Chelmer
Consultancy Services
'Groundbreaking Services'

Geotechnical Interpretive Report

Site	34A King Henry's Road London NW3 3RP
Client	Rupert West Limited
Date	November 2017
Our Ref	GEO/7806

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APPENDICES

Chelmer Consultancy Services
'Groundbreaking Services'

34A King Henry's Road

GEOTECHNICAL INTERPRETATIVE REPORT

Chelmer Job No. 7806
Chelmer Report No. GE0/7806

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7806					
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B	CHELMER / RUPERT WEST LTD	-	1

EXECUTIVE SUMMARY

34A King Henry's Road, London NW3 3RP	
Ground Conditions	The current work encountered Made Ground to a maximum depth of 2.0m below existing ground level (bgl). The Made Ground was underlain by the London Clay Formation. The London Clay Formation was recorded to the maximum borehole termination depth of 8.1m bgl.
Groundwater	No groundwater was recorded during the drilling process of the current investigation. During the two monitoring visits groundwater was recorded in BH1 at depths of 6.29m and 5.16m bgl.
Roots	Roots of live and dead appearance up to 1mm in diameter were observed in BH1 and TP2 (section B) to depths of 1.7m and 0.5m bgl respectively.
Foundations	At the location of BH1 Made Ground was encountered to a maximum depth of 2.0m bgl. Made Ground is by its nature heterogeneous in composition and therefore its engineering properties are likely to be variable both laterally and vertically across the site. Therefore it is recommended that in all cases foundations are taken below the Made Ground and set within the underlying natural soils. Based on results of the in-situ and laboratory testing, in conjunction with empirical correlations (Bjerrum, 1972), an allowable bearing pressure not exceeding 84 kPa can be adopted for foundation design at a depth of 1.0m bgl at which settlements are expected to be within normal acceptable tolerances. By calculation, the safe bearing capacity increases at a rate of 7 kPa with every metre increase in depth. In the event that shallow foundations are not suitable for the proposed development piles will offer a suitable alternative. Safe pile capacities between 50-190kN can be achieved for piles of diameter 0.3-0.35m of 7.0-13.0m length. It is recommended that the advice of competent piling contractors be sought as to the most suitable pile type at this site and for confirmation of the order of working load achievable given the ground conditions encountered and the proprietary pile type selected.
Shallow Excavations	Shallow excavations within the site will most likely be within Made Ground and the London Clay Formation. Within Made Ground short term support is likely to be required to maintain the excavations. The London Clay Formation will by contrast be self-supporting to some degree and as such excavations below Made Ground may not require support in the short term. All excavations will be subject to normal health and safety considerations.
Swelling/ Shrinkage	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. 5).
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 be variable and ranges between 0.08 and 3.10 g/l (measured as soluble SO_4) with a pH of 7.5 to 7.6. Taking the worst case data, the soils are classified as DS-4 in accordance with BRE guidance (Ref 6).
Recommendations	It is advised that in the event that piles are required for working loads greater than 130kN that a deep borehole soil investigation is carried out to provide satisfactory testing results to design deep piles, for an efficient design solution.

1.0 INTRODUCTION

1.1 This report has been prepared by Chelmer Site Investigation Laboratories Limited (CSI) to the instructions of the client for the project, Rupert West.

1.2 The address of the site is 34A King Henry's Road, London NW3 3RP and is located at approximate Ordnance Survey grid reference (OSNGR) 527780E, 184255N. The site comprises the lower ground floor flat of a four-storey property, including rear garden and front amenity area. A *Site Location Plan (Drawing 000 revision A, dated February 2017)* and *Existing Plans, Elevations and Sections (Drawings 100, 101, 200, 300, 301 & 302 revision A, dated February 2017)* have been appended to this report.

1.3 It is to our understanding that the proposed development involves extension of the lower ground floor level out from the existing footprint to front, rear and side. The lower ground floor level will be lowered as part of the development. *Proposed Plans, Elevations and Sections (Drawings 001, 102, 103, 201, 202, 203, 303, 304 & 305 revision A, dated February 2017)* have been appended to this report.

1.4 A Phase I Desk Top Study was not requested by the client.

1.5 The current site investigation was commissioned to provide information on the sub-soil conditions of the site in order to provide information to support basement and foundation design, together with preliminary contamination assessment, testing for waste disposal purposes and a preliminary ground gas risk assessment.

1.6 In addition to the site investigation, a limited groundwater/ ground gas monitoring survey was carried out using the monitoring standpipe installed during the current investigation in borehole BH1.

1.7 This report presents the work carried out and discusses the findings.

2.0 SUMMARY OF FIELDWORK EXECUTED

2.1 All fieldwork and contamination sampling was generally executed in accordance with applicable British Standard and accepted industry good practice (Ref 1 & 2).

2.2 The borehole and trial pit locations are indicated on the appended *Sketch Fieldwork Location Plan.*

2.3 The work at this site was undertaken on 11th October 2016 and comprised the following elements:

Continuous Flight Auger (c.f.a.) Borehole

2.4 A single c.f.a. borehole (BH1) was undertaken in the front garden to a depth of 8.1m below existing ground level (bgl).

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

2.6 Shear Vane tests were undertaken throughout the borehole in order to provide additional information on the consistency of the material encountered.

2.7 Upon completion of borehole BH1 a combined groundwater/ground gas monitoring standpipe was installed to a depth of 8.0m bgl.

2.8 Full details of the borehole findings are given on the appended *Borehole Record Sheet*.

Hand Excavated Trial Pits

2.9 The scope of works also included the excavation of two trial pits (TP1 & TP2) undertaken to expose and record existing foundations. Both trial pits were undertaken at lower ground floor level.

2.10 TP1 was excavated alongside the base of the external staircase towards the western side of the site. TP1 found the brick wall corbelled onto Made Ground at a depth of 0.26m bgl.

2.11 TP2 detailed two sections (A & B). Section A detailed the boundary wall with 32 King Henry's Road and Section B detailed the front wall of 34 King Henry's Road. Section A found the brick wall set directly into Mad Ground at a depth of 0.4m bgl. Section B found the brick wall corbelled onto Made Ground at a depth of 0.3m bgl.

2.12 Full details of the trial pit findings are given on the appended *Trial Pit Record Sheets.*

Groundwater & Ground Gas Monitoring

2.13 Following the initial site work, two monitoring visits have been undertaken to measure groundwater and ground gas within the site using the installation fitted within borehole BH1 on 28th October and 10th November 2016.

2.14 The concentrations (%v/v) of methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), hydrogen sulphide (H_2S) and carbon monoxide (CO) were recorded within the boreholes, along with the barometric pressure and gas flow (l/min) measurements.

2.15 Concentrations of Volatile Organic Compounds (VOC) were also recorded (in ppm) using a Photo-Ionisation Detector (PID).

2.16 Full details of the readings are included on the appended *Groundwater/Ground Gas Monitoring Record Sheet.*

3.0 GEOLOGICAL SETTING

3.1 According to information published by the British Geological Survey (BGS) the underlying geology at this site is shown as the London Clay Formation. No superficial deposits were recorded.

3.2 London Clay

It is inferred 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.

When exposed to the weathering process the upper regions of the London Clay 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 changes in moisture content and is prone to shrinkage and swelling (settlement and 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 is believed to have occurred. This action often completely destroys the structure of the material and can involve a serious loss of strength. As the soil composition is derived mostly from materials local to the point of deposition, the lithology can be variable and reflects that of the parent strata.

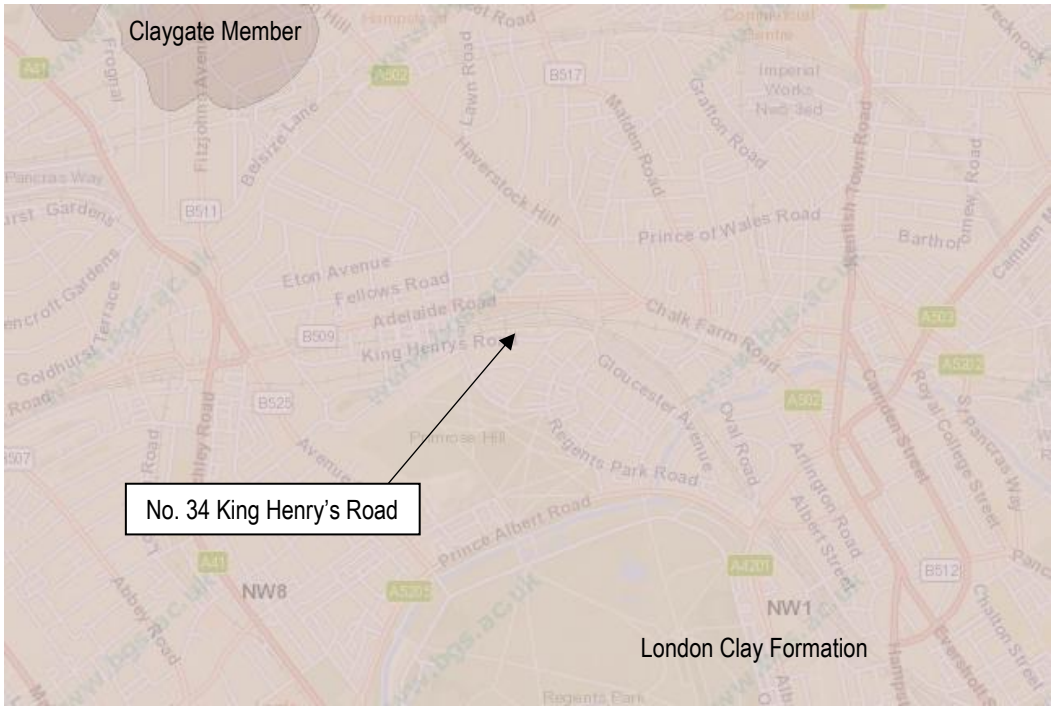

Figure 1. Site BGS Geological Plan (Contains British Geological Survey materials © NERC 2016. Base mapping is provided by ESRI)

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 to Top of Strata (m bgl)	Depth to Bottom of Strata (m bgl)	Stratum
0.00	0.10	Concrete
0.10	0.46+/2.00	Made Ground
2.00	8.10+	Weathered London Clay Formation: *stiff to very stiff fissured brown silty CLAY*

4.2 It should be noted that the Made Ground depths recorded above are those encountered in the borehole and trial pits 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 No groundwater was recorded during the drilling process of the current investigation. During the two monitoring visits groundwater was recorded in BH1 at depths of 6.29m and 5.16m bgl.

4.4 Roots of live and dead appearance up to 1mm in diameter were observed in BH1 and TP2 (section B) to depths of 1.7m and 0.5m bgl respectively.

5.0 LABORATORY TESTING

5.1 The following laboratory testing has been carried out on samples recovered from the borehole 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 3).

5.3 The chemical testing was carried out in accordance with standard industry methods in a UKAS approved laboratory which is also currently accredited in accordance with MCERTS for the majority of its testing. Further information regarding this accreditation is available on request together with a full list of test methods if required.

5.4 Atterberg Limits and Moisture Content Tests

The Atterberg Limits and moisture content have been determined for four samples of Weathered London Clay from the site.

Weathered London Clay

For the samples tested the liquid limit was found to range between 78% and 88%, with a mean of 82%, the plastic limit between 21% and 22%, the plasticity index between 56% and 67%, with a mean of 61%, and the modified plasticity index between 53% and 63%, with a mean of 57%. The moisture content of these samples was found to range between 30% and 34%.

These results indicate that the samples are classified as a Clay of 'very high' (CV) plasticity in accordance with the Casagrande Geotechnical classification system.

5.5 Particle Size Distributions

The particle size distribution has been determined for two samples of the Weathered London Clay Formation from the site.

The results are presented as grading curves appended to this report.

5.6 pH and Sulphate Tests

The pH and sulphate content has been determined for three samples from the site.

The pH value was found range between 7.5 and 7.6 with the sulphate content, on a 2:1 water:soil extract found to vary between 0.08 and 3.10 g/l.

6.0 GEOTECHNICAL ASSESSMENT

SUMMARY OF PROPOSED DEVELOPMENT

6.1 It is to our understanding that the proposed development involves extension of the lower ground floor level out from the existing footprint to front, rear and side. The lower ground floor level will be lowered as part of the development. *Proposed Plans, Elevations and Sections (Drawings 001, 102, 103, 201, 202, 203, 303, 304 & 305 revision A, dated February 2017)* have been appended to this report.

6.2 Full details of the proposed construction are not yet developed and it assumed that they will be subject to the findings of this investigation. As a consequence the foundation design discussed 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 or recommended foundation type may need to be altered accordingly.

SHALLOW FOUNDATIONS

6.4 At the location of BH1 Made Ground was encountered to a maximum depth of 2.0m bgl. Made Ground is by its nature heterogeneous in composition and therefore its engineering properties are likely to be variable both laterally and vertically across the site. Therefore it is recommended that in all cases foundations are taken below the Made Ground and set within the underlying natural soils.

6.5 Foundations are anticipated to be set at a depth of approximately 3.0m below the top of BH1 at which foundations are anticipated to be set within stiff silty Weathered London Clay.

6.6 Based on results of the in-situ and laboratory testing, in conjunction with empirical correlations (Bjerrum, 1972), an allowable bearing pressure not exceeding 84 kPa can be adopted for foundation design at a depth of 1.0m bgl at which settlements are expected to be within normal acceptable tolerances. By calculation, the safe bearing capacity increases at a rate of 7 kPa with every metre increase in depth.

Depth	*Safe Bearing Capacity (kNm^{-2})*
1.0	84
1.5	88
2.0	91
2.5	95
3.0	98
3.5	102
4.0	106

PILED FOUNDATIONS

6.7 In the event that shallow foundations are not suitable for the proposed development piles will offer a suitable alternative. Given the nature of the ground conditions encountered and the proximity to adjacent residential buildings, a non-displacement pile type (e.g. bored cast-in-place, hollow stem auger CFA, or similar) is considered most appropriate. This type of pile construction will generate pile arisings and therefore the piling technique should be selected to minimise spoil and otherwise the arisings will need to appropriately managed.

6.8 It is beyond the scope of this investigation to provide a full and detailed pile design and the advice of a specialist piling contractor should be sought in this respect. However, the following soil engineering parameters listed below are given for guidance purposes only. These soil parameters/assumptions relate to "static design" for vertically loaded single piles:

Made Ground	
Bulk unit weight, γ_b	18 kN/m^3
Effective angle of internal friction, φ'	0
Undrained shear strength, Su	0
London Clay	
Bulk unit weight, γ_b	20 kN/m^3
Effective angle of internal friction, φ'	18-22º
Undrained shear strength, Su	45-90+ kN/m^2 (based on in-situ and laboratory testing, and local case studies)

6.9 The following are estimated safe working loads (axial capacity) for a range of typical diameters for single bored piles extending from 7.0 to 13.0m below ground level. It should be noted that for piles extending beyond 10.0m below ground level the clay strength has been assumed, and in the event that pile loads exceed the required capacity of a pile end bearing approximately 10.0m below ground level, it is essential that a deeper borehole is carried out to a depth of approximately 3.0m below the deepest pile. Whilst larger diameter piles can be used to ensure the piles fall within the 10.0m depth limit, it is considerably more economical to carry out a deep site investigation and adopt a foundation solution with more, smaller diameter, deeper piles.

Pile Type	Depth (mbgl)	Diameter (m)	Estimated safe pile capacity (kN)
Bored	7.0	0.30	59
Bored	10.0	0.30	107
Bored	13.0	0.30	155
Bored	7.0	0.35	72
Bored	10.0	0.35	129
Bored	13.0	0.35	186

6.10 It is recommended that the advice of competent piling contractors be sought as to the most suitable pile type at this site and for confirmation of the order of working load achievable given the ground conditions encountered and the proprietary pile type selected.

6.11 Made Ground has been identified within this site which should always be treated as a potential source of contamination. With regard to the possible downward migration of contaminants the recommendations given in the Environment Agency in respect of piling in contaminated land should be followed.

RETAINING WALL & BASEMENT CONSTRUCTION

6.12 The full design of temporary and permanent retaining structures is beyond the scope of this investigation. Retaining structures and basements should be designed in accordance with accepted good practice such as that set out within CIRIA guidance C580 (Ref 4) or similar (e.g. BRE GBG72). The calculation of permanent lateral pressures against the sides should relate to long-term (effective) stress analysis.

6.13 Based on the findings of the site investigation undertaken the following soil parameters are recommended for use in the retaining wall design:

Made Ground	
Bulk unit weight, γ_b	18 kN/m^3
Earth pressure coefficient at rest, K_0	0.3-0.4
Undrained shear strength, Su	0
Effective angle of internal friction, φ'	20º
London Clay	
Bulk unit weight, γ_b	20 kN/m^3
Earth pressure coefficient at rest, K_0	2.0-2.45
Undrained shear strength, Su	45-90+ kN/m^2 (based on in-situ and laboratory testing)
Effective angle of internal friction, φ'	19-20º

6.14 No groundwater was recorded during the drilling process of the current investigation. During the two monitoring visits groundwater was recorded in BH1 at depths of 6.29m and 5.16m bgl. Groundwater may be subject to seasonal variation and may be present at higher levels within the site at other times of the year or under different circumstances to those prevailing at the time of investigation.

6.15 Design of the retaining walls should include allowance for groundwater in accordance with accepted good design practice and allowance for hydrostatic forces to both the ground bearing floor slab and retaining walls should be based on site specific hydrological and hydrogeological assessment. In addition the basement design should include appropriate waterproofing systems compliant with current standards and good practice (BS8102:2009 and applicable NHBC guidance) compatible with the retaining wall and foundation design.

6.16 Allowance should be made for appropriate groundwater control during construction cognisant of the prevailing site conditions and some form of dewatering may be needed.

6.17 Groundwater/surface water should be prevented from accumulating at the base of foundation excavations. It is important that the base of foundation excavations is kept dry and the exposed formation is protected to prevent softening by exposure to surface water. In the event that the formation is exposed, the material should be inspected immediately prior to floor slab construction and any soft spots are excavated and materials replaced and compacted prior to pouring foundation concrete. Alternatively 'blinding' concrete may be used to preserve the formation prior to foundation being constructed.

ANTICIPATED GROUND MOVEMENTS

6.18 London Clay can be a particularly challenging soil. It is an overconsolidated material, making it stiff and typically almost impermeable. The clay is generally competent and resists further compression under compressional loading. Below a depth of about 50m this clay gives way to substantial amounts of water-bearing silt and sand. When the clay is unloaded by excavations in-situ stress is relieved and it has a potential to expand. Any immediate rebound is generally small in magnitude and is 'lost' in the excavation process. However, following excavation the material has a potential to continue to swell. This can produce significant uplift at excavated formation level. The uplift forces need to be properly assessed and accounted for within the structural design of the basement.

6.19 Similarly, lateral stress release in the ground surrounding the excavation by both foundation construction and excavation in front of the retaining structure will manifest itself in lateral and associated vertical ground movement at the edge of excavation and line of foundations/retaining structure and extending back from the edge of the excavation/line of basement wall. The magnitude of lateral and vertical movement and the limit of its extent beyond the excavation will depend on the nature of the soils, the foundation system, and the construction methodology. There is published empirical data available to predict the degree of movement that can be expected (CIRIA C580) (Ref 4).

6.20 It is important to ensure that the construction sequence and construction method statement (CMS) is developed based on the specific development system proposed and with full recognition of anticipated ground movements as assessed from site specific Ground Movement Analysis (GMA). It is implicit within this that good standards of workmanship will be maintained throughout so as to minimise and otherwise ameliorate the effects of ground movement associated with basement construction.

SHALLOW EXCAVATIONS

6.21 Shallow excavations within the site will most likely be within Made Ground and the London Clay Formation. Within Made Ground short term support is likely to be required to maintain the excavations. The London Clay Formation will by contrast be self-supporting to some degree and as such excavations below Made Ground may not require support in the short term. All excavations will be subject to normal health and safety considerations.

SWELLING AND SHRINKAGE

6.22 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. 5).

BURIED CONCRETE

6.23 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 be variable and ranges between 0.08 and 3.10 g/l (measured as soluble SO_4) with a pH of 7.5 to 7.6. Taking the worst case data, the soils are classified as DS-4 in accordance with BRE guidance (Ref 6).

7.0 SUMMARY & RECOMMENDATIONS

7.1 At the location of BH1 Made Ground was encountered to a maximum depth of 2.0m bgl. Made Ground is by its nature heterogeneous in composition and therefore its engineering properties are likely to be variable both laterally and vertically across the site. Therefore it is recommended that in all cases foundations are taken below the Made Ground and set within the underlying natural soils.

7.2 Based on results of the in-situ and laboratory testing, in conjunction with empirical correlations (Bjerrum, 1972), an allowable bearing pressure not exceeding 84 kPa can be adopted for foundation design at a depth of 1.0m bgl at which settlements are expected to be within normal acceptable tolerances. By calculation, the safe bearing capacity increases at a rate of 7 kPa with every metre increase in depth.

7.3 Retaining structures and basements should be designed in accordance with accepted good practice such as that set out within CIRIA guidance (C580 (Ref 4) or similar (e.g. BRE GBG72). The calculation of permanent lateral pressures against the sides should relate to long-term (effective) stress analysis.

7.4 Design of the retaining walls should include allowance for groundwater in accordance with accepted good design practice and allowance for hydrostatic forces to both the ground bearing floor slab and retaining walls should be based on site specific hydrological and hydrogeological assessment. In addition the basement design should include appropriate waterproofing systems compliant with current standards and good practice (BS8102:2009 and applicable NHBC guidance) compatible with the retaining wall and foundation design.

7.5 It is important to ensure that the construction sequence and construction method statement (CMS) is developed based on the specific development system proposed and with full recognition of anticipated ground movements as assessed from site specific Ground Movement Analysis (GMA). It is implicit within this that good standards of workmanship will be maintained throughout so as to minimise and otherwise ameliorate the effects of ground movement associated with basement construction.

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Geotechnical Design Engineer

Reviewed By: Matthew Proctor BEng (Hons) FGS IAEG AMIEnvSc
Consultancy Director

End of report

References

1. BS 5930:1999+A2:2010 (2010) Code of practice for site investigations.
2. BS 10175:2011 (2011) Code of Practice for the Investigation of Potentially Contaminated Sites.
3. BS 1377:1990 (1990) Methods of Test for Soils for Civil Engineering Purposes.
4. CIRIA (2003) C580. Embedded Retaining Walls – Guidance for Economic Design
5. NHBC (2011) NHBC Standards
6. BRE (2005). Concrete in aggressive ground. Special Digest 1
7. CIRIA (2007). Assessing risks posed by hazardous ground gases in buildings.

a) This report has been prepared for the purpose of providing advice to the client pursuant to its appointment of Chelmer Site Investigation Laboratories Limited (CSI) to act as a consultant.
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.
d) Changes in the above may cause the opinion, advice, recommendations or conclusions set out in this report to become inappropriate or incorrect. However, in giving its opinions, advice, recommendations and conclusions, CSI has considered pending changes to environmental legislation and regulations of which it is currently aware. Following delivery of this report, we will have no obligation to advise the client of any such changes, or of their repercussions.
e) CSI acknowledges that it is being retained, in part, because of its knowledge and experience with respect to environmental matters. CSI will consider and analyse all information provided to it in the context of our knowledge and experience and all other relevant information known to us. To the extent that the information provided to us is not inconsistent or incompatible therewith, CSI shall be entitled to rely upon and assume, without independent verification, the accuracy and completeness of such information.
f) The content of this report represents the professional opinion of experienced environmental consultants. CSI does not provide specialist legal advice and the advice of lawyers may be required.
g) In the Summary and Recommendations sections of this report, CSI has set out our key findings and provided a summary and overview of our advice, opinions and recommendations. However, other parts of this report will often indicate the limitations of the information obtained by CSI and therefore any advice, opinions or recommendations set out in the Executive Summary, Summary and Recommendations sections ought not to be relied upon unless they are considered in the context of the whole report.
h) The assessments made in this report are based on the ground conditions as revealed by walkover survey and/or intrusive investigations, together with the results of any field or laboratory testing or chemical analysis undertaken and other relevant data, which may have been obtained including previous site investigations. In any event, ground contamination often exists as small discrete areas of contamination (hot spots) and there can be no certainty that any or all such areas have been located and/or sampled.
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l) Comments on groundwater conditions are based on observations made at the time of the investigation unless otherwise stated. Groundwater conditions may vary due to seasonal or other effects.
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p) This report is issued on the condition that CSI will under no circumstances be liable for any loss arising directly or indirectly from subsequent information arising but not presented or discussed within the current Report.
q) In addition CSI will not be liable for any loss whatsoever arising directly or indirectly from any opinion within this report.

Chelmer
Site Investigations
'Groundbreaking Services'

Factual Report

Site	34 Kings Henrys Road Camden NW3 3RF
Client	Rupert West
Date	11th October 2016
Our Ref	FACT/7806

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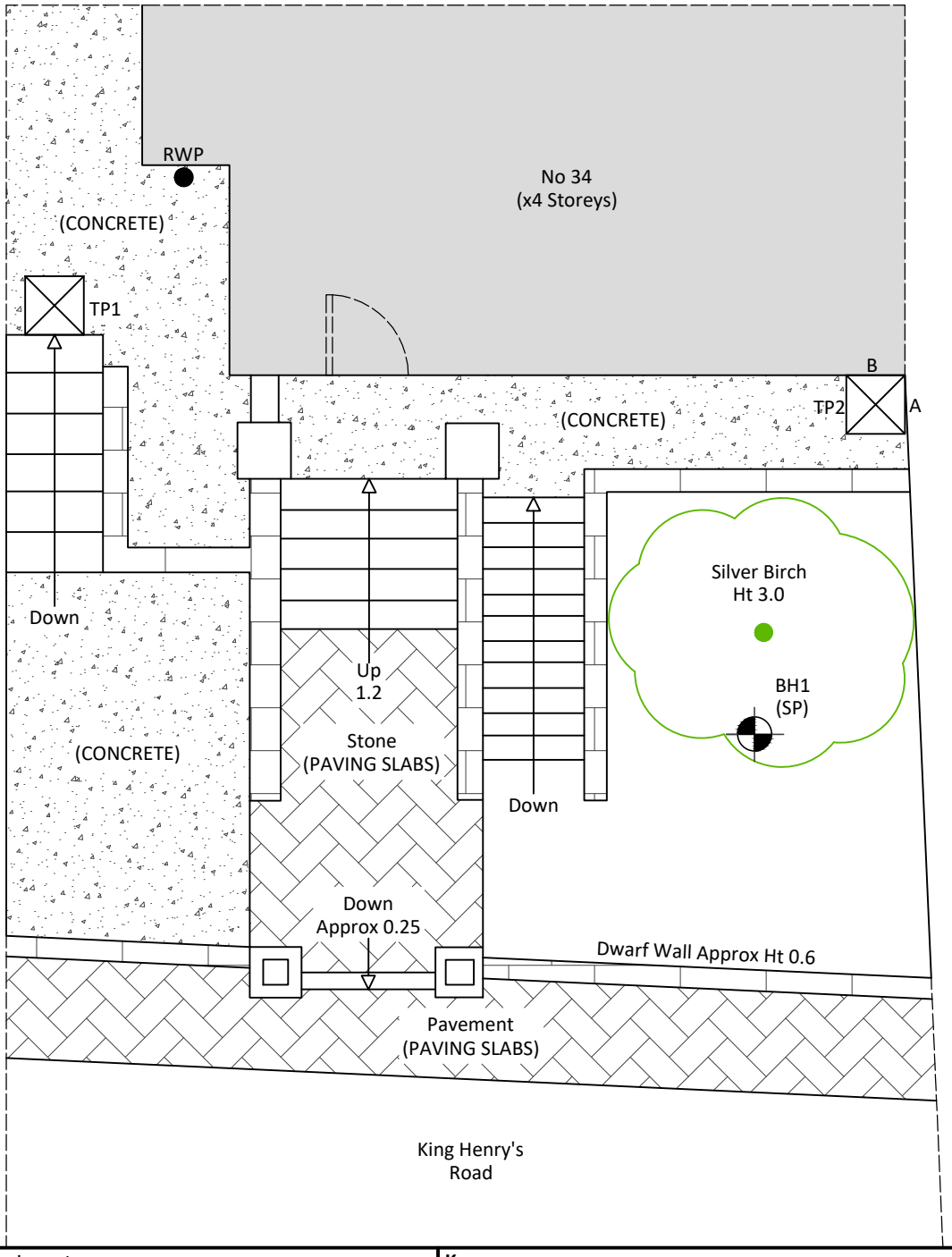
FACTUAL REPORT CONTENT

Client: Rupert West	**Scale:** N.T.S	**Sheet No:** 1 of 1	**Date:** 11.10.16	
Site: 34 King Henry's Road, Camden NW3 3RP	**Job No:** 7806	**Weather:** N/A	**Drawn by:** T.P.	**Checked by:** J.H.

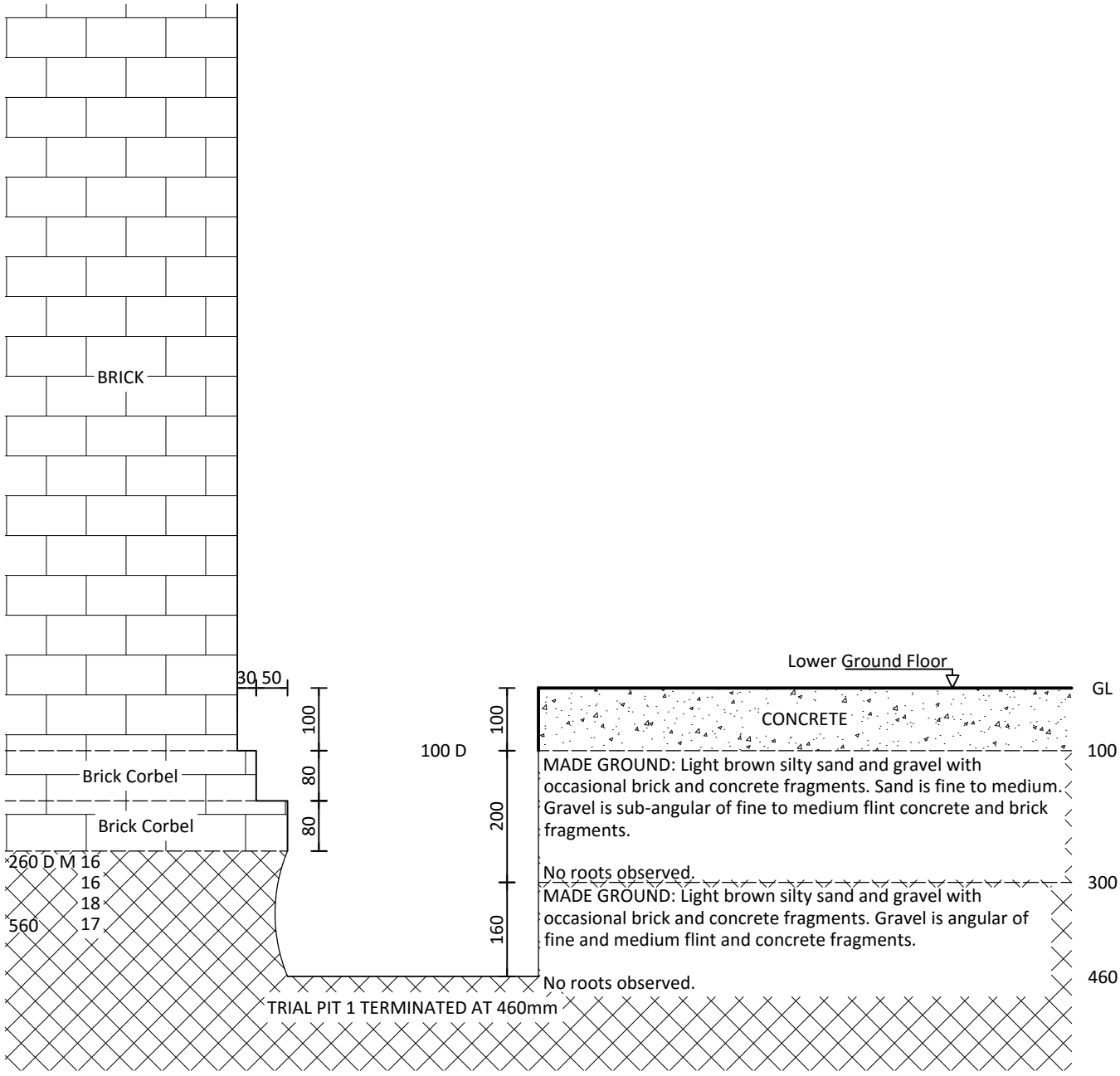


Remarks: All dimensions in metres.
On site tree identification for guidance only. Not authenticated.

Key:

BH Borehole | RWP/SVP Rainwater/ soil vent pipe | B A TP Trial pit and sections | Tree/shrub

Client: Rupert West	**Scale:** N.T.S	**Sheet No:** 1 of 1	**Date:** 11.10.16
Site: 34 King Henry's Road, Camden NW3 3RP	**Job No:** 7806	**Trial Pit No:** 1	**Weather:** Dry
Excavation Method: N/A		**Drawn by:** T.P.	**Checked by:** J.H.

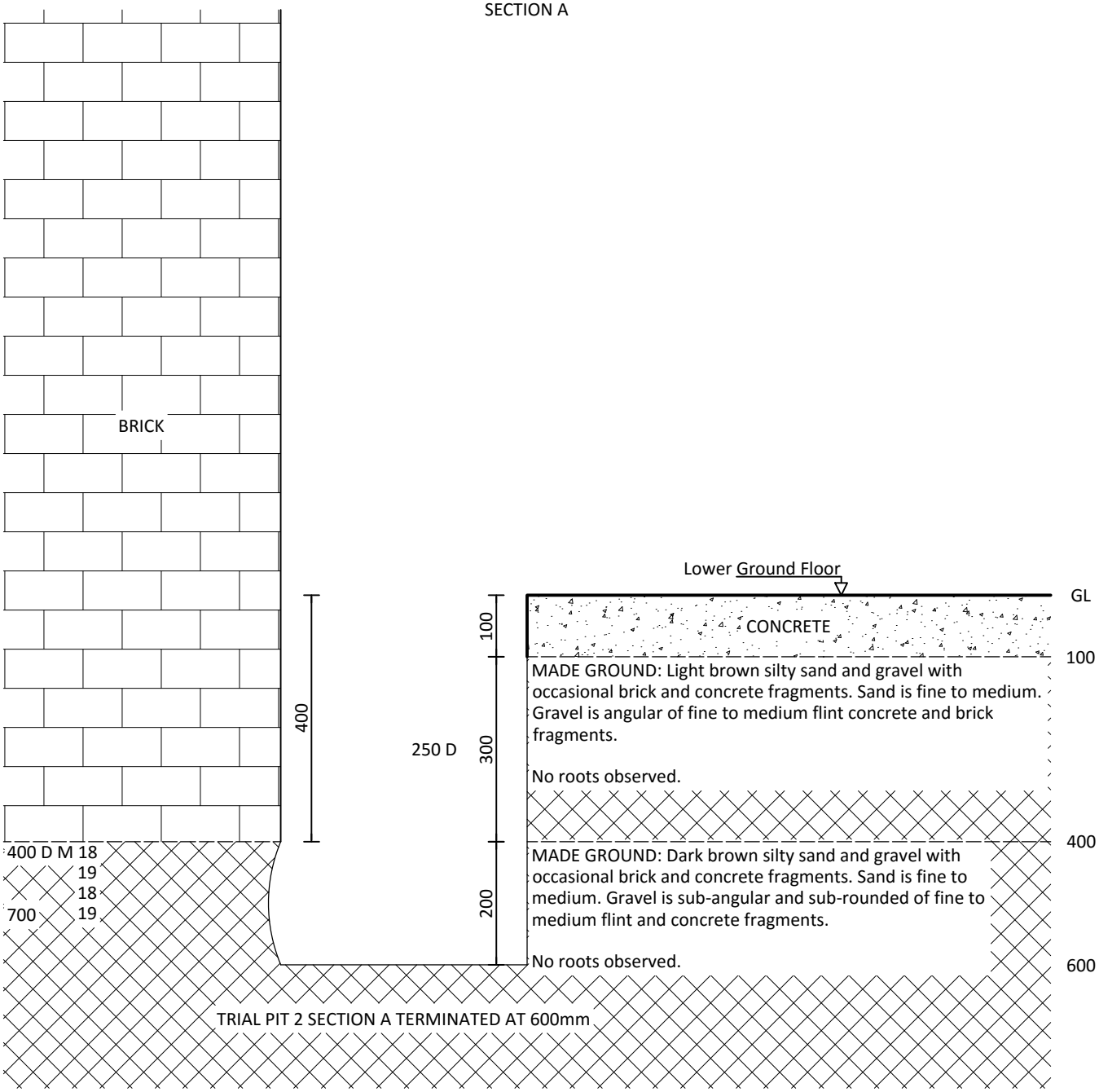


Remarks: All dimensions in millimetres.

Key: GL Ground Level
D Small Disturbed Sample
M Mackintosh Probe

Client: Rupert West	**Scale:** N.T.S	**Sheet No:** 1 of 1	**Date:** 11.10.16
Site: 34 King Henry's Road, Camden NW3 3RP	**Job No:** 7806	**Trial Pit No:** 2	**Weather:** Dry
Excavation Method: N/A		**Drawn by:** T.P.	**Checked by:** J.H.

SECTION A

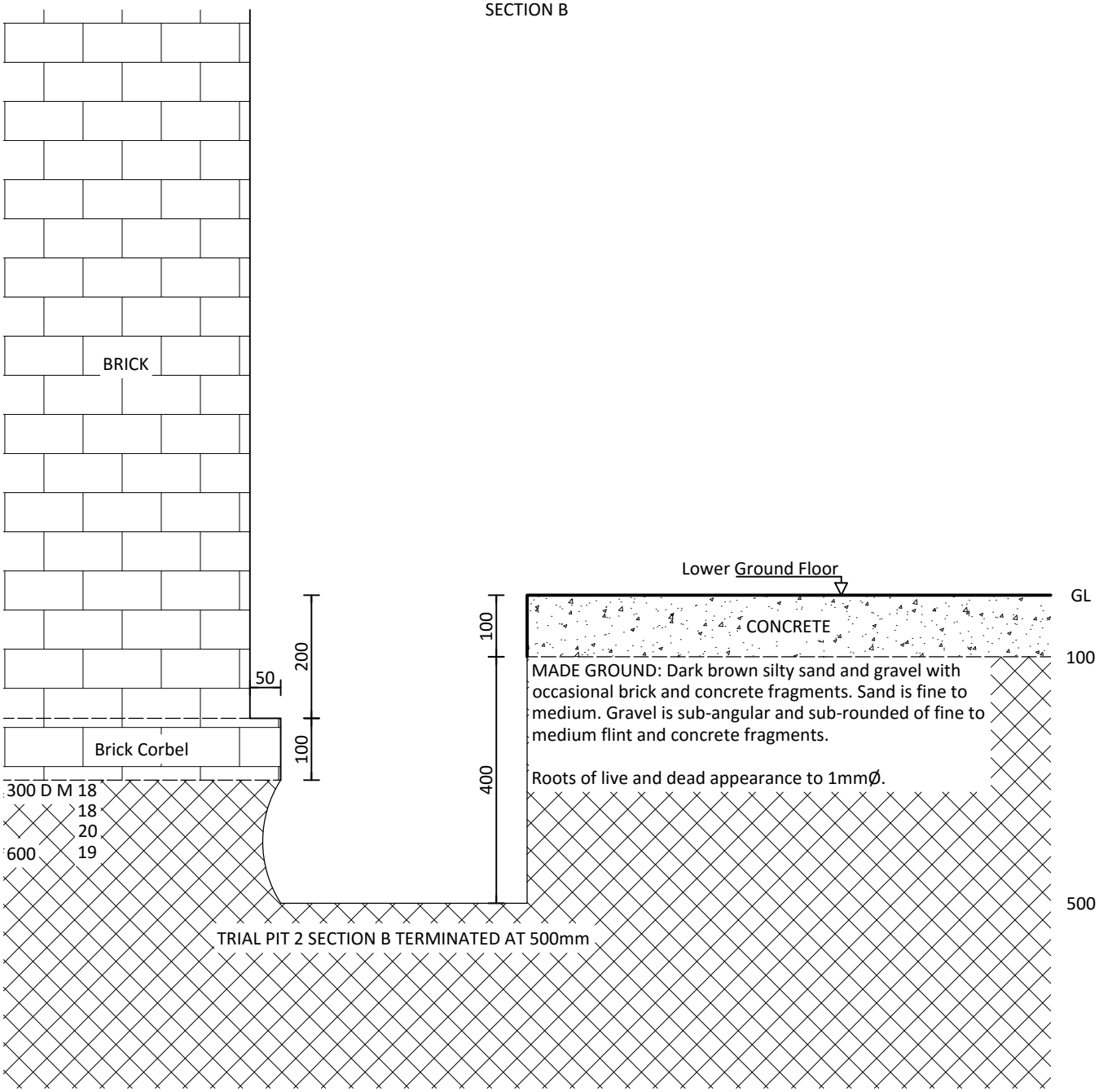


Remarks: All dimensions in millimetres.

Key: GL Ground Level
D Small Disturbed Sample
M Mackintosh Probe

Client: Rupert West	**Scale:** N.T.S	**Sheet No:** 1 of 1	**Date:** 11.10.16
Site: 34 King Henry's Road, Camden NW3 3RP	**Job No:** 7806	**Trial Pit No:** 2	**Weather:** Dry
Excavation Method: N/A		**Drawn by:** T.P.	**Checked by:** J.H.

SECTION B



Remarks: All dimensions in millimetres.

Key: GL Ground Level
D Small Disturbed Sample
M Mackintosh Probe

Chelmer Site Investigations
'Groundbreaking Services'

Client: Rupert West	**Scale:** N.T.S	**Sheet No:** 1 of 1	**Date:** 11.10.16
Site: 34 King Henry's Road, Camden NW3 3RP	**Job No:** 7806	**Borehole No:** 1	**Weather:** Dry
Boring Method: 100mmØ CFA Secondman		**Drawn by:** T.P.	**Checked by:** J.H.

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.	Concrete Slab	0.1					Roots of live and dead appearance to 1mmØ to 1.7m.		
0.1	MADE GROUND: Brown slightly sandy gravelly clayey silt with occasional brick and concrete fragments. Sand is fine to medium. Gravel is sub-angular of flint brick and concrete fragments.	0.2		D					0.5
0.3	MADE GROUND: Brown slightly sandy silty clay with occasional brick fragments. Sand is fine to medium.	0.5		D	V	66 66			1.0
0.8	MADE GROUND: Orange-brown silty clay with occasional brick fragments.	1.2		D			No roots observed below 1.7m.		1.5
2.0	Stiff fissured brown silty CLAY. (Weathered LONDON CLAY FORMATION)	6.1		D	V	74 76			2.0
				D					2.5
				D	V	80 80			3.0
				D					3.5
				D	V	84 82			4.0
				D					4.5
				D	V	86 88			5.0
				D					5.5
				D	V	94 94			6.0
	.....becoming very stiff from 7.0m.			D	V	120+ 120+			7.0
8.1	Borehole terminates at 8.1m			D	V	120+ 120+			8.0

Remarks: Borehole dry and open on completion.
75mmØ plastic standpipe installed to 8.0m (1.0m plain pipe, 7.0m slotted pipe, 1.0m bentonite sealing, 7.0 shingle surrounding, bung, valve and square plastic cover).

Key: G.L. Ground Level
D Small Disturbed Sample
V Pilcon Vane (kPa)

UKAS TESTING
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Chelmer
Geotechnical Laboratories
'Groundbreaking Services'

Laboratory Report

Site	**34 Kings Henrys Road, Camden, NW3 3RF**
Client	**Rupert West**
Date	**15-Nov-16**
Our Ref	**CSI7806**
CGL Ref	**CGL7806**

Chelmer Site Investigation Laboratories Ltd
Unit 15 East Hanningfield Industrial Estate, Old Church Road, East Hanningfield, Essex CM3 8AB
Essex: 01245 400930 | London: 0203 6409136 |info@siteinvestigations.co.uk | www.siteinvestigations.com

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 : CGL7806

Client Reference : CSI7806

For the attention of : Rupert West

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
2	Particle Size Distribution - Sieve & Sedimentation Charts
1	Limitations of Report Page

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 : CGL7806
Client : Rupert West
Client Reference : CSI7806
Site Name : 34 Kings Henrys Road, Camden, NW3 3RF

Date Received : 08/11/2016
Date Testing Started : 08/11/2016
Date Testing Completed : 15/11/2016
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]
BH1	0.5	80788	D													7.6	0.07	0.08	DS-1
BH1	2.0	80789	D	33	<5	88	21	67	0.18	63	CV			75					
BH1	2.5	80790	D													7.5	2.58	3.10	DS-4(m)
BH1	3.0	80791	D	30	<5	81	21	60	0.15	57	CV			80					
BH1	4.0	80793	D	34	<5	78	22	56	0.21	53	CV			83					
BH1	7.0	80795	D											120+		7.6	1.92	2.30	DS-3
BH1	8.0	80796	D	32	<5	81	22	59	0.17	56	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

UKAS TESTING
8284

Comments :-

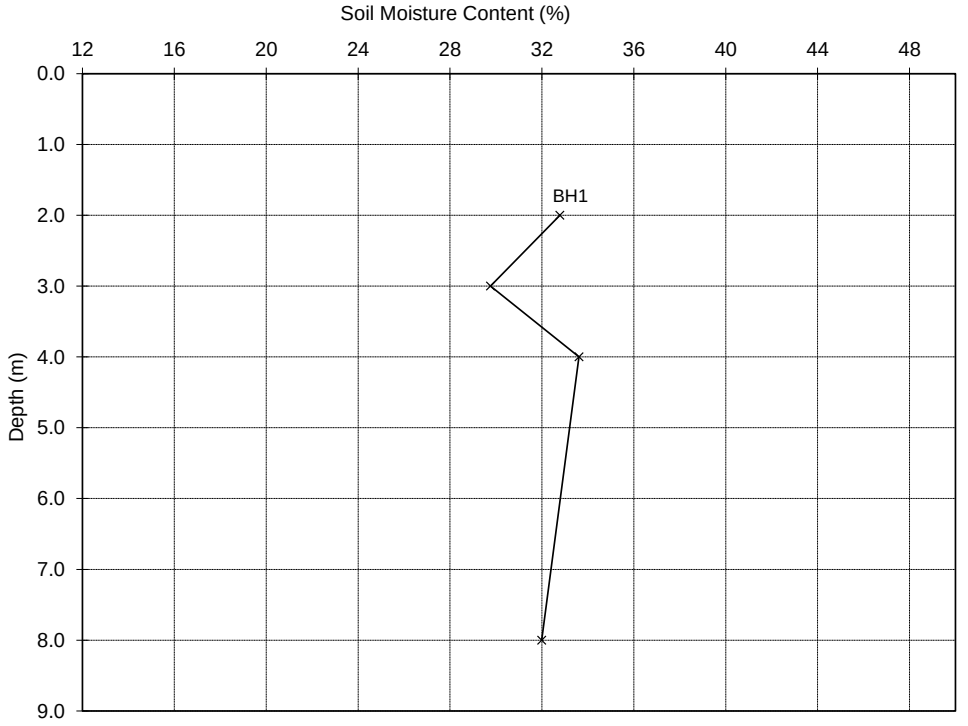
Technician :- CE
Checked By :- MC
Date Checked :- 15-Nov-16

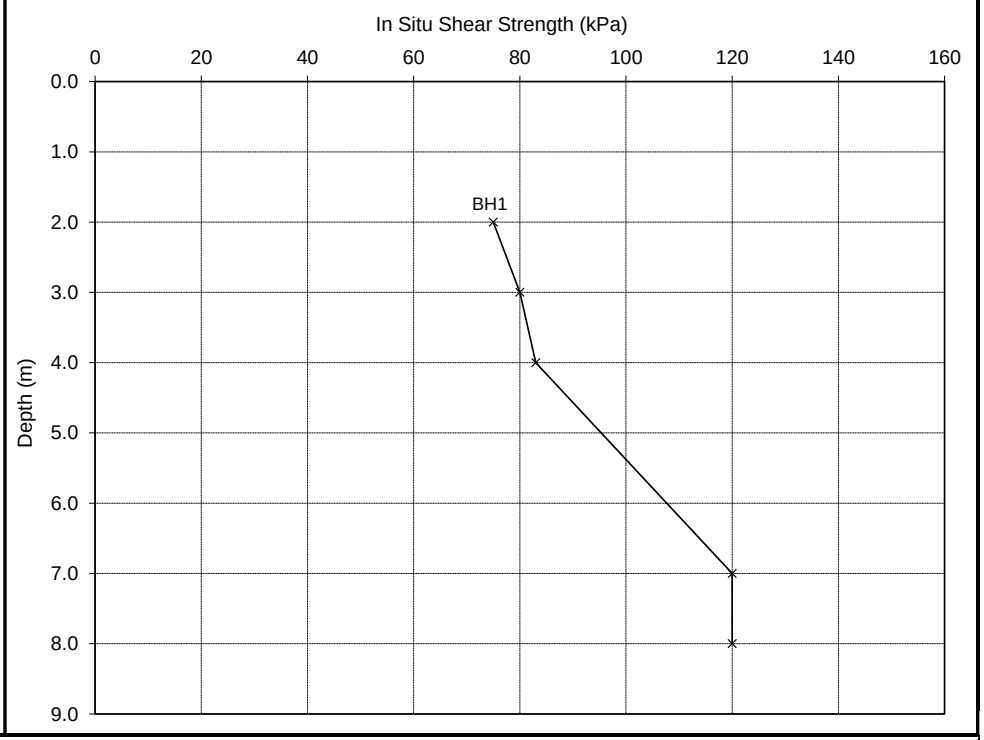
Laboratory Testing Results

Moisture Content/Shear Strength Profile

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL7806	Date Received :	08/11/2016
Client :	Rupert West	Date Testing Started :	08/11/2016
Client Reference :	CSI7806	Date Testing Completed :	15/11/2016
Site Name :	34 Kings Henrys Road, Camden, NW3 3RF	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 :-

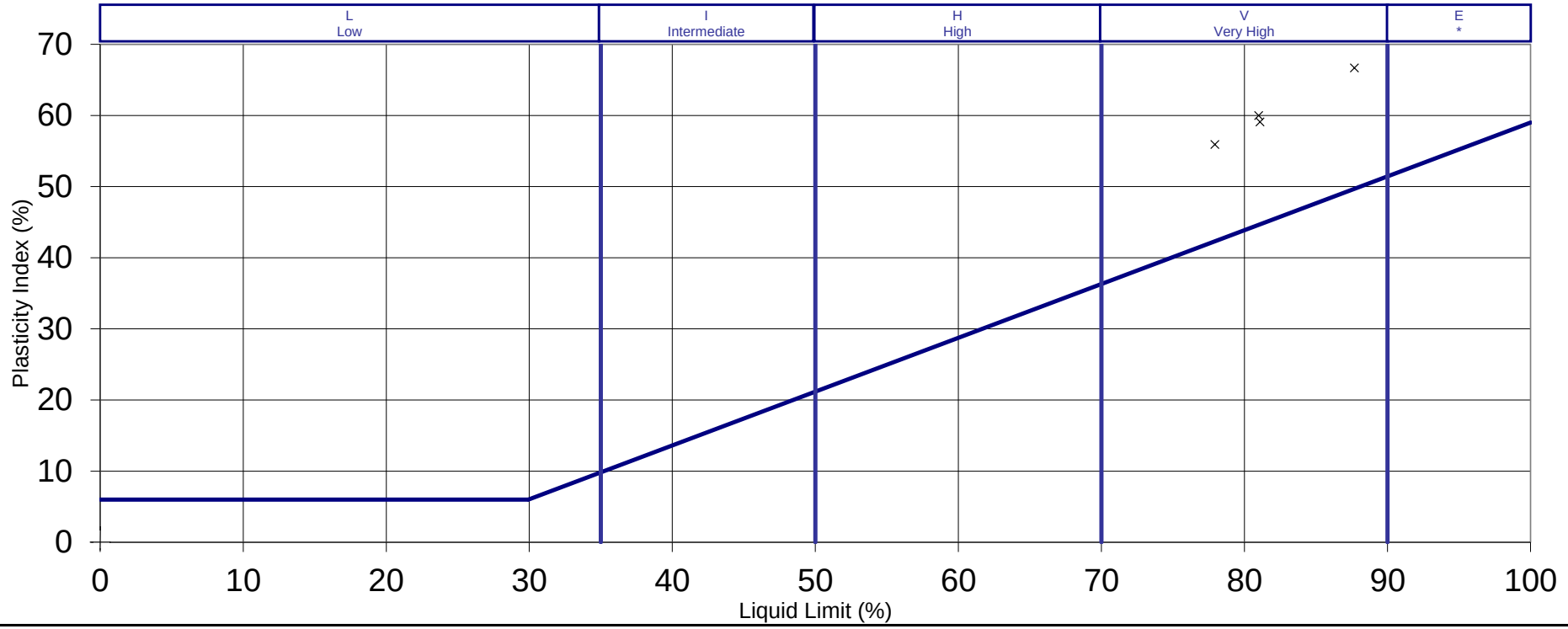
Checked By :- MC Date Checked :- 15-Nov-16

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 :	CGL7806	Date Received :	08/11/2016
Client :	Rupert West	Date Testing Started :	08/11/2016
Client Reference :	CSI7806	Date Testing Completed :	15/11/2016
Site Name :	34 Kings Henrys Road, Camden, NW3 3RF	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 :- BH1

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8284

Comments :-

Checked By :- MC Date Checked :- 15-Nov-16

PARTICLE SIZE DISTRIBUTION

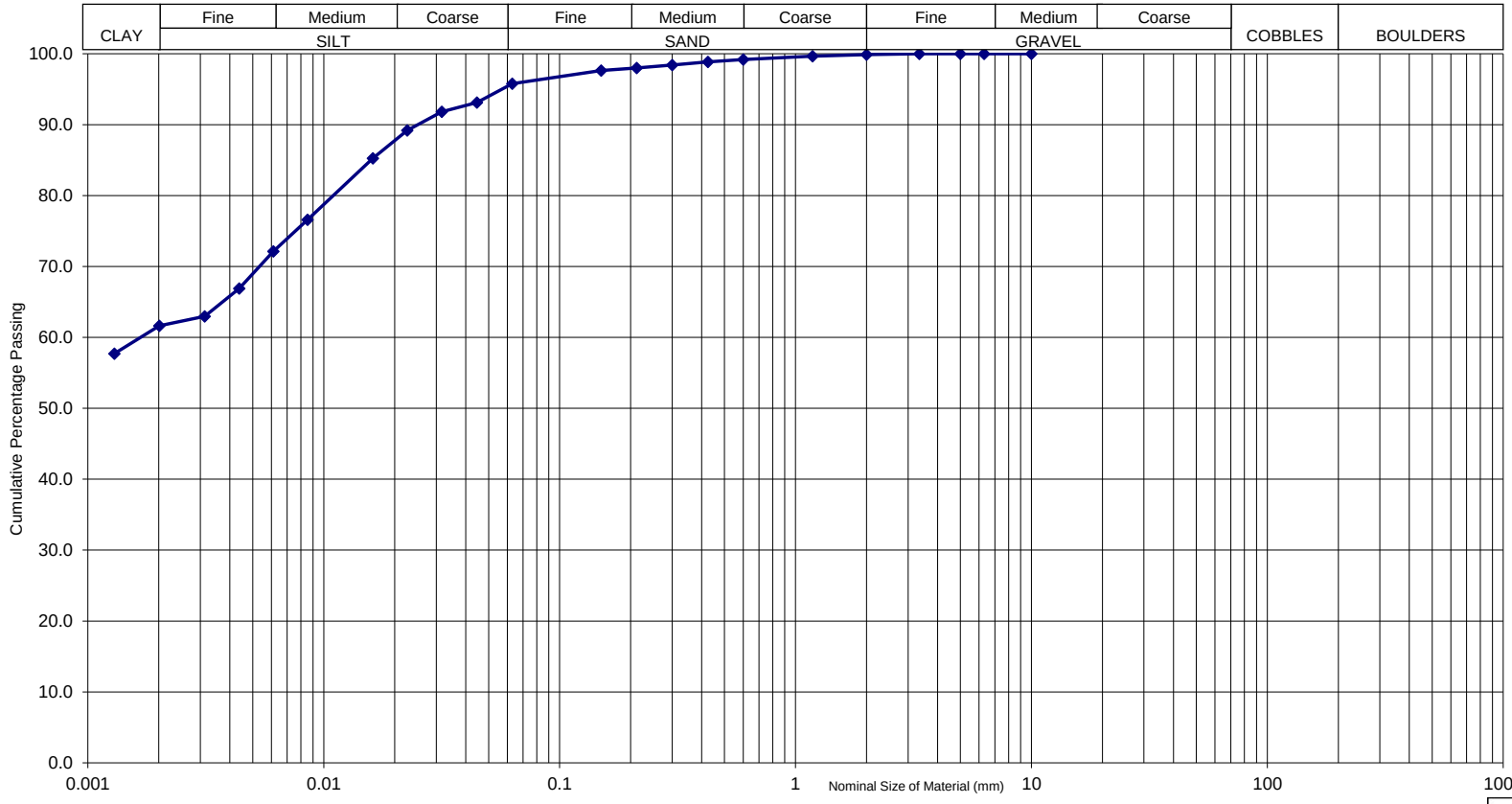
BS 1377-2:1990

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number : CGL7806
Sample Number : BH1
Depth (m) : 3.50
Sample UID : 80792

Site Name : 34 Kings Henrys Road, Camden, NW3 3RF
Soil Description : Brown Silty CLAY

Type of Sieving : Hydrometer
Date : 08-Nov-16
Tested By : SG
Laboratory : Chelmer Geotechnical CM3 8AB



Sieve Size (mm)	% Passing
90.0	100.0
75.0	100.0
63.0	100.0
50.0	100.0
37.5	100.0
28.0	100.0
20.0	100.0
14.0	100.0
10.0	100.0
6.3	100.0
5.0	100.0
3.35	100.0
2.00	99.9
1.18	99.7
0.600	99.2
0.425	98.9
0.300	98.4
0.212	98.0
0.150	97.6
0.063	95.8
0.045	93.1
0.032	91.8
0.023	89.2
0.016	85.3
0.009	76.6
0.006	72.1
0.004	66.9
0.003	63.0
0.002	61.6
0.001	57.7

Calculations :-

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100$$

$f = 100P/M_1$ (dry sieving)

f = Percentage of fines passing 0.063mm
M_1 = Mass of dried test sample before washing (kg)
M_2 = Mass of dried residue retained on the 0.063m (kg)
P = Mass of screened material remaining in the pan (kg)

Comments :-
Results Passing 63µm Sieve NOT UKAS accredited.

UKAS TESTING 8284

Checked By :- MC

Date Checked :- 16-Nov-16

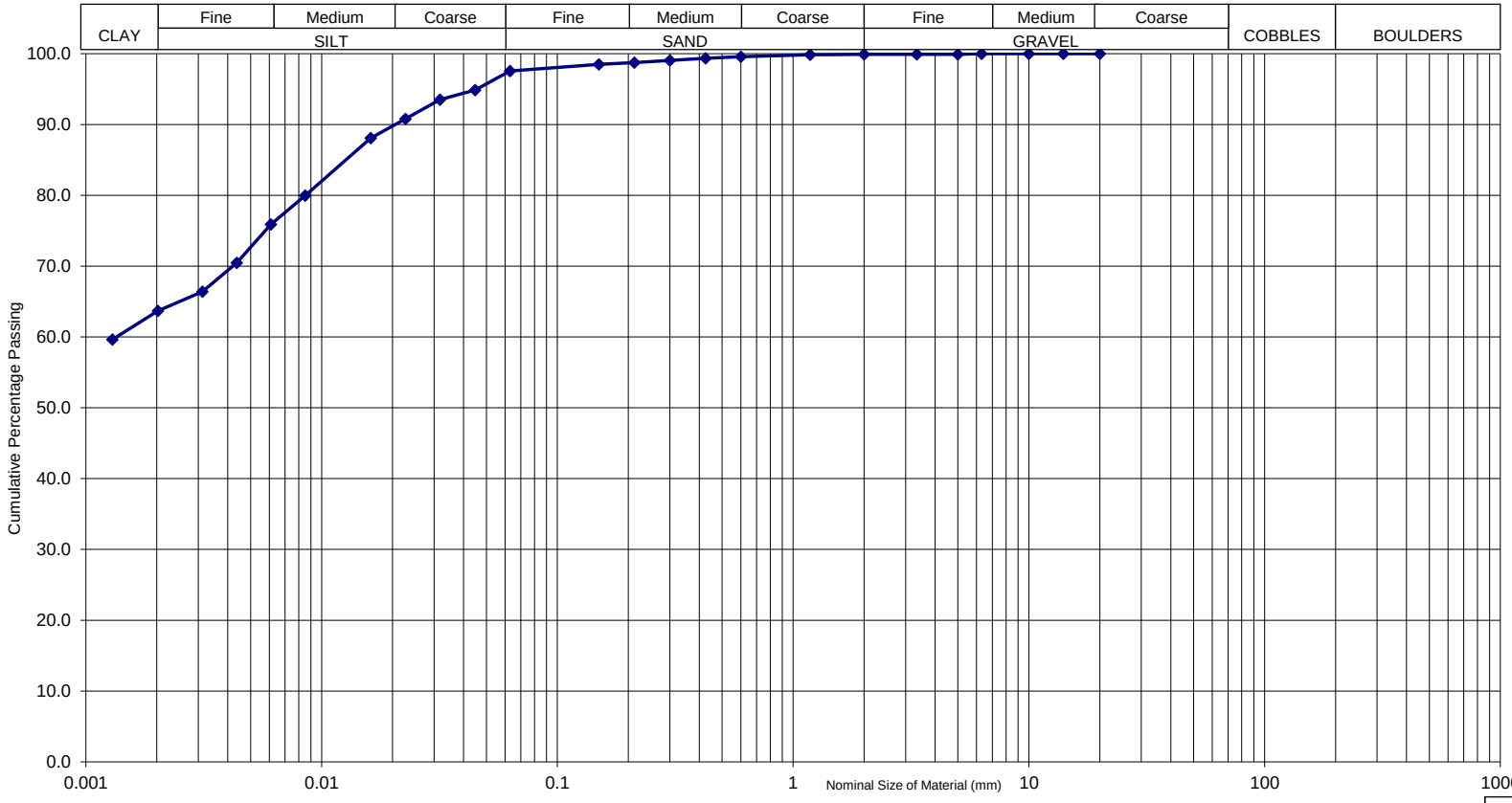
PARTICLE SIZE DISTRIBUTION

BS 1377-2:1990

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL7806	Site Name :	34 Kings Henrys Road, Camden, NW3 3RF
Sample Number :	BH1	Soil Description :	Brown Silty CLAY
Depth (m) :	4.50		
Sample UID :	80794		

Type of Sieving :	Hydrometer
Date :	08-Nov-16
Tested By :	SG
Laboratory :	Chelmer Geotechnical CM3 8AB



Sieve Size (mm)	% Passing
90.0	100.0
75.0	100.0
63.0	100.0
50.0	100.0
37.5	100.0
28.0	100.0
20.0	100.0
14.0	100.0
10.0	100.0
6.3	100.0
5.0	99.9
3.35	99.9
2.00	99.9
1.18	99.9
0.600	99.6
0.425	99.4
0.300	99.0
0.212	98.7
0.150	98.5
0.063	97.6
0.045	94.9
0.032	93.5
0.023	90.8
0.016	88.1
0.009	80.0
0.006	75.9
0.004	70.5
0.003	66.4
0.002	63.7
0.001	59.6

Calculations :-

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100$$

$f = 100P/M_1$ (dry sieving)

f = Percentage of fines passing 0.063mm
M_1 = Mass of dried test sample before washing (kg)
M_2 = Mass of dried residue retained on the 0.063m (kg)
P = Mass of screened material remaining in the pan (kg)

Comments :-
Results Passing 63µm Sieve NOT UKAS accredited.

UKAS TESTING 8284

Checked By :- MC Date Checked :- 16-Nov-16

8284

This report is personal to the client, confidential and non assignable. It is issued with no admission of liability to any third party.

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'

REPORT NOTES

Equipment Used

Hand tools, Mechanical Concrete Breaker and Spade, Hand Augers, 100mm/150mm diameter Mechanical Flight Auger Rig, GEO205 Flight Auger Rig, Window Sampling Rig, and Large or Limited Access Shell & Auger Rig upon request and/or access permitting.

On Site Tests

By Pilcon Shear-Vane Tester (kN/m^2) in clay soils, and/or Mackintosh Probe in granular soils or made ground and/or upon request Continuous Dynamic Probe Testing and Standard Penetration Testing.

Note:

Details reported in trial-pits and boreholes relate to positions investigated only as instructed by the client or engineer on the date shown.

We are therefore unable to accept any responsibility for changes in soil conditions not investigated i.e. variations due to climate, season, vegetation and varying ground water levels.

Full terms and conditions are available upon request.

Groundwater/Ground Gas Monitoring Record Sheet

Site Ref: 7806
Site Name: 34 King Henry's Road, Camden NW3 3RF

Well	Date	Methane Peak	Methane Steady	Methane GSV	Carbon Dioxide Peak	Carbon Dioxide Steady	Carbon Dioxide GSV	Oxygen	Atmos.	Flow	Response Zone	Depth to Water	CO	H2S	VOC
		%v/v	%v/v	l/hr	%v/v	%v/v	l/hr	%v/v	mbar	l/hr	m bgl	m bgl	ppm	ppm	ppm
BH1	28-10-16	0.2	0.1	-0.0002	0.7	0.5	-0.0007	20.9	1028	-0.1		6.29	0	0	0
	10-11-16	0.2	0.1	0.0000	1.5	0.8	0.0000	21.0	1000	0.0		5.16	0	0	0

Notes

NR = Not recorded
Values in Red exceed CIRIA 665 criteria (CO_2 >5.0% and CH_4 >1.0%)

CHELMER SITE INVESTIGATIONS	Penetration Test versus Depth Profile	Unit 15, East Hanningfield Industrial Estate, Old Church Road, East Hanningfield, Essex CM3 8AB Tel - (01245 400930) Fax - (01245 400933)

Project Name :	34A King Henry's Road	Job No. : GEO/7806 Date : October 2017

BH1		CORRECTED		Corrected values	
Depth (m)	Hand Vane value	(Hand vane correction factor, Bjerrum 1973)			
		PI	CF	Depth	Cu
1.00	66			1.00	46.2
2.00	75	67.00	0.7	2.00	52.5
3.00	80	60.00	0.73	3.00	58.4
4.00	83	56.00	0.75	4.00	62.25
5.00	87			5.00	65.25
6.00	94			6.00	69.56
7.00	120			7.00	88.8
8.00	120	59	0.735	8.00	88.2