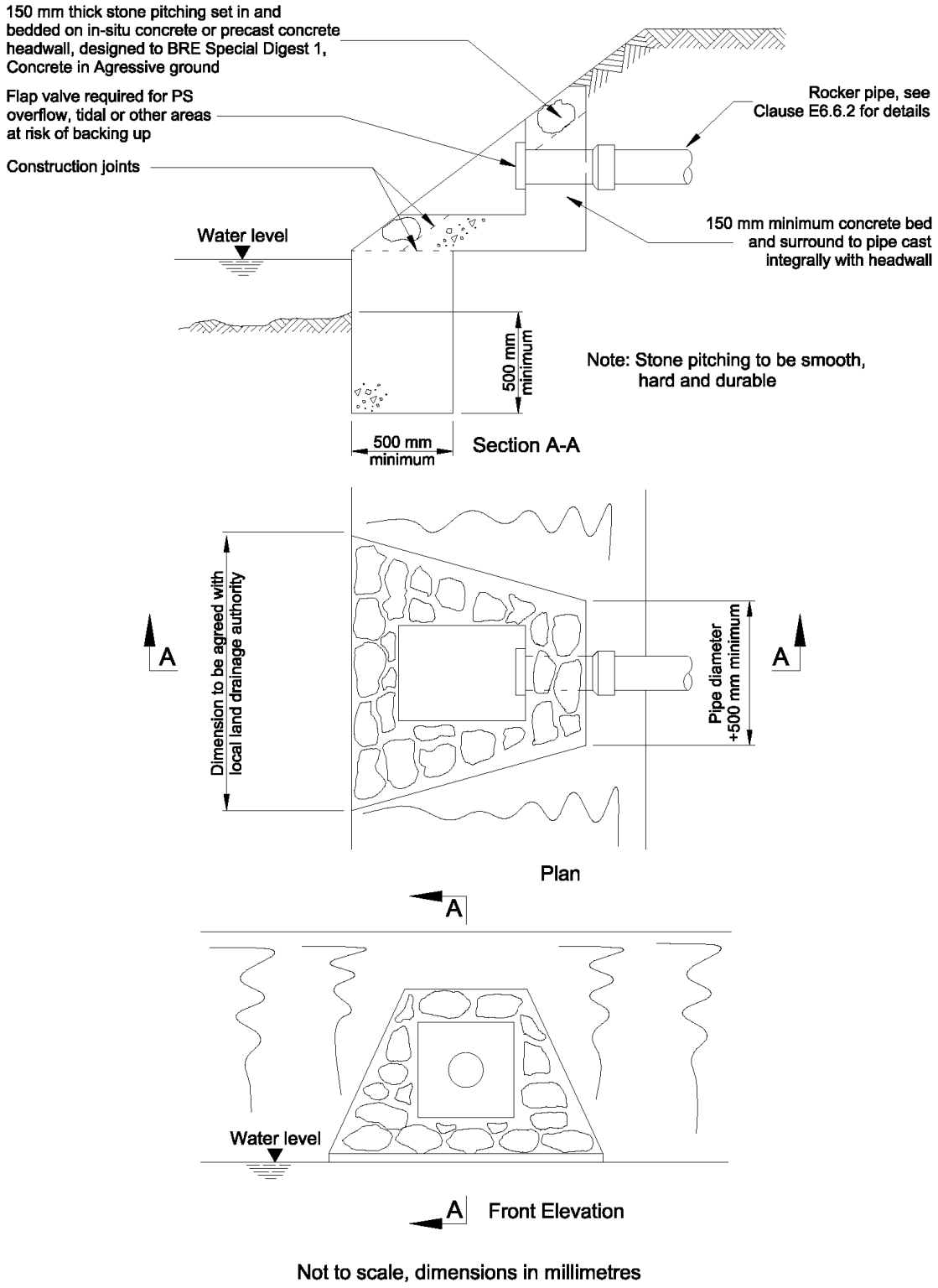
**Figure C 1**
**Typical detail of outfall to watercourse**
**Suitable for outfall pipes of less than 350 mm**




Not to scale, dimensions in millimetres

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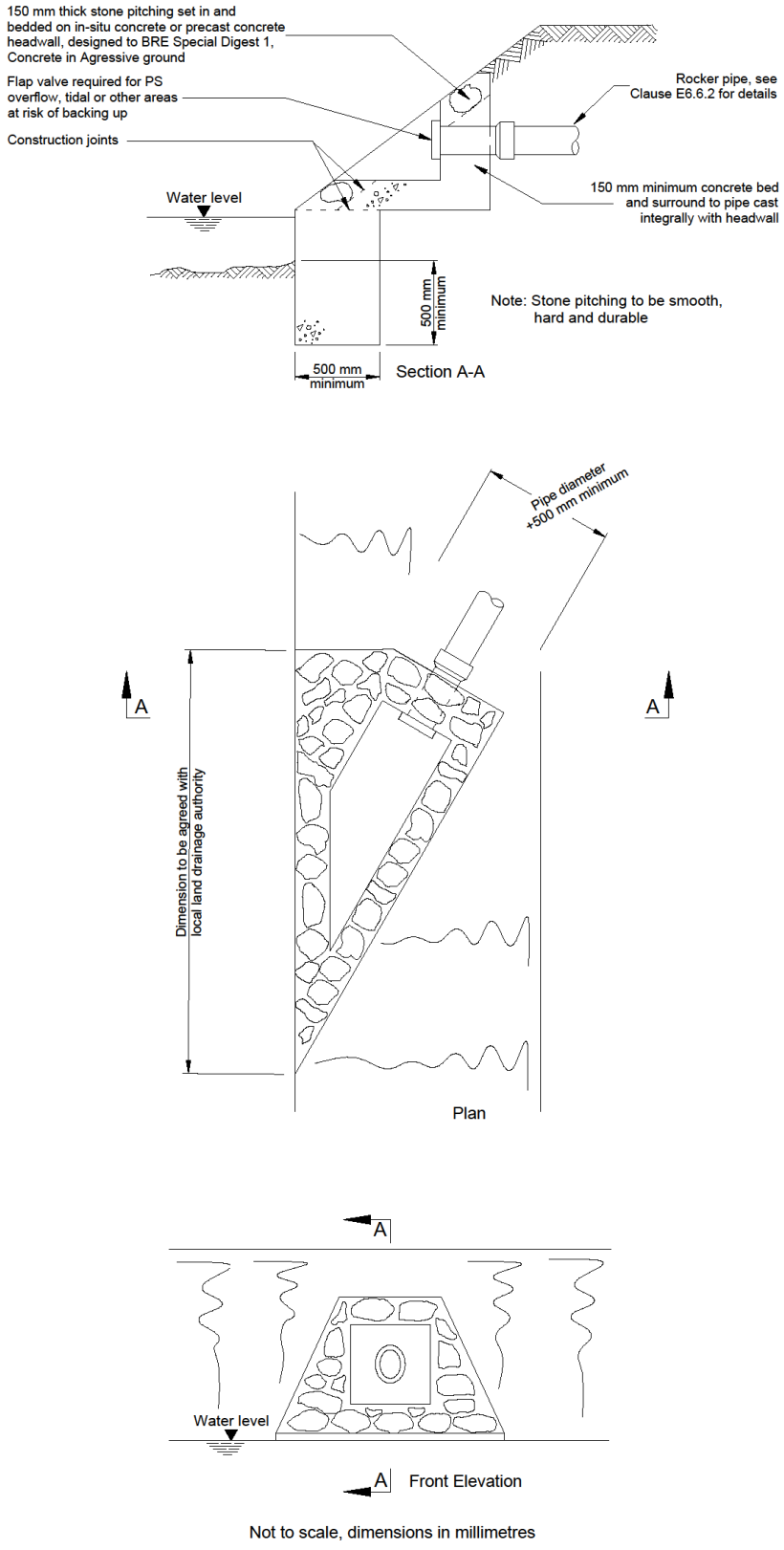
**Figure C 2**
**Typical detail of angled outfall to watercourse**
**Suitable for outfall pipes of less than 350 mm**




Not to scale, dimensions in millimetres

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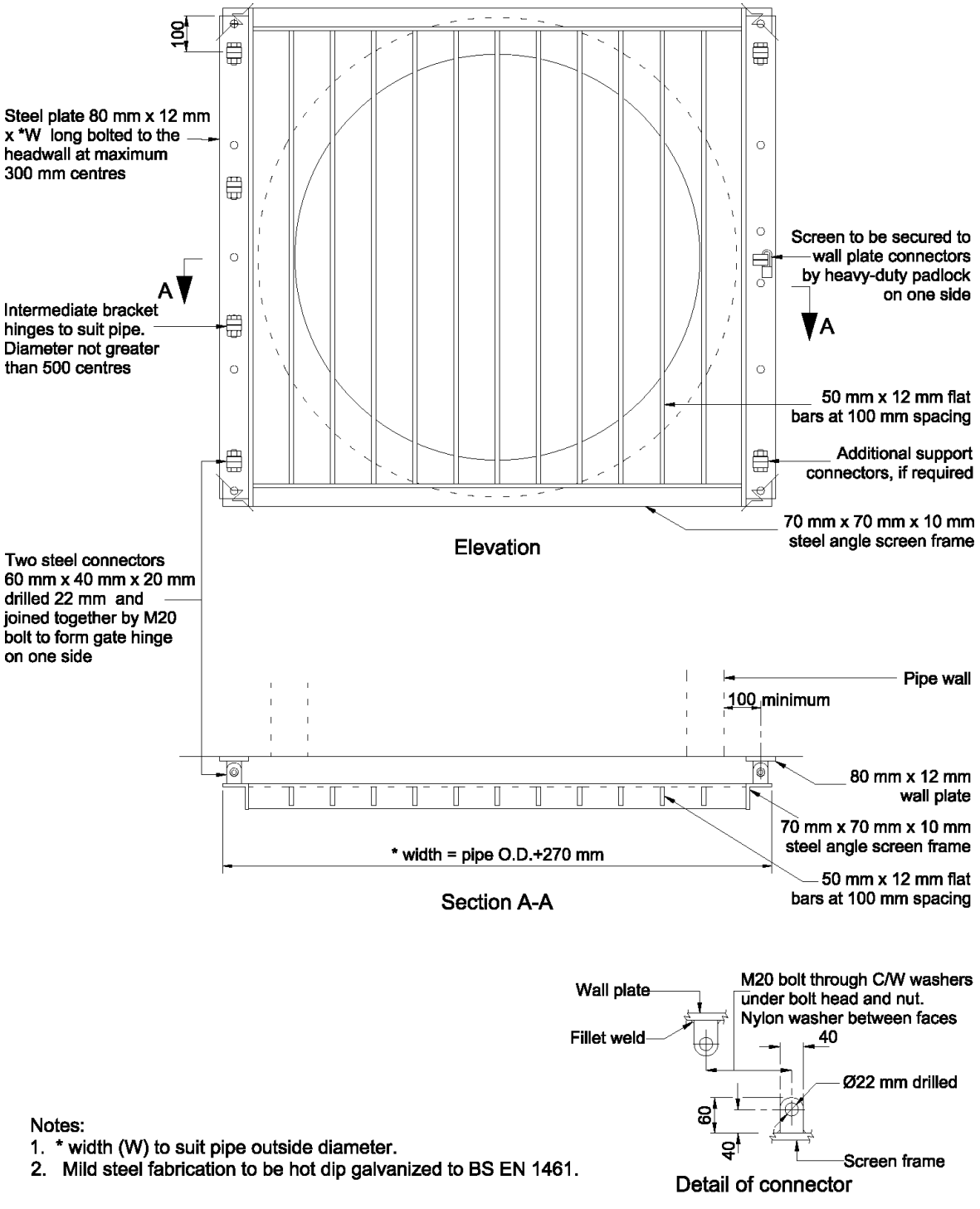
**Figure C 3**
**Typical outfall safety grille**
**For outfalls 350 mm diameter or greater**




Notes:
1. * width (W) to suit pipe outside diameter.
2. Mild steel fabrication to be hot dip galvanized to BS EN 1461.

Not to scale, dimensions in millimetres

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3. The design of flow control devices should, wherever practicable, include the following features:

a) flow controls may be static (such as vortex flow controls or fixed orifice plates) or variable (such as pistons or slide valves);
b) where debris can enter the control (e.g., where the upstream system is open or where the inlets are gullies), static controls should have a minimum opening size of 100 mm, or equivalent;
c) where the design of the upstream system will prevent debris entering the system (e.g., underground systems where the inlets are pervious pavement systems), static controls should have a minimum opening size of 50 mm;
d) variable controls may have a smaller opening provided they have a self-cleansing mechanism;
e) a bypass should be included with a surface operated penstock or valve; and
f) access should be provided to the upstream and downstream sections of a flow control device to allow maintenance.

4. All flow control devices should be installed and operating before off-site discharge is made.

5. Flow control devices should have a free discharge (no downstream surcharge), where practicable. Where it is not practicable to achieve a free discharge at all times, attenuation calculations showing both the free discharge and surcharge conditions should be provided as part of the S104 Application.

### C7.13 Proprietary Treatment Systems

1. Where treatment devices are installed on discharges from locations which have a high pollution hazard level (as defined in Table 26.2 of the CIRIA Report C753, 'The SuDS Manual') any treatment device should be part of the private drainage system, or the street drainage system, as appropriate.

2. Where the developer proposes to include a proprietary treatment device as part of the system proposed for adoption, they should consult the sewerage company at the earliest opportunity.

3. A completed copy of the design assessment checklist for proprietary treatment systems (CIRIA Report C753 'The SuDS Manual' Table B.7) should be submitted with the S104 Application.

### C7.14 Landscaping and Vegetation

1. In addition to any requirements of the local authority, landscape design and vegetation should be in accordance with Chapter 29 of the CIRIA Report C753, 'The SuDS Manual'.

2. A management plan setting out the management objectives of the landscaping and vegetation, and an initial management programme for at least the first five years, should be included in the overall management plan submitted with the S104 Application (see C11).

## C8 MATERIALS

1. Materials should comply with the requirements of Part E.

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2. Materials and components should comply with the following:

a) the manufacturing process should minimise the use of solvent-based substances that emit volatile organic compounds or ozone-depleting substances;
b) products should be made from recycled material, where reasonably practicable; and
c) the use and/or creation of substances included in the UK Red List (DoE, 1988) of toxic substances should be avoided during the manufacturing process.

## C9 CONSTRUCTION

1. Construction of the drainage system should comply with the requirements of Part E. SuDS components should be constructed in accordance with CIRIA Report C768 ‘Guidance on the Construction of SuDS’.

2. A construction method statement, prepared in accordance with Part E of CIRIA Report C768 ‘Guidance on the Construction of SuDS’ should be submitted by the developer for approval.

3. The works should be protected, where necessary, from loads imposed by construction plant during construction to avoid the over compaction of soils that could increase runoff from permeable areas and adversely affect the infiltration qualities of sub-soil layers.

4. The developer should use the checklist in Part F of CIRIA Report C768 ‘Guidance on the Construction of SuDS’ as part of their construction records and supply copies to the sewerage company.

5. The developer should carry out a survey of the completed drainage system and produce as-constructed drawings. These should be cross-checked with the design drawings and any variations not previously agreed should be highlighted.

## C10 INSPECTION AND TESTING

1. Inspection and testing of the drainage system should comply with the requirements of Part E with the recommendations of CIRIA Report C768 ‘Guidance on the Construction of SuDS’.

## C11 MAINTENANCE

1. A management plan setting out the management objectives of the scheme and an initial programme should be submitted with the S104 Application to demonstrate that the systems can be economically maintained and that appropriate access for maintenance has been provided. Additionally, long- and medium-term strategies should be outlined as part of any submission.

2. Soft SuDS components will require regular, occasional or remedial maintenance so a simple ‘establishment’ maintenance plan for the first 5 years should be provided. However, planting, wetlands and biodiverse (wild flower) grasslands in particular will require an over-arching management plan that defines how it is expected that the vegetation will develop over time, and what it seeks to achieve (in line with the 4 pillars of SuDS). This should be defined through a simple ‘vision statement’, supported by appropriate management ‘aims and objectives’.

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3. The management plan should require the quality and condition of the SuDS to be reviewed every 5 years, and a new maintenance plan devised for the forthcoming 5 year period that understands the dynamic nature of the soft SuDS, and adjusts the maintenance regime as necessary to ensure their long-term development and effectiveness.

4. The management plan should be in accordance with Chapter 32 of the CIRIA Report C753 'The SuDS Manual'. It should detail:

a) regular maintenance activities;
b) occasional maintenance activities; and
c) remedial maintenance activities.

5. The management plan should detail the type of maintenance activities required, the frequency of those activities, the estimated duration, plant and equipment requirements and estimated costs.

6. The management plan should show how appropriately-sized maintenance plant can be routed to avoid over-compaction of areas that are required to allow infiltration.

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