

W1 - Suds Trees in Streets

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What are SuDS Street Trees?

All Street trees in Edinburgh are environmental assets that take up rainwater, improve air quality, and cool urban heat effects while significantly contributing to well being and quality of life. However SuDS trees can attenuate significantly more rainwater than conventionally planted trees.

A SuDS street tree will appear visually similar to a typical street tree but differs below ground in the design of the planting system which will be designed to collect, store water and treat surface water (rainwater) runoff.

SuDS trees can be retrofitted as standalone features or designed as component in a wider sustainable drainage system. All SuDS tree systems should include good infiltration or underlying drainage to prevent waterlogging and allow excess water to drain away.

For SuDS trees in public space 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. SuDS Dundee Trial Tree Pit | BlueGreen Urban



Figure 2. SuDS Dundee Trial Tree Pit | BlueGreen Urban

SuDS street trees contribute to surface water management by;



Interception - the canopy intercepts and absorbs rainfall, slowing and reducing the amount of surface water.



Transpiration - Water is absorbed by the roots and evaporated through the leaves.



Infiltration – increases the volume and rate of surface water moving into the soil

Technical references:

- Trees and Design Principles in ERWVG
- Edinburgh Design Guide Sections: 1, 2, 3 & 4
- Factsheets: F5 – Street Trees (unpublished)
- Factsheet -xx Utilities
- CIRIA The SUDS Manual V6: Part D, Technical Detail, Chapter: 19 Trees, p360
- CIRIA The benefits of large species trees in urban landscapes: a costing, design and management guide (C712D)
- TDAS, Trees and Hard Landscape, 2012
- New trees - BS 8545:2014
- BS 5837:2012 Trees in construction and Demolition

Fitting SuDS Trees into Streets

The Edinburgh Design Guidance 4.4 sets out a hierarchy of Design Principles based on street types and activity levels that identify where SuDS features might be used. Section B of the Edinburgh Sustainable Rainwater Guidance explains which type of feature could be considered in different contexts (such as for example high streets or residential areas). Associated street furniture like tree guards, grills, kerbs, and permeable paving should be designed with reference to the ESDGF and the EDG. In areas with heritage designations 'special' EDG design principles will apply.

Street Trees located in the furniture zone



Figure 4. King's Road, Harrogate, North Yorkshire | DeepRoot

Relevant Factsheets:

Street Trees (F5)

Footway Zones (P3)



Figure 3. Fitting a SuDS Tree Pit into a street | Atkins

Technical references:

- ESRWMG - Section B Design Principles
- Edinburgh Design Guidance Section 1,2,3, & 4

Street Furniture (F1)

Street Geometry & Layout (G1)



Integrating Street trees with street furniture



Figure 5. Hull Town Centre | DeepRoot

Footway Materials & Surfacing (M1)

Fitting SuDS Trees into Streets

SuDS tree with Traffic calming and permeable paving

Street Trees located in a built out area



Figure 6. Street Tree, Fountainbridge Edinburgh | Google Maps

SuDS Tree pits can be incorporated into the design of parking bays, traffic calming or segregated cycleways.

Relevant Factsheets:
Street Trees (F5)

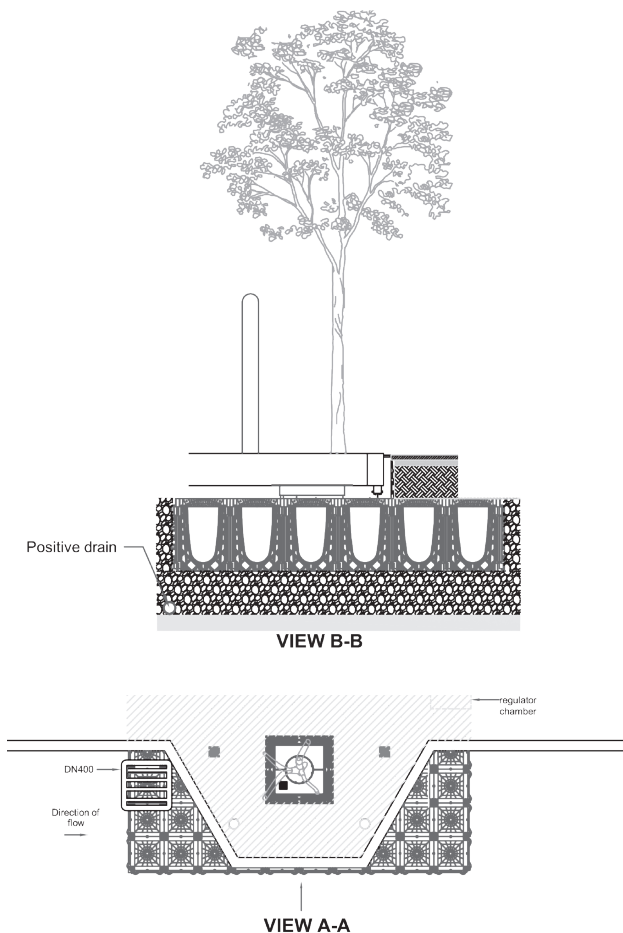


Figure 8. SuDS tree build out | GreenBlue Uran

Footway Zones (P3)
Street Furniture (F1)

Street trees in urban swales or bioretention



Figure 7. Ruskin Square, Croydon | J & L Gibbons



Street trees in urban swales or bioretention areas can be introduced as part of large scale developments or street improvements.

Swales and Rain gardens for Street Trees

Street trees in urban swales or bioretention areas in an inner-city urban environment can be a linear planted feature within a hard landscape.

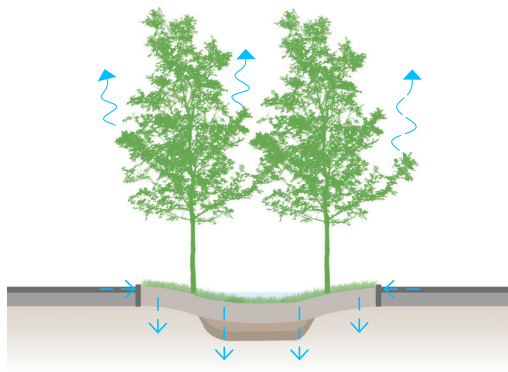


Figure 9. Swale/ rain garden with trees



Figure 11. Damp Swale, Joyce Square, London | Robert Baray Associates

Trees situated in a rain garden



Figure 10. Greener Grangetown, Cardiff | GreenBlue Urban

Trees situated in a shallow dry swale

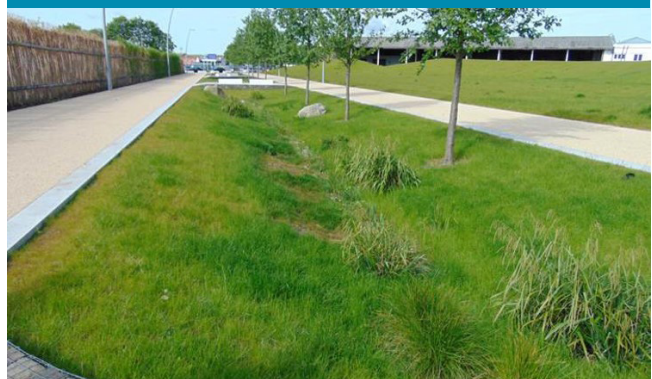


Figure 12. Dry Swale, Dalmarnock Strain Station | SNH

Relevant Factsheets:
Street Trees (F5)

Footway Zones (P3)
Street Furniture (F1)

Comparison of trees in swales and tree pits

Performance	Swale Tree Pit	Paved Tree Pit	Site Context	Swale Tree Pit	Paved Tree Pit
Peak flow reduction	Medium	Medium - High	Residential	Yes	Yes
Volume reduction (high with infiltration)	Medium - High	High	Commercial/ residential	Yes	Yes
Water quality treatment	High	Medium - High	High Density	No	Yes
Amenity potential	High	High	Retrofit	Yes	Yes
Ecology potential	Medium - high	Medium	Contaminated Sites / sites above vulnerable groundwater (with liner)	Yes	Yes
Treatment Train Sustainability	Swale Tree Pit	Paved Tree Pit	Cost Implications	Swale Tree Pit	Paved Tree Pit
source control	Yes	Yes	Land-take	High	Low
conveyance	No	No	Capital Costs	Low	High
Site Systems	Yes	Yes	Maintenance Cost	Medium	Medium
Regional System	No	No			
			Pollutant Removal		
			Total suspended solids	High	Medium
			Nutrients	Low	Medium
			Heavy Metals	High	Medium

Figure 13. Table adapted from *Green Blue Urban: Trees and Water Sensitive Urban Design*, p23

SUDS Systems for Street Trees

Street Trees in SuDS Tree pits and Trenches

The survival of a SuDS street tree is dependent on the initial establishment of the tree, soil, appropriate species selection and care throughout its lifecycle.

In sufficiently wide pavements SuDS trees in tree pits or trenches can be located within the furniture zone (ESDGF F1, Street Trees) or can be integrated into street layouts.

In a SuDS trench system a continuous connected underground structure provides attenuation and root training for a row or avenue of trees.

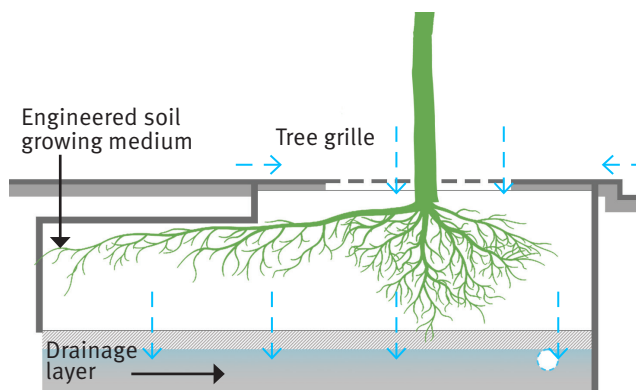


Figure 15. Tree Pit | Atkins

“Engineered soils are designed and manufactured to provide specific drainage and horticultural properties.”

CIRIA: Guidance on the Construction of SUDS p110

Engineered soils for SuDS trees should have:

- Adequate load bearing root volume
- Quality engineered soil which can cope with intermittent water logging without loss of structure
- Overflow provisions (exceedance)
- Maintainable inlets
- Drainage base
- Aeration to maintain soil health

Street Tree in SuDS pit



Figure 16. 5 Broadgate, Sun Street, London | GreenBlueUrban

Street Trees in SuDS trenches



Figure 14. Fletton Quays | GreenBlue Urban

Relevant Factsheets:

Street Trees (F5)

Footway Zones (P3)

Street Furniture (F1)

Key Design Considerations:

- ✓ **DO**, establish existing drainage and rainfall volumes to determine the drainage requirements
- ✓ **DO** survey the site to establish ground levels, street character and context to inform the design choices
- ✓ **DO** consult the design guidance in the EDG, ESRWVG and Factsheets to inform the locations of trees within the street layout design.
- ✓ **DO** ensure enough space to successfully accommodate long-term root growth
- ✓ **DO** establish location of utilities and services to avoid conflicts and if required provide root barriers/ root training.
- ✓ **DO** consider whether the location and future growth of the tree will conflict with CCTV or lighting.
- ✓ **DO** determine water availability and ensure the appropriate catchment area for each tree
- ✓ **DO** provide an appropriate volume of fertile, uncontaminated, free draining engineered soil with an open structure (as propriety SuDS soils).
- ✓ **DO** include suitable water inlets allowing were possible multiple inlet points.
- ✓ **DO** establish where any excess water drained from the tree pits/ trenches will discharge and ensure technical requirements are met and any necessary permissions obtained.
- ✓ **DO** ensure that during an extreme weather events if the tree pit/trench reaches water capacity, excess surface water can flow away safely
- ✓ **DO** specify robust tree specimens appropriate to on street locations and tolerant of periodic waterlogging or dry periods as described in this factsheet
- ✓ **DO** design associated street furniture like tree guards, grills, kerbs, and paving with reference to the ESDG Factsheets and the EDG. In areas with heritage designations ‘special ‘ EDG design principles will apply.
- ✓ **DO** ensure a regular maintenance regime for inlets/ outlets and any filter mediums.
- ✗ **DON'T** forget to provide establishment watering during dry weather in the first 2-5 years after planting
- ✗ **DON'T** allow construction of new SuDS features to negatively impact established mature trees, avoid root damage or compaction of soil within the rootzone of existing trees. Mature trees are important environmental assets and retaining existing trees should be a fundamental consideration in every development.

Alternative Methods of water inlet for SuDs Tree pits

There are a range of options for water inlets ranging from simple weir curbs with gaps where surface water drains directly from a paved area onto the surface of a tree pit to more complex below ground systems connecting with road gulleys. Care should be taken that the appropriate amount of water drains to the tree pit to enable growth without prolonged waterlogging. All tree systems need adequate drainage to remove excess water.

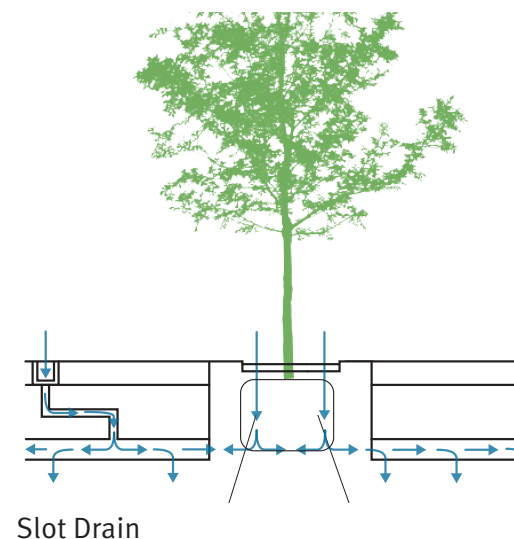
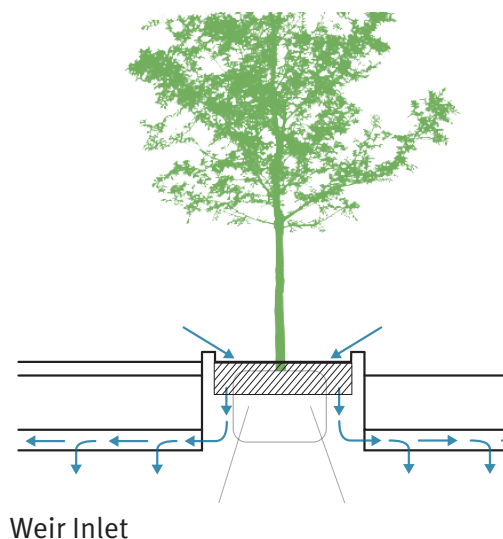
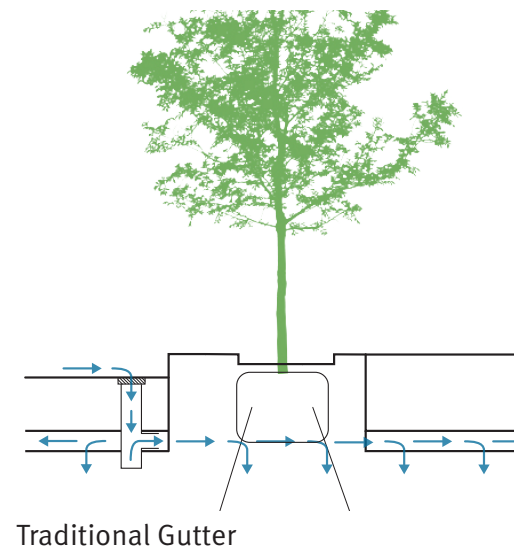
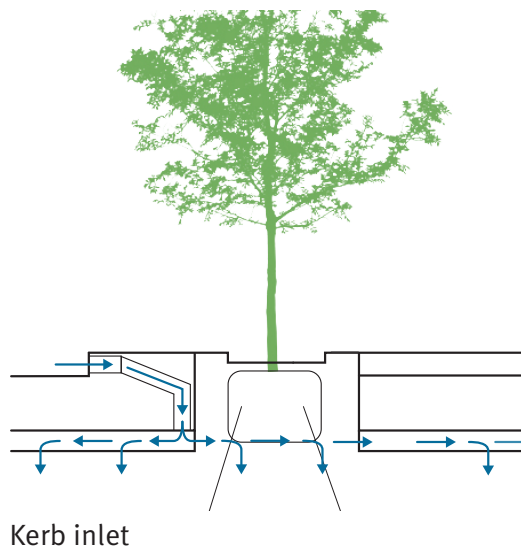
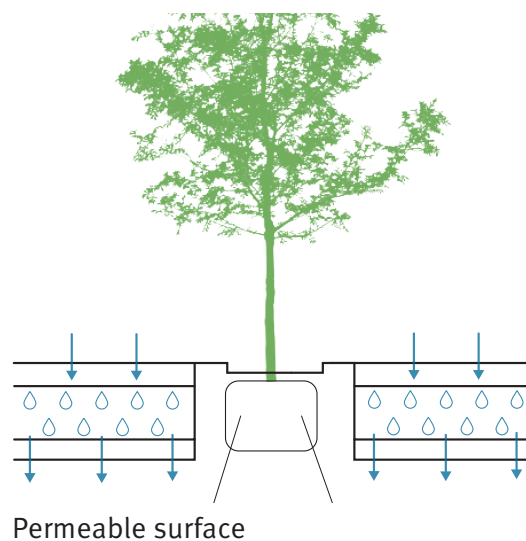


Figure 17. Methods of water inlet | Adapted from Green Blue Urban

Specifying SuDS Trees in Treepits and Trenches

Trees in SuDS treepits or trenches need to be tolerant of not only harsh dry and very wet conditions, they need to be able to adapt to sudden changes from dry to very wet.

Many of the examples should come from areas where sudden and extreme weather changes are frequent or are hybrids or cultivars, selected because of their tolerance for harsh urban environments.

SuDS trees planted in streets and paved areas also need to satisfy the same requirements of any street tree, to be tough, attractive, pollution tolerant and with an upright habit and clear stem. They will need to be robust healthy specimens of a sufficient size to resist accidental damage or deliberate vandalism.

While climate change predictions suggest more frequent hot summers and mild wet winters, Scotland is likely to continue to experience periodic cold snaps that will also require a greater degree of hardiness than trees in the southern UK.

Species which produce large quantities of pollen likely to increase allergy problems are not acceptable as street trees in Edinburgh.

Relevant Factsheets:
Street Trees (ESDG F5)

Latin Name	Common Name	Form	SuDS Tolerance
Examples Suitable for both very dry and wet conditions in hard landscapes (paved areas)			
Quercus bicolor 'Regal Prince'	White Swamp Oak (upright cultivar)	Large round crowned tree,	Very good SuDS tree, tolerant of everything including wide range of temperatures
Gleditsia triacanthos 'Sunburst'	Honey Locust (thornless cultivar)	Medium/ large tree open structure	Very good SuDS tree, tolerant of everything including wide range of temperatures
Acer x freemanni	Freemans Maple	Large round crowned tree	Good SuDS tree
Quercus palustris	Pin Oak	Large round crowned tree	Good SuDS tree tolerant of pollution and short periods of waterlogging
Examples Suitable for free draining soils (where waterlogging is rare or brief) in hard landscapes (paved areas)			
Ginkgo biloba	Ginko 'Maiden Hair Tree'	Large round crowned tree	SuDS tree tolerant of pollution and salt
Ulnus 'New Horizon'	Elm (Hybrid resistant to Dutch Elm Disease)	Large columellar tree,	SuDS tree tolerant of pollution and salt
Acer campestre 'Streetwise'	Field Maple	Medium Tree	SuDS Tree suitable only in free draining conditions
Malus (many cultivars)	Crab Apple	Small Tree	SuDS tree suitable for damp conditions were waterlogging is rare

The example species list is not exclusive

Other tree or shrub species could be considered if they are sufficiently robust, environmentally and climatically tolerant of conditions on site. Specification in general should follow the principles set out in the Edinburgh Design Guide Ch3.

Specifying Shrub and Tree Species for Bioretention Areas

Most rain gardens will be very free draining with very brief waterlogged periods therefore the examples listed have some resilience in dry and drought conditions.

Small trees, shrubs or multi-stemmed specimens are suitable for bioretention areas and can include some native and non-native species not suitable for SuDS tree pits. Raingardens that are persistently damp could accommodate a range of different species.

Trees in raingardens and bioretention areas should be underplanted with suitable perennial groundcover.

The selection of species should be site specific to suit the conditions and context of the raingarden e.g. is it:

- size and depth
- formal/ informal
- exposed/sheltered
- sunny/shady
- persistently damp or dry
- is there salt or pollution?

Species which produce large quantities of pollen likely to increase allergy problems are not acceptable in on street environments in Edinburgh. This restriction does not apply to greenspace and garden locations

Latin Name	Common Name	Form	SuDS Tolerance
Examples of small trees and shrubs suitable for free draining raingardens in hard landscapes with brief periods of waterlogging			
Acer rubrum	'Autumn Flame'	Small to medium Tree.	Dry tolerant
Crataegus x media	Hawthorn 'Paul's Scarlet'	Small tree,	Dry tolerant
Crataegus mo-nogyna	Hawthorn	Medium shrub	Dry and exposure tolerant
Viburnum Opulus Roseum	Guelder Rose	Small shrub	Reasonably dry tolerant. prefers semi shade
Fuchsia mangellica	Hardy Fuchsia	Small to medium shrub	Dry, exposure and salt tolerant
Buddlia davidi	'Nano Purple'	Small to Medium shrub,	Tolerant of a wide range of conditions
Sambucus nigra (and cultivars)	Elder	Small to Medium shrub,	Tolerant of a wide range of conditions

The example species list is not exclusive

Other tree or shrub species could be considered if they are sufficiently robust, environmentally and climatically tolerant of conditions on site. Specification in general should follow the principles set out in the Edinburgh Design Guide Ch3.

Relevant Factsheets:

[Street Trees \(ESDG F5\)](#)

[Raingardens \(ESRWG W3\)](#)

Maintenance for SuDS Trees in Tree Pits and Trenches

Once established the level of maintenance needed by SuDS Trees in paving is similar to any other kind of street tree with the addition of twice yearly checks on vents and inlets and small amount of annual or bi- annual maintenance on surface drainage components.



Figure 18. Birch Street Tree Goldhawk Road, London | Google Maps 2019

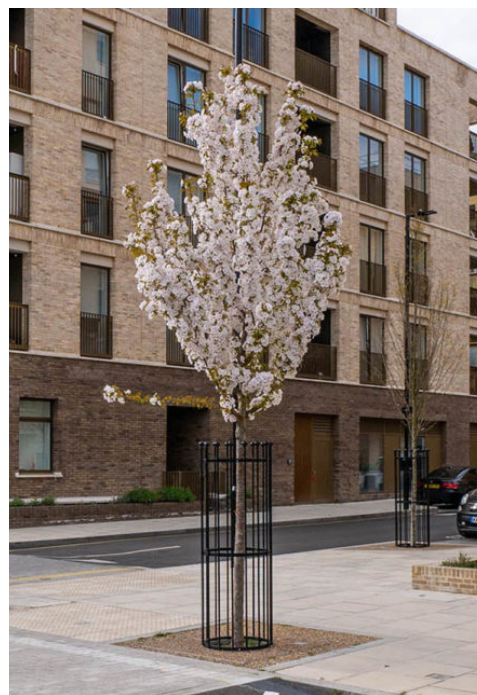


Figure 19. Kings Crescent, London | GreenBlueUrban

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.

Indicative Maintenance for SuDS Tree pits and Trenches

Water new trees regularly in dry periods during establishment period (2-5 years)	Every 2 weeks in summer months as required
Water established trees in prolonged dry periods	As required
Check and clear water inlets and soil aeration vents	6 monthly
Clear leaf debris from water inlet channels	Annually (late November)
Remove grills (if used) and clean accessible water channels	Annually
Inspect, check and clean filter media in trough systems	Bi- Annually
Manage tree growth	Pruning as required

Technical references:

- CIRIA The SUDS Manual V6: E: Supporting Guidance, Chapter: 32: Operation and Maintenance, p690

Relevant Factsheets:

[Street Trees \(F5\)](#)

[Raingardens \(W3\)](#)

Maintenance For Trees and Shrubs in Bioretention Areas

Once established the level of maintenance needed by SuDS Trees in bioretention areas is similar to any other kind of new tree or shrub with the addition of annual checks on inlets and small amount of annual maintenance on surface drainage components.

SuDS Trees and Shrubs in Raingardens and Bioretention areas	
Water trees in dry periods during establishment	Every 2 weeks in summer months as required
Water established trees in prolonged dry periods	as required
Inspect regularly	3- 6 monthly
Remove litter and leaf debris	3- 12 monthly depending on location and amount of litter (include late November for dead leaves)
Replace or top up mulch layer (if used)	Annually or as required
Manage vegetation	As required to maintain attractive healthy planting, allow for pruning back shrubs in autumn
Remove self-seeded invasive species and woody seedlings such as sycamore.	6 monthly
Soil spiking and scarifying	As required (depending on sediment levels and soil type) every 5- 10 years

Relevant Factsheets:

Street Trees (F5)

Raingardens (W3)



Figure 20. Trees in bioretention Areas | Arup/Landscape Institute

All SuDS features will require a maintenance plan that should include detailed specifications, frequency, timing, equipment and annual costs. SuDS features should 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.

Technical references:

- CIRIA The SUDS Manual V6: E: Supporting Guidance, Chapter: 32: Operation and Maintenance, p 690

Frequently Asked Questions and Clarifications

1. What is a SuDS tree?

A SuDS tree is a tree planted as a functioning part of an engineered drainage system and as a result has different requirements to conventional urban tree planting.

- **Street trees in proprietary SuDS tree pits or trenches** will include drainage layers or piped inlets, root support/ root training, engineered soils, and under drainage allowing surplus water to discharge.
- **Street Trees and shrubs in large raingardens**, which may be lined or unlined and will include engineered soils, drainage layers and underdrains allowing surplus water to discharge. (can also include root support / root training structures).
- **SuDS Trees in open greenspace** – where land drains to damp woodland planting within a low lying area. Very damp sites include appropriate drainage to allow surplus water to discharge avoiding waterlogging).

2. What are the benefits of SuDS trees?

SuDS trees can play a significant role in helping to manage surface water on site.

While all trees provide environmental benefits, SuDS trees also provide significantly greater levels of rain water management.

3. Should SuDS trees replace conventional tree planting ?

No, not all trees are or need to be SuDS trees. SuDS trees should be planted where they can make an effective contribution to surface water management in addition to conventional urban trees.

Some locations may not need the extra drainage capacity of a SuDS system or for example in a conservation area may require locally characteristic tree planting not suitable for SuDS (such as small leaved Lime).

However when planting conventional street trees reduced water benefits can still be gained by including SuDS elements (such as permeable paving) as part of

4. Do SuDS trees need to be replaced every 20 years?

No, there is no need to remove established trees for maintenance.

If planted in tree pits constructed to an appropriate standard SuDS trees in engineered systems should have a natural lifespan. The tree pit should be of sufficient size to allow the tree to reach maturity (concrete sewer rings are not acceptable).

5. How much extra maintenance do SuDS trees require?

Maintenance for SuDS trees is largely the same as a conventional urban tree with the addition of occasional inspections of water inlets and any surface drainage mediums.

6. Why does the example specification not include more native species?

In some locations or type of SuDS feature it will be possible to include native species, in others hybrids or trees from harsher climates may be more suitable. This factsheets deals specifically with urban trees in hard landscapes:

- **Street trees in proprietary SuDS tree pits or trenches** need to be to adapt to sudden changes from very wet to very dry. Few native tree species (adapted to our mild damp climate and gradual seasonal shifts) have that capability. Of those few (such as Alder) most need to be excluded from Edinburgh on street environments due to their high allergenic pollen production.
- **Street trees and shrubs in large raingardens** can include native and non-native small trees, shrubs or multi- stemmed specimens if appropriate to site conditions.
- **SuDS Trees in open greenspace** can include a range of native and non-native shrubs and trees that tolerate damp and occasionally waterlogged ground.

Image References

Figure 1. SuDS Dundee Trial Tree Pit | BlueGreen Urban

Image courtesy of GreenBlue Urban. [taken n.d.]

Figure 2. SuDS Dundee Trial Tree Pit | BlueGreen Urban

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Image courtesy of DeepRoot. Deeproot, (2015), *Kings Road Street Trees* [ONLINE]. Available at: <https://www.flickr.com/photos/deeproot/18904470586/in/album-72157652418555073/> [Accessed 1 December 2019].

Figure 3. Fitting a SuDS Tree Pit into a street | Atkins

Diagram courtesy of Atkins

Figure 5. Hull Town Centre | DeepRoot

Image courtesy of DeepRoot. DeepRoot, (2017), *Street Trees. Hull Capital of Culture* [ONLINE]. Available at: <https://www.flickr.com/photos/deeproot/36468498982/in/album-72157685182639414/> [Accessed 1 December 2019].

Figure 6. Street Tree, Fountainbridge Edinburgh | Google Maps 2019

Google Maps, (2018), Bainfield Drive, Fountainbride [ONLINE]. Available at: <https://www.google.co.uk/maps> [Accessed 1 December 2019].

Figure 7. Ruskin Square, Croydon | J & L Gibbons

Image courtesy of J.L Gibbons / Sarah Blee

Available at: https://www.susdrain.org/case-studies/pdfs/suds_awards/031_18_04_24_susdrain_suds_awards_ruskin_square_croyden.pdf. [Accessed 1 September 2029].

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Diagram courtesy of GreenBlue Urban. Available at: <https://www.greenblue.com/na/resource-centre/trees-and-water-sensitive-urban-design/>

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Image courtesy of Scottish Natural Heritage [taken n.d.]

Figure 13. Table adapted from GreenBlue Urban: Trees and Water Sensitive Urban Design, p23

GreenBlue Urban, 2019. *Trees & Water Sensitive Urban Design*.p23 [online] Available at: <https://www.greenblue.com/na/resource-centre/trees-and-water-sensitive-urban-design/>

Figure 14. Fletton Quays | GreenBlue Urban

Image courtesy of GreenBlue Urban. [taken n.d.]

Figure 15. Tree Pit | Atkins

Diagram courtesy of Atkins

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Figure 17. Methods of water inlet | GreenBlue Urban

GreenBlue Urban, 2019. *Trees & Water Sensitive Urban Design*.p16 [online] Available at: <https://www.greenblue.com/na/resource-centre/trees-and-water-sensitive-urban-design/>

Figure 18. Birch Street Tree Goldhawk Road, Londodn | Google Maps 2019

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Project: Greener Grangetown [online] Available at: <https://my.landscapeinstitute.org/case-study/greener-grangetown/6ebfbcae-c8e5-e911-a812-00224801c242> [accessed October 2020]