



**The Laurels
Dappers Lane
Angmering
West Sussex**

In Situ Infiltration Testing Report

Report Beneficiary:

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Angmering
West Sussex
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Document Control		
Report Ref	Date	Notes
R18-13291/st	1 st Nov 2018	Final for issue
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1. INTRODUCTION

It is understood that a surface water management strategy is to be implemented for a proposed new development at The Laurels, Dappers Lane, Angmering, West Sussex.

Ashdown Site Investigation Limited was requested to provide an estimate for carrying out in situ infiltration testing at the site by Andrew Carter, The Laurels, Dappers Lane, Angmering, West Sussex BN16 4EN. The scope of the works allowed for and the terms and conditions under which the works were to be undertaken were set out within the offer letter Q18-7718, dated 17th September 2018. The instruction was received from the client, Andrew Carter, in an email dated 9th October 2018.

The objectives of the works were to:

- a) Investigate the shallow ground and groundwater conditions prevailing at the site; and
- b) Undertake infiltration testing and provide calculated soil infiltration rates to assist others in undertaking design of infiltration systems.

The intrusive works were undertaken concurrently with a ground contamination risk assessment of the site which will be reported on under a separate cover.

2. SITE WORKS

The site works comprised the excavation of six dynamic sampler boreholes together with a single hand augered borehole and two hand dug trial pits. In situ infiltration testing was carried out with borehole WS01, WS05 and trial pits TP01 and TP02. The fieldwork was carried out on 17th October 2018. The exploratory hole locations are shown on Figure 1.

A groundwater monitoring standpipe was installed within one of the boreholes together with a datalogger for continuous monitoring of the groundwater levels over the winter period. The results of the groundwater monitoring will be issued on completion of the 6 month monitoring period.

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records that are appended to this report. Notes to assist interpretation of the records are also appended.

3. GROUND CONDITIONS

3.1 Stratigraphy

3.1.1 Surface Covering

In general, each of the exploratory holes was excavated through a surface cover of topsoil some 50mm to 400mm in thickness. The topsoil was recorded to contain gravel of brick, flint, charcoal-like material, concrete, asphalt and glass in variable quantities.

A layer of concrete some 150mm thick was encountered at borehole WS04.

3.1.2 Made Ground

Made ground, generally comprising gravelly clay, was encountered to a depth of 0.20m and 0.65m in exploratory holes WS04 and TP02, respectively and to the full depth of borehole HA1 of 0.25m. The gravel fraction comprised variable quantities of flint, brick, concrete, plastic, asphalt, chalk, nylon string, glass, clinker-like material and charcoal-like material.

3.1.3 Head

Beneath the surfacing/made ground, the investigation encountered slightly gravelly clay soils persisting to the full depths of the trial pits, and to depths of between 0.70m and 1.20m below ground level in the boreholes. Below the clay, the boreholes progressed into clayey gravels to a proven depth of 3.50m in borehole WS04, where the deposits graded into gravelly clay to the full depth of the investigation at 5.00m below ground level.

These deposits are considered to be representative of the Head deposits indicated to underlie the site on the published geological datasets.

3.2 Stability

Each of the exploratory holes was recorded to remain stable on completion of excavation/drilling.

3.3 Groundwater Conditions

Each of the exploratory holes that were terminated at a depth of 3.00m or less were recorded as being dry on completion of excavation/ drilling.

Groundwater was encountered at a depth of 3.50m in borehole WS04, rising to 3.00m on completion of drilling and installation of a standpipe to a depth of 5.00m below ground level. Groundwater monitoring is programmed to be undertaken over the coming winter period.

4. STORMWATER INFILTRATION SYSTEMS

In-situ infiltration testing¹ was carried out in both trial pits. For each test undertaken in TP01 the soil infiltration rate (f) was calculated by dividing the volume of water lost between 75% and 25% of the initial test depth by the sum of the average surface area of the sides of the trial pit in contact with the water during the test monitoring period, and its base area. This figure was then divided by the test duration (time taken for the water level to fall between 75% and 25% of the initial test depth) to give the soil infiltration rate in metres per second.

During the test performed within trial pit TP02, the water level within the test pit did not fall below 25% of the initial test depth and calculation of the soil infiltration rate in accordance with the BRE digest was not possible. For this test, the soil infiltration rate has therefore been calculated by dividing the volume of water lost during the test by the product of the average surface area of the trial pit in contact with water during the test period and the test duration in seconds.

In-situ infiltration testing² was also undertaken in boreholes WS01 and WS05. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

The infiltration rates derived from the tests are summarised in the following table.

Table 1. Calculated Infiltration Rates

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Calculated Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
TP01 Test 1	0.57	1.00	Head (slightly gravelly clay over gravelly clay)	1.1×10^{-4}	-
TP01 Test 2	0.55	1.00	Head (slightly gravelly clay over gravelly clay)	1.3×10^{-4}	-
TP01 Test 3	0.57	1.00	Head (slightly gravelly clay over gravelly clay)	2.6×10^{-5}	-
TP02 Test 1	0.70	1.00	Head (slightly gravelly clay)	4.2×10^{-6}	-
WS01 Tests 1, 2 & 3	2.00	3.00	Head (clayey gravel)	2.9×10^{-3}	1.0
WS05 Tests 1, 2 & 3	1.00	2.00	Head (clayey gravel)	2.5×10^{-3}	1.0

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests undertaken at the site indicate that the Head deposits possess moderate to good infiltration characteristics with the higher infiltration rates being recorded in the coarser grained soils encountered at depth. The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system.

¹ Conducted in general accordance with the requirements of BRE 365, Soakaway Design.

² Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.

To comply with building regulations³, point discharging infiltration systems (conventional ring or trench soakaways) are required to be constructed a minimum of 5.0m away from proposed or existing buildings.

Groundwater monitoring over the winter period is currently underway, as requested by the Local Authority and as suggested by the BRE365 guidance (prior to designing the proposed infiltration systems). The results of the monitoring will follow under separate cover.

Given that discharge to ground via infiltration systems is proposed, it is recommended that designers of the system provide for the prevention of pollution of groundwater. In this regard due consideration should be given to guidance provided within BRE 365 and by the Environment Agency.

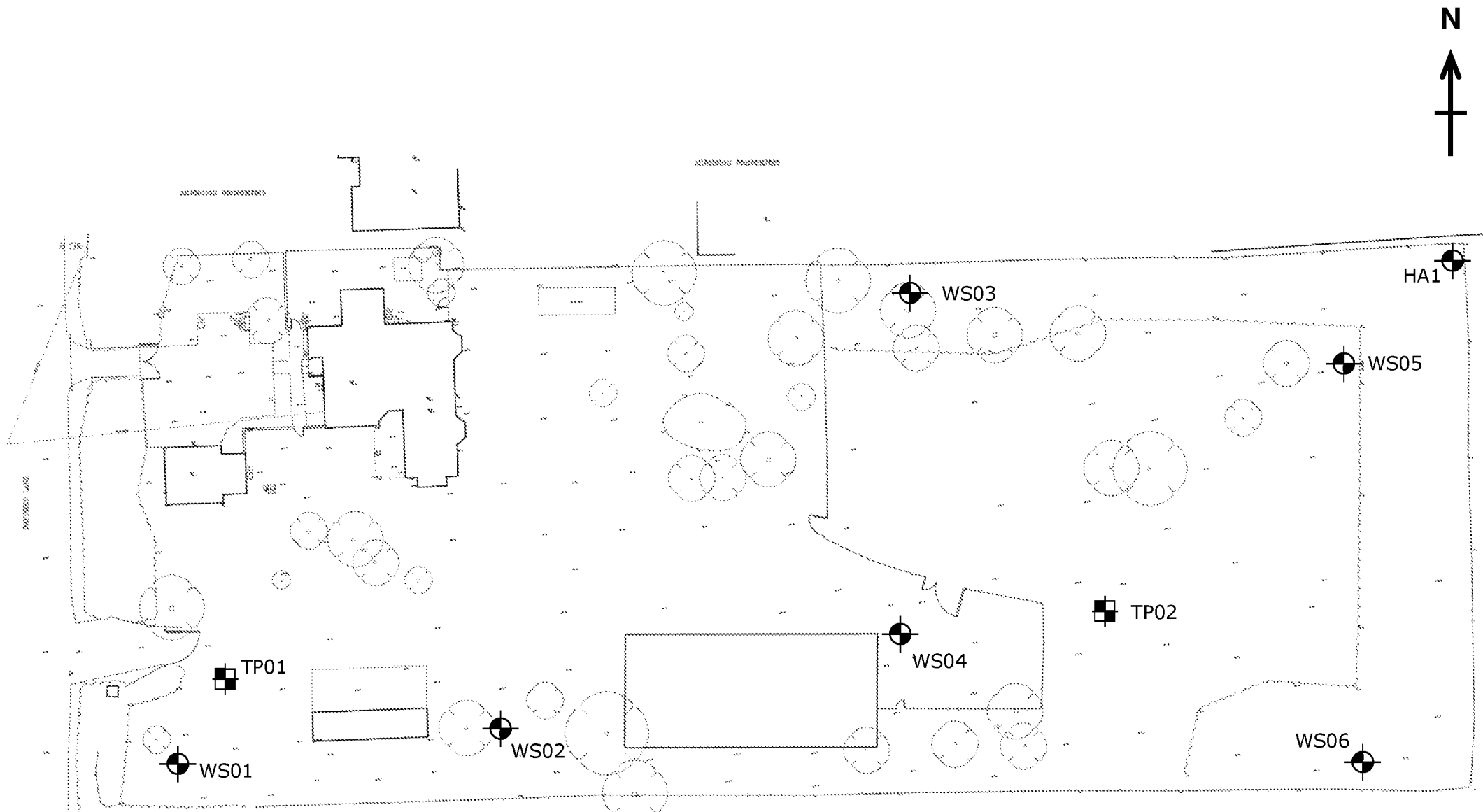
Appropriate consideration should also be given to whether there is a need for inclusion of interceptors and oil separators. The Local Authority and/or relevant water company should be consulted in relation to consent for discharge of water from rooftops, areas of hardstanding and roadways to drains.

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³ The Building Regulations 2010; Part H; Drainage and Waste Disposal
The Laurels, Dappers Lane, Angmering, West Sussex

APPENDICES AND FIGURES

Figure 1 Site Plan
Exploratory Hole Notes
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NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U	'Undisturbed' Sample: - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
Uo	Sample not obtained.
U*	Full penetration of sample not obtained.
Pi	Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D	Disturbed Sample.
R	Root Sample.
B	Bulk Disturbed Sample.
W	Water Sample.
J	Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T	Tub Sample
Vi	Vial Sample

In situ Testing

S	Standard penetration test (SPT): Using the split spoon sampler.
C	Standard Penetration Test (SPT): using a solid cone instead of the sampler - conducted usually in coarse grained soils or weak rocks.
V	Shear Vane Test: Undrained shear strength (cohesion) (kN/m ²) shown within the Vane/Pen Test and N Value column.
H	Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m ²) shown within the Vane/Pen Test and N Value column.
P	Perth Penetrometer Test: Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column.

Excavation Method

CP	Cable Percussion Borehole
WLS	Dynamic Sampler Borehole using windowless sampler tubes
WS	Dynamic Sampler Borehole using window sampler tubes
TP	Trial Pit excavated using mechanic excavator
HDP	Trial Pit excavated using hand tools

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002+A1:2013) and Part 2 Principles of classification (BS EN 14688-2:2004+A1:2013) as well as the BS5930:2015 code of Practice for Ground Investigations.

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1:2003) as well as the BS5930:2015 code of Practice for Ground Investigations.

4 Chalk Description

Chalk description is based on BS EN ISO 14688, BS EN ISO 14689 and BS5930. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk. See additional chalk classification notes.

End Date: 17/10/2018

HA1

Sheet 1 of 1

Remarks Groundwater: Borehole dry on completion. Stability: Borehole stable on completion. Notes: n/a	Excavation Method: HA
	Borehole Diameter: Various
	Made By: PM



Site Name: The Laurels, Dappers Lane, Angmering, West Sussex

Job Number: R18-13291

Start Date: 17/10/2018

End Date: 17/10/2018

Trial Pit Number: **TP01**

Sheet 1 of 1

Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth/ Reduced Level	Stratum Description
J T	0.10				0.00	Topsoil with gravel of concrete and asphalt.
J T	0.25				0.15	Orange brown slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint and occasional chalk. (Head)
D	0.28				0.30	
J T	0.60					Orange brown slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. (Head)
D	0.70					
D	0.90				0.80	Orange very gravelly CLAY. Gravel is angular to subangular fine to coarse flint. (Head)
					1.00	
						End of trial pit at 1.00m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: 1.00m

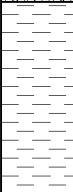
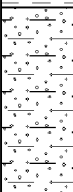
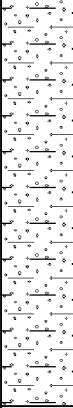
Pit Width: 0.30m

Made By: PM

End Date: 17/10/2018

Sheet 1 of 1

Remarks Groundwater: Trial pit dry on completion. Stability: Trial pit stable on completion. Notes: n/a	Excavation Method: HDP
	Pit Length: 1.00m
	Pit Width: 0.30m
	Made By: PM

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
	J T	0.15				0.00	Topsoil with occasional charcoal-like material, flint and roots.
	J T	0.60				0.40	Orange brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium flint. (Head)
	D	0.80				1.05	Brown orange clayey angular to subangular fine to coarse GRAVEL of flint. (Head)
	D	1.50					
	D	2.50				3.00	End of borehole at 3.00m

Site Name: The Laurels, Dappers Lane, Angmering, West Sussex

Job Number: R18-13291

Start Date: 17/10/2018

End Date: 17/10/2018

Borehole Number: **WS02**

Sheet 1 of 1

Samples and In Situ Testing		Legend		Depth		Stratum Description	
Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
	J T	0.10			0.00	Topsoil with gravel of flint, occasional brick and glass.	
	J T	0.30			0.15	Orange brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium flint. (Head)	
	D	0.50					
	J T	0.90			0.70	Orange brown clayey angular to subangular fine to coarse GRAVEL of flint. (Head)	
	D	1.50					
	D	2.60					
					3.00	End of borehole at 3.00m	

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: PM

Site Name: The Laurels, Dappers Lane, Angmering, West Sussex

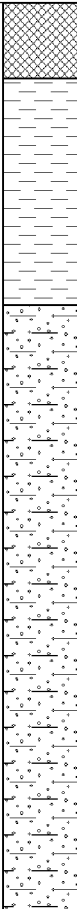
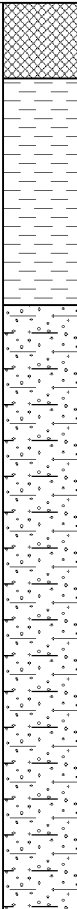
Job Number: R18-13291

Start Date: 17/10/2018

End Date: 17/10/2018

Borehole Number: **WS03**

Sheet 1 of 1

Sample/ Test Type		Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
	J T	0.10				0.00	Topsoil with gravel of brick, charcoal-like material and flint.
	J T D	0.50				0.25	Orange brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium flint. (Head)
		0.55					
	J T D	1.50				1.00	Brown orange clayey angular to subangular fine to coarse GRAVEL of flint. (Head)
	D	1.60					
		2.60					becoming very clayey between 2.80m and 3.00m depth.
						3.00	End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: PM

Site Name: The Laurels, Dappers Lane, Angmering, West Sussex

Job Number: R18-13291

Start Date: 17/10/2018

End Date: 17/10/2018

Borehole Number: **WS04**

Sheet 1 of 1

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
	J T	0.18				0.00	Concrete.
	J T	0.70				0.15	MADE GROUND: Dark brown slightly gravelly clay. Gravel is angular to subrounded fine to medium flint, roots and occasional brick. Orange brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium flint. (Head)
	D	0.80				0.20	
						1.20	Brown orange clayey angular to subangular fine to coarse GRAVEL of flint. (Head)
	J T	1.70					
	D	1.80					
	J T	2.70					
	D	3.10					
	J T	3.70				3.50	Orange very gravelly CLAY. Gravel is angular to subangular fine to coarse flint. (Head)
	D	4.10					
	J T	4.50				4.60	
	D	4.80					Orange brown slightly gravelly CLAY. Gravel is angular to subangular fine siltstone and ironstone. (Head)
						5.00	End of borehole at 5.00m

Remarks

Groundwater: Groundwater encountered at 3.50m depth.
Standing water at 3.00m depth on completion of borehole.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 5.00m depth; 5.00m to 2.00m slotted pipe with gravel surround; 2.00m to ground level plain pipe with bentonite seal; completed with end cap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: PM

Site Name: The Laurels, Dappers Lane, Angmering, West Sussex

Job Number: R18-13291

Start Date: 17/10/2018

End Date: 17/10/2018

Borehole Number: **WS05**

Sheet 1 of 1

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
	J T	0.20				0.00	Topsoil with gravel of brick, flint and glass.
	J T	0.40				0.30	Orange slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. (Head)
	D	0.50					
						0.70	Brown orange clayey angular to subangular fine to coarse GRAVEL of flint. (Head)
	D	1.50					
	J T	1.80					
							
	D	2.50					
							
							
							
							
							
							
							
							
							
							



Site Name: The Laurels, Dappers Lane, Angmering, West Sussex

Job Number: R18-13291

Start Date: 17/10/2018

End Date: 17/10/2018

Borehole Number: WS06

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Sample/ Test Type		Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
JT D	JT	0.05				0.00	Topsoil.
						0.10	Brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium flint. (Head)
		0.50 0.60				0.90	Brown orange clayey angular to subangular fine to coarse GRAVEL of flint. (Head)
JT D		1.10 1.20				1.30	End of borehole at 1.30m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: No further progress below 1.30m depth - too dense.

Excavation Method: WLS

Borehole Diameter: Various

Made By: PM

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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS01 (Test 1)	
Time (secs)	Depth to water (m bgl)
0	*
30	Dry
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS01 (Test 2)	
Time (secs)	Depth to water (m bgl)
0	*
30	Dry
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS01 (Test 3)	
Time (secs)	Depth to water (m bgl)
0	*
30	Dry
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.

*25 litres of water introduced. Water level for calculations assumed to be at 0.00m.

ASHDOWN SITE INVESTIGATION LIMITED

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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS05 (Fill 1)	
Time (secs)	Depth to water (m bgl)
0	*
25	Dry
Borehole Depth (m bgl)	2.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS05 (Fill 2)	
Time (secs)	Depth to water (m bgl)
0	*
25	Dry
Borehole Depth (m bgl)	2.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS05 (Fill 3)	
Time (secs)	Depth to water (m bgl)
0	*
25	Dry
Borehole Depth (m bgl)	2.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.

*25 litres of water introduced. Water level for calculations assumed to be at 0.00m.

ASHDOWN SITE INVESTIGATION LIMITED

Site: The Laurels, Dappers Lane, Angmering, West Sussex	Report No.: R18-13291
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SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP01 (Test 1)		TP01 (Test 2)		TP01 (Test 3)	
Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)
0	0.57	0	0.55	0	0.57
1	0.59	1	0.56	1	0.60
3	0.64	3	0.59	2	0.61
7	0.72	8	0.67	5	0.62
11	0.80	19	0.92	8	0.65
19	0.95	25	Dry	17	0.73
24	Dry			28	0.78
				51	0.87
				98	Dry
Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 1.00m bgl		Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 1.00m bgl		Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 1.00m bgl	

Remarks: bgl - below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: The Laurels, Dappers Lane, Angmering, West Sussex	Report No.: R18-13291
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SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP02 (Test 1)	
Time (mins)	Depth to water (m bgl)
0	0.70
1	0.74
2	0.75
4	0.76
15	0.78
43	0.80
80	0.82
125	0.84
146	0.84
200	0.85
Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 1.00m bgl	

Remarks: bgl - below ground level.