E. Ground Investigation Report – Southern Testing

Report reference J11827, prepared in July 2014. Prepared by J Race BSc, MSc, CGeol, FGS, approved by D Vooght, MSc, Director of Southern Testing.

Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

Site Investigation Report

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: Grove Lodge, Admirals Walk, London NW3

Client: Mr C Berendsen

Report Date: July 2014

Project Reference: J11827

Southern Testing Head Office
East Grinstead
Tel: 01342 333100
enquiries@southerntesting.co.uk

ST Consult Midlands
Northampton
Tel: 01604 500020
creaton@stconsult.co.uk

ST Consult North West
Warrington
Tel: 01925 661 700
warrington@stconsult.co.uk

ST Consult South West
Swindon
Tel: 01793 441 522
swindon@stconsult.co.uk

SUMMARY

The site which is an existing dwelling, is to be remodelled and extended as described in the text.

Geological records indicate the site to be underlain by Bagshot Formation soils overlying Claygate member.

No formal desk study has been undertaken. A single borehole was carried out.

The soils encountered comprised medium dense gravels and sandy gravels overlying a sandy clay overlying medium dense to dense clayey fine sands. A superficial layer of made ground was seen to a depth of 2.3m. The gravels, unlike the underlying sands, are not typical of the Bagshot Formation within this area.

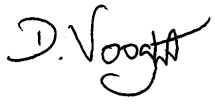
Groundwater levels were found to be at around 3.8m bgl, and appear to be perched above the layer of clay. Long-term groundwater level monitoring has been started and has shown a fairly steady standing level over the last six weeks.

The sulphate content of the fill and natural soil was found to fall within Class DS-2. The ACEC classification for the site is AC-1s.

Allowable bearing capacity of 150kPa has been recommended for foundations formed on the underlying medium dense to dense sands.

A discussion is given on basement construction and design soil parameters.

Waste Classification Tests have been undertaken on the materials likely to be excavated for the basement. The results suggest that the materials are likely to be classified as Inert, however final classification will be made by the receiving landfill.



D Vooght MSc
(Countersigned)

J Race MSc CGeol
(Signed)

For and on behalf of Southern Testing Laboratories Limited

STL: J11827
11 February 2015

TABLE OF CONTENTS

A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a signed STL project order form received from the Client on 12th May 2014.

2 Location

The site is located in Admirals Walk, approximately 250m northwest of Hampstead Underground Railway Station. The approximate National Grid Reference of the site is TQ 261 861.

3 Proposed Construction

It is understood that '**the proposals in outline involve the rationalisation of the existing *ad hoc* extensions to the southern wing including the removal of the modern games room, conservatory, garage and 1920s addition, replacing them with a high-quality sympathetic extension with basement. All existing garden buildings will be replaced with a single, ground floor orangery with a basement storage space. The garden itself will be sensitively re-landscaped. The interiors of the listed building will be refurbished and restored where appropriate throughout**'.

4 Object

This is a geotechnical investigation.

The object of the investigation was to assess foundation bearing conditions and other soil parameters relevant to the proposed development and to make an assessment of those soils for waste disposal.

5 Scope

This report presents our desk study findings, exploratory hole logs and test results and our interpretation of these data.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

Contamination issues are not considered in this report.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Mr Berendsen and his appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

B DESK STUDY & WALKOVER SURVEY

6 Desk Study

No formal desk study has been carried out as part of this project, but reference has been made to the following information sources.

- Geological Maps
- Historical Ordnance Survey Maps
- Environment Agency website

The environmental databases search report compiled for this desk study contains site-specific environmental data drawn from data sets that comprise publicly available information together with data from third parties, some of which is under review. Accordingly, Southern Testing Laboratories Limited does not warrant its accuracy, reliability or completeness.

A summary of the salient features is included in the following sections of this report.

6.1 Geology

The British Geological Survey Map No 256 North London indicates that the site geology consists of Bagshot Formation over Claygate Member over London Clay.

Bagshot Formation

This formation consists of fine white, buff and crimson sands with occasional seams of pipe clay, silt, and local beds of flint gravel.

The Beds are usually 30-45m in thickness and often have a band of flint pebbles at the base. There is a basal layer of mottled loams and clay, with subordinate amounts of reddish sand that resembles the Reading Beds. The clays are succeeded by more sandy, locally pebbly, yellow or gold coloured strata.

Claygate Member

The Claygate Member of the London Clay formation comprises sandy transition beds, about 15 m thick, at the top of the London Clay and consists of alternations of sand and clay. Sand predominates above, and clay below. They were commonly worked for brick making.

London Clay

London Clay is a well-known stiff (high strength) blue-grey, fissured clay, which weathers to a brown colour near the surface. It contains thin layers of nodular calcareous mudstone -

"claystone" - from place to place, and crystals of water clear calcium sulphate (selenite) are common. Although slopes will stand in the clay at steep angles in the short term, the long-term stable slope angle is about 7^{o} for grassed, or cleared slopes, and a few degrees more for wooded slopes.

6.2 Hydrology and Hydrogeology

Data from the Environment Agency and other information relating to controlled waters is summarised below.

Data		Remarks	Possible Hazard to/from Site Y/N
Aquifer Designation	Superficial Deposits	None present	N
	Bedrock	Secondary A - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers; this relates to the Bagshot Formation outcrop.	Y
Groundwater Vulnerability		Minor Aquifer High	Y
Abstractions		No recorded abstraction within 1 km.	N
Source Protection Zones		The site does not lie within a SPZ.	N
Surface Water Features		The nearest feature is a pond on the Vale of Heath some 300m to the north.	N
Marine/Fluvial Flood Risk		The site is not shown within an area mapped as being at risk on the EA website on 26/06/2014.	N
Surface Water Flood Risk		The site is not shown within an area mapped as being at risk on the EA website on 26/06/2014.	N
Reservoir Flood Risk		The site is not shown within an area mapped as being at risk on the EA website on 26/06/2014.	N

6.3 Historical Map Search

Online extracts of historical Ordnance Survey plans dating from 1871 were viewed and these indicate that the existing property was there at that time. The property and the immediate area has altered little since then.

7 Walkover Survey

A brief walkover survey of the front of the property and adjacent highway was carried out on 14th May during the boring works.

7.1 General Site Description

The front of the property comprises an area of sandstone flag paving where private off-street parking is available. The property itself is generally two-storey with a separate garage and is known to have an area of basement. The property is built very close to the adjacent four-storey house known as Admiral's House.

There are a number of fairly mature trees on the southern boundary of the property which can be seen when viewed from Admiral's walk. The property is located on the south-facing slope of a hill leading to Hampstead Heath some distance to the north.

The site is located within a residential area of houses with generally large gardens. The houses nearby are highly variable and range in age from historical to modern, and in size from two to four-storey, some having obvious basements. From a superficial survey from the public highway there were no obvious signs of structural problems noted that could be attributed to poor ground conditions.

C SITE INVESTIGATION

11 Method

The strategy adopted for the intrusive investigation comprised the following:

- 1 No 15m deep borehole was drilled using a light percussion, 150mm diameter, shell and auger boring rig.
- Installation of a groundwater monitoring well with a water level datalogger for long-term measurement.

The exploratory hole location is shown in Figure 1 in Appendix A.

12 Weather Conditions

The fieldwork was carried out on 14th May 2014, at which time the weather was dry and sunny.

13 Soils as Found

The soils encountered are described in detail in the attached exploratory hole log (Appendix A), but in general comprised a covering of made ground over Bagshot Formation. A summary is given below.

Depth	Thickness	Soil Type	Description
GL to 0.52m	0.52m	Made Ground	Concrete surfacing over brickwork with a concrete footing.
0.52 to 2.3m	1.78m	Made ground	Brown to reddish brown sandy cobbly GRAVEL with brick, concrete and flints.
2.3 to 6.3m	4.0m	Bagshot Formation?	Medium dense yellowish brown sandy fine to coarse GRAVEL.
6.3 to 9.0m	2.7m	Bagshot Formation	Firm to stiff pale grey sandy CLAY.
9.0 to 15.45m	6.45m+	Bagshot Formation	Medium dense to dense brownish grey to buff clayey fine SAND. Lamination of sandy clay encountered.

The very upper part of the borehole encountered insitu mortared brickwork with a concrete base, possibly the remains of a former wall.

13.1 Visual and Olfactory Evidence of Contamination

No obvious evidence of possible contamination was recorded within BH1 other than the presence of made ground, which can sometimes contain elevated levels of various contaminants.

14 Groundwater Strikes

Water was struck in the exploratory holes as follows:

BH	Water Strikes
BH1	Strike between 4.5m to 5m depth, water was being added to aid drilling which made the strike depth uncertain. Standing water level 4.5m bgl.

D FIELD TESTING AND SAMPLING

The following in-situ test and sampling methods were employed. Descriptions are given in Appendix B together with the test results.

- Disturbed Samples;
- Standard Penetration Tests;

- Open Drive (U100) Sampling;
- Hand Penetrometer Tests.

E GEOTECHNICAL LABORATORY TESTS

The following tests were carried out on selected samples. Test method references and results are given in Appendix C.

- Moisture Content & Atterberg Determinations;
- Particle Size Distribution (wet sieve & sedimentation) Tests;
- Undrained Unconsolidated Triaxial (UUT) Test;
- Sulphate & pH Determinations.

F DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

15 Soil Classification and Properties

Soil Type	Depth	Compressibility	VCP	Permeability	Frost Susceptible	CBR	Remarks
Made Ground	GL to 2.3m	Potentially high	Low to negligible	N/A	Yes	Poor	Not suitable for foundations
GRAVEL & sandy GRAVEL	2.3 to 6.3m	Low	Negligible	Fair to good	No	Good	
Sandy CLAY	6.3 to 9.0m	Moderate to high	Medium	Low	N/A	N/A	
Clayey fine SAND	9.0 to 15.0m+	Low to moderate	Low to negligible	Low to fair	N/A	N/A	

The lateral variation of the sandy clay layer has not been established; but is anticipated to vary in thickness within the local area.

16 Swelling and Shrinkage

The gravel and sand materials will have negligible swelling and shrinkage properties. The horizon of sandy clay was classified as a clay of intermediate plasticity with a plasticity index value of 26%.

In terms of NHBC precautions relating to swelling and shrinkage issues, the clay horizon is at some depth and is below the standing groundwater level, furthermore, given that any basement structure that is proposed is likely to have a formation level of around 3.5, no specific precautions

will therefore be anticipated in relation to swelling and shrinkage precautions.

17 Groundwater Levels and Monitoring

An apparent level of perched groundwater was seen during the boring at a depth of around 5m depth, however a more definitive depth was not established as water was being added to aid drilling through the gravels. When a datalogger was subsequently installed within the borehole on 10th June 2014 the standing water level was at 3.81m bgl.

Groundwater levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Longer-term monitoring of the standing water levels within a standpipe in BH1 has been commenced using a submerged datalogger, the initial 6 weeks of monitoring data was downloaded on 25th July 2014 and indicates that the standing water level has remained fairly steady around 3.78m bgl over this period. The monitoring data is presented in graphical form contained within Appendix E. The monitoring will be continued and future results will be reported in due course.

18 Sulphates and Acidity

The recorded pH values are in the range 5.3 to 6.9 for the natural soils and the groundwater sample, being mildly acidic in reaction. The sample of made ground had a recorded value of 10.1, being alkaline in reaction.

The Design Sulphate Class is DS-2 is recommended based upon the results of the groundwater sample. Groundwater should be assumed to be immobile. The ACEC site classification is AC-1s.

19 Bearing Capacity

For any new basement proposals it would be anticipated that formation levels of around 3.5m bgl will generally be formed on medium dense gravel and sandy gravel. Below this gravel is a layer of firm to stiff sandy clay, which may vary in thickness and depth laterally.

For conventional foundations of strips or pads an allowable bearing capacity of 150kPa would be recommended within these materials. Whilst this may appear to be modest for the gravels, this would allow for limiting any overall settlement within the underlying clays. Providing no weaker horizons are present within the influence of loaded foundations the above allowable bearing pressure is for a maximum estimated settlement of 25mm.

In terms of a raft or basement raft foundation, a net allowable bearing pressure of 150kPa would be available for a raft bearing onto the medium dense gravels and sandy gravels. Excavation of the basement will result in soil unloading and associated unload displacements within both the gravels and underlying clay. Within the gravels these will be immediate, but within the clay there will be an element of long-term displacement. It is therefore suggested that estimates of long-term movement be calculated once definite proposals are established, so that any necessary heave precautions can be included within the basement slab design.

19.1 Piling

If contiguous or secant bored piles are to be installed as part of the basement construction, as with any piling scheme, discussions should be held with selected piling contractors to discuss the technical and financial merits of their various systems and overall resources, with respect to

equipment available for the soils described and anticipated, to achieve the depths and diameters considered with an adequate safety margin.

From the viewpoint of pile type, and given the close proximity of adjacent structures, a bored pile solution is considered to be a more appropriate pile type. In terms of bored piles and, noting the presence of potentially unstable soils (gravels and sandy gravels), and the presence of perched groundwater, a continuous flight auger grout injected pile (CFA) would be best suited to the ground conditions encountered. Careful monitoring during construction of these pile types is, however, required. The site history is unknown however it should be noted that subsurface obstructions could be encountered in the form of old foundations etc. associated with previous development/buildings on the site. Accordingly allowances for their removal/breaking out should be made when carrying out piling works and excavations.

In the case of a contiguous bored pile wall solution, this will likely comprise a series of bored piles with a typical gap of approximately 100-150mm between each pile. There is a significant risk of erosion/migration of gravel and sandy gravel materials from between the gaps in the piles (particularly where perched groundwater is present) and therefore the use mesh/sprayed concrete to ensure that no soil erosion/movement takes place from between the pile gaps could be considered. In addition to cater for the permeation of groundwater through the piled wall and sprayed concrete, a drainage cavity or some other form of waterproofing measures will need to be considered as part of the basement construction.

20 Basement Design Parameters

There is an empirical relationship between the SPT N values for the angle of friction (ϕ') of a granular material (Peck, Hanson and Thorburn).

In addition, the peak and critical states angles of friction can also be estimated from grading, angularity and SPT N values (BS 8002, 1994).

Where: $(\phi'_{peak})=30+A+B+C$

$(\phi'_{cv})=30+A+B$

Assuming a well graded rounded gravel material (A=0, B=4) and a moderately graded sub-angular sand material (A=2, B=2), the following angles of friction are estimated for the soils encountered on site using the above relationships.

Stratum	Depth (mbgl)	ϕ'	ϕ'_{peak}	ϕ'_{cv}	Recommended
Made Ground	0.0 - 2.3				28˚ - based upon previous experience
Medium dense GRAVEL	2.3 - 6.3	32 - 34˚	36˚	34˚	
Firm to stiff sandy CLAY	6.3 - 9.0			27˚	
Medium dense clayey SAND	9.0 - 13.0	34 – 35˚	36˚	34˚	
Dense clayey SAND	13.0 - 15.0+	37-40˚	38˚	34˚	

A bulk unit weight of 19 kN/m^3 is recommended for the sand and gravel materials, 20 kN/m^3 for the clays.

Further groundwater monitoring, especially over the wetter winter months, is recommended to establish the potential rise in standing water levels within the gravels on this site. Suitable precautions for basement tanking/drainage and hydrostatic uplift, if required, should be included.

21 Excavations and Trenching

Statutory lateral earth support will be required in all excavations where men must work. An allowance for breaking out sub-surface obstructions will need to be made, as can be seen by the base of a former wall within BH1. The made ground and the shallow sandy gravels will be prone to instability and potentially unheralded collapse, so will require suitable support to be provided where excavations are proposed.

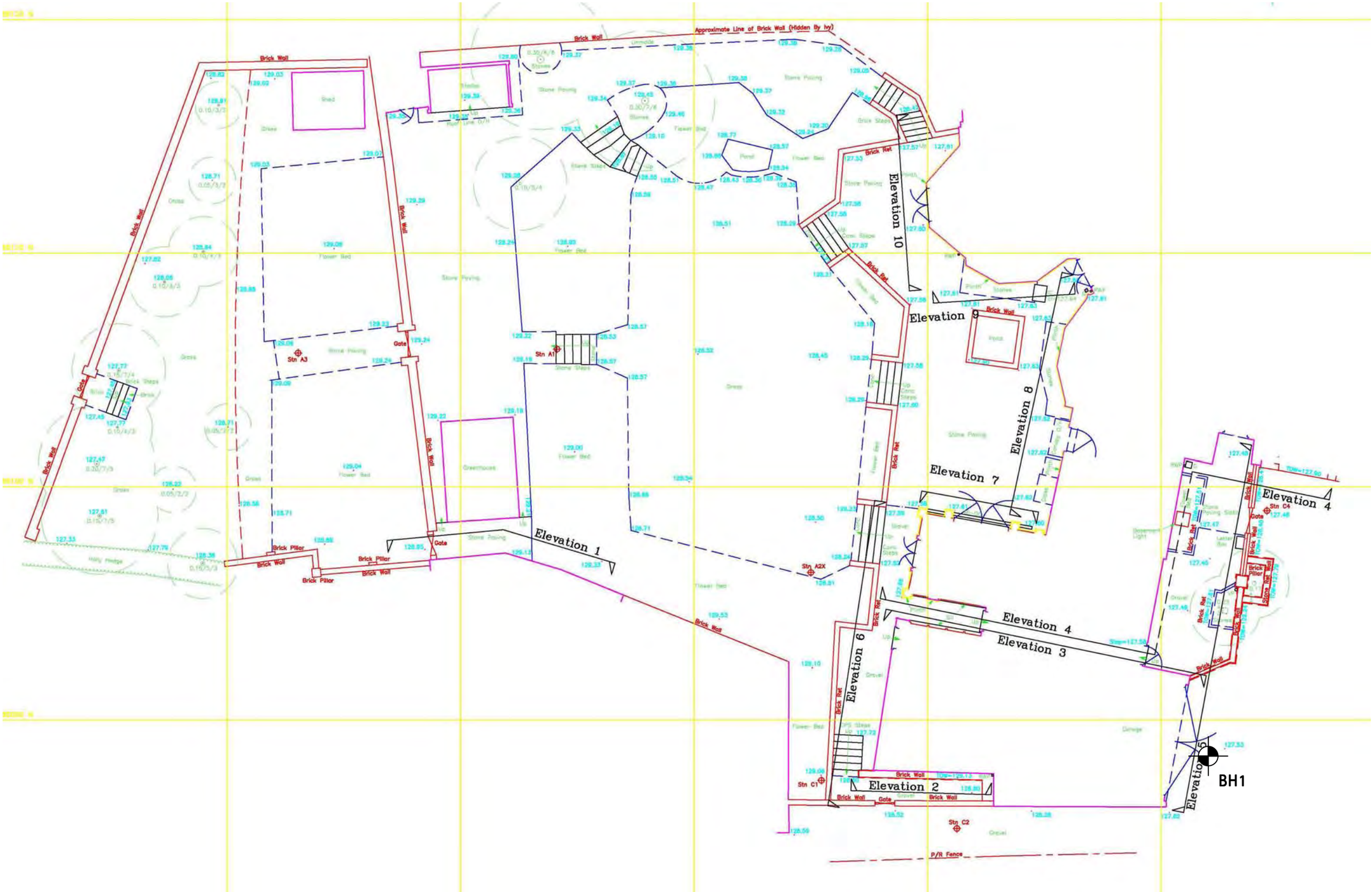
The depth and type of adjacent foundations will need to be considered when construction or excavation is proposed within the influence of these foundations. Care will need to be taken to avoid undermining adjacent foundations and great care should be taken when designing temporary and permanent support/propping systems with respect to existing and adjacent foundations/structures, and when carrying out any underpinning works.

22 Discussion on Waste Disposal

A sample of the made ground has been subject to Waste Acceptance Criteria testing and asbestos fibre screening, as these materials can contain elevated levels of contaminants. The underlying natural ground would be anticipated to be classified as inert. The test results, included within Appendix D, indicate that the made ground in also likely to be classified as inert waste. All final waste classification is determined by the receiving landfill, so we would suggest that the results be forwarded to the landfill for their assessment.

APPENDIX A

Site Plan and Exploratory Hole Log



NB: Positions of Boreholes are only indicative unless dimensioned

Site: Grove Lodge, Admirals Walk, London NW3	STL: J11827	Fig No: Figure 1
Date: 24 July 2014	Borehole Location Plan	

Southern Testing

Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA
ST Consult: Twigden Barns, Brixworth Road, Creaton, Northampton NN6 8NN

ST Consult

Key to Exploratory Hole Logs

General

All soil and rock descriptions in general accordance with BS5930:1999+A2:2010
Geology Code only entered where positive identification of the sampled strata has been made

Sampling

ES	Environmental Sample (taken in appropriate sampling container)
D	Disturbed Sample
B	Bulk Sample
LB	Large Bulk for Earthworks testing
C	Core Sample
U	Undisturbed Sample (number of blows indicated in results column)
SPTLS	SPT Liner Sampler
P	Piston Sample
W	Water Sample

Insitu Tests

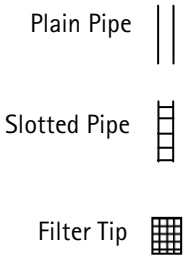
SPT	Standard Penetration Test in accordance with BS EN22476-3:2005
SPT (C)	Cone Penetration Test in accordance with BS EN22476-3:2005
PT	Penetration Test - STL documented equivalent SPT N Value
PPT	Perth Penetration Test - STL in house documented method (N Value)
UCS (⊥)	Unconfined Compressive Strength measure by hand penetrometer (kN/m^2)
IVN	Hand Vane (kPa)
PID	Photo Ionisation Detector Results (ppm)
MEXE	Mexecone CBR Result

Drilling Records (In accordance with BS 5930:1999+A2:2010)

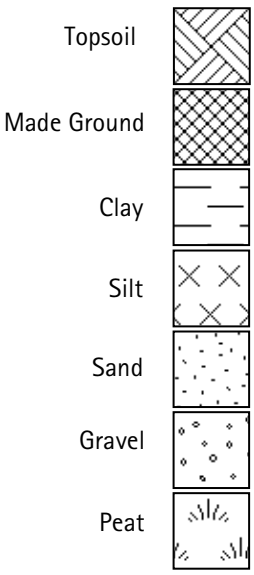
Depth to standing water level	▼
Depth to water strike	▽
TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Index (%)
FI	Fracture Index

Backfill Symbols

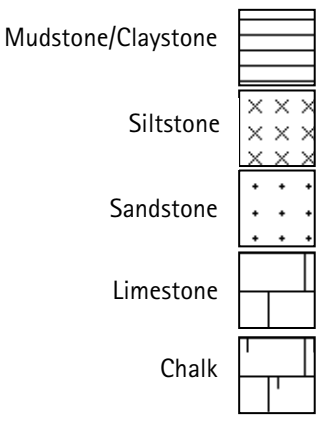
Pipe Symbols



Principal Soil Types



Principal Rock Types



Southern Testing | ST Consult

Tel: 01342 333100

Project No.	Hole Type	Borehole No
J11827	Cable	**BH1** Sheet 1 of 2

Project Name: Grove Lodge

Dates: 14/05/2014

Location: Admiral's Walk, Hampstead, London NW3

NGR: 526242E - 186089N

Client: Mr C Berendsen

Level: 127.50 m AOD

Logged By: JNR

Well	Water Strikes	Depth (m)	Type	Results	Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
					127.46	0.04		0.04	Concrete surfacing
						0.36			
					127.10			0.40	Brickwork
					126.98	0.12		0.52	Concrete
		1.10	B						Made Ground comprising brown to reddish brown slightly clayey sandy fine to cobble sized angular brick and concrete GRAVEL. Occasional medium to coarse rounded flints and large roots. (MADE GROUND)
		1.10	ES						
						1.78			
		1.50	CPT	N=6					
		1.50	B						
					125.20			2.30	
		2.50	D						Medium dense pale brown to yellowish brown sandy to slightly sandy fine to coarse occasionally cobble-sized rounded flint GRAVEL. Becoming more sandy towards the base of layer. (BAGSHOT FORMATION?)
		3.00	CPT	N=25					
		3.00	B						
		4.00	D						
						4.00			
		4.50	CPT	N=16					
		4.50	B						
		5.50	D						
		6.00	CPT	N=9					
		6.00	B						
		6.30		UCS = 180	121.20			6.30	Firm to stiff medium to high strength pale grey mottled pale brown or orange brown slightly sandy CLAY. Laminations of more sandy clay evident. Becoming more sandy with depth. (BAGSHOT FORMATION)
		7.00		UCS = 120					
		7.00	D						
		7.50	U	60 blows					
						2.70			
		8.00		UCS = 150					
		8.00	D						
		9.00	SPT	N=23	118.50			9.00	Medium dense to dense buff mottled brownish grey or greenish grey clayey fine SAND. Occasional laminations of orange brown very sandy CLAY. (BAGSHOT FORMATION)
		9.00	D						

Type	Results

Continued next sheet

Borehole Details

Casing Depth m bgl	Hole Depth m bgl	Casing Diameter mm
6.70	15.00	150

Water Strikes

Date	Water (m)	Casing (m)	Time (mins)	Rose to (m)	Sealed (m)

General Remarks:

Ground Level and Location interpolated from topographic survey.
Water added to aid drilling between 3m to 5.5m depth.
Water strike between 4.5m to 5.5m depth, standing level around 4.5m depth.

Southern Testing | ST Consult

Tel: 01342 333100

Project No.	Hole Type	Borehole No
J11827	Cable	**BH1** Sheet 2 of 2

Project Name: Grove Lodge

Dates: 14/05/2014

Location: Admiral's Walk, Hampstead, London NW3

NGR: 526242E - 186089N

Client: Mr C Berendsen

Level: 127.50 m AOD

Logged By: JNR

Well	Water Strikes	Samples & In Situ Testing			Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
		Depth (m)	Type	Results					
		10.00	D						Medium dense to dense buff mottled brownish grey or greenish grey clayey fine SAND. Occasional laminations of orange brown very sandy CLAY. (BAGSHOT FORMATION)
		10.50	SPT	N=28					
		10.50	D						
		11.50	B						
		11.50	D						
		12.00	SPT	N=26					
		12.00	D			6.45			
		13.00	D						13.00m - 15.00m: Becoming damp
		13.50	SPT	N=33					
		13.50	D						
		14.00	B						
		14.50	D						
		15.00	SPT	N=46					
		15.00	D						
					112.05			15.45	End of Borehole at 15.45 m

Type	Results

Borehole Details

Casing Depth m bgl	Hole Depth m bgl	Casing Diameter mm
6.70	15.00	150

Water Strikes

Date	Water (m)	Casing (m)	Time (mins)	Rose to (m)	Sealed (m)

General Remarks:

Ground Level and Location interpolated from topographic survey.
Water added to aid drilling between 3m to 5.5m depth.
Water strike between 4.5m to 5.5m depth, standing level around 4.5m depth.

APPENDIX B

Field Sampling and in-situ Test Methods & Results

Field Sampling and in-situ Test Methods

Disturbed Samples

Disturbed samples were taken from the exploratory holes at intervals.

Standard Penetration Test

The Standard Penetration (SPT) Test is specified in BS EN ISO 22476-3 : 2005. In this test, a 51mm diameter open-ended tube is driven into the ground by a 63.5 kg hammer falling freely through 760 mm. The tube is seated by driving to a penetration of 150mm, or by 25 standard blows, whichever occurs first. It is then driven for a maximum of a further 300mm and the number of blows is termed the penetration resistance (N). If 300mm penetration cannot be achieved in 50 blows (100 blows in soft rock), the test drive is terminated. When testing in gravels, a conical end piece is attached to the tube. The test is then called an SPT(C).

This test provides an indirect method of assessing the properties of cohesionless soils, and the following table (after Terzaghi and Peck) gives the approximate condition:-

Number Blows (N)	Density
0 - 4	Very Loose
4 – 10	Loose
10 – 30	Medium Dense
30 – 50	Dense
Over 50	Very Dense

Open Drive U100 Samples

U100 samples were taken in the clay soils at appropriate intervals. These samples are taken in a 100 mm diameter, 450 mm long, thin-walled steel tube, and are sealed with paraffin wax and tightly fitting end caps for transporting to the laboratory.

Hand Penetrometer Test

The hand penetrometer consists of a spring loaded and calibrated plunger which is forced into the soil. A reading of unconfined compression strength (equal to twice cohesion) is given on a calibrated scale. In common with other hand methods of strength assessment (eg. the shear vane) it does not give an accurate indication of bearing capacity in stiff or fissured soils, because of the small test area. The figures are used for strength classification according to the table below.

Hand Penetrometer Value (kPa)	Undrained Shear Strength cu (kPa)	Undrained Shear Strength of Clays
Less than 20	Less than 10	Extremely Low
20 to 40	10 to 20	Very Low
40 to 80	20 to 40	Low
80 to 150	40 to 75	Medium
150 to 300	75 to 150	High
300 to 600	150 to 300	Very High
More than 600	More than 300	Extremely High

APPENDIX C

Geotechnical Laboratory Test References & Results

Southern Testing | ST Consult

Atterberg and Moisture Content Summary

To BS1377-2:1990(2003) cl.3.2, 3.3, 4.2, 4.3

AGS

Project Name		*Grove Lodge, Admirals Walk (Hampstead)*					**Project Number**		*J11827*	
Client		*Michael Barclay Partnership*			**PE**	*JNR*	**Date Issued**		*12-Jun-14*	
Location	Depth m	Sample Type	Visual Description	Comments	Natural MC %	Liquid Limit %	Plastic Limit %	Plasticity Index	Classi-fication	Passing 425 micron %
BH1	7.00	D	*Firm high strength light grey brown sandy CLAY.*		*24*	*45*	*19*	*26*	*CI*	*100*

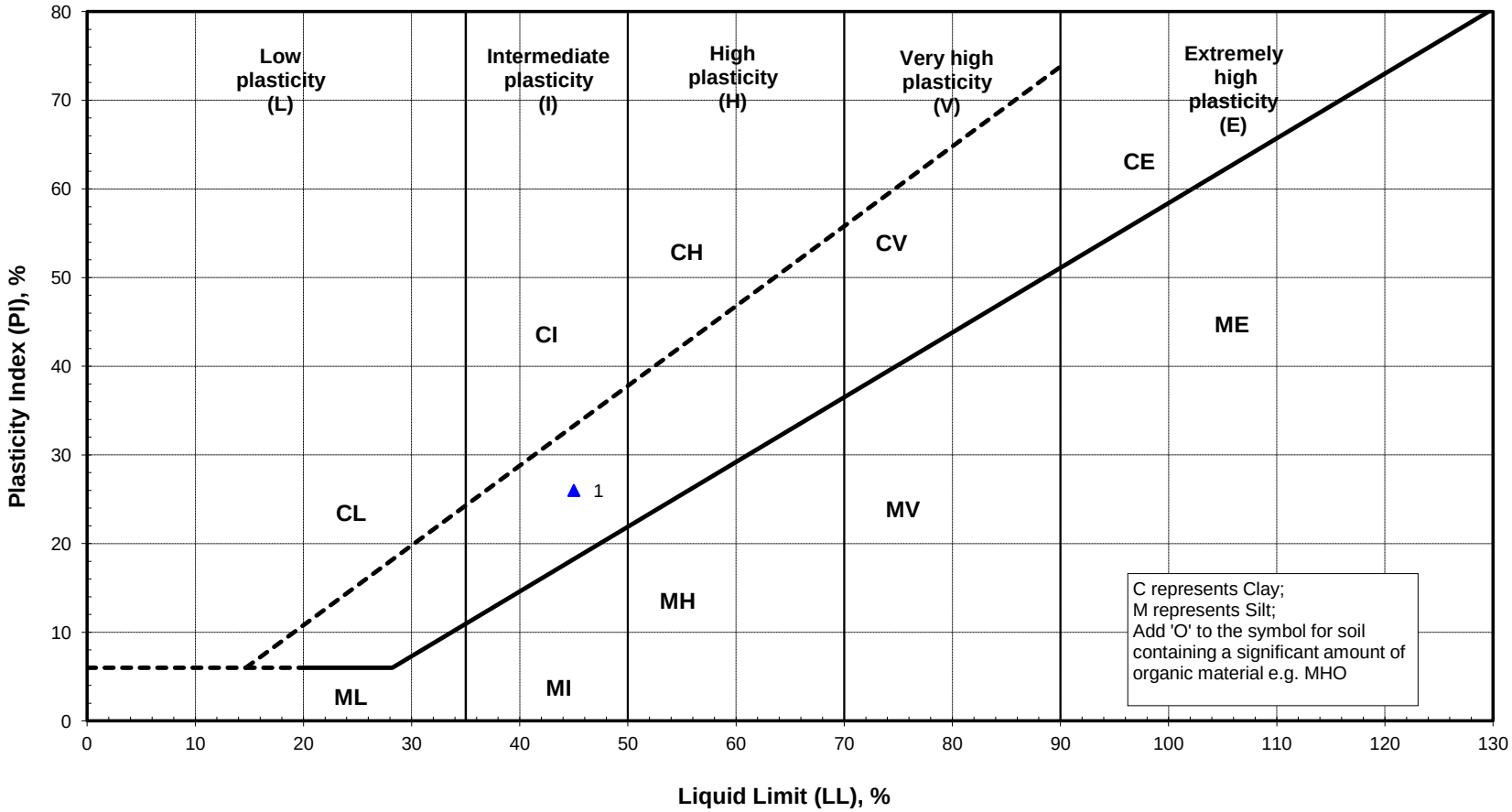
Jun 13

Plasticity Chart for Atterberg Limit Tests

Project Name	*Grove Lodge, Admirals Walk (Hampstead)*			**Project Number**	*J11827*
Client Name	*Michael Barclay Partnership*	**PE**	*JNR*	**Date Issued**	*12-Jun-14*

Key

No.	TH No.	Depth
1	BH1	7.00



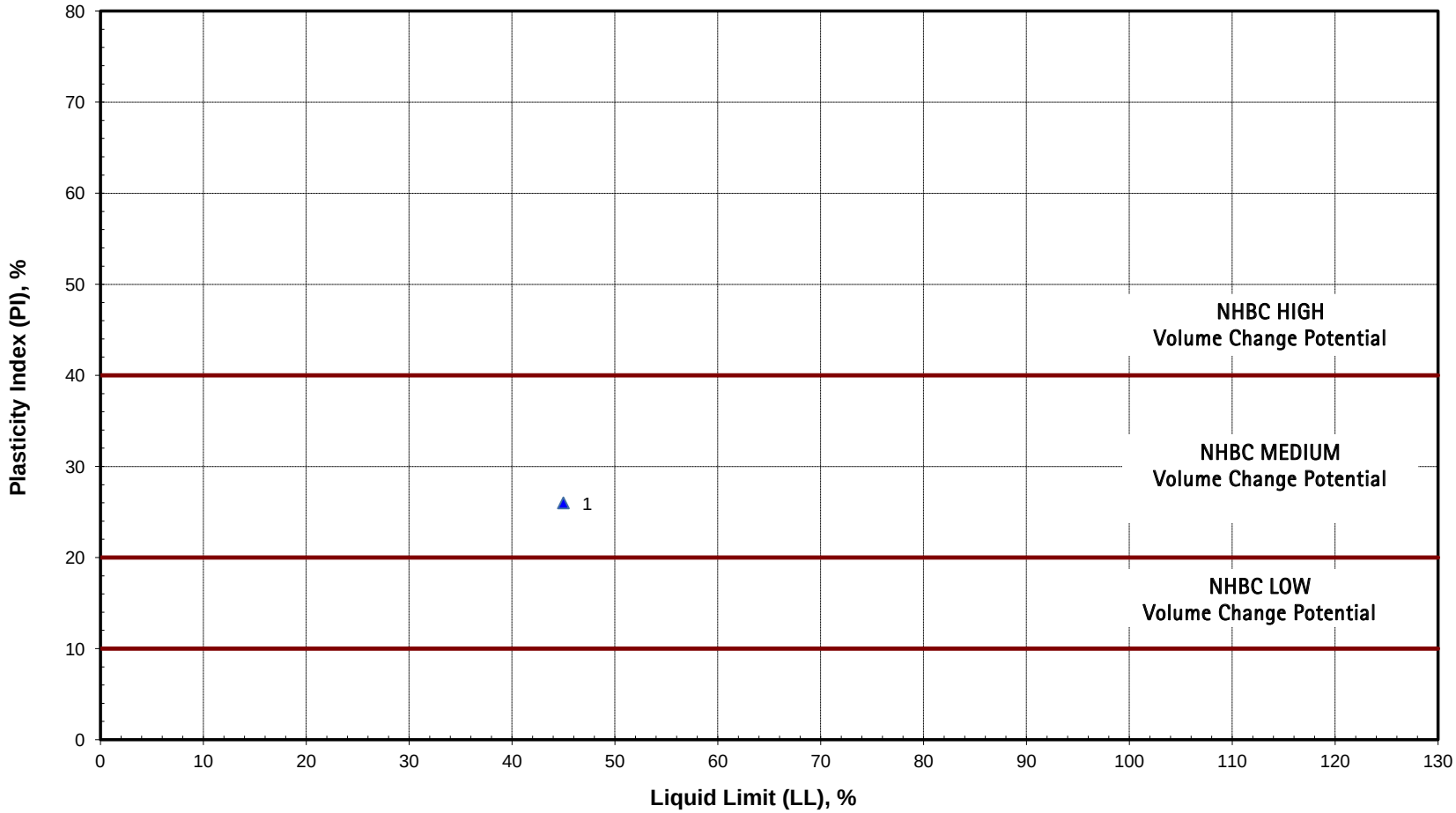
Liquid Limit		**Plastic Limit**		**Plasticity Index**	
Maximum Value	45	Maximum Value	19	Maximum Value	26
Minimum Value	45	Minimum Value	19	Minimum Value	26
Average Value	45	Average Value	19	Average Value	26

NHBC Classification for Volume Change Potential

Project Name	*Grove Lodge, Admirals Walk (Hampstead)*			**Project Number**	*J11827*
Client Name	*Michael Barclay Partnership*	**PE**	*JNR*	**Date Issued**	*12-Jun-14*

Key

No.	TH No.	Depth
1	BH1	7.00



Liquid Limit		**Plastic Limit**		**Plasticity Index**	
Maximum Value	45	Maximum Value	19	Maximum Value	26
Minimum Value	45	Minimum Value	19	Minimum Value	26
Average Value	45	Average Value	19	Average Value	26

Southern Testing | ST Consult

PARTICLE SIZE DISTRIBUTION REPORT

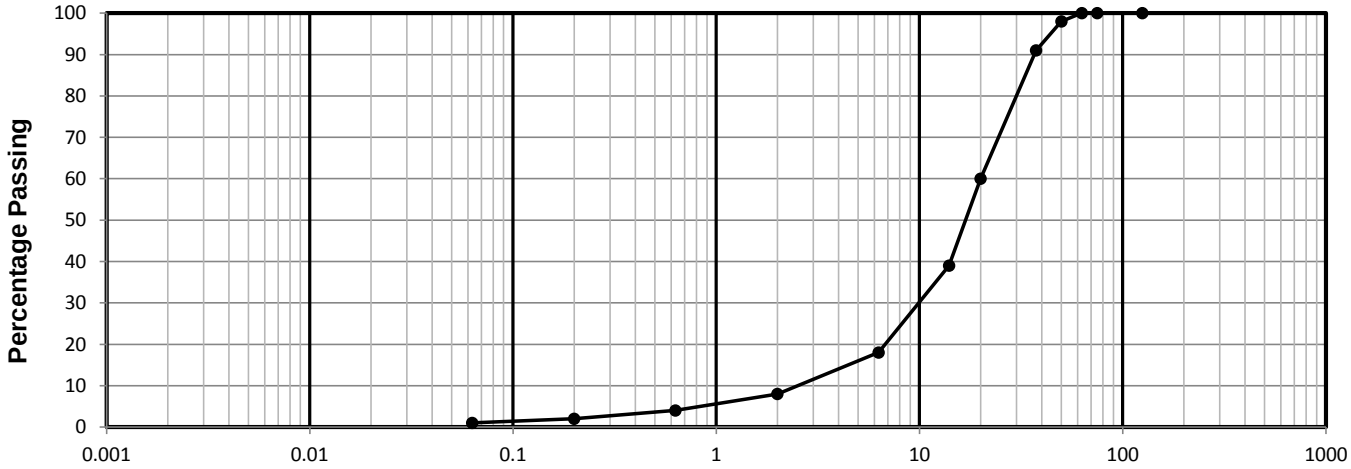
To BS1377-2:1990(2003) cl. 9.2-9.5

AGS

Project Name	*Grove Lodge, Admirals Walk (Hampstead)*			**Project Number**	*J11827*
Client Name	*Michael Barclay Partnership*	**PE**	*JNR*	**Date Issued**	*12-Jun-14*

Particle Size	% Passing
125mm	100
75mm	100
63mm	100
50mm	98
37.5mm	91
20mm	60
14mm	39
6.3mm	18
2mm	8
630µm	4
200µm	2
63µm	1

Particle Size Distribution Chart



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
	1			7			92			0

Visual Description of Sample:

Brown and grey fine to coarse subangular to rounded flint GRAVEL.

Particle Density (Assumed) Mg/m³	**2.65**

Coefficient of Uniformity	**7.95**

Location	BH1
Depth (m)	3.00
Sample Type	B

Comments:

Test Methods:

Wet & Dry Grading BS1377-2: 1990(2003) cl.9.2 & 9.3

Tested By	STL Lab
Checked By	

Southern Testing | ST Consult

PARTICLE SIZE DISTRIBUTION REPORT

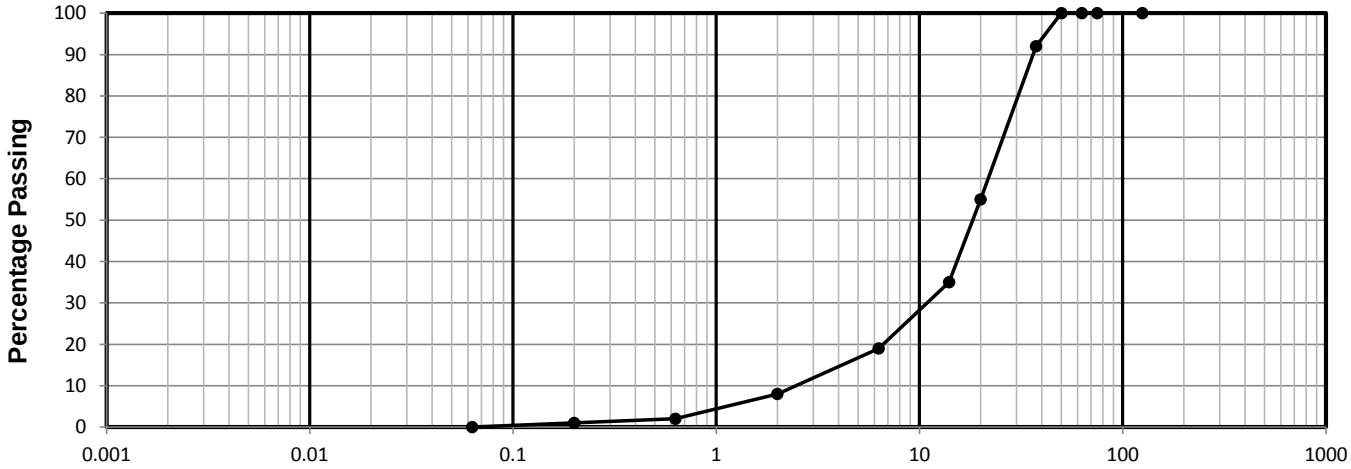
To BS1377-2:1990(2003) cl. 9.2-9.5

AGS

Project Name	*Grove Lodge, Admirals Walk (Hampstead)*			**Project Number**	*J11827*
Client Name	*Michael Barclay Partnership*	**PE**	*JNR*	**Date Issued**	*12-Jun-14*

Particle Size	% Passing
125mm	100
75mm	100
63mm	100
50mm	100
37.5mm	92
20mm	55
14mm	35
6.3mm	19
2mm	8
630µm	2
200µm	1
63µm	0

Particle Size Distribution Chart



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
	0			7			92			0

Visual Description of Sample:

Light brown and grey fine to coarse subangular to rounded flint GRAVEL.

Particle Density (Assumed) Mg/m³	**2.65**

Coefficient of Uniformity	**8.84**

Location	BH1
Depth (m)	4.50
Sample Type	B

Comments:

Test Methods:

Wet & Dry Grading BS1377-2: 1990(2003) cl.9.2 & 9.3

Tested By	STL Lab
Checked By	AnnaS

Southern Testing | ST Consult

PARTICLE SIZE DISTRIBUTION REPORT

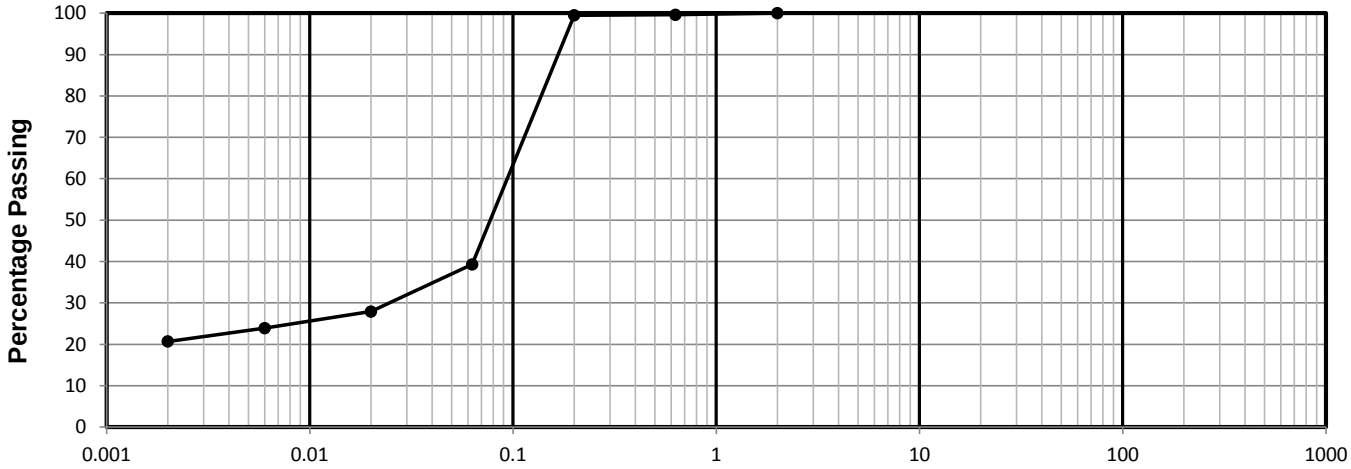
To BS1377-2:1990(2003) cl. 9.2-9.5

AGS

Project Name	*Grove Lodge, Admirals Walk (Hampstead)*			**Project Number**	*J11827*
Client Name	*Michael Barclay Partnership*	**PE**	*JNR*	**Date Issued**	*12-Jun-14*

Particle Size	% Passing
2mm	100
630µm	100
200µm	100
63µm	39
20µm	28
6µm	24
2µm	21

Particle Size Distribution Chart



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
21	19			61			0			

Sedimentation pre-treatment: None

Visual Description of Sample:

Firm medium strength light brown very sandy CLAY.

Particle Density (Assumed) Mg/m³	**2.70**
Coefficient of Uniformity	

Location	BH1
Depth (m)	11.50
Sample Type	B

Comments:

Test Methods:

Sedimentation by Pipette BS1377-2: 1990(2003) cl. 9.4

Tested By	STL Lab
Checked By	AnnaS

Southern Testing | ST Consult

PARTICLE SIZE DISTRIBUTION REPORT

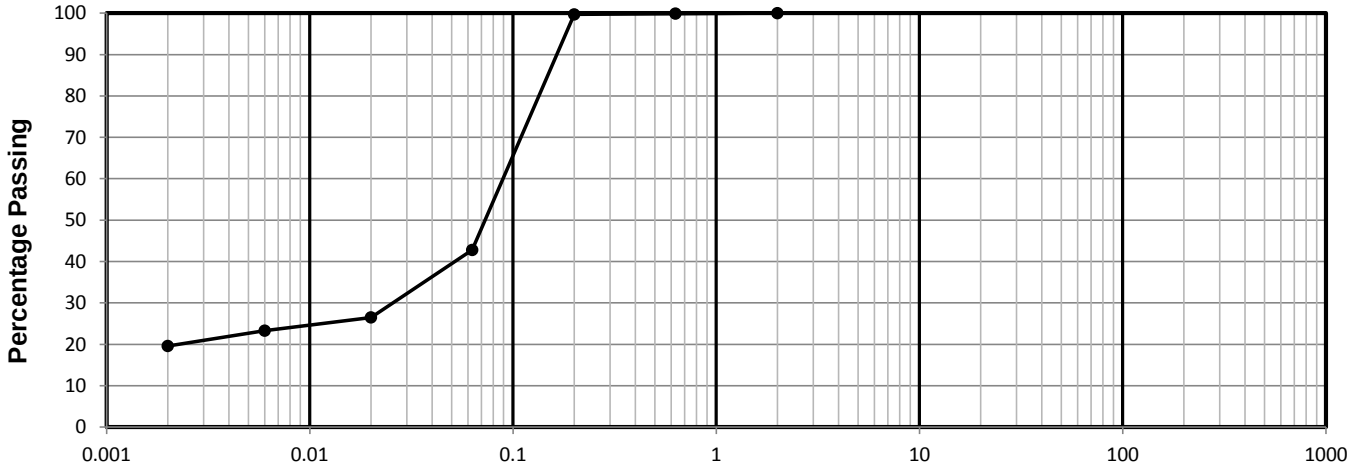
To BS1377-2:1990(2003) cl. 9.2-9.5

AGS

Project Name	*Grove Lodge, Admirals Walk (Hampstead)*			**Project Number**	*J11827*
Client Name	*Michael Barclay Partnership*	**PE**	*JNR*	**Date Issued**	*12-Jun-14*

Particle Size	% Passing
2mm	100
630µm	100
200µm	100
63µm	43
20µm	27
6µm	23
2µm	20

Particle Size Distribution Chart



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
20	23			57			0			

Sedimentation pre-treatment: None

Visual Description of Sample:

Firm medium strength light brown very sandy CLAY.

Particle Density (Assumed) Mg/m³	**2.70**
Coefficient of Uniformity	

Location	BH1
Depth (m)	14.00
Sample Type	B

Comments:

Test Methods:

Sedimentation by Pipette BS1377-2: 1990(2003) cl. 9.4

Tested By	STL Lab
Checked By	AnnaS

Southern Testing | ST Consult

CHEMICAL & ELECTROCHEMICAL TESTING SUMMARY

To BS1377-3:1990(2003) cl 5.6 & 9.5

AGS

Project Name	Grove Lodge, Admirals Walk (Hampstead)			Project Number	J11827
Client	Michael Barclay Partnership	PE	*JNR*	Date Issued	*12-Jun-14*

TH No.	Depth m	Sample Type	Visual Description	Comments	Passing 2mm %	pH Value	Soil Sulphate 2:1 Water Extract		Groundwater Sulphate	
							g/l SO_3	BRE mg/l SO_4	g/l SO_3	BRE mg/l SO_4
BH1	7.50	U	Soft to firm medium strength buff sandy CLAY.		100.0	5.3	0.07	86		
BH1	10.00	D	Soft to firm medium strength buff very sandy CLAY.		100.0	5.4	0.03	38		
BH1	13.00	D	Very soft extremely low strength buff very sandy CLAY.		100.0	6.5	0.10	125		

Southern Testing | ST Consult

CHEMICAL & ELECTROCHEMICAL TESTING SUMMARY

To BS1377-3:1990(2003) cl 5.6 & 9.5

AGS

Project Name	Grove Lodge, Admirals Walk (Hampstead)					Project Number	J11827
Client	Michael Barclay Partnership			PE	*JNR*	Date Issued	*17-Jun-14*

TH No.	Depth m	Sample Type	Visual Description	Comments	Passing 2mm %	pH Value	Soil Sulphate 2:1 Water Extract		Groundwater Sulphate	
							g/l SO_3	BRE mg/l SO_4	g/l SO_3	BRE mg/l SO_4
BH1	3.80	ES			100.0	6.9			0.39	470

Southern Testing | ST Consult

IMMEDIATE UNDRAINED TRIAXIAL SUMMARY

To BS1377-7:1990(1994)

AGS

Project Name	*Grove Lodge, Admirals Walk (Hampstead)*			Project Number	J11827
Client	*Michael Barclay Partnership*	PE	JNR	Date Issued	12-Jun-14

Location	Depth (m)	Sample Type	Visual Description	Comments	Test Type	UCS by Hand Pen. (KPa)	NMC (%)	Cell Press. (KPa)	Deviator Stress (KPa)	Apparent Cohesion C_u (KPa)	Bulk Density (Mg/m^3)
BH1	7.50	U	*Soft to firm medium strength buff sandy CLAY.*		*Single Stage*	*150*	*30.1*	*150*	*103*	*51*	*1.97*

APPENDIX D

Contamination Laboratory Test Results

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories Ltd

Certificate of Analysis

3 Crittall Drive
Springwood Industrial Estate
Braintree
Essex
CM7 2RT
Tel : 01376 560120
Fax : 01376 552923

Report Number: 400117-1

Date of Report: 17-Jun-2014

Customer: Southern Testing Laboratories
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

Customer Contact: Mr Jon Race

Customer Job Reference: J11827
Customer Purchase Order: J11827_2
Customer Site Reference: Grove Lodge, Admirals Walk (Hampstead)
Date Job Received at SAL: 06-Jun-2014
Date Analysis Started: 09-Jun-2014
Date Analysis Completed: 17-Jun-2014

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with QP22

UKAS TESTING
1650

Report checked and authorised by :
Miss Claire Brown
Customer Service Manager

Issued by :
Miss Claire Brown
Customer Service Manager

Waste Acceptance Criteria

Customer Sample Reference : BH1 @ 1.10m
SAL Sample Reference : 400117 001
Project Site : Grove Lodge, Admirals Walk (Hampstead)
Customer Reference : J11827
Test Portion Mass (g) : 175
Date Sampled : 14-MAY-2014
Type : Fill

Soil Summary					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	**Technique**	**LOD**	**Units**	**Symbol**				
pH	Probe			U	10.1		>6.0	
Loss on Ignition @450C	Ign 450C/Grav	0.1	%	U	3.1			10.0
Total Organic Carbon	OX/IR	0.1	%	WN	0.7	3.0	5.0	6.0
Acid Neutralising Capacity (pH 7)	Titration	2.0	Mol/kg	N	<2.0			
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
Coronene	GC/MS (MCERTS)	0.1	mg/kg	N	<0.1			
PAH (Sum)	Calc	1.6	mg/kg	N	<1.6	100.0		
PCB EC7 (Sum)	Calc	0.00035	mg/kg	U	<0.14	1.0		
TPH (C10-C40)	GC/FID (SE)	10	mg/kg	U	<10	500.0		
Moisture	Grav (1 Dec) (40 C)	0.1	%	N	9.6			
Moisture @ 105 C	Grav (1 Dec) (105 C)	0.1	%	N	13			
Retained on 2mm	Grav	0.1	%	N	(32) <0.1			

10:1 Leachate					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	**Technique**	**LOD**	**Units**	**Symbol**				
Antimony (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.017	0.06	0.7	5.0
Arsenic (Dissolved)	Calc / ICP/MS (Filtered)	0.0020	mg/kg	N	0.13	0.5	2.0	25.0
Barium (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.088	20.0	100.0	300.0
Cadmium (Dissolved)	Calc / ICP/MS (Filtered)	0.00020	mg/kg	N	<0.00020	0.04	1.0	5.0
Chloride	Calc / Discrete Analyser	10	mg/kg	N	30	800.0	15000.0	25000.0
Chromium (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.041	0.5	10.0	70.0
Copper (Dissolved)	Calc / ICP/MS (Filtered)	0.0050	mg/kg	N	0.13	2.0	50.0	100.0
Dissolved Organic Carbon	Calc / OX/IR	10	mg/kg	N	74	500.0	800.0	1000.0
Fluoride	Calc / Discrete Analyser	0.50	mg/kg	N	2.8	10.0	150.0	500.0
Lead (Dissolved)	Calc / ICP/MS (Filtered)	0.0030	mg/kg	N	0.017	0.5	10.0	50.0
Mercury (Dissolved)	Calc / ICP/MS (Filtered)	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.040	0.5	10.0	30.0
Nickel (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.035	0.4	10.0	40.0
Phenols(Mono)	Calc / Colorimetry (CE)	0.050	mg/kg	N	<0.050	1.0		
Selenium (Dissolved)	Calc / ICP/MS (Filtered)	0.0050	mg/kg	N	0.013	0.1	0.5	7.0
SO4--	Calc / Discrete Analyser	5.0	mg/kg	N	260	1000.0	20000.0	50000.0
Total Dissolved Solids	Calc	100	mg/kg	N	11000	**4000.0**	60000.0	100000.0
Zinc (Dissolved)	Calc / ICP/MS (Filtered)	0.020	mg/kg	N	<0.020	4.0	50.0	200.0

From: EC Directive 99/31/EC and Landfill Regulations 2002 (as ammended)

Notes:- Cumulative release at L/S=10 (mg/kg of dry matter) in accordance with BS EN 12457. Soil leaching procedure is not covered by our UKAS accreditation

SAL Reference: 400117
Project Site: Grove Lodge, Admirals Walk (Hampstead)
Customer Reference: J11827

Soil Analysed as Soil
Miscellaneous

SAL Reference	**400117 001**
Customer Sample Reference	**BH1 @ 1.10m**
Test Sample	**A40**
Date Sampled	**14-MAY-2014**
Type	**Fill**

Determinand	Method	LOD	Units	Symbol	
Asbestos ID	PLM			SU	Asbestos not detected -

SAL Reference: 400117
Project Site: Grove Lodge, Admirals Walk (Hampstead)
Customer Reference: J11827

Soil Analysed as Soil
BTEX

SAL Reference	**400117 001**
Customer Sample Reference	**BH1 @ 1.10m**
Test Sample	**AR**
Date Sampled	**14-MAY-2014**
Type	**Fill**

Determinand	Method	LOD	Units	Symbol	
Benzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	(13) <10
EthylBenzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<10
Meta/Para-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<10
Ortho-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<10
Toluene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<10

SAL Reference: 400117
Project Site: Grove Lodge, Admirals Walk (Hampstead)
Customer Reference: J11827

Soil Analysed as Soil
PCBs EC7 (SE)

SAL Reference	**400117 001**
Customer Sample Reference	**BH1 @ 1.10m**
Test Sample	**AR**
Date Sampled	**14-MAY-2014**
Type	**Fill**

Determinand	Method	LOD	Units	Symbol	
Polychlorinated biphenyl BZ#101	GC/MS	20	µg/kg	U	<20
Polychlorinated biphenyl BZ#118	GC/MS	20	µg/kg	U	<20
Polychlorinated biphenyl BZ#138	GC/MS	20	µg/kg	U	<20
Polychlorinated biphenyl BZ#153	GC/MS	20	µg/kg	U	<20
Polychlorinated biphenyl BZ#180	GC/MS	20	µg/kg	U	<20
Polychlorinated biphenyl BZ#28	GC/MS	20	µg/kg	U	<20
Polychlorinated biphenyl BZ#52	GC/MS	20	µg/kg	U	<20

SAL Reference: 400117
Project Site: Grove Lodge, Admirals Walk (Hampstead)
Customer Reference: J11827

Soil Analysed as Soil
Total and Speciated USEPA16 PAH (SE) (MCERTS)

SAL Reference	**400117 001**
Customer Sample Reference	**BH1 @ 1.10m**
Test Sample	**AR**
Date Sampled	**14-MAY-2014**
Type	**Fill**

Determinand	Method	LOD	Units	Symbol	
Naphthalene	GC/MS	0.1	mg/kg	U	<0.1
Acenaphthylene	GC/MS	0.1	mg/kg	U	<0.1
Acenaphthene	GC/MS	0.1	mg/kg	U	<0.1
Fluorene	GC/MS	0.1	mg/kg	U	<0.1
Phenanthrene	GC/MS	0.1	mg/kg	U	<0.1
Anthracene	GC/MS	0.1	mg/kg	U	<0.1
Fluoranthene	GC/MS	0.1	mg/kg	N	<0.1
Pyrene	GC/MS	0.1	mg/kg	N	<0.1
Benzo(a)Anthracene	GC/MS	0.1	mg/kg	U	<0.1
Chrysene	GC/MS	0.1	mg/kg	U	<0.1
Benzo(b/k)Fluoranthene	GC/MS	0.1	mg/kg	U	<0.1
Benzo(a)Pyrene	GC/MS	0.1	mg/kg	U	<0.1
Indeno(123-cd)Pyrene	GC/MS	0.1	mg/kg	U	<0.1
Dibenzo(ah)Anthracene	GC/MS	0.1	mg/kg	U	<0.1
Benzo(ghi)Perylene	GC/MS	0.1	mg/kg	U	<0.1
Polyaromatic Hydrocarbons (Total)	GC/MS	0.1	mg/kg	U	<0.1

Index to symbols used in 400117-1

Value	Description
8:1	Leachate to BS EN 12457-3 (8:1)
2:1	Leachate to BS EN 12457-3 (2:1)
AR	As Received
A40	Assisted dried < 40C
32	Whole sample was crushed
13	Results have been blank corrected.
W	Analysis was performed at another SAL laboratory
S	Analysis was subcontracted
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Samples submitted for GC/MS (Headspace) analysis were submitted in inappropriate containers. It is possible therefore that the results provided may be compromised.
PAH, TPH, BTEX & PCB - These samples have been analysed exceeding recommended holding times. It is possible therefore that the results provided may be compromised.
Where an asbestos result of none detected is reported, this is obtained from analysis of a representative sub sample.
No loose asbestos fibres or asbestos containing materials were found
Sub contracted analysis performed by SAL Scotland & REC Asbestos South East Limited
Retained on 2mm is removed before analysis
Reported results on as received samples are corrected to a 105 degree centigrade dry weight basis except ANC
pH, LOI, Asbestos & TOC were performed on assisted dried samples (<40 degree centigrade). All other results relate to samples as received.

APPENDIX E

Monitoring Results

Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

SOIL GAS AND GROUND WATER DAILY RECORD SHEET

Project Name: Grove Lodge, Admirals Walk, Hampstead	Project Engineer: JNR	Date: 10/06/2014	Project No:
Client: Caspar Berendsen	Operative: AW	Day of the week: Tuesday	J11827

Well / TH No.	Atmospheric Pressure (mb) and Ambient Temperature	Land Gas Data	PID	BH pressure	Flow Rate		CH_4	CO_2	O_2	CO	H_2S	Groundwater Data: Depth to base of well	Water level	Height of Cover	Remarks: Details of water samples (colour, clarity, odour etc)	Ground Conditions (soft, wet/dry, frozen etc) & Weather Conditions	General Remarks
			ppm	pa	l/hr		%	%	%	ppm	ppm	m below top of cover	m below top of cover	m above GL			
BH1		P				P						7.10	3.81	0.00	1ltr sample taken		
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings: 09:31					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					

P = Peak Reading, S = Steady reading | Equipment Used: Interface Meter, MiniRAE 2000, GFM435 Gas Analyser | Checked By

Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

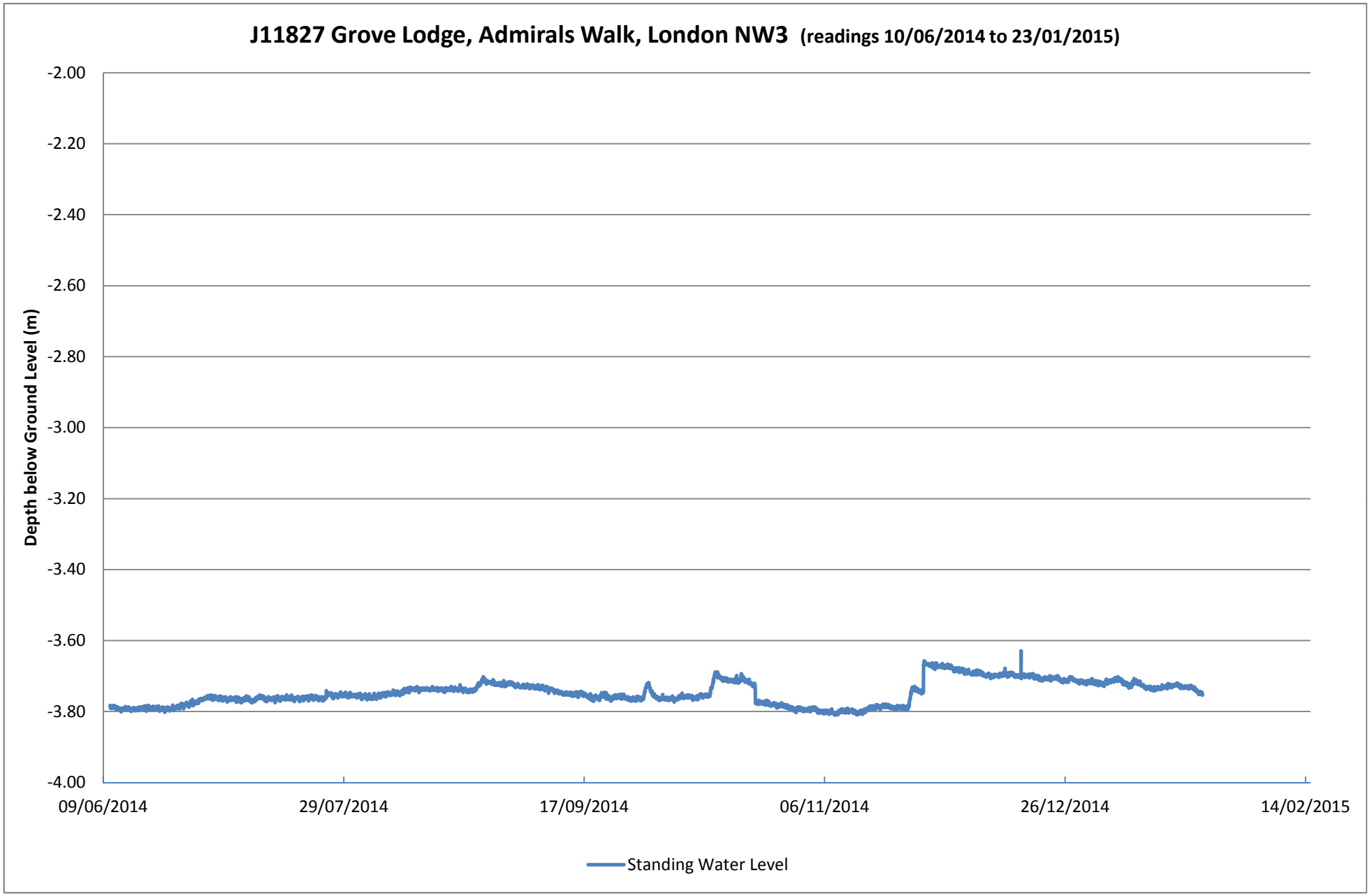
SOIL GAS AND GROUND WATER DAILY RECORD SHEET

Project Name:	**Grove Lodge, Admirals Walk, Hampstead**	**Project Engineer:**	**JNR**	**Date:**	**25-Jul-14**
Client:	**Caspar Berendsen**	**Operative:**	**AW**	**Day of the week:**	Friday
Project No:	**J11827**				

Well / TH No.	Atmospheric Pressure (mb) and Ambient Temperature		PID (ppm)	BH pressure (pa)	Flow Rate (l/hr)		CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)	Depth to base of well (m below top of cover)	Water level (m below top of cover)	Height of Cover (m above GL)	Details of water samples (colour, clarity, odour etc)	Ground Conditions (soft, wet/dry, frozen etc) & Weather Conditions	General Remarks
BH1		P				P						7.10	3.76	0.00			
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings: 08:46					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					

Land Gas Data columns: PID through H_2S; Groundwater Data columns: Depth to base of well, Water level, Height of Cover; Remarks columns: Details of water samples, Ground Conditions, General Remarks.

P = Peak Reading, S = Steady reading | Equipment Used: Interface Meter, MiniRAE 2000, GFM435 Gas Analyser | Checked By | JNR


J11827 Grove Lodge, Admirals Walk, London NW3 (readings 10/06/2014 to 23/01/2015)
Depth below Ground Level (m)
-2.00
-2.20
-2.40
-2.60
-2.80
-3.00
-3.20
-3.40
-3.60
-3.80
-4.00
09/06/2014
29/07/2014
17/09/2014
06/11/2014
26/12/2014
14/02/2015
Standing Water Level

F. Ground Investigation Report – Ground Engineering

Report reference C13390A, prepared in February 2015. Approved by S J Fleming, BSc, MSc, MCSM, CGeol, FGS, Director of Ground Engineering Ltd.

GROUND ENGINEERING LIMITED
Newark Road
Peterborough PE1 5UA
Tel: 01733 566566 Fax: 01733 315280

GROUND INVESTIGATION REPORT

GROVE LODGE

ADMIRAL'S WALK

LONDON NW3

Report Reference No. C13390A

On behalf of:-

Caspar Berendsen
c/o Michael Barclay Partnership LLP
105-109, The Strand
London
WC2R 0AA

February 2014

CASPAR BERENDSEN

MICHAEL BARCLAY PARTNERSHIP LLP

REPORT ON A GROUND INVESTIGATION

AT

GROVE LODGE

ADMIRAL'S WALK

LONDON NW3

Report Reference No. C13390A **February 2015**

INTRODUCTION

Mr Caspar Berendsen, the client, intends to add to the facilities of Grove Lodge, Admiral's Walk, London NW3. The proposed development includes a basement extension below the southern half of Grove Lodge, extending east below the south-eastern part of the garden, and a separate small Orangery/garden store basement beneath the north-western corner of the garden. The basement extension floor level will be at 124.15mOD, and the underside of the floor will be at about 123.70mOD, some 3.90m to 4.80m below the dwelling's existing ground floor level (127.60mOD) and main lawn (128.50mOD), respectively.

Ground Engineering Limited was instructed to carry out a ground investigation, under the direction of Michael Barclay Partnership LLP, in order to determine the nature and geotechnical properties of the underlying soils in relation to design of foundations and produce a factual report with additional interpretative comments to inform their basement impact assessment. In addition, groundwater monitoring was included within the scope of works.

LOCATION, TOPOGRAPHY, GEOLOGY AND HYDROGEOLOGY OF THE SITE

Location/Description

Grove Lodge is situated on the northern side of Admiral's Walk and eastern side of Windmill Hill/Lower Terrace, 100m to the south of the southern edge of Hampstead Heath, within the London Borough of Camden, London NW3. The site is located some 140m east of Branch Hill and 120m west of Heath Street, and is centred at National Grid Reference TQ 26244 86118.

The irregularly shaped site has a 20m long frontage onto Admiral's Walk from which it extends north and west for up to 50m to Windmill Hill/Lower Terrace. The site is bounded to the east by Admiral's House; to the south-west by Terrace Lodge; and to the north by No.10 Windmill Hill and its large front garden. The site's western limit is formed by the Windmill Hill/Lower Terrace roadway.

At the time of the investigation, the eastern part of the site was occupied by a large two-storey brick dwelling with attic level, Grove Lodge, with a garage block at its southern end and a small basement beneath its centre. The western side of the dwelling was bounded by an extensive patio, beyond which was a terraced garden with a lower central grassed area, raised peripheral flowerbeds and shrubberies, and a further patio upon which a greenhouse and loggia were located. The western half of the garden was sub-divided by a wall, south to north, to the west of which was a vegetable garden. The western end of this part of the site was grass covered and contained several immature trees. The western site limit was formed by a brick garden wall.

Topography

The site stands on the south-facing slopes of the Hampstead 'high ground'. The elevation of the adjacent roadway falls southward from about 130mOD to 126mOD, along the Windmill Hill/Lower Terrace site frontage, whilst the ground level falls westwards along the southern, Admiral's Walk roadway, from 128mOD to about 125mOD. Within the site, the patio

adjacent Grove Lodge stands at 127.6mOD; the main grass lawn is at 128.5mOD; and the peripheral flowerbeds/shrubberies and the rear vegetable garden are at 129.2mOD.

Geology

The 1934 geological map for this part of London (Sheet I.SE) at 6 inches to 1 mile scale (1:10,560) show the site to be directly underlain by the solid geology of the Bagshot Sand. The underlying solid geology of the Claygate Beds are indicated directly beneath the lower slopes some 300m and 350m to the south-west and south-east, respectively, whilst the underlying London Clay directly underlies the lower ground 600m to the south-west and south-east. Isolated patches of superficial Plateau Gravel are depicted covering the Bagshot Sand on this map, within the higher parts of Hampstead Heath, some 580m distant to the north.

This map also depicts the rising of headwater streams 300m to the west, flowing and converging south-westwards to become Westbourne 'Brook'. The western headwater streams of the River Fleet rise 300m to 400m to the east and south-east, and flow south and east.

The 2006 geological map for the area at 1:50,000 scale, Sheet 256, also shows the site to be underlain by the renamed Bagshot Formation, and then in turn by the Claygate Member of the London Clay Formation and undifferentiated London Clay Formation strata. The Plateau Gravel patches have been ascribed on this map to the Stanmore Gravel, a pre-Anglian river terrace deposit.

Previous work within this part of London has found an often significant cover thickness of superficial 'hillwash' or Head Deposit mantling the solid geology strata. The geological memoir for the London district indicates a maximum thickness of 18m for the Bagshot Formation in cored boreholes on Hampstead Heath. A well record on the 1934 geological map, 170m south of the site and at a lower elevation than the site, details the base of the 'sand' (Bagshot Sand) at 4.7m depth underlain by 34.6m of 'yellow sandy clay' (Claygate Member), and then at least 23.1m of 'blue clay' (London Clay).

Hydrogeology

The site is designated by the Environment Agency (EA) as being underlain by Secondary (A) Aquifers, the Bagshot Formation and Claygate Member, which overlie the Unproductive stratum of the London Clay. Based on the topography of the site area the direction of near surface groundwater and surface water flow would locally be from north to south/south-west.

Well records on the 1934 geological map indicate that the practically impervious Unproductive stratum of the London Clay is about 100m thick beneath this part of London and that the underlying Principal Aquifer of the White Chalk Subgroup lies about 160m below ground level, about -30mOD.

SITE WORK

Two cable percussive boreholes, a single window sample borehole, and three foundation inspection pits were undertaken at position determined by the Engineer. The exploratory hole positions are depicted on the site plan at the rear of this report.

The investigation was undertaken following the protocols detailed in British Standards (BS) 'Code of Practice for Site Investigations' (BS5930:1999) and 'Methods of test for soils for engineering purposes' (BS1377:1990).

Services information was provided/obtained prior to the start of the investigation and was referenced in relation to the exploratory hole position prior to boring and a scan was undertaken using a cable avoidance tool (CAT). The elevation of the exploratory hole positions were interpolated from a site survey drawing provided by the client.

Window Sample Borehole

The window sample borehole (WS 1) was undertaken by a portable dynamic sampling rig on 1st October 2014, to the western side of the dwelling's garage.

Prior to drilling, a starter pit was dug to 1.20m below ground level using hand tools, in order to ensure the absence of buried services.

The dynamic/window sampling equipment consisted of 1.00m long drive-in samplers of specially constructed and strengthened 87mm to 57mm diameter steel sample tubes with a plastic core-liner. The samplers were driven into the ground by an automatic trip hammer weighing 63.50kg falling freely through 750mm. Upon extraction a continuous profile of the soil was obtained in the plastic liners (U) inserted in the samplers. The borehole was completed at 6.00m depth.

Standard penetration tests were undertaken in the window sample borehole at regular intervals in order to give an indication of the in-situ relative density/shear strength of the material. The test was made by driving a 50mm diameter open shoe and split spoon sampler (S)

or solid cone point (C) into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 750mm. The penetration resistance was determined as the number of blows required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole. The results have been tabulated, and also plotted against depth in Figure 1 at the rear of this report.

The window sample liners were split, sub-sampled and described on site by the supervising Geoenvironmental Engineer. In made ground and the underlying natural strata, representative disturbed samples were taken from the starter pits and liners, and placed in polycarbonate pots (D samples) or large sealed plastic bags (B samples).

On completion of the window sample borehole, a 50mm diameter HDPE standpipe was installed to 6.00m depth. The annulus around the standpipe was backfilled with pea gravel and a bentonite seal placed around the top of the installations within 1.00m of ground level. A gas tap was installed in the top of the standpipe. A protective stopcock cover was concreted into the ground flush with the surface over the installation.

The window sample borehole record gives the descriptions and depths of the various strata encountered, details of all in-situ tests, the samples taken and the groundwater conditions observed during boring, on completion and subsequently within the standpipe on the day after it was installed.

Trial Pits

Two foundation inspection pits (TPs 1 and 2) were scheduled by the Engineer. However, in order to confirm the absence of an adjacent basement at the boundary with Terrace Lodge, a third foundation inspection pit (TP 3) was added. The three trial pits were undertaken using hand tools on 2nd October 2014.

The exposed strata and foundations were logged and the soils sampled by a supervising Geoenvironmental Engineer. The foundation inspection pits were completed at depths of 1.30m and 1.60m below ground level.

Disturbed samples of soil were taken at regular intervals throughout these pits and placed in polycarbonate pots, glass jars and sealed plastic bags (D samples).

On completion of each excavation, the spoil was returned to the pit and placed in layers, which were recompacted.

The trial pit records give descriptions and depths of the various strata encountered, the details of all samples and the groundwater conditions observed during excavation. Sketch sections and photographs of the exposed footings in the trial pits are presented on the pages following the record for the relevant excavation.

Cable Percussive Boreholes

Two boreholes (BHs 2 and 3) were undertaken by restricted access cable percussive boring rig, within the main garden and vegetable garden, between 8th and 10th October 2014. The borehole positions were scanned using a cable avoidance tool (CAT) and starter pits were dug to 1.20m depth using hand tools, in order to ensure the absence of buried services. The boreholes were then advanced using weighted shell and claycutter tools, initially working within 150mm diameter casing, and completed at 15.00m below ground level.

Standard penetration tests were undertaken in order to give an indication of the in-situ relative density/shear strength of the soils encountered, as instructed. The test was made by driving a 50mm diameter solid cone point (C) or open shoe and split spoon sampler (S) into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 760mm. The penetration resistance is determined as the number of blows (N) required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole. The results have been tabulated, and also plotted against depth in Figure 1 at the rear of this report.

Undisturbed samples (U) of 100mm in diameter were taken, where possible, at the instructed intervals in clay soils. The ends of each sample were capped to maintain it in as representative condition as possible during transit to the laboratory.

Representative small (D) and bulk (B) disturbed samples of soil were taken from the boring tools at regular intervals throughout the depth of the boreholes. A sample of water (W) was recovered from borehole BH 3 once sufficient water had accumulated for collection.

On completion of boring, 50mm diameter standpipes were installed to 10.00m depth in BHs 2 and 3. The annulus around each standpipe was backfilled with pea gravel with a bentonite seal placed below the 9.00m long response zones and around the top of the installation within 1.00m of ground level. The remainder of the holes, below the lower bentonite seal, were infilled with arisings. A gas tap was installed in the top of the standpipes. A protective steel stopcock cover was concreted into the ground flush with the surface over the installations.

The borehole records give the descriptions and depths of the various strata encountered, results of the in-situ tests, details of all samples taken and the groundwater conditions observed during boring, on completion and within the standpipes.

Monitoring

The BH 2 and BH 3 standpipes were monitored for methane, carbon dioxide and oxygen gas levels on 21st October and 26th November 2014. Ambient pressures and flow rates were recorded together with the depth to groundwater. The water levels in the standpipe were also checked, and together with the gas levels are presented following the exploratory hole record.

In addition, dataloggers were installed in borehole BH 2 and BH 3 standpipes during the first return visit in order to record potential variations in groundwater level. A barometric pressure recorder was also installed in BH 3. The water levels were monitored every 30 minutes between 21st October and 26th November 2013, after which they were removed. The results have been provided separately to the Engineer as xls files.

A further water level monitoring visit was undertaken on 10th February 2015.

LABORATORY TESTING

The samples were inspected in the laboratory and assessments of the soil characteristics have been taken into account during preparation of the exploratory hole records. The soil sample descriptions are in accordance with BS5930:1999. The testing was completed within a UKAS accredited laboratory.

The particle size distributions of selected samples of sand and gravel were obtained by sieve analysis. Results of these tests are given as particle size distribution curves at the end of this report.

Test specimens were prepared at full diameter from the undisturbed samples recovered from boreholes. Immediate undrained triaxial compression tests were made on the samples at full diameter using the multi-stage technique. The moisture content and bulk densities of this specimen were also determined.

Selected samples of soil and water were analysed to determine the concentration of soluble sulphates. The pH values were also determined using an electrometric method.

GROUND CONDITIONS SUMMARY

The ground conditions encountered were broadly as expected from the geological records with a variable thickness of made ground associated with the terraced nature of the existing site, covering solid geology Bagshot Formation sand with atypical interbedded subordinate sand and gravel layers about 2m thick at varying depth in the three boreholes. The boreholes then entered the slightly sandy, silty clay of the Claygate Member of the London Clay Formation at about 121.6mOD (6.80m and 7.50m depth in BHs 2 and 3, respectively). The latter was found to at least 15m depth, 113.50mOD, in BHs 2 and 3.

The atypical and variable deposits of sand and gravel encountered may well represent 'hillwash' or Head Deposits derived from upslope strata, or in part belong to the superficial Stanmore Gravel. For simplicity, the sand and gravel strata are collectively denoted as belonging to the Bagshot Formation for the remainder of this report.

Groundwater

The three shallow trial pits were dry during excavation and on completion.

The window sample borehole WS 1 encountered water at 4.90m depth (123.30mOD). The day after installation in this hole a water level was recorded in the standpipe at 5.93m depth, 122.27mOD.

The addition of water to enable boring of the coarse grained soils in BHs 2 and 3, and the use of casing, may well have masked any initial water strikes. Borehole BH 2 encountered a water seepage within the Claygate Member at 14.50m depth, whilst BH 3 was dry on completion.

The 10.00m deep standpipes in boreholes BH 2 and BH 3 yielded typical water levels at about 122.30mOD and 122.60mOD, respectively, during the monitoring period between October and February 2015.

It is understood that the water level in another borehole (BH 1), undertaken previously by others at the front of the house, was typically at 123.75mOD during the same monitoring period. Together these water levels indicate a hydraulic gradient towards the south-west, as expected.

COMMENTS ON THE GROUND CONDITIONS IN RELATION TO BASEMENT DESIGN AND CONSTRUCTION

The investigation found a cover of made ground associated with the construction of the dwelling and its terraced gardens. Foundations for the new basements will penetrate this made ground and be based within the underlying Bagshot Formation sand and gravel, which should have more than adequate bearing properties. Groundwater levels were generally recorded at 3.75m below ground level (123.75mOD) at the front of the site, and at 6.20m to 6.50m below ground level (122.30mOD to 122.60mOD) across the Grove Lodge gardens. The recorded groundwater level lies between 0.05m above and 1.40m below the proposed basement excavation level of 123.70mOD, and so may impact construction.

Foundation Depths

The three boreholes of this investigation encountered natural ground at 1.20m to 1.80m below ground level, although it was reportedly found to 2.30m depth in a previous borehole (BH 1) undertaken by others at the front of the site.

The underlying sand and gravel of the Bagshot Formation would be considered non-shrinkable but the silty sand would be potentially frost susceptible and a minimum footing depth in this stratum would be 0.60m in order to avoid the potentially damaging effects of frost action.

Basement

The construction of the proposed basements will remove the surface layers of made ground and the top of the underlying Bagshot Formation. Foundations for the basement walls at or just below the basement floor level would be within the medium dense Bagshot Formation and could be designed using the previously detailed (by others) bearing pressure of 150kN/m^2 for up to 1.20m wide foundations.

Similarly it was previously indicated that a bearing pressure of 150kN/m^2 could be applied on a basement raft foundation constructed on the Bagshot Formation strata. This pressure would not overstress the firm becoming stiff clays present 6.80m/7.50m below the garden ground levels. The results of the laboratory and in-situ testing within this stratum indicate a maximum safe bearing capacity of 180kN/m^2 for the slightly sandy, silty clay, with a factor of safety of 3.0 against general shear failure.

For the main basement, theoretical base heave movement could take place at the centre of a 14m wide, 21m long excavation where up to 90kN/m^2 of overburden pressure has been removed. However, most of the heave would be expected to dissipate between inter-grain pore spaces within the 2m of sand and gravel remaining below the basement floor, and little, if any, heave is therefore likely to take place. A similar situation would be considered likely for the smaller Orangery basement.

Adequately reinforced basement floors could be cast on the ground following proof rolling and careful inspection.

Excavations/Groundwater

The excavation of deep basements below existing ground floor level will require the construction of close support to its sides, the control of groundwater, and the need to avoid undermining adjacent structures.

The use of mass concrete walls, constructed in alternate panels around the perimeter of the basement could provide support to the excavation, although such a method of construction to the full depth required might prove difficult at this site.

An alternative would be to use sheet, contiguous or secant piled walls around the perimeter of the basement. Piling to a sufficient depth to mobilise adequate passive pressure below the basement level should be feasible on this site.

The excavation of a basement could then be undertaken within the piled walls, although it should be noted that contiguous pile lined excavations would not be water tight.

In order to construct the basement beneath this site it will be necessary to provide permanent support to the adjacent structures, which are likely to be based on relatively shallow strip foundations. This support can either be provided by underpinning these structures to the same depth as the proposed basement prior to basement construction or by constructing piled walls to the excavation that are adequately propped during construction by temporary support and permanently by the basement and ground floors, to prevent movement at the top of the retaining walls. Or a combination of the two.

Such lateral movement would otherwise be accompanied by settlement of the ground behind the basement walls. As an example, Figure 2.12 of CIRIA C580 (2003) indicates very small scale (<10mm) settlement at a distance of 1.00m from a bored pile wall to a 4m deep basement excavation, and about 10mm when only 0.50m distant from this structure. The use of a high support stiffness system (such as high propped walls and top down construction) to the basement excavation would prevent deflection of the proposed basement walls, resultant changes to the state of soil stress, and result in negligible structural movement of neighbouring structures.

The advice of specialist groundworks contractors with experience of constructing such basements should be sought, particularly in respect of other potential methods of providing support to the sides of the basement excavation, such as grouting.

The basement excavation should be inspected on completion to ensure that the condition of the soil complies with that assumed in design. Should pockets of inferior material be present, they should be removed and replaced with well graded hardcore or lean mix concrete. The excavated surface should be protected from deterioration and a blinding layer of concrete used where foundations are not completed without delay.

At the front of the site, it is understood that water was recorded in the BH 1 standpipe within the Bagshot Formation at about 3.75m depth (123.75mOD), which will be 0.05m above the base of the proposed basement excavation (123.70mOD). However, within the gardens the BH 2 and BH 3 standpipes typically recorded water levels at 6.20m depth (122.30mOD) and 6.50m depth (122.60mOD), so 1.15m to 1.45m lower than at the front of the

site. As discussed in the previous section of this report it is considered likely that this difference reflects the hydraulic gradient beneath the site.

With the recorded water levels approximately at or below the proposed basement excavation depth on this site, large scale dewatering will not be necessary, indeed during the drier summer months the excavations could remain dry. Inflows of 'perched' water should be dealt with using screened sumps.

Potential flotation due to groundwater on this site is considered unlikely to be a problem.

With potential 'perched' water present above the floor level of the proposed basement, it will be considered necessary to waterproof the basement in order to prevent the ingress of water, including downward percolating surface water, into the completed structure. A drained cavity system could also be incorporated within the basement design.

Slope Stability

The ground within which the plot is located slopes down to the south-west and falls from 130mOD at the junction of Lower Terrace and Upper Terrace, to 121mOD some 130m to the south-west where Lower Terrace meets Branch Hill. This is an approximate slope angle of 4 degrees, and hence this slope is not marked on Figure 16 of the London Borough of Camden 'Guidance for subterranean development', which indicates slopes of greater than 7 degrees.

Slopes of 8 degrees or greater within the underlying Claygate Member in Hampstead are reported in this document to be potentially unstable if the land topography is adversely disturbed. On this site, on a terraced hillside bounded upslope and downslope by existing dwellings (often with basements), gardens and retaining walls, with a relatively deep recorded groundwater level, it is considered unlikely that the proposed basement development will induce slope instability.

Other Issues

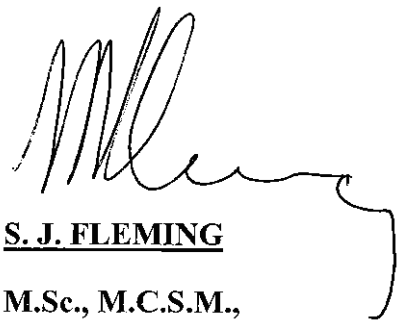
The basement development beneath this site would only be considered likely to affect the drainage system of the site itself. However, drainage and sewerage records for the surrounding buildings will need to be referenced, if available, or perhaps surveyed to confirm that the site does not share a communal drainage system that runs beneath the site.

The flow of surface water within the surrounding area, to the south-west, should not be changed by the proposed redevelopment of this site.

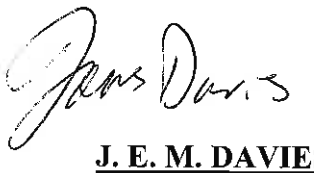
As previously described, groundwater beneath this site stands within the Bagshot Formation at 3.75m to 6.50m depth but 'perched' water may be encountered at shallower depths. The proposed basement depth does not extend below the groundwater level and so there should be no displacement of groundwater by its exclusion from beneath the area of the two basements after they have been constructed.

The orientation of the proposed main basement would be across the likely direction of near surface groundwater flow on this south-west facing slope, but as the proposed structure does not extend below the groundwater level, the drainage path should not be increased and would not be expected to impact the adjoining properties downslope to the south-west.

GROUND ENGINEERING LIMITED



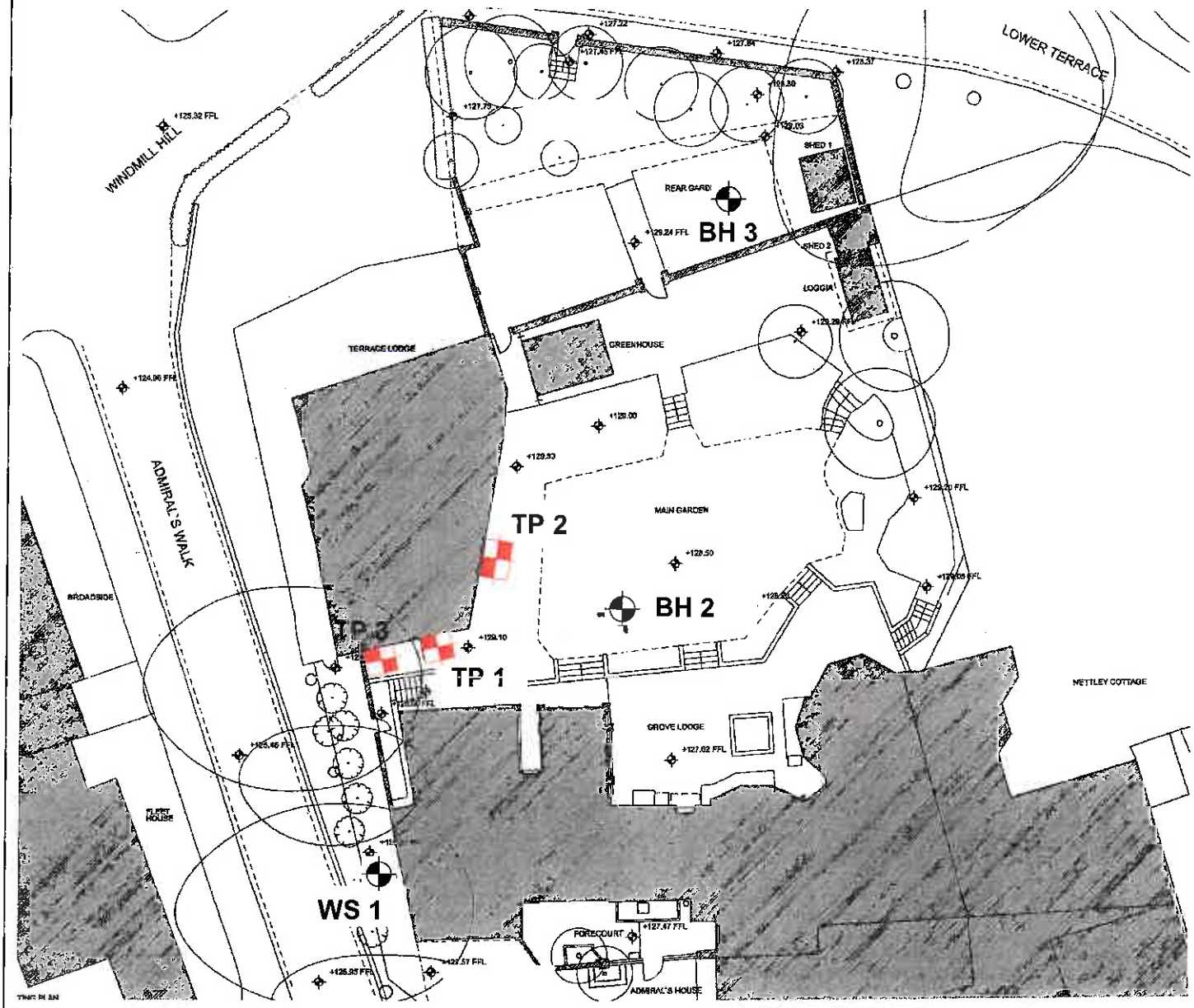
S. J. FLEMING
M.Sc., M.C.S.M.,
C.Geol., F.G.S.,
Director



J. E. M. DAVIES
B.Sc.(Hons.), M.Sc.,
C.Geol., F.G.S.,
Senior Geotechnical Engineer

Exploratory Hole Location Plan

Based on drawing provided by Engineer



Key

Borehole

Trial Pit

NOT TO SCALE

Project: Grove Lodge, Admiral's Walk, London NW3 **Client:** Caspar Berendsen	GROUND ENGINEERING LIMITED Peterborough Tel : 01733 566566	Project No. C13390

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

WINDOW SAMPLE
WS1

Date: 01/10/14

Hole Size: 87mm dia to 2.00m
77mm dia to 4.00m
57mm dia to 6.00m

Ground Level: 128.20m. O.D.

Samples and in-situ Tests			(Date) Water	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result						
0.30	D1				MADE GROUND - Dark brown, slightly gravelly, silty SAND. Gravel of flint, concrete and coal.			
0.60	D2						0.70	127.50
0.90	D3				MADE GROUND - Dark grey and brown, slightly gravelly, slightly sandy SILT. Gravel of flint, concrete, brick and coal.			
1.10	D4						1.20	127.00
1.20	D5				Medium dense, light brown, silty fine SAND.			
1.20-2.00	U1						1.80	126.40
1.35-1.65	S	N25						
1.60-2.00	B1							
2.00	D6				Orange brown, grey brown and light brown, slightly silty, gravelly, fine and medium SAND. Gravel of sub-rounded to rounded flint.		2.00	126.20
2.00-3.00	U2							
2.15-2.45	S	N36			Dense, light brown, slightly silty SAND AND GRAVEL. Gravel of angular to rounded flint and quartz.		2.50	125.70
2.50-3.00	B2							
3.00-4.00	U3				Dense, orange brown, slightly silty, very gravelly SAND. Gravel of angular to rounded flint and quartzite.			
3.15-3.45	C	N37						
3.70-4.00	B3						3.60	124.60
4.00-5.00	U4				Medium dense, light brown, slightly silty SAND AND GRAVEL. Gravel of angular to rounded flint, quartzite and quartz.			
4.15-4.45	C	N19	▼C					
4.70-5.00	B4						4.50	123.70
5.00-6.00	U5		1 ▽		Medium dense, orange brown, slightly silty SAND AND GRAVEL. Gravel of sub-angular to rounded flint, quartzite and quartz.			
5.15-5.45	C	N16						
5.60-6.00	B5							
			▼S				6.00	122.20
6.15-6.45	C	N21			Borehole completed at 6.00m depth			

REMARKS
1. Excavating a pit from 0.00m to 1.20m
2. Borehole collapsed below 4.00m depth following removal of sampler
3. Gas monitoring standpipe installed to 6.00m depth

Project No 13390

Scale 1:50 | Page 1/1

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
▽ Water Strike
▼ Depth to Water on completion
J - Jar Sample
M - Mackintosh Probe
V - Vane Shear Test Cohesion ( ) kPa
P( ) - Hand Penetrometer Cohesion ( ) kPa
▼s Standpipe Level

Groundwater Strikes

No	Depth m Struck	Rose to	Rate	Cased	Sealed
1	4.90				

Groundwater Observations

Date	Depth m Hole	Casing	Water
01/10/14	6.00		4.20
02/10/14	6.00		5.93

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

BOREHOLE BH2

Date: 08/10/14 to 09/10/14

Hole Size: 150mm dia to 15.00m

Ground Level: 128.50m. O.D.

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
0.00-0.30	B1				MADE GROUND - Dark brown, slightly gravelly, silty SAND. Gravel of flint.		0.30	128.20
0.30-0.80	B2				MADE GROUND - Brown and dark brown, slightly gravelly, silty SAND. Gravel of flint, quartzite and brick.			
0.80-1.20	B3						1.20	127.30
1.20-1.70	B4							
1.35-1.65	C	N12			Medium dense, light brown, gravelly, silty fine SAND. Gravel of angular to rounded flint and quartzite.		2.00	126.50
2.00-2.50	B5							
2.15-2.45	C	N19	1.50		Medium dense, orange brown, silty SAND AND GRAVEL. Gravel of sub-angular to rounded flint, quartzite and quartz.		3.10	125.40
3.10-3.60	B6							
3.25-3.55	C	N35	3.00		Dense, light brown, slightly silty, sandy GRAVEL. Gravel of sub-angular to rounded flint, quartzite and quartz.		4.00	124.50
4.00-4.50	B7							
4.35-4.65	C	N18	4.20		Medium dense, grey green and brown, locally clayey, silty, gravelly SAND. Gravel of rounded flint and quartzite.		5.00	123.50
5.00-5.50	B8							
5.15-5.45	C	N14	4.60		Medium dense, grey and grey brown, silty fine SAND with rare sub-rounded flint gravel.		6.80	121.70
6.00-6.50	B9							
6.15-6.45	S	N14	6.00 ▼s					
6.45	D1							
6.90	D2		▼s					
7.00-7.50	B10				Firm, becoming stiff, grey, brown, orange brown and purple mottled, slightly sandy, silty CLAY with occasional black carbonaceous staining and thin bands of fine sand and silt.			
7.15-7.45	S	N15	7.00					
7.45	D3							
8.00	D4							
8.50-8.95	U1	60	7.20					
8.95	D5				...Becoming light brown below 9.00m depth			
9.50	D6							
10.00-10.50	B11						10.00	118.50

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Water added from 2.00m to 5.00m
3. Borehole cased to 7.20m depth
4. Gas monitoring standpipe installed to 10.00m depth

Project No 13390

Scale 1:50 | Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N - SPT Blows for 0.3m
* - Blows for quoted penetration
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes

No	Depth m Struck	Rose to	Rate	Cased	Sealed
1	14.50		seepage	7.20	not

Groundwater Observations

Date	Depth m Hole	Casing	Water
08/10/14	7.00	7.00	5.40
09/10/14	7.00	7.00	5.00
09/10/14	15.00	7.20	damp
21/10/14	10.00		6.89
26/11/14	10.00		6.21

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

BOREHOLE
BH2

Date: 08/10/14 to 09/10/14

Hole Size: 150mm dia to 15.00m

Ground Level: 128.50m. O.D.

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
10.15-10.45	S	N21	7.20		Stiff, light brown, orange brown and grey green mottled, sandy, silty CLAY with occasional partings/ laminae of white silt.		10.00	118.50
10.45	D7							
11.00	D8			BENEATH INSTALLATION				
11.50-11.90	U2	55	7.20	BENEATH INSTALLATION				
11.90	D9			BENEATH INSTALLATION	...Becoming grey brown, orange brown, red brown and grey mottled below 12.00m depth			
12.50	D10			BENEATH INSTALLATION				
13.00-13.50	B12			BENEATH INSTALLATION				
13.15-13.45	S	N27	7.20	BENEATH INSTALLATION				
13.45	D11			BENEATH INSTALLATION				
14.00	D12			BENEATH INSTALLATION	...Rare sub-angular flint gravel at 14.00m depth			
14.50-14.95	U3	45	7.20 ▽ 1	BENEATH INSTALLATION				
15.00	D13			BENEATH			15.00	113.50
					Borehole completed at 15.00m depth			

REMARKS

Project No 13390

Scale 1:50 | Page 2/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N - SPT Blows for 0.3m
* - Blows for quoted penetration
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes						Groundwater Observations			
	Depth m						Depth m		
No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

Date: 10/10/14

Hole Size: 150mm dia to 15.00m

BOREHOLE BH3

Ground Level: 129.10m. O.D.

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
0.00-0.20	B1				MADE GROUND - Dark brown and black, slightly clayey, gravelly SAND. Gravel of flint and brick.			
0.20-0.40	B2						0.40	128.70
0.40-1.00	B3				MADE GROUND - Medium dense, brown and light brown, gravelly, silty SAND. Gravel of flint and occasional brick.			
1.20-1.50	B4							
1.35-1.65	C	N12						
1.50-1.80	B5							
1.80-2.30	B6						1.80	127.30
1.95-2.25	C	N13	1.50		Medium dense, brown, grey and orange brown, gravelly, silty fine and medium SAND. Gravel of sub-angular to rounded flint and quartzite.			
3.00-3.50	B7						3.00	126.10
3.15-3.45	C	N18	3.00		Medium dense, light brown, silty SAND AND GRAVEL. Gravel of sub-angular to rounded flint, quartzite and quartz.			
4.00-4.50	B8						4.00	125.10
4.15-4.45	C	N23	4.00		Medium dense, becoming dense, brown and grey, locally clayey, silty, very sandy GRAVEL. Gravel of sub-angular to rounded flint, quartzite and quartz.			
4.80-5.20	B9							
4.95-5.25	C	N30	4.70					
5.00	W1						5.10	124.00
			S		Medium dense, grey brown and grey, silty fine SAND with occasional clay bands.			
6.10-6.60	B10							
6.25-6.55	S	N21	6.10					
6.55	D1							
7.00-7.50	B11							
7.15-7.45	S	N16	7.00					
7.45	D2						7.50	121.60
7.70	D3				Firm, becoming stiff, brown, grey and orange brown mottled, slightly sandy, silty CLAY.			
7.80-8.30	B12							
7.95-8.25	S	N17	7.70					
8.25	D4							
9.00	D5							
9.50-9.95	U1	58	8.00					
9.95	D6						10.00	119.10

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Water added from 1.80m to 5.00m
3. Borehole cased to 8.00m depth
4. Gas monitoring standpipe installed to 10.00m depth

Project No 13390

Scale 1:50 | Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N - SPT Blows for 0.3m
* - Blows for quoted penetration
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes

No	Depth m Struck	Rose to	Rate	Cased	Sealed

Groundwater Observations

Date	Depth m Hole	Casing	Water
10/10/14	15.00	8.00	dry
21/10/14	10.00		5.85
26/11/14	10.00		5.91

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

Date: 10/10/14

Hole Size: 150mm dia to 15.00m

BOREHOLE BH3

Ground Level: 129.10m. O.D.

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
					Stiff, light brown, grey and orange brown mottled, sandy, locally very sandy, silty CLAY.		10.00	119.10
10.50-11.20	B13							
11.20-11.70	B14			BENEATH INSTALLATION				
11.35-11.65	S	N20	8.00					
11.65	D7			BENEATH INSTALLATION				
12.00	D8			BENEATH INSTALLATION				
12.60-13.05	U2	60	8.00	BENEATH INSTALLATION				
13.05	D9			BENEATH INSTALLATION				
13.60	D10			BENEATH INSTALLATION				
14.00	D11			BENEATH INSTALLATION				
14.65-14.95	S	N48	8.00	BENEATH INSTALLATION				
15.00	D12			BENEATH			15.00	114.10
					Borehole completed at 15.00m depth			

REMARKS

Project No 13390

Scale 1:50 | Page 2/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N - SPT Blows for 0.3m
* - Blows for quoted penetration
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes						Groundwater Observations			
	Depth m						Depth m		
No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water

Borehole Number	Depth (m)	Casing Depth (m)	Depth to Water (m)	Type of Test *	Seating Drive: Blows/Penetration (mm)	Test Drive: 300mm Blows for each successive 75 mm Penetration				N Value	Extrapolated Value
WS1	1.20 - 1.65			S	6/150	5	6	7	7	25	
	2.00 - 2.45			S	13/150	9	8	9	10	36	
	3.00 - 3.45			C	21/150	9	9	10	9	37	
	4.00 - 4.45			C	8/150	5	5	4	5	19	
	5.00 - 5.45			C	4/150	3	4	4	5	16	
	6.00 - 6.45			C	10/150	6	5	5	5	21	
BH2	1.20 - 1.65			C	3/150	2	3	3	4	12	
	2.00 - 2.45	1.50		C	5/150	3	4	6	6	19	
	3.10 - 3.55	3.00	2.50	C	9/150	8	9	9	9	35	
	4.20 - 4.65	4.20	3.90	C	5/150	4	5	4	5	18	
	5.00 - 5.45	4.60	4.00	C	4/150	3	3	4	4	14	
	6.00 - 6.45	6.00	4.50	S	4/150	3	4	3	4	14	
	7.00 - 7.45	7.00		S	5/150	3	3	4	5	15	
	10.00 - 10.45	7.20		S	5/150	4	5	6	6	21	
	13.00 - 13.45	7.20		S	6/150	6	8	6	7	27	
BH3	1.20 - 1.65			C	3/150	3	2	3	4	12	
	1.80 - 2.25	1.50		C	5/150	3	3	3	4	13	
	3.00 - 3.45	3.00	2.00	C	4/150	4	4	4	6	18	
	4.00 - 4.45	4.00	3.20	C	6/150	4	5	6	8	23	
	4.80 - 5.25	4.70	4.00	C	7/150	6	7	8	9	30	
	6.10 - 6.55	6.10	5.00	S	5/150	4	5	7	5	21	
	7.00 - 7.45	7.00	5.00	S	4/150	3	4	4	5	16	
	7.80 - 8.25	7.70		S	5/150	4	4	4	5	17	
	11.20 - 11.65	8.00		S	5/150	4	5	5	6	20	
	14.50 - 14.95	8.00		S	6/150	9	12	12	15	48	

GROUND ENGINEERING LIMITED
Tel: 01733-566566
www.groundengineering.co.uk

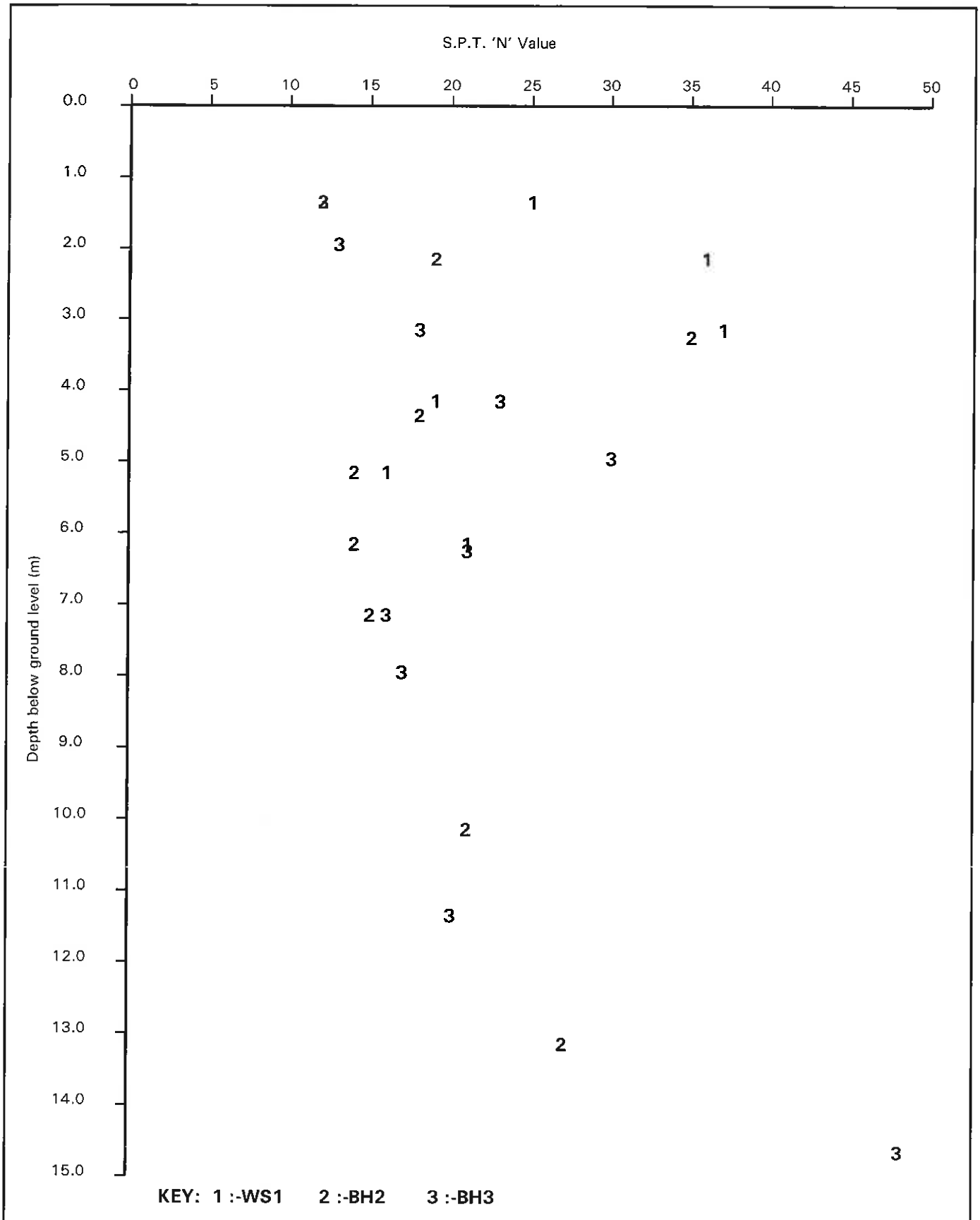
* C denotes test using a solid cone
S denotes test using a split barrel sampler

Results of Standard/Cone Penetration Tests

13390

GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

Table No 1



S.P.T. 'N' Value vs Depth below ground level (m).

SITE	GROVE LODGE, ADMIRAL'S WALK, LONDON NW3		
CLIENT	CASPAR BERENDSEN	Contract Number	13390
GROUND ENGINEERING LIMITED	Tel: 01733-566566 www.groundengineering.co.uk	Date	03/12/14
		Figure	1

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

TRIAL PIT
TP1

Date: 02/10/14

Pit Size: 0.75m L x 0.65m W x 1.30m D.

Ground Level: 129.10m. O.D.

Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.30	D1			MADE GROUND - Firm, friable, dark brown, slightly gravelly, sandy CLAY with occasional brick cobbles. Gravel of flint, brick, slate and ash.			
0.60	D2						
						0.80	128.30
0.90	D3			MADE GROUND - Brown, sandy GRAVEL with some flint cobbles. Gravel of flint.			
						1.10	128.00
1.15 1.25	D4 D5			Orange brown, slightly silty, gravelly SAND. Gravel of angular to sub-rounded flint, quartz and quartzite.			
						1.30	127.80
				Pit completed at 1.30m depth			

KEY

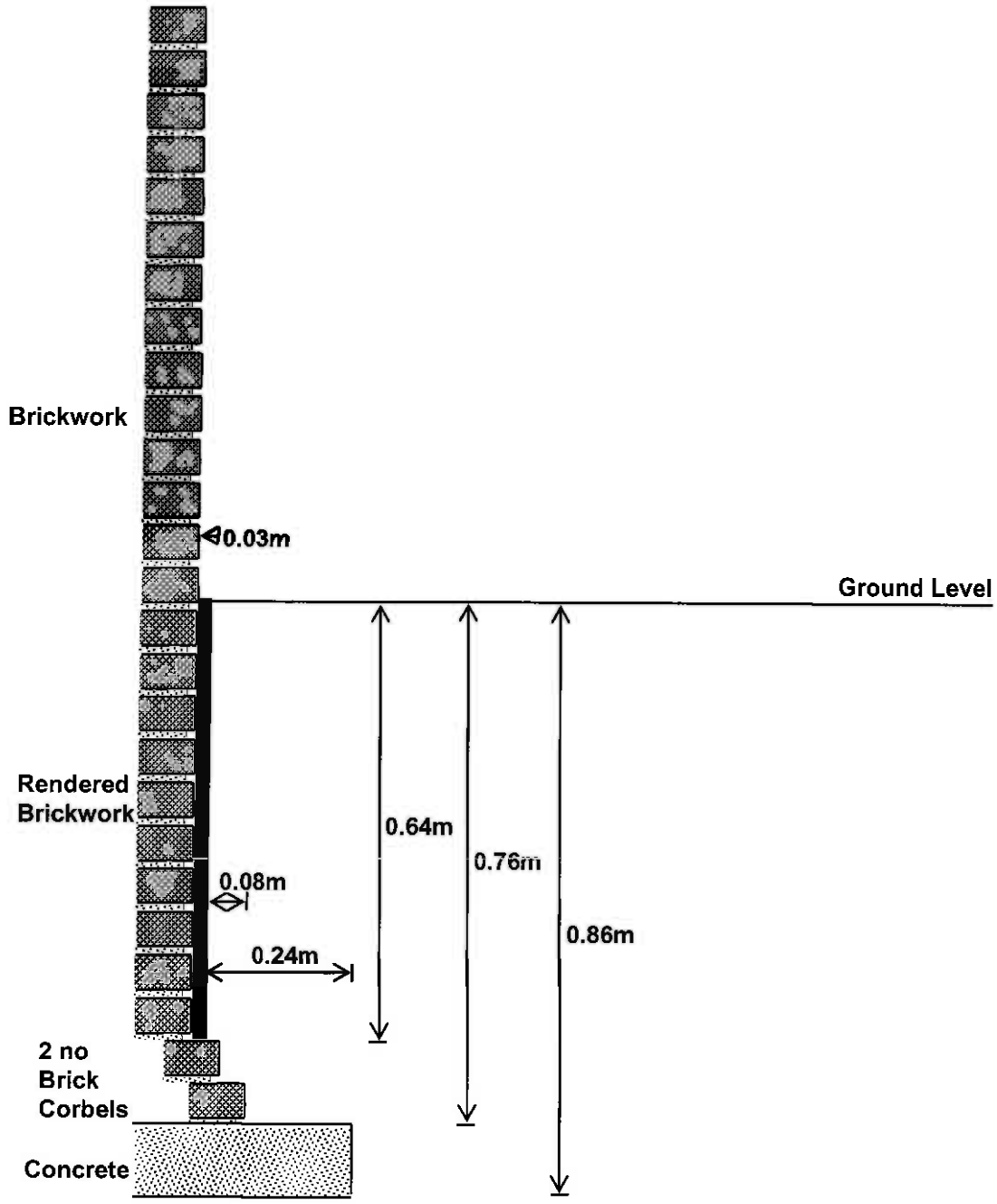
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- J - Jar Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 0.90m depth
2. Pit dry
3. Pit sides stable

Project No	
13390	
Scale	Page
1:25	1/1

Trial Pit TP1
Cross Section



Not to Scale

Project: Grove Lodge, Admiral's Walk, London NW3 **Client:** Mr. Casper Berendsen	GROUND ENGINEERING LIMITED Peterborough Tel : 01733 566566	Project No. C13390

Trial Pit TP1
Photographs

Project: Grove Lodge, Admiral's Walk, London NW3 **Client:** Mr. Casper Berendsen	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** C13390

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

TRIAL PIT
TP2

Date: 02/10/14

Pit Size: 0.70m L x 0.60m W x 1.60m D.

Ground Level: 129.20m. O.D.

Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.30	D1			MADE GROUND - Firm, friable, dark brown, slightly gravelly, sandy CLAY. Gravel of flint, brick and concrete.			
0.60	D2						
						1.00	128.20
1.10	D3			MADE GROUND - Firm, friable, brown, slightly sandy, slightly gravelly CLAY. Gravel of flint.		1.20	128.00
1.30	D4			Light brown, slightly gravelly, silty fine SAND. Gravel of angular to sub-angular flint.		1.30	127.90
1.45	D5			Grey brown and brown, silty fine SAND.			
						1.60	127.60
				Pit completed at 1.60m depth			

KEY

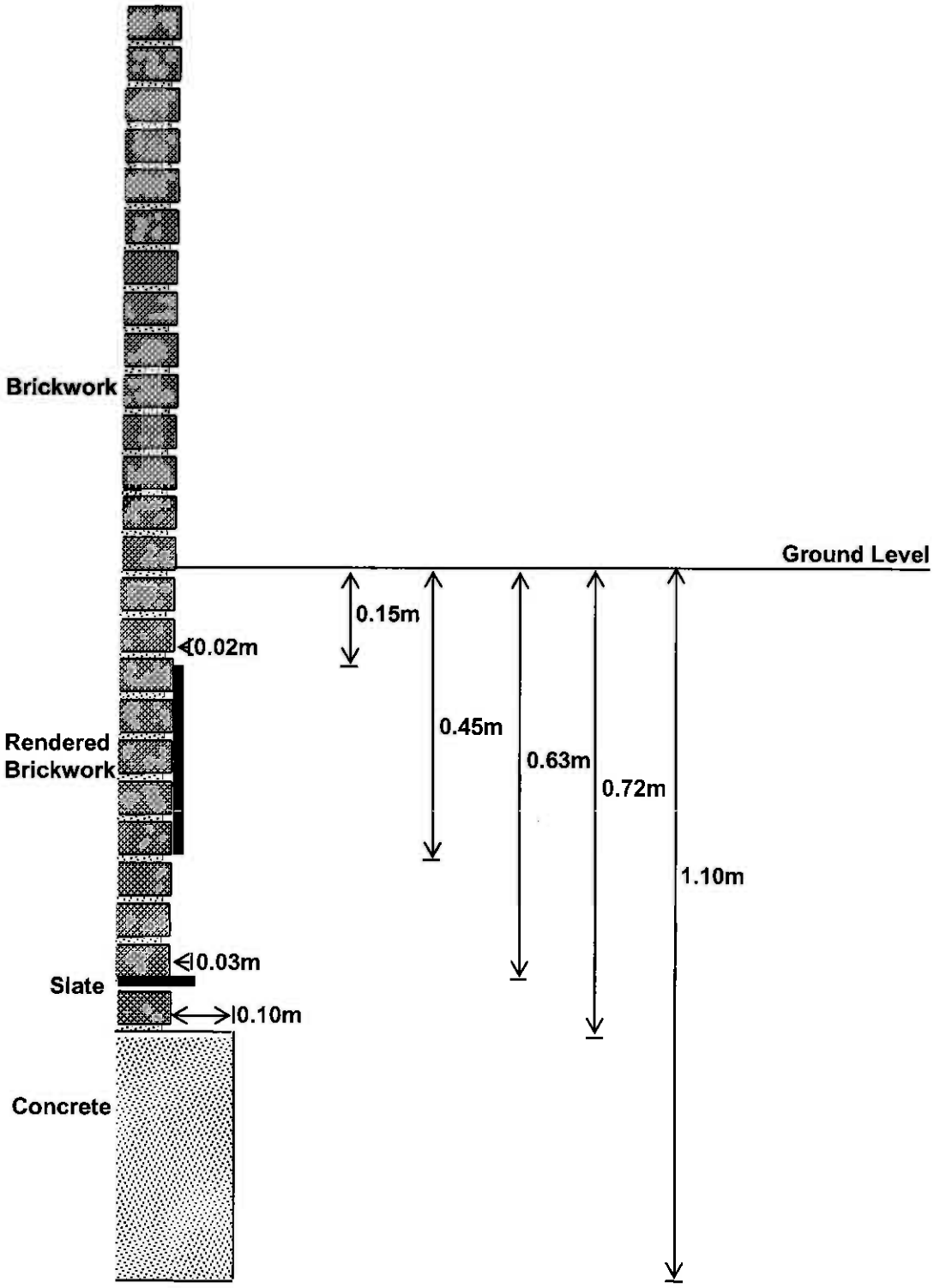
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- J - Jar Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 1.20m depth
2. Pit dry
3. Pit sides stable

Project No	
13390	
Scale	Page
1:25	1/1

Trial Pit TP2
Cross Section



Not to Scale

Project: Grove Lodge, Admiral's Walk, London NW3 **Client:** Mr. Casper Berendsen	GROUND ENGINEERING LIMITED Peterborough Tel : 01733 566566	Project No. C13390

Trial Pit TP2
Photographs

Project: Grove Lodge, Admiral's Walk, London NW3 **Client:** Mr. Casper Berendsen	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C13390**

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

TRIAL PIT
TP3

Date: 02/10/14

Pit Size: 0.70m L x 0.50m W x 1.30m D.

Ground Level: 129.00m. O.D.

Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.30	D1			MADE GROUND - Firm, friable, dark brown, slightly gravelly, sandy CLAY with occasional brick cobbles. Gravel of flint and brick.			
0.60	D2					0.70	128.30
0.80	D3			MADE GROUND - Firm, friable, brown, slightly gravelly, sandy CLAY with occasional brick cobbles. Gravel of flint, brick and ash.		0.90	128.10
0.95	D4			MADE GROUND - Brown, SAND AND GRAVEL. Gravel of flint, chalk and brick fragments.		1.00	128.00
1.15	D5			Yellow brown, slightly gravelly, silty fine SAND. Gravel of sub-rounded to rounded flint and quartzite.		1.30	127.70
				Pit completed at 1.30m depth			

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- J - Jar Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

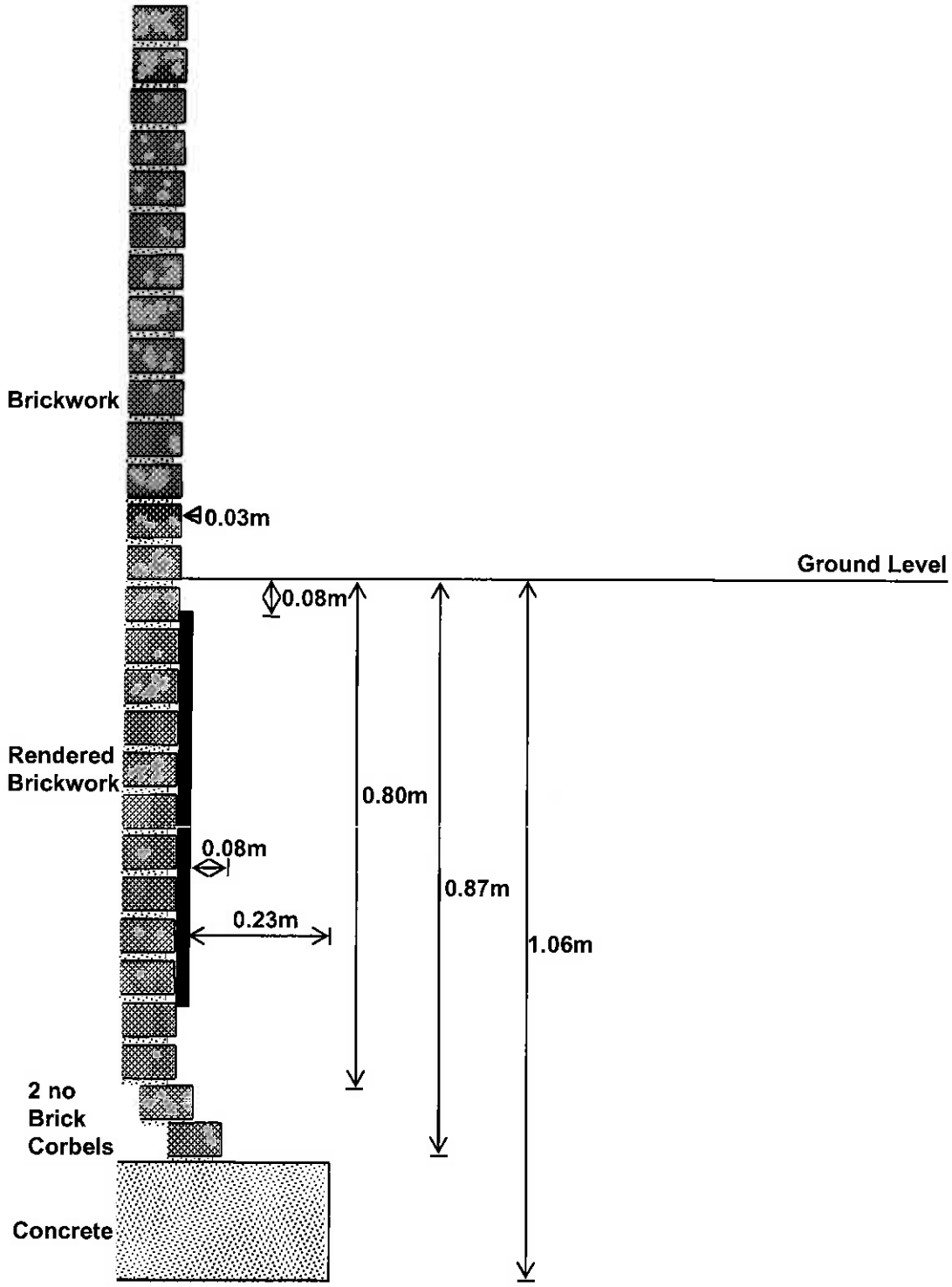
1. Live roots observed to 0.70m depth
2. Pit dry
3. Pit sides stable

Project No 13390

Scale 1:25

Page 1/1

Trial Pit TP3
Cross Section



Not to Scale

Project: Grove Lodge, Admiral's Walk, London NW3 **Client:** Mr. Casper Berendsen	GROUND ENGINEERING LIMITED Peterborough Tel : 01733 566566	Project No. C13390

Trial Pit TP3
Photographs

Project: Grove Lodge, Admiral's Walk, London NW3 **Client:** Mr. Casper Berendsen	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** C13390

Groundwater/Gas Monitoring Record

GROUND ENGINEERING LIMITED

Site: **Grove Lodge, Admiral's Walk, London NW3**

Report Ref: C13390

Date	Borehole	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Flow Rate (l/hr)	Atmosph. Pressure (mb)	Depth of Well (m)	Depth to Groundwater (m)
		Peak	Steady	Peak	Steady	Min.	Max.				
21/10/14	BH 2	<0.1	<0.1	<0.1	<0.1	20.9	20.9	<0.1	988	10.00	6.89
	BH 3	<0.1	<0.1	4.5	4.5	16.7	16.7	<0.1	988	10.00	5.85
26/11/14	BH 2	<0.1	<0.1	0.9	0.9	17.9	17.9	<0.1	995	10.00	6.21
	BH 3	<0.1	<0.1	3.8	3.8	17.8	17.8	<0.1	995	10.00	5.98
10/02/15	BH 2									10.00	6.96
	BH 3									10.00	6.09

Equipment: GasLog GFM 430, 50m tape dipmeter.

LABORATORY TEST RESULTS

CONTRACT GROVE LODGE, ADMIRAL'S WALK, LONDON NW3

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil: Total % Dry Wt.	Soil: Aqueous Extract mg/l	Water mg/l	pH	
BH2	B2	0.30 - 0.80													58		5.6	
	U1	8.50 - 8.70				23	1.94	1.58	QM	153 180 220	100 200 400	92	0		33		6.3	
	U2	11.50 - 11.90				20	1.84	1.53	QM	171 239	100 200	37	15					Test completed at 20% strain
BH3	B3	0.40 - 1.00													49		5.9	
	W1	5.00														140	6.2	
	U1	9.50 - 9.95				20	1.90	1.57	QM	179 270	100 200	29	18					Test completed at 20% strain
	U2	12.60 - 13.05													66		5.8	Unsuitable for triaxial testing - sieve undertaken

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

13390

GROUND ENGINEERING LIMITED
Tel: 01733-566566
www.groundengineering.co.uk

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/2/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

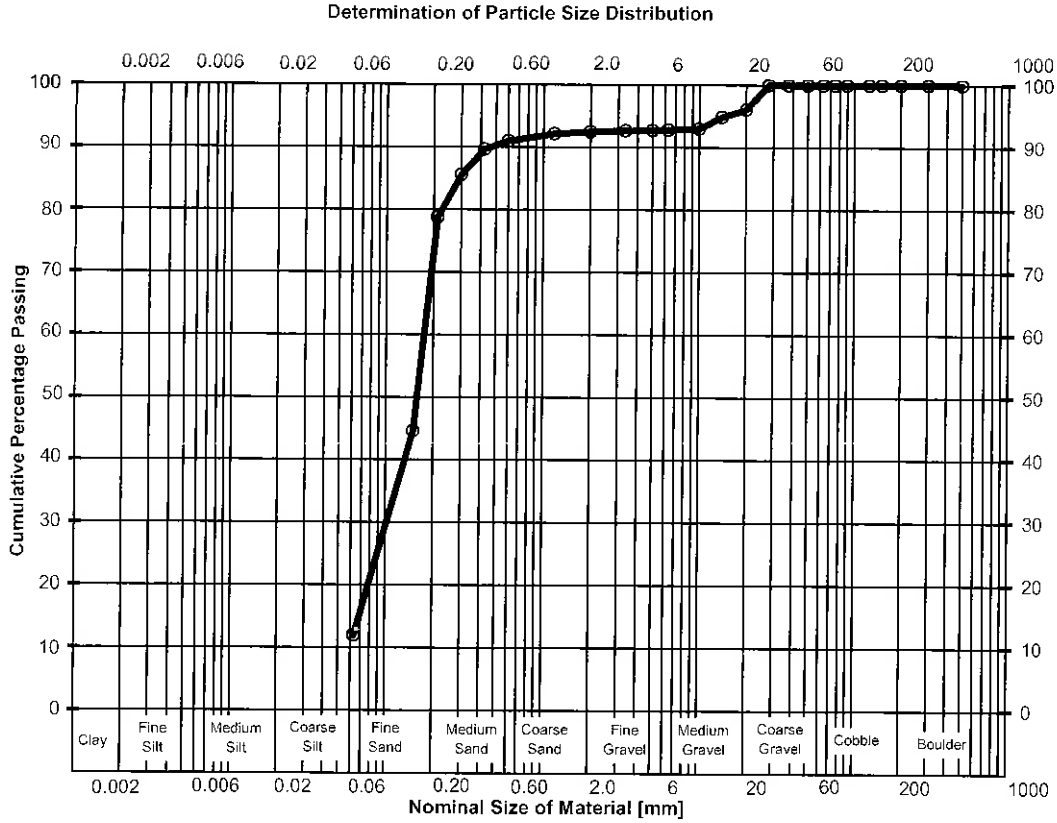
TEST RESULTS **Laboratory Reference:** PL4801-1/2
Client Reference: B4

Pre-treatment for organic material: N/A

Sample Description: Brown slightly silty slightly gravelly SAND

Material Specification: Not Required
Location: BH2
Source:

Depth Top: 1.20m
Depth Base: 1.70m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	96
14	95
10	93
6.3	93
5.0	93
3.35	93
2.00	92
1.18	92
0.600	91
0.425	90
0.300	86
0.212	79
0.150	45
0.063	12
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager

Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/3/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

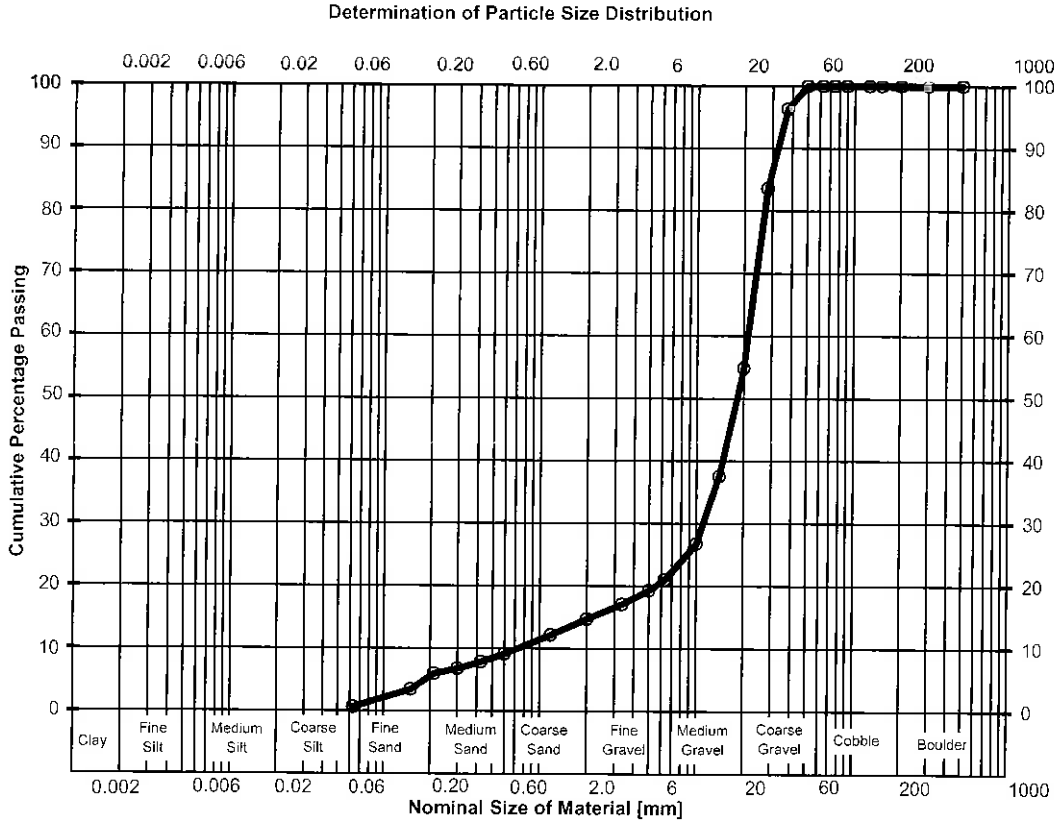
TEST RESULTS

Laboratory Reference: PL4801-1/3
Client Reference: B6
Pre-treatment for organic material: N/A

Sample Description: Brown sandy GRAVEL

Material Specification: Not Required
Location: BH2
Source:

Depth Top: 3.10m
Depth Base: 3.60m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	96
28	84
20	55
14	38
10	27
6.3	21
5.0	19
3.35	17
2.00	15
1.18	12
0.600	9
0.425	8
0.300	7
0.212	6
0.150	3
0.063	1
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager

Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

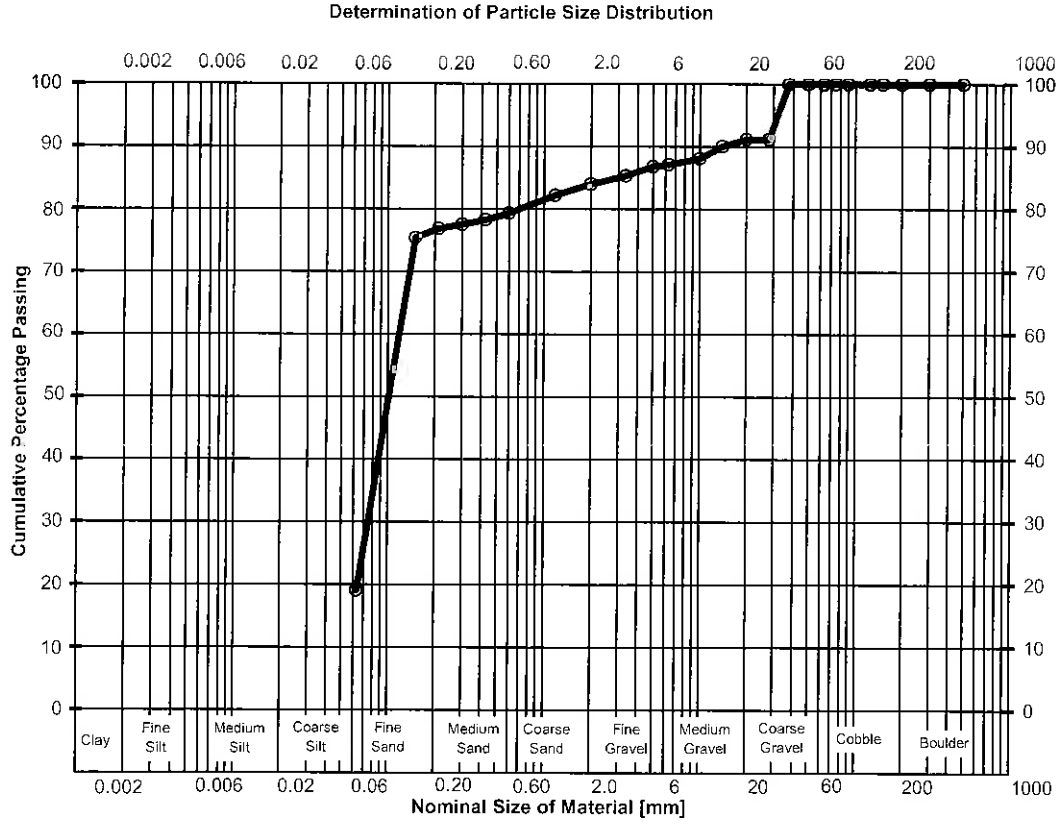
Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/4/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/4 **Pre-treatment for organic material:** N/A
Client Reference: B7

Sample Description: Brown orange brown clayey gravelly SAND

Material Specification: Not Required
Location: BH2
Source:

Depth Top: 4.00m
Depth Base: 4.50m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	91
20	91
14	90
10	88
6.3	87
5.0	87
3.35	85
2.00	84
1.18	82
0.600	79
0.425	78
0.300	78
0.212	77
0.150	75
0.063	19
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

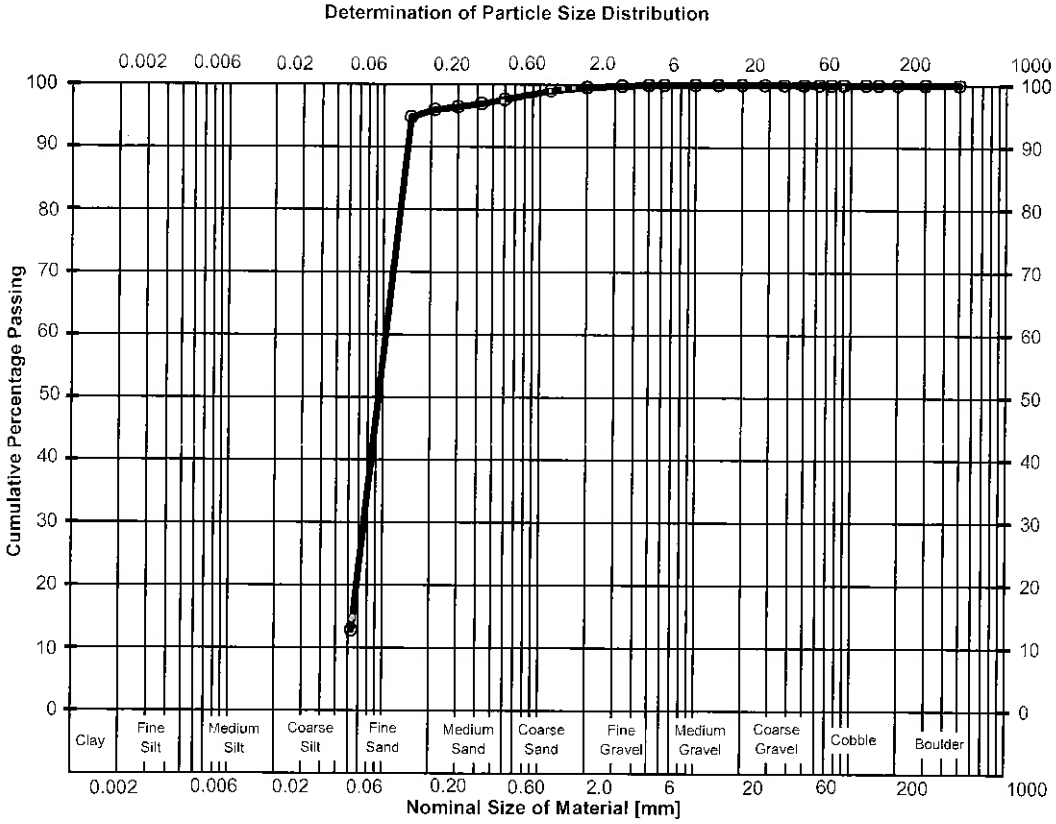
Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/5/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/5 **Pre-treatment for organic material:** N/A
Client Reference: B9

Sample Description: Brown grey slightly clayey SAND with rare fine gravel

Material Specification: Not Required
Location: BH2
Source:

Depth Top: 6.00m
Depth Base: 6.50m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5.0	100
3.35	100
2.00	100
1.18	99
0.600	98
0.425	97
0.300	96
0.212	96
0.150	95
0.063	13
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/8/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

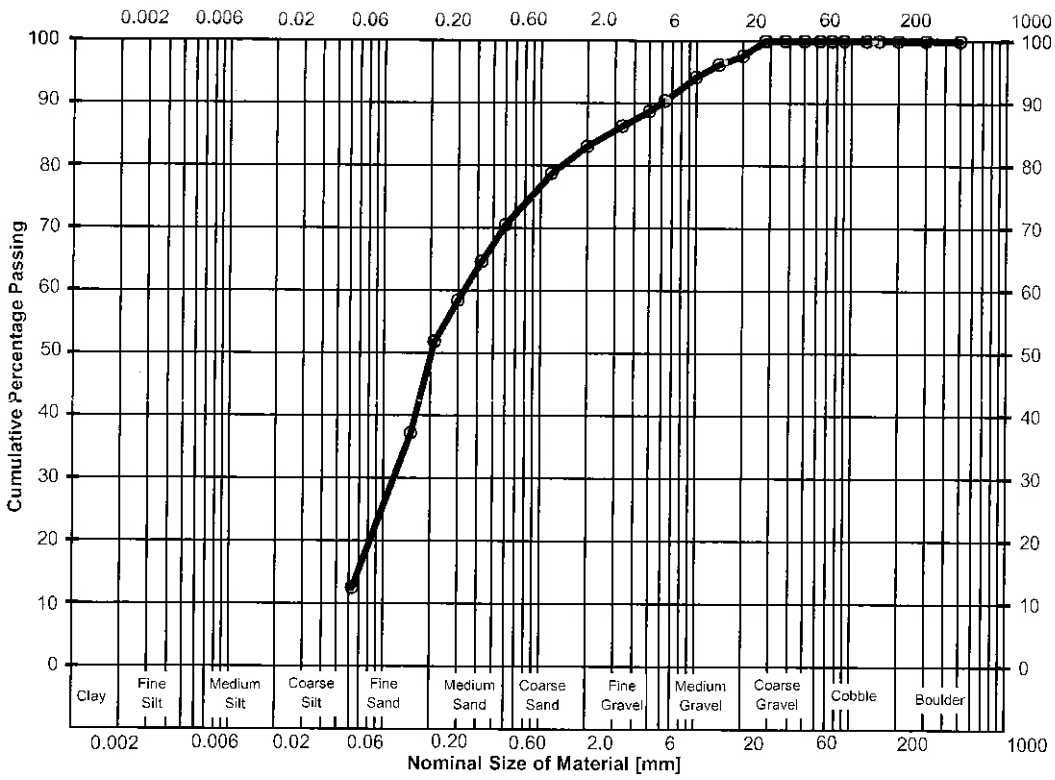
TEST RESULTS **Laboratory Reference:** PL4801-1/8 **Pre-treatment for organic material:** N/A
Client Reference: B3

Sample Description: Brown slightly clayey slightly gravelly SAND

Material Specification: Not Required
Location: BH3
Source:

Depth Top: 0.40m
Depth Base: 1.00m
Supplier:

Determination of Particle Size Distribution



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	98
14	96
10	94
6.3	90
5.0	89
3.35	86
2.00	83
1.18	79
0.600	70
0.425	65
0.300	58
0.212	52
0.150	37
0.063	13
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

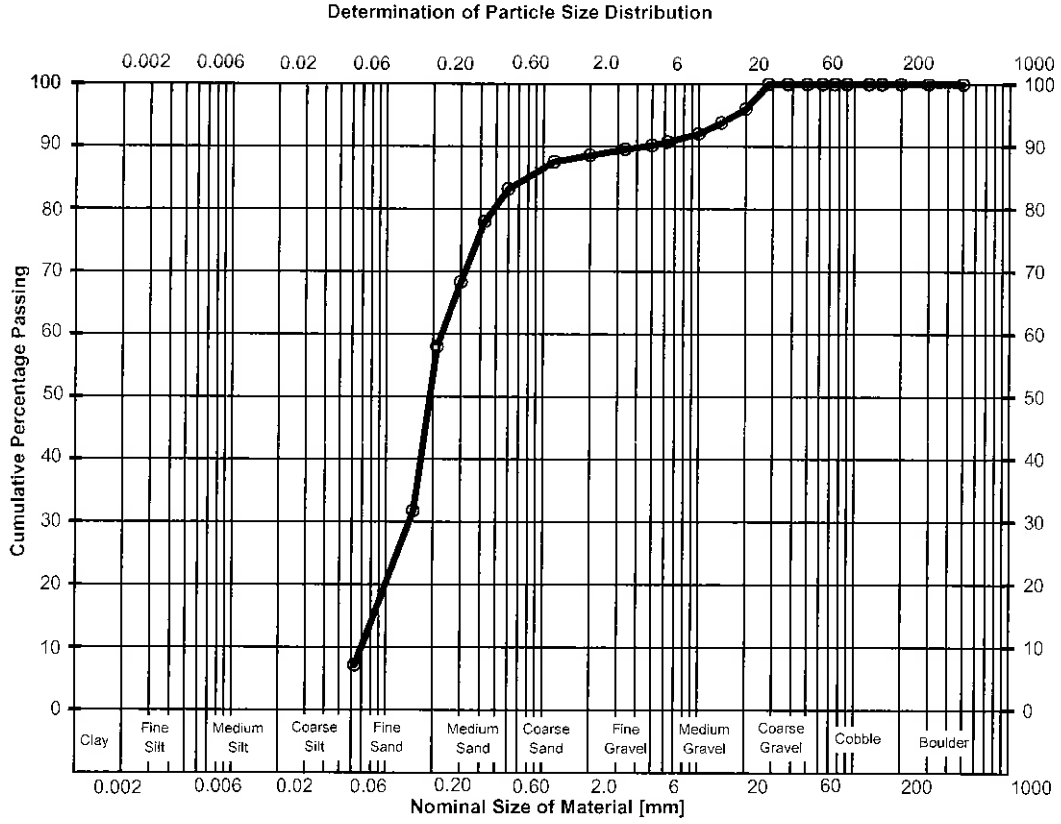
Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/9/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/9 **Pre-treatment for organic material:** N/A
Client Reference: B6

Sample Description: Brown slightly silty slightly gravelly SAND

Material Specification: Not Required
Location: BH3
Source:

Depth Top: 1.80m
Depth Base: 2.30m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	96
14	94
10	92
6.3	91
5.0	90
3.35	90
2.00	89
1.18	88
0.600	83
0.425	78
0.300	68
0.212	58
0.150	32
0.063	7
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

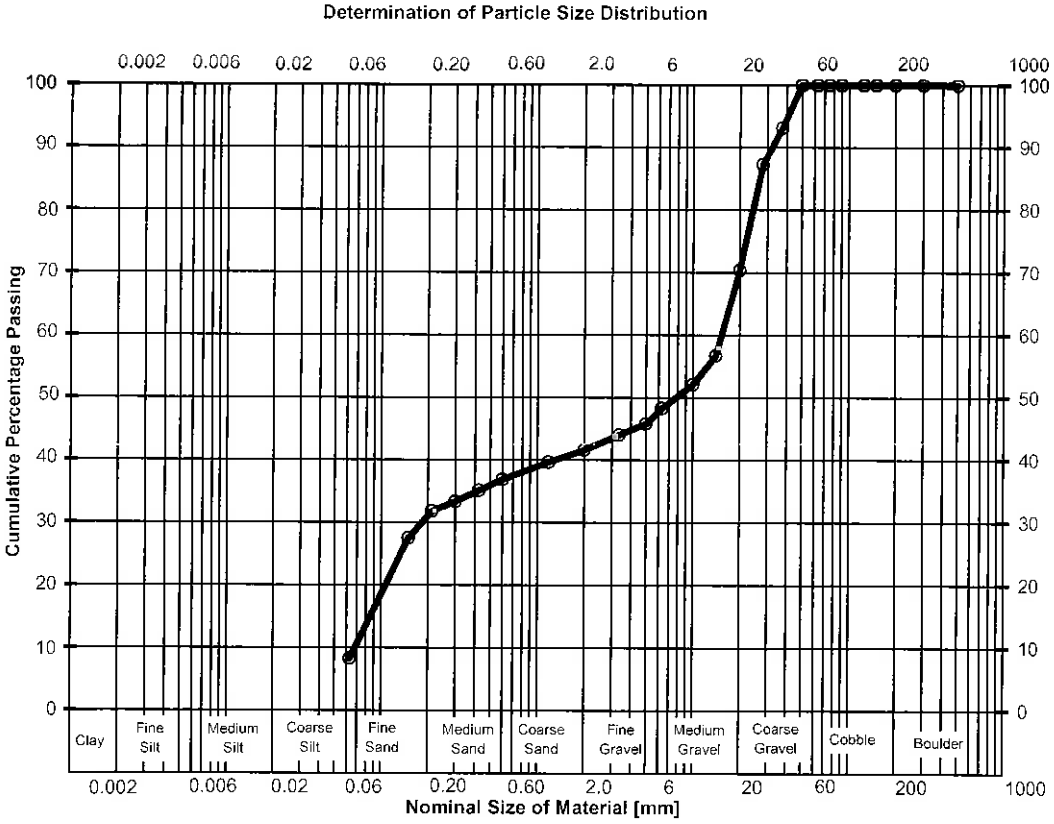
Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/10/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/10 **Pre-treatment for organic material:** N/A
Client Reference: B8

Sample Description: Brown slightly clayey SAND and GRAVEL

Material Specification: Not Required
Location: BH3
Source:

Depth Top: 4.00m
Depth Base: 4.50m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	93
28	87
20	70
14	57
10	52
6.3	48
5.0	46
3.35	44
2.00	42
1.18	40
0.600	37
0.425	35
0.300	33
0.212	32
0.150	27
0.063	8
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/12/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

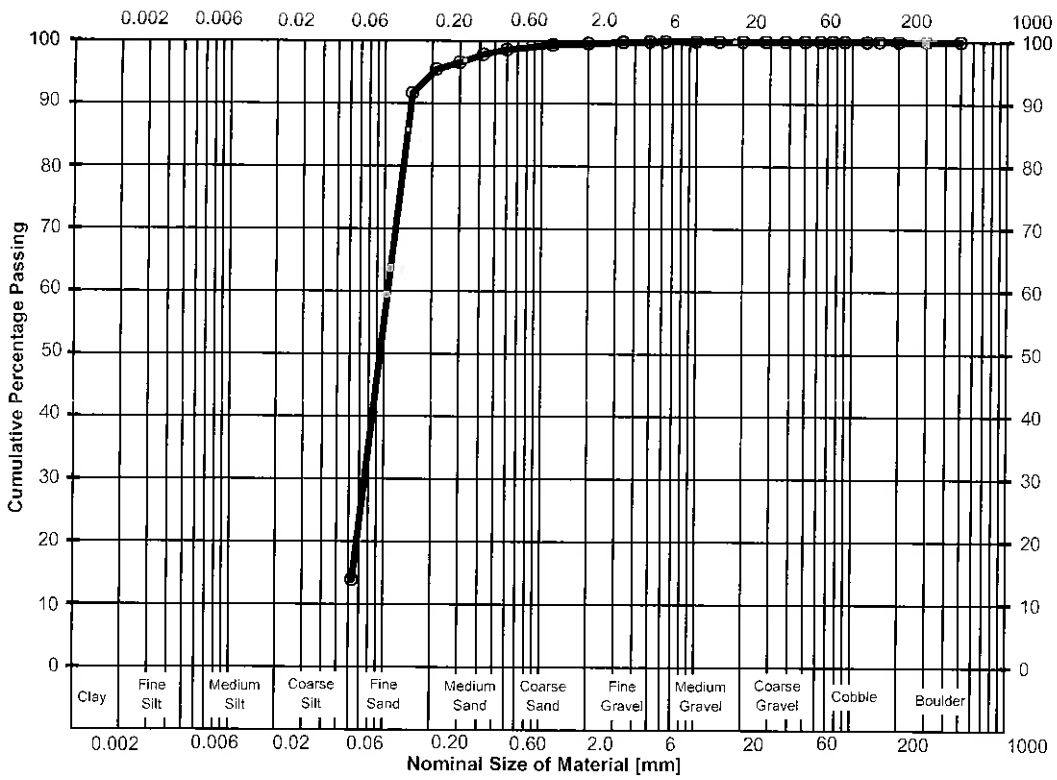
TEST RESULTS **Laboratory Reference:** PL4801-1/12 **Pre-treatment for organic material:** N/A
Client Reference: B10

Sample Description: Saturated brown clayey SAND

Material Specification: Not Required
Location: BH3
Source:

Depth Top: 6.10m
Depth Base: 6.60m
Supplier:

Determination of Particle Size Distribution



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5.0	100
3.35	100
2.00	100
1.18	99
0.600	99
0.425	98
0.300	97
0.212	95
0.150	92
0.063	14
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

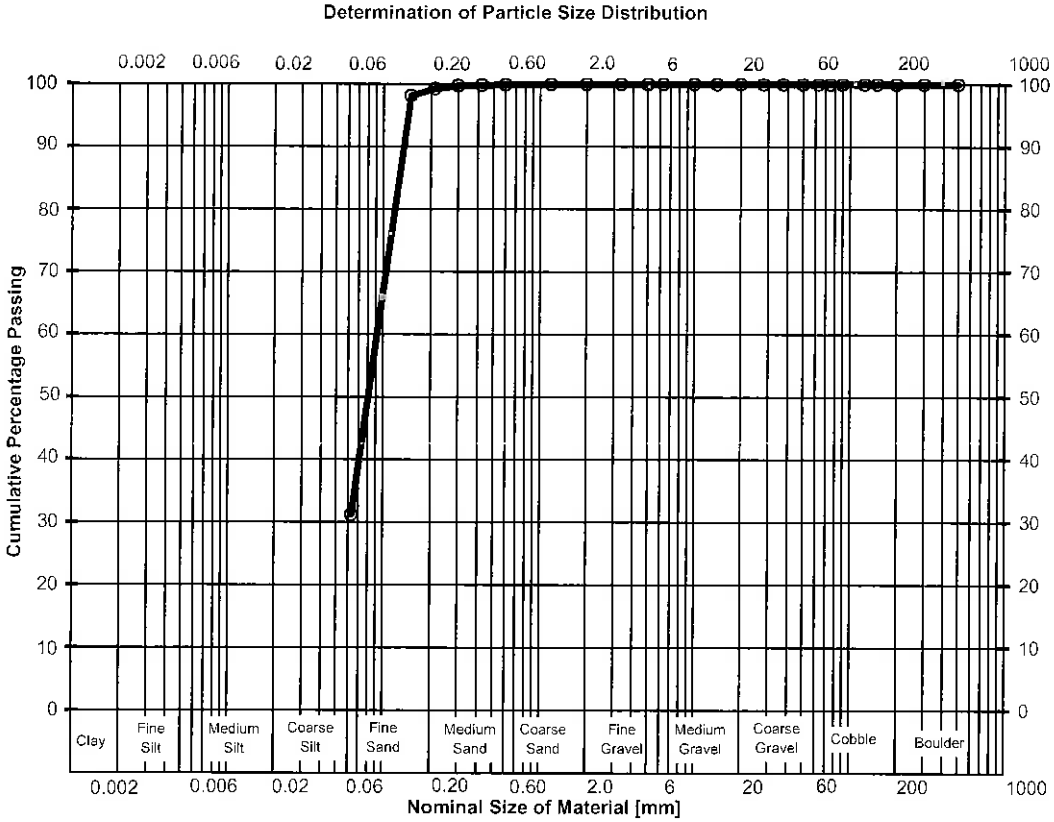
Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/14/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/14 **Pre-treatment for organic material:** N/A
Client Reference: U2

Sample Description: Light brown clayey silty SAND

Material Specification: Not Required
Location: BH3
Source:

Depth Top: 12.60m
Depth Base: 13.05m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5.0	100
3.35	100
2.00	100
1.18	100
0.600	100
0.425	100
0.300	100
0.212	99
0.150	98
0.063	31
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

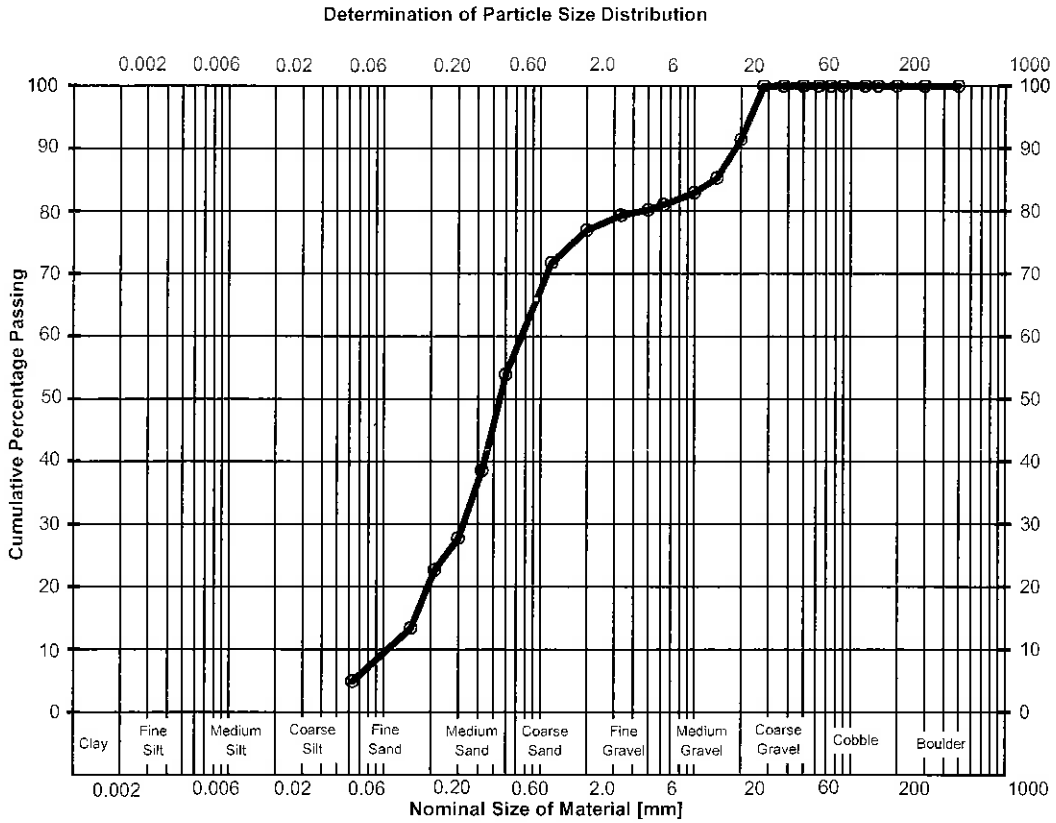
Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/15/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/15 **Pre-treatment for organic material:** N/A
Client Reference: B2

Sample Description: Brown gravelly SAND

Material Specification: Not Required **Depth Top:** 2.50m
Location: WS1 **Depth Base:** 3.00m
Source: **Supplier:**



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	91
14	85
10	83
6.3	81
5.0	80
3.35	79
2.00	77
1.18	72
0.600	54
0.425	39
0.300	28
0.212	23
0.150	13
0.063	5
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

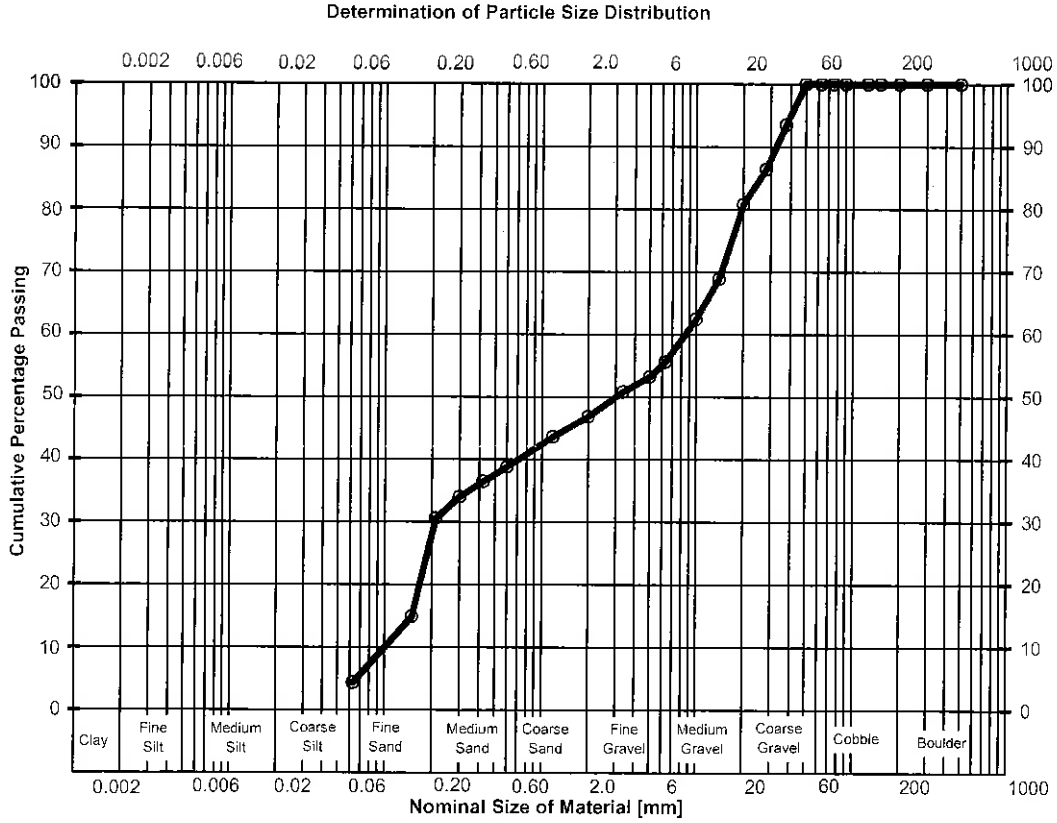
Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/16/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/16 **Pre-treatment for organic material:** N/A
Client Reference: B3

Sample Description: Brown SAND and GRAVEL

Material Specification: Not Required
Location: WS1
Source:

Depth Top: 3.70m
Depth Base: 4.00m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	94
28	86
20	81
14	69
10	62
6.3	56
5.0	53
3.35	51
2.00	47
1.18	44
0.600	39
0.425	36
0.300	34
0.212	31
0.150	15
0.063	4
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

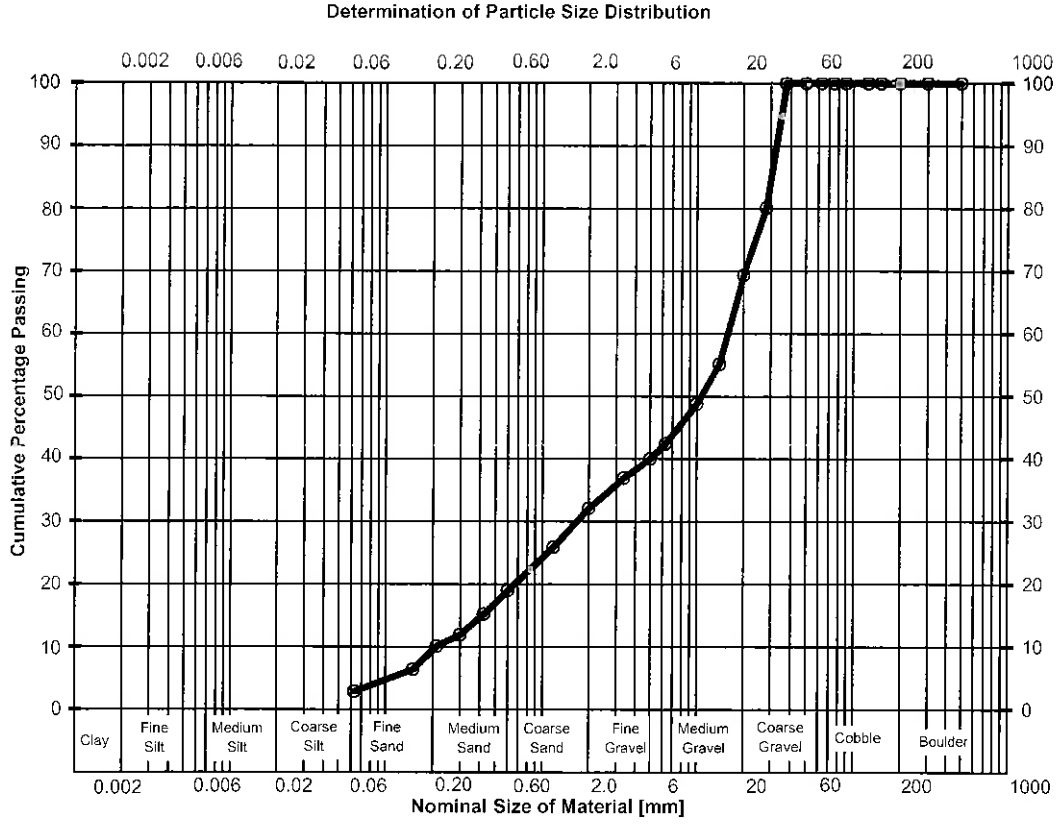
Client:	Ground Engineering Ltd	Certificate Number:	PL4801-1/17/710-2
Client Address:	Newark Road	Client Reference:	C13390
	Peterborough	Lab Job Number:	PL4801-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	05.11.2014
Contact:	Steve Fleming	Date Tested:	26.11.2014
		Certificate of Sampling:	N/A
Site Name:	Grove Lodge	Sampling Certificate No.:	N/A
Site Address:	Admirals Walk, London NW3	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL4801-1/17 **Pre-treatment for organic material:** N/A
Client Reference: B5

Sample Description: Brown slightly clayey SAND and GRAVEL

Material Specification: Not Required
Location: WS1
Source:

Depth Top: 5.60m
Depth Base: 6.00m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	80
20	69
14	55
10	49
6.3	42
5.0	40
3.35	37
2.00	32
1.18	26
0.600	19
0.425	15
0.300	12
0.212	10
0.150	6
0.063	3
0.020	
0.006	
0.002	

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 27.11.2014 Page 1 of 1
Form Number: GELab/C/709-2 Version 39

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterbrough PE1 5UA

HR Wallingford
Working with water

HR Wallingford is an independent engineering and environmental hydraulics organisation. We deliver practical solutions to the complex water-related challenges faced by our international clients. A dynamic research programme underpins all that we do and keeps us at the leading edge. Our unique mix of know-how, assets and facilities includes state of the art physical modelling laboratories, a full range of numerical modelling tools and, above all, enthusiastic people with world-renowned skills and expertise.

HR Wallingford, Howbery Park, Wallingford, Oxfordshire OX10 8BA, United Kingdom
tel +44 (0)1491 835381 fax +44 (0)1491 832233 email info@hrwallingford.com
www.hrwallingford.com

FS 516431
EMS 558310
OHS 595357