Kentish Town Road

Flood Risk Assessment & Surface Water Drainage Strategy Report

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Job Number:	26778

Date	Version	Notes/Amendments/Issue Purpose
January 2019	01	Issued for BIA
February 2019	02	Amended for BIA submission
March 2020	03	For Planning

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1 Introduction

This Flood Risk Assessment (FRA) and surface water strategy report has been produced to address Condition 16 of the Planning Permission and to accompany the Basement Impact Assessment (BIA) for 369-377 Kentish Town Road, London, NW5 2TJ.

This report has been carried out in accordance with the National Planning Policy Framework (NPPF)and the accompanying Planning Practice Guidance (PPG) “Flood Risk and Coastal Change”. This report also incorporates advice and guidance from the Environment Agency, the Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014) and CIRIA documents.

2 Flood Risk Assessment

2.1 Flood Risk from Watercourses and Tidal Flooding

The EA's indicative floodplain map shows that the site is located in Flood Zone 1 and is not at risk of fluvial flooding and/or tidal. Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere.

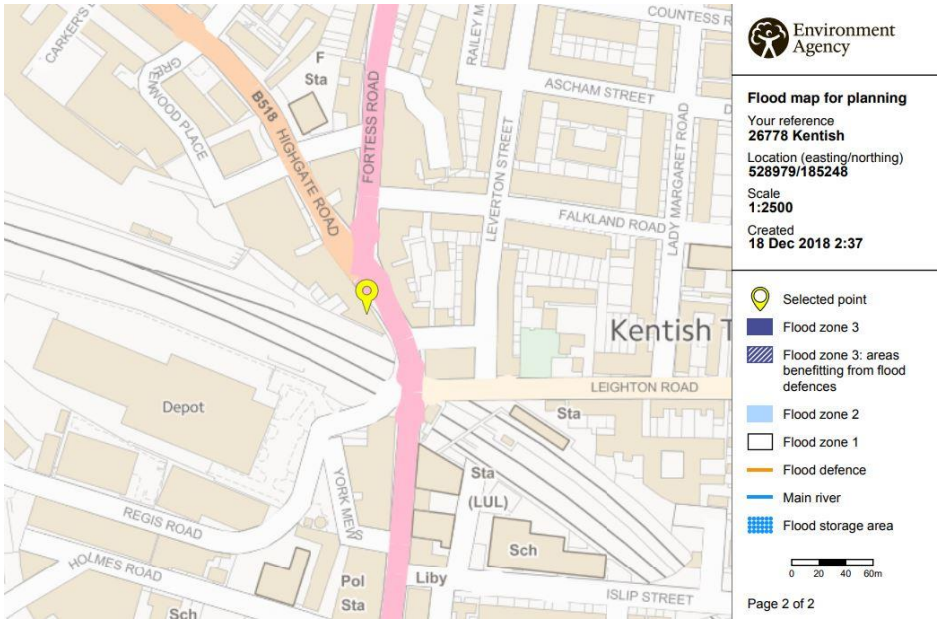

Figure 2.1: Extract from EA Flood Map for Planning

2.2 Flood Risk from Groundwater

Groundwater flooding occurs when water originating from sub-surface permeable strata emerges from the ground, typically after prolonged rainfall.

The "Increased Susceptibility to Elevated Groundwater" map in Camden Council's SFRA indicates that the proposed site is in an area with no recorded historic groundwater flooding and is not susceptible to elevated groundwater levels. An extract from the map is included in Figure 2.2 below.

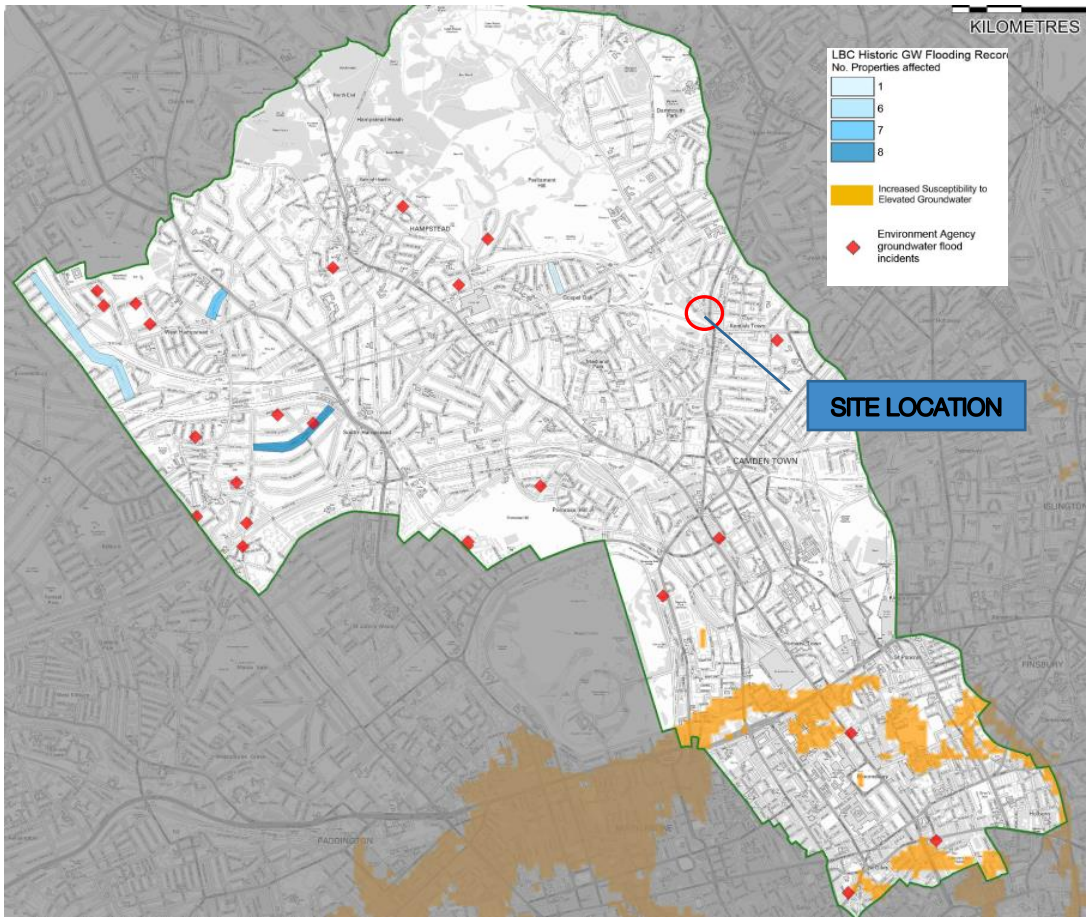

Figure 2.2: Extract from Figure 4e (Camden's SFRA-Appendix B)

In addition to the above, the site-specific investigation report, found clay in all exploratory holes in a depth from 1 to 2 meters below ground level. These findings match the information from the British Geological Survey (BGS) shown in Figure 2.3 below.

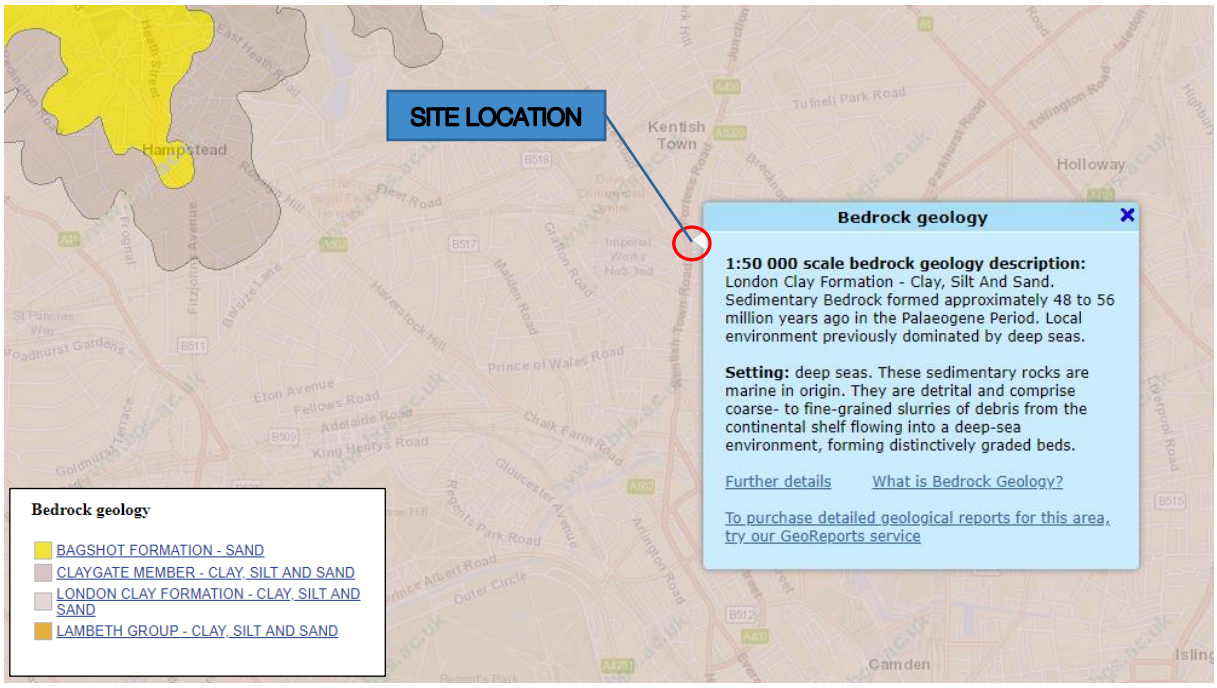

Figure 2.3: Extract from BGS Bedrock Geological Map

Groundwater flood risk is therefore considered negligible.

2.3 Flood Risk from Surface Water and Overland Flows

Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter a drainage system due to blockages or the capacity of the system being exceeded. Overland flows can also be generated by burst water mains, failed dams and any failure in a system storing or transferring water.

The EA's indicative Surface Water Flooding Map, Figure 2.4, shows that the site is at low risk of surface water flooding.

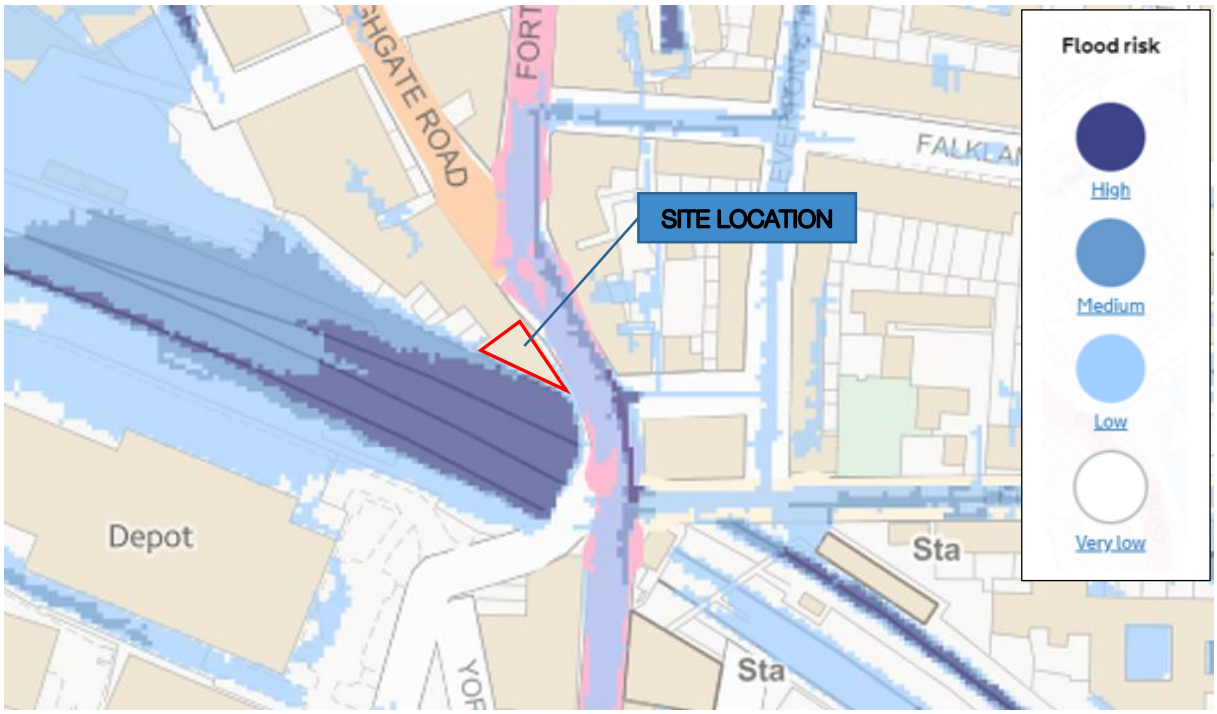

Figure 2.4 Environment Agency Surface Water Flood Risk Map

The site forms a triangle shape bounded to the south by the main railway passing through Kentish Town and to the East by Kentish Town Road.

The map in Figure 2.4 shows that the railway is at high risk of flooding from surface water, however this cannot affect the site as the railway is at a lower level in comparison with the site.

This map also shows that the western side of Kentish Town Road is at low risk of flooding, increasing to high risk at the eastern side of the road.

Therefore, the flood risk from surface water and overland flows is considered low.

2.4 Flood Risk from Reservoirs

The EA provides information on flood risk from reservoirs. The Figure below shows that the site is not at risk of reservoir flooding.

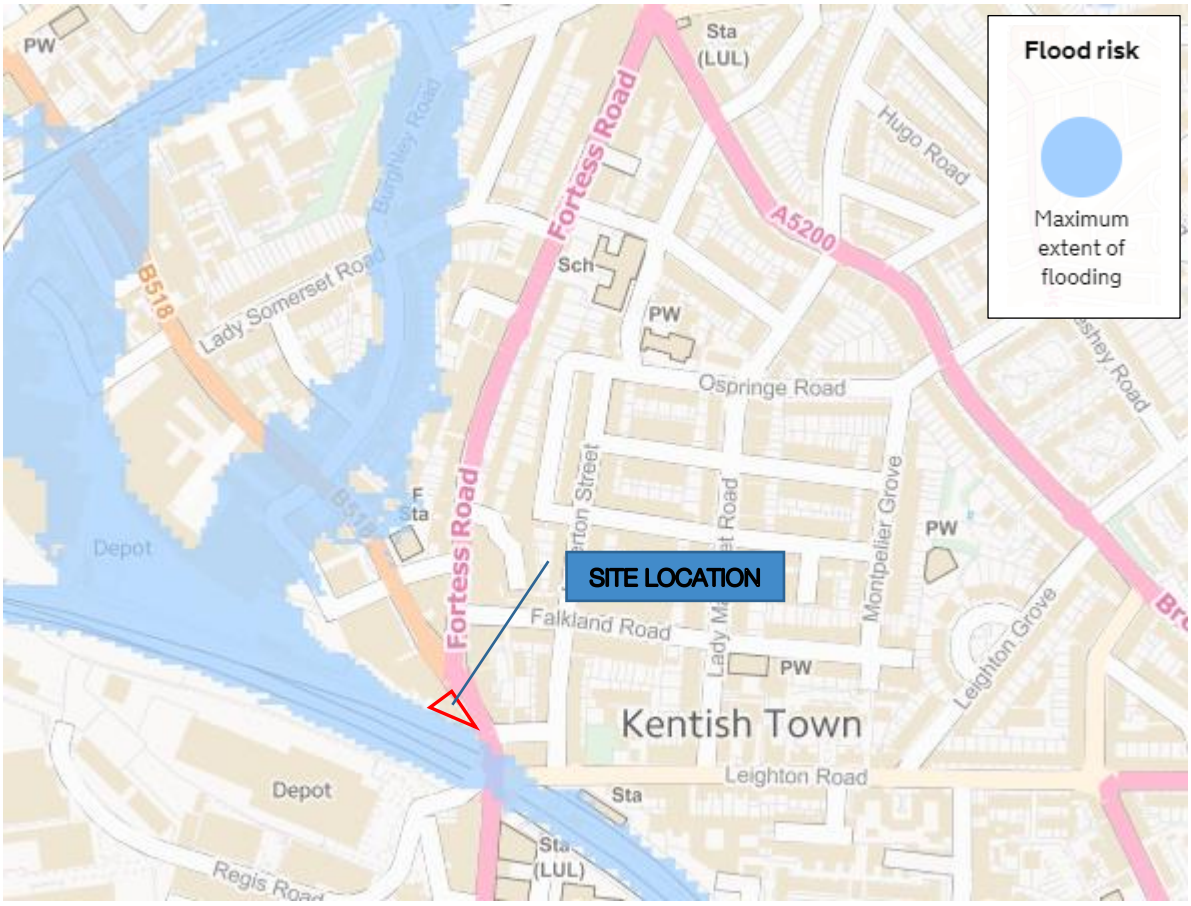

Figure 2.5 Environment Agency Risk of Reservoir Flooding Map

3 Surface Water Run-Off Assessment

3.1 Existing Run-Off

The total site area is approximately 370m^2 or 0.037 ha, which is all currently impermeable

The existing run-off rate for the 1 in 100-year storm event was calculated using the modified rational method as shown below:

$Q_x = 2.78 \times i \times A$

Where 'x' is the return period in years, 'A' is the catchment area in ha and 'i' is the rainfall intensity in mm/hr as estimated from Micro Drainage software.

Q_1 = 2.78 x 46.1 x 0.037 = 4.70 l/sec
Q_{30} = 2.78 x 112.2 x 0.037 = 11.60 l/sec
Q_{100} = 2.78 x 147.3 x 0.037 = 15.20 l/sec

The existing run-off rates for storm events of several different return periods were calculated using the Greenfield Runoff Estimator tool from uksuds.com:

$Q_{bar\ gf}$ = 0.19 l/sec
$Q_{1\ gf}$ = 0.16 l/sec
$Q_{30\ gf}$ = 0.42 l/sec
$Q_{100\ gf}$ = 0.59 l/sec

The Greenfield run-off rates have been calculated by multiplying the 100-year growth curve factor by Q_{bar}. The Greenfield run-off rate is estimated based on a minimum catchment area of 0.1ha. Therefore, the above Greenfield run-ff rates were interpolated for the development area. Refer to Appendix A for information.

3.2 Proposed Run-off

The proposed development will maintain the impermeable areas as existing. An additional allowance for climate change should also be made.

The current EA guidance states that for the years 2070 to 2115 there is a 50% chance the peak rainfall intensity will increase by 20% or more and that there is a 10% change it will increase by 40% or more. In order to decide which allowance to use the vulnerability of the development and the 'built in' resilience measures were considered.

Following the above a 40% increase in the current rainfall has been considered.

The run-off rate from the proposed development was calculated using the modified rational method.

Q_{100+40} = 2.78 x 206.2 x 0.037 = 21.20 l/sec

4 SUDS Assessment

In accordance with the London Plan, EA guidelines, the SFRA, and CIRIA documents, surface water run-off should be managed as close to its source as possible. The London Plan states that all new developments should aim to reduce run-off to Greenfield rates "utilising SUDS unless there are practical reasons for not doing so".

The possibility of implementing SUDS at the site was assessed using a hierarchy of preferred surface water management methods. The following paragraphs discuss the various methods in order of that hierarchy and evaluate the site's suitability for each method.

4.1 Store Rainwater for Later Use

Rainwater harvesting promotes the storage and re-use of rainwater collected from roofs and hard surfaced areas. This type of system contributes to the reduction of runoff rates and volumes within a development.

The capacity of rainwater harvesting systems to attenuate rainwater depends on the water use within the building. If there is no activity in the building and the harvester is full, no attenuation will be provided during a subsequent storm event. In the worst-case scenario, the rainwater harvester will provide no attenuation. Therefore, rainwater harvesting systems have not been considered as they will provide no attenuation benefits in the worst-case scenario.

4.2 Infiltration Techniques

The site investigation confirms that the site is underlain by London Clay which is unsuitable for the use of infiltration techniques. Therefore, infiltration systems are not suitable for this development.

Additionally, the site layout and extents of the building footprint limits the potential for soakaways, as soakaways should be located a minimum of 5 m away from any structural foundations as per Part H of the Building Regulations and BRE 365: Soakaway Design. Furthermore, there are no watercourses in the vicinity of the site. Therefore, the only available option is to drain to the public sewers.

4.3 Attenuation

Where infiltration is not feasible, the next preferred SUDS is attenuation to Greenfield run-off rates. It is preferable to attenuate rainwater in ponds or open water features, opposed to below ground tanks, as these systems provide wider sustainability benefits. However, there is insufficient space within the site boundary to accommodate such systems.

The total roof area is 260 m^2, of which, approximately 110 m^2 is proposed for a blue roof system. The proposed discharge rate from the blue roofs will be restricted to 2.0 l/sec via a series of series of orifice outlets. This system (designed by a Blue Roof Specialist) provides approximately 11 m^3 attenuation storage and accommodates the 1 in 100-year storm event plus 40% allowance for climate change. Refer to Appendix D for preliminary calculations and typical details.

It is proposed for the blue roofs to connect into tanked permeable paving, which is located in the external hardstanding areas. The volume of attenuation storage within the permeable strata has been designed to accommodate the 1 in 100-year storm event plus 40% allowance for climate change, whilst considering the additional 2 l/sec inflow from the blue roof system. Refer to Appendix C for MicroDrainage calculations.

Attenuating the discharge rate to the Greenfield run-off rates noted in Section 3.1 results in a high risk of flooding from blockages. A flow control of a very small diameter would be required to attenuate surface water to the 1 in 100-year Greenfield run-off rate (0.59 l/sec). Building

Regulations Part H states that surface water pipes should be at least 75mm diameter to reduce the flood risk from blockages.

It is therefore proposed to attenuate the flows from the site using a flow control device with at least 75mm intake opening. Calculations from Hydrobrake International manufacturer show that the discharge rate will need to be limited to a minimum of 1.8 l/sec to guarantee this minimum intake size, as shown on Figure 4.1 below.

A flow control device is proposed to limit surface water run-off from the development to 1.80 l/sec for all storm events – including the design storm with the climate change allowance. This will then discharge into the 1549 mm x 991 mm combined water public sewer located in Kentish Town Road via an existing drainage connection.

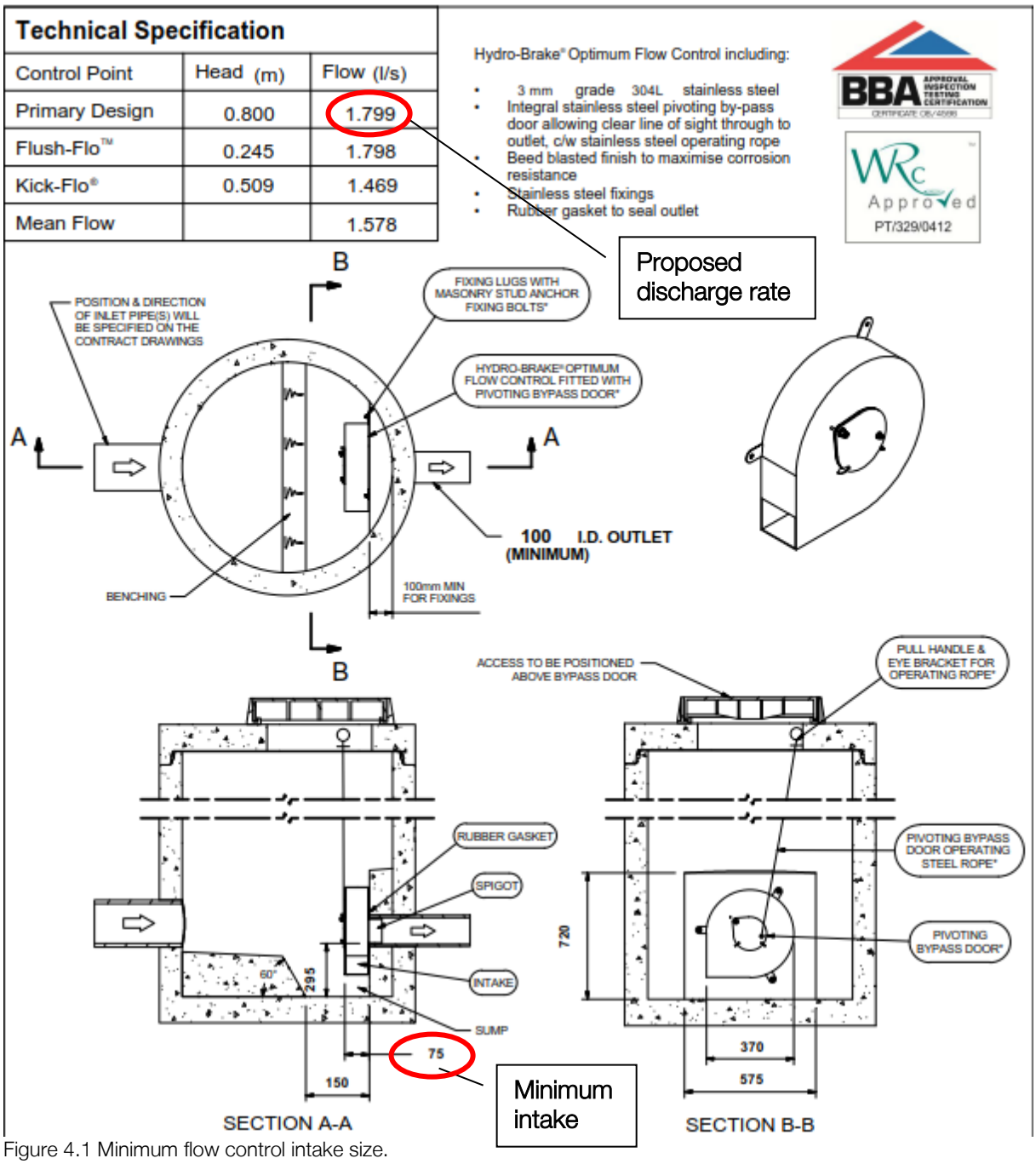

Figure 4.1 Minimum flow control intake size.

The proposed 1.80 l/sec discharge rate achieves a greater than a 50% betterment of the existing 1 in 1-year rainfall event, and a significant betterment of more intense storm events as calculated in Section 3.1.

A CCTV survey is required to confirm the existing drainage depth and arrangement. Reuse of an existing connection (or a new connection) is subject to Section 106 approval from Thames Water.

5 Surface Water Maintenance Strategy

The successful implementation and operation of a SUDS system depends on a robust and clear maintenance strategy being implemented. The following measures should form part of the site's proposed management plan.

All of the SUDS will be maintained by the future owners and will form part of the overall maintenance regime for the site.

SUDS Element	Maintenance		
	Maintenance Schedule	Required Action	Typical Frequency
Blue Roofs	Monitoring / Inspections	Inspect all components including, drains, membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
		Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	
		Inspect underside of roof for evidence of leakage	
	Regular Maintenance	Remove debris and litter to prevent clogging of inlet drains	Half yearly and annually or as required
	Remedial Actions	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

SUDS Element	Maintenance		
	Maintenance Schedule	Required Action	Typical Frequency
Permeable Paving	Monitoring / Inspections	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 hours after large storms in first six months
		Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
		Monitor inspection chambers	Annually
	Regular Maintenance	Brushing and vacuuming -standard cosmetic sweep over whole surface	Once a year after autumn leaf fall
		Rubbish and litter removal	As required
	Remedial Actions	Remediate any landscaping which through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
		Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural	

SUDS Element	Maintenance		
	Maintenance Schedule	Required Action	Typical Frequency
		performance or a hazard to users, and replace lost jointing material	
		Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required

Table 5.1 SUDS Maintenance Strategy as taken from the CIRIA SUDS Manual

6 Conclusions

- This Flood Risk Assessment (FRA) and surface water strategy report has been produced to address Condition 16 of the Planning Permission and to accompany the Basement Impact Assessment (BIA) for 369-377 Kentish Town Road, London, NW5 2TJ.

- The site is in Flood Zone 1, an area at low risk of flooding from Rivers and sea. The site is also at low risk of flooding from other sources (Surface water, groundwater, public sewers or reservoirs).

- Therefore, the proposed development has an acceptable flood risk within the terms and requirements of the NPPF.

- Condition 16 of planning permission (application ref: 2019/0910/P) notes that 20m^3 attenuation storage is required. The drainage strategy has since been revised according to correspondence with the Local Lead Flood Authority (report ref: 26778 PM LLFA Response_1). The required volume of storage has been exceeded by providing attenuation storage via the blue roof and a permeable paving system.

- A blue roof system is proposed and will provide approximately 11 m^3 attenuation storage. This will restrict surface water runoff from the building to 2.0 l/sec via a series of orifice outlets – designed by a blue roof specialist. The blue roof will discharge into a tanked permeable paving system at ground level.

- 37.8 m^3 attenuation storage via a tanked permeable paving system will be provided for the external hardstanding areas and 2.0 l/sec inflow from the blue roof.

- The proposed surface water run-off rate will be restricted to 1.80 l/sec. This run-off rate will be the limit for all storm events - including the design storm with the climate change allowance.

- It is proposed for surface water run-off to discharge into the 1549 mm x 991 mm combined water public sewer located in Kentish Town Road via an existing drainage connection. A CCTV survey is required to confirm the existing drainage depth and arrangement.

- A Section 106 application will be made to the Water Authority for consent to connect to the public sewer.

Appendix A

Greenfield Calculations

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Enrique Rodriguez Madrid
Site name:	26778 Kentish Town
Site location:	NW5 2TJ

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	51.55135° N
Longitude:	0.14106° W

Reference:	6507932
Date:	2018-12-18T15:16:49

Methodology	FEH Statistical

Site characteristics

Total site area (ha)	0.1

Methodology

Qmed estimation method	Calculate from BFI and SAAR
BFI and SPR estimation method	Specify BFI manually
HOST class	N/A
BFI / BFIHOST	0.2
Qmed (l/s)	NaN
Qbar / Qmed Conversion Factor	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm)	641	641
Hydrological region	6	6
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Interpolating for a 0.037Ha:
1 in 1=0.16 l/s
1 in 30=0.42 l/s
1 in 100=0.59 l/s

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	NaN	0.5
1 in 1 year (l/s)	NaN	0.42
1 in 30 years (l/s)	NaN	1.14
1 in 100 years (l/s)	NaN	1.59

Appendix B

MicroDrainage Calculations (Runoff Volumes)

Figure H2.1. Rainfall depths for the 6h storm events (FEH method, from Flood Estimation Handbook Web Service)

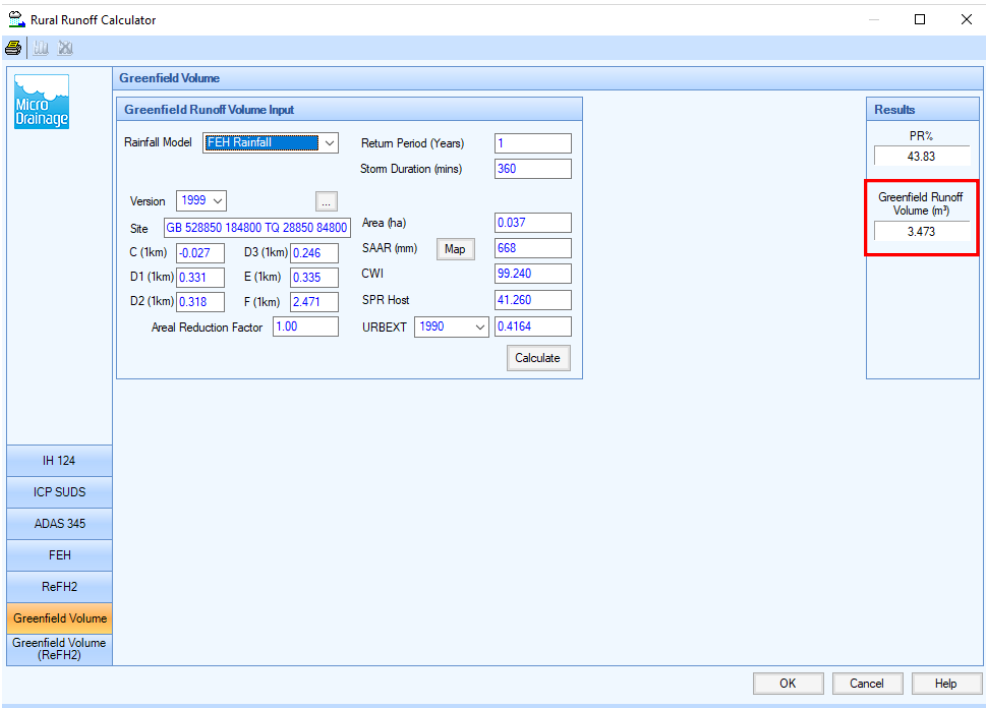

Figure H2.2. Greenfield Runoff volume calculation (1 in 1-year – 6hr event)

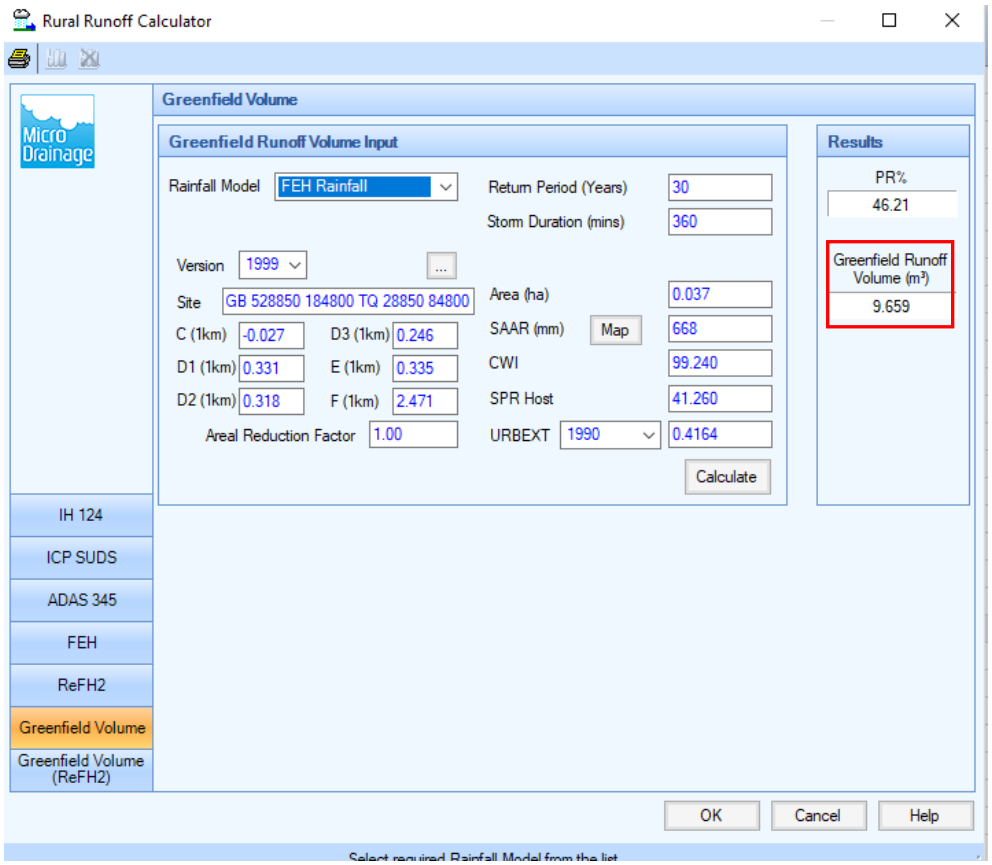

Figure H2.3. Greenfield Runoff volume calculation (1 in 30-year – 6hr event)

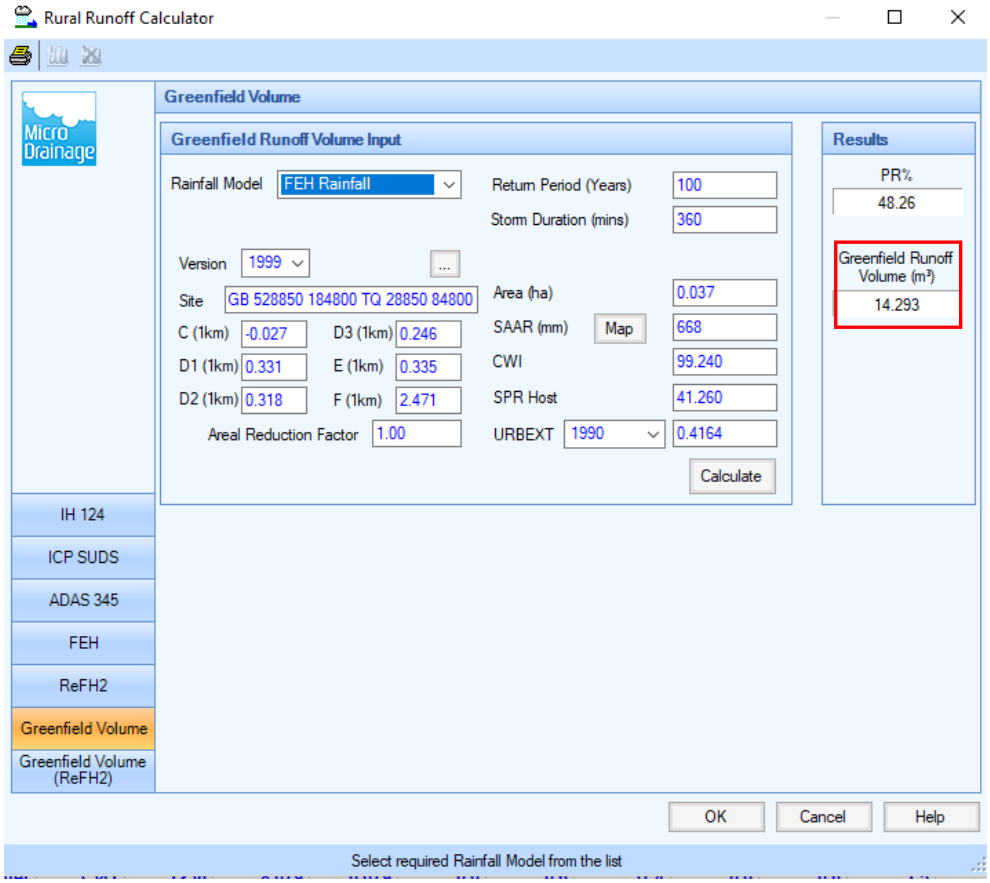

Figure H2.4. Greenfield Runoff volume calculation (1 in 100-year – 6hr event)

Storm Event	Depth (mm)	Site area (m^2)	Greenfield volume (m^3)	Existing Volume (m^3)	Proposed Volume (m^3)	Difference (m^3) (Proposed - Existing)
1 in 1 yr 6 hour	22.87	370	3.5	8.5	8.5	0
1 in 30 yr 6 hour	63.83	370	9.7	23.6	23.6	0
1 in 100 yr 6 hour	88.66	370	14.3	32.8	32.8	0
1 in 100 yr 6 hour plus 40% cc	124.124	370	20.02	45.9	45.9	0

Figure H2.5. Run-off volumes summary table

Appendix C

MicroDrainage Calculations (Attenuation Volumes)

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 64 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.068	0.068	0.0	1.4	1.4	6.5	O K
30 min Summer	29.081	0.081	0.0	1.6	1.6	7.7	O K
60 min Summer	29.087	0.087	0.0	1.7	1.7	8.3	O K
120 min Summer	29.088	0.088	0.0	1.8	1.8	8.4	O K
180 min Summer	29.085	0.085	0.0	1.7	1.7	8.0	O K
240 min Summer	29.080	0.080	0.0	1.6	1.6	7.6	O K
360 min Summer	29.072	0.072	0.0	1.4	1.4	6.9	O K
480 min Summer	29.066	0.066	0.0	1.3	1.3	6.2	O K
600 min Summer	29.060	0.060	0.0	1.2	1.2	5.7	O K
720 min Summer	29.056	0.056	0.0	1.1	1.1	5.3	O K
960 min Summer	29.048	0.048	0.0	1.0	1.0	4.6	O K
1440 min Summer	29.039	0.039	0.0	0.8	0.8	3.7	O K
2160 min Summer	29.030	0.030	0.0	0.6	0.6	2.9	O K
2880 min Summer	29.025	0.025	0.0	0.5	0.5	2.4	O K
4320 min Summer	29.019	0.019	0.0	0.4	0.4	1.8	O K
5760 min Summer	29.015	0.015	0.0	0.3	0.3	1.4	O K
7200 min Summer	29.013	0.013	0.0	0.3	0.3	1.2	O K
8640 min Summer	29.011	0.011	0.0	0.2	0.2	1.0	O K
10080 min Summer	29.010	0.010	0.0	0.2	0.2	0.9	O K
15 min Winter	29.076	0.076	0.0	1.5	1.5	7.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	147.288	0.0	7.1	17
30 min Summer	95.147	0.0	9.2	30
60 min Summer	58.456	0.0	11.4	46
120 min Summer	34.696	0.0	13.5	80
180 min Summer	25.247	0.0	14.7	114
240 min Summer	20.040	0.0	15.6	148
360 min Summer	14.437	0.0	16.8	214
480 min Summer	11.439	0.0	17.8	276
600 min Summer	9.544	0.0	18.6	340
720 min Summer	8.227	0.0	19.2	400
960 min Summer	6.505	0.0	20.2	528
1440 min Summer	4.665	0.0	21.8	766
2160 min Summer	3.341	0.0	23.4	1128
2880 min Summer	2.635	0.0	24.6	1496
4320 min Summer	1.883	0.0	26.4	2208
5760 min Summer	1.482	0.0	27.7	2936
7200 min Summer	1.230	0.0	28.7	3672
8640 min Summer	1.057	0.0	29.6	4384
10080 min Summer	0.929	0.0	30.4	5136
15 min Winter	147.288	0.0	8.0	17

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	29.091	0.091	0.0	1.8	1.8	8.7	O K
60 min Winter	29.097	0.097	0.0	1.9	1.9	9.3	O K
120 min Winter	29.096	0.096	0.0	1.9	1.9	9.1	O K
180 min Winter	29.090	0.090	0.0	1.8	1.8	8.5	O K
240 min Winter	29.083	0.083	0.0	1.7	1.7	7.9	O K
360 min Winter	29.072	0.072	0.0	1.4	1.4	6.9	O K
480 min Winter	29.064	0.064	0.0	1.3	1.3	6.1	O K
600 min Winter	29.057	0.057	0.0	1.1	1.1	5.4	O K
720 min Winter	29.051	0.051	0.0	1.0	1.0	4.9	O K
960 min Winter	29.043	0.043	0.0	0.9	0.9	4.1	O K
1440 min Winter	29.033	0.033	0.0	0.7	0.7	3.1	O K
2160 min Winter	29.025	0.025	0.0	0.5	0.5	2.3	O K
2880 min Winter	29.020	0.020	0.0	0.4	0.4	1.9	O K
4320 min Winter	29.014	0.014	0.0	0.3	0.3	1.3	O K
5760 min Winter	29.011	0.011	0.0	0.2	0.2	1.1	O K
7200 min Winter	29.009	0.009	0.0	0.2	0.2	0.9	O K
8640 min Winter	29.008	0.008	0.0	0.2	0.2	0.8	O K
10080 min Winter	29.007	0.007	0.0	0.1	0.1	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	95.147	0.0	10.3	30
60 min Winter	58.456	0.0	12.7	48
120 min Winter	34.696	0.0	15.1	86
180 min Winter	25.247	0.0	16.5	122
240 min Winter	20.040	0.0	17.5	158
360 min Winter	14.437	0.0	18.9	224
480 min Winter	11.439	0.0	19.9	290
600 min Winter	9.544	0.0	20.8	354
720 min Winter	8.227	0.0	21.5	418
960 min Winter	6.505	0.0	22.7	540
1440 min Winter	4.665	0.0	24.4	792
2160 min Winter	3.341	0.0	26.2	1144
2880 min Winter	2.635	0.0	27.6	1500
4320 min Winter	1.883	0.0	29.6	2208
5760 min Winter	1.482	0.0	31.0	2944
7200 min Winter	1.230	0.0	32.2	3744
8640 min Winter	1.057	0.0	33.2	4296
10080 min Winter	0.929	0.0	34.0	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.026

Time (mins) From:	To:	Area (ha)
0	4	0.026

Model Details

Storage is Online Cover Level (m) 30.000

Cellular Storage Structure

Invert Level (m) 29.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	100.0	0.0	0.101	0.0	0.0
0.100	100.0	0.0			

Pump Outflow Control

Invert Level (m) 29.000

Depth (m)	Flow (l/s)
0.100	2.0000

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 11 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.817	0.217	0.0	1.8	1.8	1.6	Flood Risk
30 min Summer	9.829	0.229	0.0	1.8	1.8	1.8	Flood Risk
60 min Summer	9.811	0.211	0.0	1.8	1.8	1.5	Flood Risk
120 min Summer	9.757	0.157	0.0	1.8	1.8	0.8	Flood Risk
180 min Summer	9.708	0.108	0.0	1.8	1.8	0.4	Flood Risk
240 min Summer	9.683	0.083	0.0	1.7	1.7	0.2	O K
360 min Summer	9.663	0.063	0.0	1.3	1.3	0.1	O K
480 min Summer	9.654	0.054	0.0	1.0	1.0	0.1	O K
600 min Summer	9.648	0.048	0.0	0.9	0.9	0.1	O K
720 min Summer	9.644	0.044	0.0	0.7	0.7	0.1	O K
960 min Summer	9.638	0.038	0.0	0.6	0.6	0.0	O K
1440 min Summer	9.632	0.032	0.0	0.4	0.4	0.0	O K
2160 min Summer	9.626	0.026	0.0	0.3	0.3	0.0	O K
2880 min Summer	9.623	0.023	0.0	0.2	0.2	0.0	O K
4320 min Summer	9.619	0.019	0.0	0.2	0.2	0.0	O K
5760 min Summer	9.617	0.017	0.0	0.1	0.1	0.0	O K
7200 min Summer	9.616	0.016	0.0	0.1	0.1	0.0	O K
8640 min Summer	9.614	0.014	0.0	0.1	0.1	0.0	O K
10080 min Summer	9.613	0.013	0.0	0.1	0.1	0.0	O K
15 min Winter	9.837	0.237	0.0	1.8	1.8	1.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	147.288	0.0	2.6	14
30 min Summer	95.147	0.0	3.4	23
60 min Summer	58.456	0.0	4.3	40
120 min Summer	34.696	0.0	5.2	70
180 min Summer	25.247	0.0	5.7	98
240 min Summer	20.040	0.0	6.1	126
360 min Summer	14.437	0.0	6.6	184
480 min Summer	11.439	0.0	7.0	244
600 min Summer	9.544	0.0	7.3	306
720 min Summer	8.227	0.0	7.5	366
960 min Summer	6.505	0.0	7.9	484
1440 min Summer	4.665	0.0	8.5	724
2160 min Summer	3.341	0.0	9.0	1096
2880 min Summer	2.635	0.0	9.4	1468
4320 min Summer	1.883	0.0	9.9	2148
5760 min Summer	1.482	0.0	10.1	2936
7200 min Summer	1.230	0.0	10.3	3544
8640 min Summer	1.057	0.0	10.4	4256
10080 min Summer	0.929	0.0	10.4	5088
15 min Winter	147.288	0.0	2.9	15

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	9.846	0.246	0.0	1.8	1.8	2.0	Flood Risk
60 min Winter	9.816	0.216	0.0	1.8	1.8	1.6	Flood Risk
120 min Winter	9.727	0.127	0.0	1.8	1.8	0.5	Flood Risk
180 min Winter	9.679	0.079	0.0	1.6	1.6	0.2	O K
240 min Winter	9.664	0.064	0.0	1.3	1.3	0.1	O K
360 min Winter	9.651	0.051	0.0	0.9	0.9	0.1	O K
480 min Winter	9.644	0.044	0.0	0.7	0.7	0.1	O K
600 min Winter	9.639	0.039	0.0	0.6	0.6	0.1	O K
720 min Winter	9.636	0.036	0.0	0.5	0.5	0.0	O K
960 min Winter	9.632	0.032	0.0	0.4	0.4	0.0	O K
1440 min Winter	9.626	0.026	0.0	0.3	0.3	0.0	O K
2160 min Winter	9.622	0.022	0.0	0.2	0.2	0.0	O K
2880 min Winter	9.620	0.020	0.0	0.2	0.2	0.0	O K
4320 min Winter	9.616	0.016	0.0	0.1	0.1	0.0	O K
5760 min Winter	9.615	0.015	0.0	0.1	0.1	0.0	O K
7200 min Winter	9.613	0.013	0.0	0.1	0.1	0.0	O K
8640 min Winter	9.612	0.012	0.0	0.1	0.1	0.0	O K
10080 min Winter	9.611	0.011	0.0	0.1	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	95.147	0.0	3.9	25
60 min Winter	58.456	0.0	4.9	42
120 min Winter	34.696	0.0	5.9	72
180 min Winter	25.247	0.0	6.5	96
240 min Winter	20.040	0.0	6.9	126
360 min Winter	14.437	0.0	7.5	182
480 min Winter	11.439	0.0	7.9	250
600 min Winter	9.544	0.0	8.2	306
720 min Winter	8.227	0.0	8.5	366
960 min Winter	6.505	0.0	9.0	498
1440 min Winter	4.665	0.0	9.6	722
2160 min Winter	3.341	0.0	10.2	1048
2880 min Winter	2.635	0.0	10.7	1428
4320 min Winter	1.883	0.0	11.2	2184
5760 min Winter	1.482	0.0	11.6	2840
7200 min Winter	1.230	0.0	11.8	3712
8640 min Winter	1.057	0.0	11.9	4160
10080 min Winter	0.929	0.0	12.0	4792

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.011

Time (mins) From:	To:	Area (ha)
0	4	0.011

Model Details

Storage is Online Cover Level (m) 10.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	1.5
Membrane Percolation (mm/hr)	1000	Length (m)	63.0
Max Percolation (l/s)	26.3	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.600	Cap Volume Depth (m)	0.350

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0073-1800-0350-1800
Design Head (m)	0.350
Design Flow (l/s)	1.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	73
Invert Level (m)	9.600
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.350	1.8
Flush-Flo™	0.113	1.8
Kick-Flo®	0.254	1.6
Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	3.2	3.000	4.8	7.000	7.3
0.200	1.7	1.400	3.4	3.500	5.2	7.500	7.6
0.300	1.7	1.600	3.6	4.000	5.5	8.000	7.8
0.400	1.9	1.800	3.8	4.500	5.9	8.500	8.1
0.500	2.1	2.000	4.0	5.000	6.2	9.000	8.3
0.600	2.3	2.200	4.2	5.500	6.5	9.500	8.5
0.800	2.6	2.400	4.4	6.000	6.8		
1.000	2.9	2.600	4.5	6.500	7.1		

Cascade Summary of Results for BBAttenuation capacity - External areas.SRCX

	Upstream Structures	Outflow To	Overflow To
BBAttenuation capacity-Blue roof.SRCX		(None)	(None)

Half Drain Time : 23 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.853	0.253	0.0	1.8	1.8	2.2	Flood Risk
30 min Summer	9.895	0.295	0.0	1.8	1.8	2.9	Flood Risk
60 min Summer	9.922	0.322	0.0	1.8	1.8	3.5	Flood Risk
120 min Summer	9.924	0.324	0.0	1.8	1.8	3.5	Flood Risk
180 min Summer	9.908	0.308	0.0	1.8	1.8	3.2	Flood Risk
240 min Summer	9.887	0.287	0.0	1.8	1.8	2.8	Flood Risk
360 min Summer	9.824	0.224	0.0	1.8	1.8	1.7	Flood Risk
480 min Summer	9.756	0.156	0.0	1.8	1.8	0.8	Flood Risk
600 min Summer	9.700	0.100	0.0	1.8	1.8	0.3	O K
720 min Summer	9.683	0.083	0.0	1.7	1.7	0.2	O K
960 min Summer	9.671	0.071	0.0	1.4	1.4	0.2	O K
1440 min Summer	9.658	0.058	0.0	1.1	1.1	0.1	O K
2160 min Summer	9.649	0.049	0.0	0.9	0.9	0.1	O K
2880 min Summer	9.643	0.043	0.0	0.7	0.7	0.1	O K
4320 min Summer	9.637	0.037	0.0	0.5	0.5	0.0	O K
5760 min Summer	9.632	0.032	0.0	0.4	0.4	0.0	O K
7200 min Summer	9.629	0.029	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	147.288	0.0	9.7	18
30 min Summer	95.147	0.0	12.7	34
60 min Summer	58.456	0.0	15.7	64
120 min Summer	34.696	0.0	18.7	116
180 min Summer	25.247	0.0	20.5	146
240 min Summer	20.040	0.0	21.7	178
360 min Summer	14.437	0.0	23.4	234
480 min Summer	11.439	0.0	24.8	286
600 min Summer	9.544	0.0	25.8	326
720 min Summer	8.227	0.0	26.7	376
960 min Summer	6.505	0.0	28.2	502
1440 min Summer	4.665	0.0	30.3	736
2160 min Summer	3.341	0.0	32.4	1120
2880 min Summer	2.635	0.0	34.0	1460
4320 min Summer	1.883	0.0	36.2	2192
5760 min Summer	1.482	0.0	37.8	2928
7200 min Summer	1.230	0.0	39.0	3656

Cascade Summary of Results for BBAttenuation capacity - External areas.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	9.627	0.027	0.0	0.3	0.3	0.0	O K
10080 min Summer	9.625	0.025	0.0	0.3	0.3	0.0	O K
15 min Winter	9.876	0.276	0.0	1.8	1.8	2.6	Flood Risk
30 min Winter	9.921	0.321	0.0	1.8	1.8	3.5	Flood Risk
60 min Winter	9.954	0.354	0.0	1.8	1.8	4.2	Flood Risk
120 min Winter	9.961	0.361	0.0	1.8	1.8	4.4	Flood Risk
180 min Winter	9.940	0.340	0.0	1.8	1.8	3.9	Flood Risk
240 min Winter	9.913	0.313	0.0	1.8	1.8	3.3	Flood Risk
360 min Winter	9.827	0.227	0.0	1.8	1.8	1.7	Flood Risk
480 min Winter	9.717	0.117	0.0	1.8	1.8	0.5	Flood Risk
600 min Winter	9.682	0.082	0.0	1.7	1.7	0.2	O K
720 min Winter	9.673	0.073	0.0	1.5	1.5	0.2	O K
960 min Winter	9.662	0.062	0.0	1.2	1.2	0.1	O K
1440 min Winter	9.651	0.051	0.0	1.0	1.0	0.1	O K
2160 min Winter	9.642	0.042	0.0	0.7	0.7	0.1	O K
2880 min Winter	9.637	0.037	0.0	0.6	0.6	0.0	O K
4320 min Winter	9.631	0.031	0.0	0.4	0.4	0.0	O K
5760 min Winter	9.627	0.027	0.0	0.3	0.3	0.0	O K
7200 min Winter	9.625	0.025	0.0	0.3	0.3	0.0	O K
8640 min Winter	9.623	0.023	0.0	0.2	0.2	0.0	O K
10080 min Winter	9.622	0.022	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.057	0.0	40.0	4360
10080 min Summer	0.929	0.0	40.8	5088
15 min Winter	147.288	0.0	10.9	19
30 min Winter	95.147	0.0	14.3	36
60 min Winter	58.456	0.0	17.6	64
120 min Winter	34.696	0.0	21.0	118
180 min Winter	25.247	0.0	23.0	158
240 min Winter	20.040	0.0	24.3	190
360 min Winter	14.437	0.0	26.3	254
480 min Winter	11.439	0.0	27.8	292
600 min Winter	9.544	0.0	29.0	332
720 min Winter	8.227	0.0	30.0	398
960 min Winter	6.505	0.0	31.6	520
1440 min Winter	4.665	0.0	34.0	748
2160 min Winter	3.341	0.0	36.4	1104
2880 min Winter	2.635	0.0	38.2	1496
4320 min Winter	1.883	0.0	40.8	2164
5760 min Winter	1.482	0.0	42.6	2944
7200 min Winter	1.230	0.0	44.0	3584
8640 min Winter	1.057	0.0	45.1	4432
10080 min Winter	0.929	0.0	46.0	4976

Cascade Rainfall Details for BBAttenuation capacity - External areas.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.011

Time (mins) From:	To:	Area (ha)
0	4	0.011

Cascade Model Details for BBAttenuation capacity - External areas.SRCX

Storage is Online Cover Level (m) 10.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	1.5
Membrane Percolation (mm/hr)	1000	Length (m)	63.0
Max Percolation (l/s)	26.3	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.600	Cap Volume Depth (m)	0.350

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0073-1800-0350-1800
Design Head (m)	0.350
Design Flow (l/s)	1.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	73
Invert Level (m)	9.600
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.350	1.8
Flush-Flo™	0.113	1.8
Kick-Flo®	0.254	1.6
Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	3.2	3.000	4.8	7.000	7.3
0.200	1.7	1.400	3.4	3.500	5.2	7.500	7.6
0.300	1.7	1.600	3.6	4.000	5.5	8.000	7.8
0.400	1.9	1.800	3.8	4.500	5.9	8.500	8.1
0.500	2.1	2.000	4.0	5.000	6.2	9.000	8.3
0.600	2.3	2.200	4.2	5.500	6.5	9.500	8.5
0.800	2.6	2.400	4.4	6.000	6.8		
1.000	2.9	2.600	4.5	6.500	7.1		

Appendix D

Blue Roof Calculations and Typical Detail (Designed by Others)

BLUE ROOF STORAGE AND OUTFLOW SUMMARY

PRIVATE & CONFIDENTIAL - NOT FOR DISTRIBUTION

Project Name:	369-377 Kentish Town Road, London NW5 2TJ - 5th fl terrace
Prepared for:	Price & Myers
Date:	13/03/2020
ABG Project ID:	20221 Calculator version: 1.26
Prepared by:	Kirstin, 01484 354844, kirstin@abgltd.com
Notes/description:	Ballast or paved surface finish, with PV panels - TBC. Pedestrian/amenity access only. Warm roof/inverted roof/un-insulated podium, construction, with zero falls - TBC.

Blue Roof Estimate

Input Parameters - Rainfall Information (Flood Studies Report 1975)			
Return period:	100	years	*As supplied by Client*
Allowance for Climate Change:	40	%	*As supplied by Client*
Location selected for FSR data:	London (NW)		

Input Parameters - Roof Information			
Total catchment area:	170	m^2	*As supplied by Client*
Attenuation area:	58	m^2	*As supplied by Client*
Maximum allowable runoff:	1.7	l/s	*As supplied by Client*

Output - Rainfall Calculation

Duration	Time to Empty	Restricted Outflow (l/s)
15 mins	1 hour and 20 minutes	1.5
30 mins	1 hour and 30 minutes	1.7
1 hour	1 hour and 30 minutes	1.7
2 hours	1 hour and 20 minutes	1.4
4 hours	0 hours and 40 minutes	0.8
6 hours	0 hours and 10 minutes	0.3
10 hours	0 hours and 0 minutes	0.1
24 hours	0 hours and 0 minutes	0.1
48 hours	0 hours and 0 minutes	0.0

Total attenuation required: 6.4 m^3
Half empty time: 0 hours and 40 minutes.

Output - Recommended Blue Roof System

System Name:	ABG blueroof VF HD 130mm
Description:	No.of control positions TBC by design team, and also with the structural engineer's deflection analysis. Potential additional (visual) overflow positions should also be considered by the design team.
Total attenuation capacity:	6.5 m^3
Number of Blue Roof outlets:	2

Notes:

1. This document contains an estimate which has been prepared by ABG Ltd and is illustrative only and not a detailed design.
2. Further details on the theories used in this estimate are available upon request from ABG. The values given for the performance of the system relate to testing, modelling and analysis of our systems obtained from laboratories and testing institutes. In line with our policy of continuous improvement the right is reserved to make changes to our systems without notice at any time.
3. The estimate given in this report is based on the stated parameters as per the brief. If these parameters are not correct or have changed, ABG should be contacted to provide a revised estimate.
4. This estimate is specific to the characteristics of ABG products/systems and is not applicable to other competitor products. The substitution of the whole or any component of this design for a material supplied from another source renders this estimate invalid.
5. Final determination of the suitability of any information is the sole responsibility of the user. ABG will be pleased to discuss the use of this or any other product but responsibility for selection of a material and its application in any specific project remains with the user.

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1. DEFINITIONS

'Consultant' means ABG Geosynthetics Ltd and its legal successors. 'Client' means the person, firm, company or organisation for whom the Consultant is performing the Services. 'Agreement' means the contract referred to in Clause 2. 'Services' means the services to be performed by the Consultant in accordance with the proposal from the Consultant. 'Project' means the project or works for which the Client has commissioned the Services.

2. GENERAL

Unless and until a formal agreement is entered into, the Client's acceptance of the proposal for Services from the Consultant or a request for some or all the Services to be performed by the Consultant, shall constitute a binding
contract between the Client and the Consultant which contract will be subject to any terms and conditions contained or referred to in the aforementioned proposal and these terms and conditions. In the event of any conflict, the terms and conditions in the proposal shall prevail over these terms and conditions. The Agreement so formed shall supersede all previous understandings, commitments or agreements whether written or oral between the Client and the Consultant relating to the subject matter hereof. No person or entity shall have any rights in relation to this Agreement, whether as third parties or otherwise, save the parties to this Agreement. Should any term or condition of this Agreement be held to be unenforceable or invalid by the courts of any jurisdiction to which it is subject then such term or condition shall be disregarded and the remaining terms and conditions shall remain in full force and effect.

3. PERFORMANCE OF SERVICES AND SCOPE

The Consultant shall perform the Services using the degree of skill care and diligence to be expected from a consultant experienced in the provision of services of similar scope size and complexity. The Consultant shall use reasonable endeavours to complete the Services within the time or programme agreed but shall not be responsible for any delay beyond the reasonable control of the Consultant.

The fee contained in the proposal is for the scope of services as defined therein. If not already contained in the proposal the Consultant and the Client shall agree as an initial activity an integrated project services programme to
include the activities of all the parties to the Project relevant to the Services to be supplied by the Consultant. The
aforesaid programme shall show the key dates for final information and the delivery of such to the Consultant so as to enable the Consultant to carry out the services in an efficient once through manner to achieve the programme delivery dates for the Services.

The Consultant provides various services including Design and Product use advice which is distinct from a Design Service. The Design Service may or may not attract a fee.

Where the Consultant's services are of an advisory nature and dependent upon the degree of information and release thereof by the Client then the Client agrees that any reliance placed on the services by the Client shall take due account of such constraints.

4. CONFIDENTIALITY AND INTELLECTUAL PROPERTY RIGHTS

i. The Consultant and the Client shall keep confidential all information pertaining to the Services.

ii. Copyright for all reports, documents and the like produced by the Consultant in the performance of the Services
shall remain vested with the Consultant but the Consultant shall grant an irrevocable royalty free license to the Client to use such reports, documents and the like for any purpose in connection with the Project.

5. LIABILITY

i. The Consultant shall be liable to pay compensation to the Client arising out of or in connection with this
Agreement only if a breach of the duty of care in Clause 3 is established against the Consultant.

ii. Notwithstanding any other term to the contrary in this Agreement or any related document and whether the cause of action for any claim arises under or in connection with the Agreement in contract or in tort, in negligence or for breach of statutory duty or otherwise the Consultant shall have no liability to the Client in respect of any claim for loss or damage arising from acts of war or terrorism or arising from flooding, burst water mains or failed drainage or arising from any incidence of toxic mould or asbestos but otherwise in relation to any cause of action as aforesaid the total liability of the Consultant in the aggregate for all claims shall be limited to a sum equivalent to ten (10) times the fee payable under this Agreement or £50,000, whichever is the lesser, or such other sum as may be expressly stated in the Consultant's proposal, and further but without prejudice to the aforesaid limit of liability any such liability of the Consultant shall be limited to such sum or sums as it would be just and equitable for the Consultant to pay having regard to the Consultant's responsibility for the same and on the basis that all other parties appointed or to be appointed by the Client to perform related services in connection with the Project shall be deemed to have provided undertakings on terms no less onerous than this Agreement and shall be deemed to have paid to the Client such contribution as it would be just and equitable for them to pay having regard to their responsibility for any loss or damage and providing that it shall be deemed that such other parties have not limited or excluded their liability to the Client for such loss or damage in any way which may be prejudicial to the Consultant's liability under this clause. Nothing in this clause shall operate to exclude or limit the Consultant's liability for death or personal injury.

iii. The Client shall indemnify and keep indemnified the Consultant from and against all claims, demands,
proceedings, damages, costs and expenses arising out of or in connection with this Agreement or the Project
arising from acts of terrorism or arising otherwise in excess of the liability of the Consultant under this
Agreement or which may be made in respect of events occurring after the expiry of the period of liability stated
in this Agreement.

iv. No action or proceedings under or in connection with this Agreement shall be commenced against the Consultant after the expiry of one year from completion of the Services.

v. ABG Geosynthetics Ltd is not responsible for consequential, indirect or incidental losses.

6. INSURANCE

The Consultant shall arrange Professional Indemnity Insurance cover for the amount stated in Clause 5(ii). The Consultant will use all reasonable endeavours to maintain Professional Indemnity Insurance cover for the period stated in 5(iv) above, providing such insurance remains available to the Consultant at commercially reasonable rates.

7. CLIENT'S OBLIGATIONS

The Client shall supply, without charge and in such time so as not to delay or disrupt the performance of the Consultant in carrying out the Services, all necessary and relevant information, in his possession or available to him from his other agents or consultants and all necessary approvals or consents. Any deviation on any information from the proposal shall be confirmed in writing and any attendant consequential fees will be forwarded for approval by the Client before any changes are made. The Consultant shall not be liable for any consequential delays on site. Every reasonable effort will be made to mitigate against delays, however no liability for losses and costs will be accepted. The approval or consent by the Client to the Services shall not relieve the Consultant from any liability under this Agreement. All work undertaken by the Consultant must be ratified and signed off by the Client.

8. PAYMENT

i. The Client shall pay the Consultant for the Services in accordance with the proposal and this Agreement. If the Consultant performs any additional services or if the Services are delayed or disrupted for reasons beyond the
reasonable control of the Consultant then the Consultant shall be entitled to such additional fees as are fair and

reasonable in the circumstances. The Consultant may render an invoice at monthly intervals for services properly performed. The agreed invoice, or in the event of a dispute the undisputed element, shall be paid within 28 days of receipt of the invoice by the Client. Any invoice paid after this period will attract interest at 3% above the base rate of the central bank of the country of the currency of payment along with any collection costs which may occur.

ii. The Client shall not withhold any payment of any sum or part of a sum due to the Consultant under this Agreement by reason of claims or alleged claims against the Consultant unless the amount to be withheld has been agreed between the Client and the Consultant as due to the Client or such sum arises from an award in adjudication, arbitration or litigation in favour of the Client and arises under or in connection with the Agreement. Save as aforesaid all rights of set off at common law, in equity or otherwise which the Client may otherwise be entitled to exercise are hereby expressly excluded.

9. TERMINATION

If a party is in breach of a material term of this Agreement and despite written notice from the other party fails to remedy such breach within 30 days or such other period as may be agreed between the parties, then the other party shall be entitled to terminate this Agreement forthwith. The Consultant may seek to recoup costs incurred for works completed prior to termination.

10. DISPUTE RESOLUTION

Any dispute between the parties that cannot be settled by mutual agreement shall be referred for final settlement to the arbitration of a person agreed between the parties or failing such agreement appointed upon the application of either party by the President of the Chartered Institute of Arbitrators and the said arbitration shall be carried out in accordance with the Construction Industry Model Arbitration Rules 1998 or such other version current at the time of the referral under this clause. Where the Agreement is subject to a governing law other than that of England and Wales then any dispute between the parties that cannot be settled by mutual agreement shall be finally settled by arbitration in accordance with the UNCITRAL Arbitration Rules by one arbitrator appointed in compliance with the said Rules. In either case such rules as appropriate are deemed to be incorporated into this Agreement by reference.

11. COMPLIANCE WITH LAWS

This Agreement shall be governed by and construed in accordance with the law of England and Wales unless stated otherwise in the proposal for services from the Consultant.

Changes to the above terms and conditions will only be considered if agreed in writing as part of the appointment process prior to ABG Geosynthetics commencing work.

BLUE ROOF STORAGE AND OUTFLOW SUMMARY

PRIVATE & CONFIDENTIAL - NOT FOR DISTRIBUTION

Project Name:	369-377 Kentish Town Road, London NW5 2TJ - Roof
Prepared for:	Price & Myers
Date:	13/03/2020
ABG Project ID:	20221 Calculator version: 1.26
Prepared by:	Kirstin, 01484 354844, kirstin@abgltd.com
Notes/description:	Ballast or paved surface finish, with PV panels - TBC. Maintenance or pedestrian access only. Warm roof/inverted roof/un-insulated podium, construction, with zero falls - TBC.

Blue Roof Estimate

Input Parameters - Rainfall Information (Flood Studies Report 1975)			
Return period:	100	years	*As supplied by Client*
Allowance for Climate Change:	40	%	*As supplied by Client*
Location selected for FSR data:	London (NW)		

Input Parameters - Roof Information			
Total catchment area:	53	m^2	*As supplied by Client*
Attenuation area:	53	m^2	*As supplied by Client*
Maximum allowable runoff:	0.5	l/s	*As supplied by Client*

Output - Rainfall Calculation

Duration	Time to Empty	Restricted Outflow (l/s)
15 mins	2 hours and 40 minutes	0.3
30 mins	3 hours and 10 minutes	0.3
1 hour	3 hours and 20 minutes	0.3
2 hours	3 hours and 20 minutes	0.3
4 hours	2 hours and 40 minutes	0.2
6 hours	2 hours and 0 minutes	0.2
10 hours	0 hours and 40 minutes	0.1
24 hours	0 hours and 0 minutes	0.0
48 hours	0 hours and 0 minutes	0.0

Total attenuation required: 2.7 m^3
Half empty time: 1 hours and 0 minutes.

Output - Recommended Blue Roof System	
System Name:	ABG blueroof VF HD 80mm
Description:	No.of control positions TBC by design team, and also with the structural engineer's deflection analysis. Potential additional (visual) overflow positions should also be considered by the design team.
Total attenuation capacity:	3.4 m^3
Number of Blue Roof outlets:	2

Notes:

1. This document contains an estimate which has been prepared by ABG Ltd and is illustrative only and not a detailed design.
2. Further details on the theories used in this estimate are available upon request from ABG. The values given for the performance of the system relate to testing, modelling and analysis of our systems obtained from laboratories and testing institutes. In line with our policy of continuous improvement the right is reserved to make changes to our systems without notice at any time.
3. The estimate given in this report is based on the stated parameters as per the brief. If these parameters are not correct or have changed, ABG should be contacted to provide a revised estimate.
4. This estimate is specific to the characteristics of ABG products/systems and is not applicable to other competitor products. The substitution of the whole or any component of this design for a material supplied from another source renders this estimate invalid.
5. Final determination of the suitability of any information is the sole responsibility of the user. ABG will be pleased to discuss the use of this or any other product but responsibility for selection of a material and its application in any specific project remains with the user.

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www.abgltd.com

1. DEFINITIONS

'Consultant' means ABG Geosynthetics Ltd and its legal successors. 'Client' means the person, firm, company or organisation for whom the Consultant is performing the Services. 'Agreement' means the contract referred to in Clause 2. 'Services' means the services to be performed by the Consultant in accordance with the proposal from the Consultant. 'Project' means the project or works for which the Client has commissioned the Services.

2. GENERAL

Unless and until a formal agreement is entered into, the Client's acceptance of the proposal for Services from the Consultant or a request for some or all the Services to be performed by the Consultant, shall constitute a binding
contract between the Client and the Consultant which contract will be subject to any terms and conditions contained or referred to in the aforementioned proposal and these terms and conditions. In the event of any conflict, the terms and conditions in the proposal shall prevail over these terms and conditions. The Agreement so formed shall supersede all previous understandings, commitments or agreements whether written or oral between the Client and the Consultant relating to the subject matter hereof. No person or entity shall have any rights in relation to this Agreement, whether as third parties or otherwise, save the parties to this Agreement. Should any term or condition of this Agreement be held to be unenforceable or invalid by the courts of any jurisdiction to which it is subject then such term or condition shall be disregarded and the remaining terms and conditions shall remain in full force and effect.

3. PERFORMANCE OF SERVICES AND SCOPE

The Consultant shall perform the Services using the degree of skill care and diligence to be expected from a consultant experienced in the provision of services of similar scope size and complexity. The Consultant shall use reasonable endeavours to complete the Services within the time or programme agreed but shall not be responsible for any delay beyond the reasonable control of the Consultant.

The fee contained in the proposal is for the scope of services as defined therein. If not already contained in the proposal the Consultant and the Client shall agree as an initial activity an integrated project services programme to
include the activities of all the parties to the Project relevant to the Services to be supplied by the Consultant. The
aforesaid programme shall show the key dates for final information and the delivery of such to the Consultant so as to enable the Consultant to carry out the services in an efficient once through manner to achieve the programme delivery dates for the Services.

The Consultant provides various services including Design and Product use advice which is distinct from a Design Service. The Design Service may or may not attract a fee.

Where the Consultant's services are of an advisory nature and dependent upon the degree of information and release thereof by the Client then the Client agrees that any reliance placed on the services by the Client shall take due account of such constraints.

4. CONFIDENTIALITY AND INTELLECTUAL PROPERTY RIGHTS

i. The Consultant and the Client shall keep confidential all information pertaining to the Services.

ii. Copyright for all reports, documents and the like produced by the Consultant in the performance of the Services
shall remain vested with the Consultant but the Consultant shall grant an irrevocable royalty free license to the Client to use such reports, documents and the like for any purpose in connection with the Project.

5. LIABILITY

i. The Consultant shall be liable to pay compensation to the Client arising out of or in connection with this
Agreement only if a breach of the duty of care in Clause 3 is established against the Consultant.

ii. Notwithstanding any other term to the contrary in this Agreement or any related document and whether the cause of action for any claim arises under or in connection with the Agreement in contract or in tort, in negligence or for breach of statutory duty or otherwise the Consultant shall have no liability to the Client in respect of any claim for loss or damage arising from acts of war or terrorism or arising from flooding, burst water mains or failed drainage or arising from any incidence of toxic mould or asbestos but otherwise in relation to any cause of action as aforesaid the total liability of the Consultant in the aggregate for all claims shall be limited to a sum equivalent to ten (10) times the fee payable under this Agreement or £50,000, whichever is the lesser, or such other sum as may be expressly stated in the Consultant's proposal, and further but without prejudice to the aforesaid limit of liability any such liability of the Consultant shall be limited to such sum or sums as it would be just and equitable for the Consultant to pay having regard to the Consultant's responsibility for the same and on the basis that all other parties appointed or to be appointed by the Client to perform related services in connection with the Project shall be deemed to have provided undertakings on terms no less onerous than this Agreement and shall be deemed to have paid to the Client such contribution as it would be just and equitable for them to pay having regard to their responsibility for any loss or damage and providing that it shall be deemed that such other parties have not limited or excluded their liability to the Client for such loss or damage in any way which may be prejudicial to the Consultant's liability under this clause. Nothing in this clause shall operate to exclude or limit the Consultant's liability for death or personal injury.

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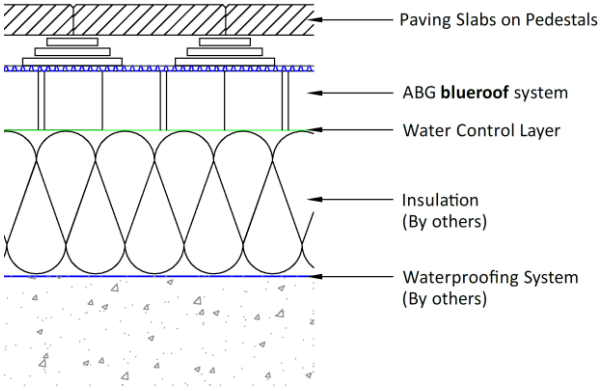
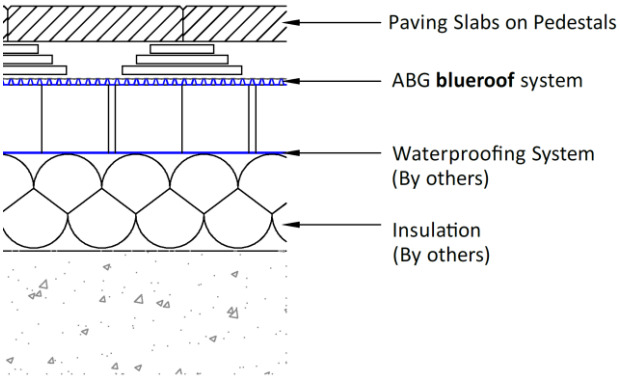
blueroof System Range D

creative geosynthetic engineering



Inverted Roof Construction



Warm Roof Construction

Data Sheet

ABG **blueroof** systems provide a constant drainage path, SuDS attenuation, filtration and controlled release of stormwater, combining all the key elements of a good SuDS design. The storage element of the system must be used in conjunction with the 'blue roof' restrictor chamber. These chambers are bespoke to each project in order to help achieve the project engineer's maximum discharge rates, and to suit the required build-up and final use of the podium/roof area. ABG's 'blue roofs' are generally used for zero falls, inverted/warm roof and podium applications, under a mix of hard and soft landscaped finishes. Other combinations of ABG **blueroof** systems and most surface finishes are available. Please refer to ABG's Technical team for project/system specific advice & 'blue roof' SuDS calculations.

		ABG blueroof VF HD							
System Properties		**58mm**	**80mm**	**108mm**	**130mm**	**158mm**	**180mm**		
Thickness at 2kPa	(mm)	58	80	108	130	158	180	±10%	EN ISO 9863-1
Maximum saturated weight	(kg/m²)	58	80	108	130	158	180	approx.	EN ISO 9864
Stormwater attenuation volume	(l/m^2)	50	65	97	113	145	160		
Growing medium recharge value	(l/m^2)	25	25	25	25	25	25		Per 100mm depth
Drainable void space	%	86	81	90	87	92	89		
Resistance to weathering		Greater than 60% retained tensile strength							EN 12224
Resistance to chemicals		Excellent							EN 14030
Upper Filter/Separator Properties									
Pore size O_{90}	(µm)	120						±30%	EN ISO 12956
Breakthrough head	(mm)	0						nominal	BS 6906 Part 3
CBR puncture resistance	(N)	1 600						-20%	EN ISO 12236
Dynamic perforation cone drop	(mm)	32						+20%	EN ISO 13433
Type and material	Non-woven needle-punched and heat-treated long staple fibre polypropylene Protector: Non-woven felt of polypropylene. Min wt. of 120g/m^2								
'Blue roof' system use & compatible surface finishes									
Suitable for ABG Load Class 2 (Pedestrians, cycles and light vehicles, MUGAs, medium sized plant installations). Landscaped, paved or permeable resin-bound gravel finishes.									

Notes

1. The values given are indicative and correspond to nominal results obtained in our laboratories and testing institutes. In line with our policy of continuous improvement the right is reserved to make changes without notice at any time.
2. Any additional installations such as plant/services, PV panels, paved areas or additional vehicular/traffic access, must be discussed with ABG prior to their installation/use.
3. Final determination of the suitability of any information is the sole responsibility of the user. ABG will be pleased to discuss the use of this or any other product but responsibility for selection of a material and its application in any specific project remains with the user.
4. Can be used in conjunction with rainwater harvesting & grey water recycling systems. Any petrochemical pollution waste discharged from the system to be treated by others.

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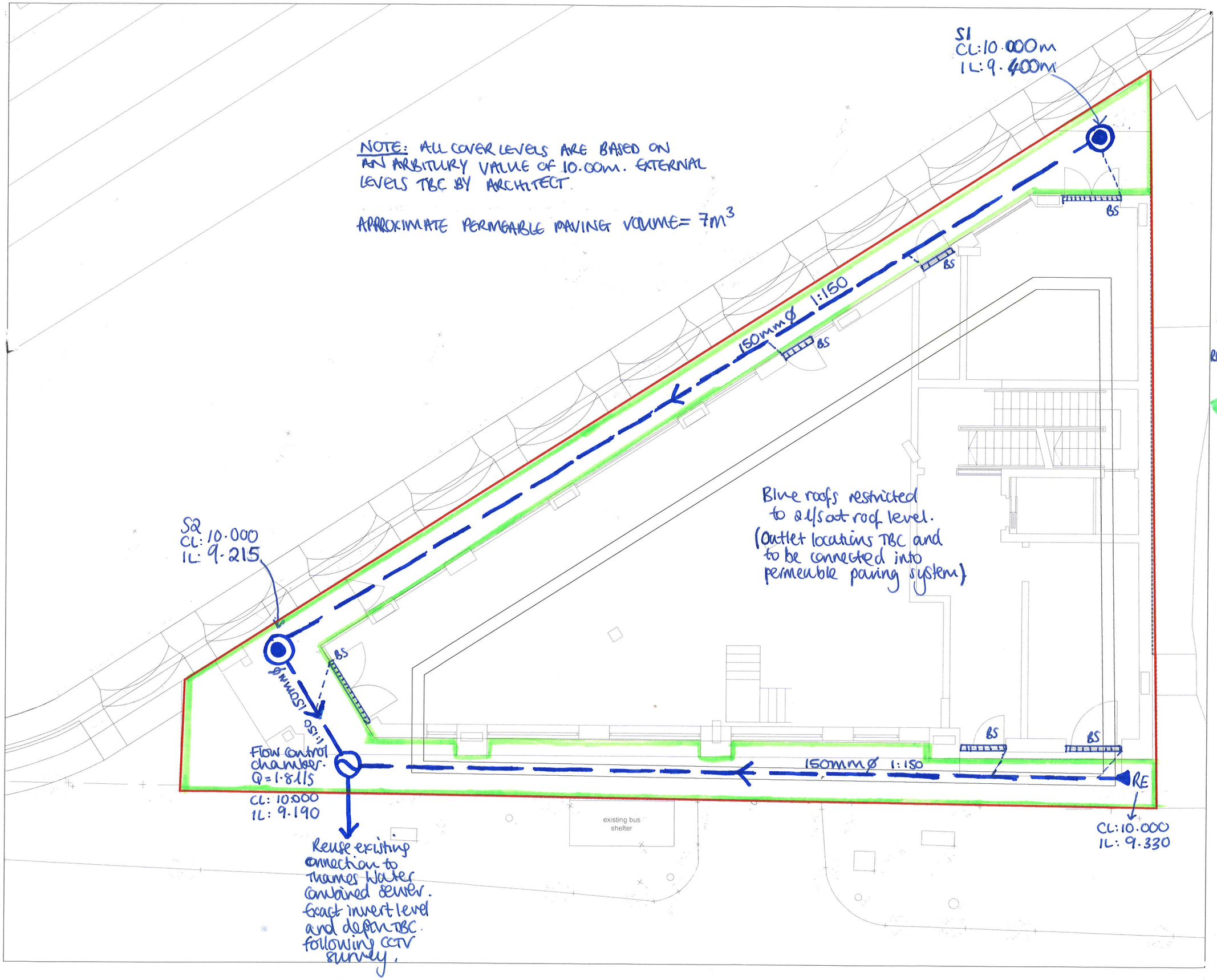
UK t 01484 852096 **e** geo@abgltd.com **Export t** +44(0)1484 852250 **e** export@abgltd.com
www.abgltd.com

Appendix E

Preliminary Drainage Layout



Notes :

1. This drawing is to be read in conjunction with all relevant Architect's, Engineer's and specialists' drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check that this drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.

KEY:

= surface water drain

= perforated pipe

= plastic inspection chamber

= flow control chamber

BS = Brickslot drain

RE = Rodding eye

= permeable paving area.

Ver	Date	Drawn	Eng	Amendment
1	24/6/11	BB	BB	Issued for Planning

369-377 KENTISH TOWN RD
LONDON

SURFACE WATER DRAINAGE STRATEGY

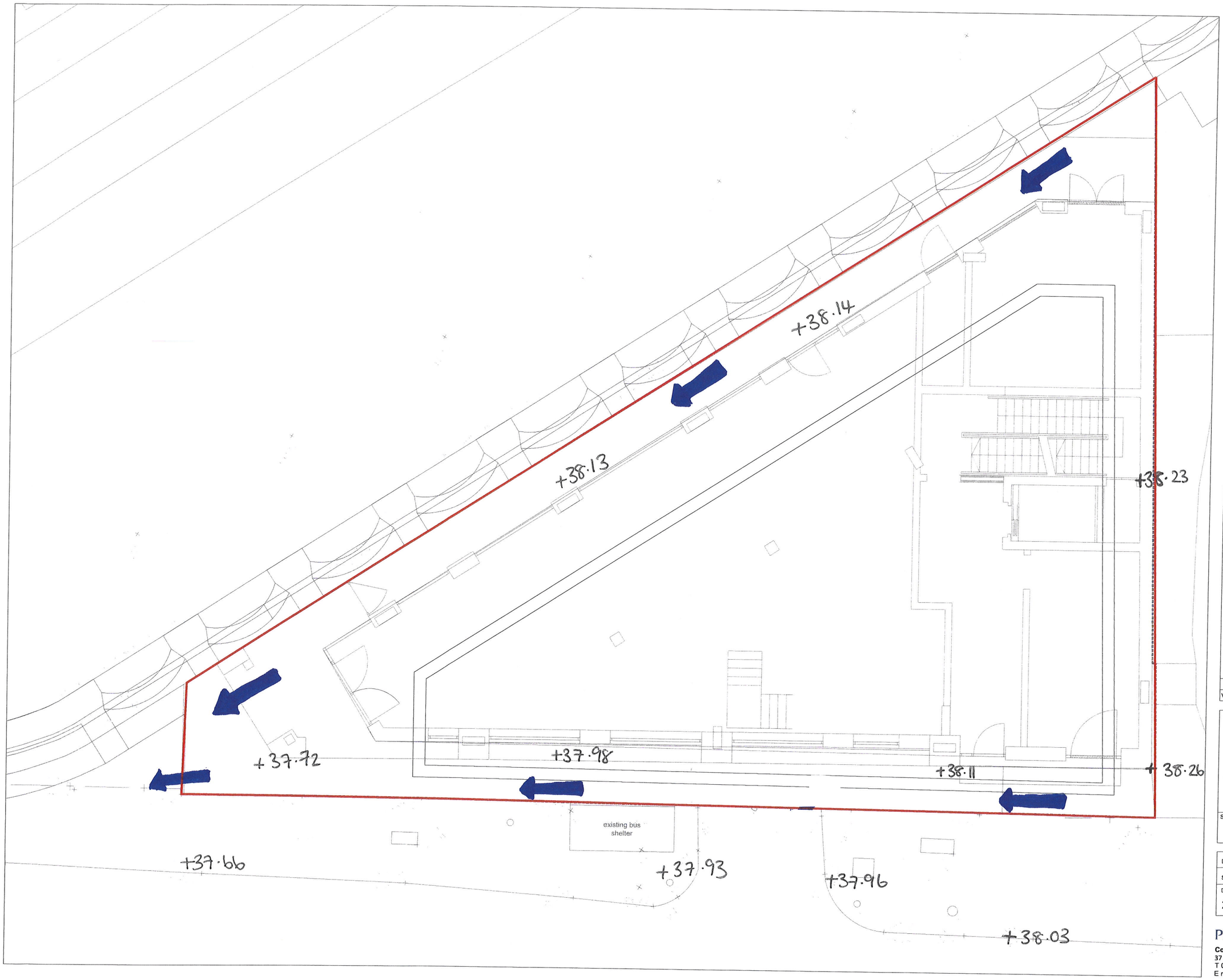
Status
FOR INFORMATION
NOT FOR CONSTRUCTION

Drawn BB	Eng BB
Scales 1:50 at A1	1:100 at A3
Drawing No 26778 /SK600	Ver 1

PRICE&MYERS
Consulting Engineers
37 Alfred Place London WC1E 7DP
T 020 7631 5128
E mail@pricemyers.com www.pricemyers.com

Appendix F

Exceedance Flow Routes



Notes :

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2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check that this drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
3. Health & Safety :
   All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".

KEY:

= flow path

Ver	Date	Drawn	Eng	Amendment
1	[illegible]	BB	BB	Issued for Planning

369-377 KENTISH TOWN RD
LONDON

EXCEEDANCE FLOW PATH DIAGRAM

Status
FOR INFORMATION
NOT FOR CONSTRUCTION

Drawn BB	Eng BB
Scales 1:50 at A1	1:100 at A3
Drawing No	Ver
26778 / SK601	1

PRICE&MYERS
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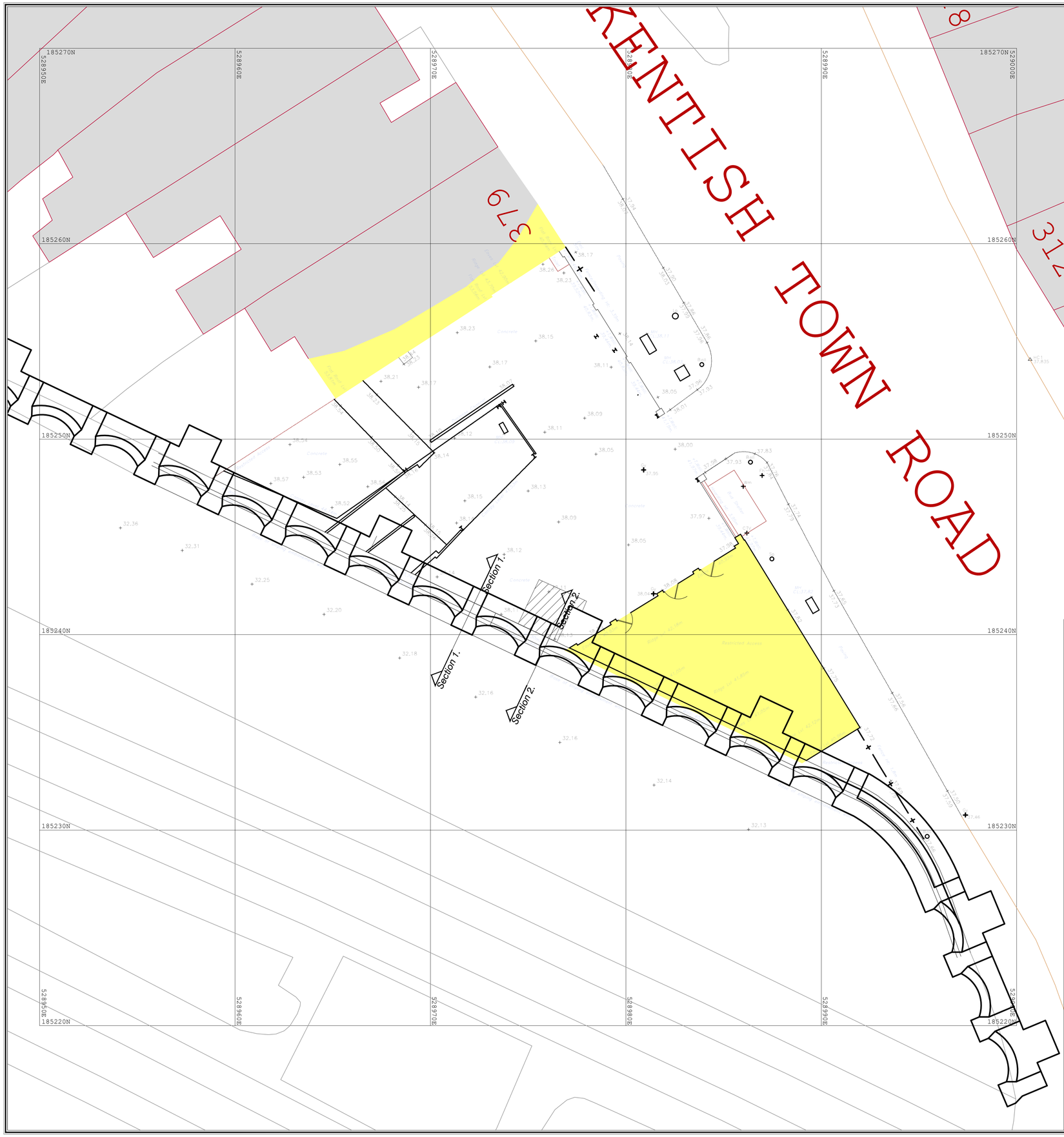
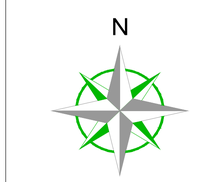
Appendix G

Topographical Survey





Survey Control Details.

Stn.	Eastings.	Northings.	Level.
HC1.	529000.683	185254.073	37.835
HC2.	529008.346	185241.941	37.608	

OS Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

OS Buildings *Surveyed Buildings*

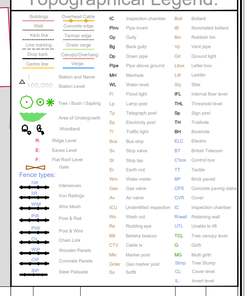
This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via Global Navigational Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

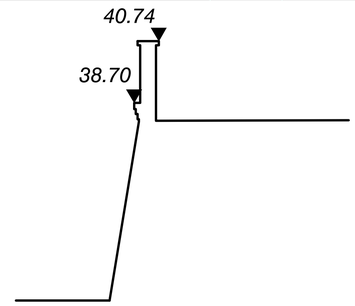
A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models.
The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

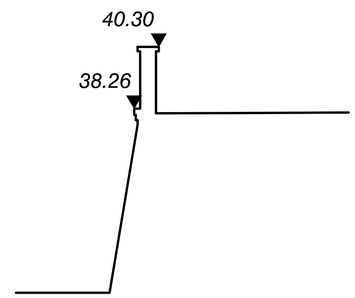
Please refer to Survey Station Table to enable establishment of the on-site grid.

Topographical Legend:





Datum: 30.00m.
Section 1.



Datum: 30.00m.
Section 2.

Rev	Date	Description	Drawn	Q. Ref

greenhatch group

- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

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Amethyst Road
Newcastle Bus. Park
Newcastle-U-Tyne
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t. (01912) 736391

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t. 0048 32 202 2292
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CLIENT
De Metz Forbes Knight Architects Ltd

PROJECT
Kentish Town Road
London
NW5 2TJ

TITLE
Topographical Survey

SCALE	DATE
A1@ 1: 100	18.10.17
DRAWN	QUALITY REF
HC	GH1727

Level datum	OS GPS
Grid orientation	OS GPS
Job number	28520
Drawing No.	Rev.
28520_01_PS	0

Comments
This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.
All dimensions should be checked on site prior to design and construction.
Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

Appendix H

Camden SUDS Proforma

Advice Note on contents of a Surface Water Drainage Statement

London Borough of Camden

1. Introduction

1.1 The Government has strengthened planning policy on the provision of sustainable drainage and new consultation arrangements for 'major' planning applications will come into force from 6 April 2015 as defined in the Written Ministerial Statement (18th Dec 2014).

1.2 The new requirements make Lead Local Flood Authorises statutory consultees with respect to flood risk and SuDS for all major applications. Previously the Environment Agency had that statutory responsibility for sites above 1ha in flood zone 1.

1.3 Therefore all 'major' planning applications submitted from 6 April 2015 are required demonstrate compliance with this policy and we'd encourage this is shown in a **Surface Water Drainage Statement**.

1.4 The purpose of this advice note is to set out what information should be included in such statements.

2. Requirements

2.1 It is essential that the type of Sustainable Drainage System (SuDS) for a site, along with **details of its extent and position**, is identified within the planning application to clearly demonstrate that the proposed SuDS can be accommodated within the development.

2.2 It will now not be acceptable to leave the design of SuDs to a later stage to be dealt with by planning conditions.

2.3 The NPPF paragraph 103 requires that developments do not increase flood risk elsewhere, and gives priority to the use of SuDS. Major developments must include SuDS for the management of run-off, unless demonstrated to be inappropriate. The proposed minimum standards of operation must be appropriate and as such, a **maintenance plan** should be included within the Surface Water Drainage Statement,clearly demonstrating that the SuDS have been designed to ensure that the maintenance and operation requirements are economically proportionate Planning Practice Guidance suggests that this should be considered by reference to the costs that would be incurred by consumers for the use of an effective drainage system connecting directly to a public sewer.

2.4 Camden Council will use planning conditions or obligations to ensure that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

2.5 Within Camden, SuDS systems must be designed in accordance with London Plan policy 5.13. This requires that developments should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve **greenfield run-off rates** and ensure that surface water run-off is managed as close to its source as possible in line with the following **drainage hierarchy**:

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

2.6 The hierarchy above seeks to ensure that surface water run-off is controlled as near to its source as possible to mimic natural drainage systems and retain water on or near to the site, in contrast to traditional drainage approaches, which tend to pipe water off-site as quickly as possible.

2.7 Before disposal of surface water to the public sewer is considered all other options set out in the drainage hierarchy should be exhausted. When no other practicable alternative exists to dispose of surface water other than the public sewer, the Water Company or its agents should confirm that there is adequate spare capacity in the existing system taking future development requirements into account.

2.8 Best practice guidance within the non-statutory technical standards for the design, maintenance and operation of sustainable drainage systems will also need to be followed. Runoff volumes from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the **greenfield runoff volume** for the same event.

2.9 Camden Development Policy 23 (Water) requires developments to reduce pressure on combined sewer network and the risk of flooding by limiting the rate of run-off through sustainable urban drainage systems. This policy also requires that developments in areas known to be at risk of surface water flooding are designed to cope with being flooded. Camden's SFRA surface water flood maps, updated SFRA figures 6 (LFRZs), and 4e (increased susceptibility to elevated groundwater) , as well as the Environment Agency updated flood maps for surface water (ufmfsw), should be referred to when determining whether developments are in an area at risk of flooding.

2.10 Camden Planning Guidance 3 (CPG3) requires developments to achieve a greenfield run off rate once SuDS have been installed. Where it can be demonstrated that this is not feasible, a minimum 50% reduction in run off rate across the development is required. Further guidance on how to reduce the risk of flooding can be found in CPG3 paragraphs 11.4-11.8.

2.11 Where an application is part of a larger site which already has planning permission it is essential that the new proposal does not compromise the drainage scheme already approved.

3. Further information and guidance

3.1 Applicants are strongly advised to discuss their proposals with the Lead Local Flood Authority at the pre-application stage to ensure that an acceptable SuDS scheme is submitted.

3.2 For general clarification of these requirements please Camden's Local Planning Authority or Lead Local Flood Authority

Surface Water Drainage Pro-forma for new developments

This pro-forma accompanies our advice note on surface water drainage. Developers should complete this form and submit it to the Local Planning Authority, referencing from where in their submission documents this information is taken. The pro-forma is supported by the Defra/EA guidance on Rainfall Runoff Management and uses the storage calculator on www.UKsuds.com. This pro-forma is based on current industry best practice and focuses on ensuring surface water drainage proposals meet national and local policy requirements. The pro-forma should be considered alongside other supporting SuDS Guidance.

1. Site Details

Site	Kentish Town Car Wash
Address & post code or LPA reference	369-377 Kentish Town Road, London. NW5 2TJ
Grid reference	TQ 28981 85245
Is the existing site developed or Greenfield?	Developed
Is the development in a LFRZ or in an area known to be at risk of surface or ground water flooding? If yes, please demonstrate how this is managed, in line with DP23?	No
Total Site Area served by drainage system (excluding open space) (Ha)*	0.037

***** The Greenfield runoff off rate from the development which is to be used for assessing the requirements for limiting discharge flow rates and attenuation storage from a site should be calculated for the area that forms the drainage network for the site whatever size of site and type of drainage technique. Please refer to the Rainfall Runoff Management document or CIRIA manual for detail on this.

2. Impermeable Area

	Existing	Proposed	Difference (Proposed-Existing)	Notes for developers
Impermeable area (ha)	0.037	0.037	0	If the proposed amount of impermeable surface is greater, then runoff rates and volumes will increase. Section 6 must be filled in. If proposed impermeability is equal or less than existing, then section 6 can be skipped and section 7 filled in.
Drainage Method (infiltration/sewer/watercourse)	Drain to public sewer unal	Attenuation via blue roof syste	N/A	If different from the existing, please fill in section 3. If existing drainage is by infiltration and the proposed is not, discharge volumes may increase. Fill in section 6.

3. Proposing to Discharge Surface Water via

	Yes	No	Evidence that this is possible	Notes for developers
Existing and proposed MicroDrainage calculations	X		Refer to Appendix B & C of the Kentish Town Road FRA & SUDS report.	Please provide MicroDrainage calculations of existing and proposed run-off rates and volumes in accordance with a recognised methodology or the results of a full infiltration test (see line below) if infiltration is proposed.
Infiltration		X	-	e.g. soakage tests. Section 6 (infiltration) must be filled in if infiltration is proposed.
To watercourse		X	-	e.g. Is there a watercourse nearby?
To surface water sewer	X		To the 1549 mm x 991 mm combined water public sewer in Kentish Town Road.	Confirmation from sewer provider that sufficient capacity exists for this connection.
Combination of above		X	-	e.g. part infiltration part discharge to sewer or watercourse. Provide evidence above.
Has the drainage proposal had regard to the SuDS hierarchy?	X		Refer to Kentish Town Road FRA & SUDS report.	Evidence must be provided to demonstrate that the proposed Sustainable Drainage strategy has had regard to the SuDS hierarchy as outlined in Section 2.5 above.
Layout plan showing where the sustainable drainage infrastructure will be located on site.	X		Refer to Appendix E of the Kentish Town Road FRA & SUDS report.	Please provide plan reference numbers showing the details of the site layout showing where the sustainable drainage infrastructure will be located on the site. If the development is to be constructed in phases this should be shown on a separate plan and confirmation should be provided that the sustainable drainage proposal for each phase can be constructed and can operate independently and is not reliant on any later phase of development.

4. Peak Discharge Rates – This is the maximum flow rate at which storm water runoff leaves the site during a particular storm event.

	Existing Rates (l/s)	Proposed Rates (l/s)	Difference (l/s) (Proposed-Existing)	% Difference (difference /existing x 100)	Notes for developers
Greenfield QBAR	0.19	N/A	N/A	N/A	QBAR is approx. 1 in 2 storm event. Provide this if Section 6 (QBAR) is proposed.
1 in 1	4.7	4.7	0	0	Proposed discharge rates (with mitigation) should aim to be equivalent to greenfield rates for all corresponding storm events. As a minimum, peak discharge rates must be reduced by 50% from the existing sites for all corresponding rainfall events.
1 in 30	11.6	5.8	-5.8	-50%	
1in 100	15.2	5.8	-9.4	-61%	
1 in 100 plus climate change	N/A	5.8	N/A	N/A	The proposed 1 in 100 +CC peak discharge rate (with mitigation) should aim to be equivalent to greenfield rates. As a minimum, proposed 1 in 100 +CC peak discharge rate must be reduced by 50% from the existing 1 in 100 runoff rate sites.

5. Calculate additional volumes for storage –The total volume of water leaving the development site. New hard surfaces potentially restrict the amount of stormwater that can go to the ground, so this needs to be controlled so not to make flood risk worse to properties downstream.

	Greenfield runoff volume (m^3)	Existing Volume (m^3)	Proposed Volume (m^3)	Difference (m^3) (Proposed-Existing)	Notes for developers
1 in 1	3.5	8.5	8.5	0	Proposed discharge volumes (with mitigation) should be constrained to a value as close as is reasonably practicable to the greenfield runoff volume wherever practicable and as a minimum should be no greater than existing volumes for all corresponding storm events. Any increase in volume increases flood risk elsewhere. Where volumes are increased section 6 must be filled in.
1 in 30	9.7	23.6	23.6	0	
1in 100 6 hour	14.3	32.8	32.8	0	
1 in 100 6 hour plus climate change	20.0	45.9	45.9	0	The proposed 1 in 100 +CC discharge volume should be constrained to a value as close as is reasonably practicable to the greenfield runoff volume wherever practicable. As a minimum, to mitigate for climate change the proposed 1 in 100 +CC volume discharge from site must be no greater than the existing 1 in 100 storm event. If not, flood risk increases under climate change.

6. Calculate attenuation storage – Attenuation storage is provided to enable the rate of runoff from the site into the receiving watercourse to be limited to an acceptable rate to protect against erosion and flooding downstream. The attenuation storage volume is a function of the degree of development relative to the greenfield discharge rate.

		Notes for developers
Storage Attenuation volume (Flow rate control) required to meet greenfield run off rates (m^3)	N/A	Volume of water to attenuate on site if discharging at a greenfield run off rate. Can't be used where discharge volumes are increasing
Storage Attenuation volume (Flow rate control) required to reduce rates by 50% (m^3)	N/A	Volume of water to attenuate on site if discharging at a 50% reduction from existing rates. Can't be used where discharge volumes are increasing
Storage Attenuation volume (Flow rate control) required to meet [OTHER RUN OFF RATE (as close to greenfield rate as possible] (m^3)	11m3 via blue roof and 37.8m3 by tanked permeable paving as per Kentish Town Road FRA & SUDS report.	Volume of water to attenuate on site if discharging at a rate different from the above – please state in 1st column what rate this volume corresponds to. On previously developed sites, runoff rates should not be more than three times the calculated greenfield rate. Can't be used where discharge volumes are increasing
Storage Attenuation volume (Flow rate control) required to retain rates as existing (m^3)	N/A	Volume of water to attenuate on site if discharging at existing rates. Can't be used where discharge volumes are increasing
Percentage of attenuation volume stored above ground,	100% (Blue roof)	Percentage of attenuation volume which will be held above ground in swales/ponds/basins/green roofs etc. If 0, please demonstrate why.

7. How is Storm Water stored on site?

Storage is required for the additional volume from site but also for holding back water to slow down the rate from the site. This is known as attenuation storage and long term storage. The idea is that the additional volume does not get into the watercourses, or if it does it is at an exceptionally low rate. You can either infiltrate the stored water back to ground, or if this isn't possible hold it back with on site storage. Firstly, can infiltration work on site?

			Notes for developers
Infiltration	**State the Site's Geology and known Source Protection Zones (SPZ)**	London clay formation. Site located outside of any SPZ.	Avoid infiltrating in made ground. Infiltration rates are highly variable and refer to Environment Agency website to identify and source protection zones (SPZ)
	Are infiltration rates suitable?	The site investigation confirms that the site is underlain by London Clay wl	Infiltration rates should be no lower than $1x10^{-6}$ m/s.
	State the distance between a proposed infiltration device base and the ground water (GW) level	N/A	Need 1m (min) between the base of the infiltration device & the water table to protect Groundwater quality & ensure GW doesn't enter infiltration devices. Avoid infiltration where this isn't possible.

	Were infiltration rates obtained by desk study or infiltration test?	Desk study	Infiltration rates can be estimated from desk studies at most stages of the planning system if a back up attenuation scheme is provided..
	Is the site contaminated? If yes, consider advice from others on whether infiltration can happen.	No	Advice on contaminated Land in Camden can be found on our supporting documents webpage Water should not be infiltrated through land that is contaminated. The Environment Agency may provide bespoke advice in planning consultations for contaminated sites that should be considered.
In light of the above, is infiltration feasible?	**Yes/No? If the answer is No, please identify how the storm water will be stored prior to release**	No. The storm water will be stored in the blue roof areas and external tanked permeable paving as per the Kentish Town Road FRA & SUDS report.	If infiltration is not feasible how will the additional volume be stored?. The applicant should then consider the following options in the next section.

Storage requirements

The developer must confirm that either of the two methods for dealing with the amount of water that needs to be stored on site.

Option 1 Simple – Store both the additional volume and attenuation volume in order to make a final discharge from site at the greenfield run off rate. This is preferred if no infiltration can be made on site. This very simply satisfies the runoff rates and volume criteria.

Option 2 Complex – If some of the additional volume of water can be infiltrated back into the ground, the remainder can be discharged at a very low rate of 2 l/sec/hectare. A combined storage calculation using the partial permissible rate of 2 l/sec/hectare and the attenuation rate used to slow the runoff from site.

		Notes for developers
Please confirm what option has been chosen and how much storage is required on site.	Option 1 Simple: Refer to Kentish Town Road FRA & SUDS report.	The developer at this stage should have an idea of the site characteristics and be able to explain what the storage requirements are on site and how it will be achieved.

8. Please confirm

		Notes for developers
Which Drainage Systems measures have been used, including green roofs?	Storm water run-off will be stored in the blue roof areas and external tanked permeable paving as	SUDS can be adapted for most situations even where infiltration isn't feasible e.g. impermeable liners beneath some SUDS devices allows treatment but not infiltration. See CIRIA SUDS Manual C697.
Drainage system can contain in the 1 in 30 storm event without flooding	Yes	This a requirement for sewers for adoption & is good practice even where drainage system is not adopted.
Will the drainage system contain the 1 in 100 +CC storm event? If no please demonstrate how buildings and utility plants will be protected.	Yes	National standards require that the drainage system is designed so that flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.
Any flooding between the 1 in 30 & 1 in 100 plus climate change storm events will be safely contained on site.	No floodings for the 1 in 30 & 1 in 100 plus climate change storm events	**Safely:** not causing property flooding or posing a hazard to site users i.e. no deeper than 300mm on roads/footpaths. Flood waters must drain away at section 6 rates. Existing rates can be used where runoff volumes are not increased.
How will exceedance events be catered on site without increasing flood risks (both on site and outside the development)?	The surface water drainage network will be sized to accommodate the 1 in 100-year + 40% climate change allowance with no flooding. The proposed run-off rates significantly better the existing condition.	**Safely:** not causing property flooding or posing a hazard to site users i.e. no deeper than 300mm on roads/footpaths. Flood waters must drain away at section 6 rates. Existing rates can be used where runoff volumes are not increased. Exceedance events are defined as those larger than the 1 in 100 +CC event.
How are rates being restricted (vortex control, orifice etc)	Vortex control.	Detail of how the flow control systems have been designed to avoid pipe blockages and ease of maintenance should be provided.
Please confirm the owners/adopters of the entire drainage systems throughout the development. Please list all the owners.	KTR Carwash Project Limited	If these are multiple owners then a drawing illustrating exactly what features will be within each owner's remit must be submitted with this Proforma.
How is the entire drainage system to be maintained?	Directly by the owners. Refer to SUDS maintenance schedule as noted in the Kentish Town Road FRA & SUDS report.	If the features are to be maintained directly by the owners as stated in answer to the above question please answer yes to this question and submit the relevant maintenance schedule for each feature. If it is to be maintained by others than above please give details of each feature and the maintenance schedule. Clear details of the maintenance proposals of all elements of the proposed drainage system must be provided. Details must demonstrate that maintenance and operation requirements are economically proportionate. Poorly maintained drainage can lead to increased flooding problems in the future.

9. Evidence Please identify where the details quoted in the sections above were taken from. i.e. Plans, reports etc. Please also provide relevant drawings that need to accompany your proforma, in particular exceedance routes and ownership and location of SuDS (maintenance access strips etc

Pro-forma Section	Document reference where details quoted above are taken from	Page Number
Section 2	Kentish town Car Wash FRA & SUDS report	
Section 3	Kentish town Car Wash FRA & SUDS report	
Section 4	Kentish town Car Wash FRA & SUDS report	
Section 5	Kentish town Car Wash FRA & SUDS report	
Section 6	Kentish town Car Wash FRA & SUDS report	
Section 7	Kentish town Car Wash FRA & SUDS report	
Section 8	Kentish town Car Wash FRA & SUDS report	

The above form should be completed using evidence from the Flood Risk Assessment and site plans. It should serve as a summary sheet of the drainage proposals and should clearly show that the proposed rate and volume as a result of development will not be increasing. If there is an increase in rate or volume, the rate or volume section should be completed to set out how the additional rate/volume is being dealt with.

This form is completed using factual information from the Flood Risk Assessment and Site Plans and can be used as a summary of the surface water drainage strategy on this site.

Form Completed By Steffan Rees
Qualification of person responsible for signing off this pro-forma Civil Engineer MEng

Company Price & Myers
On behalf of (Client's details) PKS Architects LLP
Date: 13/03/2020