BARNET
LONDON BOROUGH

Sustainable Drainage Strategy

Raingarden next to cycle lane and highway. Credit: Meristem Design(left). Visualisation of Halliwick Recreation Ground SuDS scheme in Barnet. Credit: Barnet Council (right)

Revision History

Version	Date	Description	Prepared	Approved	LLFA Sign Off
1.1	18/10/2023	First Draft for Client	SG	NJ	RS
2.0	03/11/2023	Second Draft for Client Consultation	ZB	CG	RS
3.0	15/12/2023	Third draft for Cabinet	RS		

Executive Summary

In January 2023, the Government announced the commencement of enactment of Schedule 3 to The Flood and Water Management Act 2010 in England. When implemented (envisaged to be during 2024), will trigger the enactment of SuDS Approval Body (SAB) within the Council. Barnet SuDS strategy sets out the Councils' long-term vision to encourage the delivery of SuDS throughout the borough, ahead of the implementation of Schedule 3 in England.

Schedule 3 provides a framework for the approval and adoption of drainage systems, by an approving body (SAB), and national standards on the design, construction, operation, and maintenance of SuDS. Also, it makes the right to connect surface water runoff to public sewers conditional upon the drainage system being approved before any construction work can start. It is expected that the SAB will replace the delivery of SuDS through the planning process and will empower LLFA's to ensure that the delivery of SuDS is mandatory in comparison to their current statutory consultee role.

Moreover, the flood risk within Barnet is expected to exacerbate with rapid urbanisation, unprecedented population growth, and evident impacts of climate change. Barnet's need for a robust strategy to manage surface water flood risk and increase the community's flood resilience has never been greater. The Sustainable Drainage (SuDS) strategy aligns with Barnet Corporate Plan 2023 to 2026, Barnet's Sustainability Strategy and the recently published Local Flood Risk Management Strategy**.**

The strategy releases technical guidance for delivery of SuDS in the borough and should be used by internal Council teams and developers. Moreover, it sets out a long-term program for delivery of SuDS on Barnet's highway network. These highway SuDS opportunities are presented on this online map.

The strategy aims to harness Barnet's existing policies and SuDS best practices to set out the long-term vision of implementing SuDS throughout the Borough.

The strategy (in Section 3) sets out the technical guidance for developers when designing SuDS for the developments and what requirements need to be met at different stages of planning application. The Section 4 of the strategy sets out some of the Barnet specific requirements for the SuDS design, not only for the developers but any internal Council teams like Town Centres and Highways, where SuDS are being proposed. Additionally, it provides advice on how to overcome common constraints to implementing SuDS features in new and retrofit developments. It also includes guidance for SuDS on highways in particular rain garden systems.

SuDS should be considered in all major and minor developments. Rainwater harvesting is recommended as the first level of the drainage hierarchy and residents are encouraged to consider water butts in single residential properties in new developments or as retrofits. The strategy further emphasises on prioritisation of above ground green infrastructure over underground / attenuation features, specially on major developments with site area greater than a hectare.

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Figures and Tables

Acronyms and Abbreviations

Abbreviation	Definition
Barnet	London Borough of Barnet
Defra	Department for Environment for Food and Rural Affairs
LBB	London Borough of Barnet
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SAB	SuDS Approval Body

1. Introduction to the Strategy

1.1 Purpose of the strategy

This Sustainable Drainage Strategy has been developed by the London Borough of Barnet (LBB) to encourage the delivery of SuDS within public and private developments. Developers should use this document when they are developing drainage strategies for development proposals to ensure that they have sufficiently addressed the Council's relevant planning requirements. The document should also be used by internal Barnet teams carrying out SuDS schemes throughout the borough (e.g., Barnet Town Centre Teams, Highways, etc).

Sustainable drainage systems, or 'SuDS', aim to manage surface water locally (closest to the source where generated) and are a natural alternative to traditional drainage networks like pipes and sewers. They encourage urban greening and the utilisation of more permeable surfaces to:

- Reduce the risk of surface water flooding.
- Reduce pollution from urban runoff.
- Deliver wider benefits such as enhancing biodiversity, improving aesthetics, and creating recreational space.

The strategy aims to release technical guidance for delivery of SuDS in the borough by internal Council teams and developers. Moreover, it sets out a long-term program for delivery of SuDS on Barnet's highway network. This strategy aligns with the Barnet Corporate Plan 2023 to 2026, specifically with the strategic objectives within the plan of Caring for our Places and Caring for the Planet. The Caring for our Places objective sets out a vision to make neighbourhoods into welcoming hubs for communities to enjoy their unique characteristics. Encouraging the implementation of SuDS within the borough will help achieve this vision as SuDS can bring improved aesthetic appeal and amenity to urban environments. The Caring for the Planet objective sets the vision to improve the local environment, so that residents can enjoy cleaner air and waterways as well as reduced flooding and heat stress from extreme weather. These are goals that can all be achieved through the use of SuDS.

Furthermore, the strategy aligns with the Barnet's Sustainability Strategy by adopting an adaptive approach in-line with a vision to become net zero carbon in Barnet by 2050, and for the Council by 2030. The Local Flood Risk Management Strategy (LFRMS) also adopts a sustainable adaptive approach to manage flood risk and increase the flood resilience of local communities whilst providing wider environmental, biodiversity, health and social benefits. This sustainable adaptive approach for flood risk management is outlined in further detail in this Sustainable Drainage Strategy, as it provides practical measures to help implement the objectives of the LFRMS.

Climate change is expected to increase the risk of flooding in the future meaning that effective flood mitigation needs to be implemented fast to protect properties. The Sustainable Drainage Strategy recognises this by providing technical guidance that will aid developers and internal Council teams in designing SuDS that consider the effects of climate change, and in delivering SuDS efficiently.

1.2 Vision of the strategy

Barnet Sustainable Drainage strategy aims to harness existing policies and SuDS best practices to set out the long-term vision of implementing SuDS throughout the Borough.

In addition to their primary aim to reduce flood risk, SuDS will contribute to mitigating against urban heat island effects and improving water quality, biodiversity and amenity in developed areas. SuDS can also be designed to help achieve net zero targets set out by the government and Barnet's Sustainability Strategy.

In January 2023, the Government announced the commencement of enactment of Schedule 3 to The Flood and Water Management Act 2010 in England subject to final decisions on scope, threshold, and process once a full regulatory impact assessment has been consulted which will trigger the enactment of SuDS Approval Body (SAB) within LBB. The SuDS strategy sets out the Councils' long-term vision to encourage the implementation of SuDS throughout the borough, ahead of the implementation of Schedule 3 in England (envisaged to be during 2024). Some of the sections of this strategy will be reviewed once the Schedule 3 enactment is finalised.

1.3 Structure of the strategy

Barnet's Sustainable Drainage Strategy is comprised of the following sections:

1. **Introduction to the Strategy**
2. **Background of SuDS**
3. **SuDS Specific Guidance for Developers**
4. **Barnet Specific Requirements for SuDS Design**
5. **Common Constraints**
6. **Guidance for SuDS on Highways**
7. **SuDS Adoption by the Council**
8. **Planting of SuDS**
9. **Maintenance of SuDS**

The strategy sets out the technical guidance and Barnet specific requirements for SuDS design. It provides a summary of the design stages and how they link to the planning process. Additionally, it provides advice on how to overcome common constraints to implementing SuDS features in new and retrofit developments. Section 6 includes guidance for SuDS on highways and also presents the seven priority bands for the long-term delivery of SuDS program on Barnet highways network. Section 7 further presents the high-level principles for SuDS adoption by the Council followed by Sections 8 and 9 which sets out the planting and maintenance requirements for some of the key SuDS features.

2. Background of SuDS

Sustainable Drainage Systems (SuDS) are natural approaches to surface water management which provide additional benefits such as water quality, biodiversity, and amenity value. The four key components for SuDS design are summarised in ***Error! Reference source not found.***.

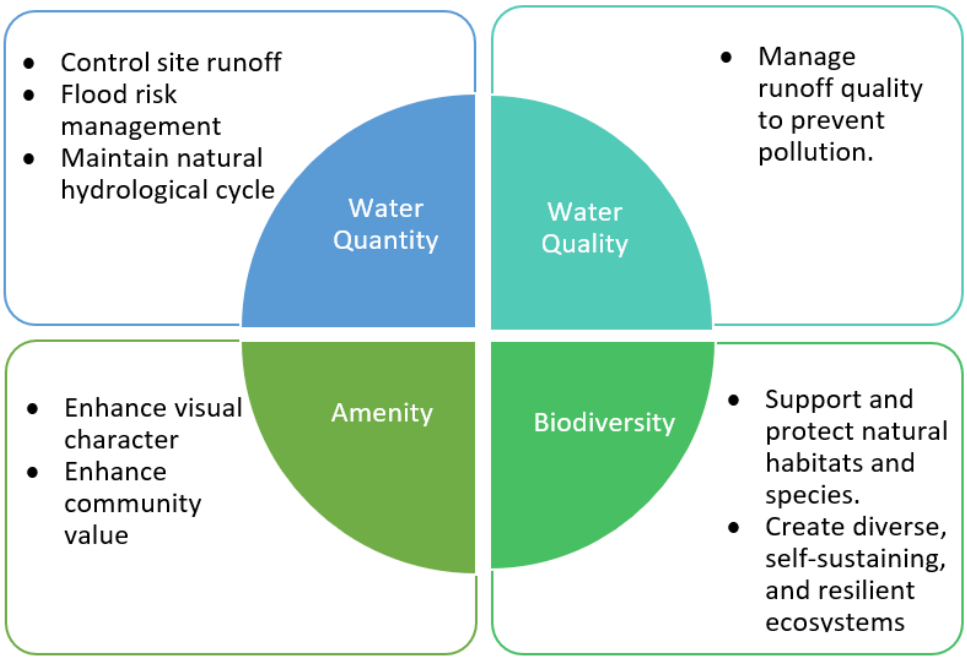

Figure 2-1. The four pillars of SuDS design (adapted from the SuDS Manual).

SuDS work by mimicking natural drainage processes to reduce the quantity of surface water entering the traditional sewer networks and to improve the quality of runoff. Different types of SuDS exist and are often categorised based on the process they employ such as water harvesting (water butts, blue roofs), infiltration (soakaways, infiltration trenches), detention or attenuation (rain gardens, detention basins) and conveyance (swales, conveyance channels). More information on the type of SuDS can be found in Table 2-1.

Table 2-1. Details of various types of SuDS (adopted from information in the CIRIA SuDS Manual, 2015).

SuDS Feature	Description
Rainwater harvesting	The direct capture and storage of rainwater from impermeable surfaces, which can then be treated (when required) and used as a supply of water. The water storage should be placed in a safe, secure location either underground, indoors, on roofs or adjacent to buildings.
Green roofs / walls	Vegetation and/or landscaping that covers building roofs and walls. They can be used on any property size and even on sloping roofs, although this will normally provide less storage.
Blue roofs	Roof design that is explicitly designed to store water. It is key to consider the structural capacity of the roof to deal with the extra loadings and the waterproofing required to protect the building.
Infiltration systems	Infiltration can be used to reduce runoff rates and volumes while supporting baseflow and groundwater recharge processes. The rate of which water

	infiltrates depends on the permeability of the soils. Different types of infiltration systems are listed below: Soakaways - Excavations, filled with material such as gravel that temporarily stores water. Best suited for runoff from small areas such as roofs of residential housing. Infiltration basins - Flat bottomed, shallow landscape depressions that store runoff before infiltration into the subsurface soils. Best suited for runoff from larger areas. Infiltration blankets - Large shallow systems that are typically constructed using permeable aggregate or geocellular units. Often used below car parks, playgrounds, or sport pitches.
Filter strips	Strips of gently sloping grass/dense vegetation designed to drain surface water uniformly, promote infiltration, and filter out particulates. They are ideal for managing runoff from roads because they are linear.
Filter drains	Shallow trenches filled with stone/gravel that create temporary subsurface storage. They are useful in mitigating against groundwater pollution as they help reduce pollutant levels.
Swales	Shallow, flat bottomed, vegetated open channels where runoff water is collected and stored. They are well suited for managing runoff from roads because they are linear. However, they should be incorporated into public open spaces as they tend to demand significant land-take.
Bioretention systems (Rain gardens/tree pits)	Shallow, vegetated depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils. They are often a cost-effective retrofit option, due to their flexibility in size and detailing. The variations are listed below: Rain gardens – System that lies below the level of its surroundings, designed to absorb rainwater that runs off from a surface. Tree pits – Additional trees and shrubs also provide addition benefits such as providing shade and facilitating groundwater recharge because of their more extensive root systems. Bioretention swale/trench – Vegetation located in the base of swales.
Pervious pavements	Allow water to soak into underlying layers whilst also being suitable for pedestrians or vehicles to use. Porous pavements infiltrate water across their entire surface, whilst permeable pavements are formed of a material that is impervious to water but is laid to provide void space through the surface.
Ponds / basins	Depressions used for storing and treating water. Ponds typically have a permanent pool, whereas basins typically only store water for a specified retention time. They should be placed in developments so they are not hidden as they can enhance aesthetics.
Wetlands	Marshy depressions, typically shallower than ponds, covered in aquatic vegetation which attenuates and filters the flow of water. They should be placed in developments so they are not hidden as they can enhance aesthetics.

SuDS can be used for new developments and can also be retrofitted in existing developments. In both cases, considering the potential benefits and opportunities when designing SuDS can help deliver the best results. Successfully designing and incorporating SuDS in developments relies on effective design. The SuDS Manual (CIRIA publication C753F) is widely used for technical advice and guidance on planning, designing, building, and maintaining SuDS.

1.4 Applying the drainage hierarchy in Barnet

LBB (as the Lead Local Flood Authority, or LLFA) are statutory consultees on planning applications relating to major development. As part of this responsibility, LBB are required to ensure that SuDS are implemented in accordance with the surface water drainage hierarchy set out in Policy SI 13 (Sustainable drainage) in The London Plan (2021).

The enactment of Schedule 3 of Flood and Water Management Act 2010 is expected to replace the delivery of SuDS through the planning process and will ensure the delivery of SuDS is mandatory via a SuDS Approving Body (SAB), envisaged to be LLFA's.

The aim of the drainage hierarchy is to ensure that surface water runoff is managed as close to its source as possible and in a way which minimises the negative impact of the development on flood risk. Development proposals should prioritise green over grey features and implement drainage options as high up on the hierarchy as reasonably practical. Sufficient justifications must be provided as to why a drainage option cannot be implemented before an option lower on the hierarchy can be considered. Often constraints cited for the non-inclusion of SuDS features are insufficient to demonstrate compliance with the drainage hierarchy. Common constraints and how to overcome them are outline in *Section 5*.

The following list provides guidance on how to follow the drainage hierarchy in Barnet, considering specific factors such as its hydrology, geological, urban setting, and sewer system.

1. **Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation).**

   Rainwater harvesting is the first level of the drainage hierarchy and should therefore be considered in all planning applications in Barnet. In small-scale developments such as single residential houses where rainwater harvesting systems have been justifiably discounted, water butts should still be considered. Water butts do not necessarily need to be included drainage calculations, but their size and location should be shown in drainage drawings.

2. **Rainwater infiltration to ground at or close to source.**

   Barnet is predominantly underlain by the London Clay Bedrock geology, which is generally unsuitable for infiltration. However, there are some areas with superficial permeable deposits where infiltration may be suitable and should be prioritised. Barnet have developed an Infiltration SuDS suitability map to define areas where infiltration is potentially suitable. In major developments, infiltration tests which conform to BRE 365 standard, or a site-specific physical ground investigation survey should be carried before infiltration drainage can be ruled out. Where infiltration is being proposed, a detailed groundwater investigation is required to confirm that ground conditions are acceptable.

3. **Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens).**

   Where rainwater cannot be fully managed by either rainwater harvesting or infiltration, attenuation SuDS features should be considered. Above ground green infrastructure

must be prioritised before underground / attenuation features can be considered, specially on major developments with site area greater than a hectare. Barnet strongly discourages the use of underground tanks as attenuation features on sites greater than a hectare. The range of attenuation SuDS options available means it is nearly always possible to incorporate some green measures. Unlike many inner London boroughs, Barnet is not as heavily developed and there are still significant areas of open space, particularly in the north-west of the borough. This provides greater opportunities for larger SuDS features such as wetlands, ponds and basins which have much greater biodiversity and amenity value than grey infrastructure.

4. **Rainwater discharge direct to a watercourse (unless not appropriate).**

   Development sites located adjacent to any watercourse should drain surface water directly into them, provided it is uncontaminated. SuDS features can remove some pollutants from runoff. However, at sites containing hazardous materials, further pollution prevention and treatment should be used to ensure the surface water is uncontaminated before entering a watercourse.

   The primary watercourses in Barnet are Dollis Brook, Pymme's Brook and Silk Stream which drain most of the borough. However, there are several other main rivers and ordinary watercourses throughout the borough. For discharging into statutory main rivers, consent must be granted by the Environment Agency by applying for an environmental permit.

   To discharge into an ordinary watercourse, consent must be granted by LBB by filling out the Ordinary Watercourse Consent Application Form and emailing it to fwm@barnet.gov.uk. To determine whether the watercourse is a Main River or an ordinary watercourse, you can view the Barnet's Flood risk management online mapping tool.

   Where there is third-party land between the development and a watercourse, it is generally acceptable to discount direct discharge.

5. **Controlled rainwater discharge to a surface water sewer or drain.**

   The sewer system in Barnet is predominantly served by separated surface water and foul water sewers. Where there is a separate sewer system located near the development, the site must discharge into the surface water sewer. A drainage strategy which proposes discharging surface water into the foul water sewer will not be accepted.

6. **Controlled rainwater discharge to a combined sewer.**

   This is only acceptable where there is no surface water sewer near the site. There are only a few areas in Barnet where the sewer systems are combined, and this is acceptable. Uncontrolled discharge will not be accepted.

3. SuDS Specific Guidance for Developers

3.1.Stages of planning

In general, there are five stages of planning applications. Not all stages are required for every development as this will depend on what stage of design the submission is made, the size and type of development, as well as the Local Planning Authorities specific requirements. The five stages are as follows:

- **Pre-application:** A pre-application is not a requirement but can be used to determine whether a project requires planning permission and provides guidance on what will be required at full application stage.
- **Outline Application:** Outline planning applications are used to gain an understanding as to whether the nature of a development is acceptable, this can help ensure viability up front. Specific details are then approved at Reserved Matters.
- **Full Application:** A full planning application is required when making detailed proposals for development. Approval can be granted at this stage but planning conditions are often applied to the planning permission. These are approved at Discharge of Conditions stage.
- **Reserved Matters:** An application for approval of Reserved Matters is only required when the applicant already has outline planning permission for a development. Detailed design can be approved at this stage. If the submission has changed significantly from the outline application, a full application may be required.
- **Discharge of Conditions:** This is required post approval of a full application to discharge conditions imposed on a planning permission.

The level of design required for each stage of planning is outlined in *Table 3-1.*

Table 3-1. Level of design required at different planning stages.

	Concept Design	Outline Design	Detailed Design
Pre-application	✓		
Outline Planning	✓	✓	
Full Planning			✓
Reserved Matters			✓
Discharge of Conditions			✓

3.2.SuDS specific requirements for developers

Developers are required to meet policy requirements on SuDS. These requirements are addressed in detail in Section 5.3.2 of Barnet's Local Flood Risk Management Strategy (LFRMS). Developers are required to submit a Sustainable Drainage Proforma with any planning applications.

It is important to consider Barnet's LFRMS when designing SuDS for the development. **The LFRMS states that developers must ensure the development will not increase the peak runoff rate. Site runoff must be restricted to the greenfield runoff rates for all events from the 1 in 1-year runoff rate up to and including the 1 in 100-year rainfall event plus the effects of climate change.** The LFRMS also requires developers to demonstrate that flooding will not occur up to and including the 1 in 30-year rainfall event in any part of the proposed development. During a 1 in 100-year rainfall event (plus climate change) developers must demonstrate that flooding will not occur in any building (including a basement), utility plant susceptible to water, or on neighbouring sites. Flows from rainfall in excess of the 1 in 100-year rainfall event (plus climate change) should be managed in exceedance routes that minimise the risks to people and property. For more information regarding Barnet's strategic actions for development, see Section D of the LFRMS Action Plan.

Typically, we would expect the Drainage Strategy to include the following but not limited to:

- A fully labelled SuDS network diagram showing, pipes and manholes, SuDS features with reference numbers, etc.
- SuDS design input data and results to support the design.
- Infiltration site investigation results showing that infiltration systems are feasible method of discharge for this site if SuDS infiltration method is proposed.
- Assessment of the proposed drainage system during the 30-year design rainfall according to Design and Construction Guidance, March 2020.
- Assessment of the attenuation storage volumes to cope with the 100-year rainfall event plus climate change.
- Evidence of Thames Water (Water Company) agreement for discharge to their system (in principle/ consent to discharge) if the proposal includes connecting to a sewer system.
- Evidence of Environment Agency permit or Ordinary Watercourse Consent if discharging to a watercourse.
- Details of overland flood flow routes in the event of system exceedance or failure, with demonstration that such flows can be appropriately managed on site without increasing the flood risk to occupants or neighbouring properties.
- SuDS operation and maintenance plan.
- SuDS detailed design drawings.
- SuDS construction phasing

3.3.Concept design

SuDS concept design should set out the surface water management objectives and outline the initial drainage design and layout for the development. The concept design may be submitted at pre-application

consultation and is also necessary for discussions with regulatory bodies, water companies and other stakeholders.

Concept design may involve the following tasks:

- Identify planning and conservation designations.
- Identify discharge constraints.
- Identify the pollution hazard level of the development and the sensitivity of the receiving water.
- Calculate the greenfield runoff rate and set hydraulic performance specifications.
- Identify potential for infiltration to ground.
- Identify any sub catchments and effective point of discharge(s).
- Identify water quality risk management objectives.
- Select the SuDS assets for the management train.
- Calculate Preliminary flow and volume calculations.
- Identify any health and safety risks.

3.4. Outline design

Outline design develops on the concept design to meet the requirements of the LPA and LLFA. It may be combined with concept design in pre-application discussions. Alternatively, outline design can be submitted as an outline application before detailed drawings are produced so that the general details of the developments can be agreed on before detailed drawings are produced. If a pre-application was submitted on the concept design, the comments can be addressed at this stage. Where an outline design is submitted, the detailed design is approved at reserved matters.

Outline design may involve the following the tasks:

- Size and refine the design of individual SuDS components.
- Confirm any assumptions from concept design such as infiltration capacities, groundwater levels and existing sewerage infrastructure and capacities, using robust investigation methods.
- Identify sub-catchments and calculate storage volumes.
- Estimate required conveyance and exceedance flow rates and ensure the proposed sediment management and treatment components are adequate.
- Determine any required flow control components.
- Develop health and safety risk assessment and operation and maintenance plan.

3.5. Detailed design

The SuDS strategy will be reasonably fixed at this stage. Detailed design is mainly for finalising and testing the scheme. The development and refinement of concept and outline design at detailed design stage will demonstrate that project objectives can be delivered upon, and the detailed design will be approved at

full application stage or discharge of conditions or reserved matters, depending upon the specific requirements outlined by the LPA.

Detailed design may involve the following tasks:

- Test the hydraulic performance of the SuDS to demonstrate compliance with the design criteria.
- Refine sizing and flow controls.
- Design specifications for the drainage strategy.
- Finalised Health & Safety and Operation & Maintenance plans.
- Confirm all required discharge consents and permits have been agreed.

3.6. Permitted development rights

When a development falls under permitted development rights in accordance with The Town and Country Planning (General Permitted Development) (England) Order 2015 (GPDO), planning permission is not required. LBB can often deliver SuDS schemes under Schedule 2, Part 13 (Class A or C) of the GPDO and therefore do not require planning approval. However, it is good practice to submit a permitted development note (lawful development certificate) to the Local Planning Authority (LPA) within Barnet to confirm that the development is permitted. For SuDS schemes that fall under permitted development, a SuDS design note may be submitted to the LPA to include the following information:

- Brief site context and description of the proposed SuDS including their location, size and discharge rates.
- Any classification of the development area.
- Volume of excavation.
- Description of why it is considered development rights referring to which Development order and class it falls under.

Most SuDS schemes undertaken by private developers do not fall under permitted development and require planning permission. However, there are Permitted Development Rights for resurfacing gardens with permeable surfaces. This means that you do not need planning permission if a new or replacement driveway of any size uses permeable (or porous) surfacing which allows water to drain through, such as gravel, permeable concrete block paving or porous asphalt, or if the rainwater is directed to a lawn or border to drain naturally. Barnet homeowners and landowners can contribute to the development of SuDS and reduce flood risk through the de-paving of their own driveways and by ensuring that their gardens are not surfaced with impermeable materials, while also preventing the need for planning permission. If the surface to be covered is more than 5m^2, planning permission will be needed for laying traditional, impermeable driveways that do not control rainwater running off onto roads. Refer to LBB Design Guidance No.3 for more information.

4. Barnet Specific Requirements for SuDS Design

Any SuDS feature that is being approved by LBB must be designed in accordance with the SUDS Manual (CIRIA publication 753). Where there are conflicting requirements, this guide shall take precedence.

General requirements which apply to all SuDS features are as follows:

- Flood Estimation Handbook (FEH) design rainfall 2013 method is to be utilised in order to estimate rainfall-runoff.
- The design must be robust and exceedance flow routes must be provided and directed away from any building or other sensitive infrastructure.
- Low flow channels should be designed to carry runoff up to a 1 in 2-year storm.
- SuDS features should be as shallow as possible with gentle side slopes (max 1 in 3). Where spatial constraints prohibit the construction of slopes within the specified gradients, LBB may approve the use of steeper profiles in some areas provided they are adequately designed. The steeper slopes should be limited to less accessible areas of the feature.
- Outlet flow controls design and maintenance must be agreed with LBB prior to construction.
- Designed to be easy to maintain.
- Fencing should be avoided. If fencing is required, it should be visually attractive and should be childproof but not prevent easy access by adults in case of emergencies or for maintenance.
- Planting should be restricted to native non-invasive species found naturally within 30km of Barnet that should naturally regenerate.
- Liners should be avoided except where it is necessary to prevent contamination from known sources of pollution entering the ground. Where a liner is used it should be sufficiently robust to resist puncture and should be covered with a minimum of 300mm depth of mixed topsoil and subsoil including at the edges.
- Vertical head walls, poorly designed rip rap and other visually obtrusive features are not accepted.

4.1. Specific Requirements

This section outlines specific design requirements for common SuDS features by LBB as LLFA.

1.4.1 Rain gardens

- The standing water level must not exceed 150mm for any storm event.

- Should be designed to half empty within 20 hours of storm event, and completely dewater within 48 hours.
- The minimum freeboard depth should be 100mm.
- A minimum depth of 300mm of topsoil is recommended for shrubs and herbaceous plants. A shallower depth of 200mm can be considered for rain gardens that will be turfed or seeded with wildflowers.
- The sub-base should be 100-500mm deep.
- Upstand kerb between the carriageway and the rain garden.

Figure 4-1. Photo of a rain garden. Credit: Meristem Design.

1.4.2 Pond / wetlands

- Should be designed to have varying permanent water depths. The maximum depth in most cases is not expected to exceed 1.2 m.
- The water level must not rise more than 500mm during a 1 in 30 year or greater rainfall event.
- A flat area should be provided around pond / wetland, to provide easy access for maintenance. This should be at least 2m wide. There should be access to the feature from a road for small, tracked excavators. If spatial constraints make this unfeasible, then alternative design must be approved by LLB prior to construction.
- Where barrier planting is required, developers must ensure that the planting schedule will provide protection from their establishment. Mature trees may be required, or temporary measures used until the trees reach maturity.
- 150mm of topsoil should be applied to the banks between the permanent water level and the maximum water level and over the wet bench. Topsoil is not to be placed over the subsoil below the permanent water level beyond the wet bench.
- Designs must include interpretation / safety boards, particularly if located in large public open spaces.

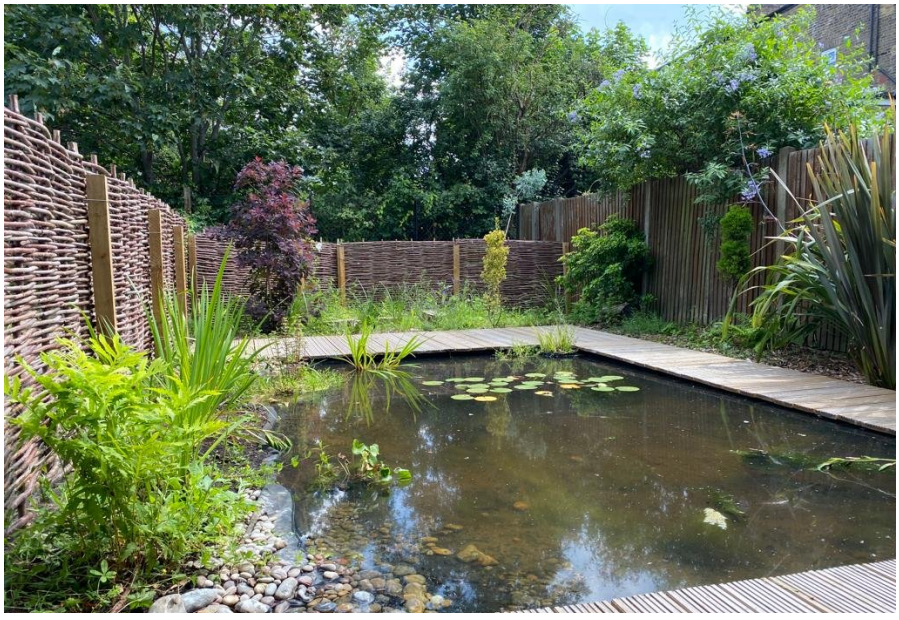

Figure 4-2. Photo of a SuDS pond. Credit: Meristem Design.

1.4.3 Detention basins

- The water level must not rise more than 1 m during 1 in 30 year or greater rainfall event. It should drain down in a max of 48 hours.
- A flat area should be provided to provide easy access for maintenance. This should be at least 2m wide. There should be access to the feature from a road for small, tracked excavators. If spatial constraints make this unfeasible, then alternative design must be approved by LLB prior to construction.
- Offline dry detention basins are to be avoided as there is a risk, they will accumulate litter.
- In infiltration basins, the base and sides (up to the maximum water level) should be covered with a suitable soil mix that is sufficiently permeable to allow water to soak through.
- Topsoil (min. 150mm thick) should be applied to the banks and base of retention basins up to the maximum water level to aid rapid and permanent establishment of vegetation and so resist erosion of the basin.

Figure 4-3. Photo of a detention basin. Credit: Susdrain.

1.4.4 Swales

- The maximum depth of a swale should normally be less than 450mm.
- Gullies should not be used at swale inlets.
- Sufficient crossover points should be provided where appropriate if pedestrians will want to cross the swale.
- Swales must ensure that access to properties via existing vehicle crossovers are not adversely impacted. Refer to LBB Domestic Vehicle Crossover Policy.
- Minimum freeboard of 150mm.
- Minimum base of 0.5m where water treatment is required. May be reduced in constrained sites if adequately designed.
- The water level in a swale should not rise more than 150mm to 300mm during a 1 in 30 year or greater rainfall event (maximum depends on location with the lower depth appropriate in streets).
- Fencing should be avoided except in street situation where some form of fencing or bollards are required to prevent vehicles parking in swales.

Figure 4-4. Photo of a swale. Credit: Susdrain.

1.4.5 Inlets, outlets and control features

- Inlets and outlets in the sloping sides of ponds, basins or swales should be chamfered pipes to suit the angle of the slope.

- Control features such as orifices and weirs should be on the surface where possible. Where control structures are below ground, they should be accessible for maintenance from the surface without the need for entry into chambers.
- There should be a safe overflow route around a control feature in case it becomes blocked.
- Control features should be inspected after rainfall events to check for blockages.

5. Common Constraints

Barnet requires the inclusion of SuDS in all developments (major and minor) unless a sufficient justification is provided as to why they can't be included. However, justifications that are frequently provided in drainage strategies are often not sufficient to gain approval from the Barnet LLFA and LPA and can be effectively overcome through careful planning, early communication, and appropriate design. This section outlines some of the common constraints cited in development proposals and suggests how to overcome them.

5.1. Cost

Cost is rarely accepted as sufficient justification for the non-inclusion of SuDS. There is a lot of evidence to show that SuDS are not any more expensive than traditional drainage and are often cheaper when they are well-designed and considered from the outset of the design process. The Department for Environment Food and Rural Affairs (Defra) has undertaken several comparative studies on the costs and benefits of traditional drainage and SuDS. All sites assessed in this study showed that the inclusion of SuDS was cheaper than a traditional drainage system. More information on these studies can be found on the Susdrain website. Defra studies have also found that maintenance costs are no higher than conventional drainage features.

Applicants / Developers should consider the cost of SuDS during the design process. Applicants can refer to the Defra evidence report to get an idea of costs for each feature.

5.2. Insufficient demand for harvested rainwater

Limited uses for harvested water are often stated as a reason for not including rainwater harvesting systems. While the demand of water is dependent on the size and use of the development, this reason is often not valid as there is a range of scales which rainwater harvesting systems can be considered.

In large developments, with high water demands such as schools, hospitals and commercial buildings, the large building footprint means there is generally space for rainwater harvesting tanks or blue roofs. The water can be stored and reused for flushing toilets and irrigation systems. Concerns about water discoloration in using recycled water for non-potable purposes are not acceptable as there are rainwater harvesting systems which treat water prior to recycling and educating end users on the importance of rainwater harvesting can harbour their support.

Green-blue roofs can be advantageous in a range of building types as the water can be automatically re-used to support the green roof element and provide additional benefits for the urban heat island effect, biodiversity, and amenity. Concerns about weight capacity limitations and waterproofing often deter developers from utilising these types of SuDS. However, cost-effective solutions can be found by following the same approach used to successively install green-blue roofs in the past. One such example is 160 Old Street. With a city centre location with limited space for other SuDS, a green-blue roof was retrofitted to provide storm water attenuation. Completed in 2018, regular site inspections ensure the structural integrity and waterproofing of the system.

In smaller-scale developments e.g., individual residential homes, where there may not be enough water demand to make large-scale rainwater harvesting viable, rainwater reuse features such as water butts should be considered. Water butts are simple and cost-effective way to manage surface water and reduce water consumption. Water can be used for gardening, cleaning cars and driveways etc. As water butts only provide small amounts of surface water storage, they do not need to be included in drainage and

storage calculations but should still be included as an additional feature and their location and size should be identified in drainage drawings.

In some cases, the usage for rainwater harvesting may be problematic. For example, it may not be most suitable in apartment buildings where there are ownership issues which makes distribution of water and maintenance costs difficult to share.

5.3. Limited space for SuDS

A common reason given for not including above ground SuDS such as basins, swales, wetlands or rain gardens is that there is limited space, or the space is being used for other purposes. These are not generally accepted as justification for not including SuDS, given that space for SuDS can usually be accommodated within existing open space requirements for major developments. SuDS can be multi-functional.

Landscaping areas can be designed as rain gardens, planters, and tree pits, proving a dual function of landscaping and flood mitigation by diverting surface water run-off into these features. Likewise, open space for recreation can be designed as attenuation basins / swales. These can function as open space for most of the year, only filling up during heavy rainfall.

Permeable paving should be included for any hardstanding area such as carparks, driveways etc as it does not affect the function of the surface. There is permeable paving available for a large range of loading capacities so can be used in most development types.

The Council expects to see proposals of open SuDS features specially for development sites greater than 1 ha which can deliver various environmental benefits rather than series of attenuation tanks.

5.4. Contaminated soils

As in most of London, most development proposals in Barnet are on brownfield sites. Therefore, the presence of contaminated soils needs to be considered when implementing SuDS. Chapter 8 in the SuDS Manual outlines many ways to overcome SuDS design challenges when working with contaminated soils.

In most cases of contaminated soils, use of infiltration is not suitable due to the mobilisation of contaminants. However, to sufficiently discount infiltration, results from soil testing should be provided to confirm the presence of contamination. If infiltration is not suitable, then SuDS components should be designed to not allow infiltration. Attenuation SuDS are acceptable in contaminated soils if they are properly designed.

There are any ways to overcome issues with soil contamination in SuDS design, as follows:

- Provide a minimum distance between the maximum likely groundwater table and the base of SuDS. This should be based on a detailed groundwater risk assessment but 1m of unsaturated soil is often sufficient.
- Impermeable barriers (liners) can also be used to prevent contaminated groundwater flowing into the any SuDS component. It is preferable to construct the SuDS component above the groundwater table to minimise the risk of groundwater entering it, rather than relying on a liner.
- Special consideration should be made for the materials used in construction to ensure they are durable in the exposure conditions.

- Well-designed, shallow SuDS can minimise excavation and disposal when compared to piped drainage and deep tanks. They can also reduce the risk of creating preferential pathways for vapour and gas migration via pipes and backfill.
- Consult a geo-environmental professional with experience in contaminated land issues as early as possible in the development planning process.

For more information, see Chapter 8 of the SuDS Manual.

5.5. High groundwater

High groundwater is not a prevalent issue in Barnet. However, in areas where there are superficial permeable deposits, particularly along the banks of the River Brent, high groundwater may be encountered. In this case, Infiltration may be suitable if an adequate depth of soils (i.e., greater than 1m) can be achieved between the infiltrating surface and the maximum groundwater level. Shallow infiltration basins or permeable paving should be considered before infiltration is discounted. Where this is not achievable, SuDS features should be designed to not allow infiltration.

Attenuation SuDS can be designed in areas where high groundwater is predicted. However, the base of the attenuation features such be designed above the maximum likely groundwater level to ensure groundwater cannot enter and reduce the storage capacity of the feature. Uplift pressure from high groundwater should also be considered in the design of any attenuation features. Suitable ground investigations such as trial pits or borehole tests must be submitted to confirm high groundwater and justifiably discount infiltration.

It is important to keep storage and conveyance systems above maximum likely groundwater levels, wherever possible. This will avoid difficulties during construction caused by water flows into excavations and will ensure that the hydraulic and treatment capacity of the SuDS component is always retained.

5.6. Steep slopes

Barnet has a very varied topography, and some parts of the borough can have steep slopes which can present some challenges for SuDS design. Infiltration is often not suitable in steep slopes due to the risk of water reappearing downslope. However, attenuation features can be implemented by using checked dams or staged storage. Bioretention and wetland features can be easily staggered in a terraced arrangement on slopes.

5.7. Utilities

In new developments, SuDS should be an integral part of the development's design and not a final consideration. In this way, utilities should be positioned to avoid SuDS features and therefore should not interfere with their design. In all cases, SuDS designers should work closely with utility owners to avoid expensive and disruptive utility diversions. During initial stages of SuDS design, the team should apply to each utility owner for information on their assets or associated assets. This information should be validated with trial pits before detailed design.

In brownfield sites where existing utilities are being retained, utilities can interfere with SuDS design. Utility companies require access to utilities for maintenance purposes and if SuDS features are constructed over them, there is a risk that the feature will have to be dug up during maintenance with no guarantee that they will be reinstated properly. Using SuDS such as permeable paving and bioretention systems should be avoided in major service strips where the main shallow services are present. However,

compatibility can be achieved by constructing dedicated and well-marked service strips that are designed with access in mind. Surface water and foul sewers are acceptable below permeable pavements.

There are many ways to design SuDS features to around utilities. The size and shape of SuDS features can be altered to avoid utilities. For examples, the Urban Design London Design Guide shows how rain gardens can be installed where utilities such as electricity, gas and water are located within the proposed construction depth by reducing the depth of the rain garden at the location of the buried services and increasing the depth where there are no services. This minimises digging around services whilst maintaining the desired storage capacity.

Tree pits can also be designed to avoid utilities through tree root management and using root barriers between utility service corridors. The type of root management required will depend on the depth of the utilities on site. Above ground utilities such as bins and lamp posts can be moved to make way for SuDS.

5.8. Health and safety

Health and Safety issues are often cited as reason for not implementing SuDS, particularly open water features like detention basins, wetlands, and ponds. While there is always a risk of drowning in any depth of open water, this is no more of a risk associated with SuDS features than any natural water feature.

SuDS features can also be designed to minimise health & safety risks by avoiding fast flowing water or areas that become inundated very quickly with rapid water level rises and steep slopes. Chapter 36 in the SuDS Manual outlines ways to minimise health and safety risks and this include:

- Designing a 'dry bench' before the feature to provide a level surface for an individual to assess the surroundings.
- All slopes (where there is direct access) not greater than 1 in 3, both above and below the water line to allow access for able bodied visitors and maintenance personnel.
- Clear identification of the water edge e.g., using planting or soft or hard edging (where appropriate).
- Avoid fast flowing water or areas that become inundated very quickly with a rapid rise in water level, steep slopes, and high vertical drops.
- Use barriers where necessary. Soft barriers using planting is preferable to deter people away from areas of risk. In some instances, where there are hard features such as culverts etc hard barriers such as fencing may be required.

Therefore, Barnet does not typically accept health and safety issues as a valid justification for not including SuDS in development proposals. When SuDS are properly designed, they can be low risk and are suitable for implementation in most sites regardless of the end-users.

6. Guidance for SuDS on Highways

6.1. Introduction

Highway SuDS are an environmentally conscious approach to managing surface water runoff from road networks, and are designed to mimic natural drainage processes, promoting flood prevention, water quality improvement, and habitat enhancement. Highway SuDS aim to reduce the impact of urban development on local water systems by incorporating a range of features such as permeable surfaces, rain gardens, swales, attenuation ponds and other types of green infrastructure (see Table 6-1). This approach not only addresses the challenges of stormwater management but also contributes to the overall resilience and ecological health of the surrounding environment, aligning infrastructure development with ecological preservation.

Table 6-1. Commonly used SuDS for highways.

SuDS Feature	Description
Filter strips	Strips of gently sloping grass/dense vegetation designed to drain surface water uniformly, promote infiltration, and filter out particulates. They are often used as a pre-treatment component before swales, bioretention systems and trenches.
Filter drains	Shallow trenches filled with stone/gravel that create temporary subsurface storage for the attenuation, conveyance, and filtration of surface water runoff.
Swales	Shallow, flat bottomed, vegetated open channels where runoff water is collected and stored. They can be designed to filter particulates with vegetation and allow infiltration, ground conditions permitting. They can be used to replace conventional pipework as a means of conveying runoff.
Rain gardens	Manage urban stormwater by capturing and absorbing rain, preventing flooding and filtering pollutants with plants and engineered soils, enhancing functionality and aesthetics.
Tree pits	Bioretention systems with enhanced performance achieved through extra planting.
Pervious pavements	Footpaths that allow water to soak into underlying soil/construction. Porous pavements infiltrate water across their entire surface, whilst permeable pavements are formed of a material that is impervious to water but is laid to provide void space through the surface.

6.2. General requirements for rain gardens

Barnet is an urban environment where there is a lot of potential for rain gardens. For this reason, this section highlights general requirements for rain gardens in accordance with the Urban Design London Design Guide.

Rain gardens should be located at low points where surface water will flow to. Existing gullies are usually located at local low points, so constructing a rain garden just upstream of the gully or incorporating the gully into the rain garden provides an in-built overflow.

A typical rain garden consists of a freeboard, topsoil and sub-base. The freeboard is an area of potential water storage above the topsoil. Its depth should be 200-300mm from the carriageway / footpath level to the top of the topsoil to encourage water to flow into the rain garden and accommodate silt and leaf-litter accumulation. If the freeboard is too shallow, it will not allow water to flow into the rain garden. The minimum freeboard depth should be 100mm. An erosion pad or a launching apron should be located at the inlets to the rain garden so as to deflect the runoff into the rain garden, accumulate any silt and avoiding the washing away of the soil.

Topsoil usually comprises of a mixture of soil, sand and compost in ratios that dictate the soil permeability. It is common for rain garden topsoil to have high sand content (approximately 50% sand, 30% topsoil and 20% compost) to be suitable for most plants while allowing for faster infiltration. However, note that not all plants cope well in sandy soil conditions. It is recommended to consult with a horticulturist, landscape architect or ground maintenance specialist when deciding on the topsoil and plant species in your rain garden. A minimum depth of 300mm of topsoil is recommended for shrubs and herbaceous plants. A shallower depth of 200mm can be considered for rain gardens that will be turfed or seeded with wildflowers. A layer of mulch should be added to planted rain gardens to help suppress weeds and reduce competition for water and nutrients whilst the planting becomes established.

The sub-base should be 100-500mm deep, depending on the required storage capacity and budget. A deeper sub-base will store more water. In the instance where the sub-soil is free draining, or the catchment area is small, it may be considered appropriate not to include a sub-base.

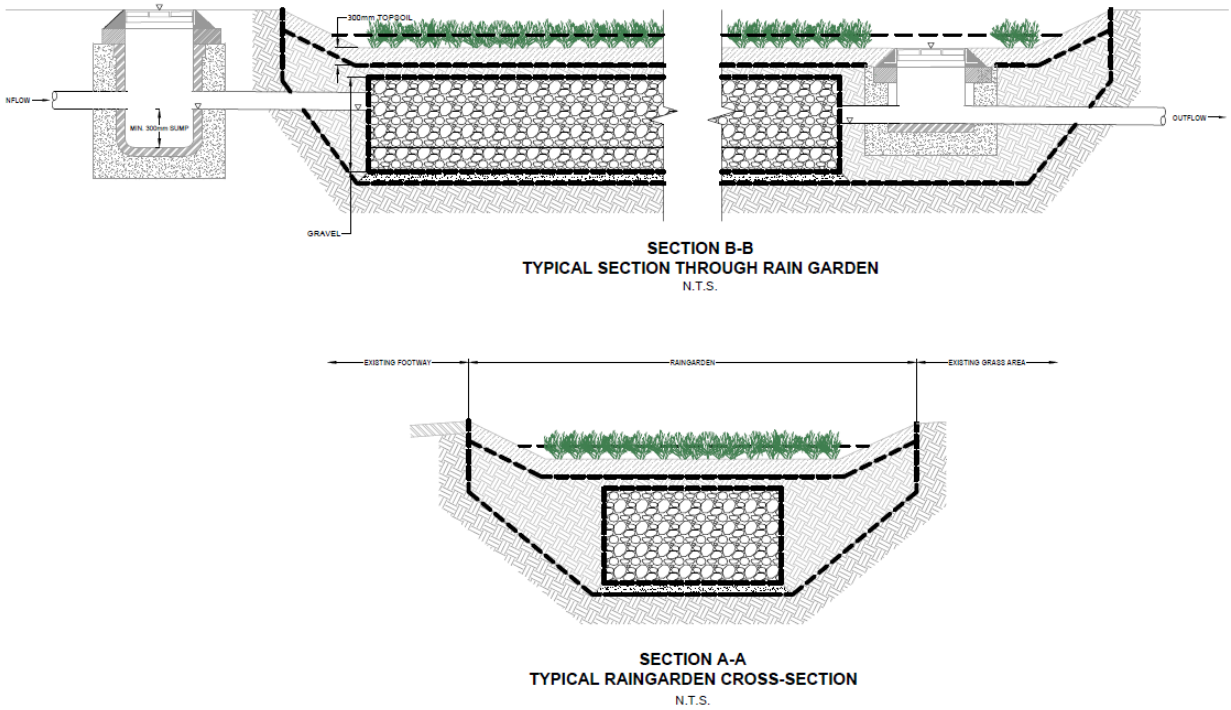

Figure 6-1. Section through and cross-section of a typical rain garden.

6.3.SuDS on highways programme

The drafting of this technical guidance aligns with the launch of the Council's comprehensive delivery programme of SuDS on Barnet's highway network. A detailed geographic information system (GIS) modelling exercise was undertaken to identify borough-wide SuDS opportunities, including basins and wetlands in the greenspaces, as well as highway SuDS prospects throughout the borough highway network. The modelling identified 38 locations very suitable for large storage features and 507 locations for highway SuDS based on the predicted risk of surface water flooding for a 1 in 30-year return period, reported flooding, infiltration suitability, and sites of Importance Nature Conservation, among others. These locations are accessible on this online map.

Furthermore, the 507 highway SuDS opportunities underwent additional prioritization into 7 priority bands as below. This was based on three key criteria: Social (deprivation bands), Flooding (suitable area of proposed SuDS opportunities, considering existing critical drainage areas and historical flooding), and Economic (deliverability and opportunities to connect with existing highways, drainage schemes), each weighted at 25%, 50% and 25%, respectively.

The highway opportunities within Priority Bands 1 -7 are detailed in Appendix 2. It must be noted that the prioritisation will be subject to annual monitoring and can change once the program for each priority band is developed in detail.

Table 6-2. Highway SuDS opportunity programme.

TIME FRAME	PRIORITY BAND	No. OF HIGHWAY SuDS OPPORTUNITIES	HIGH LEVEL COST ESTIMATE (m£)
Years 0-4	1	6	1.6
	2	20	4.8
Years 4-10	3	80	13.9
	4	129	13.5
>10 years	5	98	8.1
	6	56	5.2
	7	100	5.4

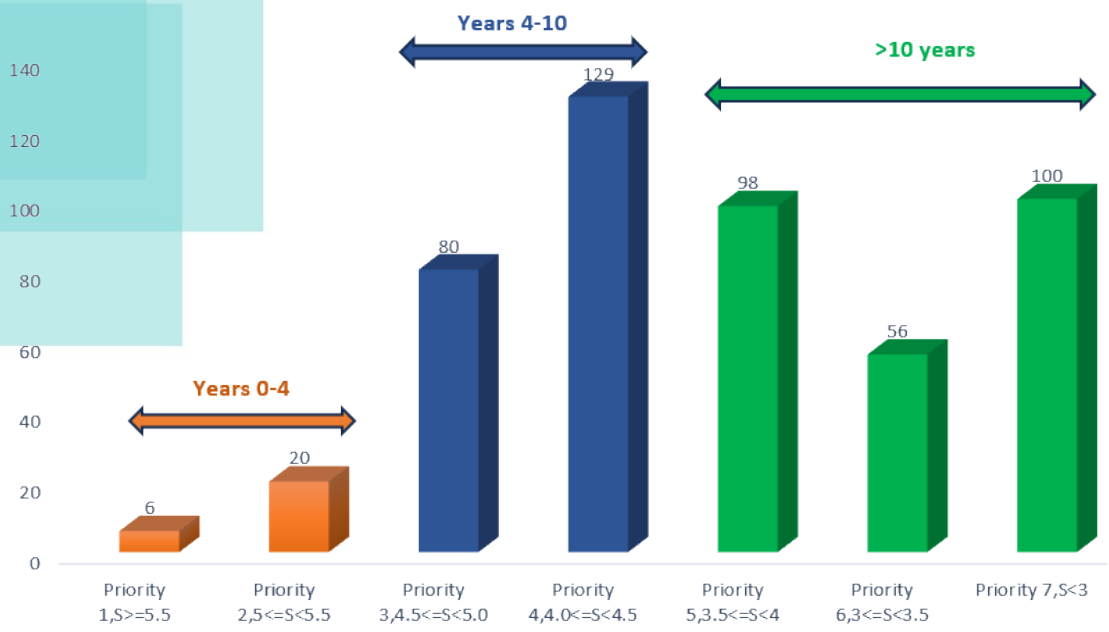

Figure 6-2. Barnet Highway SuDS Prioritisation Programme.

7. SuDS Adoption by the Council

SuDS can be retained by a private development and maintained by an accountable management company with a maintenance plan which has been approved by LBB.

For SuDS in open spaces the developers must contact Barnet Parks and Greenspaces team.

LBB as Highways or LLFA would generally adopt SuDS within highway verges, open spaces or adoptable / adopted highways serving more than 50 properties in accordance to with Barnet's highway adoption policy. They must be designed in accordance with this guide, The SuDS Manual (CIRIA publication C753), the Construction, Design and Management Regulations 2007 and where relevant, the Manual of Contract Documents for Highway Works.

Adoption will be made following a legal agreement between LBB and the developer which confirms that all the LBB adoption requirements have been met (See *Section 6.2* and *4.1*) and that construction has been verified (See *Section 7.1*). All adopted SuDS will attract commuted sums. Commuted sums should be charged at 60 years and the maintenance period set at 2 years. This attributes to the cost of the maintenance of the SuDS scheme, the drainage elements will be adopted by the LBB Highways while the planting and general grass cutting will be adopted by the Street Scene Service within the Council.

Before SuDS can be adopted, LBB will require a maintenance period of two year after the completion of the whole development served by the SuDS. During this time, the performance of the SuDS should be monitored, and minor adjustments based on the observed performance should be made, at the expense of the developer. LBB should have the opportunity to comment on proposed changes before any work is undertaken to ensure the validity of the works and the affect upon the suitability for adoption/repercussions for the drainage system as a whole. LBB may wish to extend the maintenance period should remedial/minor adjustments be required. This extension period is to be determined on a case-by-case basis. A review of the performance of SuDS and any changes made to the design should be provided to LBB. At the end of the maintenance period, there will be a final inspection by LBB before adoption can take place. Any accumulated silt should be removed at this time and any areas of erosion or other defects repaired. The planting will also be inspected and should natural regeneration prove unsatisfactory after that maintenance period, supplementary planting shall be undertaken at the developer's expense. LBB reserves the right to decline the adoption of any system that is not designed in accordance with the adoption requirements detailed within this document.

Note: *Adoption requirements are subject to change, depending on Schedule 3 of the Flood and Water Management Act (2010) which is likely to be enacted in 2024.*

7.1. Verification of construction

LBB will require verification that any SUDS they are to adopt have been constructed in accordance with the agreed design and specification. This will always involve an inspection by LBB during construction (see *Section* ***Error! Reference source not found.***) and a verification report (see *Section 1.4.7*) provided by the developer and reviewed by LBB.

1.4.6 Construction inspection

- Adoption design plans and specifications must be formally approved in writing by the Barnet Highways/LLFA before construction work begins on site.

- LBB must be given at least two weeks' notice of the construction start date and a programme of works should be provided. LBB should be notified of any changes to the programme.
- LBB Engineers shall be provided with free access at all reasonable times to any part of the SUDS works or other works that may affect the operation of the SUDS.
- During construction, the thickness and type of any material or layer may be inspected. If it has been covered prior to inspection without the appropriate notice, it may be re-opened for inspection and reinstated at the expense of the developer.
- A pre-excavation inspection will be required to ensure construction run-off is being adequately dealt with and will not clog constructed SUDS features or pollute downstream features.

1.4.7 Verification report

A verification report should be provided to LBB for review. This will be reviewed on a site-specific basis but as a minimum, should include:

- Photographs of excavations, confirmation of soil conditions, confirmation of levels, profiles and general earthworks.
- Photographs and full manufacturer's details (if appropriate) of inlets, outlets and any control structures associated with any feature to be adopted.
- Confirmation of topsoil sources with appropriate certificates.
- Full planting list and confirmation of plant sources, planting method statement and initial maintenance regime.
- Confirmation of subsoil and topsoil depths.
- Confirmation of gravel fill specification and sources, installation method statement of filter drains.
- Conformation of source and test certificates for membrane liners if used. Membranes shall have welded joints and shall be inspected, and the joints tested after installation. Records of the tests shall be provided.
- Photographs of the feature before and after planting.
- Full 'as constructed' drawings and a topographical survey of the 'as constructed' feature.
- Confirmation of initial maintenance regimes.

8. Planting of SuDS

Planting within SuDS should prioritise the selection of plants suited to their growing conditions. Aesthetic appeal, judged by the public, is crucial, but it should be harmonised with functional suitability. Preference should be given to locally native species and those benefiting wildlife. However, species selection depends on planting purposes, location, and meeting both council and public expectations.

Generally, the following constraints should be considered (CIRIA, 2015):

- Soil depth in lined systems must be sufficient for plant or tree growth, preventing liner damage.
- Trees should not be planted on water-retaining earth embankments.
- Trees should avoid proximity to inlets, outlets or other drainage structures where their roots may affect their structural integrity.

All plants should be specified in line with BS 3936-1:1992 (British Standards Institution., 1992) and the National Plant Specification (https://palette.csdhub.com/helpNPS/), which lists a wide range of species that are commercially available, and the sizes in which they are normally grown.

The key considerations that should be taken into account when selecting the right plants for SuDS are as follows:

- Moisture Regime: Determine the moisture level to select appropriate plants tolerant to the conditions.
- Water Regime: Assess whether the SuDS area is generally damp or wet, considering saturation frequency and average water depth.

Additionally, height, colour and flowering period may also be considered. Taller plants tend to be placed at the centre of the garden while the shorter ones are situated around the edges. Diversify species to create a densely vegetated, stable bed with robust root systems, requiring less maintenance. A typical rain garden may have around 10 species in 2 to 3 clumps per square meter, with the perimeter berm seeded with a wildflower grassland mix (Bray et al., n.d.).

Figure 8-1. Community rain garden planting. A diverse array of plant species is used. Credit: Meristem Design.

9. Maintenance of SuDS

The purpose of maintenance interventions is to ensure that those involved in the maintenance and operation of the SuDS system understand its functionality and maintenance requirements to support long-term performance of the SuDS system. This will ensure that the system behaves as it was designed to and meets relevant design criteria.

SuDS can be retained by a private development and maintained by an accountable management company with a maintenance plan which has been approved by LBB. Refer to *Section 7* for further details on maintenance responsibilities.

9.1. Maintenance for manholes

According to the CIRIA SuDS Manual and industry knowledge, maintenance for the manholes associated with the SuDS feature will be required every 6 months or after a large storm event. On every maintenance check:

- Check for accumulation of debris and silt and clean as necessary.
- Covers and frames to be checked for damage.
- Exposed concrete and adjacent surfacing are to be checked for cracking and general damage.
- Check the condition of inlet and outlet pipes, flap valves, baffles, etc.

On occasional maintenance checks:

- Clean as necessary.
- All manhole and inspection chamber covers and frames are to be replaced as necessary.
- Repair exposed concrete and surfacing as necessary.
- Repair/rehabilitation of inlets, outlets, overflows, and vents, as required.

9.2. Maintenance for rain gardens

According to the CIRIA SuDS Manual and industry knowledge, maintenance for rain gardens will be required every 3 months or after a large storm event. On every maintenance check:

- Inspect infiltration surfaces for silting and ponding, record the de-watering time of the facility, and assess standing water levels in underdrain to determine if maintenance is necessary.
- Assess plants for disease infection, poor growth, invasive species, etc, and replace them as necessary.
- Inspect inlets and outlets for blockage.
- Remove litter, surface debris and weeds.
- Remove sediment, litter, and debris build-up from around the inlet or from forebays.

On occasional maintenance checks:

- Check operation of underdrains by inspection of flows after rain.
- Replace any plants, to maintain planting density.
- Infill any holes or scour in the filter medium and improve erosion protection if required.

- Repair minor accumulation of slit by raking away surface mulch, scarifying surface of medium, and replacing mulch if required.
- Remove silt and replace filter medium and vegetation if required (usually to be needed every 10-15 years).

It is important to consider that plants are likely to require additional watering / maintenance during their establishment period.

Figure 9-1. Design visualisation of a rain garden.

9.3. Maintenance for swales / filter strips

According to the CIRIA SuDS Manual and industry knowledge, maintenance for swales / filter strips will be required every month or after a large storm event. On every maintenance check:

- Inspect infiltration surfaces for silting and ponding, record the de-watering time of the facility, and assess standing water levels in underdrain to determine if maintenance is necessary.
- Assess plants for disease infection, poor growth, invasive species, etc, and replace them as necessary.
- Inspect inlets and outlets for blockage.
- Remove litter, surface debris and weeds.
- Remove sediment, litter, and debris build-up from around inlets, outlets and overflows.
- Cut grass to retain grass height within specified design range.
- Check for uneven surfaces.

On occasional maintenance checks:

- Relevel uneven surfaces and reinstate design levels.
- Reseed areas of poor vegetation growth and alter plant types to better suit conditions as necessary.

- Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.
- Repair erosion or other damage by re-turfing or reseeding.
- Remove and dispose of oils or petrol residues using safe standard practices.
- Repair minor accumulation of slit by raking away surface mulch, scarifying surface of medium, and replacing mulch if required.

It is important to consider that plants are likely to require additional watering/maintenance during their establishment period.

10. References

Barnet Local Flood Risk Management Strategy 2023-29

Barnet Highway SuDS opportunity mapping

Bray, B., Gedge, D., Grant, G., & Leuthvilay, L. (n.d.). *Rain garden guide*. Retrieved November 18, 2023, from https://raingardens.info/wp-content/uploads/2012/07/UKRainGarden-Guide.pdf

British Standards Institution. (1992). *Nursery stock. part 1, Specification for trees and shrubs*. 20.

CIRIA. (2015). *The Suds Manual*. *1*, 386–435. https://www.ciria.org/ItemDetail?iProductCode=C753F&Category=FREEPUBS

Kukadia, J., Lunldholm, M., & Russell, I. (2018). *Designing Rain Gardens: A Practical Guide.* Retrieved December 06, 2023, from https://www.urbandesignlearning.com/resources/publications/details?recordId=recOcYos3UmeZ9PMw

Appendices

Appendix 1- Barnet highway SuDS Prioritisation Programme

Excel spreadsheet template with Highway SuDS opportunities and their prioritisation rank.

Appendix 2 - Adoption Checklists

A 1. Adoption Checklist for Pond / Wetland. Checklists can be made for all features if required.

Requirements	***Details (Developer)***	***Approved (LBB)***
General		
Greenfield runoff rate (1 in 100 +40% CC)	*The runoff rate is… This is lower than the greenfield runoff as shown in the calculations provided in Doc XX*	✓
Exceedance flow route	*The Exceedance flow route is show in drawing XX and is directed north, away from the development…*	✓
Low flow channel (1 in 1 year)		
Side slopes (max 1 in 3)		
Outflow control		
Native, non-invasive planting		
Fencing		
Liners		
Headwalls		
Specific		
Max depth? Varied?		
Water level rise (1 in 30-year event)		
2m wide maintenance strip		
Appropriate barrier planting		
Depth of topsoil between max and permanent water level		
Interpretation / safety boards.		
Verification report		
Photographs of excavations	Link to relevant Doc..	
Photographs and full manufacturer's details of inlets, outlets and controls		
Confirmation of topsoil		
Full planting list		
Subsoil depth		
Topsoil depth		
Gravel fill specification and sources		
Source and test certificates for membrane liners		
Photographs of the feature before and after planting		
Full 'as constructed' drawings		
Topographical survey		
Initial maintenance regime		