

RUSHBY BREWSTER
CONSULTING CIVIL & STRUCTURAL ENGINEERS

DRAINAGE STRATEGY

for

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

Client:

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Issue		A	B
Issued By	Allen Rushby		
Date	March 2016		
Purpose	Planning		
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 a Rainwater Harvesting tank with exceedance flows directed to a storm water 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 525mm 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 the 'green field' run-off rate which has been determined as 5.0litres/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 affect 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 and rainwater harvesting 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 pollutions hazard if 'low' and the table refers to the 'simple index approach'.

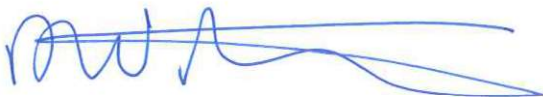
Table 26.1 shows the approach to water quality risk management from which the 'simple index approach' refers to tables 26.2 and 26.4.

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 Rushby Brewster

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APPENDIX 1

Southern Water Sewer Plan

SEWER RECORDS PAGE 1 OF 2

107491



107203

O.S. REF. SU7107SW		Drawn by: mondalb		471647
Title: 188188_Land Adjacent Blerdwort		Scale: 1:1250		
Date: 15/01/2015		The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. 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		
Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.				

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape
1401X	11.51		750	CI	CIRC	5305X			150	VC	CIRC						
1450X	8.16	5.06	UNK	UNK	CIRC	5306X			150	VC	CIRC						
2202X	8.16	5.06	225	CP	CIRC	5310X			225	VC	CIRC						
2250X	8.07	5.87	300	VC	CIRC	5400X			200	VC	CIRC						
2301X	10.09		150	VC	CIRC	5401X	13.14	11.4	450	CP	CIRC						
2302X	9.78		150	VC	CIRC	5402X	12.78	11.61	450	CP	CIRC						
2303X	10.86	9.79	150	PF	CIRC	5403X			UNK	UNK	CIRC						
2304X	10.78	9.78	150	VC	CIRC	5404X			UNK	UNK	CIRC						
2305X	10.06	8.44	150	VC	CIRC	5405X			UNK	UNK	CIRC						
2306X	10.47	8.96	150	VC	CIRC	5406X			UNK	UNK	CIRC						
2307X	10.13	8.98	225	CP	CIRC	5407X			UNK	UNK	CIRC						
2311X	10.49	9.15	225	CP	CIRC	5408X			UNK	UNK	CIRC						
2312X	10.88	9.55	225	CP	CIRC	5409X			UNK	UNK	CIRC						
2313X	10.88	9.55	225	CP	CIRC	5410X			UNK	UNK	CIRC						
2314X	10.55	9.29	225	CP	CIRC	5411X			UNK	UNK	CIRC						
2315X	10.55	9.29	225	CP	CIRC	5412X			UNK	UNK	CIRC						
2316X	10.55	9.29	225	CP	CIRC	5413X			UNK	UNK	CIRC						
2317X	9.6	8.29	300	CP	CIRC	5414X			UNK	UNK	CIRC						
2318X	9.17	8.29	300	CP	CIRC	5415X			UNK	UNK	CIRC						
2319X	9.32	9.32	150	VC	CIRC	5416X			UNK	UNK	CIRC						
2320X	10.55	9.32	150	VC	CIRC	5417X			UNK	UNK	CIRC						
2321X	10.55	9.32	150	VC	CIRC	5418X			UNK	UNK	CIRC						
2322X	10.55	9.32	150	VC	CIRC	5419X			UNK	UNK	CIRC						
2323X	10.55	9.32	150	VC	CIRC	5420X			UNK	UNK	CIRC						
2324X	10.55	9.32	150	VC	CIRC	5421X			UNK	UNK	CIRC						
2325X	10.55	9.32	150	VC	CIRC	5422X			UNK	UNK	CIRC						
2326X	10.55	9.32	150	VC	CIRC	5423X			UNK	UNK	CIRC						
2327X	10.55	9.32	150	VC	CIRC	5424X			UNK	UNK	CIRC						
2328X	10.55	9.32	150	VC	CIRC	5425X			UNK	UNK	CIRC						
2329X	10.55	9.32	150	VC	CIRC	5426X			UNK	UNK	CIRC						
2330X	10.55	9.32	150	VC	CIRC	5427X			UNK	UNK	CIRC						
2331X	10.55	9.32	150	VC	CIRC	5428X			UNK	UNK	CIRC						
2332X	10.55	9.32	150	VC	CIRC	5429X			UNK	UNK	CIRC						
2333X	10.55	9.32	150	VC	CIRC	5430X			UNK	UNK	CIRC						
2334X	10.55	9.32	150	VC	CIRC	5431X			UNK	UNK	CIRC						
2335X	10.55	9.32	150	VC	CIRC	5432X			UNK	UNK	CIRC						
2336X	10.55	9.32	150	VC	CIRC	5433X			UNK	UNK	CIRC						
2337X	10.55	9.32	150	VC	CIRC	5434X			UNK	UNK	CIRC						
2338X	10.55	9.32	150	VC	CIRC	5435X			UNK	UNK	CIRC						
2339X	10.55	9.32	150	VC	CIRC	5436X			UNK	UNK	CIRC						
2340X	10.55	9.32	150	VC	CIRC	5437X			UNK	UNK	CIRC						
2341X	10.55	9.32	150	VC	CIRC	5438X			UNK	UNK	CIRC						
2342X	10.55	9.32	150	VC	CIRC	5439X			UNK	UNK	CIRC						
2343X	10.55	9.32	150	VC	CIRC	5440X			UNK	UNK	CIRC						
2344X	10.55	9.32	150	VC	CIRC	5441X			UNK	UNK	CIRC						
2345X	10.55	9.32	150	VC	CIRC	5442X			UNK	UNK	CIRC						
2346X	10.55	9.32	150	VC	CIRC	5443X			UNK	UNK	CIRC						
2347X	10.55	9.32	150	VC	CIRC	5444X			UNK	UNK	CIRC						
2348X	10.55	9.32	150	VC	CIRC	5445X			UNK	UNK	CIRC						
2349X	10.55	9.32	150	VC	CIRC	5446X			UNK	UNK	CIRC						
2350X	10.55	9.32	150	VC	CIRC	5447X			UNK	UNK	CIRC						
2351X	10.55	9.32	150	VC	CIRC	5448X			UNK	UNK	CIRC						
2352X	10.55	9.32	150	VC	CIRC	5449X			UNK	UNK	CIRC						
2353X	10.55	9.32	150	VC	CIRC	5450X			UNK	UNK	CIRC						
2354X	10.55	9.32	150	VC	CIRC	5451X			UNK	UNK	CIRC						
2355X	10.55	9.32	150	VC	CIRC	5452X			UNK	UNK	CIRC						
2356X	10.55	9.32	150	VC	CIRC	5453X			UNK	UNK	CIRC						
2357X	10.55	9.32	150	VC	CIRC	5454X			UNK	UNK	CIRC						
2358X	10.55	9.32	150	VC	CIRC	5455X			UNK	UNK	CIRC						
2359X	10.55	9.32	150	VC	CIRC	5456X			UNK	UNK	CIRC						
2360X	10.55	9.32	150	VC	CIRC	5457X			UNK	UNK	CIRC						
2361X	10.55	9.32	150	VC	CIRC	5458X			UNK	UNK	CIRC						
2362X	10.55	9.32	150	VC	CIRC	5459X			UNK	UNK	CIRC						
2363X	10.55	9.32	150	VC	CIRC	5460X			UNK	UNK	CIRC						
2364X	10.55	9.32	150	VC	CIRC	5461X			UNK	UNK	CIRC						
2365X	10.55	9.32	150	VC	CIRC	5462X			UNK	UNK	CIRC						
2366X	10.55	9.32	150	VC	CIRC	5463X			UNK	UNK	CIRC						
2367X	10.55	9.32	150	VC	CIRC	5464X			UNK	UNK	CIRC						
2368X	10.55	9.32	150	VC	CIRC	5465X			UNK	UNK	CIRC						
2369X	10.55	9.32	150	VC	CIRC	5466X			UNK	UNK	CIRC						
2370X	10.55	9.32	150	VC	CIRC	5467X			UNK	UNK	CIRC						
2371X	10.55	9.32	150	VC	CIRC	5468X			UNK	UNK	CIRC						
2372X	10.55	9.32	150	VC	CIRC	5469X			UNK	UNK	CIRC						
2373X	10.55	9.32	150	VC	CIRC	5470X			UNK	UNK	CIRC						
2374X	10.55	9.32	150	VC	CIRC	5471X			UNK	UNK	CIRC						
2375X	10.55	9.32	150	VC	CIRC	5472X			UNK	UNK	CIRC						
2376X	10.55	9.32	150	VC	CIRC	5473X			UNK	UNK	CIRC						
2377X	10.55	9.32	150	VC	CIRC	5474X			UNK	UNK	CIRC						
2378X	10.55	9.32	150	VC	CIRC	5475X			UNK	UNK	CIRC						
2379X	10.55	9.32	150	VC	CIRC	5476X			UNK	UNK	CIRC						
2380X	10.55	9.32	150	VC	CIRC	5477X			UNK	UNK	CIRC						
2381X	10.55	9.32	150	VC	CIRC	5478X			UNK	UNK	CIRC						
2382X	10.55	9.32	150	VC	CIRC	5479X			UNK	UNK	CIRC						
2383X	10.55	9.32	150	VC	CIRC	5480X			UNK	UNK	CIRC						
2384X	10.55	9.32	150	VC	CIRC	5481X			UNK	UNK	CIRC						
2385X	10.55	9.32	150	VC	CIRC	5482X			UNK	UNK	CIRC						
2386X	10.55	9.32	150	VC	CIRC	5483X			UNK	UNK	CIRC						
2387X	10.55	9.32	150	VC	CIRC	5484X			UNK	UNK	CIRC						
2388X	10.55	9.32	150	VC	CIRC	5485X			UNK	UNK	CIRC						
2389X	10.55	9.32	150	VC	CIRC	5486X			UNK	UNK	CIRC						
2390X	10.55	9.32	150	VC	CIRC	5487X			UNK	UNK	CIRC						
2391X	10.55	9.32	150	VC	CIRC	5488X			UNK	UNK	CIRC						
2392X	10.55	9.32	150	VC	CIRC	5489X			UNK	UNK	CIRC						
2393X	10.55	9.32	150	VC	CIRC	5490X			UNK	UNK	CIRC						
2394X	10.55	9.32	150	VC	CIRC	5491X			UNK	UNK	CIRC						
2395X	10.55	9.32	150	VC	CIRC	5492X			UNK	UNK	CIRC						
2396X	10.55	9.32	150	VC	CIRC	5493X			UNK	UNK	CIRC						
2397X	10.55	9.32	150	VC	CIRC	5494X			UNK	UNK	CIRC						
2398X	10.55	9.32	150	VC	CIRC	5495X			UNK	UNK	CIRC						
2399X	10.55	9.32	150	VC	CIRC	5496X			UNK	UNK	CIRC						
2400X	10.55	9.32	150	VC	CIRC	5497X			UNK	UNK	CIRC						
2401X	10.55	9.32	150	VC	CIRC	5498X			UNK	UNK	CIRC						
2402X	10.55	9.32	150	VC	CIRC	5499X			UNK	UNK	CIRC						
2403X	10.55	9.32	150	VC	CIRC	5500X			UNK	UNK	CIRC						
2404X	10.55	9.32	150	VC	CIRC	5501X			UNK	UNK	CIRC						

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



CALCULATIONS

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Job Title	BLUNDWORTH CRESCENT HAMM7	Job No.	DMC 288	Sht. No.	D2
Element	SURFACE WATER DRAINAGE	Prepared	AVL	Date	FEB '16
		Checked		Date	

TOTAL SITE AREA 11670 m² (1.16 Ha) Q_{bal} = 5.04/s

POST DEVELOPMENT SITE IMPERMEABLE AREAS

BUILDINGS	HOUSES	155 m ²
	HOUSES	290 m ²
	HOUSES	290 m ²
	HOUSES	320 m ²
	HOUSES	155 m ²
	FLATS	790 m ²
TOTAL BUILDINGS		2000 m ²

TARMAC ROADWAY 1145 m²

PARKING AREAS 1495 m²

TOTAL HARD SURFACES 4640 m²

CHECK STORAGE VOLUME REQUIRED FOR 1 IN 100 YEAR + 30% EVENT TO ESTIMATE TIME TO DISCHARGE ALL STORED WATER (SEE TEDDS CALCULATIONS.).

EFFECTIVE AREA FOR 30% ADDITION FOR CLIMATE CHANGE
= 4640 x 1.3 = 6032 m²

FROM SPREADSHEET STORAGE VOLUME REQUIRED
269 m³

DISCHARGE AT 5.0 L/S

TIME TO DISCHARGE FULL VOLUME = $\frac{269 \times 10^3}{5 \times 60 \times 60}$

15 HRS

OK

 RUSHBY BREWSTER CONSULTING CIVIL AND STRUCTURAL ENGINEERS	Project			Job no.	
	Blendworth Crescent Havant			PMC238	
	Calcs for			Start page no./Revision	
	Surface Water Attenuation Whole Site			1/3	
	Calcs by	Calcs date	Checked by	Checked date	Approved by
	AWR	12/03/2016			Approved date
Rushby Brewster					

ATTENUATION DESIGN

In accordance with CIRIA publication C697 - The SUDS Manual

Tedds calculation version 1.0.00

EA_Defra method

Site characteristics

Location	Other
Hydrological region	7
Soil type (Wallingford Procedure W.R.A.P map)	4
Standard percentage runoff	SPR = 0.47
Average annual rainfall	SAAR = 720 mm
5 year return period rainfall of 60 minute duration	M5_60min = 19.0 mm
Ratio 60-minute to 2 day rainfalls of 5 year return	r = 0.36
Rainfall intensity increase due to global warming	p _{climate} = 30%
Impervious area req. attenuation storage	α = 100.0 %

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%)	Impermeable. area (ha)
1	Whole Site	1.16	40.0	0.46
Total		1.16	40.0	0.46

Greenfield runoff rates

Catchment area	AREA = 50.00 hectare
Greenfield runoff rate (50 hectare site)	$\bar{Q}_{\text{rural}} = 0.00108 \text{ m}^3/\text{s} \times (\text{AREA}/1\text{km}^2)^{0.89} \times (\text{SAAR}/1\text{mm})^{1.17} \times \text{SPR}^{2.17} =$ 249.5 l / s
Greenfield runoff rate	$\bar{Q} = \bar{Q}_{\text{rural}} / \text{AREA} \times A =$ 5.8 l / s
Greenfield runoff rate per unit area	$\bar{Q}_A = \bar{Q} / A =$ 5.0 l / s / hectare

Estimated site discharges

FSR growth rate (1 year)	FSR _{1yr} = 0.85
Discharge (1 year)	Q _{1yr} = $\bar{Q} \times \text{FSR}_{1\text{yr}} =$ 4.9 l/s
FSR growth rate (30 year)	FSR _{30yr} = 2.30
Discharge (30 year)	Q _{30yr} = $\bar{Q} \times \text{FSR}_{30\text{yr}} =$ 13.3 l/s
FSR growth rate (100 year)	FSR _{100yr} = 3.19
Discharge (100 year)	Q _{100yr} = $\bar{Q} \times \text{FSR}_{100\text{yr}} =$ 18.5 l/s

Estimated attenuation volume - 1 year

Attenuation storage vol (fig A7.1 - A7.8)	Uvol _{1yr} = 51.4 m ³ / hectare
Basic storage volume	BSV _{1yr} = Uvol _{1yr} × α × A = 59.61 m ³
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF _{1yr} = 1.00
Storage volume ratio (fig A8.1 - A8.8)	SVR _{1yr} = 1.45
Adjusted storage volume	ASV _{1yr} = SVR _{1yr} × BSV _{1yr} = 86.50 m ³
Hydrological regional volume ratio (fig A9.1)	HR _{1yr} = 1.01
Final estimated attenuation storage	Vol _{1yr} = HR _{1yr} × ASV _{1yr} = 87.19 m ³

Estimated attenuation volume - 30 year

Attenuation storage vol (fig A7.1 - A7.8)	Uvol _{30yr} = 125.4 m ³ / hectare
Basic storage volume	BSV _{30yr} = Uvol _{30yr} × α × A = 145.50 m ³
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF _{30yr} = 1.00
Storage volume ratio (fig A8.1 - A8.8)	SVR _{30yr} = 1.45

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	Calcs by AWR	Calcs date 12/03/2016	Checked by	Checked date	Approved by	Approved date	

Adjusted storage volume

$$ASV_{30yr} = SVR_{30yr} \times BSV_{30yr} = 211.13 \text{ m}^3$$

Hydrological regional volume ratio (fig A9.1)

$$HR_{30yr} = 1.02$$

Final estimated attenuation storage

$$Vol_{30yr} = HR_{30yr} \times ASV_{30yr} = 215.23 \text{ m}^3$$

Estimated attenuation volume - 100 year

Attenuation storage vol (fig A7.1 - A7.8)

$$Uvol_{100yr} = 163.5 \text{ m}^3 / \text{hectare}$$

Basic storage volume

$$BSV_{100yr} = Uvol_{100yr} \times \alpha \times A = 189.60 \text{ m}^3$$

FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)

$$FF_{100yr} = 1.00$$

Storage volume ratio (fig A8.1 - A8.8)

$$SVR_{100yr} = 1.45$$

Adjusted storage volume

$$ASV_{100yr} = SVR_{100yr} \times BSV_{100yr} = 275.12 \text{ m}^3$$

Hydrological regional volume ratio (fig A9.1)

$$HR_{100yr} = 1.03$$

Final estimated attenuation storage

$$Vol_{100yr} = HR_{100yr} \times ASV_{100yr} = 284.28 \text{ m}^3$$

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{hydro} = 1.25$$

Maximum attenuation storage required

$$V_{req_max} = Vol_{30yr} \times p_{hydro} = 269.0 \text{ m}^3$$

Interception storage

Interception rainfall depth

$$d_{int} = 5 \text{ mm}$$

Volume of interception storage required

$$V_{int_req} = 0.8 \times A_{imp} \times d_{int} = 18.56 \text{ m}^3$$

Long term storage

Proportion of paved area draining in to network

$$\alpha = 1.0$$

Proportion of pervious area draining in to network

$$\beta = 0.5$$

Rainfall depth for 100years, 6 hour event

$$RD = M100_360 = 77.5 \text{ mm}$$

Extra runoff vol of dev.runoff over greenfield runoff

$$Vol_{xs} = \max(RD \times A \times (PIMP \times \alpha \times 0.8 + ((1 - PIMP) \times \beta \times SPR) - SPR), 0 \text{ m}^3) = 0.00 \text{ m}^3$$

Treatment volume

Treatment volume (assume 80% runoff)

$$T_{vol} = 0.8 \times A \times 15 \text{ mm} \times PIMP = 55.68 \text{ m}^3$$

 RUSHBY BREWSTER CONSULTING CIVIL AND STRUCTURAL ENGINEERS	Project			Job no.	
	Blendworth Crescent Havant			PMC238	
	Calcs for			Start page no./Revision	
	Surface Water Attenuation Whole Site			DS	
	Calcs by	Calcs date	Checked by	Checked date	Approved by
	AWR	12/03/2016			Approved date

Rushby Brewster

ATTENUATION DESIGN

In accordance with CIRIA publication C697 - The SUDS Manual

Tedds calculation version 1.0.00

Pre post runoff method

Site characteristics

Location	Other
Hydrological region	7
Soil type (Wallingford Procedure W.R.A.P map)	4
Standard percentage runoff	SPR = 0.47
Average annual rainfall	SAAR = 720 mm
5 year return period rainfall of 60 minute duration	M5_60min = 19.0 mm
Ratio 60-minute to 2 day rainfalls of 5 year return	r = 0.36
Rainfall intensity increase due to global warming	p _{climate} = 30%
Routing coefficient	C _r = 1.30
Volumetric runoff coefficient	C _v = 0.75

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%)	Impermeable area (ha)
1	Whole Site	1.16	40.0	0.46
Total		1.16	40.0	0.46

Greenfield runoff rates

Catchment area	AREA = 50.00 hectare
Greenfield runoff rate (50 hectare site)	$\bar{Q}_{\text{rural}} = 0.00108 \text{ m}^3/\text{s} \times (\text{AREA}/1\text{km}^2)^{0.89} \times (\text{SAAR}/1\text{mm})^{1.17} \times \text{SPR}^{2.17} =$ 249.5 l/s
Greenfield runoff rate	$\bar{Q} = \bar{Q}_{\text{rural}} / \text{AREA} \times A =$ 5.8 l/s
Greenfield runoff rate per unit area	$\bar{Q}_A = \bar{Q} / A =$ 5.0 l/s / hectare

Estimated site discharges

FSR growth rate (1 year)	FSR _{1yr} = 0.85
Discharge (1 year)	Q _{1yr} = $\bar{Q} \times \text{FSR}_{1\text{yr}} =$ 4.9 l/s
FSR growth rate (30 year)	FSR _{30yr} = 2.30
Discharge (30 year)	Q _{30yr} = $\bar{Q} \times \text{FSR}_{30\text{yr}} =$ 13.3 l/s
FSR growth rate (100 year)	FSR _{100yr} = 3.19
Discharge (100 year)	Q _{100yr} = $\bar{Q} \times \text{FSR}_{100\text{yr}} =$ 18.5 l/s

Table equations

Peak flow	$Q_{\text{post_imp}} = C_r \times I_{\text{max}} \times A_{\text{imp}}$
Runoff volume	$V_{\text{post_imp}} = Q_{\text{post_imp}} \times D / C_r$
Post development runoff	$\bar{Q}_{\text{post}} = Q_{\text{post_imp}} + Q_{\text{post_open}}$
Permitted discharge	$O_{\text{exist}} = Q \times D$
Post development runoff volume	$I_{\text{post}} = Q_{\text{post_open}} \times D + V_{\text{post_imp}}$
Storage volume required	$S_{\text{post}} = I_{\text{post}} - O_{\text{exist}}$

Required storage for period of 1 year

Discharge per hectare	Q _{1yr_area} = Q _{1yr} / A = 4.2 l/s/hectare
Greenfield runoff rate post development	Q _{1yr_post_open} = Q _{1yr_area} × A _{imp} = 2.0 l/s

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	Calcs for Surface Water Attenuation Whole Site				Start page no./Revision 2 DCE	
	Calcs by AWR	Calcs date 12/03/2016	Checked by	Checked date	Approved by	Approved date

Duration (min)	1 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	5.4	65.3	0.11	25.3	0.11	1.48	25.85	24.37
10	7.7	46.5	0.08	36.0	0.08	2.95	37.14	34.19
15	9.5	38.1	0.06	44.1	0.07	4.43	45.92	41.49
30	12.5	24.9	0.04	57.8	0.04	8.86	61.31	52.46
60	16.3	16.3	0.03	75.5	0.03	17.71	82.59	64.88
120	20.5	10.2	0.02	95.1	0.02	35.42	109.29	73.86
240	25.3	6.3	0.01	117.6	0.01	70.84	145.90	75.06
360	29.0	4.8	0.01	134.5	0.01	106.27	176.96	70.69
600	33.5	3.4	0.01	155.4	0.01	177.11	226.29	49.18
1440	44.0	1.8	0.00	204.0	0.01	425.07	374.06	-51.01

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{hydro} = 1.25$$

Maximum attenuation storage required

$$V_{req_max} = V_{max_1yr} \times p_{hydro} = 93.8 \text{ m}^3$$

Required storage for period of 30 year

Discharge per hectare

$$Q_{30yr_area} = Q_{30yr} / A = 11.5 \text{ l/s/hectare}$$

Greenfield runoff rate post development

$$Q_{30yr_post_open} = Q_{30yr_area} \times A_{imp} = 5.3 \text{ l/s}$$

Duration (min)	30 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	13.1	157.5	0.26	60.9	0.27	3.99	62.49	58.50
10	19.0	114.1	0.19	88.2	0.20	7.99	91.40	83.41
15	23.4	93.6	0.16	108.6	0.16	11.98	113.35	101.37
30	30.1	60.2	0.10	139.6	0.11	23.96	149.17	125.21
60	37.9	37.9	0.06	175.8	0.07	47.92	194.97	147.05
120	45.6	22.8	0.04	211.5	0.04	95.85	249.85	154.00
240	54.2	13.6	0.02	251.5	0.03	191.70	328.18	136.48
360	60.3	10.0	0.02	279.6	0.02	287.55	394.62	107.07
600	67.3	6.7	0.01	312.3	0.02	479.24	504.03	24.79
1440	83.1	3.5	0.01	385.5	0.01	1150.19	845.60	-304.59

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{hydro} = 1.25$$

Maximum attenuation storage required

$$V_{req_max} = V_{max_30yr} \times p_{hydro} = 192.5 \text{ m}^3$$

Required storage for period of 100 year

Discharge per hectare

$$Q_{100yr_area} = Q_{100yr} / A = 15.9 \text{ l/s/hectare}$$

Greenfield runoff rate post development

$$Q_{100yr_post_open} = Q_{100yr_area} \times A_{imp} = 7.4 \text{ l/s}$$

Duration (min)	100 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
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 RUSHBY BREWSTER CONSULTING CIVIL AND STRUCTURAL ENGINEERS Rushby Brewster	Project				Job no.	
	Blendworth Crescent Havant				PMC238	
	Calcs for				Start page no./Revision	
Surface Water Attenuation Whole Site				3D7		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
AWR	12/03/2016					

Duration (min)	100 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m ³ /s)	Runoff volume (m ³)	Post dev. runoff (m ³ /s)	Permit dischrge (m ³)	Post dev. runoff vol (m ³)	Storage vol. reqd (m ³)
5	16.7	201.0	0.34	77.7	0.34	5.54	79.92	74.38
10	24.6	147.5	0.25	114.1	0.25	11.08	118.50	107.42
15	30.5	122.1	0.20	141.6	0.21	16.62	148.23	131.61
30	39.5	79.1	0.13	183.4	0.14	33.23	196.74	163.50
60	49.7	49.7	0.08	230.5	0.09	66.47	257.09	190.62
120	59.3	29.7	0.05	275.3	0.06	132.94	328.47	195.54
240	70.1	17.5	0.03	325.3	0.04	265.88	431.61	165.73
360	77.5	12.9	0.02	359.8	0.03	398.81	519.35	120.54
600	86.1	8.6	0.01	399.5	0.02	664.69	665.36	0.67
1440	104.2	4.3	0.01	483.6	0.01	1595.26	1121.68	-473.58

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{\text{hydro}} = 1.25$$

Maximum attenuation storage required

$$V_{\text{req_max}} = V_{\text{max_100yr}} \times p_{\text{hydro}} = 244.4 \text{ m}^3$$

Interception storage

Interception rainfall depth

$$d_{\text{int}} = 5 \text{ mm}$$

Volume of interception storage required

$$V_{\text{int_req}} = 0.8 \times A_{\text{imp}} \times d_{\text{int}} = 18.56 \text{ m}^3$$



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Job Title	BLEND WORTH CRESCENT HAMANT		Job No.	PMC 238		Sht. No.	D8	
Element	SURFACE WATER DRAINAGE		Prepared	PWR	Date	FEB 16	Checked	Date

FLATS BUILDING ROOF DRAINAGE TO BE DISCHARGED
VIA RAIN - WATER HARVESTING TANK TO PROVIDE
INTERCEPTION STORAGE

DESIGN ATTENUATION TANK FOR 1 IN 100 YEAR
EVENT WITH 30% ALLOWANCE FOR CLIMATE CHANGE.
SEE 'TODS' CALCULATIONS.

ATTENUATION VOLUME REQUIRED = 47.4 m^3 .
DISCHARGE LIMITED TO 1.0 L/S .

USING HYDRO-INTERNATIONAL STORMBLOCK SYSTEM
MODULES $800 \times 800 \times 660$ DEEP. (95% VOIDS)

AREA REQUIRED FOR SINGLE LAYER

$$= \frac{47.4}{0.66 \times 0.95} = 76 \text{ m}^2$$

USING 8 MODULES WIDE = $8 \times 0.8 = 6.4 \text{ m}$

LENGTH REQD = $\frac{76}{6.4} = 11.8 \text{ m}$

USE 15 UNITS LONG (12m)

 RUSHBY BREWSTER CONSULTING CIVIL AND STRUCTURAL ENGINEERS Rushby Brewster	Project Blendworth Crescent Havant			Job no. PMC238	
	Calcs for Surface Water Attenuation Flats			Start page no./Revision D9	
	Calcs by AWR	Calcs date 12/03/2016	Checked by	Checked date	Approved by Approved date

ATTENUATION DESIGN

In accordance with CIRIA publication C697 - The SUDS Manual

Tedds calculation version 1.0.00

EA_Defra method

Site characteristics

Location	Other
Hydrological region	7
Soil type (Wallingford Procedure W.R.A.P map)	4
Standard percentage runoff	SPR = 0.47
Average annual rainfall	SAAR = 720 mm
5 year return period rainfall of 60 minute duration	M5_60min = 19.0 mm
Ratio 60-minute to 2 day rainfalls of 5 year return	r = 0.36
Rainfall intensity increase due to global warming	p _{climate} = 30%
Impervious area req. attenuation storage	α = 100.0 %

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%)	Impermeable area (ha)
1	Flats	0.08	100.0	0.08
Total		0.08	100.0	0.08

Greenfield runoff rates

Catchment area	AREA = 50.00 hectare
Greenfield runoff rate (50 hectare site)	$\bar{Q}_{\text{rural}} = 0.00108 \text{ m}^3/\text{s} \times (\text{AREA}/1 \text{ km}^2)^{0.89} \times (\text{SAAR}/1 \text{ mm})^{1.17} \times \text{SPR}^{2.17} =$ 249.5 l / s
Greenfield runoff rate	$\bar{Q} = \bar{Q}_{\text{rural}} / \text{AREA} \times A =$ 0.4 l / s
Greenfield runoff rate per unit area	$\bar{Q}_A = \bar{Q} / A =$ 5.0 l / s / hectare

Estimated site discharges

FSR growth rate (1 year)	FSR _{1yr} = 0.85
Discharge (1 year)	Q _{1yr} = $\bar{Q} \times \text{FSR}_{1\text{yr}}$ = 0.3 l/s
FSR growth rate (30 year)	FSR _{30yr} = 2.30
Discharge (30 year)	Q _{30yr} = $\bar{Q} \times \text{FSR}_{30\text{yr}}$ = 0.9 l/s
FSR growth rate (100 year)	FSR _{100yr} = 3.19
Discharge (100 year)	Q _{100yr} = $\bar{Q} \times \text{FSR}_{100\text{yr}}$ = 1.3 l/s

Estimated attenuation volume - 1 year

Attenuation storage vol (fig A7.1 - A7.8)	Uvol _{1yr} = 149.8 m ³ / hectare
Basic storage volume	BSV _{1yr} = Uvol _{1yr} × α × A = 11.83 m ³
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF _{1yr} = 1.00
Storage volume ratio (fig A8.1 - A8.8)	SVR _{1yr} = 1.43
Adjusted storage volume	ASV _{1yr} = SVR _{1yr} × BSV _{1yr} = 16.95 m ³
Hydrological regional volume ratio (fig A9.1)	HR _{1yr} = 1.01
Final estimated attenuation storage	Vol _{1yr} = HR _{1yr} × ASV _{1yr} = 17.07 m ³

Estimated attenuation volume - 30 year

Attenuation storage vol (fig A7.1 - A7.8)	Uvol _{30yr} = 329.6 m ³ / hectare
Basic storage volume	BSV _{30yr} = Uvol _{30yr} × α × A = 26.04 m ³
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF _{30yr} = 1.00
Storage volume ratio (fig A8.1 - A8.8)	SVR _{30yr} = 1.43

 RUSHBY BREWSTER CONSULTING CIVIL AND STRUCTURAL ENGINEERS Rushby Brewster	Project Blendworth Crescent Havant			Job no. PMC238	
	Calcs for Surface Water Attenuation Flats			Start page no./Revision 2/10	
	Calcs by AWR	Calcs date 12/03/2016	Checked by	Checked date	Approved by Approved date

Adjusted storage volume

$$ASV_{30yr} = SVR_{30yr} \times BSV_{30yr} = 37.29 \text{ m}^3$$

Hydrological regional volume ratio (fig A9.1)

$$HR_{30yr} = 1.02$$

Final estimated attenuation storage

$$Vol_{30yr} = HR_{30yr} \times ASV_{30yr} = 37.90 \text{ m}^3$$

Estimated attenuation volume - 100 year

Attenuation storage vol (fig A7.1 - A7.8)

$$Uvol_{100yr} = 415.1 \text{ m}^3 / \text{hectare}$$

Basic storage volume

$$BSV_{100yr} = Uvol_{100yr} \times \alpha \times A = 32.80 \text{ m}^3$$

FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)

$$FF_{100yr} = 1.00$$

Storage volume ratio (fig A8.1 - A8.8)

$$SVR_{100yr} = 1.43$$

Adjusted storage volume

$$ASV_{100yr} = SVR_{100yr} \times BSV_{100yr} = 46.97 \text{ m}^3$$

Hydrological regional volume ratio (fig A9.1)

$$HR_{100yr} = 1.03$$

Final estimated attenuation storage

$$Vol_{100yr} = HR_{100yr} \times ASV_{100yr} = 48.26 \text{ m}^3$$

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{hydro} = 1.25$$

Maximum attenuation storage required

$$V_{req_max} = Vol_{30yr} \times p_{hydro} = 47.4 \text{ m}^3$$

Interception storage

Interception rainfall depth

$$d_{int} = 5 \text{ mm}$$

Volume of interception storage required

$$V_{int_req} = 0.8 \times A_{imp} \times d_{int} = 3.16 \text{ m}^3$$

Long term storage

Proportion of paved area draining in to network

$$\alpha = 1.0$$

Proportion of pervious area draining in to network

$$\beta = 0.5$$

Rainfall depth for 100years, 6 hour event

$$RD = M100_360 = 77.5 \text{ mm}$$

Extra runoff vol of dev.runoff over greenfield runoff

$$Vol_{xs} = \max(RD \times A \times (PIMP \times \alpha \times 0.8 + ((1 - PIMP) \times \beta \times SPR) - SPR), 0 \text{ m}^3) = 20.22 \text{ m}^3$$

Treatment volume

Treatment volume (assume 80% runoff)

$$T_{vol} = 0.8 \times A \times 15 \text{ mm} \times PIMP = 9.48 \text{ m}^3$$



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Job Title	Job No.	Sht. No.		
BLANDWORTH CRESCENT HAMM7.	PMC 238	D11		
Element	Prepared	Date	Checked	Date
	PN	FEB '16		

PERMEABLE PAVING

DESIGN SUB BASE FOR 1 IN 100 YEAR EVENT + 30%
FOR CLIMATE CHANGE

RUN-OFF VOLUME FOR 6 HR EVENT = $0.085 \text{ m}^3/\text{m}^2$

FOR FREE VOLUME Voids IN SUB-BASE 30%

DEPTH OF SUB-BASE REQUIRED = $\frac{0.085}{0.3} = 283 \text{ mm.}$

FOR STRUCTURAL PURPOSES USE 350 mm DEPTH SUB-BASE.
FOR AREAS WHERE NO RUN-OFF FROM BUILDINGS.

1



CALCULATIONS

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CONSULTING CIVIL AND STRUCTURAL ENGINEERS

Job Title	Job No.	Sht. No.
BLENDWORTH CRESCENT	PMC 238	D12
Element	Prepared	Date
	DM	FEB 16
	Checked	Date

DISCHARGE ROOF RUN-OFF DIRECTLY INTO PERMEABLE PAVING SUB-BASES.

PLOTS 1-8 AND 9-15.

ROOF AREA	920 m ²
PERMEABLE PAVING CATCHMENT	990 m ²
TOTAL	1910 m ²

DESIGN SUB-BASE FOR 1 IN 100 YEAR GHR EVENT

RUN-OFF FROM SPREADSHEET = 62.6 mm

ALLOW 30% ADDITION FOR CLIMATE CHANGE = 62.6×1.3
= 81 mm

SUB-BASE FREE VOLUME = 30%

∴ DEPTH OF SUB-BASE REQUIRED FOR STORAGE

$$= \frac{0.081 \times 1910}{0.3 \times 990} = 520 \text{ mm}$$

USE 550 DEEP SUB-BASE.



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Job Title	Job No.	Sht. No.
BLENDWORTH CRESCENT	AMC 238	D13
Element	Prepared	Date
PAVEMENT STRUCTURAL DESIGN.	PR	03/16
	Checked	Date

FROM GROUND INVESTIGATION REPORT CBL = 7.6.

1) PARKING AREAS. (NO HEAVY VEHICLES)

FROM TABLE 20.5 SUBS MANUAL

TRAFFIC CATEGORY BS 7533 = 4.

FOR MODULAR (BLOCK) PAVING TABLE 20.10.

BLOCKS	80 mm
MINIMAL BEDDING LAYER	50 mm
SUB BASE CQA	300 mm

THIS CONSTRUCTION DEPTH IS LESS THAN THAT REQUIRED FOR HYDRAULIC DESIGN.

2) ACCESS ROAD.

TRAFFIC CATEGORY = 5.

FROM TABLE 20.10.

BLOCKS	80 mm
BEDDING LAYER	50 mm
BASE HBCQA	100 mm (OR 70 mm AC32)
SUB BASE CQA	150 mm

THIS CONSTRUCTION DEPTH IS LESS THAN HYDRAULIC REQUIREMENT.

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: I5411/LR

4th February 2016

Dear Antony

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

Strata	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	1.30-150 ¹	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 ¹	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: ¹ 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



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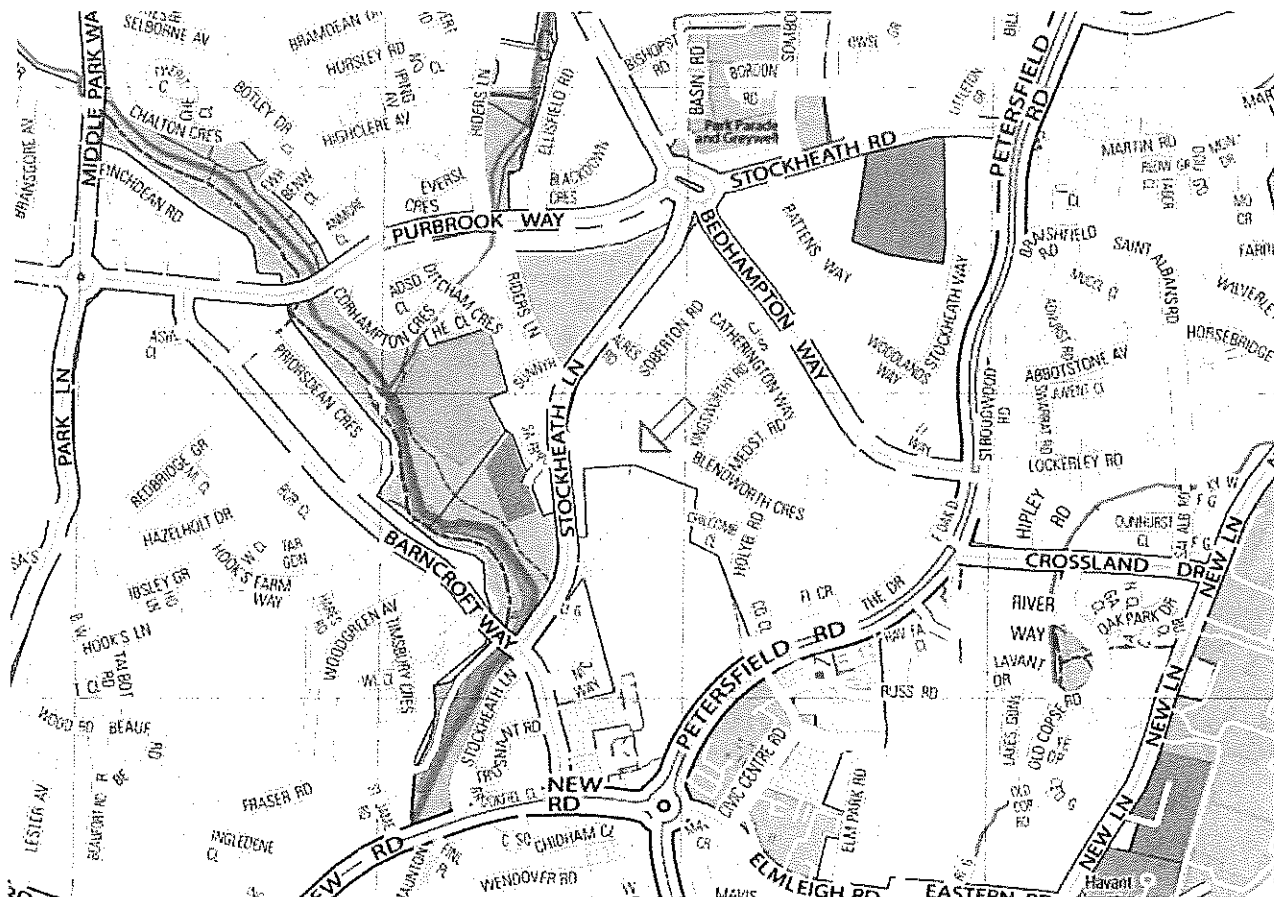


Figure number

1

Title

Site Location Map

ProjectLand to rear of 22-24 Blendworth Crescent, Havant
PO9 2BE**Date**

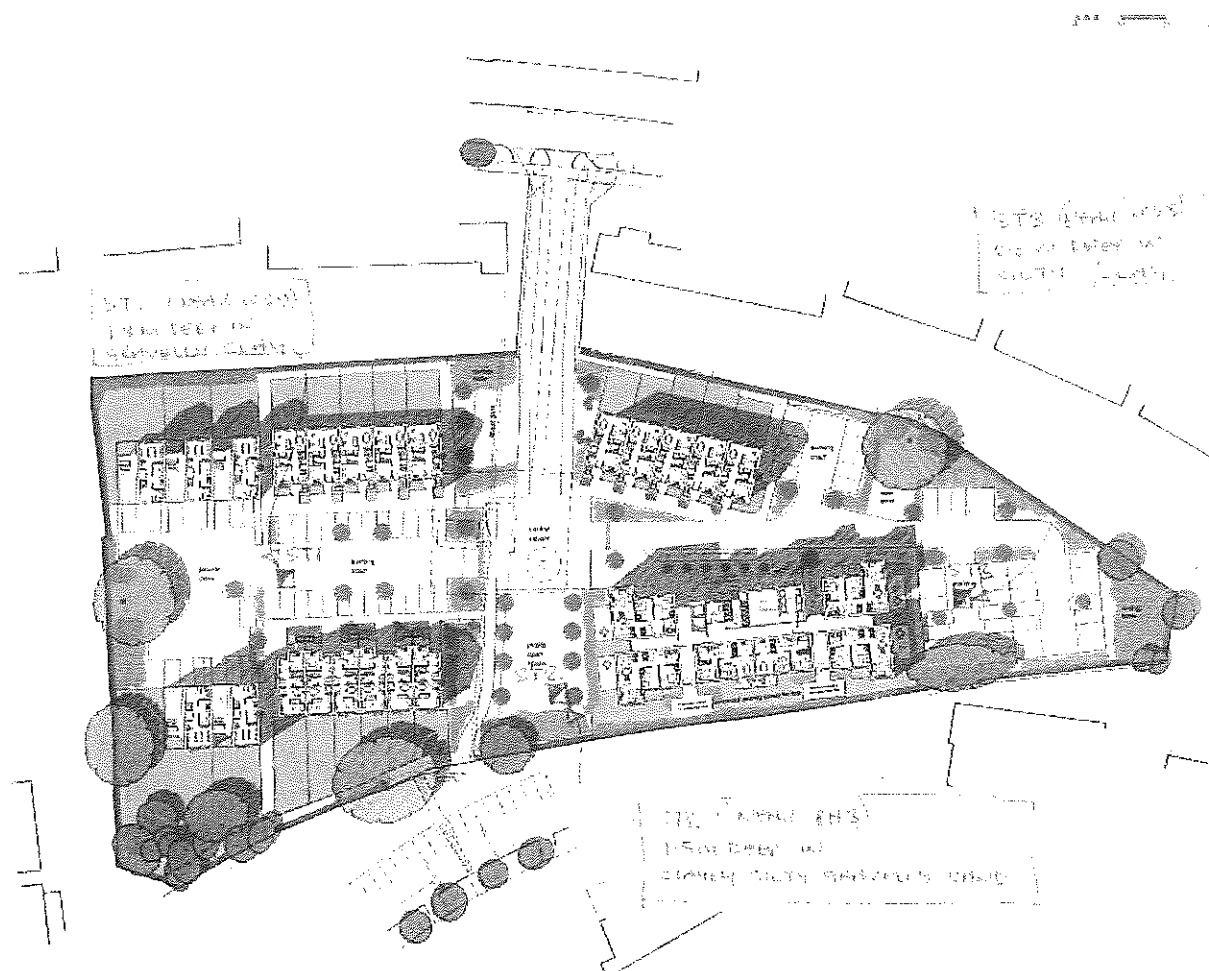
February 2016

Client

Ridge and Partners LLP

Reference

15411



ILLUSTRATIVE SITE PLAN

1:400

Figure number	Title
2	Trail hole location plan

Project	Date
Land to rear of 22-24 Blendworth Crescent, Havant	February 2016
PO9 2BE	

Client	Reference
Ridge and Partners LLP	15411