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HENRY BOOT DEVELOPMENTS LIMITED

PARADISE ROAD, RICHMOND

PRELIMINARY PHASE II GEOENVIRONMENTAL ASSESSMENT REPORT

MLM Environmental
Townfield House
30-33 Townfield Street
Chelmsford
Essex
CM1 1QL

Tel: 01245 359 911
Fax: 01245 359001
Web: www.mlm.uk.com

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Prepared Katie Linehan
Graduate Geoenvironmental Engineer

Checked Mark Henderson
Principle Environmental Consultant

Approved K Bruce Jackson
Technical Director

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EXECUTIVE SUMMARY

This report has been prepared by MLM Environmental for Henry Boot Developments Limited who is proposing to redevelop the site at Paradise Road, Richmond as a commercial end use. The report presents an interpretation of the ground conditions and provides guidance on contamination issues.

Block paving up to 0.2mbgl was present across the majority of the site and overlies the Made Ground. The Made Ground was encountered in all the intrusive holes, which varied in thickness between 0.6m and 1.8m. Hackney Gravel was observed underlying the Made Ground in all boreholes whose thickness was between 1.1m in BH1 and 2.6m in BH3. The Hackney Gravel was described as medium dense green and orange slightly clayey SAND and medium dense orange brown sandy GRAVEL. The London Clay is underlying the Hackney Gravel but its full thickness was not proved.

Soil contamination not identified when compared with guidelines for the proposed commercial end use.

WRAS guidelines are exceeded and services protection is required.

Measures will be required for the protection of site workers and the general public during construction.

An assessment of foundation solutions has determined that shallow foundations to support the buildings would not be technically viable due to differential settlements and that a piled solution l should be considered for the building.

The basement excavation will need to be supported by either secant or sheet pile wall on all sides due to the presence of high groundwater table. Potential groundwater uplift forces will need to be considered in the basement design.

We would recommend further site investigation to identify fully the risk posed to groundwater from low levels of contamination present in BH2.

Marginally elevated carbon dioxide concentrations were present, which could require gas protection measures in new buildings. However, extended gas monitoring will be required to fulfil the design requirements of CIRIA document C665.

Prior to any demolition works or extensive refurbishment works it is a requirement to undertake a full access Type-3 asbestos survey.

Following the introduction of the national standard planning system in April 2008 it will be necessary to provide a Site Waste Management Plan (SWMP).

LIMITATIONS AND EXCEPTIONS

1. This report and its findings should be considered in relation to the terms and conditions proposed and scope of works agreed between MLM Environmental and the client.

2. The Executive Summary, Conclusions and Recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon until considered in the context of the whole report.

3. The assessment and interpretation of contamination and associated risks are based on the scope of work agreed with the client and the report may not be sufficient to address fully contaminations or to allow detailed remediation design to proceed without further investigation and analysis.

4. Any assessments made in this report are based on the ground conditions as revealed by the exploratory holes and pits, together with the results of any field or laboratory testing undertaken and, where appropriate, other relevant data which may have been obtained for the sites including previous site investigation reports. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which have not, therefore, been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available.

5. Interpretations and recommendations contained in the report represent our professional opinions, which were arrived at in accordance with currently accepted industry practices at the time of reporting and based on current legislation in force at that time.

6. Where the data available from previous site investigation reports, supplied by the Client, have been used, it has been assumed that the information is correct. No responsibility can be accepted by MLM Environmental for inaccuracies within the data supplied.

7. Whilst the report may express an opinion of possible configuration of strata between or beyond exploratory hole or pit locations, or on the possible presence of features based on visual, verbal or published evidence, this is for guidance only and no liability can be accepted for the accuracy.

8. Comments on groundwater conditions are based on observations made at the time of the investigation unless otherwise stated. It should be noted, however, that groundwater levels vary due to seasonal or other effects.

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10. This report is prepared and written in the context of the proposals stated in the introduction to this report and should not be used in a differing context. Furthermore, new information, improved practices and legislation may necessitate an alteration to the report in whole or in part after its submission. Therefore, with any change in circumstances or after the expiry of one year from the date of the report, the report should be referred to us for re-assessment and, if necessary, re-appraisal.

ACRONYMS & ABBREVIATIONS

Acronym / Abbreviation	Definition
ACM	Asbestos containing material
ADE	Average daily exposure
ASPT	Average score per Taxon
BOD	Biochemical oxygen demand
BH	Borehole
BRE	Building Research Establishment
BS	British Standard
BTEX	Benzene, Toluene, Ethyl benzene and Xylenes
CAT	Cable avoidance tool
CIRIA	Construction Industry Research and Information Association
CLEA	Contaminated Land Exposure Assessment
CLR	Contaminated Land Research reports
DEFRA	Department of the Environment, Food and Rural Affairs (formerly the DoE and DETR)
DETR	DETR Department of the Environment, Transport and the Regions (formerly the DoE and now Defra)
DO	Dissolved oxygen
DoE	Department of the Environment (then DETR and later Defra)
DQRA	Detailed quantitative risk assessment (Tier 2)
EA	Environment Agency
EPH	Extractable Petroleum Hydrocarbons
EQI	Environmental Quality Index
EQS	Environmental Quality Standards
FID	Flame ionisation detector
GC	Gas chromatography
GQA	General quality assessment
GQRA	Generic quantitative risk assessment (Tier 1)
HCV	Health criteria value
HHRA	Human health risk assessment
ICRCL	Interdepartmental Committee on the Redevelopment of Contaminated Land
ID	Index dose
LEL	Lower explosive limit
LOD	Limit of detection
mAOD	Metres above ordnance datum
mbgl	Metres below ground level
MCERTS	Monitoring Certification Scheme
MDI	Mean daily intake
NGR	National grid reference
NHBC	National House Building Council
NRA	National Rivers Authority (now the Environment Agency)
PACM	Potentially asbestos containing material
PAH	Polyaromatic hydrocarbon (a.k.a. polynuclear aromatic hydrocarbon)
pH	A measure of acidity of a solution, defined as the negative logarithm of the concentration of hydrogen ions in a substance

Acronym / Abbreviation	Definition
PPE	Personal Protective Equipment
RBCA	Risk-based contamination assessment
RMS	Remediation Method Statement
RQO	River Quality Objective
QRA	Quantitative risk assessment
TDI	Tolerable daily intake
SGV	Soil Guideline Value
SNIFFER	Scottish and Northern Ireland Forum for Environmental Research
SPT	Standard penetration test
SSTL	Site-specific target level
TDSI	Tolerable daily soil intake
TP	Trial pit
TPH	Total petroleum hydrocarbon
TPHCWG	Total petroleum hydrocarbon criteria working group
TOX	CLR 9 Toxicological Reports
UKAS	United Kingdom Accreditation Service
USEPA	United States Environmental Protection Agency
WHO	World Health Organisation
WQS	Water Quality Standards
WS	Window sample

1. INTRODUCTION

1.1. General

This report has been prepared by MLM Environmental for Henry Boot Developments Limited who is proposing to redevelop the site at Paradise Road, Richmond.

The extent of investigations and analyses undertaken as part of this study are considered sufficient to identify sources of contamination, pathways and targets, with comparison of sample analysis against guideline values and is also considered sufficient to allow assessment of ground conditions with respect to future construction.

The report provides a qualitative assessment of contamination risks to health and safety and the environment and provides a summary of recommended mitigation measures based on this qualitative assessment.

The report provides and assessment of ground conditions with respect to foundations, slabs and infrastructure and gives recommendations for appropriate solutions.

1.2. Terms of Reference

The terms of reference for the work were set out in a letter by MLM Environmental; ref. DMB/731117/001/KBJ dated 11 July 2008.

The proposals for site investigation included for the following scope of work:

- Utilities clearance and coring of hard surfacing at exploratory positions
- Excavation of three hand dug pits
- Cable percussive boreholes
- Installation of gas/groundwater monitoring wells
- In situ geotechnical testing
- Recovery of soil samples for chemical and geotechnical analysis
- Assessment of ground conditions with respect to foundation and infrastructure design
- A generic quantitative risk assessment of contamination and outline guidance on remediation

1.3. Report Structure

This report is divided into a number of sections, which contain:

- Site description
- Description of the intrusive investigations, monitoring and analyses undertaken
- Description of ground, groundwater and gas conditions
- Geotechnical and foundation assessment
- Comparison of chemical test results to relevant generic guideline values
- Conceptual site model

- Generic quantitative risk assessment using source-pathway-receptor scenarios
- Summary of risks and proposed remedial action
- Summary and conclusions
- Factual data from the investigation

1.4. Technical Approach

The process of assessment adopted in this report generally follows the model procedures for the management of contaminated land described in the Environment Agency Contaminated Land Report 11 (CLR11) (ref. 1).

The basic approach is:

- Hazard identification – establishing contaminant sources
- Hazard assessment – analysing the potential for unacceptable risks
- Risk estimation – predicting the magnitude and probability of the possible consequences
- Risk evaluation – deciding whether a risk is unacceptable

This report forms part of the CLR11 assessment process which is.

- Tier 1 preliminary assessment
- **Tier 2 generic quantitative risk assessment (GQRA) – this report**
- Tier 3 detailed quantitative risk assessment (DQRA).

1.5. Previous Reports

MLM Environmental has been provided with the following report to assist in this investigation:

- '*Phase I Desk Study and Conceptual model for Paradise road, Richmond*' prepared by Applied Geology on behalf of Tellus Estates, Report No. AG342-06-C05, dated 15/06/2006.

2. THE SITE

2.1. Location and Description

The site is located at 9 to 19 Paradise Road, Richmond, at approximate National Grid Reference 518033, 174788. The site covers an area of approximately 0.13 hectares.

The location plan of the site is presented as Figure 1.

The site is currently occupied by a three storey office building and associated hard standing. A basement is located at the eastern part of the building and it was flooded and therefore could not be inspected. The office building is currently vacant.

2.2. Proposed Development

The proposed to redevelopment is to comprise a three-storey office building with part basement, although there are two areas which are proposed only as single storey.

2.3. Site Reconnaissance

A walkover survey of the site was undertaken on 04 August 2008 as part of the Phase II works a summary of the findings is provided below:

Current Site Use/Structures/Buildings

The site is currently occupied by a three storey L-shaped brick building and associated car park. The building was formally utilised as offices. The office building has a basement level. Concrete bollards are located on Paradise Road and Halford Road located between the building and the pavement.

Site Boundaries

The existing building extends to the northern site boundary of block paving, bollards and concrete paving with paradise road located parallel to the site. The southern boundary is marked by a brick wall leading to Vinyard Passage further east. A building and wall bound the site to the east. The western boundary is marked by bollards on block paving extending to Halford Road which runs parallel to the site.

Site Topography

The site is generally level.

Water Features On-site

No water features were noted during the site walkover; however the basement of the existing build was flooded by 150mm of water.

Aboveground Storage Tanks (ASTs) & Underground Storage Tanks (USTs)

There were no observed ASTs or USTs on site during the walkover.

Hazardous Material and Waste Storage

No hazardous material or waste storage was observed on site during the site walkover.

Asbestos Containing Materials (ACMs)

Although the building was not subjected to internal inspection, ACMs were observed during the walkover.

Surrounding Site Use

North of the site is Paradise Road with residential land use extending farther north. South of the site is also utilised for residential land use. East of the site is a walkway and office building. West of the site is Halford road with residential properties extending further west.

2.4. Summary of Site History

According to the Phase I Desk Study prepared by Applied Geology, the site has been developed from 1866 with semi-detached housing which were demolished by 1913. By 1930 redevelopment occurred with a number of small builds and a garage constructed by 1960. Some time between 1960 and 1996 the site was redeveloped with the current L-shaped office building.

2.5. Geological Setting

Details of the geology underlying the site have been obtained from the British Geological Survey map, sheet no.270, 'South London', solid and drift edition, 1:50,000 scale, published 1981.

The geological map indicates that only the north-western corner of the site is underlain by superficial deposits of the "River Terrace 3 Deposits" now referred to as the Hackney Gravel.

The whole of the site is underlain by the solid geology of the London Clay described as "stiff, blue clay becoming brown when weathered with selenite crystals".

The site is within an urban area and, although not indicated as present, the presence of Made Ground cannot be discounted.

2.6. Hydrogeological Setting

The Phase I Desk Study and Conceptual model for Paradise road, Richmond' prepared by Applied Geology indicates that the site partially overlies a Minor Aquifer, namely the Hackney Gravel, of High leaching potential and also a Non-aquifer namely the London Clay. The site is not located within a source protection zone.

2.7. Hydrological Setting

The nearest surface watercourse is the River Thames located 350m west of the site. The Environment Agency web site indicates the site lies on the boundary of the flood plain of the River Thames.

2.8. Potential Sources of Contamination Identified within the Phase I Desk Study

On site: possible Made Ground associated with previous site development is anticipated. A garage was located on site in the 1960s and any fuel tanks located on site are a potential source of hydrocarbon contamination, as wells as hydrocarbon vapour.

Off site: A graveyard was identified 1km east of the site which could be a source of ground gas and mobile contaminants.

3. ENVIRONMENTAL INVESTIGATION

3.1. Fieldwork

The intrusive site work was undertaken between 04 and 07 August 2008. No gas or groundwater monitoring was undertaken during the site works. The site works were carried out in accordance with practises outlined in BS5930:1999 (ref.2).

3.2. Scope of fieldwork

Cable Percussive Boreholes

A total of four boreholes (ref. BH1 to BH4) were constructed across the site using a Cable Percussive Shell and Auger Borehole Rig to a maximum depth of 25mbgl. Boreholes were constructed to provide general site coverage. Upon excavation to the required depth or when obstructions were met, all boreholes were completed with gas and groundwater monitoring installations.

Geotechnical SPT testing was undertaken in all boreholes, details of which are included on the engineer's logs.

The depths of the exploratory holes, description of strata encountered and sample depths are included within the engineer's borehole logs presented in Appendix A.

Representative disturbed soil samples for chemical analysis were recovered in plastic tubs and glass jars at the depths shown within the exploratory hole logs and were dispatched to the laboratory for chemical analysis the day following recovery.

The locations of all exploratory holes were positioned by a MLM Environmental engineer to provide coverage of the site taking into account existing buildings, observed features and underground services.

Locations of all exploratory holes are presented in Figure 2.

3.3. Hand Dug Inspection Pits

A total of 4 No. inspection pits (refs. HP1 – HP4) were hand excavated to a maximum depth of 1.3m bgl. Initially three pits were dug and in one of them, HP3, the base of the concrete was encountered and therefore an additional pit HP4 was dug at the front of the building.

Soil samples were recovered from each stratum or in areas of obvious contamination for chemical analysis purposes in tubs and jars.

Upon excavation to the required depth or when obstructions were met, the trial pits were backfilled with arising in the reverse order to their removal and compacted upon completion. The surfacing was reinstated with either tarmac or concrete.

Engineer's hand inspection pit details are presented in Figure 2.

3.4. Site Constraints

The time allowed for initial site works was increased due to:

1) The thickness of concrete slabs and foundations slowing down the process of hand excavation.

2) Removal and reinstatement of concrete outside of the original scope of work.

4. LABORATORY ANALYSIS

4.1. Chemical Analysis

The following analytical tests were scheduled on samples recovered from the boreholes. Analysis undertaken on a range of compounds that could be expected based on site history and process as follows.

Table 4.1 Summary Schedule of Chemical Testing

Contaminant	Made Ground	Natural
Metals (arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc)	4	1
TPH, AA-split (Aromatic/Aliphatic LQM split)	4	1
Speciated PAH	4	1
pH	4	1
Sulphate (2:1 ratio)	4	1

Chemical analysis was undertaken by an UKAS accredited laboratory. The results are presented in Appendix B.

4.2. –Geotechnical Testing

The following laboratory tests were scheduled on soil samples recovered from the boreholes:

Table 4.2 Summary schedule of geotechnical testing

Test (BS1377:1990 part/ clause (ref. 3))	No.
Moisture Content 2/3.2	6
Atterberg Limits 2/4.4, 5.3, 5.4	6
pH and Sulphate 3/5.5, 3/9.5	5
Quick Undrained Single Stage Triaxial Test (100mm dia.) 7/9	12
Particle Size Distribution by Wet Sieve 2/9.2	2

Geotechnical testing was undertaken by a UKAS-accredited laboratory to BS1377 (ref.3) the results are presented in Appendix C.

5. GROUND AND GROUNDWATER CONDITIONS

5.1. General

In general the findings confirmed the expected published geology. The encountered general strata sequence is summarised as follows:

Table 5.1 Generalised strata sequence

Strata	Depth range (m bgl)		Thickness range (m)
	Top	Base	
Made Ground	GL	0.6-1.8	0.6-1.8
Hackney Gravel	0.6-1.8	2.9-4.4	1.1-2.6
London Clay	2.9-4.4	>25.0	>23.6
> Base of stratum not proven			

5.2. Made Ground and Surfacing

At the time of the site investigation, block paving (0.20m thick) was present across the majority of the external area of the site and overlies the Made Ground, elsewhere the surfacing comprised asphalt (0.05m thick).

The Made Ground was encountered in all the intrusive holes and varied in thickness between 0.60m in BH2, and a maximum of 1.80m in BH1. The Made Ground is described as varying between concrete hardcore and soft dark brown sandy gravelly clay containing flint and brick.

5.3. Hackney Gravel

Hackney Gravel was observed underlying the Made Ground between the depth of 0.6m below ground level (mbgl) in BH2, and 1.8mbgl in BH1 and BH3 respectively. The thickness of the Hackney Gravel in the intrusive holes was between 1.1m in BH1 and a maximum of 2.6m in BH3. The Hackney Gravel was described as varying between medium dense green and orange slightly clayey SAND and medium dense orange brown sandy GRAVEL, locally the gravel was found to be dense.

The Hackney Gravel appears to be more extensive across the site than the published map indicated.

5.4. London Clay

The London Clay was encountered beneath the Hackney Gravel in all the boreholes. The depth to the London Clay varied between 2.9mbgl in BH2 and 4.4mbgl in BH3. The thickness of the London Clay was not proven in any of the boreholes, which were driven to a maximum depth of 25mbgl.

The London Clay was described as varying from firm to stiff brown silty CLAY near the surface to very stiff brown to grey fissured CLAY at depth.

5.5. Contamination Observations

Made Ground, which is often an indicator for the potential presence of contamination, was encountered within all of the exploratory holes.

In addition to the presence of Made Ground, there were visual signs of contamination as follows:

- BH2: described as silty sand and gravel becoming dark grey with hydrocarbon contamination from 1.3mbgl

5.6. Groundwater

Groundwater was encountered during the fieldwork and the details are given in Table 5.2.

Table 5.2 Summary of groundwater monitoring during the site works

Date	Depth to groundwater (m.bgl)				Comments
	BH1	BH2	BH3	BH4	
04-07 August 2008	Nil	nil	2.5 and 7.8	2.3	BH3 recorded as seepage only

During a subsequent monitoring visit, window sample holes installed as part of previous site investigations were discovered and the water levels in these were also measured. The groundwater levels were recorded as follows.

Table 5.3 Summary of groundwater monitoring undertaken on 1st September 2008

Well	Depth to groundwater (mbgl)	Depth to base (mbgl)
BH1	Dry	15.45
BH2	1.7	25
BH3	2.8	15
BH4	2.3	25
WS1	2.05	2.4
WS2	NT	NT
WS3	1.45	3
WS4	1.65	4
WS5	2.15	3.5
NT: no reading taken		

It should be recognised however, that groundwater levels will fluctuate seasonally and timing of construction may dictate the extent of groundwater control required.

6. GEOTECHNICAL ASSESSMENT

6.1. General

Details of the proposed development are presented in the following drawings produced by BPR Architects:

- Drawing No 0779-01-sk13, Rev A, Basement Plan – Option A, August 2008
- Drawing No 0779-01-sk14, Rev A, Ground Floor Plan – Option A, August 2008
- Drawing No 0779-01-sk15, Rev A, First Floor Plan – Option A, August 2008
- Drawing No 0779-01-sk16, Rev A, Second Floor Plan – Option A, August 2008
- Drawing No 0779-01-sk17, Rev A, Roof Floor Plan – Option A, August 2008
- Drawing No 0779-01-sk19, Rev A, Elevations – Option A, August 2008

The aforementioned drawings indicate the construction of a commercial three storey building that fronts Paradise Road and Halford Road.

The ground floor footprint occupies the majority of the site. A garden is located at the southern end of the site with vehicular access provided at the south west corner. The footprint of the first and second floors span over the vehicular access but do not extend to the rear of the site.

A basement is shown in the eastern part of the site and its footprint covers half of the single storey part of the building and part of the three storey section of the building. For this report, the basement slab level has been assumed to be 2.5m below existing ground level.

The above drawings only indicate the positions of the buildings. Provisional structural loading for the three storey section has been given as 1500KN per footing by MLM Consulting Engineers.

6.2. Material Properties and Geotechnical Parameters

For each of the geological units encountered on site, design parameters have been derived from the ground investigations data and the laboratory test results, and are presented below.

For cohesive soils laboratory measured data was compared with undrained shear strength derived from the results of standard penetration tests based on the theory published by Stroud (ref. 4). Stroud indicates that the undrained shear strength of a clay soil may be assessed from expression

$$cu = f1 \times N,$$

where:

cu is the undrained shear strength

f1 is a factor related to the plasticity of the clay

N is the penetration resistance.

Stroud indicates that coefficient of volume compressibility (mv) may be assessed from the expression

$$m_v = 1/ f2 \times N,$$

where:

m_v is coefficient of volume compressibility

f2 is a factor related to the plasticity of the clay

N is the penetration resistance

The angle of shearing resistance (φ) of granular soil has been derived from the uncorrected Standard Penetration Resistance N using the relationship published by Peck et al. (ref. 5).

The plasticity index recorded as part of the Atterberg limits test is not however a true representation of the volume changes of the cohesive deposits. The actual plasticity index, and therefore the potential volume change of the cohesive deposits will be lower than the recorded value due to the presence of sand and gravel particles. To take some account of this factor, the modified plasticity index is calculated based on the percentage of sample passing the 0.425mm sieve in accordance with BRE Digest 240 (ref. 6):

Modified Plasticity = lp x (percentage <0.425mm / 100%)

Made Ground

The Made Ground is highly variable in nature and assigning parameters to this material are extremely difficult. Therefore no laboratory geotechnical testing was undertaken on this material.

Hackney Gravel

The SPT tests in the granular Hackney Gravel formation gave N values of 8 blows at a depth of 2m bgl in BH1 and 33 blows at a depth of 2m bgl in BH4. A plot of uncorrected SPT N tests values for the Hackney Gravel formation from the boreholes is presented as Figure 3.

For design purposes, a lower bound N value of 10 can be taken with a correlating angle of friction of 30º.

London Clay

The test results indicate that in the samples tested there was no significant difference in the strength of the materials between the weathered and unweathered London Clay. The parameters presented below are therefore for both weathered and unweathered material.

Atterberg Limits testing indicated the London Clay deposits to have liquid limits of between 71% and 82%, plastic limits of 27% to 31% and plasticity index of 44% to 51%. This indicates that the London Clay is of very high plasticity with high swelling and shrinkage potential.

The uncorrected SPT N tests values against depth for London Clay encountered at the site are shown on Figure 4. The SPT N values for London Clay generally ranged between 9 and 41.

A plot of undrained shear strength determined from undrained unconsolidated triaxial laboratory tests against depth is presented Figure 5. The undrained shear strength values ranged between 40kN/m^2 and 170kN/m^2. The undrained shear strength derived from Stroud's relationship, using a correlation factor of f1 of 4.2, is plotted on the Figure 5. The SPT derived undrained shear strength values correlates reasonably well with the values measured from triaxial tests.

The suggested design values, based on the lower bound undrained shear strength, is shown on Figure 5 and can be summarised as commencing with an undrained shear strength of 40kN/m² at a depth of 3m bgl and linearly increasing to an undrained shear strength of 150kN/m² at a depth of 20m bgl and then linearly increasing to an undrained shear strength of 170kN/m² at a depth of 25m bgl.

The m_v values derived from SPT N values are presented below as a linearly decreasing from 3m bgl to 20m bgl.

The m_v values have been derived from the SPT N values and can be summarised as commencing with a m_v value of 0.198 m²/MN at a depth of 4m bgl and linearly decreasing to a m_v value of 0.064 m²/MN at a depth of 20.0m bgl and then linearly decreasing to a m_v value of 0.058 m²/MN at a depth of 25.0m bgl.

6.3. Excavations

Ground conditions will provide generally straightforward dig conditions for standard construction plant, however breaking out of buried foundations and structures is anticipated, and will require consideration during any below ground excavations, including piling, at the site.

Ground support should be provided for all excavations where workers are required to enter if there are any risks to their safety, in accordance with Health and Safety legislation

Significant groundwater ingress is likely to be encountered due to the presence of the underling granular Made Ground and Hackney Gravel, and the site being affected by water levels in the River Thames. During the site visit, the groundwater was observed to be at a minimum depth of 1.45m bgl, however the level of water will be affected by both the level in River Thames and seasonal variations in rainfall. For excavations below the water table, suitably designed cut offs and specialist dewatering will be required.

6.4. Foundations for the Building

The appropriate foundation solution adopted for the site will not only depend on ground conditions, but also on structural loading and load distribution and the limiting criteria for movement or settlement of the buildings. The future buildings may have high specification finishes and unevenly distributed loadings such that settlement and particularly differential settlement will be required to be maintained within tight tolerances.

Details of the proposed development layouts of the basement were not provided at the time of this assessment. It is anticipated that following a general site levelling exercise, the development will take place at or close to existing ground level except for the basement at the south east corner of the site.

The proposed development can be separated in to the following two groups:

- Three and single storey commercial block.

- Basement in the eastern part of the site

The Made Ground will not provide a suitable load bearing stratum even for lightly loaded structures without some form of ground improvement. The inherent variability, poor consistency, low shear strength and consolidation characteristics of these materials will result in total and differential settlement occurring that will not be accommodated by the structures proposed without unacceptable structural or aesthetic damage occurring.

Foundations should be extended into the underlying natural soils. The foundation details of the building are described below and the basement details are described in section 6.5.

Three and single storey commercial block

The ground conditions within the footprint of the block mainly comprise of Made Ground overlying Hackney Gravel and London Clay. Thickness of the Made Ground within the footprint varied between 0.6m and 1.8m bgl.

The foundation design has to consider the following facts:

- The presence of Made Ground, which is up to 1.8m thick
- Variable thickness of Hackney Gravel under the footprint of the building
- Approximate maximum footing load of 1500kN
- Presence of groundwater near the surface

Shallow foundations located at 1.8m bgl will need to be constructed below water line and will require temporary cofferdams. Variable loading conditions between the majority of the three storey building, the two storey section located at the southern western part of the site where vehicular access is provided and the single storey section is likely to lead to differential settlements. Therefore to minimise the effect of differential settlement, it is recommended that the building be founded on piles.

The recommendations for the design and construction of piled foundations in relation to the ground conditions are presented in Table 6.1.

Table 6.1 Recommendations for Piled Foundations

Design/Construction Considerations	Design/Construction Recommendations
Pile Type	Groundwater was observed within 1.45m from the existing ground level. Therefore driven piles, bored piles with the use of casing or CFA piles can be considered. Driven piles will be noisy and are not recommended. For ease of construction, CFA piles are recommended, as these will not require casing.
Possible Constraints on choice of pile type	Medium dense to dense Hackney Gravel was observed near the surface, the presence of mudstones bands within the London Clay and the presence of underground obstructions from previous developments across the site.
Temporary Casing for bored piles	Groundwater was observed during the boring of the intrusive holes and it is recommended that the piling contractor allows for the use of temporary casing and possibly bentonite support, if bored piling is considered.
Hard strata	A band of claystone was observed at a depth of 7.8m bgl in borehole BH3 and therefore their presence elsewhere at the site cannot be discounted.

Design/Construction Considerations	Design/Construction Recommendations	
Soil and pile design parameters for the London Clay	Adhesion Factor (α) for CFA Piles	0.45 for Bored cast in place, based on the recommendation of Skempton (1959)
	Adhesion Factor (α) for Straight Shafted Bored Piles	0.6 for Bored cast in place (LDSA2000)
	Bearing Capacity Factor (N_c)	9
	Undrained Shear Strength (c_u)	See previous section
	Global factor of safety	3 without any load tests 2.5 with a preliminary pile test and 2.0 with Maintained Load Test on 1% of the Working Piles
Soil and Pile design parameters for the Made Ground.	The skin friction in the Made Ground be discounted.	

Based on the soil parameters in section 5, preliminary pile dimensions are given for single CFA pile in Table 6.2 for factors of safety of 3.0. The safe working load and pile dimensions are given for guidance only. The safe working loads given are for single isolated piles and the effect of group action should be considered, if applicable, in the design of the piles. The following were assumed for the analysis:

- Pile skin friction in fine grained soils calculated using total stress method
- Skin friction in Made Ground has been discounted and the effect of Negative Skin Friction discounted.
- The groundwater level was assumed to be 1.45m bgl.

Table 6.2 Preliminary Pile Dimensions

Shaft Diameter (m)	Pile Type	Length of Pile (m)	Safe Working Load (kN) For Factor of Safety of 3
0.45	CFA	15	260
0.45	CFA	20	420
0.60	CFA	15	380
0.60	CFA	20	590

It is considered the proposed factor of safety of 3.0 will limit the settlement of the piles to less than 10mm for piles less than 600mm in diameter.

It is recommended that specialist piling contractors are approached for their proposals and budget. The pile design should be carried out by and should remain the responsibility of the specialist piling contractor.

6.5. Basement Design and Construction

General

A basement is to be constructed under the eastern footprint of the building. The eastern and southern walls of the basement follow the site boundary. The northern wall is set some 4m from the front wall of the building.

Basement Wall Design

The basement wall construction has to consider the following:

- The edge of the basement traverses close to the existing public footpath and private gardens along the eastern and the southern boundaries respectively.

- Groundwater monitoring data indicate the presence of perched water within the Hackney Gravel at a depth of 1.45m bgl. It is considered that the groundwater may be in hydraulic continuity with the River Thames. The basement floor will be below the observed ground water level.

- The presence of London Clay, a material with low permeability, between the depths of 2.9m and 4.4m bgl and approximately 0.4m and 1.9m below the basement slab level.

The basement on the eastern and the southern sides will need to be supported by a temporary retaining wall during the construction stage to prevent the movement of the ground at the surface as the edge is close to site boundary. Therefore embedded retaining walls should be considered along the eastern and southern sides of the basement and this could be a contiguous piled wall, a secant piled wall or steel sheet piled wall.

Groundwater was observed at a depth of 1.45m bgl, the basement excavations will therefore be taken below the water table and the use of groundwater cut off to lengthen the drainage paths or well point dewatering system will be required. It is considered that the use of a well point system to support the excavation will not be suitable due to the expected high volume of pumping and discharging of water that will be required to achieve the necessary drawdown and the result in the lowering of groundwater locally due to the effect of drawdown curve spreading outside the site boundary and may cause subsidence under the adjoining properties as a result of increased overburden pressure. Therefore it is considered that a contiguous wall will not be suitable to support the excavation of the basement and that secant pile or sheet pile wall will need to be adopted on all sides of the excavation to minimise the inflow of water in to the excavation

Embedded Retaining Wall

Assuming a basement depth of 2.5m bgl, the minimum depth to the London Clay will be only 0.4m below the basement slab level and therefore the lower part of the retaining wall will need to be embedded in the underlying London Clay and will prevent the ingress of water through the base of the excavation. Any water seeping in to the excavation through the embedded wall or the base will need to be pumped out using sump and ditches within the excavation.

The selection of the type of wall, which can be either a secant pile wall or a sheet piled wall, will depend on a range of factors such as basement depths, environmental constraints, such as noise and vibration, as well as cost. The wall may either require tie back anchors to aid stability of the walls or be fully cantilevered without support.

The use of tie back anchors may not be feasible, as the anchors are likely to extend into the adjacent public highways and internal propping or a cantilevered wall will be recommended. Specialist advice should be sought on all aspects of the construction.

Based on published guidance, the depth of cantilevered wall required to support the excavations will be in region of 9 m. Based on data published by Mana and Clough (ref. 15) and St John et al (ref. 16), the predicted maximum lateral movement of the cantilevered wall at ground level, before the roof slab is constructed, will be between 20mm and 40mm. Mana and Clough's data was derived from observations made in braced excavation. Their work was adopted to derive the above predicted values. St John et. al. work relates to observations undertaken in the London Clay. It is recommended that during the design stage a detailed analysis is undertaken to verify this predicted range in lateral movement.

As the basement is overlain by the proposed building, it is considered embedded wall may be utilised to carry any vertical loads from the proposed buildings. However this needs to be reviewed once further details become available.

Basement Slab

The basement slab will need to withstand the water pressure on the underside of it as well as differential settlement caused by the applied vertical load and the reaction from the retaining walls at the sides. The slab can be designed as either a raft or piled slab. The present monitoring data indicate that the hydrostatic pressure on the basement slab is approximately 1m and therefore it is possible to support the basement on a raft slab, assuming that the pressure of the basement slab and the roof slab is greater than the 20kN/m^2, assuming a factor of safety of 2 against buoyancy. However no historic groundwater levels in the area are available and any increase in water level may distort the equilibrium, and cause heaving of the slab and excessive leakage within the basement. Therefore it is recommended that the basement slab be designed to cater for a higher groundwater level than those observed on site and the slab supported on tension piles designed to resist predicted uplift forces. The loads can be distributed between the embedded retaining walls and internal piles.

Generally within the footprint of the basement car park the London Clay is overlain by minimum 3m thick layer of Made Ground and gravel deposit, therefore it is considered that the basement formation level is unlikely to swell when excavated and only the water uplift pressure will need to be considered.

6.6. Floor Slabs

Suspended slabs would be the most appropriate solution for buildings given the presence of Made Ground to a maximum depth of 1.8m below existing ground level.

However suspended slabs for large floor areas are not practical or economic and ground bearing solutions would likely be required for any larger structures. The sub grade for any ground bearing slab will comprise Made Ground where a CBR value of 2% is appropriate for design. Crushed concrete screened to a suitable grading could be used as a capping layer for ground bearing slabs.

6.7. Below Ground Concrete Design

The available results of pH and sulphate determination on soil and groundwater indicate that based on BRE Special Digest 1 Concrete in Aggressive Ground (2001) Ref. 7, the soils at the site fall (based on worst case) within ACEC Class AC-3 with a corresponding Design sulphate Class of DS-3.

6.8. Swelling and Shrinkage Potential

The underlying Made Ground and the London Clay encountered at the site has a low and high swelling and shrinkage potential respectively as a result of seasonal moisture content change. The published aerial photograph shows the presence of mature trees along the southern boundary. It is considered the presence of high groundwater table will prevent the desiccation of the underlying Made Ground London Clay and therefore swelling and shrinkage will not be an issue.

6.9. Soakaway Potential

The standing groundwater level was recorded at 1.45m bgl which will reduce for the viability of soakaways.

7. DISCUSSION OF SOIL TEST RESULTS

7.1. Contaminant Trigger Levels and Reference Criteria

General

The primary purpose of the guideline values are as 'screening values for assessment of human health and other risks in relation to land use. These, and any other generic guideline values, are indicators of potential health hazards on a site and do not necessarily indicate that risks exist or that remediation is required.

Where guidance values are exceeded, any sources identified are carried through to the conceptual model and qualitative risk assessment.

Human Health

MLME have compared the available test results with current Soil Guideline Values (SGVs) (ref. 8) published by Defra, EA, CLEA and the most recent LQM criteria, in-line with current guidance.

Water Supply

Risks to water supply pipes and services are assessed through the Water Regulations Advisory Scheme (WRAS) guidance note 9-04-03 (ref.9).

The WRAS guidance note provides threshold concentrations above which permeation by organic compounds can occur through polymer supply pipes to taint or affect the quality of potable water.

Phytotoxicity

Risks from phytotoxicity have been assessed through the British Standard BS 3882:2007 (ref.10), this standard sets out the threshold values in topsoil for potential phytotoxic effects from certain metals.

7.2. Soil Dependent Factors

Appropriate Generic Assessment Criteria (GAC) have been adopted using the following soil dependent factors:

Table 7.1 Physiochemical parameters for soils <1m bgl

Soil dependent factor	Measured range	Adopted value
pH	7.4 to 10.5	8
OMC (%)	0.19 to 1.2	1
Soil type	granular	granular

Future site use is as commercial offices, therefore the results of analysis have been compared to GAC for a commercial end use and are summarised as follows.

Table 7.2 Comparison of soil test results to guideline values

Compound		GAC mg kg^{-1}	Source	Number of tests	Min.	Max.	Number exceeding GAC
Metals							
Arsenic		500	CLEA	5	7.9	21	0
Cadmium, pH		1400	CLEA	5	<0.5	1.3	0
Chromium		5000	CLEA	5	11	24	0
Lead		750	CLEA	5	16	210	0
Mercury		480	CLEA	5	<0.6	<0.6	0
Selenium		8000	CLEA	5	<0.25	<0.25	0
Nickel		5000	CLEA	5	10	20	0
Zinc		188000	LQM	5	35	190	0
Copper		45700	LQM	5	8	33	0
Organics							
Benzo[a]pyrene		29.7	LQM	5	<0.1	2.3	0
TPH Banding							
Aliphatic	EC >5-6	95.3	LQM	5	<0.01	0.12	0
	EC >6-8	242	LQM	5	<0.01	6.1	0
	EC >8-10	65.9	LQM	5	<0.01	5.5	0
	EC >10-12	29900	LQM	5	<0.01	5	0
	EC >12-16	29900	LQM	5	<1	4.5	0
	EC >16-35	617000	LQM	5	9.5	99	0
Aromatic	EC >5-7 (Benzene)	26.9	LQM	5	<0.01	<0.1	0
	EC >7-8 (Toluene)	30.4	LQM	5	<0.01	<0.1	0
	EC >8-10	107	LQM	5	<0.01	8.4	0
	EC >10-12	625	LQM	5	<0.01	7.6	0
	EC >12-16	12200	LQM	5	<1	3.3	0
	EC >16-21	9190	LQM	5	1.6	19	0
	EC >21-35	9250	LQM	5	8	130	0

The results for total polyaromatic hydrocarbons (PAHs) range between <0.1mg kg^{-1} for samples D3 and D4 obtained at 1.3 and 2.0mbgl respectively in BH2 and 20.1mg kg^{-1} in sample D2 obtained from BH4.

7.3. Distribution of Soil Contamination and Risk to Humans

The proposed development consists of a commercial end-use. The risk assessment has been based on GAC for commercial end-use.

Should the proposed end use of the site be changed in the future then further risk assessment may be required, particularly should a more sensitive end-use be envisaged such as residential with gardens.

Measured concentrations of potential soil contaminants do not exceed GAC across the site.

7.4. Phytotoxicity

A summary of the results of analysis when compared to the BS3882:2007 guidelines for planted areas are tabulated below.

Table 7.3 Comparison of soil test results to BS3882 criteria

Compound	BS3882	Number of Tests	Min.	Max.	Number Exceeding BS3882
Copper	200	5	8	33	0
Nickel	110	5	10	20	0
Zinc	300	5	35	190	0
All units mg kg^{-1}					

The BS3882:2007 guideline criteria were not exceeded in any of the soil samples of obtained from across the site; as such the risk posed to vegetation from phytotoxic elements is deemed **Low**.

7.5. Water Supply

Concentrations of arsenic and TPH exceeded their respective WRAS (ref. 9) guideline value of 10mg/kg and 50mg/kg respectively as shown in table 6.3.

Table 6.3 Comparison of soil test results to WRAS guidelines

Compound	WRAS Threshold (mg/kg)	Number samples exceeding criteria
Arsenic	10	3
Cadmium	3	0
Chromium, total	600	0
Lead	500	0
Mercury	1	0
Selenium	3	0
PAH	50	0
TPH	50	4
Phenol	5	0
pH	<5	0

Arsenic was exceeded within BH2 at depths of 1.3mbgl and 2.0mbgl as well as in BH3 at a depth of 0.2mbgl within the Hackney Gravel strata.

The WRAS guideline value for TPH of 50mg kg^{-1} was exceeded in BH1 at 0.2mbgl, BH2 at 1.3mbgl and 2.0mbgl respectively along withBH4 at 0.5mbgl.

8. DISCUSSION OF GAS MONITORING RESULTS

8.1. Gas Assessment Criteria

The proposed development is understood to be residential and the Characteristic Situations, described in CIRIA publication C665 (ref.12) and the British Standard BS8485:2007 (ref.13), are adopted according to a range of Gas Screening Values (GSV).

GSV's for methane and carbon dioxide have been derived from site maximum concentrations of gas and flow rate.

GSV's are derived according to the following formula:

- GSV = gas concentration in percent/100 x flow rate in litres per hour

To provide an accurate GSV in accordance with current guidance a minimum of six soil-gas monitoring visits should be undertaken. Monitoring wells should be positioned to provide gas readings covering the entire site. As part of the site investigation, MLME were commissioned to undertake preliminary soil-gas readings and comment on the presence of soil-gas based on less than the recommended guideline for monitoring visits as outlined within current CIRIA C665 guidance. As such the results will be commented on in relation to the now superseded gas guidance CIRIA 149 (ref 14)

8.2. Gas Monitoring Results

The presence of Made Ground (and localised evidence of hydrocarbon contamination) across the site indicated the potential for ground gases (and organic vapours) to be present. All monitoring wells were monitored for potential ground gas presence.

Table 8.1 Summary of gas monitoring after fieldwork

Monitoring date	Methane (%)	Carbon dioxide (%)	VOC (ppm)	Gas flow ($l\ hr^{-1}$)	Barometric pressure (mb)
01/09/08	0.0 – 0.1	0.0 – 1.9	NT	0.1 – 0.5	1008 -1010 (rising)
NT: No readings taken					

8.3. Nature and Distribution of Gas Contamination in relation to CIRIA 149

Carbon dioxide

Monitoring Well	Gas	Level Recorded (%)	Characteristic Situation as per CIRIA 149
WS1	Carbon Dioxide	1.8	2
WS2		1.9	2

Based on the results for carbon dioxide the site would be classed as a CIRIA Characteristic Situation 2 as a worse case scenario. This would recommend the following protection measures: ventilation of confined spaces within the building, well constructed ground slab, low permeability gas membrane and minimum penetration of ground slab by services. We would recommend further investigation inline with current guidance in order to confirm the aforementioned recommendations are necessary.

Depleted Oxygen

No areas of depleted oxygen (<16% v/v) were identified during the monitoring visit.

Volatile Organic Compounds (VOCs)

VOCs were not analysed as part of this investigation but is recommended for future monitoring visits.

9. RISK ASSESSMENT

9.1. Updated Conceptual Site Model

The phase I desk study, site investigation, results of chemical analysis and risk screening assessment has allowed the conceptual site model developed in the Applied Geology desk study to be updated. This is then used to assess qualitative and quantitative risks to human health and the environment.

The basis for the model is presented below:

Source Characterisation	**On-site:** • Made Ground identified across the site
Potential Pathways	• Direct contact • Inhalation of gas/vapour • Groundwater movement • Direct contact of contaminants with building materials
Potential Receptors	• Future site users (commercial office occupants) • Site workers (construction/maintenance) • Future buildings and services • Groundwater (Minor Aquifer)

10. LIABILITY AND RISK

10.1. Current UK Legislation and Liability

Provisions for dealing with contaminated land have been given effect through section 57 of the Environment Act 1995; this adds Part IIA (ss.78A-78YC) to the Environmental Protection Act 1990 and contains legislative framework for identifying and dealing with contaminated land. These sections of the Act and the Contaminated Land (England) Regulations 1999 were brought into force on 01 April 2000.

The law represents nothing more than the application of established principles of liability to the contaminated land situation, however it will mean in practice that Local Authorities will have an express mandate to inspect and enforce against contaminated land. This will potentially result in a greater risk of liability than at present.

Prior to April 2000 there were already a number of legal aspects regarding site liability which could be applied in relation to contamination:

- To prevent a danger to public health either by public accessing of the site or by allowing contamination to migrate off the site (EPA 1990 Clause 79-81).

- To prevent pollution of rivers or groundwater adversely affecting the quality of the water resource (WRA 1991 Clause 85, 76/464/EEC, 80/68/EEC).

In addition to the above criminal liabilities, civil (or tortuous) liabilities exist in common law with respect to four main headings; nuisance, negligence, the rule in Rylands vs. Fletcher and trespass. Parts III of the EPA 1990 has regularised many of these civil liabilities and empowers the Local Authority to issue abatement notices to control any statutory nuisance and recover costs.

Under Part IIa of the EPA 1990, liability for sites identified as "Contaminated Land" under the new legal definition will follow the "polluter pays" principle, or if the polluter cannot be found liability will pass to the owner or occupier.

10.2. Liability and Risk – General

The key environmental issues relevant to purchase, divestiture, ownership, development and occupation of any site are:

- Health and Safety Risks
- Environmental Risks
- Contamination Liability
- Construction Costs
- Effects on Construction and Building Materials.

The levels of risk are defined in Appendix D.

10.3. Health and Safety Risks

Elevated concentrations of compounds were not identified when compared with guidelines for the proposed commercial end use.

10.4. Environmental Risks

The groundwater vulnerability map suggests the site overlies a Minor Aquifer, the Hackney Gravel. The risk posed to groundwater in the minor aquifer is considered to be **LOW** given the absence of significant soil contamination and that a large volume of Made Ground may be removed as part of foundation and basement construction. However, it would be prudent to undertake chemical analysis of the groundwater in order to prove there is a negligible risk posed to the minor aquifer.

10.5. Deleterious Effects on Construction Materials and Services

Water supply pipes may be impacted by identified levels of TPH, which exceed WRAS guidelines.

10.6. Construction Costs

Off site disposal of soil will have significant cost implications irrespective of the level of compounds present in relation to human health or risks to the environment.

All material removed to facilitate construction will be subject to landfill tax. It is therefore recommended that wherever possible the amount of material to be removed off-site is minimised, and the waste classification of any such material be reduced as much as possible. These objectives could be met by either remediation / pre-treatment and/or re-use on site.

Where material is to be removed from site it is recommended that waste acceptance analysis be undertaken on soils to be disposed off site in order to fully classify the material to be disposed at landfill.

Protected services and clean services corridors attract a greater construction cost than water supply pipes and services laid in uncontaminated land.

Provision should be made in contractor's costs for the use of personal protective equipment, particularly with regard to direct contact with soils and inhalation of potentially toxic and asphyxiating gas (carbon dioxide) and hydrocarbon vapour.

10.7. Liability Issues

Under current UK liability in relation to contaminated land it is the polluter, or if the polluter cannot be found, the current landowner who is responsible for remediation of a site designated as contaminated land under the new regime.

Responsibilities for clean up could however, be transferred to future site owners and occupiers on the basis of 'sold with information'.

Ownership and occupation of the site will carry greater risk and liability with respect to contamination than ownership and occupation of a greenfield site. However, these risks and liabilities are clearly understood and can be managed at acceptable levels by appropriate risk management.

Based on the information and assessments to date, we consider that the site is unlikely to be classified as contaminated land under Part IIa of the EPA 1990 by the local authority given the existing on site conditions and nature of the proposed development.

11. RISK REDUCTION AND MANAGEMENT

11.1. General

Based upon the results of this investigation soil contamination was not identified when compared with guidelines for commercial end use.

However, soils do contain contaminants that can impact other aspects of the development as follows.

11.2. Preliminary Remediation Options

In order to reduce risks and liabilities associated with the localised areas of contamination, the following are recommended:

Upgrading Water Supply Pipes

Concentrations of TPH exceeded WRAS a guideline value of 50mg kg^{-1} and protected services in the form of upgraded water supply pipes is required in line with the requirements of WRAS and the local water supply company.

Clean Services Corridors

Because TPH and arsenic exceed WRAS criteria, the bedding, backfill and surround to all services constructed at the site must be clean imported materials such that installation of new pipe work and future services maintenance is in clean soil.

11.3. Gas Protection

The basic principles of gas protection measures are ventilation to reduce gas pressures and concentrations and also sealing buildings against gas intrusion.

Gas-protection measures require detailed design by geo-environmental specialists in consultation with foundation designers to ensure the most appropriate gas protection details for the structure.

Before finalising requirements for gas protection, it is recommended that extended gas, vapour and flow rate monitoring is undertaken in order to comply with the design requirements of CIRIA report C665.

11.4. Construction Health and Safety

It is recommended that construction workers on site adopt appropriate personal hygiene precautions, particularly wearing of gloves and avoidance of hand to mouth contact when dealing with soils with elevated contaminant levels.

Handling of soil and water should be minimised, and dust suppression measures should be implemented, particularly during any excavation through the Made Ground.

Gas and vapour monitoring should be carried out before man-entry into confined spaces such as deep excavations.

These precautions are considered to be industry standard when developing sites of this nature, and reference can be made to CIRIA Report 132 – A Guide for Safe Working on Contaminated Sites, for further information.

11.5. Excavation and Disposal of Arisings

Excavation for foundations, services etc will result in generation of soil for off-site disposal purposes.

A waste classification test will be needed from areas where excavations on site (e.g. for foundations) will generate soil for off-site disposal. All non-hazardous soils require pre-treatment prior to disposal. Effective pre-treatment, involving separation, sorting and screening can offer cost reductions through reducing the hazardous nature and/or volume of soil waste. Costs for disposal of non-hazardous/hazardous soils are significant compared to disposal of inert.

11.6. Documentation to be Submitted

Site Waste Management Plan

If the development was submitted to planning after 06 April 2008, and construction work is to commence after 01 July 2008 then a site waste management plan will be required in accordance with the Site Waste Management Plans Regulations 2008.

12. CONCLUSIONS AND RECCOMENDATIONS

12.1. Conclusions

- A Phase II Geoenvironmental Investigation has been undertaken to provide an assessment of potential environmental risks and contamination associated with the site.

- The investigation, involving cable percussive boreholes has proved Made Ground across the development area overlying Hackney Gravel and London Clay strata.

- Soil contamination was not identified with respect to the site end use for the purposes of commercial offices end use.

- Low levels of soil contamination are present that would require protected services in line with WRAS guidance and local water company requirements.

- Any soil to be disposed off site arising from foundation and basement construction should undergo WAC analysis in order to be fully classified.

- One round of gas and groundwater monitoring was undertaken as part of this investigation and the design requirements of CIRIA report C665 will necessitate extended monitoring of existing wells on site before final design of gas/vapour protection measures, if any.

- We consider that the site is unlikely to be classed as contaminated land in accordance with Part IIa of the EPA 1990 for its future end use.

- Made Ground has been proved on site therefore site workers involved in construction, maintenance or site investigation should observe a good standard of site hygiene and appropriate PPE and health and safety procedures used.

- It is recommended that the buildings at the site be supported on CFA piles to minimise the differential settlement between different parts of the buildings considered within this report. The design and construction of piles will need to consider the presence of mudstone bands within the London Clay

- The basement excavation to be supported by secant pile wall. The basement floor slab and building over it is supported on piled foundations [22]to minimise differential settlement.

12.2. Further Works and Recommendations

Contamination

We would recommend further site investigation to fully establish the risks posed to the proposed development from seasonal changes in groundwater levels and to identify fully the risk posed to groundwater from low levels of contamination present in BH2.

In addition, soil-gas monitoring should be undertaken in accordance with current CIRIA C665 guidance to ensure that appropriate gas protection measures can be designed if required. As part of the proposed monitoring, VOCs should be recorded also. This would require a minimum of six monitoring visits and preparation of a separate sol-gas report would be completed following the works.

The further investigation work will enable an enhanced assessment of site wide soil-gas generation.

Pre-planning Works

Following the introduction of the national standard planning system in April 2008 it is necessary to fulfil a number of requirements as part of the planning process in respect of site contamination and waste production.

The requirements include the provision of:

- A Site Waste Management Plan (SWMP) on projects greater than £300k

Type-3 Asbestos Survey

Prior to any extensive refurbishment or demolition works it will be necessary to undertake a full access Type-3 asbestos survey to enable an assessment of the type and approximate quantity of any asbestos containing materials present within the fabric of the existing buildings on site.

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FIGURES

Project	Made NE	Job No.
9-19 Paradise Road, Richmond, TW9 1RX	Date 29/07/08	731117
Drawing Title	Checked	Drg. No
SITE LOCATION PLAN	Approved	FIGURE 1.
Status of Drawing		Scale NTS

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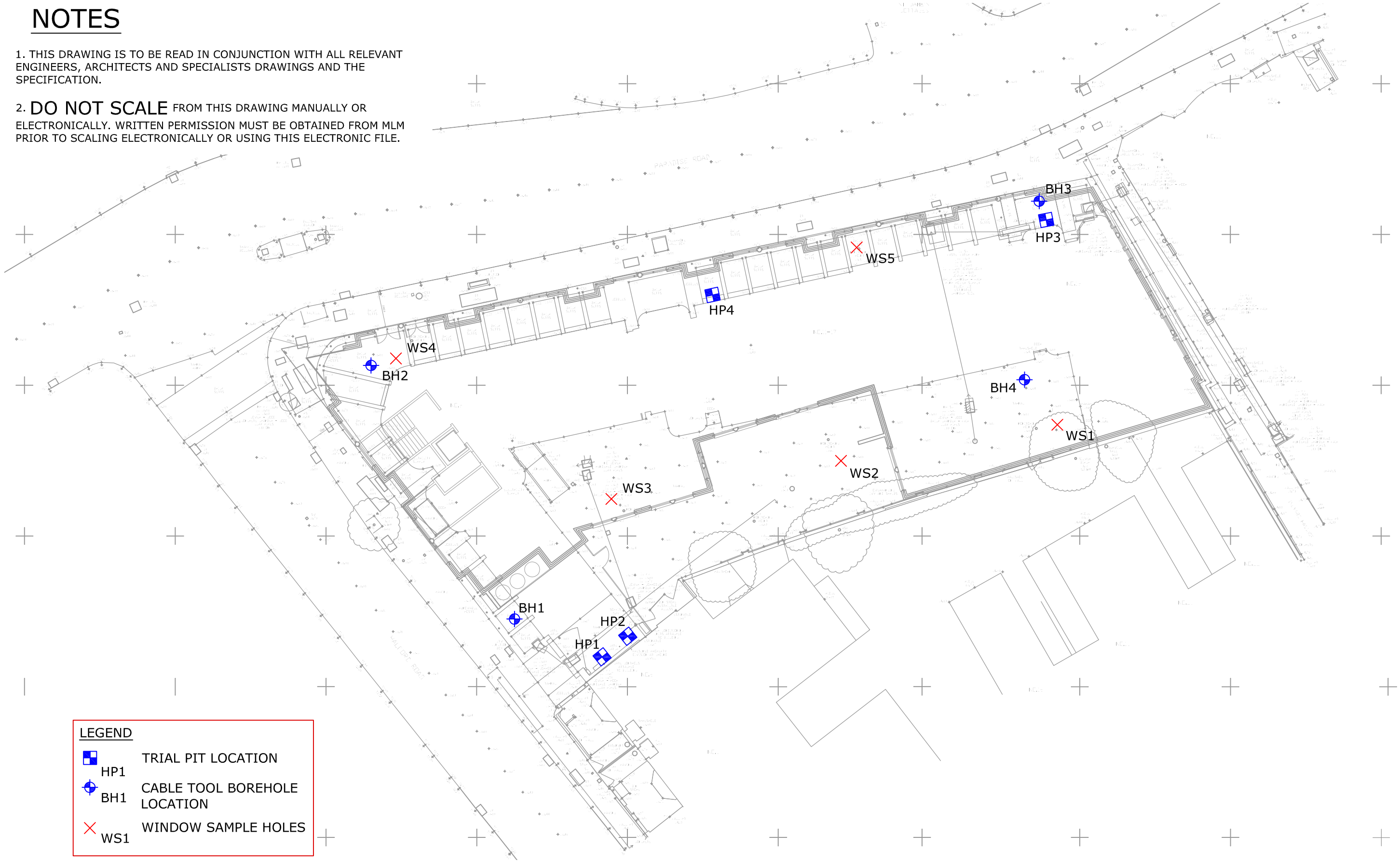

LEGEND

- HP1 — TRIAL PIT LOCATION
- BH1 — CABLE TOOL BOREHOLE LOCATION
- WS1 — WINDOW SAMPLE HOLES

Rev	Date	Description	Made	Ckd
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MLM

Environmental, Geotechnical & Waste Management Consultants

Townfield House, 30-33 Townfield Street, Chelmsford, CM1 1QL
Tel: 01245 359911 Fax: 01245 359001
Website: www.mlm.uk.com
Ashford * Cambridge * Ipswich * London * Norwich.

Figure Status: FINAL

Client: HENRY BOOT DEVELOPMENTS LTD

Project: PARADISE ROAD
RICHMOND

Fig Title: EXPLORATORY HOLE LOCATION PLAN

Drawn/Design	Checked	Approved	Date
GB	SC	SC	19/09/2008

Scales: 1:250 @ A3

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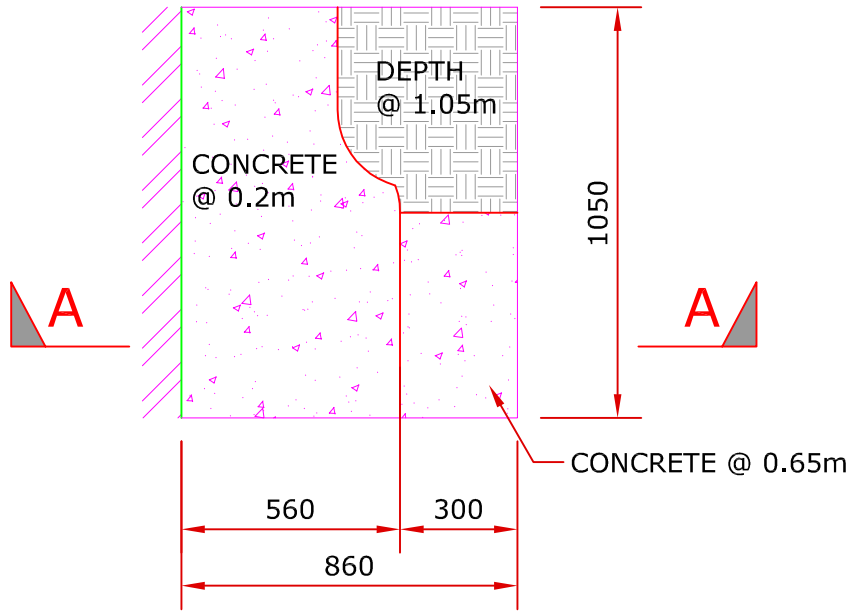
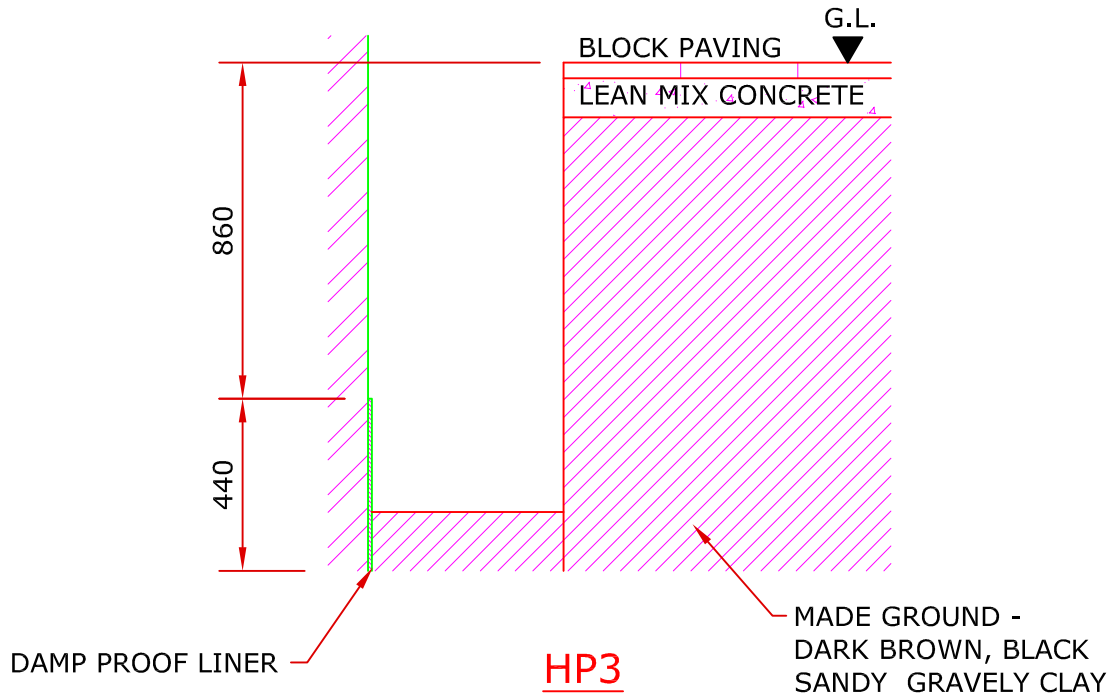
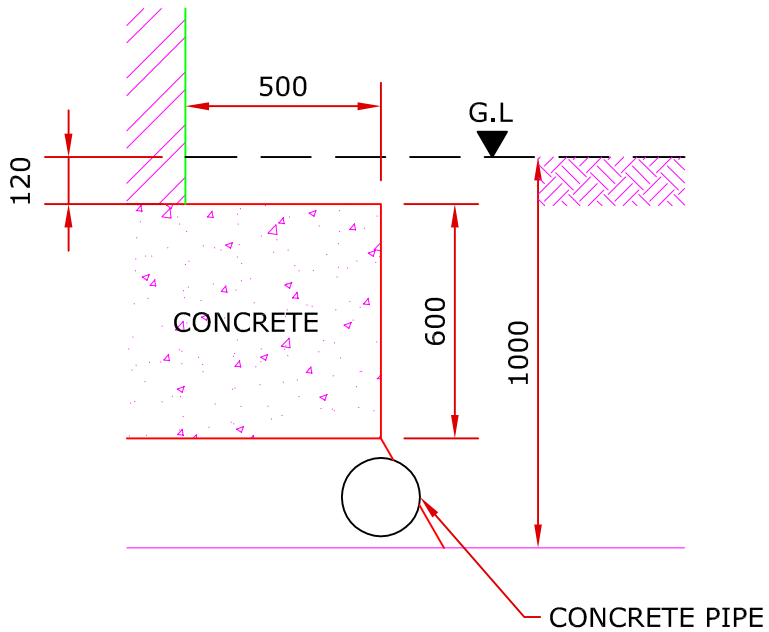


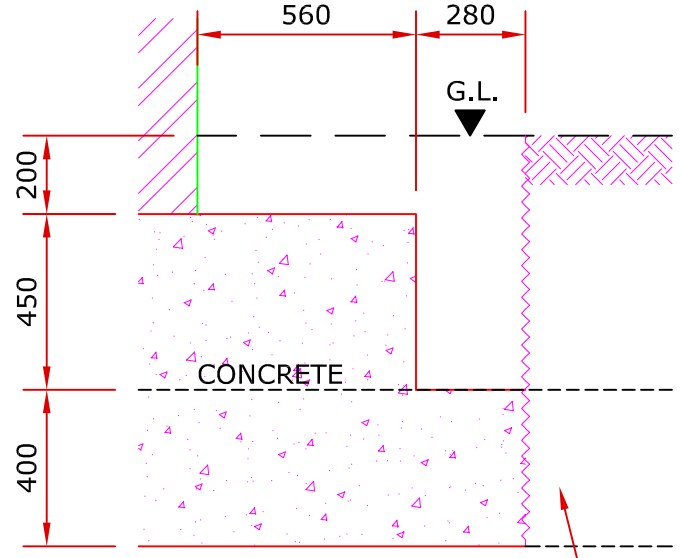
HP2 - PLAN



HP3

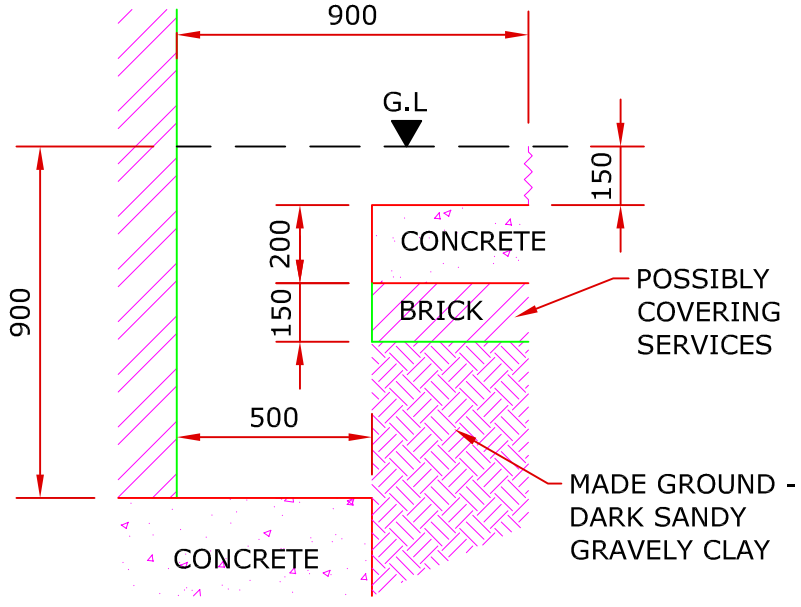


HP1



HP2- SECTION A-A

CONCRETE POSSIBLY EXTENDED THROUGH, COULDN'T EXCAVATE AS RESTRICTED ACCESS



HP4

Rev	Date	Description	Made	Ckd
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MLM

Environmental, Geotechnical & Waste Management Consultants

Townfield House, 30-33 Townfield Street, Chelmsford, CM1 1QL
Tel: 01245 359911 Fax: 01245 359001
Website: www.mlm.uk.com
Ashford * Cambridge * Ipswich * London * Norwich.

Figure Status: FINAL

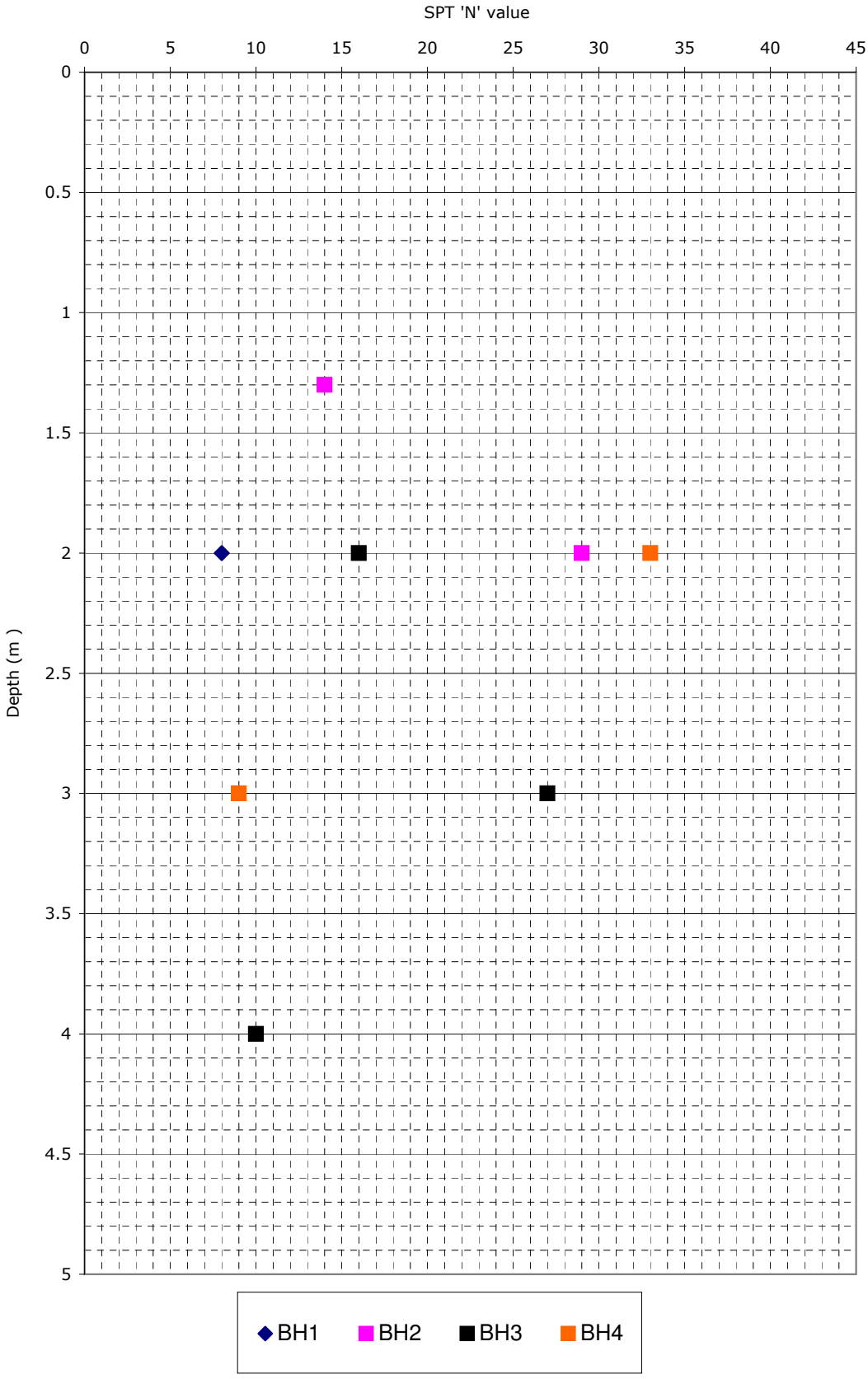
Client: HENRY BOOT DEVELOPMENTS LTD

Project: PARADISE ROAD
RICHMOND

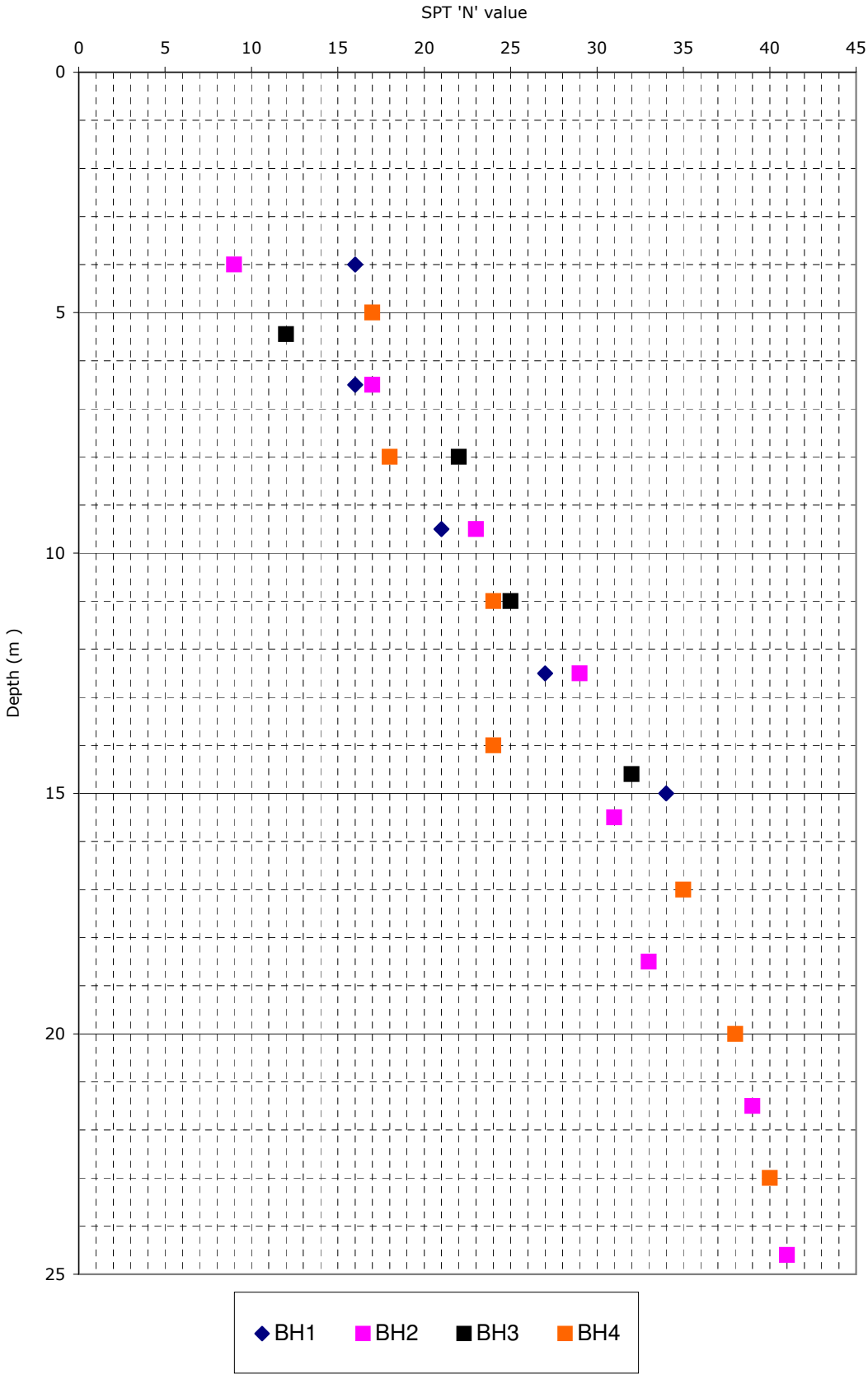
Fig Title: HAND PIT DETAILS

Drawn/Design	Checked	Approved	Date
GB	SC	SC	19/09/2008

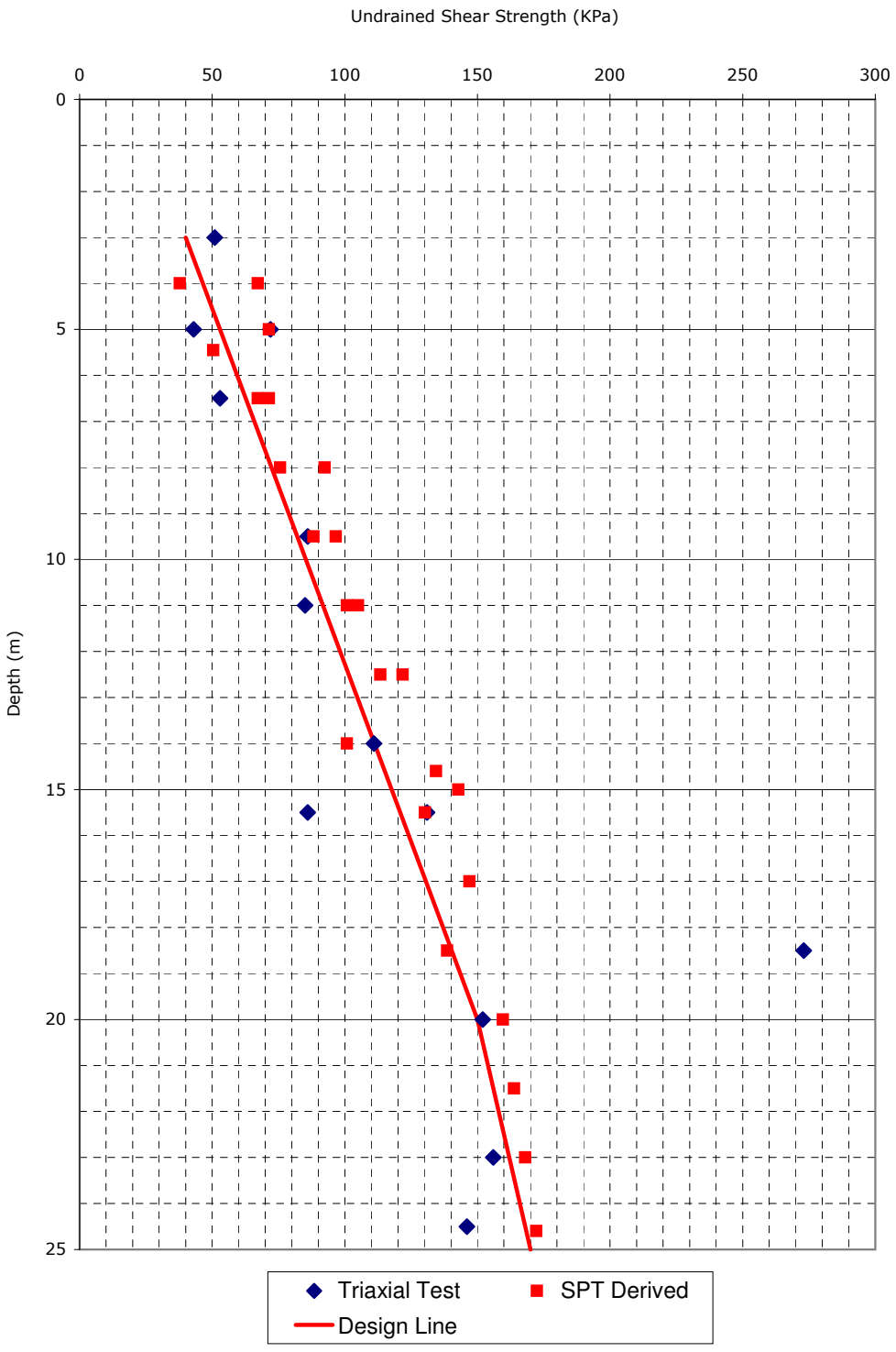
Scales	Fig No.	Rev
1:20 @ A3	731117/003	.



MLM www.mlm.uk.com	Figure:	4	SPT V Depth for Hackney Gravel	
	Project:	Paradise Road	Project Ref.	731117



MLM www.mlm.uk.com	Figure:	5	SPT V Depth for London Clay	
	Project:	Paradise Road	Project Ref.	731117



MLM www.mlm.uk.com	Figure:	6	Undrained Shear Strength V Depth for London Clay	
	Project:	Paradise Road	Project Ref.	731117

APPENDICES

Appendix A: Borehole Logs

Appendix B: Results of Chemical Analysis: Test Report 08-53725

Appendix C: Results of Geotechnical Analysis

Appendix D: Defining Risk

APPENDIX A

Borehole Sample Logs

Project: Paradise Road
Location: Richmond

Project ID: 731117
Client: Henry Boot Developments Ltd
Project Engineer: CM
Logged by: CM

BOREHOLE REF: BH1

Drilling Method: Cable Percussion
Start of Drilling: 05/08/2008
Completion: 06/08/2008
Ground Level: (mAOD) -
Coordinates: -

MLM
www.mlm.uk.com
MLM Environmental
Townfield House
30-33 Townfield Street
Chelmsford
Essex, CM1 1QL
Tel: 01245 359911
Fax: 01245 359001
Email: chelmsford@mlm.uk.com

IN SITU TESTS/SAMPLING				STRATA									
Depth (m)	Sample Ref.	SPT Results (Type)	Shear Strength (kPa)	Level (mAOD)	Depth (m)	Legend	Description of Strata	Thickness (m)	Installation Details	Chiselling Depth (m)	Chiselling Time (mins)	Water (m)
0.20	D1				0.20		Block paving.	0.20				Dry
0.50	D2						Soft dark brown sandy gravelly clay. Gravel is predominantly fine to coarse sub angular to rounded flint with brick content. (MADE GROUND)	1.60				
1.00	B1	(C) N=1 (0,1,0,0,1,0)										
	D3											
1.80	D4				1.80			1.10				
2.00	B2	(C) N=8 (0,2,2,2,2,2)										
2.90	D5				2.90		Medium dense orange brown sandy GRAVEL. Gravel is predominantly fine to coarse sub angular to rounded.	0.60				
3.00	D6				3.50							
3.50	U1											
4.00		(S) N=16 (2,2,4,3,4,5)						1.80				
4.45	D7											
5.00	D8				5.30		Firm brown silty CLAY.					
5.50	D9						Stiff brown and yellow mottled CLAY with occasional grey veins and rare decayed roots.					
6.50		(S) N=16 (2,3,3,4,4,5)										
6.95	D10						Stiff brown fissured CLAY with occasional grey veins and selinite cystals.					
8.00	U2											
8.50	D11											
9.50		(S) N=21 (2,3,4,5,5,7)										
9.95	D12							10.15				
11.00	U3											
11.50	D13											
12.5		(S) N=27 (2,5,6,7,6,8)										
12.95	D14											
14.00	U4											
14.50	D15											
15.0		(S) N=34 (5,5,8,8,8,10)										
15.45	D16				15.45		*End of Borehole at 15.45 m*					

Notes:
Casing Depth (m bgl): 2.90
Well Diameter (mm): 19
Remarks:

Legend:

▽	Water Strike
▼	Water Standing
S	Standard Penetration Test - Split Spoon Method
C	Standard Penetration Test - Solid Cone Method
N=17	SPT "N" Value with number of blows per 75mm in brackets
55/25	55 blows to achieve 25mm
D	Small Disturbed Sample
U	Undisturbed Samples
B	Bulk Sample
J	Jar Sample
W	Water Sample

Well Installation/Backfill Legend:

Backfill Details:
- Concrete
- Bentonite
- Filter Gravel
- Arisings Backfill

Pipe Details:
- Plain Pipe
- Slotted Pipe
- Piezometer Tip

Project: Paradise Road
Location: Richmond

Project ID: 731117
Client: Henry Boot Developments Ltd
Project Engineer: CM
Logged by: CM

BOREHOLE REF: BH2

Drilling Method: Cable Percussion
Start of Drilling: 07/08/2008
Completion: 08/08/2008
Ground Level (mAOD): -
Coordinates: -

MLM
www.mlm.uk.com
MLM Environmental
Townfield House
30-33 Townfield Street
Chelmsford
Essex, CM1 1QL
Tel: 01245 359911
Fax: 01245 359001
Email: chelmsford@mlm.uk.com

IN SITU TESTS/SAMPLING				STRATA									
Depth (m)	Sample Ref.	SPT Results (Type)	Shear Strength (kPa)	Level (mAOD)	Depth (m)	Legend	Description of Strata	Thickness (m)	Installation Details	Chiselling Depth (m)	Chiselling Time (mins)	Water (m)
					0.20		Block paving.	0.20				Dry
0.60	D1				0.60		(MADE GROUND)	0.40				
1.00	D2	(C) N=14					Concrete hardcore.					
1.30	D3	(1,1,2,3,3,6)					(MADE GROUND)	2.30				
2.00	B1	(C) N=29										
	D4	(4,4,6,7,7,9)										
2.90	D5				2.90		Medium dense brown silty gravelly SAND with pockets of soft dark brown organic clay. Gravel is fine to coarse flint. Strong smell of hydrocarbons from 1.3m.	0.30				
3.00	U1				3.20							
3.50	D6											
4.00		(S) N=9										
4.45	D7	(1,1,2,2,2,3)										
5.00	U2						Firm dark brown CLAY with rare decayed roots.					
5.45	D8											
							Firm to stiff grey brown CLAY.					
6.50		(S) N=17										
6.95	D9	(3,2,3,4,5,5)						7.80				
8.00	U3											
8.50	D10											
9.50		(S) N=23										
9.95	D11	(4,3,4,6,6,7)										
11.00	U4				11.00		Very stiff fissured dark grey CLAY.					
11.45	D12											
12.5		(S) N=29										
12.95	D13	(4,4,6,7,8,8)										
14.00	U5											
14.45	D14											
15.5		(S) N=31										
15.95	D15	(4,4,6,8,8,9)										
17.00	U6											
17.50	D16							14.00				
18.5		(S) N=33										
18.95	D17	(4,4,6,8,9,10)										
20.00	U7											
20.50	D18											
21.5		(S) N=39										
		(5,5,9,9,10,11)										
24.6		(S) N=41										
		(6,5,9,10,11,11)			25.00		*End of Borehole at 25.00 m*					

Notes:
Casing Depth (m bgl): 4.00
Well Diameter (mm): 19
Remarks:

Legend:

▽	Water Strike
▼	Water Standing
S	Standard Penetration Test - Split Spoon Method
C	Standard Penetration Test - Solid Cone Method
N=17	SPT "N" Value with number of blows per 75mm in brackets
55/25	55 blows to achieve 25mm
D	Small Disturbed Sample
U	Undisturbed Samples
B	Bulk Sample
J	Jar Sample
W	Water Sample

Well Installation/Backfill Legend:

Backfill Details: Concrete; Bentonite; Filter Gravel; Arisings Backfill

Pipe Details: Plain Pipe; Slotted Pipe; Piezometer Tip

Project: Paradise Road
Location: Richmond

Project ID: 731117
Client: Henry Boot Developments Ltd
Project Engineer: CM
Logged by:

BOREHOLE REF: BH3

Drilling Method: Cable Percussion
Start of Drilling: -
Completion: -
Ground Level (mAOD): -
Coordinates: -

MLM
www.mlm.uk.com
MLM Environmental
Townfield House
30-33 Townfield Street
Chelmsford
Essex, CM1 1QL
Tel: 01245 359911
Fax: 01245 359001
Email: chelmsford@mlm.uk.com

IN SITU TESTS/SAMPLING				STRATA									
Depth (m)	Sample Ref.	SPT Results (Type)	Shear Strength (kPa)	Level (mAOD)	Depth (m)	Legend	Description of Strata	Thickness (m)	Installation Details	Chiselling Depth (m)	Chiselling Time (mins)	Water (m)
0.20	D1				0.20		Block paving. (MADE GROUND)	0.20				
0.50	D2											
1.00	B1	(C) N=27 (0,1,1,1,2,23)						1.60				
	D3											
1.80	D4				1.80		Concrete hardcore. (MADE GROUND)					
2.00	B2	(C) N=16 (1,2,2,4,5,5)										2.50
3.00	D5	(C) N=27 (2,4,5,7,7,8)					Medium dense orange brown sandy GRAVEL. Gravel is predominantly fine to coarse sub angular to rounded.	2.60				
4.00		(C) N=10										
4.40	D6	(1,2,2,3,3,2)			4.40							
5.00		(S) N=12			4.60		Firm brown silty CLAY.	0.20				
5.45	D7	(1,2,3,2,3,4)					Firm dark grey CLAY.	1.90				
6.50	U1				6.50		Stiff brown fissured CLAY. Claystone at 7.8m.					
7.00	D8											
8.00		(S) N=22										
8.45	D9	(2,4,6,5,5,6)										
9.50	U2											
10.00	D10											
11.0		(S) N=25						8.50				
11.45	D11	(3,4,5,6,6,8)										
13.20	D12											
14.6		(S) N=32										
15.00	D13	(4,4,7,8,8,9)			15.00		*End of Borehole at 15.00 m*					

Notes:
Casing Depth (m bgl): 4.60
Well Diameter (mm): 19
Remarks:

Legend:

▽	Water Strike
▼	Water Standing
S	Standard Penetration Test - Split Spoon Method
C	Standard Penetration Test - Solid Cone Method
N=17	SPT "N" Value with number of blows per 75mm in brackets
55/25	55 blows to achieve 25mm
D	Small Disturbed Sample
U	Undisturbed Samples
B	Bulk Sample
J	Jar Sample
W	Water Sample

Well Installation/Backfill Legend:

Backfill Details:
- Concrete
- Bentonite
- Filter Gravel
- Arisings Backfill

Pipe Details:
- Plain Pipe
- Slotted Pipe
- Piezometer Tip

Project: Paradise Road
Location: Richmond

Project ID: 731117
Client: Henry Boot Developments Ltd
Project Engineer: CM
Logged by: CM

BOREHOLE REF: BH4

Drilling Method: Cable Percussion
Start of Drilling: 04/08/2008
Completion: 04/08/2008
Ground Level (mAOD): -
Coordinates: -

MLM
www.mlm.uk.com
MLM Environmental
Townfield House
30-33 Townfield Street
Chelmsford
Essex, CM1 1QL
Tel: 01245 359911
Fax: 01245 359001
Email: chelmsford@mlm.uk.com

IN SITU TESTS/SAMPLING				STRATA									
Depth (m)	Sample Ref.	SPT Results (Type)	Shear Strength (kPa)	Level (mAOD)	Depth (m)	Legend	Description of Strata	Thickness (m)	Installation Details	Chiselling Depth (m)	Chiselling Time (mins)	Water (m)
0.20	D1				0.05		Asphalt.	0.05				
0.50	D2				0.25		(MADE GROUND)	0.20				
1.00	D3	(C) N=8						1.15				
1.40	D4	(1,1,1,1,2,4)			1.40		Concrete.	0.40				
1.80	D5				1.80		(MADE GROUND)					
2.00	B1	(C) N=33										2.30
		(2,7,5,9,9,10)					Soft dark brown sandy gravelly clay. Gravel is predominantly fine to coarse sub angular to rounded flint with brick content.	1.90				2.40
3.00		(C) N=9										
		(2,3,2,2,2,3)										
3.70	D6				3.70		(MADE GROUND)					
4.00	U1											
4.50	D7						Medium dense green and orange slightly gravelly slightly clayey SAND. Gravel is predominantly fine to coarse sub angular to rounded flint.					
5.00		(S) N=17										
5.45	D8	(2,3,4,4,4,5)										
6.30	D9						Medium dense orange brown sandy GRAVEL. Gravel is predominantly fine to coarse sub angular to rounded.	5.80				
6.50	U2											
7.00	D10											
7.70	D11						Firm to stiff grey brown CLAY.					
8.00		(S) N=18										
8.45	D12	(2,2,4,4,4,6)										
9.30	D13				9.50		Stiff brown fissured CLAY.					
9.50	U3											
10.00	D14											
11.0		(S) N=24										
11.45	D15	(3,3,5,5,7,7)										
12.20	D16											
12.50	U4											
13.00	D17											
13.70	D18											
14.0		(S) N=24										
14.45	D19	(2,4,5,5,7,7)										
15.20	D20							15.50				
15.50	U5											
16.00	D21											
17.0		(S) N=35										
		(5,4,7,9,9,10)										
20.0		(S) N=38										
		(6,6,9,9,9,11)										
23.0		(S) N=40										
		(6,6,8,10,11,11)										
					25.00		*End of Borehole at 25.00 m*					

Notes:
Casing Depth (m bgl): 4.50
Well Diameter (mm): 19
Remarks:

Legend:

▽	Water Strike
▼	Water Standing
S	Standard Penetration Test - Split Spoon Method
C	Standard Penetration Test - Solid Cone Method
N=17	SPT "N" Value with number of blows per 75mm in brackets
55/25	55 blows to achieve 25mm
D	Small Disturbed Sample
U	Undisturbed Samples
B	Bulk Sample
J	Jar Sample
W	Water Sample

Well Installation/Backfill Legend:

Backfill Details:
- Concrete
- Bentonite
- Filter Gravel
- Arisings Backfill

Pipe Details:
- Plain Pipe
- Slotted Pipe
- Piezometer Tip

APPENDIX B

Results of Chemical Analysis: Test Report 08-53725

ALcontrol Laboratories
Sample Description

Matrix: Soil
Project Name: Paradise Road

Job Number: 08-53725
Client: MLM Environmental
Project Code: 731117

Laboratory Reference No	Sample Reference	Sample Depth (m)	Date Sampled	Sample Description
332352	BH3 D1	0.2	06/08/08	Brown clay with gravel
332357	BH2 D3	1.3	07/08/08	Grey & brown clay with gravel
332358	BH2 D4	2	07/08/08	Brown sandy clay with gravel
332585	BH1 D1	0.2	05/08/08	Dark brown sandy clay with gravel
332589	BH4 D2	0.5	04/08/08	Dark brown sand with gravel

ALcontrol Laboratories
Table Of Results

Project Name: Paradise Road
Client : MLM Environmental

Job Number : 08-53725
Matrix : Soil
Project Code: 731117

Sample Reference	BH3 D1	BH2 D3	BH2 D4	BH1 D1	BH4 D2	Method No	Units	LOD
Sample Depth (m)	**0.20**	**1.30**	**2.00**	**0.20**	**0.50**			
Date Sampled	**06/08/08**	**07/08/08**	**07/08/08**	**05/08/08**	**04/08/08**			
Date Scheduled	**08/08/08**	**08/08/08**	**08/08/08**	**04/08/08**	**04/08/08**			
Laboratory Reference No	**332352**	**332357**	**332358**	**332585**	**332589**			
Analysis								
Moisture Content (Dry Weight)	14.8	18.5	13.1	9.0	9.7		%	0.1
Moisture Content (Wet Weight)	12.9	15.6	11.6	8.3	8.9		%	0.1
Arsenic	12	18	21	18	7.9	069S[IM]	mg/kg	3
Beryllium	0.5	0.9	0.7	0.7	< 0.5	069S[IM]	mg/kg	0.5
Boron (W/S)	< 0.5	< 0.5	< 0.5	1.1	< 0.5	016S[IM]	mg/kg	0.5
Cadmium	< 0.5	< 0.5	< 0.5	1.3	< 0.5	069S[IM]	mg/kg	0.5
Chromium	16	24	22	21	11	069S[IM]	mg/kg	10
Copper	22	9.5	8.0	33	16	069S[IM]	mg/kg	5
Lead	91	25	16	210	180	069S[IM]	mg/kg	10
Mercury	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	069S[IM]	mg/kg	0.6
Nickel	10	14	20	17	8.4	069S[IM]	mg/kg	4
Selenium	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	069S[IM]	mg/kg	2.5
W/S Sulphate as SO4	0.12	0.11	0.05	0.16	0.15	074[IM]	g/l	0.02
Vanadium	33	44	44	42	22	069S[IM]	mg/kg	3
Zinc	46	47	35	190	41	069S[IM]	mg/kg	10
Total Cyanide	< 1	< 1	< 1	< 1	< 1	061S[IM]	mg/kg	1
Organic Matter	1.7	0.55	0.33	2.1	1.2	092[I]	%	0.2
Organic Carbon	0.96	0.32	0.19	1.2	0.68	092[IM]	%	0.1
pH	9.1	7.9	7.4	8.5	10.5	084S[IM]	pH Units	1
* * PHENOLS SUITE * *								
Phenol	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	020S[IM]	mg/kg	0.1
Total Monohydric Phenols	< 1	< 1	< 1	< 1	< 1	020S[I]	mg/kg	1

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Project Name: Paradise Road
Client : MLM Environmental

Job Number : 08-53725
Matrix : Soil
Project Code: 731117

Sample Reference	BH3 D1	BH2 D3	BH2 D4	BH1 D1	BH4 D2	Method No	Units	LOD
Sample Depth (m)	0.20	1.30	2.00	0.20	0.50			
Date Sampled	06/08/08	07/08/08	07/08/08	05/08/08	04/08/08			
Date Scheduled	08/08/08	08/08/08	08/08/08	04/08/08	04/08/08			
Laboratory Reference No	332352	332357	332358	332585	332589			
Analysis								
* * PAH SUITE * *								
Naphthalene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Acenaphthylene	< 0.1	< 0.1	< 0.1	< 0.1	0.11	022S[IM]	mg/kg	0.1
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Fluorene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Phenanthrene	0.24	< 0.1	< 0.1	0.24	0.56	022S[IM]	mg/kg	0.1
Anthracene	< 0.1	< 0.1	< 0.1	< 0.1	0.20	022S[IM]	mg/kg	0.1
Fluoranthene	0.53	< 0.1	< 0.1	0.51	2.3	022S[IM]	mg/kg	0.1
Pyrene	0.45	< 0.1	< 0.1	0.48	2.1	022S[IM]	mg/kg	0.1
Benzo(a)anthracene	0.23	< 0.1	< 0.1	0.24	1.1	022S[IM]	mg/kg	0.1
Chrysene	0.36	< 0.1	< 0.1	0.28	1.6	022S[IM]	mg/kg	0.1
Benzo(b)fluoranthene	0.31	< 0.1	< 0.1	0.34	2.8	022S[IM]	mg/kg	0.1
Benzo(k)fluoranthene	0.13	< 0.1	< 0.1	0.13	0.88	022S[IM]	mg/kg	0.1
Benzo(a)pyrene	0.17	< 0.1	< 0.1	0.22	2.3	022S[IM]	mg/kg	0.1
Indeno(1,2,3-cd)pyrene	0.11	< 0.1	< 0.1	0.12	2.5	022S[IM]	mg/kg	0.1
Dibenzo(a,h)anthracene	< 0.1	< 0.1	< 0.1	< 0.1	0.52	022S[IM]	mg/kg	0.1
Benzo(g,h,i)perylene	0.15	< 0.1	< 0.1	0.15	3.1	022S[IM]	mg/kg	0.1
PAH (Sum of EPA 16)	2.68	ND	ND	2.71	20.01	022S[I]	mg/kg	1.6

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Project Name: Paradise Road
Client : MLM Environmental

Job Number : 08-53725
Matrix : Soil
Project Code: 731117

Sample Reference	BH3 D1	BH2 D3	BH2 D4	BH1 D1	BH4 D2	Method No	Units	LOD
Sample Depth (m)	0.20	1.30	2.00	0.20	0.50			
Date Sampled	06/08/08	07/08/08	07/08/08	05/08/08	04/08/08			
Date Scheduled	08/08/08	08/08/08	08/08/08	04/08/08	04/08/08			
Laboratory Reference No	332352	332357	332358	332585	332589			
Analysis								
* * CWG SUITE * *								
Aliphatic C5-C6	< 0.01	0.06	0.12	< 0.01	0.11	CWGS	mg/kg	0.01
Aliphatic >C6-C8	< 0.01	2.1	6.1	< 0.01	0.32	CWGS	mg/kg	0.01
Aliphatic >C8-C10	< 0.01	3.4	5.5	< 0.01	< 0.10*	CWGS	mg/kg	0.01
Aliphatic >C10-C12	< 0.01	2.9	5.0	< 0.01	< 0.10*	CWGS	mg/kg	0.01
Aliphatic >C12-C16	< 1	2.1	4.5	1.2	4.1	CWGS[I]	mg/kg	1
Aliphatic >C16-C21	3.3	7.7	4.5	4.8	21	CWGS[I]	mg/kg	1
Aliphatic >C21-C35	6.2	35	20	17	78	CWGS[I]	mg/kg	5
Total Aliphatics (C5-C35)	9.5	53	46	23	100	CWGS	mg/kg	5
Aromatic C6-C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.10*	CWGS	mg/kg	0.01
Aromatic >C7-C8	< 0.01	< 0.01	< 0.01	< 0.01	< 0.10*	CWGS	mg/kg	0.01
Aromatic >C8-C10	< 0.01	5.1	8.4	< 0.01	< 0.10*	CWGS	mg/kg	0.01
Aromatic >C10-C12	< 0.01	4.3	7.6	< 0.01	< 0.10*	CWGS	mg/kg	0.01
Aromatic >C12-C16	< 1	2.1	3.3	< 1	2.4	CWGS[I]	mg/kg	1
Aromatic >C16-C21	1.6	4.4	2.6	7.0	19	CWGS[I]	mg/kg	1
Aromatic >C21-C35	11	8.0	8.7	42	130	CWGS[I]	mg/kg	5
Total Aromatics (C5-C35)	13	24	30	49	150	CWGS	mg/kg	5
Volatile Hydrocarbons (C5-C12)	< 0.01	18	33	< 0.01	0.43	CWGS	mg/kg	0.01
Extractable Hydrocarbons (C12-C35)	23	59	44	71	260	CWGS	mg/kg	5
Total Hydrocarbons (C5-C35)	23	77	77	71	260	CWGS	mg/kg	5
MTBE	< 0.010	< 0.010	0.11	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01
Benzene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01
Toluene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01
Ethylbenzene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01
m,p-Xylenes	< 0.010	< 0.010	< 0.010	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01
o-Xylene	< 0.010	< 0.010	0.051	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01
1,3,5-Trimethylbenzene	< 0.010	< 0.010	0.32	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01
1,2,4-Trimethylbenzene	< 0.010	0.12	0.65	< 0.010	< 0.10*	CWGS[IM]	mg/kg	0.01

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results - Appendix

Project Name: Paradise Road
Client : MLM Environmental

Job Number : 08-53725

Project Code: 731117

Summary of methods contained within report :

Method No.	Reference	Description	Wet/Dry Analysis
061S	In-house method based on Method 4500-CN, "Standard Methods for the Examination of Water and Waste Water", APHA AWWA WEF, Edition 18, 1992	Determination of cyanides and thiocyanate in soil samples by continuous flow colorimetry (Skalar)	W
022S	In-house method	Determination of PAH compounds in soil samples by hexane / acetone extraction followed by GC-MS detection [Note: this method does not separate benzo(j)fluoranthene, and this PAH will be included in the sum of benzo(b)fluoranthene & benzo(k)fluoranthene]	W
020S	In-house method based on Second Site Property: Environmental Assessment Guidance Version 3: March 2003	Determination of methanol/water based mobile phase extractable phenols in soil samples by HPLC with electrochemical detection	W
CWGS	In-house method based on "Total Petroleum Hydrocarbon Criteria Working Group" series, 1998-9	Determination of "CWG" banded petroleum hydrocarbons in soil samples using a combination of headspace GC-FID (C5-C12) and hexane:acetone extraction / silica-alumina aliphatic - aromatic split / GC-FID (C12-C35) techniques with banding by comparison to alkane standards	W
084S	In-house method referencing BS1377: Part 3: 1990 and Second Site Property: Environmental Assessment Guidance Version 3: March 2003	Determination of pH by addition of water followed by electrometric measurement	D
074	In-house method based on BS1377 Part 3, "Chemical and Electrochemical Tests", 1990	Determination of 2:1 water soluble sulphate in soil samples by Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES)	D
069S	In-house method based on MEWAM "Methods for the Determination of Metals in Soil", HMSO, 1986	Determination of metals in soil samples by aqua-regia digestion followed by ICP-OES detection	D
016S	In-house method	Determination of water soluble boron by 2:1 extraction in hot water followed by ICP-OES detection	D
092	In-house method	Determination of organic matter in soil samples by combustion analyser	D

Appendix

Code	Description
On Results	
*	Detection limit(s) raised due to matrix interference
¥	Detection limit(s) raised due to reduced amount of sample available for analysis
‡	Dilution factor applied due to nature of sample
NAD	No asbestos detected
$	Analysis sub-contracted
U/S	Analysis unsuitable for sample due to its matrix or properties
I/S	Insufficient sample
M/S	Sample cannot be located within the laboratory
ND	Not detected (below relevant analytical detection limit)
ç	Sample filtered prior to analysis
§	Please note product present, therefore this result is for indicative purpose only
On the Sample Numbers	
†	Sample type outside the scope of our MCERTS accreditation since matrix not included in method validation
¢	Unsuitable for analysis due to asbestos content
General Statements	
æ	Please note TOC's & LOI's have been repeated and the apparently anomalous results confirmed
¶	UKAS and/or MCERTS accreditation removed due to duration of sample in laboratory prior to testing
¤	The BOD analysis was carried out prior to the COD analysis and included an oily layer, which is the likely cause of the anomalous results
Note:	Analysis carried out for organic compounds on water samples containing free product is on a "best endeavour" basis
Note:	All results calculated from organic carbon on a dry weight basis
Note:	Fe(II) and dissolved Fe are analysed by different methods, sometimes leading to slight discrepancy between results
Note:	"Total" results calculated by summing individual components are not rounded
Note:	The reporting limit stated in the LOD column is the standard method reporting limit, derived statistically from validation data, however it is occasionally necessary to raise reporting limits due to matrix interference or limited sample availability
Note:	During soil preparation, best efforts are made to produce analytical subsamples representative of the entire submitted sample, without exclusion of stones

APPENDIX C

Results of Geotechnical Analysis

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : 26/08/08 PAGE 1 of 28 Pages

Contract: PARADISE ROAD.

Serial No. S21341

UKAS TESTING 0998

CLIENT:

MLM ENVIRONMENTAL LTD
Townfield House,
30/33 Townfield Street,
CHELMSFORD
CM1 1QJ

Soil Property Testing

18 Halcyon Court, St Margarets Way,
Stukeley Meadows, Huntingdon,
Cambs. PE29 6DG.

Telephone (01480) 455579 Fax (01480) 453619
Email SPTownend@btclick.com

SAMPLES SUBMITTED BY:

MLM ENVIRONMENTAL LTD

APPROVED SIGNATORIES:

☐ **S.P.TOWNEND FGS**
Technical Director

☐ **W.JOHNSTONE**
Deputy Technical/Quality Manager

☑ **J.C.GARNER B.Eng (Hons.) FGS**
Quality Manager

SAMPLES LABELLED:

PARADISE ROAD.

DATE RECEIVED: 11/08/08

SAMPLES TESTED BETWEEN 11/08/08 **and** 26/08/08

REMARKS: For the attention of Mr S Chara
Your ref: 731117

NOTES:

1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.

2 (a) UKAS - United Kingdom Accreditation Service.
(b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.

4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 2 of 28

Contract: PARADISE ROAD.

Serial No.: S21341

SCHEDULE OF LABORATORY TESTS

Bh./ Tp No.	Sample Ref	Depth (from)	1:Moisture Content Determination	4:Liquid/Plastic limit 1 point	5:Wet Sieve Preparation for Limit	13:Triaxial Test s/s 102mm dia	34:Sulphate Test (2:1 Water Soil)	36:ph value of Soil or Water	7:PSD by Wet Sieve	Remarks
BH1	D4	1.80	*	*	*					
	U1	3.00			*					60 kPa
	D6	3.50	*	*						
	D7	4.45				*	*			
	U2	5.00			*					100 kPa
	D11	9.95				*	*			
	U5	14.00			*					250 kPa
	D14	14.50				*	*			
BH2	B1	2.00				*	*			
	D5	2.90				*	*			
	U2	5.00			*					100 kPa
	D9	6.95	*	*						
	U4	11.00			*					120 kPa
	D13	12.95	*	*						
	U7	20.00			*					400 kPa
	U8	23.00			*					460 kPa
	D20	23.50	*	*						
BH3	B2	2.00						*		
	U1	6.50			*					130 kPa
BH4	D4	1.40	*	*	*					
	B1	2.00						*		
	U3	9.50			*					190 kPa
	U5	15.50			*					310 kPa
	U6	18.50			*					370 kPa
	U8	24.50			*					490 kPa
-	-	-	6	6	2	12	5	5	2	<— Total Number of Tests —

Scheduled by: MLM ENVIRONMENTAL LTD

Target Date: 22/08/08

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 3 of 28

Contract: PARADISE ROAD.

Serial No. S21341

UKAS TESTING 0998

SUMMARY OF MOISTURE CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plast-icity Index (%)	Liqu-idity Index (%)	SAMPLE PREPARATION				Description	CLASS
								Method S/N	Ret'd 0.425um (%)	Corr'd M/C <0.425um	Curing Time (hrs.)		
BH1	1.80	D4	8.9	36	16	20	0.60*	S	68(M)	28	24	Brown, black and white fine to coarse angular to rounded GRAVEL in a firm locally stiff orangey brown slightly sandy clay matrix	CI
BH1	3.50	D6	32	75	29	46	0.07	N	0(A)		24	Stiff brown CLAY with occasional grey veins, dark yellowish brown mottling and rare decayed roots	CV
BH2	6.95	D9	30	77	28	49	0.04	N	0(A)		28	Stiff locally very stiff very dark greyish brown CLAY with occasional dark grey and dark greyish brown mottling	CV
BH2	12.95	D13	27	71	27	44	0.00	N	0(A)		28	Very stiff very dark greyish brown CLAY with occasional dark grey and very dark grey mottling	CV
BH2	23.50	D20	27	82	31	51	-0.08	N	0(A)		51	Very stiff very dark greyish brown CLAY with occasional dark grey and dark greyish brown mottling	CV
BH4	1.40	D4	12	23	17	6.0	0.00*	S	28(M)	17	25	Very soft locally soft light olive grey slightly gravelly sandy CLAY/very clayey fine and medium SAND with occasional olive grey and orange mottling. Gravel is fine to coarse rounded to subangular	ML/ CL

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2 S = Wet Sieved Specimen N = prepared from Natural

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter. A = Assumed, M = Measured

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

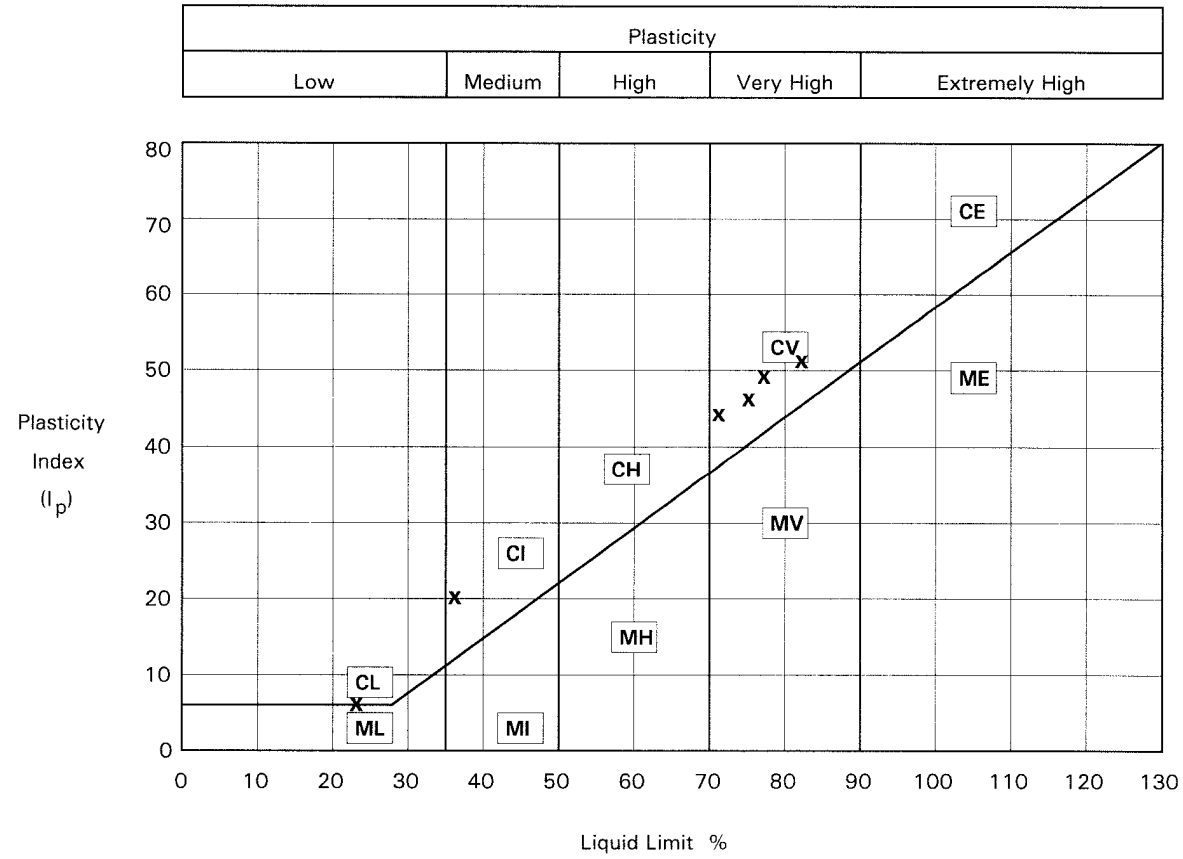
ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 4 of 28

Contract: PARADISE ROAD.

Serial No.: S21341

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 5 of 28

Contract: PARADISE ROAD.

Serial No.: S21341

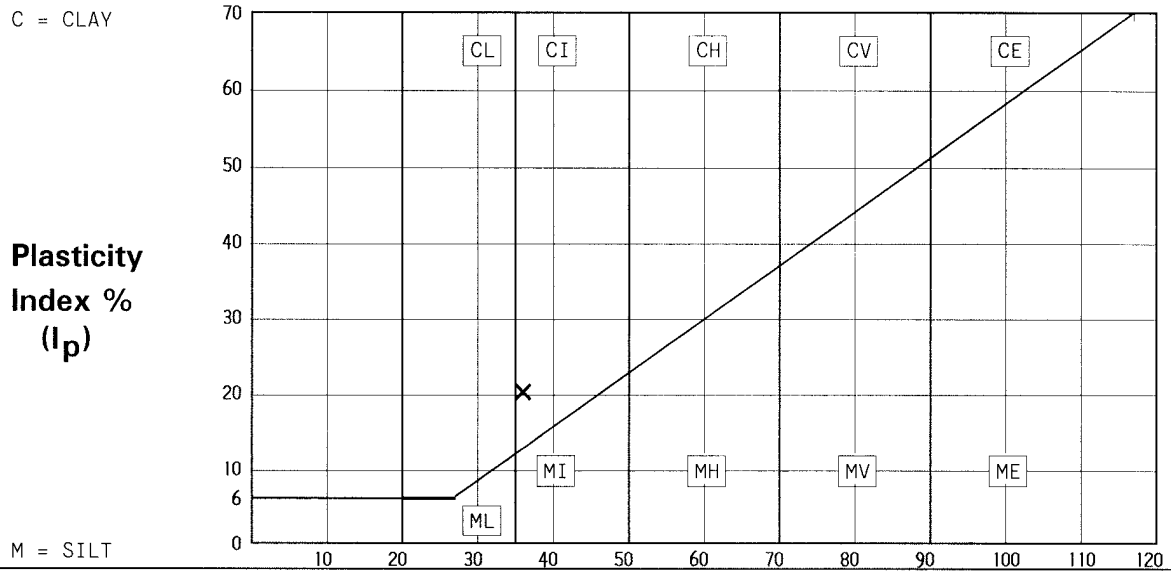
UKAS TESTING 0998

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH1	1.80	D4	8.9	Brown, black and white fine to coarse angular to rounded GRAVEL in a firm locally stiff orangey brown slightly sandy clay matrix	

PREPARATION

Method of Preparation	Sieved Specimen	Liquid Limit	36 %
Sample retained 0.425 sieve	(Measured) 68 %	Plastic Limit	16 %
Corrected moisture content for material passing 0.425mm	28 %	Plasticity Index	20 %
Curing Time	24 Hours	Liquidity Index	0.60
		Clay Content	Not analysed. %
		Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
57% RETAINED ON 2mm SIEVE
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 6 of 21

Contract: PARADISE ROAD.

Serial No. S21341

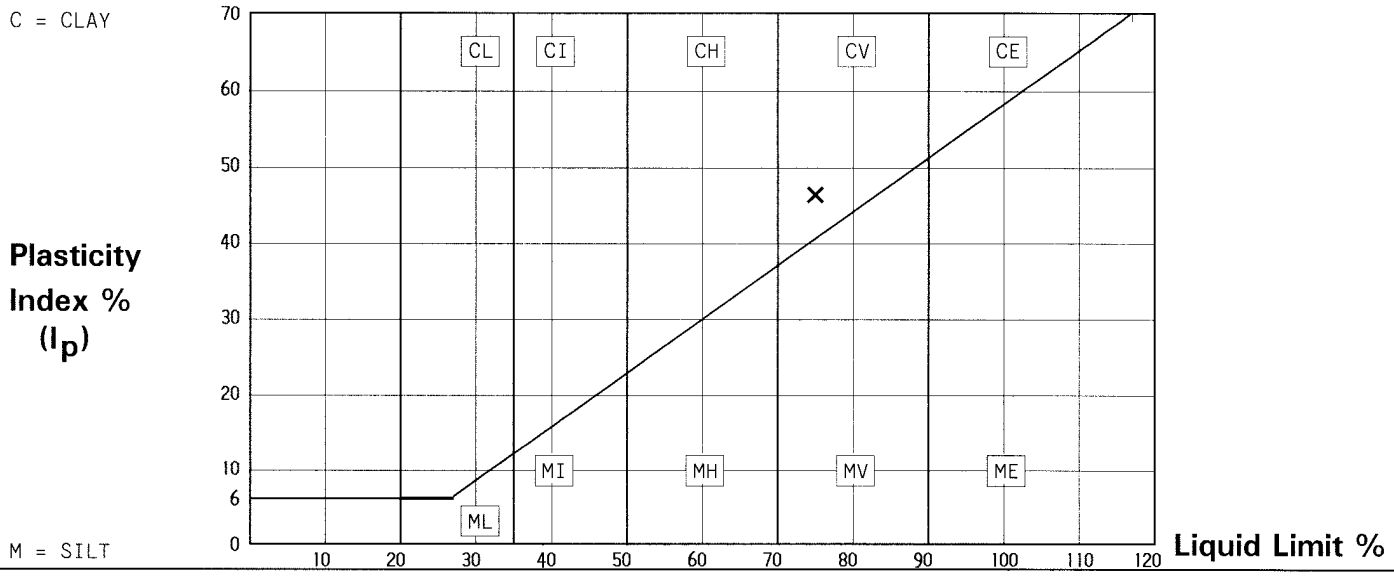
UKAS TESTING 0998

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH1	3.50	D6	32	Stiff brown CLAY with occasional grey veins, dark yellowish brown mottling and rare decayed roots	

PREPARATION

Method of Preparation	Specimen from Natural Soil	Liquid Limit	75 %
Sample retained 0.425 sieve	(Assumed) 0 %	Plastic Limit	29 %
Corrected moisture content for material passing 0.425mm	%	Plasticity Index	46 %
Curing Time	24 Hours	Liquidity Index	0.07
		Clay Content	Not analysed. %
		Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 7 of 28

Contract: PARADISE ROAD.

Serial No.: S21341

UKAS TESTING 0998

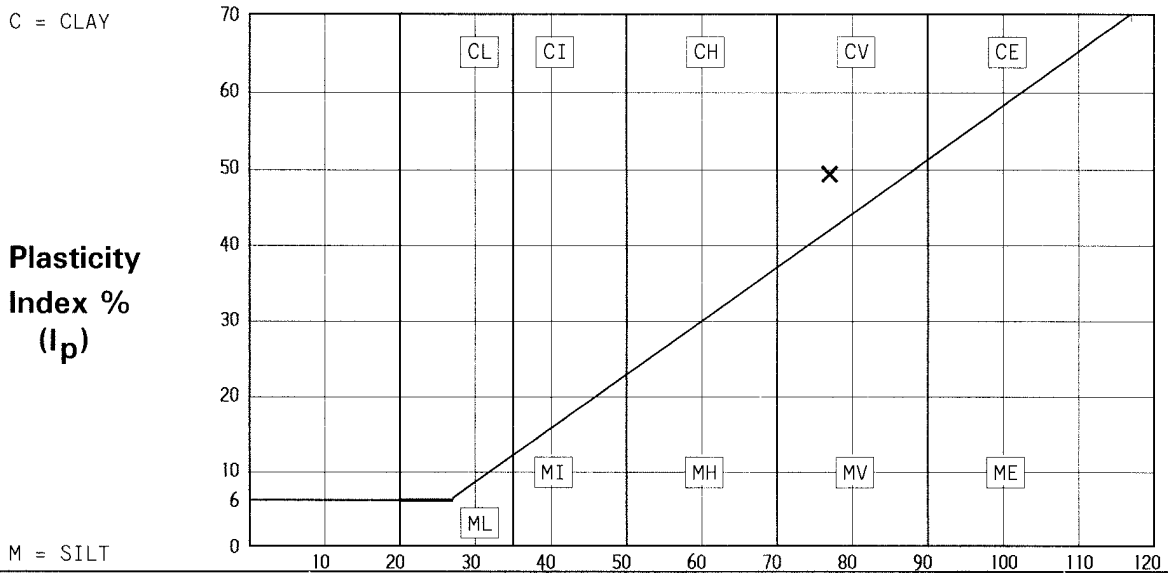
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH2	6.95	D9	30	Stiff locally very stiff very dark greyish brown CLAY with occasional dark grey and dark greyish brown mottling	

PREPARATION

Method of Preparation	Specimen from Natural Soil
Sample retained 0.425 sieve (Assumed)	0 %
Corrected moisture content for material passing 0.425mm	%
Curing Time	28 Hours

Liquid Limit	77 %
Plastic Limit	28 %
Plasticity Index	49 %
Liquidity Index	0.04
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 8 of 28

Contract: PARADISE ROAD.

Serial No.: S21341

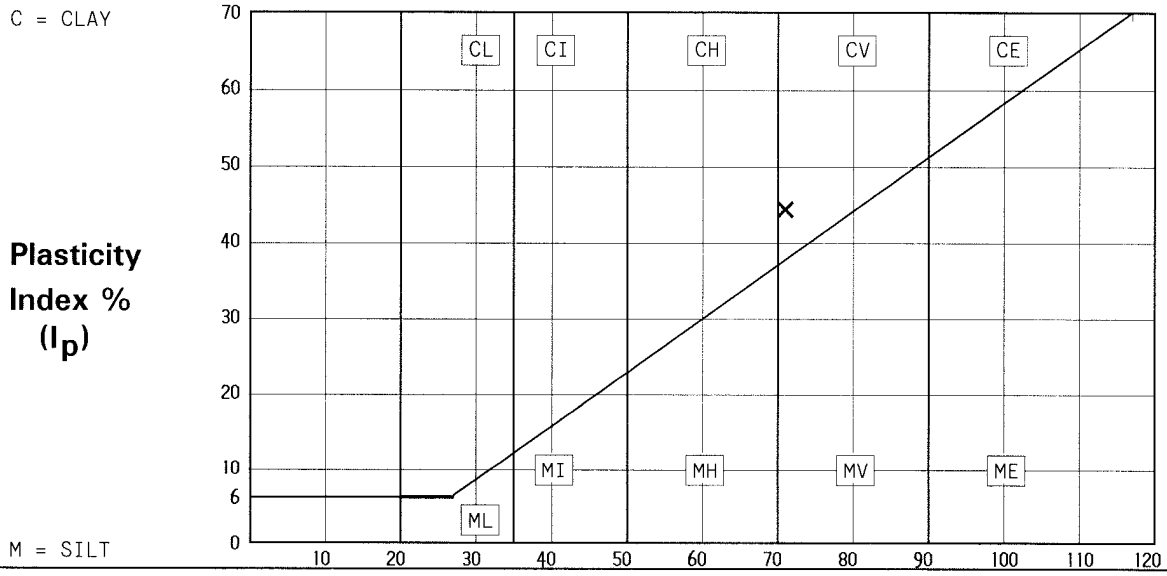
UKAS TESTING 0998

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH2	12.95	D13	27	Very stiff very dark greyish brown CLAY with occasional dark grey and very dark grey mottling	

PREPARATION

Method of Preparation	Specimen from Natural Soil	Liquid Limit	71 %
Sample retained 0.425 sieve (Assumed)	0 %	Plastic Limit	27 %
Corrected moisture content for material passing 0.425mm	%	Plasticity Index	44 %
Curing Time	28 Hours	Liquidity Index	0.00
		Clay Content	Not analysed. %
		Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 9 of 18

Contract: PARADISE ROAD.

Serial No. S21341

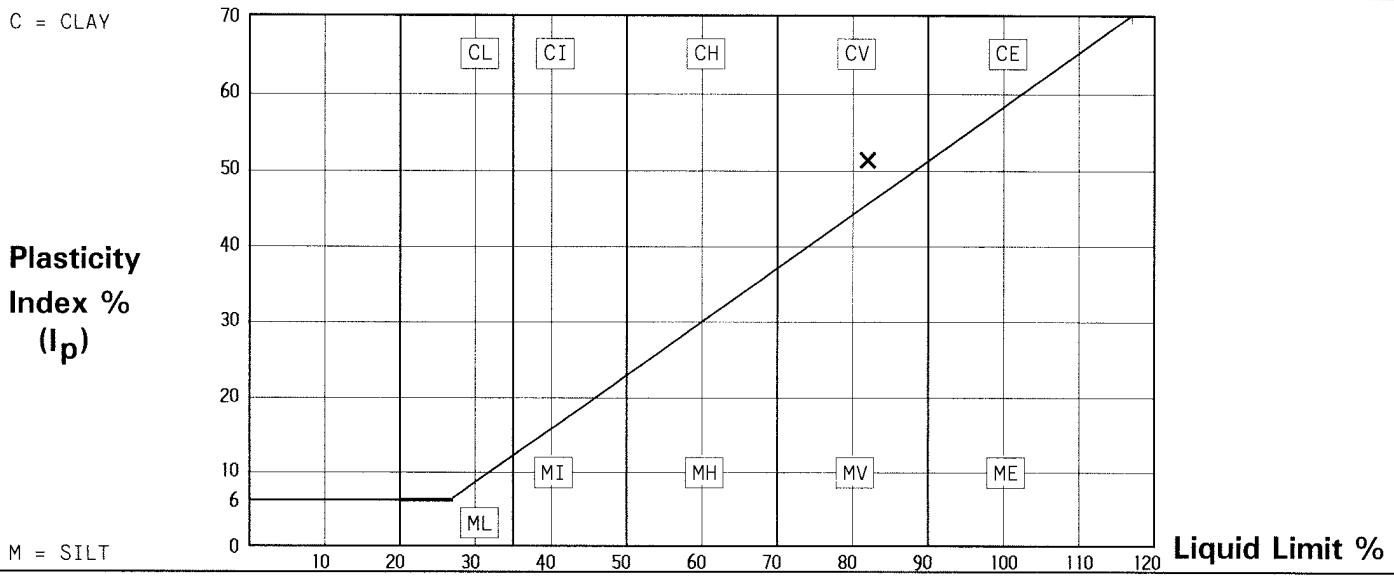
UKAS TESTING 0998

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH2	23.50	D20	27	Very stiff very dark greyish brown CLAY with occasional dark grey and dark greyish brown mottling	

PREPARATION

Method of Preparation	Specimen from Natural Soil	Liquid Limit	82 %
Sample retained 0.425 sieve (Assumed)	0 %	Plastic Limit	31 %
Corrected moisture content for material passing 0.425mm	%	Plasticity Index	51 %
Curing Time	51 Hours	Liquidity Index	-0.08
		Clay Content	Not analysed. %
		Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 10 of 28

Contract: PARADISE ROAD.

Serial No.: S21341

UKAS TESTING 0998

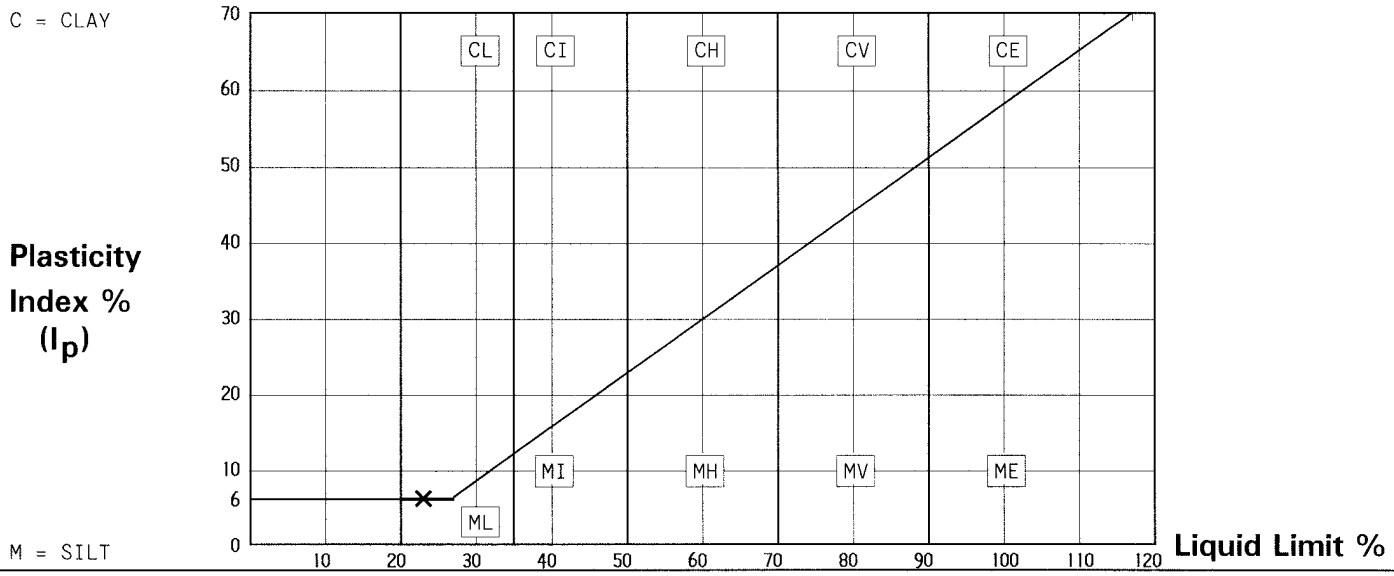
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH4	1.40	D4	12	Very soft locally soft light olive grey slightly gravelly sandy CLAY/very clayey fine and medium SAND with occasional olive grey and orange mottling. Gravel is fine to coarse rounded to subangular	

PREPARATION

Method of Preparation	Sieved Specimen
Sample retained 0.425 sieve (Measured)	28 %
Corrected moisture content for material passing 0.425mm	17 %
Curing Time	25 Hours

Liquid Limit	23 %
Plastic Limit	17 %
Plasticity Index	6.0 %
Liquidity Index	0.00
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
19% RETAINED ON 2mm SIEVE
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1

Contract: PARADISE ROAD.

Serial No. S21341

UKAS TESTING 0998

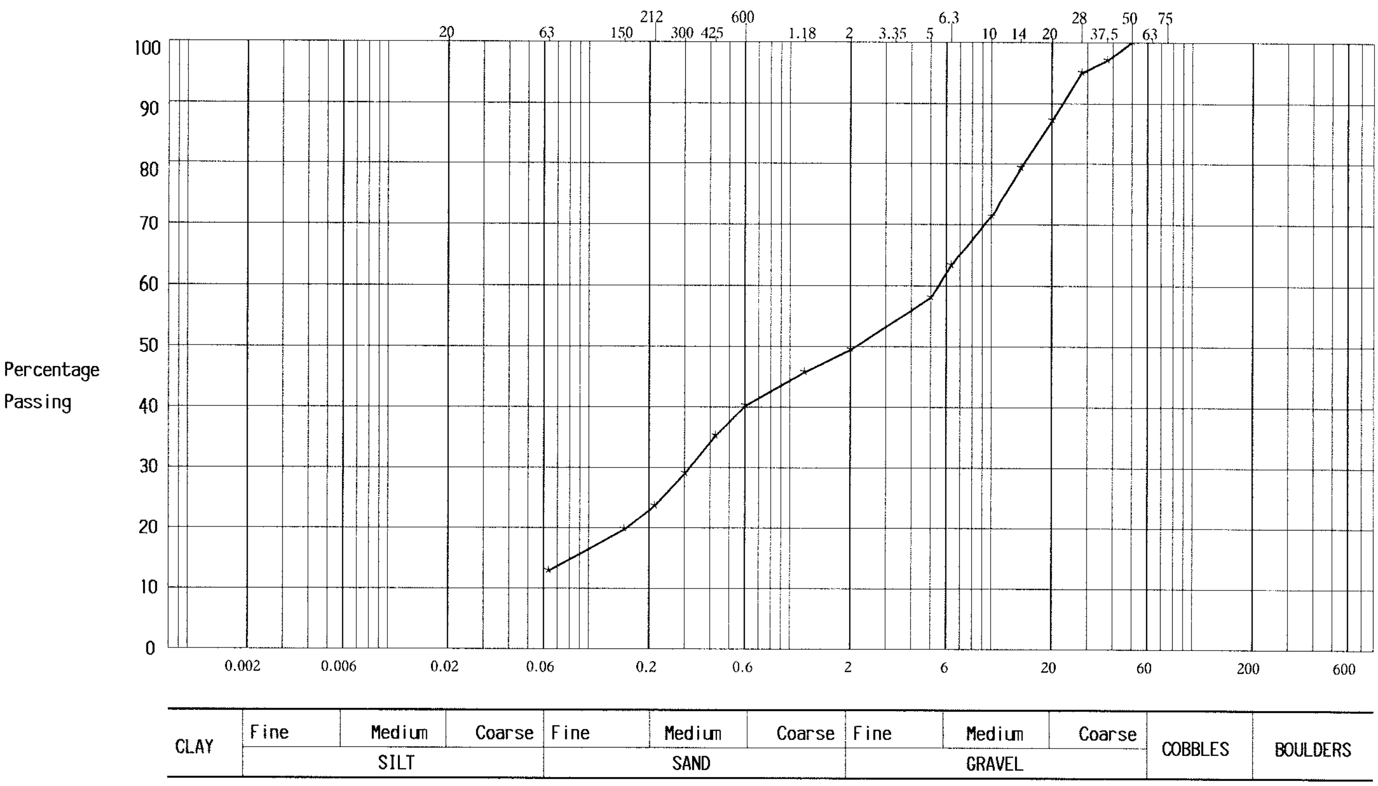
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH3	2.00 -2.50	B2	Brown and white clayey very sandy rounded to subangular GRAVEL. Sand is brown	

Method of Test: Wet Sieve

Method of pre-treatment:

	Size (microns)						Size (mm)										
Sieve Size	63	150	212	300	425	600	1.18	2	5	6.3	10	14	20	28	37.5	50	75
Percentage by Mass passing Sieve	13	20	24	29	35	40	46	49	58	63	71	79	87	95	97	100	-



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3 & 7.4.5

METHOD OF TEST : BS 1377:PART 2:1990:9.2

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

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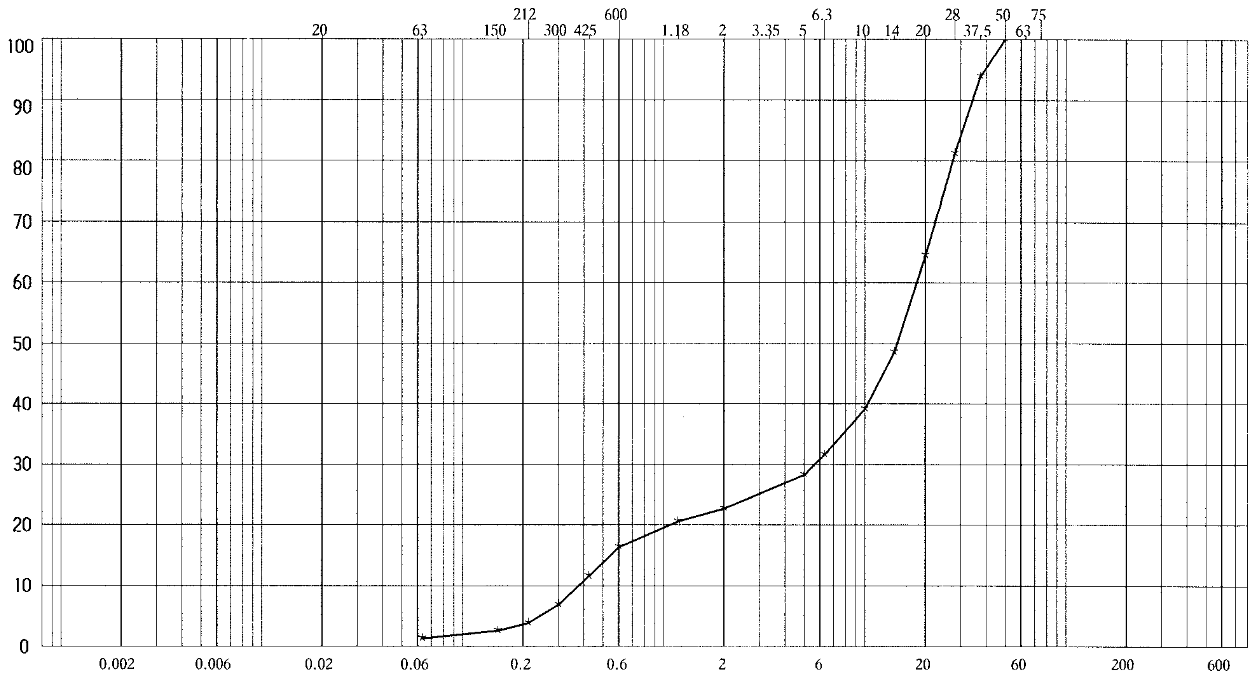
UKAS TESTING 0998

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH4	2.00 -2.50	B1	Brown, black and white slightly silty very sandy angular to subrounded GRAVEL. Sand is yellowish brown	

Method of Test:	Wet Sieve	Method of pre-treatment:	

	Size (microns)						Size (mm)										
Sieve Size	63	150	212	300	425	600	1.18	2	5	6.3	10	14	20	28	37.5	50	75
Percentage by Mass passing Sieve	1	2	4	7	12	16	20	23	28	31	39	49	64	81	94	100	-



CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3 & 7.4.5

METHOD OF TEST : BS 1377:PART 2:1990:9.2

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

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UKAS TESTING 0998

DETERMINATION OF DENSITY, MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Lateral Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	MOHRS CIRCLE ANALYSIS Cu (kPa)	MOHRS CIRCLE ANALYSIS ∅ (degrees)	Description
BH1	3.00	U1	33	1.95	1.47	60	103	51			Firm brown CLAY with occasional grey mottling
BH1	5.00	U2	34	1.92	1.43	102	143	72			Firm brown CLAY with occasional grey mottling
BH1	14.00	U5	28	2.01	1.57	250	222	111			Stiff fissured brown CLAY with rare grey mottling
BH2	5.00	U2	33	1.92	1.44	101	85	43			Firm brown CLAY with rare fossil fragments
BH2	11.00	U4	28	1.98	1.55	221	171	85			Stiff dark grey CLAY
BH2	20.00	U7	28	1.99	1.55	398	304	152			Very stiff fissured dark grey CLAY
BH2	23.00	U8	28	1.98	1.55	459	312	156			Very stiff fissured dark grey CLAY
BH3	6.50	U1	31	1.96	1.50	132	107	53			Firm dark grey CLAY
BH4	9.50	U3	29	1.96	1.52	191	172	86			Stiff fissured dark grey CLAY
BH4	15.50	U5	28	1.98	1.55	312	262	131			Stiff fissured dark grey CLAY
BH4	18.50	U6	25	2.03	1.62	370	546	273			Very stiff fissured dark grey CLAY
BH4	24.50	U8	28	1.98	1.55	491	292	146			Very stiff fissured dark grey CLAY

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4.2 & 8 PART 2:1990:7.2 PART 7:1990:8.3

METHOD OF TEST : BS 1377:PART 2:1990:3 Determination of Moisture Content 1990:7 Determination of Density
:PART 7:1990:8 Undrained Shear Strength 1990:9 Multi-stage test
Note Multi-stage test used when specimen has granular content / behaviour and length of specimen precludes the taking of 3 x 100mm dia by 200mm long specimens.

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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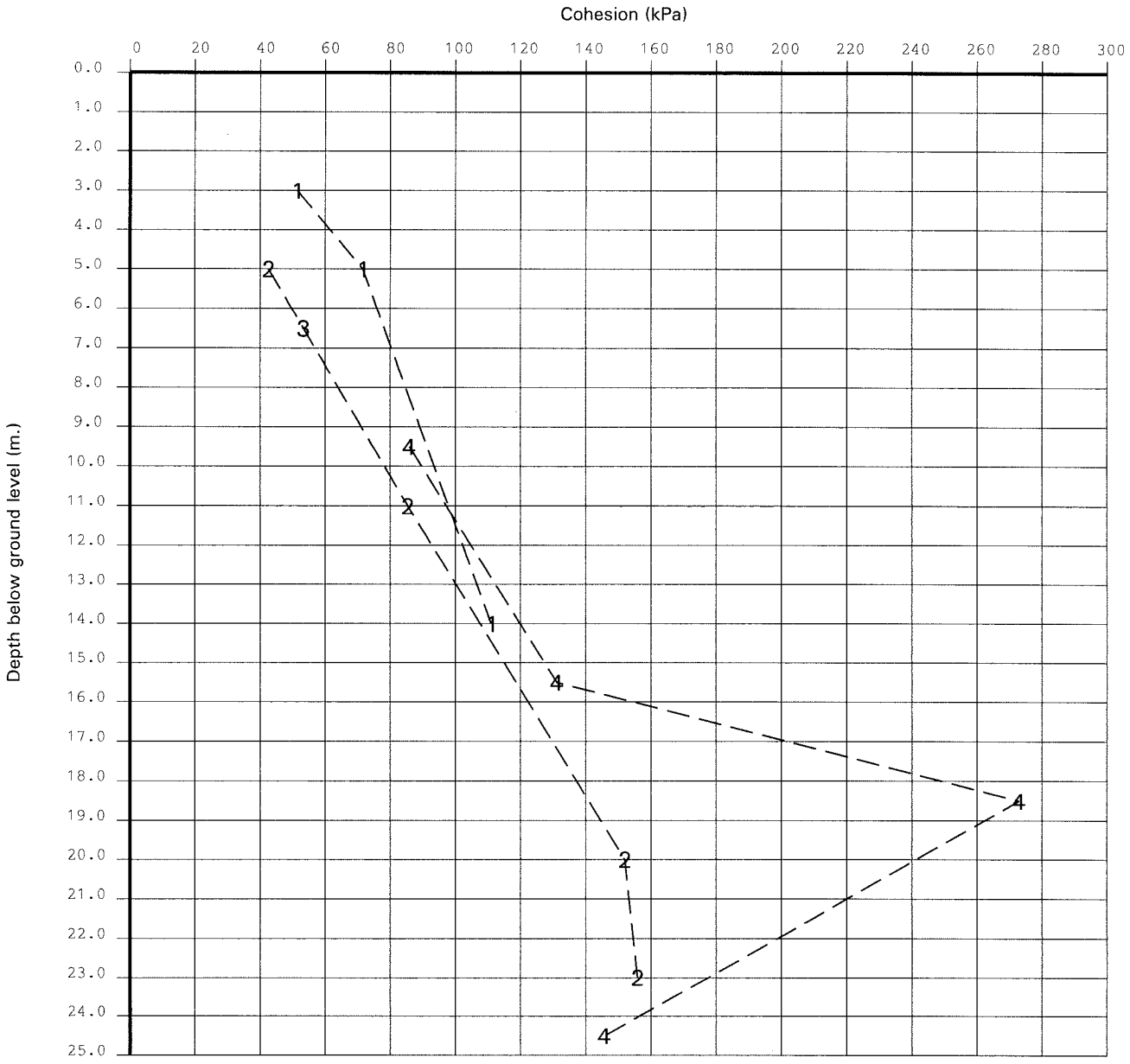
Cohesion (kPa) vs Depth below ground level (m.).



Key to Data Points	1 : BH1	2 : BH2	3 : BH3	4 : BH4				

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DETERMINATION OF UNDRAINED SHEAR STRENGTH

IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

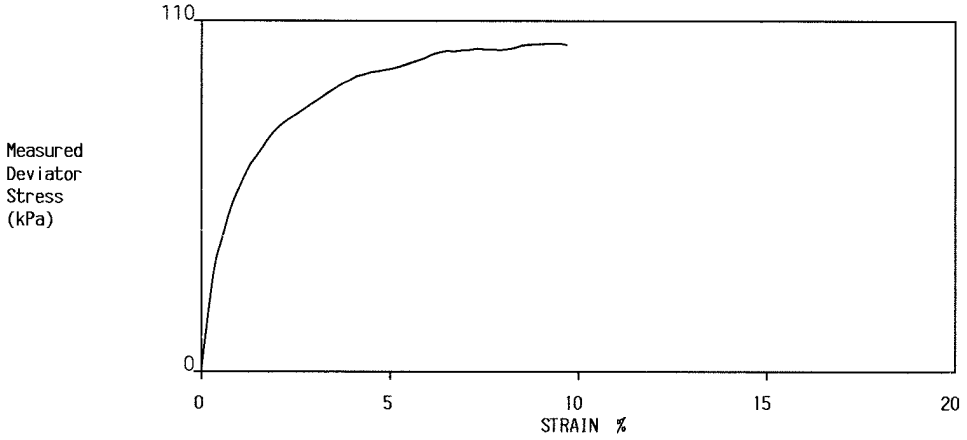
Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	3.00	U1	Firm brown CLAY with occasional grey mottling	

Initial Specimen

Depth of Top of Specimen (m): 3.15

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
199.9	102.7	3221	33	1.95	1.47

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	60	9.3	0.6	/	103	51		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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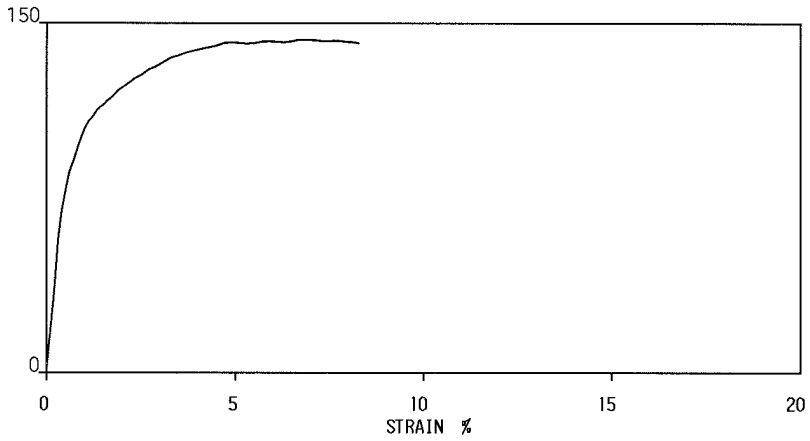
DETERMINATION OF UNDRAINED SHEAR STRENGTH

IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	5.00	U2	Firm brown CLAY with occasional grey mottling	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 5.08	199.9	102.9	3196	34	1.92	1.43

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	102	6.9	0.4	/	143	72		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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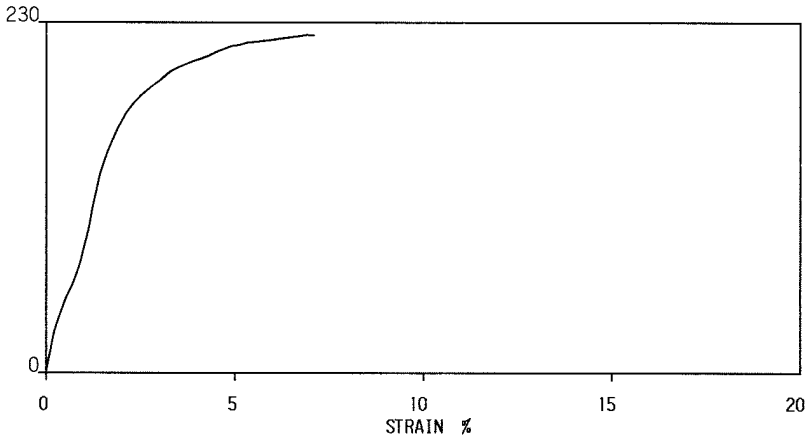
DETERMINATION OF UNDRAINED SHEAR STRENGTH
IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	14.00	U5	Stiff fissured brown CLAY with rare grey mottling	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 14.16	199.9	102.3	3296	28	2.01	1.57

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	250	7.1	0.4	/	222	111		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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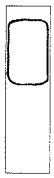
DETERMINATION OF UNDRAINED SHEAR STRENGTH

IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	5.00	U2	Firm brown CLAY with rare fossil fragments	

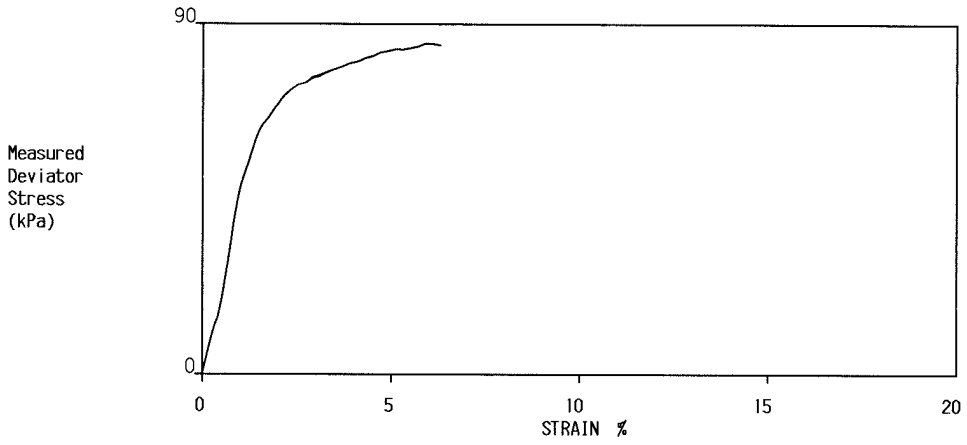
Initial Specimen



Depth of Top of Specimen (m): 5.11

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
200.0	102.7	3185	33	1.92	1.44

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	101	6.1	0.4	/	85	43		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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DETERMINATION OF UNDRAINED SHEAR STRENGTH
IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

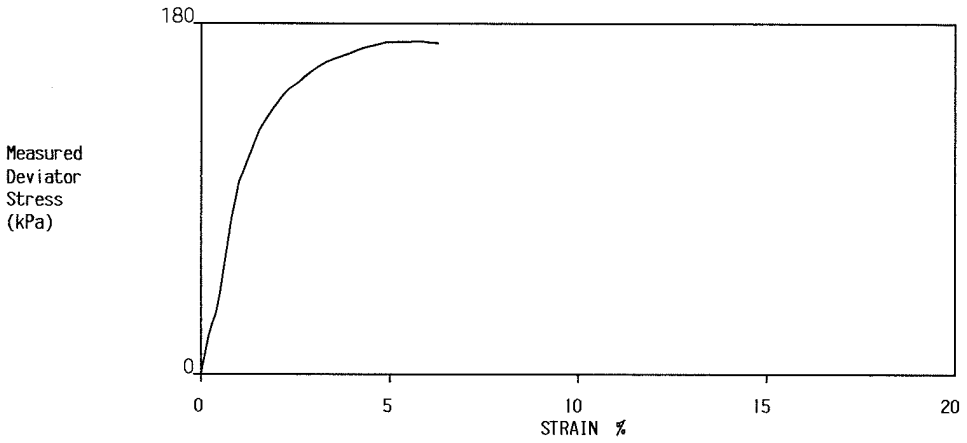
Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	11.00	U4	Stiff dark grey CLAY	

Initial Specimen

Depth of Top of Specimen (m): 11.14

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
200.0	102.3	3260	28	1.98	1.55

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	221	5.1	0.4	/	171	85		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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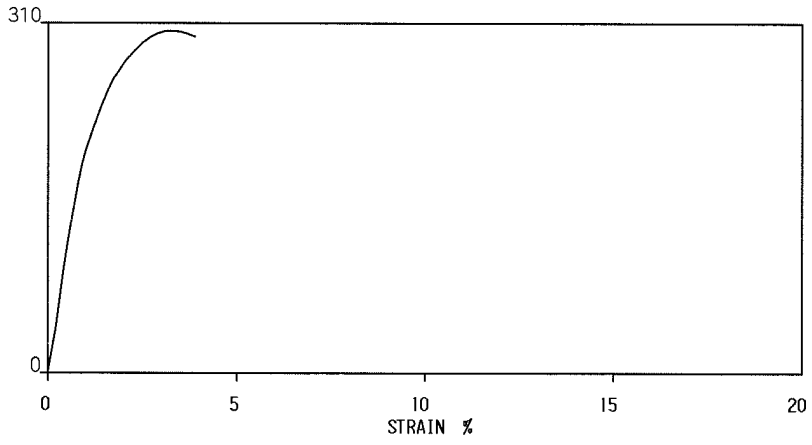
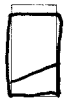
DETERMINATION OF UNDRAINED SHEAR STRENGTH
IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	20.00	U7	Very stiff fissured dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 20.09	200.0	102.7	3291	28	1.99	1.55

TEST INFORMATION — Rate of Strain 0.9 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	398	3.3	0.2	/	304	152		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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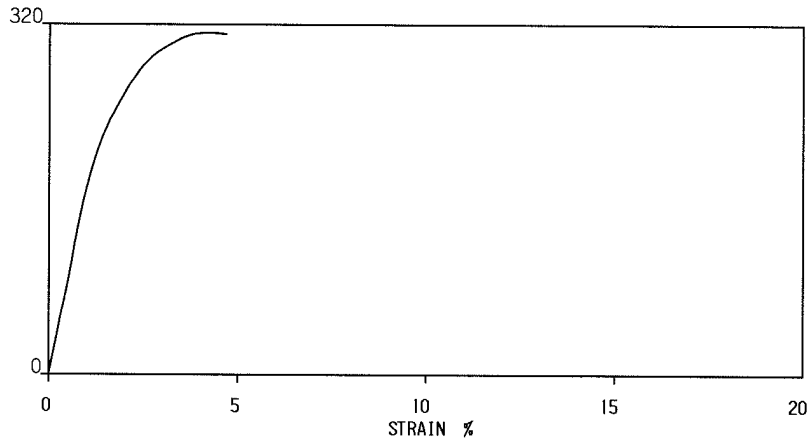
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	23.00	U8	Very stiff fissured dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 23.09	200.0	102.9	3292	28	1.98	1.55

TEST INFORMATION — Rate of Strain 0.9 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	459	4.1	0.3	/	312	156		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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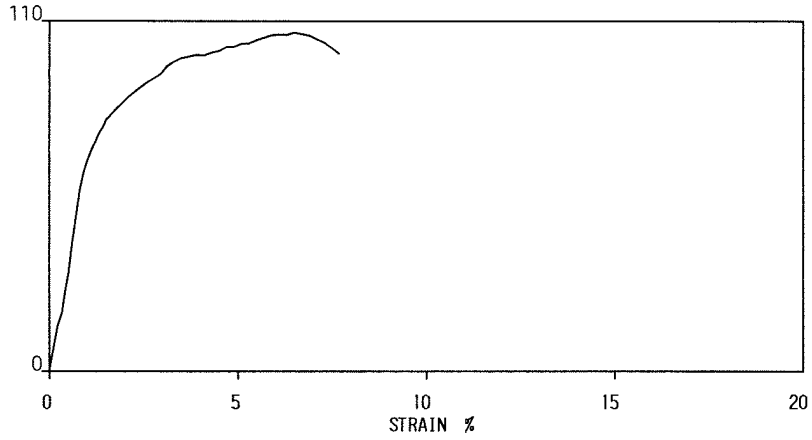
DETERMINATION OF UNDRAINED SHEAR STRENGTH

IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH3	6.50	U1	Firm dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 6.58	200.0	102.4	3221	31	1.96	1.50

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	132	6.7	0.4	/	107	53		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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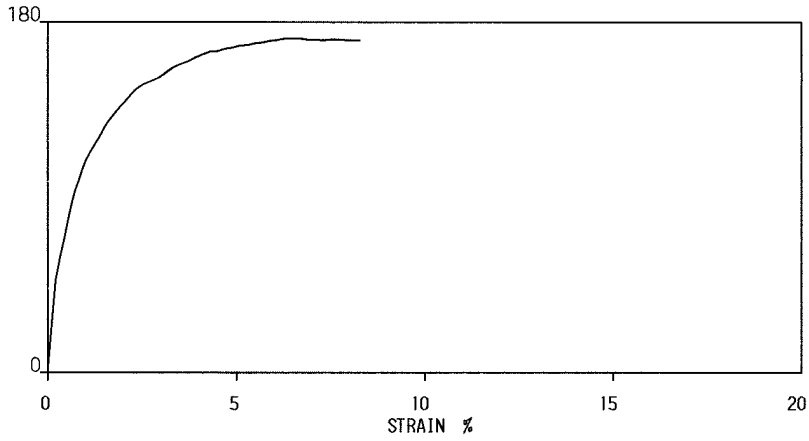
DETERMINATION OF UNDRAINED SHEAR STRENGTH
IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH4	9.50	U3	Stiff fissured dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 9.61	200.0	102.5	3234	29	1.96	1.52

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	191	6.5	0.4	/	172	86		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

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Contract: PARADISE ROAD.

Serial No. S21341

UKAS TESTING 0998

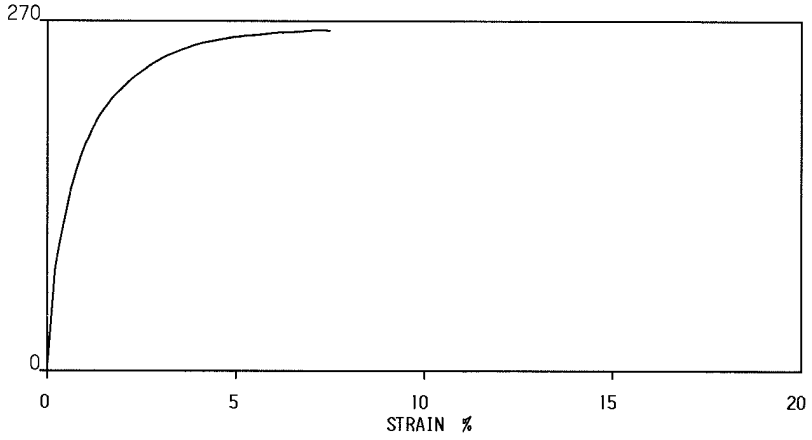
DETERMINATION OF UNDRAINED SHEAR STRENGTH

IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH4	15.50	U5	Stiff fissured dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 15.71	184.9	102.7	3038	28	1.98	1.55

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	312	7.5	0.6	/	262	131		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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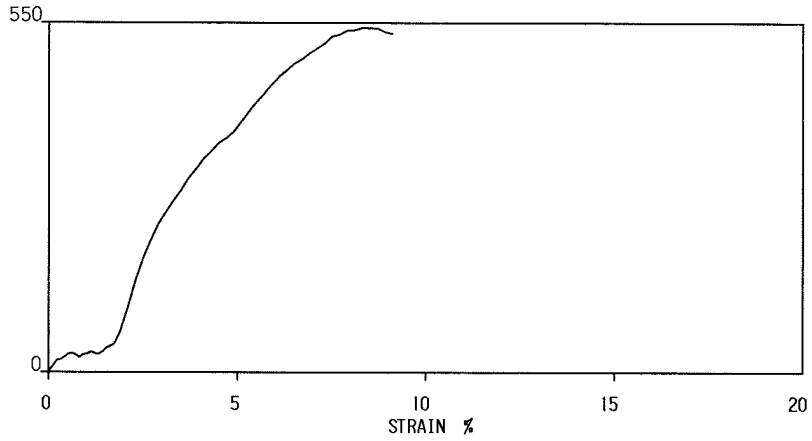
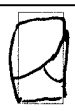
DETERMINATION OF UNDRAINED SHEAR STRENGTH
IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH4	18.50	U6	Very stiff fissured dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 18.80	73.8	38.4	173	25	2.03	1.62

TEST INFORMATION — Rate of Strain 1.7 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	370	8.6	1.6	/	546	273		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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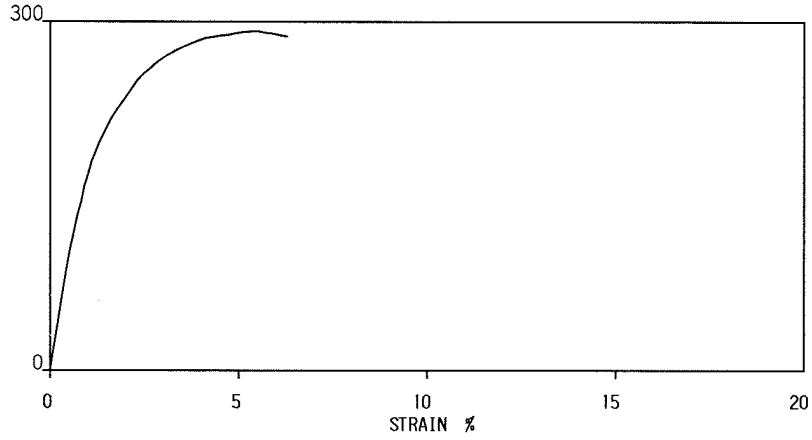
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH4	24.50	U8	Very stiff fissured dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 24.59	200.0	102.6	3272	28	1.98	1.55

TEST INFORMATION — Rate of Strain 0.9 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	491	5.3	0.4	/	292	146		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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DETERMINATION OF THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Pit No.	Depth m.	Sample	Concentration of Soluble Sulphate: Soil: Acid Soluble SO3 %	Concentration of Soluble Sulphate: Soil: Water Soluble 2:1 SO3 g/l	Concentration of Soluble Sulphate: Groundwater g/l	% of sample passing 2mm sieve	Description	Remarks
BH1	4.45	D7		1.59		100	Stiff brown CLAY with occasional grey veins, rare decayed roots and selenite crystals	
BH1	9.95	D11		0.30		100	Very stiff dark grey CLAY	
BH1	14.50	D14		0.34		100	Very stiff dark grey CLAY	
BH2	2.00	B1		0.14		55	Soft locally firm dark brownish grey slightly sandy gravelly organic CLAY with brown and dark grey pockets. Gravel is fine to coarse flint	Strong smell of hydrocarbons
BH2	2.90	D5		0.04		100	Stiff brown CLAY with rare decayed roots	

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.5 BS1377:PART 3:1990:5.2 Acid Soluble, 5.3 Soil/Water Extract :5.4 Groundwater

METHOD OF TEST : BS 1377:PART 3:1990:5.5

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Test not UKAS accredited.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

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DETERMINATION OF THE pH VALUE

Borehole/ Pit No.	Depth m.	Sample	pH Value	Description	Remarks
BH1	4.45	D7	7.5	Stiff brown CLAY with occasional grey veins, rare decayed roots and selenite crystals	
BH1	9.95	D11	8.1	Very stiff dark grey CLAY	
BH1	14.50	D14	8.0	Very stiff dark grey CLAY	
BH2	2.00	B1	7.8	Soft locally firm dark brownish grey slightly sandy gravelly organic CLAY with brown and dark grey pockets. Gravel is fine to coarse flint	Strong smell of hydrocarbons
BH2	2.90	D5	7.8	Stiff brown CLAY with rare decayed roots	

METHOD OF PREPARATION: BS 1377:PART 1:1990:7 BS 1377:PART 3:1990:9.4

METHOD OF TEST : BS 1377:PART 3:1990:9.5

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Test not UKAS accredited.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

APPENDIX D

Defining Risk

Defining Risk

The terms High, Medium or Low are used to describe the risk associated with a particular SPR Linkage and is defined by the completeness of the SPR Linkage combined with the Severity of Impact (in the event of a linkage being realised). **Recommended Action** is associated with the degree of risk as given below.

These terms are defined as follows:

High An impact event is only defined as high risk if the following occurs:

The SPR linkage is proven to be complete and the Severity of Impact is Serious and presently being realised (i.e. if there is an ongoing adverse impact upon human health, livestock, crops, buildings, protected ecosystems or controlled waters or there is a similar impact upon the proposed usage for which we are undertaking the risk assessment).
Recommended Action: A high risk must involve further investigation and/or remedial action.

Medium An impact event is defined as medium risk if the following occurs:

The SPR linkage is suspected but not proven where the Severity of Impact would be Serious. The possibility that there may be a high risk should be indicated;
The SPR linkage is completed but the Severity of Impact is Moderate;
The SPR linkage is incomplete but the potential exists for the linkage to be completed in the future (e.g. change in site end-use, introduction of a new pathway, etc.) where the Severity of Impact would be either Moderate or Serious.
Recommended Action: A medium risk should involve further investigation and/or remedial action.

Low An impact event is defined as low risk if the following occurs:

The SPR linkage is complete but the Severity of Impact is Negligible (i.e. the levels of contamination are below guideline limits posing a hazard for the proposed end use);
The SPR linkage is incomplete and there is no foreseeable mechanism by which it could be realised.

Recommended Action: A low risk requires no further action although investigation should be considered as a prudent and sensible measure.