

Simple SuDS for Local People

A Guide to Sustainable Drainage in Developments



Sustainable Drainage Systems (SuDS)

Working with nature to manage water and flood risk

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DOING THINGS DIFFERENTLY IN A CHANGING CLIMATE

Drainage systems used to be invisible. Most of us in this country expected rainwater in our streets and public spaces to be efficiently removed from our lives through underground pipes. Drainage was very much out of sight and out of mind, until something went wrong, at which point we expected the authorities to intervene and solve the problem.

Recently, new drainage systems have been designed that behave quite differently. They capture rainwater where it falls, they store it and they filter it. All this slows the speed at which rainwater enters our rivers, streams and other drainage systems and reduces the risk of flooding.

Even better, these new drainage systems create all sorts of additional benefits along the way. The systems are known as Sustainable Drainage Systems, or SuDS.

WHAT IS THE GUIDE ABOUT AND HOW TO USE IT?

This guide is designed to help residents and community groups in England understand more about Sustainable Drainage Systems (SuDS), how they should be built and how they should be maintained. It explains how SuDS help to manage flood risk, drought and water quality while creating better environments for both people and wildlife. Well-designed SuDS have multiple benefits and can greatly enhance a development both in terms of what they do, how they look and by providing open green spaces for local people to enjoy.

The guide provides information to help local people to:

- Work with developers and the local planning authority as SuDS are built,
- Monitor the ongoing maintenance of SuDS and trouble-shoot potential problems.

You can use this guide to:

- Find out more about what SuDS are and how they work,
- Identify and locate the SuDS features on developments,
- Recognise some of the signs that they might not be working properly,
- Understand what actions might be taken to make SuDS work better,
- Monitor SuDS schemes in your local area over time.

It is important that SuDS are installed and maintained correctly. Whilst there are many well designed and maintained SuDS, things can sometimes go wrong in their installation or maintenance. As a result, they may not work correctly, or they may fail. This is where communities and residents can help by monitoring their local SuDS on a regular basis and tracking their condition over time. We hope this guide will help you to do this and identify any problems that need to be put right.

This guide is intentionally straightforward, pulled together by residents for residents and assumes no professional expertise on your part. It should be viewed as a living, developing guide that will grow over time as more residents' groups use it and feed information back to us about what they learn.

We welcome your input and experience in the continuing development of this simple and practical guide. In doing so you will help us adapt and improve this guide. Please email us at phiala@sky.com and bridgemanteresa@gmail.com with the following information:

- **Name**
- **Location**
- **Flood Group (where applicable)**
- **Clearly labelled photographs, ideally stamped with location, and permission to use them in this guide**
- **As much information about the SuDS/your experience of SuDS/etc as possible**

WHO WE ARE AND WHY HAVE WE WRITTEN THIS GUIDE?

We are a couple of 'floodies' who have had to do a lot of learning ourselves over the past decade or so. We first wanted to produce this guide because there is so little information available that is written for residents rather than designers and engineers. As SuDS become more common, as their 'green' components become established, and as they develop and change, their maintenance will become an increasingly important issue affecting many people's lives. Although we started out thinking solely about flood risk (we are floodies after all), we soon realised that there is far more to SuDS than flooding.

We've worked hard to keep this guide simple. As floodies, we have experienced complicated technical flood documents which require constant checking and rechecking of glossaries and decoding of acronyms and abbreviations. We have stuck with the acronym SuDS, because it is in common use (feel free to email us to express your disapproval). We have also included technical terms that we've found useful to know and which you'll undoubtedly come across the more you work with SuDS. We've provided explanations for these in everyday language.

WHAT IS NOT IN THIS GUIDE

This guide does not look at SuDS in the planning system as this topic is too complex to cover here. Nor does it discuss the SuDS that can be installed on individual properties. Its focus is the 'public' SuDS found in developments and other public places.

If you want to know more about how the planning process deals with flood risk management and SuDS, some useful advice and links can be found on Warwickshire Council's [website](#). **[Note: this**

guide has embedded links, simply click on the relevant word to go straight to the website/document]. If you have come across other useful guides, please let us know so that we can add the links into this document for other people.

For more information about individual [property level SuDS](#) and [property resilience](#):

BE SAFE

This guide covers only visual inspections that may be carried out over time to monitor the performance of the SuDS. Visual inspections must be undertaken safely and from a safe position. If in doubt, take photographs/videos and send them to the relevant responsible person or body. Do not put yourselves or others at any risk (physical or legal) when inspecting SuDS.

It is not safe or sensible to enter areas of construction, to clamber into SuDS or to wade into ponds to remove litter. Think before you act. Don't put yourself or others in danger.

Before starting please carefully consider the Health & Safety implications of your visual inspection. You will find a useful approach to risk assessment on p. 816 of the [SuDS Manual](#) produced by [CIRIA \(construction industry research and information association\)](#). Although it isn't designed for exactly this purpose, it does cover elements that you need to think about before getting started. We recommend that you read this before you carry out any SuDS inspection.

THE STRUCTURE OF THIS GUIDE

1. INTRODUCTION

- 1.1 What are Sustainable Drainage Systems?
- 1.2 Does the development where we live have SuDS?
- 1.3 Who is responsible for maintaining the SuDS?
- 1.4 What is a maintenance schedule?
- 1.5 What can residents and local people do?
- 1.6 What can local authorities do?

2. STEP BY STEP GUIDE TO INDIVIDUAL SuDS FEATURES

- 2.1 Dry landscaping: swales and detention basins
- 2.2 Wet landscaping: wetlands and retention ponds
- 2.3 Filter strips
- 2.4 'Greening the street' and rain gardens: bioretention systems
- 2.5 Permeable paving systems
- 2.6 Trees
- 2.7 Soil
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- 2.9 Sediment in the whole system

3. ACKNOWLEDGEMENTS

4. ADDITIONAL INFORMATION

1. INTRODUCTION

1.1 What are Sustainable Drainage Systems?

Sustainable Drainage Systems (or SuDS) are designed to manage rainwater in a housing or industrial development in ways that copy natural processes. Most developments will combine several different measures. For more information visit the [susdrain website](#).

If SuDS are designed and installed correctly and in a way that is suited to the site, then their maintenance can be relatively simple and low-cost.

In most natural environments, the ground is permeable, acting as a sponge, soaking up rain and releasing it slowly. How quickly water soaks (or infiltrates) into the ground and how long it stays there will depend on the type of soil, the condition it is in and what lies beneath the soil.

Plants and trees also affect what happens to rainfall. Like the soil, they both absorb water (through their roots) and release it (through their leaves). As a bonus, they also filter the water, reducing pollution. And, of course, they enhance our local green spaces!

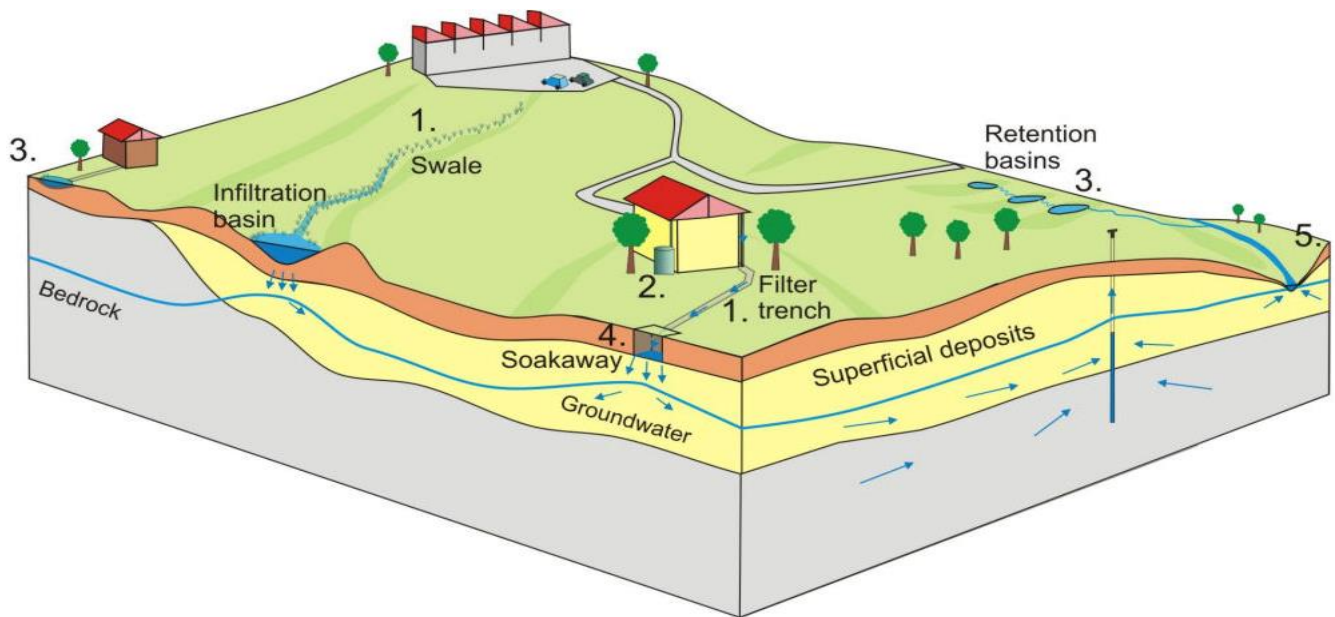
By contrast, in urban areas, hard, impermeable surfaces such as concrete and tarmac are common, leaving less 'sponge' available to soak up rainwater. Traditional drainage systems pipe the water away from a site into watercourses or into the main sewage network. The pipes have limited capacity, so in heavy rain too much fast-flowing water enters the system and overwhelm it. This can result in localised flooding, often with raw sewage in the water.

SuDS put the sponge back into where we live. Like the natural environment, they can store water and may re-use it, or slow the rate at which it flows into local watercourses or other drainage systems. They help us to reduce flooding and better manage the effects of drought. The SuDS process can be described in three simple steps: Slow, Store and Filter.

SuDS have positive environmental benefits, they improve the quality of the water, increase biodiversity and provide habitats for wildlife. Well-designed SuDS can also enhance the local area, providing pleasant and attractive places to live and work.

Some sustainable drainage features are clearly visible, but parts of them may be under the ground. Others, such as infiltration systems (where rainwater soaks in) and tanks, are entirely hidden away, often under driveways and roads. This guide focuses on what is visible, safe and easy to monitor. But don't forget the existence of what is beneath your feet, as these parts of the system can influence the performance of the SuDS you can see. If they fail, this can lead to subsidence and flooding in unexpected places.

We think that the following image from the British Geological Society ([BGS](#)) is useful in showing the basic way that SuDS work. Common SuDS features that slow, store and filter water are described in more detail in Part 2 of this guide.



This image shows how, during heavy rain, surface water flows through filter trenches (to remove pollutants) and along swales (1). At times when drains are filling up fast, rainwater can be held back. It can be stored for re-use (2), stored in ponds (3), or can soak slowly into the ground through infiltration basins and soakaways (4). As a result, rivers and the main sewage network are less likely to flood, and their water quality is improved. *(Reproduced and adapted with the permission of the British Geological Survey ©UKRI. All rights Reserved)*

1.2 Does the development where we live have SuDS?

This is complicated. It will depend in part on the size of your development. If there are fewer than 10 houses, there will have been less pressure on the developer to install SuDS.

But it will also depend on when your homes were built, even if they are part of a large development:

- Before 2015: some housing developments may have some SuDS features;
- After 2015: housing developments more likely to include SuDS features, especially in larger developments;
- After 2018: developments *should* use SuDS feature to manage water and there *should* also be a maintenance plan for SuDS in place with designated responsibility.

If you live in an older development, some forms of SuDS can readily be put in (this is known as retrofitting). For example, some of the impermeable surfaces can be removed and replaced with rain gardens or other simple features which help rainwater to soak (infiltrate) into the ground.

1.3 Who is responsible for maintaining the SuDS?

Responsibility for maintaining SuDS is equally complicated. There are a variety of bodies who could be responsible for the SuDS where you live, or even for the maintenance of different parts of a SuDS system:

- Nobody (where no agreement was made or there is nobody left who was originally involved) – this is where you can play an important role in raising issues with either your management company or local authority,
- The developer (during development and in the period immediately following completion),
- Your landlord (if they own the development or part of it),
- A management company (acting for residents or others),
- Your local authority, if they have adopted the SuDS,

- County/Unitary/Borough Highways Departments (for the SuDS associated with the roads, if adopted),
- Your local water company, if they have adopted part or all the system (after 2019),
- Individual private property owners – for maintaining any SuDS which are within the boundaries of their properties.

1.4 What is a maintenance schedule?

Developments built after 2015 there should be a maintenance schedule in place which designates responsibility for maintenance, held by one of the above groups/institutions (1.3). This should make it easier to find out who is responsible. The maintenance schedule should contain:

- a. Plans of the SuDS detailing their location and form
- b. Dates for inspections
- c. Monthly maintenance plans
- d. Annual maintenance plans
- e. Reactive measures for identified problems
- f. Objective of the maintenance for each feature/element
- g. Standard of work required

Even if you have no further involvement, knowing what SuDS maintenance is expected in your local neighbourhood is useful. However, your regular inspections will also help you to understand how SuDS and their maintenance requirements change through the seasons. You will also get to know the signs that there is something wrong with the SuDS system.

Please do share whatever you learn with us. In doing so you will help us adapt and improve this guide. Please email us at phiala@sky.com and bridgemanteresa@gmail.com with the following information:

- **Name**
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- **As much information about the SuDS/your experience of SuDS/etc as possible**

1.5 What can residents and local people do?

A good starting point is to find out who has responsibility for the SuDS and, if possible, work with them to:

- Obtain a copy of the **drainage strategy** developed through the local planning process. This will help you understand what SuDS features should be on site and where they should be (note: development layouts often change as they are built, so the original strategy may not exactly reflect what is in place). Your Local Planning Authority should have a record of this if you can't get it from the organisation who is responsible.
- Obtain a copy of the SuDS **maintenance schedule** (see 1.4). This guide will help you understand the objective of the maintenance for each feature in the maintenance schedule and the standard of work required.

- For developments post-2018, there should be a maintenance schedule available through your Local Planning Authority as this will have had to be approved. For developments before 2018, it is still worth talking to your Local Planning Authority as they may hold copies or know how to obtain one.
- For other developments, ask your management company/landlord whether there is a schedule.
- Please be aware that you may find there is no maintenance plan in place.

If there is no maintenance plan or schedule (for whatever reason) you can use this guide (and others, see section 3) in any discussions you have with the responsible organisation. You may be able to encourage them to develop one. If there is already a plan and/or schedule, you can use this guide to help you check it is being followed correctly.

If you have access to the plans, the best way to understand them is to walk the site (if you are legally entitled to do so, otherwise you will have to view it from a safe distance). If you don't, you may want map out what SuDS are in place/being built for yourselves. You can take photos and log both the actual location (which may be different from the plan) and the condition of the SuDS. If possible, try to persuade the developer/groups responsible for the SuDS and a representative of your local planning authority to come along for the walk and talk with you about the features and what they do.

Keeping a log of visits, conversations, meetings, etc, is vital, whether you are observing a build or looking at a completed site. Creating an on-going log of the SuDS through photographs and videos can also help you to track gradual changes over time that may eventually lead to the SuDS feature failing.

You can download free phone Apps that will embed the location in your photos. You can then use these photos to generate inspection reports. For example, for Android: [Dioptra](#), or for Apple: [Theodolite](#).

There are other ways that residents can help keep SuDS (and traditional drainage) in good shape:

- Litter picking. Rubbish can easily block SuDS. NB if litter has blown into SuDS features which can contain water: swales, ponds, inlets or outlets, don't attempt to retrieve it yourselves. Ask the maintenance team.
- Checking drains, inlets and outlets are not blocked and ensuring that surface debris is removed before bad weather is due.
- Checking features after leaves have fallen in autumn. Again, ask the maintenance team to unblock them, don't attempt to do so yourselves.
- Making sure that cars do not cover traditional drains when they park is also a good idea. If parking spaces are marked out in a way that makes this likely, report it and see if you can get it changed. Maintenance crews won't be able to keep drains clear if there are cars on them.
- Checking that any grass that is supposed to be cut is mown according to schedule and that the cuttings are not being stored somewhere that will cause future blockages. Remember that longer gaps between cuts at sometimes of year can encourage biodiversity.
- Looking out for unexpected waterlogging, erosion or silt build-up.

BE SAFE

As a resident, your local SuDS could be all around you (and under you). Although you see many of your SuDS features every day, it can be dangerous to enter some of them, especially when they contain water. Many SuDS will fill up rapidly during heavy rain.

It is not safe, sensible or permissible to enter a construction site. Any observations must only be made from a safe distance outside the fenced off construction area. However, you may be given permission by the developer to walk the site with the appropriate representatives. It is worth asking.

1.6 What can Local Authorities do?

Developers are expected to build their SuDS features according to the plans that have been approved by the Local Planning Authority. If you are concerned that this is not the case, then you should let your Local Planning Authority know and send them as much detail as possible. If they decide that the developer has not followed the approved plans, they can take action to get the developer to put it right.

Local Planning Authorities can choose whether to take formal enforcement action. If they think that the change is a minor or technical one that doesn't do any harm or affect how the SuDS works, they may not act. Indeed, it may be that the SuDS works better because of the change. If they do choose to act, they may just provide advice and guidance, rather than going as far as a prosecution. They will do whatever they think will best achieve a safe result. And whatever they do should always be proportionate to the risks or impact on people or the environment of the change. Being involved can help ensure that the correct decision is made for your development.

2. STEP BY STEP GUIDE TO INDIVIDUAL SuDS FEATURES

There are many different types and forms of SuDS. This section takes you through the most common of these. This guide is very much a living and developing document and we are actively seeking your SuDS experiences and pictures to incorporate into it. The guide will develop as individuals and community groups contribute to the knowledge held within it.

Please do share whatever you learn with us. In doing so you will help us adapt and improve this guide. Please email us at phiala@sky.com and bridgemanteresa@gmail.com with the following information:

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Each section of this part of the guide describes a SuDS feature, explaining:

- What it is and what it is designed to do;
- What it should look like and how it should work;
- Signs that something has gone wrong, either with the design or the maintenance of the SuDS and
- What maintenance measures would ensure that the SuDS work as well as possible.

For more detailed and technical information on SuDS, see the links in section 4.

2.1 Dry landscaping: swales and detention basins

What are swales and detention basins?

Swales and detention basins are usually designed to be dry under normal conditions but convey and/or hold water during wet weather. Because they are designed to be dry much of the time, residents may not realise what they are there for. One danger, as time goes by, is that people forget the purpose of these features and change them so that they no longer do their job. This can cause localised flooding. A way to prevent this is to have information boards by the SuDS to explain what they are and how they work.



Detention basin:

<https://www.susdrain.org/delivering-suds/using-suds/suds->



Swale: https://www.susdrain.org/case-studies/pdfs/queen_caroline_estate_london_final_v2.pdf

How do swales and detention basins work?

A swale is a shallow flat-bottomed open channel or dip in the ground, often used in areas where heavy soil doesn't soak up water easily or quickly. It works by capturing rainwater and then allowing it to be released slowly into the public drainage system or to a ditch, stream or river.

A detention basin works in a similar way by holding the water back and then allowing it to soak slowly into the ground, retaining the water on site. Detention basins are used in areas where the soil is lighter and drains freely.

The sides of swales and detention basins should not be too steep (no more than 1 in 3) and should be planted with grass or wetland plants (not left as bare soil). When it is in full flow, water in a swale should be no deeper than 600mm (2 feet).

If the sides are too steep (more than 1 in 3) then ideally these needs to be corrected. Ideally, the responsible body would re-profile the feature and plant it up following national and local SuDS guidelines.

BE SAFE

DO NOT enter the water to measure its depth. If in doubt report problems to your maintenance team/ local authority.

Other features that swales and detention basins should/should not have:

- No trees should be planted near any inlets and outlets.
- Tussocky grass is not suitable as it stops the water flowing properly and can result in the creation of channels which erode over time.
- Wildflower mixes can offer an attractive alternative to grass.
- Sometimes longer grass/wetland plants may be grown in the bed of the feature to encourage biodiversity and catch and slow the water. However, there is a balance between the length of the grass and how well the SuDS function. If in doubt, speak to the organisation responsible for the maintenance of the SuDS.

All residents should be aware that seemingly dry swales and detention ponds will fill up quickly with water during wet weather and should keep well away from them at such times.

How can you tell when something has gone wrong with swales and detention basins?

Swales and detention basins are designed to be dry for periods of time. If they are permanently wet, or the water in them is too deep, then the system may have a blockage which needs to be cleared by the organisation with responsibility for the SuDS. Keep a photographic record of the condition of the swales/detention basins over time. This will help you to tell if the ground is looking unusually waterlogged (by comparison with other inspections).

Unfortunately, being permanently wet doesn't automatically turn these features into a working wetland area (see 2.2). It only reduces their ability to hold rainwater and can therefore increase flood risk. Permanent wetness can lead to:

- Algae growing on the surface of the water (algal bloom). Algae can be dangerous to dogs, for more information click [here](#). It is advisable to get the developer, management company or council to put up warning signs during periods of algal bloom.
- Concentration of pollutants in the water,
- Mosquito infestations,
- Failure of the swale/detention basin, causing flooding of roads, homes and businesses.

Watch out, too, for swales/detention basins that smell bad and/or have [sewage fungus](#) growing on the surface of any water they contain. This could be due to misconnected sewage/waste pipes, for example, toilets on the site may have been plumbed into the surface water systems rather than into the foul sewage system. This can also happen where sewage pipes have been damaged allowing the contents of a sewer to leak out. In either case contact the sewerage company.

If the sides of the swale/detention basin are bare and steep, soil will be washed down into the bottom and may either block the outlets or change the shape of the swale.

- Bare sides are dangerous for children and animals.
- If the sides are bare, check for signs of erosion damage (deep cracks or bank washed away) and for silt on the bottom of the swale/detention basin.

A poorly designed or blocked swale or detention basin can look like this:



A blockage has resulted in standing water which has developed an algal bloom. The sides of the swales are not correctly planted



Half built swale but left as if complete (courtesy of Bob Haddon)

What maintenance do swales and detention basins require?

The following should be carried out by whoever is responsible for maintenance. However, some of these checks can safely be made by residents. Sometimes just a photo (with the location embedded into the photo) sent to the responsible organisation will be enough.

- Swales and detention basins should be inspected twice a year for signs of erosion damage, silt deposits and too much waterlogging.
 - Taking regular photos will help you track and monitor whether any of these are occurring.
- Grassy areas should be maintained.
 - How often they are mown and how short the grass should be depends on the grasses used and the biodiversity plan. However, the most important factor in deciding how frequently to mow is the height and density of the grass. It needs to be 'rough' enough to slow the flow, but not so dense that it simply diverts water elsewhere.
 - Mowing should not happen when the ground is wet as this can result in soil compaction and reduced drainage.
 - Grass cuttings must not be left where they can wash into the swale/detention basin or block inlets and outlets.
- Plants in and around the swale/detention basin should be regularly checked to ensure they are healthy, growing well and being maintained. Look out for overbearing, invasive or poisonous species. For more information about invasive species see the [RHS website](#) and the [Woodland Trust](#) for poisonous plants.
- Swales should not be permanently full of standing water. If water remains in them for long periods of time (a few weeks at a time or through hot sunny periods) then they may be blocked. This may indicate that they are not being maintained as they should be.
- Litter should be removed regularly.
- There should be monthly inspections of inlets and outlets.
- Leaves should not be allowed to build up in the SuDS or in places where they can be washed into SuDS and should be removed as needed. Use of leaf blowers can often make things worse, not better.
- Overhanging branches should be cut back to reduce shade and help plant growth. This also reduces the risk of broken branches blocking the inlets or outlets.
- Silt build-up should be removed as required and at least on a 5-year cycle because it will reduce the capacity of the SuDS.

2.2 Wet landscaping: wetlands and retention ponds

What are wetlands and retention ponds?

Ponds and wetlands are designed to be permanently wet and should have suitable planting to encourage habitats and biodiversity.

They should be located somewhere where they receive enough water and their banks shouldn't be too steep, max of 1 in 3. There should be a risk assessment available for wet landscaping features.



Wetland feature: [https://www.susdrain.org/case-studies/pdfs/elvetham heath residential hampshire final v2.pdf](https://www.susdrain.org/case-studies/pdfs/elvetham_heath_residential_hampshire_final_v2.pdf)



Wetland feature [https://www.susdrain.org/case-studies/pdfs/aztec west business park south Gloucestershire final v2.pdf](https://www.susdrain.org/case-studies/pdfs/aztec_west_business_park_south_gloUCEstershire_final_v2.pdf)

How do wetlands and retention ponds work?

Wetlands and retention ponds are designed to hold water and therefore provide rich habitats, particularly important for aquatic invertebrates, wetland plants and amphibians. Specially selected wetland plant species gradually filter the water to improve water quality throughout the year.

A well-designed pond should have edges that form a varied and interesting shape with scalloped edges and small bays and spits to increase the length of the pond margin. The edges should be gently shelving in at least some areas to allow easy access for amphibians and to improve safety (less than 1 in 4), Ideally there will be both deep and shallow areas to create a range of habitats, but this needs to be balanced against safety issues. There should be a variety of planting to create a range of habitats and encourage plant growth at different times of the year. All in all, the wetland features should be attractive assets for the local area.

How can you tell when something has gone wrong with wetlands and retention ponds?

- Algae is possible during the first few years as the ecosystem gets established.
 - Algae can be dangerous to dogs, for more information click [here](#). It is advisable to get the developer, management company or council to put up warning signs during periods of algal bloom.
 - We recommend taking photos to track the development and growth of algae. If you are concerned about algae being present for a long time, contact the organisation responsible for managing the SuDS.
- Particular species can take over the wetlands and retention ponds, for example, invasive duckweed or pondweed. This should be reported as soon as it is spotted.
- The sides are bare:
 - As with swales and detention basins, bare sides will make the pond silt up as soil gets washed down. This not only affects its ability to reduce flooding, it is also bad for the invertebrates and amphibians that might live there.

- Steep banks: as with dry swales, if the banks of a permanent pond are too steep, they will be unsafe, and the drainage system won't work properly. It may be possible (if challenging) to negotiate to have the banks re-profiled (particularly if you spot this problem as the pond is being created).
- The water level in the wetlands and retention ponds drops. There can be several reasons for this:
 - Inlets are blocked.
 - The pond does not have a good enough feed of water i.e. it is in the wrong place. While it may seem impossible to do anything about this, you could still speak to the person or organisation responsible for the wetland/pond to see what might be done.
 - The banks are damaged, and water is escaping (this is a potential flooding problem). NB Bear in mind that low water levels can also be caused by long dry spells of weather.
- The water level is constantly rising. This can also have several causes:
 - Outlets are blocked
 - There is too much water entering the pond.
 - The wetland or pond bed is set too high.
 - Sediment has shifted over time and changed the shape (and therefore the capacity) of the wetland or pond.
- The wetland/retention ponds basin smells bad and/or sewage fungus is growing in the feature. As with the dry features described in 2.1, this could be due to misconnected sewage pipes, for example, toilets on the site may have been plumbed into the surface water systems rather than into the foul sewage system. This can also occur where sewage pipes have been damaged allowing the contents of a sewer to leak out. In either case contact the sewerage company.

What maintenance do wetlands and retention ponds require?

The maintenance for wetlands and retention ponds is very similar to that of swales and detention pond. Because these features always contain water, it is even more important to leave any actions to the organisation responsible for maintenance.

- Wetlands and retention ponds should be inspected twice a year for signs of erosion damage (cracks, slipped banks, scoured out banks), silt deposits and too much waterlogging.
 - Taking regular photos will help you track whether these problems have appeared.
- Regular maintenance is needed to keep the surrounding area free of litter. Litter can readily block the inlets and outlets. Do not enter the water yourselves to retrieve litter.
- The water in ponds should be clean.
- Inlets and outlets should be inspected monthly to ensure they are clear and undamaged.
- Grassy areas should be maintained.
 - How often they are mown and how short the grass should be depends on the grasses used and the biodiversity plan. However, the most important factor in deciding how frequently to mow is the height and density of the grass. It needs to be 'rough' enough to slow the flow, but not so dense that it simply diverts water elsewhere.
 - Mowing should not happen when the ground is wet as this can result in soil compaction and reduced drainage.
 - Grass cuttings must not be left where they can wash into the wetlands/retention ponds or block inlets and outlets.
- Plants in and around the wetlands/retention ponds should be regularly checked to ensure they are healthy, growing well and being maintained. Look out for overbearing, invasive or

poisonous species. For more information about invasive species see the [RHS website](#) and the [Woodland Trust](#) for poisonous plants.

- Leaves should not be allowed to build up in the SuDS or in places where they can be washed into SuDS and should be removed as needed. Use of leaf blowers can often make things worse, not better.
- Overhanging branches should be cut back to reduce shade and help plant growth. This also reduces the risk of broken branches blocking the inlets or outlets.
- Silt build-up should be removed as required and at least on a 5-year cycle because it will reduce the capacity of the SuDS. Care should be taken to protect wildlife during removal.

2.3 Filter strips

What are filter strips?

Filter strips are green planted sections of land designed to soak up and slow the flow of runoff. Filter strips are also designed to filter out pollutants and sediments as water flows across them.



Example filter strip from [Anglian Water](#), the fencing provides protection from cars and pedestrian access.

How do filter strips work?

The filter strip intercepts rainwater, for example from a road, and slows the water as it crosses the strip. Water will also soak (infiltrate) into the ground as it passes across the filter strip. Filter strips feed into other SuDS features or directly into a watercourse.

How can you tell when something has gone wrong with filter strips?

- Filter strips should be 5-15 metres wide and have a cross slope of 1 in 20 or less. In other words, the slope should be very shallow. The filter strip will not work if it is too steep.
- Waterlogging is a sign that something has gone wrong. This can be due to several problems:
 - Uneven areas. These can create channels and/or pooling. Channels can cause erosion which will prevent the filter strip working as it should.
 - 'Tussocky' humps and clumps of grass can create channels and cause waterlogging. They need to be removed and the strip reseeded with smoother grass.
 - People and vehicles can create paths and ruts that provide channels for water to flow along. The strip should be protected against pedestrian and vehicular access in some way.
 - Erosion or silt deposits can also result in water pooling on the surface of the filter strip reducing its effectiveness.

Taking photographs regularly will help you to notice any gradual changes over time that might otherwise be missed.

What maintenance do filter strips require?

Unless the filter strip is designed to be a wildflower meadow, grass should be periodically mown (as for the banks of swales and ponds):

- How often strips are mown and how short the grass should be depends on the grasses used and the biodiversity plan. However, the most important factor in deciding how frequently to mow is the height and density of the grass. It needs to be 'rough' enough to slow the flow, but not so dense that it simply diverts water elsewhere.
 - Mowing should not be carried out when the ground is wet as this can cause compaction and reduce drainage.
- Plants in the filter strip should be regularly checked to ensure they are healthy, growing well and being maintained. In particular, look out for overbearing, invasive or poisonous species. For more information about invasive species see the [RHS website](#) and the [Woodland Trust](#) for poisonous plants.
- Regular checks should be carried out for pooling and waterlogging caused by uneven surfaces (photos are useful here to monitor problems).
- Checks should be made for erosion and the damage should be repaired.
- Re-turfing of some parts of the strip may be necessary from time to time.
- Litter should be removed monthly or more frequently, as needed.
- Leaves should be removed in winter to prevent damage to the grass.

2.4 'Greening the street' and rain gardens also known as bioretention systems

What are bioretention systems and how do they work?

Bioretention systems (including rain gardens) are shallow landscaped dips in the ground or small gardens sunk in the street that can slow the flow and absorb water. They can even use the soils and plants they contain to treat pollution; this is especially useful by roads. In effect, they intercept rainwater and reduce flood risk whilst creating 'greener' and more attractive places to live and work.



Rain garden : https://www.susdrain.org/case-studies/pdfs/renfrew_close_london_final_v2.pdf



Photo courtesy of Danielle Sinnett, UWE: Lyon

A well-designed SuDS strategy will use a range of 'greening the street' features.

How can you tell when something has gone wrong with bioretention systems?

Bioretention systems most commonly fail when the gravel gets clogged or the soil surface loses its open structure and develops a sort of crust. This prevents rainwater from soaking (infiltrating) into the soil. You can spot this easily as there will be pools of water or soggy patches on the surface.

Dead or dying plants can also suggest that something is wrong. If the planting is too dense, this can make it harder for the rain to soak into the soil, reducing the system's effectiveness. As a rule of thumb, you should be able to see that rainwater is entering the bioretention system with ease.

What maintenance do bioretention systems require?

The organisation responsible for these types of SuDS should be checking them regularly and carrying out the maintenance described below. While you can carry out your own checks, you should talk to your maintenance providers about any actions that need to be taken.

During the first few months after installation the system should be inspected regularly after rain to check the water is not ponding/pooling on the surface. Whilst rainwater shouldn't pool on the surface, it also shouldn't disappear too quickly either.

As with other SuDS, frequent litter picking is essential. Maintenance of the surrounding area is also important to prevent silt and leaf litter from entering and blocking the bioretention system. Although the bioretention feature may seem simple on the surface, it may have quite a complex structure underneath.

Quarterly inspections should include:

- Inspection of the surface for silting and ponding,
- Checking for plants with poor growth and disease and for invasive species. In particular, look out for overbearing, invasive or poisonous species. For more information about invasive species see the [RHS website](#) and the [Woodland Trust](#) for poisonous plants, these should be reported. Ask for plants to be replaced if needed.
- Some of these features won't have inlets and outlets, but if they do, they should be checked.

Maintenance by those responsible should involve:

- Filling in any holes or channels in the soil scoured out by water, finding out why they have appeared and putting the problem right,
- Removing and replacing soil and plants where problems have been identified.

2.5 Permeable paving systems

What are permeable paving systems and how do they work?

'Permeable paving' is a misleading term. It is not the pavers themselves that are permeable but the *system* as a whole. Gaps between the pavers allow rainwater to filter through to layers of permeable materials below. Usually, unless you live on very sandy soil, a layer of stones and gravel must be laid underneath the paving. If your local soil is not good at soaking up water, an underground tank may also be needed to collect the water and then release it slowly.

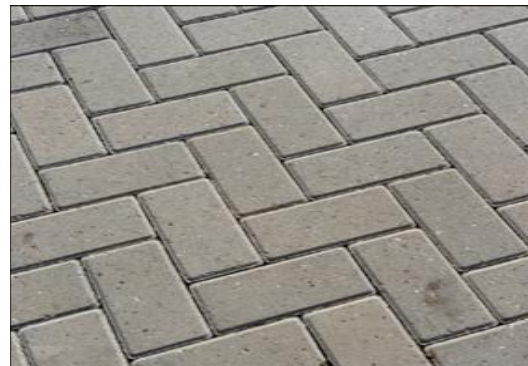
You should be able to identify permeable paving from the notches in the sides of the pavers – as demonstrated below.



Blocked or poor-quality examples of permeable paving



Blocked permeable paving



Author's photo of so-called 'permeable paving' which isn't permeable at all; there are no notches in the pavers or gaps between them

How can you tell when something has gone wrong with permeable paving?

The most obvious sign of a problem is a lot of water pooling on the surface or running off it instead of soaking down through the gaps. This may be because the paving has not been laid correctly or because the gaps between the pavers have become clogged. Permeable paving can easily become blocked by leaves, weeds and soil/sediment.

What maintenance do permeable paving systems require?

A good permeable paving system will absorb water for an area twice its size. Most of the permeable paving system will not be visible but maintenance still needs to happen. If the permeable paving system is new it should be monitored monthly to begin with:

- To keep permeable paving working it must be regularly swept and/or vacuumed and any weeds growing through the blocks need to be removed.
- The gaps between the pavers should have been filled loosely with grit which helps them to stay in position. They may need to be re-gritted after a few months as the ground settles.
- The system should be flat, with no dips where water can collect. Over the longer term the paving must be maintained to ensure it remains flat and even. Any dips, rutting, or cracked/broken blocks need to be fixed or replaced.
- There should be no pooling on the surface. Pooling is a sign that water is not filtering down into the system.

Once the system has bedded in it can be checked twice a year and after storms:

- Make sure that the system is draining properly, look for sunken areas, weed growth and damage to blocks.
- Leaves, mud and litter should be removed regularly by brushing (taking care not to remove the grit between the blocks).
- Weeds should be removed twice a year and any gaps left by the roots filled with grit.
- As required, work should be carried out to correct uneven surfaces, replace cracked or broken blocks etc.

NB if paving is on private property then the owner or tenant is responsible for its upkeep (depending on the terms of the lease). Permeable pavements are often installed on driveways.

2.6 Trees

Why are trees useful?

Trees are an important part of any SuDS scheme.

- Trees intercept water before it hits the ground and encourage evaporation.
- They draw large amounts of water up through the soil.
- As a tree's roots grow its ability to take up water increases, and the roots also help water soak into the soil.

Trees can absorb an impressive amount of water.

Tree variety	Water absorbed in litres per year (mature tree)
Oak	747
Willow	609
Beech	304
Silver birch	460
Ash	296

Developers tend to avoid trees they think may cause problems later, especially because of their roots. But if the right tree is planted in the right place and under the right conditions it can absorb water, act as habitat for wildlife and provide attractive surroundings. It can also help clean the air you breathe.

- See the [RSPB SuD's guide](#) for 'which tree in which place'.

The more trees the better, provided that care is taken in selecting the trees. Wherever possible, native trees should be chosen. If a tree is removed, for whatever reason, you can always ask for it to be replaced by another suitable tree.

NB If you have mature ash trees on your development, it is useful to think about planting replacements now as it will take many years to replace the water taken up by a mature ash that has to be felled as the result of ash dieback disease.

What can go wrong?

- Lack of water can easily kill a young tree. Mulching around young trees keeps moisture in the ground as well as suppressing weeds and protecting the soil from erosion. The mulch should not touch the tree.
- Planting trees at the wrong time of year can also cause problems. For best results planting should be carried out between November and March. If trees are planted during the drier months and while they are actively growing, they will be more stressed and will need more watering.
- Trees that have seeded themselves into unwanted places need to be removed as soon as possible before their roots can establish themselves too deeply. For example:
 - Trees growing near inlets, outlets
 - Trees on embankments
 - Trees in drains

Poorly planted or located trees can crowd out other more suitable trees, can damage permeable paving or can create trip hazards on paths.

- Waterlogging can kill trees. Waterlogging can happen for several reasons, for example, when trees have been planted in dips (unless they are in specifically designed tree pits), where soils are compacted, at the bottom of slopes or in flood plains. NB a flood plain does not have to be large. It is simply the area that a stream or ditch would naturally occupy if it had no banks. The water under the ground will be at the same level as the water you can see in the stream or ditch.
- Trees planted next to roads can help to soak up run-off, but care needs to be taken to ensure that waterlogging doesn't occur.



Waterlogged tree



Tarmac around a tree whose roots are pushing up the surface of the pavement.

What maintenance do trees require?

Young trees

When trees are young, they should be inspected frequently. Invasive plants should be removed from around the base of the tree, and they should be watered during long dry periods. Mulching will help suppress weeds and protect soil, but the mulch shouldn't be right up against the trunk as this can cause disease.

While they are becoming established young trees often need appropriate support, such as posts and buckles. Without support, they can tilt or fall, especially during windy weather and their roots can become weakened.

Established trees

Established trees in public places need to be inspected annually to make sure they are healthy and are not a hazard.

Any maintenance should be carried out in winter when the tree is not in growth and outside the main bird-nesting season of March to August.

2.7 Soil

The most important, most extensive and mostly invisible part of SuDS is the soil itself. Like a sponge, soil has a structure which contains as much air as it does solid matter. For plants and organisms to flourish, they need the air as much as the water. When soil gets compacted, its structure breaks down and several things happen:

- Plants and organisms die
- Water flows over the surface, carrying some of the soil away as sediment, and creates a flood risk.

A serious problem on many development sites and new estates is soil compaction. This happens following the use of heavy machinery and storage of heavy materials (bricks, construction equipment, etc) on site. Often well-structured healthy topsoil is removed leaving only compacted subsoil. Or, new poor quality non-local soil is brought in and deposited directly over building rubble. Compaction can cause flooding and/or damp in properties. If you are concerned that compaction has occurred contact the developer and your local authority. It is also worthwhile talking to your local wildlife trust about soil compaction. Find your local branch [here](#).

The capacity of soil to absorb water can also be seriously reduced when just a thin layer on the surface becomes compacted, forming a hard crust. This can be dealt with relatively easily, but can have significant consequences for drainage, flooding and the health of anything planted in it.



Compacted soil leading to water pooling on the surface

For more information about soil and its structure please see [Cranfield University's guide: A GUIDE TO BETTER SOIL STRUCTURE](#)

The type of soil and rock your development is built on will determine what sort of features should be included in the SuDS scheme and how they should be designed. There is no point in putting permeable paving over a hard/impermeable layer of ground unless additional provision is made for the water to be stored and eventually drain away. In other words, there is no point creating a nice spongy surface for rainwater to soak through if there is nowhere for the water to go after that.

Whether developers decide to put in a detention pond, or a swale is also affected by your local soil type. Detention ponds are fine for sandy soil, but swales are likely to be better for clay.

2.8 More traditional drainage features

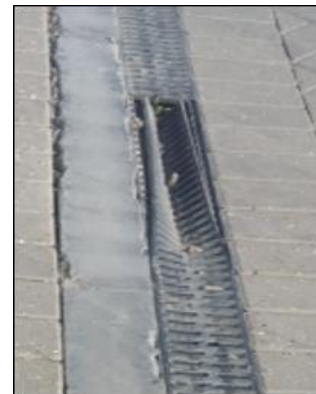
Often, more traditional drainage features such as road drains and French drains are combined with SuDS features. They can also fail and need to be maintained. It is important that these features are not built over, so mapping their location could prevent future problems. In older developed areas it has been known for old channel under housing, that nobody knows, to cause water to come up through the floor during heavy or prolonged rain. It is worthwhile keeping an open mind about where flood water comes from!

When traditional features fail this can have a knock-on effect on SuDS, increasing flood risk. It is therefore important that traditional drainage features are also checked to be sure they are in good working order.

What can go wrong?

Very heavy rainfall can overwhelm traditional features resulting in flooding. While this may simply be the result of too much water in the system, there may be other causes for the flooding:

- Traditional drainage features can become blocked with litter, leaves, sediment, or road chippings etc.,
- Weeds and other plants can grow through the drains blocking them,
- Drain covers can become damaged or mis-aligned.



- The maintenance of some drains can be the responsibility of individual homeowners as they can run along the boundary between a drive and a pavement. They are there to prevent water running from properties onto the pavement or road.
- The grilles should be lifted regularly in order to clear out the shallow gullies underneath.

NB It is illegal to allow gutters and downpipes to discharge directly onto pavements.

2.9 Inlets and outlets

It is very important to the functioning of SuDS that inlets and outlets are correctly located and not blocked. However, their location will generally mean that you can only observe them from a distance.



Outlet and inlets need maintenance to be kept clear (photograph courtesy of Bob Haddon)

BE SAFE

DO NOT climb into or on SuDS features in order to inspect inlets or outlets. If you have concerns that they are not functioning correctly, take photos and send them to the organisation who is responsible for the SuDS. If you can't take photos, just tell them.

What should we be checking for?

When carrying out visual inspections, you should check that:

- Inlets and outlets are in good condition and not blocked by litter or vegetation.
- There is no erosion or scouring around inlets/outlets.
- There are not large amounts of sediment or soil going through inlets/outlets. This can block both the inlets/outlets and the SuDS feature itself.
 - Any build-up of soil or sediment should be removed. Contact the organisation responsible for the SuDS to arrange the removal of the soil/sediment.
- Usually, there should not be any oil (from cars, for instance) passing through the inlets/outlets. NB Certain types of SuDS are designed to capture oil (at MOT centres, for example). It is advisable to check the drainage strategy to find out whether oil should be entering the system at a particular location.

What maintenance do inlets/outlets require?

- Grass around inlets and outlets should be mown periodically.
 - How often mowing is carried out and how short the grass is kept depends on grass type and the biodiversity plan, but inlets and outlets are critical parts of the system so it is likely that these areas will require more frequent attention than some others.
 - Mowing should not happen when the ground is wet as this can result in compaction and reduced drainage.
 - Grass cuttings must not be left where they can wash into features and block inlets/outlets.
- Litter should be regularly removed.
- Dead leaves that might cause blockages should be removed as necessary.

- Nearby trees and bushes should be well-maintained, so broken branches do not block the inlet/outlet.
- Silt should be removed.



Rubbish could create blockages



A collapsed structure creates a blockage that prevents water from leaving the feature



Outlets blocked by other features

2.9 Sediment in the whole system

Sediment has often been mentioned in this guide. SuDS commonly fail when fine particles of soil are washed down into a feature and block inlets, outlets, pipes etc.

The best solution is to prevent sediment from reaching this point in the first place. This is why it is so important to check for erosion, scouring, etc. It is not just water that flows down a rut in the ground, it is the soil as well. And once lost, soil cannot easily be replaced.

It is worth starting your inspection walks at the 'top' of the SuDS system and working your way down to the last outfall where the water in the system leaves the development. This will enable you to track the build-up of silt through the SuDS system. It is a good idea to take regular photographs of SuDS features from fixed locations so you can easily compare photographs to establish not just the condition of the SuDS but the build-up of sediment over time.

2.10 Summary

Well designed, correctly installed and properly maintained SuDS are a boon to a development. They provide multiple benefits whilst providing us with attractive places to live. In the face of climate change, SuDS have an even more vital role to play in managing the environments that we live and work in. Over time we will see more and more use of SuDS in new developments. Whilst this is a huge positive, it does bring with it negatives including who 'polices' the installation and maintenance of SuDS.

This is where residents and communities can play an important role in monitoring the installation and performance of SuDS. We are often the only people who see these features on a daily basis which means that we can quickly become of expert about the condition and functioning of SuDS in the developments we live and work in.

Both Teresa and Phiala hope that this guide is the start of creating a broader more inclusive guide which supports residents and communities in understanding SuDS. We are very keen that this guide grows by gathering the knowledge and experience of other residents and community groups. As noted throughout this guide we would very much welcome your input.

Please do to get involved. **Please do share whatever you learn with us. In doing so you will help us adapt and improve this guide.** Please email us at phiala@sky.com and bridgemanteresa@gmail.com with the following information:

- **Name**
- **Location**
- **Flood Group (where applicable)**
- **Clearly labelled photographs, ideally stamped with location, and permission to use them in this guide**
- **As much information about the SuDS/your experience of SuDS/etc as possible**

3. ACKNOWLEDGEMENTS

Huge thanks go to Paul Shaffer (for his knowledge, time and for being our 'phone an expert' lifeline) and Louise Walker (both from CIRIA) and to Eleanor Starkey (Newcastle University) for your careful work checking the sense and accuracy of this guide. Frankly, we couldn't have done this without you. A special thank you, too, to Anna Beasley from JBA Consulting for providing a sounding board, especially during the early stages of the development of this guide.

We are really humbled by the good will shown by all the other busy people who have made time to help us: Bob Haddon (Shifnal Flood Partnership Group), Daniel John (Anglian Water), Daniel Martin and Martyn Ford (Somerset County Council), Danielle Sinnett (Centre for Sustainable Planning and Environments), John Belford (Telford and Wrekin Council), Julie Blackburn and Simon Bunn (Somerset IDB).

Many of the photographs used in this guide are used with kind permission from Susdrain [case studies](#). You may wish to have a look at these in more detail.

4. ADDITIONAL INFORMATION

- CIRIA downloads: there is a huge amount of information [here](#) and the CIRIA SuDS manual can be downloaded from [this page](#).
- Susdrain has information on [delivering SuDS](#) and [retro-fitting SuDS](#),
- Somerset Rivers Authority have conducted a review of local SuDS and this document is worth a read. Find it [here](#).
- Detailed Guidance On Good Practice In The Design and Maintenance Of Soft SuDS ([Aberdeenshire Council 2012](#))
- Anglian Water '[Towards Sustainable Water Stewardship](#)'