

Appendix A – Field Data

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.

ST1

Sheet 1 of 1

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

Project No.: 15411

Method: Machine Excavation

Hole Type

TP

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

Plant:

Support:

Scale

1:25

Client: Ridge and Partners LLP

Trial Pit Length: 2.00m

Trial Pit Width: 0.50m

Logged By

GB

Dates: 27-01-2016

Level:

Co-ords:

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	D		0.25			Turf over dark brown clayey SILT with occasional fine to medium sub-angular to angular flint gravel. Occasional rootlets and fine roots. TOPSOIL	
	0.50	D					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. HEAD	
	1.00	D					Firm 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	1
	1.50	D		1.30				
	1.80	D		1.80				
							End of Pit at 1.80m	2
								3
								4
								5

General Remarks:

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

Sample Type

D: Disturbed
B: Bulk
J: Jar
W: Water

Groundwater Remarks:

**Soils Limited**

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Trial Pit Log

Trial Pit No.

ST2

Sheet 1 of 1

Project Name:	Land to rear of 22-24 Blendworth Crescent	Project No.:	15411	Method:	Machine Excavation	Hole Type	TP
Location:	Land to rear of 22-24 Blendworth Crescent, Havant PO9 2BE	Support:		Scale	1:25	Logged By	GB
Client:	Ridge and Partners LLP	Trial Pit Length:	2.00m	Trial Pit Width:	0.50m		
Dates:	27-01-2016	Level:		Co-ords:			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	D		0.25			Turf over dark brown clayey SILT with occasional fine to medium sub-angular to angular flint gravel. Occasional rootlets and fine roots. TOPSOIL	
	0.50	D					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. HEAD	
	1.00	D						1
	1.50	D		1.50			End of Pit at 1.50m	
								2
								3
								4
								5

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

Groundwater Remarks:

Sample Type

D: Disturbed
B: Bulk
J: Jar
W: Water

**Soils Limited**

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Trial Pit Log

Trial Pit No.

ST3

Sheet 1 of 1

Project Name:	Land to rear of 22-24 Blendworth Crescent	Project No.:	15411	Method:	Machine Excavation	Hole Type	TP
Location:	Land to rear of 22-24 Blendworth Crescent, Havant PO9 2BE	Support:				Scale	1:25
Client:	Ridge and Partners LLP	Trial Pit Length:	2.00m	Trial Pit Width:	0.50m	Logged By	GB
Dates:	27-01-2016	Level:		Co-ords:			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	D		0.25			Turf over dark brown clayey SILT with occasional fine to medium sub-angular to angular flint gravel. Occasional rootlets and fine roots. TOPSOIL	
	0.50	D					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. HEAD	
	1.00	D						1
	1.50	D		1.50			End of Pit at 1.50m	
								2
								3
								4
								5

General Remarks:

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

Sample Type

D: Disturbed
B: Bulk
J: Jar
W: Water

Groundwater Remarks:

Soakaway Calculations

Soakaway Test No.	TP1-T1
Contract:	Blendworth Crescent, Havant, Hampshire PO9 2BE
Contract No.	15411

Field Test

Trial Pit Log (include details of groundwater):

See trial Pit record

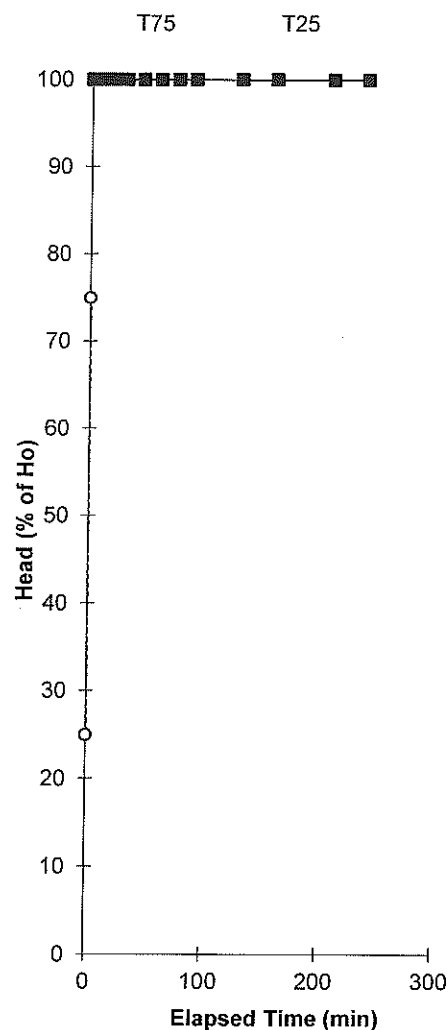
Depth of Pit	1.80 m
Width of Pit	0.50 m
Length of Pit	2.00 m
Depth of Pit Soaked	1.33 m

ap50	4.325 m2
Vp75-25	0.665 m3
t75-25	0.0 min
water used	1.3300 m3
f	N/A m/sec.

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)	Head of Water (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

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



Comments

Zero infiltration observed over test period.

SOILS LIMITED

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Soakaway Calculations

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

Field Test

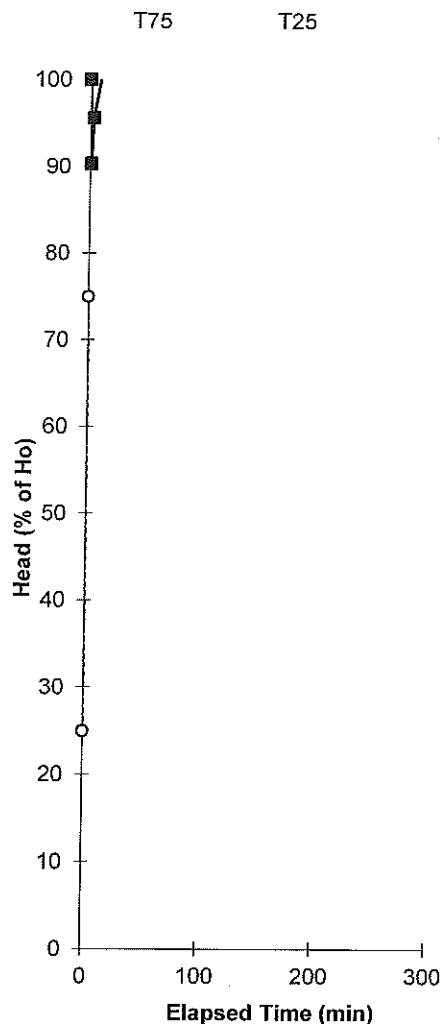
Trial Pit Log (include details of groundwater):

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 m2
Vp75-25	0.57 m3
t75-25	0.0 min
water used	1.1400 m3
f	N/A m/sec.

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)	Head of Water (m)
0.36	0	100	1.14
0.47	1.0	90	1.03
0.41	3.0	96	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	123	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



Comments

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

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Soakaway Calculations

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

Field Test

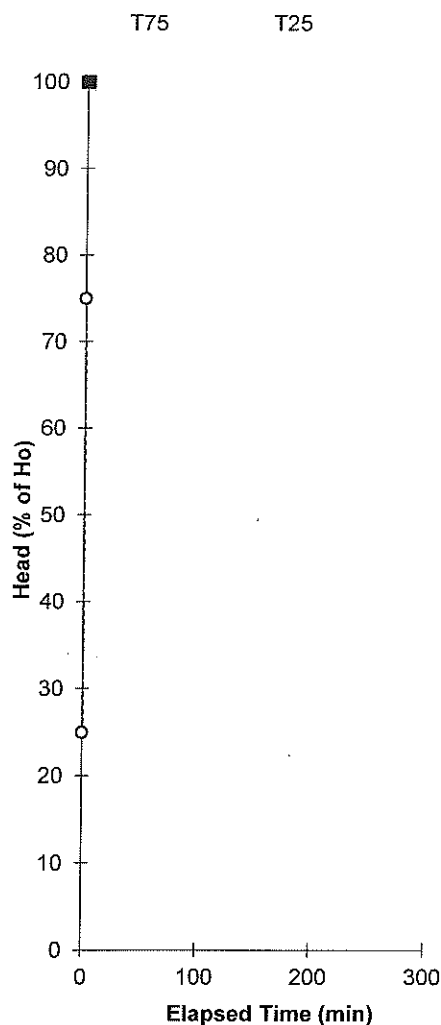
Trial Pit Log (include details of groundwater):
See trial Pit record

Depth of Pit	1.50 m
Width of Pit	0.50 m
Length of Pit	2.00 m
Depth of Pit Soaked	0.95 m
ap50	3.375 m2
Vp75-25	0.475 m3
t75-25	0.0 min
water used	0.9500 m3
f	N/A m/sec.

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)	Head of Water (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 test period due to saturated ground near surface

SOILS LIMITED

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RIDGE

Property and Construction Consultants



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
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Partnership House
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Ground Condition Assessment

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

PARTNERSHIP HOUSE
MOORSIDE ROAD
WINCHESTER
HAMPSHIRE, SO23 7RX
Also at Reading, Bristol, London and Leicester

CLIENT
PORTSMOUTH CITY COUNCIL

SCALE
NTS @ A4

DATE
20.07.15

DRAWN BY
DAP

CHECKED BY
AP

FIGURE 2

REV

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No BH1
Job No 151238	Date 15-06-15 16-06-15	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 (Thickness)			DESCRIPTION
0.30	D1	40 blows				0.10	Soft brown slightly sandy CLAY with frequent rootlets		
0.30	ESA					(1.00)	Brown silty gravelly fine SAND. Gravel is of fine to medium angular flint		
0.50-0.70	B2					1.10			
1.10	D3					1.40	Soft to firm orange brown CLAY		
1.20-1.65	U4	N22			(1.40)	2.80	Firm brown gravelly CLAY. Gravel is of fine to medium angular flint		
1.65	D5								
2.00-2.45	D6								
2.00									
3.00-3.25	U7	35 blows					Firm to stiff grey brown CLAY		
3.40	D8								
4.00-4.45	D9	N15							
4.00									
5.00-5.45	U10	50 blows					Stiff grey CLAY		
5.45	D11								
6.00	D12	N19							
6.50-6.95	D13								
6.50									
7.50	D14		55 blows			(3.60)	Stiff grey CLAY		
8.00-8.30	U15								
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	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

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No BH2
Job No 151238	Date 16-06-15 16-06-15	Ground Level (m)	Co-Ordinates ()	
Contractor DJ DRILLING				Sheet 1 of 2

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Description (Thickness)		
						0.10	Soft brown silty CLAY with frequent rootlets	
0.30	D1					0.40	Soft to firm brown silty gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint and brick fragments	
0.50-0.70	B2						Firm to stiff brown silty slightly gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint	
1.20	D3	N18				(1.90)		
1.20								
2.20	D4	N5				2.30	Firm brown to grey silty CLAY	
2.20								
2.80	D5							
3.00-3.45	U6	45 blows						
3.45	D7							
4.00	D8	N14				(3.90)		
4.00								
5.00-5.45	U9	54 blows						
5.45	D10							
6.00	D11					6.20	Stiff grey CLAY	
6.50	D12	N19						
6.50								
7.50	D13							
8.00-8.30	U14	70 blows						
8.50	D15							
9.00	D16							
9.50	D17	N23				(6.50)		
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
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Report ID: AGS4 UK BH || Project: BLENDWORTH CRESCENT.GPJ || Library: GINT STD AGS 4 0.GLB || Date: August 27, 2015

RIDGE

Ridge & Partners LLP
Partnership House
Moorside Road

BOREHOLE LOG

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

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thickness)	STRATA	Geology	Instrument/Backfill
Depth	Type No	Test Result					DESCRIPTION		
10.50	D18						Stiff grey CLAY (continued)		
11.00-11.45	U19	75 blows							
11.45	D20								
12.00	D21								
12.50	D22				12.70		Grey silty clayey medium to coarse sub angular to rounded flint GRAVEL and COBBLES		
12.50		N50/110 mm			13.00				
12.60-13.00	B23								

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

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BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No BH3	
Job No 151238	Date 17-06-15 17-06-15	Ground Level (m)	Co-Ordinates ()		
Contractor DJ DRILLING				Sheet 1 of 2	

SAMPLES & TESTS			Water	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	B2					0.80			
1.00	D3					(0.80)	Grey brown clayey silty gravelly fine SAND		
1.20	B4					1.60			
1.20		N6							
2.00-2.20	U5	37 blows				(0.90)	Firm orange brown silty CLAY		
2.50	D6					2.50			
3.00		N11							
4.00-4.45	U8	45 blows				(3.50)	Firm to stiff brown to grey slightly silty CLAY		
4.45	D9								
5.00	D10					6.00			
5.00		N14							
6.00	D11						Stiff grey CLAY		
6.50-6.95	U12	50 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	B15					8.20			
8.00		N21					Stiff grey CLAY		
9.00	D16								
9.50-9.95	U17	65 blows							
9.95	D18								

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		

RIDGE

Ridge & Partners LLP
Partnership House
Moorside Road

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No BH3	
Job No 151238	Date 17-06-15 17-06-15	Ground Level (m)	Co-Ordinates ()		
Contractor DJ DRILLING				Sheet 2 of 2	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
10.50	D19	N28				(5.40)	Stiff grey CLAY (continued)		
11.00	D20								
11.00									
12.00	D21								
12.50-12.95	U22	70 blows							
12.95	D23								
13.50	D24	N21				13.60			
13.70						13.70	Grey wet clayey medium to coarse sub rounded to rounded flint GRAVEL		
						14.15	Grey slightly silty fine SAND		

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

BOREHOLE LOG

Project Blendworth 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

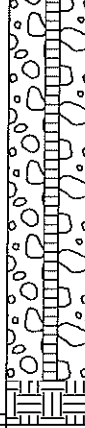
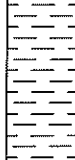
SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)		
0.30	D1	N7			0.10	Soft brown CLAY with frequent rootlets		
0.30-0.30	ESA				0.40	Light brown SAND and GRAVEL. Gravel is of fine to coarse sub angular flint		
0.50-0.70	B2				(0.70)	Brown silty gravelly fine SAND. Gravel is of fine to medium angular to sub angular flint		
1.20-1.65	D3	30 blows			1.10	Brown silty fine SAND		
1.20					(1.40)			
2.00-2.45	U4				2.50			
2.45	D5	N10				Firm brown grey silty CLAY		
3.00-3.45	D6				(2.30)			
3.00								
4.00-4.50	U7	46 blows						
4.45	D8				4.80			
5.00-5.45	D9							
5.00		N16				Firm to stiff grey CLAY		
6.00	D10							
6.50-6.90	U11				(3.90)			
6.90	D12	55 blows						
7.50	D13							
8.00-8.45	D14							
8.00		N25			8.70			
8.70-9.00	B15				(0.50)	Very stiff grey CLAY and claystone		
					9.20			
9.50-9.95	U16	66 blows				Stiff grey CLAY		
9.95	D17							

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: 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 BH4
Job No 151238	Date 17-06-15 18-06-15	Ground Level (m)	Co-Ordinates (°)	
Contractor DJ DRILLING				Sheet 2 of 2

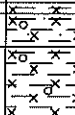
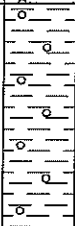
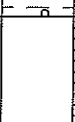
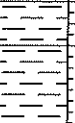
SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thickness)	STRATA	Geology	Instrument/ Backfill
Depth	Type No	Test Result					DESCRIPTION		
10.50	D18	N26				(5.10)	Stiff grey CLAY <i>(continued)</i>		
11.00-11.45	D19								
11.00									
12.00	D20								
12.50-12.85	U21	70 blows							
12.85	D22								
13.50	D23								
14.00-14.40	D24	N50/ 235 mm				14.30 14.40	Grey clayey medium to coarse sub rounded to roudned flint GRAVEL		
14.00									

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	

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BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No BH5
Job No 151238	Date 18-06-15 18-06-15	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)		
0.20	D1	N5			0.10	Soft brown silty CLAY with frequent rootlets		
0.30	ESA				0.40	Soft brown silty sandy gravelly CLAY. Gravel is of medium angular to sub angular flint		
0.50-0.70	B2				(0.70)	Soft to firm brown silty gravelly CLAY. Gravel is of fine to coarse sub angular flint		
1.20-1.65	D3	40 blows			1.10	Firm orange brown gravelly CLAY. Gravel is of medium sub angular flint		
1.20					(2.20)			
2.00-2.05	B4							
2.50-2.85	U5	N14			3.30	Firm brown grey CLAY		
2.85	D6							
3.00-3.45	D7							
3.00		44 blows			5.80	Stiff grey CLAY		
4.00-4.45	U8				(2.50)			
4.45	D9							
5.00-5.45	D10	N16			7.80	Very stiff grey CLAY and claystone		
5.00								
6.00	D11							
6.50-6.85	U12	50 blows			(2.00)	Stiff grey CLAY		
6.85	D13							
7.50	D14							
8.00-8.50	B15	N18			8.20	Very stiff grey CLAY and claystone		
8.00								
9.00	D16				(1.80)			
9.50-9.95	U17	80 blows			10.00	Stiff grey CLAY		
9.95	D18							

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	

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BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS1	
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	Reduced Level	Legend	Depth (Thickness)	STRATA	Geology	Instrument/Backfill
Depth	Type No	Test Result					DESCRIPTION		
0.10-0.30	ES1	N9				0.30	Light brown silty slightly clayey gravelly fine SAND with frequent rootlets. Gravel is of fine to coarse angular to sub rounded flint		
0.50-1.00	ES2					(0.80)	Clayey silty sandy fine to coarse angular to sub rounded flint GRAVEL. Locally very clayey or very sandy.		
1.00						1.10			
1.50-2.00	U3	N9					Firm to stiff light orange brown mottled light grey silty CLAY		
2.00						(2.35)			
2.50-3.00	U4								
3.00		N12				3.45			
4.00		N18				(1.55)	Firm to stiff grey brown slightly silty CLAY		
5.00		N22				5.00			

Boring Progress and Water Observations

Chiselling

Water Added

GENERAL REMARKS

Depth	Date	Time	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	GENERAL REMARKS

All dimensions in metres
Scale 1:65.625

Client PCC

Method/
Plant Used

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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							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	N11							
3.00		N12				(4.20)			
3.50-4.00	U4	N16							
4.00-5.00 4.00	B5								
5.00		N18				5.00			

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	GENERAL REMARKS

All dimensions in metres
Scale 1:65.625

Client PCC

Method/
Plant Used

Logged By

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS3
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			
0.10-0.20	ES1				x	0.20	Brown silty clayey fine SAND with frequent rootlets			
0.40-0.60	ES2					(0.60) 0.80	Firm light brown to grey silty slightly sandy gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint. 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				5.00				

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

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS4	
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 (Thickness)	DESCRIPTION		
0.30-0.60	ES1	N7				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	ES2						Firm to stiff orange brown mottled grey to dark brown grey slightly silty CLAY		
1.20-2.00	B3								
2.00		N10				(3.50)			
3.00		N13							
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	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 Blendworth Crescent				BOREHOLE No WS5	
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 (Thickness)	DESCRIPTION		
0.10-0.30	ES1	N7				0.25	Firm brown silty sandy CLAY with frequent rootlets		
0.50-0.70	ES2					(0.70)	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						0.95			
1.50-2.00	U3	N9				(3.05)	Firm to stiff Orange brown to grey CLAY Partial recovery 3-4m		
2.00-3.00	B4								
2.00									
3.00		N10				4.00			
4.00		N20							

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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	

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS6	
Job No 151238	Date 10-06-15 10-06-15	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 (Thickness)	DESCRIPTION		
0.10-0.30	ES1	N11			x	0.20	Brown silty slightly clayey fine SAND with frequent rootlets		
0.50-0.80	ES2				x	(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					x	0.85			
1.50-2.00	B3	N10			x	(2.15)	Firm light brown mottled grey silty CLAY. Locally pockets of fine to coarse angular to sub angular flint gravel. No recovery beyond 3m		
2.00-3.00	B4				x				
2.00					x				
3.00		N15			x	3.00			

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

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS7
Job No 151238	Date 10-06-15 10-06-15	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		
0.30-0.50	ES1	N4			0.10	Brown silty slightly clayey fine SAND with frequent rootlets			
0.70-0.90	ES2				0.50	Brown silty sandy gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint and brick fragments			
1.00					(0.65)	Firm brown to grey brown silty gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint			
1.50-2.00	B3	N10			1.15	Firm to stiff brown to grey slightly silty CLAY			
2.00					(2.85)				
3.00-4.00	B4				4.00				
3.00		N13							
4.00		N15							

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

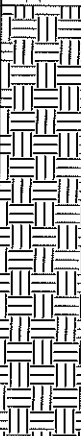
All dimensions in metres Scale 1:65.625	Client PCC	Method/ Plant Used	Logged By
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BOREHOLE LOG

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

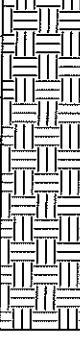
SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill	
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)			DESCRIPTION
0.20-0.40	ES1	N8				(0.50) 0.50	Brown silty slightly clayey slightly gravelly fine SAND with frequent rootlets		
0.60-0.80	ES2					0.95	Light brown silty slightly sandy gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint		
1.00-2.00 1.00	B3					(3.05) 4.00	Firm to stiff light brown to grey slightly silty CLAY.		
2.00	N12								
3.00	N16								
4.00	N15								

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

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BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS9	
Job No 151238	Date 10-06-15 10-06-15	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 (Thickness)	DESCRIPTION	
0.10-0.30	ES1	N29				0.35	Brown silty slightly gravelly fine SAND with frequent rootlets	
0.40-0.60	ES2					(0.55) 0.90	Firm light brown silty gravelly slightly cobbly CLAY. Gravel is of fine to coarse sub angular to sub rounded flint, brick and concrete.	
1.00						(1.10) 2.00	Firm to stiff brown silty gravelly CLAY. Gravel is of fine to coarse angular to sub angular flint	
2.00		N17				(1.00) 3.00	Firm to stiff brown grey slightly silty CLAY	
2.50-3.00	U3	N15						
3.00								

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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	

BOREHOLE LOG

Project Blendworth Crescent				BOREHOLE No WS10
Job No 151238	Date 10-06-15 10-06-15	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 (Thickness)		
0.30-0.50	ES1	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	ES2					(0.55) 1.15	Light brown to orange brown silty gravelly CLAY. Gravel is of fine to coarse angular to sub rounded flint.	
1.50-2.00	U3	N12			(2.85)		Firm to stiff brown to grey silty CLAY	
2.00-3.00 2.00	B4							
3.00-4.00 3.00	B5							
4.00		N25				4.00		

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		

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 ³ . Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required ⁵ .	

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.)

- 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.
- 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.
- The application of the simple index approach should follow the approach outlined in Section 26.7.1 (or equivalent approved).
- 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.
- 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-practise.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.