Southstudio

Appendix 3

Basement Impact Assessment
'The Cottage', Spaniards Road, London, NW3 7JH

July 2014

Intended for
Lawrence Kershen

Document type
Basement Impact Assessment

Date
March 2014

THE COTTAGE, SPANIARDS ROAD, LONDON
BASEMENT IMPACT ASSESSMENT

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BASEMENT IMPACT ASSESSMENT

Revision	**1**
Date	**06/03/2014**
Made by	**Oli Mills**
Checked by	**Ian Lewis**
Approved by	**Andy Rose**
Description	**Basement Impact Assessment**

Ref 61020760/GT/R01

Revision History

Revision	Date	Purpose / Status	Document Ref.	Comments
-	November 2013	For Approval	61020760/GT/R01	
1	March 2014	Final	61020760/GT/R01	Executive Summary added

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1. EXECUTIVE SUMMARY

Ramboll have been commissioned to carry out a Basement Impact Assessment (BIA) for a proposed development in the London Borough of Camden. The development involves the demolition of an existing two storey residential building and the construction of a new building with two storeys above ground and a basement.

In order to satisfy the requirements of the Camden Planning Guidance a BIA is necessary to prove there is no undue risk or disruption presented in proposed developments. A BIA must consider any change to the flood risk caused by the proposed scheme. The risk of ground instability as a result of the construction of the basement and disruption to local amenities can be mitigated through good design and appropriate construction methods.

Following evaluation at screening stage, it is deemed that a full BIA is not required for this site for the following reasons;

- The site has never flooded but is located on Spaniards Road, where sections of the road located at a lower elevation were flooded during the summer of 1975 when an extreme rainfall event overwhelmed the drainage system. During a similar extreme rainfall event in 2002 Spaniards Road was not subject to flooding. The flood risk maps for surface water flooding indicate that the property is at very low risk of flooding.
- Groundwater was not encountered during the ground investigation or subsequently during monitoring of the 8 metre deep groundwater standpipes installed. As the proposed basement level is a maximum (base of swimming pool) of 4.5 metres below ground level, the groundwater is likely to be at a depth twice as deep as the basement.
- The Mount Tyndal apartment building lies approximately 35 metres south-south west from the property and the proposed basement. The distance is sufficient as to have no effect upon the foundations of the adjacent property during or after construction.
- The site is situated 500 metres west and at an elevation higher than the nearest surface water features, these being the Hampstead Ponds.
- Due to the relatively low slope gradients at the site location, ground conditions and lack of groundwater, slope instability is not a risk.

Following CPG4 section 2.33, it is deemed that an independent verification of this BIA is not required.

2. INTRODUCTION

2.1 Background

Ramboll have been commissioned by UCHI Architecture on behalf of Lawrence Kershen to carry out a basement impact assessment screening report to support the planning application for a new basement for The Cottage, Spaniards Road, London. Since appointment, UCHI Architecture has been replaced on the project first by Sidell Gibson Architects and then subsequently by South Studio Architects.

This report has been prepared following guidance in the London Borough of Camden's Planning Guidance document No 4.

2.2 Qualification of Authors

The qualifications of the authors of this report are summarised below:

Oli Mills, Design Engineer, BSc (Hons) FGS

Ian Lewis, Principal Engineer, BEng (Hons) MSc CEng MIED FGS ACSM

Andy Rose, Project Director Geotechnics, BSc MSc CGeol FGS

3. DESCRIPTION OF PROJECT

3.1 Location

The site is located at the northern end of Spaniards Road, Hampstead, within the Borough of Camden, London, NW3 7JH. The site is located at grid reference TQ 26645 87189. The site lies on the northern perimeter of the Hampstead Heath Extension, approximately 400 metres south of Hampstead Golf Course as shown in Figure 1.

At its closest point the existing house and proposed basement is positioned approximately five metres from Spaniards Road. Based on available information the site is not underlain by tunnels or affected by exclusion zones associated with tunnels or railway lines.

3.2 Proposed Development

The key proposals for the site are as follows:

- Substantial alteration to the existing dwelling including an increase in the current building footprint.
- Creation of a new 3.6 metre deep basement containing a swimming pool (4.5 metre total depth) beneath the property. The proposed basement will be approximately ten metres from Spaniards Road (see plan in Appendix A).

4. SOURCES OF INFORMATION

The following sources of information have been used in this assessment:

- Camden Planning Guidance No 4: Basements and Light wells,
- Camden Development Policy DP22: Promoting Sustainable Design and Construction
- Camden Development Policy DP23: Water
- Camden Development Policy DP27: Basements and Lightwells
- Camden Geological, Hydro-geological and Hydrological Study, by Ove Arup & Partners Ltd 2010 including Appendices and Report Figures.

- Report on Ground Investigation, The Cottage, Spaniards Road, London, NW3 7JH, Site Analytical Services, March 2011. (Appendix B)
- Exploratory hole logs, Harrisons Environmental Group Ltd, April 2013. (Appendix C)
- Map 8 Flood Risk Plan, North London Waste Plan.
- North London Waste Plan Strategic Flood Risk Assessment Plan.

5. CONCEPTUAL MODEL

5.1 Topography

A plan view of the site is shown in Appendix A. The elevation of the site varies between 132.9 metres above ordnance datum (mAOD) and 129.3 mAOD; the highest elevation is to the west where the site adjoins Spaniards Road. The south east area of the site which consists of the garden is at a lower level and typically at an elevation of 131 mAOD. The north and east perimeter of the garden slopes steeply from 130.7 mAOD to 129.3 mAOD.

In a wider context the site lies on the shoulder of a hill that continues to extend up gently towards the south west to an elevation of approximately 140 mAOD. Figure 2 shows the site to lie within a hillside with a slope of less than 7º. Localised steeper slopes are shown north, west and immediately east of the site.

5.2 Hydrology

An extract of the surface water features in the Camden area is shown in Figure 3. This shows that the site is not located adjacent to existing surface water features.

Figure 12 and Figure 13 within the Camden Geological, Hydro-geological and Hydrological Study show the site to be approximately 500 metres west of the closest Hampstead Pond (Wood Pond). An extract showing the location of the site in relation to the Hampstead Ponds is presented in Figure 3. Although not shown, the site is also higher in elevation than the ponds.

Figure 14 within the Camden Geological, Hydro-geological and Hydrological Study shows the site to lie within the Highgate Chain drainage and catchment area of the Hampstead Ponds. An extract showing the location of the site with respect to the surface water and drainage catchment areas is presented in Figure 4.

Based on the information available there are no watercourses associated with the Lost Rivers of London adjacent to the site. An extract showing the location of the lost rivers relative to the site is presented in Figure 5.

Figure 15 within the Camden Geological, Hydro-geological and Hydrological Study and Map 22 of North London Waste Plan shows Spaniards Road approximately 50 metres north of The Cottage to have had street flooding in 1975. However, the road at this location is at a lower level than the site. This information has been reproduced and presented in Figure 6.

5.3 Site Drainage

5.3.1 Existing Drainage

At present, runoff from hard standing areas and rain water pipes at the front of the property is understood from information provided by South Studio Architects to discharge into the combined public sewer. A rain water pipe located at the rear of the property runs below existing decking and runoff is likely to discharge to ground directly. It is not known if there is an existing soakaway present on site.

5.3.2 Area of Hard-standing/Pavement to Drain

The volume of runoff post development will be increased as there is additional impermeable area being introduced on site. The proposal for the works is to increase the size of the building and to introduce a basement.

5.3.3 Proposed Drainage

The proposed drainage is that surface water runoff will be discharged using existing discharge points, which may include a soakaway to the rear of the building. We note that provision of new soakaways would be screened as "suitable" given the ground conditions encountered at the site (Section 4.5). Where it is proposed to reuse any existing soakaway it should be tested to confirm its adequacy.

5.3.4 Changes to Surface Water Quality

There will be no downstream receptor for the surface water as the overflow from the rainwater harvesting tank would discharge at source to a soakaway.

As indicated in Figure 8 the site is underlain by strata that are considered a secondary aquifer which may form the base flow to a river.

5.3.5 Risk of Flooding

Figure 9 within the LBC Guidance for subterranean development by Arup (dated Nov 2010) and the North London Strategic Flood Risk Assessment (SFRA), Map 22 by Mouchel (dated Aug 2008) suggests that the northern end of Spaniards Road may have been subject to flooding in 1975. This is reported as being a result of localised surcharge within the public sewer due to a one in one hundred years storm event. An extract showing the streets where floods have been recorded is shown in Figure 6.

At present the foul water discharges via gravity into the public sewer. It is currently not known how foul sewerage will be discharged.

As shown in Figure 5 one of the tributaries of a Lost River of London is situated to the south east of Spaniards Road. The direction of flow of the tributary is in an easterly to south-easterly direction into the Hampstead Ponds, which were created in the 17th Century to increase the London water supply. From here the flow continues towards Kentish Town to join the River Fleet.

5.4 Geology

The published British Geological Survey (BGS) 1:50,000 geological map sheet 256 : North London (solid and drift), shows the site to be underlain by the Bagshot Formation which overlies the Claygate Member which in turn overlies the London Clay Formation. The boundary between the Bagshot Formation and the Claygate Member is approximately 50 metres to the east of the existing property. A small deposit of Stanmore Gravel lies approximately 10 metres to the west of the site. The digital geological map at a scale of 1:10,000 shows an area approximately 100 metres west of the site as previously worked ground. Similar features are common in the area and are typically where Bagshot Formation materials have been excavated. An extract of the digital geological map at a scale of 1:10,000 showing the site location is shown in Figure 7.

5.5 Ground Conditions

Two ground investigations have been carried out at the site. Site Analytical Services (SAS) carried out an investigation during February 2011 under the direction of UCHI Architecture and a copy of the factual report is presented in Appendix B. Harrison Environmental Group Ltd carried out an investigation on 4 April 2013 under the direction of Ramboll and a copy of the exploratory hole logs are presented in Appendix C.

A simplified ground profile encountered below the site is given in Table 5.1.

Stratum	Range of Base Depth		Description
	Metres below ground level	Metres above ordnance datum	
Made Ground	0.6 to 1.6	130.54 to 129.4	Loose to medium dense silty sand with rubble
Bagshot Formation	Not proved at 8.13	Not proved at 121.87	Medium dense yellow brown silty fine to medium sand.

Table 5.1 Simplified ground profile

The available exploratory holes reveal the Bagshot Formation to be at a shallow depth below the site, and the top of the Claygate Member, which was not encountered, to be at a depth greater than 8.13 metres below ground level (mbgl).

5.6 Hydrogeology and Groundwater Conditions

An extract of the aquifer designation map showing the site location is presented in Figure 8 and shows the site to be in a designated Secondary A (or Upper) Aquifer. This is consistent with the Bagshot Formation encountered at shallow depth in the ground investigation. The chalk (or Lower) aquifer is at considerable depth below the site; it is estimated based on the geological map that the top of the chalk aquifer is at least 90 metres below the site. The proposed development therefore is likely to affect the upper aquifer but not the lower aquifer.

Springs are not indicated adjacent to the site. The nearest spring is located approximately 300 metres to the east and approximately 25 metres lower than ground level at the site. Springs are anticipated at the boundary between the Bagshot Formation (Upper Aquifer) and underlying Claygate Formation; which is present approximately 50 metres to the east of the site. However, springs in the local area seem to coincide with the interface between the Claygate Formation and London Clay Formation. This interface will be to the south and east of the site and considerably lower, based on the ground investigation data; the current proposals are therefore not expected to influence, or be influenced by, these "possible" seepage points.

On the site, groundwater was not encountered within the boreholes. 8 metre deep groundwater monitoring standpipes were installed during the ground investigation carried out by Harrison Environmental Group Ltd within exploratory holes WS1, WS2 and WS3; groundwater levels were measured on two occasions and are reported as no groundwater present. The proposed basement will therefore be above groundwater level.

Groundwater flow is expected to follow existing levels, and the rate of flow is expected to be typically rapid due to the high permeability of the Bagshot Formation. The proposed construction will however be above groundwater level.

An outer source protection zone is shown in Figure 8 of the Camden Geological, Hydro-geological and Hydrological Study to be approximately 2000 metres to the south of the site.

5.7 Risk of Instability

The published BGS 1:50,000 Geological map Sheet 256 North London (solid and drift), presents an assessment of the potential for slope instability. This shows the site not to lie within "Areas of significant landslide potential", although it is recognised that it is difficult to exactly define the coverage of this zone due to the scale of the geological map. This zone appears to coincide with the boundary between the Claygate Member and the London Clay Formation. This suggests that there is a low risk of slope instability at the site.

Figure 2 shows the site to be within an area with slopes less than 7°; however steeper slopes are indicated north, west and immediately east of the site. The low gradient and the presence of Bagshot Formation indicates that there is a low risk of existing instabilities within the site; however a higher risk of instability exists within the local

steeper slopes. The available ground investigation information shows that groundwater was not encountered. Due to the relatively low slope gradients at the site location, ground conditions and lack of groundwater, slope instability is not considered to be a high risk.

The highest risk of instability is considered to be associated with proposed basement construction and its potential effects on adjacent buildings and roads, both during construction and in the longer term. The proposed basement construction incorporates an excavation of up to 4.5 metres below the existing property. Basement design will need to consider the resultant earth pressures to provide safe long term stability, and the proximity and depth of the adjacent properties' foundations.

The Mount Tyndal apartment building lies approximately 35 metres from the property and the proposed basement. This is not required to be considered in the design of the temporary works to deepen the foundation and form the basement in The Cottage as the distance should be sufficient as to have no effect upon the foundations of the adjacent property during or after construction.

5.8 Shrinkage Potential

The site is underlain by the Bagshot Formation comprising sand with little or no fines present. This strata will not be acted upon by shrinkage or swelling.

The root system of a large oak tree located to the rear of the property could potentially be affected by the excavation of the basement.

6. BASEMENT IMPACT ASSESSMENT

6.1 Screening

The screening flowcharts presented in Camden Planning Guidance CPG4 are presented below with the site specific information. Where an answer of yes is entered this is considered in more detail in Section 6.2.

Flowchart Question	Answer	Justification
Is the site within the catchment of the pond chains on Hampstead Heath	Yes	Refer to Section 5.2 and 6.2.1
As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	Refer to Section 5.3.2
Will the proposed basement development result in a change in the proportion of hard surfaced/paved external areas?	Yes	Refer to Section 5.3.2
Will the proposed basement result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	No	Refer to Section 5.3.3
Will the basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	Refer to Section 5.3.4
Is the site in an area known to be at risk from surface water flooding or at risk from flooding?	No	Refer to Section 5.3.5

Table 6.1 Surface flow and flooding screening flowchart

Flowchart Question	Answer	Justification
Is the site located directly above an aquifer?	Yes	Refer to Section 5.5 and 6.2.2
Will the proposed basement extend beneath the water table surface?	No	Refer to Section 5.2.1

Flowchart Question	Answer	Justification
Is the site within 100 metres of a watercourse, well (used/ disused) or potential spring line?	No	Refer to Sections 5.2 and 5.6
Is the site within the catchment of the pond chains on Hampstead Heath?	Yes	Refer to Section 5.2. and 6.2.2
Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	Yes	Refer to Section 5.3.2
As part of the site drainage, will more surface water than at present be discharged into the ground?	Yes	The site drainage is to be replaced but uses the same discharge point.
Is the lowest point of the proposed excavation close to, or lower than the mean water level in any local pond or spring line?	No	Refer to Section 5.6

Table 6.2 Subterranean (groundwater) flow screening flowchart

Flowchart Question	Answer	Justification
Does the site include slopes, natural or man-made greater than 7 degrees?	No	Refer to Section 5.1 and 5.7
Will the proposed re-profiling/ landscaping at site change slopes at the property boundary to more than 7 degrees?	No	Refer to Section 3.2 and 5.1
Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees?	Yes	Refer to Section 5.7
Is the site within a wider hillside setting in which the slope is greater than 7 degrees?	Yes	Refer to Section 5.1
Is the London Clay the shallowest strata at the site?	No	Refer to Table 5.1
Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are retained?	No	Refer to Section 3.2
Is there a history of seasonal shrink-swell subsidence in the area, and/or evidence of such effects on site?	No	Refer to Section 5.8
Is the site within 100 metres of a watercourse or a potential spring line?	No	Refer to Section 5.6
Is the site within an area of previously worked ground?	No	Refer to Section 5.4
Is the site within an aquifer?	Yes	Refer to Section 5.6
Is the site within 50 metres of the Hampstead Ponds	No	Refer to section 5.2
Is the site within 5 metres of a highway or pedestrian right of way?	No	Refer to Section 3.1
Is the site over any tunnels or within exclusion zone of tunnels?	No	Refer to Section 3.1

Table 6.3 Slope stability screening flowchart

6.2 Scoping

The items with 'Yes' responses in Tables 6.1, 6.2 and 6.3 are considered and discussed in this section to determine if the issue is required to be considered further.

6.2.1 Surface Flow and Flooding Screening

The site is within the catchment zone of the Highgate Chain of Hampstead Ponds; however, due to the groundwater level being lower than the proposed basement level, there should be no impact on groundwater flow. Proposals also include plans to increase the surface hard-standing area, which would result in an increase in surface run-off. However it is proposed to use the existing discharge point and either reuse existing or construct new soakaways. It is therefore recommended that this potential impact is not considered further.

6.2.2 Hydro-geological Screening

As stated in Section 5.6 the site is located within a secondary aquifer. As the groundwater level within the aquifer is lower than the proposed level of the underside of the basement, and the footprint of the proposed basement will lie within the footprint of

the existing building resulting in no change in the surface water regime, it is considered that there should be no impact on the aquifer itself. It is recommended that this potential impact is not considered further.

As discussed in 6.2.1, the site is within the catchment zone of the Highgate Chain of Hampstead Ponds and plans are to increase the amount of hardstanding on the site therefore an increase in surface run-off is to be expected.

6.2.3 Slope Stability Screening

The site is within a wider hillside setting in which the slope angle is greater than 7°, but the site is in a local setting in which the slope angle is less than 7°.

Based on the slope angles and ground conditions local to the site it is not deemed necessary to consider the slope stability as an issue pertinent to the site. Considering the distance of adjacent structures and their associated foundations from the proposed construction works they are unlikely to impact on the design and construction of the basement with relation to stability.

It is therefore recommended that the slope stability screening issues are not considered further.

7. CONCLUSIONS

The proposed development has been screened using the process given in CPG4 and this highlighted several factors that required consideration at the scoping stage.

This report has discussed and reviewed each of these factors with respect to the proposed development plan and design.

Based on the outcome of the review of the factors it is concluded that this basement impact assessment is not required to be developed into a full impact assessment.

FIGURES

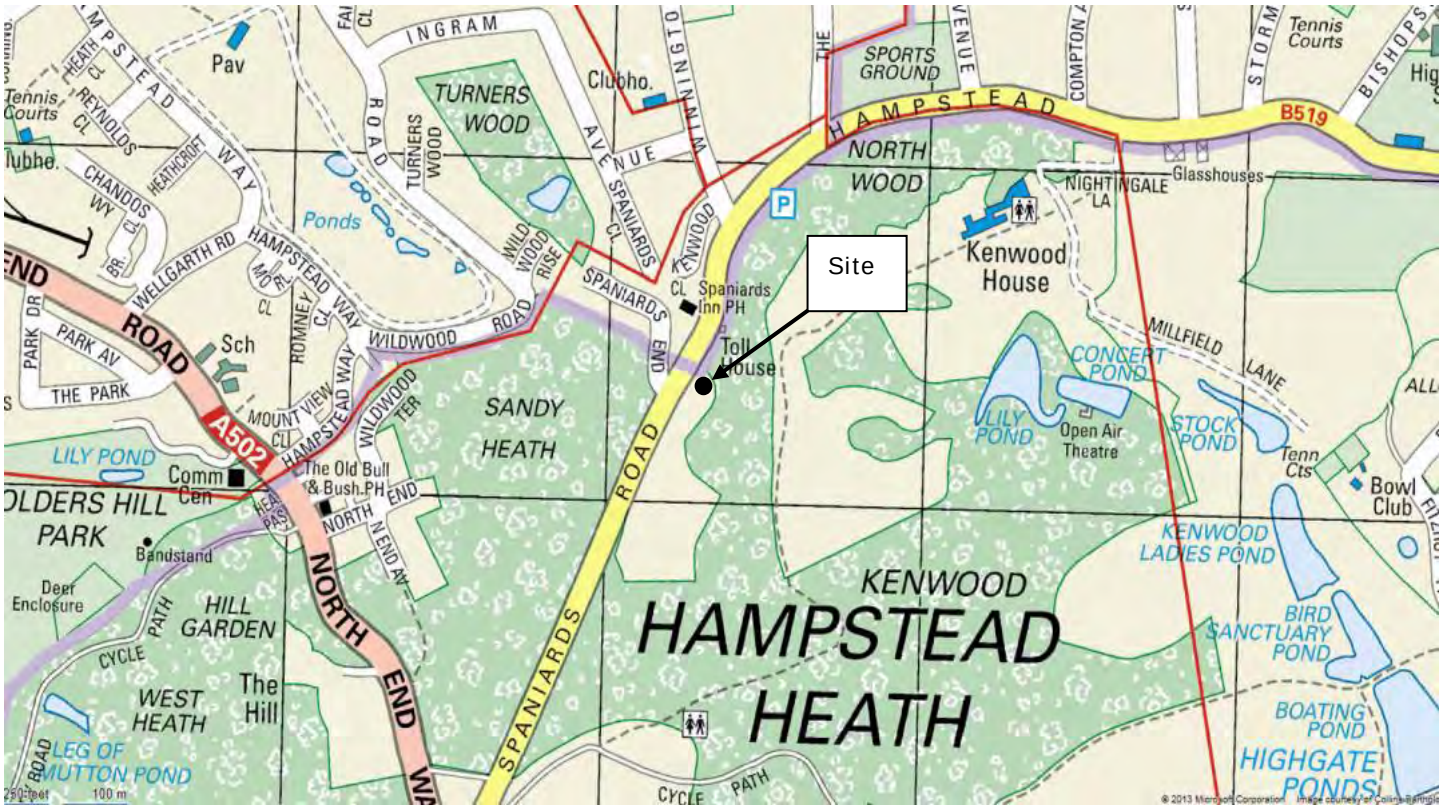


Figure 1 Site location map

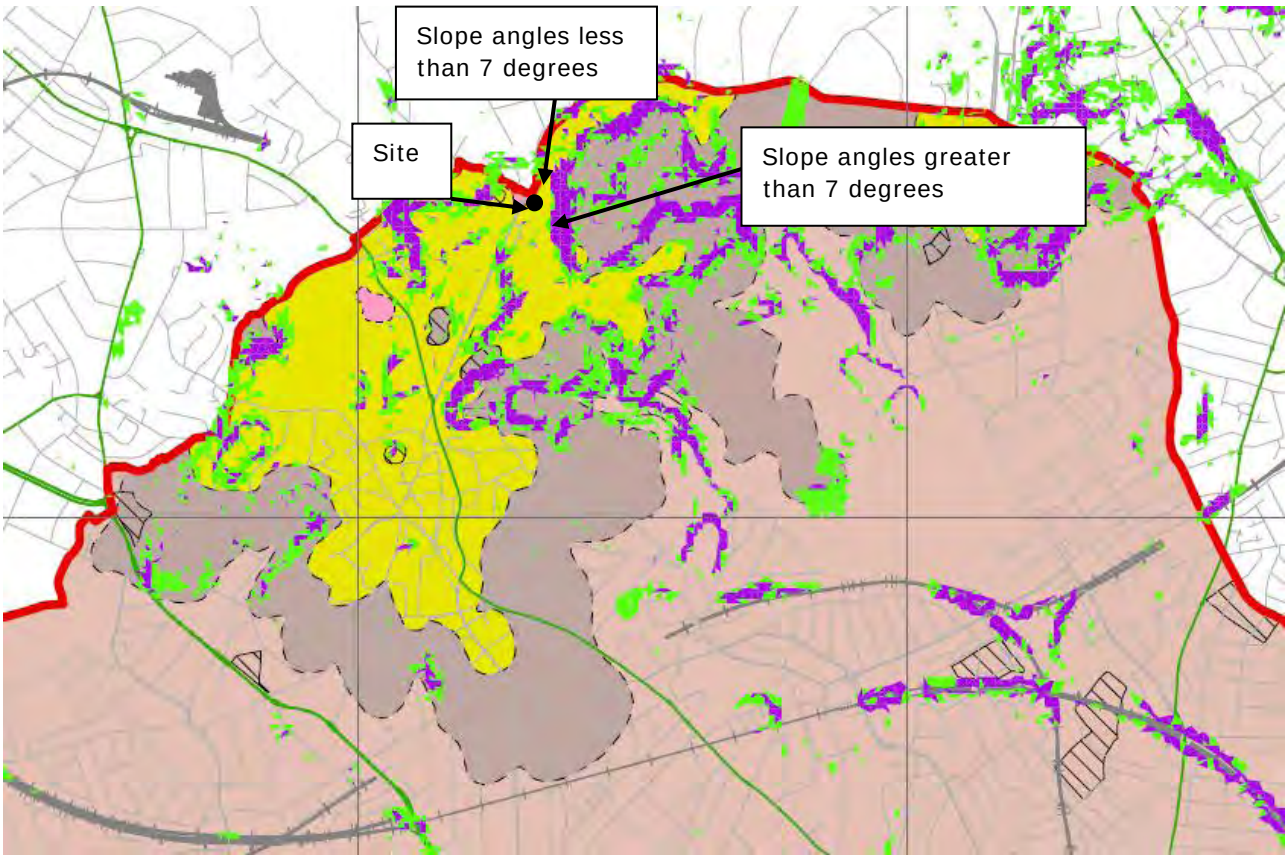


Figure 2 Extract showing slope angle of surrounding area

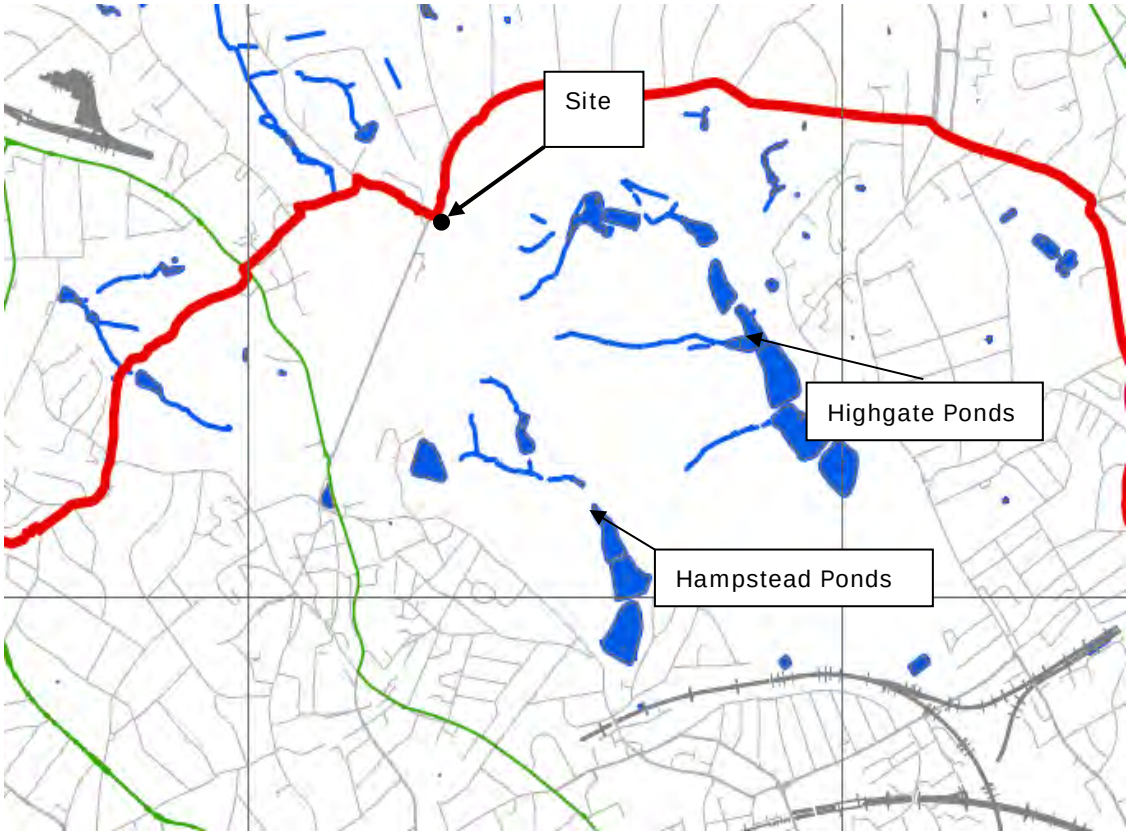


Figure 3 Extract showing Camden Surface Water Features and Pond Chains

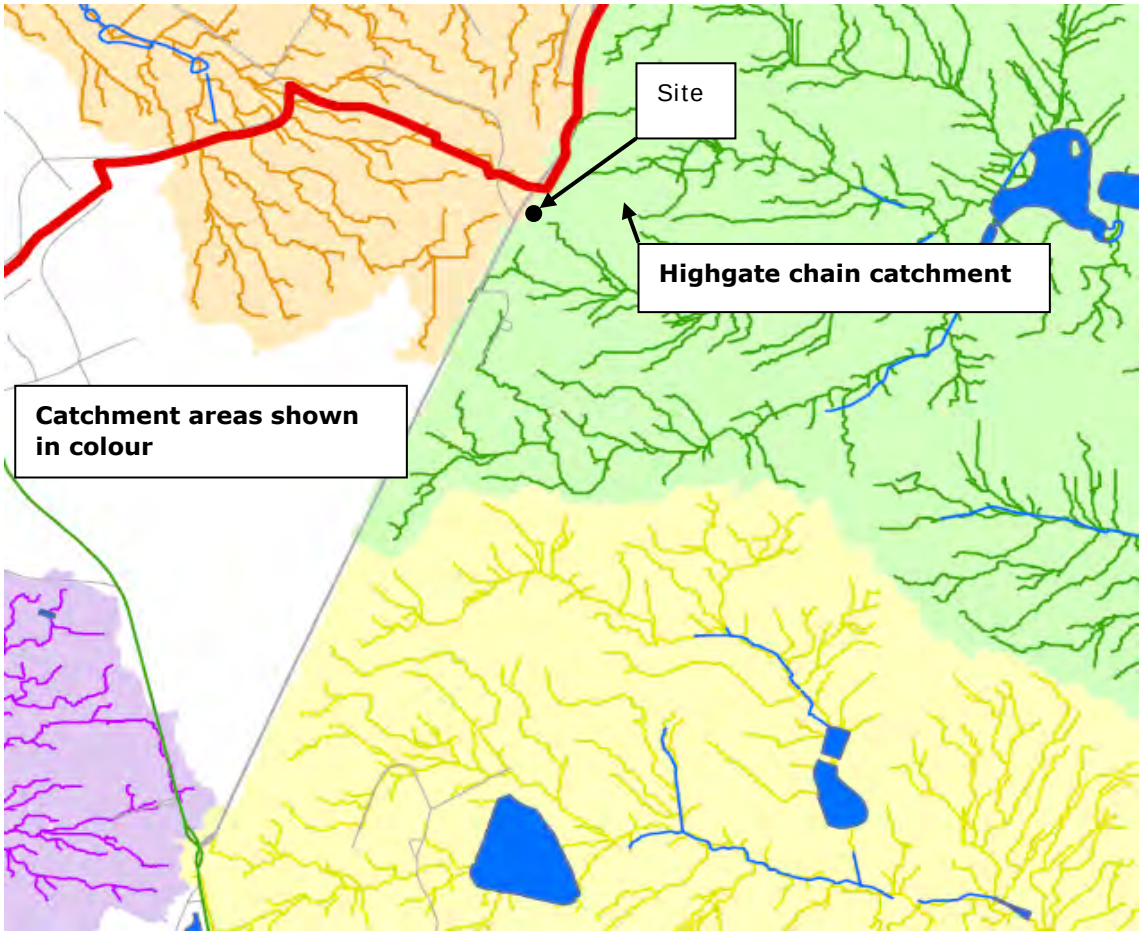


Figure 4 Extract showing Surface Water Catchment and Drainage

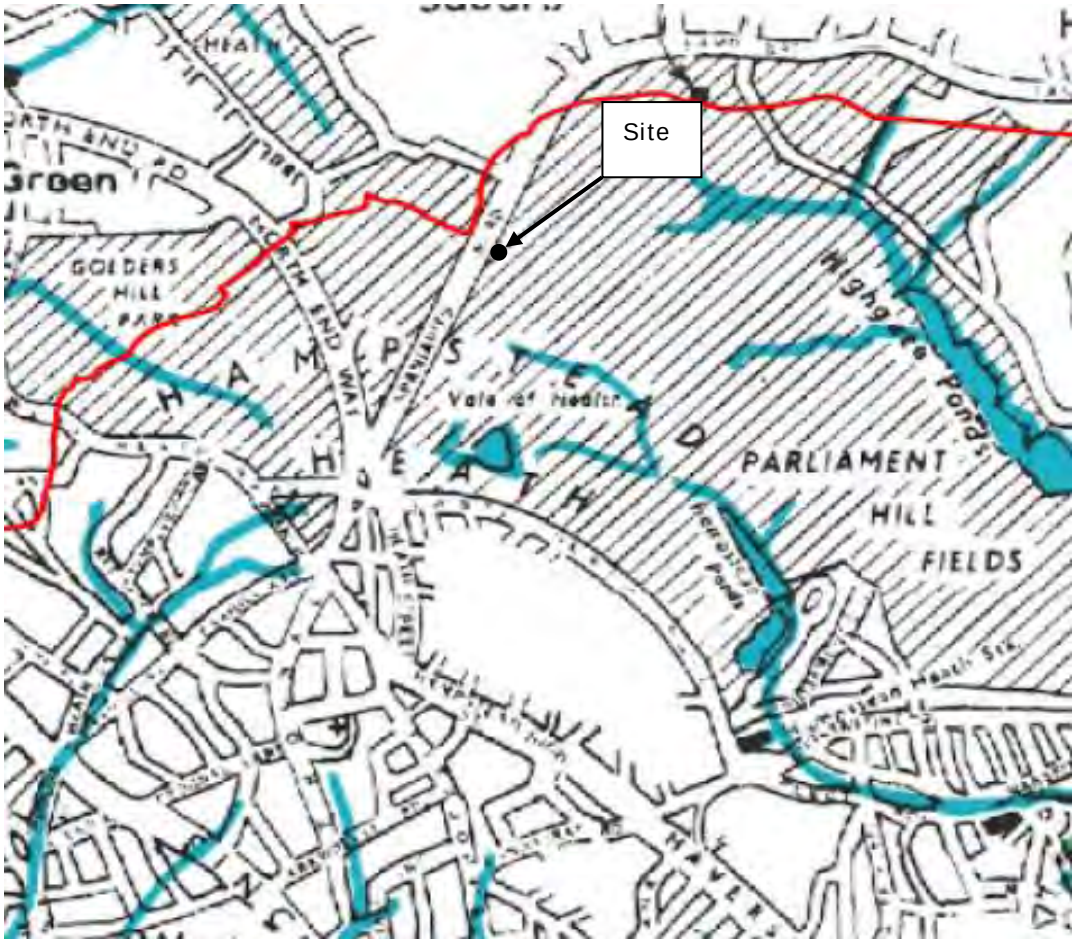


Figure 5 Extract showing Watercourses (source - Lost Rivers of London)

Figure 6 Extract showing locations of Historic Flooding

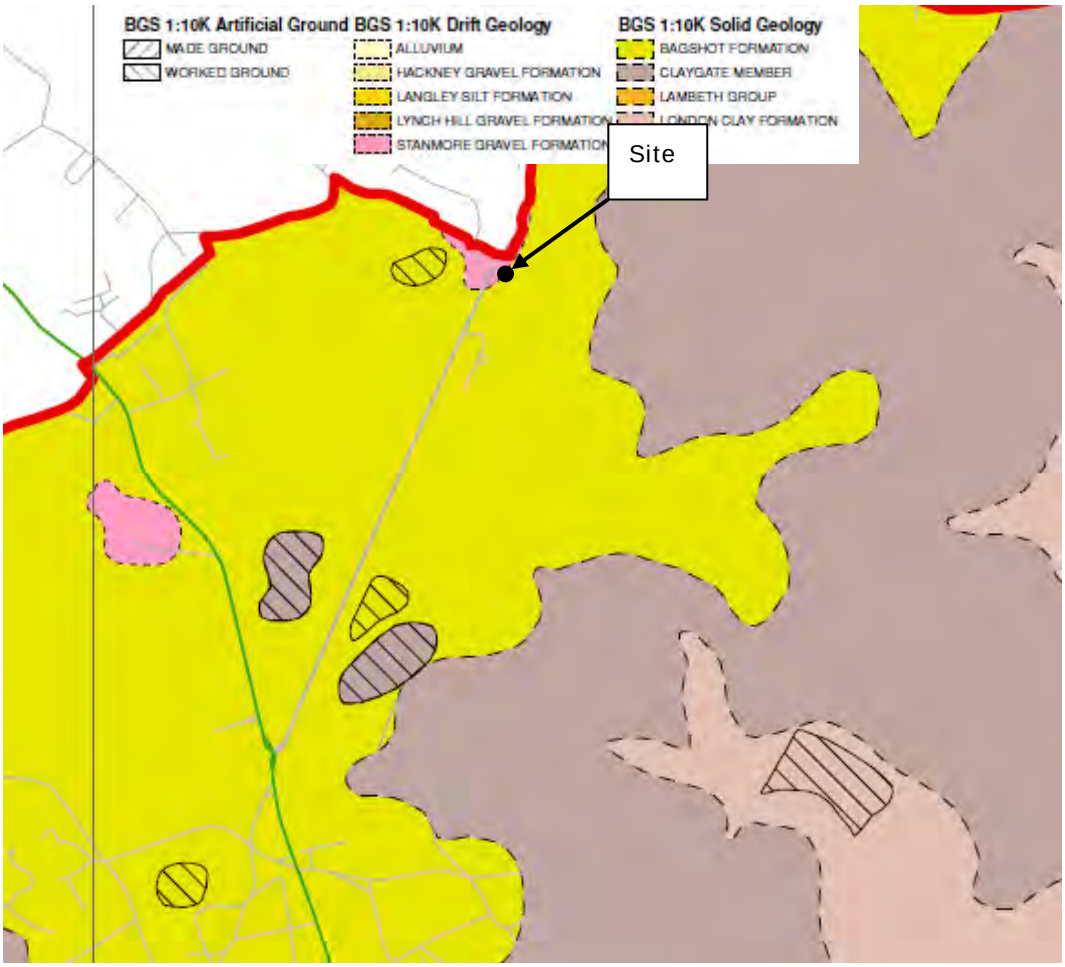


Figure 7 Extract showing the Geology of North Camden

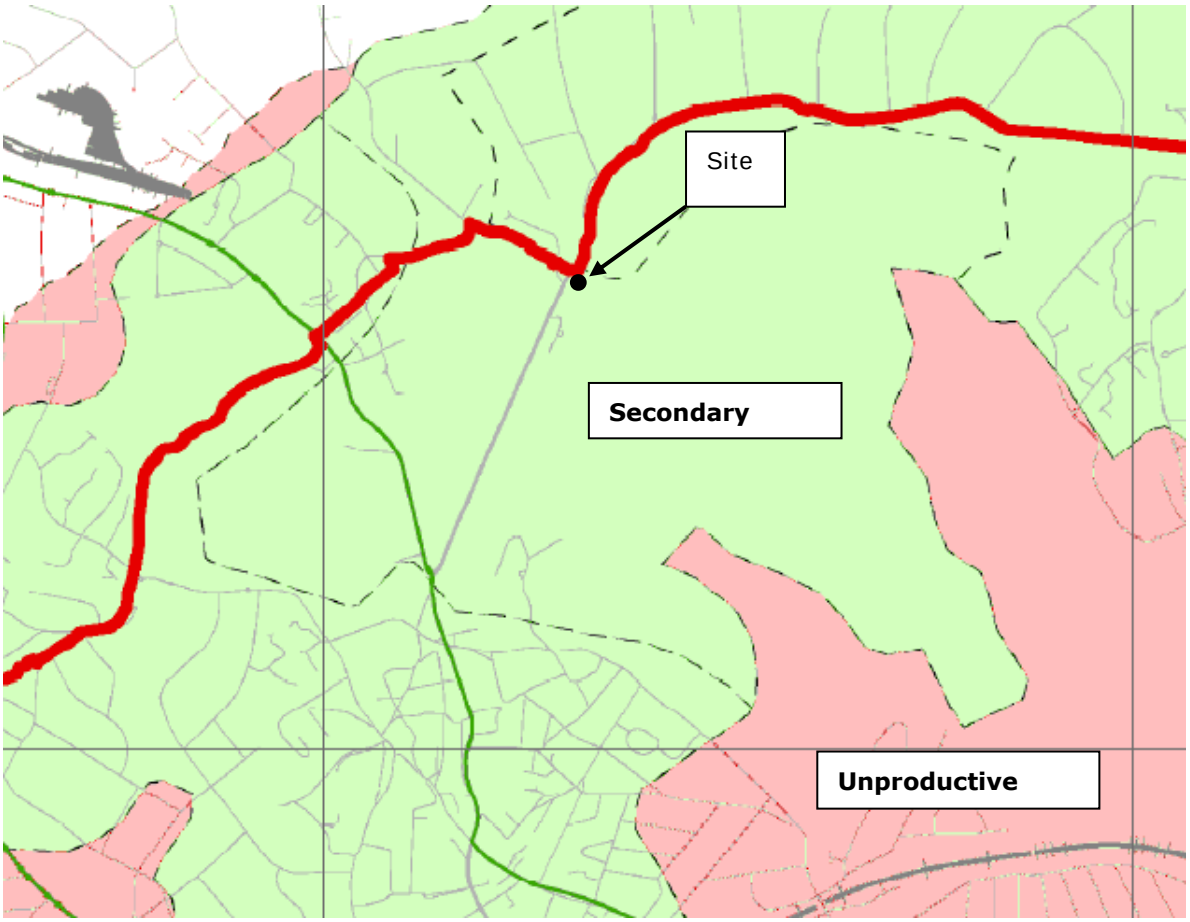
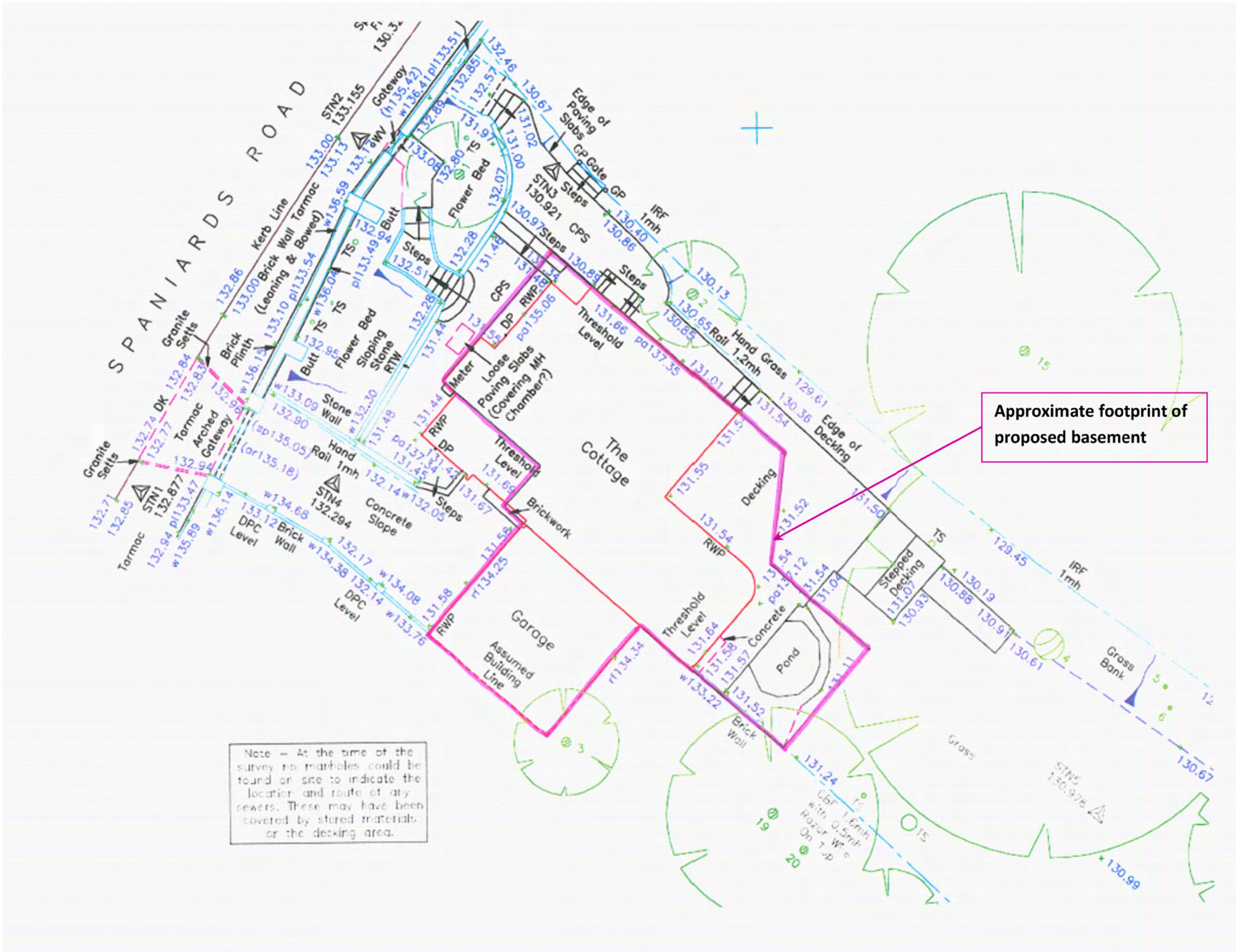


Figure 8 Extract showing Camden Aquifer Designation

APPENDIX A

20760-GT-001 PLAN OF EXISTING BUILDING WITH PROPOSED BASEMENT FOOTPRINT



NOTES

Rev.	Drawn	Chkd.	Apprvd	Date	Description
A	OM	ANR		07.11.13	PRELIMINARY
-	OM	JAF		28.03.13	PRELIMINARY

Client

LAWRENCE KERSHEN

Project

THE COTTAGE
SPANIARDS ROAD
HAMPSTEAD HEATH

Drawing Title

PLAN OF EXISTING BUILDING WITH PROPOSED BASEMENT FOOTPRINT

RAMBOLL

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scale (at A3)	date	drawn
AS SHOWN	MAR 2013	OM

drg. no.	rev.
20760-GT-001	A

10 0 10 20 50 100mm NATURAL SCALE

ORIGINAL DRAWING SIZE 420 x 297

APPENDIX B

SITE ANALYTICAL SERVICES LTD REPORT ON A GROUND INVESTIGATION 11/17550

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Site Investigations, Analytical & Environmental Chemists, Laboratory Testing Services.

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F. J. Gibbs, F.I.B.M.S. F.I.F.S.T., F.R.S.H. K. J. Blanchette

Your Ref:

Our Ref: **11/17550**
March 2011

THE COTTAGE, SPANIARDS ROAD

LONDON, NW3 7JH

REPORT ON A GROUND INVESTIGATION

Prepared for

UCHI Architecture Limited

Reg Office: Units 14 + 15, River Road Business Park,
33 River Road, Barking, Essex IG11 0EA
Business Reg. No. 2255616

Ref: 11/17550
March 2011

Report on a Ground Investigation

At

The Cottage, Spaniards Road, Hampstead, London, NW3 7JH

For

UCHI Architecture Limited

1.0 INTRODUCTION

At the request of UCHI Architecture Limited, a ground investigation was carried out in connection with a proposed residential development at the above site.

The information was required for the design and construction of foundations and infrastructure for the proposed development. A study to assess whether any remediation was required for the protection of the end-user from the presence of potential contamination within the soils encountered was outside the scope of the present investigation.

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

2.0 THE SITE AND LOCAL GEOLOGY

(National Grid Reference: TQ 266 871)

2.1 General

The site of the proposed development is situated at 'The Cottage' located on Spaniards Road in the Hampstead area of London, NW3 7JH. The site consists of an existing detached red brick house with associated gardens.

The site is situated on ground sloping to the south and west away from higher ground forming Hampstead Heath.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by the Bagshot Formation resting on deposits of the Claygate Member with the London Clay Formation at depth.

3.0 SCOPE OF WORK

3.1 General

The scope of the investigation was generally specified by the Architect and comprised:

- The drilling of two continuous flight auger boreholes to depths of 8m below ground level. In the event, the boreholes were extended to slightly deeper depths of up to 8.13m below ground level to allow for in-situ testing to be carried out.
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the boreholes.
- Laboratory testing to determine the engineering properties of the soils encountered in the boreholes.
- Interpretative reporting on foundation options for the proposed building works and infrastructure.
- A study into the possibility of the presence of toxic substances in the soil, together with any remediation required was outside the scope of the present investigation.

3.2 Ground Conditions

The boreholes were located towards the front and rear of the existing property with their exact locations being recorded by the architect.

The exploratory holes revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised made ground some 0.90m in thickness resting on deposits typical of the Bagshot Formation.

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

The made ground extended down to depths of between 0.90m and 0.60m below ground level in Boreholes 1 and 2 respectively and consisted of a surface layer of either paving slabs set on a sand cement mortar mix or topsoil underlain by a mixture of loose and medium dense silty sand, fine gravel, brick and concrete fragments with roots up to 10mm in diameter.

Natural soils were encountered below the made ground and generally consisted of loose becoming medium dense silty fine to medium sands. In Borehole 2, the near surface sands above 2.00m were noted to be slightly clayey and contained fine to medium gravel and occasional roots up to 5mm depth.

These soils are typical of the Bagshot Formation and extended down to the full depths of investigation of 8.11m below ground level in Borehole 2 and 8.13m below ground level in Borehole 1.

3.3 Groundwater

Groundwater was not encountered in the either of the boreholes and the material remained essentially dry throughout.

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

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

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (February 2011) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

4.0 IN-SITU AND LABORATORY TESTS

4.1 In-Situ Tests

In essentially granular soils encountered in the boreholes, Mackintosh Probe tests were made at regular depth increments in order to assess the relative density of the materials. The results indicate that the natural sands are in a general loose becoming medium dense state of compaction with all results being interpreted based on the generally accepted correlation as follows:

Mackintosh N75 X 0.38 = SPT 'N' Value

or

Mackintosh N300 X 0.1 = SPT 'N' Value

The results of the in-situ tests are shown on the exploratory hole record contained in Appendix A.

4.2 Classification Tests

Particle size distribution tests were carried out on four selected samples of essentially granular natural soil using wet sieving methods.

The results of the tests are presented in both graphical and tabular formats in Appendix B.

4.3 Sulphate and pH Analyses

The results of the sulphate and pH analyses made on four soil samples are presented on Table 1, contained in Appendix B. The results show the soil samples tested to have water soluble sulphate contents of up to 0.19g/litre associated with slightly acidic to alkaline pH values.

4.4 Resistivity tests

Electrical resistivity tests were carried out in the laboratory on samples recovered from each borehole at 3m below ground level using the methods outlined in BS 1377: Part 3.

The results of the test are presented in both in Appendix B.

5.0 FOUNDATION DESIGN

5.1 General

It is proposed to demolish the existing property on the site and construct a new residential house supported on either conventional spread foundations or piled foundations. Exact details of the structure, layout and loadings were not available at the time of preparation of this report.

5.2 Conventional Spread Foundations

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

Based on the ground and groundwater conditions encountered in the boreholes, it may be possible to support the proposed new development on conventional spread foundations taken down below the made ground and any weak superficial soils and placed in the medium dense silty sand deposits encountered at a depths of between 0.90m and 2.00m below existing ground level in the boreholes.

Such foundations could be designed to an allowable net bearing pressure of the order of 90kN/m^2 at 1.00m depth increasing to about 150kN/m^2 at 2.00m depth in order to allow for a factor of safety of about three against general shear failure. Total and differential settlement is expected to be within tolerable limits, should not exceed approximately 10-15mm under the loadings given above and be substantially complete by the end of the construction period.

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

5.3 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, a piled foundation will be required. In these ground conditions, it is considered that some form of bored and in-situ cast concrete piled foundation with reinforced concrete ground beams should prove satisfactory.

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

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

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

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

5.4 Ground Floor Slabs

The floor slab may be cast directly on the natural silty sands provided that the exposed formation is adequately compacted and protected from the elements.

5.5 Excavations

Shallow excavations for foundations and services are likely to require nominal side support in the short term and groundwater is unlikely to be encountered in significant quantities once any accumulated surface water within the made ground has been removed. Deeper and longer excavations below approximately 0.60m below existing ground level will require close side support and some seepages of groundwater are likely to be encountered.

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

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

5.6 Chemical Attack on Buried Concrete

The results of the chemical analyses show the natural soil samples tested to have water soluble sulphate contents of up to 0.19g/litre associated with slightly acidic to alkaline pH values.

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

p.p. SITE ANALYTICAL SERVICES LIMITED

A P Smith BSc (Hons) FGS.
Geotechnical Engineer

pp J I Pattinson BSc (Hons) MSc
Senior Geotechnical Engineer

REFERENCES

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

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

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

NHBC Standards, Chapter 4.2, "Building near Trees", April 2003.

Driscoll, R (1983) "The influence of vegetation on the shrinking and swelling of clay soils in Great Britain", Geo-technique 33, 93-107

Tomlinson, M J (2001) "Foundation Design and Construction", Seventh Edition, Prentice Hall (ISBN 0-13-031180-4).

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

APPENDIX `A'

Borehole / Trial Pit Logs

Site Analytical Services Ltd.

Site	Borehole Number
THE COTTAGE, SPANIARDS ROAD, LONDON, NW3 7JH	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m		UCHI ARCHITECTURE LIMITED	1117550
	Location TQ 266 871	**Dates** 15/02/2011	**Engineer** -	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.10) 0.10	MADE GROUND : york stone paving set on fine to coarse sand with cement		
0.25	D1					(0.80)	MADE GROUND : loose to medium dense brown silty sand with abundant brick and concrete rubble with roots up to 5mm diameter from 0.20m to 0.90m depth		
0.50	D2								
0.75	D3					0.90	Medium dense yellow brown silty fine to medium SAND		
1.00 1.00-1.21	D4 M1 138/205								
1.50 1.50-1.80	D5 M2 160/300								
2.00 2.00-2.30	D6 M3 144/300								
2.50 2.50-2.80	D7 M4 123/300								
3.00 3.00-3.30	D8 M5 134/300								
3.50 3.50-3.80	D9 M6 146/300								
4.00 4.00-4.30	D10 M7 139/300								
4.50 4.50-4.80	D11 M8 158/300					(7.23)			
5.00 5.00-5.30	D12 M9 165/300								
6.00 6.00-6.23	D13 M10 128/225								
7.00 7.00-7.18	D14 M11 129/175								
8.00 8.00-8.13	D15 M12 100/130			15/02/2011:DRY		8.13	Complete at 8.13m		

Remarks
M = Mackintosh Probe - Blows/Penetration (mm)
D = Disturbed Sample
Groundwater was not encountered during boring

Scale (approx)	Logged By
1:50	SL

Figure No. 1117550.BH1

Site Analytical Services Ltd.

Site	Borehole Number
THE COTTAGE, SPANIARDS ROAD, LONDON, NW3 7JH	BH2

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m		UCHI ARCHITECTURE LIMITED	1117550
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 266 871	15/02/2011	-	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.25	D1					(0.60)	MADE GROUND - grass over dark grey brown fine to medium sandy silty topsoil with brick fragments and roots up to 10mm diameter		
0.50	D2					0.60			
0.75	D3						Loose dark brown clayey silty fine to medium SAND with occasional fine to medium flint gravel and roots up to 5mm diameter above 0.90m depth		
1.00 1.00-1.30	D4 M1 92/300					(1.40)			
1.50 1.50-1.80	D5 M2 96/300								
2.00 2.00-2.30	D6 M3 155/300					2.00	Medium dense yellow brown silty fine to medium SAND		
2.50 2.50-2.80	D7 M4 140/300								
3.00 3.00-3.30	D8 M5 142/300								
3.50 3.50-3.80	D9 M6 163/300								
4.00 4.00-4.22	D10 M7 130/220								
4.50 4.50-4.80	D11 M8 173/300								
5.00 5.00-5.21	D12 M9 130/205					(6.11)			
6.00 6.00-6.13	D13 M10 100/130								
7.00 7.00-7.13	D14 M11 100/130								
8.00 8.00-8.11	D15 M12 100/110			15/02/2011:DRY		8.11	Complete at 8.11m		

Remarks
M = Mackintosh Probe - Blows/Penetration (mm)
D = Disturbed Sample
Groundwater was not encountered during boring

Scale (approx)	Logged By
1:50	SL

Figure No.
1117550.BH2

APPENDIX `B'

Laboratory Test Data

Site Analytical Services Ltd.

Ref: 11/17550

SULPHATE & pH DETERMINATIONS

LOCATION The Cottage, Spaniards Road, London, NW3 7JH

BH/TP No.	DEPTH BELOW GL m	SOIL SULPHATES AS SO_4 TOTAL %	SOIL SULPHATES AS SO_4 WATER SOL g/l	WATER SULPHATES AS SO_4 g/l	pH	CLASS	SOIL - 2mm %
BH1	0.75		0.19		9.6	DS-1	see note
	2.00		0.01		8.6	DS-1	100
BH2	0.75		0.03		6.8	DS-1	97
	1.50		0.02		5.8	DS-1	100

Classification – Tables C1 and C2 : BRE Special Digest 1 : 2005

NOTE:

Sample comprised Made Ground – total sample prepared for analysis

Table 1

Site Analytical Services Ltd.

Laboratory Test Results

Site : THE COTTAGE, SPANIARDS ROAD, LONDON, NW3 7JH

Client : UCHI ARCHITECTURE LIMITED

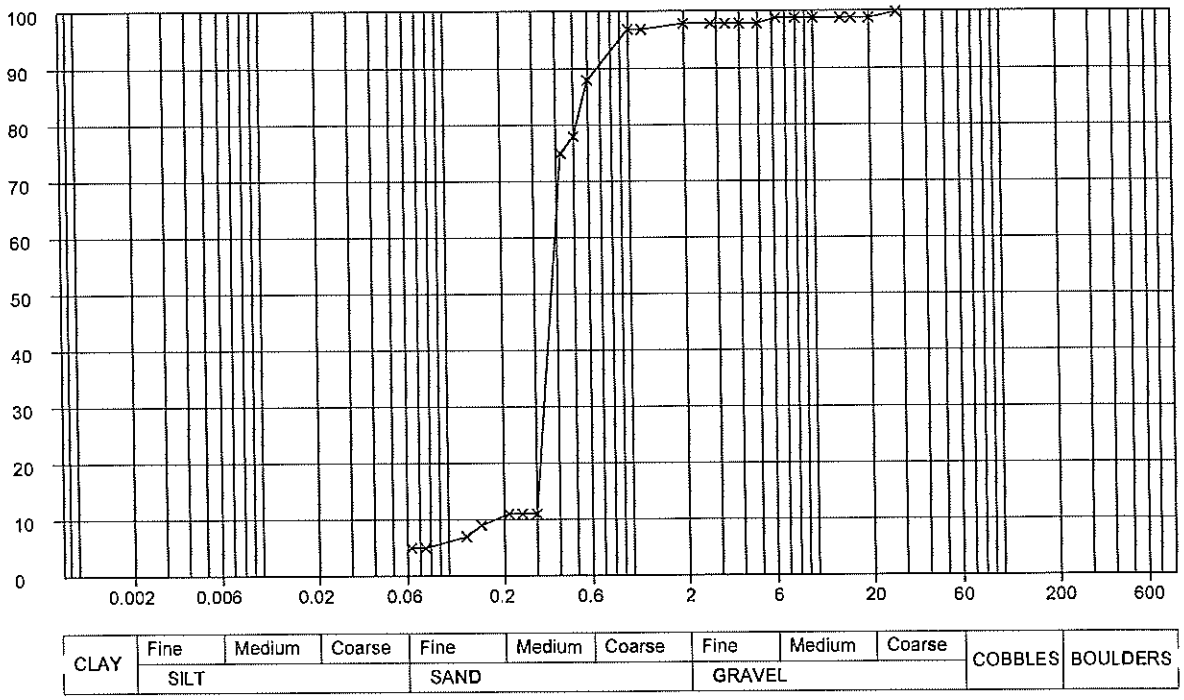
Engineer: -

Job Number 1117550

Sheet 1/4

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH1	1.50	D5	



Grading Analysis	
D85	568.1 µm
D60	391.7 µm
D10	178.3 µm
Uniformity Coefficient	2.2

Particle Proportions	
Cobbles + Boulders	-
Gravel	2.0%
Sand	93.0%
Silt	-
Clay	-

Sieve / Particle Size	% Passing
28 mm	100.0
20 mm	99.0
16 mm	99.0
14 mm	99.0
10 mm	99.0
8 mm	99.0
6.3 mm	99.0
5 mm	98.0
4 mm	98.0
3.35 mm	98.0
2.8 mm	98.0
2 mm	98.0
1.18 mm	97.0
1 mm	97.0
600 µm	88.0
500 µm	78.0
425 µm	75.0
300 µm	11.0
250 µm	11.0
212 µm	11.0
150 µm	9.0
125 µm	7.0
75 µm	5.0
63 µm	5.0

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Site Analytical Services Ltd.

Laboratory Test Results

Site : THE COTTAGE, SPANIARDS ROAD, LONDON, NW3 7JH

Client : UCHI ARCHITECTURE LIMITED

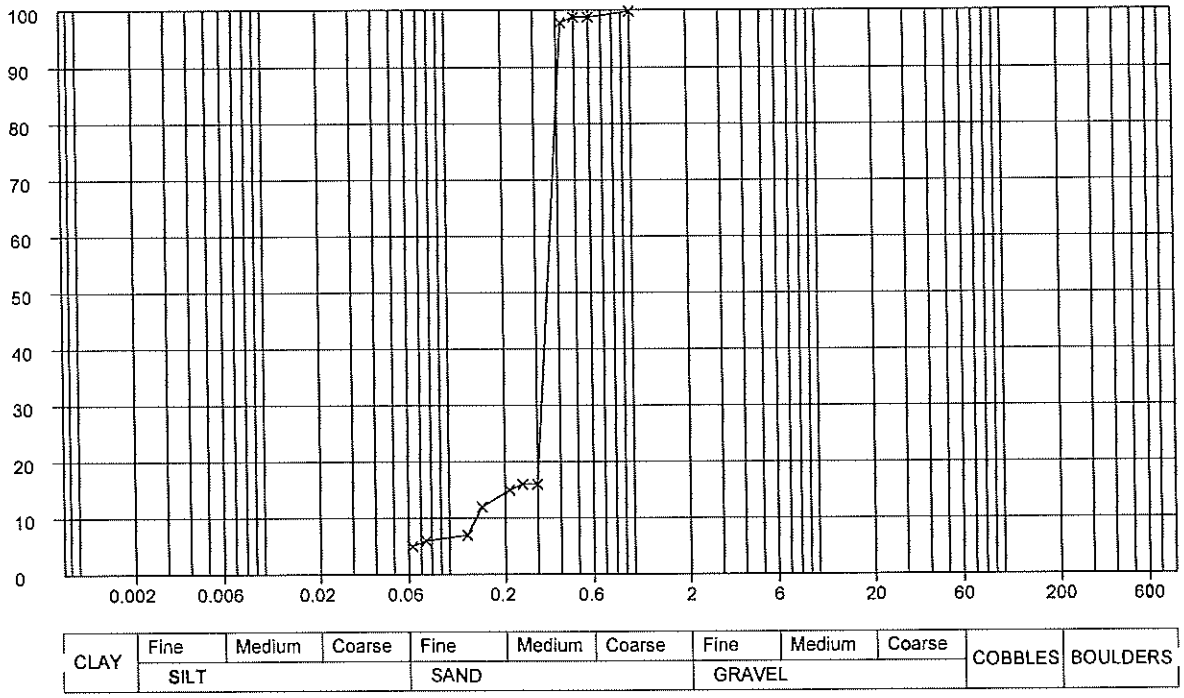
Engineer : -

Job Number 1117550

Sheet 2/4

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH1	2.50	D7	



Sieve / Particle Size	% Passing
1 mm	100.0
600 µm	99.0
500 µm	99.0
425 µm	98.0
300 µm	16.0
250 µm	16.0
212 µm	15.0
150 µm	12.0
125 µm	7.0
75 µm	6.0
63 µm	5.0

Grading Analysis	
D85	402.2 µm
D60	361.7 µm
D10	139.5 µm
Uniformity Coefficient	2.6

Particle Proportions	
Cobbles + Boulders	-
Gravel	-
Sand	95.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Site Analytical Services Ltd.

Laboratory Test Results

Site : THE COTTAGE, SPANIARDS ROAD, LONDON, NW3 7JH

Client : UCHI ARCHITECTURE LIMITED

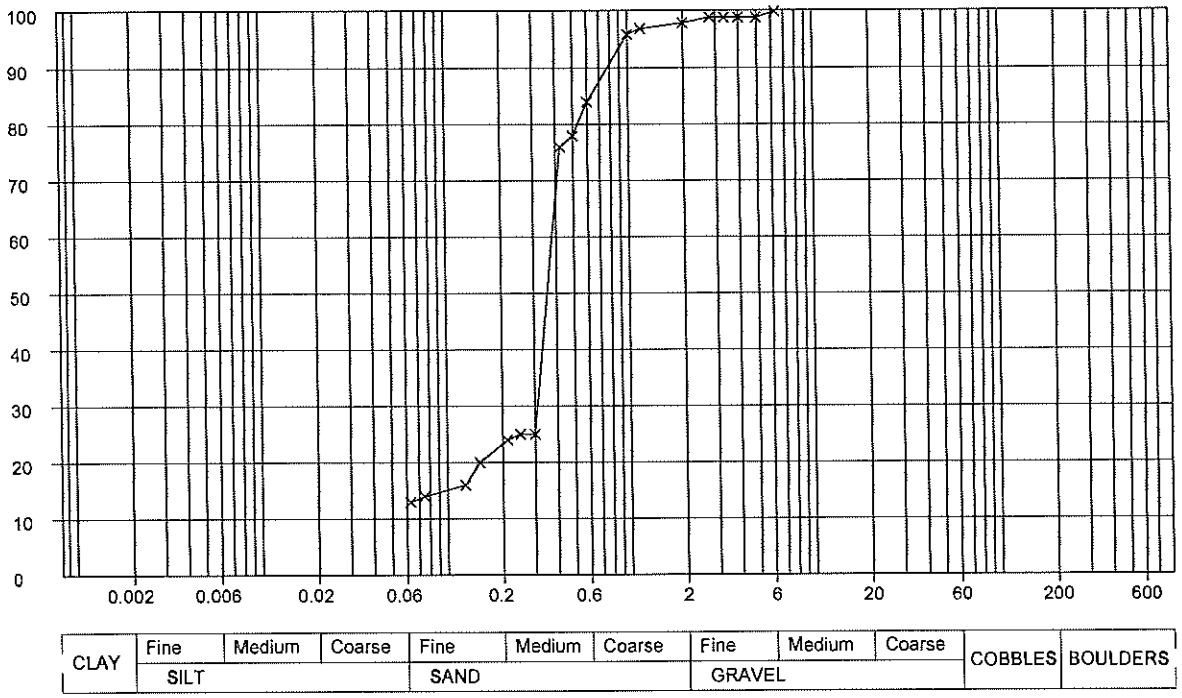
Engineer: -

Job Number 1117550

Sheet 3/4

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH2	1.00	D4	



Sieve / Particle Size	% Passing
6.3 mm	100.0
5 mm	99.0
4 mm	99.0
3.35 mm	99.0
2.8 mm	99.0
2 mm	98.0
1.18 mm	97.0
1 mm	96.0
600 µm	84.0
500 µm	78.0
425 µm	76.0
300 µm	25.0
250 µm	25.0
212 µm	24.0
150 µm	20.0
125 µm	16.0
75 µm	14.0
63 µm	13.0

Grading Analysis	
D85	626.1 µm
D60	381.0 µm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	2.0%
Sand	85.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Site Analytical Services Ltd.

Laboratory Test Results

Site : THE COTTAGE, SPANIARDS ROAD, LONDON, NW3 7JH

Client : UCHI ARCHITECTURE LIMITED

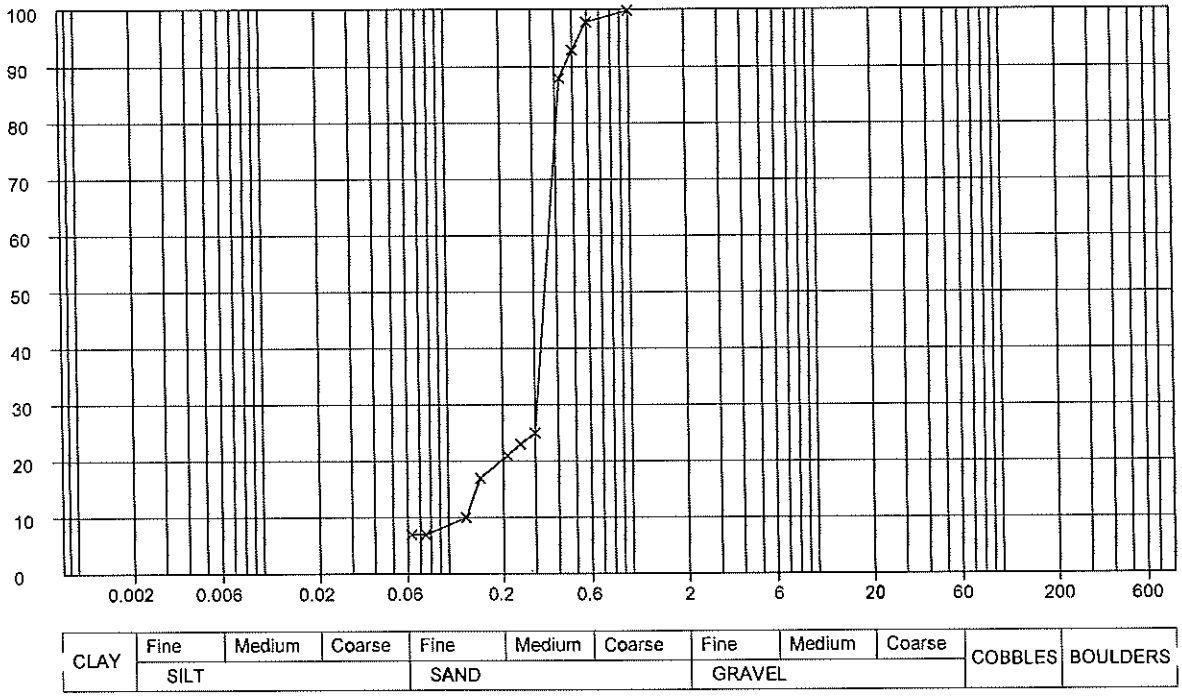
Engineer : -

Job Number 1117550

Sheet 4/4

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH2	2.00	D6	



Sieve / Particle Size	% Passing
1 mm	100.0
600 µm	98.0
500 µm	93.0
425 µm	88.0
300 µm	25.0
250 µm	23.0
212 µm	21.0
150 µm	17.0
125 µm	10.0
75 µm	7.0
63 µm	7.0

Grading Analysis	
D85	418.0 µm
D60	364.0 µm
D10	125.0 µm
Uniformity Coefficient	2.9

Particle Proportions	
Cobbles + Boulders	-
Gravel	-
Sand	93.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

celtest
INDEPENDENT MATERIALS TESTING | DIAMOND DRILLING & SAWING

Site Analytical Services Ltd
Units 14+15,River Road Business Park
33 River Road
Barking
Essex
IG11 0EA

Date: 14 March 2011
Test Report Ref: STR 243657

Order No: 8942/SL

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Electrical Resistivity of an Undisturbed or disturbed sample of Soil in accordance with **BS 1377: Part 3 : 1990 Clause 10 SubClause 4 : Open Container Method**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S34449**
Client Ref. No:	**BH1**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**25/02/2011**
Date of Start of Test:	**09/03/2011**
Sampling Location:	**Unknown**
Name of Source:	**The Cottage, Spniards Road**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification	**N/A**

RESULTS:

Type of Electrodes:	**Steel**
Temperature of Test:	**20 oC**
Resistivity (Initially):	**170 Ω m**
Resistivity (Saturated After 1 hour):	**149 Ω m**
Density	**1.80 Mg/M^3**
Moisture Content	**9.9%**
Dimensions of Sample	**232 x 100 x 100mm**
Sample Removed	**55.8%**

Comments
None

Certificate Prepared by:-
Mathew Sayer - Job Coordinator

Approved by: -
Eric Goulden
Technical Manager

celtest
INDEPENDENT MATERIALS TESTING | DIAMOND DRILLING & SAWING

Site Analytical Services Ltd
Units 14+15,River Road Business Park
33 River Road
Barking
Essex
IG11 0EA

Date: 14 March 2011
Test Report Ref: STR 243658

Order No: 8942/SL

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Electrical Resistivity of an Undisturbed or disturbed sample of Soil in accordance with **BS 1377: Part 3 : 1990 Clause 10 SubClause 4 : Open Container Method**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S34449**
Client Ref. No:	**BH2**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**25/02/2011**
Date of Start of Test:	**10/03/2011**
Sampling Location:	**Unknown**
Name of Source:	**The Cottage, Spniards Road**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**core**
Target Specification	**N/A**

RESULTS:

Type of Electrodes:	**Steel**
Temperature of Test:	**20 oC**
Resistivity (Initially):	**498 Ω m**
Resistivity (Saturated After 1 hour):	**367 Ω m**
Density	**1.66 Mg/M^3**
Moisture Content	**4.3%**
Dimensions of Sample	**232 x100 x 100mm**
Sample Removed	**50.3%**

Comments
None

Certificate Prepared by:-
Mathew Sayer - Job Coordinator

Approved by: -
Eric Goulden
Technical Manager

APPENDIX C

HARRISON ENVIRONMENTAL LTD WINDOWLESS SAMPLER LOGS

harrisongroup

Window Sample Record

Contract No. SW16619

WS1

Sheet 1 of 1

Location: The Cottage, Spaniards Road, Hampstead Heath

Date: 04/04/2013

Client: Mr & Mrs Kershen

Plant: Premier Tracker 110 Series

Ordnance Datum: -

Coordinates:

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Sample Test Depth (m)	Results / Remarks	Installations
PAVING		0.00					
MADE GROUND (Soft orange/brown sandy gravelly CLAY. Gravel is fine to coarse flint, brick and clay pipe fragments).		0.93					
Orange/brown mottled pale grey/brown fine to medium clayey SAND. Occasional medium to coarse flint gravel.		1.50					
Yellow/brown fine SAND.		1.75					
Pale brown mottled orange/brown fine SAND. Rare fine to medium flint gravel. Occasional pockets of red/brown silty sand.		3.00					
Pale grey fine SAND. Pockets of medium sand and red/brown silty sand.		3.30					
Pale yellow/brown fine SAND. With occasional thin orange/brown clayey sand bands.		6.50					
Orange/brown mottled brown and pale grey/brown fine SAND.		8.00					
Window Sample Complete at 8.00 m							

Drive Records

Diameter (mm)	From (m)	To (m)	Recovery (%)
87	0.95	2.10	87
87	2.10	3.10	100
77	3.10	4.10	100
77	4.10	5.10	100
67	5.10	6.10	100
67	6.10	7.10	100
57	7.10	8.00	100

KEY

D	Disturbed Sample
U	Undisturbed Sample (38mm)
W	Water Sample
ES	Environmental Sample
▽	Water Strike
▼	Standing Water Level

Water Level Observations

Date	Time	Water Strike (m)	Standing Level (m)	Casing Depth (m)	Depth Sealed (m)

Remarks:

1. Groundwater was not encountered.
2. Backfilled: 0.45m to 0.75m bentonite, 0.75m to 8.00m gravel.
3. Installations: 50mm temporary standpipe installed GL to 1.00m plain, 1.00m to 8.00m slotted fitted with gas-tap/bung and flush cover.

Drilled By: KT/DB | Logged By:KT | Checked By: KT

harrisongroup

Window Sample Record

Contract No. SW16619

WS2

Sheet 1 of 1

Location: The Cottage, Spaniards Road, Hampstead Heath

Date: 04/04/2013

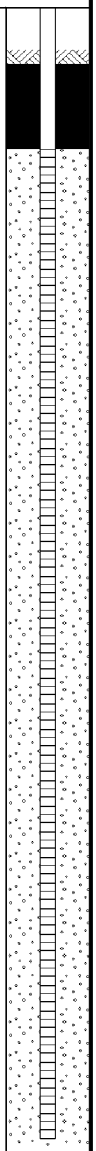
Client: Mr & Mrs Kershen

Plant: Premier Tracker 110 Series

Ordnance Datum: -

Coordinates:

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Sample Test Depth (m)	Results / Remarks	Installations
PAVING		0.00					
MADE GROUND (Grey/brown sandy coarse GRAVEL of brick fragments).		0.40					
MADE GROUND (Orange/brown becoming dark grey gravelly SAND. Gravel is medium to coarse flint and brick. Some coarse woody roots).		1.60					
Light brown slightly clayey fine SAND. Occasional fine to medium flint gravel.		2.40					
Brown mottled pale brown fine SAND.		3.10					
Pale yellow/brown fine SAND.		7.40					
Very dense pale grey brown fine SAND.		8.10					
Window Sample Complete at 8.10 m							



Drive Records

Diameter (mm)	From (m)	To (m)	Recovery (%)
87	1.10	2.10	100
87	2.10	3.10	100
77	3.10	4.10	100
77	4.10	5.10	100
67	5.10	6.10	100
67	6.10	7.10	100
57	7.10	8.10	100

KEY

D	Disturbed Sample
U	Undisturbed Sample (38mm)
W	Water Sample
ES	Environmental Sample
▽	Water Strike
▼	Standing Water Level

Water Level Observations

Date	Time	Water Strike (m)	Standing Level (m)	Casing Depth (m)	Depth Sealed (m)

Remarks:

1. Groundwater was not encountered.
2. Backfilled: 0.40m to 1.00m bentonite, 1.00m to 8.05m gravel.
3. Installations: 50mm temporary standpipe installed GL to 1.00m plain, 1.00m to 8.00m slotted fitted with gas-tap/bung and flush cover.

Drilled By: KT/DB | Logged By:KT | Checked By: KT

harrisongroup

Window Sample Record

Contract No. SW16619

WS3

Sheet 1 of 1

Location: The Cottage, Spaniards Road, Hampstead Heath

Date: 04/04/2013

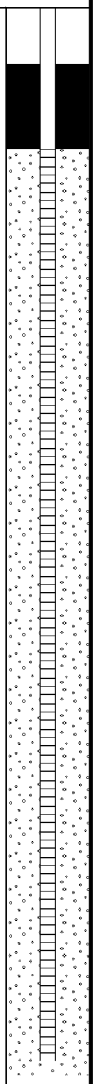
Client: Mr & Mrs Kershen

Plant: Premier Tracker 110 Series

Ordnance Datum: -

Coordinates:

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Sample Test Depth (m)	Results / Remarks	Installations
TURF/TOPSOIL		0.00					
Orange/brown mottled brown and pale brown fine SAND.		1.10					
Pale brown mottled yellow/brown fine SAND.		2.60					
Pale yellow brown fine SAND.		3.40					
Yellow/brown becoming orange/brown fine SAND.		5.80					
Window Sample Complete at 7.60 m		7.60					



Drive Records

Diameter (mm)	From (m)	To (m)	Recovery (%)
87	1.20	2.10	100
87	2.10	3.10	100
77	3.10	4.10	100
77	4.10	5.10	100
67	5.10	6.10	100
67	5.80	6.80	100
57	6.60	7.60	100

KEY

D	Disturbed Sample
U	Undisturbed Sample (38mm)
W	Water Sample
ES	Environmental Sample
▽	Water Strike
▼	Standing Water Level

Water Level Observations

Date	Time	Water Strike (m)	Standing Level (m)	Casing Depth (m)	Depth Sealed (m)

Remarks:

1. Groundwater was not encountered.
2. Backfilled: 0.40m to 1.00m bentonite, 1.00m to 7.55m gravel.
3. Installations: 50mm temporary standpipe installed GL to 1.00m plain, 1.00m to 3.00m slotted fitted with gas-tap/bung and flush cover.

Drilled By: KT/DB | Logged By:KT | Checked By: KT