5.4.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. To this end the table below indicates those contaminants of concern that have values in excess of a generic human health risk based guideline values which are either that of the CLEA[6] Soil Guideline Value where available, or is a Generic Screening Value calculated using the CLEA UK Version 1.06[7] software assuming a residential end use, or is based on the DEFRA Category 4 Screening values[8]. The key generic assumptions for this end use are as follows:

- that groundwater will not be a critical risk receptor;
- that the critical receptor for human health will be a young female child aged 0 to six years old;
- that young children will not have prolonged exposure to the site;
- that the exposure duration will be six years;
- that the critical exposure pathways will be direct soil and indoor dust ingestion, consumption of homegrown produce, consumption of soil adhering to homegrown produce, skin contact with soils and dust, and inhalation of dust and vapours; and
- that the building type equates to a two-storey small terraced house

It is considered that these assumptions are acceptable for this generic assessment of this site, although being underlain by a Secondary 'A' Aquifer, groundwater is also considered to be a sensitive receptor. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

6 *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.

7 Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009

8 CL:AIRE (2013) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Final Project Report SP1010 and DEFRA (2014) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Policy Companion Document SP1010

The results of the contamination testing have revealed a single elevated concentration of lead, which has resulted in the US^{95} concentration also being elevated above the generic guideline value. All of the other contaminants were found to be below their respective generic guideline value and of generally low concentrations. This assessment is based upon the potential for risk to human health, which at this site is considered to be the critical risk receptor. The significance of the contamination results is considered further in Part 2 of the report.

5.5 Existing Foundations

The findings of the trial pits are summarised in the table below. Sketches and photographs of each pit are included in the Appendix.

Trial Pit No	Structure	Foundation detail	Bearing Stratum
1	Front Elevation	Concrete strip / ground beam / raft Top 300 mm above ground level Base 0.55 m (87.15 m OD) below ground level (bgl) Flush with wall	Firm fissured brown silty LONDON CLAY
2	Southeastern Corner	Mass concrete strip Top 1.20 m bgl (86.60 m OD) Base 1.40 m bgl (86.40 m OD) Lateral projection 300 mm	Firm fissured brown silty LONDON CLAY
3	Southern Corner	Mass concrete strip Top 1.05 m bgl (86.82 m OD) Base 1.20 m bgl (86.67 m OD) Lateral projection 250 mm	Firm fissured brown silty LONDON CLAY
4	Northwestern Corner	Mass concrete strip Top 0.85 m bgl (86.81 m OD) Base 1.20 m bgl (86.46 m OD) Lateral projection 300 mm	Firm fissured brown silty LONDON CLAY

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to foundation options and contamination issues.

6.0 INTRODUCTION

Consideration is being given to the refurbishment of the existing property, which will include the construction of an additional storey and an extension to the front of the property. It is also proposed to construct a basement level below the new extension, which will also extend beneath the southern end of the existing house. Due to the sloping nature of the front of the site, the basement level will exit at approximately the same level as existing ground level. Proposed and existing loads are not known at this stage but are anticipated to be relatively light to moderate.

7.0 GROUND MODEL

The desk study has revealed that the site and surrounding area have not had a potentially contaminative history, and on the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- below a generally moderate thickness of made ground, the Claygate Member is absent and the site underlain by the London Clay Formation;
- the made ground extends to depths of 0.33 m and 2.30 m, levels of between 87.87 m OD and 85.44 m OD;
- stiff fissured high strength brown clay with occasional partings of grey silt to a depth of between 8.70 m (79.50 m OD) and 10.80 m (76.94 m OD);
- below these depths the London Clay increase in strength and is present to the maximum depth investigated of 20.00 m. (64.40 m OD);
- the London Clay is desiccated to a depth of 3.00 m (79.80 m OD) within the front garden in close proximity of the existing mature trees;
- perched groundwater is present in the made ground at depths of 1.23 m (83.17 m OD) and 2.18 m (85.56 m OD); and
- the made ground has been found to contain elevated concentrations of lead.

8.0 ADVICE AND RECOMMENDATIONS

It is understood that the proposed basement will extend to a depth of approximately 4.50 m below ground floor level, a level of approximately 83.00 m OD. Perched groundwater is likely be encountered, particularly close to existing structures, as indicated by the trial pit findings and the groundwater monitoring carried out to date. The most appropriate means of supporting the basement excavation will probably be through the use of conventional underpinning coupled with some form of bored pile wall.

8.1 Basement Construction

The formation level for the basement is likely to be within the London Clay at a depth of approximately 4.50 m (83.00 m OD). On the basis of the groundwater observations to date, perched groundwater from within the made ground is likely to be encountered in the basement extension, as encountered in a number of the trial pits and the standpipes. Whilst these inflows are unlikely to be prolonged and should be adequately dealt with using sump pumping, the rate of inflow is unknown. As with any basement project it would be prudent to undertake trial excavations to a depth as close to the proposed basements as possible in order to determine the likely inflow rate of any groundwater. In addition, rising head tests could be carried out within the standpipes to determine the likely inflow rate of the anticipated perched groundwater.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by whether it is to be incorporated into the permanent works and have a load bearing function. The final choice will depend to a large extent on the need to protect nearby structures from movements, the required overall stiffness of the support system, and the need to control groundwater movement through the wall in the temporary condition. In this respect the stability of the existing and adjacent buildings, will be paramount.

On the basis of the existing foundation details established from the trial pitting, it is likely that the most appropriate method way of supporting the basement where it extends below the existing house will be through the use of conventional mass concrete underpinning using a ‘hit and miss’ approach. As discussed above, perched groundwater may be encountered although these inflows should be adequately dealt with using sump pumping. It would however be prudent for the chosen contractor to have a contingency plan in place to deal with more significant inflows as a precautionary measure.

The use of underpinning will require the soils being underpinned to stand unsupported and difficulties may be encountered with unsupported excavations in the made ground, particularly where groundwater is encountered. As also discussed above, ideally a number of trial excavations should be carried out, to depths as close to the proposed basement depth in order to check the stability of the soil and to provide an indication of the extent to which the basement excavation will be affected by groundwater inflows.

Where the basement extends out below the front driveway and the front garden beyond, the use of a bored pile wall is likely to be the best option as the noise and vibrations associated with the installation of sheet piles is likely to be unacceptable. On the basis of the ground conditions encountered, the use of a contiguous bored pile should be suitable, with the use of localised grouting in between piles to prevent perched groundwater inflows, as discussed above. Alternatively consideration could be given to the use of a secant bored pile wall, which would not require secondary groundwater control.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity and the timing of the provision of support to the wall will have an important effect on movements. The stability of the adjacent foundations will need to be ensured at all times and the retaining walls will need to be designed to support the loads from these foundations unless they are underpinned. Careful workmanship will be required in the construction of the underpins and it is recommended that a suitable specialist contractor is consulted in this respect.

8.1.1 Retaining Walls

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

Stratum	Bulk Density (kg/m³)	Effective Cohesion (c′ – kN/m²)	Effective Friction Angle (Φ′ – degrees)
Made ground	1700	Zero	27
London Clay	2000	Zero	25

Groundwater is unlikely to be encountered within the excavation, although monitoring of the standpipe should be continued in order to establish equilibrium levels. At this stage, it is recommended that for the design of the retaining walls, that groundwater level should be assumed to be ¾ of the retained height, unless the risk of groundwater and surface water collecting behind the retaining walls can be suitably mitigated through the use of the use of a fully effective drainage system. The advice in BS8102:2009[9] should be followed in the design of the basement retaining walls and with regard to waterproofing requirements.

8.1.2 Basement Heave

The 4.50 m deep excavation of the basement will result in a net unloading of around 80 kN/m², which will result in heave of the underlying London Clay. This will comprise immediate elastic movement, which will account for approximately 40 % of the total movement and be expected to be complete during the construction period, and long term movements, which will theoretically take many years to complete. These movements will, to some extent, be mitigated by the continued presence of the existing building and the proposed new extension. It is recommended that further consideration is given to the possible heave movements, once the basement design and loading have been finalised.

8.2 Spread Foundations

New spread foundations excavated from below basement depth may be designed to apply a net allowable bearing pressure of 120 kN/m², which incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

Where the basement level exits the slope at approximately existing ground level, spread foundations will need to be designed in accordance with National House Building Council (NHBC) guidelines due to the presence of existing mature trees. In this respect, new spread foundations should be placed at a minimum depth of 1.5 m, assuming that no restrictions are applied on planting of shrubs in the vicinity of foundations, and that a no planting zone is applied in accordance with Table 4 of NBHC Standards Chapter 4.2 (2014).

9 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

Foundations will need to be deepened in the vicinity of existing and proposed trees in accordance with NHBC guidelines and high shrinkability clays should be assumed. Where trees are to be removed the required founding depth should be determined on the basis of the existing tree height if it is less than 50% of the mature height and on the basis of full mature height if the current height is more than 50% of the mature height. Where a tree is to be retained the final mature height should be adopted. Notwithstanding NHBC guidelines, all foundations should extend beyond the zone of desiccation, which has been encountered to a depth of 3.00 m from the lower level of the front garden. It is therefore recommended that foundation depths are taken below any visible roots and that foundation excavations are inspected by a suitably qualified engineer. Due allowance should be made for future growth of the trees and the requirement for compressible material alongside foundations should be determined by reference to the NHBC guidelines.

If, for any reason, spread foundations are not considered appropriate, piled foundations would provide a suitable alternative foundation solution.

8.3 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate type. A conventional rotary augered pile may be appropriate, with temporary casing installed to maintain stability and prevent groundwater inflows, or alternatively the use of bored piles installed using continuous flight auger (cfa) techniques, which would not require the provision of casing, would also be appropriate.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, based on the SPT & Cohesion / level graph in the appendix.

Stratum	Level m OD	kN / m^2
Ultimate Skin Friction		
Made Ground and London Clay	All soil above 83.00	Ignore (Basement excavation)
London Clay (α=0.5)	83.00 to 64.00	Increasing linearly from 35 to 85
Ultimate End Bearing		
London Clay	75.00 to 64.00	Increasing linearly from 990 to 1575

In the absence of pile tests, guidance from the London District Surveyors Association (LDSA)[10] suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads. On the basis of the above coefficients it has been estimated that a 300 mm diameter pile extending 75.00 m OD, approximately 8.00 m below the proposed basement level, should provide a safe working load of about 155 kN, whereas the same diameter pile extending to 72.00 m OD, approximately 12.00 m below the proposed basement should provide a safe working load of approximately 230 kN. A 450 mm diameter pile founding at the same depth should provide about 365 kN.

10 LDSA (2009) *Foundations No 1 – Guidance notes for the design of straight shafted bored piles in London Clay*. LDSA Publications

The above examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of an appropriate piling scheme and their attention should be drawn to potential groundwater inflows within the made ground and silt and sand partings within the London Clay.

8.4 Basement Floor Slab

Following the excavation of the basement, it is likely that the floor slab for the proposed basement will need to be suspended over a void to accommodate the anticipated heave and any potential uplift forces from groundwater pressures unless the slab can be suitably reinforced to cope with these movements. This should be reviewed once the levels and loads are known.

8.5 Shallow Excavations

On the basis of the borehole findings it is considered likely that it will be feasible to form relatively shallow excavations for services extending through the made ground and terminating within the London Clay without the requirement for lateral support, although localised instabilities may occur.

However, should deeper excavations be considered or if excavations are to remain open for prolonged periods it is recommended that provision be made for battered side slopes or lateral support. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

Inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from perched water tables within the made ground, particularly within the vicinity of existing foundations, although such inflows should be suitably controlled by sump pumping.

8.6 Effect of Sulphates

Chemical analyses carried out on a single sample of made ground have revealed concentrations of soluble sulphate and near-neutral pH in accordance with Class DS-1 and DS-2 conditions of Table C2 of BRE Special Digest 1 Part C (2005). The measured pH value of the samples shows that an ACEC class of AC-1s would be appropriate for the site. This assumes a static water condition at the site. The guidelines contained in the above digest should be followed in the design of foundation concrete.

8.7 Site Specific Risk Assessment

The desk study has indicated that the site has not had a contaminative history, having been occupied by residential properties throughout its developed history and has been set in an area dominated by residential streets. Therefore no sources of contamination have been identified. The results of the contamination testing have however identified an elevated concentration of lead within a single sample of made ground. No elevated concentrations of the other contaminants were identified.

The exact source of the contamination is unknown, however the made ground was noted as containing variable amounts of extraneous material. At this stage only a limited number of samples have been tested and additional testing would be required in order to draw meaningful conclusions from the results and to fully assess the risk to end users. Therefore it is recommended that once the proposals have been finalised and the areas of future soft landscaping determined, further testing should be carried out.

8.8 Waste Disposal

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE guidance[11], will need to be disposed of to a licensed tip. Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste going to landfill is subject to landfill tax at either the standard rate of £80 per tonne (about £145 per m^3) or at the lower rate of £2.50 per tonne (roughly £5 per m^3). However, the classification for tax purposes is not the same as that for disposal purposes. Currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring rocks and soils which are accurately described as such in terms of the 2011 Order[12] would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the Environment Agency[13] it is considered likely that the made ground from this site, as represented by the chemical analyses carried out, would be classified as a NON-HAZARDOUS waste under the waste code 17 05 04 (soils and stones not containing dangerous substances) and would be taxable at the standard rate. It is likely that the natural soils, if separated out, could be classified as an INERT waste also under the waste code 17 05 04. This material would be taxable at the lower rate, if accurately described as naturally occurring sand and gravel in terms of the 2011 Order on the waste transfer note. As this site has not had a contaminative history there should be no requirement for WAC leaching analyses to confirm that this material is suitable for landfilling, although this would require confirmation from the receiving site.

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[14] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be segregated onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

The above opinion with regard to the classification of the excavated soils and its likely landfill taxable rate is provided for guidance only and should be confirmed by the receiving landfill once the soils to be discarded have been identified.

The local waste regulation department of the Environment Agency should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material but may require further testing.

11 CL:AIRE (2011) *The Definition of Waste: Development Industry Code of Practice* Version 2, March 2011
12 *Landfill Tax (Qualifying Material) Order 2011*
13 Environment Agency (2013) *Hazardous Waste: Interpretation of the definition and classification of hazardous waste. Technical Guidance* WM2 Third Edition, August 2013
14 Regulatory Position Statement (2007) *Treating non-hazardous waste for landfill - Enforcing the new requirement* Environment Agency 23 Oct 2007

9.0 BASEMENT IMPACT ASSESSMENT

The screening identified a number of potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

Potential Impact	Site Investigation Conclusions
The site is located directly above an aquifer.	The investigation has indicated that the site is not underlain by the Claygate Member but the London Clay Formation, which is classified as a non-aquifer.
The proposed basement may extend beneath the water table surface.	A continuous groundwater level has not been encountered below the site, although perched groundwater is present within the made ground. Such inflows are unlikely to be sustained and therefore the basement structure will not pose a risk to the hydrogeological or hydrological setting, particularly as adequate space will remain around the basement structure
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	The site is approximately 100 m southwest of a spring line to the former River Westbourne, with the former course of river located approximately 50 m to the east of the site. However the site is located topographically below the level of the spring line, but topographically above the river course. And furthermore the site is not shown to be an area at risk of flooding. Therefore this is not considered to be an issue to the site or the proposed development and in any case a continuous groundwater level has not been encountered below the site.
The site within 5 m of a public highway and pedestrian right of way.	The investigation has not indicated any specific problems, such as weak or unstable ground, voids or a high water table that would make working within 5 m of public infrastructure particularly problematic at this site. The actual basement excavations are in any case over 5 m from the highway.
Trees will be felled as part of the development	Although the London Clay is shallowest stratum, there are no critical slope angles that are dependent on the presence of the existing trees to aid long term stability. New foundations will however need to be designed in accordance with NHBC guidelines to protect from future shrinking and swelling associated with tree removal / growth

The results of the site investigation have therefore been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The site is not underlain by an Aquifer

The investigation has indicated that the site is underlain by the London Clay rather than the Claygate Member and there is not underlain by a designated aquifer. Perched groundwater has been encountered within the made ground, however the excavation of the proposed basement will not have an impact on the hydrogeological or hydrological setting as a continuous groundwater table is not present below the site.

The site is located 100 m of a spring line and 50 m from a former river course

The site is approximately 100 m southwest of a spring line to the former River Westbourne, with the former course of river located approximately 50 m to the east of the site. However the site is located topographically below the level of the spring line, but topographically above the river course. And furthermore the site is not shown to be an area at risk of flooding. Therefore this is not considered to be an issue to the site or the proposed development and in any case a continuous groundwater level has not been encountered below the site.

Location of public highway

Although the site bordered the public highway, the actual basement excavation is over 5 m from the highway, such that the basement excavation should not affect the highway. In addition, the proposed development will include retaining walls that will be designed to maintain the stability of the surrounding ground, thus protecting the adjacent road and associated infrastructure beyond. There is nothing unusual or exceptional in the proposed development or the findings of the investigation that give rise to any concerns with regard to stability over and above any development of this nature.

Trees will be felled during the development

It is likely that a number of trees will be felled during the proposed development and a number of trees have already been felled. However, there are no critical slope angles within the site that are dependent on presence of the existing trees to aid stability. The clay soils however have been found to be desiccated to a depth of approximately 3.00 m (79.80 m OD) in the front garden area, where a large number are currently present. Provided that new foundations within the zone of influence of the trees and in the area of desiccation are designed in accordance with NHBC guidelines, as recommended within this report, there is no need for the removal of the trees to affect the proposed structure. It is however recommended that the trees to be removed are identified and a check made against NHBC guidelines to ensure that neighbouring foundations are not affected by future shrinking and swelling of the clay soils due to tree removal and or continued growth.

10.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work is considered to be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

It would be prudent to carry out additional investigations to confirm the configuration of the existing footings of the house and garden boundary walls, prior to basement construction.

Further groundwater monitoring should be carried out to confirm that groundwater will not be encountered during basement excavation or ideally trial excavations are undertaken, to depths as close to the full basement depth.

Whilst the use of NHBC guidelines will generally ensure that foundations extend to an appropriate depth, foundation excavation should be inspected by a geotechnical engineer to ensure that they are of sufficient depth.

If during ground works any visual or olfactory evidence of contamination is identified it is recommended that further investigation be carried out and that the risk assessment is reviewed. These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

As only a limited number of samples have been tested, it would be prudent to carry out contamination testing on additional samples of made ground / topsoil recovered from the areas of the site that are to remain as soft landscaped gardens, in order to ensure the absence of any significant contamination.

APPENDIX

Borehole Record

SPT Summary Sheet

Trial Pit Records

Geotechnical Laboratory Test Results

SPT & Cohesion / Depth Graph

Chemical Analyses (Soil)

Generic Risk Based Screening Values

Envirocheck Report Summary

Historical Maps

Site Plan

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware,Herts
SG12 7QE

Site	Borehole Number
41 Frognal, Hampstead, NW3 6YD	BH01

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 1.50m	87.74	BTP Group	J15019

Location	Dates	Engineer	Sheet
	30/01/2015	Elliot Wood	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					87.49	(0.25) 0.25	Reinforced concrete		
0.40	D1						Made Ground (brown gravelly clay with gravel and brick rubble)		
0.80	D2								
1.20-1.65 1.20	CPT N=7 B1			2,1/2,1,2,2		(2.05)			
2.00-2.45 2.00	CPT N=8 B2			1,1/2,2,2,2					
					85.44	2.30	Firm becoming stiff fissured brown CLAY with occasional pockets of grey and pale yellow and orange silt		
2.70	D3								
3.00-3.45	U1						clusters of selenite crystals present		
3.50	D4								
3.80	D5						selenite crystals present but no clusters		
4.00-4.45 4.00	SPT N=10 S1			1,2/2,3,2,3					
4.80	D6								
5.00-5.45	U2								
5.50	D7								
6.00-6.45 6.00	SPT N=14 S2			2,2/3,3,4,4					
						(8.50)			
7.50-7.95	U3						large pockets of pale silty sand		
8.00	D8								
9.00-9.45 9.00	SPT N=20 S3			3,4/4,5,5,6					

Remarks
Excavating services insepction pit from GL to 1.2 m for 1 hr.
Chiselling on a claystone from 17.80 m to 18.30 m for 30 mins.
Groundwater not encountered during drilling
Groundwater monitoring standpipe installed to 6.00 m.
Subsequent standpipe monitoring revealed ground water dry on 18/2/15 and at 2.18m depth (85.54 mOD) on 3/3/15

Scale (approx)	Logged By
1:50	KB

Figure No. J15019.BH01

Geotechnical & Environmental Associates (GEA)	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	Site 41 Frognal, Hampstead, NW3 6YD	Borehole Number **BH01**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 1.50m	87.74	BTP Group	J15019
	Location	**Dates** 30/01/2015	**Engineer** Elliot Wood	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(8.50)			
10.50-10.95	U4								
					76.94	10.80	Very stiff fissured dark grey CLAY with fine selenite present.		
11.00	D9								
12.00-12.45 12.00	SPT N=26 S4			4,5/6,6,7,7			occassional pockets of dark grey silt		
13.50-13.95	U5								
14.00	D10								
15.00-15.45 15.00	SPT N=27 S5			5,5/6,6,7,8					
						(9.20)			
16.50-16.95	U6								
17.00	D11								
							claystone encountered at 17.8 m		
18.00-18.45 18.00 18.30	SPT N=35 S6 D12			6,7/8,8,9,10					
19.50-19.95	U7								
20.00	D13				67.74	20.00			

Remarks

Scale (approx)	Logged By
1:50	KB

Figure No.
J15019.BH01

Geotechnical & Environmental Associates Widbury Barn, Widbury Hill, Ware,Herts, SG12 7QE	Site: 41 Frognal, Hampstead, NW3 6YD	Borehole Number: BH02

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 1.50m	84.40	BTP Group	J15019
	Location	**Dates**	**Engineer**	**Sheet**
		29/01/2015	Elliot Wood	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					84.20	(0.20) 0.20	Topsoil		
0.30	D1					(1.10)	Made Ground (dark brown clayey silty gravelly sand with roots, gravel and brick rubble)		
1.00	D2								
1.20-1.65	CPT N=8			1,1/1,2,2,3	83.10	1.30	"Stiff" fissured brown CLAY with occassional partings of grey silt and roots to 3.6 m. Dessicated Soil		
1.20	B1								
1.80	D3								
2.00-2.45	U1					(1.50)			
2.50	D4								
2.80	D5				81.60	2.80	Firm fissured brown CLAY with partings of pale silty sand and rare carbonaceous material and some selenite crystals		
3.00-3.45	SPT N=11			2,3/3,3,2,3					
3.00	S1								
3.70	D6								
4.00-4.45	U2					(3.20)			
4.50	D7								
4.80	D8								
5.00-5.45	SPT N=13			2,2/2,3,4,4					
5.00	S2								
6.00-6.45	U3				78.40	6.00	Firm fissured brown CLAY with pockets of orange silty sand and rare selenite crystals		
6.50	D9					(1.50)			
7.50-7.95	SPT N=17			3,3/4,4,4,5	76.90	7.50	Firm becoming stiff fissured brown CLAY with occasional partings of grey silt		
7.50	S3					(1.20)			
8.80	D10				75.70	8.70	Very stiff fissured dark grey CLAY with rare pockets of dark grey and orange silt and very fine selinite		
9.00-9.45	U4								
9.50	D11								

Remarks
Excavating services insepction pit from GL to 1.2 m for 1 hr.
Chiselling on a claystone from 14.80 m to 15.70 m for 30 mins.
Groundwater not encountered during drilling
Groundwater monitoring standpipe installed to 6.0 m.
Subsequent standpipe monitoring revealed ground water dry on 18/2/15 and at 1.23 m depth (83.17 mOD) on 3/3/15

Scale (approx)	Logged By
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Figure No. J15019.BH02

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 41 Frognal, Hampstead, NW3 6YD	**Borehole Number** **BH02**

Boring Method	**Casing Diameter**	**Ground Level (mOD)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 1.50m	84.40	BTP Group	J15019
	Location	**Dates** 29/01/2015	**Engineer** Elliot Wood	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95 10.50	SPT N=24 S4			4,5/5,6,6,7					
						(3.30)			
12.00-12.45	U5				72.40	12.00	Very stiff fissured dark grey CLAY with very fine selenite		
12.50	D12								
13.50-13.95 13.50	SPT N=27 S5			5,5/6,6,7,8					
							claystone encountered at 14.8 m		
15.70 15.80-16.25	D13 U6					(8.00)			
16.30	D14						partings of pale yellow fine silt		
16.50-16.95 16.50	SPT N=33 S6			6,7/7,8,9,9					
18.00-18.45	U7								
18.50	D15								
19.50-19.95 19.50	SPT N=37 S7			7,7/8,9,10,10					
					64.40	20.00			

Remarks	**Scale (approx)**	**Logged By**
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	Figure No. J15019.BH02	

Geotechnical & Environmental Associates
Widbury Barn
Widbury Hill
Ware,Herts
SG12 7QE

Site	Number
41 Frognal, Hampstead, NW3 6YD	BH03

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Opendrive Percussive Sampler (Terrier rig)		88.20	BTP Group	J15019
	Location	**Dates**	**Engineer**	**Sheet**
		28/01/2015	Elliot Wood	1/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				87.87	(0.33) 0.33	Made Ground (dark brown silty sandy gravelly clay with brick fragments and rootlets)		
0.50	D1			87.20	(0.67) 1.00	Firm fissured pale brown mottled orange-brown CLAY with pockets of orange-brown fine sand		
1.00-1.45	SPT N=9		1,2/2,2,2,3			Firm becoming stiff fissured pale brown mottled grey silty CLAY with partings of grey silt and pockets of orange-brown sand		
1.50	D2							
2.00-2.45	SPT N=9		1,2/1,2,3,3					
2.50	D3					selenite crystals encountered below 2.50 m		
3.00-3.45	SPT N=13		2,1/3,2,4,4					
3.50	D4							
4.00-4.45	SPT N=11		2,1/2,3,2,4					
4.50	D5							
					(7.70)			
5.00-5.45	SPT N=13		2,2/2,3,4,4					
5.50	D6							
6.00-6.45	SPT N=16		2,2/3,4,4,5					
7.00-7.45	SPT N=20		3,3/4,5,5,6					
7.50	D7							
8.00-8.45	SPT N=19		3,3/4,4,5,6					
8.50	D8			79.50	8.70			
8.70	D9					Stiff fissured dark brownish grey silty slightly sandy CLAY with selenite crystals		
9.00-9.45	SPT N=17		2,3/3,4,5,5			claystone encountered at 8.90 m		
9.50	D10				(1.75)			
10.00-10.45	SPT N=21		3,3/4,5,6,6					

Remarks
Groundwater not encountered during drilling.
Groundwater monitoring standpipe installed to 6.00 m.
Subsequent standpipe monitoring revealed to be dry on 18/2/15 and 3/3/15

Scale (approx)	Logged By
1:50	KB

Figure No. J15019.BH03

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 41 Frognal, Hampstead, NW3 6YD	**Number** **BH03**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Opendrive Percussive Sampler (Terrier rig)		88.20	BTP Group	J15019
	Location	**Dates** 28/01/2015	**Engineer** Elliot Wood	**Sheet** 2/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(1.75)			
				77.75	10.45			
						Complete at 10.45m		

Remarks	**Scale (approx)** 1:50	**Logged By** KB
	Figure No. J15019.BH03	