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Your Ref:

Our Ref: **15/23223**
March 2015

9 PARKHILL ROAD,

LONDON, NW3 2YH

REPORT ON A GROUND INVESTIGATION

Prepared for

Ecos Maclean

Acting on behalf of

Mr C.H. Bennett

CONTENTS

1.0 INTRODUCTION

1.1 Outline and Limitations of Report

At the request of Ecos Maclean, acting on behalf of Mr C.H. Bennett, a ground investigation was carried out in connection with a proposed residential development at the above site.

The information was required for the design and construction of foundations and infrastructure for the proposed development which includes construction of a basement below the existing property on the site.

The recommendations and comments given in this report are based on the ground conditions encountered in the exploratory hole made during the investigation and the results of the tests made in the field and the laboratory. It must be noted that there may be special conditions prevailing at the site remote from the exploratory hole location which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

2.0 SITE DETAILS

(National Grid Reference: TQ 277 849)

2.1 Site Location

The site is located on the western side of Parkhill Road and comprises of a four storey semi-detached residential building, including front and rear garden areas. The site is located at the approximate postcode of NW3 2YH with the general area being under the authority of the London Borough of Camden.

2.2 Published Geology

According to the British Geological Survey (BGS) 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) the site is underlain by the London Clay Formation.

There are two BGS boreholes within 100m of the site; TQ28SE1165 and TQ28SE1164 both located at Haverstock Hill, approximately 85m south-west of the site. The geology in these boreholes indicates a surface cover of Made Ground overlying the London Clay Formation.

2.3 Previous Investigations

It is our understanding that no previous reports have been completed for this site.

2.4 Proposed development

It is proposed to construct a basement development below the existing property.

3.0 SCOPE OF WORK

3.1 Site Works

The proposed scope of works was agreed by the client prior to the commencement of the investigations. To achieve this, the following works were undertaken:-

- The drilling of one continuous flight auger borehole to a depth of 6.00m below ground level (Borehole 1).
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the borehole.
- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory hole.
- Interpretative reporting on foundation options for the proposed building and infrastructure.
- A study into the possibility of the presence of toxic substances in the soil together with comments on any remediation required was outside the scope of the present investigation.

3.2 Ground Conditions

The location of the exploratory hole is shown on the site sketch plan, Figure 1.

The borehole revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 0.40m in thickness with the London Clay Formation at depth.

For detailed information on the ground conditions encountered in the borehole reference should be made to the exploratory hole record presented in Appendix A.

3.3 Groundwater

Groundwater was encountered in Borehole 1 as a slight seepage at a depth of 2.00m below ground level.

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the borehole and hence be detected, particularly within more cohesive soils.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

Groundwater was subsequently found to have stabilised at a depth of 1.49m below ground level in the monitoring standpipe placed in Borehole 1 after a period of approximately three weeks.

Given the presence of a non-aquifer below the site it is likely that groundwater within these soils is recharged via intermittent seepages from surface water associated with weather conditions rather than any large scale subterranean groundwater flow. As a result the impact from the basement development on the local groundwater regime is likely to be minimal.

However, as it may be necessary to control this water during the construction period and consideration could be given to conventional internal pumping methods from open sumps.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (February and March 2015) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

Groundwater is by its nature, hidden from view and unforeseen ground conditions can occur. It is therefore recommended that the water levels in the monitoring borehole be periodically measured immediately prior to, and during construction. Should groundwater levels rise to within the excavation volume, or should significant groundwater inflow be observed during excavation, professional advice should be sought.

4.0 IN-SITU AND LABORATORY TESTS

4.1 In-Situ Vane Tests

In the essentially cohesive natural soils encountered in Borehole 1, in-situ shear vane tests were made at regular depth increments in order to assess the undrained shear strength of the materials.

The results indicate that the natural soils are of a generally medium becoming high strength with increasing depth below ground level in accordance with BS5930 (2007).

4.2 Classification Tests

Atterberg Limit tests were conducted on two selected samples taken from the upper cohesive sections of the natural and made ground soils in Borehole 1 and showed the samples tested to fall into Class CV, according to the British Soil Classification System.

These are fine grained silty clay soils of very high plasticity and as such generally have a low permeability and a high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values between 42% and 44%, with both of the samples being above the 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential and the other sample falling just below this boundary.

The test results are given in Table 1, contained in Appendix B.

4.3 Sulphate and pH Analyses

The results of the sulphate and pH analyses made on two soil samples are presented in the i2 Analytical Limited Report Reference 15-67412, contained in Appendix B. The results show the soil samples tested to have water soluble sulphate contents of up to 5.5g/litre associated with near neutral pH values.

5.0 FOUNDATION DESIGN

5.1 General

It is proposed to construct a basement below the existing property. Further details of the development including the exact structure, layout and loadings were not available at the time of preparation of this report.

5.2 Site Preparation Works

The main contractor should be informed of the site conditions and risk assessments should be undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions. It is recommended that extensive searches of existing man-made services are undertaken over the site prior to final design works.

5.3 Conventional Spread Foundations

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should therefore, be taken through any Made Ground and either into, or onto a suitable underlying natural strata of adequate bearing characteristics.

Based on the ground and groundwater conditions encountered in the borehole, it should be possible to support the proposed new development on conventional strip or basement raft foundations taken down below the Made Ground and any weak superficial soils and placed in the natural stiff high strength silty sandy clay deposits which were encountered at a depth of 0.40m below ground level at the site.

Using theory from Terzaghi (1943), strip foundations placed within natural soils may be designed to allowable net bearing pressures of approximately 250kN/m^2 at 2.00m depth rising to 280kN/m^2 at 3.00m depth in order to allow for a factor of safety of 2.5 against general shear failure. The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from "Foundation Design and Construction", Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from "Foundation Design and Construction", Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

Any soft or loose pockets encountered within otherwise competent formations should be removed and replaced with well compacted granular fill.

In addition, foundations may need to be taken deeper should they be within the zones of influence of existing trees. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, "Building near Trees" and it is considered that this document is relevant in this situation.

5.4 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required.

The use of piles at the site will be limited by working inside the existing building with associated issues with access, headroom and fume extraction. Therefore the advice of a reputable contractor, familiar with the access constraints, type of soil and groundwater conditions encountered at this site should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of pile chosen and method of installation adopted.

To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

Driven piles could also be used and would develop much higher working loads approximately 2.5 to 3 times higher than bored piles of a similar diameter at the same depth. However, the close proximity of adjacent buildings will in all probability preclude their use due to noise, access constraints and vibration.

5.5 Basement Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls.

Founding Material	Depth to top (m)	Description	Critical Angle of Shearing Resistance (°) (Φ'_{crit})[1]	Coefficient active pressure (Ka)	Coefficient passive resistance (Kp)
London Clay	1.40m to 3.20m	Firm becoming stiff and then very stiff silty sandy CLAY	21	0.47	2.12

Notes:

1. Calculated using guidance from BS8002 (1994)
2. As the structural details of the proposed basement are unknown these values should be used as guidance only and should be seen as 'very cautious values' using guidance from Eurocode 7.

The site lies above the London Clay Formation recorded in this investigation to have a medium to high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2 (2010).

The amount of movement will depend upon a number of factors including the construction timetable, ultimate loads and critically, the depth of the final excavation. Consideration should therefore be given to providing heave protection measures to the floor slab and foundations to mitigate this.

5.6 Basement Floor Slabs

Due to the presence of soils assessed to be of high swelling and shrinkage potential below the site, it is recommended that ground slabs should be fully suspended.

Within the zone of influence of trees, either retained or removed, floor slabs should incorporate either underfloor voids or suitable depths of compressible material in accordance with NHBC requirements, for soils with high volume change potential.

5.7 Excavations

Shallow excavations for foundations and services are likely to require nominal side support in the short term and groundwater is unlikely to be encountered in significant quantities once any accumulated surface water has been removed. Deeper and longer excavations below approximately 1.00m below existing ground level will require close side support and some seepages of groundwater could be encountered.

No particular difficulties are envisaged in removing such water by conventional internal pumping methods from open sumps.

Normal safety precautions should be taken if excavations are to be entered.

5.8 Chemical Attack on Buried Concrete

The results presented in Appendix B show the soil sample tested to have water soluble sulphates content of up to 5.5g/litre associated with near neutral pH values.

In these conditions, it is considered that deterioration of buried concrete due to sulphate or acid attack may occur unless precautions are taken. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-4 conditions.

In addition, segregations of gypsum were noted within the London Clay and scattered small gypsum crystals were also noted at depth. Consequently, it is considered that any buried concrete at depth may also be attacked by such sulphates in solution and that it would be prudent to design any such deep buried concrete in accordance with full Class DS-4 conditions.

p.p. SITE ANALYTICAL SERVICES LIMITED

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Geotechnical Engineer

A P Smith BSc (Hons) FGS MCIWEM
Senior Geologist

6.0 REFERENCES

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2. British Standards Institution, 2001. Investigation of Potentially Contaminated Sites - Code of Practice, BS 10175, BSI, London

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4. British Standards Institution, 1990. Methods for test for soils for civil engineering purposes, BS1377, BSI, London

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8. Building Research Establishment Special Digest 1, 2005, "Concrete in Aggressive Ground – Third Edition."

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10. Eurocode 1: Actions on structures – BS EN 1991-1-1:2002: General actions – Densities, self weight and imposed loads, BSI, London

11. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

12. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

13. Stroud M.A. and Butler F.G. (1975) Symposium on the Engineering Behaviour of Glacial Materials; the Midland Soil Mechanics and Foundation Engineering Society; pgs 124 et seq.

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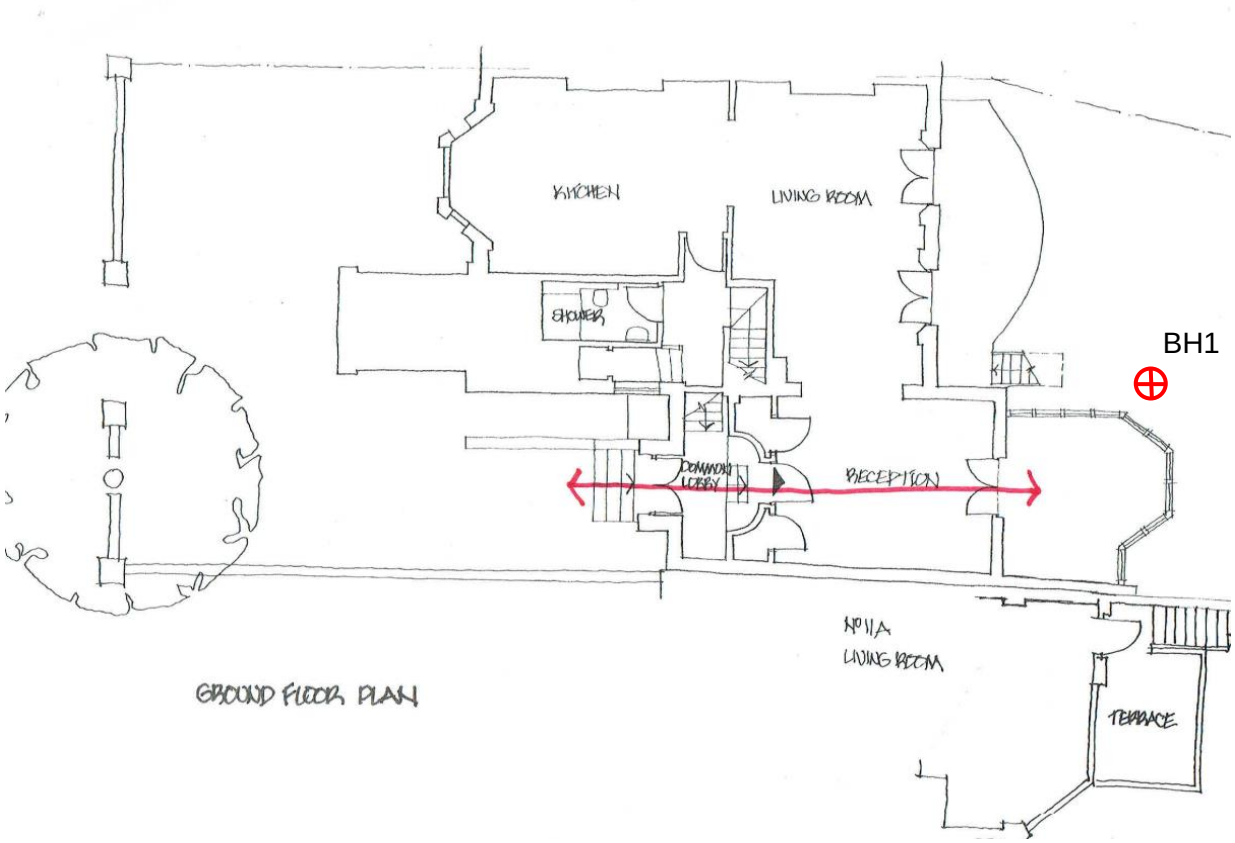
APPENDIX `A'

Borehole / Trial Pit Logs

Site Analytical Services Ltd.		REF: 15/23223
LOCATION:	9 Parkhill Road, London, NW3 2YH	FIG: 1
TITLE: Site Sketch Plan	DATE: March 2015	SCALE: NTS



Site Analytical Services Ltd.

Site	Borehole Number
9 PARKHILL ROAD, LONDON, NW3 2YH	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m		MR C H BENNETT	1523223
	Location TQ277849	**Dates** 18/02/2015	**Engineer** ECOS MACLEAN	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.40)	MADE GROUND: Grass surface over dark brown very silty clay/clayey silt containing gravel.		
0.25	D1					0.40			
0.50	D2						Firm becoming stiff brown/orange silty sandy CLAY containing sand and silt lenses and gypsum crystals.		
0.50	V1 63								
0.75	D3								
1.00	D4								
1.00	V2 81								
1.50	D5								
1.50	V3 115								
2.00	D6			Slight seepage(1) at 2.00m.					▽1
2.00	V4 123					(3.90)			
2.50	D7								
2.50	V5 140+								
3.00	D8								
3.00	V6 140+								
3.50	D9								
3.50	V7 140+								
4.00	D10								
4.00	V8 140+					4.30			
4.50	D11						Very stiff dark brown/grey silty sandy CLAY containing gypsum crystals.		
4.50	V9 140+								
5.00	D12								
5.00	V10 140+					(1.70)			
6.00	D13			18/02/2015:DRY		6.00			
6.00	V11 140+						Complete at 6.00m		

Remarks
D = Disturbed sample
V = Vane test - Results in kPa

Scale (approx)	Logged By
1:50	TM

Figure No. 1523223.BH1

Site Analytical Services Ltd.

Site	Borehole Number
9 PARKHILL ROAD, LONDON, NW3 2YH	BH1

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 19 mm	MR C H BENNETT	1523223

Location	Ground Level (mOD)	Engineer	Sheet
TQ277849		ECOS MACLEAN	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				1.00	Bentonite Seal
	▽1			6.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	
18/02/15		2.00	0.00	Slight seepage					

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
18/02/15				DRY			6.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks
Lockable cover set in concrete.

APPENDIX `B'

Laboratory Test and Groundwater Monitoring Data

Site Analytical Services Ltd.

Ref: 15/23223

PLASTICITY INDEX & MOISTURE CONTENT DETERMINATIONS

LOCATION 9 Parkhill Road, London, NW3 2YH

BH/TP No.	Depth m	Natural Moisture %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing 425 µm %	Class
BH1	2.50	31	71	29	42	100	CV
	4.00	30	73	29	44	100	CV

Table 1

Site Analytical Services Ltd.

Ref: 15/23223

GROUNDWATER MONITORING

LOCATION 9 Parkhill Road, London, NW3 2YH

MONITORING DATE 5th March 2015

BOREHOLE REF:		**BH1**
Water Level	(m.bgl)	1.82
Depth to base of well	(m.bgl)	5.23

Table 2

Site Analytical Services Ltd.

Ref: 15/23223

GROUNDWATER MONITORING

LOCATION	9 Parkhill Road, London, NW3 2YH
MONITORING DATE	13th March 2015

BOREHOLE REF:		**BH1**
Water Level	(m.bgl)	1.49
Depth to base of well	(m.bgl)	5.23

Table 2a

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t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 15-67412

Project / Site name:	9 Parkhill Rd	**Samples received on:**	20/02/2015
Your job number:	15-23223	**Samples instructed on:**	20/02/2015
Your order number:	21264	**Analysis completed by:**	27/02/2015
Report Issue Number:	1	**Report issued on:**	27/02/2015
Samples Analysed:	2 soil samples		

Signed: CCStone

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

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

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

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: 15-67412
Project / Site name: 9 Parkhill Rd
Your Order No: 21264

Lab Sample Number				419482	419483			
Sample Reference				BH1	BH1			
Sample Number				None Supplied	None Supplied			
Depth (m)				3.00	5.00			
Date Sampled				20/02/2015	20/02/2015			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Moisture Content	%	N/A	NONE	25	16			
Total mass of sample received	kg	0.001	NONE	1.4	1.5			
Whole Sample Crushed		N/A	NONE	Crushed	Crushed			

General Inorganics

pH	pH Units	N/A	MCERTS	6.6	6.8			
Water Soluble Sulphate (Soil Equivalent)	g/l	0.0025	MCERTS	11	7.4			
Water Soluble Sulphate as SO_4 (2:1)	mg/kg	2.5	MCERTS	11000	7400			
Water Soluble Sulphate (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	5.5	3.7			

Analytical Report Number : 15-67412

Project / Site name: 9 Parkhill Rd

* 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 topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
419482	BH1	None Supplied	3.00	Light brown clay.
419483	BH1	None Supplied	5.00	Light brown clay.

Analytical Report Number : 15-67412

Project / Site name: 9 Parkhill Rd

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
Crush Whole Sample	Either: Client specific preparation instructions - sample(s) crushed whole prior to analysis; OR Sample unsuitable for standard preparation and therefore crushed whole prior to analysis.	In house method, applicable to dry samples only.	L019-UK	D	NONE
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	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. Stones not passing through a 10 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES. Results reported corrected for extraction ratio (soil equivalent) as g/l and mg/kg; and upon the 2:1	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-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.