AECOM

The Hillingdon Hospital Redevelopment

Proposed Drainage Strategy

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Quality information

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1. Introduction

This report has been produced by AECOM for The Hillingdon Hospitals NHS Foundation Trust in relation to The Hillingdon Hospital Redevelopment proposals at the Hillingdon Hospital in Uxbridge, Greater London.

This strategy has been developed to ensure a viable surface water and foul water system can be implemented across the whole application site, whilst maximising the sites potential for use of SuDS.

This report is intended for planning submission and will serve as a baseline document which sets out the drainage design parameters for the design work at The Hillingdon Hospitals Redevelopment.

2. Site Description

2.1 Site Location and Background

The proposed development site is centred at National Grid Reference TQ067818. The site is located in the London Borough of Hillingdon approximately 2.5km south-east of the Uxbridge London Underground Station. The site is bounded by Pield Heath Road, Colham Green Road and Royal Lane to the North, East and West of the site respectively.

The address of the development site is:

Pield Heath Road, Hillingdon, UB8 3NN

Greater London, England,

United Kingdom.

Figure 1- Site Plan (IBI Drawing reference THHR_01-IBI-WS-XX-DR-A-100001)

The site comprises a ten storey block built in the 1960s and a mix of other hospital buildings scattered across the site. Many of the acute beds are in single storey wards built in the 1940s, which are in very poor condition.

The remainder of the site consists mainly of surface level car parking, interspersed with pockets of landscaping. Hillingdon Hospital is located within the urban area of Hillingdon and is not
subject to any designations such as Green Belt or site allocations. It is not within a conservation area.

The site is located within Flood Risk Zone 1. There are two Tree Preservation Order (TPO) within the site: one south of The Furze and the second is west of the Woodlands Centre. A culvert runs west-east crossing both TPO's and being canalised under the service road and partially under the Woodlands Centre. On the east of the Site is a Grade II Listed Building, The Furze.

There are several points of access to the site; the main entrance is from Pield Heath Road with a separate access for A&E. There are three separate access points from Royal Lane and a separate access from Colham Green Road. Cycle access is only through the vehicular traffic road path. The site has a PTAL rating of 3. There are three bus stops on Pield Heath Road with links to Uxbridge, Heathrow Central and Hayes Town.

To the west of the site along Royal Lane comprises two storey detached and semi-detached residential properties, to the north west corner of the site lies a three storey flatted residential block rising to four storeys along Pield Health Road opposite the entrance to the Outpatient Department.

2.2 Development Proposals

The Proposed Development will comprise the demolition of the existing buildings and the redevelopment of the site to provide a new hospital, a mixed-use development (residential and commercial), multi-storey and surface carpark and cycleparks, vehicle access improvements, landscaping and public open spaces, utilities and associated works.

The hybrid planning application for the proposed development includes:

1. FULL application seeking planning permission for demolition of existing buildings and redevelopment of the site to provide the new Hillingdon Hospital, multi-storey car park and mobility hub, vehicle access, highways works, associated plant, generators, substation, new internal roads, landscaping and public open space, utilities, servicing area, surface car park/ expansion space, and other works incidental to the proposed development.
2. OUTLINE lanning application (all matters reserved, except for access) for the demolition of buildings and structures on the remaining site (excluding the Grade II Furze and Tudor Centre) for a mixed-use development comprising residential (Class C3) and supporting Commercial, Business and Service uses (Class E), new pedestrian and vehicular access; public realm, amenity space, car and cycling parking.

The proposed development will be carried out in phases (See Figure 2 below).

- Phase 1 a – comprising the demolition of the western buildings and construction of the new hospital, multi storey carpark and access.
- Phase 1 b – interim elements that will eventually be modified or replaced by the final park (phase ac) of the detailed application being built.
- Phase 1 c – construction of elements that can only be built upon demolition of the hospital i.e the triangle of public open space, surface carpark, woodland, new road/ junction and bus stops and roads.
- Phase 2 – comprising the demolition of the current hospital and the construction of the outline planning application for the residential buildings.

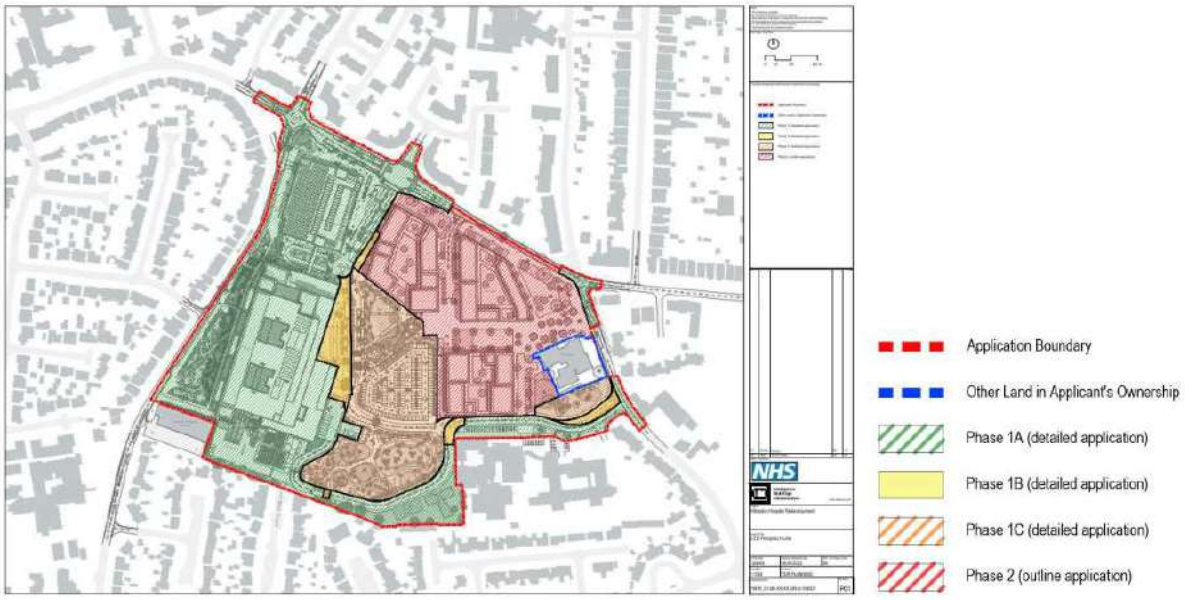

Figure 2- Site Phasing Plan (IBI Drawing reference THHR_01-IBI-XX-XX-DR-A-100007)

Figure 3- Proposed Site Plan (IBI Drawing reference THHR_01-IBI-XX-XX-DR-A-100003)

2.3 Site Geology

Geology of the site has been obtained from the ground investigation report and published geological map for the area. The site is shown to be underlain by superficial River Terrace Deposits comprising the Boyn Hill Gravel Member. Beneath the superficial deposits is the London Clay Formation followed by the Lambeth Group.

Soakaway tests were carried out as part of the ground investigation on the layer of Boyn Hill Gravels beneath the site (0.5 -4.2m thick). The tests were not able to determine the infiltration rate. Further infiltration tests are required at later design stages to determine the likelihood of infiltration.

3. Planning Policy & Guidance

The planning policies and guidance that are relevant to the proposed development with regards to flood risk and surface water management are outlined below:

National Planning Policy

- The 2021 revised National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG) published in 2021 by the Ministry of Housing, Communities and Local Government.
- SuDS Manual (CIRIA 753)
- Environment Agency's Standing Advice and Climate Change Allowance Guidance
- Approved Document H - Drainage and Waste Disposal (2015 edition)

Regional Policy and Strategy

- Greater London Authority The London Plan 2021.
- Greater London Authority Reimagining rainwater in hospitals.
- Sustainable Design and Construction, Supplementary Planning Guidance

Local Planning Policy

- London Borough of Hillingdon Local Plan Part 2: Development Management Policies
- London Borough of Hillingdon Surface Water Management Plan, January 2014
- London Borough of Hillingdon Local Flood Risk Management Strategy 2015
- Sustainable Drainage Design & Evaluation Guide by the London Borough of Hillingdon

Based on the above policies, the key requirements in relation to the surface water management and flood risk for the proposed development are considered to be as follows:

- Greater London Authority The London Plan 2021. Policy SI 12 Flood risk Management:

  A. Current and expected flood risk from all sources (as defined in paragraph 9.2.12, London Plan 2021) across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.

  B. Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London.

  C. Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

  D. Developments Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including authorities outside London, to safeguard an appropriate location for a new Thames Barrier.

  E. Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.

  F. Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.

G. Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat.

- Greater London Authority The London Plan 2021. Policy SI 12 Flood risk Management: Policy SI 13 Sustainable Drainage:

  A. Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

  B. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

     1. rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
     2. rainwater infiltration to ground at or close to source
     3. rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
     4. rainwater discharge direct to a watercourse (unless not appropriate)
     5. controlled rainwater discharge to a surface water sewer or drain
     6. controlled rainwater discharge to a combined sewer

  C. Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

  D. Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

- London Borough of Hillingdon Local Plan Part 2: Development Management Policies Policy DMEI 9

  A. Development proposals in Flood Zones 2 and 3a will be required to demonstrate that there are no suitable sites available in areas of lower flood risk. Where no appropriate sites are available, development should be located on the areas of lowest flood risk within the site. Flood defences should provide protection for the lifetime of the development. Finished floor levels should reflect the Environment Agency's latest guidance on climate change.

  B. Development proposals in these areas will be required to submit an appropriate level Flood Risk Assessment (FRA) to demonstrate that the development is resilient to all sources of flooding.

  C. Development in Flood Zone 3b will be refused in principle unless identified as an appropriate development in Flood Risk Planning Policy Guidance. Development for appropriate uses in Flood Zone 3b will only be approved if accompanied by an appropriate FRA that demonstrates the development will be resistant and resilient to flooding and suitable warning and evacuation methods are in place.

  D. Developments may be required to make contributions (through legal agreements) to previously identified flood improvement works that will benefit the development site.

  E. Proposals that fail to make appropriate provision for flood risk mitigation, or which would increase the risk or consequences of flooding, will be refused.

- London Borough of Hillingdon Local Plan Part 2: Development Management Policies Policy DMEI 10:

  A. Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems

(SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).

B. All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.

C. Rain Gardens and non householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.

D. Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.

E. Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.

F. Developments should be drained by a SuDS system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.

Water Efficiency

G. All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rain water and grey water.

H. All new residential development should demonstrate water usage rates of no more than 105 litres/person/day.

I. It is expected that major development8 proposals will provide an integrated approach to surface water run-off attenuation, water collection, recycling and reuse.

Water and Wastewater Infrastructure

J. All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the local planning authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered.

4. Correspondence

This section outlines correspondence to date with the statutory undertakers with regards to the existing assets, capacity of the network and appropriate connection locations for the future drainage of the development site.

4.1 Thames Water

Thames Water is the main asset operator for both surface water drainage and foul water drainage in the vicinity of the proposed development site.

Discussions have been carried with Thames Water in November 2021 to establish the appropriate connection points for the surface water and foul water flows from the proposed development. An asset record search was carried out and is attached in Appendix G.

A preplanning application has been submitted to Thames Water to verify the capacity on their drainage network. A response is awaited.

4.2 Lead Local Flood Authority

Discussions and meetings have taken place with the Lead Local Flood Authority (LLFA) to agree the drainage strategy for the proposed site. This report reflects comments from recent discussions.

5. Existing Drainage

5.1 Watercourses

Following a review of the EA Flood Map for Planning (FMfP) and Ordnance Survey (OS) Mapping, the closest watercourse with Main River status is the River Pinn which is situated approximately 0.45 km west of the Proposed Development. There is an unnamed Ordinary Watercourse which runs through the Proposed Development site, hereafter referred to as Hillingdon Ordinary Watercourse. The Hillingdon Ordinary Watercourse is urban in nature and flows in a south westerly direction along the south eastern boundary of the proposed development site. The Hillingdon Ordinary Watercourse is culverted in sections, specifically downstream of Colham Green Park and immediately downstream of the site boundary, before discharging into the River Pinn approximately 0.6 km south west of the proposed development.

5.2 Public Surface Water Sewers

The asset record from Thames Water indicates presence of public surface water sewers along Royal Lane and Pield Heath Road, surrounding the site. Records from Thames Water indicate 600mm surface water sewer located in Royal Lane to the west of the proposed site. Results from the Asset Location Search are attached in Appendix G.

5.3 Hospital Surface Water Sewers

The existing hospital is currently served by an existing surface water network mainly discharging into the public sewer and the existing watercourse. An existing catchment plan was prepared based on existing utility survey information which provides a high-level overview of the likely catchment split across the existing site. The catchment plan is attached in Appendix C .

It can be assumed that the western side of the site, Catchment 1 on the Existing Catchment Plan, is mainly served by a private network which discharges into the public sewer along Royal Lane. Catchment 2 can be assumed to discharge into the existing watercourse to the south. An existing tank is located at the centre of the site which is servesd Catchment 3. It is assumed that runoff from the tank is then pumped out at the restricted rate. Available survey information is limited therefore not enabling a complete tracing of the network. However, it is assumed that the existing Catchment 3 makes its way eventually discharging into the existing watercourse.

Catchment 4 and 5 are assumed to discharge into existing soakaways.

The proposed drainage network serving the proposed development will be independent from the existing network serving the hospital. As the existing hospital will remain operational during the construction of the new hospital, all live sewer networks will remain as existing to cater for the operational hospital.

5.3.1 Existing Surface Water Runoff Rates

Runoff rates for the existing hospital site has been calculated using the rational method and are listed in Table 1 below.

Table 1- Existing Brownfield Discharge Rate

Catchment	Area (ha)	1 in 1 year Brownfield Runoff Rate (l/s)	1 in 30 year Brownfield Runoff Rate (l/s)	1 in 100 year Brownfield Runoff Rate (l/s)
1	2.6	285	695	912
2	1.1	122	297	390
3	4.6	504	1,228	1,611
4	0.2	20	48	63
Total	**8.5**	**931**	**2,268**	**2,976**

5.4 Foul Water Sewers

The asset record from Thames Water indicates the presence of 225mm foul water sewers along Royal Lane and Pield Heath Road.

Private foul sewer networks are also present on site servicing the current hospital. Surveys indicate that these discharge to the public sewer. As the existing hospital will remain operational during the construction works of the new hospital, the existing live foul sewers serving the hospital are expected to remain operational. It is proposed that the drainage network serving the proposed development will be independent from the existing network serving the hospital.

6. Phase 1 Surface Water Drainage Strategy

A surface water drainage strategy has been prepared for the Phase 1 site in accordance with the general design principles set out below. The strategy ensures that there is no increase in flood risk arising from the proposed development for up to and including a 1 in 100-year probability rainfall event (plus 40% allowance for climate change).

This strategy is based on the use of SuDS, the principles set out by the national, regional, and local policies which requires that post development runoff quantity and quality matches the existing Greenfield Runoff Rate.

The Building Regulations Approved Document H3 stipulates that rainwater from roofs and paved areas should discharge to one of the following, listed in order of priority:

1) An adequate soakaway or some other adequate infiltration system,

2) a watercourse or

3) a sewer.

Therefore, the following options have been considered in order of priority relative to the Building Regulations hierarchy.

Option 1 – Infiltrate to Groundwater

Based on the existing ground conditions described in Section 2, the superficial layers found across the site may have limited potential for permeability due to the presence of London Clays.

Therefore, the preliminary surface water drainage strategy assumes at this stage, that infiltration drainage techniques are not feasible for this site and is unlikely to be feasible in future stages.

Option 2 – Discharge into the Existing Watercourses/Ditches

It is proposed that south-east part the proposed development would discharge into the existing watercourse running across the southern end of the site with appropriate measures to control the discharge. The existing watercourse however, can only provide shallow discharge points which limits its use for the wider site.

Option 3 – Discharge into Public/Private Sewer(s)

The current site is served by a public sewer network operated by Thames Water. This includes a surface water sewer which runs along Royal Lane. It is proposed that the rest of the proposed development is discharged to the public sewer.

Option 1 is unlikely to be a viable option. Therefore, Option 2 and Option 3 have been considered as the preferred method of surface water runoff discharge from the site and have formed the basis of developing this drainage strategy.

6.1 Design Parameters

The proposed surface water drainage system will be designed in accordance with the Water UK Codes of Adoption, which supersedes guidance previously outlined in Sewers for Adoption. The following criteria will be adopted for the design:

- The proposed piped surface water drainage system will be designed to ensure self-cleansing velocities are achieved in a 1 in 1 year rainfall event.
- FEH rainfall data (industry standard practice) will be used.
- A volumetric runoff coefficient (cv) of 0.75 will be adopted in accordance with industry standard practice.
- MicroDrainage design software has been used to verify the hydraulic design of the network. Storms for the 1 in 2 years, 1 in 30 years and 1 in 100 years (+40% Climate Change) have been modelled.

All SuDS features will be designed in compliance with the best practice and to the approval of the Lead Local Flood Authority (Hillingdon Council). Private systems will comply with the requirements of Building Regulations Part H.

6.2 Sustainable Drainage Systems (SuDS)

It is proposed that SuDS will be integrated within the development to manage surface water runoff and contribute to environmental betterment and enhancement.

The Reimagining Rainwater in Hospitals guidance document has been used to identify suitable SuDS techniques to be adopted in hospitals. These techniques also provide other benefits to hospital staff, patients and visitors, besides the surface water runoff management and the water quality.

The main objectives are treatment and control of runoff nearest to the source as possible, protecting the downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

- **Prevention** - the use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse/harvesting.
- **Source Control** - control of runoff at source or as close to source as possible.
- **Site Control** - management of water in a local area, this can include below ground storage/attenuation, detention basins, large infiltration devices etc.
- **Regional Control** - management of water from a site or various sites and can include wetlands and balancing ponds.

The drainage techniques proposed for this site include prevention, source control, site and regional controls. The drainage techniques to be incorporated are discussed below.

Options for the proposed attenuation have been assessed in accordance with the SuDS hierarchy shown Figure 2 below.

	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
Most Sustainable	Living roofs	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviors	✔	✔	
Least Sustainable	Tanked systems - over-sized pipes/tanks - storms cells	✔		

Figure 4 - SuDS Hierarchy

The following SuDS features are proposed for Phase 1 of the development:

- Swales and wetlands are proposed for the development to manage surface water runoff and quality along with enhancing the surrounding landscape providing amenity as shown on drawing THHR_01-ACM-WS-XX-DR-C-772001 attached in Appendix A. The area available for the swales and wetlands has been maximised and is located on the western side of the hospital building and the multistorey car park. The swales and wetlands will also create biodiversity within the hospital site.

- Infiltration feature are unlikely to be proposed due to the presence of London Clay and its unsuitable nature for the said disposal technique. Although there is evidence that soakaways are presently on site, one in the area under the proposed MSCP, one under the proposed new hospital building location and two in the northern section of Phase 2. The surveys carried out on site could not verify the effectiveness of the soakaways as the gulleys connected to them were generally blocked, this may be due to the soakaways not providing an effective drainage route into the ground. The inconclusive results from the soakaway tests do not reliably indicate where infiltration within the Phase 1 site is viable and the design has therefore ruled out infiltration as a discharge option at this stage. Further boreholes and testing will be carried out during the next stage of design to investigate and hopefully locate areas where the gravels may be suitable for infiltration.

- Two attenuation tanks are proposed. The proposed attenuation tanks will be located within the proposed service yard and ambulance access road of the hospital.

- Greenroofs are proposed on the two proposed buildings. The roofs will slow the flow of runoff reducing the amount of water that is released to the drainage network. This will also improve air quality in the hospital and supports diversity. The greenroofs also benefit the building infrastructure in providing cooler buildings in the summer and improving the efficiency of solar panels on the roof.

- During a meeting with the LLFA, it was suggested by the LLFA that rainwater harvesting for WC flushing, is considered and if practical (for example considering tanks sizing, site configuration and resulting pipework runs) installed to serve the entire hospital. Whilst such systems are generally considered a sustainable approach to helping manage rainwater, they are not considered good practice in healthcare

settings due to known risks associated with waterborne diseases, such as legionella. Moreover, this would be derogation from current design guidance HTM 04-01, which states “2.23 Greywater and rainwater should not be collected for use on, or in, healthcare premises”, but would provide significant mains water savings and could offer variable payback periods. it is currently not anticipated that a rainwater harvesting system will be used for WC flushing given the potential health implications within a healthcare facility and the estimated financial implications given the small areas where this may be feasible. Small volume of rainwater harvesting will be included in the design for external areas. Possible uses may include: irrigation and vehicle washing or general external area clean down in the FM yard area.

- Raingardens are also proposed across the hospital site as sustainable drainage systems.
- Permeable pavement is proposed along the ambulance access south of the site. The road will feature permeable asphalt allowing rainwater to pass through and be stored into the sub base layer then discharging into the existing watercourse.

6.3 Limiting Surface Water Discharge Rates

Policy DMEI 10 from the Hillingdon Local Plan and Policy SI 12 from The London Plan 2021 stipulates that new developments should aim at reducing the surface water runoff rates to no higher than pre-development greenfield runoff rates in a 1 in 100 year storm scenario plus an appropriate allowance for climate change for the worst storm duration.

Greenfield rates have been considered as part of developing the drainage strategy.

SuDS techniques used in the design proposals have been tailored to the opportunities and challenges of the proposed site. The development site has space constraints due to the requirement of maintaining an operational hospital during the phased development. The available space will therefore be maximised to include SuDS features. As described in Section 6.2, SuDS techniques will be prioritised in line with the SuDS Hierarchy. This includes maximising the areas used as swales and wetlands as part of the SuDS belt west of the buildings, using greenroofs and permeable pavement. The remaining spaces available in the service yard and ambulance access road will then be used to install underground attenuation.

The proposed Greenfield Runoff Rates have been calculated using the Institute of Hydrology Report 124 (IH124) ‘Flood Estimation for Small Catchments’ (1994) methodology and catchment specific rainfall parameters derived from the Flood Estimation Handbook (FEH). Calculations for the greenfield runoff rates are attached in Appendix F.

The maximum allowable proposed discharge rates and respective catchment areas for the three networks are shown in Table 2 below.

Table 2- Proposed Greenfield Discharge Rates

Catchment	Catchment Area (ha)	1 in 1 year Greenfield Runoff Rate (l/s)	1 in 30 year Greenfield Runoff Rate (l/s)	1 in 100 year Greenfield Runoff Rate (l/s)
A	2.41	3.26	8.81	12.23
B	1.6	2.16	5.85	8.12
C	0.51	0.69	1.87	2.59
Total	**4.52**	**6.11**	**16.53**	**22.93**

The discharge rates for network A and B will be limited to the maximum allowable discharge rate which is the greenfield rate for their respective return periods. Complex flow controls devices will restrict the discharge rate from the site with the above ground SuDS features and storage tanks providing the required attenuation. The discharge rate for Network C will be limited to the maximum of the 1 in 100 year return period using a flow control device.

6.4 Climate Change

As discussed earlier in the report, this surface water management strategy has considered the effects of climate change and 40% climate change allowance have been applied for the drainage design and sizing of the attenuation storage features.

6.5 Surface Water Drainage Design – Phase 1

The proposed development will have an independent surface water network to drain the site. The surface water drainage plans, THHR_01-ACM-WS-XX-DR-C-772001 and THHR_01-ACM-WS-XX-DR-C-772002 are attached in Appendix A.

The proposed surface water drainage network will discharge into both the Thames Water Surface water sewer running along Royal Lane and the existing water course running across the southern end of the site.

6.5.1 Discharge into public Sewer

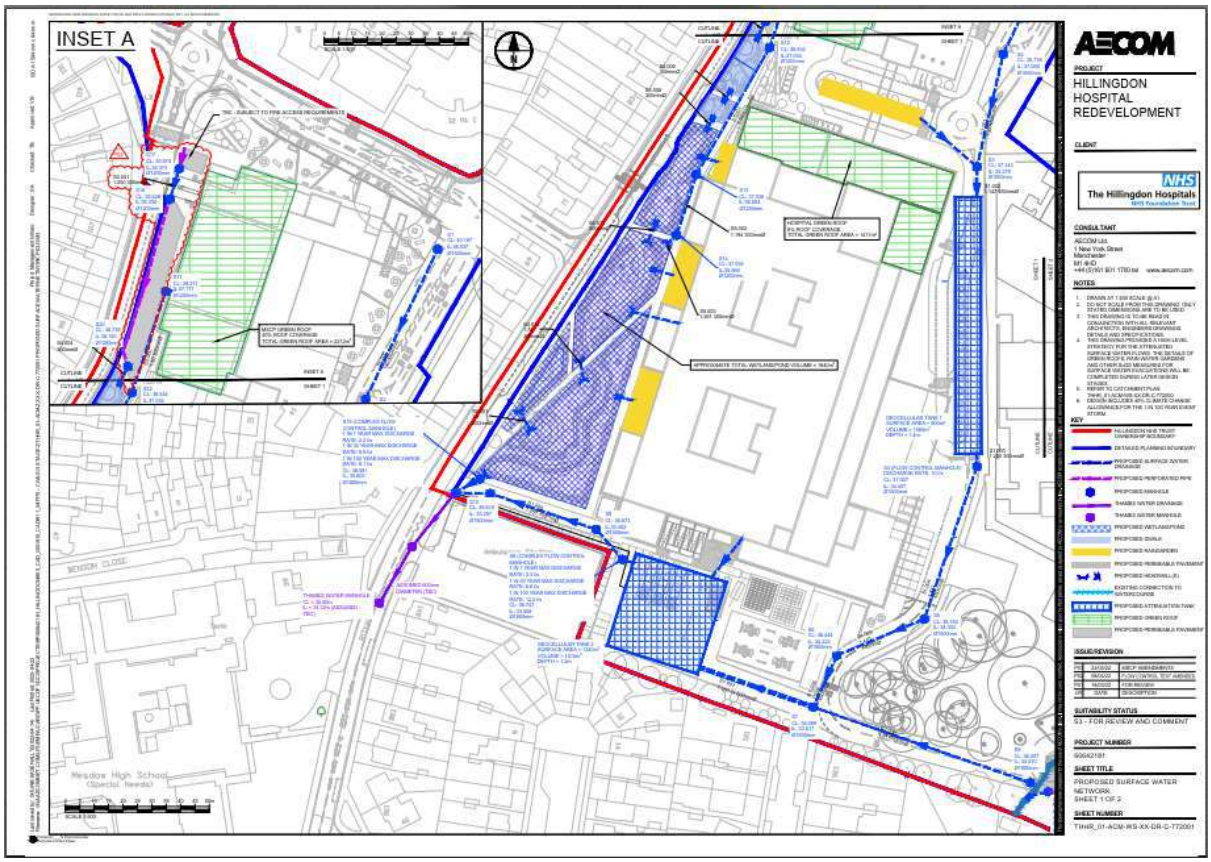

Figure 5- Proposed Surface Water Network Plan- Thames Water Discharge (AECOM Drawing Reference THHR_01-ACM-WS-XX-DR-C-772001)

6.5.1.1 Tanked System- Network A

A drainage network is proposed to the east of the multistorey carpark and main hospital building.

This network includes carrier drains and manholes. Underground storage system is also proposed in the form of geocellular crates. Two storage tanks are proposed which will be located in the service yard of the hospital south of the main hospital building and along the ambulance access road east of the hospital building.

The catchments served by this network include the external areas of the hospital east of both the multistorey carpark and the main hospital building. The remaining catchment of the two roofs are also proposed to drain into this network.

Two flow control devices are proposed across this network. The first flow control device will be located downstream of tank 1, restricting the discharge rate to allow for attenuation available in the tank to be fully utilised. The second flow control device will be located downstream of tank 2 in the service yard and this is proposed as a complex flow control device. The complex flow control device will restrict the discharge rate to the maximum greenfield runoff rate for the 1 in 1 year, 1 in 30 year and 1 in 100 year return periods respectively.

The preliminary design for the attenuation tanks is:

- Geocellular Tank 1
  - Surface Area: 800m^2
  - Depth: 1.4m
  - Volume: 1065m^3
- Geocellular Tank 2
  - Surface Area: 1100 m^2
  - Depth: 1.2m
  - Volume: 1254m^3

Hydraulic modelling results for the Network is attached in Appendix E.

6.5.1.2 SuDS Belt- Network B

A green SuDS belt is proposed on the area west to the multistorey carpark and main hospital building. This SuDS network eventually discharges into the public sewer.

The network starts with two areas of permeable pavement along the footway west of the multistorey carpark building. These permeable pavement areas then connect to two swales which eventually discharge into a series of wetlands through gravity, all interconnected with headwalls and connecting pipes. The series of swales and permeable paving are proposed to cater for the runoff from the external areas of the hospital building to the west, the multistorey carpark to the North and the West, along with the respective catchments of the swales. The permeable pavements and swales therefore provide water treatment of the runoff before discharging into the wetlands.

The wetlands are proposed to receive runoffs from the catchments of the multistorey carpark roof, main hospital buildings along with the runoff from the catchments of the external areas being fed by the swales. Only part of the roofs of the two buildings will discharge into the wetlands. The remaining catchments will then discharge into the other network as described in the next section.

Greenroofs are also proposed on part of the multistorey carpark roof and the main hospital building roof. 40% and 8% of the roofs of the multistorey carpark and hospital building have been considered as greenroofs respectively. This needs to be further developed in the detailed design. The runoffs from the respective greenroofs will discharge directly into the wetlands. This will be achieved using carrier drains in areas where direct connection is not possible. These carrier drains bypass the swales to discharge directly into the wetlands. Part of the roof of the main hospital building is also proposed to discharge into the wetlands.

A proposed complex flow control device is proposed downstream of the wetlands to restrict the discharge rate to the maximum greenfield runoff rate for the 1 in 1 year, 1 in 30 year and 1 in 100 year return periods respectively.

The total storage volume available for use as attenuation in the wetlands is 1,640 m^3.

Hydraulic modelling results for the Network is attached in Appendix E.

6.5.2 Discharge into the Water Course

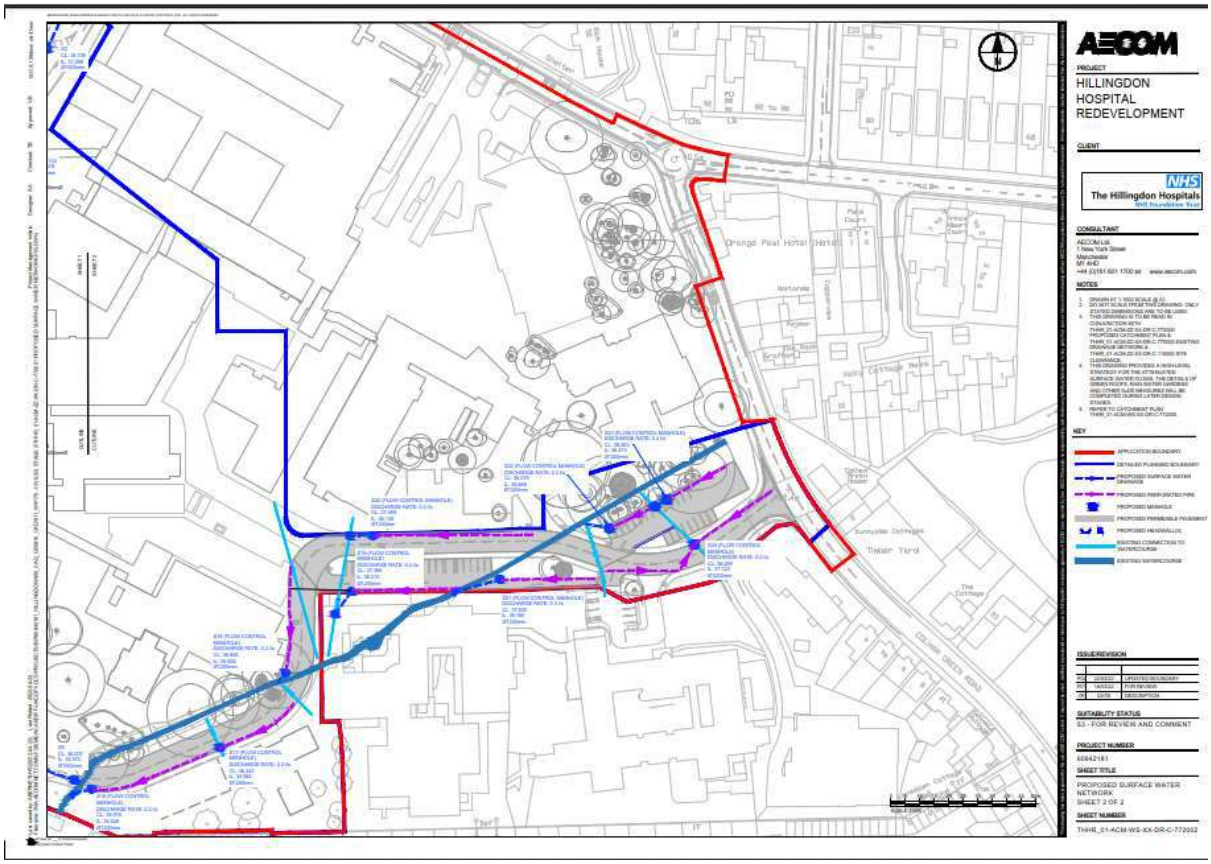

Figure 6- Proposed Surface Water Network Plan- Water Course Discharge (AECOM Drawing Reference THHR_01-ACM-WS-XX-DR-C-772002)

6.5.2.1 Permeable Paving- Network C

A series of permeable pavement is proposed along the entrance of the ambulance access. The permeable pavement will provide attenuation discharging at 9 different points. These discharge points are either discharging to the existing culverts or directly to the watercourse through the proposed headwalls. All the proposed discharge points for the permeable paving surface eventually discharge into the existing watercourse at the greenfield runoff rate for the 1 in 100 year return period using a flow control device. Only a fixed flow control device set at the maximum discharge rate of the 1 in 100 year return period is proposed due to the low rates of discharge. Due to the low rates of discharge and smaller size flow controls proposed, a mesh guard should be proposed to reduce the risk of blockages.

Hydraulic modelling results for the Network is attached in Appendix E.

6.6 Summary

The drainage strategy in the Phase 1 of the developments follows the SuDS Hierarchy and complies with the national and regional planning policy guidelines. The proposed drainage strategy is optimised for the site following the guidelines mentioned in the previous section of the report and in line with the development's phasing approach to keep the existing hospital in operations during construction.

The proposed network maximises the use of greenroofs, swales, wetlands, permeable paving and uses geocellular crates as attenuation and restricts the site runoff to predevelopment greenfield rate discharging into the public sewer by Thames Water and into the existing watercourse.

The proposed drainage strategy provides an overall betterment of the surface water runoff exiting the site.

Comparisons for the existing and proposed surface water discharge rates from Network A and B into the public sewer by Thames water are summarised in Table 3 below.

Table 3- Discharge Rate Percentage Reduction into Thames Water Sewer

	Existing Discharge Rate (l/s)	Proposed Discharge Rate (l/s)	Percentage Reduction
1 in 1 year	285	5.5	98%
1 in 30 year	695	14.7	98%
1 in 100 year	912	20.3	98%

The following Table 4, shows the comparison of the proposed discharge rate to an equivalent brownfield rate for the catchment area of Network C showing the percentage reduction.

Table 4- Discharge Rate Percentage Reduction into Existing Water Course

	Existing Discharge Rate (l/s)	Proposed Discharge Rate (l/s)	Percentage Reduction
1 in 100 year	179	2.59	99%

7. Phase 2 Surface Water Drainage Strategy

A high level outline design for the Phase 2 works, part of the outline planning application, has been carried out. This provides a high level overview of the likely impacts of surface water drainage in regards to proposed discharge rates and likely attenuation storage required to achieve the proposed discharge rate. Further detailed design is required in latter stages of work.

7.1 Limiting Surface Water Discharge Rates

Policy DMEI 10 from the Hillingdon Local Plan and Policy SI 12 from The London Plan 2021 stipulates that new developments should aim at reducing the surface water runoff rates to no higher than pre-development greenfield runoff rates in a 1 in 100 year storm scenario plus an appropriate allowance for climate change for the worst storm duration.

Greenfield runoff rates were therefore considered to determine the proposed discharge rate for the site.

The proposed Greenfield Runoff Rates have been calculated using the Institute of Hydrology Report 124 (IH124) 'Flood Estimation for Small Catchments' (1994) methodology and catchment specific rainfall parameters derived from the Flood Estimation Handbook (FEH). Calculations for the greenfield runoff rates are attached in Appendix F

The proposed catchment area and greenfield rates at the different return periods shown in Table 3 below.

Table 5- Proposed Greenfield Discharge Rate

Catchment Area (ha)	1 in 1 year Greenfield Runoff Rate (l/s)	1 in 30 year Greenfield Runoff Rate (l/s)	1 in 100 year Greenfield Runoff Rate (l/s)
3.7	5.0	13.5	18.8

7.2 Climate Change

The effects of climate change were considered, and 40% climate change allowance have been applied for the drainage design and sizing of the attenuation storage features.

7.3 Outline Surface Water Drainage Design – Phase 2

In order to discharge at greenfield rates, attenuation storage should be provided across the site. The required storage volume required for the catchment area at the different return periods has been calculated using the Quick Storage Estimate feature on Source Control, part of the Innovyze MicroDranaige software package.

The maximum required storage volume for the site is 3,650 m^3. This maximum storage volume has been calculated based on the critical storm for the 1 in 100 year return period at its respective greenfield runoff rate with an allowance of 40% for climate change.

This attenuation storage can be provided in the form of SuDS features namely through ponds, swales, green/blue roofs etc. An indicative drainage strategy plan for the Phase 2 site was prepared identifying potential locations for storage as well as the potential location for the discharge point into the existing watercourse. Any additional storage required can also be provided through underground storage solution in storage crates. Rainwater harvesting may be proposed when further explored in the later design stages.

A cut off drain is also proposed along the north east boundary of the site running south down to the existing watercourse. This cut off drain is proposed to discharge into the existing watercourse. Existing highway runoff currently enters the site and follows the existing topography to the watercourse. The cut off drain therefore captures the runoff to discharge into the watercourse preventing excess runoff from entering the site completely.

The indicative drainage strategy layout is attached in Appendix D.

8. Foul Water Drainage Strategy

This section outlines the preliminary foul water drainage strategy for the Phase 1 works. This strategy has been produced in line with industry standards, best practice, and relevant policy and guidance.

Thames Water is the main asset operator for both surface water drainage and foul water drainage in the vicinity of the proposed development site.

A peak flow rate has been estimated based on the typical floor layout of the hospital. This flow rate only provides a guidance which indicates the pipe sizes to be used. Detailed calculations are required to calculate the exact flow rates at the next stage of the design.

The estimated flow rates are as follows:

- Peak Flow Rate: 38 l/s
- Average Flow Rate: 9.5 l/s

The average flow rate has been assumed to be 25% of the peak flow rate considering the 24 hours operation of the hospital.

8.1 Outline Foul Water Drainage Design – Phase 1

It is proposed to provide two discharge points for the foul outfall for the development site. Both discharge points will be on Royal Lane into the Thames Water foul sewer. The first discharge point will be at the existing Thames Water Manhole (MH Ref 6802) on the Bradshaw Way/ Royal Lane Junction. The second discharge point will be further south on Royal Lane near the Ambulance Station of the hospital. (MH Ref 6803)

A 150mm foul sewer laid in 1 in 150 is proposed around the North side of the hospital which will accommodate part of the outflow from the building in that area.

A 150mm and 225mm foul water sewer laid in 1 in 150 slopes is proposed around the southern perimeter of the building.

Due to the levels of the basements, a pumped solution is proposed. This will involve a network of gravity sewers discharging into a proposed pumping station. The network of gravity sewers will start at the north east corner of the building running to the south east cover of the main hospital building into the pumping station. The pumping station will accommodate the outflows coming from the basement. The pumping station will then pump the outflow

at the same rate of the incoming flow through a small length of rising main into the gravity sewers at the perimeter of the building.

The proposed foul water network plan is attached in Appendix B.

8.2 Outline Foul Water Drainage Design – Phase 2

Two discharge points are proposed for the foul outfall for the Phase 2 developments. These will discharge into the Thames Water foul sewer located along Pield Heath Road and Colham Green Road.

The proposed foul water strategy plan is attached in Appendix D

9. Maintenance Plan

9.1 Piped Drainage and Manhole Chamber Maintenance

Drainage infrastructure covered in this section includes manholes, manhole fittings and surrounding pipework, gullies and drainage channels. Correct operation of this drainage infrastructure allows collection and transportation of water but requires regular maintenance as outlined in Table 6 below.

Table 6- Piped Drainage and Manhole Chambers Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Before Start up	Removal of any inappropriate material from within the chamber and dispose off-site to a suitable licenced site.	At Start
	All pipe lines to be flushed with water to remove silt and check for blockages	At Start
Regular Maintenance	Removal of debris (which could include leaves, rubbish, branches) from areas served by drainage (where it may cause risk to performance)	Monthly
Remedial Actions	For blockages resulting in flooded manhole chambers, drain down manhole chamber and unblock.	As required
	For pipe blockages, rod or jet clean between access points to unblock	As required
Monitoring	Lift covers and inspect chambers. Inspect covers, surrounding gullies and drainage channels for signs of damage and incorrect operation. If required, undertake remedial action.	As required

Source: SuDS Manual CIRIA 753

9.2 Greenroofs

The function of vegetated roofs is to provide pre-treatment to the surface water before it enters the below ground surface water system, whilst also providing attenuation at roof level. Table 7 shows a typical maintenance schedule for Greenroofs.

Table 7- Greenroofs Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Before Start up – manufacturer to confirm exact requirements	Remove debris and litter to prevent blockage of the outlets with potential brown roof material.	At Start
	Check infiltration through to the outlet	At Start
Regular Maintenance – manufacturer to confirm exact requirements	Remove debris and litter to prevent clogging of inlet drains	Six monthly/ annually or as required
	Remove nuisance and invasive vegetation including weeds	Six month or as required

Remedial Actions – manufacturer to confirm exact requirements	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required
Monitoring – manufacturer to confirm exact requirements	Inspect all components including, drains, membranes and roof structure for proper operation, integrity of waterproofing and structural stability. Inspect drain outlets to ensure there are no blockages Inspect underside of roof for evidence of leakage	Annually/ after severe storms
Monitoring – manufacturer to confirm exact requirements	Inspect all components including, drains, membranes and roof structure for proper operation, integrity of waterproofing and structural stability. Inspect drain outlets to ensure there are no blockages Inspect underside of roof for evidence of leakage	Annually/ after severe storms Annually/after severe storms Annually/after severe storms

Source: SuDS Manual CIRIA 753

9.3 Attenuation Storage Tanks

The function of the attenuation tanks is to collect and store water prior to discharging to the receiving waterbody or surface water sewers. Table 8 refers to the maintenance schedule highlighted in the SuDS Manual

Table 8- Attenuation tanks Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action Removal of debris from the catchment surface (where it may cause risk to performance) Remove sediment from pre-treatment structures	Monthly for three months, then annually Monthly Annually or as required
Remedial Actions	Repair of inlets, outlets, overflows and vents	As required
Monitoring	Inspect and check all inlets, outlets and vents to ensure that they are in good condition and operating as designed allowing surface water to be stored. Survey inside of tank for sediment build-up and remove if necessary. This is dependent upon the design style of the tank	Annually Every 5 years or as required

Source: SuDS Manual CIRIA 753

9.4 Swales

Swales will be implemented within the development site to convey, treat, and attenuate surface water runoff. They can enhance the natural landscape and provide aesthetic and biodiversity benefits but will require regular maintenance to ensure continued operation to design performance standards. The typical maintenance schedule for swales is shown in Table 9.

Table 9- Swales Maintenance Schedule

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify the spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Source: SuDS Manual CIRIA 753