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Ref: GGC18630/R4

24th January 2018

Surface Water Drainage Statement – Sustainable Drainage System (SuDS)
63 Hillfield Road, London, NW6 1QB

Report Status: **FINAL**		
Role	**By**	**Signature**
Calculations and report by:	Roberta McAlister BSc MSc FGS	
Report checked by:	Keith Gabriel MSc DIC CGeol FGS UK Registered Ground Engineering Adviser	
SuDS assessment approved by:	Mike Summersgill MSc CEng MICE C.WEM FCIWEM	

1. Introduction

1.1 This site-specific assessment of surface water run-off has been undertaken in general accordance with the 'CPG3 – Sustainability' (July 2015) policy document from the London Borough of Camden (LBC). It has been checked and approved by Mike Summersgill, who is a Chartered Civil Engineer (CEng) and Chartered Water and Environmental Manager (C.WEM) (geotechnical and hydrological specialist).

1.2 The aim of this assessment is to reduce the surface water run-off rate for the proposed development by incorporating one or more SuDS into the scheme, in accordance with LBC's CPG3. The SuDS have been recommended following the drainage hierarchy in Policy 5.13 of the London Plan, reproduced in LBC's Advice Note.

1.3 This assessment has been carried out using the 'greenfield runoff rate estimation' and 'surface water storage volume estimation' tools which have been developed by HR Wallingford Ltd and are available on www.uksuds.com (see Appendix A).

2. Assessment

2.1 The geology on site was recorded during the site-specific ground investigation to comprise Made Ground (generally variably sandy, variably silty clay) over London Clay (see GGC's Basement Impact Assessments (Reports 18630/R2 & R3). As such, the site is classified as within SOIL type 4, as defined by HR Wallingford.

2.2 A 'climate change allowance factor' of 1.4 has been applied in these analyses, which increases the design rainfall by a factor of 1.4, alongside an 'urban creep allowance factor' of 1.1.

2.3 The site currently comprises a terraced house with small front garden and large, split level rear garden. The proposals for the site include rear and side extensions to the existing house and the creation of a front lightwell, and the construction of a new house within the rear garden. The areas covered with permeable and impermeable surfacing have been calculated for the site, both pre- and post- development. The net differences have also been calculated, as summarised in Table 1 below. A substantial increase in impermeable surfacing can be seen between the existing site and proposed development, which will predominantly be caused by the construction of the proposed new building. It should be noted that the roof of the existing house, the hard-surfaced lower level side/rear garden, and a majority of the front garden, currently drain entirely to the public sewer.

Table 1: Comparison of areas of permeable and impermeable surfacing between existing site and proposed development

Area (ha)	Existing	Proposed	Difference
Permeable	0.020	0.007	-0.013
Impermeable	0.015	0.028	+0.013
Total	0.035	0.035	N/A

2.4 'Greenfield' surface water run-off rates have been calculated for the site using the greenfield runoff rate estimation tool (see Appendix A). Run-off rates have been calculated for mean annual maximum surface water run-off rate (Qbar), as well as for events with probabilities of 1 in 1 year, 1 in 30 years and 1 in 100 years; the calculated run-off rates are summarised in Table 2 below. The minimum site area applicable for this tool is 0.1ha, so the resultant run-off rate had to be scaled down accordingly.

Table 2: Summary of greenfield run-off rates for different rainfall events

	Greenfield Run-off Rates (l/s)
Qbar	0.154[1]
1 in 1 year	0.133[1]
1 in 30 years	0.357[1]
1 in 100 years	0.494[1]
1 in 100 years plus climate change	N/A

[1] Calculated pro-rata to the site area (0.035ha) relative to HR Wallingford's 0.1ha minimum input.

2.5 The volumes of run-off storage required to mitigate the proposed increase in impermeable surface area for the proposed development were calculated using the surface water storage volume estimation tool with the same volume control approach of 'flow control to a max of 2l/s/ha' (see Appendix B), both with and without mitigation measures. The total site area used in this calculation is equal to the proposed increase in impermeable surface area of 0.013ha. The calculated volumes of run-off storage

required are summarised in Table 3 below. The mitigation used includes an allowance for an impervious area of 0.006ha (56.3m²) drained by infiltration.

Table 3: Summary of required storage volumes for the proposed development		
	Proposed (no mitigation)	**Proposed (with mitigation)**
Storage Volume (m³)	Interception: 1 (to one significant figure [1 s.f.]) Attenuation: 4 (to 1 s.f.) Total: 4 (to 1 s.f.) Additionally, Treatment: 2 (to 1 s.f.)	Interception: 0 (to 1 s.f.) Attenuation: 2 (to 1 s.f.) Total: 2 (to 1s.f.) Additionally, Treatment: 1 (to 1 s.f.)

3. Sustainable Drainage System (SuDS) Recommendations

3.1 The flat roof of the proposed new building is shown in the scheme drawings to comprise a green sedum roof. Some of the interception and attenuation storage recommended above could be provided in the granular layer at the base of this green roof. During small (frequent) rainfall events which provide rainfall depths of up to approximately 5mm, this green roof will absorb the rainfall, provide short-term storage and then allow evapotranspiration, thereby minimising the discharge from the roof, although these benefits reduce once the green roof is fully saturated (typically in storm conditions) or frozen. An upstand of at least 25mm above soil level should be included around the edges of this green roof, to ensure the required depths of rainfall from small (frequent) events are being stored.

3.2 Less frequent events with rainfall depths greater than 5mm can be catered for by incorporating attenuation storage into the scheme. The total storage required to mitigate the increase in impermeable area for the proposed site, without incorporating the permeable paving mitigation measures, is given in Table 3 as 4m³ (4000 litres). This is the equivalent of approximately 30mm of rainfall over a total impermeable area of 130m² (the proposed increase in impermeable surfacing). The green roof is expected to take at least 5mm of this rainfall (i.e. from a small, frequent rainfall event) over that roof area (44.8m²) (see paragraph 3.1); this relates to a storage volume of approximately 0.22m³ (224 litres). A storage tank capacity of approximately **3800 litres (3.8m³)** would therefore be required, should **no mitigation measures** be incorporated into the scheme. Alternatively, the total storage required to mitigate the increase in impermeable area for the proposed site, incorporating the permeable paving mitigation measures, is given in Table 3 as 2m³ (2000 litres). This is the equivalent of approximately 27mm of rainfall over a total impermeable area of 73.7m² (as proposed; 130m² total impermeable area minus proposed impervious area of 56.3 m²). As above, the green roof is expected to provide a minimum storage volume of approximately 0.22m³ (224 litres), so a storage tank capacity of approximately **1800 litres (1.8m³)** would therefore be required, should **permeable paving mitigation measures** be incorporated into the scheme. Regardless of the size of the final storage tank, the tank should be designed to gradually release the stored water into the public sewer, by incorporating a throttled outflow at 0.5l/s in order to match the maximum greenfield

run-off rate in Table 2, subject to commercial availability of suitable equipment to achieve this limited flow rate. It should be noted that HR Wallingford recommend that run-off rates are limited to 5l/s to allow for blockages from vegetation and other materials (see Appendix A) so run-off from this site would be significantly below that rate.

3.3 Use of soakaways within this site will not be acceptable owing to the small size of the soft landscaped amenity space, the requirement to keep soakaways at least 5m from any building and the impervious nature of the soils. However, the soft landscaped amenity spaces in the central and northern parts of the site could be finished with permeable granular soils and vegetation to aid temporary retention and limited infiltration. To achieve the reduction of attenuation storage required on site from 3800 litres to 1800 litres (see paragraph 3.2 above), the hard surfaces to the front of the existing house and between the existing and new houses should be made from permeable paving in order to reduce run-off during rainfall events (as per the mitigation described in paragraph 2.5 using the impervious area of 0.006ha drained by infiltration). As the site is underlain by London Clay which will generally allow little or no infiltration, this permeable paving should have a permeable sub-base of sufficient porosity and thickness to store 2000 litres of 'mitigated' surface water and gradually release it into the drainage the system.

3.4 To minimise the risk of pollution within any run-off from the proposed green roof, the green roof should not be constructed from a material that will add pollutants to the rainwater that percolates through it (i.e. not from traditional copper roofing). The run-off from the green roof will benefit from treatment within the soil and root uptake zone through natural physical, biological and chemical treatment processes during infiltration and evapotranspiration. Some pollutants within the air and rainwater will be filtered out of the run-off, reducing pollution levels in the subsequent system.

3.5 Local drainage system failure (caused by extreme rainfall or lack of maintenance) is very unlikely to cause flooding of the proposed development (see paragraph 10.9 of GGC's 18630/R3 Basement Impact Assessment).

Appendices:

Appendix A HR Wallingford – Greenfield runoff estimation – Site area 0.1ha

Appendix B HR Wallingford – Surface water storage requirements for proposed site – Site area 0.013ha

- Without mitigation
- With mitigation

APPENDIX A

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Roberta McAlister
Site name:	63 Hillfield Road
Site location:	Camden

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:	51.55250° N
Longitude:	0.19836° W

Reference:	6224334
Date:	2018-01-16T14:47:13

Methodology	IH124

Site characteristics

Total site area (ha)	0.1

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	4	4
HOST class	---	---
SPR/SPRHOST	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	650	650
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?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	0.44	0.44
1 in 1 year (l/s)	0.38	0.38
1 in 30 years (l/s)	1.02	1.02
1 in 100 years (l/s)	1.41	1.41

APPENDIX B1

HR Wallingford
Working with water

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Roberta McAlister
Site name:	63 Hillfield Road
Site location:	Camden

This is an estimation of the storage volume requirements 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). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the drainage scheme.

Site coordinates

Latitude:	51.55250° N
Longitude:	0.19836° W

Reference:	6224359
Date:	2018-01-23T15:02:58

Methodology	IH124

Site characteristics

Total site area (ha)	0.013
Significant public open space (ha)	0
Area positively drained (ha)	0.013
Pervious area contribution (%)	30
Impermeable area (ha)	0.013
Percentage of drained area that is impermeable (%)	100
Impervious area drained via infiltration (ha)	0
Return period for infiltration system design (year)	10
Impervious area drained to rainwater harvesting systems (ha)	0
Return period for rainwater harvesting system design (year)	10
Compliance factor for rainwater harvesting system design (%)	66
Net site area for storage volume design (ha)	0.02
Net impermeable area for storage volume design (ha)	0.01

* Where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50 % of the 'area positively drained', the 'net site area' and the estimates of Qbar and other flow rates will have been reduced accordingly.

Design criteria

Volume control approach	Flow control to max of 2 l/s/ha or

	Default	Edited
Climate change allowance factor	1.4	1.4
Urban creep allowance factor	1.1	1.1
Interception rainfall depth (mm)	5	5
Minimum flow rate (l/s)	1	1

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
Qbar total site area (l/s)	0.06	--
SOIL type	4	4
HOST class	N/A	N/A
SPR	0.47	0.47

Hydrology

	Default	Edited
SAAR (mm)	650	650
M5-60 Rainfall Depth (mm)	20	20
'r' Ratio M5-60/M5-2 day	0.4	0.4
Rainfall 100 yrs 6 hrs	63	
Rainfall 100 yrs 12 hrs	102.41	
FEH/FSR conversion factor	1.33	1.33
Hydrological region	6	
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 10 year	1.62	1.62
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Site discharge rates

	Default	Edited
Qbar total site area (l/s)	0.06	0.06
Qbar net site area (l/s)	0.09	0.09
1 in 1 year (l/s)	1	1
1 in 30 years (l/s)	1	1
1 in 100 years (l/s)	1	1

Estimated storage volumes

	Default	Edited
Interception storage (m^3)	1	1
Attenuation storage (m^3)	4	4
Long term storage (m^3)	0	0
Treatment storage (m^3)	2	2
Total storage *(excluding treatment)* (m^3)	4	4

APPENDIX B2

HR Wallingford
Working with water

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Roberta McAlister
Site name:	63 Hillfield Road
Site location:	Camden

This is an estimation of the storage volume requirements 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). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the drainage scheme.

Site coordinates

Latitude:	51.55250° N
Longitude:	0.19836° W

Reference:	6224359
Date:	2018-01-23T15:02:38

Methodology	IH124

Site characteristics

Total site area (ha)	0.013
Significant public open space (ha)	0
Area positively drained (ha)	0.013
Pervious area contribution (%)	30
Impermeable area (ha)	0.013
Percentage of drained area that is impermeable (%)	100
Impervious area drained via infiltration (ha)	0.006
Return period for infiltration system design (year)	10
Impervious area drained to rainwater harvesting systems (ha)	0
Return period for rainwater harvesting system design (year)	10
Compliance factor for rainwater harvesting system design (%)	66
Net site area for storage volume design (ha)	0.02
Net impermeable area for storage volume design (ha)	0.01

* Where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50 % of the 'area positively drained', the 'net site area' and the estimates of Qbar and other flow rates will have been reduced accordingly.

Design criteria

Volume control approach	Flow control to max of 2 l/s/ha or

	Default	Edited
Climate change allowance factor	1.4	1.4
Urban creep allowance factor	1.1	1.1
Interception rainfall depth (mm)	5	5
Minimum flow rate (l/s)	1	1

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
Qbar total site area (l/s)	0.06	--
SOIL type	4	4
HOST class	N/A	N/A
SPR	0.47	0.47

Hydrology

	Default	Edited
SAAR (mm)	650	650
M5-60 Rainfall Depth (mm)	20	20
'r' Ratio M5-60/M5-2 day	0.4	0.4
Rainfall 100 yrs 6 hrs	63	
Rainfall 100 yrs 12 hrs	102.41	
FEH/FSR conversion factor	1.33	1.33
Hydrological region	6	
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 10 year	1.62	1.62
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Site discharge rates

	Default	Edited
Qbar total site area (l/s)	0.06	0.06
Qbar net site area (l/s)	0.09	0.09
1 in 1 year (l/s)	1	1
1 in 30 years (l/s)	1	1
1 in 100 years (l/s)	1	1

Estimated storage volumes

	Default	Edited
Interception storage (m^3)	0	0
Attenuation storage (m^3)	2	2
Long term storage (m^3)	0	0
Treatment storage (m^3)	1	1
Total storage *(excluding treatment)* (m^3)	2	2