



Intrusive Site Investigation Report

LOCATION	Proposed Pitch, University of Reading, RG2 7BW
ISSUE DATE	25 th March 2019
FOR	Sports Labs Ltd.
CLIENT REF.	PO-11747
OUR REF.	G19090

Prepared by



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1. Introduction

In accordance with your instruction Geoinvestigate Ltd. carried out a site investigation at the above site on 5 March 2019.

2. Scope of Investigation

Five (5) windowless sampling boreholes were sunk using a Dando Terrier mini drilling rig to depths of between 1.40m and 1.60m (ref. BH1-BH5).

Information on the ground conditions revealed by the investigation is presented on the borehole logs which are included in Appendix 1 of this report. The results of hand vane shear strength tests which were carried out in cohesive natural soils (where present) are shown on the logs as well as the results of Standard Penetration Test (SPTs) undertaken at a depth of 1.00m in each borehole.

California bearing ratio (CBR) testing was carried out in surface deposits at each borehole location using a handheld Mexeprobe to give indicative information regarding the competency of the near-surface soils for subbase/capping design. The results of these tests are presented on the borehole logs.

Water infiltration testing was carried out in BH3 according to the BS 5930 “Falling head tests in boreholes” method. Results are presented in Appendix 2 together with the calculation of the infiltration rate for these soils (test zone between 1.00m and 1.40m below ground level). Note that relatively shallow (perched) groundwater was encountered in some of the boreholes which may affect the functionality of any proposed soakaway features; the London Clay Formation is expected to be present at depth below the sands and gravels of the Boyn Hill Gravel Member which were encountered by the boreholes.

Results of Atterberg limits tests and moisture determinations are presented in Appendix 2 (Table 1) together with moisture and shear strength profiles of the boreholes. Results of water soluble sulphate and pH tests are presented in Appendix 3.

Minor roots were recorded to a depth of 1.00 in BH3.

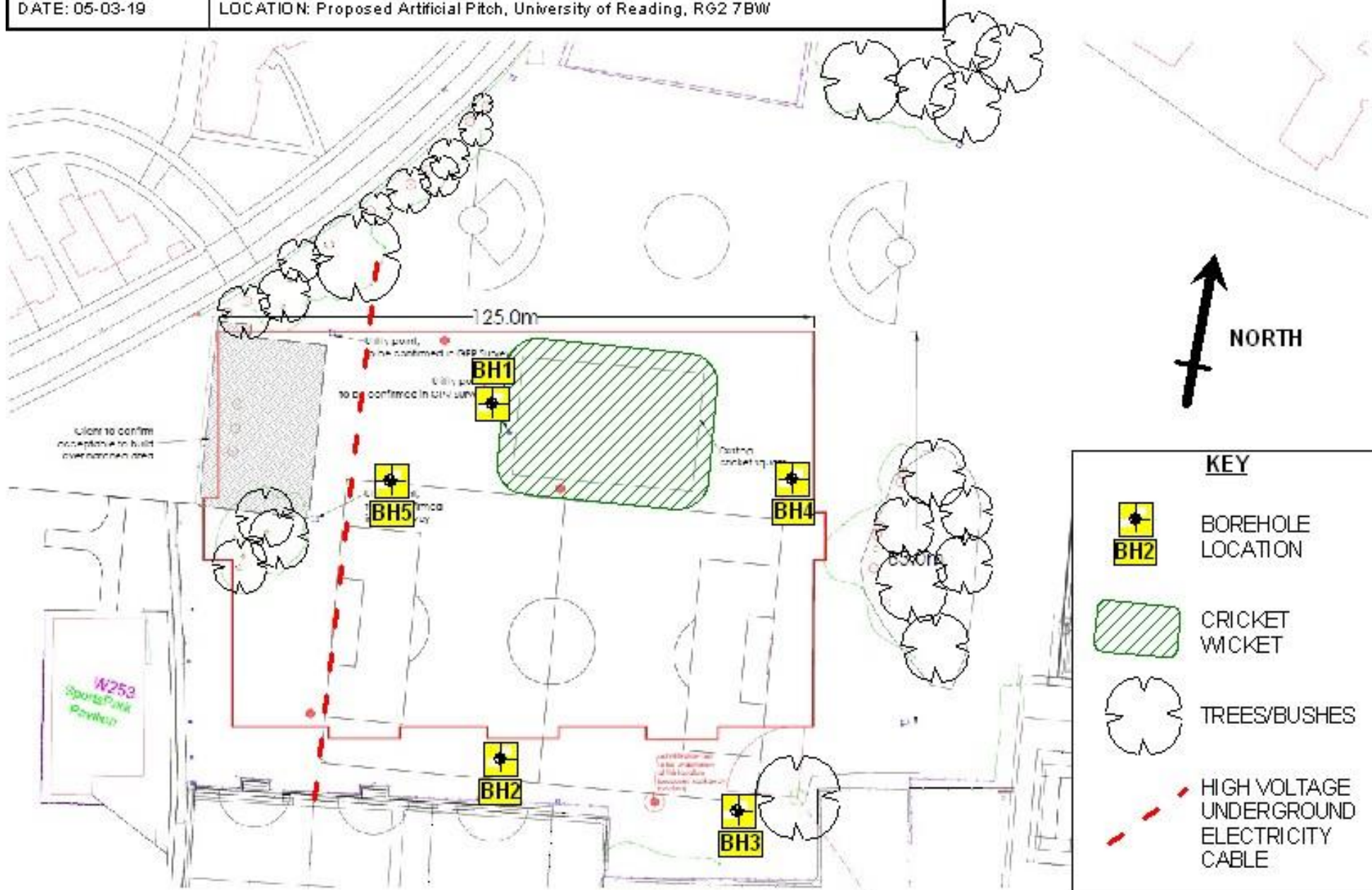
We trust that you will find the results of this investigation satisfactory and we would be pleased to provide any further assistance you may require with this matter.

END OF REPORT



APPENDIX 1
Site Plan
and
Borehole Logs

OUR REF: G19090	YOUR REF: PO 11474	SITE PLAN (NOT TO SCALE)
DATE: 05-03-19	LOCATION: Proposed Artificial Pitch, University of Reading, RG2 7BW	



GEOINVESTIGATE Ltd.

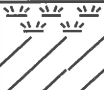
Your Ref. PO 11474

Our Ref. G19090

BH No.1 Sheet No. 1 of 1

Location: Proposed Artificial Pitch, University of Reading, RG2 7BW

DATE: 05/03/19

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF and TOPSOIL. Loose brown slightly clayey gravelly sand. Gravel is fine to coarse of flint, brick and coal. Becoming very gravelly below 0.20m	300					Cv kN/m ² 1.00m-1.45m 8,10,13, 15,15,17 N = 60	SWL at 0.95m	0.25
0.80	"Medium dense" pale brown very clayey sandy GRAVEL. Gravel is fine to coarse of flint with occasional cobbles.	500			O				0.50
1.00	"Dense" orangish brown very sandy GRAVEL. Gravel is fine to coarse of flint.	200			O S				0.75
1.50	Very dense pale brown gravelly SAND. Gravel is fine to coarse of flint. Sand is medium to coarse. Wet.	500			O				1.00
									1.25
									1.50

Borehole Terminated at 1.50m due to refusal

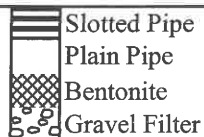
Mexeprobe CBR test results following removal of turf:

Depth (m)	1 st Test (%)	2 nd Test (%)	3 rd Test (%)
0.050	2.0	2.0	2.0
0.125	4.0	2.5	2.5
0.200	8.0	Refusal	Refusal
0.275	8.0		
0.350	Refusal		

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.50m
Borehole closed below 1.30m on completion
Standing water level at 0.95m on completion

Key:



O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test (with solid cone)

BH1

GEOINVESTIGATE Ltd.

Your Ref. PO 11474

Our Ref. G19090

BH No.2 Sheet No. 1 of 1

Location: Proposed Artificial Pitch, University of Reading, RG2 7BW

DATE: 05/03/19

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well			Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)																				
0.40	TURF and TOPSOIL. Loose brown slightly clayey gravelly sand. Gravel is fine to coarse of flint. Becoming very gravelly below 0.20m	400						Cv kN/m ²			0.25																				
1.20	Medium dense pale brown very clayey sandy GRAVEL. Gravel is fine to coarse of flint with occasional cobbles.	800					O		1.00m-1.45m 4,4,9,10,15,15 N = 49		0.50																				
							O S	0.75																							
								1.00																							
								1.25																							
1.40	Dense orangish brown very sandy GRAVEL. Gravel is fine to coarse of flint.	200					O				1.40																				
Borehole Terminated at 1.40m due to refusal																															
Mexeprobe CBR test results following removal of turf:																															
<table><tr><th>Depth (m)</th><th>1st Test (%)</th><th>2nd Test (%)</th><th>3rd Test (%)</th></tr><tr><td>0.050</td><td>3.0</td><td>2.5</td><td>4.0</td></tr><tr><td>0.125</td><td>6.0</td><td>4.0</td><td>8.0</td></tr><tr><td>0.200</td><td>Refusal</td><td>8.0</td><td>Refusal</td></tr><tr><td>0.275</td><td></td><td>Refusal</td><td></td></tr></table>												Depth (m)	1 st Test (%)	2nd Test (%)	3rd Test (%)	0.050	3.0	2.5	4.0	0.125	6.0	4.0	8.0	0.200	Refusal	8.0	Refusal	0.275		Refusal	
Depth (m)	1 st Test (%)	2nd Test (%)	3rd Test (%)																												
0.050	3.0	2.5	4.0																												
0.125	6.0	4.0	8.0																												
0.200	Refusal	8.0	Refusal																												
0.275		Refusal																													

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.40m
Borehole remained open and dry on completion

Key:

	Slotted Pipe
	Plain Pipe
	Bentonite
	Gravel Filter

	Disturbed sample
	Cv Shear vane
	W Water sample
	S Standard Penetration Test (with solid cone)

BH2

GEOINVESTIGATE Ltd.

Your Ref. PO 11474

Our Ref. G19090

BH No.3 Sheet No. 1 of 1

Location: Proposed Artificial Pitch, University of Reading, RG2 7BW

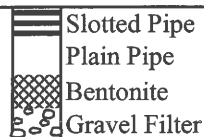
DATE: 05/03/19

Depth (m)	Description of Strata	Thickness	Legend	Gas Well			Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)												
0.40	TURF and TOPSOIL. Loose brown slightly clayey gravelly sand. Gravel is fine to coarse of flint. Becoming very gravelly below 0.10m and clayey below 0.25m	400						Cv kN/m ²			0.25												
1.00	Soft to firm pale brown mottled grey very sandy gravelly CLAY. Gravel is fine to coarse of flint.	600					O	17	1.00m-1.45m 4,7,9,10,10,14 N = 43		0.50												
							O S	20		0.75													
										1.00													
1.30	Dense pale orangish brown very clayey gravelly SAND. Gravel is fine to coarse of flint. Sand is medium. Wet.	300					O			1.25													
1.60	Dense orangish brown sandy GRAVEL. Gravel is fine to coarse of flint. Wet.	300					O				1.50												
Borehole Terminated at 1.60m due to refusal Mexeprobe CBR test results following removal of turf: <table><tr><th>Depth (m)</th><th>1st Test (%)</th><th>2nd Test (%)</th><th>3rd Test (%)</th></tr><tr><td>0.050</td><td>2.0</td><td>2.0</td><td>2.0</td></tr><tr><td>0.075</td><td>Refusal</td><td>Refusal</td><td>Refusal</td></tr></table> Minor roots to 1.00m Water infiltration test carried out in borehole following drilling with 1.0m casing left in situ. Borehole collapsed below 1.40m on filling with water See Infiltration Test 1 results for details.												Depth (m)	1 st Test (%)	2nd Test (%)	3rd Test (%)	0.050	2.0	2.0	2.0	0.075	Refusal	Refusal	Refusal
Depth (m)	1 st Test (%)	2nd Test (%)	3rd Test (%)																				
0.050	2.0	2.0	2.0																				
0.075	Refusal	Refusal	Refusal																				

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.60m
Borehole remained open on completion
Some water at base of borehole on completion

Key:



O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test (with solid cone)

BH3

GEOINVESTIGATE Ltd.

Your Ref. PO 11474

Our Ref. G19090

BH No.4 Sheet No. 1 of 1

Location: Proposed Artificial Pitch, University of Reading, RG2 7BW

DATE: 05/03/19

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF and TOPSOIL. Loose brown slightly clayey gravelly sand. Gravel is fine to coarse of flint. Becoming very gravelly below 0.10m	300				Cv kN/m ²			0.25
0.60	Loose pale orangish brown fine SAND. Occasional fine to coarse gravel of flint. Moist.	300			O				0.50
0.90	Soft to firm pale brown mottled grey very sandy gravelly CLAY. Gravel is fine to coarse of flint.	300				24			0.75
1.50	Medium dense orangish brown very sandy slightly clayey GRAVEL. Gravel is fine to coarse of flint. Slightly Moist.	600			O S		1.00m-1.45m 3,4,5,7,7,9 N = 28		1.00
								SWL at 1.47m	1.25
					O				1.50

Borehole Terminated at 1.50m due to refusal

Mexeprobe CBR test results following removal of turf:

Depth (m)	1 st Test (%)	2 nd Test (%)	3 rd Test (%)
0.050	1.5	1.5	1.5
0.075	Refusal	Refusal	Refusal

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.50m
Borehole remained open on completion
Standing water level at 1.47m on completion

Key:

	Slotted Pipe
	Plain Pipe
	Bentonite
	Gravel Filter

	Disturbed sample
	Shear vane
	Water sample
	Standard Penetration Test (with solid cone)

BH4

GEOINVESTIGATE Ltd.

Your Ref. PO 11474

Our Ref. G19090

BH No.5 Sheet No. 1 of 1

Location: Proposed Artificial Pitch, University of Reading, RG2 7BW

DATE: 05/03/19

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF and TOPSOIL. Loose brown slightly clayey gravelly sand. Gravel is fine to coarse of flint.	100				Cv kN/m ²			
									0.25
	Loose pale brown silty gravelly SAND. Gravel is fine to coarse of flint.	500			O				0.50
0.60									
	Soft pale brown very sandy CLAY. Occasional fine to coarse gravel of flint.	150					1.00m-1.45m 7,10,14, 16,18,22 N = 70		0.75
0.85									
	Dense pale brown sandy GRAVEL. Gravel is fine to coarse of flint. Wet. Becoming very dense below 1.20m. Slightly clayey sand band at 1.00m.	550			O S			SWL at 1.20m	1.00
									1.25
1.40					O				1.40

Borehole Terminated at 1.40m due to refusal

Mexeprobe CBR test results from surface:

Depth (m)	1 st Test (%)	2nd Test (%)	3rd Test (%)
0.00	1.5	2.5	2.5
0.075	2.5	4.0	4.5
0.150	4.0	4.5	9.0
0.225	Refusal	8.0	8.0
0.300		6.0	8.0
0.375		6.0	Refusal
0.450		6.0	
0.525		6.0	

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.40m
Borehole remained open on completion
Standing water level at 1.20m on completion

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

Disturbed sample
 Cv Shear vane
 W Water sample
 S Standard Penetration Test (with solid cone)

BH5

APPENDIX 2

Moisture Determination and Atterberg Limits Test Results (Table 1), Moisture / Shear Strength Profiles and Water Infiltration Test Results

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G19090

Table 1

Your ref. PO 11474

Location: Proposed Artificial Pitch, University of Reading, RG2 7BW

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification
1	0.50	13.6	46.0	29.6	17.5	31.4	13.9	CL
	1.00	7.7						
	1.50	11.3						
2	0.40	9.7						
	1.00	5.8						
	1.40	10.1						
3	0.50	17.9	82.8	25.8	*	*	*	*
	1.00	21.4						
	1.25	14.1						
	1.60	5.9						
4	0.50	16.2	29.9	33.7	18.0	36.5	18.5	CI
	1.00	10.1						
	1.50	13.5						
5	0.50	13.1						
	1.00	14.4						
	1.40	12.3						

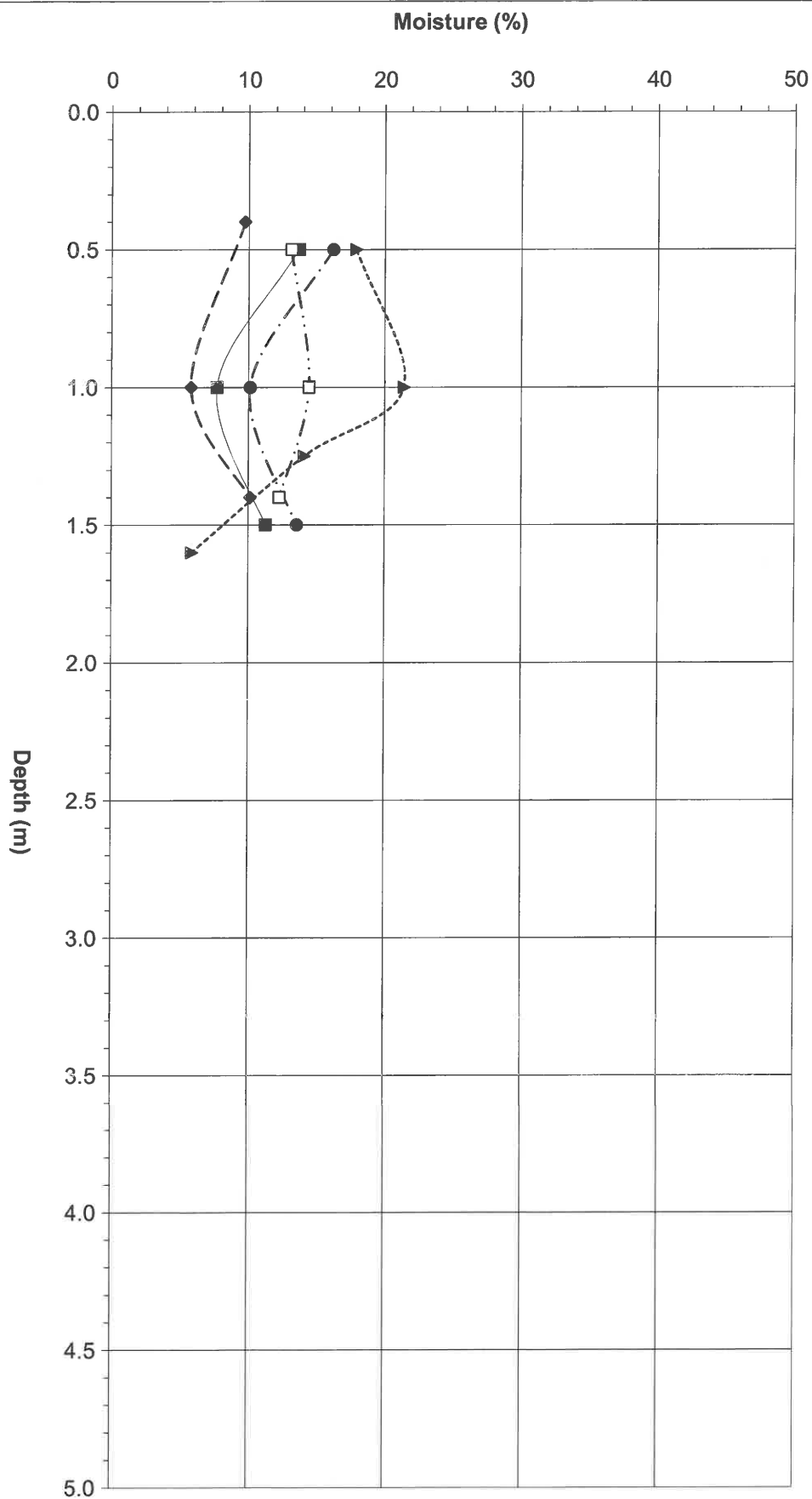
* Essentially non-plastic material

CL = Clay of Low Plasticity according to BS 5930

CI = Clay of Intermediate Plasticity according to BS 5930

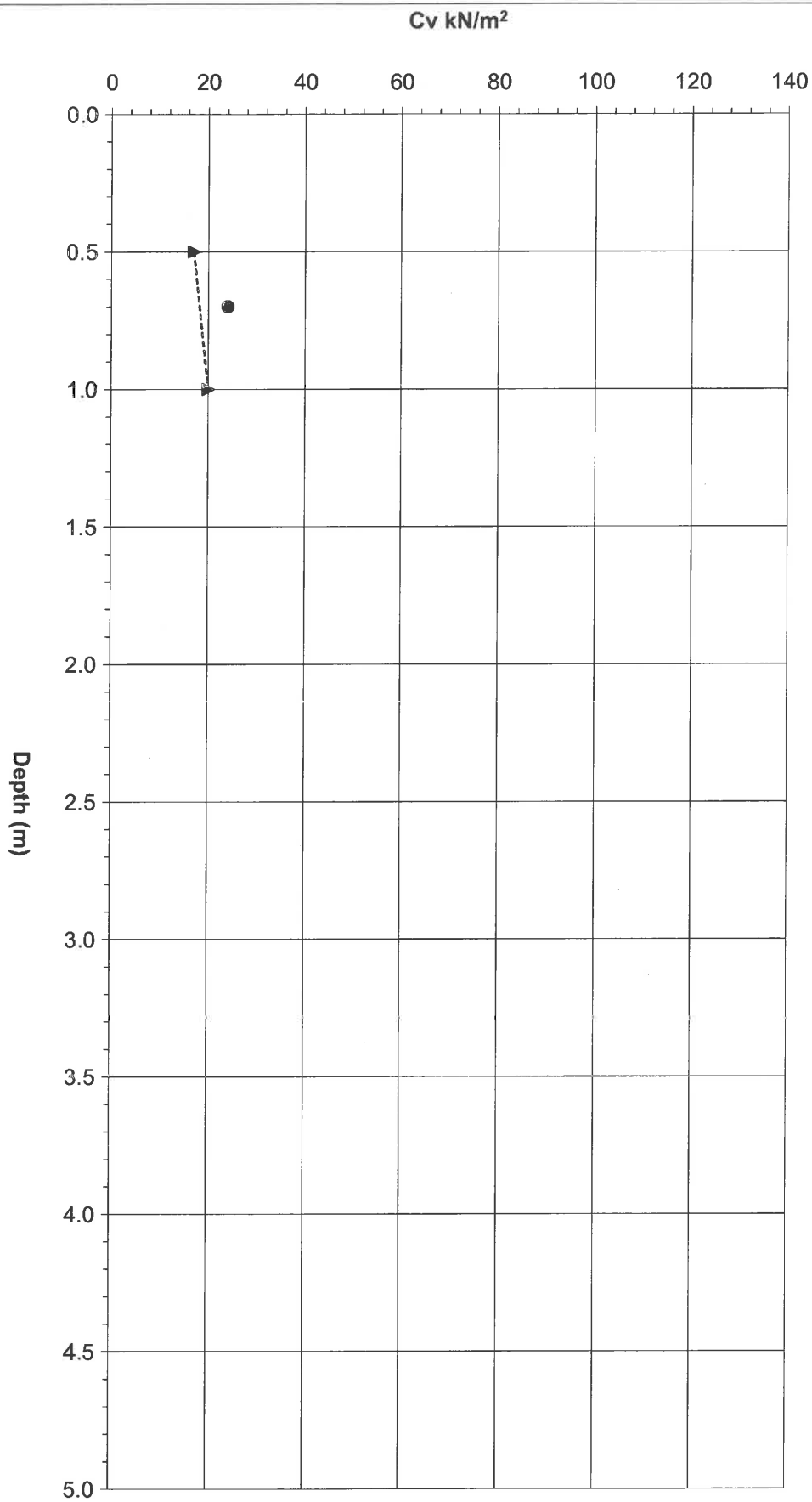
Moisture / depth profile

G19090



Shear strength / depth profile

G19090



Infiltration Test Result

G19090

Proposed Pitch, University of Reading,
Reading, RG2 7BW

05/03/19

Infiltration test 1

(BH3)

Time/s	Depth to water/m	Head/m (above base of borehole)
0	0.000	1.400
30	0.008	1.392
60	0.013	1.387
90	0.017	1.383
120	0.020	1.380
240	0.042	1.358
300	0.051	1.349
600	0.097	1.303
900	0.144	1.256
1200	0.175	1.225
1800	0.235	1.165
2700	0.310	1.090
3600	0.370	1.030

Borehole dimensions:

Depth of Casing, D = 1.00 m

Diameter of Casing, D = 0.125 m

Cross-sectional area, A = 0.012277 m²

Depth below Casing, L = 0.40 m

Ground Water Level = N/A m

Intake factor, F, using:

$$F = \frac{2\pi L}{\log_e [(L/D) + \sqrt{1 + (L/D)^2}]}$$

Source: BS 5930

Intake factor, F = 1.337 m

Choose start time t_1 to be: $t_1 = 0$ s

Choose end time t_2 to be: $t_2 = 3600$ s

Head at time t_1 , $H_1 = 1.400$ m

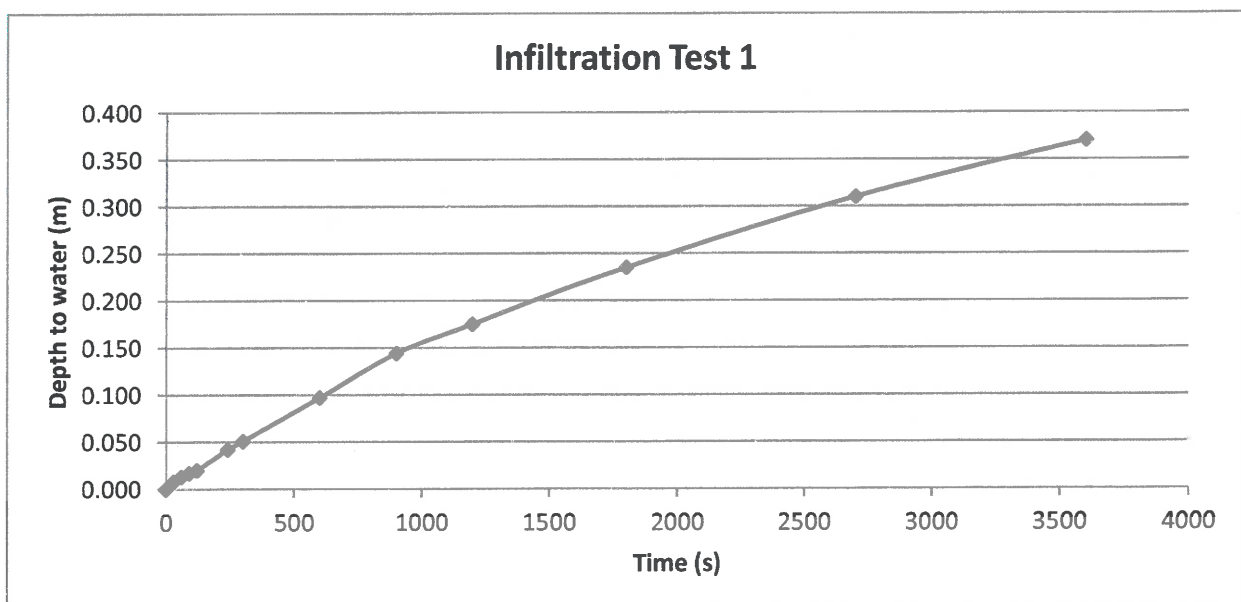
Head at time t_2 , $H_2 = 1.030$ m

Permeability, k, using:

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2} \text{ (general approach)}$$

Source: BS 5930

Permeability, k = 7.83E-07 ms⁻¹



APPENDIX 3

Water Soluble Sulphate and pH Test Results



ANALYTICAL TEST REPORT

Contract no: 77367

Contract name: Proposed Artificial Pitch - Reading University, RG2 7BW

Client reference: G19090

Clients name: Geo Investigate

Clients address: Units 3a & 4 Terry Dicken Industrial Estate
Ellerbeck Way, Stokesley
North Yorkshire
TS9 7AE

Samples received: 12 March 2019

Analysis started: 12 March 2019

Analysis completed: 18 March 2019

Report issued: 19 March 2019

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by:

K Campbell

Karan Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
77367-1	BH3	0.50	Sandy Clay with Gravel	-	-	5.9
77367-2	BH4	0.50	Sandy Clay with Gravel	-	-	0.2
77367-3	BH5	0.50	Sandy Clay with Gravel	-	-	15.2

Chemtech Environmental Limited

SOILS

Lab number			77367-1	77367-2	77367-3
Sample id			BH3	BH4	BH5
Depth (m)			0.50	0.50	0.50
Date sampled			05/03/2019	05/03/2019	05/03/2019
Test	Method	Units			
pH	CE004 ^M	units	8.3	8.0	8.0
Sulphate (2:1 water soluble)	CE061 ^M	mg/l SO ₄	15	33	15

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO ₄

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
77367-1	BH3	0.50	N	
77367-2	BH4	0.50	N	
77367-3	BH5	0.50	N	