

MAYOR OF LONDON

**Reimagining
rainwater in hospitals**

Funded and commissioned by:

Greater London Authority

Produced by:

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We appreciate the help and considerable input from individuals in developing this booklet:

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Esther Coffin-Smith	North Bristol NHS Trust
John Clayton	London Borough of Waltham Forest
Patricia Cuervo	The Royal Borough of Kensington and Chelsea
Lindis Danson	Jacobs, UK
Tricia Down	North Bristol NHS Trust
George Gebski	University College London Hospitals NHS Foundation Trust
Tracey Langford	Langford Direct and Sudstech
Anna Parr	Environment Agency
Lee Sencier	Essex County Council
Michael Waithe	NHS England and NHS Improvement



Contents

1.	Introduction	4
1.1	Purpose of this booklet	5
2.	What are SuDS?	7
2.1	Why use SuDS to manage rainwater?	8
2.1.1	Spaces and places for people - health and wellbeing	9
2.1.2	Hospital Management - adaptation and resource use	10
2.1.3	Spaces and places for nature - biodiversity	10
2.1.4	Managing water quantity - flooding and water availability	11
2.1.5	Managing water quality - pollution	11
2.2	SuDS features for hospitals	12
2.3	Including SuDS in and around hospitals	17
3.	Getting the best outcomes	23
3.1	Maximising the value from SuDS	23
3.2	Delivering SuDS	26
3.3	Dispelling the myths	27
4.	Funding approaches	31
5.	Case studies	33
6.	Further guidance	37

1 Introduction

1.0 INTRODUCTION

How we manage water within our spaces and places has a huge impact on the quality of our environment and lives. Good management of rainfall and surface water within towns and cities can make the places in which we live, work and play healthier, greener, more attractive and resilient to climate change.

Sustainable Drainage Systems, or SuDS create beautiful green spaces and are a fundamental part of green infrastructure that provide functional and attractive places for people and wildlife, as well as reduce the risk of flooding buildings, waterlogging, and water pollution.

In a hospital setting SuDS can contribute to better green spaces that improve patient recovery and provide attractive places for staff and visitors. SuDS are widely accepted as a better approach to managing rainfall than traditional drainage and they will be vital in building greater resilience and responding to the climate and ecological emergencies we are facing.

Figure 1.1 Rain garden capturing rain from the roof at Basildon and Thurrock University Hospital

Image courtesy Courtesy Essex County Council



1.1. PURPOSE OF THIS BOOKLET

This document explains SuDS, their contribution to climate change adaptation and health and wellbeing benefits for hospital patients, staff, visitors and the wider community enabling readers to make informed decisions about their inclusion. This document is designed for those operating and managing hospitals, making decisions on the quality and upkeep of existing estate and opportunities for expansion and refurbishment. This includes property and landscape managers, asset managers, sustainability managers, and site

managers or supervisors. Community or 'Friends of' groups that have an interest in improving hospital environments may also find this document useful to understand how greening the hospital and NHS Trust estates can also provide opportunities to integrate rainwater management and create beautiful places and spaces.

Image courtesy DSA Environment & Design



2 What are SuDS?

2.0 WHAT ARE SuDS?

Sustainable Drainage Systems (SuDS) manage surface water runoff (the flow of rainwater across the surface) by capturing, using, absorbing, storing and transporting rainfall in a way that mimics nature. SuDS slow the flow and reduce the amount of rainfall that drains into sewers, streams and rivers which reduces the risk of flooding and the need for unnecessary treatment. The most beneficial SuDS manage rain close to where it falls, are on (or close to) the surface and often include vegetation.

High quality SuDS deliver a variety of benefits, this delivery of multiple benefits is sometimes referred to as the “four pillars of SuDS” (figure 2.1).

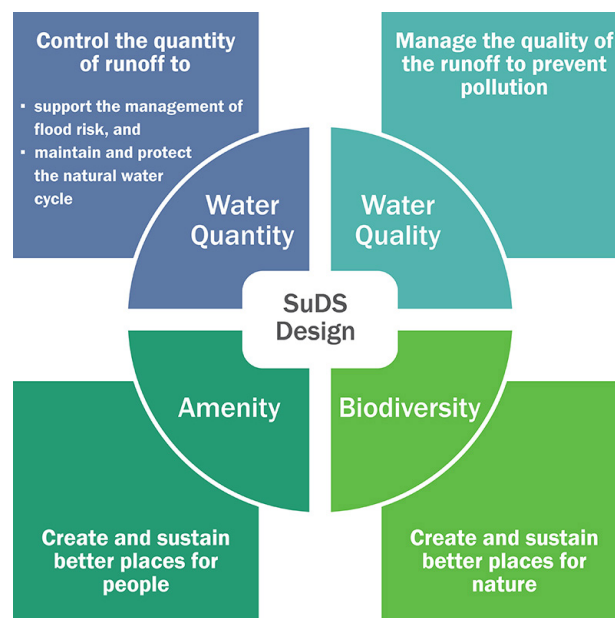
Typical SuDS features used in and around hospitals and health centres are presented in table 2.1, they include rain planters, rain gardens, and swales. Where it is not possible to manage water on the surface (e.g. where space is at a premium) SuDS can also include permeable surfaces, green, or blue roofs and hard landscaping or, if necessary, underground storage tanks. Rainwater harvesting can also reduce runoff and the amount of mains water used for watering gardens.

SuDS can be inexpensive to design, build and maintain. The SuDS approach includes simple changes, like diverting rainwater so runoff soaks into the ground, or using permeable surfaces in car parks and courtyards. SuDS can also include more complex features such as a wetland, or a larger scheme where many features are connected (→ case studies in section 5).

SuDS for new major developments have been a planning requirement since 2015. New health centres, hospitals and those that have been refurbished or expanded have included SuDS in and around their property (→ Figure 2.2 Alder Hey Hospital → Southmead Hospital).

The SuDS approach is not new and is no more difficult than traditional drainage, it is just a different approach that provides multiple benefits. There are case studies of successful SuDS retrofitting in Section 5 of this document. The [susdrain website](#) also includes over a hundred case studies or award submissions where SuDS have been successfully delivered, including a number of examples from the health care sector.

Figure 2.1 The four pillars of SuDS



2.1 WHY USE SuDS TO MANAGE RAINWATER?

There is substantial evidence linking green features like SuDS to better health outcomes. Provision of SuDS can encourage exercise, and when situated in and around hospitals they can reduce recovery times, and the need for treatment thereby helping to reduce costs for health care providers.

SuDS help us adapt to the challenges created by climate change, urbanisation and poor water management. They also offer a fantastic opportunity to improve the quality of health care buildings and their grounds. Multi-beneficial green spaces connect people to nature and each other, as well as improving mental and physical health and wellbeing.

Figure 2.2 Green roof is an attractive approach to manage rainfall at Alder Hey Children's Hospital, Liverpool

Image courtesy Alder Hey Children's Hospital



Well-designed SuDS provide more benefits and are often cheaper than traditional approaches to drainage and landscaping. SuDS for hospitals and the associated estate can be easy to maintain, often requiring nothing more than standard landscape maintenance which in most instances can be carried out by site managers, existing landscape contractors and community volunteers.

Hospitals tend to have large flat roofs and in some parts of London they have areas of car parking comprising impermeable surfaces that generate significant amounts of surface water runoff, making them ideal for retrofitting SuDS and delivering health and wellbeing benefits for patients, staff and visitors. The use of SuDS within the context of water management is covered in the Department of Health's Health Technical Memorandum (HTM) 07-04: Water management and water efficiency – best practice advice for the healthcare sector.

Using SuDS to manage rainfall delivers exciting opportunities to benefit patients, visitors and staff at hospitals, our wider communities and environment. These include:

- Spaces and places for people
- health and wellbeing
- Hospital Management - adaptation and resources use
- Spaces and places for nature – biodiversity
- Managing water quantity - flooding and water availability

In recent years a number of hospitals have won accolades for gardens and landscaped courtyards that have been retrofitted around their buildings. One such example is Chapel Garden in the Norfolk and Norwich University Hospital (figure 2.3). This is a lovely garden, with a few design modifications this can also be used to better manage rainfall.

2.1.1 Spaces and places for people - health and wellbeing

SuDS features that manage rainfall on the surface provide attractive, vibrant places and spaces for people to enjoy (figure 2.4). There is evidence suggesting that pleasant natural surroundings and a view of greenery can improve the mental wellbeing and recovery of patients in hospitals, (Ulrich, 1984 and Ulrich et al, 1991).

SuDS can improve spaces and places for patients, staff and visitors. Flourishing green gardens and water features provide a sanctuary for recovery, recuperation, relaxation and rest away from the hustle bustle of the wards, beds and other hospital functions (figure 2.4). SuDS enable patients to connect with the natural environment, improving health and wellbeing. They can attract birds and other wildlife, providing a focal point which changes through the seasons for people to watch and enjoy. SuDS features integrated into the surrounding landscape can provide an improved view from inside, opportunities for exercise, rehabilitation and physical or horticultural therapy for patients. Food growing on the estate (on roofs, or courtyards) can be combined with

other programmes that focus on therapeutic lifestyle benefits for patients and staff.

Extensive research has identified the benefits of green infrastructure (which includes SuDS) for reducing heat stress, improved air quality, stress reduction, increased social interaction and physical activity (POST, 2016).

SuDS can cool neighbouring buildings in the summer. Trees provide shade from the sun, and SuDS features on, or around buildings (e.g. rain gardens) help cool through evaporation of water from surfaces and transpiration by plants. These types of features provide a healthier and more comfortable environment in both the summer and winter. As such SuDS can help mitigate the problem of overheating of wards and buildings in summer months.

By absorbing, filtering and dispersing harmful airborne pollutants from vehicles SuDS can improve local air quality. They also help absorb and reduce noise from traffic etc., with green SuDS features capable of reducing noise by between 4 and 46 decibels (The IGNITION project, 2020).

Figure 2.3 Chapel Garden and Norfolk and Norwich University Hospital

Image courtesy Plan to Garden



Figure 2.4 Rain planters in courtyard at Basildon University Hospital

Image courtesy Jacobs UK



2.1.2 Hospital management – adaptation and resource use

As well as managing and adapting to the risks of climate change such as overheating and flooding, some SuDS features reduce the costs and carbon associated with energy use (for heating and cooling) and water consumption. For example, green roofs and green walls can provide 7% and 15% (respectively) in energy savings associated with cooling spaces directly below, or behind these features (The IGNITION project, 2020). The reduction in demand for energy and water contribute to the NHS Sustainable Development Strategy (SDU, 2014) and improve performance when using the Sustainable Development Assessment Tool.

“The SuDS scheme around the hospital showcases our ethos of providing green space in and around the hospital. We’re keen to provide an opportunity for staff and patients to enjoy the site providing areas for rest and recuperation as well as looking after the natural world”

Tricia Down, North Bristol NHS Trust

The delivery of multiple benefits from SuDS can positively contribute to a Health Trust’s Corporate Social Responsibility. SuDS and landscape features can provide a focal point for activities for staff sustainability volunteers and local ‘Friends of...’ groups. A good external environment can also bring reputational benefits and accolades. This is recognised by the Building Better Healthcare Awards which has categories for external environments.

Operationally SuDS can be readily integrated within the capital and maintenance investment programmes of hospitals. Some features like green roofs, or permeable surfaces can be incorporated during refurbishment and/or expansion and can potentially prolong the life of other assets, for example green roofs can extend the life of a flat roof by an

average of 23 years (The IGNITION project, 2020). SuDS features (especially those on the surface) can be easier to maintain when considered within existing landscape design and maintenance activities.

2.1.3 Spaces and places for nature – biodiversity

SuDS can contribute to and help deliver many of the outcomes within a Biodiversity Management Plan for hospitals and a local authority area. SuDS also deliver attractive and lush green places for biodiversity by creating new habitats, or improving existing ones (figure 2-5). SuDS features deliver important urban biodiversity, plants and wildlife that encourage pollinators and birds.

Figure 2.5 Biodiversity in the SuDS scheme at Southmead Hospital

Image courtesy North Bristol NHS



2.1.4 Managing water quantity – flooding and water availability

During its ‘Drain London’ project, the Greater London Authority worked with 11 hospitals to assess the risks of surface water flooding. Many hospitals have critical facilities and equipment in the basement or ground floor that can be catastrophically damaged by flooding. SuDS can divert, slow and reduce the amount of surface water runoff that can cause flood disruption and damage. SuDS also enable a once waterlogged courtyard or car park to be more accessible and useable.

SuDS reduce the impact of rain entering our drainage and sewerage systems, which in many parts of London are easily overwhelmed. This can often trigger overflows of sewage into our streams and rivers (creating pollution), and worse still cause homes and businesses to be flooded by sewage.

London is also one of the most water scarce locations in the UK. Some SuDS features allow water to soak into underground aquifers helping maintain the flows of streams and rivers in periods of dry weather. Rainwater harvesting if appropriately designed can also be used to substitute mains water, particularly for garden watering helping to reduce water usage and associated costs.

2.1.5 Managing water quality – pollution

Most of London’s rivers or streams are polluted to some degree, with only one of London’s 41 rivers being classed as “good” under EU environmental legislation. SuDS can improve our water quality and local environment through filtration and break down of pollutants by the sun and microbes potentially reducing pollution in our surface water runoff by up to 90%. Where SuDS reduce the amount of rainfall entering drainage and sewerage systems they also reduce overflows of polluted water in watercourses. This can improve the quality of water and biodiversity in our streams and rivers.

“The SuDS attenuation ponds are amazing! We’re integrating these into green walks around the hospital with an Explorer Map showing walking and running routes as well as ‘Routes to Recovery’ for patients”

Tricia Down, North Bristol NHS Trust

Image courtesy North Bristol NHS



2.2 SuDS FEATURES FOR HOSPITALS

The SuDS approach includes a ‘toolkit’ of various SuDS features, offering different benefits that can be used at different scales and budgets.

Not all SuDS features will be suitable for every hospital, but their flexibility means that better rainwater and surface water management can be delivered by SuDS anywhere. Table 2.1 provides some examples of common SuDS features. These are loosely listed in order based on ease of delivery, i.e. overall level of disruption caused, ease of construction, likely costs and the potential value.

Table 2.1 SuDS features



	SuDS feature	Benefits
	<p>Basin</p> <p>Typically a shallow depression. These can be covered with amenity or meadow grass. They can also be hard landscaped.</p>	<ul style="list-style-type: none"> • Can be a multifunctional space, e.g. used for amenity (if designed appropriately). • Reduces runoff for day-to-day rainfall. • Depending on basin size it can be used to manage rain from heavy storms.
<p>Image courtesy Groundwork, London</p>  <p>Image courtesy Robert Bray Associates</p>	<p>Basins capture water and allow it to soak into the ground where possible, or slow the flow of runoff.</p>	

Table 2.1 continued

	SuDS feature	Benefits
	<p>Swale</p> <p>This is a shallow, flat bottomed ditch with gentle sloping sides.</p> <p>They can be used to transport water from part of the site to another, or to temporarily store runoff when it rains.</p>	<ul style="list-style-type: none"> • Can be visually appealing. • Effectively cleans runoff. • Connects people to water on the surface and is simple to maintain. • Reduces runoff for day-to-day rainfall. • Collects, cleans and transports runoff to other parts of the site. • Can form a wildlife corridor.
<p>Vegetated swale Image courtesy Robert Bray Associates</p>	<p>Dry most of the time, they typically have around 50-150 mm depth of water when it rains.</p> <p>They can be planted with grasses or more attractive vegetation.</p>	
		
<p>Grassed swale Image courtesy North Bristol NHS Trust</p>	<p>Rain garden</p> <p>A small planted basin, typically designed to receive runoff from roofs or hard surfaces.</p> <p>The water can be directed to the rain garden using pipes or rills.</p>	<ul style="list-style-type: none"> • Highly visual and attractive feature. • Easily incorporated into small green spaces which are fairly close to buildings. • With appropriate planting supports biodiversity. • Effectively cleans runoff. • Reduces runoff for day-to-day rainfall.
 <p>Image courtesy Robert Bray Associates</p>		

Table 2.1 continued

	SuDS feature	Benefits
 <p data-bbox="97 902 576 983">Image courtesy Jacobs, UK</p>	<p data-bbox="603 405 798 443">Rain planter</p> <p data-bbox="603 468 1034 624">A raised planter with the ability to collect and soak roof runoff into soil and drainage layers in the planter.</p> <p data-bbox="603 663 959 902">An overflow into a drain or another SuDS feature is recommended as it is rare the planter alone will cope with rainfall from a heavy storm.</p>	<ul data-bbox="1070 394 1458 913" style="list-style-type: none"> • An attractive display of sustainable rainwater management. • Enables SuDS where space is limited, or is only available close to buildings. • Can be integrated with additional outdoor seating. • Can be used for food growing and gardening.
 <p data-bbox="97 1588 576 1789">Image courtesy OTA Water</p>	<p data-bbox="603 1012 935 1050">Rainwater harvesting</p> <p data-bbox="603 1075 1002 1473">Rainwater from roofs and impermeable surfaces can be stored and used in and around buildings. They can range from simple water butts to more comprehensive systems that harvest and provide non-mains water for garden watering and toilet flushing.</p> <p data-bbox="603 1512 1027 1709">Rainwater harvesting can slow the flow of runoff, reducing the amount of water that is released to drains or other SuDS features.</p>	<ul data-bbox="1070 1001 1465 1308" style="list-style-type: none"> • Reduces runoff for day-to-day rainfall. • More sophisticated systems can be used to manage heavy rainfall. • Reduces mains water usage.

Table 2.1 continued

	SuDS feature	Benefits
 <p data-bbox="97 808 576 954">Image courtesy North Bristol NHS Trust</p>	<p data-bbox="576 376 1042 448">Wetland or pond</p> <p data-bbox="576 448 1042 627">A permanently wet area designed as a wildlife habitat resource, amenity feature or both.</p> <p data-bbox="576 627 1042 954">Before entering a wetland, or pond, runoff may need to go through other SuDS features to clean it.</p>	<ul data-bbox="1042 376 1506 954" style="list-style-type: none"> • Creates a valuable ecological and amenity resource. • Can be visually appealing. • Can be a raised feature if levels allow, enabling wheelchair access. • Effectively cleans runoff. • Connects people to water on the surface and is simple to maintain.
 <p data-bbox="97 1355 576 1473">Image courtesy Illman Young</p>	<p data-bbox="576 954 1042 1030">Filter drain</p> <p data-bbox="576 1030 1042 1209">A stone-filled trench that collects runoff from hard surfaces (road or car park) to clean and transport it.</p> <p data-bbox="576 1209 1042 1473">It can include a perforated pipe to slow the flow and enable runoff to soak into the ground.</p>	<ul data-bbox="1042 954 1506 1473" style="list-style-type: none"> • Effective where space is limited. • Collects, cleans and transports runoff to other parts of the site.
 <p data-bbox="97 1854 576 1986">Image courtesy DSA Environment & Design</p>	<p data-bbox="576 1473 1042 1568">Permeable or pervious surfaces</p> <p data-bbox="576 1568 1042 1986">Hard surfaces that can support vehicles (including ambulances), which also allow rainwater to soak into the ground, or into underground storage to slow the release of runoff.</p>	<ul data-bbox="1042 1473 1506 1986" style="list-style-type: none"> • Good range of attractive product types available. • Enables use of surface for footpaths, courtyards or parking. • Cleans runoff. • If designed appropriately can help cool local area.

Table 2.1 continued

	SuDS feature	Benefits
 <p data-bbox="97 902 576 1014">Image courtesy Groundworks, London</p>	<p data-bbox="603 405 826 443">SuDS tree pits</p> <p data-bbox="603 465 1002 745">SuDS tree pits can be used on their own or integrated into other SuDS features like rain gardens, wetlands etc. Existing tree pits can also be adapted to manage surface water.</p> <p data-bbox="603 779 1002 947">The tree canopy intercepts rain and trees also draw up large amounts of water through the soil.</p>	<ul data-bbox="1074 394 1458 958" style="list-style-type: none"> • Attractive feature that contributes to health and wellbeing. • Supports biodiversity. • Can provide cooling and shade. • Can improve air quality. • Reduces runoff for day-to-day rainfall. • Cleans runoff. • Can be used as part of traffic calming.
 <p data-bbox="97 1361 576 1440">Image courtesy North Bristol NHS Trust</p>	<p data-bbox="603 1025 890 1064">Green or blue roof</p> <p data-bbox="603 1086 1034 1440">Sometimes called a 'living roof' these are roofs that are adapted or designed to support plants. A range of plants can be used. The roofs can slow the flow of runoff, reducing the amount of water that is released to drains or other SuDS features.</p> <p data-bbox="603 1485 1010 1597">A blue roof captures more water to slow the flow and reduce the volume of runoff.</p>	<ul data-bbox="1074 1032 1474 1776" style="list-style-type: none"> • Supports biodiversity. • Can provide cooler buildings in the summer. • Can prolong the lifespan of a flat roof. • Cleans roof runoff. • Improves efficiency of solar panels on the roof. • Reduces runoff for day-to-day rainfall. • Can improve air quality. • A blue roof is similar to a green roof but it can be used to temporarily store runoff and slow the flow from heavy rainfall.

2.3 INCLUDING SuDS IN AND AROUND HOSPITALS

Opportunities for SuDS differ from site to site depending upon budget and whether the estate has reasonable amounts of green space, is in a constrained dense setting, or has predominantly hard surfaces. When considering changes to the existing building or estate there may be opportunities to retrofit SuDS features, for example changing courtyards, renewing surfaces or roofs.

Other considerations may include the potential risk of infection from rain-fed water features or rainwater harvesting. A risk assessment may be required considering where the water comes from, how it will be stored, transported and treated, potential maintenance requirements and the likelihood of patients coming into contact with the water.

Most SuDS features introduced will have a benefit for patients, staff, visitors, the estate and the local environment. The more features that can be created, the better, but this may be limited by budgets and space.

Approaches to the introduction of SuDS in hospitals differ. Some estates have introduced only single interventions like permeable surfaces. Other projects are more aspirational and combine permeable surfaces with more attractive green SuDS features.

The following diagrams show multiple SuDS features in cross-section and plan views. Many of these features such as rain gardens, rain planters, swales, ponds and wetlands can be installed individually and still provide significant benefits, however these are maximised when delivered in combination.

Figures 2.6 to 2.9 show how particular SuDS features can be used in and around hospitals and how people may interact with them. The suitability of these features is outlined in table 2.1 and will depend on the opportunities and constraints of the site, as well as the benefits desired.

Figure 2.6 SuDS features within a courtyard and rain chain adding to the soundscape

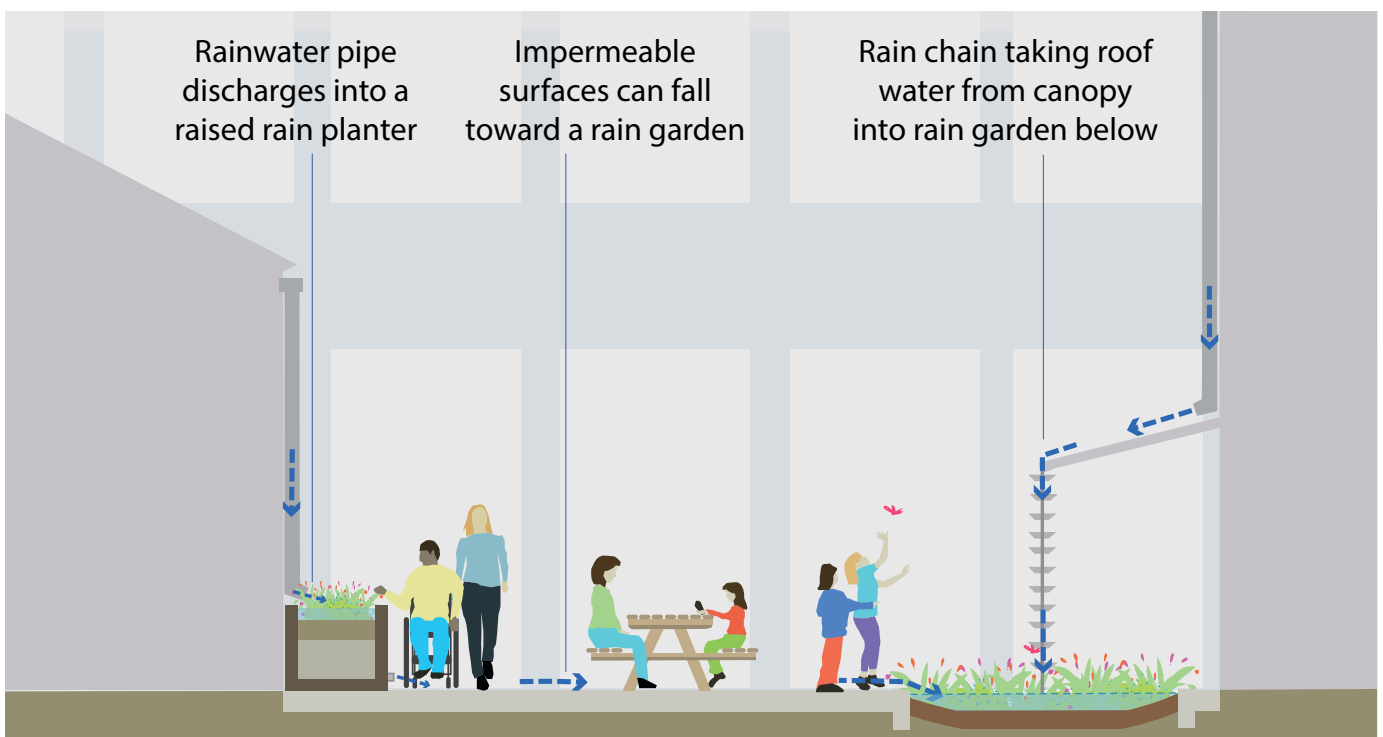


Figure 2.7 SuDS features on the roof and ground

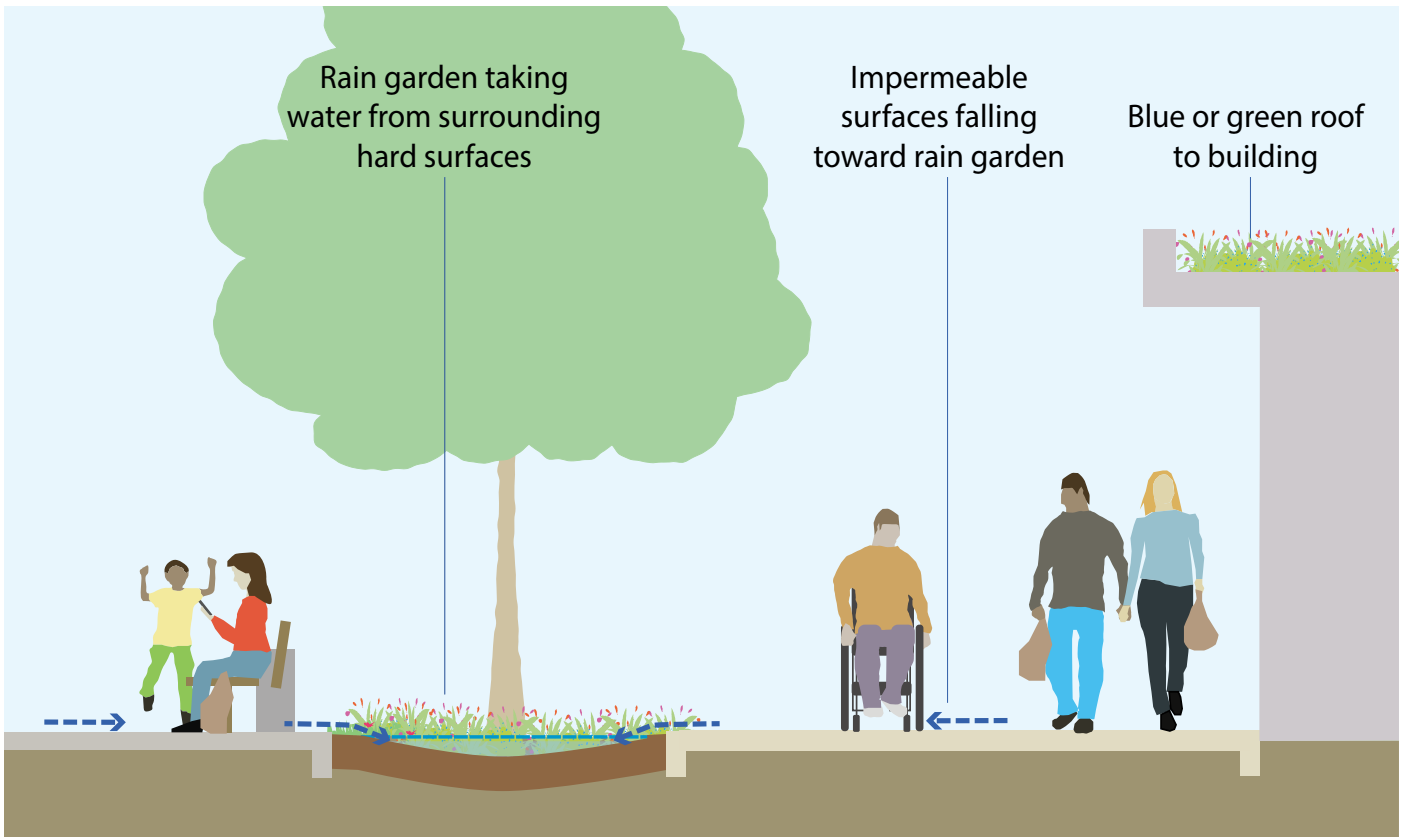


Figure 2.8 Permeable surface and rain garden

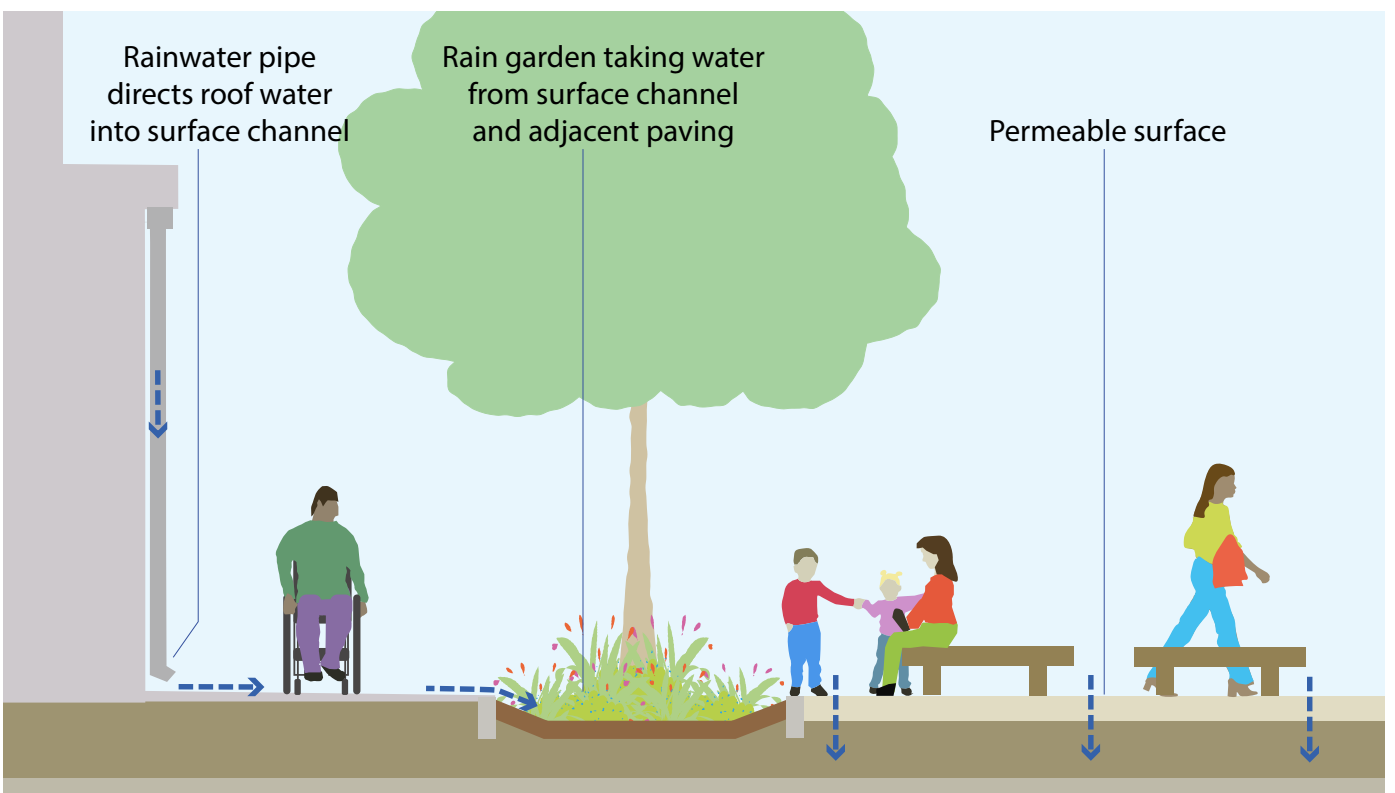


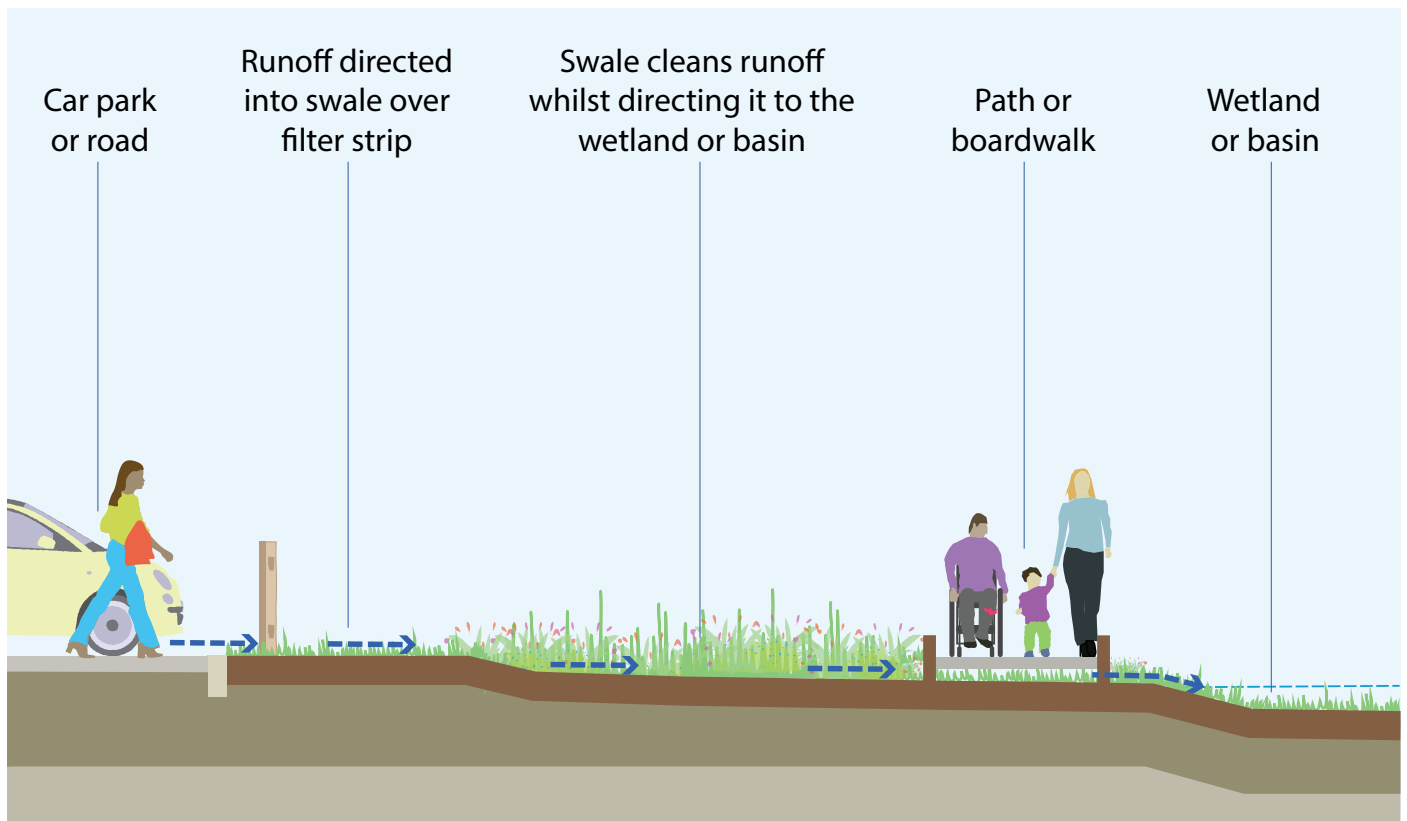
Figure 2.9 Car park and wetland

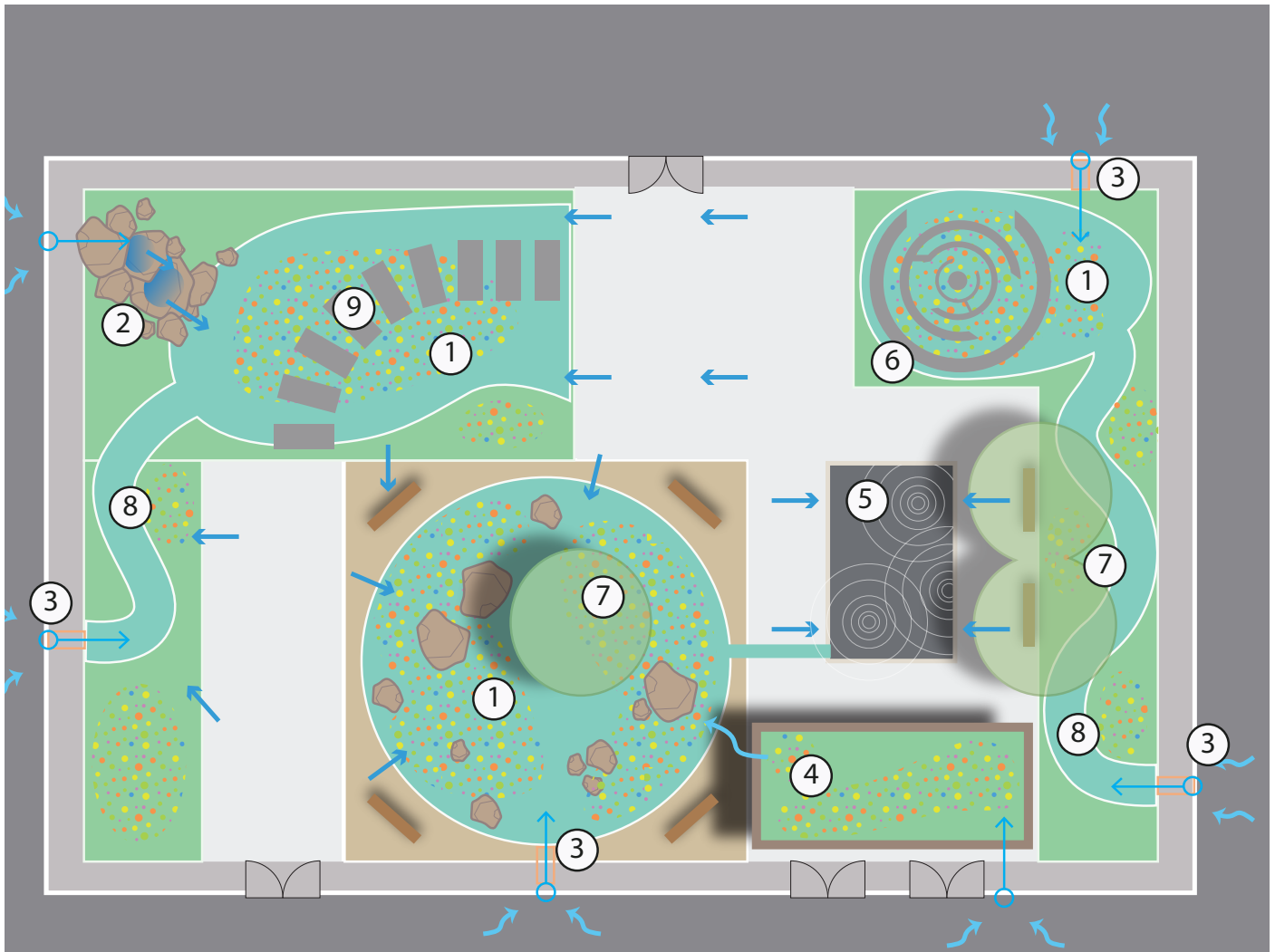
Figure 2.10 is a typical SuDS plan that demonstrates a range of SuDS features that could be created in an existing hospital, and which can be enjoyed by those inside and outside the hospital. Figure 2.11 suggests how SuDS may be retrofitted where space is at a premium and a sensory garden can be created that introduces colour, movement, sounds and smells. These can assist therapy, provide a welcome distraction and also manage rainwater better.

Figure 2.10 Concept for SuDS in hospital estate



- ① Car parks resurfaced with permeable paving.
- ② Part of car park areas resurfaced with permeable paving to collect and clean runoff from surrounding parking areas.
- ③ Pedestrian areas resurfaced with permeable paving.
- ④ Blue green roofs installed to walkways and new buildings.
- ⑤ New cycle store or shelter with blue green roof.
- ⑥ SuDS tree pits collect runoff from existing paved areas.
- ⑦ Planted rain gardens to collect and clean runoff from surrounding roof areas or bioretention rain gardens to manage runoff from vehicular surfaces.
- ⑧ Linear swales are used as attractive features to collect runoff from surrounding surfaces and provide a green corridor.
- ⑨ Grass or meadow basins collect runoff in large storms.

Figure 2.11 Concept for a sensory SuDS garden



- ① Planted rain gardens collect and clean runoff from pavements and roofs providing an attractive, calming or stimulating experience.
- ② Water sculpture/cascade delivers roof runoff to the rain garden below providing visual and auditory stimulus.
- ③ Roof and hard surface runoff feeds a rain garden containing sensory planting and other sensory features such as boulders.
- ④ Pergola structure provides shade and shelter with green roof.
- ⑤ Shallow reflection pool adds relaxing visual interest.
- ⑥ Features such as this maze can be incorporated into rain garden sensory planting.
- ⑦ Tree planting provides shade and shelter to outdoor space.
- ⑧ Roof runoff travels in shallow swales or channels to rain gardens.
- ⑨ Path through rain garden sensory planting.

3 Getting the best outcomes

3.0 GETTING THE BEST OUTCOMES

Obtaining engagement and buy-in from patients, staff, the wider community and those volunteering at the hospital is one of the most important tasks in delivering SuDS. It should be one of the first activities undertaken as it helps develop a shared vision for the SuDS features.

It is also important to engage with those who will be maintaining the SuDS to ensure they are happy with the design and associated maintenance requirements.

The delivery of the rain garden in Basildon University Hospital is a good example of effective collaboration and engagement (→ case studies in section 5). The project was delivered by an integrated team that included the client, landscape architects, engineers and contractors. Patients and visitors also provided input on the design and helped raise awareness about the project.

To get the best outcomes contact a SuDS specialist, Landscape Architect or engineer early in the process. They should engage other relevant disciplines on your behalf if necessary, depending on the scale and type of SuDS required.

3.1 MAXIMISING THE VALUE FROM SUDS

Understanding the context, drivers and potential funders for the SuDS scheme helps to focus on what benefits are desired from the scheme. This could be more about the use of gardens for health outcomes primarily, but can easily include SuDS. There are some common approaches to getting the best from SuDS, these should be discussed with those involved in designing the SuDS:

- Manage water on the surface as much as possible. It can help cool buildings and external environments, connect people with the SuDS, planting and wildlife as well as making SuDS easier and cheaper to construct and

maintain. It also allows breakdown of pollutants by sunlight and microbes.

- Manage rainfall as close to where it falls as possible. This ensures that flows through the SuDS features are slowed and any low levels of pollution in the runoff are treated and therefore safer and beneficial for patients, staff, visitors and wildlife.
- Ensure that appropriate safety is considered as part of the design process for SuDS features. This does not necessarily mean fencing them off. Integrate discussions about risks around water into the stakeholder engagement.

Specific approaches to maximising benefits are discussed in table 3.1 and there is also guidance on overcoming some of the challenges faced in table 3.3.

Figure 3.1 A SuDS wetland cleaning and slowing runoff at Victoria Park Health Centre, Leicester

Image courtesy DSA Environment & Design



Table 3.1 Approaches to maximising the benefits

Category	Approach
Spaces and places for people	<ul style="list-style-type: none"> • Involve patients, staff, visitors and volunteers as early as possible to obtain their input in design decisions, planting and potential upkeep. Work with them to run events to celebrate the new green space they have. • Consider the number, variety and quality of the uses of SuDS, such as relaxation, therapy and car parking. • Prior to runoff being drained into the areas designed for people ensure it is clean by using SuDS features. • Consider multifunctional SuDS features that can: <ul style="list-style-type: none"> • provide a sanctuary where users can ‘escape’ from the hustle and bustle of the hospital • provide shady meeting places • be seen from inside • be planted and managed by volunteers • be used for therapy and horticulture • help support comfortable building temperatures (e.g. green roofs) • help improve air quality. • Ensure that safety is considered as part of the design process for SuDS features – this does not mean including fences, or burying rainwater underground. • Consider how the SuDS feature and places will be used by people. • Consider the inclusion of interpretation boards to inform all patients, staff and visitors about the function of the SuDS features.
Spaces and places for nature	<ul style="list-style-type: none"> • Use vegetated SuDS features wherever possible. • Improve habitats for local wildlife by using appropriate Biodiversity Action Plans to help inform the design. • Prior to runoff being drained into the areas designed for biodiversity ensure it is managed and clean.

Table 3.1 Continued

Category	Approach
Hospital management	<ul style="list-style-type: none"> • Consider whether funding opportunities and changes to the building fabric, or other parts of the site (e.g. roofs, car parks) will enable SuDS features to be retrofitted. • Ensure the designers consider ease of construction and maintenance of SuDS features when planning and designing the SuDS. • Encourage designers to exploit natural gradients, flow paths and existing waterlogging to keep flows on the surface, reduce the estate's flood risk and reduce overall costs of the SuDS (by reducing the need for excavation). • Celebrate the greenspace and the potential to improve the quality of places and spaces. Make good use of engagement activities and 'Friends of' the hospital groups to improve relationships with patients, staff and visitors throughout the process. • Consider approaches to actively involve and, where appropriate, train and develop the skills of volunteers in the delivery and maintenance of SuDS features.
Managing water quantity	<ul style="list-style-type: none"> • Use surface water as a resource, allow it to be used to water gardens and green spaces. Rainfall should also be allowed to soak into the ground to help replenish underground aquifers. • Prioritise SuDS features that manage water at the surface, allowing water to soak into the ground as well as evaporate and be transpired from plants. • Discharge runoff managed by SuDS to watercourses instead of drainage and sewer systems. • Consider where the water will flow during extreme rainfall or if there is a blockage in the system and design-in a flow path.
Managing water quality and pollution	<ul style="list-style-type: none"> • Prioritise SuDS features that include vegetation and healthy soils to assist with the treatment of low level pollution. • Ensure the designers consider risk of pollution from surfaces and include the right type and right number of connected SuDS features.

3.2 DELIVERING SuDS

The SuDS design should be tailored to the opportunities and challenges of the site as well as how the area will be used. As explained earlier, the effective engagement of stakeholders and early involvement of the right design team will provide greatest chance of success of delivering cost effective SuDS.

Once you have decided that you would like a designed SuDS scheme for your site and have considered what you would like to achieve you should engage a SuDS specialist to talk about the process. Some organisations providing technical support on SuDS can be found on the [susdrain website](#). This is likely to involve an initial consultation, the development of an outline/concept design, detailed design, construction of features and then inspection. During this process it would be useful to discuss how and when to engage with others, the likely costs and timescales involved as well as the timing of works to reduce disruption for everyone in the hospital.

It is difficult to provide an indication of costs, as each site is likely to have specific requirements, opportunities and challenges however some rough estimates of costs are provided in Table 3.2. Experience has shown that well designed SuDS are often cheaper than traditional drainage approaches. SuDS also deliver more benefits that may attract funding from other organisations (→ section 4). If funders request quantification of benefits your SuDS specialist can use a free tool called B£ST to provide this information (→ B£ST resources).

Table 3.2 Estimated costs for delivery activities

Activity	Estimated cost
Cost of initial consultation	£300-£1,200
Cost of design (scale dependent)	£3,000-£10,000
Construction of surface SuDS features in existing soft landscape	£20-£50/m ²
Construction of surface SuDS features in existing hard landscapes	£50-£100/m ²
Permeable paving	£50-£70/m ²
Construction of green/blue roof	£50-£150/m ²

3.3 DISPELLING THE MYTHS

Although widely and successfully used across the UK, misconceptions on SuDS can arise which should be challenged. Most concerns (e.g. from colleagues, hospital users) can be overcome with good design, effective engagement and awareness raising.

There are a number of examples of SuDS being successfully delivered in health care buildings and hospitals (→ susdrain case studies), Section 5 also has some relevant case

studies. Some possible misconceptions and responses (solutions) are presented in Table 3.3. to help navigate some of these challenges.

“Biodiverse SuDS features left to look more natural are less expensive to maintain than other landscaped areas”

Tricia Down, North Bristol NHS Trust

Table 3.3 Overcoming challenges or misconceptions for SuDS delivery

Misconception	Response
<p>Safety</p> <p>‘Do SuDS have permanent water and can they be dangerous?’</p>	<p>Good SuDS are designed to be safe, minimising the risk of drowning.</p> <p>Unless a feature has been designed to permanently hold water, such as a pond or wetland, SuDS are dry most of the time except after heavy rainfall. Typically, SuDS are shallow, with gentle side slopes and controlled water flows.</p> <p>A risk assessment should be undertaken for the scheme which takes into account how the site will be used and by whom. It is important to consider the frequency of SuDS features being full, the water depth and ensure that water quality of accessible permanent water is managed.</p> <p>In terms of water quality, the use of runoff from roofs and other hard impermeable surfaces should be possible in sub-surface features that enable runoff to soak into the ground. Some health care buildings, particularly new developments, have incorporated ponds, and wetlands (Southmead, Basildon and Thurrock University Hospital) when designers and managers are satisfied infection risks are minimised.</p> <p>As outlined in Department of Health’s Health Technical Memorandum (HTM) 07-04 (Department of Health, 2013) a risk assessment should be undertaken taking into consideration the area from which rainwater is collected and how it is transported and treated. Where and how the harvested rainwater is used will also have a bearing on its suitability for non-main water use like toilet flushing and garden watering.</p> <p>The Scottish HTM 04-02 from Health Facilities Scotland (2015) also provides guidance on the use of harvested rainwater in hospitals. Research into roof water quality and the health implications of using harvested rainwater suggests that breakdown by sunlight and other natural elements on roofs can destroy many bacteria and wind removes some heavy metals collected in the atmosphere. (Villareal and Dixon, 2005). Water quality of runoff will however vary from location to location.</p>

Table 3.3 Overcoming challenges for SuDS delivery cont.

Misconception	Response
<p>Costs</p> <p>‘Are SuDS more expensive?’</p>	<p>SuDS are often no more expensive than traditional drainage, they tend to be cheaper in new developments and can easily be achieved in retrofit situations. However, costs will be dependent on the site and the design. It is also important to consider the benefits provided. A high-quality SuDS scheme will deliver more benefits than traditional drainage.</p> <p>The more that designs are incorporated into the fabric of development to manage rainwater, the more cost effective they become. Note that SuDS features such as planting, trees, block paving and play features should not be considered as extra costs if these items would be provided anyway.</p>
<p>Maintenance</p> <p>‘Are SuDS difficult and expensive to maintain?’</p>	<p>Thoughtfully designed SuDS can be easy to maintain with minimal, if any additional costs over a traditionally drained site. Those designing the SuDS features should provide a maintenance schedule that outlines the tasks and whether maintenance should be undertaken by SuDS specialists, or landscape maintenance teams, site managers, or volunteers and members of the community.</p> <p>When choosing SuDS features, consideration should be given to both the day-to-day and long-term maintenance of the SuDS and whether they are appropriate and practical.</p> <p>Soft-landscape and permeable surfaces usually require the least additional or specialist maintenance. Features like rainwater harvesting systems may need specialist maintenance to ensure long term performance.</p>
<p>Litter</p> <p>‘Will SuDS create more litter?’</p>	<p>Soft landscape areas tend to collect litter because of the trapping effect of planting, however, corners in raised surfaces such as kerbs, edges and walls as well as sheltered spaces beneath seating also tend to collect litter.</p> <p>Litter often needs to be collected to keep the public realm tidy and attractive. There are many factors that affect the amount of litter in our landscapes including the types of uses/activities, the amount of footfall and the number of litter bins. Studies have shown that spaces that look more attractive and cared for suffer less littering than unattractive, poorly maintained spaces.</p>

Table 3.3 Overcoming challenges for SuDS delivery cont.

Misconception	Response
Suitability of ground conditions 'If water cannot soak into the ground, or we have poor ground conditions can we use SuDS?'	<p>The ability of rainfall to soak into the ground (infiltration), the levels of the water in the ground, and potential soil contamination can influence the type of SuDS feature used. These conditions however will not prevent SuDS being used.</p> <p>SuDS do not need to soak runoff into the ground. It is quite common for schemes to use other ways to manage the runoff if clay and other factors stop or slow infiltration. This includes using flow control devices to slow the flows of runoff and allow it to be drained to a watercourse, surface water sewer - or combined sewer if neither of these is available.</p>

4. Funding approaches

4. FUNDING APPROACHES

Sufficient funds and resources will be required to cover both the capital and maintenance costs of SuDS. Finding funds can be challenging and is likely to be required from multiple organisations. This is also where effective and early engagement can be helpful.

It may also be possible to alter the approach to planned changes or annual maintenance to enable gradual implementation of SuDS features or implementation of SuDS principles.

Where the benefits can be clearly understood and are greater than the costs of SuDS the case for funding will be more attractive. Some options for finding additional external funds are presented in table 4.1.

Table 4.1 Potential funding sources

Potential funding source	Comments
Local Authority	Those managing flood risk or the public realm may have the ability to unlock funds from others sources (e.g. Section 106 Agreements and regeneration projects). They may also be able to provide links to other council funding pots, such as community greening initiatives as well as external partnerships and funders. If appropriate the Local Authority may also support a grant application for Central Government funds related to flood risk management. This is best discussed with the Local Authority's Flood Risk Manager.
Greater London Authority (GLA)	The GLA occasionally provides grants for delivering greener communities. Appropriate applications for funding for critical infrastructure such as hospitals and healthcare facilities are always likely to be well received. The funding opportunities are often time limited so for 'greening' projects look at https://glagrants.org.uk/ for further information.
Thames Water	Thames Water has a fund (for 2020 -2025) to improve surface water in their catchment, this specifically includes SuDS. Funding decisions will be based on the site and the potential social and environmental benefits of the proposed scheme. For further information contact swm.partnerships@thameswater.co.uk or contact the Local Authority's Flood Risk Manager.
<u>Local Wildlife Trusts</u> <u>Local River Trusts</u>	Wildlife and river trusts may occasionally have access to funds and partners that may be interested in supporting the delivery of SuDS in communities, particularly if they also deliver some of their remit (typically around biodiversity and water quality) too.
Other charity and third sector groups	Third sector organisations and charity organisation with aligned drivers (health and wellbeing, improving communities etc.) like the Heritage Lottery Fund, and possibly local companies may be interested in supporting SuDS if the benefits for them and their interests are clearly stated.

5 Case studies

BASILDON AND THURROCK UNIVERSITY HOSPITAL RAIN GARDEN, ESSEX

Essex County Council worked with Basildon and Thurrock University Hospitals to retrofit SuDS within courtyards. The aims of the project were to store surface water reduce runoff. Patients, staff and visitors shaped early conceptual work through engagement events and a stakeholder survey.

Identifying multiple benefits helped identify multiple sources of funds to deliver the project.

Benefits include:

- The planting and design provided additional biodiversity.
- The scheme improved amenity with a new meeting space and walkway.
- Between 2900 - 4200 m³ additional storage of surface water was provided and a 50% reduction in existing surface water discharge from the site.

- An estimated £4m in avoided flood damages to local properties was provided and the downstream sewer system was protected.

SuDS features delivered include rain planters collecting runoff from the roof, permeable surfaces, a washland area and rain gardens that reduce hard, impermeable surfaces. These features were integrated with seating areas, sun awnings and a walkway. The contractor will maintain the scheme for one year, longer term management will be undertaken by volunteers and the hospital’s estate management department.

All Images courtesy Essex County Council



WYTHENSHAW HOSPITAL DEMENTIA UNIT, MANCHESTER

The Dementia Trust commissioned a garden within the hospital grounds for use by dementia patients and their families. The brief was to create a pleasant, safe space, with a low maintenance poured, resin bound permeable surface that was non-slip. A surface was chosen that has no joints and could be moulded to provide a smooth ramped surface toward the hospital entrance.

Benefits include:

- Permeable surface capturing and slowing the flow of runoff.
- Low maintenance.
- Green SuDS features can be integrated into permeable paving to deliver additional benefits.

(Information provided by Sudstech)

Image courtesy CIRIA



WEXHAM PARK HOSPITAL, SLOUGH, UK

Wexham Park is a large NHS hospital providing multi-disciplinary health and emergency services. Staff parking was inadequate, so the Frimley Foundation Trust decided to develop an adjacent greenfield site to provide an increased number of parking spaces.

A porous surface was preferred for the new car park as it enabled compliance with local planning conditions regarding rainwater discharges and was cost effective compared to an impermeable surface with an infiltration tank. A 6500 m² permeable paving system of interlocking cellular plastic porous pavers designed for the stabilisation of trafficked grass or gravel surfaces was installed.

Benefits include:

- Permeable surface capturing and slowing the flow of runoff.
- Surface water treatment through filtration.
- Carbon footprint saving.
- Material cost savings.
- Heat island effect reduction compared to hard surfaces.

(Information provided by ABG Geosynthetics Ltd.)

Images courtesy ABG Geosynthetics



SOUTHMEAD HOSPITAL, BRUNEL BUILDING, BRISTOL

North Bristol NHS Trust (NBT) wanted to deliver an exceptionally sustainable hospital at Southmead, delivering long term environmental, social and financial benefits for patients, staff, visitors and the local community.

SuDS including six sedum green roofs and therapy gardens, were created to slow down surface water flow, which is collected and used for irrigation. Runoff from the car park passes through swales which clean the water before entering four ponds. Landscaping on site has resulted in its recognition as an NHS Forest site.

The site is maintained and managed to a high standard by the Private Finance Initiative contractors and reviewed by the NBT who have created a biodiversity management

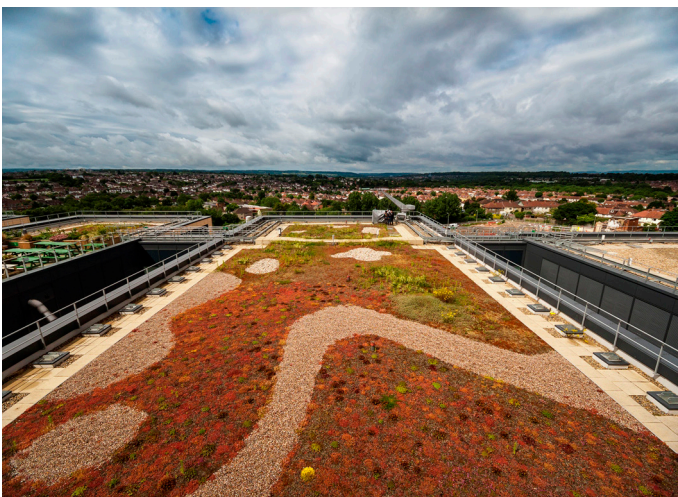
plan. The herb garden is managed by the NBT with the help of volunteers.

The SuDS have reduced surface water runoff by almost 40% and water consumption by 25%, which has led to an annual saving of approximately £130,000.

Benefits include:

- Increased infiltration into the groundwater / water storage.
- Reduced runoff.
- Increased quality and quantity of blue-green infrastructure.
- Increased species richness and biodiversity.
- Provision of health benefits.
- Reduce costs for water treatment.

Images courtesy North Bristol NHS Trust



6. FURTHER GUIDANCE

1. Bray, B, Gedge, D, Grant, G, Leuthvilay, L. Rain Garden Guide. [Web link](#)
2. CIRIA - susdrain website. [Web link](#)
3. Department of Health. (2013). Health Technical Memorandum 07-04: Water management and water efficiency – best practice advice for the healthcare sector. [Web link](#)
4. Health Facilities Scotland. (2015). Scottish Health Technical Memorandum 04-02. Part B: Rainwater harvesting. [Web link](#)
5. GLA SuDS sector guidance. [Web link](#)
6. Graham, A, Day, J, Bray, B, Mackenzie, S. (2012) Sustainable drainage systems – maximising the potential for people and wildlife. RSPB and WWT. [Web link](#)
7. POST. (2016). Green space and health. [Web link](#)
8. Sustainable Development Unit. (2014). Sustainable, resilient, healthy people & places – A Sustainable Development Strategy for the NHS, Public Health and Social Care System. [Web link](#)
9. The IGNITION project. (2020). Nature-based solutions to the climate emergency – the benefits to business and society. [Web link](#)
10. Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224: 42-421. [Web link](#)
11. Ulrich, R.S. Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A. and Zelson, M. 1991. Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, 11: 201-230. [Web link](#)
12. Woods Ballard, B, Wilson, S, Udale-Clarke, H, Illman, S, Scott, T, Ashley, R, Kellagher, R. (2015). The SuDS Manual, CIRIA C753, London (ISBN: 978-0-86017). [Web link](#)

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