



DRAINAGE STRATEGY

for

**Proposed Residential Development
at
Blendworth Crescent
Leigh Park
Havant**

Client:

PMC Construction and Development
Services Ltd
106 Queens Road
Portsmouth
Hampshire
PO2 7NE

Architect:

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Concept House
35 Kingston Crescent
North End
Portsmouth
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Issue		A	B
Issued By	Allen Rushby	Allen Rushby	
Date	March 2016	Nov 2016	
Purpose	Planning	Approval	
Approved By			

Project No: PMC 238

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1.0 Introduction

It is proposed to re-develop the site at Blendworth Crescent, Leigh Park to provide new residential accommodation of 20 No houses and 31 No flats with associated entrance road, parking areas and soft landscaping

This report outlines the proposed foul and surface water drainage strategy for the proposed development

2.0 The Site

2.1 Site Location and Description

The site is located to the south of Blendworth Crescent in a predominantly residential area of Havant. The site is irregular in plan shape tapering towards the east. The site comprises 1.13ha of level grassland currently used as a recreation area; primarily dog walking and as an access route. The northern boundary of the site is denoted by the fences, mature trees and vegetation to the rear of residential properties along Blendworth Crescent. The southern site boundary is marked by a number of tall mature trees dotted along a hedge row concealing a fence line separating the site from Trosnant Junior School, immediately to the south. The western site limit is denoted by a line of vegetation, fence and trees separating the site from the residential properties along Stockheath Lane

2.2 Existing Site Topography and Drainage

Refer to the Hampshire Land Surveys Ltd drawing in the Appendix.

Site topography is relatively flat with a gradual fall from east to west with the lowest levels being at the south west corner.

There is currently no known foul drainage on the site. A 225mm diameter public foul sewer is located on the southern side of Blendworth Crescent. A 525mm diameter storm sewer crosses the site in a north-south direction from Blendworth Crescent to the grounds of Trosnant School to the southern boundary.

2.3 Ground Conditions

Reference to the British Geological Survey (BGS) Map (Sheet 315, Southampton, Scale 1:50,000) indicates the site to directly overlie superficial geology of Head Deposits (sand, silt and clay) and the London Clay Formation (clay, silt and sand).

A ground investigation report has been prepared by Ridge Property and Construction Consultants together with additional infiltration tests by Soils Ltd. Relevant extracts from these reports are contained within the Appendix for reference.

2.4 Environment Agency Data

The Environment Agency Ground Water Vulnerability map indicates that the site is underlain by superficial Secondary Aquifer.

The site lies within a ground water source protection zone (SPZ), recorded as 1C- Inner Catchment within a confined aquifer.

3.0 Proposed Foul Water Drainage

It is proposed that foul water from the site will be discharged to the existing public sewer in Blendworth Crescent subject to agreement with Southern Water. Due to the relative site levels a foul water pumping station will be required which will be located to the western end of the site.

In accordance with 'Sewers For Adoption', the design peak flow rate to the receiving sewer based upon 4000 litres per dwelling per day – 2.36 litres/sec

4.0 Proposed Surface Water Drainage

4.1 Control of Water Quantity Run-off

The ground investigation carried out in January by Soils Ltd to determine the soakage characteristics of the soils concluded that the use of infiltration systems to dispose of surface water is not feasible. A copy of their report is contained within the Appendix

It is proposed therefore that the following methods will be used to receive, store and attenuate the surface water run-off from the site:-

- a) Rainwater from house roofs will be discharged directly to the adjacent permeable pavement sub base which will have sufficient depth to store the 1 in 100 year + 30% rainfall event.
- b) Rainwater from the flats' roof will be discharged to the existing 525 diameter surface water sewer that traverses the site via an attenuation tank with capacity for the 1 in 100 year + 30% rainfall event.
- c) All access roadway and car parking areas will be constructed in permeable paving with sufficient depth of sub base to store the 1 in 100 + 30% rainfall event.

- d) The stored water within the systems described in a) to c) above will be discharged into the existing 625mm diameter public storm sewer that traverses the site north to south via a system of control chambers. The discharge rate to the public sewer will be limited to 8.5litres/sec which is considerably less than the 1 in 30 year 'green field' run off rate which has been determined as 13.8litres/sec. (see calculations within the Appendix.)

Volume of Run-off

It is clearly not possible for this development to limit the volume of surface water run-off to the pre development condition as the soils are essentially impermeable.

The rate of run-off has therefore been limited in accordance with recommendations within the SuDs manual to limit any effect on receiving water systems.

4.2 Water Quality Management

Ciria 753 SuDs Manual – 2015 has specific guidance on water quality management for the protection of surface and ground water and extracts are included in Appendix 4 for reference.

Interception

Wherever possible SuDs should be designed to intercept run-off (and associated pollutants) for most rainfall events up to approximately 5mm in depth.

The proposals described above to use permeable pavements will satisfy this requirement.

Protection of Ground and Surface Water

Table 4.3 refers to the minimum water quality management requirements for discharges to receiving ground water.

For residential roofs the pollution hazard is 'very low' and therefore discharge of rainwater directly to the permeable paving sub base via filter chambers to intercept sediment is acceptable. For the driveway and parking areas, the pollution hazard is 'low' and the table refers to the 'simple index approach'.

Table 26.1 shows the approach to water quality risk management from which the 'simple index approach' refers to tables 26.2 and 26.4.

Table 26.2 lists the pollution hazard indices for various land use and these indices have to be exceeded by the mitigation indices shown in Table 26.4.

With reference to these tables permeable paving will provide the required mitigation measures and therefore the driveway and parking areas will be constructed with sufficient sub base storage to contain the 1 in 100 year storm + 30% climate change run-off.

5.0 Maintenance of SuDs Components

The maintenance requirements of the surface water drainage system is outlined on the drainage strategy drawing. This maintenance will be the responsibility of the building management company which will be put in place upon commission of the building.



Allen Rushby IEng, AMIStructE
For and on behalf of Arch Associates

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APPENDIX 1

Southern Water Sewer Plan

[illegible]

SU7107SW

Title: 188188_Land Adjacent Blendwort

Drawn by: mondalb

Scale: 1:1250

Date: 15/01/2015

The actual positions should be determined on site.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.
WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement

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Southern
Water

1401

SEWER RECORDS PAGE 2 OF 2

Note	Cover	Invert	Size	Material	Shape	Note	Cover	Invert	Size	Material	Shape	Note	Cover	Invert	Size	Material	Shape	Note	Cover	Invert	Size	Material	Shape
1401X	11.51		750	CP	CRD	5305X			150	VC	CRD												
1450X			UNK	UNK	UNK	5306X			150	VC	CRD												
2201X	8.15	5.35	525	CP	CRD	5310X			225	VC	CRD												
2202X	9.2	5.33	450	CP	CRD	5350X	13.14	11.4	225	VC	CRD												
2250X	9.07	5.87	300	VC	CRD	5400X	13.89	11.51	225	VC	CRD												
2301X	10.05		150	VC	CRD	5401X	12.75		450	CP	CRD												
2302X	9.78		150	VC	CRD	5402X			UNK	UNK	CRD												
2303X	10.85	9.78	150	PP	CRD	5403X			UNK	UNK	CRD												
2304X	5.78		150	VC	CRD	5404X			UNK	UNK	CRD												
2305X	10.05	9.44	150	VC	CRD	5405X			UNK	UNK	CRD												
2306X	10.47	8.65	150	VC	CRD	5406X			UNK	UNK	CRD												
2350X	10.15	8.98	225	CP	CRD	5407X			UNK	UNK	CRD												
2351X	10.48	9.15	225	CP	CRD	5408X			UNK	UNK	CRD												
2352X	10.69	9.55	225	CP	CRD	5409X			UNK	UNK	CRD												
2353X	10.85	9.71	225	CP	CRD	5450X			225	VC	CRD												
2354X	10.55	9.29	225	CP	CRD	5451X	12.81		450	CP	CRD												
2355X	9.85		UNK	UNK	CRD	5500X	14.14	12.99	225	VC	CRD												
2356X	9.5		300	CP	CRD	5550X	13.73	10.23	525	CP	CRD												
2357X	2.17	8.29	150	VC	CRD				300	VC	CRD												
2358X	5.3	8.05	375	CP	CRD																		
2359X	10.55	9.52	150	VC	CRD																		
2360X	9.5	7.95	300	CP	CRD																		
2381X	11.48	10.47	225	VC	CRD																		
2401X	12.61	10.21	450	VC	CRD																		
2402X	12.41		750	CP	CRD																		
			100	CP	CRD																		
			100	CP	CRD																		
			100	CP	CRD																		
2452X	12.37	11.5	225	VC	CRD																		
2453X	11.58	10.73	150	VC	CRD																		
2454X	11.11	9.85	225	CP	CRD																		
2455X	12.75	11.51	225	VC	CRD																		
3201X	10.4	8.98	150	VC	CRD																		
3202X	9.01	7.5	150	VC	CRD																		
3203X	9.92	7.15	150	VC	CRD																		
3204X	9.5	7.9	150	VC	CRD																		
3205X			UNK	UNK	CRD																		
3206X			UNK	UNK	CRD																		
3207X			UNK	UNK	CRD																		
3208X			UNK	UNK	CRD																		
3250X	5.65	8.6	225	VC	CRD																		
3251X	11.37	7.42	500	CP	CRD																		
3350X	9.35	7.16	375	CP	CRD																		
3401X	12.03	10.84	225	VC	CRD																		
3402X	11.88	10.47	225	VC	CRD																		
3404X	12.91	10.25	450	VC	CRD																		
3451X	12.49	9.66	450	CP	CRD																		
3452X	11.94	9.44	450	CP	CRD																		
3453X	11.78	10.05	225	VC	CRD																		
4250X	12.15		500	CP	CRD																		
4350X	12.22		525	CP	CRD																		
4351X	11.02		525	CP	CRD																		
4401X	12.82	10.78	225	VC	CRD																		
4402X	12.35	11.15	225	VC	CRD																		
4403X	12.4	11.47	225	VC	CRD																		
4404X	12.75	10.57	450	VC	CRD																		
4450X	12.61	9.63	450	CP	CRD																		
4451X	12.48		525	CP	CRD																		
		12.23	225	VC	CRD																		
	13.09		225	VC	CRD																		
	13.25		525	CP	CRD																		
	13.54	11.74	525	CP	CRD																		
5252X	14.34	12.1	225	VC	CRD																		
5300X	12.74	11.47	225	VC	CRD																		
5301X	12.97	10.52	450	CP	CRD																		

LINE SYMBOLS		CONTOURS		WATER LINES		LEGEND - SEE 1500	
1	1/2" Sewer	1	1/2" Contour	1	1/2" Water Line	1	1/2" Sewer
2	3/4" Sewer	2	3/4" Contour	2	3/4" Water Line	2	3/4" Sewer
3	1" Sewer	3	1" Contour	3	1" Water Line	3	1" Sewer
4	1 1/2" Sewer	4	1 1/2" Contour	4	1 1/2" Water Line	4	1 1/2" Sewer
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100	534" Sewer	100	534" Contour	100	534" Water Line	100	534" Sewer

APPENDIX 2

Drainage Calculations

Greenfield runoff estimation for sites

Site name: Blendworth Crescent

Site location: Havant

Site coordinates

Latitude: 50.86150° N

Longitude: 0.98681° W

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 CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcp33e13twv1 / 1.16

Date: 12 Mar 2016

Site characteristics

Total site area	1.16	ha
Significant public open space	0	ha
Area positively drained	1.16	ha

Methodology

Greenfield runoff method	IH124
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	4
HOST class	N/A
SPR	0.47

Hydrological characteristics

	Default	Edited	
SAAR	743	743	mm
M5-60 Rainfall Depth	20	20	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.84	0.84	
Hydrological region	7	7	
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	

Greenfield runoff rates

	Default	Edited	
Qbar	6.00	6.00	l/s
1 in 1 year	5.10	5.10	l/s
1 in 30 years	13.81	13.81	l/s
1 in 100 years	19.16	19.16	l/s

Please note that a minimum flow of 5 l/s applies to any site


$$\text{C}_2\text{Al}(\text{CH}_3)_2\text{Al}(\text{CN})_2$$

Rushby Brewster Associates		Page D3
Town House, St George's Square Bishops Waltham Southampton, SO32 1AF	Blendworth Crescent Leigh Park Havant	
Date Nov. 2016 File Plots 1 to 15.srcx	Designed by AWR Checked by	
XP Solutions	Source Control 2016.1	

Summary of Results for 100 year Return Period (+40%)							
Half Drain Time : 448 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.158	0.208	0.0	2.0	2.0	38.7	O K
30 min Summer	10.216	0.266	0.0	2.0	2.0	52.7	O K
60 min Summer	10.275	0.325	0.0	2.0	2.0	67.0	O K
120 min Summer	10.329	0.379	0.0	2.0	2.0	80.0	O K
180 min Summer	10.353	0.403	0.0	2.0	2.0	85.9	O K
240 min Summer	10.364	0.414	0.0	2.0	2.0	88.5	O K
360 min Summer	10.368	0.418	0.0	2.0	2.0	89.6	O K
480 min Summer	10.363	0.413	0.0	2.0	2.0	88.4	O K
600 min Summer	10.356	0.406	0.0	2.0	2.0	86.7	O K
720 min Summer	10.348	0.398	0.0	2.0	2.0	84.8	O K
960 min Summer	10.330	0.380	0.0	2.0	2.0	80.3	O K
1440 min Summer	10.293	0.343	0.0	2.0	2.0	71.5	O K
2160 min Summer	10.242	0.292	0.0	2.0	2.0	59.1	O K
2880 min Summer	10.196	0.246	0.0	2.0	2.0	48.0	O K
4320 min Summer	10.124	0.174	0.0	2.0	2.0	30.4	O K
5760 min Summer	10.077	0.127	0.0	2.0	2.0	19.1	O K
7200 min Summer	10.050	0.100	0.0	1.9	1.9	12.6	O K
8640 min Summer	10.037	0.087	0.0	1.8	1.8	9.5	O K
10080 min Summer	10.028	0.078	0.0	1.6	1.6	7.7	O K
15 min Winter	10.180	0.230	0.0	2.0	2.0	44.0	O K
Storm Event	Rain (mm/hr)		Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)		
15 min Summer	126.074		0.0	40.4	22		
30 min Summer	84.745		0.0	55.7	37		
60 min Summer	54.368		0.0	72.5	66		
120 min Summer	33.674		0.0	90.7	124		
180 min Summer	25.065		0.0	101.7	184		
240 min Summer	20.180		0.0	109.4	242		
360 min Summer	14.839		0.0	120.9	360		
480 min Summer	11.923		0.0	129.6	438		
600 min Summer	10.054		0.0	136.7	498		
720 min Summer	8.741		0.0	142.7	560		
960 min Summer	7.003		0.0	152.3	680		
1440 min Summer	5.114		0.0	166.6	942		
2160 min Summer	3.727		0.0	181.5	1340		
2880 min Summer	2.973		0.0	192.4	1708		
4320 min Summer	2.159		0.0	207.9	2424		
5760 min Summer	1.718		0.0	218.8	3112		
7200 min Summer	1.438		0.0	227.2	3752		
8640 min Summer	1.245		0.0	234.2	4416		
10080 min Summer	1.102		0.0	240.1	5144		
15 min Winter	126.074		0.0	45.7	22		

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Model Details

Storage is Online Cover Level (m) 10.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.8
Membrane Percolation (mm/hr)	1000	Length (m)	48.0
Max Percolation (l/s)	224.0	Slope (1:X)	500.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.950	Membrane Depth (m)	0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0073-2000-0600-2000
Design Head (m)	0.600
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	73
Invert Level (m)	9.950
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	2.0
Flush-Flo™	0.177	2.0
Kick-Flo®	0.397	1.7
Mean Flow over Head Range	-	1.7

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	1.9	1.200	2.7	3.000	4.2	7.000	6.3
0.200	2.0	1.400	2.9	3.500	4.5	7.500	6.5
0.300	1.9	1.600	3.1	4.000	4.8	8.000	6.7
0.400	1.7	1.800	3.3	4.500	5.1	8.500	6.9
0.500	1.8	2.000	3.5	5.000	5.3	9.000	7.1
0.600	2.0	2.200	3.6	5.500	5.6	9.500	7.3
0.800	2.3	2.400	3.8	6.000	5.8		
1.000	2.5	2.600	3.9	6.500	6.0		

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

Half Drain Time : 122 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.999	0.349	0.0	2.5	2.5	16.4	O K
30 min Summer	11.060	0.410	0.0	2.5	2.5	21.9	O K
60 min Summer	11.106	0.456	0.0	2.5	2.5	26.1	O K
120 min Summer	11.122	0.472	0.0	2.5	2.5	27.5	O K
180 min Summer	11.115	0.465	0.0	2.5	2.5	26.8	O K
240 min Summer	11.103	0.453	0.0	2.5	2.5	25.8	O K
360 min Summer	11.079	0.429	0.0	2.5	2.5	23.6	O K
480 min Summer	11.052	0.402	0.0	2.5	2.5	21.2	O K
600 min Summer	11.024	0.374	0.0	2.5	2.5	18.6	O K
720 min Summer	10.997	0.347	0.0	2.5	2.5	16.2	O K
960 min Summer	10.947	0.297	0.0	2.5	2.5	11.9	O K
1440 min Summer	10.856	0.206	0.0	2.5	2.5	5.7	O K
2160 min Summer	10.763	0.113	0.0	2.4	2.4	1.7	O K
2880 min Summer	10.735	0.085	0.0	2.0	2.0	1.0	O K
4320 min Summer	10.715	0.065	0.0	1.5	1.5	0.6	O K
5760 min Summer	10.705	0.055	0.0	1.2	1.2	0.4	O K
7200 min Summer	10.699	0.049	0.0	1.0	1.0	0.3	O K
8640 min Summer	10.695	0.045	0.0	0.9	0.9	0.3	O K
10080 min Summer	10.692	0.042	0.0	0.8	0.8	0.2	O K
15 min Winter	11.026	0.376	0.0	2.5	2.5	18.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.074	0.0	18.6	21
30 min Summer	84.745	0.0	25.5	35
60 min Summer	54.368	0.0	33.1	62
120 min Summer	33.674	0.0	41.4	110
180 min Summer	25.065	0.0	46.3	142
240 min Summer	20.180	0.0	49.8	174
360 min Summer	14.839	0.0	55.0	244
480 min Summer	11.923	0.0	59.0	314
600 min Summer	10.054	0.0	62.2	378
720 min Summer	8.741	0.0	64.9	440
960 min Summer	7.003	0.0	69.3	562
1440 min Summer	5.114	0.0	75.8	786
2160 min Summer	3.727	0.0	82.7	1108
2880 min Summer	2.973	0.0	87.7	1468
4320 min Summer	2.159	0.0	94.9	2200
5760 min Summer	1.718	0.0	100.0	2896
7200 min Summer	1.438	0.0	104.0	3608
8640 min Summer	1.245	0.0	107.4	4264
10080 min Summer	1.102	0.0	110.2	5112
15 min Winter	126.074	0.0	21.0	21

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Micro Drainage

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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 E Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	11.095	0.445	0.0	2.5	2.5	25.0	O K
60 min Winter	11.151	0.501	0.0	2.5	2.5	30.1	O K
120 min Winter	11.176	0.526	0.0	2.5	2.5	32.3	O K
180 min Winter	11.166	0.516	0.0	2.5	2.5	31.4	O K
240 min Winter	11.150	0.500	0.0	2.5	2.5	30.0	O K
360 min Winter	11.114	0.464	0.0	2.5	2.5	26.8	O K
480 min Winter	11.074	0.424	0.0	2.5	2.5	23.2	O K
600 min Winter	11.028	0.378	0.0	2.5	2.5	19.0	O K
720 min Winter	10.985	0.335	0.0	2.5	2.5	15.2	O K
960 min Winter	10.905	0.255	0.0	2.5	2.5	8.8	O K
1440 min Winter	10.769	0.119	0.0	2.4	2.4	1.9	O K
2160 min Winter	10.728	0.078	0.0	1.9	1.9	0.8	O K
2880 min Winter	10.714	0.064	0.0	1.5	1.5	0.6	O K
4320 min Winter	10.702	0.052	0.0	1.1	1.1	0.4	O K
5760 min Winter	10.695	0.045	0.0	0.9	0.9	0.3	O K
7200 min Winter	10.691	0.041	0.0	0.7	0.7	0.2	O K
8640 min Winter	10.688	0.038	0.0	0.6	0.6	0.2	O K
10080 min Winter	10.685	0.035	0.0	0.6	0.6	0.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	84.745	0.0	28.7	35			
60 min Winter	54.368	0.0	37.3	62			
120 min Winter	33.674	0.0	46.5	116			
180 min Winter	25.065	0.0	52.1	150			
240 min Winter	20.180	0.0	56.0	188			
360 min Winter	14.839	0.0	61.8	264			
480 min Winter	11.923	0.0	66.3	340			
600 min Winter	10.054	0.0	69.9	408			
720 min Winter	8.741	0.0	72.9	470			
960 min Winter	7.003	0.0	77.9	586			
1440 min Winter	5.114	0.0	85.2	768			
2160 min Winter	3.727	0.0	92.9	1100			
2880 min Winter	2.973	0.0	98.6	1464			
4320 min Winter	2.159	0.0	106.8	2204			
5760 min Winter	1.718	0.0	112.7	2928			
7200 min Winter	1.438	0.0	117.2	3656			
8640 min Winter	1.245	0.0	121.1	4280			
10080 min Winter	1.102	0.0	124.4	5032			
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Model Details

Storage is Online Cover Level (m) 11.250

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	83.3	Slope (1:X)	150.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	10.650	Membrane Depth (m)	0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0081-2500-0600-2500
Design Head (m)	0.600
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	81
Invert Level (m)	10.650
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points

	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	2.5
Flush-Flo™	0.179	2.5
Kick-Flo®	0.404	2.1
Mean Flow over Head Range	-	2.1

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	2.4	1.200	3.4	3.000	5.3	7.000	7.9
0.200	2.5	1.400	3.7	3.500	5.7	7.500	8.1
0.300	2.4	1.600	3.9	4.000	6.0	8.000	8.4
0.400	2.1	1.800	4.1	4.500	6.4	8.500	8.7
0.500	2.3	2.000	4.4	5.000	6.7	9.000	8.9
0.600	2.5	2.200	4.5	5.500	7.0	9.500	9.2
0.800	2.9	2.400	4.7	6.000	7.3		
1.000	3.2	2.600	4.9	6.500	7.6		

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

Half Drain Time : 47 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.934	0.234	0.0	2.0	2.0	6.1	O K
30 min Summer	10.970	0.270	0.0	2.0	2.0	8.2	O K
60 min Summer	10.988	0.288	0.0	2.0	2.0	9.3	O K
120 min Summer	10.989	0.289	0.0	2.0	2.0	9.4	O K
180 min Summer	10.978	0.278	0.0	2.0	2.0	8.7	O K
240 min Summer	10.964	0.264	0.0	2.0	2.0	7.9	O K
360 min Summer	10.931	0.231	0.0	2.0	2.0	6.0	O K
480 min Summer	10.898	0.198	0.0	2.0	2.0	4.4	O K
600 min Summer	10.867	0.167	0.0	2.0	2.0	3.1	O K
720 min Summer	10.838	0.138	0.0	2.0	2.0	2.1	O K
960 min Summer	10.796	0.096	0.0	2.0	2.0	1.0	O K
1440 min Summer	10.772	0.072	0.0	1.6	1.6	0.6	O K
2160 min Summer	10.756	0.056	0.0	1.1	1.1	0.4	O K
2880 min Summer	10.749	0.049	0.0	0.9	0.9	0.3	O K
4320 min Summer	10.740	0.040	0.0	0.7	0.7	0.2	O K
5760 min Summer	10.735	0.035	0.0	0.5	0.5	0.1	O K
7200 min Summer	10.732	0.032	0.0	0.4	0.4	0.1	O K
8640 min Summer	10.729	0.029	0.0	0.4	0.4	0.1	O K
10080 min Summer	10.727	0.027	0.0	0.3	0.3	0.1	O K
15 min Winter	10.953	0.253	0.0	2.0	2.0	7.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.074	0.0	7.3	17
30 min Summer	84.745	0.0	10.4	31
60 min Summer	54.368	0.0	13.8	52
120 min Summer	33.674	0.0	17.5	86
180 min Summer	25.065	0.0	19.7	120
240 min Summer	20.180	0.0	21.2	154
360 min Summer	14.839	0.0	23.5	218
480 min Summer	11.923	0.0	25.2	280
600 min Summer	10.054	0.0	26.6	336
720 min Summer	8.741	0.0	27.8	390
960 min Summer	7.003	0.0	29.7	494
1440 min Summer	5.114	0.0	32.4	734
2160 min Summer	3.727	0.0	35.2	1080
2880 min Summer	2.973	0.0	37.1	1436
4320 min Summer	2.159	0.0	39.7	2188
5760 min Summer	1.718	0.0	41.5	2920
7200 min Summer	1.438	0.0	42.7	3656
8640 min Summer	1.245	0.0	43.6	4264
10080 min Summer	1.102	0.0	44.3	5008
15 min Winter	126.074	0.0	8.4	17

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Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control E (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.991	0.291	0.0	2.0	2.0	9.5	O K
60 min Winter	11.011	0.311	0.0	2.0	2.0	10.9	O K
120 min Winter	11.010	0.310	0.0	2.0	2.0	10.8	O K
180 min Winter	10.994	0.294	0.0	2.0	2.0	9.7	O K
240 min Winter	10.973	0.273	0.0	2.0	2.0	8.4	O K
360 min Winter	10.920	0.220	0.0	2.0	2.0	5.5	O K
480 min Winter	10.866	0.166	0.0	2.0	2.0	3.1	O K
600 min Winter	10.815	0.115	0.0	2.0	2.0	1.5	O K
720 min Winter	10.788	0.088	0.0	1.9	1.9	0.9	O K
960 min Winter	10.771	0.071	0.0	1.6	1.6	0.6	O K
1440 min Winter	10.756	0.056	0.0	1.1	1.1	0.4	O K
2160 min Winter	10.746	0.046	0.0	0.8	0.8	0.2	O K
2880 min Winter	10.740	0.040	0.0	0.7	0.7	0.2	O K
4320 min Winter	10.733	0.033	0.0	0.5	0.5	0.1	O K
5760 min Winter	10.729	0.029	0.0	0.4	0.4	0.1	O K
7200 min Winter	10.727	0.027	0.0	0.3	0.3	0.1	O K
8640 min Winter	10.725	0.025	0.0	0.3	0.3	0.1	O K
10080 min Winter	10.723	0.023	0.0	0.2	0.2	0.1	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	84.745	0.0	11.9	31			
60 min Winter	54.368	0.0	15.7	58			
120 min Winter	33.674	0.0	19.8	92			
180 min Winter	25.065	0.0	22.3	130			
240 min Winter	20.180	0.0	24.0	168			
360 min Winter	14.839	0.0	26.6	232			
480 min Winter	11.923	0.0	28.5	288			
600 min Winter	10.054	0.0	30.1	336			
720 min Winter	8.741	0.0	31.4	376			
960 min Winter	7.003	0.0	33.5	492			
1440 min Winter	5.114	0.0	36.6	736			
2160 min Winter	3.727	0.0	39.7	1084			
2880 min Winter	2.973	0.0	42.0	1444			
4320 min Winter	2.159	0.0	45.1	2224			
5760 min Winter	1.718	0.0	47.2	2920			
7200 min Winter	1.438	0.0	48.6	3576			
8640 min Winter	1.245	0.0	49.8	4280			
10080 min Winter	1.102	0.0	50.8	4984			
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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)	19.200	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.038

Time (mins)		Area
From:	To:	(ha)
0	4	0.038

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Model Details

Storage is Online Cover Level (m) 11.050

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	65.0
Max Percolation (l/s)	90.3	Slope (1:X)	150.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	10.700	Membrane Depth (m)	0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0076-2000-0350-2000
Design Head (m)	0.350
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	10.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.350	2.0
Flush-Flo™	0.117	2.0
Kick-Flo®	0.256	1.7
Mean Flow over Head Range	-	1.6

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	2.0	1.200	3.5	3.000	5.4	7.000	8.2
0.200	1.9	1.400	3.8	3.500	5.8	7.500	8.5
0.300	1.9	1.600	4.0	4.000	6.2	8.000	8.7
0.400	2.1	1.800	4.2	4.500	6.5	8.500	9.0
0.500	2.3	2.000	4.4	5.000	6.9	9.000	9.3
0.600	2.6	2.200	4.7	5.500	7.2	9.500	9.5
0.800	2.9	2.400	4.8	6.000	7.6		
1.000	3.2	2.600	5.0	6.500	7.9		

Rushby Brewster Associates					Page 15	
Town House, St George's Square Bishops Waltham Southampton, SO32 1AF						
Date 17/11/2016 17:23		Designed by allen.rushby				
File Flats 100+CC box culver...			Checked by			
XP Solutions			Source Control 2016.1			
Summary of Results for 100 year Return Period (+40%)						
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	
15 min Summer	10.074	0.424	1.9	17.4	O K	
30 min Summer	10.198	0.548	1.9	22.6	O K	
60 min Summer	10.310	0.660	1.9	27.3	O K	
120 min Summer	10.368	0.718	1.9	29.8	O K	
180 min Summer	10.364	0.714	1.9	29.6	O K	
240 min Summer	10.348	0.698	1.9	28.9	O K	
360 min Summer	10.310	0.660	1.9	27.3	O K	
480 min Summer	10.267	0.617	1.9	25.5	O K	
600 min Summer	10.217	0.567	1.9	23.4	O K	
720 min Summer	10.169	0.519	1.9	21.4	O K	
960 min Summer	10.083	0.433	1.9	17.8	O K	
1440 min Summer	9.948	0.298	1.9	12.1	O K	
2160 min Summer	9.828	0.178	1.9	7.1	O K	
2880 min Summer	9.768	0.118	1.7	4.6	O K	
4320 min Summer	9.727	0.077	1.4	2.8	O K	
5760 min Summer	9.712	0.062	1.1	2.2	O K	
7200 min Summer	9.704	0.054	0.9	1.9	O K	
8640 min Summer	9.699	0.049	0.8	1.6	O K	
10080 min Summer	9.695	0.045	0.7	1.5	O K	
15 min Winter	10.127	0.477	1.9	19.7	O K	
30 min Winter	10.272	0.622	1.9	25.7	O K	
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)		
15 min Summer	127.517	0.0	18.9	18		
30 min Summer	85.701	0.0	25.4	33		
60 min Summer	54.957	0.0	32.6	62		
120 min Summer	34.010	0.0	40.3	120		
180 min Summer	25.295	0.0	45.0	154		
240 min Summer	20.351	0.0	48.2	186		
360 min Summer	14.971	0.0	53.2	254		
480 min Summer	12.028	0.0	57.0	324		
600 min Summer	10.141	0.0	60.1	388		
720 min Summer	8.817	0.0	62.7	452		
960 min Summer	7.063	0.0	67.0	578		
1440 min Summer	5.157	0.0	73.3	810		
2160 min Summer	3.757	0.0	80.1	1152		
2880 min Summer	2.997	0.0	85.2	1500		
4320 min Summer	2.176	0.0	92.8	2204		
5760 min Summer	1.731	0.0	98.5	2936		
7200 min Summer	1.449	0.0	103.0	3672		
8640 min Summer	1.255	0.0	107.1	4352		
10080 min Summer	1.111	0.0	110.6	5080		
15 min Winter	127.517	0.0	21.2	18		
30 min Winter	85.701	0.0	28.4	32		
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Rushby Brewster Associates					Page 216
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Date 17/11/2016 17:23		Designed by allen.rushby			
File Flats 100+CC box culver...		Checked by			
XP Solutions		Source Control 2016.1			
Summary of Results for 100 year Return Period (+40%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	10.400	0.750	1.9	31.1	O K
120 min Winter	10.477	0.827	1.9	34.3	O K
180 min Winter	10.477	0.827	1.9	34.3	O K
240 min Winter	10.453	0.803	1.9	33.3	O K
360 min Winter	10.402	0.752	1.9	31.2	O K
480 min Winter	10.341	0.691	1.9	28.6	O K
600 min Winter	10.275	0.625	1.9	25.8	O K
720 min Winter	10.193	0.543	1.9	22.4	O K
960 min Winter	10.057	0.407	1.9	16.7	O K
1440 min Winter	9.874	0.224	1.9	9.0	O K
2160 min Winter	9.757	0.107	1.7	4.1	O K
2880 min Winter	9.728	0.078	1.4	2.9	O K
4320 min Winter	9.707	0.057	1.0	2.0	O K
5760 min Winter	9.699	0.049	0.8	1.6	O K
7200 min Winter	9.693	0.043	0.7	1.4	O K
8640 min Winter	9.690	0.040	0.6	1.3	O K
10080 min Winter	9.687	0.037	0.5	1.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	54.957	0.0	36.5	60	
120 min Winter	34.010	0.0	45.1	118	
180 min Winter	25.295	0.0	50.4	170	
240 min Winter	20.351	0.0	54.0	194	
360 min Winter	14.971	0.0	59.6	272	
480 min Winter	12.028	0.0	63.9	350	
600 min Winter	10.141	0.0	67.3	428	
720 min Winter	8.817	0.0	70.2	492	
960 min Winter	7.063	0.0	75.0	614	
1440 min Winter	5.157	0.0	82.1	838	
2160 min Winter	3.757	0.0	89.8	1148	
2880 min Winter	2.997	0.0	95.5	1472	
4320 min Winter	2.176	0.0	103.9	2204	
5760 min Winter	1.731	0.0	110.3	2880	
7200 min Winter	1.449	0.0	115.4	3672	
8640 min Winter	1.255	0.0	119.9	4312	
10080 min Winter	1.111	0.0	123.8	5136	
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XP Solutions		Source Control 2016.1

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)	19.400	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.079

Time (mins)	Area
From: To:	(ha)
0 4	0.079

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Date 17/11/2016 17:23	Designed by allen.rushby	
File Flats 100+CC box culver...	Checked by	

XP Solutions	Source Control 2016.1
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Model Details

Storage is Online Cover Level (m) 11.300

Double Box Culvert Structure

Height (m) 1.000 Slope (1:X) 500.000 Downstream Invert (m) 9.650
Width (m) 2.000 Length (m) 10.000

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	9.650
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

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	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

CALCULATIONS



The Town House
1300 Maple Street
Baltimore, Maryland
21202-1234
Tel: (410) 555-1234

Job Title:	Job No.:	Est. No.:
Prepared:	Date:	Checked:

1. $100 \times 100 = 10,000$

2. $10,000 \times 1.05 = 10,500$

3. $10,500 \times 1.05 = 11,025$

4. $11,025 \times 1.05 = 11,576.25$

5. $11,576.25 \times 1.05 = 12,155.06$

6. $12,155.06 \times 1.05 = 12,762.81$

7. $12,762.81 \times 1.05 = 13,400.95$

8. $13,400.95 \times 1.05 = 14,071.00$

9. $14,071.00 \times 1.05 = 14,774.55$

10. $14,774.55 \times 1.05 = 15,513.28$

11. $15,513.28 \times 1.05 = 16,288.94$

12. $16,288.94 \times 1.05 = 17,103.39$

13. $17,103.39 \times 1.05 = 17,958.56$

14. $17,958.56 \times 1.05 = 18,856.49$

15. $18,856.49 \times 1.05 = 19,799.31$

16. $19,799.31 \times 1.05 = 20,789.18$

17. $20,789.18 \times 1.05 = 21,828.64$

18. $21,828.64 \times 1.05 = 22,920.07$

19. $22,920.07 \times 1.05 = 24,066.07$

20. $24,066.07 \times 1.05 = 25,269.38$

21. $25,269.38 \times 1.05 = 26,532.85$

22. $26,532.85 \times 1.05 = 27,859.49$

23. $27,859.49 \times 1.05 = 29,252.47$

24. $29,252.47 \times 1.05 = 30,715.09$

25. $30,715.09 \times 1.05 = 32,250.85$

26. $32,250.85 \times 1.05 = 33,863.39$

27. $33,863.39 \times 1.05 = 35,556.56$

28. $35,556.56 \times 1.05 = 37,334.39$

29. $37,334.39 \times 1.05 = 39,191.11$

30. $39,191.11 \times 1.05 = 41,150.67$

31. $41,150.67 \times 1.05 = 43,208.20$

32. $43,208.20 \times 1.05 = 45,368.61$

33. $45,368.61 \times 1.05 = 47,637.04$

34. $47,637.04 \times 1.05 = 50,018.89$

35. $50,018.89 \times 1.05 = 52,520.84$

36. $52,520.84 \times 1.05 = 55,146.88$

37. $55,146.88 \times 1.05 = 57,904.22$

38. $57,904.22 \times 1.05 = 60,799.43$

39. $60,799.43 \times 1.05 = 63,839.40$

40. $63,839.40 \times 1.05 = 67,031.37$

41. $67,031.37 \times 1.05 = 70,382.94$

42. $70,382.94 \times 1.05 = 73,902.09$

43. $73,902.09 \times 1.05 = 77,597.19$

44. $77,597.19 \times 1.05 = 81,477.05$

45. $81,477.05 \times 1.05 = 85,550.90$

46. $85,550.90 \times 1.05 = 89,828.45$

47. $89,828.45 \times 1.05 = 94,320.87$

48. $94,320.87 \times 1.05 = 99,036.91$

49. $99,036.91 \times 1.05 = 103,988.76$

50. $103,988.76 \times 1.05 = 109,188.20$

51. $109,188.20 \times 1.05 = 114,647.61$

52. $114,647.61 \times 1.05 = 120,380.00$

53. $120,380.00 \times 1.05 = 126,399.00$

54. $126,399.00 \times 1.05 = 132,718.95$

55. $132,718.95 \times 1.05 = 139,354.90$

56. $139,354.90 \times 1.05 = 146,322.65$

57. $146,322.65 \times 1.05 = 153,638.78$

58. $153,638.78 \times 1.05 = 161,320.72$

59. $161,320.72 \times 1.05 = 169,386.76$

60. $169,386.76 \times 1.05 = 177,856.10$

61. $177,856.10 \times 1.05 = 186,748.91$

62. $186,748.91 \times 1.05 = 196,086.36$

63. $196,086.36 \times 1.05 = 205,890.68$

64. $205,890.68 \times 1.05 = 216,185.21$

65. $216,185.21 \times 1.05 = 226,994.47$

66. $226,994.47 \times 1.05 = 238,344.19$

67. $238,344.19 \times 1.05 = 250,161.40$

68. $250,161.40 \times 1.05 = 262,469.47$

69. $262,469.47 \times 1.05 = 275,293.94$

70. $275,293.94 \times 1.05 = 288,658.63$

71. $288,658.63 \times 1.05 = 302,491.46$

72. $302,491.46 \times 1.05 = 316,816.03$

73. $316,816.03 \times 1.05 = 331,656.83$

74. $331,656.83 \times 1.05 = 347,039.67$

75. $347,039.67 \times 1.05 = 362,991.65$

76. $362,991.65 \times 1.05 = 379,541.24$

77. $379,541.24 \times 1.05 = 396,718.30$

78. $396,718.30 \times 1.05 = 414,554.12$

79. $414,554.12 \times 1.05 = 433,081.83$

80. $433,081.83 \times 1.05 = 452,335.91$

81. $452,335.91 \times 1.05 = 472,352.71$

82. $472,352.71 \times 1.05 = 493,170.35$

83. $493,170.35 \times 1.05 = 514,828.87$

84. $514,828.87 \times 1.05 = 537,370.31$

85. $537,370.31 \times 1.05 = 560,838.83$

86. $560,838.83 \times 1.05 = 585,180.87$

87. $585,180.87 \times 1.05 = 610,439.91$

88. $610,439.91 \times 1.05 = 636,661.91$

89. $636,661.91 \times 1.05 = 663,895.01$

90. $663,895.01 \times 1.05 = 692,089.76$

91. $692,089.76 \times 1.05 = 721,194.25$

92. $721,194.25 \times 1.05 = 751,253.96$

93. $751,253.96 \times 1.05 = 782,216.66$

94. $782,216.66 \times 1.05 = 814,127.50$

95. $814,127.50 \times 1.05 = 847,033.88$

96. $847,033.88 \times 1.05 = 880,985.57$

97. $880,985.57 \times 1.05 = 915,984.85$

98. $915,984.85 \times 1.05 = 952,024.09$

99. $952,024.09 \times 1.05 = 989,125.30$

100. $989,125.30 \times 1.05 = 1,027,281.56$

Approved: _____ Date: _____

APPENDIX 3

Extracts from Ground Investigation Report



Ridge and Partners LLP

F.A.O. Antony Platt

By Email only: APlatt@ridge.co.uk

Our Ref: 15411/LR

4th February 2016

Dear Antony

Thomas Telford House
Sun Valley Business Park
Winnall Close
Winchester SO23 0LB

01942 673 330
soilslimited.co.uk

RE: Land to rear of 22-24 Blendworth Crescent, Havant, Hampshire PO9 2BE

We are writing in regards to the intrusive investigation undertaken at the above named site.

Brief

The Soils Limited quotation (reference Q17230, dated 15th January 2016) set out the scope of the investigation. The investigation was to comprise machine excavated trial pits and infiltration tests in accordance with the principles of BRE Digest 365 Soakaway design: 1991.

General

The site had an approximate area of 0.95ha and was located between Blendworth Crescent and Stockheath Lane, Havant, Hampshire at O.S Land Ranger Grid Reference of SU 714 074.

A site location plan has been included as Figure 1.

Site Works

Site works were undertaken on the 27th January 2016 and comprised three machine excavated trial pits (ST1 – ST3). Following the construction of the trial holes, infiltration tests broadly in accordance with the principles of BRE 365 were carried out. A trial hole location plan is included as Figure 2. Infiltration tests could only be carried out once in each of the trial pits due to the slow infiltration observed over the test period, heavy rainfall and saturated ground conditions.

Upon completion all trial holes were backfilled with arisings and mounded over for future settlement.

Ground Conditions

The ground conditions encountered during the site investigation have been summarised below:

**Topsoil
Head**

Table 1 – Summary of Ground Conditions

Stratum	Depth Encountered (m bgl)		Typical Description
	Top	Base	
Topsoil	0.00	0.20	Turf over dark brown clayey SILT with occasional fine to medium sub-angular to angular flint gravel. Occasional fine roots and rootlets.
Head	0.20	1.30-1.50'	Soft light to dark orange grey brown silty sandy CLAY with occasional to frequent fine to medium sub-angular to angular flint gravel, occasional black staining and rare rootlets.
	1.30	1.80'	Firm dark grey and orangey brown CLAY occasional fine silt pockets and occasional fine to medium sub-angular to angular flint gravel. Occasional rootlets.

Notes: † encountered to base of trial hole

Whilst groundwater was not encountered during the excavation of the trial pits a moderate seepage was recorded entering each trial pit from ground level due to the saturated ground at the time of the investigation.

Infiltration Testing

Infiltration tests were performed in all three of the trial pits during the investigation, in areas selected by Ridge and Partners LLP, in order to provide guidance on the suitability of the ground for the adoption of a surface water drainage system. Each test was undertaken within the Head at depths of 1.80m bgl (ST1), 1.50m bgl (ST2) and 1.50m bgl (ST3). Tests were conducted broadly in accordance with the principles of BRE Digest 365 Soakaway design: 1991.

BRE 365 states for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test is completed once 75% of the water present has drained away, in order to determine whether or not the underlying ground conditions may be suitable for surface water drainage. Only one test was completed in each trial pit due to the infiltration rates observed, the site conditions (i.e. saturated ground) and the time restrictions.

The test comprised piping water via a water tanker into the open trial hole, the drop in water level over time was then recorded to give an indication of soakage potential. The test stratum comprised of the Head (HEAD).

Table 2 - Infiltration Test Results

Trial Hole (Test No.)	Test Stratum	Test Depth (m bgl)	Infiltration Rate (m/sec)	Notes
ST1	HEAD	1.80	N/A	Zero infiltration observed over test period

Trial Hole (Test No.)	Test Stratum	Test Depth (m bgl)	Infiltration Rate (m/sec)	Notes
ST2	HEAD	1.50	N/A	Water levels rising in pit after 1 minute due to saturated ground at surface
ST3	HEAD	1.50	N/A	Water levels rising over test period minute due to saturated ground at surface

Infiltration rates could not be calculated due to the negligible infiltration rates, saturated ground conditions and heavy rainfall on the day of the tests.

Full results are included within Appendix A.

Conclusions

Given the observed infiltration over the test period, it is considered unlikely that the site would benefit from the adoption of a soakaway system for surface water drainage and is likely to require an alternative means of surface water disposal. The drainage conditions across the rest of the site are unknown. It is recommended that further, extensive soakage testing be carried out in order to assess the suitability of the rest of the site for soakaway surface water drainage.

It should be noted that the Environment Agency must be consulted on any works which may impact groundwater sources.

The following attachments make up the remainder of this letter report.

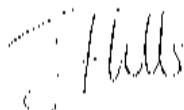
Figure 1. Site Location Plan

Figure 2. Trial Hole Location Plan

Appendix A. Field Data

Should you have any further questions please do not hesitate to contact the undersigned.

Yours Sincerely



John Hills BSc. (Hons).
Graduate Geo-Environmental Engineer
 jh@soilslimited.co.uk

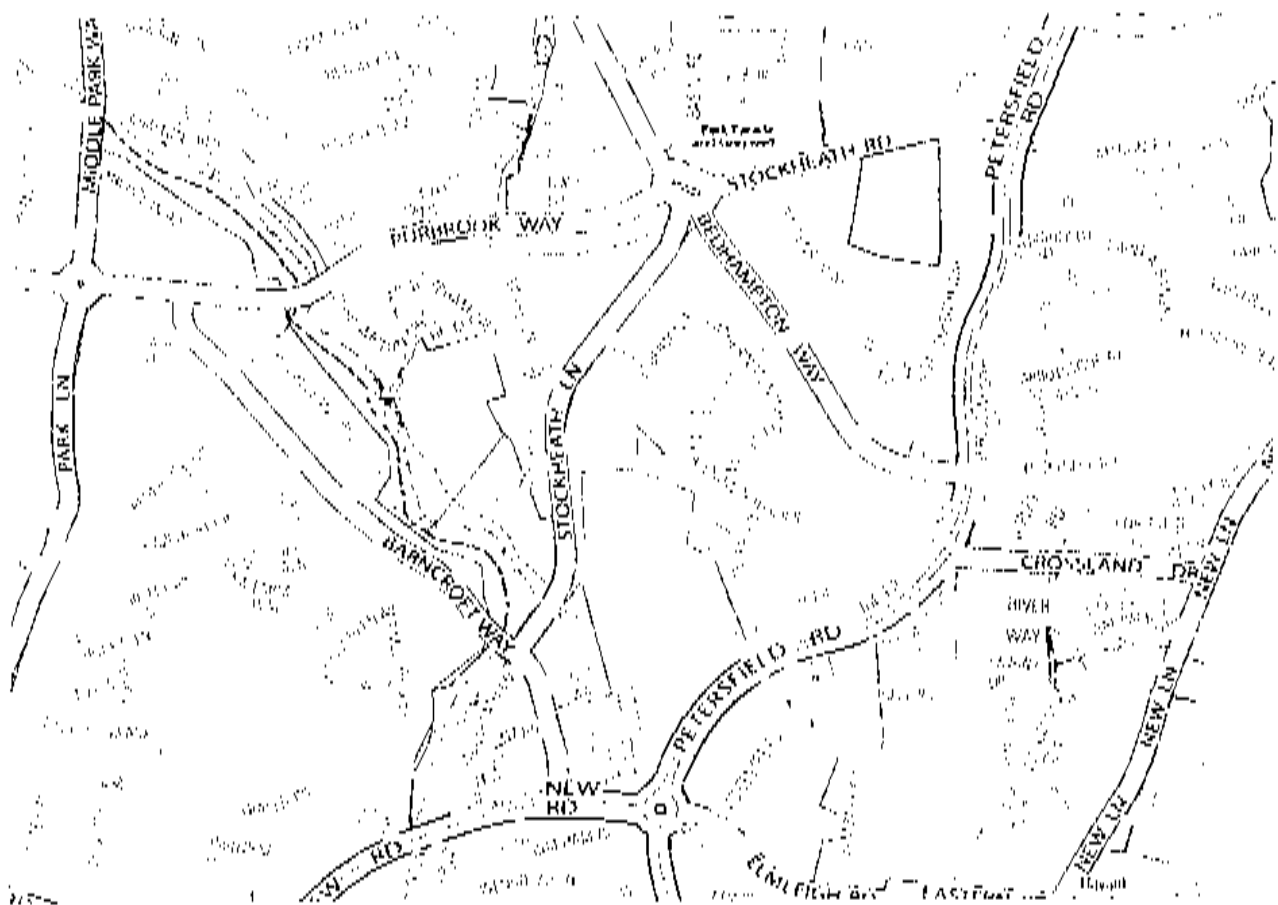


Figure number
1

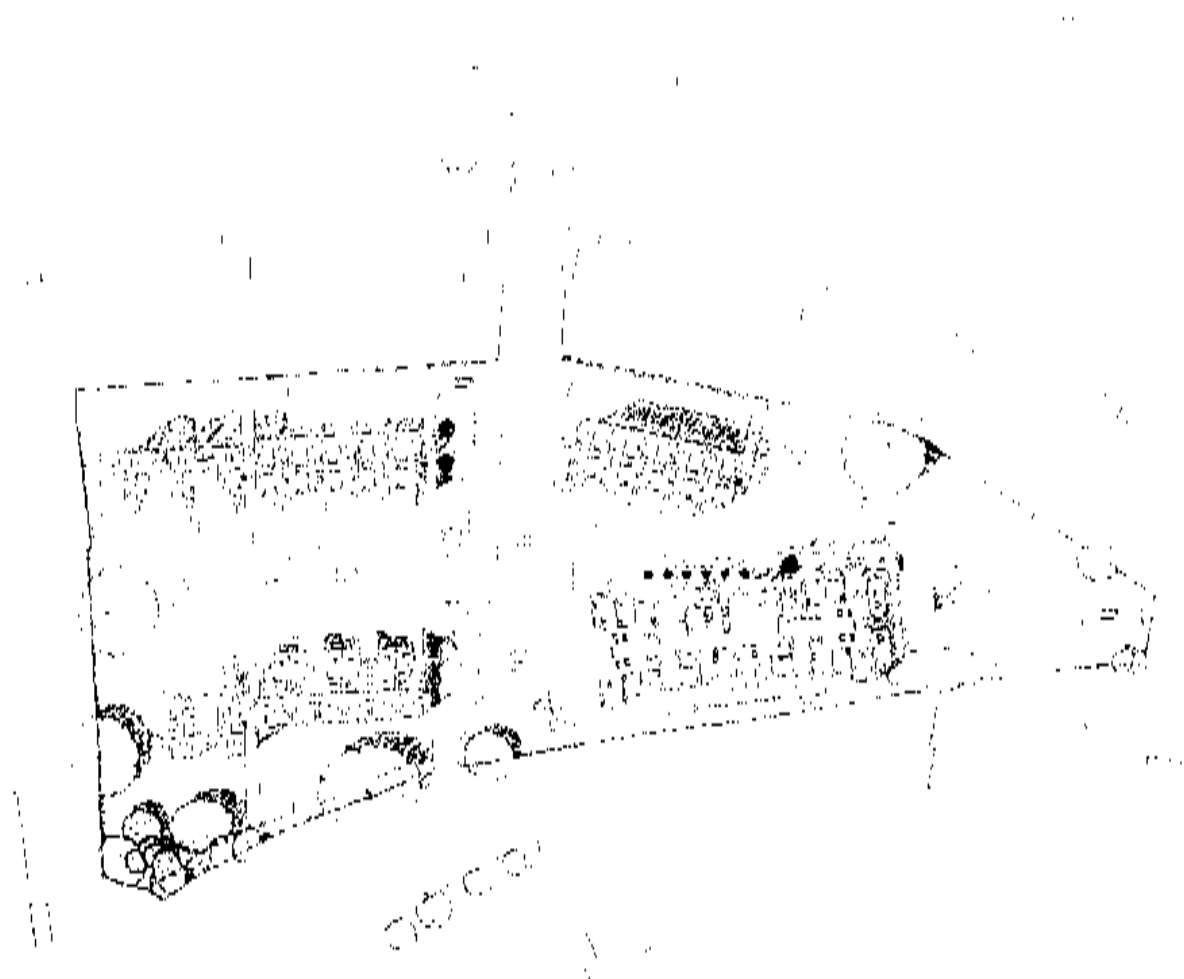
Title
Site Location Map

Project
Land to rear of 22-24 Blendworth Crescent, Havant
PO9 3RE

Date
February 2016

Client
Ridge and Partners LLP

Reference
15411



ILLUSTRATIVE SITE PLAN

15411

Figure number
2

Title
Trail hole location plan

Project
Land to rear of 22-24 Blendworth Crescent, Havant
PO9 2BE

Date
February 2016

Client
Ridge and Partners LLP

Reference
15411

Appendix A – Field Data



Soils Limited

Newton House, Cross Road, Lutworth K120 5BX
tel: 01737 814224 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.

ST1

Sheet 1 of 1

Hole Type
TP

Scale

1:25

Logged By
CR

Project Name Land to rear of 22-24 Blendworth Crescent

Project No.: 15411

Method: Machine Excavation

Plant:

Support:

Location: Land to rear of 22-24 Blendworth Crescent, Havant PO9 2BL

Client: Reigo And Partners LLP

Trial Pit Length: 2.00m

Trial Pit Width: 0.50m

Date: 27-01-2016

Level

Co-ords.

Depth (m)	Samples & In Situ Testing		Depth (m)	Level (m)	Legend
	Depth	Type			
0.20		D	0.25		
0.50		D			
1.00		D	1.30		
1.50		D			
1.80		D	1.80		

Stratum Description

Turf over dark brown clayey Silt T with occasional fine to medium sub-angular to angular flint gravel. Occasional rootlets and tree roots. TOPSOIL

Soft light to dark orange grey brown silty sandy CLAY with occasional to frequent fine to medium sub-angular to angular flint gravel, occasional black staining and rare rootlets. (H, A)

Light dark grey and orange brown CLAY with occasional fine silt pockets and occasional fine to medium sub-angular to angular flint gravel, occasional rootlets. HEAD

End of Pit at 1.80m

1

2

3

4

5

General Remarks

Roots observed to 1.80m bgl. Groundwater sampling / rapid from ground level

Groundwater Remarks

Sample Type

D: Disturbed
H: Hole
J: Jet
W: Water



Soils Limited

Newton House, Cross Road, Tadworth KT20 6SL
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.

ST3

Sheet 1 of 1

Hole Type

TP

Scale

1:25

Logged By

GB

Project Name: Land to rear of 22-24 Bladworth Crescent

Project No.: 15411

Method: Machine Excavation

Location: Land to rear of 22-24 Bladworth Crescent, Havant PO9 2RF

Plant:

Support:

Client: Ridge and Partners LLP

Trial Pit Length: 2.00m Trial Pit Width: 0.50m

Date: 27-01-2016

Level:

Grids:

Depth (m)	Samples & In Situ Testing		Depth (m)	Level (m)	Legend
	Depth	Type	Results		
0.25	0.25	D			
0.50	0.50	D			
1.00	1.00	D			
1.50	1.50	D			

Stratum Description

Turf over dark brown clayey Silt 1 with occasional fine to medium sub-angular to angular flint gravel. Occasional rootlets and fine roots. TOPSOIL.

Soil light to dark orange grey brown silty sandy CLAY with occasional to frequent fine to medium sub-angular to angular flint gravel, occasional black staining and rare rootlets. RFA13

End of Pit at 1.50m

General Remarks

Roots observed to 1.50m bgl. Groundwater seeping / rapid from ground level

Groundwater Remarks

Sample Type

D: Disturbed
H: Bulk
J: Jet
W: Water

Soakaway Calculations

Trackway Tag No.	TP1 T1
Contract	Blendworth Crescent, Havant, Hampshire PO9 2BE
Contract No.	10411

Field Test

Test Pit Log (include details of groundwater):

None but fit persons

Depth of Pit	1.80 m
Width of Pit	0.50 m
Length of Pit	2.00 m
Depth of Pit located	1.33 m
sp/s0	4.325 m2
V _{B75-25}	0.005 m3
t ₇₅₋₂₅	0.0 min
water Used	1.3300 m3
t	N/A m/sec

Field Data

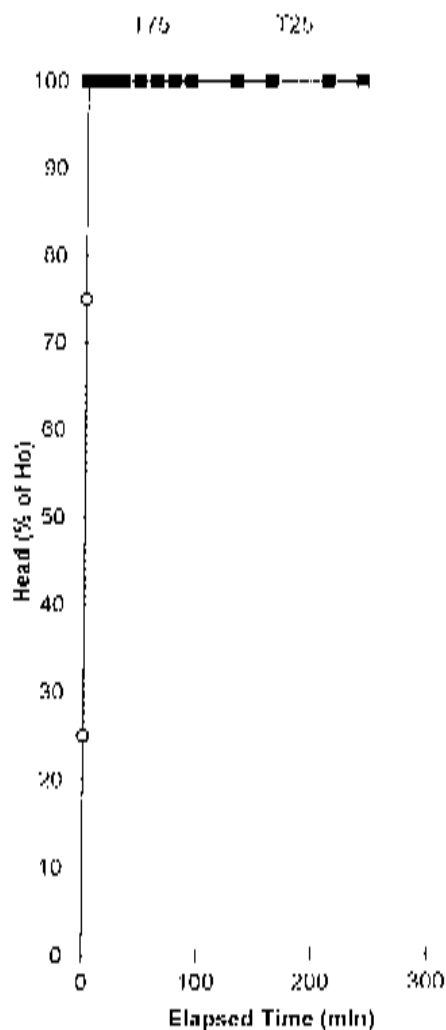
Depth to Water	Elapsed Time	Head of Water	Head of Water
(m)	(min)	(% of Ho)	(m)
0.47	0	100	1.33
0.47	1.0	100	1.33
0.47	3.0	100	1.33
0.47	5.0	100	1.33
0.47	10.0	100	1.33
0.47	15.0	100	1.33
0.47	20.0	100	1.33
0.47	25.0	100	1.33
0.47	30.0	100	1.33
0.47	45.0	100	1.33
0.47	60.0	100	1.33
0.47	75.0	100	1.33
0.47	90.0	100	1.33
0.47	130.0	100	1.33
0.47	160.0	100	1.33
0.47	210.0	100	1.33
0.47	240.0	100	1.33

1. **NAME** _____
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 6. **REMARKS** _____
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 22. **LOCATION** _____
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 190. **LOCATION** _____
 191. **REASON** _____
 192. **REMARKS** _____
 193. **SIGNATURE** _____
 194. **DATE** _____
 195. **TIME** _____
 196. **LOCATION** _____
 197. **REASON** _____
 198. **REMARKS** _____
 199. **SIGNATURE** _____
 200. **DATE** _____
 201. **TIME** _____
 202. **LOCATION** _____
 203. **REASON** _____
 204. **REMARKS** _____
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 209. **REASON** _____
 210. **REMARKS** _____
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 213. **TIME** _____
 214. **LOCATION** _____
 215. **REASON** _____
 216. **REMARKS** _____
 217. **SIGNATURE** _____
 218. **DATE** _____
 219. **TIME** _____
 220. **LOCATION** _____
 221. **REASON** _____
 222. **REMARKS** _____
 223. **SIGNATURE** _____
 224. **DATE** _____
 225. **TIME** _____
 2

T75	0.000	75
125	0.000	25
T75 25	0.000	Derived from Best Fit

Comments

Zero infiltration observed over test period.



SOILS LIMITED

Newton House, Cross Road, Tadworth
Surrey, KT20 5GR

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Soakaway Calculations

Soakaway Test No.	TP2-T1
Contract:	Blondworth Crescent, Havant, Hampshire PO9 2BE
Contract No.	15411

Field Test

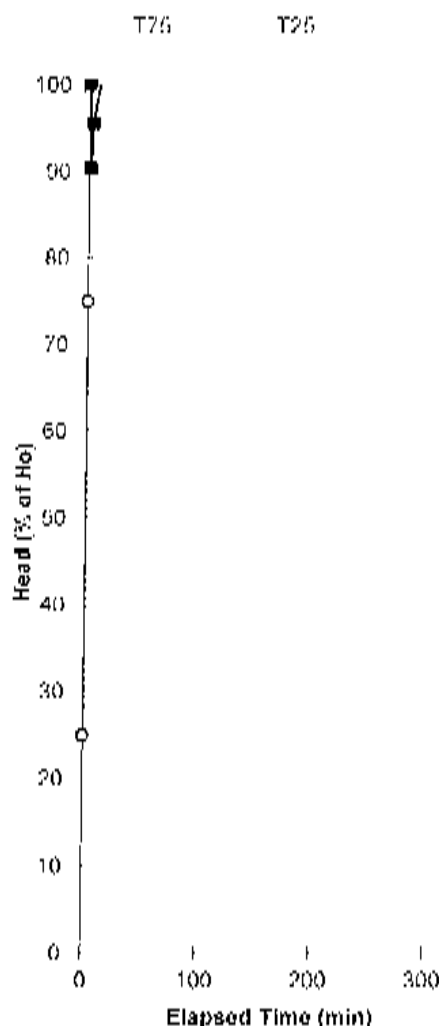
Trial Pit Log (includes details of groundwater)
See Trial Pit record

Depth of Pit	1.50 m
Width of Pit	0.50 m
Length of Pit	2.00 m
Depth of Pit Soaked	1.14 m
ap50	3.85 m ²
Vp75-25	0.57 m ³
t75-25	0.0 min
water used	1.1400 m ³
t	N/A m/sec.

Field Data

Depth to	Elapsed	Head of	Head of
Water	Time	Water	Water
(m)	(min)	(% of Ho)	(m)
0.36	0	100	1.14
0.47	1.0	90	1.03
0.41	3.0	95	1.09
0.35	10.0	101	1.15
0.3	15.0	105	1.20
0.25	25.0	110	1.25
0.20	50.0	114	1.30
0.10	60.0	125	1.40
0.00	75.0	131	1.50
0.00	90.0	131	1.50
0.00	130.0	131	1.50
0.00	160.0	131	1.50
0.00	210.0	131	1.50
0.00	240.0	131	1.50

T75	0.000	75
T25	0.000	25
T75-25	0.000	Derived from Best Fit



Comments

Water levels rising in pit after 1 minute due to saturated ground at surface

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Surrey, KT20 6SR

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Soakaway Calculations

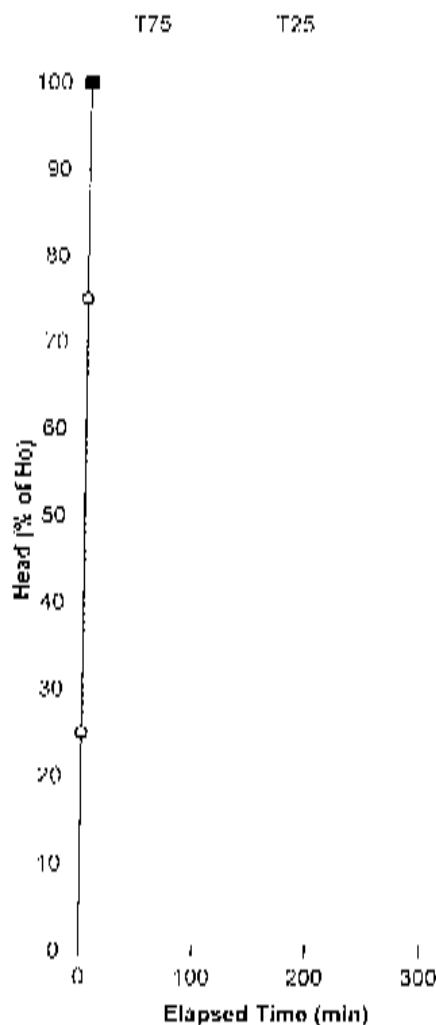
Drawaway Test No.	TP3-T1
Contract:	Blondworth Crescent, Havant, Hampshire PO9 2BE
Contract No.	15411

Field Test

Depth of Pit	1.50 m
Width of Pit	0.50 m
Length of Pit	2.00 m
Depth of Pit Soaked	0.95 m
V_p	3.375 m ³
V_{p15-25}	0.475 m ³
t_{75-75}	0.0 min
water used	0.9500 m ³
f	N/A m/sec.

Field Data

Depth	Elapsed Time	Head of Water	Head of Water
(m)	(min)	(% of Ho)	(m)
0.55	0	100	0.95
0.55	1.0	100	0.95
0.51	3.0	104	0.99
0.49	5.0	106	1.01
0.49	6.0	106	1.01
0.49	7.0	106	1.01
0.48	8.0	107	1.02
0.46	10.0	109	1.04
0.44	12.0	112	1.06
0.44	15.0	112	1.06
0.43	20.0	113	1.07
0.43	25.0	113	1.07
0.43	30.0	113	1.07
0.36	45.0	120	1.14
0.3	60.0	126	1.20
0.24	75.0	133	1.26
0.1	100.0	147	1.40
0.00	130.00	158	1.50
0.00	160	158	1.50
0.00	180.00	158	1.50
0.00	210.00	158	1.50
0.00	240.00	158	1.50
T75	0.000	75	
T25	0.000	25	
T75-25	0.000	Derived from Best Fit	



Comments

Water levels rising over fast period due to saturated ground near surface

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RIDGE

Property and Construction Consultants



Portsmouth
CITY COUNCIL

Ground Condition Assessment Land at Blendworth Crescent, Havant

August 2015

Prepared for:
Portsmouth City Council
Housing Development
Core 1 Floor 1
Civic Offices
Guildhall Square
Portsmouth
Hampshire
PO1 2AY

Prepared by:
Ridge and Partners LLP
Partnership House
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Section 9 – Conclusions and Recommendations

9.1 Contamination

No significant on or off site sources of contamination have been identified by this assessment. Therefore, no viable pollutant linkages are considered to be present.

General Notes

In order to mitigate the generic risks associated with development on potentially contaminated land the following mitigation measures are recommended:

- Preparation of a Discovery Strategy outlining the procedures to be followed in the event that unanticipated contamination is encountered during the development.
- Compliance with relevant Health and Safety procedures during construction works.
- Contractors on site should wear appropriate PPE to mitigate the risks from the chemical and physical impacts to the Made Ground at the site.
- The local authority should be informed if any sources of contamination are identified during the development that have not been assessed in this report. These sources should then be assessed and dealt with appropriately, with the agreement of the local authority.

These mitigation measures, as with any such mitigation or remedial measures, are subject to agreement with the regulatory authority, be it the Local Authority for human health related issues or the Environment Agency for environmental issues.

It is recommended that any removal and disposal of sub-soil arisings and/or groundwater from the site should be undertaken in a controlled manner to a licensed facility, with due regard to Duty of Care responsibilities. In addition, an appropriate degree of health and safety provision should be incorporated to protect both the site workers and the general public alike.

During any ground works, it is recommended that skin contact with soils is kept to a minimum in accordance with good working practice / specific control measures and the HSE guidance document 'Protection of Workers and the General Public During the Development of Contaminated Land', 1991.

9.2 Geotechnical

The ground investigation revealed the site to be underlain by Topsoil / Made Ground over Head Deposits in turn overlying London Clay Formation to the full depth of the investigation. The Head Deposits comprised a mixture of compositions including gravelly clay and fine sand; whilst the London Clay Formation consisted of silty clay.

Groundwater seepages were recorded during the ground investigation and subsequent monitoring visits indicated a minimum at rest groundwater level to be 0.98mbgl.

Ground Condition Assessment

Shallow Foundations

It is recommended that shallow foundations at a minimum depth of 1.00mbgl or below the any Made Ground, should thicker sequences be encountered, are adopted for this site. Foundation excavations should remain stable in the short term; however founding materials should not be left exposed for extended periods of time.

Ultimate bearing resistance calculations have been carried out for foundations constructed in either the London clay Formation or the Head Deposits and returned a ULS bearing resistance of 120kN/m².

In order to allow for any potential variation in founding material the characteristic angle of friction of the Head Deposit was reduced to that of the London Clay Formation so that the presented ULS bearing resistance is appropriate for both strata.

Serviceability limit state settlement analyses were carried out under a foundation loading of 120kN/m² on a strip foundation constructed within the Head Deposits. The results show that, with the foundation loading of 120kN/m², total settlement of less than 25mm should be expected.

Although the foundations may cross between two different strata, the similarity between the two material is such that differential settlement is not expected to present a significant problem.

Piled Foundations

It is unclear at the time of reporting whether any multi-storey blocks are to form part of this development. If this is the case it is possible that the calculated bearing resistance may be too restrictive. Therefore, ULS axial pile resistances have been calculated for a range of diameters and lengths of augured pile. However, when sizing piles from these results all applied actions must be factored in accordance with the UK National Annex to Eurocode 7.

It should be noted that the carrying capacity of a pile group is usually less than the sum of the individual piles. Therefore it is recommended that a detailed pile group analysis is carried out when all loads and serviceability limits are known.

Other Geotechnical Considerations

Given the high volume change potential of the founding strum and the slight desiccation of this material a suspended floor slab solution is recommended for this site.



KEY:

- BOREHOLE LOCATION
- WINDOW SAMPLE LOCATION
- TRL PROBE LOCATION

20.07	PRELIMINARY	DAP	AP	
REF	DATE	REVISION	DRAWN	CHECKED

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PROJECT
BLENDWORTH CRESCENT
HAVANT

DRAWING
151238 - SITE INVESTIGATION LOCATIONS

RIDGE

CLIENT
PORTSMOUTH CITY COUNCIL

SCALE NTS @ A4	DATE 20.07.15	DRAWN BY DAP	CHECKED BY AP
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PARTNERSHIP HOUSE
MOORSIDE ROAD
WINCHESTER
HAMPSHIRE, SO23 7RX
Also at Reading, Bristol, London and Leicester

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FAX: 01993 815001
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FIGURE 2

REV

RIKKE

Ridgo & Partners LLP
Partnership House
Moorside Road

BOREHOLE LOG

Project Blindworth Crescent						BOREHOLE No BH1			
Job No 151238		Date 15-06-15 16-06-15		Ground Level (m)		Co-Ordinates ()			
Contractor DI DRILLING						Sheet 1 of 1			

SAMPLES & TESTS			STRATA				Geology	Parameter Bucket
Depth	Type No	Test Result	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.30	D1				0.10	Soft brown slightly sandy CLAY with frequent rootlets		
0.30	FSA				(1.00)	Brown silty gravelly fine SAND Gravel is of fine to medium angular flint		
0.80-0.70	B2				1.10			
1.10	D3				1.40	Soft to firm orange brown CLAY		
1.20-1.65	D4	40 blows			(1.40)	Firm brown gravelly CLAY Gravel is of fine to medium angular flint		
1.65	D5				2.80			
2.00-2.45	D6	N22			(1.40)			
2.90					2.80	Firm to stiff grey brown CLAY		
3.00-3.25	D7	35 blows			(3.90)			
3.40	D8				5.70			
4.00-4.45	D9	N15			(0.60)	Stiff grey CLAY		
4.00					6.30			
5.00-5.45	D10	50 blows			6.40	Soft grey clayey coarse sub rounded to rounded flint GRAVEL		
5.45	D11					Stiff grey CLAY		
6.00	D12							
6.50-6.95	D13	N19						
6.50								
7.50	D14							
8.00-8.30	D15	55 blows			(3.60)			
8.30	D16							
9.00	D17							
9.50-9.95	D18	N24			10.00			
9.50								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:65,625		Client PCC		Method/ Plant Used		Logged By	
--	--	---------------	--	-----------------------	--	-----------	--

151238 - BOREHOLE LOG - PRESENTATION - 15/06/2015 - 16/06/2015 - 151238 - BOREHOLE LOG - PRESENTATION - 15/06/2015 - 16/06/2015

BOREHOLE LOG

2000 年 12 月 1 日 星期一 晴

RIDGE

Ridge & Partners LLP
Partnership House
Monasid Road

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No BH2	
Job No 151238	Date 16-06-15	Ground Level (m)	Co-Ordinates ()		
Contractor DI DRILLING				Sheet 2 of 2	

SAMPLES & TESTS			STRATA					Geology	Estimate Bucket
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
10.50	D18						Still grey CLAY (<i>continued</i>)		
11.00-11.45	D19	75 blows							
11.45	D20								
12.00	D21								
12.50	D22	850/110 mm				12.70			
13.50						13.00	Gray silty clayey medium to coarse sub angular to rounded flint GRAVEL and COBBLES		
12.60-14.00	D23								

Boring Progress and Water Observations					Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth (Dia. mm)	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:65.625					Client PCC		Method/ Plant Used		Logged By	

Report ID: 42881-1-K-BH1 Blendworth Crescent BH1 Level: GWT 510.4334, 510.511 Depth: 16.000m 2015

BOREHOLE LOG

Project		Blendworth Crescent		Borehole No	BH3
Job No	Date	Ground Level (m)	Ce Coordinates (i)		
151738	17-06-15				
Contractor				Sheet	1 of 2
DJ DRILLING					

SAMPLES & TESTS			STRATA				Geology	Instrument	Backfill
Depth	Type No	Test Result	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION			
0.30	D1				0.10	Brown clayey SILT with frequent rootlets			
0.30	ESA				(0.70)	Soft to firm brown silty slightly gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint			
0.50-0.70	D2				0.80				
1.00	D3				(0.80)	Grey brown clayey silty gravelly fine SAND			
1.20	D4				1.60				
1.20		N6			(0.90)	Firm orange brown silty CLAY			
2.00-2.20	D5	37 blows			2.50				
2.50	D6					Firm to soft brown to grey slightly silty CLAY			
3.00		N11							
4.00-4.45	D8	45 blows			(3.50)				
4.45	D9								
5.00	D10								
5.00		N14			6.00				
6.00	D11					Soft grey CLAY			
6.50-6.95	D12	80 blows			(1.70)				
6.95	D13				7.70				
7.50	D14				(0.50)	Grey clayey fine to coarse angular to sub rounded flint GRAVEL.			
8.00	D15				8.70				
8.00		N21				Soft grey CLAY			
9.00	D16								
9.50-9.95	D17	65 blows							
9.95	D18								

[illegible]

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BOREHOLE LOG:

913 23509323.4761780715.240.1367 .167.235887-1.60 40079 29003 .46 473367 0.00000

BOREHOLE LOG

Project Blanchworth Crescent				Borehole No BH4
Job No 151238	Date 17-06-15 18-06-15	Ground Level (m)	Co-Ordinates ()	
Contractor DJ DRILLING				Sheet 1 of 2

SAMPLES & TESTS			STRATA				Geology	Instrument	Backfill
Depth	Type No	Test Result	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION			
0.30	D1	N7			0.10	Soft brown CLAY with frequent rootlets			
0.30-0.30	PSA				0.40	Light brown SAND and GRAVEL. Gravel is of fine to coarse sub angular flint			
0.50-0.70	D2				(0.70)	Brown silty gravelly fine SAND. Gravel is of fine to medium angular to sub angular flint			
1.20-1.65	D3				1.10	Brown silty fine SAND			
1.70					(1.40)				
2.00-2.45	D4	30 blows			2.50	Finer brown grey silty CLAY			
2.45	D5								
3.00-3.45	D6	N10			(2.30)				
3.00									
4.00-4.50	D7	46 blows			4.80	From to stiff grey CLAY			
4.5	D8								
5.00-5.45	D9	N16							
5.00									
6.00	D10								
6.50-6.90	D11	55 blows			(3.90)				
6.90	D12								
7.50	D13								
8.00-8.45	D14	N25			8.70				
8.00									
8.70-9.00	D15				(0.50)	Very stiff grey CLAY and claystone			
					9.70	Stiff grey CLAY			
9.50-9.95	D16	66 blows							
9.95	D17								

[illegible]

Ridger & Partners, LLP
Partnership Offices
Mopac Road

BOREHOLE LOG

Project				BORISHOFF No.	
Blondworth Crescent				BH4	
Job No.	Date	Ground Level (m)	Co Ordinate (t)		
151238	17-06-15 18-06-15				
Contractor				Sheet	
MIDRILLING				2 of 2	

SAMPLES & TESTS			STRATA				Geology	Geological Description (Bathymetry)
Depth	Type No	Test Result	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
10.50	D18					Stiff grey CLAY (continued)		
11.00	D19							
11.45		N76						
11.00					(5.10)			
12.60	D20							
12.50	D21	70 blows						
12.85								
12.85	D22							
13.50	D23							
14.00- 14.40	D24				14.30			
14.00		N80/ 135 mm			14.40	Grey clayey medium to coarse sub rounded to rounded flint GRAVEL		

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BOREHOLE LOG

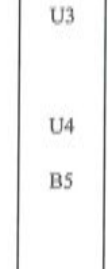
100% of the total sample. The mean age of the sample was 36.5 years (SD = 10.5), with a range from 18 to 65 years. The majority of the sample was female (70.5%), and the majority of the sample was married (65.5%). The majority of the sample was employed (75.5%). The majority of the sample was white (85.5%). The majority of the sample was born in the United States (85.5%). The majority of the sample was a native-born citizen (85.5%). The majority of the sample was a native-born citizen (85.5%).

BOREHOLE LOG

Project Blendworth Crescent							BOREHOLE No WS1																																			
Job No 151238		Date 05-06-15 05-06-15		Ground Level (m)		Co-Ordinates (Y)		Sheet 1 of 1																																		
Contractor DJ DRILLING																																										
SAMPLES & TESTS				STRATA																																						
Depth	Type No	Test Result	Reduced Level	Depth (Thickness)	DESCRIPTION			Geology	Insturment																																	
0.10-0.30	FS1			0.30	Light brown silty slightly clayey gravelly fine SANDY with frequent mottles. Gravel is of fine to coarse angular to sub rounded flint																																					
0.50-1.00	FS2			0.80	Clayey silty sandy fine to coarse angular to sub rounded flint GRAVEL. Locally very clayey or very sandy.																																					
1.00		N9		1.10	Fine to stiff light orange brown mottled light grey silty CLAY																																					
1.50-2.00	U3																																									
2.00		N9		2.45																																						
2.50-3.00	U4																																									
3.00		N12		3.45	Fine to stiff grey brown slightly silty CLAY																																					
4.00		N18		4.55																																						
5.00		N22		5.00																																						
<table border="1"> <tr> <th colspan="5">Boring Progress and Water Observations</th> <th colspan="3">Chiselling</th> <th colspan="2">Water Added</th> <th rowspan="2">GENERAL REMARKS</th> </tr> <tr> <th>Depth</th> <th>Date</th> <th>Time</th> <th>Casing Diameter</th> <th>Water Depth</th> <th>From</th> <th>To</th> <th>Hours</th> <th>From</th> <th>To</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										Boring Progress and Water Observations					Chiselling			Water Added		GENERAL REMARKS	Depth	Date	Time	Casing Diameter	Water Depth	From	To	Hours	From	To												
Boring Progress and Water Observations					Chiselling			Water Added		GENERAL REMARKS																																
Depth	Date	Time	Casing Diameter	Water Depth	From	To	Hours	From	To																																	
All dimensions in metres Scale 1:65,625			Client PCX			Method/ Plant Used			Logged By																																	

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS2
Job No 151238	Date 05-06-15 05-06-15	Ground Level (m)	Co-Ordinates ()	
Contractor DJ DRILLING				Sheet 1 of 1

SAMPLES & TESTS			Water				STRATA	Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION		
0.25-0.50	ES1	N5		 0.25	Light brown silty slightly clayey gravelly fine SAND with frequent rootlets				
0.80-1.00 1.00	ES2			 (0.55)  0.80	Firm to stiff light brown to grey silty gravelly CLAY. Gravel is of fine to medium angular to sub angular flint				
2.00	N11			(4.20) 	Firm to stiff grey brown to light brown silty CLAY Several small black stained / mottled areas from 0.8-1.0m				
2.50-3.00	U3								
3.00	N12								
3.50-4.00	U4								
4.00-5.00 4.00	B5			N16					
5.00	N18								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:65.625			Client PCC				Method/ Plant Used				Logged By

Report ID: AGS4 UK BH || Project: BLENDWORTH CRESCENT.GPJ || Library: GINT STD AGS 4 0.GLB || Date: August 27, 2015

BOREHOLE LOG

Project Blendworth Crescent		Borehole No WS3	
Job No 151238	Date 05/06/13	Ground Level (m) 05/06/13	Co-Ordinates ()
Contractor DD DRILLING		Sheet 1 of 1	

SAMPLES & TESTS				STRATA		Geology	Elevation Feet
Depth	Type No	Test Result	Reduced Level	Depth (Thick-ness)	DESCRIPTION		
0.10-0.20	T81				0.20	Brown silty clayey fine SAND with frequent nodules.	
0.40-0.60	T82				(0.60)	Firm light brown to grey silty slightly sandy gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flat Occasional brick fragments.	
1.00		N6				Firm to stiff light brown to grey slightly silty CLAY	
2.00		N10					
3.00		N14			(4.20)		
4.00		N17					
5.00		N22			5.60		

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BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS4	
Job No 151238	Date 05-06-15	Ground Level (m) 05-06-15	Co-Ordinates ()		Sheet 1 of 1
Contractor DI DRILLING					

SAMPLES & TESTS			STRATA				Geology	Tested Borehole
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick ness)	DESCRIPTION	
0.30-0.60	BS1					0.10 (0.80) 0.90	Brown silty clayey fine SAND with frequent rootlets Firm light brown to grey silty gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint and brick fragments	
1.00-1.20	BS2						Firm to stiff orange brown mottled grey to dark brown grey slightly silty CLAY	
1.30-2.00	B3	N7						
2.00		N10						
3.00		N13				(3.50)		
4.00		N13				4.40		
						(0.60) 5.00	No recovery	

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:65.625						Client		PCV		Method/ Plant Used	
Logged By											

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Moorside Road

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS5	
Job No 151238	Date 05-06-15 08-06-15	Ground Level (m)	Co-Ordinates ()		
Contractor DJ DRILLING				Sheet 1 of 1	

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Geology	Stratigraphic Column
0.10-0.30	ES1					0.25	Firm brown silty sandy CLAY with frequent rootlets		
0.50-0.70	ES2					(0.70) 0.95	Light brown to grey brown silty sandy gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint, brick and concrete		
1.00		N7					Firm to stiff Orange brown to grey CLAY - Partial recovery 3-6m		
1.50-2.00	U3								
2.00-3.00	B4	N9				(3.05)			
3.00		N10							
4.00		N10				4.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:63,625						Client PCC		Method/ Plant Used		Logged By	

Report ID: 4034-X-24, Project: BLENDWORTH CRESCENT, JOB: BS, SITE: 051, 005, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

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BOREHOLE LOG

Project				BOREHOLE No.	
Blendsworth Crescent				WS6	
Job No.	Date	Ground Level (m)	Co Ordinates ()		
151238	10-06-15	10-06-15			
Contractor				Sheet	
DJ DRILLING				1 of 1	

SAMPLES & TESTS			STRATA			Geology	Estimated Backfill
Depth	Type No	Test Result	Reduced Level	Legend	DESCRIPTION		
0.10-0.30	ES1				0.30	Brown silty slightly clayey fine SAND with frequent rootlets	
0.50-0.80	ES2				(0.65)	Firm to stiff orange brown silty slightly sandy gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint	
1.00		N11			0.85	Firm light brown moulded grey silty CLAY. Locally pockets of fine to coarse angular to sub angular flint gravel. No recovery beyond 3m	
1.50-2.00	ES3						
2.00-3.00	ES4	N10			(2.15)		
3.00		N15			3.00		

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BOREHOLE LOG

Project				BORER HOLE No.	
Blendworth Crescent				WS7	
Job No.	Date	Ground Level (m)	C/c Coordinates (°)		
151238	10-06-15				
Contractor				Sheet	
M DRILLING				1 of 1	

SAMPLES & TESTS				STRATA			Geology	Geological Basemap
Depth	Type No.	Test Result	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.30-0.50	1-S1				0.10 0.50	Brown silty slightly clayey fine SAND with frequent rootlets Brown silty sandy gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint and brick fragments		
0.70-0.90	1-S2				(0.65) 1.15	Firm brown to grey brown silty gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint		
1.00		N4				Firm to stiff brown to grey slightly silty CLAY		
1.50-2.00	R3							
2.00		N10						
					(2.85)			
3.00-4.00	R4							
3.00		N13						
4.00		N15						

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BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS8	
Job No 151238	Date 10-06-15 10-06-15	Ground Level (m)	Co-Ordinates (E)		
Contractor DJ DRILLING				Sheet 1 of 1	

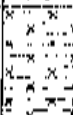
SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thickness)	STRATA		Geology	Lithological Description				
Depth	Type No	Test Result					DESCRIPTION							
0.20-0.40	PS1	NR				(0.50)	Brown silty slightly clayey slightly gravelly fine SAND with frequent nodules.							
0.60-0.80	PS2					(0.95)	Light brown silty slightly sandy gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint.							
1.00-2.00 1.00	PS					Fine to stiff light brown to grey slightly silty CLAY.								
2.00		N12				(3.05)								
3.00		N16												
4.00		N15												

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:65 625						Client PCC		Method/ Plant Used		Logged By	

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BOREHOLE LOG

Project Blondworth Crescent				BOREHOLE No WS9	
Job No 151238	Date 10-06-15 10-06-13	Ground Level (m)	Co-Ordinates ()		
Contractor DJ DRILLING				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Circ Log	Logging or Bathym.
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.10-0.30	BS1					0.15	Brown silty slightly gravelly fine SAND with frequent rootlets		
0.40-0.60	BS2					(0.55) 0.90	Firm light brown silty gravelly slightly calcify CLAY. Gravel is of fine to coarse sub angular to sub rounded flint, brick and concrete.		
1.00		N29				(1.10)	Firm to stiff brown silty gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint		
2.00		N17				2.00	Firm to stiff brown gray slightly silty CLAY		
2.50-3.00	U3					(1.00)			
3.00		N15				3.00			

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BOREHOLE LOGS

Project Blendworth Crescent				Borehole No WS10	
Job No 151238	Date 10-06-15 10-06-15	Ground Level (m)	Co-Ordinates (y)		
Contractor GEODRILLING				Sheet 1 of 1	

SAMPLES & TESTS			STRATA			Geology	Backfill
Depth	Type No	Test Result	Reduced Level	Legend	DESCRIPTION		
0.30-0.80	BS1	N9			0.25 Light brown silty slightly gravelly fine SAND with frequent rootlets		
					0.60 Orange brown clayey sandy SILT		
0.80-1.00 1.00	BS2			(0.55)	Light brown to orange brown silty gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint.		
1.50-2.00	BS3	N12			1.15 Fine to stiff brown to grey silty CLAY		
2.00-3.00 3.00	BS4			(2.85)			
3.00-4.00 3.00	BS5						
4.00		N25			4.00		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:65.625			Client		PCC	Method/ Plant Used		Logged By			

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APPENDIX 4

Extracts from SuDs Manual re Water Quality Managment

TABLE 4.3 Minimum water quality management requirements for discharges to receiving surface waters and groundwater

Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries ²	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach ³ <i>Note: extra measures may be required for discharges to protected resources¹</i>	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach ³ <i>Note: extra measures may be required for discharges to protected resources¹</i>	Simple index approach ³ <i>Note: extra measures may be required for discharges to protected resources¹</i> In England and Wales, Risk Screening ⁴ must be undertaken first to determine whether consultation with the environmental regulator is required. In Northern Ireland, the need for risk screening should be agreed with the environmental regulator.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit ⁵ . Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required ⁶ .	

Notes

The minimum water quality management requirements for discharges to receiving surface waters and groundwater are presented here. (For Northern Ireland, this guidance should be considered as interim until such time as Northern Ireland publishes its own legislation/policy/guidance.)

- 1 These are not required in Scotland and Northern Ireland. For England and Wales, see Step 3 of the simple index approach (Section 26.7.1).

Protected surface water resources will include those designated for drinking water abstraction or for other environmental protection reasons. Protected groundwater resources are represented by SPZ1s in England and Wales.

- 2 In Scotland, the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 General Binding Rules, Rule 10 (d) (iv) effectively provides an exemption from requiring SuDS for coastal discharges. However, control of any contaminants likely to be present in surface water runoff is still required, but can be delivered using alternative methods such as proprietary treatment products. As the term 'SuDS' in this manual includes proprietary treatment products, this exemption is not valid in this context.
- 3 The application of the simple index approach should follow the approach outlined in Section 26.7.1 (or equivalent approved).
- 4 Risk screening is an assessment to identify high risk scenarios where the Environment Agency or Natural Resources Wales (NRW) would wish to be consulted regarding infiltration of water from surface runoff in order to agree the proposed design approach. The risk screening method is provided in Section 26.7.2.
- 5 The risk assessment should determine the appropriate design approach to mitigate risk to acceptable levels following the guidance outlined in Section 26.7.3. This assessment should be approved by the environmental regulator.

- detailed risk assessment methods
- process-based treatment modelling methods (which, where used, are likely to form part of a detailed risk assessment).

Each of these methods is summarised in **Table 26.1** and described in more detail in the subsequent sections.

TABLE 26.1 Approaches to water quality risk management

Design method	Hazard characterisation	Risk reduction	
		For surface water	For groundwater
Simple index approach	Simple pollution hazard indices based on land use (eg Table 26.2 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.3 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.4 or equivalent)
Risk screening ¹	Factors characterising traffic density and extent of infiltration likely to occur (eg Table 26.5 or equivalent)	N/A	Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (eg Table 26.5 or equivalent)
Detailed risk assessment	Site specific information used to define likely pollutants and their significance	More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels	
Process-based treatment modelling	Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff	Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in event mean discharge concentrations and total annual load reductions delivered by the system	

Note

¹ Risk assessment may be required as a result of the risk screening process.

Table 4.3 (Chapter 4) sets out which of these methods is required – for different generic land use types and receiving waters. Process-based modelling is not currently readily available for SuDS design in the UK, and is not therefore specified as a requirement. However, where robust models can be developed by designers, this approach should not be discounted as a future option for SuDS design.

It is important to ensure that risks to both surface and groundwater are managed effectively, and the approach taken should be agreed with the drainage approving body and/or environmental regulator in advance of the design, as local differences in requirements may exist.

Approaches that consider a number of key pollutant types are recommended because:

- receiving water quality standards tend to be specified in terms of individual pollutant thresholds (**Section 26.4**)
- different components tend to have different capacities to remove different types of pollutants (**Section 26.6**)
- any component (proprietary product or otherwise) will need to demonstrate performance across a range of pollutants, or where this is not possible, different types of component will be needed to remove different pollutants. A series of sediment removal components, such as gulley pots, would be unlikely to meet the performance requirements for the full suite of pollutants.

26.7.1 Simple index approach

The simple method described in this section, and summarised in **Box 26.2**, has been developed from that set out in Ellis *et al* (2012), a summary of which is presented in **Annex 5**.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

Notes

- 1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).
- 2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Where a site land use falls outside the defined categories, the indices should be adapted (and agreed with the drainage approving body) or else the more detailed risk assessment method should be adopted.

Where nutrient or bacteria and pathogen removal is important for a particular receiving water, equivalent indices should be developed for these pollutants (if acceptable to the drainage approving body) or the risk assessment method adopted.

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required, where:

$$\text{Total SuDS mitigation index} = \text{mitigation index}_1 + 0.5 (\text{mitigation index}_2)$$

Where:

$$\text{mitigation index}_n = \text{mitigation index for component } n$$

A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentrations.

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates ¹	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.6 ⁴	0.5	0.6
A soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.8 ⁴	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Notes

- 1 All designs must include a minimum of 1 m unsaturated depth of aquifer material between the infiltration surface and the maximum likely groundwater level (as required in infiltration design – [Chapter 25](#)).
- 2 For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance.
- 3 Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater – see note 1.
- 4 If significant volumes of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure.
- 5 See [Chapter 14](#) for approaches to demonstrate product performance. Note: a British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: www.britishwater.co.uk/Publications/codes-of-practice.aspx
- 6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution, where there is a requirement to retrofit treatment. WAT-RM-08 (SEPA, 2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

The following should be noted:

- Where the indices are not considered representative by the designer, a risk assessment can be undertaken ([Section 26.7.3](#)).
- Components should always be designed for treatment, as described in the design guidance set out in the individual component chapters. If they are undersized, incorrectly designed or constructed or inadequately maintained, their treatment performance could be significantly affected. Component checklists ([Appendix B](#)) can be used to confirm design and construction adequacy and set appropriate maintenance regimes.
- Where the infiltration component itself does not provide sufficient pollution mitigation, the design should include upstream SuDS components that are lined to prevent infiltration from occurring. The mitigation indices set out in [Table 26.3](#) (for discharges to surface water) should be used for any upstream treatment.