1 Approaches for integration of SuDS in existing and future development in GMCA

It is recognised that the majority of the land within the GMCA area is within private ownership and, therefore, future improvements to manage and make the area, buildings and infrastructure more resilient to surface water flooding will be predominantly developer led.

The majority of the areas have already been developed with significant areas of impermeable surfaces, a general absence of SuDS and a reliance on a traditional piped drainage system.

Opportunities to reduce the current and future levels of flood risk through the integration of a coherent and integrated SuDS approach across the GMCA area will help provide an opportunity to both manage surface water flooding and improve water quality through mitigating the impacts of diffuse pollution. Appropriate SuDS techniques also provide the opportunity to provide local amenity and wider biodiversity benefits.

By adopting the recommendations made within the GM SWMP, there is an opportunity to incorporate effective SuDS approaches within future development which takes into account both the increased runoff from the proposed development and the limitations of the existing surface drainage system. There is also an opportunity to encourage the retrofitting and incorporation of SuDS within existing development (both public and private areas) particularly through the improved utilisation of areas of open green space and highways and relatively low scale modifications to current water management and land management practices in order to reduce the existing flood risk.

SuDS need to be integrated with redevelopment opportunities within future employment sites identified in the Employment Land Review. Given that it's unlikely that potential development areas could be safeguarded for natural attenuation (unless there are very significant reductions in flood risk or if a site is at too high a risk of flooding to mitigate) new development will, therefore, be encouraged to integrate various SuDS techniques to achieve the required objectives of this SWMP.

All new development proposals will need to take into account the GMCA SuDS requirements and the Defra Non-Statutory National Standards for Sustainable Drainage Systems. Future development should incorporate appropriate SuDS measures to:

- Reduce the flood risk to the development site associated with surface water runoff.
- Reduce the offsite surface water flood and pollution impacts from the proposed development.

For the GMCA area, LPAs will particularly encourage future development proposals to contribute to reducing the existing risk from surface water flooding and pollution in the locality of the development. This can be achieved through the incorporation of additional attenuation allowances to accommodate existing unattenuated impermeable development and climate change impacts.

The extent and type of SuDS components are influenced by the specific characteristics of the site. There are a variety of SuDS components which are considered suitable that may be used independently or in combination (as part of the SuDS management train). The following section summarises the most common SuDS techniques (based on the 2015 CIRIA SuDS Manual[1]) and indicates the general suitability for the GMCA area. Further information to aid the selection of appropriate SuDS techniques can be found in the SuDS Selection Summary, included as Appendix F2.

1.1 Rainwater Harvesting

Rainwater harvesting is the localised interception of rainwater runoff, normally for use at source. Runoff collected from roofs and impermeable surfaces can be stored and following appropriate treatment utilised for use within domestic or commercial properties. This approach can reduce surface water flood risk by reducing the volume of runoff from a site, and can reduce the volume of attenuation storage required. This approach provides sustainability and climate resilience

1 The SuDS Manual CIRIA Report C753. CIRIA. 2015

benefits and can be used to meet some or all of the properties water demands. Harvesting systems usually require the provision of a storage tank, pump, power controls and pipework.

Suitability for GMCA:

Given that development within the GMCA generally encompasses large impermeable areas including extensive roof areas, rainwater harvesting offers significant opportunities both for incorporation in new development and also retrofitting within existing development. In addition to the potential savings from non-potable domestic water for use such as flushing toilets, individual sites may benefit from commercial or industrial use of the collected water.

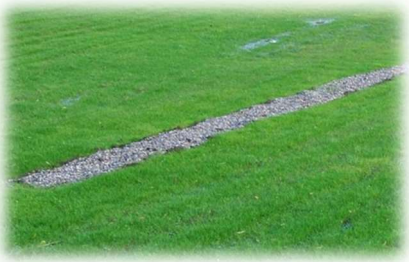
1.2 Green Roofs

Green roofs involve the localised interception of rainwater through the installation of vegetated areas on building roofs. The intercepted rainfall is absorbed by the vegetation and substrate which reduces runoff most significantly from normal summer rainfall events due to the evapotranspiration process and temporary storage provided. Whilst it is recognised that green roofs are generally more expensive to install and maintain they can provide additional benefits such as improving the visual appearance of an area, providing ecological value and enhancing the buildings thermal performance (reducing energy use). They can also extend the design life of roof waterproofing by protecting it from mechanical damage, ultraviolet radiation and temperature extremes.

Suitability for GMCA:

As development within the GMCA generally encompasses commercial units and buildings with large extensive roof areas. Green roofs therefore offer opportunities to improve surface water management, are particularly suitable for incorporation in new development. Retrofitting, whilst less straightforward can often be undertaken providing the existing roofs have sufficient structural capacity (or are strengthened accordingly). Whilst it is recognised that lightweight industrial buildings may not normally have sufficient structural capacity to support a green roof, the cost of the green roof and extra structural provision can be offset against the long term benefits in reduces attenuation costs and improved building efficiency. Incorporation of green roofs in both new development and through retrofitting opportunities will therefore be actively encouraged by GMCA.

1.3 Infiltration Systems



There are a range of SuDS systems which collect and store runoff, allowing it to infiltrate into the ground. This contributes to reducing runoff rates and surface water flooding whilst supporting baseflow and groundwater recharge. The inclusion of overlying vegetation can reduce the risk of pollution to underlying soils through filtration. Types of infiltration systems include soakaways, infiltration trenches, infiltration blankets and infiltration basins. Bioretention systems and pervious pavements can also be designed to allow infiltration. Infiltration systems are reliant on groundwater levels being at least 1 m below the base of the feature and soils having a suitable permeability. Infiltration to the ground at or near the source reduces reliance on downstream drainage systems.

Suitability for GMCA:

Dependent on the groundwater levels and the permeability of the soil these systems are useful for small urban catchments as is characterised by the drainage within GMCA areas. They can therefore potentially be used to intercept and infiltrate local surface flows. Infiltration systems can be compact and therefore are potentially suited for retrofitting in existing green space areas or other available areas within an area, however their suitability will require a consideration of the location of impermeable areas and flow routes. As the system facilitates discharge

ultimately to groundwater it is critical to ensure runoff is suitably clean so that groundwater is not put at risk of contamination. They are subsequently best suited to deal with runoff from roofs. Retrofitting infiltration systems to existing sites and redirecting roof drainage from the existing drainage system to these areas components may provide the opportunity to reduce surface water flood risk and would be encouraged. New development will be expected to have considered infiltration as a means of managing both existing and post development surface water flood risk.

1.4 Proprietary Treatment Systems

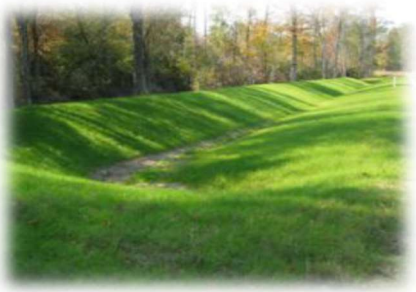
These manufactured SuDS systems are designed to provide treatment of surface water through the removal of contaminants. They are generally most suitable where site constraints such as available space limitations preclude the use of other more natural treatment measures.

Typical treatment systems include proprietary bioretention systems, treatment channels, hydrodynamic or vortex separators, filtration systems and oil and multi process system. These types of treatment systems are generally used alongside SuDS techniques which are designed to manage water quantity.

Suitability for GMCA:

Whilst suitable for incorporation as part of the SuDS surface water management train in the GMCA area, Councils would discourage proprietary systems that require regular maintenance in favour of alternative more sustainable approaches such as green roofs, bioretention and filter strips. Whilst it is recognised that these systems would be likely to be incorporated within individual sites (both new and retrofit) with individual operators, they rely on regular maintenance and therefore their ongoing reliability cannot be easily monitored by LPAs. However, it is recognised that space constraints and runoff contamination levels means that in some circumstances proprietary systems provide the most suitable approach to treat surface water prior to discharge.

1.5 Filter Strips

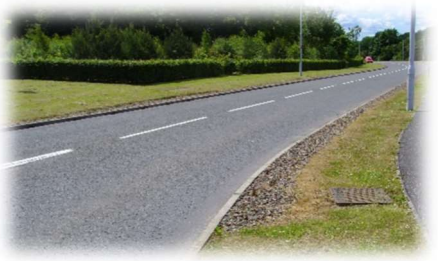


Filter Strips are uniformly graded gently sloping grassed or densely planted areas which are located between impermeable area and the receiving drainage systems or watercourse. Filter strips are designed to intercept sheet flows and provide vegetative filtration to contaminants and sediments as the water flows across them. They can also encourage some infiltration. They generally provide a pre-treatment component, capturing silt before flow enters bioretention systems or swales. Alternatively, if there is sufficient flow path surface they can provide a more significant contamination treatment component. Where space allows, filter strips are useful for managing runoff from linear features such as roads and also from carparks and other impermeable areas. Filter strips should generally be lined to prevent infiltration where there is a high risk of leaching on brownfield sites or a high risk of groundwater pollution from significantly contaminated runoff. Designed primarily for water quality treatment, filter strips tend not to reduce peak flows or significantly reduce runoff volume, although they can help to retain runoff from smaller rainfall events on site. Filter strips do require maintenance to ensure their continued operation, although the maintenance requirements are generally limited to mowing (ideally grass length of 75-150mm across the treatment surface) and occasional silt removal. Therefore, the additional costs are relatively low. They are also useful on industrial sites where the surface feature enables visible pollution and sources to be identified.

Suitability for GMCA:

Filter strips should always be considered within new development areas as they provide an effective means to reduce runoff contamination through either a pre-treatment or full treatment approach. They are particularly suitable for use with small contributing areas. Filter strips should be used in combination with attenuation SuDS approaches to manage surface water runoff quantity and reduce existing and future flood risk. Retrofitting filtration strips within existing green landscaped areas (many of which are adjacent to roads and impermeable areas) may be possible, however, space and other constraints may limit their suitability. The land-take is usually moderate, requiring a minimum 6 m width with a slope not exceeding a gradient of 1 in 20.

1.6 Filter Drains



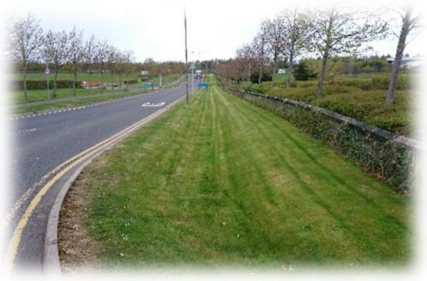
Filter drains are gravel filled trench that creates subsurface storage for infiltration or downstream discharge. They also provide some filtration of surface water runoff. They are not normally intended as sediment traps and ideally should receive inflow from adjacent impermeable areas that is pre-treated using a vegetated filter strip or equivalent. Trenches can be used to filter, attenuate, convey and dissipate storm water into the ground through the base and sides of the trench and/or provide a level of treatment prior to reaching a secondary SuDS feature. There is a requirement to separate filter media from surrounding ground with a geotextile where infiltration is desirable, or include a membrane where infiltration is not permitted. Where there is no upstream filtration they should incorporate a geotextile or sacrificial stone at a shallow depth which can be regularly removed and cleaned of silt. The filter drain should incorporate a perforated pipe near the base to collect and convey water to downstream drainage. The voids in the filter drainage material and pipe can provide attenuation storage and they can in certain circumstances replace conventional conveyance drainage systems. Filter drains require regular maintenance to ensure continued maintenance and should incorporate inspection points and rodding points.

Suitability for GMCA:

Filter strips should always be considered within new development areas as they provide an effective means to both reduce runoff rate and volume. They also provide a water quality

treatment function. They are particularly suitable for use with small contributing impermeable areas and in areas without significant slopes. The land take for filter drains is usually low, typically 0.5-1.0 m width meaning that they are potentially suited for retrofitting within existing green landscaped areas. However, they do need to be used in conjunction with additional treatment where runoff is likely to be contaminated. In addition, with a depth of 1-2 m they need to take into account constraints such as existing utilities and groundwater levels. The location of the filter trenches should be carefully considered so there is no interaction with people and vehicles. They therefore may not be suitable for all areas although it is noted that they can also be located beneath impermeable areas. As a conveyance and storage system, there will need to be a requirement to consider connectivity to the runoff source, connectivity between green areas and also to the downstream discharge points such as the existing conventional surface water drainage system, downstream SuDS components or direct to watercourse.

1.7 Swales



Swales are shallow flat-bottomed channels or depressions designed to treat, filter, store and convey runoff as part of the SuDS management train. Usually vegetated with grass, swales can be either 'dry' (where water is stored beneath the ground in a gravel filter drain layer except after rainfall events) or 'wet' where runoff is stored above the surface in the channel so may be permanently wet. Swales can be lined or unlined (to accommodate infiltration). Where runoff may be contaminated, appropriate geotextile filtration linings can be incorporated. To limit the rate and volume of runoff, swales can incorporate check dams across the flow path to provide attenuation storage. Where incorporated into site design, swales can enhance the natural environment and provide aesthetic and biodiversity benefits. They can also be designed to incorporate bioretention systems or constructed deeper to provide additional attenuation storage volume. Whilst requiring maintenance, this is relatively straightforward which should not be dissimilar to that which would be required for standard public open spaces.

Suitability for GMCA:

Swales are an effective method of collecting and conveying runoff from impermeable areas and provide an alternative to conventional piped drainage which can provide additional surface attenuation storage. Their use should therefore be considered as part of the surface water management train in all new development as they will provide an effective means of providing attenuation to manage surface water flood risk, provide additional surface water treatment benefits and a conveyance route. As long surface level features with shallow side slopes, they are likely to be potentially suitable for retrofitting within some of the existing green areas, however this will be dependent upon constraints such as existing services and land area. Providing connectivity between green areas will require consideration of existing site accesses. Swales are well suited for managing runoff from roads, carparks and other impermeable areas and as a surface feature they are well suited for industrial sites as any pollution is visible. The swales will however be likely to require enhancement or deepening to provide sufficient storage to reduce current levels of flood risk.

1.8 Bioretention Systems

Bioretention systems are vegetated areas such as shallow depressions rain gardens or raised planters which can reduce run off rates and volumes and provide a pollution treatment process. These areas are planted with specially selected plant species to allow runoff to pond temporarily on the surface and filter through vegetation and soils where it is either infiltrated or conveyed further along the surface water management train. They can be integrated into a wide variety of development landscapes. Trees can also be classed as bioretention systems, where they are incorporated into impermeable areas with an appropriate tree pit and geocellular root cell. Bioretention systems are most commonly used for managing

and treating runoff from more frequent less extreme rainfall events. In addition to the vegetation, bioretention systems usually incorporate an appropriate underlying filter medium (to filter out pollutants and control rate of infiltration) and an underlying drainage layer which is designed to collect water and transfer it to the perforated pipes for further conveyance downstream.

Suitability for GMCA:

Bioretention systems take a number of different forms and combined with other SuDS measures are likely to provide a suitable solution to managing surface water. The measures may range from rain gardens, and raised planters which can be used to collect roof runoff and contribute to the management of runoff from individual sites through to site wide bioretention tree pits, swales or trenches both within new development and existing public green spaces. The nature of bioretention systems means that they are particularly well suited for local site retrofitting and can provide amenity and biodiversity enhancements.

1.9 Trees

Trees can be incorporated within a range of SuDS components to improve their performance and contribute to effective surface water strategies. Including trees in new development can provide a number of surface water benefits by increasing transpiration, interception, increased infiltration and phytoremediation (where through drawing up water from the soil through transpiration harmful contaminants are taken into the tree and may be transformed into less harmful substances. In addition, trees within impermeable areas can effectively incorporate root storage systems as part of an effective bioremediation approach. Trees therefore contribute both to managing surface water quantities and contamination. Trees also have many other benefits to the surrounding environment including aesthetics, filtering harmful chemicals from the air, masking and reducing noise, creating wildlife habitats and absorbing and storing carbon dioxide.

Suitability for GMCA:

Whilst incorporating trees alone are unlikely to be sufficient to manage surface water issues, the local and site wide benefits they can deliver as part of a coherent SuDS strategy is recognised. Their incorporation would therefore be encouraged both in new development as part of a retrofitting approach. Landscape management practices will be reviewed so that they contribute to effective surface water management.

1.10 Pervious Pavements

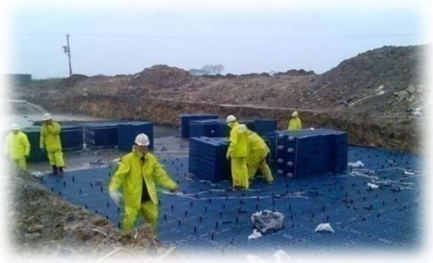
Pervious pavements are structural paving in roadways, carparks, hard standings and pedestrian areas which are designed to allow runoff to soak through them. They can consist of block pacing (with gaps between the blocks) or porous blocks where water drains through the blocks themselves. Pervious pavements are designed with a sub base which allows water to be stored and discharge to the ground via infiltration and they provide an efficient means of managing surface water close to the source. They can contribute to reduce both the peak flow and volume of run off. The structure and underlying subsurface layer can also provide a water quality treatment function. Examples forms of permeable pavements include modular surfacing and block paving, porous asphalt, grass reinforcement or resin bound gravel. Pervious pavements can be designed to allow total infiltration to the sub soil, partial infiltration to the subsoil (where there is an overflow drainage connection used when the underlying soil can no longer infiltrate) or no infiltration (where infiltration is not technically feasible and water is conveyed to an outfall point via perforated subsurface pipes). Pervious pavements systems can incorporate subsurface tanks to attenuate or collect flow before reuse within rainwater harvesting systems or discharge

to downstream SuDS. In terms of maintenance, pervious pavements need to be cleaned of silt and other sediments to preserve their infiltration capacity.

Suitability for GMCA:

Pervious pavements can be used on most sites and will be particularly suitable where new and existing development includes extensive areas of carparking and hardstanding. Pervious pavements are an effective alternative to impermeable surfaces and therefore require no extra development space for their construction. As they only require a small head difference between the runoff level and the outfall, they are suitable for use on flat terrain. Whilst they generally tend to be used in areas with low traffic volumes and light traffic loading (such as car parks) they are capable of supporting heavy goods vehicles. Pervious pavements can be used in most ground conditions and by incorporating suitable lining systems they can be used in brownfield areas. Runoff contamination, groundwater levels and existing services will require consideration and the design will need to consider proximity to existing building foundations as is the case with infiltration systems. Given their suitability and benefits, the use of permeable pavements should therefore be integral to the design of new surfaces. They can be combined with other SuDS solutions to effectively manage surface water. Retrofitting of pervious pavements to existing impermeable areas would also be encouraged.

1.11 Attenuation Storage Tanks

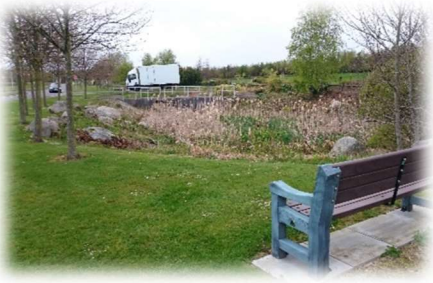


Attenuation tanks are designed to temporarily store runoff before infiltration, controlled release or use. They usually consist of subsurface tanked systems such as geocellular storage systems, glass reinforced plastic or concrete tanks or oversized pipes. The key benefits of attenuation tanks is that they can provide a high storage volumes (compared to aggregate filled structures such as filter drains and bioretention systems) and they can be installed below roads, carparks (with appropriate structural loading design) and open space areas thus reducing land take. As an attenuation/storage system, tanks are generally used in combination with other SuDS approaches including treatment components. Regular maintenance of attenuation tanks is an important consideration as any failures or blockages are less visible.

Suitability for GMCA:

The requirement to make best use of available space on the already intensively developed areas means that providing subsurface attenuation and storage tanks is likely to be a suitable approach to managing surface water within new development. The tanks can be integrated beneath areas of carparking, hardstanding and open space without significantly impacting available development area. As storage systems, their use will need to consider connectivity to downstream discharge points and will therefore need to be employed alongside other SuDS techniques to provide an effective surface water management approach. However as large storage volumes can be provided by subsurface storage tank systems, given the extent and volumes of surface water runoff and flooding, their use is therefore likely to particularly suitable. However, given the maintenance requirements, Councils would like to see detention basins used only once other forms of attenuation storage have been investigated. Attenuation storage tanks will also be required to be used in conjunction with effective upstream surface level vegetated pre-treatment.

1.12 Detention Basins



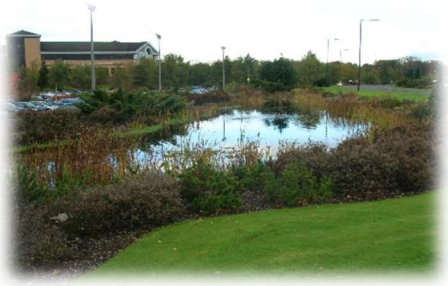
Detention basins are a dry landscaped depression which are designed to collect runoff and fill up temporarily during and for a short while after rainfall events. By integrating a suitable flow control at the outlet, they provide an effective means to attenuate flow by providing flood storage and releasing it to the downstream system more slowly and in line with flow control limits. As well as reducing flood risk locally by collecting surface water runoff they reduce the risk of downstream flooding by

reducing the rate of discharge. Through the incorporation of suitable vegetation, basins can also form a useful water quality treatment function by enabling settlement of particulates. Detention basins work well in areas with low permeability soils, but can also reduce the volume of runoff by allowing infiltration where this is technically viable. Basins can also be designed to function as recreational areas or habitat areas when planted, for example wet woodlands and are generally relatively easy to construct and maintain. Detention basins can also be hard landscaped areas which are normally designed to manage runoff during more extreme events.

Suitability for GMCA:

Detention basins are generally suitable to most types of development and can be used for retrofitting where existing drainage networks and land availability allows. They will provide an effective means to manage surface water flood risk and can provide valuable multifunctional benefits aesthetic, amenity and biodiversity benefits. The size of the detention basins will be constrained by the available areas of open space, both in new development and in retrofitting to areas of public open space. The volumes of surface water flooding indicate that a number of smaller detention basins (constrained by areas of available green space) appropriately connected may provide an effective means of managing surface water flooding. All available open space should be reviewed for their suitability of incorporating a detention basin.

1.13 Retention Ponds and Wetlands



Landscaped depressions containing permanent pools of water, retention ponds are similar in many respects to detention basins, in that they can collect and temporarily store / attenuate surface water runoff and release it more slowly to the discharge point. The attenuation storage volume is provided above the permanent water level and thus they provide a smaller storage volume than the equivalent sized detention pond. However, they can provide an enhanced level of water quality treatment and also provide biodiversity and amenity benefits by supporting emergent and submerged vegetation along the waterline and within shallow marshy areas. Retention ponds need to be designed with suitable upstream pre-treatment systems to prevent open water areas becoming blocked with silt, odorous due to pollution or stagnant. Well managed ponds and wetlands can add significant economic value to a development.

Suitability for GMCA:

Similar to detention basins retention ponds are generally suitable to most types of development and can be used for retrofitting where existing drainage networks and land availability allows. They will however provide less storage than detention basins and therefore their siting and use will require consideration of existing and future flood volumes. They do however provide an effective means to manage surface water flood risk and can provide valuable multifunctional benefits aesthetic, amenity and biodiversity benefits. The volumes of surface water flooding indicate that a number of smaller retention basins (constrained by areas of available green space) appropriately connected may provide an effective means of managing surface water flooding.

1.1 Retention

General Suitability				Land Use Suitability							
	Technique	Suitability Conditions	Management Train Suitability	Low Density	Residential	Local Roads	Commercial	Industrial	Construction Site	Brownfield	Contaminated Land
Retention	**Retention Pond**	Liner is required for permeable soil Only suitable for large spaces	Site and regional control	✓	✓	✓	✓	✓	✓	✓	✓
	Subsurface storage		Conveyance and site control	✓	✓	✓	✓	✓	✓	✓	✓
						One treatment Stage may be sufficient	One treatment Stage may be sufficient	One treatment Stage may be sufficient			One treatment Stage may be sufficient

		Water Quantity Suitability	Water Quality Suitability							Environmental Benefits		Cost Suitability	
					Removal Treatment Potential								
			Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrient	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Retention	**Retention Pond**	Detention Water Harvesting Infiltration - some opportunities, subject to design	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	Medium	Medium	Medium	High (Suitable)	High(Suitable) (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	High (Suitable)	Medium	Medium
	Subsurface storage	Conveyance Detention	Sedimentation - some opportunities, subject to design Filtration - some opportunities, subject to design	Nutrients, sediments, metals, hydrocarbons	Low	Low	Low	Low	Low	High (Suitable)	Low	Low (Suitable)	Medium

1.2 Wetland

General Suitability				Land Use Suitability							
	Technique	Suitability Conditions	Management Train Suitability	Low Density	Residential	Local Roads	Commercial	Industrial	Construction Site	Brownfield	Contaminated Land
Wetland	**Shallow Wetland**	Surface flow may be required Slope should not exceed 5% Only suitable for large spaces Only suitable where high flows are diverted around SuDS component for area of more than 2 ha	Site control and regional control. Conveyance - some opportunities, subject to design	✓	✓	✓	✓	✓	✗	✓	✓
	Extended detention wetland	Surface flow may be required Slope should not exceed 5% Only suitable for large spaces Only suitable where high flows are diverted around SuDS component for area of more than 2 ha	Site control and regional control. Conveyance - some opportunities, subject to design	✓	✓	✓	✓	✓	✗	✓	✓
	Pond/ wetland	Surface flow may be required Slope should not exceed 5% Only suitable for large spaces Only suitable where high flows are diverted around SuDS component for area of more than 2 ha	Site control and regional control. Conveyance - some opportunities, subject to design	✓	✓	✓	✓	✓	✗	✓	✓
	Pocket wetland	Surface flow may be required Slope should not exceed 5% Not suitable if area draining into SuDS is more than 2 ha	Site control and regional control. Conveyance - some opportunities, subject to design	✓	✓	✓	✓	✓	✗	✓	✓
	Submerged gravel wetland	Surface flow may be required Slope should not exceed 5% Only suitable for large spaces Only suitable where high flows are diverted around SuDS component for area of more than 2 ha	Site control and regional control. Conveyance - some opportunities, subject to design	✓	✓	✓	✓	✓	✗	✓	✓
	Wetland Channel	Surface flow may be required Slope should not exceed 5% Only suitable for large spaces Only suitable where high flows are diverted around SuDS component for area of more than 2 ha	Site control and regional control. Conveyance - some opportunities, subject to design	✓	✓	✓	✓	✓	✗	✓	✓

SuDS Suitability

		Water Quantity Suitability	Water Quality Suitability							Environmental Benefits		Cost Suitability	
					Removal Treatment Potential								
			Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrient	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Wetland	**Shallow Wetland**	Detention, water harvesting Conveyance and infiltration - some opportunities, subject to design	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	Medium	High (Suitable)	Medium	High (Suitable)	High (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	High (Suitable)	High	High
	Extended detention wetland	Detention, water harvesting Conveyance and infiltration - some opportunities, subject to design	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	Medium	High (Suitable)	Medium	High (Suitable)	High (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	High (Suitable)	High	High
	Pond/ wetland	Detention, water harvesting Conveyance and infiltration - some opportunities, subject to design	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	Medium	High (Suitable)	Medium	High (Suitable)	High (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	High (Suitable)	High	High
	Pocket wetland	Detention, water harvesting Conveyance and infiltration - some opportunities, subject to design	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	Medium	High (Suitable)	Medium	High (Suitable)	Medium (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	High (Suitable)	High	High
	Submerged gravel wetland	Detention, water harvesting Conveyance and infiltration - some opportunities, subject to design	Sedimentation, filtration, adsorption, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	Medium	High (Suitable)	Medium	High (Suitable)	Low	Medium	Medium	High
	Wetland Channel	Detention, water harvesting Conveyance and infiltration - some opportunities, subject to design	Sedimentation, filtration, adsorption, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	Medium	High (Suitable)	Medium	High (Suitable)	High(Suitable) (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	High (Suitable)	High	High

1.3 Source Control

General Suitability				Land Use Suitability							
	Technique	Suitability Conditions	Management Train Suitability	Low Density	Residential	Local Roads	Commercial	Industrial	Construction Site	Brownfield	Contaminated Land
Source control	**Green Roof**	A roof has to be able to support 2KN/m3 for extensive, 7 KN/m3 for semi-intensive and 10 KN/m3 for intensive considerations Not suitable if area draining into SuDS is more than 2 ha	Prevention, pre-treatment and source control	✓	✓	✗	✓	✓	✗	✓	✓ One treatment Stage may be Sufficient
	Rain Water Harvesting	Not suitable if area draining into SuDS is more than 2 ha	Prevention Source control and conveyance - some opportunities, subject to design	✓	✓	✗	✓	✓	✗	✓	✓ One treatment Stage may be Sufficient
	Subsurface storage	Minimum depth to water table shouldn't be less than 1 m Slope should not exceed 5 %	Prevention, source control Site control - some opportunities, subject to design	✓	✓	✗	✓	✓	✗	✓	✓ Will require draw-down rehabilitation following construction activity, prior to use as a permanent drainage system Potentially suitable providing that design prevents mobilisation of contamination
		Infiltration-dependent components; will only work with permeable soil									

SuDS Suitability

		Water Quantity Suitability	Water Quality Suitability							Environmental Benefits		Cost Suitability	
					Removal Treatment Potential								
			Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrient	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Source control	**Green Roof**	Detention	Filtration, adsorption, volatisation, precipitation, uptake by plants, de-nitrification, biodegradation	Sediments, hydrocarbons, metals, pesticides, chlorides cyanides, organic matter, BOD, nutrients	Not suitable / not applicable	Not suitable / not applicable	Not suitable / not applicable	Not suitable / not applicable	High (Suitable)	High (Suitable)	High (Suitable)	High	High
	Rain Water Harvesting	Infiltration Detention, conveyance and water harvesting - some opportunities, subject to design	Sedimentation, filtration, adsorption, volatisation, precipitation, uptake by plants, de-nitrification and biodegradation - some opportunities, subject to design	Sediments, hydrocarbons, metals, pesticides, chlorides cyanides, organic matter, BOD, nutrients	Medium	Low	Low	Low	Not suitable / not applicable	Medium (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	Low	High	High
	Pervious pavement	Detention, infiltration Water harvesting - some opportunities, subject to design	Sedimentation, filtration, adsorption, volatisation, biodegradation	Sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD, nutrients	High (Suitable)	High (Suitable)	High (Suitable)	High (Suitable)	High (Suitable)	Medium	Low	Medium	Medium
		Infiltration-dependent components; will only work with permeable soil											

1.4 Infiltration

General Suitability				Land Use Suitability							
	Technique	Suitability Conditions	Management Train Suitability	Low Density	Residential	Local Roads	Commercial	Industrial	Construction Site	Brownfield	Contaminated Land
Infiltration	**Infiltration trench**	Minimum depth to water table shouldn't be less than 1 m Not suitable if area draining into SuDS is more than 2 ha Only if available head is less than 1 m	Site and source control Conveyance - some opportunities, subject to design	✓	✓	✓	✓	✗	✗	✓	✓
											One treatment Stage may be sufficient Will require draw-down and rehabilitation following construction activity, prior to use as a permanent drainage system Potentially suitable providing that design prevents mobilisation of contamination
			Infiltration-dependent components: will only work with permeable soil								
	Infiltration Basin	Minimum depth to water table shouldn't be less than 1 m Only suitable for large spaces Only if available head is less than 1 m	Site and regional control	✓	✓	✓	✓	✗	✗	✓	✓
											One treatment Stage may be sufficient Will require draw-down and rehabilitation following construction activity, prior to use as a permanent drainage system Potentially suitable providing that design prevents mobilisation of contamination
			Infiltration-dependent components: will only work with permeable soil								
	Soakaway	Minimum depth to water table shouldn't be less than 1 m Not suitable if area draining into SuDS is more than 2 ha Only if available head is less than 1 m	Source control	✓	✓	✓	✓	✗	✗	✓	✓
											Will require draw-down rehabilitation following construction activity, prior to use as a permanent drainage system Potentially suitable providing that design prevents mobilisation of contamination
			Infiltration-dependent components; will only work with permeable soil								

SuDS Suitability

		Water Quantity Suitability	Water Quality Suitability							Environmental Benefits		Cost Suitability	
					Removal Treatment Potential								
			Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrient	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Infiltration	**Infiltration trench**	Detention, infiltration Conveyance - some opportunities subject to design	Filtration, adsorption, volatisation, biodegradation	Sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	Medium	Low	Low (Suitable)	Low (Suitable)
		Infiltration-dependent components: will only work with permeable soil											
	Infiltration basin	Detention and infiltration	Filtration, adsorption, volatisation, biodegradation	Sediments, hydrocarbons, metals, pesticides, cyanides, nutrients, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	High (Suitable) (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	Medium	Medium	Low (Suitable)
		Infiltration-dependent components: will only work with permeable soil											
	Soakaway	Infiltration	Filtration, adsorption, biodegradation	Sediments, hydrocarbons, metals, pesticides, nutrients, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	Medium	Low	Low (Suitable)	Medium
		Infiltration-dependent components; will only work with permeable soil											

1.5 Filtration

General Suitability				Land Use Suitability							
	Technique	Suitability Conditions	Management Train Suitability	Low Density	Residential	Local Roads	Commercial	Industrial	Construction Site	Brownfield	Contaminated Land
Filtration	**Surface sand filter**	Minimum depth to water table shouldn't be less than 1m Slope should not exceed 5% Only suitable for large spaces Only available head is between 1 and 2 m	Site control and pre-treatment. Regional control - some opportunities, subject to design	✗	✓	✓	✓	✓	✗	✓	✓
	Sub-surface sand filter	Minimum depth to water table shouldn't be less than 1m Slope should not exceed 5% Only available head is between 1 and 2 m Not suitable if area draining into SuDS is more than 2 ha	Site control and pre-treatment. Regional control - some opportunities, subject to design	✗	✓	✓	✓	✓	✗	✓	✓
	Perimeter sand filter	Minimum depth to water table shouldn't be less than 1m Slope should not exceed 5% Not suitable if area draining into SuDS is more than 2 ha	Site control and pre-treatment. Regional control - some opportunities, subject to design	✗	✗	✓	✓	✓	✗	✓	✓
	Bioretention / filter strip	Minimum depth to water table shouldn't be less than 1m Slope should not exceed 5% Only suitable for large spaces Not suitable if area draining into SuDS is more than 2 ha	Pre-treatment and source control	✓	✓	✓	✓	✓	✗	✓	✓
	Filter trench	Line is required for permeable soil Minimum depth to water table shouldn't be less than 1m Slope should not exceed 5% Not suitable if area draining into SuDS is more than 2 ha	Source control and conveyance. Site control - some opportunities, subject to design	✓	✓	✓	✓	✓	✗	✓	✓

SuDS Suitability

		Water Quantity Suitability	Water Quality Suitability							Environmental Benefits		Cost Suitability	
					Removal Treatment Potential								
			Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrient	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Filtration	**Surface sand filter**	Detention Infiltration - some opportunities, subject to design	Filtration, adsorption, biodegradation, volatisation, precipitation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	Low	Medium	Medium	High
	Sub-surface sand filter	Detention Infiltration - some opportunities, subject to design	Filtration, adsorption, biodegradation, volatisation, precipitation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	Low	Low	Medium	High
	Perimeter sand filter	Detention Infiltration - some opportunities, subject to design	Filtration, adsorption, biodegradation, volatisation, precipitation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	Low	Low	Medium	High
	Bioretention/ filter strip	Infiltration, conveyance and detention - some opportunities, subject to design	Filtration, adsorption, biodegradation, sedimentation	Nutrients, sediments, hydrocarbons, metals, pesticides, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	High (Suitable)	High (Suitable)	High	Medium
	Filter trench	Conveyance and detention	Filtration, adsorption, volatisation, biodegradation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	Medium	Low	Medium	Medium

1.6 Detention

General Suitability				Land Use Suitability							
	Technique	Suitability Conditions	Management Train Suitability	Low Density	Residential	Local Roads	Commercial	Industrial	Construction Site	Brownfield	Contaminated Land
Detention	**Detention basin**	Line is required for permeable soil Minimum depth to water table shouldn't be less than 1m Only suitable for large spaces Only if available head is between 1 and 2 m	Site and regional control	✓	✓	✓	✓	✓	✓	✓	✓

		Water Quantity Suitability	Water Quality Suitability							Environmental Benefits		Cost Suitability	
					Removal Treatment Potential								
			Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrient	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Detention	**Detention basin**	Detention	Sedimentation, biodegradation Uptake by plants, filtration and adsorption - some opportunities, subject to design	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	Medium	Medium	Low	Low	Low	High(Suitable) (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	Medium	Low (Suitable)	Low (Suitable)

1.7 Open channels

General Suitability				Land Use Suitability							
	Technique	Suitability Conditions	Management Train Suitability	Low Density	Residential	Local Roads	Commercial	Industrial	Construction Site	Brownfield	Contaminated Land
Open channels	**Conveyance swale**	Minimum depth to water table shouldn't be less than 1 m Follows contours for slope greater than 5% Only suitable for large spaces Not suitable if area draining into SuDS is more than 2 ha Only available if head is less than 1 m	Conveyance, pre-treatment and site control	✓	✓	✓	✓	✓	✓	✓	✓
	Enhanced dry swale	Minimum depth to water table shouldn't be less than 1 m Follows contours for slope greater than 5% Only suitable for large spaces Not suitable if area draining into SuDS is more than 2 ha Only available if head is less than 1 m	Conveyance, pre-treatment and site control	✓	✓	✓	✓	✓	✓	✓	✓
	Enhanced wet swale	Surface base flow may be required Follows contours for slope greater than 5% Only suitable for large spaces Not suitable if area draining into SuDS is more than 2 ha Only available if head is less than 1 m	Conveyance, pre-treatment and site control	✓	✓	✓	✓	✓	✓	✓	✓

Water Quality Suitability	Environmental Benefits	Cost Suitability

		Water Quantity Suitability			Removal Treatment Potential								
			Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrient	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Open channels	**Conveyance swale**	Detention, conveyance and infiltration - some opportunities, subject to design	Filtration, adsorption, biodegradation, sedimentation, Some opportunities, subject to design: uptake by plants	Sediments, hydrocarbons, metals, pesticides, organic matter, BOD, nutrients	High (Suitable)	Medium	Medium	Medium	High (Suitable)	Medium (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	Medium	Low (Suitable)	Low (Suitable)
	Enhanced dry swale	Detention, conveyance and infiltration - some opportunities, subject to design	Filtration, adsorption, biodegradation, sedimentation, Some opportunities, subject to design: uptake by plants	Sediments, hydrocarbons, metals, pesticides, organic matter, BOD, nutrients	High (Suitable)	High (Suitable)	High (Suitable)	Medium	High (Suitable)	Medium (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	Medium	Low (Suitable)	Medium
	Enhanced wet swale	Detention, conveyance and infiltration - some opportunities, subject to design	Filtration, adsorption, biodegradation, sedimentation, Some opportunities, subject to design: uptake by plants	Sediments, hydrocarbons, metals, pesticides, organic matter, BOD, nutrients	High (Suitable)	High (Suitable)	Medium	High (Suitable)	High (Suitable)	Medium (There may be some public safety concern associated with open water which needs to be addressed at the design stage)	High (Suitable)	Medium	Medium