Swales

Contents

What are Swales?

A swale is a grassed or vegetated shallow linear feature similar to a ditch that can gather, attenuate, and/ or convey surface water within a site.

Some swales will retain some water all year round while others may contain water at times of high rainfall. A swale can be used to gather and slow surface water allowing it to infiltrate the ground or may be lined and convey water to the next stage of the SuDS management train. The vegetation in the swale acts to slow water allowing sediment to settle out and reducing pollutants.

Small check dams in the form of earth mounds, rocks or kerbs can increase the storage capacity of a swale allowing water to slowly seep through the barrier into the next section. Steeply sloping sites check pools can be incorporated to create a form of terraced swale.

Biodiverse swales can be attractive landscape features providing wildlife habitat while carrying out practical drainage functions. Check dams can help to create a variety of damp or wet habitats supporting a range of native wetland plants and grasses.

The type of construction, function, planting and related maintenance requirements should be agreed with the adopting authority as part of the planning and design process.

Figure 1. Dry Swale, Queen Margaret University | Raeburn Farquhar Bowen

Figure 2. Wet Swale, Heriot Watt University | Raeburn Farquhar Bowen

Advantages of Swales

Swales are versatile features that can be tailored to carry out several SuDS functions in a variety of contexts

Swales are particularly useful for draining linear features like paths and roads

A well designed swale can be integrated into overall landscape design as an attractive feature

With appropriate design swales can provide valuable wildlife habitat

Disadvantages of Swales

Although low maintenance they do require regular maintenance including vegetation management.

As a shallow surface feature, a swale requires sufficient space so retrofit opportunities can be limited in narrow urban streets.

Biodiverse swales with established wetland planting (such as sedges and Iris) are less suitable for areas with frequent high flows.

Technical references:

- Edinburgh Design Guidance 4.
- Edinburgh's Sustainable Rainwater Management Guidance
- CIRIA The SUDS Manual section
- SUDS for Roads 4
- CIRIA Guidance on the Construction of SUDS

Typical Locations where Swales are used

Swales can form part of a SuDS network within the greenspace of a new development or provide drainage for linear features like roads or paths.

Swales in an inner-city urban environment may also be a linear green feature within a hard landscape with permeable paving or perforated kerb inlets. Guidance on fitting swales into urban streets can found in the ***Edinburgh Design Guidance section 4*** and ***Edinburgh's Sustainable Rainwater Management Guidance section B.***

Examples:

- Residential Developments
- Commercial/industrial Developments
- Roads and surfaced paths
- High density (dependent on design and available space)
- Retrofit (dependent on design and available space)
- Contaminated sites (with liner)
- Sites above vulnerable groundwater (with liner)

Swale in a residential setting

Figure 3. Upton, Northamptonshire | Susdrain, CIRIA

Swale situated in a car park

Figure 4. Swale in a car park | CIRIA

Swales in educational setting

Figure 5. Bridget Joyce Square | Robert Bray Associates

Relevant Factsheets:

Street Trees (F5)

Footway Zones (P3)

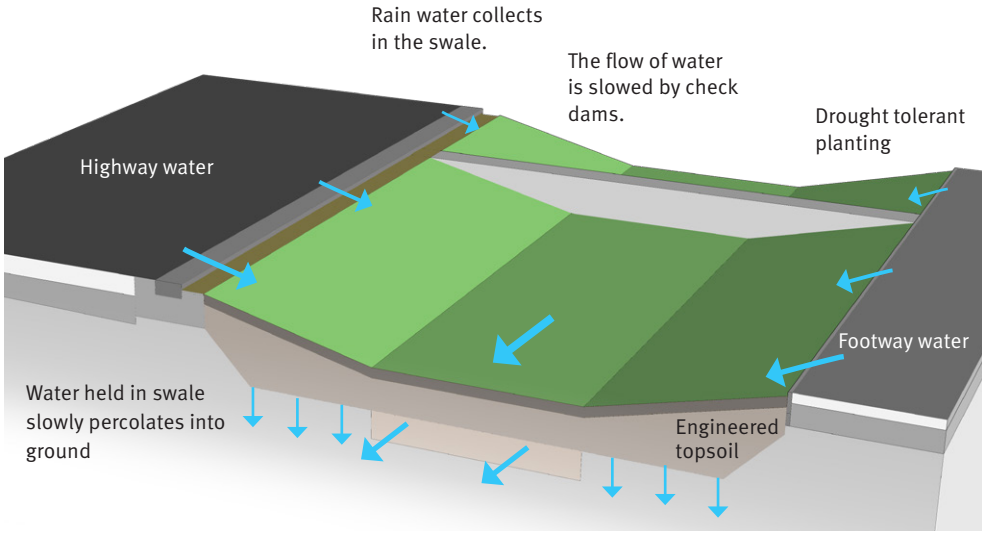
Street Furniture (F1)

Street Geometry & Layout (G1)

Alternative Types of Swale Construction

A swale is designed to collect sheet flow (rainwater moving over the ground surface) rather then as an "end of pipe" feature.

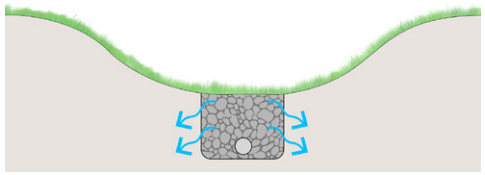
Water can enter a swale through inlets or 'over the edge' along the length of the swale. The type of swale construction will depend on its primary function (e.g.. infiltration, conveyance etc.), context and site conditions.



Technical references:

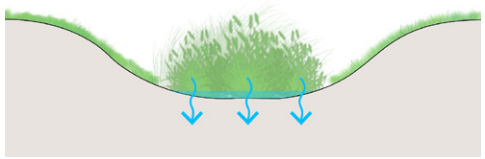
- Edinburgh's Sustainable Rainwater Management Guidance
- CIRIA The SUDS Manual (C753), Chapter 17: Swales, p312
- Guidance on the construction of SuDS C768, Chapter 30: Swales, p195

Dry Swale



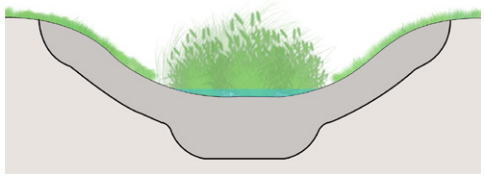
A dry grassy swale remains dry for most of the year and are used to manage surface water during high rainfall. Water is attenuated and soaks away into the soil.

Wet Swale



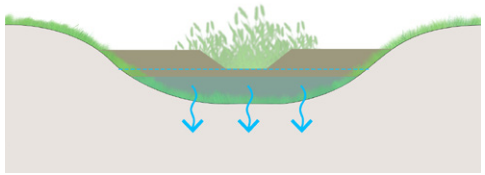
A wet swale is a, linear shallow biofiltration or linear wetland treatment system used to attenuate surface water. The wetland planting helps to filter sediment and nutrients, reduce water quantity and slows water flow. Useful in areas where soil is poor draining and flat areas.

Lined Swale



A lined swale would be used where infiltration is not possible either due to the nature of the soil or the surface water run off or where there is danger of ground water contamination. A lined swale can attenuate and convey water while using planting acts to filter and reduce water flows

Biodiverse Swale



A biodiverse swale may have lined and unlined sections to maximise habitat diversity. Large shallow biodiverse swales can include trees and shrubs.

Methods of Water Inlet

The simplest and most effective way for water to enter a swale is over the edge along its length. Water can also enter through a filter strips along a swale edge filtering sediment and pollutants. In hard surface areas 'over the edge' inlets be achieved by using perforated or flush chamfered kerbs. Water can also enter through a piped inlet (for example from a filter drain) if the depth of the pipe is sufficiently shallow.

Simple 'Over the edge ' water inlet

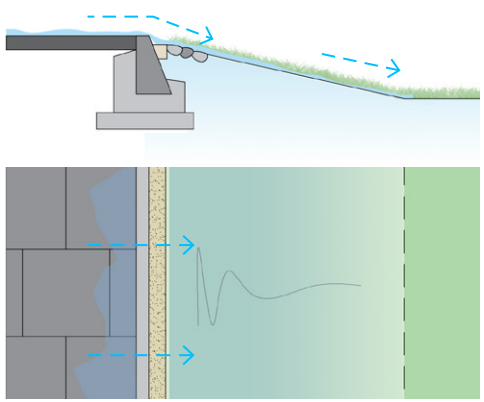


Figure 6. 'Over the edge' inlet | SNH

Using a filter strip to reduce pollutants

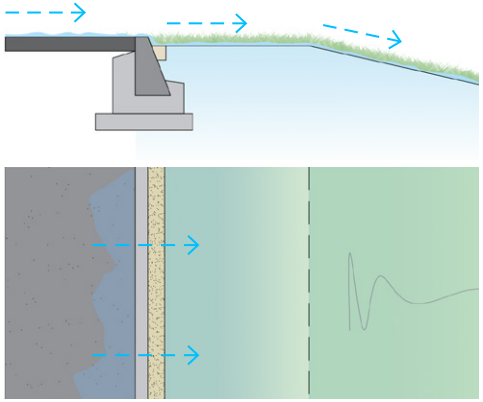


Figure 7. Swale with filter strip | RaeburnFarquhar-Bowen

Water inlets using kerb openings

Water inlets using disconnected down pipes

Figure 8. Queen Caroline Estate, London | Susdrain

water inlet via a piped connection

Technical references:

- CIRIA The SUDS Manual (C753), Chapter 28: Inlets, Outlets & Flow Control, p605
- Guidance on the construction of SuDS C768, Chapter 30: Swales, p179
- Susdrain.org

Key Design Considerations

Designing a swale

- ☑ **Do** consider SuDS design at from the outset of a project to maximise benefits and efficient land use.
- ☑ **Do** integrate the swale into the landscape design making it an attractive feature.
- ☑ **Do** make sure that levels and gradients allow water to move gently through the system avoiding ponding or rapid flows. The maximum flow velocity should be less than 2m/s, and less that 1m/s where possible.
- ☑ **Do** consider the Manning's roughness value of the type vegetation for the purpose of hydraulic design. (Typically, a Manning's roughness value of 0.250 should be use for treatment flows to 150mm depth, reducing to 0.100 for flow at the design depth of say 600mm (full capacity). For biodiverse swales with reeds and sedges this value will be higher).
- ☑ **Do** allow for a minimum 1 in 30 year rainfall event in the swale design.
- ☑ **Do** ensure that depths and gradients work for 'over the edge 'surface water flows from surrounding areas.
- ☑ **Do** ensure planting is appropriate to the habitat, soil type, moisture or water level (the base of a swale may require different planting to the drier banks).
- ☑ **Do** ensure inlet, outlet and weir designs are integrated into the landscape design as they may otherwise detract from the appearance of the scheme and be more vulnerable to damage.
- ☑ **Do** ensure that the swale base width is between 900mm and 2m.
- ☑ **Do** create consider silt and sediment traps at inlet and outlet points.

Don't design a swale with a linear gradient steeper than 1/40.

- ☒ **Don't** make the sides steeper than 1/4 for a planted swale or 1/6 for a grassed swale as they will be difficult to maintain, reduce the water storage and may be a safety hazard.
- ☒ **Don't** create a swale with a maximum flow velocity of more than 2m per second, wherever possible this maximum figure should be less than 1m per second.

Designing a Biodiverse Swale

- ☑ **Do** use soft naturalistic slopes and linear curves fitting the swale into the contours of the landscape.
- ☑ **Do** provide a variety of wet, damp and dry habitat.
- ☑ **Do** provide some planted areas along banks away from paths and disturbance to encourage wildlife
- ☑ **Do** ensure water quality that will allow plants and wildlife to thrive by providing some pre-treatment (filtering) of potential contaminants in the SuDS management train.
- ☑ **Do** use appropriate native planting of Scottish provenance
- ☑ **Do** consider mixing native and appropriate non native planting to increase biodiversity and improve climate resistance
- ☒ **Don't** plant invasive species such as Bulrush (Typha)

Construction Considerations

Construction checklist

- ☑ **Do** use good quality topsoil of the right depth and specification to allow vegetation to grow
- ☑ **Do** construct the swale near the end of a building project to reduce the likelihood of damage or contamination
- ☑ **Do** ensure the swale, inlets and outlets are at the correct depth to the to avoid unintentional ponding
- ☑ **Do** ensure the right geotextiles and pipes are installed
- ☑ **Do** allow vegetation to establish before connecting drainage into a swale to allow it to resist water flows, alternately use turf or seeded mats to prevent erosion during establishment.
- ☒ **Don't** allow the build-up of sediment during construction
- ☒ **Don't** compact soil during construction
- ☒ **Don't** construct a swale within the rooting zone of established trees, if the swale is within 5m of established trees consider if a root protection barrier is required

Figure 9. Swale during Construction | Sheffield City Council

Figure 10. Swale during Construction with erosion prevention | ARUP

Technical references:

- ESRWMG Section B
- EDG Chapter: 1,2,3 & 4
- Edinburgh's Biodiversity Action Plan
- RSPB guide
- CIRIA The SUDS Manual (C753), Chapter 17: Swales, p312
- Guidance on the construction of SuDS C768, Chapter 30: Swales, p195

Establishing Vegetation

Avoid exposing newly seeded or planted areas to rapid water flows that may wash away soil and seeds (allow one year for establishment).

Where there is an unavoidable danger of erosion before vegetation can be established banks can be turfed or covered in pre-seeded jute, coir or hessian mats to provide short term protection and aid soil stability while the plants establish.

Principles of Planting Specification

General Principals of Planting Specification

Suitable planting will depend on the type of swale, the context and the amount of ground moisture or retained water levels.

Amenity, visual appearance and biodiversity value may also be considerations. Swales next to busy roads may also need planting that has some tolerance to salt.

For all types of swale it is important to protect planting from erosion during establishment. (see *Construction Considerations p6*).

Various types of planting may be acceptable as an integral part of a wider landscape design if they satisfy the requirements of a SuDS system and are appropriate to the local context (see EDG3).

Technical references:

- ESRWMG Section B
- EDG Chapter: 1,2,3 & 4
- CIRIA The SUDS Manual (C753), Chapter 17: Swales, p312
- Guidance on the construction of SuDS C768, Chapter 30: Swales, p195

Use an appropriate professional to design and specify planting or seeding.

Shrubs and Trees

Large unlined biodiverse swales can include shrubs or trees that can tolerate a range of dry to damp conditions with short periods of waterlogging. Trees and shrubs are unsuitable in or in close proximity to lined swales due to potential for root damage to the liner. Trees and shrubs can also be planted along the banks of unlined swales to create a riparian corridor.

Tree species with potential to cause pollen allergy problems such as Birch should not be used in on street locations.

Figure 12. Vegetated swale at Queen Margaret University, | Raeburn Farquhar Bowen

Planting: Dry Swales

A dry swale can be planted with suitable low growing groundcover. In Edinburgh all grassed swales must have slopes no greater than 1/6 to allow future maintenance.

Grassy swales that are dry for most of the year need regular mowing or can be seeded with a slow growing low maintenance grass or native wildflower meadow that will need twice yearly or yearly mowing. All wildflower seed should be of Scottish provenance.

Planting: Wet Swales

In damp or wet swales marginal and emergent planting like sedges, iris and other wetland plants can be planted along the base with a dry meadow wildflower grass mix along the banks. Consider using plug planting (or a mix of seeding and plug planting) in boggy or wet sections of swale for faster establishment.

Figure 11. Dry Grassy Swale | Scotia Seeds

Maintenance

Routine maintenance will include removal of debris, clearing inlets and outlets, vegetation or grass management and periodic removal of silt.

In grounds under single ownership the maintenance of a swale is usually the responsibility of the landowner and may be managed by a factor or specialist contractor. For swales in public space or in association with roads or buildings in multiple ownership early consultation with the adopting authority is advisable.

Figure 13. Wet swale populated with invasive bull rush, Heriot Watt Campus | SNH

Technical references:

- CIRIA Guidance on the Construction of SUDS Section F chapter 30

The Maintenance Plan

All SuDS features will require a maintenance plan that should include detailed specifications, frequency, timing, equipment and annual costs. SuDS features be regularly inspected and the maintenance monitored by a competent professional.

For all SuDS elements the contract maintenance period after construction should be 5 years.

Typical Maintenance Requirements for a Swale

Action	Frequency
Remove debris and litter	Monthly for first year then 3 times a year
Inspection and clearance of inlets, outlets, overflows	Monthly in first year then three times a year
Grass cutting	In grassy swales cut monthly between spring and autumn – maintain at 100mm height. (Alternately plant low a maintenance SuDS mix or meadow grass and cut twice a year).
Removal of invasive species such as Bulrush (Typha)	Monthly in first year then three times a year
Vegetation management including replacement or reseeding of dead or damaged vegetation	Annually
Repair erosion or other damage, reinstate design levels and re-turf or replant	Every 5 years
Scarify and spike topsoil to improve infiltration and break up silt deposits	As required
Removal of silt build up to restore capacity (and if necessary, replant and reseed)	As required

Image References

Figure 1. Dry Swale, Queen Margaret University
Image courtesy of RaeburnFarquharBowen [taken n.d.]

Figure 2. Wet Swale, Heriot Watt University
Image courtesy of RaeburnFarquharBowen [taken n.d.]

Figure 4. Swale in a car park
Illman,S. Wilson, S, 2017. *Guidance on the Construction of SuDS C768*. p193

Figure 3. Upton, Northamptonshire
Susdrain, (2012), *Swale at Upton* [ONLINE]. Available at: https://www.flickr.com/photos/139555361@N08/26098485748/in/album-72157669002326149/ [Accessed 1 December 2019].

Figure 5. Bridget Joyce Square
Robert Bray Associates, 2018. *Bridget Joyce Square, London*. Available at: https://robertbrayassociates.co.uk/ [Accessed 1 September 2019]

Figure 6. 'Over the edge' inlet
Image of swale at Dalmarnock Train Station courtesy SNH. [taken: n.d]

Figure 7. Swale with filter strip
Image of swale at Heriot Watt University courtesy of RaeburnFarquharBowen [taken n.d.]

Figure 8. Queen Caroline Estate, London
Susdrain, (2016), Queen Caroline Estate Image 3 [ONLINE]. Available at: https://www.flickr.com/photos/139555361@N08/25100416897/in/album-72157689917356882/ [Accessed 1 December 2019].

Figure 9. Swale during Construction
Image courtesy of Sheffield City Council [taken. n.d.]

Figure 10. Swale during Construction with erosion prevention
CIRIA, 2015. Figure: 17.16 *Swale during construction*. p327. The SuDS Manual.

Figure 11. Dry Grassy Swale
Scotia Seeds, (2019), Dry Meadow Mix [ONLINE]. Available at: http://www.scotiaseeds.co.uk/shop/dry-meadow-mix/ [Accessed 1 December 2019].

Figure 12. Vegetated swale at Queen Margaret University
Image courtesy of RaeburnFarquharBowen [taken n.d.]

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