

5.3.4 Discharge to a Combined Sewer

There are no public sewers located within the vicinity of the Site therefore, it would not be possible to discharge to the public sewers.

5.3.5 Summary

For the purposes of this assessment the most likely scenario of discharge via infiltration SuDS methods has been considered. The drainage characteristics across the Site have also shown to be variable and it will be possible to utilise infiltration for discharge of surface water runoff at the Site.

5.4 Surface Water Runoff

Currently the majority of rainfall infiltrates into the soil substrate and/or runoff from the Site. It is proposed that the Site will be surfaced with grass, crushed permeable stone and compacted impermeable stone or similar.

The proposed structures such as the inverter containers, transformers and switch gear will be situated on small concrete sleepers which will sit on and be surrounded by permeable surfaces (see Figure 5). Any rainfall falling on the containers will runoff onto permeable surfaces and therefore, they have been treated as permeable surfaces within the calculations below. The rest of the Site (with the exception of the access roads) will be constructed from free draining stone or grass which will allow infiltration of rainfall.

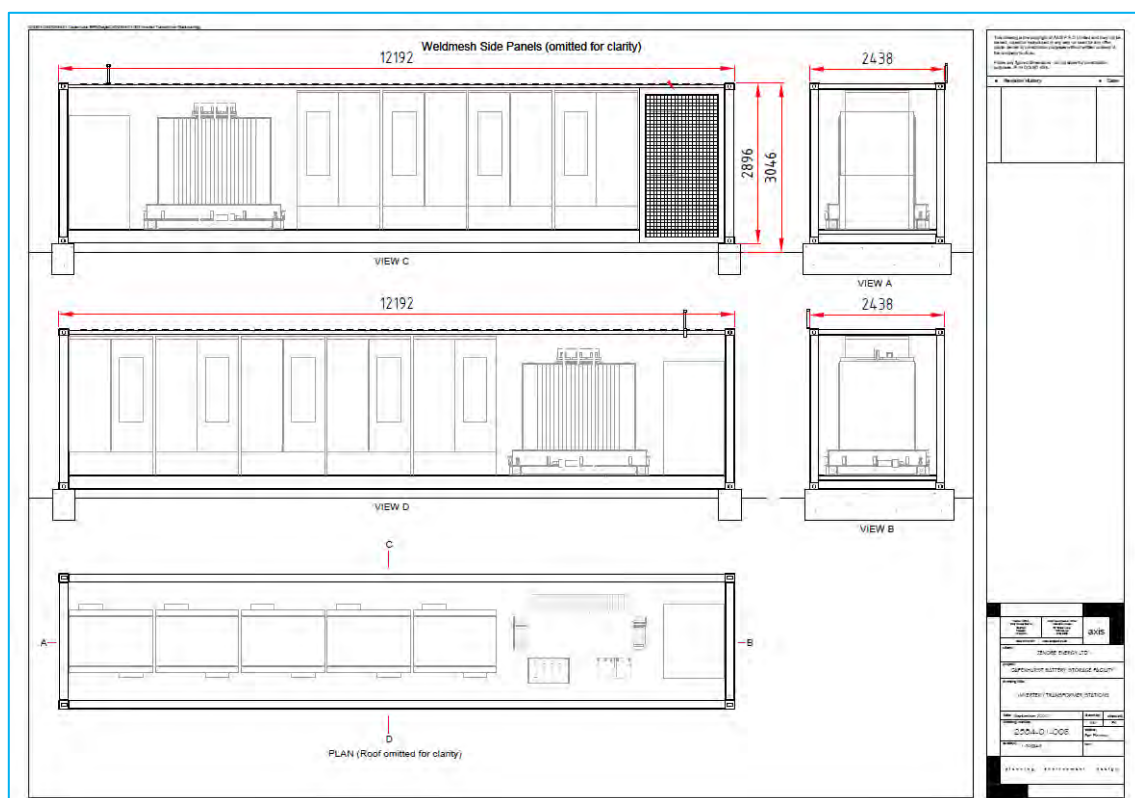


Figure 5 - Structures Location on Permeable Surfaces

The proposed impermeable area associated with the Site road and northern sub-station area will total 2,500m² and will be constructed of compacted 'Type 1' stone. There will also be areas of uncompacted stone surfacing which will be permeable

An estimation of surface water runoff is required to permit effective Site surface water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the Greenfield runoff from the Site has been calculated using the IoH124 method⁷. Table 6 shows the IoH124 method Greenfield runoff rates calculated for the proposed impermeable area of 2,500m². The mean annual maximum flow rate from a Greenfield site (QBAR: approximately a 2.30 year return period) has been calculated to be 1.40 litres/second (l/s) (see Appendix 3).

The method used for calculating the runoff complies with the NPPF, as well as the Defra non-statutory technical standards for SuDS, and assumes that the excess runoff associated with the Proposed Development (plus an allowance for future climate change) will need to be managed by the proposed SuDS scheme.

Table 6 - IoH124 Method Greenfield Runoff Rates

Rainfall Event	Runoff Rate (l/s)
1	1.20
QBAR (rural)	1.40
30	2.80
100	3.60

5.5 SuDS Strategy

One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity. Systems incorporating these features are often termed SuDS and it is the requirement of NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the Site.
- No increase in flooding to people or property off-site as a result of the Proposed Development.
- No surface water flooding of the Site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The proposed SuDS Strategy will take the form of:

- **Infiltrate to Ground:**
 - Infiltration trenches for surface water run-off from the Site road with pre-treatment via vegetated filter strip.
 - Infiltration Basin for runoff from the sub-station area.

⁷ Institute of Hydrology, Flood Estimation of Small Catchments, June 1994.

- Permeable areas - crushed permeable stone and grass.

The SuDS Design is shown in Appendix 4 and the MicroDrainage calculations for the infiltration basin and infiltration trenches are shown in Appendix 5. The calculation procedure for the infiltration basin and trenches within MicroDrainage was used to demonstrate that the proposed surface water runoff volumes can be viably accommodated on Site and drained by infiltration during the 1 in 100 year with a 40% allowance for climate change assuming an impermeable area of 2,500m² for the northern sub-station and the Site road (including a 10% increase for urban creep). This is based on an infiltration rate of 0.0000054m/s.

A half emptying time of 24 hours for the design event has been met. A conservative estimate of 100% runoff from impermeable areas has been used within the calculations. The infiltration basin and infiltration trenches will allow infiltration into the ground and has been designed to accommodate the 1 in 100 year event plus climate change (+40%) therefore, flooding would not occur for all events up to the 1 in 100 year (+40%) event. Surface water runoff from the sub-station area will be conveyed to the nearby infiltration basin and will allow infiltration into the ground. An infiltration trench will be formed alongside the Site road to provide natural drainage from the road.

The permeable areas, infiltration basin and infiltration trenches will provide interception storage. The free draining stone will have a sufficient void ratio of 30% and permeability of granular fill to allow adequate percolation and to control the risk of blockage (examples include coarse aggregate 4-40mm (4/40), 4-20mm (4/20) as defined in BS 753313:2009 or Type 3 sub-base 0-40mm (0/40)). A permeable/open-graded (reduced fines) sub-base layer (i.e. Type 3 with a void ratio of 30%) will be used as a drainage layer below the permeable surfaces which will be sufficiently permeable to allow water to drain through and to store water temporarily. The selected gravel fill and bedding would be clean, free-draining, angular shaped material in the specified size range.

Infiltration capacities of free draining stone are significantly greater than the design rainfall intensities and are not a limiting factor. A minimum value of 2500mm/hr is considered reasonable within The SuDS Manual (see Section 20.5.1 of the SuDS Manual). These are SuDS source control compliant and will as a minimum provide storage for the first 5mm (interception storage). Permeable surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. These systems encourage biological treatment of flow and extraction of oils and heavy metals from the runoff. Treatment processes that occur within the surface structure and the geotextile layers include:

- Filtration
- Absorption
- Biodegradation
- Sedimentation

It will also assist in reducing the flood profile of the Site by significantly attenuating the runoff from the Proposed Development within the sub-base material.

These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this Site. The infiltration trenches will feature a filter strip between the road and the infiltration trench to act as pre-treatment of pollutants allowing the sediments to settle out and reduce the velocity of stormwater runoff. The adoption SuDS features for the Site represents an enhancement from the current conditions as the current surface water runoff from the Site is

uncontrolled, untreated, unmanaged and unmitigated. The SuDS features will reduce the risk of flooding to the Site and off-site locations.

In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

5.6 Designing for Local Drainage System Failure

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the Site and this reduces the risk of flooding however, it is not possible to completely remove the risk.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground. However, this is considered unlikely in the immediate future due to the 40% allowance for climate change used in the calculations.

The design of the Proposed Development provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur. There will not be an extensive sewerage network on the Proposed Development and therefore any potential exceedance flooding would be from the lateral drains connecting the impermeable areas to the storage areas. It is very unlikely that a catastrophic failure would occur. An exceedance or blockage event of the sewers would not affect the proposed buildings/structures because the finished floor level will be raised above surrounding ground levels, ensuring any exceedance flooding would not affect the buildings/structures. Exceedance flows would be contained within the permeable areas within the Site and would flow to the lower ground levels. It is not considered that there is an increased risk to the Site or properties located adjacent to the Site.

Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the structures and through contouring of the hardstanding areas. When considering the impacts of a storm event that exceeds the design event, there is safety factor, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system to accommodate this (i.e. within the manholes, pipes etc.). If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

The above manages and mitigates the flood risk from surface water runoff to the adjacent premises and Site infrastructure from surface water runoff generated by the Proposed Development.

6.0 WATER QUALITY

6.1 SuDS and Water Quality

According to the SuDS Standards (see Table 7), the proposed development is a medium hazard (industrial).

Table 7 - Level of hazard

Hazard	Source of Hazard
Low	Roof drainage
Medium	Residential, amenity, commercial, industrial uses including car parking spaces and roads
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards)

The proposed development has a 'low' pollution hazard level (see Table 8), as per Table 26.2 of the SuDS Manual.

Table 8 - Pollution Hazard Indices

Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, homezones, and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day	0.50	0.40	0.40

* Indices values range from 0-1.

To deliver adequate treatment, the SuDS features should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type). Water treatment will be provided via the SuDS components included throughout the drainage network.

Table 9, 10 and 11 show the indicative SuDS pollution hazard indices as per Tables 26.3 and 26.4 the SuDS Manual. It is therefore considered that adequate water quality treatment can be provided via SuDS components.

Table 9 - SuDS Mitigation Indices for Discharges to Groundwater (Permeable Surfaces)

Characteristics of the material overlying the proposed infiltration surfaces, through which the runoff percolates	TSS	Metals	Hydrocarbons
Constructed permeable surfaces with soil with good contaminant attenuation potential of at least 300mm in depth	0.70	0.60	0.70
Total	0.70	0.60	0.70

Table 10 - SuDS Mitigation Indices for Discharges to Groundwater (Infiltration Trenches)

Characteristics of the material overlying the proposed infiltration surfaces, through which the runoff percolates	SuDS Feature	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential	Vegetated filter strip	0.40	0.40	0.50
	Infiltration trench	0.20*	0.20*	0.20*
Total	---	0.60	0.65	0.70

* a factor of 0.50 is used to account for the reduced performance of secondary components associated with already reduced inflow concentrations.

Table 11 - SuDS Mitigation Indices for Discharges to Groundwater (Infiltration Basin)

Characteristics of the material overlying the proposed infiltration surfaces, through which the runoff percolates	SuDS Feature	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential	Infiltration Basin	0.80	0.80	0.80
Total	---	0.80	0.85	0.80

The design of the system will allow any silt and debris from the development an opportunity to settle. The infiltration trenches, infiltration basin and permeable surfaces will naturally filter potentially suspended solids contained in the surface water runoff from the hardstanding areas.

A vegetated filter strip will be included between the Site road and the infiltration trenches for additional pollution pre-treatment.

7.0 MANAGEMENT AND MAINTENANCE REQUIREMENTS

7.1 Operation and Maintenance Requirements

The following maintenance schedules are based on The SuDS Manual, for standard maintenance regimes. However, planting and maintenance regimes may be changed to enhance biodiversity. In order for any surface water drainage system to operate as originally intended, it is necessary to ensure that it is adequately maintained throughout its lifetime. Therefore, over the lifetime of a development there is strong possibility that the system could either fail or its performance be reduced if it is not correctly maintained. This is even more important when SuDS form part of the SuDS Strategy compared to traditional piped networks.

The surface water drainage scheme will be installed and fully operational before occupation of the Site occurs. The surface water drainage scheme will be regularly maintained. The key maintenance requirements are regular inspection and removal of sediment and debris as required.

Regular inspection and maintenance is required to ensure the effective long-term operation of below ground systems. Maintenance responsibility for the system will be placed with the owner of the Site who will employ responsible organisations when required. Specific maintenance needs of the system will be monitored, and maintenance schedules adjusted to suit requirements.

Preventative measures will be taken rather than corrective measures. Preventative maintenance ensures both the condition monitoring and life-extending tasks are carried out at scheduled regular intervals, ensuring failure and regular repair of the system is avoided.

Table 12 provides general details of the maintenance requirements.

Table 12 - General Requirements

General Requirements	
Maintenance activities comprise • Regular maintenance • Occasional tasks • Remedial work	Frequency
Generally Litter Collect all litter or other debris and remove it from the site at each visit	Monthly

- Avoid use of weed killers and pesticides to prevent chemical pollution.
- Avoid de-icing agents wherever possible.
- Protect all below ground drainage through careful selection and placement of hard and soft landscaping.

Permeable Surfaces

Permeable surfaces are porous to allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Table 13 provides details of the maintenance requirements.

Table 13 - Permeable Surfaces

General Requirements	Frequency
Brush regularly and remove sweepings from all hard surfaces	Monthly
Occasional Tasks	Frequency
Brush and vacuum surfaces once a year to prevent silt blockages and enhance design life	Annually
Remedial Work	Frequency
Monitor effectiveness of permeable surfaces and when water does not infiltrate immediately advise Client of possible need for reinstatement of top layers or specialist cleaning	As Required
Recent experience suggests jet washing and suction cleaning will substantially reinstate surfaces to 90% efficiency	As Required

Infiltration Basins/Trenches

Infiltration basins are vegetated depressions designed to store runoff on the surface and infiltrate it gradually into the ground. They are dry except in periods of heavy rainfall. Infiltration trenches are shallow excavations with rubble or stone that create temporary subsurface storage of stormwater runoff, thereby enhancing the natural capacity of the ground to store and drain water. Infiltration trenches allow water to exfiltrate into the surrounding soils from the bottom and sides of the trench. Table 14 provides details of the maintenance requirements

Table 14 - Infiltration Basins/Trenches

Regular Maintenance	Frequency
- Remove debris from the catchment surface (where it may cause risks to performance) - Remove sediment from pretreatment structures and/or internal forebays	Monthly for first three months then annually
- Cut grass – for spillways and access routes - Cut grass – meadow grass in and around basin - Tidy all dead growth before start of growing season - Manage other vegetation and other nuisance plants - Reseed areas of poor vegetation growth	Monthly during growing season and then as required (i.e. half yearly before nesting season and autumn)
Remedial Works	Frequency
- Repair erosion or other damage by re-seeding or re-turfing - Realignment of rip-rap - Repair/rehabilitation of inlet/outlets and overflows - Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Frequency
Inspect and identify any areas that are not operating correctly, if required take remedial action	Monthly

- Inspect banksides and structures for signs of damage

7.2 Health and Safety

In order to comply with the Construction (Design and Management) Regulations (CDM) 2015, SuDS designers must assess all the foreseeable risks during the construction phase and during the ongoing maintenance of the schemes.

Contractors and those responsible for future maintenance will be made aware of the risks by the Site owner, keeping a record of the key health and safety factors that will need to be managed during future ongoing maintenance works. During construction, the residual risks should be identified, and an action plan developed to deal with them appropriately.

All those responsible for maintenance should also take the appropriate health and safety precautions for all maintenance activities, this should additionally include lone working when relevant, and risk assessments should be undertaken for all activities.

7.3 Spillage – Emergency Action

Most spillages on development are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency, with residual spillage allowed to bioremediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s) (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric).

7.4 Maintenance Costs

The following costed maintenance schedules (see Tables 15,16 and 17) have been based on material in HR Wallingford, 2004⁸, The SuDS Manual 2007⁹, DEFRA WT1505¹⁰, Cambridge City Council¹¹.

Table 15 - Regular Maintenance Activities

Peripheral Planting	Frequency	Unit Rate (£)	Unit Cost (£)
All grass verges 1.20m – 3.00m wide or as drawings. All grass around source control areas. All cuttings collected and removed from site, at first and last cut annually. Cuts at 35 – 50mm with 75mm max.	12 cuts	236	2832
Meadow grass and native planting areas will require 2 cuts at 75mm at an agreed frequency, probably July and October. All arisings to be raked off and stacked in wildlife piles on site.	2 cuts	400	800
All native planting to be checked at grass maintenance visits and stake guards kept in good order at all times. All losses to be made good, October – December each year.	3 visits	60	180

⁸ Wallingford, 2004 Operation and maintenance of sustainable drainage systems (and associated costs)

⁹ Ciria 697, The SuDS Manual, 2007.

¹⁰ DEFRA WT1505, Final Surface Water Drainage Report, 31/07/2013.

¹¹ Cambridge City Council, Cambridge SuDS Design & Adoption Guide.

Allowance to pick up all litter in planting during sits visits.	12 visits	39	468
SuDS Features	Frequency	Unit Rate (£)	Unit Cost (£)
Aquatic plant management within infiltration basin, September to November each year. Remove nuisance plants, end of season clearance up to 25% of growth.	5 visits	100	500
Monthly Visual Monitoring	Frequency	Unit Rate (£)	Unit Cost (£)
Inspect surfaces and infiltration basin for sediment accumulated and damage, monitor aquatic vegetation. Monitor system effectiveness and identify requirements for rehabilitation works	12	150	1800
Total			6580

The frequency at which irregular maintenance is required is difficult to predict. If regular monitoring of the system is undertaken over, for example, a three-year period, then these frequencies can be defined with more confidence and long-term maintenance costs re-evaluated.

Table 16 - Irregular Maintenance Activities

SuDS Features	Frequency	Unit Rate (£)
Infiltration Basin/Trenches Remove planting and silt from 25% to 30% of base and place in site piles (subject to testing).	3	689
Permeable Paving Remove excess silt due to slow accumulation and place in site piles (subject to testing).	3	250
Limited weed control (using no-toxic/biodegradable substances).	3	50
Removal and cleaning of stone, removal and safe disposal of geotextile, replacement of geotextile and clean stone.	25	1000

Remedial maintenance has been managed as much as possible through good design. A lump sum contingency is entered into the 'unit rate' column, as it is not likely that all the identified activities will be required.

Table 17 - Remedial Operation and Maintenance/Rehabilitation

SuDS Features	Frequency	Unit Rate (£)
Infiltration Basin Removal of silt. Repair erosion or other damage. Replacement of aquatic or barrier planting.	10	5000