GROUND INVESTIGATION REPORT

for the site at

THE COACH HOUSE, 98A PRIORY ROAD, LONDON NW6 3NT

on behalf of

MICHAEL COHEN

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1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by Michael Cohen on the 21st April 2015 to undertake a Ground Investigation at The Coach House, 98a Priory Road, London NW6 3NT. The scope of the investigation was detailed within the Ground and Water Limited fee proposal ref: GWQ2435, dated 20th April 2014.

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.

2.0 SITE SETTING

2.1 Site Location

The site comprised an approximately rectangular shaped plot of land, totalling ~100m^2 in area and orientated in an east to west direction, located on the eastern side of Priory Road, adjacent to No. 98 Priory Road. The site was located in South Hampstead in the London Borough of Camden. Priory Road was noted to be at ~47.4m AOD at its intersection with Compayne Gardens ~50m to the north-west of the site.

The national grid reference for the centre of the site was approximately TQ 25704 84444. A site location plan is given within Figure 1 and a plan showing the site area is given within Figure 2.

2.2 Site Description

The site was occupied by a detached two storey brick built residential house with a tarmac surfaced front driveway. The rear courtyard area of the property was only accessible through a porch to the existing building and a ~0.71m wide doorway. An aerial view of the site is provided within Figure 3.

2.3 Proposed Development

At the time of reporting, June 2015, it is our understanding that the proposed development will comprise the construction of a two storey side extension, a single storey rear extension, the excavation of a basement below the entire footprint of the house and a loft conversion. The basement is anticipated to be founded at ~3.0 – 3.5m below existing ground level (bgl).

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.

A plan and section view of the proposed basement is given within Figure 4.

2.4 Geology

The geology map of the British Geological Survey of Great Britain of the North London area (Sheet No. 256) revealed the site to be situated the London Clay Formation. An area with the propensity for Head Deposits was noted 500m west, east and north of the site. No areas of Worked Ground or Made Ground were noted within a 250m radius of the site.

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.

Head Deposits

The majority of Head Deposits are clay-dominated, derived from the London Clay. Generally less than 2m thick, they probably accumulated in shallow mudslides of softened brecciated bedrock in the active layer. They consist of soft, ochreous brown silty clay with blue-grey mottling in places and angular, frost-shattered fragments of flint occur sporadically throughout. At the base of these deposits and interbedded in places, there is a bed of pebbly clay, generally less than 0.2m thick, with well-rounded flint pebbles derived from nearby outcrops of 'high level' gravel such as Stanmore Gravel.

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.

In the north London area the upper part of the London Clay Formation has been disturbed by glacial and/or periglacial action and may contain pockets of sand and gravel.

A BGS borehole located ~250m south-west of the site revealed brown, becoming dark grey to blue grey with depth, fissured silty clay of the London Clay Formation underlying a 1.0m thick capping of Made Ground. Selenite crystals were also noted.

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).

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 no major subterranean infrastructure (including existing and proposed tunnels) was noted within close proximity to the site. Overground railway lines were noted ~200m north of the site.

2.6 Hydrogeology and Hydrology
A study of the aquifer maps on the Environment Agency website revealed the site to be located within **Unproductive Strata** comprising the London Clay Formation.

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.

No surface water features were noted within a 250m radius of the site. Figure 12 of the Camden Geological, Hydrogeological and Hydrological Study revealed no surface water feature within a close proximity of the site. Figure 11 revealed the site was located close to where a southerly flowing tributary of the “Lost” Westbourne River was present.

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 depth (>8m below existing ground level (bgl)) and it was considered that the groundwater was flowing in alignment with local topography.

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.

Examination of the Environment Agency records showed that the site was not at risk from flooding from rivers or seas. Figure 15 the Camden Geological, Hydrogeological and Hydrological Study revealed that Priory Road, and roads to the south, suffered surface water flooding in 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

Site works were undertaken on the 1st May 2015 and comprised the drilling of two hand held Window Sampler Boreholes (WS1 & WS2) to a depth of 7.00m and the excavation of a Trial Pit (TP1/FE1), to a depth of 0.90m bgl. A Heavy Dynamic Probe (HDP) (DP1) was constructed adjacent to WS2 to a depth of 10.00m bgl.

A groundwater monitoring standpipe was installed in WS1 to a depth of 5.00m bgl to enable the measurement of standing groundwater levels.

The construction of the well installed can be seen tabulated below.

Combined Bio-gas and Groundwater Monitoring Well Construction				
Trial Hole	**Depth of Installation (m bgl)**	**Thickness of slotted piping with gravel filter pack (m)**	**Depth of plain piping with bentonite seal (m bgl)**	**Piping external diameter (mm)**
WS1	5.00	4.00	1.00	19

The approximate locations of the trial holes can be seen within Figure 5.

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 Megan James 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 with a capping of Made Ground and Head Deposits were underlain by the London Clay Formation.

The ground conditions encountered during the investigation are described in this section. For more complete information about the Made Ground, Head Deposits and 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
Head Deposits
London Clay Formation

Made Ground

Made Ground was encountered within WS1 and WS2, beneath a capping of Tarmac or Paving Slabs (incl. sharp sand and concrete sub-base) to a depth of between 0.60 – 0.90m bgl. The soils comprised a brown/light brown/orange/yellow and grey gravelly sand to sandy gravelly silty clay. The sand was fine to coarse grained. The gravel was occasional to abundant, fine to coarse, sub-rounded to sub-angular flint, concrete, brick, carbonaceous material and cemented sands.

Head Deposits

Head Deposits were encountered underling the Made Ground in WS1 and WS2 to a depth of 1.25m bgl. The deposits comprised brown and orange brown/orange mottled sandy gravelly silty clays. The sand was fine to coarse grained. The gravel was rare to abundant, fine to medium, sub-rounded/rounded to sub-angular flint.

London Clay Formation

Soils described as the London Clay Formation were encountered underlying the Head Deposits in WS1 and WS2 for the remaining depth of each borehole, a maximum depth of 7.00m bgl. The soils comprised a brown/orange brown and grey mottled silty clay with occasional sandy silty pockets. Fine selenite crystals were noted.

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 to the rear of the

existing property. The exact location of the trial hole can be seen in Figure 5 with a section drawing of the foundation encountered in Figure 6.

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 0.23m bgl a brick wall was noted. The brick wall was noted to rest upon a brick footing which stepped out by 0.15m and was 0.15m in thickness. The brick footing was noted to rest upon a layer of crushed brick, 0.17m in thickness. The ground conditions encountered directly surrounding the foundation are shown in Figure 5. The foundation was noted to rest on Made Ground comprising a light brown and orange brown mottled sandy gravelly silty clay at 0.55m bgl.

4.3 Roots Encountered

Roots were noted to a depth of 1.00m bgl in WS1 and 1.30m bgl in WS2.

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 observed within WS1 at 4.20m bgl. No groundwater was encountered in WS2. A standing water level of 1.02m bgl was recorded in the standpipe installed in WS1 on the 10TH June 2015.

The standing water level in WS1 is likely to represent surface water or perched groundwater, migrating through the Made Ground, Head Deposits or London Clay Formation, collecting within a standpipe installed within the impermeable soils of the London Clay Formation.

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 May 2015, when groundwater levels are likely to be falling from their annual maximum (i.e. highest level).

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

4.5 Obstructions

No 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) (DP1) was undertaken adjacent to WS2 to a depth of 10.00m bgl. The test results are presented on the borehole logs within Appendix B.

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 63.0kg hammer onto the top of the rods through a set height (760mm), thus ensuring a consistent energy input. The numbers 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 'Super Heavy' (SHDP) Tests were conducted in accordance with BS 1377; 1990; Part 9, Clause 3.2).*

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

Undrained Shear Strength from Field Inspection/ Equivalent SPT "N" Blow Counts derived from SHDP 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.

Interpretation of In-situ Geotechnical Testing Results					
Strata	**Equivalent SPT "N" Blow Counts derived from SHDP**	**Undrained Shear Strength kPa (based on Stroud, 1974)**	**Soil Type**		**Trial Hole/s**
			Cohesive	**Granular**	
London Clay Formation	4 – 42	20 – 210	Very Low/low – Very High	-	DP1 (1.25 - >7.00)

*Assumed based on the results of the dynamic probing and reference to WS2.

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, Head Deposits and 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	5
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 one sample of Made Ground, two samples of Head Deposits and two 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**
Made Ground	35	99	41.58	CH	Stiff	High	High
Head Deposits	31 – 34	50 – 99	18.00 – 46.53	MH – CV	Stiff – Very Stiff	Low – High	Low – High
London Clay Formation	34	100	45.00	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 one sample of Made Ground, two samples of Head Deposits and two 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 overleaf.

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**
Made Ground WS1/0.50m bgl (Brown and orange brown CLAY with sandy patches and rare fine gravel)	35	27	41.58	0.19	Heavily Overconsolidated
Head Deposits WS2/0.80m bgl (Brown CLAY with rare fine gravel)	31	25	46.53	0.13	Heavily Overconsolidated
Head Deposits WS1/1.00m bgl (Brown and orange brown gravelly CLAY with sandy patches (gravel is fine to coarse and sub-angular to angular))	34	26	18.00	0.44	Overconsolidated
London Clay Formation WS2/3.00m bgl (Brown CLAY with blue grey veins and orange brown sandy patches)	34	29	45.00	0.11	Heavily Overconsolidated
London Clay Formation WS1/6.00m bgl (Brown CLAY with blue veins)	34	32	45.00	0.04	Heavily Overconsolidated

Liquidity Index testing revealed no evidence for a moisture deficit within the overconsolidated to heavily overconsolidated samples of the Head Deposits or 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 overleaf.

Moisture Content vs. Liquid Limit				
Strata/Trial Hole/Depth/Soil Description	**Moisture Content (MC) (%)**	**Liquid Limit (LL) (%)**	**40% Liquid Limit (LL)**	**Result**
Made Ground WS1/0.50m bgl (Brown and orange brown CLAY with sandy patches and rare fine gravel)	35	69	27.6	MC > 0.4 x LL (No significant moisture deficit)
Head Deposits WS2/0.80m bgl (Brown CLAY with rare fine gravel)	31	72	28.8	MC > 0.4 x LL (No significant moisture deficit)
Head Deposits WS1/1.00m bgl (Brown and orange brown gravelly CLAY with sandy patches (gravel is fine to coarse and sub-angular to angular))	34	62	24.8	MC > 0.4 x LL (No significant moisture deficit)
London Clay Formation WS2/3.00m bgl (Brown CLAY with blue grey veins and orange brown sandy patches)	34	74	29.6	MC > 0.4 x LL (No significant moisture deficit)
London Clay Formation WS1/6.00m bgl (Brown CLAY with blue veins)	34	77	30.8	MC > 0.4 x LL (No significant moisture deficit)

No evidence for a potential significant moisture deficit was noted within the overconsolidated to heavily overconsolidated samples of the Head Deposits or heavily overconsolidated samples of the London Clay Formation tested.

5.2.4 Sulphate and pH Tests

A sulphate and pH test was undertaken on one sample of the Head Deposits (WS2/1.00m bgl). The sulphate concentration was 0.26g/l with a pH of 7.99.

5.2.5 BRE Special Digest 1

In accordance with BRE Special Digest 1 'Concrete in Aggressive Ground' (BRE, 2005) one sample of Made Ground (WS2/0.50m bgl) and one sample of the London Clay Formation (WS1/1.50m bgl) were 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	-	6.8	6.9
Ammonium as NH_4	mg/kg	3.9	4.7
Sulphur	mg/kg	<200	<200
Chloride (water soluble)	mg/kg	9	12
Magnesium (water soluble)	g/l	0.0106	0.0166
Nitrate (water soluble)	mg/kg	9	14
Sulphate (water soluble)	g/l	0.08	0.11
Sulphate (total)	mg/kg	301	406

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 noted to a depth of between 0.60 – 0.90m bgl.

  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.

- Head Deposits were encountered underling the Made Ground in WS1 and WS2 to a depth of 1.25m bgl. The deposits comprised brown and orange brown/orange mottled sandy gravelly silty clays. The sand was fine to coarse grained. The gravel was rare to abundant, fine to medium, sub-rounded/rounded to sub-angular flint.

  The Head Deposits were shown to have a **low to high** potential for volume change in accordance with both BRE240 and NHBC Standards Chapter 4.2. Consistency Index calculations indicated the Head Deposits to be stiff to very stiff. Liquidity Index testing revealed the soils to be overconsolidated to heavily overconsolidated. Geotechnical analysis revealed no potential moisture deficits were present within the samples of the Head Deposits tested.

  Given the proposal to construct a basement beneath the footprint of the proposed structure, and therefore likely absence of footings structural remote from the basement, it is considered likely that foundations will bypass these materials and therefore are no longer considered as a founding strata for the proposed development.

- Soils of the London Clay Formation were encountered under the Head Deposits for the remaining depth of each borehole, a maximum depth of 7.00m bgl. These soils comprised a very low/low to very high undrained shear strength (20 – 210kPa) brown/orange brown and grey mottled silty clay with occasional sandy silty pockets. Fine selenite crystals were noted.

  The London Clay Formation was shown to have a **high** potential for volume change in accordance with both BRE240 and NHBC Standards Chapter 4.2. Consistency Index calculations indicated the London Clay Formation stiff. Liquidity Index testing revealed the soils to be heavily overconsolidated. Geotechnical analysis revealed no potential moisture deficits were present within the samples of the London Clay Formation tested.

  The heavily overconsolidated soils of the London Clay Formation are considered suitable stratum for lightly to moderately loaded traditional footings. The settlements induced on loading are likely to be low to moderate.

- Roots were noted to a depth of 1.00m bgl in WS1 and 1.30m bgl in WS2.

- A groundwater strike was observed within WS1 at 4.20m bgl. No groundwater was encountered in WS2. No groundwater was encountered in WS2. A standing water level of

1.02m bgl was recorded in the standpipe installed in WS1 on the 10th June 2015.

The standing water level in WS1 is likely to represent surface water or perched groundwater, migrating through the Made Ground, Head Deposits or London Clay Formation, collecting within a standpipe installed within the impermeable soils of the London Clay Formation.

6.2 Basement Foundations

At the time of reporting, June 2015, it is our understanding that the proposed development will comprise the construction of a two storey side extension, a single storey rear extension, the excavation of a basement below the entire footprint of the house and a loft conversion. The basement is anticipated to be founded at ~3.0 – 3.5m below existing ground level (bgl).

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.

A plan and section view of the proposed basement is given within Figure 4.

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 and 1.30m bgl in WS2. Foundation depths are proposed to extend beyond the maximum root penetrated soils noted.

It is considered likely the proposed basement will be constructed with load bearing concrete retaining walls with semi-ground bearing concrete floors. The following bearing capacities could be adopted for 5.0m long by 0.75m and 1.00m wide retaining wall strip footings pads at a depth of 3.00m bgl and 3.50m bgl. The bearing capacities and settlements were determined based on WS2/DP1.

Limit State: Bearing Capacities Calculated (Based on WS2/DP1)		
Depth (m BGL)	**Foundation System**	**Limit Bearing Capacity (kN/m^2)**
3.00	5.00m by 0.75m Strip	120.51
	5.00m by 1.00m Strip	121.50
	1.50m by 1.50m Pad	128.34
3.50	5.00m by 0.75m Strip	123.60
	5.00m by 1.00m Strip	124.59
	1.50m by 1.50m Pad	147.82

Serviceability State: Settlement Parameters Calculated (Based on WS2/DP1)			
Depth (m BGL)	**Foundation System**	**Limit Bearing Capacity (kN/m^2)**	**Settlement (mm)**
3.00	5.00m by 0.75m Strip	120	<20
	5.00m by 1.00m Strip	120	<24
	1.50m by 1.50m Pad	120	<21
3.50	5.00m by 0.75m Strip	120	<16
	5.00m by 1.00m Strip	120	<19
	1.50m by 1.50m Pad	120	<17

It must be noted that a bearing capacity of less than 55kN/m^2 at 3.00m bgl and less than 65kN/m^2 at 3.50m bgl may result in heave of the underlying soils.

Excavations must 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.

General Recommendations for Spread Foundations:

- 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.

- 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.

- Any groundwater or surface water ingress must be prevented from entering foundation trenches. Excavations must 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 and this could result in increased settlements.

- 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.

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

spots.

- 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 and the developments proximity to former, present and proposed trees.

A groundwater strike was observed within WS1 at 4.20m bgl. No groundwater was encountered in WS2. No groundwater was encountered in WS2. A standing water level of 1.02m bgl was recorded in the standpipe installed in WS1 on the 10th June 2015.

The standing water level in WS1 is likely to represent surface water or perched groundwater, migrating through the Made Ground, Head Deposits or London Clay Formation, collecting within a standpipe installed within the impermeable soils of the London Clay Formation.

It was considered unlikely that groundwater will be encountered during the construction of the basement. Perched water will be encountered within the Made Ground, Head Deposits and London Clay Formation, especially after period of prolonged rainfall. This will need to be taken into account in final design.

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

Given the results of the investigation a piled foundation scheme was not considered likely to be required at this site.

6.4 Basement Excavations & Stability

Shallow excavations in the Made Ground, Head Deposits and 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 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 HDP 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
Head Deposits	17 – 18	0	20	0.49	2.04
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.

A groundwater strike was observed within WS1 at 4.20m bgl. No groundwater was encountered in WS2. No groundwater was encountered in WS2. A standing water level of 1.02m bgl was recorded in the standpipe installed in WS1 on the 10th June 2015.

The standing water level in WS1 is likely to represent surface water or perched groundwater, migrating through the Made Ground, Head Deposits or London Clay Formation, collecting within a standpipe installed within the impermeable soils of the London Clay Formation.

It was considered unlikely that groundwater will be encountered during the construction of the basement. Perched water will be encountered within the Made Ground, Head Deposits and London Clay Formation, especially after period of prolonged rainfall.

6.5 Hydrogeological Effects

A study of the aquifer maps on the Environment Agency website revealed the site to be located within **Unproductive Strata** comprising the London Clay Formation.

The ground conditions encountered generally comprised a capping of Topsoil/Made Ground over the cohesive Head Deposits and then the cohesive London Clay Formation. Based on a visual appraisal of the soils encountered the permeability of the cohesive soils was likely to be negligible.

A groundwater strike was observed within WS1 at 4.20m bgl. No groundwater was encountered in WS2. No groundwater was encountered in WS2. A standing water level of 1.02m bgl was recorded in the standpipe installed in WS1 on the 10th June 2015.

The standing water level in WS1 is likely to represent surface water or perched groundwater, migrating through the Made Ground, Head Deposits or London Clay Formation, collecting within a standpipe installed within the impermeable soils of the London Clay Formation.

It was considered unlikely that groundwater will be encountered during the construction of the

basement. Perched water will be encountered within the Made Ground, Head Deposits and London Clay Formation, especially after period of prolonged rainfall.

In relation to the basement, once constructed, the Made Ground, Head Deposits and underlying cohesive London Clay Formation are unlikely to act as a porous medium for water to migrate, therefore additional drainage should be considered as the deposits will act as a barrier for groundwater migration.

6.6 Sub-Surface Concrete

Sulphate concentrations measured in 2:1 water/soil extracts taken from the Made Ground and Kempton Park Gravel Formation, from both the geotechnical and chemical laboratory testing, fell into Classes DS-1 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-1 for foundations within the Made Ground and Kempton Park Gravel Formation. For the classification given, the "mobile" and "natural" case was adopted given the geology (infiltration rates in the Head Deposits and Made Ground are likely to exceed 10 -7m/sec and the presence of a groundwater strike in WS1), and the history of the site.

The sulphate concentration in the samples ranged from 80 - 260mg/l with a pH range of 6.8 – 8.0. The total sulphate concentration recorded ranged from ~0.03 – 0.04%.

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 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.

6.7 Surface Water Disposal

Infiltration tests were beyond the scope of the investigation.

Soakaway construction within the Made Ground, Head Deposits and London Clay Formation are unlikely to prove satisfactory due to negligible anticipated infiltration rates.

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.

6.8 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.

6.9 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 classified 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).

6.10 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.

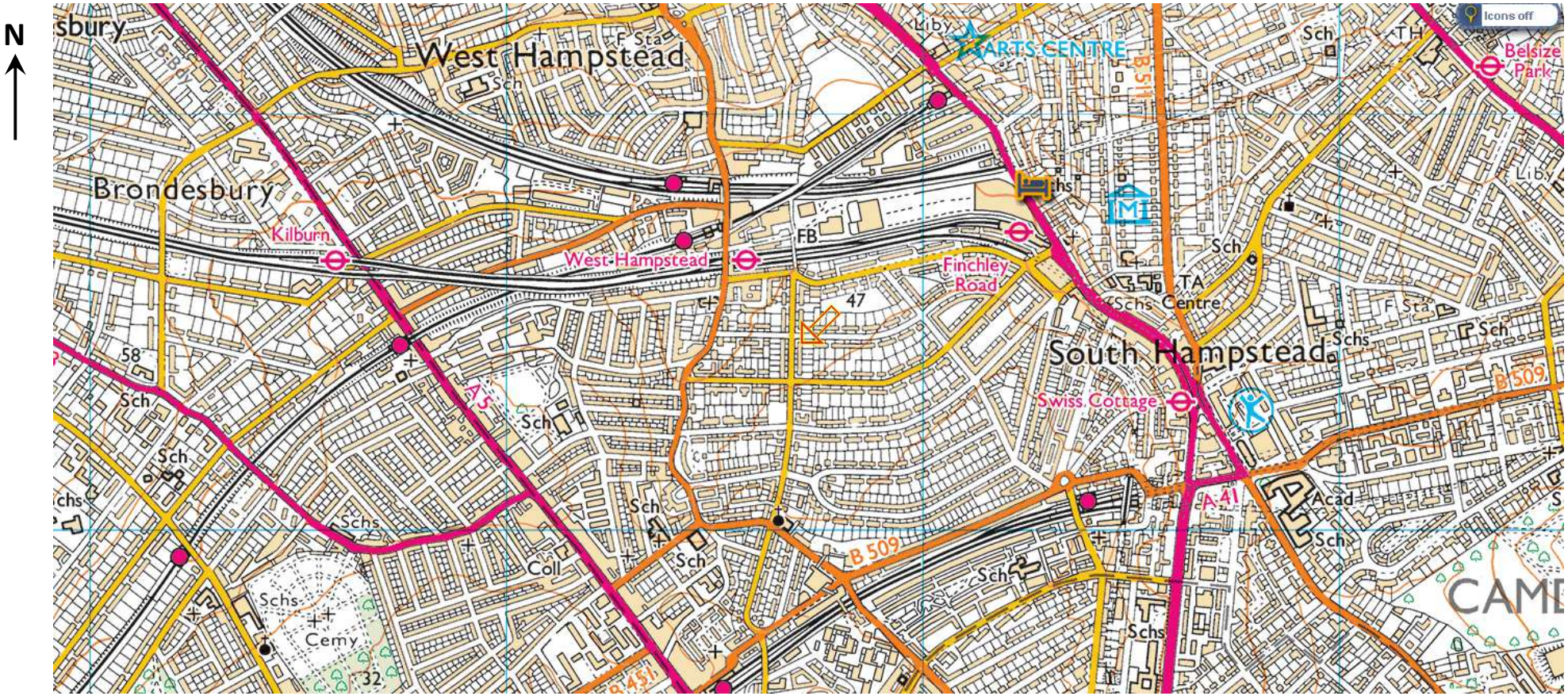
The Topsoil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be tested, either prior to placing (ideally) or after placing, to ensure that the human receptor cannot come into contact with compounds that could be detrimental to human health.

6.11 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.



NOT TO SCALE

Project: The Coach House, 98a Priory Road, London NW6 3NT		**Figure 1**
Client: Michael Cohen	**Date:** June 2015	ground&water
Site Location Plan	**Ref:** GWPR1256	

N

APPROXIMATE SITE BOUNDARY

NOT TO SCALE

Project: The Coach House, 98a Priory Road, London NW6 3NT		**Figure 2**
Client: Michael Cohen	**Date:** July 2015	ground&water
Site Development Area	**Ref:** GWPR1256	

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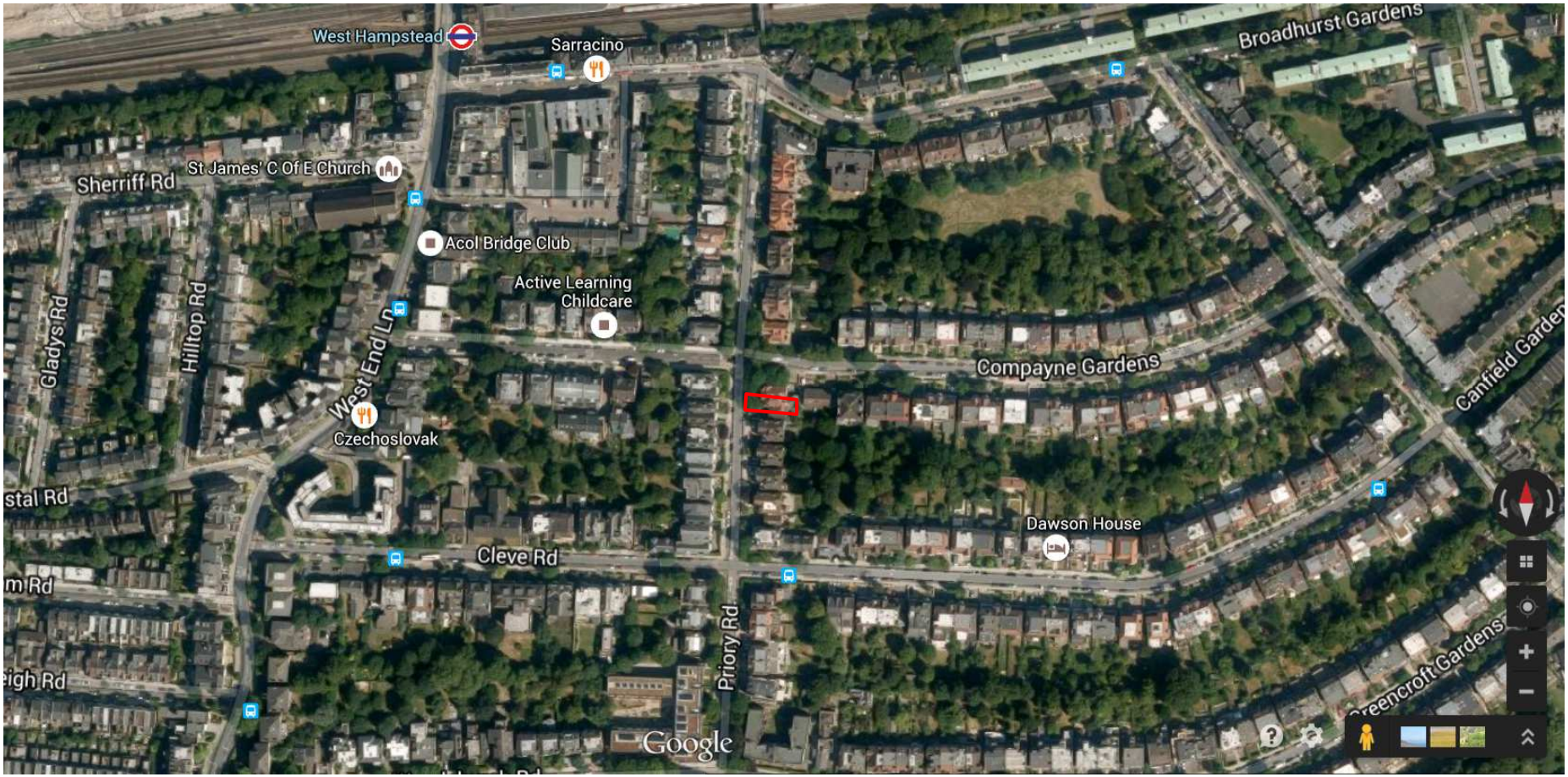
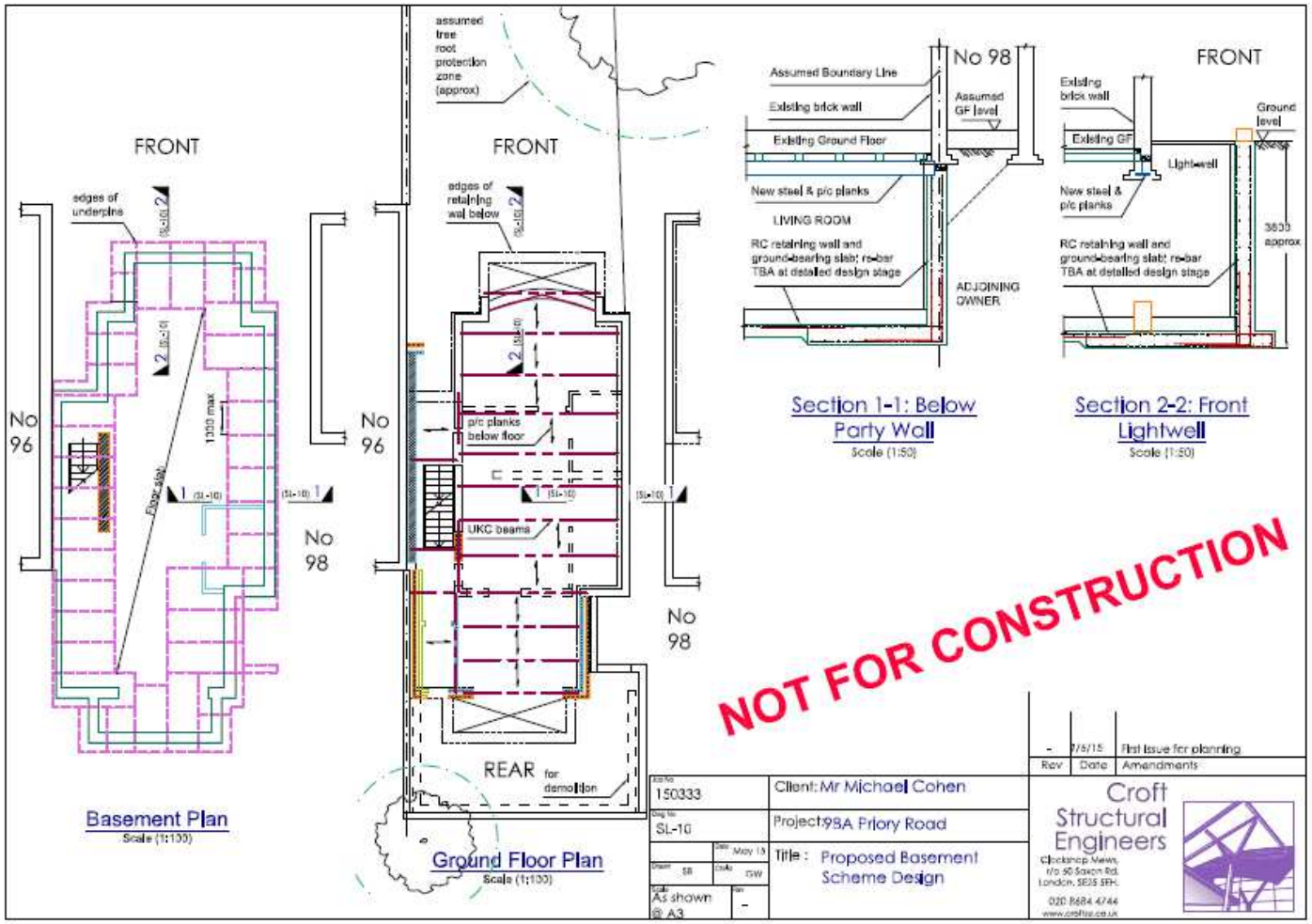


APPROXIMATE SITE BOUNDARY

NOT TO SCALE

Project: The Coach House, 98a Priory Road, London NW6 3NT		**Figure 3**
Client: Michael Cohen	**Date:** July 2015	ground&water
Aerial View of Site	**Ref:** GWPR1256	

N



NOT TO SCALE

Project: The Coach House, 98a Priory Road, London NW6 3NT	**Figure 4**
Client: Michael Cohen	**Date:** June 2015
Proposed Development – Plan and Section View	**Ref:** GWPR1256

ground&water

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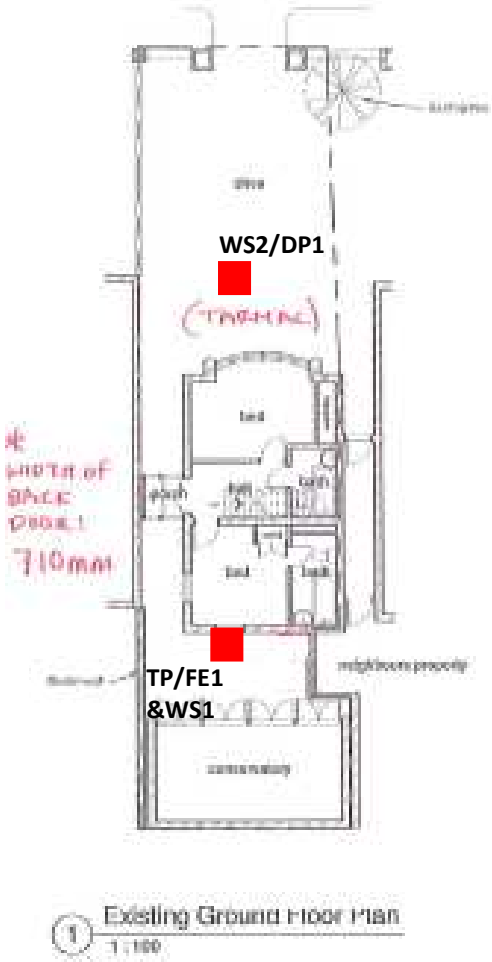
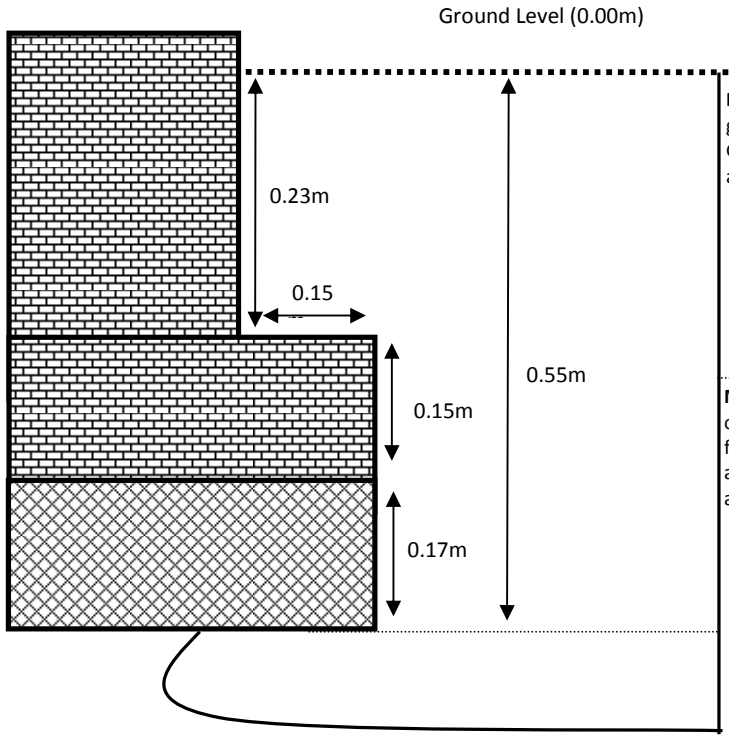


APPROXIMATE SITE BOUNDARY

NOT TO SCALE

Project: The Coach House, 98a Priory Road, London NW6 3NT		**Figure 5**
Client: Michael Cohen	**Date:** June 2015	ground&water
Trial Hole Location Plan	**Ref:** GWPR1256	



NOTE: NOT TO SCALE

Project: **The Coach House, 98a Priory Road, London NW6 3NT**		**Figure 6**
Client: **Michael Cohen**	**Date:** **June 2015**	ground&water
Section Drawing: Foundation Exposure TP/FE1	**Ref:** **GWPR1256**	

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 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.

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.

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 samples 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 The Coach House, 98a Priory Road, London NW6 3NT.

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.

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

Borehole No
WS1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
The Coach House	GWPR1256		WS
Location: 98A Priory Road, London NW6 3NT		Level: -	Scale 1:50
Client: Michael Cohen		Dates: 14/05/2015	Logged By MJ

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.25	D		0.30			MADE GROUND: Paving slab/sand/brick/concrete over a brown yellow and grey gravelly sand sub-base. Sand is fine to medium grained. Gravel is abundant, fine to coarse, sub-rounded to sub-angular flint, concrete and cemented sands.
		0.50	D					
		0.80	D		0.90			MADE GROUND: Light brown and orange brown mottled sandy gravelly silty clay. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-rounded to sub-angular, cemented sands, flint and brick.
		1.00	D					
		1.50	D		1.25			HEAD DEPOSITS: Orange brown and brown mottled sandy gravelly silty CLAY. Sand is fine to coarse grained. Gravel is abundant, fine to medium, sub-rounded to sub-angular flint.
		2.00	D					LONDON CLAY FORMATION: Medium brown, with occasional orange and grey mottling, silty CLAY. Fine selenite crystals noted throughout. Occasional sandy/silty pockets noted.
		2.50	D					
		3.00	D					
		3.50	D					
	▽	4.00	D					
		4.50	D					
		5.00	D					
		5.50	D					
		6.00	D					
		6.50	D					
		7.00	D		7.00			End of Borehole at 7.00 m
			Type	Results				

Remarks: Water strike at 4.20m bgl.
Roots noted at 1.00m bgl.
19mm installation to 5.00m bgl.

AGS

ground &water
geotechnical and environmental consultants

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

Borehole No
WS2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
The Coach House	GWPR1256		WS
Location: 98A Priory Road, London NW6 3NT		Level: -	Scale 1:50
Client: Michael Cohen		Dates: 01/05/2015	Logged By MJ

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.25	D		0.30			MADE GROUND: Tarmac over a brown and light brown mottled sandy gravelly silty clay. Sand is fine to coarse grained. Gravel is occasional, fine to coarse, sub-angular to sub-rounded brick and carbonaceous material.
		0.50	D		0.60			
		0.85	D		0.90			MADE GROUND: Light brown and orange brown mottled sandy gravelly silty clay. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-rounded to sub-angular flint and brick.
		1.00	D		1.25			
		1.50	D					HEAD DEPOSITS: Brown and orange brown mottled gravelly silty CLAY. Gravel is rare, fine, rounded to sub-rounded flint.
		2.00	D					HEAD DEPOSITS: Orange and brown mottled sandy gravelly silty CLAY. Sand is fine to coarse grained. Gravel is abundant, fine to medium, sub-rounded to sub-angular flint.
		2.50	D					LONDON CLAY FORMATION: Medium brown, with occasional orange and grey mottling, silty CLAY. Fine selenite crystal noted throughout. Occasional sandy/silty pockets noted.
		3.00	D					
		3.50	D					
		4.00	D					
		4.50	D					
		5.00	D					
		5.50	D					
		6.00	D					
		6.50	D					
		7.00	D		7.00			End of Borehole at 7.00 m
			Type	Results				

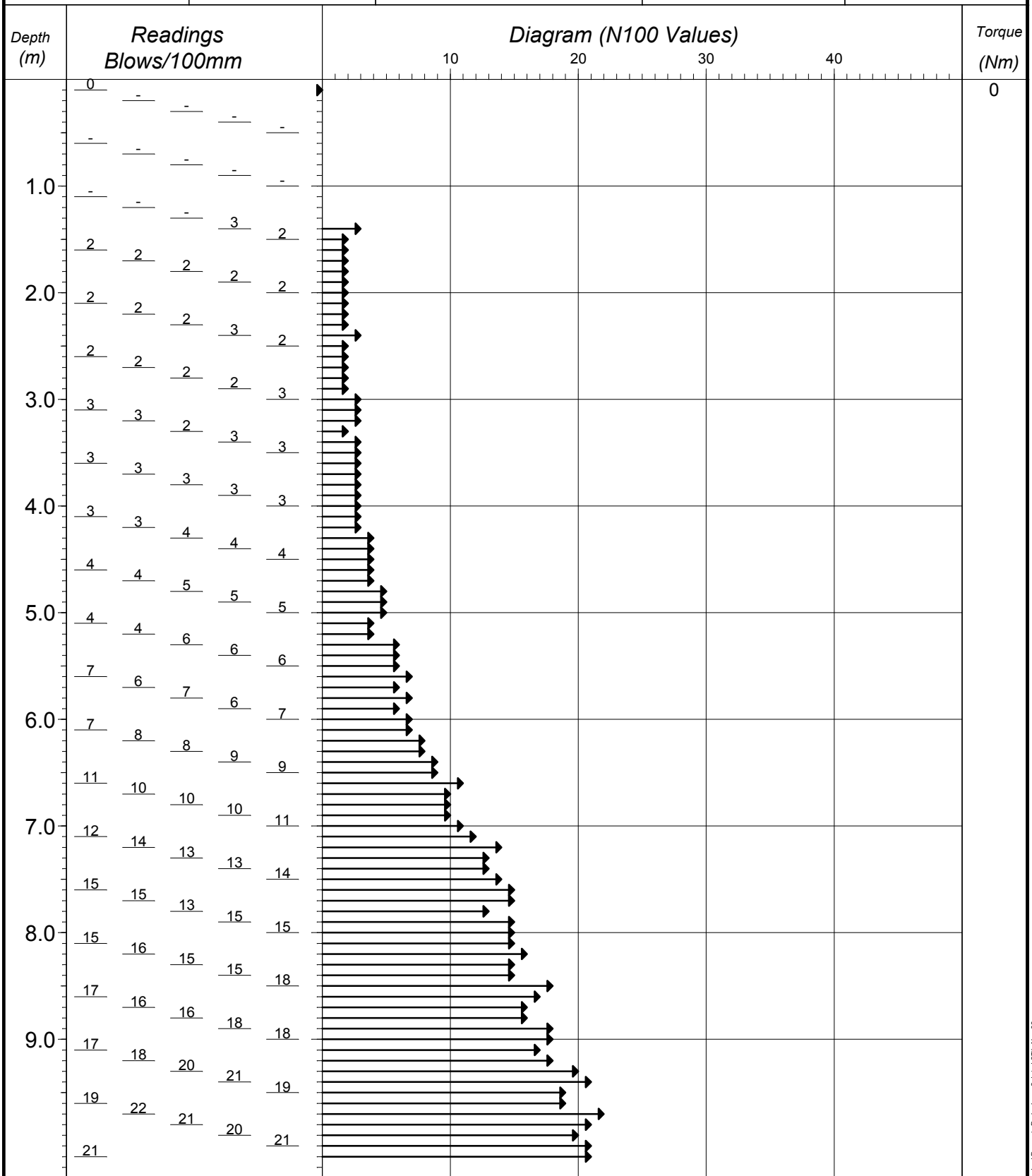
1 2 3 4 5 6 7 8 9

Remarks: Roots noted at 1.30m bgl.
No groundwater encountered.

AGS

DYNAMIC PROBING

Probe No **DP1/WS2**			
Client **Michael Cohen**		Sheet 1 of 1	
Site **The Coach House**		Project No **GWPR1256**	
E -	N -	Level -	Date **01/05/2015**	Logged by **SJM**



Ground and Water Ltd Tel: 0333 600 1221 email: enquiries@groundandwater.co.uk www.groundandwater.co.uk			
Fall Height	**500**	*Cone Base Diameter*	**43**
Hammer Wt	**50.00**	*Final Depth*	**10.00**
Probe Type	**DPH**	*Log Scale*	1:50

APPENDIX C
Geotechnical Laboratory Test Results

Summary of Classification Test Results

Job No.	Project Name	Programme	
18855	The Coach House, 98a Priory Road	Samples received	15/05/2015
		Schedule received	15/05/2015
Project No.	Client	Project started	15/05/2015
1256	Ground and Water Ltd	Testing Started	22/05/2015

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top	Base	Type		%	%	%	%	%	
WS1		0.50		D	Brown and orange brown CLAY with sandy patches and rare fine gravel	35	99	69	27	42	
WS1		1.00		D	Brown and orange brown gravelly CLAY with sandy patches (gravel is fmc and sub-angular to angular)	34	50	62	26	36	
WS1		6.00		D	Brown CLAY with blue grey veins	34	100	77	32	45	
WS2		0.80		D	Brown CLAY with rare fine gravel	31	99	72	25	47	
WS2		3.00		D	Brown CLAY with blue grey veins and orange brown sandy patches	34	100	74	29	45	

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

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

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials **J.P**

Date: 27/05/2015

Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results

Tested in accordance with BS1377 : Part 3 : 1990, clause 5.3 and clause 9

Job No.	Project Name	Programme	
18855	The Coach House, 98a Priory Road	Samples received	15/05/2015
		Schedule received	15/05/2015
Project No.	Client	Project started	15/05/2015
1256	Ground and Water Ltd	Testing Started	26/05/2015

Hole No.	Sample				Soil description	Dry Mass passing 2mm	SO3 Content	SO4 Content	pH	Remarks
	Ref	Top	Base	Type		%	g/l	g/l		
WS2		1.00		D	Brown very gravelly silty CLAY (gravel is fmc and sub-angular to rounded)	60	0.22	0.26	7.99	

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials J.P

Date: 27/05/2015

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: 15-31474

Site Reference:	The Coach House, 98a Priory Road, London NW6 3NT
Project / Job Ref:	GWPR1256
Order No:	None Supplied
Sample Receipt Date:	15/05/2015
Sample Scheduled Date:	15/05/2015
Report Issue Number:	1
Reporting Date:	20/05/2015

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

4480

Soil Analysis Certificate							
QTS Environmental Report No: 15-31474	**Date Sampled**	01/05/15	01/05/15			
Ground & Water Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: The Coach House, 98a Priory Road, London NW6 3NT	**TP / BH No**	WS1	WS2			
Project / Job Ref: GWPR1256	**Additional Refs**	None Supplied	None Supplied			
Order No: None Supplied	**Depth (m)**	1.50	0.50			
Reporting Date: 20/05/2015	**QTSE Sample No**	148739	148740			

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	**MCERTS**	6.8	6.9			
Total Sulphate as SO_4	mg/kg	< 200	NONE	301	406			
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	**MCERTS**	0.08	0.11			
Total Sulphur	mg/kg	< 200	NONE	< 200	< 200			
Ammonium as NH_4	mg/kg	< 0.5	NONE	3.9	4.7			
W/S Chloride (2:1)	mg/kg	< 1	**MCERTS**	12	9			
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	**MCERTS**	9	14			
W/S Magnesium	g/l	< 0.0001	NONE	0.0166	0.0106			

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: 15-31474	
Ground & Water Ltd	
Site Reference: The Coach House, 98a Priory Road, London NW6 3NT	
Project / Job Ref: GWPR1256	
Order No: None Supplied	
Reporting Date: 20/05/2015	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 148739	WS1	None Supplied	1.50	19.7	Light brown clay
$ 148740	WS2	None Supplied	0.50	21.2	Light brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample I/S

Unsuitable Sample U/S

$ samples exceeded recommended holding times

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: 15-31474
Ground & Water Ltd
Site Reference: The Coach House, 98a Priory Road, London NW6 3NT
Project / Job Ref: GWPR1256
Order No: None Supplied
Reporting Date: 20/05/2015

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 (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	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 (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received