ground&water

GROUND INVESTIGATION REPORT

for the site at

43 BURGHLEY ROAD, KENTISH TOWN, CAMDEN, LONDON NW5 1UH

on behalf of

ELI NATHENSON C/O MARTIN EVANS ARCHITECTS

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1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by Eli Nathenson c/o Martin Evans Architects on the 14th August 2014 to undertake a Ground Investigation on a site at 43 Burghley Road, Kentish Town, Camden, London NW5 1UH. The scope of the investigation was detailed within the Ground and Water Limited fee proposal ref: GWQ2139, dated 9th June 2014. Ground and Water Limited were instructed by Eli Nathenson c/o Martin Evans Architects on the 7th March 2016 to undertake further analysis comprising a Ground Movement Assessment for the site in accordance with CPG4. The scope of the additional work was detailed within an email dated 4th March 2016.

1.2 Aims of the Investigation

The aim of the investigation was understood to be to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

The investigation was to be undertaken to provide parameters for the design of foundations by means of in-situ and laboratory geotechnical testing undertaken on soil samples recovered from trial holes.

The requirements of the London Borough of Camden, Camden Geological, Hydrogeological and Hydrological Study, Guidance for Subterranean Development (November 2010) was reviewed with respect to this report.

A Desk Study and full scale contamination assessment were not part of the remit of this report.

The techniques adopted for the investigation were chosen considering the anticipated ground conditions and development proposals on-site, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.

1.3 Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A.

This report supersedes the previous Ground Investigation Report for the site, Ground and Water Ltd reference GWPR1006/GIR/October 2014.

2.0 SITE SETTING

2.1 Site Location

The site comprised an approximately rectangular shaped plot of land, totalling ~160m^2 in area and orientated in a north-west to south-east direction, located on the north-western side of Burghley Road. The site was located ~30m north-west of Burghley Road's cross-road junction with Lady Somerset Road in Kentish Town in the London Borough of Camden.

The national grid reference for the centre of the site was approximately TQ 28770 85704. A site location plan is given within Figure 1. A plan showing the site area is given within Figure 2.

2.2 Site Description

The site was occupied by a terraced four storey brick built residential house. A <0.80m wide gate allowed access to the access stairs up to a raised ground floor level. A paved rear garden was only accessible through the existing building. It was understood the property had no existing lower ground floor/basement level.

Burghley Road, located adjacent to the south-east boundary of the site, appeared to be at ~41.5m AOD.

The sites environs were noted to be sloping gently to moderately to the south-west.

2.3 Proposed Development

At the time of reporting, March 2016, it is understood the proposed development will comprise the construction of a lower ground floor beneath the front of the existing building. There is an option to extend the lower ground floor beneath the entire footprint of the proposed structure. The basement is anticipated to be founded at ~2.0 – 2.5m below the ground level (front garden).

The proposed development fell within Geotechnical Design Category 2 in accordance with Eurocode 7. The proposed foundation loads were not known to Ground and Water Limited at the time of reporting but are likely to range from 75 – 150kN/m^2.

The proposed development was understood not to involve any re-profiling of the site and its immediate environs. It is understood that no trees will be removed to facilitate the construction of the basement.

2.4 Geology

The geology map of the British Geological Survey of Great Britain of the Kentish Town area (Sheet No. 256 North London) revealed the site to be situated on the London Clay Formation.

Figure 3 of the Camden Geological, Hydrogeological and Hydrological Study indicated that no Made Ground or Worked Ground was noted within a close proximity of the site.

London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay Formation, and precautions against sulphate attack to concrete are sometimes required.

The lowest part of the formation is a sandy bed with black rounded gravel and occasional layers of sandstone and is known as the Basement Bed.

Examination of the online BGS borehole records revealed a borehole located ~200m south-east of the site. The borehole encountered ~1.0m capping of Made Ground to overlie a firm brown, with grey veining, silty clay with fine sand and selenite crystals. The deposits were noted for the full depth of the borehole, a depth of 7.62m bgl.

2.5 Slope Stability and Subterranean Developments

The site was not situated within an area where a natural or man-made slope of greater than 7^{o} was present (Figure 16 Camden Geological, Hydrogeological and Hydrological Study). The site was located close, to the north-east, to a localised slope on Burghley Road where a natural or man-made slope of greater than 7^{o} was noted.

Figure 17 of the Camden Geological, Hydrogeological and Hydrological Study indicated the site was not situated within an area prone to landslides.

Figure 18 of the Camden Geological, Hydrogeological and Hydrological Study indicated that one major subterranean infrastructure (including existing and proposed tunnels) were noted ~120m north of the site.

2.6 Hydrogeology and Hydrology

A study of the aquifer maps on the Environment Agency website, and Figure 8 of the Camden Geological, Hydrogeological and Hydrological Study, revealed the site to be located on **Unproductive Strata** relating to the bedrock of the London Clay Formation. No designation was given for any superficial deposits due to their likely absence.

Unproductive strata are rock layers with low permeability that have negligible significance for water supply or river base flow. These were formerly classified as non-aquifers.

Superficial (Drift) deposits are permeable unconsolidated (loose) deposits, for example, sands and gravels. The bedrock is described as solid permeable formations e.g. sandstone, chalk and limestone.

Examination of the Environment Agency records showed that the site did not fall within a Groundwater Source Protection Zone as classified in the Policy and Practice for the Protection of Groundwater.

In accordance with Figure 11 of the Camden Geological, Hydrogeological and Hydrological Study the southerly flowing "lost" River Fleet was shown passing in a close proximity to the site.

In accordance with Figure 12 of the Camden Geological, Hydrogeological and Hydrological Study there were no surface water features in a close proximity to the site.

Figure 14 of the Camden Geological, Hydrogeological and Hydrological Study revealed the site was not located within the catchment of Hampstead Ponds.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at moderate to deep depth (4-6m below existing ground level (bgl)) and it was considered that the groundwater was flowing in a south-westerly direction in accordance with the local topography.

Examination of the Environment Agency records showed that the site was not situated within a floodplain or flood warning area. Figure 15 the Camden Geological, Hydrogeological and Hydrological Study revealed that whilst the site was not subject to surface water flooding. Ingestre Road ~120m to the north of the site was flooded during 2002.

2.7 Radon

BRE 211 (2007) Map 5 of London, Sussex and West Kent revealed the site **was not** located within an area where mandatory protection measures against the ingress of Radon were required. The site **was not** located within an area where a risk assessment was required.

3.0 FIELDWORK

3.1 Scope of Works

Fieldwork was undertaken on the 29th August 2014 and comprised the drilling of one window sampler borehole (WS1) to a depth of 5.00m bgl and the hand excavation of one trial pit foundation exposure (TP/FE1) at the front of the property. In addition, a Heavy Dynamic Probe (HDP) was undertaken adjacent to WS1 (DP1) to 10.00m bgl.

It was not possible to install a standpipe in WS1 due to a collapse of the borehole at 2.30m bgl upon completion of the borehole.

The approximate locations of the trial holes can be seen within Figure 4.

Prior to commencing the ground investigation, a walkover survey was carried out to identify the presence of underground services and drainage. Where underground services/drainage were suspected and/or positively identified, exploratory positions were relocated away from these areas.

Upon completion of the site works, the trial holes were backfilled and made good/reinstated in relation to the surrounding area.

3.2 Sampling Procedures

Small disturbed samples were recovered from the trial holes at the depths shown on the trial hole records. Soil samples were generally retrieved from each change of strata and/or at specific areas of concern. Samples were also taken at approximately 0.5m intervals during broad homogenous soil horizons.

A selection of samples were despatched for geotechnical testing purposes.

4.0 ENCOUNTERED GROUND CONDITIONS

4.1 Soil Conditions

All exploratory holes were logged by David McMillan of Ground and Water Limited generally in accordance with BS EN 14688 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.

The ground conditions encountered within the trial holes constructed on the site generally conformed to that anticipated from examination of the geology map. A capping of Made Ground was noted to overlie the soils of the London Clay Formation.

The ground conditions encountered during the investigation are described in this section. For more complete information about the Made Ground and the London Clay Formation at particular points, reference must be made to the individual trial hole logs within Appendix B.

The trial hole location plan can be viewed in Figure 5.

For the purposes of discussion the succession of conditions encountered in the trial holes in descending order can be summarised as follows:

Made Ground
London Clay Formation

Made Ground

Made Ground was encountered beneath a 0.20m thickness of concrete hardstanding to 2.30m bgl in WS1. The Made Ground comprised an orange brown slightly gravelly silty clay. The gravel was rare, fine, sub-angular brick and concrete. The base of the Made Ground was not proved within TP/FE1 which was probed to 2.20m bgl.

London Clay Formation

Soils of the London Clay Formation comprising an orange brown silty clay, with blue grey mottling, was encountered for the remaining depth of WS1, a depth of 5.00m bgl.

4.2 Foundation Exposures

A description of the foundation layout and ground conditions encountered within the hand dug trial pit/foundation exposures are given within this section of the report.

TP/FE1

Trial pit foundation exposure TP/FE1 was hand excavated from ground level at the front of the existing property. The exact location of the trial hole can be seen in Figure 4 with a section drawing of the foundation encountered in Figure 5.

The foundation exposure was measured from ground level.

The foundation layout encountered consisted of a brick wall to ground level. From ground level to a depth of 0.15m bgl a brick wall was noted resting upon a concrete footing. The concrete footing was proved via hand excavating to 1.50m and then by dynamic probing to ~2.20 – 2.30m bgl. The base of the concrete footing was estimated, by probing to be 2.20 – 2.30m bgl. The ground conditions encountered directly surrounding the foundation are shown in Figure 5.

4.3 Roots Encountered

Roots were noted to a depth of 1.0m bgl in WS1.

It must be noted that the chance of determining actual depth of root penetration through a narrow diameter borehole is low. Roots may be found to greater depths at other locations on the site, particularly close to trees and/or trees that have been removed both within the site and its close environs.

4.4 Groundwater Conditions

A groundwater strike was noted in WS1 at 3.30m bgl.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. Exact groundwater levels may only be determined through long term measurements from monitoring wells installed on-site. The investigation was undertaken in August 2014, when groundwater levels are likely to be close to their annual minimum (lowest elevation).

Isolated pockets of groundwater may be perched within any Made Ground found at other locations around the site.

4.5 Obstructions

It was not possible to install a standpipe in WS1 due to a collapse of the borehole at 2.30m bgl upon completion of the borehole. The borehole could not be extended beyond 5.00m bgl due to the collapse of the borehole.

No other artificial or natural sub-surface obstructions were noted during construction of the trial holes.

5.0 INSITU AND LABORATORY GEOTECHNICAL TESTING

5.1 In-Situ Geotechnical Testing

A Heavy Dynamic Probe (HDP) was undertaken adjacent to WS1 (DP1) to 10.00m bgl. The test results are presented on the trial hole logs within Appendix B.

Windowless Sampler Boreholes provide samples of the ground for assessment but they do not give any engineering data. Dynamic Probing involves the driving of a metal cone into the ground via a series of steel rods. These rods are driven from the surface by a hammer system that lifts and drops a 50.0kg hammer onto the top of the rods through a set height, thus ensuring a consistent energy input. The number of hammer blows that are required to drive the cone down by each 100mm increment are recorded. These blow counts then provide a comparative assessment from which correlations have been published, based on dynamic energy, which permits engineering parameters to be generated. *(The Dynamic Probe 'Heavy' (HDP) Tests were conducted in accordance with BS 1377; 1990; Part 9, Clause 3.2).*

The cohesive soils of the Made Ground and the London Clay Formation were classified based on the table below.

Undrained Shear Strength from Field Inspection/Equivalent SPT results derived from HDP Cohesive Soils (EN ISO 14688-2:2004 & Stroud (1974))		
Classification	**Undrained Shear Strength (kPa)**	**Field Indications**
Extremely High	>300	-
Very High	150 – 300	Brittle or very tough
High	75 – 150	Cannot be moulded in the fingers
Medium	40 – 75	Can be moulded in the fingers by strong pressure
Low	20 – 40	Easily moulded in the fingers
Very Low	10 – 20	Exudes between fingers when squeezed in the fist
Extremely Low	<10	-

An interpretation of the in-situ geotechnical testing results is given in the table below.

In-Situ Geotechnical Testing Results Summary					
Strata	**Equivalent SPT "N" Blow Counts derived from HDP**	**Undrained Shear Strength kPa (based on Stroud, 1974)**	**Soil Type**		**Trial Hole**
			Cohesive	**Granular**	
Made Ground	2 – 4	10 – 20	Very Low	-	WS1 (1.30 – 2.30m bgl)
London Clay Formation	4 – 6	20 – 30	Very Low/Low - Low		WS1 (2.30 – 5.00m bgl)
Assumed London Clay Formation	6 – 22	30 – 110	Low – High	-	WS1 (5.00 – 10.00m bgl)

It must be noted that field measurements of undrained shear strength are dependent on a number of variables including disturbance of sample, method of investigation and also the size of specimen or test zone etc.

The test results are presented on the trial hole logs within Appendix B.

5.2 Laboratory Geotechnical Testing

A programme of geotechnical laboratory testing, scheduled by Ground and Water Limited and carried out by K4 Soils Laboratory and QTS Environmental Limited, was undertaken on samples recovered from the Made Ground and the London Clay Formation. The results of the tests are presented in Appendix C.

The test procedures used were generally in accordance with the methods described in BS1377:1990.

Details of the specific tests used in each case are given below:

Standard Methodology for Laboratory Geotechnical Testing		
Test	**Standard**	**Number of Tests**
Atterberg Limit Tests	BS1377:1990:Part 2:Clauses 3.2, 4.3 & 5	3
Water Soluble Sulphate & pH	BS1377:1990:Part 3:Clause 5	1
BRE Special Digest 1 (incl. Ph, Electrical Conductivity, Total Sulphate, W/S Sulphate, Total Chlorine, W/S Chlorine, Total Sulphur, Ammonium as NH4, W/S Nitrate, W/S Magnesium)	BRE Special Digest 1 “Concrete in Aggressive Ground (BRE, 2005).	2

5.2.1 Atterberg Limit Tests

A précis of Atterberg Limit Tests undertaken on three samples of the London Clay Formation can be seen tabulated below.

Atterberg Limit Tests Results Summary							
Stratum/Depth	**Moisture Content (%)**	**Passing 425 µm sieve (%)**	**Modified PI (%)**	**Soil Class**	**Consistency Index (Ic)**	**Volume Change Potential**	
						NHBC	**BRE**
London Clay Formation	32 - 33	100	50 – 52	CV	Stiff	High	High

NB: NP – Non-plastic
BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
Soil Classification based on British Soil Classification System.
Consistency Index (Ic) based on BS EN IS0 14688-2:2004.

5.2.2 Comparison of Soil’s Moisture Content with Index Properties

5.2.2.1 Liquidity Index Analyses

The results of the Atterberg Limit tests undertaken on three samples of the London Clay Formation were analysed to determine the Liquidity Index of the samples. This gives an indication as to whether the samples recovered showed a moisture deficit and their degree of consolidation. The results are tabulated overpage.

The test results are presented within Appendix C.

Liquidity Index Calculations Summary					
Stratum/Trial Hole/Depth	**Moisture Content (%)**	**Plastic Limit (%)**	**Modified Plasticity Index (%)**	**Liquidity Index**	**Result**
London Clay Formation WS1/3.00m bgl (Brown CLAY)	33	25	50	0.160	Heavily Overconsolidated.
London Clay Formation WS1/4.00m bgl (Brown silty CLAY)	33	29	51	0.078	Heavily Overconsolidated
London Clay Formation WS1/5.00m bgl (Brown silty CLAY)	32	31	52	0.019	Heavily Overconsolidated.

Liquidity Index testing revealed no evidence for moisture deficit within the heavily overconsolidated samples of the London Clay Formation tested.

5.2.2.2 Liquid Limit

A comparison of the soil moisture content and the liquid limit can be seen tabulated below.

Moisture Content vs. Liquid Limit				
Strata/Trial Hole/Depth/Soil Description	**Moisture Content (MC) (%)**	**Liquid Limit (LL) (%)**	**40% Liquid Limit (LL)**	**Result**
London Clay Formation WS1/3.00m bgl (Brown CLAY)	33	75	30.0	MC > 0.4 x LL (No significant moisture deficit)
London Clay Formation WS1/4.00m bgl (Brown silty CLAY)	33	80	32.0	MC > 0.4 x LL (No significant moisture deficit)
London Clay Formation WS1/5.00m bgl (Brown silty CLAY)	32	83	33.2	**MC < 0.4 x LL (Potentially significant moisture deficit)**

The results in the table above indicated that a potential significant moisture deficit was present within one sample of the London Clay Formation tested (WS1/5.00m bgl). The moisture content value was marginally below 40% of the liquid limit.

The heavily overconsolidated samples of the London Clay Formation was described as a brown silty clay. Roots were noted to a depth of 1.00m bgl in WS1. Consequently the apparent moisture deficit could be related to the lithology of the soil (heavily overconsolidated soils) rather than the possible effect of water demand from roots from nearby trees.

The results in the table above indicate that the remaining samples of the heavily overconsolidated samples of the London Clay Formation tested showed no evidence of a significant moisture deficit.

5.2.3 Sulphate and pH Tests

A sulphate and pH test was undertaken on one sample from the London Clay Formation

(WS1/3.50m bgl). The sulphate concentration was 570mg/l with a pH of 7.9.

5.2.4 BRE Special Digest 1

In accordance with BRE Special Digest 1 'Concrete in Aggressive Ground' (BRE, 2005) one sample of the Made Ground (WS1/1.50m bgl) and one sample of the London Clay Formation (WS1/2.50m bgl was scheduled for laboratory analysis to determine parameters for concrete specification.

The results are given within Appendix C and a summary is tabulated below.

Summary of Results of BRE Special Digest Testing			
Determinand	**Unit**	**Minimum**	**Maximum**
pH	-	7.6	8.2
Ammonium as NH_4	mg/kg	13.6	13.6
Sulphur	mg/kg	<200	<200
Chloride (water soluble)	mg/kg	82	110
Magnesium (water soluble)	g/l	0.0044	0.0125
Nitrate (water soluble)	mg/kg	3	4
Sulphate (water soluble)	g/l	0.08	0.31
Sulphate (total)	mg/kg	522	583

6.0 ENGINEERING CONSIDERATIONS

6.1 Soil Characteristics and Geotechnical Parameters

Based on the results of the intrusive investigation and geotechnical laboratory testing the following interpretations have been made with respect to engineering considerations.

- Made Ground was encountered to 2.30m bgl in WS1. As a result of the inherent variability of Made Ground, 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 stratum of adequate bearing characteristics.

- Soils of the London Clay Formation comprising an orange brown silty clay, with blue grey mottling, were encountered for the remaining depth of WS1, a depth of 5.00m bgl.

  The cohesive soils of the London Clay Formation comprised very low/low to high undrained shear strength (20 -110kPa) soils between 2.30-10.00m bgl in WS1. The undrained shear strength of the soils generally increased with depth.

  The soils of the London Clay Formation were shown to have a **high** potential for volume change in accordance both BRE240 and NHBC Standards Chapter 4.2.

  Consistency Index calculations indicated the London Clay Formation to be stiff. Liquidity Index testing revealed the soils to be heavily overconsolidated.

  Geotechnical analysis revealed a potential significant moisture deficit was present within one sample of the London Clay Formation tested (WS1/5.00m bgl). The moisture content value was marginally below 40% of the liquid limit. The heavily overconsolidated samples of the London Clay Formation was described as a brown silty clay. Roots were noted to a depth of 1.00m bgl in WS1. Consequently the apparent moisture deficit could be related to the lithology of the soil (heavily overconsolidated soils) rather than the possible effect of water demand from roots from nearby trees.

  The soils of the London Clay Formation are heavily overconsolidated cohesive soils and are therefore likely to be a suitable stratum for the proposed traditional strip or mat foundations associated with the basement. The settlements induced on loading are likely to be low to moderate.

  The final design of foundations will need to take into account the volume change potential of the soil, the depth of root penetration and/or moisture deficit and the likely serviceability and settlement requirements of the proposed structure. These parameters for design are discussed in the next section of this report.

- A groundwater strike was noted in WS1 at 3.30m bgl.

- Roots were noted to a depth of 1.00m bgl in WS1.

6.2 Basement Foundations

At the time of reporting, March 2016, it is understood the proposed development will comprise the construction of a lower ground floor beneath the front of the existing building. There is an option to extend the lower ground floor beneath the entire footprint of the proposed structure. The basement is anticipated to be founded at ~2.0 – 2.5m below the ground level (front garden).

The proposed development fell within Geotechnical Design Category 2 in accordance with Eurocode 7. The proposed foundation loads were not known to Ground and Water Limited at the time of reporting but are likely to range from 75 – 150kN/m^2.

Foundations should be designed in accordance with soils of **high volume change potential** in accordance with BRE Digest 240 and NHBC Chapter 4.2.

Given the cohesive nature of the shallow deposits foundations must therefore **not** be placed within cohesive root penetrated and/or desiccated soils and the influence of the trees surrounding the site must be taken into account (NHBC Standards Chapter 4.2). It is recommended that foundations are taken at least 300mm into non-root penetrated strata or granular soils of no volume change potential.

Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping. Should trees be removed from the footprint of the proposed building then an alternative foundation system, such as piles or isolated pads should be considered.

Roots were noted to a depth of 1.00m bgl in WS1. Made Ground was noted to a depth of 2.30m bgl.

The basement formation level must be carefully inspected for the presence of fresh/live roots. Should live roots be noted at basement formation level then the basement formation level should be extended at least 300mm into non-root penetrated soils. The void should be backfilled to the proposed slab level using a granular engineered fill.

It is considered likely the proposed basement will be constructed with load bearing concrete retaining walls with semi-ground bearing concrete floors. Given the depth of Made Ground encountered in the trial holes (2.30m bgl), the following bearing capacities could be adopted for 5.0m long by 0.75m and 1.0m wide footings, a 1.5m by 1.5m pad constructed at 2.50m bgl and 3.00m bgl.

Limit State: Bearing Capacities Calculated (Based on WS/DP1)		
Depth (m BGL)	**Foundation System**	**Limit Bearing Capacity (kN/m^2) (EC2)**
2.50m	5.00m by 0.75m Strip	83.64
	5.00m by 1.00m Strip	84.33
	1.50m by 1.50m Pad	91.57
3.00m	5.00m by 0.75m Strip	93.35
	5.00m by 1.00m Strip	94.10
	1.50m by 1.50m Pad	104.28

Serviceability State: Settlement Parameters Calculated (Based on WS/DP1)			
Depth (m BGL)	**Foundation System**	**Limit Bearing Capacity (kN/m^2)**	**Settlement (mm)**
2.50m	5.00m by 0.75m Strip	80	<19
	5.00m by 1.00m Strip	80	<24
	1.50m by 1.50m Pad	80	<19
3.00m	5.00m by 0.75m Strip	90	<18
	5.00m by 1.00m Strip	90	<22
	1.50m by 1.50m Pad	100	<12

It must be noted that a bearing capacity of less than $40kN/m^2$ at 2.50m bgl and $50kN/m^2$ at 3.00m bgl could result in heave due to a reduction in effective stress at depth. This will need to be taken into account in final design.

General Recommendations for Spread Foundations:

- Foundation excavations must be carefully bottomed out and any loose soil or soft spots removed prior to the foundation concrete or blinding being placed. Failure to ensure that foundation excavations are suitably bottomed out could result in additional settlements.

- Inspection of foundation excavations, prior to concreting, must be made by a competent and suitably qualified person to check for any soft spots and to check for the presence of roots.

- The excavation must be kept dry as accumulation of water could result in increased settlements.

- Foundations must not be cast over foundations of former structures and/or other hard spots.

- Any groundwater or surface water ingress must be prevented from entering foundation trenches.

- Isolated Pad Foundations must be at least 1.5 times the width of the widest pad apart to keep to the anticipated settlements.

- Final designs for the foundations should be carried out by a suitably qualified Engineer based on the findings of this investigation and with reference to the anticipated loadings, serviceability requirements for the structure, volume change potential of the soils encountered and the developments proximity to former, present and proposed trees.

It must be mentioned that it was assumed that excavations will be kept dry and either concreted or blinded as soon after excavation as possible. If water were allowed to accumulate on the formation for even a short time not only would an increase in heave occur resulting from the soil increasing in volume by taking up water, but also the shear strength and hence the bearing capacity would also be reduced.

If the construction works take place during the winter months, when the groundwater level is expected to be at its higher elevation, perched water could accumulate thus dewatering could be required to facilitate the construction and prevent the base of the excavation blowing before the slab was cast. The advice of a reputable dewatering contractor, familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the design of the excavation for the basement.

The basement must be suitably tanked to prevent ingress of groundwater and also surface water run-off. The basement must also be designed to take into account pressure exerted by the presence of groundwater in and around the basement.

6.3 Piled Foundations

Should the bearing capacities provided be unsuitable for the proposed development then a piled foundation solution could be adopted.

The construction of a piled foundation is a specialist job, and the advice of a reputable contractor, familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the foundation design, as the actual pile working load will depend on the particular type of pile and method of installation adopted.

Additional Investigation in the form of deeper boreholes would be required to provide parameters for a pile design.

6.4 Basement Excavations & Stability

Shallow excavations in the Made Ground and the London Clay Formation are likely to be marginally stable at best. Long, deep excavations, through both of these strata are likely to become unstable.

The excavation of the basement must not affect the integrity of the adjacent structures beyond the boundaries. The excavation must be supported by suitably designed retaining walls. It is considered unlikely that battering the sides of the excavation, casting the retaining walls and then backfilling to the rear of the walls would be suitable given the close proximity of the party walls.

The retaining walls for the basement will need to be constructed based on cohesive soils with an appropriate angle of shear resistance (*Φ'*) for the ground conditions encountered.

Based on the ground conditions encountered within the boreholes the following parameters could be used in the design of retaining walls. These have been designed based on the SPT profile recorded, results of geotechnical classification tests and reference to literature.

Retaining Wall/Basement Design Parameters					
Strata	**Unit Volume Weight (kN/m^3)**	**Cohesion Intercept (c') (kPa)**	**Angle of Shearing Resistance (Ø)**	**Ka**	**Kp**
Made Ground	~15	0	12	0.66	1.52
London Clay Formation	~20-22	0	24	0.42	2.37

Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported before excavations are entered by personnel.

Based on the groundwater readings taken during this investigation to date, it was considered unlikely that perched groundwater would be encountered during basement construction. Dewatering from sumps introduced into the floor of the excavation is likely to be required if perched groundwater is encountered within the Made Ground, especially after a period of excessive rainfall. Consideration should be given to creating a coffer dam using contiguous piled or sheet piled walls to aid basement construction below the perched water table.

6.5 Assessment of Ground Movement

An assessment of ground movements has been carried out as follows:

- Movement has been assessed for the neighbouring properties due to the excavation of the basement. The site was surrounded by two storey brick built residential properties.
- The northern flank wall of No. 45 Burghley Road at its closest point to the proposed basement was ~5.50m away with its southern flank wall adjoining No. 43 Burghley Road.
- The southern flank wall of No. 41 Burghley Road at its closest point to the proposed basement was ~5.80m away with its northern flank wall adjoining No. 43 Burghley Road.
- The magnitude of ground movements has been assessed for the excavation in front of the traditional underpinned retaining wall structures.
- It is important to note that CIRIA Report C580 was written for embedded retaining walls. Therefore movement calculations for the excavation of soil and installation of the underpins does not strictly apply to C580.

The following parameters have been used to inform this assessment:

- The maximum excavation depth is approximately 4.00m below the level of the existing ground floor slab;
- The method of basement construction will be traditional underpinning;
- A high wall stiffness has been assumed;
- In the permanent case the wall will always be propped at high level;
- The width of No. 45 adjacent to the subject site is ~5.50m. The width of No. 41 adjacent to the subject site is ~5.80m.
- Both buildings are estimated to be ~12.0m high.
- Soil comprising a stiff clay has been assumed.

Based on reference to C580 the following ground movements have been developed based on of the excavation of soils to form the basement.

No. 45 Burghley Road:

The total horizontal movement due to the excavation was calculated to be 6.00mm at the nearest wall, reducing to 3.94mm at its far end.

The total vertical movement due to the excavation was calculated to be 1.60mm at the nearest wall, increasing to 2.43mm at its far end.

No. 41 Burghley Road:

The total horizontal movement due to the excavation was calculated to be 6.00mm at the nearest wall, reducing to 3.83mm at its far end.

The total vertical movement due to the excavation was calculated to be 1.60mm at the nearest wall, increasing to 2.34mm at its far end.

Other issues to note:

- Deep Made Ground was noted underlying the site.
- Trees are present close to the proposed structure. Removal of trees and bushes, or their retention and its effect on ground movement has not been accounted for in the calculations.

In terms of building damage assessment and with reference to Table 2.5 of C580 (after Burland et al, 1977), the 'Description of typical damage' given the calculated movements it is likely that the damage assessment will fall into Category 0, 'Negligible'.

There are a number of key points to note in using this assessment:

- Most ground movement will occur during excavation and construction so the adequacy of temporary support will be critical in limiting ground movements;
- The speed of propping and support is key to limiting ground movements;
- Good workmanship will contribute to minimising ground movements;
- The assessment assumes the wall is in competent clay, whereas ground conditions encountered were for low to high undrained shear strengths clays;
- Larger movements will be expected where soft soils are encountered at, above and below formation;
- Ground movement can be minimised by adopting a number of measures, including;
    - Ensuring that adequate propping is in place at all times during construction
    - Installation of the first (stiff) support quickly and early in the construction sequence for each underpin panel.

6.6 Hydrogeological Effects

The proposed development is located on an **Unproductive Strata** relating to the bedrock of the London Clay Formation.

The ground conditions encountered generally comprised a capping of Made Ground over cohesive soils of the London Clay Formation. Based on a visual appraisal of the soils encountered the permeability of the London Clay Formation Beds were likely to be very low to negligible permeability.

A groundwater strike was noted in WS1 at 3.30m bgl.

Based on the above it is considered unlikely that the basement will be constructed below the groundwater level. Perched groundwater may be encountered during construction within the Made Ground, especially after a period of excessive rainfall.

In relation to the basement, once constructed, the Made Ground will act as a slightly porous medium for water to migrate however additional drainage should be considered as the London Clay Formation will act as a barrier for groundwater migration.

6.7 Sub-Surface Concrete

Sulphate concentrations measured in 2:1 water/soil extracts taken from the Claygate Member of the

London Clay Formation, from both the geotechnical and chemical laboratory testing, fell into Class DS-1 and DS-2 of the BRE Special Digest 1, 2005, *'Concrete in Aggressive Ground'.*

Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of AC-1s for foundations within the London Clay Formation. For the classification given, the "static" and "natural" case was adopted given the cohesive nature of the deposits (permeability unlikely to exceed 10-7 m/se) and residential use of the site.

The sulphate concentration in the samples ranged from 80-570mg/l with a pH range of 7.6-8.2. The total sulphate concentration recorded was 0.052-0.058%.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1, 2005, *'Concrete in Aggressive Ground'* taking into account the pH of the soils.

It is prudent to note that pyrite nodules may be present within the Claygate Member of the London Clay Formation and the London Clay Formation. Pyrite can oxidise to gypsum and this normally only occurs in the upper weathered layer, but excavation allows faster oxidation and water soluble sulphate values can rapidly increase during construction. Therefore rising sulphate values should be taken into account should ferruginous staining/pyrite nodules be encountered within the London Clay Formation.

6.8 Surface Water Disposal

Soakaways constructed within the cohesive soils of the London Clay Formation are unlikely to prove satisfactory due to negligible to low anticipated infiltration rates. Therefore an alternative method of surface water disposal is required.

Consultation with the Environment Agency must be sought regarding any use that may have an impact on groundwater resources.

The principles of sustainable urban drainage system (SUDS) should be applied to reduce the risk of flooding from surface water ponding and collection associated with the construction of the basement.

6.9 Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation. For example, there may have been underground storage tanks (UST's) not identified during the Ground Investigation for which there is no historical or contemporary evidence.

Such occurrences may be discovered during the demolition and construction phases for the redevelopment of the site.

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

Should a new source of contamination be suspected or identified then the Local Authority will need to be informed.

6.10 Waste Disposal

The excavation of foundations is likely to produce waste which will require classification and then recycling or removal from site.

Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal all waste must be classified as;

- Inert;
- Non-hazardous, or;
- Hazardous.

The Environment Agency's Hazardous Waste Technical Guidance (WM2) document outlines the methodology for classifying wastes.

Once classification was established the waste can be removed to the appropriately licensed facilities, with some waste requiring pre-treatments prior to disposal.

INERT waste classification should be undertaken to determine if the proposed waste confirms to INERT or NON-HAZARDOUS Waste Acceptable Criteria (WAC).

6.11 Imported Material

Any soil which is to be imported onto the site must undergo chemical analysis to prove that it is suitable for the purpose for which it is intended.

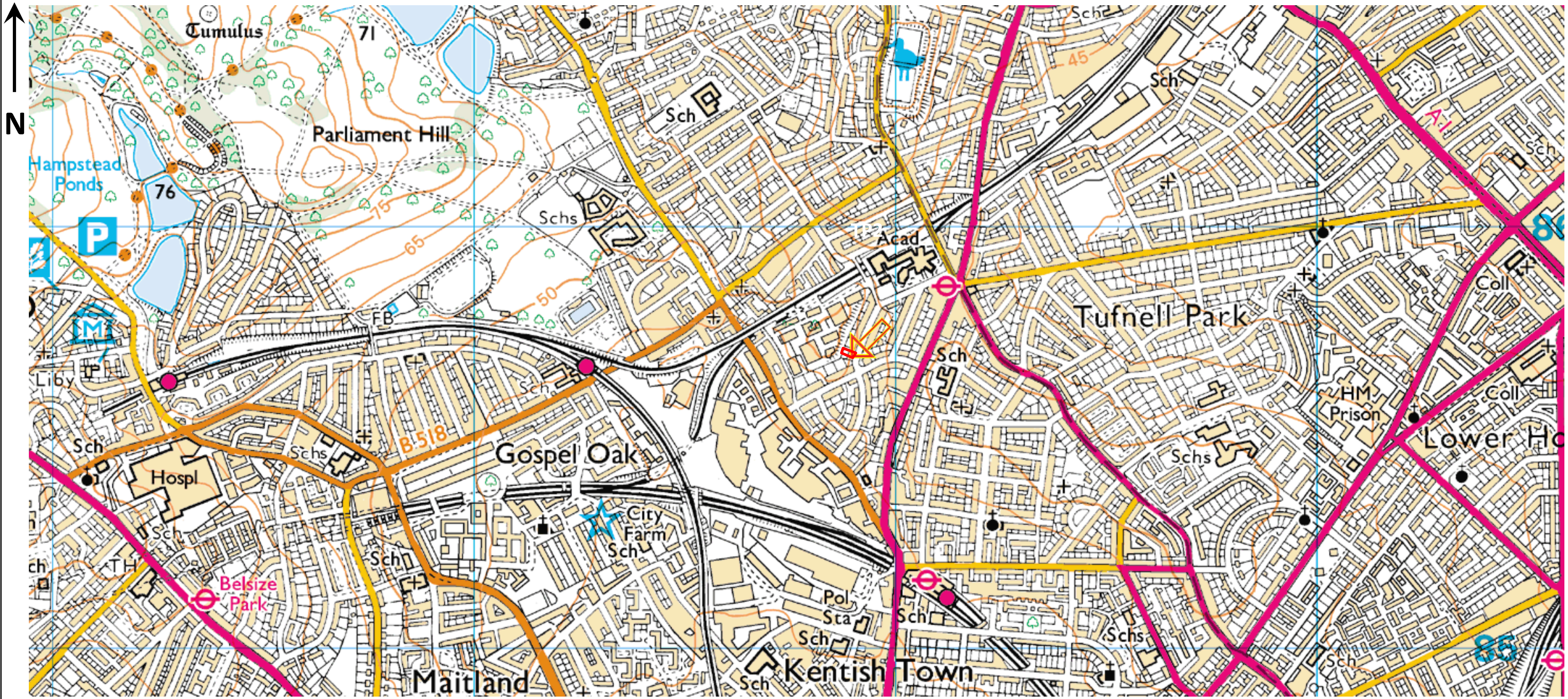
The Topsoil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be tested, either prior to placing (ideally) or after placing, to ensure that the human receptor cannot come into contact with compounds that could be detrimental to human health.

6.12 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust were generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.



Approximate Site Boundary

NOT TO SCALE

Project:Town 43 Burghley Road, Kentish Town, Camden, London NW5 1UH		Figure 1 ground&water
Client: Eli Nathenson c/o Martin Evans Architects	Date: March 2016	
Site Location Plan	Ref: GWPR1599	

APPROXIMATE SITE BOUNDARY

NOTE: NOT TO SCALE

Project: 43 Burghley Road, Kentish Town, Camden, London NW5 1UH		Figure 2
Client: Eli Nathenson c/o Martin Evans Architects	Date: March 2016	ground&water
Site Development Area	Ref: GWPR1599	

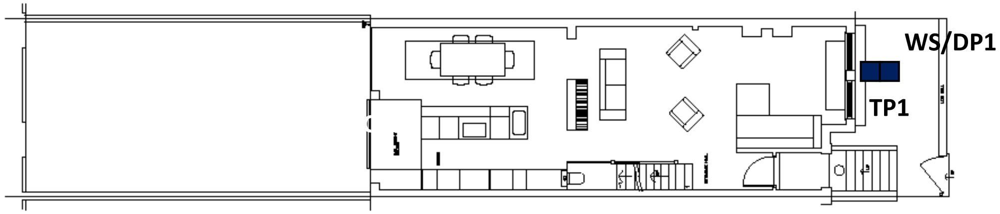
Approximate Site Boundary

NOT TO SCALE

Project: 43 Burghley Road, Kentish Town, Camden, London NW5 1UH	**Figure 3**
Client: Eli Nathenson c/o Martin Evans Architects	**Date:** March 2016
Aerial View of the Site	**Ref:** GWPR1599

ground&water

PLANNING



Martin Evans
Architects

18 Charlotte Road
London EC2A 3PB
tel 020 7729 2474

JOB
43 BURGHLEY ROAD
LONDON
NW5 1UH

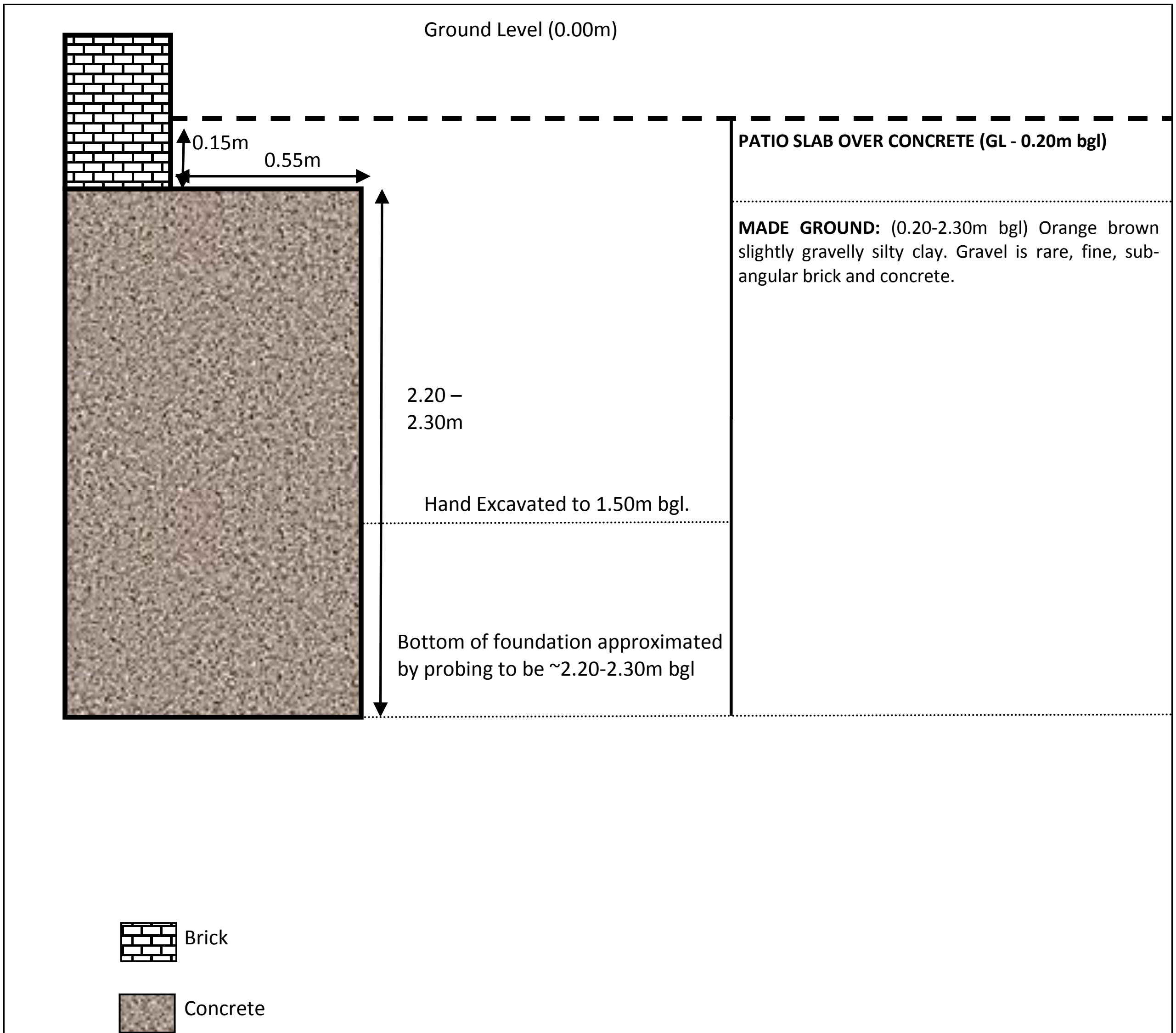
TITLE
EXISTING FLOOR PLAN

DATE	11.08.2014
SCALE	1:100 @ A3, 1:50 @ A1
DRAWN	S.R.

DRAWING NO. BRL-PL-EX-02

NOT TO SCALE

Project: 43 Burghley Road, Kentish Town, Camden, London NW5 1UH	**Figure 4**
Client: Eli Nathenson c/o Martin Evans Architects — **Date:** March 2016	ground&water
Trial Hole Location Plan — **Ref:** GWPR1599	



NOTE: NOT TO SCALE

Project:
43 Burghley Road, Kentish Town, Camden, London NW5 1UH

Figure 5

Client:
Eli Nathenson
c/o Martin Evans Architects

Date: **March 2016**

Section Drawing: Foundation Exposure TP/FE1

Ref: **GWPR1599**

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APPENDIX A
Conditions and Limitations

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment/contaminated land considerations.

The conclusions and recommendations relate to 43 Burghley Road, Kentish Town, Camden, London NW5 1UH.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets, remain with Ground and Water Limited. Licence is for the sole use of the client and may not be assigned, transferred or given to a third party.

Recipients are not permitted to publish this report outside of their organisation without our express written consent.

APPENDIX B
Fieldwork Logs

ground &water
geotechnical and environmental consultants

Ground and Water Ltd
Tel: 0333 600 1221
email: enquiries@groundandwater.co.uk
www.groundandwater.co.uk

Project Name 43 Burghley Road	Project No. GWPR1006	Co-ords: -	Borehole No **WS1** Sheet 1 of 1
			Hole Type WS
Location: London NW5 1UH		Level: -	Scale 1:50
Client: Eli Nathenson		Dates: 29/08/2014	Logged By DM

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			CONCRETE
		0.50	D					MADE GROUND: Orange brown slightly gravelly silty clay. Gravel is rare, fine, sub-angular brick and concrete.
		1.00	D					
		1.50	D					
		2.00	D					
		2.50	D		2.30			LONDON CLAY FORMATION: Orange brown silty CLAY with blue grey mottling.
		3.00	D					
	▽	3.50	D					
		4.00	D					
		4.50	D					
		5.00	D		5.00			End of Borehole at 5.00 m

Type | Results

Remarks: Groundwater strike at 3.30m bgl.
Roots noted to 1.00m bgl.
Borehole collapsed to 2.30m on completion. No install possible.

AGS

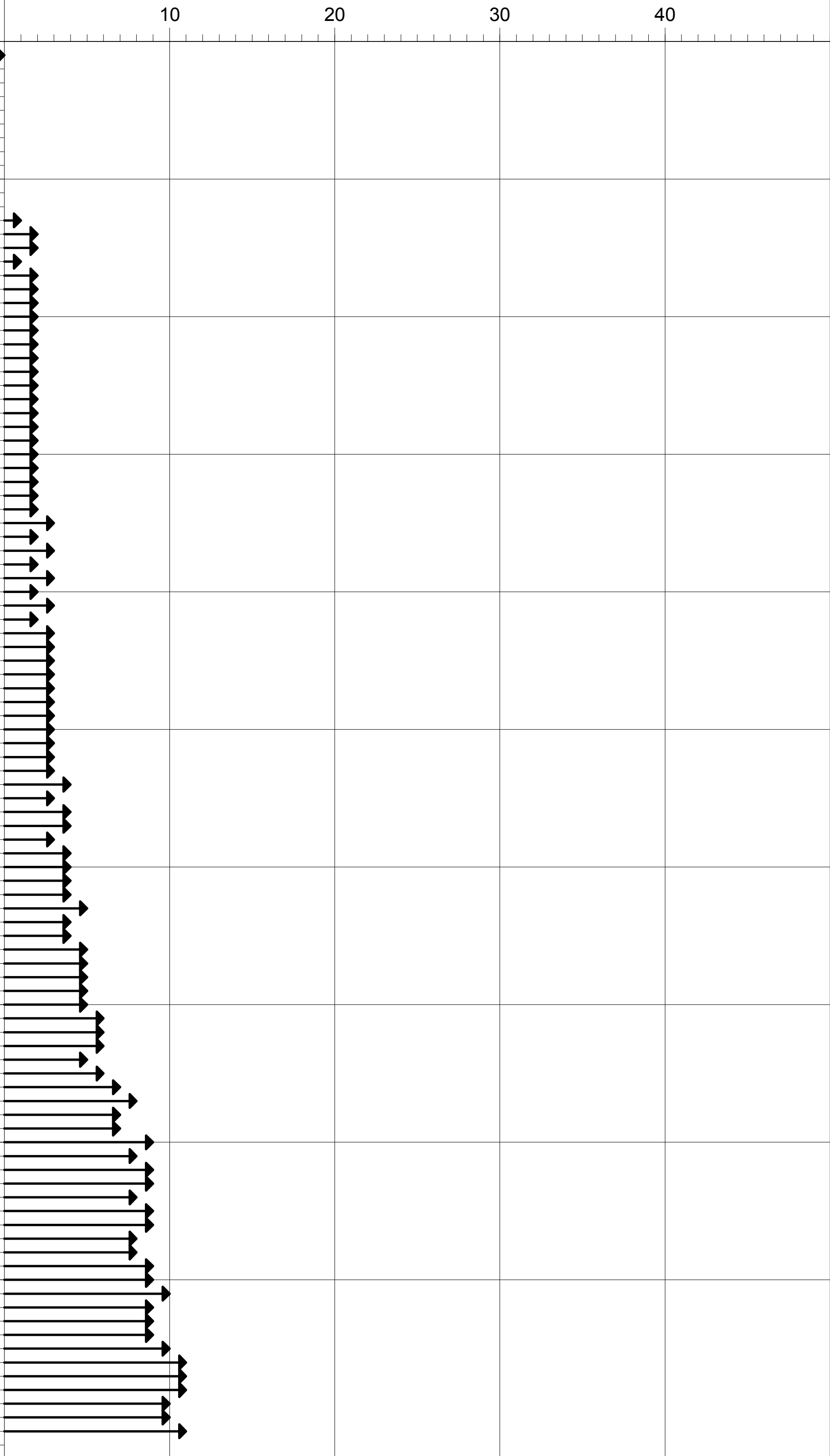
DYNAMIC PROBING

Client **Eli Nathenson**		*Probe No* **DP1**	
Site **43 Burghley Road**		Sheet 1 of 1	
		Project No **GWPR1006**	
E **-**	*N* **-**	*Level* **-**	
Date **29/08/2014**		*Logged by* **SJM**	

Readings Blows/100mm

Depth (m)					
0.0	0	-	-	-	-
0.5	-	-	-	-	-
1.0	-	-	1	2	2
1.5	1	2	2	2	2
2.0	2	2	2	2	2
2.5	2	2	2	2	2
3.0	2	2	2	2	3
3.5	2	3	2	3	2
4.0	3	2	3	3	3
4.5	3	3	3	3	3
5.0	3	3	3	4	3
5.5	4	4	3	4	4
6.0	4	4	5	4	4
6.5	5	5	5	5	5
7.0	6	6	6	5	6
7.5	7	8	7	7	9
8.0	8	9	9	8	9
8.5	9	8	8	9	9
9.0	10	9	9	9	10
9.5	11	11	11	10	10
10.0	11				

Diagram (N100 Values)



Torque (Nm)

0

0
0
0
0
0
0
0
0
0
0
0
0
0

Fall Height	**500**	*Cone Base Diameter*	**35**
Hammer Wt	**50.00**	*Final Depth*	**10.00**
Probe Type	**DPH**	*Log Scale*	1:50

ground & water
geotechnical and environmental consultants
Ground and Water Ltd
Tel: 0333 600 1221
email: enquiries@groundandwater.co.uk
www.groundandwater.co.uk

AGS

APPENDIX C
Geotechnical Laboratory Test Results

Project Name:	43 Burghley Road, London			Samples Received:	04/09/2014	K4 SOILS
				Project Started:	04/09/2014	
Client:	Ground and Water Ltd			Testing Started:	15/09/2014	
Project No:	GWPR1006	Our job/report no:	17397	Date Reported:	16/09/2014	

Borehole No:	Sample No:	Depth (m)	Description	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425 mm (%)	Remarks
WS1	-	3.00	Brown silty CLAY	33	75	25	50	100	
WS1	-	4.00	Brown silty CLAY	33	80	29	51	100	
WS1	-	5.00	Brown silty CLAY	32	83	31	52	100	

UKAS TESTING 2519

Summary of Test Results

BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method.
BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index.
BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.

Checked and Approved
Initials: K.P
Date: 16/09/2014

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

Test Results relate only to the sample numbers shown above. Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Project Name:	43 Burghley Road, London			K4 SOILS
Client:	Ground and Water Ltd	Project no:	GWPR1006	
		Our job no:	17397	

Borehole No:	Sample No:	Depth m	Description	pH	Sulphate content (g/l)
WS1	-	3.50	Brown mottled blue grey CLAY	7.9	0.57

Date	Summary of Test Results	Checked and Approved
16/09/2014	BS 1377 : Part 3 :Clause 5 : 1990 Determination of sulphate content of soil and ground water : gravimetric method	Initials : kp

Francis Williams
Ground & Water Ltd
2 The Long Barn
Norton Farm
Selborne Road
Alton
Hampshire
GU34 3NB

QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 14-24494

Site Reference:	43 Burghley Road
Project / Job Ref:	GWPR1006
Order No:	None Supplied
Sample Receipt Date:	04/09/2014
Sample Scheduled Date:	04/09/2014
Report Issue Number:	1
Reporting Date:	10/09/2014

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
QTS Environmental Report No: 14-24494	Date Sampled	29/08/14	29/08/14			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 43 Burghley Road	TP / BH No	WS1	WS1			
Project / Job Ref: GWPR1006	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	1.50	2.50			
Reporting Date: 10/09/2014	QTSE Sample No	116469	116470			

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.6	8.2			
Total Sulphate as SO_4	mg/kg	< 200	NONE	583	522			
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	MCERTS	0.08	0.31			
Total Sulphur	mg/kg	< 200	NONE	< 200	< 200			
Ammonium as NH_4	mg/kg	< 0.5	NONE	13.6	13.6			
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	82	110			
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	MCERTS	4	3			
W/S Magnesium	g/l	< 0.0001	NONE	0.0044	0.0125			

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 14-24494	
Ground & Water Ltd	
Site Reference: 43 Burghley Road	
Project / Job Ref: GWPR1006	
Order No: None Supplied	
Reporting Date: 10/09/2014	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
116469	WS1	None Supplied	1.50	20.2	Light brown clay
116470	WS1	None Supplied	2.50	20.5	Light brown clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 14-24494
Ground & Water Ltd
Site Reference: 43 Burghley Road
Project / Job Ref: GWPR1006
Order No: None Supplied
Reporting Date: 10/09/2014

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	TPH LQM	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6 - C10)	Determination of hydrocarbons C6-C10 by headspace GC-MS	E001

D Dried
AR As Received