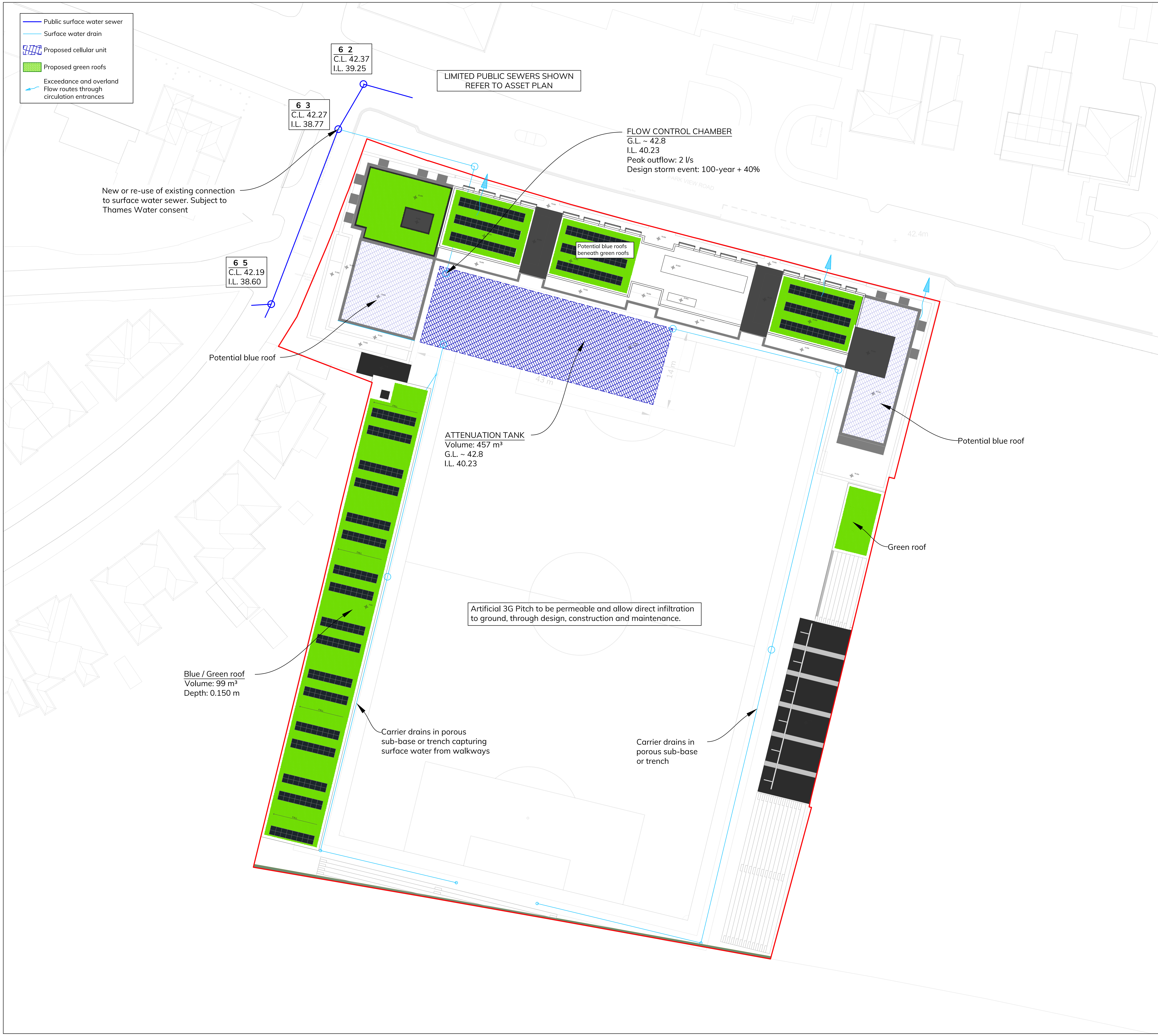

NOTES:

1. Do not scale from this drawing. Approximate positions only. Report all errors and omissions to author.
2. This drainage strategy should be read in conjunction with FRA and drainage strategy R203-FRA-01.0_4765 (November 2023).
3. Suitability of the strategy is dependent on final development proposals, SuDS features and confirmation of existing drainage on the site.
4. All access cover to be situated within the perimeter walkway or away from the pitch surface.
5. Rainwater harvesting tanks to be incorporated into the design upstream of the surface water attenuation tank. These will be used to slicken the pitch surface before use and for flushing changing room toilets.
6. Existing on site drainage and drainage connections to public sewer to be surveyed. Where existing connections are to be reused a CCTV condition survey will need to be undertaken.
7. Agreement will need to be sought from Thames Water to connect into their sewer.
8. Proposed artificial 3G pitch to be designed by others. The design, construction and maintenance should ensure that the pitch is able to infiltrate to ground throughout its intended design life.
9. Site investigations will need to be undertaken to determine the infiltration potential of the ground beneath the football pitch. Where possible infiltration should be prioritised over a connection into the public sewer.

REV	DESCRIPTION	DES	CHK	DATE

LUSTRE CONSULTING

Lustre Consulting Limited
2nd Floor North
The Fitted Rigging House
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Client

Woolwich Road Ltd

Project

Welling United Football Club
Welling

Drawing Title

Surface Water
Drainage strategy

	Name	Date	Scale 1:320
Designed	SCS	Nov 23	File No. 4765_D_001.dwg
Checked	AR	Nov 23	Drawing Status FOR INFORMATION

Drawing No.	Revision
4765-D-001	-

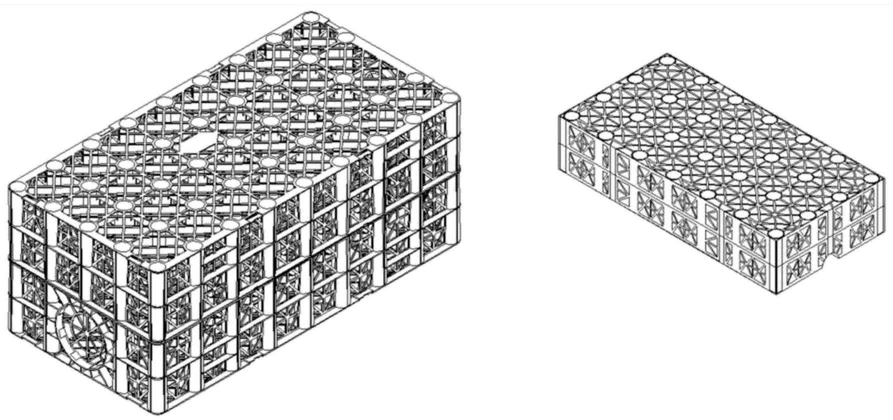
1.0 Attenuation Storage Tanks

Geocellular storage systems are modular plastic units with a high porosity (generally around 95%) that can be used to efficiently create a below ground structure of the temporary storage of surface water before controlled release or use.

They often come as modular systems, providing a high degree in flexibility in terms of size and shape they can be positioned.

They can be designed underneath roads and car parks or landscaped areas.

There are a number of different manufacturers of these systems, each having a specific use or benefit, such as ease of maintenance or strength to withstand certain loading requirements.



Illustrations below courtesy of Polypipe.

Design

These systems can be fully lined to prevent mobilisation of contaminates on the site.

Groundwater conditions will need to be considered within the final design to ensure the risks of floatation area taken into account.

The final cellular system shall be designed with good access arrangements for maintenance.

These can be used for both infiltration schemes as well as attenuation schemes.

Cellular attenuation benefits

Attenuation storage tanks provide multiple benefits when considered against the four pillars of SuDS. The benefits will vary in relation to the final makeup of the attenuation storage tanks.

Water Quantity

Cellular units are very effective in providing water quantity, generally with porosity at around 95%. They are very adaptable and can be located under multiple surfaces, subject to design for maximum flexibility.

The volume of attenuation which cellular units provides is derived by the design of the flow control and allowable outflow rate.

Water Quality

Cellular units in themselves do not provide advantages for water quality. SuDS components incorporated into the design, such as pervious pavements and tree pits will help improved water quality prior to reaching cellular units.

Catchpits may be required where a primary means of surface water cleaning has not been provided.

Biodiversity

Cellular units do not provide any biodiversity benefits. However by managing the surface water runoff from the site, they will reduce impacts of high flows downstream.

Amenity

The flexibility of tanks allows for multiple use of surfaces be used above. This can be used to improve amenity at the surface.

Maintenance

The maintenance requirements for attenuation storage tanks have been derived from The SuDS Manual (Table 21.3) and set out in Table 1.

Table 1 Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

2.0 Green Roofs

Green roofs are areas of living vegetation, installed on top of buildings. They provide multiple benefits when considering the four pillars of SuDS. These include visual benefit, ecological value, enhanced building performance (insulation and sound absorption) and the reduction of surface water runoff. The types of green roof can be divided into two main categories:

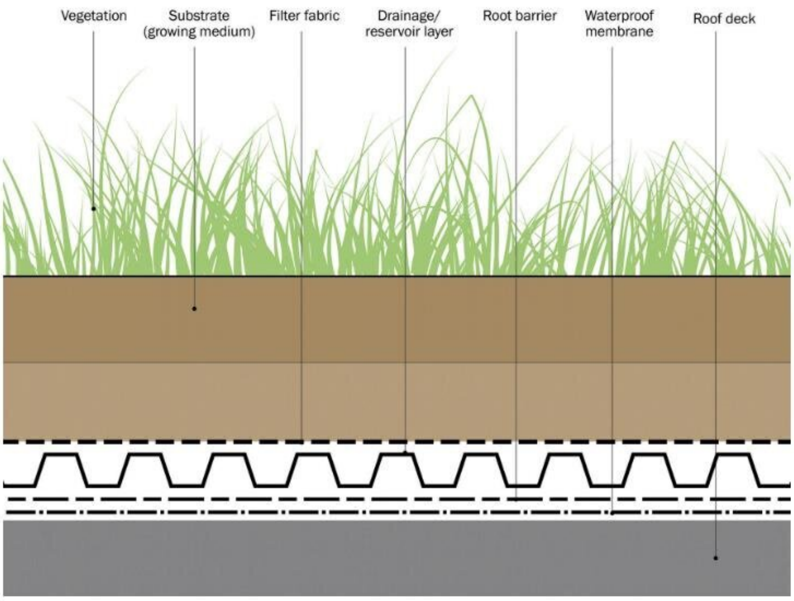
Extensive roofs, have low substrate depths (and therefore low loadings on the building structure), simple planting and low maintenance requirements; they tend not to be accessible.

Intensive roofs, (or roof gardens) have deeper substrates (and therefore higher loadings on the building structure) that can support a wide variety of planting but which tend to require more intensive maintenance; they are usually accessible.

Design

Green roofs typically have a substrate depth of between 80 – 150 mm. The depth of substrate will determine the type of plants, overall use and overall benefit when considering the four pillars of SuDS. Intensive roofs generally have substrate depths from 200 mm but is typically much deeper.

The following figure (from The SuDS Manual) shows a typical green roof section showing extensive green roof components.



Section showing typical extensive green roof components

Green roof benefits

Green roofs provide multiple benefits when considered against the four pillars of SuDS. The benefits will vary in relation to the final makeup of the green roof.

Water Quantity

Retention of water in the substrate reduces and slows runoff. Evidence as noted within the SuDS Manual states that green roofs can provide benefits in terms of reducing peak flow rates to the site drainage system principally for small and medium sized events. Their impact tends to be most significant in summer where intense short duration events may generate very little runoff from the roof.

During extreme events and during critical storm events in the order of 12 to 36 hours, the overall runoff volumes from green roofs are likely to be small. This will be affected by the depth and storage potential of the substrate and the antecedent soil moisture and any specific drainage layer capacity.

Water Quality

Improves water quality through filtration.

Vegetation filters out airborne particulates as the air passes over the plants, settling on the leaves and stems. These particles are washed down into the growing substrate via natural rainfall or irrigation. They are then held within the green roof substrates and prevented from getting into the drainage system. Heavy metals such as lead, zinc and coper are recognised pollutants within urban areas, green roofs play a major role in limiting their potential to contaminate downstream receptors.

Biodiversity

Providing habitat at roof level, especially within urban areas, can have significant benefits for wildlife, notably invertebrates and birds.

The extent and type of biodiversity will depend on the makeup and layout of the final design. Green roofs provide opportunities to provide different habitats for different species.

Amenity

Roofs can provide areas for recreation and relaxation and can be aesthetically pleasing.

Green roofs can provide climate resilience, through:

- Improved building thermal efficiency, reduced energy demand and reduction of the urban heat island effect.
- Improved air quality
- Reduced noise levels
- Increased building service life

Maintenance

The maintenance requirements for greens roofs have been derived from The SuDS Manual (Table 12.5) and set out in Table 2.

Table 2 Operation and maintenance requirements for greens roofs

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where >5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required

Table 2 Operation and maintenance requirements for greens roofs

Maintenance schedule	Required action	Typical frequency
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

3.0 Pervious Pavements

Pervious pavements are described by the SuDS Manual as providing a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. There are two type of pervious pavements that are defined on the basis of the surfacing materials:

Porous pavements infiltrate water across their entire surface material, for example reinforced grass or gravel surfaces, resin bound gravel, porous concrete and porous asphalt.

Permeable pavements have a surface that is formed of material that is itself impervious to water. The materials are laid to provide a void space through the surface to the sub-base.

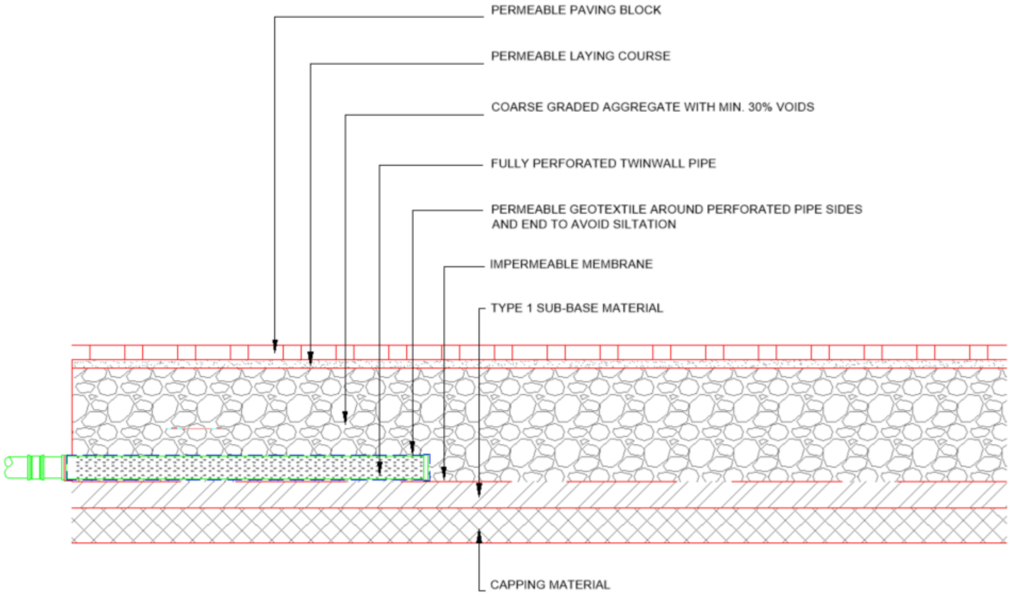
Design

Pervious paving should be used wherever possible on external hard standing areas.

Where there is a risk of mobilizing contaminates the system should be fully lined to prevent rainwater from seeping through the underlaying geology.

A porous sub-base should be provided to provide a degree of cleaning, attenuation and a further measure to slow water down.

A perforated drain could be provided at the base of the porous sub-base layer to convey surface water to an attenuation tank if required. Service corridors could be provided.



TYPICAL PERMEABLE PAVING CONSTRUCTION DETAIL

Pervious pavements benefits

Pervious pavements provide multiple benefits when considered against the four pillars of SuDS. The benefits will vary in relation to the final makeup of the pervious pavements.

Water Quantity

The design will ultimately attenuate surface water within a combination of porous sub-base and cellular storage.

The volume and water level within the system can be controlled using a vortex control. Porous sub-base usually has approximately 30% voids.

Water Quality

Treatment processes occurring within pervious pavements include:

- Filtration of silt and the attached pollutants
- Biodegradation of organic pollutants, such as petrol and diesel within the pavement construction
- Adsorption of pollutants

- Settlement and retention of solids

Permeable pavement drainage has been shown to have decreased concentrations of a range of surface water pollutants when compared to impermeable surface drainage, including heavy metals, oil and grease, sediment and some nutrients.

Biodiversity

Pervious pavements do not have any direct biodiversity benefits. However, the improvements in water quality will play a role in maximising the benefits downstream.

Amenity

There are no specific design requirements to achieve amenity over and above the choice of surface as part of the overall planning, architectural or landscape design. Pervious pavements provide flexibility in visual aspects for multiple uses and activities.

Maintenance

The maintenance requirements for pervious pavements have been derived from The SuDS Manual (Table 20.15) and set out in Table 3.

Table 3 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
	Remediate any landscaping which, through vegetation maintenance or	As required

Table 3 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Remedial actions	soil slip, has been raised to within 50 mm of the level of the paving	
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and / or weed growth–if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

4.0 Trees

Trees can help protect and enhance the urban environment. Trees and their planning structures provide benefits to surface water management in the following ways:

Transpiration: The process by which water, taken in from the soil by tree roots, is evaporated through the pores or stomata on the surface of leaves.

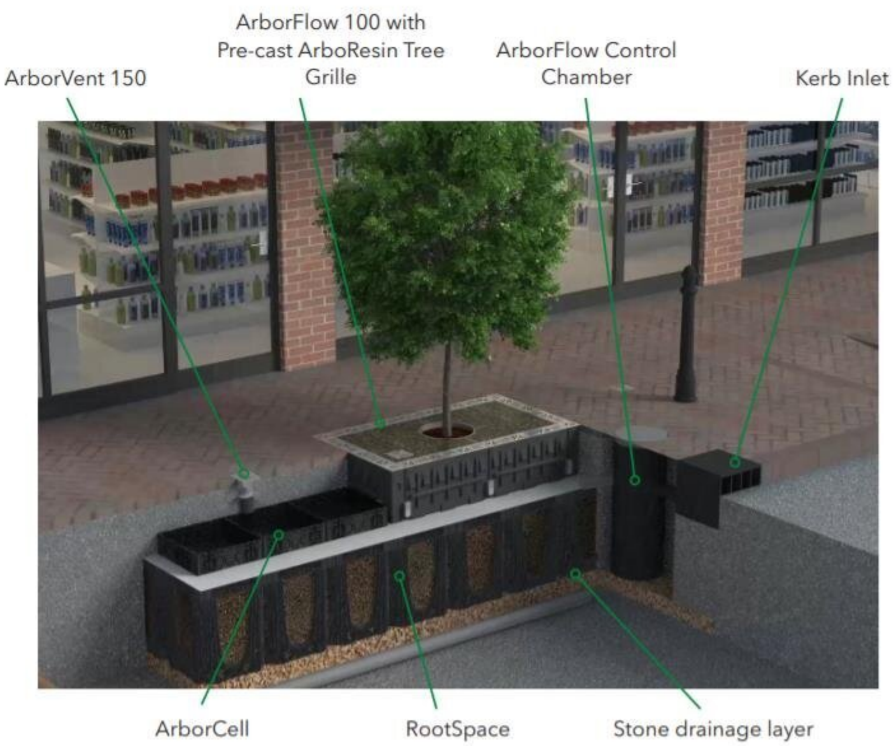
Interception: Leaves, branches and trunk surfaces intercept and absorb rainfall

Increased infiltration: Root growth and decomposition increase soil infiltration capacity and rate

Phytoremediation: The process of drawing water from the soil, tress also take up trace amounts of harmful chemicals, including metals, organic compounds, fuels and solvents that are present in the soil

Design

An Arbor Flow has been developed by GreenBlue Urban as an effective and environmentally robust means of managing surface water runoff. The Arbor Flow system provides multiple benefits. An illustration from GreenBlue Urban is provided below.



Tree pit benefits

Tree pits provide multiple benefits when considered against the four pillars of SuDS. The benefits will vary in relation to the final makeup of the tree pit.

Water Quantity

Trees naturally provide interception storage although the level of which will depend on may factors such as time of year, species and age.

Tree pits such as the Arbor Flow area ideal for use in urban areas where space is at a premium. The tree pit reduces the velocity and flow rate of surface water runoff in urban areas.

Water Quality

Tree pits will filter out pollutants from runoff and by reducing the volume of runoff will also help to reduce pollutant loadings to receiving surface waters.

The makeup of the soils can be designed to provide further filtering of the water.

Trees will also take up trace amounts of harmful chemicals.

Biodiversity

The site is currently entirely hardstanding and therefore has very little biodiversity potential. The inclusion of trees on the site will encourage urban wildlife. Combined with the onsite landscaping and carefully designed biodiversity could be enhanced even further.

Amenity

The location of the tree planting should be selected to maximise their visual impact as well as their potential to deliver surface water management.

Maintenance

The maintenance requirements for trees have been derived from The SuDS Manual (Table 19.3) and set out in Table 4.

Table 4 Operation and maintenance requirements for trees (after CRWA, 2009)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

5.0 References

- Creating Green Roofs for Invertebrates, A best practice guide, Buglife
- The GRO Green Roof Code (Anniversary Edition 2021)
- GreenBlue Urban products including ArborFlow SuDS Tree Pits [greenblue.com]
- Polypipe products including Permavoid products [polypipe.com]

Asset Location Search Sewer Map - ALS/ALS Standard/2023_4889752

The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 547132,175612

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
371A	n/a	n/a
381F	n/a	n/a
381G	n/a	n/a
3813	n/a	n/a
281B	n/a	n/a
2801	44.5	43.41
2701	43.96	42.88
2806	44.59	42.44
2710	43.99	42.44
2805	44.83	42.2
271B	n/a	n/a
271A	n/a	n/a
3803	44.84	43.94
3804	44.81	43.79
371J	n/a	n/a
371I	n/a	n/a
371H	n/a	n/a
3811	n/a	n/a
3703	44.1	n/a
3704	44.67	43.63
3802	45.01	43.89
3810	45	41.92
371D	n/a	n/a
381D	n/a	n/a
3812	n/a	n/a
381C	n/a	n/a
371F	n/a	n/a
371E	n/a	n/a
371L	n/a	n/a
371K	n/a	n/a
371G	n/a	n/a
1602	42.48	41.73
171F	n/a	n/a
171D	n/a	n/a
171A	n/a	n/a
171B	n/a	n/a
171G	n/a	n/a
171H	n/a	n/a
171I	n/a	n/a
1701	43.11	41.15
1801	43.29	41.97
181H	n/a	n/a
181F	n/a	n/a
181G	n/a	n/a
181C	n/a	n/a
181A	n/a	n/a
181E	n/a	n/a
1603	42.77	41.37
1607	42.73	41.33
2707	43.31	41.3
2708	43.75	41.7
2705	43.73	42.21
2709	43.8	41.92
2702	43.79	42.48
2703	44.04	42.87
2706	44.12	42.88
2704	44.02	43.1
181J	n/a	n/a
2803	44.19	43.36
181I	n/a	n/a
281A	n/a	n/a
2802	44.51	43.59
281G	n/a	n/a
281F	n/a	n/a
281C	n/a	n/a
371C	n/a	n/a
371B	n/a	n/a
9618	42.26	40.04
9606	42.75	41.25
9620	42.79	n/a
9704	43.2	41.12
9705	43.68	41.42
0702	43.01	39.56
0703	43	41.86
0708	43.08	40.45
9706	44.48	41.77
9712	44.32	43.26
9702	44.13	n/a
971A	n/a	n/a
9708	44.53	42.41
971B	n/a	n/a
981E	n/a	n/a
061M	n/a	n/a
061R	n/a	n/a
061S	n/a	n/a
0601	42.32	41.05
0602	42.37	39.25
0610	42.36	40.44
0709	42.44	40.41
0704	42.44	41.26
0710	42.48	40.74

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0711	n/a	n/a
0712	n/a	n/a
171E	n/a	n/a
071H	n/a	n/a
0707	43.78	41.17
071I	n/a	n/a
071J	n/a	n/a
261A	n/a	n/a
261B	n/a	n/a
2609	n/a	n/a
2604	42.92	41.77
261C	n/a	n/a
2608	43.13	39.81
3601	43.17	39.7
3606	43.14	42.13
3608	43.65	40.62
3607	43.58	42.44
3609	n/a	n/a
361B	n/a	n/a
361A	n/a	n/a
3613	n/a	n/a
3604	43.55	42.19
3611	43.78	40.44
3605	43.84	42.55
9804	45.91	44.67
981D	n/a	n/a
071B	n/a	n/a
071H	n/a	n/a
071A	n/a	n/a
071I	n/a	n/a
0701	44.4	40.2
0706	44.32	41.74
071K	n/a	n/a
071F	n/a	n/a
071M	n/a	n/a
071N	n/a	n/a
0803	44.72	42.1
071L	n/a	n/a
071G	n/a	n/a
081B	n/a	n/a
081E	n/a	n/a
081A	n/a	n/a
081F	n/a	n/a
n/a	n/a	n/a
071O	n/a	n/a
081H	n/a	n/a
081G	n/a	n/a
171C	n/a	n/a
181B	n/a	n/a
9711	44.44	42.14
9703	45.3	n/a
9701	n/a	n/a
9803	n/a	n/a
981B	n/a	n/a
881A	n/a	n/a
881C	n/a	n/a
9801	45.86	44.13
981A	n/a	n/a
981C	n/a	n/a
881B	n/a	n/a
351A	n/a	n/a
351B	n/a	n/a
3614	43.19	42.17
3603	43.48	39.87
3610	43.48	39.67
3602	43.29	39.81
351G	n/a	n/a
351E	n/a	n/a
351D	n/a	n/a
351C	n/a	n/a
061O	n/a	n/a
061N	n/a	n/a
0606	42.27	38.55
0604	n/a	n/a
0605	42.19	38.6
0611	42.2	40.74
061J	n/a	n/a
061F	n/a	n/a
061G	n/a	n/a
0603	42.27	38.77
061H	n/a	n/a
061I	n/a	n/a
061L	n/a	n/a
061K	n/a	n/a
161A	n/a	n/a
161B	n/a	n/a
1601	42.26	41.3
1606	42.27	40.33
1604	42.49	39.29
2606	42.69	40
2607	42.7	39.98
2601	43.12	40.88
2602	43.01	39.49

Manhole Reference	Manhole Cover Level	Manhole Invert Level
2603	42.85	41.75
9604	42.2	40.64
961A	n/a	n/a
951A	n/a	n/a
9614	42.22	39.11
9611	42.1	40.56
961D	n/a	n/a
961C	n/a	n/a
9509	n/a	n/a
9619	42.27	40.52
9507	n/a	n/a
9605	42.29	41.01
9502	43.76	41.84
961F	n/a	n/a
9508	n/a	n/a
961E	n/a	n/a
9506	n/a	n/a
951B	n/a	n/a
9612	41.93	n/a
9613	n/a	n/a
9505	43.41	38.35
061B	n/a	n/a
061A	n/a	n/a
061D	n/a	n/a
0612	42.81	41.18
061E	n/a	n/a
061Q	n/a	n/a
0607	42.59	38.43
061P	n/a	n/a
9501	43.61	40.79
9504	43.64	38.11
961B	n/a	n/a
9601	41.44	40.07
9608	41.51	40.17
9616	41.6	39.13
9615	41.78	39.16
9609	n/a	n/a
9610	41.83	40.25
9602	42	n/a
9617	41.66	39.69
9603	41.95	40.54
9607	42.24	40.62
9621	42.26	n/a
8613	42.35	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Cellular Storage	0.420	10.00	2.200	52.909	52.365	2.200
Green roof (west)	0.090	15.00	10.000	-3.899	18.188	0.300

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	0.2
Summer CV	1.000	Drain Down Time (mins)	240	30 year (l/s)	0.4
Winter CV	1.000	Additional Storage (m³/ha)	20.0	100 year (l/s)	0.6
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.10	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	0.2
Positively Drained Area (ha)	1.230	Growth Factor 2 year	0.88	Q 2 year (l/s)	0.2
SAAR (mm)	602	Growth Factor 30 year	2.40	Q 30 year (l/s)	0.4
Soil Index	1	Growth Factor 100 year	3.19	Q 100 year (l/s)	0.6

Node Cellular Storage Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	0.000	Product Number	CTL-SHE-0067-2000-1000-2000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node Green roof (west) Offline Orifice Control

Flap Valve	x	Invert Level (m)	9.700	Discharge Coefficient	0.600
Loop to Node	Cellular Storage	Diameter (m)	0.025		

Node Cellular Storage Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	0.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	600.0	0.0	0.800	600.0	0.0	0.801	0.0	0.0

Node Green roof (west) Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	9.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	790.0	0.0	0.150	790.0	0.0	0.151	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	Cellular Storage	465	0.152	0.152	12.3	87.1152	0.0000	OK
1440 minute winter	Green roof (west)	1320	9.732	0.032	0.9	23.8469	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
600 minute summer	Cellular Storage	Hydro-Brake®		1.8	63.1
1440 minute winter	Green roof (west)	Orifice	Cellular Storage	0.2	10.5

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	Cellular Storage	585	0.381	0.381	18.4	218.3663	0.0000	OK
960 minute winter	Green roof (west)	930	9.768	0.068	2.6	51.3990	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
600 minute winter	Cellular Storage	Hydro-Brake®		2.0	77.0
960 minute winter	Green roof (west)	Orifice	Cellular Storage	0.3	14.0

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Cellular Storage	945	0.534	0.534	16.7	306.1963	0.0000	OK
960 minute summer	Green roof (west)	960	9.791	0.091	5.3	68.5012	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	Cellular Storage	Hydro-Brake®		2.0	107.4
960 minute summer	Green roof (west)	Orifice	Cellular Storage	0.4	16.8

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Cellular Storage	945	0.797	0.797	23.3	457.1884	0.0000	OK
960 minute winter	Green roof (west)	945	9.830	0.130	4.9	98.4594	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	Cellular Storage	Hydro-Brake®		2.0	109.7
960 minute winter	Green roof (west)	Orifice	Cellular Storage	0.4	21.2

1. Project & Site Details	
Project / Site Name (including sub-catchment / stage / phase where appropriate)	Welling United Football Club
Address & post code	Welling United Football Club Park View Road Welling DA16 1SY
OS Grid ref. (Easting, Northing)	E 547130 N 175610
LPA reference (if applicable)	
Brief description of proposed work	Multi-use sports facility, with street level commercial / retail space. Proposals alos include 104 new homes.
Total site Area	12300 m^2
Total existing impervious area	2800 m^2
Total proposed impervious area	5100 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	Not within a Critical Draiange Area
Existing drainage connection type and location	existing drainage connecting into public sewers in multple locations
Designer Name	Simon Stoate
Designer Position	Principal
Designer Company	Lustre Consulting

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility	
Superficial geology classification	None
Bedrock geology classification	Harwich Formation London Clay in the south of the site
Site infiltration rate	m/s
Depth to groundwater level	m below ground level
Is infiltration feasible?	

2b. Drainage Hierarchy	*Feasible (Y/N)*	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	Y	Y
3 attenuate rainwater in ponds or open water features for gradual release	N	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	Y	Y
7 discharge rainwater to the combined sewer.	N	N

2c. Proposed Discharge Details	
Proposed discharge location	Public surface water sewer
Has the owner/regulator of the discharge location been consulted?	opment Application form submitted to Thar

3. Drainage Strategy

3a. Discharge Rates & Required Storage

	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m³)*	*Proposed discharge rate (l/s)*
Qbar	0.2			
1 in 1	0.2	9.8	85	1.9
1 in 30	0.4	36.6	217	2
1 in 100	0.6	47.8	308	2
1 in 100 + CC			452	2
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Vortex control with attenuation		

3c. Proposed SuDS Measures

	Catchment area (m²)	*Plan area (m²)*	*Storage vol. (m³)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	1447	1447	7
Blue roofs	900	790	112
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	0	0	0
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	4200		457
Total	**6547**	**2237**	**576**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Not assessed at this stage due to ongoing use of football pitch
Drainage hierarchy (2b)	From Section 6.8
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Pre Development Enquiry submitte
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Table 8 and Appendix D
Proposed SuDS measures & specifications (3b)	From Section 5.30 and Appendix D
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix B
Detailed drainage design drawings, including exceedance flow routes	Appendix D
Detailed landscaping plans	Appendix B
Maintenance strategy	Appenidix D
Demonstration of how the proposed SuDS measures improve:	Appendix D
a) water quality of the runoff?	Appendix D
b) biodiversity?	Appendix D
c) amenity?	Appendix D

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