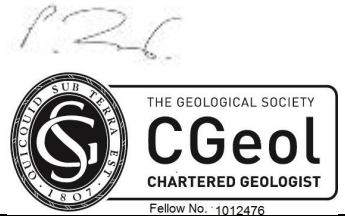
LMB GEOSOLUTIONS LTD

GROUND INVESTIGATION & ASSESSMENT

ROCHESTER SQUARE SPIRITUALIST TEMPLE, ROCHESTER SQUARE, LONDON NW1

December 2016

DOCUMENT RECORD

Document Title	Ground Investigation & Assessment
Site	Rochester Square Spiritualist Temple, London NW1
Document Date	7th December 2016
Document Version	Issue 1
Document Authorisation	Philip Lewis BSc (Hons), MSc, CGeol, FGS
	

LMB

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Company No. 8303397
LMB Home

TABLE OF CONTENTS

Contents

EXECUTIVE SUMMARY

Executive Summary

Site Details	Rochester Square Spiritualist Temple, Rochester Square, London NW1 9RY
Proposed Development	The development proposals include demolition of the existing structure and construction of a new mixed use four storey structure that will include a single storey basement.
Ground & Groundwater Conditions	Made Ground overlying Head Deposits and the London Clay Formation. Groundwater was recorded during monitoring and is considered to form a thin but laterally continuous aquifer unit within the Head Deposits over the area of the site.
Geotechnical Advice	For traditional spread or raft foundations placed on the competent firm to stiff clay at a depth of 4.00m to 4.50m bgl (i.e. approximate formation level) a net safe bearing pressure of 140kN/m2 should be available. However, should a piled foundation solution be considered, a preliminary assessment indicates that for a 10m pile (founded on the London Clay Formation) safe working loads of 263kN and 371kN are estimated for 450mm and 600mm pile diameters respectively. The above advice assumes that the proposed basement development and in particular foundations would not be within the influence of any trees or tree routes. Given the size of the excavation, the adjacent and nearby structures and the presence of shallow groundwater it is considered likely that temporary or permanent support (sheet/secant piles or similar) will be needed for construction. Coefficient of active earth pressure: Made Ground: 0.35. Head Deposits 0.30.London Clay Formation: 0.40. Coefficient of passive earth resistance: Made Ground: 3.5. Head Deposits 4.0.London Clay Formation: 2.5. Buried concrete: Made Ground: DS-1, AC-1s. Head Deposits DS-1, AC-1s. London Clay Formation: DS-2, AC-2.
Recommendations	The full set of recommendations should be reviewed but in summary the following are provided: • The preliminary pile assessment should be confirmed and/or amended by a competent piling contractor. • It is recommended that additional groundwater and ground gas monitoring be undertaken.
This executive summary is not a stand alone document and should be read in conjunction with the full report text, including conclusions and recommendations.	

INTRODUCTION

Introduction

AUTHORISATION

LMB Geosolutions Ltd (LMB) was instructed by Spacelab (Architects) on behalf of Camden Land Partnership Ltd (the Client) in November 2016 to undertake ground investigation and assessment works in relation to the proposed development at Rochester Square Spiritualist Temple, Rochester Square, London NW1 9RY (the Site).

PROJECT AND SITE DETAILS

Site Address	Rochester Square Spiritualist Temple, Rochester Square, London NW1 9RY (the Site). A Site Location Plan is provided as **Figure 1**.
Proposed Development	The site currently comprises a former temple that is occupied by live in security. The main entrance is via gate located on the southern side of Rochester Square with the rear garden accessed from a gate on the northern side of Rochester Square. Information provided by the Architects and Symmetrys Ltd (Consultant Engineers) indicates that the proposed development involves demolition of the existing structure and construction of a new mixed use four storey structure that will include a single storey basement. Based on the information provided, the following assumptions have been made: • The development will comprise demolition of the existing building and construction of commercial space and residential flats; • The basement will comprise a single storey structure; • The basement will occupy most the footprint of the development (326m^2 of 426m^2); and • The basement will be utilised for office space (front) and residential units (rear).
Background	The scope of works and requirements of this report were based on the information provided by Symmetrys (Consultant Engineers) within the following documents: • Specification for Geotechnical Site Investigation for 110 Rochester Square, London NW1 (ref. 2016061, 3rd November 2016); & • Borehole Location Plan (ref. SI01).

INTRODUCTION

AIMS & OBJECTIVES

This report aims to provide information sufficient to meet the requirements of the specification provided by the Consultant Engineers.

SCOPE OF WORKS

The following scope of works has been completed:

- Site set up including liaison with Consultant Engineers, Client and appointment of sub-contractors;
- Mobilisation to site and transport of the rig to the proposed location;
- Completion of 2No 'cut down' cable percussive boreholes to depths of 15.00m bgl (or refusal) with insitu SPTs and collection of disturbed and undisturbed samples for laboratory testing;
- Supervision and geological logging of the soil arisings in accordance with BS5930 by an appropriately experienced geo-environmental engineer;
- Installation of two monitoring wells to depths of 4.0m and 8.0m below ground level and return monitoring of groundwater levels on 1no. occasion;
- Geotechnical laboratory testing of the soil samples for an appropriate suite of determinands (including pH, sulphate, atterberg limits, and moisture content);
- Chemical analysis of 1no. sample of Made Ground, including Waste Acceptance Criteria (WAC);
- Completion of a factual and interpretive report that includes;
    - Details of the ground and groundwater conditions encountered;
    - Presentation of chemical analytical results;
    - Geotechnical laboratory testing and provision of advice on the material properties of the shallow soil horizon including parameters to aid in retaining wall design and foundation options; &
    - Conclusions and recommendations.

LIMITATIONS

LMB has prepared this report solely for the use of the named Client and those parties with whom a warranty agreement and/or assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from LMB and the Client.

LMB accepts no responsibility or liability for:

a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and

b) issue of this document to any third party with whom an agreement has not been executed.

The risk assessment and opinions provided, among other things, take in to consideration currently available guidance and best available techniques relating to acceptable contamination concentrations and

interpretation of these values. No liability can be accepted for the retrospective effects of any future changes or amendments to these value.

Ground Investigation & Findings

INTRODUCTION

The ground investigation works were undertaken between 21st and 22nd November 2016 and comprised the progression of two 'cut down' cable percussive boreholes to 15.0m bgl with sampling of soil for laboratory testing (see **Figure 2**).

Groundwater monitoring was undertaken following completion of the fieldworks on 30th November 2016.

Details of the ground investigation completed, along with the findings of the investigation, are provided in the following sections. The exploratory hole logs and laboratory results are presented in **Appendix A, B** and **C** respectively.

Guidance Documents

Details of the best practice guidance documents and reference information used in undertaking the ground investigation and assessment are provided at the end of this report (see REFERENCES & GUIDANCE).

INVESTIGATION STRATEGY

The ground investigation was designed based on the requirements of the Consultant Engineers set out in the Specification for Geotechnical Site Investigation for 110 Rochester Square, London NW1 (ref. 2016061, 3rd November 2016).

Soil Chemical Analysis & Laboratory Testing

Soil samples were submitted to the UKAS and MCERTS accredited laboratories of i2 Analytical for chemical analysis and geotechnical testing.

The results of the geotechnical and chemical analysis (including waste acceptance criteria testing) are presented in **Appendix B** and **C** respectively.

GROUND & GROUNDWATER CONDITIONS

Ground Conditions

The table below provides a summary of ground conditions encountered with full descriptions provided in the associated exploratory hole logs provided in **Appendix A**:

GROUND INVESTIGATION & FINDINGS

Strata	Depth Range to Top (m bgl)	Depth Range to (Base (m bgl)	Summary Description
Made Ground	Ground Level	0.50 – 0.80	In BH1 (frontage) the ground surface was found to comprise concrete. The Made Ground soils were generally found to comprise an upper layer (0.15m) of slightly sandy clay with rootlets over clay with brick gravel. In BH1 the base of the Made Ground included broken tile and brick.
Head Deposits	0.50 – 0.80	3.65 – 3.75	Soils interpreted as Head Deposits were found to comprise an upper horizon (approx. 1m) of soft becoming firm clay overlying gravelly clay.
London Clay Formation	3.65 – 3.75	15.00(1)	The London Clay was found to comprise firm becoming stiff very closely fissured clay.

(1) Base of the London Clay was not determined.

Visual and Olfactory Observations

No visual or olfactory evidence of contamination was observed during the ground investigation works. However, Made Ground soils were encountered in all exploratory hole locations and can be indicative of the presence of contaminants.

Groundwater Conditions

Groundwater strikes were recorded during the ground investigation works within BH1 (0.70m and 7.0m). In BH2 no groundwater strikes were observed during drilling, but groundwater was recorded the following morning within the open hole (3.40m).

Return Monitoring

Groundwater and ground gas levels were monitored on Wednesday 30th November 2016 and the results are summarised in the table below:

Location	Strata	Groundwater Depth (m bgl)	VOC (ppm)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	Flow Rate (l/hr)	Gas Screening Value (l/hr)
BH1	London Clay	6.58	0.7	0.10	1.40	18.2	0.2	0.0028
BH2	Head Deposits	1.64	-	-	-	-	-	-

GROUND INVESTIGATION & FINDINGS

Characteristic Values of Soil Parameters

A summary of the geotechnical properties of the strata based on the field and laboratory testing is provided in the table below.

Soil Property	**Stratum**		
	Made Ground	Head Deposits	London Clay
SPT 'N' Value	-	10 -25	18 – 26
Undrained Shear Strength (kN/m^2)	-	-	51 – 82
Bulk Density (mg/m^3)	1.70(1)	1.80(1)	1.96 – 2.03
Moisture Content (%)	15 – 20	12	19 – 29
Plasticity Index (%)	-	-	44
pH	7.2	8.4	8.3
Sulphate (g/l)	0.018	0.065	0.55

(1) Value based on BS8002

A plot of SPT 'N' value against depth is provided in **Appendix D.**

The plot indicates that there is a fairly uniform correlation between depth and relative density (SPT N Value).

Geotechnical Advice

INTRODUCTION

The temple currently comprises a main building of approximately three storey height with a rear single storey height extension. It is understood that the proposed development will comprise demolition of the existing structure and construction of a new mixed use four storey structure that will include a single storey basement.

On this basis, it the following assumptions have been made:

- The finished floor level of the basement will be -2.80m.
- The load from the existing structure will be in the region of 10-15kN/m^2 (rear extension) to 30-40KN/m^2 (main building).
- For the existing structure (including the roof) the wall load is estimated at approximately 60-80kN/m run.
- The new development will comprise a four-storey structure that will include a single storey basement. Assuming a weight from the new development of 12.5kN/m^2 / per storey (Tomlison, MJ 2001) that will equate to approximately 62.5kN/m^2.
- There will be no significant changes in elevation over the proposed basement development.
- Foundations will not be eccentrically loaded.

GROUND CONDITIONS SUMMARY AND ENGINEERING PARAMETERS

The ground conditions encountered in the exploratory holes comprise Made Ground overlying firm clay and gravelly clay (interpreted as Head Deposits), which rest on the firm becoming stiff London Clay.

Groundwater associated with the Head Deposits was recorded at a depth of approximately 1.64m bgl during monitoring. The groundwater is considered to form a thin but laterally continuous aquifer unit within the Head Deposits.

FOUNDATION DESIGN

Non-piled Foundations

Based on the information supplied, the finished floor level is at 2.80m bgl and it has been estimated that this would equate to a formation level of approximately 3.30m bgl. However, the presence of shallow groundwater within the Head Deposits is likely to preclude formation of foundations at this depth.

As such it has been assumed that formation level for foundations will be extended through the Head Deposits to the top of the underlying London Clay Formation at a depth of c.4.50m bgl.

GEOTECHNICAL ADVICE

Based on the findings of the ground investigation and the subsequent laboratory testing it has been concluded that for a traditional spread or raft foundations placed within the London Clay at the assumed formation level (4.50m bgl) a net safe bearing pressure of 140kN/m^2 should be available. The bearing pressure is based on a factor of safety of 3 to ensure that settlement remains within normally acceptable limits.

Foundations should be placed on the firm to stiff cohesive London Clay deposits present at the site and it is recommended that the undrained shear strength of soils at formation level be confirmed using a hand shear vane and should exceed 60kN/m^2.

The above advice assumes that the proposed basement development and in particular foundations would not be within the influence of any trees or tree routes.

Piled Foundations

Based on the proposed basement development and the ground conditions encountered it is possible that a piled foundation would be an economic and feasible solution.

At present, there is no information regarding the actual loads for the proposed building and at this stage the assessment of the likely pile capacities has been undertaken purely as an illustration of the feasibility of a piled solution and possible pile capacities.

A factor of safety (FOS) of 2.5 has been adopted in the following preliminary pile design. A lower FOS may be adopted but this will require preliminary and working pile tests and the approval of the local District Surveyor.

Based on the ground investigation data the following preliminary pile design is provided and should be confirmed and/or amended by a competent piling contractor.

Founding Depth (m)	Pile Diameter (mm)	Safe Working Load (kN)	Founding Stratum
10	450	263	Stiff London Clay Formation.
	600	371	

The actual pile design will depend on a number of factors including the particular details of the piling system to be adopted. The advice of a specialist piling contractor should be sought such that the final design of the piles can be undertaken and the suitability of the particular piling system can be considered. All information relating to the site should be provided to the piling contractor. The piling contractor should review all information available for the site and confirm that the information is adequate to complete the design of the piles or undertake further investigation as required.

The specialist piling contractor should consider noise and vibration and confirm the technique proposed is acceptable for the site and any impact on adjacent structures.

In addition, it is likely that due to the presence of groundwater, the retaining wall will need to be formed by the use of sheet piling or a secant pile wall and this is discussed in the further sections.

GROUND STABILITY & RETAINING STRUCTURES

The boreholes remained stable during the investigation but in BH2 there was some collapse following removal of casing and walls constructed in open cut are unlikely to be feasible for this situation. The instability is believed to be related to groundwater ingress from the Head Deposits.

The groundwater is considered to form a thin but laterally continuous aquifer unit within the Head Deposits and sustained inflows would be anticipated into any open excavations taken through the aquifer unit. This is supported by anecdotal information from site personnel at the adjacent site

To prevent inflow of groundwater and to enable construction of the basement and retaining wall it is recommended that consideration is given to the following:

- Use of temporary or permanent sheet piles that would be carried through the Head Deposits and 'keyed' into the firm to stiff London Clay below formation level.
- Use of a secant piles for formation of the basement retaining wall that would be carried through the Head Deposits and 'keyed' into the firm to stiff London Clay below formation level.

A discussion of potential heave, settlement and inward yielding is provided in the next section, however it is likely that any excavations will need to be trimmed back following heave of clay at formation level.

In addition, zones loosened by the removal of existing and relict construction may be particularly unpredictable and liable to collapse.

It would be beneficial to install the basement retaining wall and floor slab sequentially to provide propping and/or lateral restraint, which could help to minimise deflections.

Safe working conditions should be ensured where persons are required to work in excavations. It is recommended that reference be made to CIRIA Report No. 97,"Trenching Practice" 1992.

The parameters presented in the table below may be considered within the design of retaining walls.

Strata	Depth Range (m bgl)		Effective Angle of Shear Resistance (2)	Coefficient of Active Earth Pressure (Ka) (2)	Coefficient of Earth Pressure at rest (Kr) (3)	Coefficient of Passive Earth Resistance (Kp) (2)	Bulk Density
	Top	Base					
Made Ground	Ground Level	0.50 – 0.80	28	0.35	0.75	3.5	1.70(1)
Head Deposits	0.50 – 0.80	3.65 – 3.75	30	0.30	0.75	4.0	1.80(1)
London Clay Formation	3.65 – 3.75	15.00	22	0.40	1.0	2.5	1.96 – 2.03

(1) Assumed value based on literature information.

(2) Based on soil properties and reference to BS8002 & Tomlinson, M.J. (1986) for a free standing wall.
(3) Based on soil properties and reference to BS8002 & Tomlinson, M.J. (1986) for an embedded wall.

BURIED CONCRETE

In accordance with BRE Special Digest 1 (2005), the results indicate that the following design sulphate classes and Aggressive Chemical Environment for Concrete (ACEC) classes would apply:

Strata	Design Sulphate Class	ACEC Class
Made Ground	DS-1	AC-1s
Head Deposits	DS-1	AC-1s
London Clay Formation	DS-2	AC-2

ADDITIONAL CONSIDERATIONS

Existing Structures

It is recommended that any existing buried construction that will underlie the new development is broken out and removed. However, if buried construction (such as existing foundations) are to remain close to the new structure then care should be taken to avoid interaction i.e. to prevent the slab 'breaking its back' over the existing construction.

Potential for Heave, Settlement & Inward Yielding

Although the laboratory testing on the Head Deposits suggests that it is not high plasticity, the London Clay near assumed formation level is known to have high plasticity indices with a high volume change potential.

The removal of the overburden during the excavation of the basement is likely to result in heave and inward yielding of the London Clay soils at formation level and possibly a subsequent settlement of the soils outside the excavation. Based on the ground investigation data, the London Clay at formation level is anticipated to comprise firm to stiff clay and so the potential effects maybe limited by their relatively low compressibility (as compared to soft clay soils). Inward yielding in firm to stiff clays is typically in the range of 5-40mm (Tomlinson, M.J. (1986).

The total uplift will be a function of the soil heave pressure and water pressure, it is anticipated that almost half of this will be immediate upon excavation, while the remainder would be long term. The estimated depth of excavation is between 3.50m and 4.50m below current ground level, assuming an unsaturated unit weight of 20kN/m^3 and accounting for groundwater within the Head Deposits, the estimated unload due to the excavation would be in the order of 60kN/m^2 to 80kN/m^2

GEOTECHNICAL ADVICE

It is anticipated that following excavation and construction of the basement, the load imposed by the new sub-structure will be less than the overburden pressure at formation prior to excavation.

However, it is anticipated the basement slab would not be loaded if strip footings are adopted. In this case a suspended basement floor slab would be appropriate, constructed with suitable compressible void formers that can accommodate the expected ground heave.

As outlined, the basement is estimated to extend beneath the majority of the footprint of the site but there will be areas outside the basement. As such, there will be a difference in load at formation level between the area inside and outside the basement, which could result in differential heave over the long term.

This means there is the potential for longer term heave of the London Clay soils at formation level following basement construction.

Groundwater

As outlined, groundwater was encountered during the ground investigation works and recorded in the Head Deposits at approximately 1.64m bgl during monitoring.

The groundwater is considered to form a laterally continuous aquifer unit that is possibly confined and it is considered prudent to adopt a conservative approach in relation to the basement design and account for groundwater at a depth of approximately 1.00m bgl.

Based on the information presented above it is recommended that the basement design takes into account the following:

- The potential for short term and long term heave and inward yielding during construction and following construction.
- The potential for differential heave that will occur in the areas of the basement and areas where the basement doesn't extend.
- The potential for groundwater to cause both lateral and uplift pressure.
- The potential for groundwater ingress into the basement following construction.

Management of Formation Level

Should pockets of inferior material be present during the inspection of the foundation excavation, they should be removed and replaced with well graded, well compacted 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. Any surface or perched water should not be allowed to collect in the base of excavations since the clay is prone to rapid deterioration in the presence of water, with loss of their favourable bearing properties.

GEOTECHNICAL ADVICE

Groundwater Management

It is presumed that the retaining wall would be constructed to act as a 'cut-off' to groundwater ingress. However, some dewatering should be anticipated during the construction of the basement and foundations. Assuming the retaining wall is installed prior to excavation then inflow of groundwater is likely to be dealt with by pumping from sumps. Should this not be the case then a larger dewatering system is likely to be required.

Potential Project Risk

It should be noted that the excavation of the basement may undermine the adjacent property and could lead to settlement in gardens and damage to buildings and below ground services. It is recommended that the principle contractor should allow for suitable mitigation measures that may include:

- A survey of existing ground levels and buildings;
- A survey of existing below ground services,
- Monitoring of adjacent buildings during construction
- Monitoring of adjacent ground levels during construction.
- Careful construction planning to deal with the above potential issues and potential groundwater ingress during construction.

REFERENCES & GUIDANCE

1. Environment Agency/Defra (2002). Model procedures for the Management of Land Contamination (CLR 11)
2. Environment Agency/Defra.. Contaminated Land Statutory Guidance (April 2012)
3. BS 10175 (2011) Investigation of Potentially Contaminated Sites. Code of Practice.
4. BS5930 (2007) Code of Practice for Site Investigations.
5. BS 5667-11:2009. Water quality sampling. Part 11: Guidance on sampling of groundwaters.
6. BS 8002 (1994) Code of Practice for Earth Retaining Structures
7. Tomlinson, M.J. (1986) Foundation Design and Construction.
8. Department of the Environment Industry Profiles.
9. Environment Agency/Defra (2002). Sampling strategies for contaminated land (CLR4)1
10. Environment Agency/Defra (2002). Priority Contaminants for the Assessment of Land (CLR8)2
11. CIRIA (2007). Assessing risks posed by hazardous ground gases to buildings
12. BS 8485:2007. Code of Practice for the Characterisation and Remediation from Ground Gas in affected Development.
13. NHBC (2007). Guidance on the Evaluation of Development proposals on sites where Methane and Carbon dioxide are present.
14. CL:AIRE (December 2013). Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination.
15. CL:AIRE / CIEH (2008), Guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008;
16. CL:AIRE / EIC (2009), The Soil Generic Assessment Criteria for Human Health, December 2009.
17. Environment Agency (2003), Review of fate & transport of selected contaminants in the Environment, Report P5-079-TR1;
18. Environment Agency (2004), Model Procedures for the Management of Land Contamination, September 2004, ISBN: 1844322955;
19. Environment Agency (2008a), Compilation of Data for Priority Organic Pollutants, Report SC050021/SR7, November 2008;
20. Environment Agency (2009a), Human Health Toxicological Assessment of Contaminants in Soil, Report SC050021/SR2, January 2009;
21. Environment Agency (2009b), CLEA Software (Version 1.04) Handbook (and Software), Report SC050021/SR4, January 2009;
22. Environment Agency (2009c), Updated Technical Background to the CLEA Model, Report SC050021/SR3, January 2009;

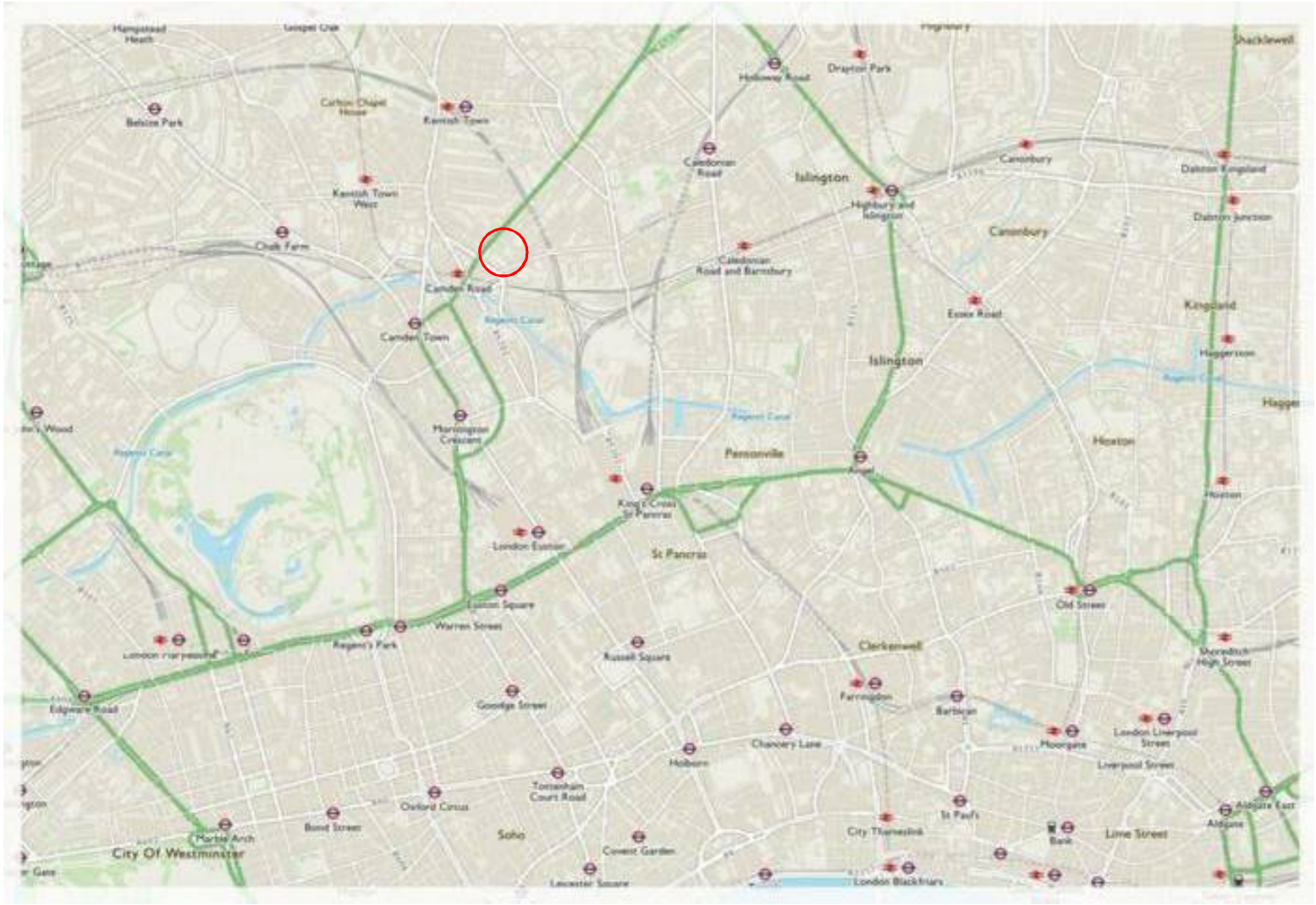
[1] This document has been withdrawn but is considered to remain useful in proving technical background for designing ground investigation works.

[2] This document has been withdrawn but is considered to remain useful in proving technical background for designing ground investigation works.

REFERENCES & GUIDANCE

23. Environment Agency (2009d), A Review of Body Weight and Height Data Used in the CLEA Model, Report SC050021/Final Technical Review 1, January 2009;
24. Nathanial et. al., (2009), The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition), Land Quality Press, Nottingham, ISBN 0-9547474-7-X
25. USEPA (2004), User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings
26. Environment Agency (2013). Groundwater Protection: Principles and Practice (GP3)
27. Water Framework Directive (2000/60/EC)
28. Groundwater Regulations (2009).
29. Drinking Water Quality Standards England & Wales 2000 (Amended 2004, DWS).
30. World Health Organisation (WHO) Petroleum Products in Drinking Water.
31. Environmental Quality Standards (EQS). The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010.
32. Environment Agency (2006). Remedial Targets Methodology. Hydrogeological Risk Assessment for Land Contamination.
33. Environment Agency (2013). Technical Guidance WM2 (v3). Interpretation of the definition and classification of hazardous waste.

FIGURES



N

Key:

Approximate site location

IMPORTANT – Please Read

This drawing is for illustrative purposes only and is for use only in conjunction with associated reports relating to the project details below. LMB accepts no liability for the mis-interpretation or use of this illustration by any other parties.

LMB

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

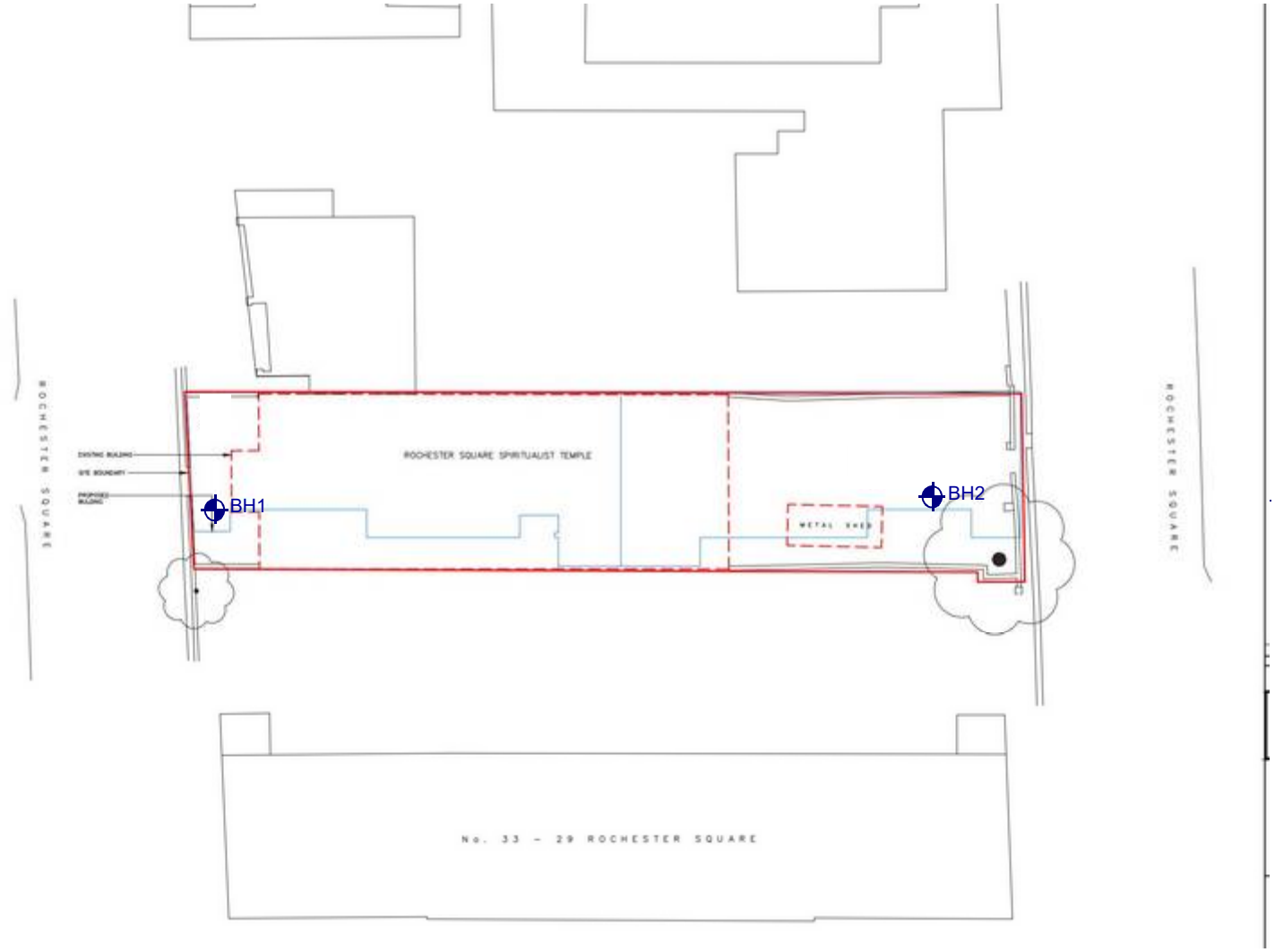
Site: Rochester Square, London NW1

Figure Number: Figure 1

Title: Site Location Plan

Project No:	Created By:	Date:
	PIL	Nov 2016

Client: Camden Land Partnership Ltd



Key:

BH Cable Percussive Borehole location

IMPORTANT – Please Read

This drawing is for illustrative purposes only and is for use only in conjunction with associated reports relating to the project details below. LMB accepts no liability for the mis-interpretation or use of this illustration by any other parties.

LMB

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Site: Rochester Square London NW1

Figure Number: Figure 2

Title: Exploratory Hole Location Plan

Project No:	Created By:	Date:
	PIL	Nov 2016

Client: Camden Land Partnership Ltd

APPENDICES

Appendices

APPENDIX A EXPLORATORY HOLE LOGS

Borehole Log

Borehole No. **BH1**

Sheet 1 of 2

Project Name: Rochester Square	Project No. LMB_Rochester	Co-ords: -	Hole Type CP
Location: Rochester Square, London NW1		Level:	Scale 1:50
Client: Camden Land Partnerships Ltd		Dates: 22/11/2016 - 22/11/2016	Logged By PIL

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05			Concrete.
		0.50	ES					MADE GROUND: dark brown slightly sandy slightly gravelly clay. Gravel sub-angular fine to medium brick and occasional gravel.
					0.80			*broken tile and brick.*
		1.20	B					Soft becoming firm brown to light brown CLAY. (HEAD DEPOSITS).
		1.20		N=10 (1,1/2,2,3,3)				
					1.75			Firm brown to light brown gravelly CLAY. Gravel sub-angular to rounded fine to coarse flint. (HEAD DEPOSITS).
		2.00	D					
		2.00		N=25 (4,5/5,6,7,7)				
		3.00	B					
		3.00		N=21 (6,5/6,6,4,5)				
					3.65			Firm becoming stiff brown with occasional blue/ grey veining CLAY. Closely fissured. (LONDON CLAY FORMATION).
		4.00	U					*becomes stiff.*
		5.00	D					
		5.00		N=18 (2,2/3,4,5,6)				
								occasional rare orange/brown silty partings.
		6.50	U					
		8.00	D					
		8.00		N=18 (3,4/4,4,5,5)				
					8.75			Stiff becoming very stiff dark grey/brown CLAY with rare fine white shell gravel. Very closely fissured. (LONDON CLAY FORMATION).
		9.50	U					
								Continued on next sheet

Remarks

water level at 7m after pulling casing. likely to be reflective of water from head deposits.

Borehole Log

Borehole No. **BH1**

Sheet 2 of 2

Project Name: Rochester Square	Project No. LMB_Rochester	Co-ords: -	Hole Type CP
Location: Rochester Square, London NW1		Level:	Scale 1:50
Client: Camden Land Partnerships Ltd		Dates: 22/11/2016 - 22/11/2016	Logged By PIL

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		11.00 11.00	D	N=21 (3,4/5,5,5,6)				
		12.50	U					
		14.55 14.55	D	N=26 (3,4/5,6,7,8)				
					15.00			End of borehole at 15.00 m

Remarks

water level at 7m after pulling casing. likely to be reflective of water from head deposits.

Borehole Log

Borehole No. **BH2**

Sheet 1 of 2

Project Name: Rochester Square	Project No. LMB_Rochester	Co-ords: -	Hole Type CP
Location: Rochester Square, London NW1		Level:	Scale 1:50
Client: Camden Land Partnerships Ltd		Dates: 21/11/2016 - 21/11/2016	Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15			MADE GROUND: dark brown slightly sandy clay with numerous rootlets and occasional brick gravel.
		0.30	ES					
		0.50	B		0.50			MADE GROUND: brown to light brown clay with rare angular fine to medium brick gravel.
								Soft becoming firm light brown to brown CLAY. (HEAD DEPOSITS).
		1.20	D					
	▼	1.20		N=14 (1,2/2,3,3,6)				
					1.50			Firm brown to orange/brown with occasional grey mottling very gravelly CLAY. Gravel sub-angular to rounded fine to coarse flint. (HEAD DEPOSITS).
		2.00	B					
		2.00		N=18 (3,5/3,5,4,6)				
								becomes less gravelly.
		3.00	D					
		3.00		N=19 (7,5/5,4,4,6)				
					3.75			Firm becoming stiff brown with occasional orange/brown sandy partings CLAY. Some close fissuring visible. (LONDON CLAY FORMATION).
		4.00	U					
		5.00	D					
		5.00		N=17 (2,3/3,4,4,6)				*becomes very closely fissured and stiff.*
		6.50	U					
		8.00	D					
		8.00		N=18 (2,3/4,4,5,5)				
		9.50	U		9.50			Stiff becoming very stiff dark grey CLAY. Very closely fissured. (LONDON CLAY FORMATION).
								Continued on next sheet

Remarks

water level at 1.40m in open hole overnight.

Borehole Log

Borehole No. **BH2**

Sheet 2 of 2

Project Name: Rochester Square	Project No. LMB_Rochester	Co-ords: -	Hole Type CP
Location: Rochester Square, London NW1		Level:	Scale 1:50
Client: Camden Land Partnerships Ltd		Dates: 21/11/2016 - 21/11/2016	Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		11.00 11.00	D	N=22 (3,4/4,5,6,7)				
		12.50	U					
		14.55 14.55	D	N=28 (3,4/6,6,7,9)				
					15.00			End of borehole at 15.00 m

11 12 13 14 15 16 17 18 19 20

Remarks
water level at 1.40m in open hole overnight.

APPENDICES

APPENDIX B GEOTECHNICAL LABORATORY RESULTS

TEST CERTIFICATE

Determination of Moisture Content

Tested in Accordance with BS 1377-2:1990: Clause 3.2

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Client:	LMB Geosolutions Ltd	Client Reference:	16-33913
Client Address:	28 Dresden Road London N19 3BD	Job Number:	16-33913
		Date Sampled:	Not Given
		Date Received:	22/11/2016
Contact:	Philip Lewis	Date Tested:	01/12/2016
Site Name:	Rochester Square	Sampled By:	PIL
Site Address:	Not Given		

Test results

Laboratory Reference	Sample Reference	Location	Depth Top [m]	Depth Base [m]	Sample Type	Description	Moisture Content [%]
664320	Not Given	BH1	2	Not Given	D	Yellowish brown gravelly clayey SAND	12
664322	Not Given	BH1	5	Not Given	D	Brown CLAY	29

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Date Reported: 05/12/2016

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

4041

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client:	LMB Geosolutions Ltd	Client Reference:	16-33913
Client Address:	28 Dresden Road London N19 3BD	Job Number:	16-33913
		Date Sampled:	Not Given
		Date Received:	22/11/2016
Contact:	Philip Lewis	Date Tested:	01/12/2016
Site Name:	Rochester Square	Sampled By:	PIL
Site Address:	Not Given		

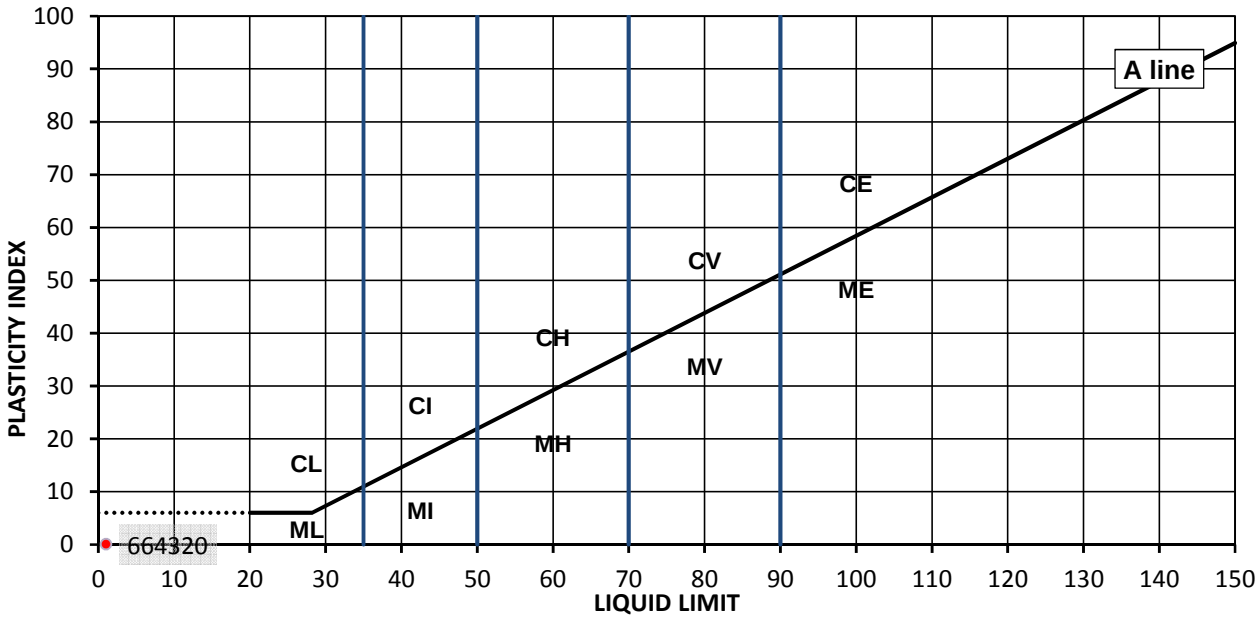
TEST RESULTS

Laboratory Reference: 664320
Sample Reference: Not Given

Description: Yellowish brown gravelly clayey SAND
Location: BH1
Sample Preparation: N/A

Sample Type: D
Depth Top [m]: 2
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
12	N/A	NP	N/A	N/A



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks: Sample unsuitable for the Atterberg test

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 05/12/2016

for and on behalf of i2 Analytical Ltd

GF 105.10

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

4041

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

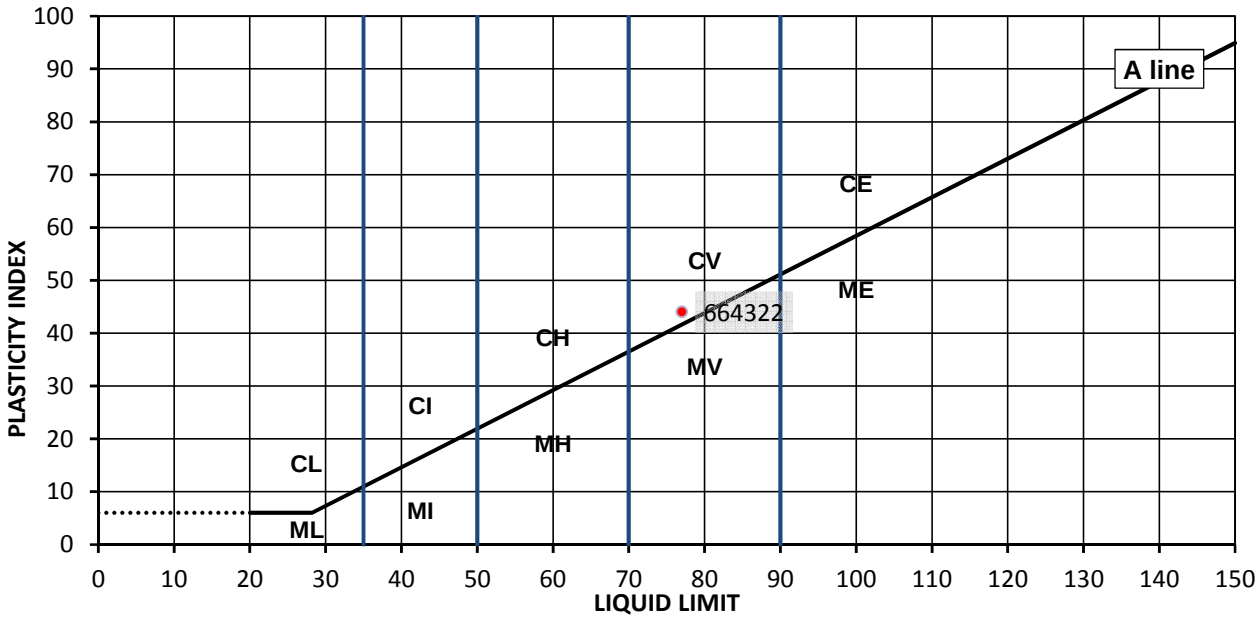
Client:	LMB Geosolutions Ltd	Client Reference:	16-33913
Client Address:	28 Dresden Road London N19 3BD	Job Number:	16-33913
		Date Sampled:	Not Given
		Date Received:	22/11/2016
Contact:	Philip Lewis	Date Tested:	01/12/2016
Site Name:	Rochester Square	Sampled By:	PIL
Site Address:	Not Given		

TEST RESULTS

Laboratory Reference: 664322
Sample Reference: Not Given

Description:	Brown CLAY	Sample Type:	D
Location:	BH1	Depth Top [m]:	5
Sample Preparation:	Tested in natural condition	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
29	77	33	44	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 05/12/2016

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Summary of Classification Test Results

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Client: LMB Geosolutions Ltd
Client Address: 28 Dresden Road
London
N19 3BD

Contact: Philip Lewis
Site Name: Rochester Square
Site Address: Not Given

Client Reference: 16-33913
Job Number: 16-33913
Date Sampled: Not Given
Date Received: 22/11/2016
Date Tested: 01/12/2016
Sampled By: PIL

Test results

Laboratory Reference	Hole No.	Sample				Soil Description	Density		M/C	Attenberg				PD
		Reference	Top depth [m]	Base depth [m]	Type		bulk Mg/m3	dry Mg/m3	%	% Passing 425um %	LL %	PL %	PI %	Mg/m3
664320	BH1	Not Given	2.00	Not Given	D	Yellowish brown gravelly clayey SAND	-	-	12	N/A	NP	N/A	N/A*	-
664322	BH1	Not Given	5.00	Not Given	D	Brown CLAY	-	-	29	100	77	33	44	-

Comments: * Sample unsuitable for the Atterberg test

Approved:

Mirosława Pytlik
PL Head of Geotechnical Section

Signed:

Sushil Sharda
Technical Manager (Geotechnical Division)

Date Reported: 05/12/2016

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Particle Size Distribution

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

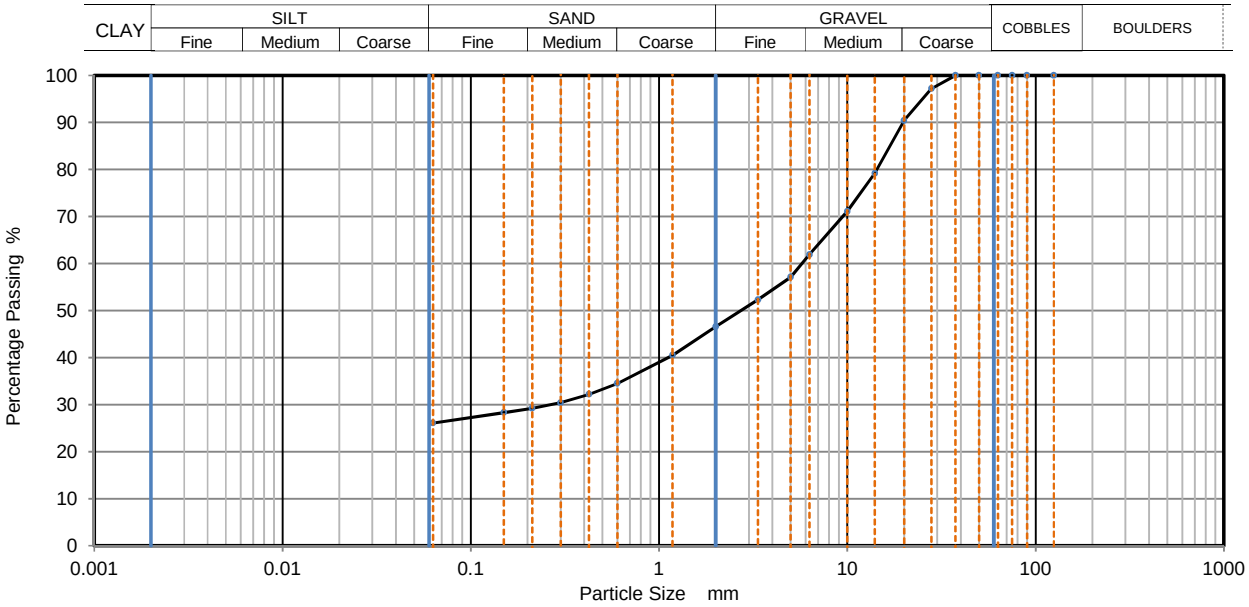
4041

Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Client:	LMB Geosolutions Ltd	Client Reference:	16-33913
Client Address:	28 Dresden Road London N19 3BD	Job Number:	16-33913
		Date Sampled:	Not Given
		Date Received:	22/11/2016
Contact:	Philip Lewis	Date Tested:	07/11/3718
Site Name:	Rochester Square	Sampled By:	PIL
Site Address:	Not Given		

TEST RESULTS Laboratory Reference: 664323 Sample Reference: Not Given

Sample description:	Yellowish brown slightly sandy gravelly CLAY	Sample Type:	B
Location:	BH2	Depth Top [m]:	2
Supplier:	Not Given	Depth Base [m]:	Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	90		
14	79		
10	71		
6.3	62		
5	57		
3.35	52		
2	47		
1.18	41		
0.6	35		
0.425	32		
0.3	30		
0.212	29		
0.15	28		
0.063	26		

Dry Mass of sample [g]: 2442

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	53.40
Sand	20.50
Fines <0.063mm	26.10

Grading Analysis		
D100	mm	37.5
D60	mm	5.75
D30	mm	0.266
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 05/12/2016

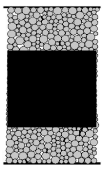
for and on behalf of i2 Analytical Ltd

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details



sketch showing specimen location in original sample

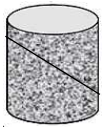
Depth	4.00		
Description	Yellowish brown CLAY with thin laminae of grey clay		
Type	U		
Initial Sample Length	L_0	(mm)	199.0
Initial Sample Diameter	D_0	(mm)	98.2
Initial Sample Weight	W_0	(gr)	2994.1
Bulk Density	ρ_0	(Mg/m3)	1.99
Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

Initial Cell Pressure	σ_3	(kPa)	80
Strain Rate	m_s	(mm/min)	3.98020
MembraneThickness	m_b	(mm)	0.27
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	31
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.51
Initial Voids Ratio	e_0	.	0.75
Initial Degree of Saturation	S_o	(%)	100

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	102
MembraneCorrection	m_c	(kPa)	0.337
Strain At Max Stress	$\varepsilon_f\%$	(%)	3.28
Shear Strength	c_u	(kPa)	51
Final Moisture	$\omega_f\%$	(%)	31
Final Dry Density	ρ_{df}	(Mg/m3)	1.51
Final Voids Ratio	e_f	.	0.75
Final Degree of Saturation	S_f	(%)	100.0



Failure Sketch

(surface inclination)

Notes

Triaxial at over burden

Test Method	BS1377-7 : 1990 Clause 8			Test Name	664321
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	01/12/2016
Site Reference	Rochester Square			Borehole	BH1
Jobfile	16-33913			Sample	664321
Client	LMB Geosolutions Ltd			Depth	4.00
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

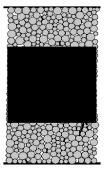
i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details				
 *sketch showing specimen location in original sample*	Depth	4.00		
	Description	Yellowish brown CLAY with thin laminae of grey clay		
	Type	U		
	Initial Sample Length	L_0	(mm)	198.6
	Initial Sample Diameter	D_0	(mm)	98.8
	Initial Sample Weight	W_0	(gr)	2979.4
	Bulk Density	ρ_0	(Mg/m3)	1.96
	Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

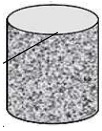
Initial Cell Pressure	σ_3	(kPa)	80
Strain Rate	m_S	(mm/min)	3.97220
MembraneThickness	m_b	(mm)	0.28
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	32
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.48
Initial Voids Ratio	e_0	.	0.79
Initial Degree of Saturation	S_o	(%)	100

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	161
MembraneCorrection	m_C	(kPa)	0.893
Strain At Max Stress	$\varepsilon_f\%$	(%)	11.36
Shear Strength	c_U	(kPa)	81
Final Moisture	$\omega_f\%$	(%)	32
Final Dry Density	ρ_{df}	(Mg/m3)	1.48
Final Voids Ratio	e_f	.	0.79
Final Degree of Saturation	S_f	(%)	100.0

Notes

Triaxial at over burden



Failure Sketch

(surface inclination)

Test Method	BS1377-7 : 1990 Clause 8			Test Name	664324
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	01/12/2016
Site Reference	Rochester Square			Borehole	BH2
Jobfile	16-33913			Sample	664324
Client	LMB Geosolutions Ltd			Depth	4.00
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

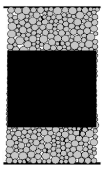
i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS
i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details



sketch showing specimen location in original sample

Depth	9.50		
Description	Brown CLAY		
Type	U		
Initial Sample Length	L_0	(mm)	196.6
Initial Sample Diameter	D_0	(mm)	97.9
Initial Sample Weight	W_0	(gr)	3010.2
Bulk Density	ρ_0	(Mg/m3)	2.03
Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

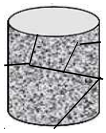
Initial Cell Pressure	σ_3	(kPa)	190
Strain Rate	m_S	(mm/min)	3.93260
MembraneThickness	m_b	(mm)	0.29
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	29
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.58
Initial Voids Ratio	e_0	.	0.68
Initial Degree of Saturation	S_o	(%)	100

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	164
MembraneCorrection	m_C	(kPa)	0.500
Strain At Max Stress	$\varepsilon_f\%$	(%)	5.28
Shear Strength	c_U	(kPa)	82
Final Moisture	$\omega_f\%$	(%)	29
Final Dry Density	ρ_{df}	(Mg/m3)	1.58
Final Voids Ratio	e_f	.	0.68
Final Degree of Saturation	S_f	(%)	100.0

Notes

Triaxial at over burden



Failure Sketch

(surface inclination)

Test Method	BS1377-7 : 1990 Clause 8			Test Name	664325
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	01/12/2016
Site Reference	Rochester Square			Borehole	BH2
Jobfile	16-33913			Sample	664325
Client	LMB Geosolutions Ltd			Depth	9.50
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

APPENDICES

APPENDIX C CHEMICAL LABORATORY TESTING RESULTS

Philip Lewis
LMB Geosolutions Ltd
28 Dresden Road
London
N19 3BD

e: philip@lmbgeosolutions.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 16-33916

Project / Site name:	Rochester Square	**Samples received on:**	22/11/2016
Your job number:		**Samples instructed on:**	23/11/2016
Your order number:		**Analysis completed by:**	02/12/2016
Report Issue Number:	1	**Report issued on:**	02/12/2016
Samples Analysed:	4 soil samples		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 16-33916

Project / Site name: Rochester Square

Lab Sample Number				664337	664338	664339	664340	
Sample Reference				BH1	BH1	BH2	BH2	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				5.00	0.50	0.30	2.00	
Date Sampled				Deviating	Deviating	Deviating	Deviating	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	19	15	20	12	
Total mass of sample received	kg	0.001	NONE	0.25	0.86	1.1	0.49	
Asbestos in Soil	Type	N/A	ISO 17025	-	Not-detected	Not-detected	-	
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.3	-	7.2	8.4	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.55	-	0.018	0.065	
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	
Acenaphthylene	mg/kg	0.1	MCERTS	-	-	< 0.10	-	
Acenaphthene	mg/kg	0.1	MCERTS	-	-	< 0.10	-	
Fluorene	mg/kg	0.1	MCERTS	-	-	< 0.10	-	
Phenanthrene	mg/kg	0.1	MCERTS	-	-	0.42	-	
Anthracene	mg/kg	0.1	MCERTS	-	-	< 0.10	-	
Fluoranthene	mg/kg	0.1	MCERTS	-	-	0.97	-	
Pyrene	mg/kg	0.1	MCERTS	-	-	0.86	-	
Benzo(a)anthracene	mg/kg	0.1	MCERTS	-	-	0.51	-	
Chrysene	mg/kg	0.05	MCERTS	-	-	0.53	-	
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	-	-	0.46	-	
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	-	-	0.25	-	
Benzo(a)pyrene	mg/kg	0.1	MCERTS	-	-	0.34	-	
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	-	-	< 0.10	-	
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	-	-	< 0.10	-	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	-	-	4.34	-	
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	28	13	-	
Boron (water soluble)	mg/kg	0.2	MCERTS	-	1.0	2.0	-	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	< 0.2	< 0.2	-	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	27	38	-	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	97	65	-	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	610	360	-	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	1.8	1.2	-	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	25	24	-	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	< 1.0	-	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	150	140	-	
Petroleum Hydrocarbons								
TPH C10 - C40	mg/kg	10	MCERTS	-	-	< 10	-	

Analytical Report Number : 16-33916

Project / Site name: Rochester Square

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
664337	BH1	None Supplied	5.00	Brown clay.
664338	BH1	None Supplied	0.50	Brown loam and clay with gravel and vegetation.
664339	BH2	None Supplied	0.30	Brown loam and clay with gravel and vegetation.
664340	BH2	None Supplied	2.00	Light brown sandy clay.

Analytical Report Number : 16-33916

Project / Site name: Rochester Square

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding.	L076-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH1		S	16-33916	664337	a			
BH1		S	16-33916	664338	a			
BH2		S	16-33916	664339	a			
BH2		S	16-33916	664340	a			

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

Philip Lewis
LMB Geosolutions Ltd
28 Dresden Road
London
N19 3BD

e: philip@lmbgeosolutions.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 16-33918

Project / Site name:	Rochester Square	**Samples received on:**	22/11/2016
Your job number:		**Samples instructed on:**	23/11/2016
Your order number:		**Analysis completed by:**	05/12/2016
Report Issue Number:	1	**Report issued on:**	05/12/2016
Samples Analysed:	1 10:1 WAC sample		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

i2 Analytical
7 Woodshots Meadow
Croxley Green Business Park
Watford, WD18 8YS

Telephone: 01923 225404
Fax: 01923 237404
email:reception@i2analytical.com

Waste Acceptance Criteria Analytical Results

Report No:	**16-33918**						
					Client:	**LMBGEOSOL**	
Location	**Rochester Square**						
Lab Reference (Sample Number)	664345 / 664346				**Landfill Waste Acceptance Criteria**		
					Limits		
Sampling Date	Deviating				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	BH1						
Depth (m)	0.50						
Solid Waste Analysis							
TOC (%)**	1.3				3%	5%	6%
Loss on Ignition (%) **	-				--	--	10%
BTEX (µg/kg) **	-				6000	--	--
Sum of PCBs (mg/kg) **	-				1	--	--
Mineral Oil (mg/kg)	-				500	--	--
Total PAH (WAC-17) (mg/kg)	-				100	--	--
pH (units)**	8.4				--	>6	--
Acid Neutralisation Capacity (mol / kg)	6.1				--	To be evaluated	To be evaluated
Eluate Analysis	10:1			10:01	Limit values for compliance leaching test		
(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	0.0203			0.146	0.5	2	25
Barium *	0.0321			0.230	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0054			0.039	0.5	10	70
Copper *	0.015			0.10	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0030			0.0218	0.5	10	30
Nickel *	0.0027			0.019	0.4	10	40
Lead *	0.036			0.26	0.5	10	50
Antimony *	0.0027			0.019	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.019			0.14	4	50	200
Chloride *	0.84			6.0	800	4000	25000
Fluoride	0.51			3.7	10	150	500
Sulphate *	3.2			23	1000	20000	50000
TDS	33			240	4000	60000	100000
Phenol Index (Monhydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	3.75			26.9	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	0.86						
Dry Matter (%)	85						
Moisture (%)	15						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and I2 cannot be held responsible for any discrepencies with current legislation

*= UKAS accredited (liquid eluate analysis only)
** = MCERTS accrediited

Analytical Report Number : 16-33918

Project / Site name: Rochester Square

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
664345	BH1	None Supplied	0.50	Brown loam and clay with gravel and vegetation.

Analytical Report Number : 16-33918

Project / Site name: Rochester Square

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance an Sampling and Testing of Wastes to Meet Landfill Waste Acceptance""	L046-UK	W	NONE
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033-PL	W	NONE
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by electrometric measurement.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-PL	W	NONE
Total organic carbon in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	MCERTS

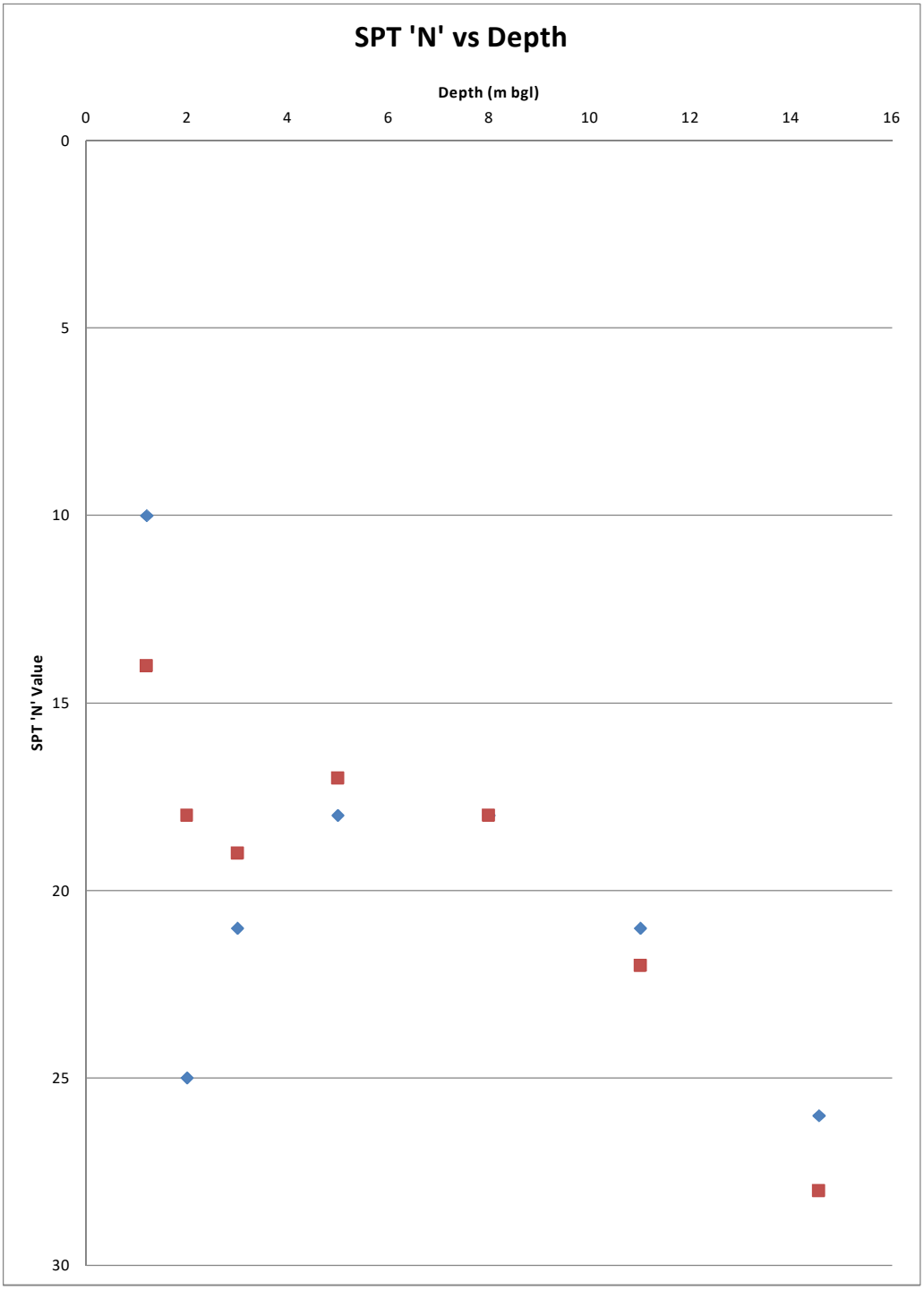
For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH1		L	16-33918	664346	a			
BH1		S	16-33918	664345	a			

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

APPENDICES

APPENDIX D PLOT OF SPT ‘N’ VLAUE VS DEPTH



LMB GEOSOLUTIONS LTD

SPT N DEPTH PLOT

Project: Rochester Square Spiritualist Temple
Client: Camden Land Partnership Ltd
Logged By: PIL

Depth	SPT N BH1	BH2		Geol
1.2		10	14	HD
2		25	18	HD
3		21	19	HD
5		18	17	LC
8		18	18	LC
11		21	22	LC
14.55		26	28	LC