

5. SURFACE WATER DRAINAGE OPTIONS

The use of sustainable urban drainage systems (SUDS) is mandatory for most new surface water drainage systems within the UK. SUDS can be used as source control (interception of surface water), conveyance, storage and discharge dependent on various site conditions. Table 5.1 below describes many of the SUDS approaches that are available and explains their advantages, disadvantages and appropriateness for use on the proposed development site.

Table 5.1 – Sustainable Urban Drainage (SuDS) Options

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Retention	Balancing pond		Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation.	Good removal of pollutants, can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits.	No reduction in runoff volume, land take may limit use in high density sites.	☐ ☐ ☒ No
	Subsurface storage		Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.	Modular and flexible, dual usage (infiltration/storage, high void ratios, can be installed beneath trafficked and soft landscaped areas.	No water quality treatment.	☒ ☐ ☐ Yes
	Shallow wetland					☐ ☐ ☒

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Wetland	Extended detention wetland		Wetlands provide stormwater attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants. They can provide significant ecological benefits.	Good pollutant removal and if lined can be used where groundwater is vulnerable. Good community acceptability, ecological and amenity benefits.	Land take is high, requires baseflow, little reduction in runoff volume, not suitable for steep sites.	No
	Pond wetland					
	Pocket wetland					
	Submerged gravel wetland					
	Wetland channel					

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Infiltration	Infiltration trench		Surface water runoff can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated.	Reduces the volume of runoff, effective at pollutant removal, contributes to groundwater recharge, simple and cost-effective, easy performance observation.	Requires appropriate pre-treatment, basins require a large flat area, offset from foundations.	☐☐☒ No – High water table
	Infiltration basin					
	Soakaway					
Filtration	Surface sand filter		Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required.	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations.	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2m required, possible odour problems, high capital and maintenance cost.	☐☐☒ No – High water table
	Sub-surface sand filter					
	Perimeter sand filter					

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Detention	Bioretention/filter swale		Vegetated strips of land designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system.	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit capability, effective pre-treatment option	Requires landscaping and management, large land requirement, not suitable for steep sites, no significant attenuation or reduction of flows.	☐☐☒X No – High water table
	Filter trench/drain		Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water runoff. Receive lateral inflow from an adjacent impermeable surface.	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site landscaping and fit well beside roads and car parks.	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material.	☐☐☒X No – Not suitable for development site (land constraints)
	Detention basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility.	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain.	Land take, little reduction in runoff volume, detention depths constrained by levels.	☐☐☒X No – Not suitable for development site (land constraints)

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Conveyance	Enhanced dry swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces runoff rates and volumes, low cost.	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking.	X□□ Yes – Not suitable for development site (land constraints)
	Enhanced wet swale					
	Conveyance swales		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation. Possible reduction in runoff volume via plant uptake and infiltration.	Potential trip/wheel hazard, disabled access issues.	□□X No – Space Constraints.
	Rills					
Source control	Green/Brown roof		Multi-layered system that covers the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption.	Additional weight, not appropriate for steep roofs, maintenance of roof vegetation.	□□X No – Space Constraints.

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
	Rainwater harvesting		Uses rainwater coming from roofs to supply toilets, washing machines and irrigation systems. Harvested rainwater is stored underground and is substituted for potable water mains supply, reducing both site discharge and water consumption.	Can provide source control of storm water runoff, reduces demand on mains water.	Use is dependent on demand requirements, contributing surface area, and seasonal rainfall characteristics	☐ ☐ ☒ X No – Not suitable for development site (land constraints)

6. RISK REGISTER

Table 6.1 below details the site specific drainage related risks which are currently outstanding, and the implication on the project should that risk transpire. The action required in order to mitigate the risk is also stated alongside the proposed owner of that action. Should a 'closed' item retain an agreed residual risk to the client, this will be described within the drainage strategy section and should be included within any operation and maintenance manual documentation.

Table 6.1 – Risk Register

Risk	Implication	Action to close out risk	By	Status
Specialist sub-contractor design input required (i.e. pervious paving)	Late selection of preferred supplier prevents incorporation of proprietary information. May impact on associated elements i.e. kerb setting out, formation levels, drainage connections etc.	Preferred specialist sub-contractor to be nominated/selected during design stage.	Cli/Con	Live/Closed Not applicable
Condition of existing drainage system (recent CCTV surveys complete)	Existing system may require significant remedial works. Routing of pipework may differ from that expected requiring modification to the proposed system.	CCTV survey to be commissioned of proposed retained drains.	Cli/Con	Live/Closed Surveys required
Local Authority approvals	Local authorities may request changes to proposed scheme at planning.	Pre-planning discussions to be held with all relevant Local Authorities, where appropriate.	Ram	Live/Closed
Existing drainage connection point invert levels are different to that anticipated.	Requirement for pumping; shallow drains requiring additional protection; use of backdrops.	Level survey to be undertaken of proposed connection point drainage inverts.	Cli/Con	Live/Closed Surveys required
Movement/addition of foul water drain points	Additional drain runs/manholes required. Possible requirement to pump if distance to discharge point increases.	Frozen above ground drainage layouts to be issued to Ramboll prior to issue of project stage information.	Arch/M&E	Live/Closed Surveys required
Change of legislation during project	Reduced allowable flow rates/volumes leading to greater volumes of attenuation. Change of material specifications.	Ramboll to keep abreast of proposed legislation changes and inform Client, design team of possible implications where appropriate.	Ram	Live/Closed Subject to consultation with Local Authority
Change of building drainage strategy (i.e. move to siphonic rainwater pipes)	Siphonic break manholes/drainage laterals required. Possible need to introduce velocity reducing measures to prevent erosion of SUDS.	Preferred roof rainwater strategy to be agreed and design team informed.	Arch/M&E	Live/Closed Design principles agreed
Client/design team approval of philosophy (i.e. acceptability/inclusion of open water)	Addition/increased volume of below ground attenuation. Lack of SUDS train may require introduction of additional cleansing measures.	Present drainage philosophy to design team and inform client of residual H&S risks, maintenance risks. Obtain Client approval to proceed.	Ram/Cli	Live/Closed Design principles agreed

Risk	Implication	Action to close out risk	By	Status
Co-ordination with foundations/other below ground services	Additional drain runs/manholes required. Realignment of pipework. Increased embedment of pipework.	Co-ordinated below ground services and foundation drawings to be produced and agreed by design team.	Arch/Ram/M&E	Live/ Closed To be developed as part of detailed design
CBR values lower than anticipated	Increased subbase depth/hydraulically bound subbase required for pervious paving.	CBR testing at proposed pervious paving locations.	Cl/Con	Live/ Closed Site CBR testing required by Contractor
Previously unidentified contamination found on site	Infiltration devices restricted. Drainage philosophy re-evaluated.	Detailed assessment of contamination risk to be undertaken during design stages.	Cl/Con	Live/ Closed
Buried Obstructions	Localised removal required at proposed drainage locations or drainage to be re-routed around obstruction.	Detailed desk study of construction history to be undertaken during design stages. Possible use of geophysical maps.	Cl/Con	Live/ Closed

Action by:

- Client (Cli)
- Contractor (Con)
- Architect (Arch)
- M&E Engineer (M&E)
- Ramboll (RAM)

7. CONSTRUCTION APPROACH

Table 7.1 below details the site specific approach to construction of the below ground drainage system. In order to provide the most cost efficient solution, the preferred design option or material specification for each element of the system has been determined in accordance with Clients and/or contractors requirements.

Table 7.1 – Construction Method

Element	Standard Options	Selected Option
Pipework Below Ground	Clay Plastic Ductile iron HDPE Concrete	Clay Ductile Iron Concrete (300mm dia and above)
Pipework External	Clay Plastic Ductile iron HDP Concrete	Clay Plastic Ductile Iron Concrete (300mm dia and above)
Access chambers	Concrete rings Brick chambers PPIC Reduced access	Concrete rings PPIC
Building Drain Point Connection	Below slab 'y' connections External 'y' connections Connect to internal manholes Connect to external manholes	Below slab 'y' connections External 'y' connections Connect t internal Manholes Connect to external manholes
Repair to existing drainage systems	No re-use of existing drains Localised pipe replacement Pipe lining/patching	No re-use of existing Drains (exception of final outfall systems of-site)
Pipework through foundations/floor slabs	Cast within rafts/ground beams/pile caps Cast below rafts/ground beams/pile caps	Cast below raft/ground Beams/pile caps
Below ground attenuation	Oversized pipework Geocellular modular storage units GRP tanks Gravel filled pits	Oversized pipework Geo-cellular modular storage units
Infiltration devices	Granular pits/trenches Concrete ring chambers Geocellular modular storage units Borehole soakaways	N/A
Pervious Paving Finishes	Interlocking blocks Pervious asphalt Reinforced gravel/grass	N/A
Pipe Bedding	Standard single sized aggregate Recycled aggregate	Standard single size Aggregate Recycled aggregate (Contractors choice)
Significant invert level changes	Backdrops (at what level change) Steep graded pipework	N/A

PHASE 1 DRAINAGE STRATEGY AND SUDS REPORT REV.03

STATION HILL, READING



Element	Standard Options	Selected Option
Point Drainage Preference	Gullies Channel drains Channel drains at door thresholds	Gullies Channel drains Channel drains at door thresholds
Pump Stations	Preferred supplier Single/dual pumps Storage time period/volume	Single/dual pumps