INTRODUCTION

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AUTHORISATION

LMB Geosolutions Ltd (LMB) was instructed COWI UK Ltd (Consultant Engineers) on behalf of Royal London Mutual Insurance Society (the Client) in June 2018 to undertake ground investigation works to support the proposed development at Castlewood House & Medius House, 77-91 & 63-69 New Oxford Street, London WC1A 1DG (the Site).

PROJECT AND SITE DETAILS

Site Address	Castlewood House & Medius House, 77-91 & 63-69 New Oxford Street, London WC1A 1DG. A Site Location Plan is provided as **Figure 1**.
Site/Building Area	The site is currently occupied by Castlewood House and Medius House. Castlewood House currently comprises a T- shaped nine storey building with a two storey basement. The structure is bounded by a five storey building to the east (occupied by Tony & Guy), Earnshaw Street to the west side and by Bucknall Street to the south of the site. Castlewood House fronts onto New Oxford Street. Castlewood House also includes an external courtyard area at basement level contained within a retaining wall that bounds Bucknall Street to the south and Earnshaw Street to the west (see Photo 3). Medius House currently comprises a five storey building with a single storey basement that is accessed from New Oxford Street. The building is bounded by Tony & Guy to the west, Dyott Street to the east and to the south there are warehouse and office buildings. The site covers an area of approximately 0.30 hectares.
Proposed Development	The proposed development includes comprise demolition of Castlewood House and partial demolition of Medius House with construction of an eleven storey office building with retail / restaurant use at ground level and enlargement of the existing double basement. At Medius House a two storey roof extension with private roof terraces will be constructed with a change of use from office to residential, but with retail use retained at ground floor level.
Previous Reporting	LMB has produced the following reports in relation to the site and proposed development:

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	• LMB (ref. LMB.18.05.14_REPPIL_SIS_v1.1, dated May 2018). Site Investigation Scheme. Castlewood House & Medius House, 77-91 & 63-69 New Oxford Street, London WC1A 1DG. • LMB (ref. LMB.18.07.25_REPPIL_PRA_Castlewood&Medius_v1.1, dated July 2018). Preliminary Risk Assessment. Castlewood House & Medius House, 77-91 & 63-69 New Oxford Street, London WC1A 1DG.

SCOPE OF WORKS

The scope of works completed included the following:

- Site set up including liaison with Consultant Engineers, Client and appointment of sub-contractors;
- Mobilisation to site and transport of the rigs to the proposed location;
- Completion of a service avoidance survey at proposed exploratory hole locations;
- Completion of 4no. cable percussive borehole drilling to a maximum depth of 47.0m bgl with completion of insitu SPTS and collection of disturbed and undisturbed samples for laboratory testing;
- Completion of 11no. hand and machine excavated trial pits to a maximum depth of 1.95m bgl with collection of disturbed samples for laboratory testing;
- Field screening of soil samples (headspace) using a Photo-Ionisation Detector (PID);
- Supervision and geological logging of the soil arisings in general accordance with BS5930 by an appropriately experienced geo-environmental engineer;
- Installation of dual groundwater and ground gas monitoring wells in all boreholes and return monitoring of groundwater and ground gas levels on 3no. occasions;
- Geotechnical laboratory testing of soil samples (including atterberg limits, moisture content, triaxial testing and particle size distribution testing);
- Chemical laboratory testing of soil and groundwater samples for a range of determinands (including heavy metals, Petroleum Hydrocarbons Semi-Volatile Organic Compounds (SVOC, including Polycyclic Aromatic Hydrocarbons (PAH)), Volatile Organic Compounds (VOC) and asbestos screening).
- Completion of a factual report that will include;
  - A summary of the field works completed.
  - A summary of the ground and groundwater conditions encountered.
  - Geological logs in AGS format.
  - Presentation of geotechnical and chemical laboratory testing results.

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PUBLISHED GEOLOGY

Reference to the relevant British Geological Survey map for the area indicates that the site is located on the Lynch Hill Gravel Member (typically sand and gravel, locally clayey), which in turn overlies the London Clay Formation (typically silty clay) and Lambeth Group (typically mottled clay and silty clayey sand).

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 information provided, among other things, take in to consideration currently available guidance and best available techniques. No liability can be accepted for the retrospective effects of any future changes or amendments to best available techniques.

Ground Investigation

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The ground investigation works were undertaken between 18th June and 29th June 2018 and comprised the progression of 4no. cable percussive boreholes to depths of between 35.00m and 47.00m bgl, and completion of 11no. machine and/or hand excavated trial pits to depths of between 0.95m and 1.90m bgl, with insitu testing and sampling of soil for laboratory testing.

In addition, probe holes were drilled to help ascertain the potential presence of an historical vault. However, nothing indicative of a vault (e.g. void behind wall) was detected.

An exploratory hole location plan is provided as **Figure 2**.

Ground gas and groundwater monitoring was undertaken following completion of the fieldworks between 13th July and 1st August 2018.

Details of the ground investigation completed are provided in the following sections. A photographic record, 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 discussions between LMB and the Consultant Engineers. All works and exploratory holes were supervised and logged by an appropriately experienced geo-environmental engineer.

FIELDWORKS

Cable Percussive Boreholes

Four cable percussive boreholes were completed using standard and modular cable drilling rigs to depths of 35.00m and 47.00m bgl. Disturbed and/or bulk samples were generally collected at regular intervals.

Standard Penetration Tests (SPTs) were generally completed at alternate 1.0m intervals in the upper 5.0m and at alternating 1.50m intervals thereafter. Undisturbed samples were collected at approximately 1.50m alternate intervals in the London Clay Formation and cohesive Lambeth Group.

GROUND INVESTIGATION

Machine & Hand Excavated Trial Pits

Eleven machine and hand excavated trial pits were completed in external and internal areas of the existing buildings to a maximum depth of 1.90m bgl.

To reduce fumes, dust and general mess, the concrete surfacing of internal areas removed by the use of a concrete corer.

An exploratory hole location plan provide by the consultant engineers is presented as **Figure 2**.

In Situ Tests

Standard Penetration Tests (SPTs) were carried out in the cable percussion boreholes in accordance with BS EN ISO 22476-3.

Calibration certificates for the SPT hammers are provided in **Appendix E**.

LABORATORY TESTING

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

Laboratory test results are provided in **Appendix B** and **C.**

SUMMARY OF 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**:

Strata	Depth Range to Top (m bgl)	Depth Range to (Base (m bgl)
Ground surfacing	Ground level (GL)	0.06 – 0.32
Made Ground(1)	0.06 – 0.32	0.90 – 2.00
Lynch Hill Gravel Member	0.90 – 2.00	3.50 – 4.10
London Clay Formation (2)	3.50 – 4.10	23.00 – 24.70
Lambeth Group	23.00 – 24.70	Not Determined

(1) Not determined in all locations.

GROUND INVESTIGATION

Groundwater Observations

No groundwater strikes were recorded during the drilling works, however water was added to aid drilling and thus may have masked any strike.

During return monitoring groundwater was recorded in monitoring wells installed in the Lynch Hill Gravel Member at depths of between 3.11m and 3.95m bgl.

In monitoring wells installed in the London Clay Formation groundwater was recorded at depths of between 3.35m and 12.12m bgl and in monitoring wells installed in the Lambeth Group between 20.24m and 29.70m bgl.

Details are provided on the exploratory hole logs presented in **Appendix A** and the monitoring results presented in **Appendix D**.

MONITORING AND INSTRUMENTATION

All four cable percussive boreholes were completed with dual installation groundwater monitoring wells as summarised in the table below:

Exploratory Hole	Screened Lithology	Depth of Screened Section (m bgl)
BHDA-101 (shallow)	Made Ground & Lynch Hill Gravel Member	0.50 – 4.00
BHDA-101 (deep)	Lambeth Group	41.00 – 42.00
BHDA-102 (shallow)	Lynch Hill Gravel Member	1.00 – 4.10
BHDA-102 (deep)	London Clay Formation	19.00 – 20.00
BHDA-103 (shallow)	Made Ground & Lynch Hill Gravel Member	0.50 – 4.00
BHDA-103 (deep)	London Clay Formation	11.00 – 12.00
BHDA-104 (shallow)	Made Ground & Lynch Hill Gravel Member	0.50 – 4.00
BHDA-104 (deep)	Lambeth Group	27.00 – 28.00

Details of the monitoring well installations can be viewed in **Appendix A**.

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;

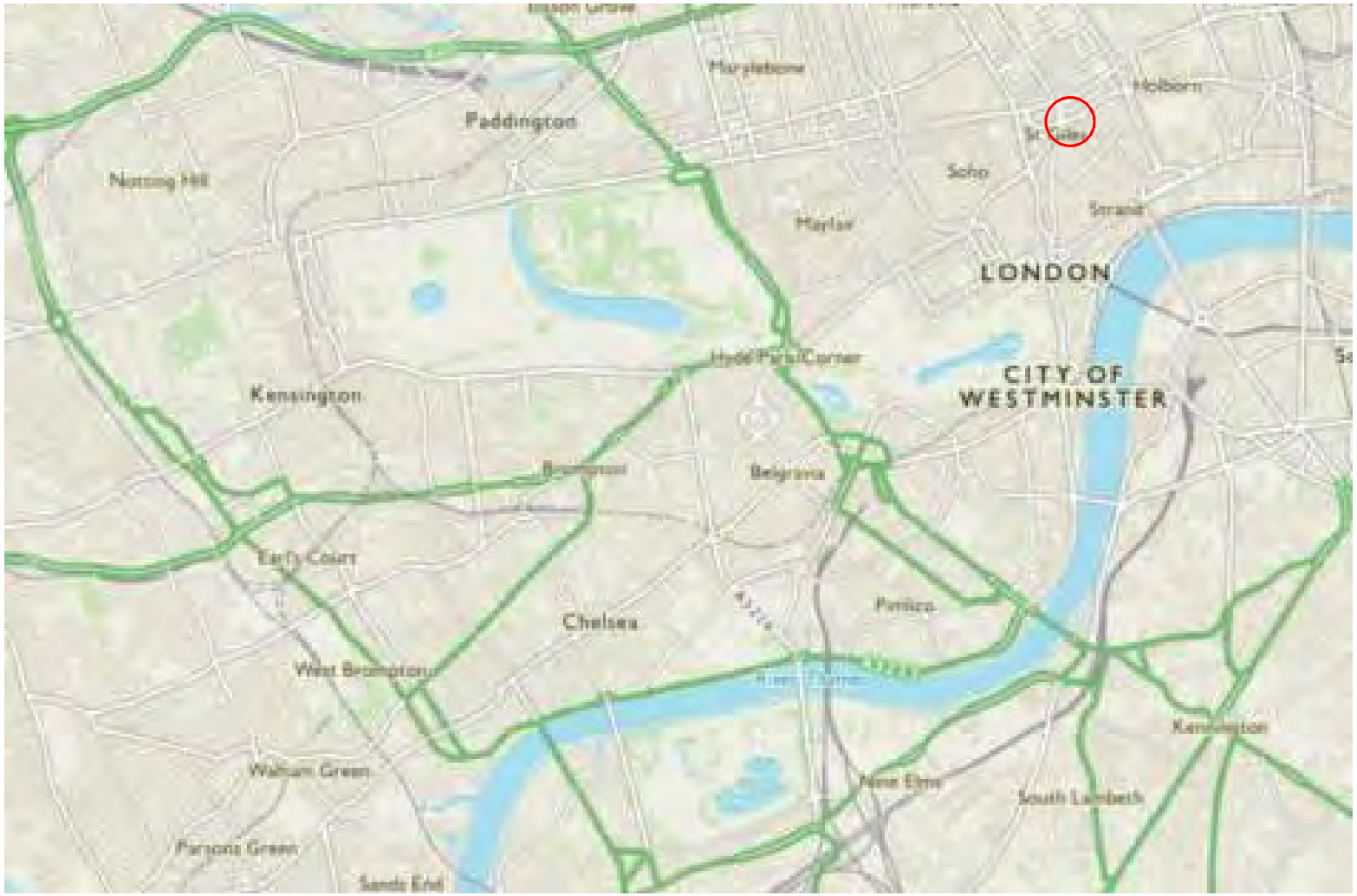
[1] This document has been withdrawn but is considered to remain useful in proving technical background for designing ground investigation works.

[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



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: Castlewood & Medius House, London

Figure Number: Figure 1

Title: Site Location Plan

Project No:	Created By:	Date:
	PIL	July 2018

Client: RLAM Ltd

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