Chelmer
Consultancy Services
'Groundbreaking Services'

Bearing Pressure Report

Site	3 Honeybourne Road London NW6 1HH
Client	Imogen Strachan
Date	February 2016
Our Ref	BPR/5678A

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APPENDICES

EXECUTIVE SUMMARY

Item	Comments
Site	**3 Honeybourne Road, London NW6 1HH**
Ground Conditions	The current work encountered Made Ground to a maximum depth of 1.08m below existing ground level. This in turn was found to be underlain by the London Clay which was not penetrated at the maximum borehole termination depth of 8.00m.
Groundwater	Groundwater was not encountered at the time of the investigation.
Roots	Roots of live and dead appearance to 2mm in diameter were noted within BH1, BH2, TP2 and TP3 down to a maximum depth of 1.90m. Hair and Fibrous roots were observed in BH1 to a maximum depth of 2.30m below ground level.
Bearing Pressure	It is assumed that the proposed extension foundations will be set at a depth between 1.00m and 2.00m below existing ground level. At this depth the extension foundations should be set within the firm to stiff London Clay Formation. Based on in-situ and laboratory testing in conjunction with empirical correlations (Bjerrum, 1972) the clay at a depth of 1.00m below existing ground level is estimated to have an undrained shear strength (cu) of around 66 kPa which rises to 83 kPa at a depth of 2.00m. Based on the estimated shear strength, the maximum bearing capacity of the London Clay at 1.00m is 340 kPa which rises to 425 kPa at 2.00m. Applying a global factor of safety of 3 it is recommended that an allowable bearing pressure not exceeding 113 kPa is applied for foundations set at a depth of 1.00m and 142 kPa at a depth of 2.00m, at which settlements are expected to be within normal acceptable tolerances. It is assumed that the potential basement will be set at a depth of 3.50m below existing ground level. At this depth the basement would be set within the stiff London Clay Formation. Based on in-situ and laboratory testing in conjunction with empirical correlation (Bjerrum, 1972) the clay at a depth of 3.50m below existing ground level is estimated to have an undrained shear strength (cu) of around 90 kPa. Based on the estimated shear strength, the maximum bearing capacity of the London Clay at 3.50m is 460 kPa. Applying a global factor of safety of 3 it is recommended that an allowable bearing pressure not exceeding 153 kPa is applied for a basement set at a depth of 3.50m, at which settlements are expected to be within normal acceptable tolerances.
Buried Concrete	Chemical testing has been carried out to determine the nature of the soils in the context of the durability of buried concrete. Based on the available test data the soluble sulphate content of the soils is noted to show little variation and ranges between 0.95 and 2.01 g/l (measured as soluble SO4) but with a pH of 7.7 to 8.1. Taking the worst case data, the soils are classified as DS-3 in accordance with BRE guidance (Ref. 3) with a corresponding ACEC class of AC-3.
Swelling and Shrinking	The London Clay Formation has been confirmed to possess 'high' volume change potential in accordance with the National House Building Councils (NHBC) classification system given in Part 4 of their Standards (Ref 4).
Recommendations for Further Work	Prior to or as part of the final design stage it is recommended that a full Ground Movement Analysis for the project be undertaken in order to assess the impact of the proposed basement on the adjacent properties during both temporary and permanent works, together with recommending in detail on heave protection measures related to anticipated stress changes. A Basement Impact Assessment (BIA) should also be considered if the proposed basement plans are confirmed. A BIA should be used to fully understand the hydrogeological regime at the site and the impact that basement construction may have. Any planning requirements of Camden Council will need to be followed regarding basement construction.

1.0 INTRODUCTION & SCOPE OF WORKS

1.1 This report has been prepared by Chelmer Site Investigation Laboratories Limited (CSI) to the instructions of INGealtoir Consulting Structural Engineers on behalf of the client, Imogen Strachan

1.2 This intrusive investigation has been commissioned to provide information on the sub-soil conditions of the site which included the depth and condition of the property foundations as well as to identify the geological strata on which the building has been founded on and to provide a bearing capacities for the strata encountered.

1.3 The site under consideration belongs to a three storey terraced house with an extension extending into the rear garden. The site address is 3 Honeyburne Road, London NW6 1HH and is located at the approximate Ordnance Survey grid reference 525561E 185080N.

1.4 It is understood that this investigation will aid with the development of a single storey extension to the rear of the property and the possible extension of the existing cellar to form a new single-storey basement below the footprint of the existing dwelling.

1.5 A Desk Top Study was not requested by the client.

1.6 This report presents a summary of the site investigation work carried out and discusses the findings.

2.0 SUMMARY OF FIELDWORK EXECUTED

2.1 All fieldwork was generally executed in accordance with applicable British Standard and accepted industry good practice (Ref 1).

2.2 The borehole and trial pit locations were chosen by the Structural Engineer and are indicated on the appended *Sketch Fieldwork Location Plan*.

2.3 Fieldwork was undertaken on the 11th and 19th August 2015 and comprised the following elements:

Hand Excavated Trial Pits

2.4 The scope of works involved the excavation of four trial pits (TP1-TP4) in order to establish the depth and condition of the current properties foundations and the geological strata on which the house was built on. The locations of the trial pits are indicated on the Sketch Fieldwork Location Plans (Sheet 1 and Sheet 2).

2.5 TP1 was excavated to a depth of 1275mm and found that the building brickwork was resting on a 75mm brick corbel which in turn was sitting on natural London Clay strata at a depth of 1.07m.

2.6 TP2 was terminated at a depth of 450mm as a result of contact with a drainage run.

2.7 TP3 was excavated between the kitchen bay and the main building extending into the rear garden (see TP3 section A & B). The trial pit found that the main building brickwork was constructed upon two 75mm brick corbel foundations which in turn was built upon Made Ground at a depth of 0.80m. The kitchen bay brickwork was resting on three 75mm brick corbels which in turn was resting on Made Ground at a depth of 0.875m bgl.

2.8 TP4 was excavated against the front elevation to a depth of 725mm and found that the brickwork was resting on a 75mm brick corbel which in turn was resting on a 300mm concrete foundation. The Concrete foundation was sitting on natural London Clay deposits at 0.56m bgl. A hand augered borehole (BH1) was sunk through the base of TP4.

2.5 Discrete disturbed samples were taken from the underside of the foundation footings for laboratory testing in each of the trial pits.

2.6 Mackintosh and Pilcon Vane Tests were undertaken on the strata encountered below the underside of the foundation footings in order to provide additional information on the consistency and strength of the material.

2.7 Full details of the trial pit findings are given on the appended *trial pit record sheets*

Hand Augered Borehole

2.8 A single hand augered borehole (BH1) was sunk at the site at the position indicated on the *Sketch Fieldwork Location Plan* through the base of TP4. It was originally proposed that a borehole was undertaken on the properties front driveway but the client's car was obstructing drilling on the day of the investigation, as such a hand augered borehole was undertaken. The borehole was advanced to a depth of 3.70m below ground level before it was terminated as a result of the ground becoming too dense to auger.

2.9 Discrete disturbed samples were taken from the borehole at regular depth intervals as the borehole was advanced.

2.10 Pilcon Vane Tests were undertaken throughout the borehole in order to provide additional information +on the consistency and strength of the material encountered.

2.11 Full details of the borehole findings are given on the appended *borehole record sheets.*

C.F.A Borehole

2.12 A single c.f.a borehole (BH2) was undertaken at the site on the 19th August 2015 and was located on the front driveway as indicated on the *Sketch Fieldwork Location Plan.* BH2 was advanced to a depth of 8.00m below existing ground level.

2.13 Discrete disturbed samples were taken from the borehole at regular depth intervals as the borehole was advanced.

2.14 Pilcon Vane Tests were undertaken throughout the borehole in order to provide additional information on the consistency and strength of the material encountered.

2.15 Full details of the borehole findings are given on the appended *borehole record sheets*.

3.0 GEOLOGICAL SETTING

3.1 According to information published by the British Geological Survey (England and Wales, 1:50,000 Sheet E256; North London and BGS online resources) the underlying geology at this site is shown as the London Clay Formation.

London Clay

3.2 It is thought that the London Clay formation was deposited during a period of sea inundation in the area up to 200m in depth. The London Clay can be up to 150m thick beneath south Essex thinning across London to about 90m near Reading. The formation consists of mainly dark blue to brown grey clay containing variable amounts of fine-grained sand and silt. London Clay generally weathers to an orange-brown colour with pockets of silty fine sand. The formation is particularly susceptible to swelling and shrinking when subjected to moisture content changes. In addition, gypsum (selenite) crystals and pyrite nodules are commonly found throughout the formation.

London Clay consists mainly of dark bluish grey to brownish grey clay containing variable amounts of fine-grained sand and silt. When exposed to the weathering process its upper regions oxidise to brown in colour. It usually contains selenite crystals, often grouped in bands or layers, which are thought to have originated from the decomposition of shell fragments. London Clay contains clay minerals in the form of illite, kaolinite and smectite. The presence of smectite renders the London Clay particularly susceptible to heave caused by alternate wetting and drying near the surface. In addition, weathering and possible slight transportation of semi-frozen material “en-masse” in glacial or peri-glacial regions can occur. This action often completely destroys the structure of the material and can involve a serious loss of strength. As the materials are based on local constituents, the lithology of the deposit is often similar to that of the parent strata.

4.0 SUMMARY OF GROUND CONDITIONS ENCOUNTERED

4.1 Full details of the ground conditions encountered are presented on the *borehole and trial pit records* appended to this report and can be summarised as follows:

Depth (m bgl)	Depth To (m bgl)	Description
0.00	0.05 - 0.40	TOPSOIL/BLOCK PAVING/CONCRETE
0.05 – 0.40	1.08 +	MADE GROUND: *Medium dense, brown, slightly gravelly fine to medium sand with numerous brick, clinker, bitumen, concrete fragments and pieces*
0.20 - 0.30	0.53 – 1.08	MADE GROUND: *Medium dense, dark brown, gravelly sandy silty clay with numerous brick, concrete and clinker fragments*
0.40 - 1.08	8.00	*Firm to stiff, brown slightly sandy silty CLAY with partings of brown and orange silt and fine sand. Occasional disseminated selenite crystals* (LONDON CLAY)

4.2 It should be noted that the Made Ground depths recorded above are those encountered within the boreholes and trial pits undertaken during the current work. Owing to the variable nature and unknown provenance of Made Ground it is possible that deeper or more extensive areas of Made Ground may exist at this site which have not been revealed by the current work.

4.3 In-situ testing within the London Clay deposits found beneath the property in TP1 & TP4 and both boreholes indicated that the material was 'firm' becoming 'very stiff' in consistency with depth.

4.4 Groundwater was not encountered at the time of the investigation.

4.5 Roots of live and dead appearance to 3mm in diameter were noted within TP1. Roots of live and dead appearance to 2mm were noted within BH1, BH2, TP2 and TP3 down to a maximum depth of 1.90m. Hair and Fibrous roots were observed in BH1 to a maximum depth of 2.30m below ground level.

5.0 LABORATORY TESTING

5.1 The following geotechnical laboratory testing has been carried out on samples recovered from the boreholes and trial pits undertaken at this site.

5.2 Unless otherwise stated, the geotechnical tests have generally been carried out in accordance with applicable British Standard (Ref. 2).

5.3 *Atterberg Limits and Moisture Content Tests*

The Atterberg Limits and moisture content have been determined for three samples from the London Clay formation from BH2.

For the samples tested, the liquid limit (LL) was found to range between 66% and 77%, the plastic limit (PL) was found to range between 23% and 25%, the plasticity index between 42% and 52% and a modified plasticity index from 40% to 49%. The moisture content of these samples was found to range from 27% to 31%.

These results indicate that the samples tested would be classified as Clay of 'high' to 'very high' plasticity (CH–CV) in accordance with the Casagrande Geotechnical classification system.

5.4 *BRE Special Digest 1:2005 Concrete Classification Tests*

Three samples taken from the site were selected and tested to assess the aggressive chemical environment for concrete (ACEC) within the site. Two samples were taken from the London Clay Formation in BH2 and one sample was taken from the Made Ground in TP3.

The pH value was found to range between 7.7 and 8.1 with the sulphate content, on a 2:1 water:soil extract found to range between 0.95 and 2.01 g/l.

6.0 DISCUSSION

SUMMARY OF PROPOSED DEVELOPEMNT

6.1 As discussed in the introduction it is understood that the proposed development will comprise the construction of a single storey extension to the rear of the property and the possible extension of the existing cellar to form a new single-storey basement below the footprint of the existing dwelling.

6.2 Full details of the proposed construction are not yet developed and it is assumed that they will be subject to the findings of this investigation. As a consequence the bearing pressure below is, by necessity, general in nature and is subject to confirmation following the results of this investigation and further design.

6.3 Should ground conditions during construction be found to differ significantly from those described in our report Chelmer Site Investigation Laboratories Limited should be contacted immediately and that the below noted allowable bearing pressures may need to be altered accordingly.

BEARING PRESSURE

6.4 It is assumed that the proposed extension foundations will be set at a depth between 1.00m and 2.00m below existing ground level. At this depth the extension foundations should be set within the firm to stiff London Clay Formation. Based on in-situ and laboratory testing in conjunction with empirical correlations (Bjerrum, 1972) the clay at a depth of 1.00m below existing ground level is estimated to have an undrained shear strength (c_u) of around 66 kPa which rises to 83 kPa at a depth of 2.00m. Based on the estimated shear strength, the maximum bearing capacity of the London Clay at 1.00m is 340 kPa which rises to 425 kPa at 2.00m. Applying a global factor of safety of 3 it is recommended that an allowable bearing pressure not exceeding 110 kPa is applied for foundations set at a depth of 1.00m and 140 kPa at a depth of 2.00m, at which settlements are expected to be within normal acceptable tolerances.

6.5 It is assumed that the potential basement will be set at a depth of 3.50m below existing ground level. At this depth the basement would be set within the stiff London Clay Formation. Based on in-situ and laboratory testing in conjunction with empirical correlation (Bjerrum, 1972) the clay at a depth of 3.50m below existing ground level is estimated to have an undrained shear strength (c_u) of around 90 kPa. Based on the estimated shear strength, the maximum bearing capacity of the London Clay at 3.50m is 460 kPa. Applying a global factor of safety of 3 it is recommended that an allowable bearing pressure not exceeding 150 kPa is applied for a basement set at a depth of 3.50m, at which settlements are expected to be within normal acceptable tolerances.

BURIED CONCRETE

6.6 Chemical testing has been carried out to determine the nature of the soils in the context of the durability of buried concrete. Based on the available test data the soluble sulphate content of the soils is noted to show little variation and ranges between 0.95 and 2.01 g/l (measured as soluble SO_4) but with a pH of 7.7 to 8.1. Taking the worst case data, the soils are classified as DS-3 in accordance with BRE guidance (Ref. 3) with a corresponding ACEC class of AC-2s.

SWELLING AND SHRINKAGE

6.7 The London Clay Formation has been confirmed to possess 'high' volume change potential in accordance with the National House Building Councils (NHBC) classification system given in Part 4 of their Standards (Ref 4).

RECOMMENDATIONS FOR FURTHER WORK

6.8 Prior to or as part of the final design stage it is recommended that a full Ground Movement Analysis for the project be undertaken in order to assess the impact of the proposed basement on the adjacent properties during both temporary and permanent works, together with recommending in detail on heave protection measures related to anticipated stress changes.

6.9 A Basement Impact Assessment (BIA) should also be considered if the proposed basement plans are confirmed. A BIA should be used to fully understand the hydrogeological regime at the site and the impact that basement construction may have. Any planning requirements of Camden Council will need to be followed regarding basement construction.

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Reviewed By: Matthew Proctor BEng (Hons), FGS
Executive Director

References

1. BS 5930:1999+A2:2010 (2010) Code of practice for site investigations.
2. BS 1377:1990 (1990) Methods of Test for Soils for Civil Engineering Purposes.
3. BRE (2005). Concrete in aggressive ground. Special Digest 1.
4. NHBC (2011) NHBC Standards, Chapter 4.2, Building Near Trees.

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b) Save for the client no duty is undertaken or warranty or representation made to any party in respect of the opinions, advice, recommendations or conclusions herein set out.
c) All work carried out in preparing this report has used, and is based upon, our professional knowledge and understanding of the current relevant English and European Community standards, approved codes of practice, technology and legislation.
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Chelmer Site Investigations 'Groundbreaking Services'

Client: James Strachlan	Scale: N.T.S.	Sheet No: 1 of 1	Weather: Overcast	Date: 11.08.15
Site: 3 Honeybourne Road, London, NW6 1HH	Job No: 5678	Borehole No: 1	Boring method: Hand Auger	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
	SEE TP4 LOG	0.75		D			Roots of live and dead appearance to 2mmØ to 1.9m.		0.5
0.75	Firm, dark brown, slightly sandy silty CLAY with partings of brown and orange silt and fine sand and crystals.	2.95		D	V	100 106	Hair and fibrous roots to 2.3m.		1.0
				D	V	118 124	No roots observed below 2.3m.		1.5
	Becoming stiff from 1.9m.			D	V	130+ 130+			2.0
				D	V	130+ 130+			2.5
				D	V	118 124			3.0
				D	V	130+ 130+			3.5
3.7	Borehole ends at 3.7m. Too dense to hand auger. Thought to be claystone.								

Drawn by: DB **Approved by:** JH

Remarks: *Borehole dry and open on completion.*

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Chelmer Site Investigations 'Groundbreaking Services'

Client: James Strachlan	Scale: N.T.S.	Sheet No: 1 of 1	Weather: Overcast	Date: 19.08.15
Site: 3 Honeybourne Road, London, NW6 1HH	Job No: 5678	Borehole No: 2	Boring method: CFA 100mmØ Secondman	

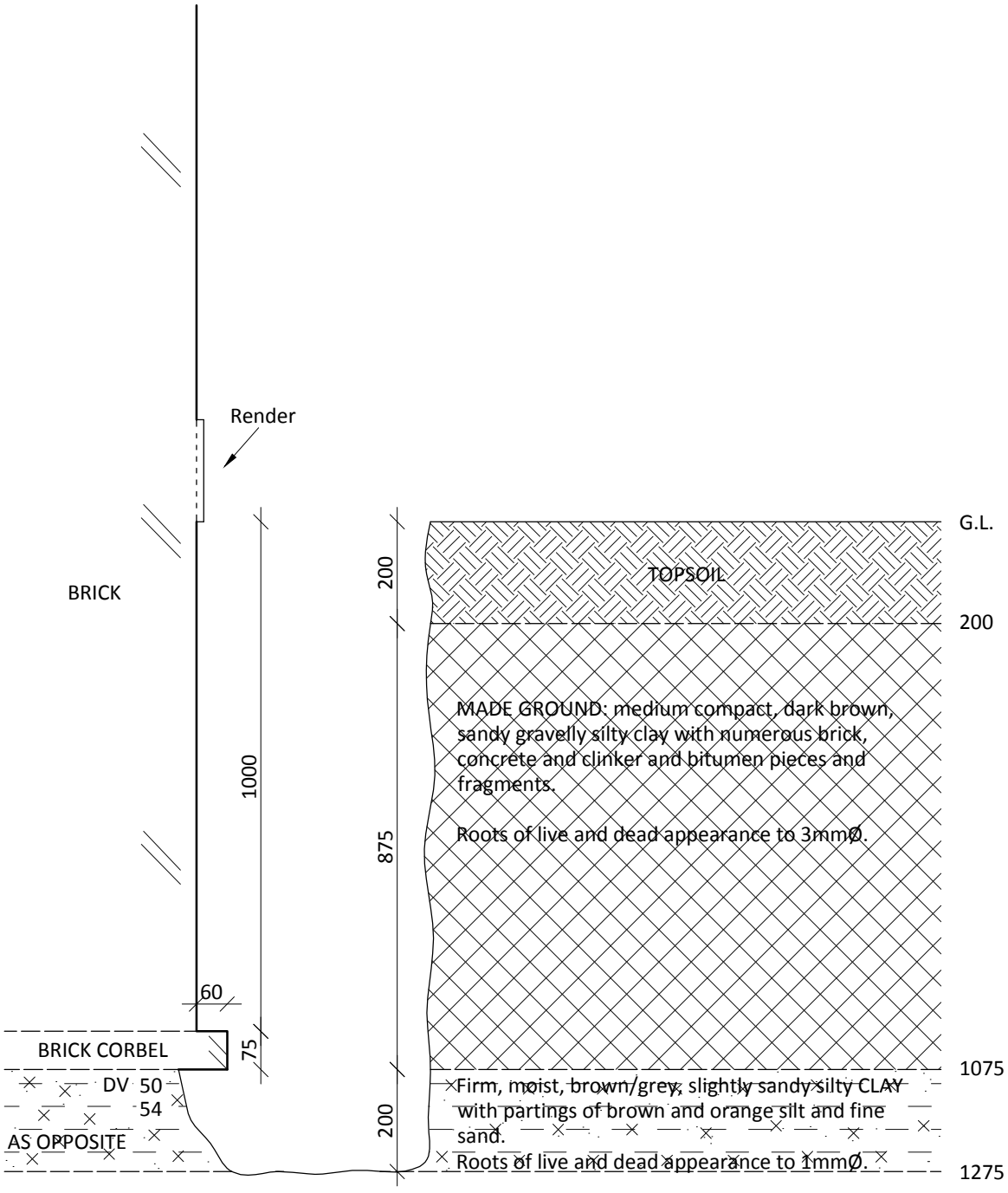
Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.	BRICK PAVING SLABS	0.01							
0.01	SAND	0.39							
0.4	Firm, brown slightly sandy silty CLAY with partings of brown and orange silt and fine sand.			D			Roots of live and dead appearance to 1mmØ to 0.6m.		0.5
				D	V	62 64			1.0
				D			No roots observed below 0.6m.		1.5
				D	V	70 72			2.0
				D					2.5
				D	V	78 80			3.0
				D					3.5
3.0	Becoming stiff from 3.0m.	7.6		D	V	84 84			4.0
				D					4.5
				D	V	90 92			5.0
				D					5.5
				D	V	102 106			6.0
	Becoming very stiff from 7.0m.			D	V	120+ 120+			7.0
8.0	Borehole ends at 8.0m			D	V	120+ 120+			8.0

Drawn by: LS **Approved by:** JH

Remarks: *Borehole dry and open on completion.*

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	James Strachlan	**Scale:**	N.T.S.	**Sheet No:**	1 of 1	**Date:**	11.08.15
Location:	3 Honeybourne Road, London, NW6 1HH	**Job No:**	5678	**Trial Pit No:**	1	**Weather:**	Overcast
Excavation Method:	Hand tools			**Drawn by:**	DB	**Checked by:**	JH



TP1 ENDS AT 1275mm

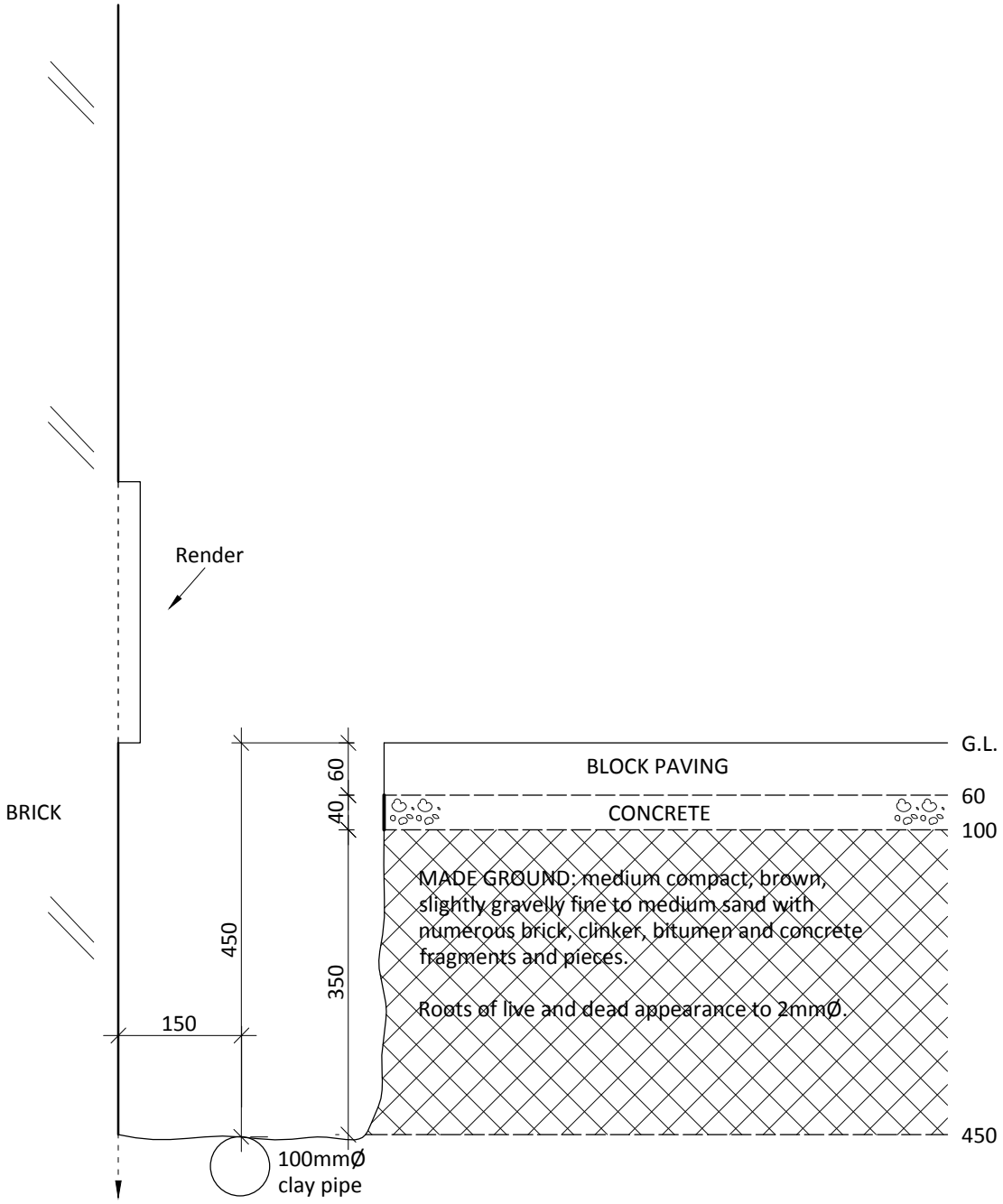
Remarks:

Key:

D Small disturbed sample
B Bulk disturbed sample
U Undisturbed sample (U100)
N Standard Penetration Test Blow Count
J Jar sample
V Pilcon Vane (kPa)
M Mackintosh Probe
W Water Sample

Chelmer Site Investigations
'Groundbreaking Services'

Client:	James Strachlan	**Scale:**	N.T.S.	**Sheet No:**	1 of 1	**Date:**	11.08.15
Location:	3 Honeybourne Road, London, NW6 1HH	**Job No:**	5678	**Trial Pit No:**	2	**Weather:**	Overcast
Excavation Method:	Hand tools			**Drawn by:**	DB	**Checked by:**	JH



TP2 ENDS AT 450mm due to drainage obstruction.
Unable to establish underside foundation.

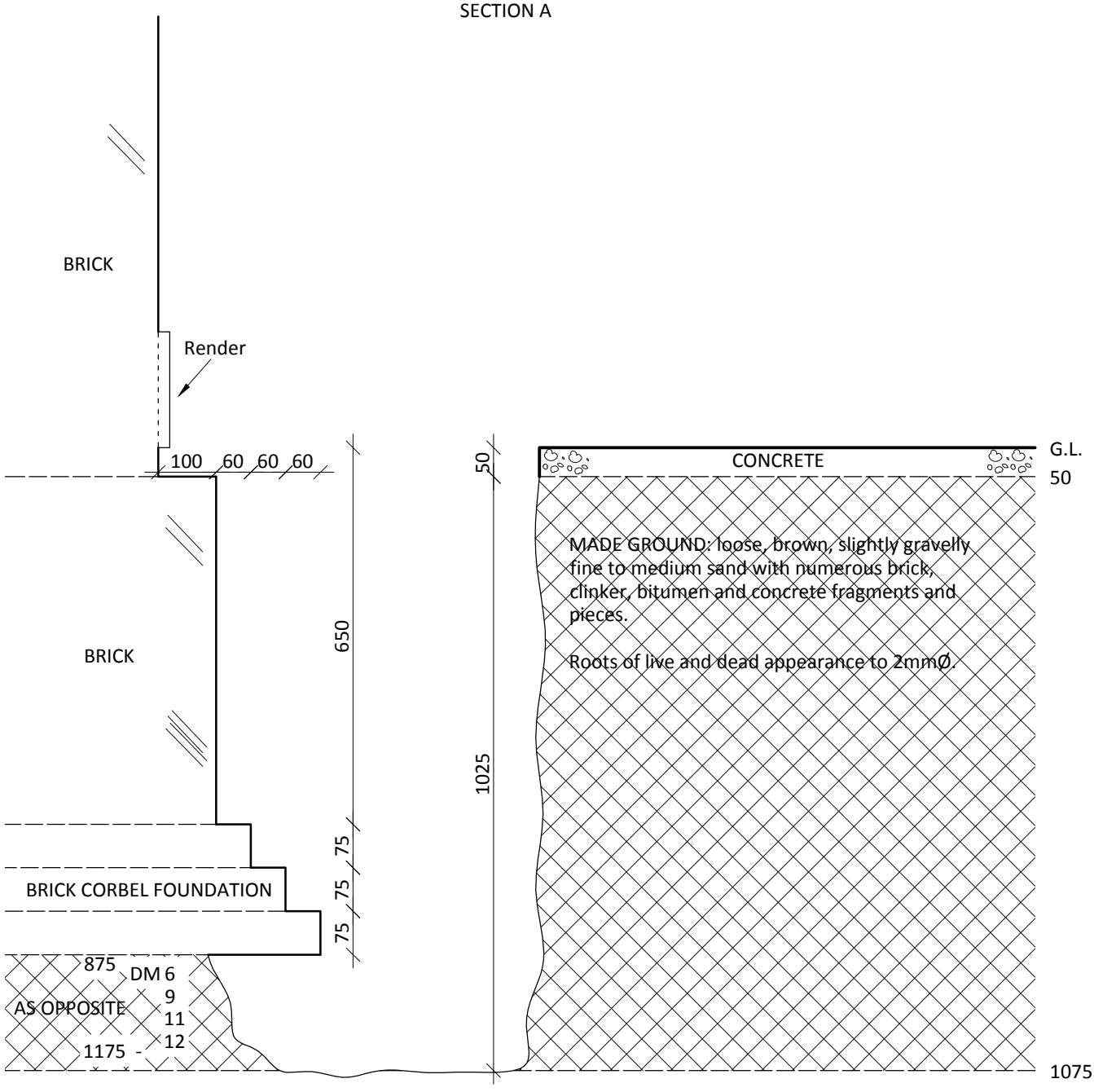
Remarks:

Key:

D Small disturbed sample
B Bulk disturbed sample
U Undisturbed sample (U100)
N Standard Penetration Test Blow Count
J Jar sample
V Pilcon Vane (kPa)
M Mackintosh Probe
W Water Sample

Client:	James Strachlan	**Scale:**	N.T.S.	**Sheet No:**	1 of 2	**Date:**	11.08.15
Location:	3 Honeybourne Road, London, NW6 1HH	**Job No:**	5678	**Trial Pit No:**	3	**Weather:**	Overcast
Excavation Method:	Hand tools			**Drawn by:**	DB	**Checked by:**	JH

SECTION A



TP3 SECTION A ENDS AT 1075mm

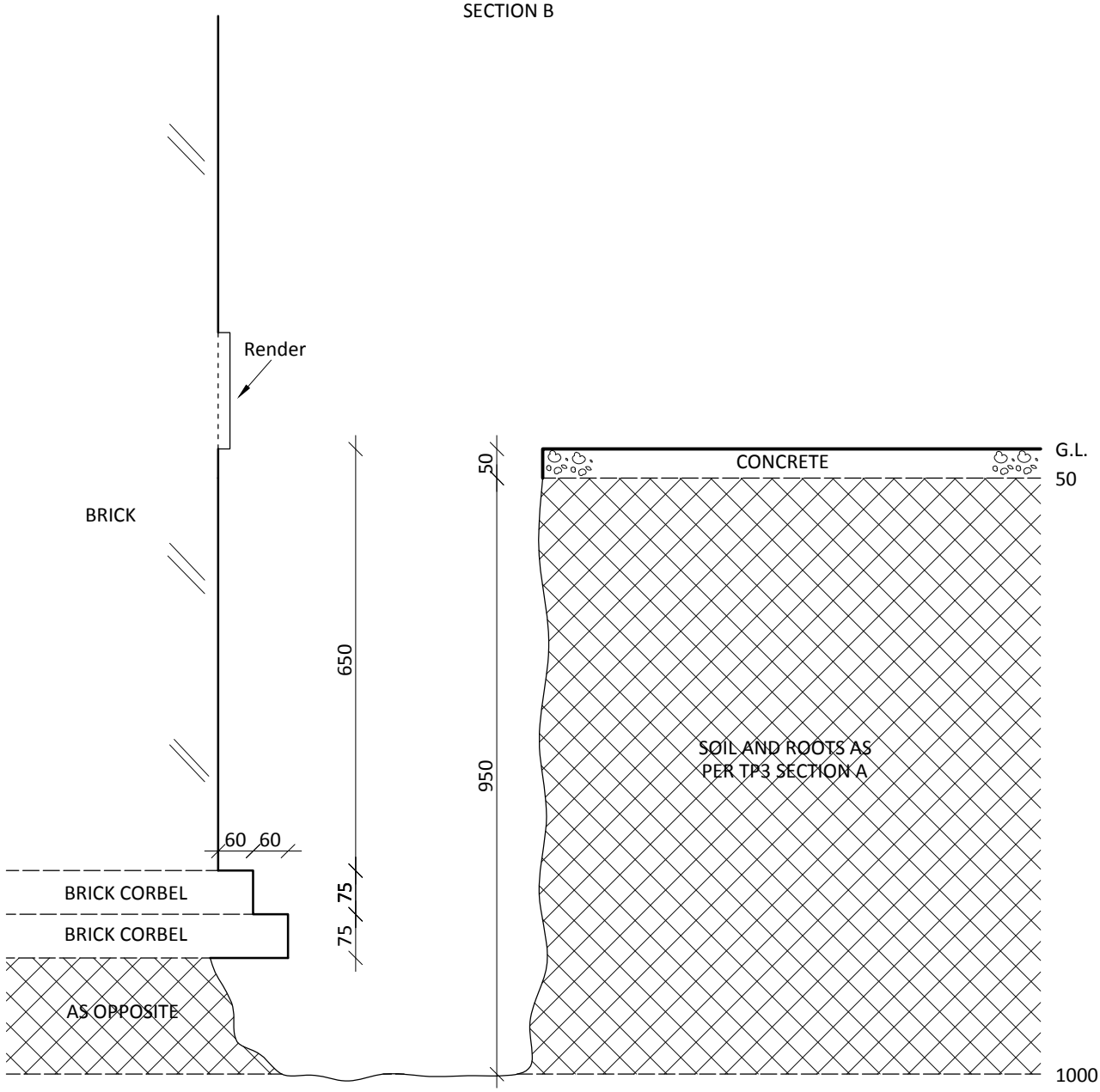
Remarks:

Key:

D Small disturbed sample
B Bulk disturbed sample
U Undisturbed sample (U100)
N Standard Penetration Test Blow Count
J Jar sample
V Pilcon Vane (kPa)
M Mackintosh Probe
W Water Sample

Client:	James Strachlan	**Scale:**	N.T.S.	**Sheet No:**	2 of 2	**Date:**	11.08.15
Location:	3 Honeybourne Road, London, NW6 1HH	**Job No:**	5678	**Trial Pit No:**	3	**Weather:**	Overcast
Excavation Method:	Hand tools			**Drawn by:**	DB	**Checked by:**	JH

SECTION B



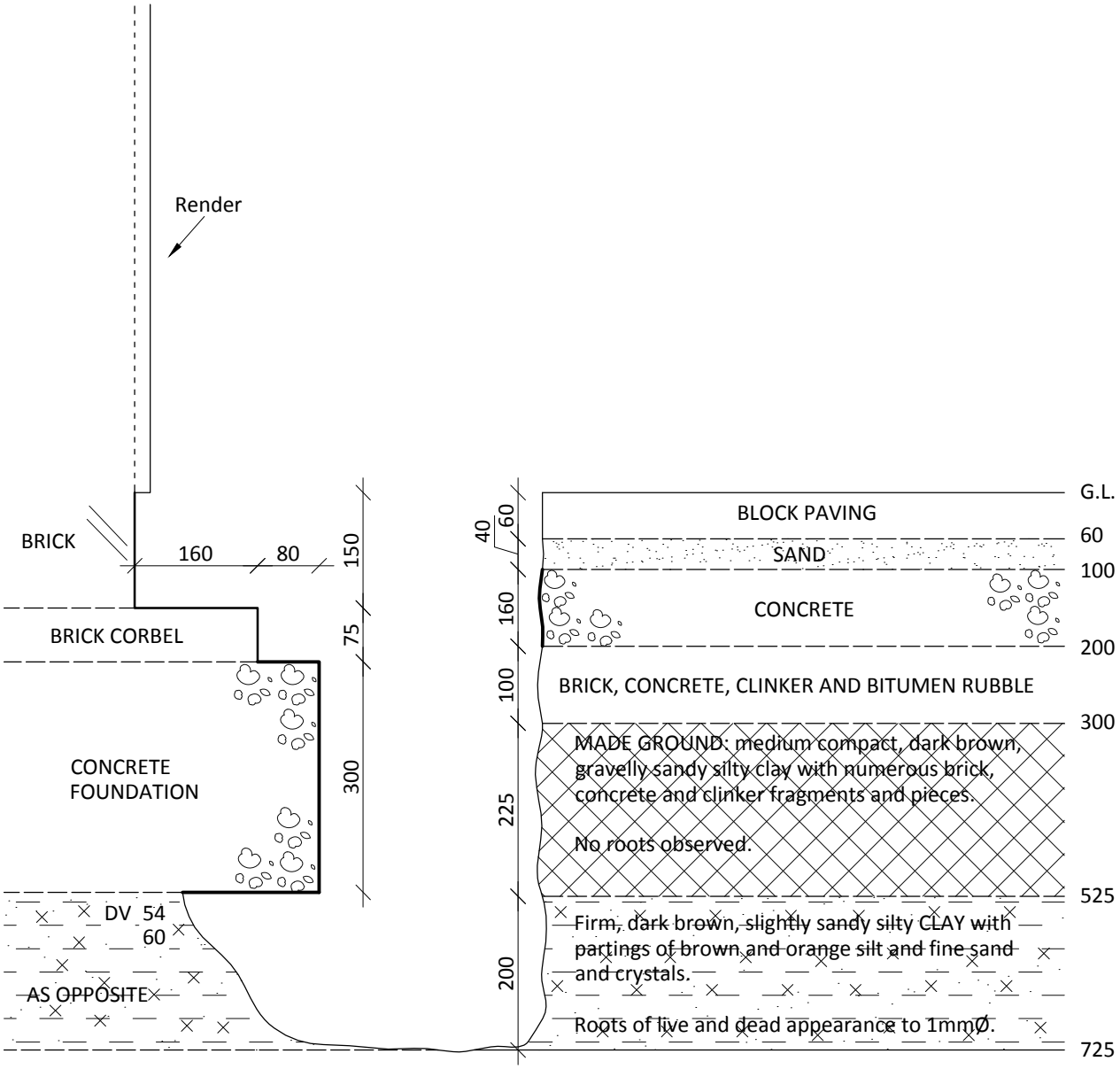
TP3 SECTION B ENDS AT 1000mm

Remarks:

Key:

D Small disturbed sample
B Bulk disturbed sample
U Undisturbed sample (U100)
N Standard Penetration Test Blow Count
J Jar sample
V Pilcon Vane (kPa)
M Mackintosh Probe
W Water Sample

Client:	James Strachlan	**Scale:**	N.T.S.	**Sheet No:**	1 of 1	**Date:**	11.08.15
Location:	3 Honeybourne Road, London, NW6 1HH	**Job No:**	5678	**Trial Pit No:**	4	**Weather:**	Overcast
Excavation Method:	Hand tools			**Drawn by:**	DB	**Checked by:**	JH



FOR STRATA BELOW 725mm SEE BH1 LOG

Remarks:

Key:

D Small disturbed sample
B Bulk disturbed sample
U Undisturbed sample (U100)
N Standard Penetration Test Blow Count
J Jar sample
V Pilcon Vane (kPa)
M Mackintosh Probe
W Water Sample

UKAS TESTING
8284

Chelmer
Geotechnical Laboratories
'Groundbreaking Services'

Laboratory Report

Site	**3 Honeybourne Road, NW6**
Client	**James Strachlan**
Date	**11-Sep-15**
Our Ref	**CSI5678**
CGL Ref	**CGL5678**

Chelmer Site Investigation Laboratories Ltd
Unit 15 East Hanningfield Industrial Estate, Old Church Road, East Hanningfield, Essex CM3 8AB
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UKAS TESTING
8284

Chelmer Geotechnical Laboratories
'Groundbreaking Services'

Content Summary

This report contains all test results as indicated on the test instruction/summary.

CGL Reference : CGL5678

Client Reference : CSI5678

For the attention of : James Strachlan

This report comprises of the following :

1 Cover Page
1 Inside Cover/Contents Page
1 Page of Results
1 Moisture/Shear Strength Chart
1 Plasticity Chart
4 Pages of BRE SD1 Results
1 Limitations of Report

Notes :

General

Please refer to report summary notes for details pertaining to methods undertaken and their subsequent accreditations

Samples were supplied by Chelmer Site Investigations

All tests performed in-house unless otherwise stated

Deviant Samples

Samples were received in suitable containers	Yes
A date and time of sampling was provided	Yes
Arrived damaged and/or denatured	No

Laboratory Testing Results

BS 1377 : 1990

Chelmer Geotechnical Laboratories "Groundbreaking Services"

Job Number : CGL5678
Client : James Strachlan
Client Reference : CSI5678
Site Name : 3 Honeybourne Road, NW6

Date Received : 08/09/2015
Date Testing Started : 09/09/2015
Date Testing Completed : 11/09/2015
Laboratory Used : Chelmer Geotechnical, CM3 8AB

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
BH2	2.0	65783	D	27	<5	69	23	46	0.09	43	CH			71					
BH2	3.0	65784	D		<5									74					
BH2	4.0	65785	D	31	<5	66	24	42	0.16	40	CH			84					
BH2	8.0	65786	D	29	<5	77	25	52	0.07	49	CV			120					

Notes :- *UKAS Accredited Tests

[1] BS 1377 : Part 2 : 1990, Test No 3.2
[2] Estimated if <5%, otherwise measured
[3] BS 1377 : Part 2 : 1990, Test No 4.4
[4] BS 1377 : Part 2 : 1990, Test No 5.3
[5] BS 1377 : Part 2 : 1990, Test No 5.4
[6] BRE Digest 240 : 1993
[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils
[8] In-house method S9a adapted from BRE IP 4/93
[9] Values of shear strength were determined in situ by Chelmer Site Investigations using a Pilcon hand vane or Geonor vane (GV).
[10] BS 1377 : Part 3 : 1990, Test No 4
[11] BS 1377 : Part 2 : 1990, Test No 9
[12] BS 1377 : Part 3 : 1990, Test No 5.6
[13] $SO_4 = 1.2 \times SO_3$
[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key

D - Disturbed sample
B - Bulk sample
U - U100 (undisturbed sample)
W - Water sample
ENP - Essentially Non-Plastic
U/S - Underside Foundation

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Comments :-

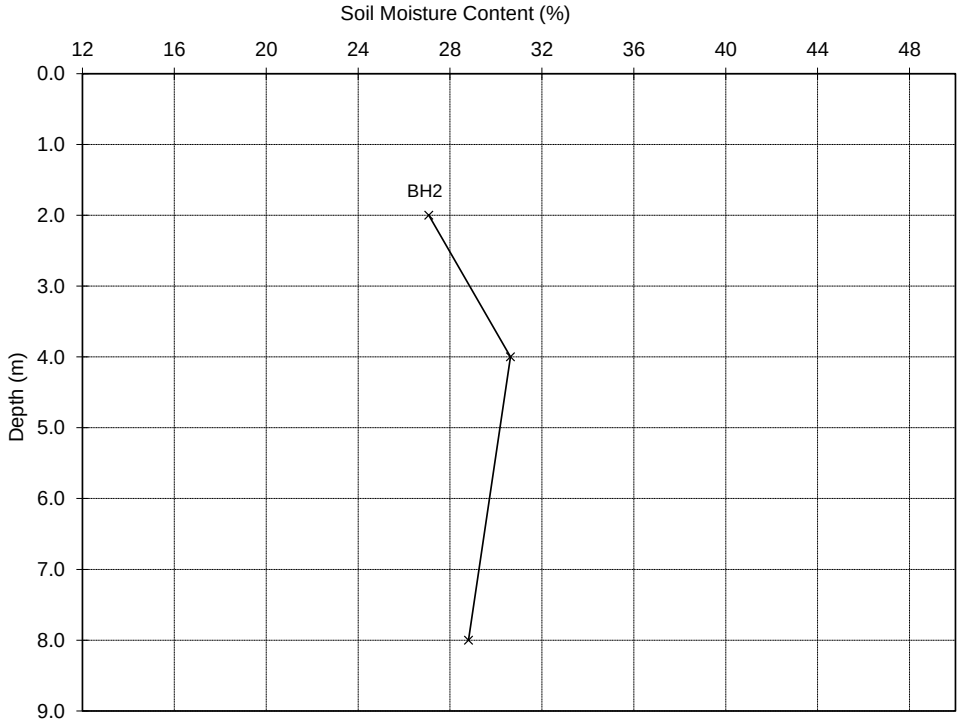
Technician :- HS
Checked By :- MC
Date Checked :- 11-Sep-15

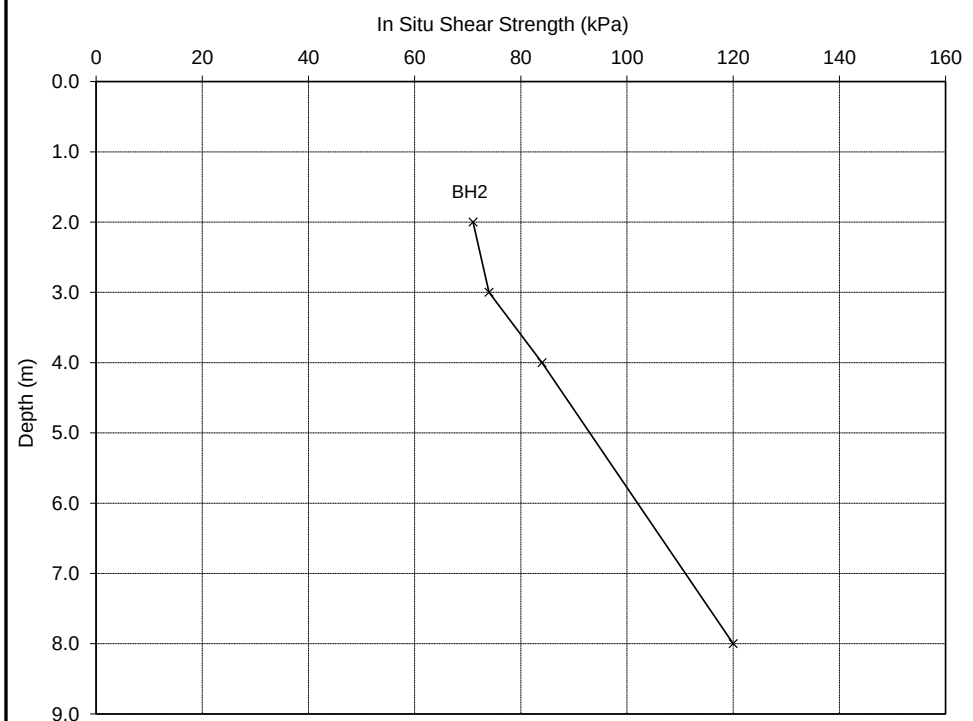
Laboratory Testing Results

Moisture Content/Shear Strength Profile

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL5678	Date Received :	08/09/2015
Client :	James Strachlan	Date Testing Started :	09/09/2015
Client Reference :	CSI5678	Date Testing Completed :	11/09/2015
Site Name :	3 Honeybourne Road, NW6	Laboratory :	Chelmer Geotechnical Laboratories, CM3 8AB





Notes :-

1. If the Soil Fraction > 0.425mm exceeds 5% the Equivalent Moisture Content of the remainder (calculated in accordance with BS 1377: Part 2 : 1990, cl.3.2.4 note 1) is also plotted and the alternative profile additionally shown as an appropriately coloured broken line.
2. If plotted, 0.4 LL and PL+2 (after Driscoll, 1983) should only be applied to London Clay (and similarly over consolidated clays) at shallow depths.

Unless otherwise stated, values of Shear Strength were determined in situ by Chelmer Site Investigations using a Pilcon Hand Vane the calibration of which is limited to a maximum reading of 140 kPa. (Not UKAS accredited)

UKAS TESTING 8284

Comments :-

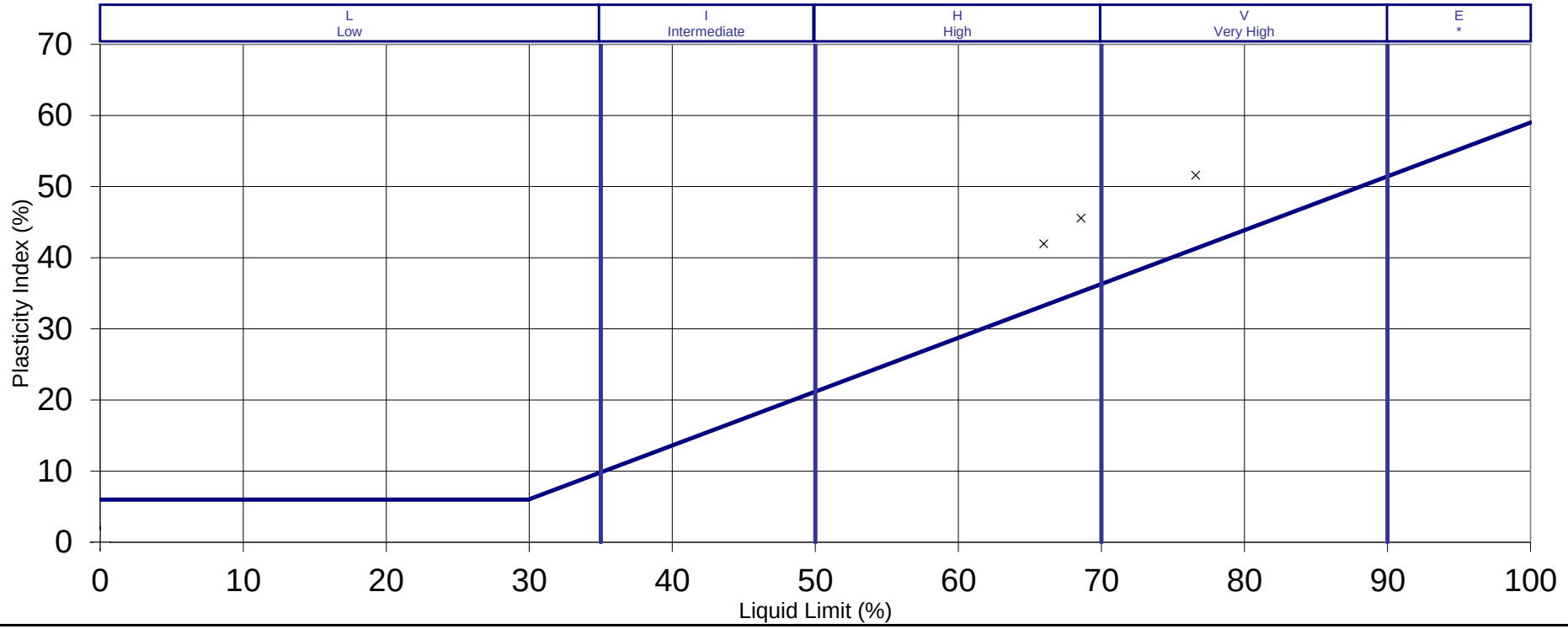
Checked By :- MC Date Checked :- 11-Sep-15

Laboratory Testing Results

Plasticity Chart for the classification of fine soils and the finer part of coarse soils
In Compliance with BS5930 : 1999

Chelmer Geotechnical Laboratories
'Groundbreaking Services'

Job Number :	CGL5678	Date Received :	08/09/2015
Client :	James Strachlan	Date Testing Started :	09/09/2015
Client Reference :	CSI5678	Date Testing Completed :	11/09/2015
Site Name :	3 Honeybourne Road, NW6	Laboratory :	Chelmer Geotechnical Laboratories, CM3 8AB



Notes :-

SILT (M-SOIL), M, plots below A-Line
CLAY, C, plots above A-Line }M and C may be combined as FINE SOIL, F.

Key :- BH2

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Comments :-

Checked By :- MC Date Checked :- 11-Sep-15

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QTS Environmental Ltd
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t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 15-35332

Site Reference:	3 Honeybourne Road, NW6
Project / Job Ref:	CGL5678
Order No:	5089
Sample Receipt Date:	10/09/2015
Sample Scheduled Date:	10/09/2015
Report Issue Number:	1
Reporting Date:	16/09/2015

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd

QTS Environmental Ltd
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Rose Lane
Lenham Heath
Maidstone
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Tel : 01622 850410

4480

Soil Analysis Certificate							
QTS Environmental Report No: 15-35332	Date Sampled	11/08/15	11/08/15	11/08/15		
Chelmer Site Investigation Laboratories Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: 3 Honeybourne Road, NW6	TP / BH No	65784	65785	65787		
Project / Job Ref: CGL5678	Additional Refs	2	2	TP3		
Order No: 5089	Depth (m)	3.00	4.00	0.90		
Reporting Date: 16/09/2015	QTSE Sample No	166335	166336	166337		

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.7	7.7	8.1		
Total Sulphate as SO_4	mg/kg	< 200	NONE	4973	6550	3172		
Total Sulphate as SO_4	%	< 0.02	NONE	0.50	0.66	0.32		
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	950	2010	1440		
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.95	2.01	1.43		
Total Sulphur	%	< 0.02	NONE	0.17	0.22	0.12		
Ammonium as NH_4	mg/kg	< 0.5	NONE	6.8	11.3	3.6		
Ammonium as NH_4	mg/l	< 0.05	NONE	0.68	1.13	0.36		
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	35	23	22		
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	17.7	11.7	11.1		
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Water Soluble Nitrate (2:1) as NO_3	mg/l	< 1.5	MCERTS	< 1.5	< 1.5	< 1.5		
W/S Magnesium	mg/l	< 0.1	NONE	16	86	86		

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

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Tel : 01622 850410

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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 15-35332	
Chelmer Site Investigation Laboratories Ltd	
Site Reference: 3 Honeybourne Road, NW6	
Project / Job Ref: CGL5678	
Order No: 5089	
Reporting Date: 16/09/2015	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 166335	65784	2	3.00	20.7	Light brown clay
$ 166336	65785	2	4.00	20.2	Brown clay
$ 166337	65787	TP3	0.90	15.4	Grey sandy gravel

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample I/S

Unsuitable Sample U/S

$ samples exceeded recommended holding times

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Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 15-35332
Chelmer Site Investigation Laboratories Ltd
Site Reference: 3 Honeybourne Road, NW6
Project / Job Ref: CGL5678
Order No: 5089
Reporting Date: 16/09/2015

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

8284

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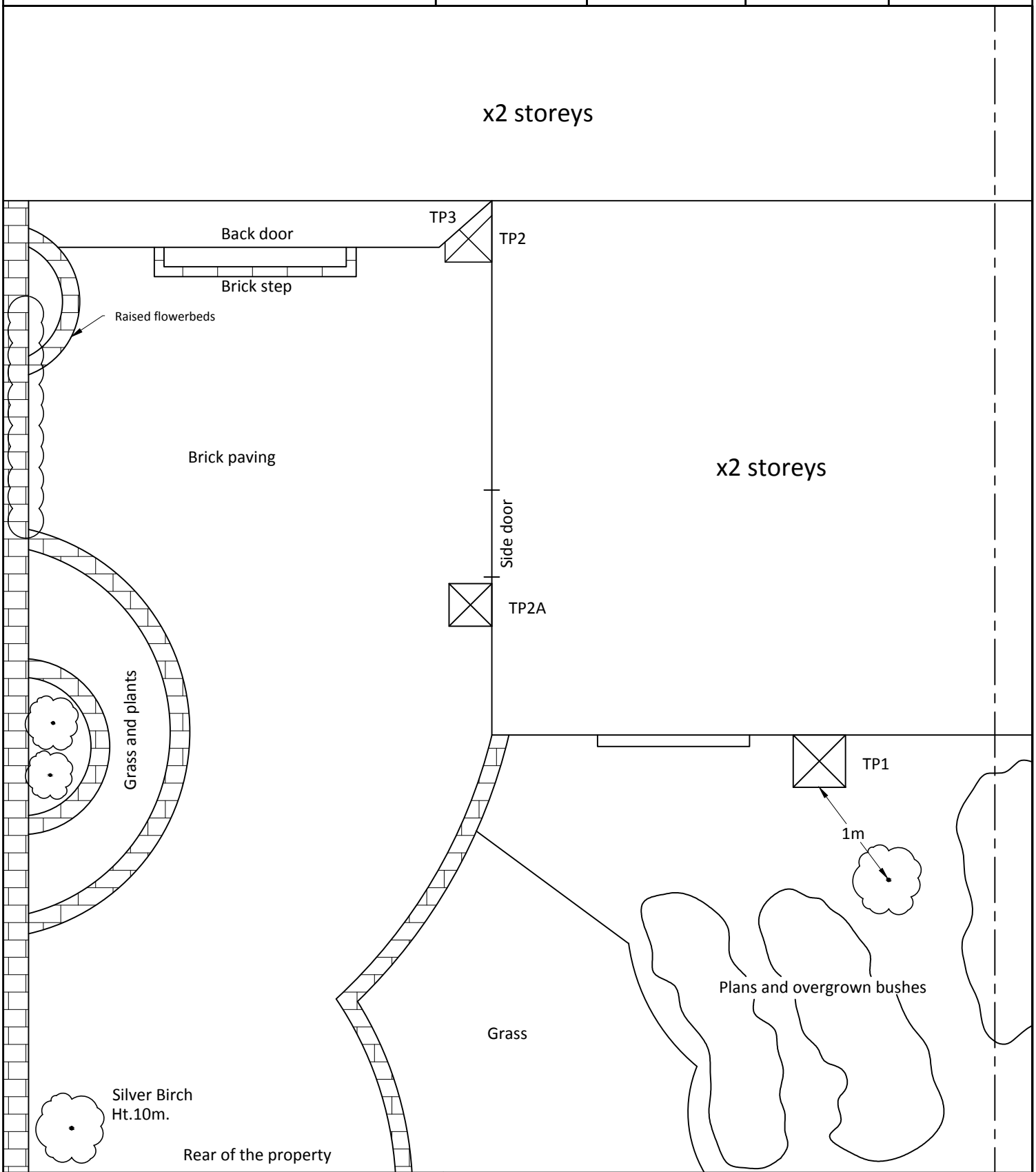
This report shall not be reproduced, except in full, without the written approval of Chelmer Site Investigations Laboratories Ltd.

Where our involvement consists exclusively of testing samples, the results and comments (if provided) relate only to the samples tested.

Any samples that are deemed to be subject to deviation will be recorded as such within the test summary.

Chelmer Site Investigations
'Groundbreaking Services'

Client: James Strachlan		**Scale:** N.T.S.	**Sheet:** 1 of 2	**Date:** 11.08.15	
Location: 3 Honeybourne Road, London, NW6 1HH		**Job No:** 5678	**Weather:** Fine	**Drawn by: DB**	**Checked by: JH**



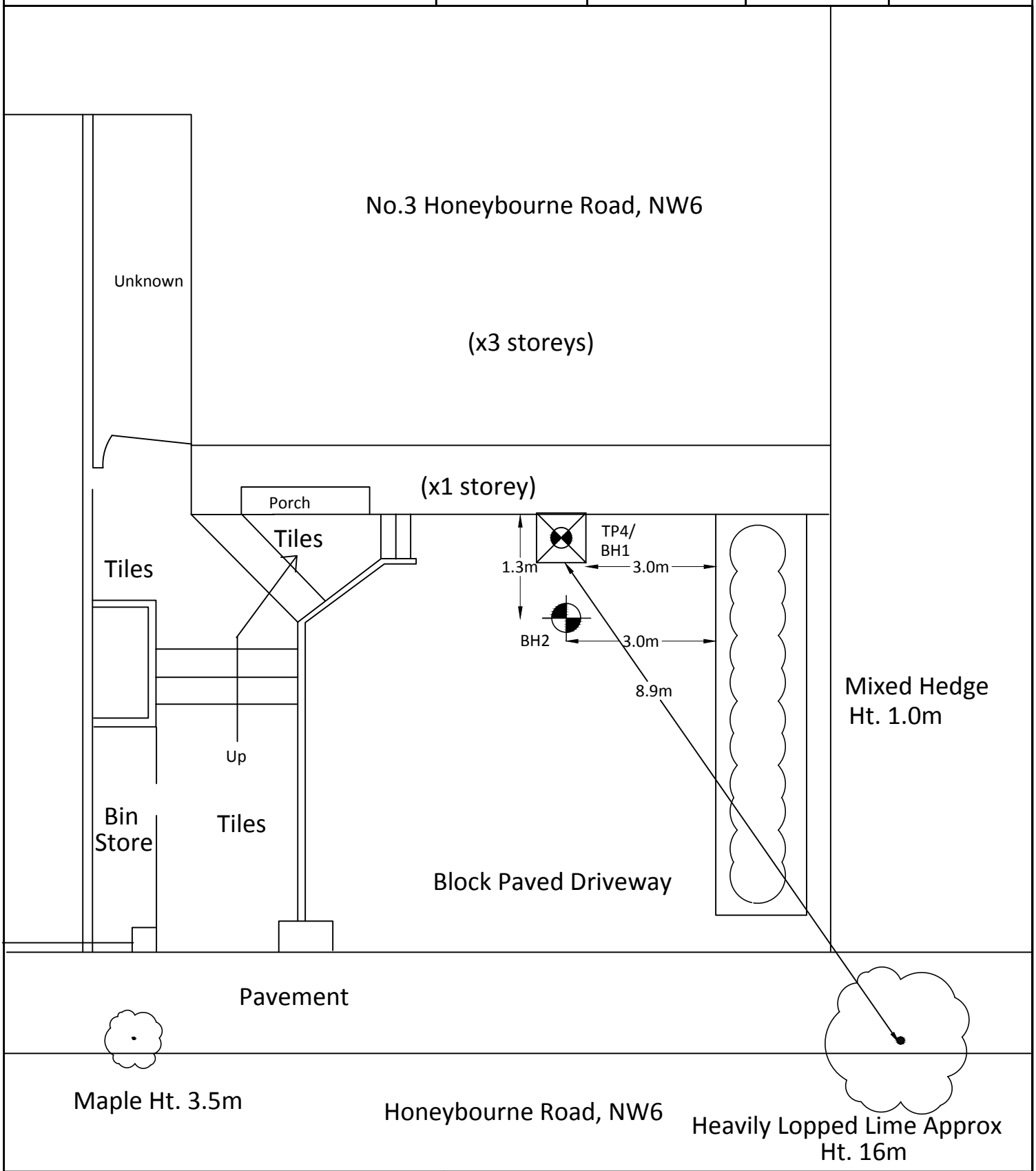
Notes:

Key:

Tree/Shrub | Borehole | Trial Pit | G Gully | Tree Stump | Rain Water/ Soil Pipe | MH Manhole

Chelmer Site Investigations
'Groundbreaking Services'

Client: James Strachlan	**Scale:** N.T.S.	**Sheet:** 2 of 2	**Date:** 19.08.15	
Location: 3 Honeybourne Road, London, NW6 1HH	**Job No:** 5678	**Weather:** Fine	**Drawn by:** DB	**Checked by:** ME



Notes: *Front of Property*

Key:

Tree/Shrub | Borehole | Trial Pit | G Gully | Tree Stump | Rain Water/ Soil Pipe | MH Manhole