

RAIN GARDEN GUIDE

Bob Bray, Dusty Gedge, Gary Grant & Lani Leuthvilay

Principal Sponsor's Foreword



Helen Newman
Head of Corporate Responsibility and Sustainability
Thames Water

Everyone can help address the impact of climate change without making major lifestyle changes. This guide shows how changing the way you manage your outside space can help reduce localised flooding whilst at the same time providing an enjoyable area for the benefit of both wildlife and people.

Providing rain gardens is part of a growing desire to have more sustainable drainage systems. Other current initiatives include installing a "green roof" on top of buildings in urban spaces and reducing the amount of non permeable surfacing for example in car parks.

Thames Water is pleased to sponsor this guide. Our organisation is in favour of driving changes to the way we manage outdoor spaces to benefit both customers and wildlife that exists within our catchment. We are actively working on a number of projects to provide alternative routes for rainwater, reducing the burden on overloaded sewers in parts of our area. We believe this can have a real impact in terms of reducing flooding from overloaded sewers and makes better use of the water collected. In particular, rainwater gardens provide an altogether healthier alternative to enjoying our outside spaces.

Contents

What is a Rain Garden?	1
Why Rain Gardens?	2
Who is this Guide for?	2
Planning & Design	3
Construction	4
Planting	6
Planting Suggestions	7
Aftercare	8
Resources	8

Statement of Support



Dave Wardle
London Environment Team Manager
Environment Agency

Water is a vital resource for people and wildlife. In the UK we expect to have enough water to meet our needs - having water readily available is something we often take for granted. Even in record breaking periods of prolonged summer rain, water is a precious resource, to be used and managed wisely.

The Environment Agency supports this guide which offers practical information on installing a small scale rain garden. It also reminds us how drains overwhelmed by a sudden downpour can affect water quality in the local river. Even one raing arden can make a small but positive difference in addressing localised flooding and the quality of the local water environment. Alongside other sustainable drainage systems and actions to tackle diffuse pollution, rain gardens can be an effective part of a bigger solution.

Front cover: Ashby Grove rain garden, north London | **Robert Bray Associates**

Above: Crocosmia | **Bob Gibbons**

What is a RAIN GARDEN?

In its simplest form, a rain garden is a shallow depression, with absorbent, yet free draining soil and planted with vegetation that can withstand occasional temporary flooding. Rain gardens are designed to mimic the natural water retention of undeveloped land and to reduce the volume of rainwater running off into drains from impervious areas and treat low level pollution. In this guide, we also suggest establishing rain gardens in planters, which can receive water from a downpipe.

Rain gardens were first developed in the United States in the 1990s, where they have become increasingly popular. In the UK, the mimicking of natural drainage in urban areas is officially encouraged and known as Sustainable Drainage Systems (SuDS). This approach is part of a new philosophy to urban water management, developed in Australia, which is known as Water Sensitive Urban Design (WSUD).

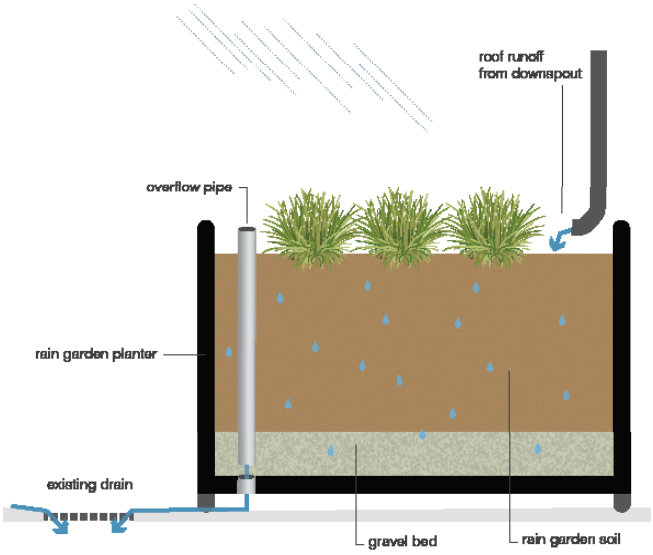
The term rain garden is wide ranging and has been used to describe a number of different features (see Why Rain Gardens? below). However, for the purposes of this guide a rain garden is a simple intervention designed to receive rainwater which has come from a downpipe or a large domestic paved area. The rainwater enters the soil and drains away into the ground or is taken up by the plants and lost back to the air by a process known as evapotranspiration.

Rain gardens usually absorb all the rainwater that flows into them, but when they do fill up following particularly heavy rainfall, any excess water is redirected to the existing drains. These simple rain gardens do not require any redesign of the existing drainage system and can be installed wherever space permits (see Planning and Design below) and in most soil types.

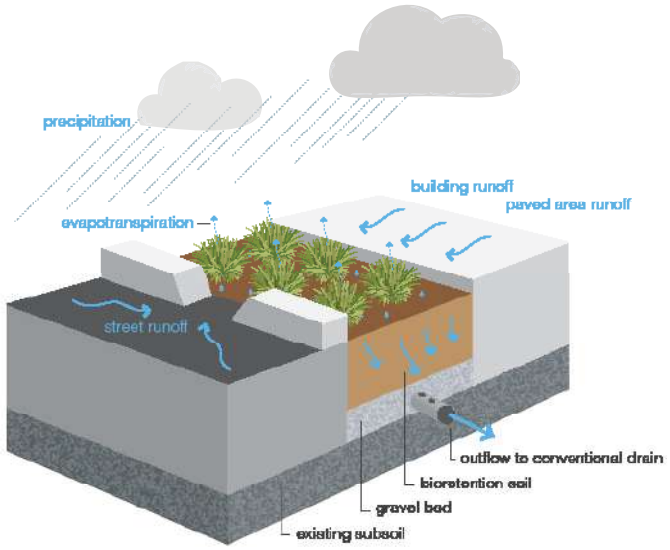


Typical domestic rain garden, Ashby Grove, London | CIRIA

Other features that may be described as rain gardens include bioretention strips, swales and specially designed tree-pits, which may receive the often more polluted surface water run-off from roads and other paved areas. These features usually include gravel layers, engineering soils and perforated drains and are normally installed in the street. Advice on the planning and design of these and other similar installations is outside of the scope of this guide. For more information see the CIRIA website in the Resources section.



Rain garden planter



Street rain garden

Why RAIN GARDENS?

The extensive areas of sealed surfaces, including roofs, pavements and roads, in our towns and cities, cause problems. When it rains, water is normally directed straight to drains, which can be overwhelmed during storms. When this happens, localised flooding can occur, damaging property and blocking streets. In some cities where surface water drains and foul sewers are interconnected, sewage can find its way into watercourses and streets.

Even when flooding does not occur, runoff may wash oil, heavy metals and other pollutants into watercourses, damaging the plants and animals that live in aquatic environments. Sealed surfaces can also cause problems during warm weather. When the sun shines, more heat is absorbed, causing urban areas to be hotter than the surrounding countryside – a phenomenon known as the Urban Heat Island Effect.

These problems have become worse as our towns and cities have grown and are expected to be exacerbated by climate change, which is likely to bring about more frequent and heavier downpours and stronger heat waves. One of the most effective ways of tackling these problems and adapting to climate change is to increase the quantity and quality of vegetation and soils in our towns and cities. All the green spaces and other environmental features, which include parks, gardens, green roofs and street trees, which are collectively known as green infrastructure, combine to provide various benefits at minimal cost, which are often described as ecosystem services.

Rain gardens help our gardens to deal more effectively with rainfall, but they also filter and clean runoff. By providing more and more rain gardens, we will be able to reduce our risk of flooding and curb urban heat islands.

The many benefits of green infrastructure include:

- Reduced risk of flood
- Reduction in water, air and noise pollution
- Better health through stress reduction and more places to exercise
- Space to relax and play
- Habitat for wildlife and space for people to enjoy nature
- Environmental education
- Local food production

Rain gardens can also be planted to attract wildlife (see Planting below) and can reduce the cost of maintenance, for example, where frequently mown lawns are replaced. They can be easily combined with schemes to harvest rainwater. By increasing the amount of water entering the soil, rain gardens help to reduce the effects of drought and help gardens to thrive without the need for irrigation.

Rain gardens work well by bringing about many small incremental improvements, which cumulatively can bring about huge beneficial change – each project, however small, makes a significant contribution towards the overall goal of making the city greener.

Who is this GUIDE for?

The rain gardens described in this guide are relatively simple and straightforward, suitable for establishment anywhere where local conditions are suitable and an adjacent downpipe can be intercepted or water from a paved area redirected. This guide is intended to help the homeowner or property manager (or practical person working on behalf of others) to create a simple rain garden within their own property. Even in places without gardens, like many apartment blocks, offices or factories, there may be space to create container gardens or raised beds that receive water from downpipes and overflow into the drain. In some situations it may even be possible to remove paving or asphalt in order to create space for your rain garden.

We hope that this guide will encourage everyone to look for opportunities to establish rain gardens throughout our towns and cities. We should also consider how we can encourage managers of our parks and streets to restore more natural patterns of drainage in our neighbourhoods. For information on the various components of sustainable drainage systems and sources of professional advice see the Resources section at the end of this document or email us at: info@raingardens.info

Planning & Design

The first consideration is, if the rain garden overflows, where will the water go? This might be the existing drain, which the disconnected downpipe enters, but in some cases could be an alternative drain. If you are using the existing drain, you don't need to worry about drainage capacity, because the rain garden will be reducing the overall volume of water entering the drain. The rain garden will need to work in terms of levels, with the overflow point being higher than the receiving drain. If a suitable receiving drain cannot be identified, you should not proceed without taking professional advice.

You will usually site your rain garden in an existing flower bed or lawn. Rain gardens are usually situated some distance from buildings or site boundaries, although the exact location will depend on the local topography and available space. In order to reduce the likelihood of property damage to insignificant levels, authorities in the US recommend that rain gardens are situated at least 3m (10 feet) from any building. (Note that rain gardens as described here are not point soakaways as described under Part H of the Building Regulations. However, if your property is situated in an area with chalk or other material that could be adversely affected by localised increases in the flow of ground water you should contact your local authority Building Control Officer for advice). If a rain garden is based on a planter, it will normally be most convenient to place it below the downpipe and close to the receiving drain.

Most gardens slope away from buildings and It is usual to establish a rain garden on a gentle slope – the steeper it is, the more difficult it is to remodel the ground to create a level perimeter. Slopes of more than about 12% or 1:8 are difficult to work with and may require retaining structures. Seek professional advice if you would like to establish a rain garden on a steeper slope than this. The downpipe should feed into the head of the rain garden. If the garden is some distance from the downpipe, create a swale (a small, shallow channel) or use a pipe to take the water to the rain garden.

It is possible to locate a rain garden in the shade of large trees, however the range of plants that will thrive will be limited to those that are shade tolerant and there could be problems with tree roots, which are best left alone. When planning the location of your rain garden, consider how it will relate to other existing and planned features and how it will look from various viewpoints both inside and out.

We recommend that you undertake a simple percolation test before building your rain garden. Dig a hole at least 250mm deep, fill with water and let it drain. Fill the pit with water again. If it drains away at the rate of 50mm per hour or more you have suitable conditions for a rain garden. Water will not drain away quickly enough if the water table is at or very close to the surface or if the soil is composed of a heavy clay. The soil can be improved (see Construction section over the page), so it will usually be possible to work on sites with almost any soil type, although again, if you have any concerns about ground conditions in the local area, contact your local authority Building Control Officer for advice.

If your soil is clay it will require much more improvement than a light, sandy soil. If you are unsure of the soil type at your site, you can run this simple test: take a handful of damp soil and squeeze it in the palm of your hand. If it holds its shape at first but easily crumbles you have a loamy soil, which is ideal for a rain garden. If it falls apart as soon as you open your hand, it is a sandy soil, which is also suitable for a rain garden. If your sample holds its shape and stays intact it is a clay soil, which will need to be improved.







Before, during and after the installation of a rain garden at Kingsmead Way, Hackney, London, led by Groundwork London's Green Team and Sanctuary Housing, and planted up by local residents
| Groundwork London

The next step is to consider the size of the rain garden. The bigger the rain garden the better. Experienced 'rain gardeners' in the US suggest that rain gardens are between 3m and 5m wide, with the length adjusted to suit the slope and area available. Although a rain garden of any size may bring some benefits, if it is very small, it may overflow too frequently and may become waterlogged and less effective in reducing run-off rates.

To calculate the volume of water that your rain garden may be receiving, measure the size of the roof that drains into the downpipe that you will be intercepting and consider how much rain may fall during a particular downpour or period. The volume of water that the rain garden will be receiving in litres, equals the area of the roof (in square metres) multiplied by the rainfall (in millimetres).

A rain garden 150mm deep and 20% of the area of the area of the roof that it serves will be able to intercept all of the run-off from a typical summer storm where 10-15mm of rain might fall. Rain gardens on more permeable soils will be even more effective. Over the course of an average year, a rain garden of this size will intercept most of the rainfall that it receives, only overflowing after several days of persistent rainfall.

Construction

Once you have determined the location, size and shape of your rain garden, you should mark the outline on the ground with rope or hose (or if it has straight sides, with pegs and string). You can reduce the effort of digging up existing turf by covering it with dark plastic for a few weeks, until it has died off.

Dig out your rain garden to create a saucer shaped profile, to create a flat base for infiltration. You may place the spoil around the margins to create a level berm or lip. At the centre, the base of the excavation for a typical rain garden will be between 150mm and 450mm below original ground level. You can check that the perimeter lip is level by using a series of wooden stakes, parallel sided board and spirit level or, on larger excavations, a length of hosepipe filled with water.

The berm will hold back water during a storm so will need to be approximately 300mm in width, approximately 100mm high and well compacted. The amount of material in the berm will be greater on the lower part of the slope. Berms are usually tapered off so that they blend in with the adjoining garden.

In order to allow excess water to flow out of the rain garden in the direction of the drain, create a permeable channel through the berm in the required location by making a 150mm wide slot and filling this with gravel. The lower level of the outfall channel or pipe should be existing ground level. A shallow swale filled with gravel or pebbles can be created to channel the overflow towards the drain. In a similar way, if an inlet channel is required to direct water from the downpipe to the rain garden, this can be lined with clay and made with bricks, setts or pebbles (to ensure that the water reaches the rain garden and doesn't erode the soil).

Where a downpipe feeds water directly into a rain garden, stones or gravel should be used to dissipate the energy of the water and prevent heavy flows from washing away soil. Or alternatively, a pipe can be used to direct water to the rain garden.

You can redirect your downpipe towards the rain garden by adding bends and new sections or alternatively use a proprietary rainwater diverter of the type normally used to divert water from a downpipe to a water butt. The City of Toronto provides useful advice on the practicality of disconnecting downpipes (see Resources section on p10).

Once the rain garden is excavated to the required depth, the excavated soil should be improved to make it more water absorbent and free draining. The act of digging your soil will bring some improvement but it is also helpful to add organic matter. This could be in the form of your own home made compost, shredded paper, leaf mould, well-rotted bark or charcoal. If your soil is a heavy clay, the addition of sand, crushed brick, gravel, stones, as well as organic material will help.

Once your soil has been well mixed with any improver, backfill the excavation to the original ground level. This should leave a freeboard between the original ground level and the surrounding berm, an area that may flood for a few hours following particularly heavy rain.

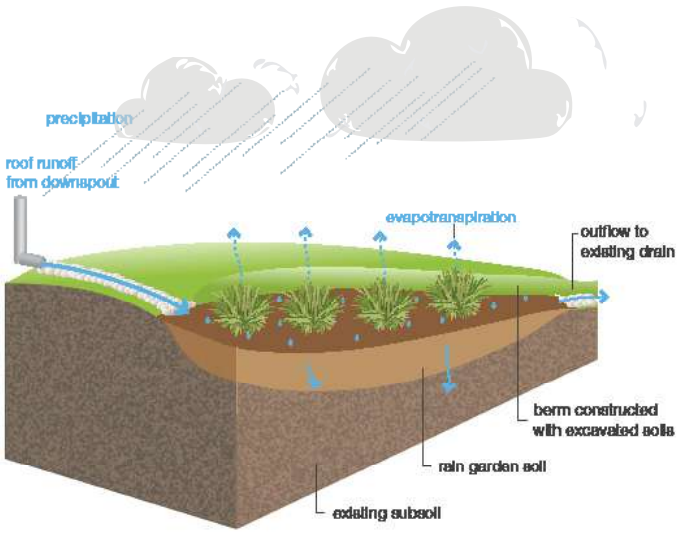


Rain gardens can be incorporated into conventional front gardens, keeping the ground permeable while allowing for car port and parking, as in this Hampton Court Flower Show Gold Medal winning design by Wendy Allen | Wendy Allen Designs

Rain gardens that are created using stone, concrete or metal planters should have a drainage hole near the base, which is close to the receiving drain. The bottom of the planter should be filled with stones and gravel to a depth of at least 50mm, with a 'fleece' over the gravel, and the remainder filled with a water absorbent and free draining soil. Avoid the use of clay and include plenty of organic material.

An overflow pipe, set at the height of the rim of the planter allows water to run straight to the base of the planter when the planter is saturated. Where the down-pipe empties into the planter, stones should be used to dissipate the energy of the falling water and prevent the soil being washed away.

Once you have filled your rain garden with the improved soil, it is ready to plant!!



Section of a typical domestic rain garden



Ashby Grove rain garden, north London | CIRIA

Planting

Your rain garden is designed to slow surface water run-off and improve water quality. However it is a garden feature and should work for you in terms of the overall design of your property. Like any garden, there is range of possible planting styles: your rain garden might have ornamental, low maintenance ground cover, designed to provide a habitat for wildlife or quirky, perhaps, with stone, gravels or even sculpture – the choice is yours. The English cottage, American prairie or ornamental grass styles are particularly well suited to rain gardens. In larger planters, you may be able to grow fruit and vegetables.

When choosing plants you may want to consider height, colour and flowering period. Taller plants tend to be situated at the centre of the garden and shorter ones around the edges, so that all can be seen and so that deeper-rooted plants can benefit from the deeper soil in the middle of the bed. By grouping plants of various size and texture you will be able to create an interesting looking garden even when few flowers are in bloom. If you wish to create habitat for wildlife, plant native species or plants that are known to attract insects like bees and butterflies and other wildlife. For further information on plants for pollinators see the Royal Horticultural Society's list, and for general advice on wildlife gardening see the Wild About Gardens website (see the Resources section).

It is recommended that your rain garden is planted with a wide range of species in order to create a densely vegetated, stable and thriving bed with dense and thick root systems which will thrive without frequent maintenance. A typical rain garden is planted with about 10 species planted in 2 to 3 clumps per square metre. By planting several species, you will be creating a rain garden that can still succeed even if one or two species do not thrive. A typical planting density is 6-10 plants per square metre, but you may wish to vary this, depending on the size and nature of the plants chosen.



Bugle, *Ajuga reptans* | Bob Gibbons

Plant the rain garden with nursery-grown stock. Good results have been achieved with one or two year old plugs or potted plants, which have a strong root system. Before you plant, it is advisable to have a good idea of what goes where, by preparing a planting plan. Excavate a hole for each plant about twice the size of the root ball, place the plant in the hole and press the soil firmly around the roots. The stem should be at the same level relative to the ground as it was in the growing container. Once the garden is planted, you may consider spreading bark mulch across bare soil to suppress weed growth.



Yellow flag iris, *Iris pseudocorus* | Bob Gibbons

The perimeter berm can be seeded with a general purpose wildflower grassland mix, which can be left to grow, or mown as required, in order to match the adjacent garden. Unless it rains, plants should be watered during establishment. During hot weather, the soil loses about 3 litres per square metre per day by evaporation, so it is advisable to replace this if possible. Once established, the plants will not need to be watered unless the weather has been exceptionally dry. Plants can be planted anytime during the growing season, as long as they are watered. If watering is difficult, it may be advisable to plant in autumn.

A very wide range of plants can be planted in rain gardens, however you should avoid using plants that do not withstand occasional flooding - for example species which are usually associated with dry Mediterranean style gardens, like Lavender. Other plants to avoid include those susceptible to root rot including Azalea, Juniper and Chinese privet.

The frequency that the rain garden is inundated will depend on the size of the rain garden and the weather, so it is important to keep an eye on the rain garden, replace any failures and adjust the planting palette to suit the actual conditions. A selection of suggested plants is included in the table. There are many others that will be suitable which are not listed, so feel free to experiment and apply your own plant knowledge if you are a keen gardener. If you have success or notice problems with particular species, please let us know at: www.raingardens.info.

Planting Suggestions

Common name	Scientific name	Habit	Sunlight and Aspect	Origin
Guelder rose	*Viburnum opulus*	Perennial shrub	Any	Native. Flowers attract insects and berries are eaten by birds.
Dogwood	*Cornus sanguinea*	Perennial shrub	Any	Native. Leaves are larval food for vase bearer moth and berries eaten by birds. Often planted for attractive winter stems.
Culvers root	*Veronicastrum virginicum*	Herbaceous perennial	Full sun or partial shade	Non-native. Tall with long terminal blue flower spikes. On the RHS 'plants for pollinators' list.
Aster	*Aster spp.*	Herbaceous perennial	Full sun or partial shade	Non-native. Often late flowering. Clump forming. Several species on the RHS 'plants for pollinators' list.
Black eyed susan	*Rudbeckia birta*	Herbaceous annual or biennial	Full sun or partial shade	Non-native. Spectacular yellow and black flowers. On RHS 'plants for pollinators' list.
Stinking hellebore	*Helleborus foetidus*	Herbaceous perennial	Full sun or partial shade	Native. Winter flowers.
Montbretia	*Crocosmia spp.*	Deciduous rhizomatous perennial	Partial shade	Naturalised. Red flowers. Thrives in most conditions.
Bugle	*Ajuga reptans*	Rhizomatous perennial	Partial shade	Native. Low growing and will form a mat.
Columbine	*Aquilegia spp.*	Herbaceous perennial	Full sun or partial shade	Non-native. Clump forming with tall flower spikes. On RHS 'plants for pollinators' list.
Inula	*Inula hookeri*	Herbaceous perennial	Partial shade	Tall clump forming with yellow flowers. On RHS 'plants for pollinators' list.
Hemp agrimony	*Eupatorium cannabinum*	Herbaceous perennial	Full sun or partial shade	Native. Sub-shrubs with pink flowers.
Bellflower	*Campanula glomerata*	Herbaceous perennial	Full sun or partial shade	Native. Clumps bearing violet-blue bell shaped flowers.
Sneezeweed	*Helenium sp.*	Herbaceous perennial	Full sun	Non-native. Clump forming with red flowers. On RHS 'plants for pollinators' list.
Lesser periwinkle	*Vinca minor*	Perennial sub-shrub	Any	Non-native. Ground cover with blue flowers.
Elephants ear	*Bergenia sp.*	Rhizomatous perennial	Full sun or partial shade	Non-native. Large leaves and pink flowers.
Plantain lilies	*Hosta spp.*	Herbaceous perennial	Part shade	Non-native. Attractive light coloured flowers.
Yellow flag	*Iris pseudocorus*	Rhizomatous perennial	Full sun or partial shade	Native. Likely to prefer wetter areas near inlet.
Siberian flag	*Iris sibirica*	Rhizomatous perennial	Full sun or partial shade	Non-native. Blue flowers. Prefers moist but well drained soil.
Garlic and onions	*Allium spp.*	Bulbous perennials	Full sun	Non-native. On RHS 'plants for pollinators' list.
Soft rush	*Juncus effusus*	Evergreen perennial	Full sun or partial shade	Native. Form tussocks – likely to prefer wetter areas.
Pendulous sedge	*Carex pendula*	Rhizomatous perennial	Full sun or partial shade	Native. Nodding flower spikes. Likely to prefer wetter areas near inlet.
Zebra grass	*Miscanthis sinensis*	Perennial, deciduous grass	Full sun	Non-native. Tussock forming ornamental grass with silky flowers.
Switch grass	*Panicum virgatum*	Deciduous perennial grass	Full sun	Non-native. Tussock forming ornamental grass.
Royal fern	*Osmunda regalis*	Deciduous fern	Any	Native. Large clump-forming plants.
Male fern	*Dryopteris felix-mas*	Deciduous or evergreen fern	Partial shade or full shade	Native. Large shuttlecock-like form.
Broad buckler fern	*Dryopteris dilatata*	Deciduous or evergreen fern	Partial shade or full shade	Native. Large shuttlecock-like form.

Maintenance

Occasional weeding may be required during the first two years of the life of the rain garden. Remove by hand any weeds, ensuring that you remove the whole plant, including the roots. As the plants in the beds mature, they will fill in any gaps and suppress weed growth.

During winter, you may want to remove any dead or untidy plants, although it is good to leave some dead stems and seed heads for wildlife.

Regular mowing is not required, but the bed may benefit from cutting occasionally. If required, cutting can be undertaken in late summer or autumn with a scythe or strimmer with particularly tough material cut by hand with secateurs. Remove cut material for composting.



Rain garden, Hampton Court Flower Show | Wendy Allen Designs

Resources

This **Rain Garden Guide** is available for free download at the associated website:
www.raingardens.info

Low Impact Development
www.lowimpactdevelopment.org

Sustainable drainage systems
www.ciria.com/suds

Water sensitive urban design
www.wsud.melbournewater.com.au

London and the Urban Heat Island Effect
www.london.gov.uk/lccp/ourclimate/overheating.jsp

Defra Green Infrastructure Partnership
www.defra.gov.uk/environment/natural/green-infrastructure

Natural England on green infrastructure
www.naturalengland.org.uk/ourwork/planningtransport-localgov/greeninfrastructure/default.aspx

UK National Ecosystem Assessment
www.uknea.unep-wcmc.org

Regional climates: Meteorological Office
www.metoffice.gov.uk/climate/uk/regional

Soil and water
www.noble.org/ag/soils/soilwaterrelationships/index.htm

Building Regulations Part H – Drainage (Amended 2010)
www.planningportal.gov.uk/buildingregulations/approveddocuments/parth/approved

Disconnecting downpipes
www.toronto.ca/water/protecting_quality/downspout.htm

Depave Movement
www.depave.org

How to check levels using a hose
www.factsfacts.com/MyHomeRepair/WaterLevel.htm

Planting sources
www.rhs.org.uk/Gardening/Sustainable-gardening/pdfs/RHS_Pollinators_PlantList

www.wildaboutgardens.org.uk

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Above: Hemp agrimony | **Bob Gibbons**

Back cover: Highway rain garden, Portland Oregon US | **Dusty Gedge**



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