DESK STUDY & BASEMENT IMPACT ASSESSMENT REPORT

26 Rosecroft Avenue
London NW3

Client: Vipul Panchal

Engineer: Hestia Developments

J15226

December 2015




GEA Geotechnical & Environmental Associates

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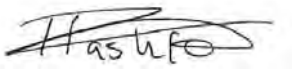
Report prepared by			
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	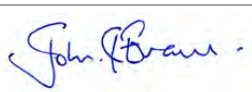		
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	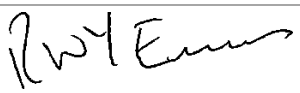		
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EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Vipul Panchal, with respect to the proposed deepening and extending of the existing basement beneath the majority of the footprint of the house; the proposed basement will extend to a depth of 2.80 m below existing ground floor level. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground conditions and hydrogeology, to assess the extent of any contamination and to provide information to assist with the design of the basement structure and suitable foundations for the proposed development. The report also includes information required to comply with London Borough of Camden (LBC) Planning Guidance CPG4, relating to the requirement for a Basement Impact Assessment (BIA). A ground movement assessment is being undertaken and will be reported separately.

DESK STUDY FINDINGS

The earliest map studied, dated 1864, does not have any coverage of the site but does show two ponds, located 300 m to the west and 320 m to the northwest. On the next map, studied, dated 1879, part of the site is shown to have been developed by an irregular shaped building, which appears to form part of a larger development, with outbuildings to the north of the site and what appear to be numerous tracks. A well is shown 20 m to the west of the site and seven features, assumed to be ponds, are shown within 250 m of the site. The closest pond like feature was located 40 m to the south of the site. A watercourse flowing in a southerly direction is shown issuing to the south of the pond located 170 m to the southeast of the site. On the 1896 map, the site remained partly occupied by a building that is first labelled on this map as Child's Hill House. At some time between 1896 and 1915 the building that occupies part of the site was demolished and replaced by the existing house. None of the ponds that were located within 100 m of the site are shown on maps after 1915.and had presumably been infilled. On this map the route of the watercourse, located 170 m to the southeast of the site is still visible from the layout of plots. The headwaters are shown further north than previously identified on the 1879 map and are shown 20 m to the northeast of the site.

GROUND CONDITIONS

The investigation encountered the expected ground conditions in that, below a nominal to moderate thickness of made ground or topsoil, the Bagshot Formation was encountered overlying the Claygate Member, which was proved to the maximum depth investigated. The made ground / topsoil extended to depths of between 0.15 m and 1.20 m (49.69 m TBM and 46.86 m TBM). The Bagshot Formation has been inferred to extend to a depth of 5.70 m (42.36 m TBM) and comprised brown mottled orange-brown, yellowish brown and grey silty sandy clay interbedded with layers of clayey silty fine sand and clay with rare nodules of cemented sand. A thin layer of water-bearing sandy silt was encountered in Borehole No 2 from 2.00 m to 2.10 m (47.84 m TBM and 47.74 m TBM). The clay of the Bagshot Formation was found to be 'stiff' in Borehole No 1 to a depth of 2.30 m, located near a 6 m high bay tree, indicating possible signs of desiccation and the results of the laboratory tests indicates that the desiccation extends to a depth of about 1.70 m. The Claygate Member comprises firm becoming stiff medium strength becoming high strength locally fissured grey silty sandy clay with pockets of silt and sand, proved to the full depth of investigation of 15.45 m (32.61 m TBM). A groundwater seepage was encountered in Borehole No 1 at a depth of 5.95 m during drilling near the top of the Claygate Member, with further inflows at depths of 6.90 m, 8.90 m and 10.40 m. The soil was noted to be wet within a silty layer in Borehole No 2 from a depth of 2.00 m to 2.10 m. Monitoring of the standpipes have measured groundwater at depths of between 4.88 m and 4.90 m (43.18 m TBM and 43.16 m TBM).

The existing house is founded on natural soils of the Bagshot Formation. The made ground around existing foundations has been found to contain elevated concentrations of lead.

RECOMMENDATIONS

Groundwater is not anticipated to be encountered during the excavation of the 2.8 m deep basement and the most suitable method of support will probably therefore be to form the retaining walls by concrete underpinning of the existing foundations using a traditional 'hit and miss' approach. This technique will require the soils being underpinned to stand unsupported, and difficulties may be encountered with unsupported excavations, particularly if groundwater is encountered, and the contractor should have contingency to manage such occurrences. Trial excavations to the proposed basement depth should ideally be carried out to determine the stability of the soil and the presence of groundwater. If trial excavations indicate traditional underpinning to be impractical, jet grouting could be considered or piled retaining walls will be required. The BIA has indicated that the proposed development will not have an effect on the local hydrological and hydrogeological setting.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Vipul Panchal, to carry out a desk study and ground investigation at 26 Rosecroft Avenue, London, NW3 7QB. This report also forms part of a Basement Impact Assessment (BIA), which has been carried out in accordance with guidelines from the London Borough of Camden (LBC) in support of a planning application.

In addition a ground movement analysis is currently underway and will be reported separately.

1.1 Proposed Development

It is proposed to make minor internal alterations at ground floor level, demolish a single storey extension, deepen the existing lower ground floor slab by 0.36 m and extend the basement beneath the footprint of the majority of the existing house. The proposed basement extension will extend to a depth of about 2.80 m below existing ground floor level, extending to a level of 47.2 m TBM. The proposals also include the construction of front and rear lightwells and a new patio terrace.

This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to check the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to investigate the configuration of existing foundations;
- to provide advice and information with respect to the design of suitable foundations and retaining walls;
- to assess the impact of the proposed basement on the local hydrogeology;
- to provide an indication of the degree of soil contamination present; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out followed by a ground investigation. The desk study comprised:

- a review of available historical Ordinance Survey (OS) maps;
- to check records of data on groundwater, surface water and other publicly available environmental data;
- a review of readily available geology maps; and
- a walkover survey of the site carried out prior to the fieldwork.

In the light of this desk study, an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- a single borehole advanced to a depth of 15.45 m, from the front garden, by means of a dismantlable cable percussion drilling rig;
- standard penetration tests (SPTs), carried out at regular intervals in the cable percussion borehole, to provide quantitative data on the strength of the soils;
- three drive-in window sampler boreholes advanced to depths of between 4.40 m and 4.80 m from the rear garden level;
- installation of three standpipes to depths of between 4.00 m and 8.00 m and two subsequent groundwater monitoring visits to record groundwater levels;
- a total of seven manually excavated trial pits to determine the configuration of the existing foundations of the house;
- testing of selected soil samples for contamination and geotechnical purposes; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11[1] and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

1.3.1 Basement Impact Assessment

The work carried out also includes a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), all of which form part of the BIA procedure specified in the London Borough of Camden (LBC) Planning Guidance CPG4[2] and their Guidance for Subterranean Development[3] prepared by Arup ('the Arup

1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004
2 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*

Report'). The aim of the work is to provide information on surface water, groundwater and land stability and in particular to assess whether the development will affect neighbouring properties or groundwater movements and whether any identified impacts can be appropriately mitigated by the design of the development.

1.3.2 Qualifications

The land stability element of the Basement Impact Assessment (BIA) has been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng), member of the Institution of Civil Engineers (MICE), and Fellow of the Geological Society (FGS) who has over 20 years' specialist experience in ground engineering. The subterranean (groundwater) flow assessment has been carried out by John Evans, MSc in Hydrogeology, Chartered Geologist (CGeol) and Fellow of the Geological Society of London (FGS). The surface water and flooding assessment has been carried out by Rupert Evans, a hydrologist with more than ten years consultancy experience in flood risk assessment, surface water drainage schemes and hydrology / hydraulic modelling. Rupert Evans is a Chartered Environmentalist, Chartered Water and Environmental Manager and a Member of CIWEM.

The assessments have been made in conjunction with Steve Branch, a BSc in Engineering Geology and Geotechnics, MSc in Geotechnical Engineering, a Chartered Geologist (CGeol) and Fellow of the Geological Society (FGS) with over 25 years' experience in geotechnical engineering and engineering geology.

All assessors meet the qualification requirements of the Council guidance.

1.4 Limitations

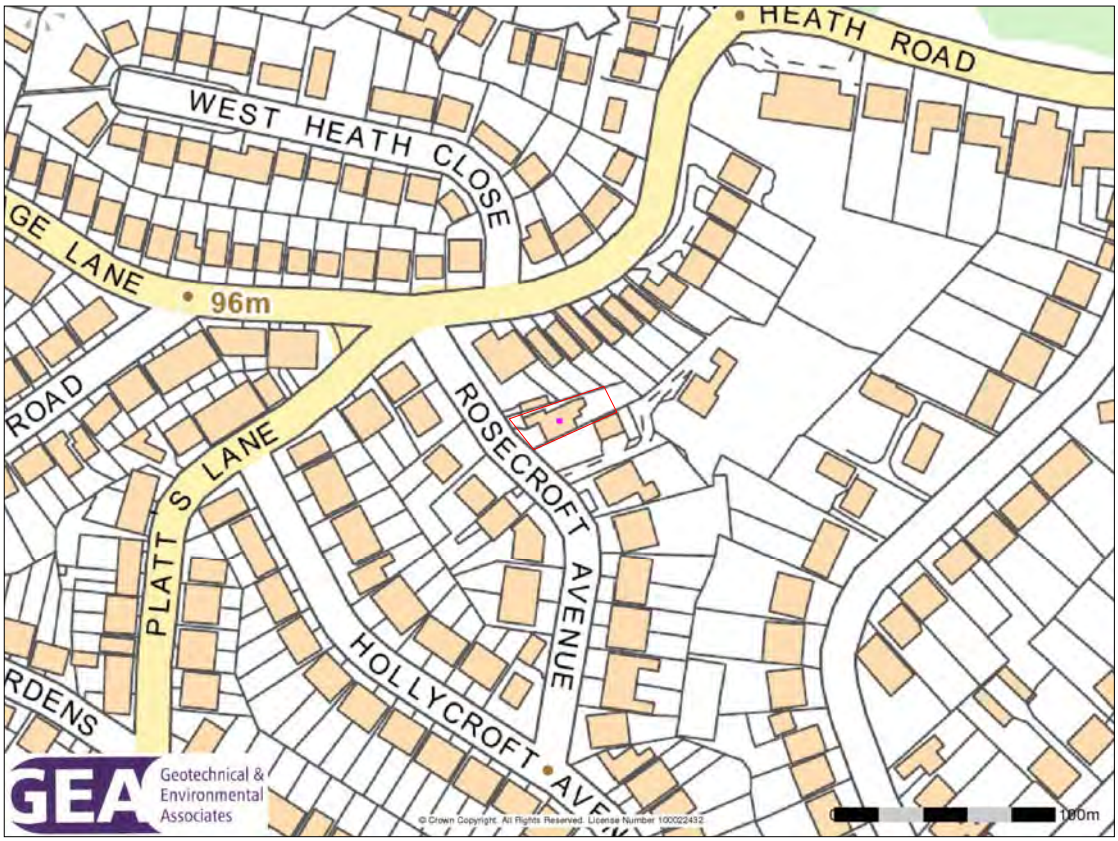
The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located in the London Borough of Camden in a residential area, approximately 1 km to the northwest of Hampstead Heath London Underground station. The site is irregular in shape and measures approximately 15 m north-south by 35 m east-west and fronts onto Rosecroft Avenue to the west. It is bounded to the north by a single storey brick building, which houses an electricity substation, and the rear gardens of Nos 44 and 46 Platt's Lane. To the east the site is bordered by the rear garden of No 26A Rosecroft Avenue and to the south by No 24 Rosecroft Avenue; a two-storey house set back from the road. The site may be additionally located by National Grid Reference 525470, 186240 and is shown on the map extract overleaf.

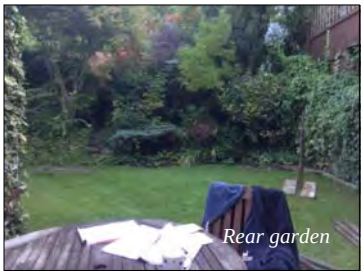
3 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010



A walkover of the site was carried out by a geotechnical engineer from GEA on 23 September 2015. Selected photographs are included below.


Western elevation and adjacent sub-station


Shared driveway and access to 26A Rosecroft Avenue


Rear garden


Entrance to 26 Rosecroft Avenue


Eastern elevation

The local topography slopes down towards the northwest and west. The site generally slopes down to the southwest and there are a number of changes in ground level across the site to accommodate the change in slope. The site is currently occupied by a two-storey detached brick house with roof accommodation and two single storey rear extensions. A lower ground floor extending to a level of 47.56 m TBM is present beneath the northwestern corner, measuring 10 m by 4 m in plan and extends 2.44 m below existing ground floor level. It is understood that this was formerly a garage, prior to its conversion. The house is divided into two self-contained flats; the lower ground floor and ground floor is owned by the client and the first floor and second floor forms 26A Rosecroft Avenue, along with the driveway, northern passageway along the house and a private rear garden, located at a higher level.

The site has its own front garden located at roughly 48 m TBM. The front garden comprises a gravel area with shrub borders and a central brick paved path, lined with five Bay trees, 6 m high. Steps lead up to a raised ground floor level, located roughly 2 m above the level of the front garden at 50 m TBM. Steps lead down from the front garden to the driveway at roughly 47.2 m TBM.

A narrow passageway which slopes down to the southwest is present along the southern elevation although access is currently restricted as it is used as a storage area.

At the rear of the house is a patio area located 150 mm higher than the central lawn at a level of 49.84 m TBM. Trees ranging from 5 m to 9 m in height are present along the eastern perimeter of the garden. Along the eastern garden boundary is a slope with an angle of about 38º, which over a distance of 3.50 m, rises by 1.53 m

The site is not shown on Figure 16 of the Arup Report to be within an area of critical slope angles of greater than 7º or within an area of landslide potential, as shown by Figure 17 of the same report.

At the time of the walk-over, building works were being undertaken on No 26A Rosecroft Avenue.

2.2 Site History

The history of the site and surrounding area has been researched by reference to historical Ordnance Survey (OS) maps sourced from the Envirocheck database.

The earliest map studied, dated 1864 does not have any coverage for the site but does show two ponds, located 300 m to the west and 320 m to the northwest.

On the next map, studied, dated 1879, part of the site is shown to have been developed with an irregular shaped building, which appears to form part of a larger development, with outbuildings to the north of the site and what appears to be numerous tracks. A brickfield is shown 320 m to the southwest. A well is shown 20 m to the west of the site and seven features, assumed to be ponds, are shown within 250 m of the site. The closest pond feature was located 40 m to the south of the site. A watercourse flowing in a southerly direction is shown issuing to the south of the pond located 170 m to the southeast of the site. Another pond was located 400 m to the southeast of the site with a watercourse issuing and flowing in a southerly direction for a distance of 120 m before terminating. To the southwest of the site, at a distance of 180 m, a feature inferred to be a watercourse was trending in an east-west direction.

On the 1896 map, the site remained partly occupied by a building that is first labelled on this map as Child's Hill House. West Middlesex Water Works Reservoir (Covered) are located 320 m south. On this map, two of the assumed ponds like features, located within 100 m of the site are no longer shown, along with the inferred watercourse 400 m to the southeast, brickfield and the well. Redington Road has been constructed to the east of the site.

At some time between 1896 and 1915 the building that occupies part of the site was demolished and replaced by the existing house. Rosecroft Avenue was constructed during this time along with the immediate surrounding area, apart from the plot immediately to the south of the site and on the opposite side of the road. Phyllis Court was constructed to the northeast. All the ponds that were located within 100 m of the site are not shown on subsequent maps after 1915 and the ponds may have been infilled. On this map the route of the watercourse, located 170 m to the southeast of the site is still visible from the layout of plots. The headwaters are shown further north, than previously identified on the 1879 map and is shown at Phyllis Court, 20 m to the northeast of the site. The surrounding area comprises houses with gardens, with the same road system seen in the present day.

Between 1955 and 1965, the site to the south is developed with No 24 Rosecroft Avenue, along with the plot on the opposite side of the road. The site and surrounding area remain essentially unchanged to the present day.

A search of the Camden online planning portal indicates that planning permission was granted in 1981 to convert the property into two self-contained flats. Numerous applications have been submitted and approved for tree works at the property. In September 2013 permission was granted for alterations to the neighbouring property at No 26a Rosecroft Avenue (ref 201/5643/P).

2.3 Other Information

A search of public registers and databases has been made via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The Envirocheck report has indicated no landfill sites, waste management or waste transfer sites located within 1 km of the site. In addition, there are no pollution incidents within 500 m of the site and there are no discharge consents of fuel stations within 250 m of the site.

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1% of homes are affected by radon emissions and therefore radon protective measures will not be necessary.

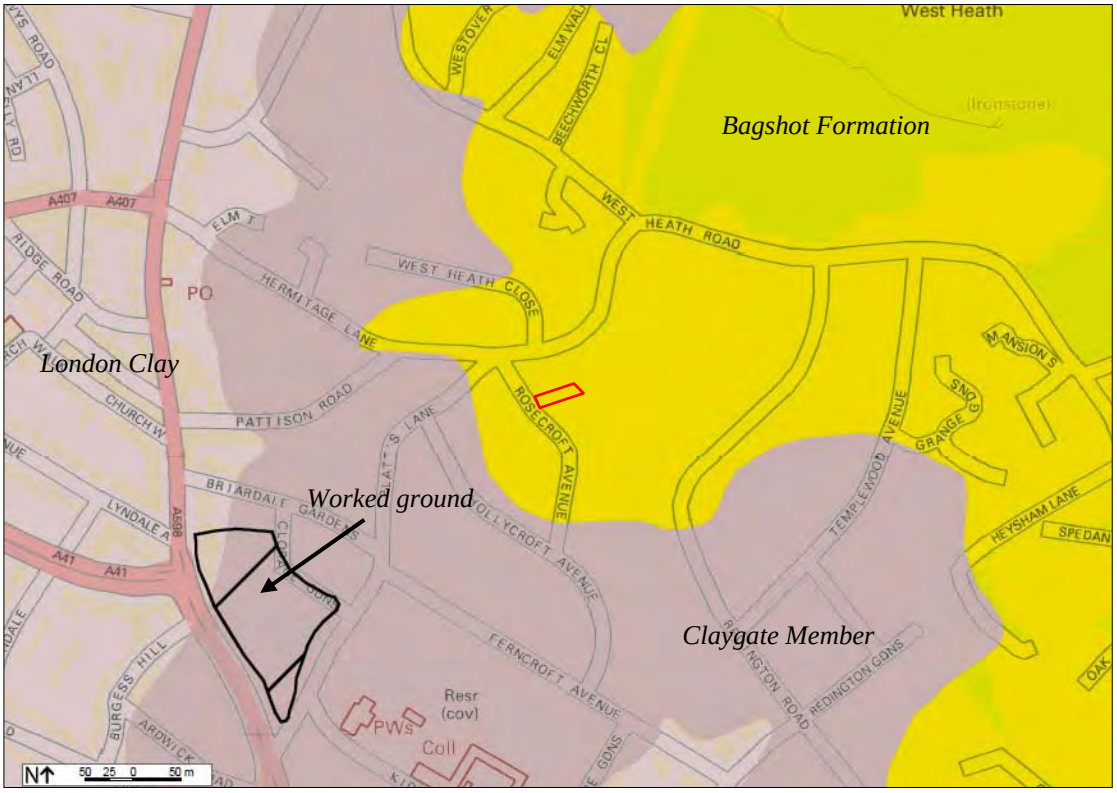
The site is not located within a nitrate vulnerable zone or any other sensitive land use.

A search of the Camden Planning Portal for planning applications relating to the properties surrounding the site to determine those with basements or basement applications has been undertaken. Planning permission was granted in September 2011 for No 20 Rosecroft Avenue to form a basement (ref 2011/4331/L). It is not known if this basement was constructed.

2.4 Geology

The British Geological Survey (BGS) map of the area[4], and the BGS 1:50,000 Bedrock and Superficial Geological Map Sheet No.256 indicate the site is underlain by the Bagshot Formation, which is underlain by the Claygate Member, and London Clay. The site is not indicated to have a propensity to head deposits.

According to the geology map, the boundary between the Bagshot Formation and Claygate Member is located approximately 75 m to the southwest and the boundary between the Claygate Member and London Clay is shown 300 m to the southwest. An area of worked ground is shown 275 m to the southwest, which is assumed to be associated with former brickfield. An extract from Findmaps is included below, indicating the location of the site with respect to the geological boundaries.



A borehole drilled by the BGS on Hampstead Lane, generally referred to as the Hampstead Heath borehole, to a depth of 66.74 m (61.97 m OD), about 2 km to the northeast of the site at National Grid Reference 526455, 186890, found the Bagshot Formation to extend to a level of 109.71 m OD and penetrated the full thickness of the Claygate Member, which was found to extend to a level of 93.71 m OD.

The geology in this area is generally horizontally bedded such that the boundary between the geological formations roughly follows the ground surface contour lines. The Bagshot Beds is expected to extend to a level of approximately 115 m OD to 110 m OD and the Claygate Member to levels of roughly between 90 m OD to 85 m OD in this area.

[4] www.bgs.ac.uk/geoindex

According to the British Geological Lexicon[5], the Bagshot Formation is *"composed of pale yellow-brown to pale grey or white, locally orange or crimson, fine- to coarse-grained sand that is frequently micaceous and locally clayey, with sparse glauconite and sparse seams of gravel. The sands are commonly cross-bedded but some are laminated. Thin beds and lenses of laminated pale grey to white sandy or silty clay or clay ('pipe-clay') occur sporadically, becoming thicker towards the top of the formation."*

Whilst the Claygate Member "*comprises dark grey clays with sand laminae, passing up into thin alternations of clays, silts and fine-grained sand, with beds of bioturbated silt"*. The London Clay Formation is described as "*bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand, which commonly increase towards the base and towards the top of the formation."*

The boundary between the Bagshot Formation and Claygate Member is often difficult to determine.

A nearby investigation undertaken by GEA in 2012, 200 m to the southeast of the site on Redington Road found the Bagshot Formation to extend to levels of between 106.35 m OD and 105.95 m OD. Another investigation undertaken by GEA, 150 m to the south-southwest on Hollycroft Avenue, encountered the Claygate Member which was proved to a level of 86.30 m OD.

2.5 Hydrology and Hydrogeology

The Bagshot Formation and the Claygate Member are both classified as Secondary 'A' Aquifers, which refers to permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers, as defined by the Environment Agency (EA). The London Clay is classified as an Unproductive Stratum, which refers to rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Based on this, groundwater is likely to be present within the Bagshot Beds and the Claygate Member, and other investigations carried out around the area of Hampstead Heath indicate that spring lines are present at the interface of the Bagshot Beds and the Claygate Member, and to a much lesser extent at a lower level at the boundary between the Claygate Member and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's "lost" rivers, notably the Fleet, Westbourne and Tyburn, which all rose on Hampstead Heath, to the south of the current site, at the base of the Bagshot Beds.

Historically a tributary of the River Westbourne rose approximately 100 m to the southeast of the site, according to the Lost Rivers of London[6]. The tributary is shown on the map dated 1879 rising from a pond, flowing in a southerly direction along the route of Redington Road, which had not yet been constructed. The Westbourne runs from Hampstead Heath, through Kilburn and Paddington, across Hyde Park to the Thames at Chelsea. It is understood that the Westbourne is now covered and culverted and forms part of the surface water sewerage system called Ranelagh Sewer.

[5] http://www.bgs.ac.uk/lexicon
[6] Nicholas Barton (2000) *London's Lost Rivers.* Historical Publications Ltd

On comparison, the historical map and lost rivers map have an almost identical layout, however, the locations of the streams are slightly different when considering the surface features. It is considered likely that the historical topographical map is more accurate than the lost rivers map.

Given the location of the source of the Westbourne, it is likely that it was formed by a spring issuing from within the interface of the sandy Bagshot Formation and the underlying less permeable Claygate Member.

Any water infiltrating the Bagshot Formation will generally tend to flow vertically downwards at a slow rate towards the Claygate Member and London Clay. The direction of groundwater flow within the Bagshot Beds beneath the site is likely to be controlled by the local topography and is therefore likely to be in a southerly or southeasterly direction, in the direction that the former river flowed.

In the aforementioned ground investigation on Redington Road, groundwater was measured in the standpipes at levels of between 97.52 m OD and 106.88 m OD.

The site lies outside the catchment of the Hampstead Heath chain of ponds.

The site is not at risk of flooding from rivers or sea, as defined by the Environment Agency and Rosecroft Avenue has not been identified as a street at risk of surface water flooding, specified in the London Borough of Camden (LBC) Planning Guidance CPG4 [7] and therefore a flood risk assessment will not be required.

The nearest surface water feature to the site is located 448 m to north of the site. There are no Environment Agency designated Source Protection Zones (SPZs) on the site and no listed water abstractions within 1 km of the site.

The site is largely covered by the existing building and hardstanding and therefore infiltration of rain water into the ground beneath the site is limited to the area of soft landscaping in the front and rear garden, therefore the majority of surface runoff is likely to drain into combined sewers in the road.

2.6 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2.6.1 Source

The desk study research has indicated that the site has only been occupied by residential properties and the site was first developed with Child's Hill House. This house was demolished and replaced by the existing house by at least 1915. The site is therefore not considered to have had a contaminative history and no specific possible sources of contamination have been identified on the site, or within the immediate surrounding area, which comprises residential streets.

[3] London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*

Demolition of the house previously present on the site is likely to have resulted in the presence of a moderate thickness of made ground. This would mostly be inert rubble, but is likely to include small quantities of contaminants such as lead, present in paintwork, and other metals.

Historical ponds located within 100 m of the site appear to have been infilled over 100 years ago. In addition, there are no historical or existing landfill sites within 1 km of the site and made ground associated with demolition of the building previously present on the site is likely to be predominantly inert demolition rubble. On the basis of this information a risk of soil gas has not been identified.

2.6.2 Receptor

The continued use of the site as a residential dwelling represents a relatively high sensitivity end-use and end users are considered to be sensitive receptors. As the site is underlain by a Secondary 'A' Aquifer, groundwater is considered to be a moderate sensitive receptor. Site workers will come into contact with underlying soils during the construction phase, as will new buried services and both are therefore considered to be sensitive receptors. Neighbouring sites would also be considered to be moderately sensitive receptors.

2.6.3 Pathway

Below the existing house, surrounding areas of hardstanding and the proposed basement structure, end users will effectively be isolated from the underlying soils. The front and rear soft landscaped gardens are however to remain and therefore in these areas a pathway by which end users can come into direct contact with the underlying soils will exist. Groundwater within the Secondary 'A' Aquifer is considered to be a potential pathway by which any soluble contaminants may migrate off and onto to the site, although this pathway is already in existence. The construction phase is considered to be a pathway by which site workers and new buried services may come in contact with any contamination.

2.6.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a low risk of there being a significant contaminant linkage at this site, which would result in a requirement for major remediation work. Furthermore as there is no evidence of filled ground within the vicinity, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site; there should thus be no need to consider soil gas exclusion systems.

3.0 SCREENING

The LBC guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full BIA is required.

3.1 Screening Assessment

A number of screening tools are included in the Arup document and for the purposes of this report reference has been made to Appendices E1, E2 and E3 which include a series of questions within screening flowcharts for surface flow and flooding, subterranean (groundwater) flow and land stability. The flowchart questions and responses to these questions are tabulated below.

3.1.1 Subterranean (groundwater) Screening Assessment

Question	Response for 26 Rosecroft Avenue
1a. Is the site located directly above an aquifer?	*Yes, a Secondary 'A' Aquifer.*
1b. Will the proposed basement extend beneath the water table surface?	*Possible.*
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	*Yes. Historical well located 20 m to the west of the site. A tributary of the River Westbourne was present to the southeast of the site, although the exact location of the headwaters is not known, it is thought to have been within 100 m based on a review of historical map records.*
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	*Yes. The amount of hardstanding will be increased slightly where the front lightwell is proposed.*
5. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No. Run-off from hardstanding will drain to the sewer system, as it does currently.
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line?	*Possible.*

The above assessment has identified the following potential issues that need to be assessed:

Q1a The site is located directly above the Bagshot Formation, which is a Secondary 'A' Aquifer.
Q1b There is a possibility that the proposed basement may extend beneath the water table.
Q2 The site is within 100 m of a historical well and possible watercourse.
Q4 There will be a slight increase in the amount of hardstanding.
Q6 The lowest point of the proposed excavation may be lower than a local pond or spring line.

3.1.2 Stability Screening Assessment

Question	Response for 26 Rosecroft Avenue
1. Does the existing site include slopes, natural or manmade, greater than 7°?	*Yes. Along the eastern garden boundary is a slope greater than 7°, according to the site survey drawing.*
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No. *With reference to the Camden Geological, Hydrogeological and Hydrological Study, (refer Figure (16).*
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	No. With reference to the Camden Geological, Hydrogeological and Hydrological Study, (refer Figure (16).
5. Is the London Clay the shallowest strata at the site?	No. The underlying soil is indicated as the Bagshot Formation.
6. 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 to be retained?	No. It is understood that no trees will be felled as part of the proposals.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	*Possible. The clays of the Bagshot Formation are considered to have similar properties to the Claygate Member, i.e. medium volume change potential.*

Question	Response for 26 Rosecroft Avenue
8. Is the site within 100 m of a watercourse or potential spring line?	*Yes.*
9. Is the site within an area of previously worked ground?	No.
10. Is the site within an aquifer?	*Yes the site is located above a Secondary 'A' Aquifer as designated by the EA.*
11. Is the site within 50 m of Hampstead Heath ponds?	No.
12. Is the site within 5 m of a highway or pedestrian right of way?	*Yes. The site fronts onto Rosecroft Avenue.*
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	*Possible.*
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No.

The above assessment has identified the following potential issues that need to be assessed:

Q1 The site includes slopes greater than 7° locally.
Q7 The site is in an area likely to be affected by seasonal shrink-swell.
Q8 The site is within 100 m of a possible watercourse.
Q10 The site is located directly above a Secondary 'A' Aquifer.
Q12 The site is located 5 m of a highway.
Q13 The proposed basement may increase the differential depth of foundations relative to neighbouring properties.

3.1.3 Surface Flow and Flooding Screening Assessment

Question	Response for 26 Rosecroft Avenue
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Figure 14 of the Arup report confirms that the site is not located within this catchment area.
2. 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 – any additional surface water from the slight increase hardstanding area will be attenuated to ensure the surface water flow regime will be unchanged. The basement will largely be beneath the footprint of the existing building and surrounding hard standing areas and therefore the 1m distance between the roof of the basement and ground surface as recommended by the Arup report and para 2.16 of the CPG4. However, as the basement will also slightly extend into parts of the site which are currently permeable, these parts (namely the proposed front lightwell) will therefore not meet the 1m criteria. It is considered that the use of SUDS attenuation will mitigate any impact by not fully meeting the 1m requirement.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	*Yes - The amount of hardstanding will be increased slightly where the front lightwell is proposed.* *SUDS attenuation will reduce the impact to acceptable levels.*
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent	No. – it is proposed to allow for new SUDS attenuation to control how water is stored from additional hardstanding areas. The attenuation size will be based upon peak surface

Question	Response for 26 Rosecroft Avenue
properties or downstream watercourses?	water flows and discharge rates into existing sewers will be agreed with Thames Water. The basement will largely be beneath the footprint of the existing building and surrounding hard standing areas and therefore the 1m distance between the roof of the basement and ground surface as recommended by the Arup report and para 2.16 of the CPG4. However, as the basement will also slightly extend into parts of the site which are currently permeable, these parts (namely the proposed lightwells) will therefore not meet the 1m criteria. It is considered that the use of SUDS attenuation will mitigate any impact by not fully meeting the 1m requirement.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No - the proposed basement is very unlikely to result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses. It is proposed to allow for new attenuation to control how water is stored from additional hardstanding areas and it will be unpolluted roof water draining into the sewer system.
6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk of flooding, for example because the proposed basement is below the static water level of nearby surface water feature?	No. The findings of this BIA together with the Camden Flood Risk Management Strategy dated 2013, together with Figures 3iv, 4e, 5a and 5b of the SFRA dated 2014, and Environment Agency online flood maps show that the site has a low flooding risk from surface water, sewers, reservoirs (and other artificial sources), groundwater and fluvial/tidal watercourses. In accordance with paragraph 5.11 of the CPG a positive pumped device will be installed in the basement in order to further protect the site from sewer flooding. The site is not located within the Critical Drainage Area or a Local Flood Risk Zone as identified in the Camden SWMP and Updated SFRA Figure 6/Rev 2.

Q3 There will be a slight increase in the amount of hardstanding.

4.0 SCOPING AND SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

4.1 Potential Impacts

The following potential impacts have been identified by the screening process

Potential Impact	Consequence
The site is a Secondary 'A' Aquifer.	The site is underlain by the Bagshot Formation, which is classified as a Secondary 'A' Aquifer. This has the potential of being able to support local water supplies as well as forming an important source of base flow for local rivers. There is the potential for the hydrogeological setting to be affected by a basement development.
The proposed basement extends beneath the water table surface.	It is possible that the basement excavation will extend below the water table. Should this happen, the basement structure is capable of diverting groundwater flow such that groundwater level is affected on both the up slope and down

Potential Impact	Consequence
	slope side of the basement structure. This in turn has the potential to affect the local hydrogeology and any adjacent structures. The potential presence of groundwater needs to be considered in terms of construction methods and long term design of the basement, to prevent flooding and instability.
The lowest point of the basement may be lower than a local pond.	The proposed basement structure may cause overflowing of ponds and may lead to flooding of the basement at times of high run-off.
The existing site includes limited areas where the slopes are greater than 7°.	The proposed development could lead to slope instability in the surrounding area.
The site within 100 m of a watercourse, well (used/ disused) or potential spring line.	The historical well and tributary of the River Westbourne may indicate a shallow groundwater and groundwater may be encountered during basement excavation. Impact on the flow of groundwater or quantity of groundwater to the well by the basement construction. The site is not shown to be an area at risk of flooding and therefore this is not considered to be an issue to the site or the proposed development.
Site within 5 m of a public highway.	Rosecroft Avenue is located to the west of the site and the excavation of a basement can cause instability of such structures. However the proposed basement excavation is actually over 5 m away from the pavement.
Seasonal shrink-swell.	If a new basement is not dug to below the depth likely to be affected by tree roots this could lead to damaging differential movement between the subject site and adjoining properties.
Founding depths relative to neighbours.	If not designed and constructed appropriately, the excavation of a basement may result in structural damage to neighbouring buildings and structures.
Surface water flows may be materially changed from the existing routes.	Consideration of the impact to the groundwater and receiving drainage systems should be considered.

These potential impacts have been investigated through the site investigation, as detailed in Section 9.0.

4.2 Exploratory Work

Access to the rear of the property was limited by the presence of the existing house. Therefore, in order to meet the objectives described in Section 1.2, as far as possible within the access restrictions, a single cable percussion borehole was drilled within the front garden to a depth of 15.00 m using a dismantlable drilling rig. Standard Penetration Tests (SPTs) were carried out at regular intervals in the cable percussion borehole to provide quantitative data on the strength of soils encountered and disturbed and undisturbed samples were recovered for subsequent laboratory examination and testing.

Access to the rear garden was through the house and in order to supplement the cable percussion borehole, three drive-in window sampler boreholes were advanced with hand-held equipment to depths of between 4.40 m and 4.80 m from the rear garden level and disturbed samples were recovered.

Groundwater monitoring standpipes were installed in three boreholes, to depths of between 4.00 m and 8.00 m and have been monitored on two occasions to date, following the fieldwork.

Seven trial pits were excavated around the perimeter of the existing building as shown on the site plan included in the appendix.

A selection of the samples recovered from the boreholes and trial pits was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole and trial pit records and results of the laboratory testing are enclosed, together with a site plan indicating the exploratory positions. Temporary bench mark (TBM) levels indicated on the borehole and trial pit records and quoted within the report have been interpolated from spot heights shown on the site survey drawing by Hestia (ref EX100), dated July 2015. Ground floor level has been attributed a level of 50 m TBM.

4.3 Sampling Strategy

The scope of the works was specified by GEA with input from the consulting engineer. The trial pit positions were specified by the consulting engineers and the borehole locations were determined by GEA, based on access constraints. All exploratory locations were positioned in site by GEA with due regard to the proposed development, whilst avoiding areas of known services.

Four samples of the made ground were subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The soil samples was selected to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure or groundwater pathway and to provide advice in respect of re-use or for waste disposal classification.

The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs accreditation and test methods are included in the Appendix together with the analytical results.

A number of samples recovered from the boreholes were submitted to a geotechnical laboratory for a programme of testing that included moisture content and Atterberg limit tests, undrained triaxial compression tests and soluble sulphate and pH level analysis.

5.0 GROUND CONDITIONS

The investigation has encountered the expected ground conditions in that, below a covering of made ground / topsoil, the Bagshot Formation was encountered over the Claygate Member, which was proved to the full depth of investigation of 15.45 m (32.61 m TBM).

5.1 Made Ground / Topsoil

In the cable percussion borehole, undertaken in the front garden on the gravel area at a level of 48.06 m TBM, a thin covering of pea shingle was encountered, overlying topsoil comprised of greyish brown sandy clay with partings of orange-brown fine sand and silt, which extended

to a depth of 0.20 m (47.86 m TBM). Below this depth, made ground extending to a depth of 1.20 m (46.86 m TBM), was encountered which comprised 'stiff' brown mottled orange-brown and yellowish brown silty sandy clay with fine to coarse subangular to subrounded flint gravel, rootlets and rare brick. The laboratory results indicate that the made ground at this location is desiccated, which was located in close proximity to 6 m high Bay trees.

To supplement the cable percussion boreholes, three window sampler boreholes were undertaken in the rear garden, located at an elevation 2 m higher than the front garden. Borehole No 2 was undertaken beneath the lawn in an area where the ground was noted by the client to be waterlogged. This borehole encountered topsoil comprised of dark brown silty sandy clay with pockets of orange-brown mottled grey clay flint gravel, rootlets and fragments of brick and extended to a depth of 0.15 m (49.69 m TBM).

Borehole No 3 was undertaken off the lawn, to the east of the single storey rear extension and made ground was found to extend to a depth of 0.40 m (49.44 m TBM), comprised of brownish grey silty clay with flint gravel, rootlets and fragments of brick and glass.

Borehole No 4 was drilled through the base of Trial Pit No 4, along the rear elevation of the existing house, and beneath a paving slab which extended to a depth of 0.07 m (49.93 m TBM), a 100 mmm thick layer of concrete was encountered. This concrete was underlain by made ground which initially comprised brick fill, extending to a depth of 0.27 m (49.73 m TBM), over dark brown clay with fragments of brick and glass extending to a depth of 0.52 m. Below this depth reworked ground comprised of firm orange-brown mottled greenish grey silty sandy clay was encountered around the existing footing to a depth of 1.10 m (48.90 m TBM).

No visual or olfactory evidence of contamination was noted in the made ground, however four samples of the made ground have been subject to contamination testing as a precautionary measure and the results are presented in Section 5.4.

5.2 Bagshot Formation

The base of this formation is marked in the Hampstead area by a layer of coarse sand and rounded flint gravel, but this marker layer was not encountered, so the base of the formation has been interpreted on the basis of an inspection of the recovered soil.

The Bagshot Formation has been inferred to extend to a depth of 5.70 m (42.36 m TBM) and generally comprised brown mottled orange-brown, yellowish brown and grey silty sandy clay interbedded with layers of clayey silty fine sand and clay with nodules of cemented sand. Sand was encountered at the base of the window sampler boreholes from a depth of 3.00 m to 3.90 m (46.84 m TBM and 46.10 m TBM) and was encountered in the cable percussion borehole at a depth of 2.30 m (45.76 m TBM). The sand appears to be laterally continuous across the site.

The base of this formation was not proved in the window sampler boreholes because of the density of the sand encountered at the base of the boreholes and extended to the full depth investigated at these locations of 4.40 m (45.54 m TBM) and 4.80 m (45.04 m TBM).

A thin layer of water-bearing sandy silt was encountered in Borehole No 2 from 2.00 m to 2.10 m (47.84 m TBM and 47.74 m TBM).

Plasticity index tests have indicated the clay of the Bagshot Formation to be of low and moderate volume change potential.

Numerous semi-mature to mature trees are present on the site and the clay of the Bagshot Formation was found to be 'stiff' in Borehole No 1, located near a 6 m high bay tree, indicating possible signs of desiccation. The laboratory results indicate that the desiccation extends to a depth of about 1.70 m. The triaxial test undertaken on a sample from 1.00 m to 1.45 m measured a high strength of 77 kPa confirming the presence of desiccation.

Fine rootlets were noted in Borehole No 2 to a depth of 0.80 m. A root was encountered at a depth of 1.80 m in Borehole No 3, located in close proximity to trees along the eastern garden boundary. In Borehole No 1, a rootlet was encountered at a depth of 4.50 m.

SPTs have indicated the sand to be medium dense.

These soils were observed to be free of any visual or olfactory evidence of soil contamination.

5.3 Claygate Member

The Claygate Member generally comprised firm becoming stiff grey silty sandy clay with pockets of silt and sand, proved to the full depth of investigation of 15.45 m (32.61 m TBM).

The results of undrained triaxial compression tests indicate the clay to increase in strength with depth from medium strength to high strength.

Plasticity index tests have indicated the clay of the Claygate Member to be of moderate volume change potential.

These soils were observed to be free of any evidence of soil contamination.

5.4 Groundwater

In Borehole No 1, a groundwater seepage was encountered at a depth of 5.95 m during drilling. Subsequent groundwater inflows were encountered at depths of 6.90 m, 8.90 m and 10.40 m. The soil was noted to be wet within a silty layer in Borehole No 2 from a depth of 2.00 m to 2.10 m. Groundwater was not encountered at the other exploratory locations.

Monitoring of the standpipes installed in each of the boreholes has been carried out over a one month period and the results are shown in the table below.

Borehole No	Standpipe depth(m) [Level (m TBM)]	Depth to groundwater [(m) m TBM		
		09/10/2015	21/10/2015	03/11/2015
BH1	7.30 [40.76]	4.89 [43.17]	4.90 [43.16]	4.88 [43.18]
BH3	4.25 [45.59]	Not installed	DRY	DRY
BH4	4.60 [45.4]	Not installed	DRY	DRY

5.5 Soil Contamination

The table below sets out the values measured within four samples of made ground analysed; all concentrations are in mg/kg unless otherwise stated.

Determinant	Maximum concentration recorded (mg/kg)	Minimum concentration recorded (mg/kg)	Number of samples below detection limit	Normalised upper bound US95
pH	10.2	8.4	-	-
Arsenic	25	18	NONE	25.5
Cadmium	0.87	<0.1	1	0.8
Chromium	36	32	NONE	36.8
Copper	240	19	NONE	208.3
Mercury	0.78	0.19	NONE	0.8
Nickel	30	20	NONE	28.6
Lead	**900**	370	NONE	**930.4**
Selenium	0.44	<0.2	Two	0.4
Zinc	500	55	NONE	568
Total Cyanide	<0.5	<0.5	ALL	<0.5
Total Phenols	<0.3	<0.3	ALL	<0.3
Sulphide	6.3	2.3	NONE	5.7
Total TPH	35	<10	Two	21.1
Naphthalene	0.76	<0.1	One	0.7
Benzo(a)pyrene	3.4	0.77	NONE	3.2
Total PAH	46	8.6	NONE	43.3
Total organic carbon %	2.1	1.2	NONE	2.0

Note: The use of the normalised upper bound for 95th percentile confidence aims to remove some of the uncertainty associated with calculation of an arithmetic sample mean of a relatively small number of samples. The US95 value is the upper bound of the range within which it can be stated with 95% confidence that the true mean concentration of the data set will fall Figure in **bold** indicates concentration in excess of risk-based soil guideline values, as discussed below

5.5.1 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[8] Soil Guideline Value where available, or is a Generic Screening Value calculated using the CLEA UK Version 1.06[9] software assuming a residential end use, or is based on the DEFRA Category 4

[8] *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.
[9] Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009

Screening values[10]. 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.

The results of the contamination testing have revealed elevated concentrations 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.

[10] 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

5.6 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	Western elevation (existing lower ground floor)	Not proved, concrete at base of pit at a depth of 0.50 m	Not proved
1A	Flowerbed	Not proved, concrete at base of pit at a depth of 0.50 m	Not proved
2	Western elevation (bay window)	Two brick corbels over concrete Top 0.23 bgl Base 0.80 bgl Lateral projection 260 mm	Firm orange-brown mottled brown silty sandy CLAY with fine rootlets (Bagshot Formation)
3	Southern elevation	Not proved, due to presence of services, extends to at least 0.65 m	Not proved
4	Rear of house	Two brick corbels over blinding layer Top 0.47 m bgl Base 1.10 m bgl Lateral projection 70 mm	Firm brown mottled grey and brown silty sandy CLAY with roots and fine rootlets (Bagshot Formation)
5	Bedroom	Three brick corbels over blinding layer Top 0.52 m bgl Base 0.88 m bgl Lateral projection 250 mm	Firm orange-brown mottled brown and grey silty sandy CLAY (Bagshot Formation)
6	Eastern elevation of single storey extension	Three brick corbels over concrete Top 160 mm bgl Base 0.44 m bgl Lateral projection 330 mm	Dark brown clay with brick and roots (Made Ground)

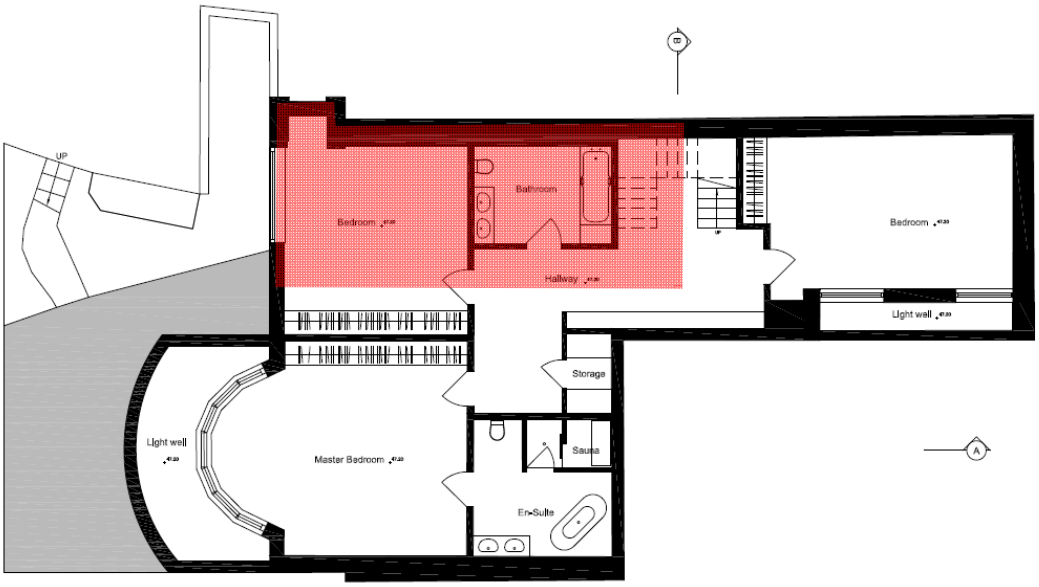
Part 2: DESIGN BASIS REPORT

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

It is proposed to make minor internal alterations at ground floor level, demolish the single storey rear extension, deepen the existing lower ground floor slab by 0.36 m and extend the basement beneath the footprint of the majority of the existing house. The proposed basement extension is shown on the plan below and will extend to a depth of about 2.80 m below existing ground floor level, extending to a level of 47.2 m TBM. The proposals also include the construction of front and rear lightwells. The extent of the existing lower ground floor is shown in red on the plan below.

Existing and proposed loads have not been provided at this stage.



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 nominal to moderate thickness of made ground or topsoil, the Bagshot Formation was encountered overlying the Claygate Member proved to the maximum depth investigated;
- the made ground / topsoil extended to depths of between 0.15 m and 1.20 m (49.69 m TBM and 46.86 m TBM);

- the Bagshot Formation has been inferred to extend to a depth of 5.70 m (42.36 m TBM) and comprises brown mottled orange-brown, yellowish brown and grey silty sandy clay interbedded with layers of clayey silty fine sand and clay with rare nodules of cemented sand;

- a thin layer of water-bearing sandy silt was encountered in Borehole No 2 from 2.00 m to 2.10 m (47.84 m TBM and 47.74 m TBM);

- the clay of the Bagshot Formation was found to be 'stiff' in Borehole No 1 to a depth of 2.30 m, located near a 6 m high Bay tree, indicating possible signs of desiccation and the results of the laboratory tests indicates that the desiccation extends to a depth of about 1.70 m;

- the Claygate Member comprises firm becoming stiff medium strength becoming high strength locally fissured grey silty sandy clay with pockets of silt and sand, proved to the full depth of investigation of 15.45 m (32.61 m TBM);

- a groundwater seepage was encountered in Borehole No 1 at a depth of 5.95 m during drilling near the top of the Claygate Member, with further inflows at depths of 6.90 m, 8.90 m and 10.40 m. The soil was noted to be wet within a silty layer in Borehole No 2 from a depth of 2.00 m to 2.10 m;

- monitoring of the standpipes have measured groundwater at depths of between 4.88 m and 4.90 m (43.18 m TBM and 43.16 m TBM); and

- the made ground has been found to contain elevated concentrations of lead.

8.0 ADVICE AND RECOMMENDATIONS

Excavations for the proposed basement structure will require temporary support to maintain stability of the surrounding structures and to prevent any excessive ground movements. Based on the groundwater observations to date, groundwater is not expected to be encountered within the 2.8 m deep excavation, given that monitored levels are approximately 4 m below the proposed excavation depth.

Formation level for the proposed development is likely to be within the Bagshot Formation, which will provide an eminently suitable bearing stratum for the support of the anticipated light to moderate loads by means of spread foundations excavated from basement level. Alternatively, if proposed loads are high or spread foundations become uneconomic piled foundations would also provide a suitable solution.

8.1 Basement Excavation

8.1.1 Basement Construction

It is understood that it is proposed to deepen the existing basement by about 0.36 m and extend beneath the majority of the footprint of the entire house. The proposed new basement will extend to a depth of about 2.80 m (47.20 m TBM) and formation level is likely to be within the Bagshot Formation.

On the basis of the groundwater monitoring to date, which indicates the shallowest groundwater level at 4.88 m below the front garden at a level of 43.18 m TBM, groundwater is not anticipated to be encountered during excavation of the basement. It is however recommended that further monitoring of the standpipes should be carried out to determine the extent of any seasonal fluctuations. Perched water may be encountered from within sand layers over clay bands. These perched waters will therefore be of relatively low volume and individual inflows may cease once the perched water is emptied. On this basis, it is considered that inflows from the clayey silty sand, although unlikely to be fast flowing, are likely to cause stability issues during excavation. It would be prudent to carry out trial excavations, to depths as close to the full basement depth as possible, to assess the stability of the granular soils of the Bagshot Formation.

There are a number of methods by which the sides of the basement excavations 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, and the extent to which groundwater inflows need to be prevented.

On the basis of the groundwater monitoring results to date, it may be possible to form the retaining walls by underpinning of the existing foundations, using a traditional 'hit and miss' approach, subject to further monitoring.

In any case, inflows could conceivably occur from perched water tables, particularly in the vicinity of existing foundations but should be adequately dealt with through sump pumping.

It is important to bear in mind that this technique will require the soils being underpinned to stand unsupported. The contractor should therefore have a contingency in place to deal with groundwater inflows and / or instability of the granular soils.

Careful workmanship will be required to ensure that movement of the surrounding structures does not arise during underpinning of the existing foundations, but this method will have the benefit of minimising the plant required and maximising usable space in the new basement.

Trial excavations to the proposed basement depth should be carried out to confirm the stability of the soil and the absence of groundwater. If trial excavations indicate traditional underpinning to be impractical, jet grouting could be considered or piled retaining walls will be required.

On the basis of the groundwater observations to date, it should be possible to utilise contiguous bored piles without the requirement for significant groundwater control, with additional grouting between the piles if necessary. A contiguous bored piled wall would have the disadvantage of reducing usable space in the basement, and in this respect a secant wall may be preferable as it would overcome the requirement for any secondary groundwater protection in the permanent works and maximise the basement area.

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. In this respect 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 existing foundations will need to be underpinned prior to construction of the proposed new basement or will need to be supported by new retaining walls.

8.1.1 Retaining Walls

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

Stratum	Bulk Density (kg/m^3)	Effective Cohesion ($c' - kN/m^2$)	Effective Friction Angle (Φ' – degrees)
Made Ground	1700	Zero	24
Bagshot Formation (clay)	1850	Zero	26
Bagshot Formation (sand)	1850	Zero	33
Claygate Member	1850	Zero	25

Groundwater has been measured at a depth of 4.88 m below the front garden at a level of 43.18 m TBM. On this basis, groundwater is not anticipated to be encountered in the 2.80 m deep basement, extending to a level of 47.2 m TBM although monitoring of the standpipe should be continued in order to establish equilibrium levels.

Provided a fully effective drainage system can be ensured in order to prevent the build up of groundwater behind the retaining walls from surface water inflows and periodic seepages within the made ground and Bagshot Formation, it should be possible to design the basement on the basis that water will not collect behind the walls. If an effective drainage system cannot be ensured, then a water level of two-thirds of the basement depth should be assumed. The advice in BS8102:2009[11] should be followed in this respect and with regard to the provision of suitable waterproofing.

8.1.2 Basement Heave

The existing lower ground floor level is located beneath the northwest corner of the existing house, and will be lowered by roughly 0.36 m, which will result in negligible unloading. The basement will also be extended beneath most of the footprint of the existing house, to a depth of 2.80 m below existing ground floor level with an approximately 500 mm thick slab and will result in a net unloading of about 60 kN/m².

The proposed excavations will result in elastic heave and long term swelling of the underlying Claygate Member. The effects of the longer term swelling movement will be mitigated to some extent by the load applied by the new foundations and the continued presence of the existing house.

Consideration will need to be given to the effects of differential movement that will occur beneath the new basement and existing lower ground floor level and will be undertaken as part of the ground movement analysis.

8.2 Spread Foundations

The trial pitting carried out to date has indicated that the existing foundations will need to be underpinned to a suitable depth to prevent them being undermined and to ensure the stability of the existing structure during excavation of the proposed basement. This could be achieved by traditional mass concrete underpinning, using a “hit and miss” approach.

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

All new foundations or underpins should bypass the made ground and potentially desiccated clay soils to bear within the Bagshot Formation. Groundwater is not anticipated to be encountered within the proposed 2.80 m deep basement, based on the results of groundwater monitoring to date and it should therefore be possible to adopt spread foundations.

New foundations or underpins bearing within the firm silty sandy clay or sand of the Bagshot Formation may be designed to apply a net allowable bearing pressure of 120 kN/m² below the level of the proposed basement floor. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

8.3 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate type. Piles installed using continuous flight auger (cfa) techniques are likely to be the most suitable in order to avoid potential problems associated with instability within the Bagshot Formation and possible groundwater inflows within the silt and sand partings of the Claygate Member.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, for retaining walls and for any structural loads, based on the measured SPT / depth graph in the appendix. For the purposes of these parameters the formation level of the proposed new single level basement has been used as 47.20 m TBM and groundwater level has been assumed to be at a level of 43.18 m TBM.

Stratum	Level m TBM	kN / m²
Ultimate Skin Friction		
Made Ground and Bagshot Formation	All soil above 2.30 m (45.76)	Ignore (Basement excavation and desiccated clay soils)
Bagshot Formation (unsaturated) (Ks=0.7)	2.30 m to 4.50 m (45.76 to 43.56)	25
Bagshot Formation (saturated) (Ks=0.7)	4.50 to 5.70 (43.56 to 42.36)	40
Claygate Member (α=0.45)	5.70 m to 15.45 m (42.36 to 32.61)	Increasing linearly from 20 to 50
Ultimate End Bearing		
Claygate Member	5.70 m to 15.45 m (42.36 to 32.61)	Increasing linearly from 380 to 930

On the basis of the above coefficients and a factor of safety of 3.0 the following safe working loads have been estimated for 300 mm and 450 mm diameter CFA piles.

Level (m TBM) [depth below basement (m)]	Safe Working Load (kN)	
	300 mm Ø	450 mm Ø
36.00 [12.00]	105	150

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 the presence of groundwater within the Claygate Member.

Consideration will also need to be given to the effects of heave as a result of the basement excavation.

8.4 Basement Floor Slab

Following the excavation of the basement, it is possible that the floor slab for the proposed basement will need to be suspended over a void or layer of compressible material to accommodate the anticipated heave 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 and trial pit findings it is considered likely that it will be feasible to form relatively shallow excavations terminating within the made ground and Bagshot Formation without the requirement for lateral support, although localised instabilities may occur. 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.

Significant inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from perched water tables within the made ground or from within more sandy horizons within the Bagshot Formation, although such inflows should be suitably controlled by sump pumping. However, if deeper excavations are 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.

8.6 Effect of Sulphates

Chemical analyses carried out on three samples, including a single sample of made ground and two samples of the natural soils of the Bagshot Formation have revealed concentrations of soluble sulphate and near-neutral pH in accordance with Class DS-1 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 all four samples of made ground tested from around existing foundations. No elevated concentrations of the other contaminants were identified.

The lead concentrations could thus pose a potentially unacceptable risk to human health through direct contact, accidental ingestion or inhalation of soil or soil derived dust.

Lead was elevated above the threshold level of 200 mg/kg at 900 mg/kg. The exact source of the contamination is unknown, however the made ground was noted as containing variable amounts of extraneous material and the metal compounds within the made ground are considered likely to be of low solubility and a risk to groundwater has not been identified.

At this stage the proposals do not include the alteration of the private garden area and therefore new pathways will not be created and remedial measures are not deemed necessary.

8.7.1 Site Workers

Site workers should be made aware of the metal contamination within the soils and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[12] and CIRIA[13] and the requirements of the Local Authority Environmental Health Officer.

8.8 Waste Disposal

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 classification is a staged process and this investigation represents the preliminary sampling exercise of that process. Once the extent and location of the waste that is to be removed has been defined, further sampling and testing may be necessary. The results from this ground investigation should be used to help define the sampling plan for such further testing, which could include WAC leaching tests where the totals analysis indicates the soil to be a hazardous waste or inert waste from a contaminated site. It should however be noted that the Environment Agency guidance WM3[14] states that landfill WAC analysis, specifically leaching test results, must not be used for waste classification purposes.

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE[15] guidance, will need to be disposed of to a licensed tip. Waste going to landfill is subject to landfill tax at either the standard rate of £82.60 per tonne (about £150 per m^3) or at the lower rate of £2.60 per tonne (roughly £5 per m^3). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring soil and stones, which are accurately described as such in terms of the 2011 Order , would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the Environment Agency it is considered likely that the soils encountered during this ground investigation, as represented by the three chemical analyses carried out, would be generally classified as follows;

Soil Type	Waste Classification (Waste Code)	WAC Testing Required Prior to Landfill Disposal?	Comments
Made ground	Non-hazardous (17 05 04)	No	-
Bagshot Formation	Inert (17 05 04)	Should not be required but confirm with receiving landfill	-
Claygate Member	Inert (17 05 04)	Should not be required but confirm with receiving landfill	-

12 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO
13 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association
14 Environment Agency 2015. *Guidance on the classification and assessment of waste.* Technical Guidance WM3 First Edition
15 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2

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[16] 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 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 (EA) 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.

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.

The site investigation indicates that the site is directly underlain by the Bagshot Beds, which is classified as Secondary 'A' Aquifer.

Potential Impact	Site Investigation Conclusions
The site is a Secondary 'A' Aquifer - the basement may extend into the underlying aquifer and affect the groundwater flow regime	The site investigation indicates that the proposed basement excavation which extends to 47.20 m TBM is located above the water table by approximately 4 m (43.20 m TBM). Perched water may also be encountered within the Bagshot Formation from within silt and sand bands overlying clay bands. These perched waters will therefore be of relatively low volume and individual inflows may cease once the perched water is emptied, however, it is likely to cause excavations to be unstable.
The proposed basement may extend below the water table and affect the groundwater flow regime	
The excavation may be lower than a local pond or spring line.	The River Westbourne has been culverted to form a drain and is, therefore, unlikely to have any impact on, or be influenced by, the surrounding groundwater level and is not, therefore, considered to present a risk to slope stability at this site. The proposed basement development would not impact on the surrounding water environment as the groundwater table is located 4 m below the proposed basement. The ground investigation has confirmed the presence of a

16 Environment Agency 23 Oct 2007 *Regulatory Position Statement Treating non-hazardous waste for landfill - Enforcing the new requirement*

Potential Impact	Site Investigation Conclusions
The site is located within 100m of a historical well, spring line and watercourse.	groundwater table within the Bagshot Formation. The basement is unlikely to extend into the main groundwater table and there is lnegligible risk that the construction will
Changes in surface runoff.	The proposal will marginally increase the amount of hardstanding at the site through the installation of a front lightwell.
The existing site includes limited areas where the slopes are greater than 7°.	No excavation is proposed into the existing slopes. The existing slope is only just greater than 7° and is limited to the driveway and there are no proposals to alter this, it shows no sign of instability. The construction will be suitably shored in the short term and suitably designed to retain and support the soils in the long term.
Seasonal shrink-swell can result in foundation movements	Results on the sandy silty clay of the Bagshot Formation has indicated a low and moderate potential change, with the Claygate Member a moderate volume change. Shrinkable clay is present within a depth that can be affected by tree roots and desiccation of the clay soils was noted and should be bypassed. 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. Subject to inspection of foundation excavations in the normal way.
Site within 5 m of a highway – excavation of basement could lead to damage	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. *In any case, a retention system will be adopted that maintains the stability of the excavation at all times.*
Founding depths relative to neighbours - excavation may lead to structural damage to neighbouring properties if there is a significant differential depth between adjacent properties	The site is a detached house. The retention system will ensure the stability of the excavation and neighbouring properties at all times. A ground movement analysis is being undertaken to assess the damage to nearby neighbouring structures. And the results will be included within a separate report.

The results of the site investigation have 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 underlain by a Secondary 'A' Aquifer but will not extend below water table

The investigation has indicated that the site is directly underlain by the Bagshot Formation, with the Claygate Member present at depth. Both stratum are classified as Secondary 'A' Aquifers. Groundwater seepages were noted throughout the Claygate Member with a minor seepage within a sandy silt layer in the Bagshot Formation. The measured groundwater table is approximately 4 m below the level of the proposed basement excavation.

It is proposed to incorporate sufficient drainage as part of the retaining wall design, which will allow perched water from behind the wall to drain to the existing drainage, preventing any effect on neighbouring properties.

There is adequate space for water to flow beneath the existing basement and between neighbouring structures, such that there will not be a cumulative impact on any groundwater flow.

On the basis of all of the above, it is still concluded that the proposed development will not have an impact on the hydrogeological setting.

There will be an increase in the proportion of hardstanding

A front lightwell is proposed within an area currently underlain by permeable areas, resulting in a minimal increase in the proportion of hardstanding.

The site includes slopes of greater than 7º

A slope greater than 7º is present along the eastern boundary of the site in the rear garden. The slope is vegetated and there are no signs of movement. No excavation work is planned in this area and no trees are to be felled, such that the slope should remain stable.

Shrink / swell potential

Shrinkable clay is present within a depth that can be affected by tree roots. There is no evidence of structural movement within the existing building, but desiccated clay of the Bagshot Formation was noted in the cable percussion borehole to a depth of about 1.70 m. NHBC guidance should be followed to ensure all foundations extend to a suitable depth and all foundation excavations should be inspected by a suitably qualified geotechnical engineer to ensure foundations have bypassed any desiccated soils.

Site within 5 m of highway

The site is located within 5 m of Resecoft Avenue. A retention system will need to be adopted that maintains the stability of the excavation at all times to protect the highways. This is however standard construction practice.

Differential founding depths

The property is detached and is set back some distance from neighbouring properties. All foundations will be underpinned to ensure the stability of the existing property and a ground movement assessment is currently underway to determine the damage category to neighbouring properties. The findings of the ground movement assessment will be included within a separate report and made available once the assessment is complete.

9.1 Non-Technical Summary of Evidence

This section provides a short summary of the evidence acquired and used to form the conclusions made within the BIA.

9.1.1 Screening

The following table provides the evidence used to answer the surface water flow and flooding screening questions.

Question	Evidence
1. Is the site within the catchment of the pond chains on Hampstead Heath?	Figures 12 and 14 of the Arup report.
2. 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?	A site walkover and existing plans of the site have confirmed the proportions of hardstanding and soft landscaping, which have been compared to the proposed drawings to determine the changes in the proportions.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	As above.
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	
6. Is the site in an area known to be at risk from surface water flooding such as South Hampstead, West Hampstead, Gospel Oak and Kings Cross, or is it at risk of flooding because the proposed basement is below the static water level of a nearby surface water feature?	Flood risk maps acquired from the Environment Agency as part of the desk study, Figure 15 of the Arup report, the Camden Flood Risk Management Strategy dated 2013 and the North London Strategic Flood Risk Assessment dated 2008.

The following table provides the evidence used to answer the subterranean (groundwater flow) screening questions.

Question	Evidence
1a. Is the site located directly above an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
1b. Will the proposed basement extend beneath the water table surface?	Previous nearby GEA investigations.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	Historical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	Figures 12 and 14 of the Arup report.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	A site walkover and existing plans of the site have confirmed the proportions of hardstanding and soft landscaping, which have been compared to the proposed drawings to determine the changes in the proportions.
5. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	The details of the proposed development do not indicate the use soakaway drainage.
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.

The following table provides the evidence used to answer the subterranean (groundwater flow) screening questions.

Question	Evidence
1. Does the existing site include slopes, natural or manmade, greater than 7°?	Site survey drawing and Figures 16 and 17 of the Arup report and confirmed during a site walkover
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	The details of the proposed development provided do not include the re-profiling of the site to create new slopes
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	Topographical maps and Figures 16 and 17 of the Arup report and confirmed during a site walkover
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	
5. Is the London Clay the shallowest strata at the site?	Geological maps and Figures 3, 5 and 8 of the Arup report
6. 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 to be retained?	A site walkover confirmed that there are trees on site. An arboriculturist should be consulted if any trees are to be removed from the site.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	Knowledge on the ground conditions of the area was used to make an assessment of this, in addition to a visual inspection of the buildings carried out during the site walkover
8. Is the site within 100 m of a watercourse or potential spring line?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report
9. Is the site within an area of previously worked ground?	Geological maps and Figures 3, 5 and 8 of the Arup report
10. Is the site within an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
11. Is the site within 50 m of Hampstead Heath ponds?	Topographical maps acquired as part of the desk study and Figures 12 and 14 of the Arup report.
12. Is the site within 5 m of a highway or pedestrian right of way?	Site plans and the site walkover.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Camden planning portal and the site walkover confirmed the position of the proposed basement relative the neighbouring properties.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	Maps and plans of infrastructure tunnels were reviewed.

9.1.2 Scoping and Site Investigation

The questions in the screening stage that there were answered ‘yes’, were taken forward to a scoping stage and the potential impacts discussed in Section 4.0 of this report, with reference to the possible impacts outlined in the Arup report.

A ground investigation was carried out, which has allowed an assessment of the potential impacts of the basement development on the various receptors identified from the screening and scoping stages. Principally the investigation aimed to establish the ground conditions, including the groundwater level, the engineering properties of the underlying soils to enable suitable design of the basement development and the configuration of existing party wall foundations. The findings of the investigation are discussed in Section 5.0 of this report and summarized in both Section 7.0 and the Executive Summary.

9.1.3 Impact Assessment

Section 9.0 of this report summarises whether or not, on the basis of the findings of the investigation, the potential impacts still need to be given consideration and identifies ongoing risks that will require suitable engineering mitigation. Section 8.0 of this report also provides recommendations for the design of the proposed development, whilst Part 3 provides the outcomes of a ground movement analysis, building damage assessment and slope stability analysis, which has also been used to provide a conclusion on any potential impacts from the proposed basement development.

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 may 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.

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.

Careful consideration will need to be given to the stability of the Bagshot Formation during underpinning and it would be prudent to undertake trial pit excavations to the full depth of the proposed basement.

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.

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** 26 Rosecroft Avenue, London NW3 7QB	**Borehole Number** **BH1**

Boring Method	**Casing Diameter**	**Ground Level (mTBM)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 11.50m	48.06	Vipul Panchal	J15226
	Location	**Dates** 28/09/2015- 30/09/2015	**Engineer** Hestia Developments	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mTBM)	Depth (m) (Thickness)	Description	Legend	Water
					47.86	(0.20) 0.20	MADE GROUND (pea shingle over topsoil)		
0.20-0.60	B1						MADE GROUND (greyish brown silty sandy gravelly clay with pockets of orange-brown fine sand and silt and brick fragments)		
0.70	D2					(1.00)			
1.00-1.45	U3			32 blows	46.86	1.20	'Stiff' high strength brown mottled orange-brown and grey silty sandy CLAY with layers of silty sand and rootlets - possibly desiccated to a depth of about 1.70 m		
1.45	D4								
1.70	D5					(1.10)			
2.00-2.45 2.00-2.45	SPT N=20 D6	2.00	DRY	1,2/3,4,6,7	45.76	2.30	Medium dense orange-brown mottled grey silty fine SAND with occasional bands of silty clay. A pocket of light brown silt was encountered at a depth of 4.20 m. A rootlet was encountered at a depth of 4.50 m		
2.70	D7								
3.00-3.45 3.00-3.50	U8 B9			30 blows					
3.50-3.95 3.50-3.95	SPT N=19 D10	3.50	DRY	1,2/4,4,5,6					
						(3.40)			
4.20	D11								
4.50-4.95 4.50-4.95	SPT N=25 D12	3.50	DRY	2,3/8,8,6,3					
					42.36	5.70			
5.70	D13						Firm medium strength grey mottled orange-brown and yellowish brown silty sandy CLAY		▼1
				Seepage(1) at 5.95m, rose to 5.90m in 20 mins, sealed at 6.50m.		(1.20)			▼1
6.00-6.45 6.45-6.60	U14 D15	3.50	5.90	30 blows 28/09/2015:DRY					▼2
6.90	D16			29/09/2015:DRY Slow(2) at 6.90m, rose to 6.85m in 20 mins, sealed at 8.00m.	41.16	6.90	Medium dense orange-brown silty fine SAND		▼2 ▼3
						(0.80)			
7.50-7.95 7.50-7.95	SPT N=14 D17	7.50	7.10	1,2/3,3,5,3	40.36	7.70	Stiff greenish grey mottled orange-brown and yellowish brown silty sandy CLAY		
						(1.00)			
8.50	D18								
					39.36	8.70			
8.70	D19				39.16	(0.20) 8.90	Stiff grey silty sandy CLAY		▽3
9.00-9.45	D20			Fast(3) at 8.90m, rose to 7.30m in 20 mins, sealed at 9.60m.		(0.30)	Grey silty fine SAND		
					38.86	9.20			
9.00-9.45	SPT N=11	9.00	7.30	1,2/2,2,3,4			Stiff fissured high strength grey silty sandy CLAY with occasional partings of light grey or orange-brown fine sand and silt.		

Remarks
Four hours manhandling equipment onto position and setting up rig
One hour spent hand-digging service pit
Unloading extra casing (60 minutes)
Bailing out water (45 minutes)
Standpipe installed to a depth of 8.00 m - see separate sheet for installation details
Five hours demobilising equipment, bagging up excess spoil and clearing up

Scale (approx)	**Logged By**
1:50	HD

Figure No.
J15226.BH1

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Borehole Number** **BH1**

Boring Method	**Casing Diameter**	**Ground Level (mTBM)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 11.50m	48.06	Vipul Panchal	J15226
	Location	**Dates** 28/09/2015- 30/09/2015	**Engineer** Hestia Developments	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mTBM)	Depth (m) (Thickness)	Description	Legend	Water
10.00	D21			Seepage(4) at 10.40m, rose to 10.30m in 20 mins, sealed at 11.50m.					
10.50-10.95	U22	9.60	DAMP	30 blows					
10.95	D23								
11.50	D24								
12.00-12.45	SPT N=19	11.50	11.90	2,3/4,4,5,6					
12.00-12.45	D25								
						(6.25)			
13.00	D26								
13.50-13.95	U27	11.50	DAMP	35 blows					
13.95	D28								
14.50	D29								
15.00-15.45	SPT N=22	11.50	DAMP	2,3/4,5,6,7					
15.00-15.45	D30								
					32.61	15.45			
				29/09/2015:14.90m					
				30/09/2015:DRY			Complete at 15.45m		

Remarks

Scale (approx)	**Logged By**
1:50	HD

Figure No.
J15226.BH1

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Borehole Number** **BH1**

Installation Type Standpipe	**Dimensions** Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 200 mm	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Ground Level (mTBM)** 48.06	**Engineer** Hestia Developments	**Sheet** 1/1

Legend	Water	Instr (A)	Level (mTBM)	Depth (m)	Description
			47.86	0.20	Cement/Bentonite Grout Bentonite Seal
			47.06	1.00	
					Slotted Standpipe
	▼1				
	▼2				
	▼3				
			40.06	8.00	
					Bentonite Seal
	▽3		39.06	9.00	
	▼4				
	▽4				
					General Backfill
			33.06	15.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		5.95	3.50	Seepage				5.90	6.50
		6.90	6.50	Slow				6.85	8.00
		8.90	8.00	Fast				7.30	9.60
		10.40	9.60	Seepage				10.30	11.50

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mTBM)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mTBM)
28/09/15	08:30			DRY		16:00	6.50	6.50	DRY	
29/09/15	08:30	6.50	6.50	DRY		16:00	15.45	11.50	14.90	33.16
30/09/15	08:30	8.00	8.00	DRY						

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mTBM)	Remarks
09/10/15	15:00	4.89	43.17	
21/10/15	12:00	4.90	43.16	
03/11/15	16:00	4.88	43.18	

Remarks

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Number** **BH2**

Excavation Method	**Dimensions**	**Ground Level (mTBM)**	**Client**	**Job Number**
Drive-in Window Sampler		49.84	Vipul Panchal	J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mTBM)	Depth (m) (Thickness)	Description	Legend	Water
				49.69	(0.15)	Topsoil (dark brown silty sandy clay with pockets of orange-brown mottled grey clay, flint gravel, rootlets and fragments of brick)		
0.10	D1				0.15			
0.25	D2		(PP) 0.50	49.44	(0.25)			
					0.40	Soft orange-brown mottled grey and brown silty very sandy CLAY with black specks and fine rootlets. At a depth of 0.50 m medium subangular flint gravel was noted		
0.55	D3		(PP) 1.00	49.04	(0.40)			
					0.80	Firm brown mottled orange-brown, grey and mauve, orange-brown silty very sandy CLAY laminated with grey clay. Fine rootlets noted		
0.85	D4		(PP) 1.25		(0.60)			
1.20	D5		(PP) 0.75	48.44	1.40			
						Light brown very clayey silty fine SAND with pockets of soft to firm brown clay		
1.50	D6		(PP) 0.75					
			(PP) 1.25			Firm brown mottled orange-brown silty very sandy CLAY with black specks laminated with firm brown clay. Between 2.00 m and 2.10 m layer of soft brown laminated orange-brown and grey sandy silt with pockets of soft grey clay and yellowish brown sand. At a depth of 2.80 m very rare nodules of cemented orange-brown fine sand		
2.00	D7		Water strike(1) at 2.00m.					▽1
2.15	D8		(PP) 1.00		(1.95)			
			(PP) 1.50					
2.50	D9							
			(PP) 1.50					
3.00	D10		(PP) 1.50					
				46.49	3.35			
3.40	D11			46.38	(0.11)	Stiff grey silty CLAY with abundant partings of orange-brown fine sand and silt		
					3.46			
					(0.84)	Brown mottled orange-brown and yellowish brown silty fine SAND with very rare pockets of firm brown fissured clay		
4.00	D12							
				45.54	4.30			
						Complete at 4.40m		

Remarks
Soils noted to be damp from 2.00 m to 2.10 m

Scale (approx)	**Logged By**
1:50	HD

Figure No.
J15226.BH2

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Number** **BH3**

Excavation Method	**Dimensions**	**Ground Level (mTBM)**	**Client**	**Job Number**
Drive-in Window Sampler		49.84	Vipul Panchal	J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mTBM)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	MADE GROUND (brownish grey silty sandy clay with flint gravel, rootlets and fragments of brick and glass)		
0.20	D1			49.44	0.40			
0.60	D2		(PP) 1.00			Light brown mottled orange-brown silty very clayey SAND with black specks and rare rootlets		
1.00	D3				(1.00)			
				48.44	1.40			
1.50	D4		(PP) 1.00		(0.35)	Firm brown silty very sandy CLAY laminated with firm brown clay and 50 mm thick sand layers, rare nodules of orange-brown cemented sand and black specks		
				48.09	1.75			
1.90	D5				(0.35)			
			(PP) 2.25	47.74	2.10	Orange-brown mottled brown silty very clayey SAND with fine rootlets. Root encountered at a depth of 1.80 m		
2.30	D6		(PP) 1.25		(0.55)			
			(PP) 1.00	47.19	2.65	Firm brown laminated grey and orange-brown silty very sandy CLAY with very rare pockets of firm grey clay, very rare nodule of cemented sand and fine subangular flint gravel		
2.80	D7		(PP) 2.00		(0.35)			
				46.84	3.00	Stiff brown laminated orange-brown, brown, mauve, grey and yellowish brown silty fissured CLAY with partings of fine sand		
3.50	D8					Brown mottled orange-brown silty fine SAND with very rare pockets of firm brown clay		
					(1.80)			
4.50	D9							
				45.04	4.80			
						Complete at 4.80m		

Remarks
Groundwater not encountered during drilling
Standpipe installed to a depth of 4.80 m - see separate sheet for installation details

Scale (approx)	**Logged By**
1:50	HD

Figure No.
J15226.BH3

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Borehole Number** **BH3**
Installation Type Standpipe	**Dimensions** Internal Diameter of Tube [A] = 50 mm	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Ground Level (mTBM)** 49.84	**Engineer** Hestia Developments	**Sheet** 1/1

Legend	Water	Instr (A)	Level (mTBM)	Depth (m)	Description
			49.64	0.20	Cement/Bentonite Grout
					Bentonite Seal
			49.04	0.80	
					Slotted Standpipe
			45.04	4.80	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mTBM)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mTBM)

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mTBM)	
21/10/15	12:00	DRY		
03/11/15	16:00	DRY		

Remarks

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Number** **BH4**
Excavation Method Drive-in Window Sampler	**Dimensions**	**Ground Level (mTBM)** 50.00	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mTBM)	Depth (m) (Thickness)	Description	Legend	Water
				49.93	(0.07)	Paving slab		
				49.83	0.07			
				49.73	(0.10)	Concrete		
					0.17			
0.45	D1			49.48	(0.10)	MADE GROUND (brick)		
					0.27			
					(0.25)	MADE GROUND (dark brown clay with fragments of brick and glass)		
					0.52			
1.10	D2			48.90	(0.58)	MADE GROUND (orange-brown mottled greenish grey silty sandy clay)		
1.30	D3		(PP) 0.75		1.10			
			(PP) 1.50		(0.40)			
				48.50	1.50	Firm light brown silty sandy CLAY with laminations of grey clay and black specks		
1.80	D4		(PP) 1.50			Light brown mottled orange-brown silty very clayey fine SAND with nodules of orange-brown cemented fine sand		
			(PP) 0.50		(1.30)			
			(PP) 1.00					
2.50	D5							
			(PP) 1.00	47.20	2.80			
3.00	D6		(PP) 1.50			Firm light brown mottled orange-brown and yellowish brown silty sandy CLAY with nodule of cemented orange-brown sand. Between 3.60 m and 3.70 m stiff light grey mottled mauve silty fissured clay with occasional partings of orange-brown and yellowish brown fine sand and silt. Between 3.90 m and 3.96 m layer of light grey fissured clay		
			(PP) 0.50		(1.16)			
3.65	D7							
				46.04	3.96	Light brown mottled orange-brown silty fine SAND		
4.00	D8				(0.64)			
				45.40	4.60			
						Complete at 4.60m		

Remarks
Borehole drilled through base of Trial Pit No 4
Groundwater not encountered during drilling
Standpipe installed to a depth of 4.60 m - see separate sheet for installation details

Scale (approx)	**Logged By**
1:50	HD

Figure No.
J15226.BH4

Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware,Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Borehole Number** **BH4**
Installation Type Standpipe	**Dimensions** Internal Diameter of Tube [A] = 19 mm	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Ground Level (mTBM)** 50.00	**Engineer** Hestia Developments	**Sheet** 1/1

Legend	Water	Instr (A)	Level (mTBM)	Depth (m)	Description
			49.80	0.20	Cement/Bentonite Grout
					Bentonite Seal
			48.50	1.50	
					Slotted Standpipe
			45.40	4.60	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mTBM)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mTBM)

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mTBM)	
21/10/15	12:00	DRY		
03/11/15	16:00	DRY		

Remarks

GEA Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware,Herts
SG12 7QE

Standard Penetration Test Results

Site : 26 Rosecroft Avenue, London NW3 7QB

Client : Vipul Panchal

Engineer : Hestia Developments

Job Number J15226

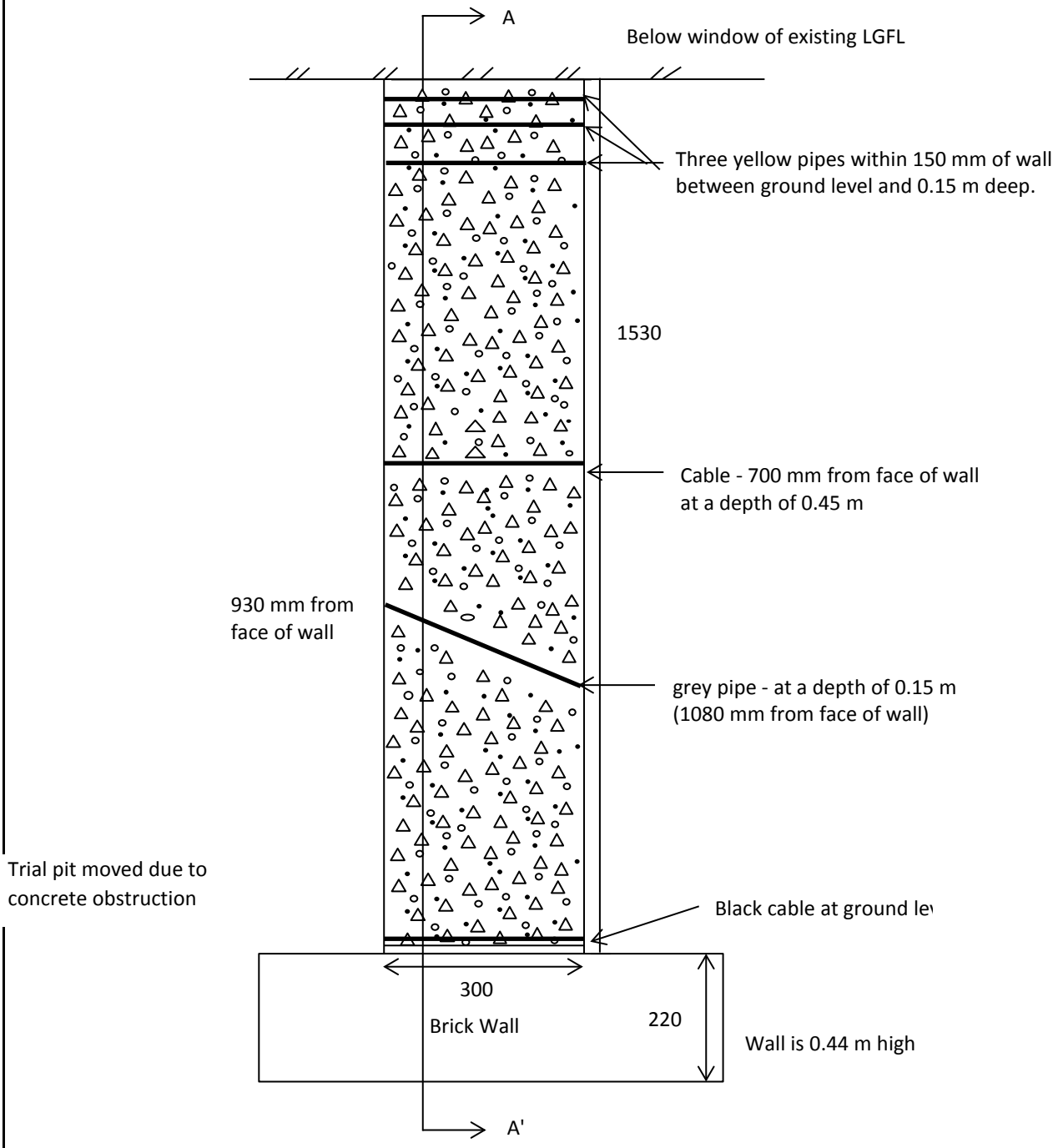
Sheet 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH1	2.00	2.15	2.45	SPT	1	2	3	4	6	7	N=20	
BH1	3.50	3.65	3.95	SPT	1	2	4	4	5	6	N=19	
BH1	4.50	4.65	4.95	SPT	2	3	8	8	6	3	N=25	
BH1	7.50	7.65	7.95	SPT	1	2	3	3	5	3	N=14	
BH1	9.00	9.15	9.45	SPT	1	2	2	2	3	4	N=11	
BH1	12.00	12.15	12.45	SPT	2	3	4	4	5	6	N=19	
BH1	15.00	15.15	15.45	SPT	2	3	4	5	6	7	N=22	

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** 1

Excavation Method Manual	**Dimensions** 300 x 500 x 1530	**Ground Level (mTBM)** 47.62	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 1/20

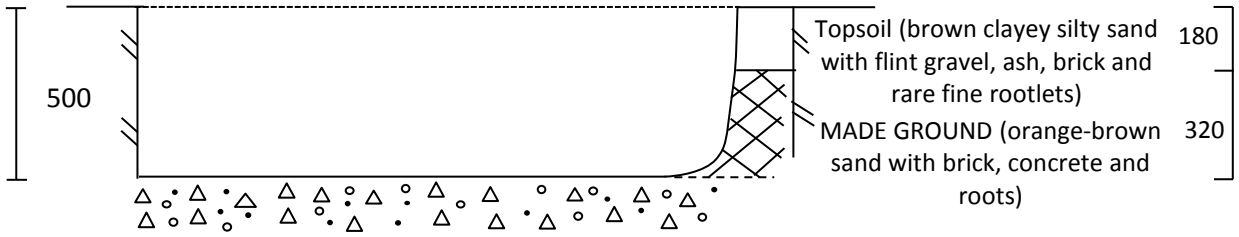
PLAN



Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained stable during excavation	Logged by:
Groundwater: Not encountered	HD

GEA Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware Herts SG12 7QE			**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** 1
Excavation Method Manual	**Dimensions** 300 x 500 x 1530	**Ground Level (mTBM)** 47.62	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 2/20

SECTION A - A'



Concrete at base of pit - terminated trial pit and relocated 0.70 m to the north

Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained stable during excavation	Logged by:
Groundwater: Not encountered	GT

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

Trial Pit No 1

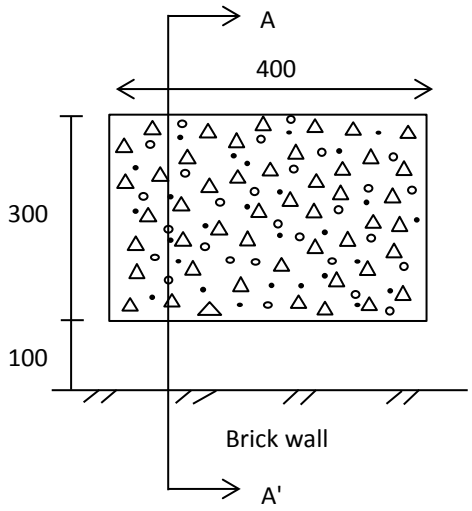
Site	26 Rosecroft Avenue, London, NW3 7QB
Client	Vipul Panchal
Engineer	Hestia Developments

Job Number J15226

Sheet 3/20

GEA Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware Herts SG12 7QE			**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **1A**
Excavation Method Manual	**Dimensions** 300 x 400 x 500	**Ground Level (mTBM)** 47.62	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 4/20

PLAN

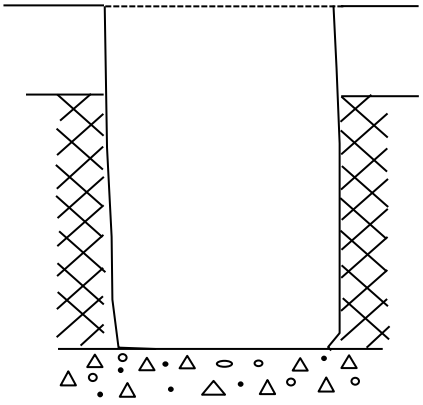


Remarks: All dimensions in millimetres Sides of trial pit remained relatively stable during excavation Groundwater: Not encountered	Scale: 1:10 Logged by: HD

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **1A**

Excavation Method Manual	**Dimensions** 300 x 400 x 500	**Ground Level (mTBM)** 47.62	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 5/20

SECTION A - A'



Topsoil (brown clayey silty sand with rare fine rootlets and flint gravel) — 130

MADE GROUND (greyish brown sand with brick, concrete and roots) — 370

Concrete at base of pit at a depth of 0.50 m - trial pit abandoned due to buried services

Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

Trial Pit No 1A

Site	26 Rosecroft Avenue, London, NW3 7QB
Client	Vipul Panchal
Engineer	Hestia Developments

Job Number J15226

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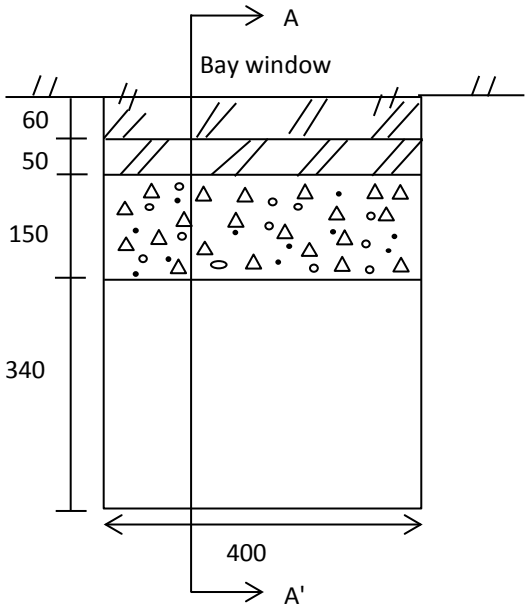
GEA Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware Herts SG12 7QE			**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **2**
Excavation Method Manual	**Dimensions** 400 x 600 x 860	**Ground Level (mTBM)** 49.53	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 7/20

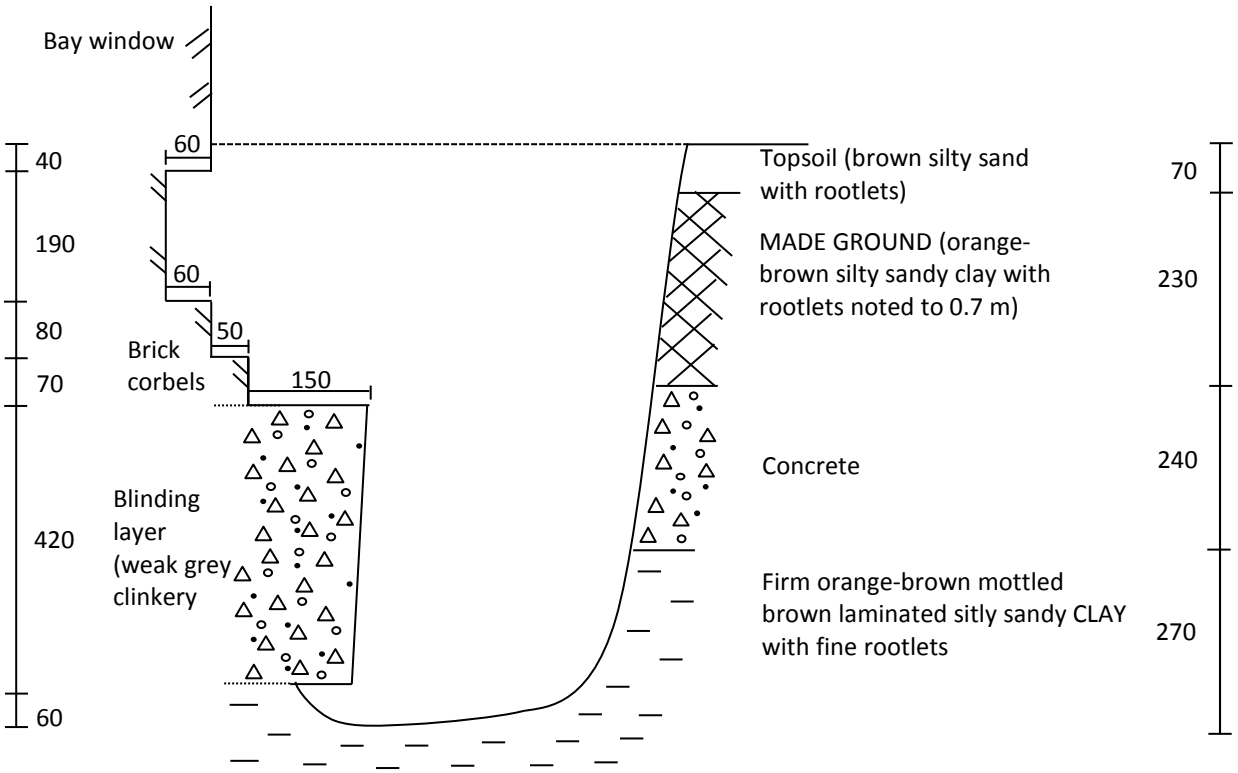
PLAN



Remarks: All dimensions in millimetres Sides of trial pit remained relatively stable during excavation Groundwater: Not encountered	Scale: 1:10 Logged by: HD

GEA Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware Herts SG12 7QE			**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **2**
Excavation Method Manual	**Dimensions** 400 x 600 x 860	**Ground Level (mTBM)** 49.53	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 8/20

SECTION A - A'



Remarks: All dimensions in millimetres Sides of trial pit remained relatively stable during excavation Groundwater: Not encountered	Scale: 1:10 Logged by: HD

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

Trial Pit No 2

Site	26 Rosecroft Avenue, London, NW3 7QB
Client	Vipul Panchal
Engineer	Hestia Developments

Job Number J15226

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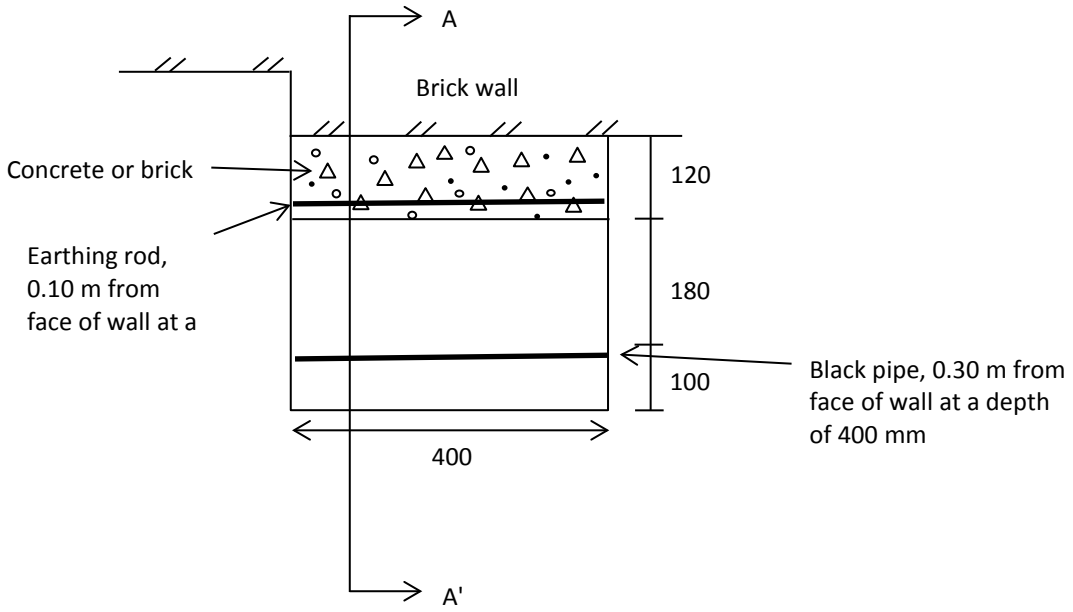
Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** 3

Excavation Method Manual	**Dimensions** 400 x 400 x 650	**Ground Level (mTBM)** 49	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 10/20

PLAN

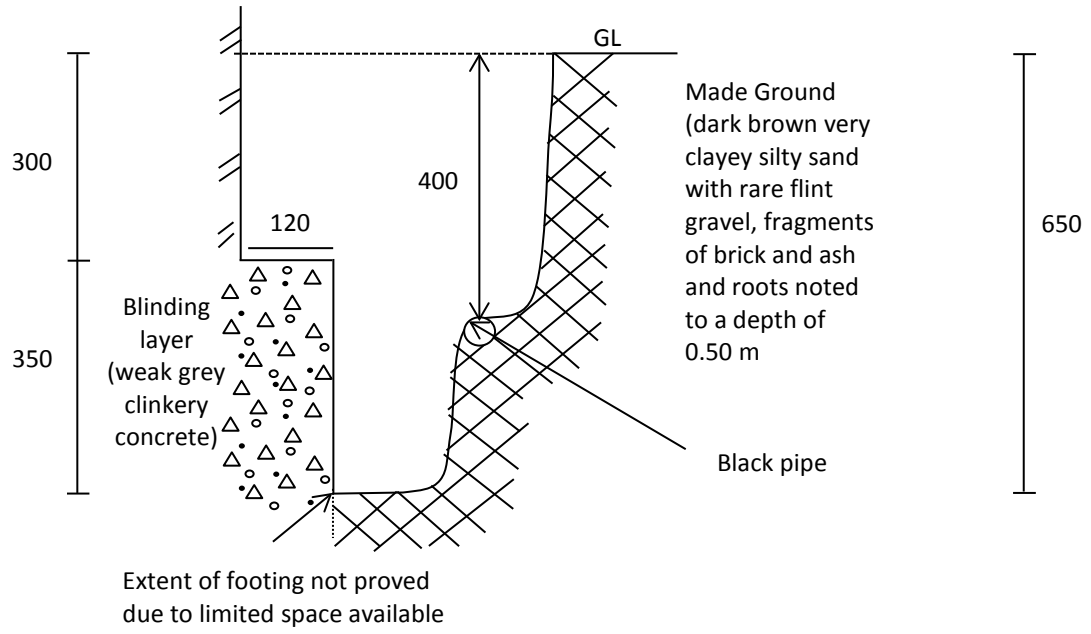


Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **3**

Excavation Method Manual	**Dimensions** 400 x 400 x 650	**Ground Level (mTBM)** 49	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 11/20

SECTION A - A'



Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

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

Trial Pit No 3

Site	26 Rosecroft Avenue, London, NW3 7QB
Client	Vipul Panchal
Engineer	Hestia Developments

Job Number J15226

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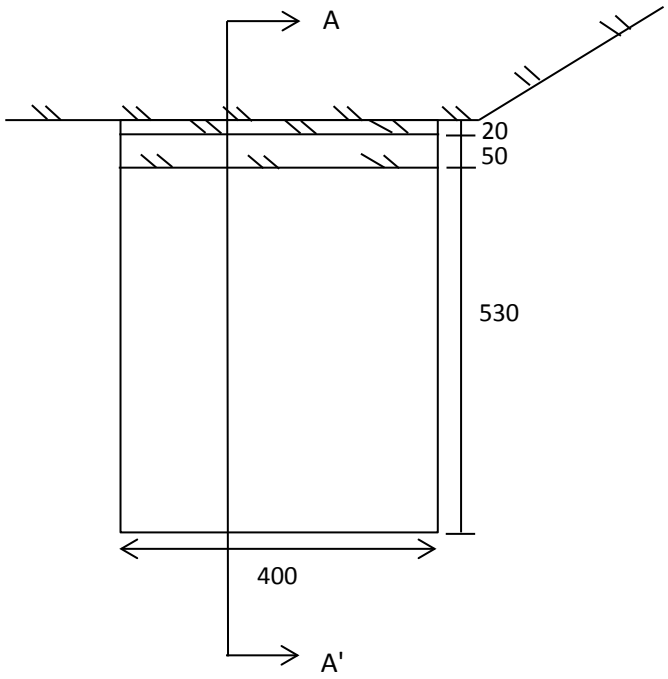
GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **4**

Excavation Method Manual	**Dimensions** 400 x 600 x 1150	**Ground Level (mTBM)** 49.97	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 13/20

PLAN

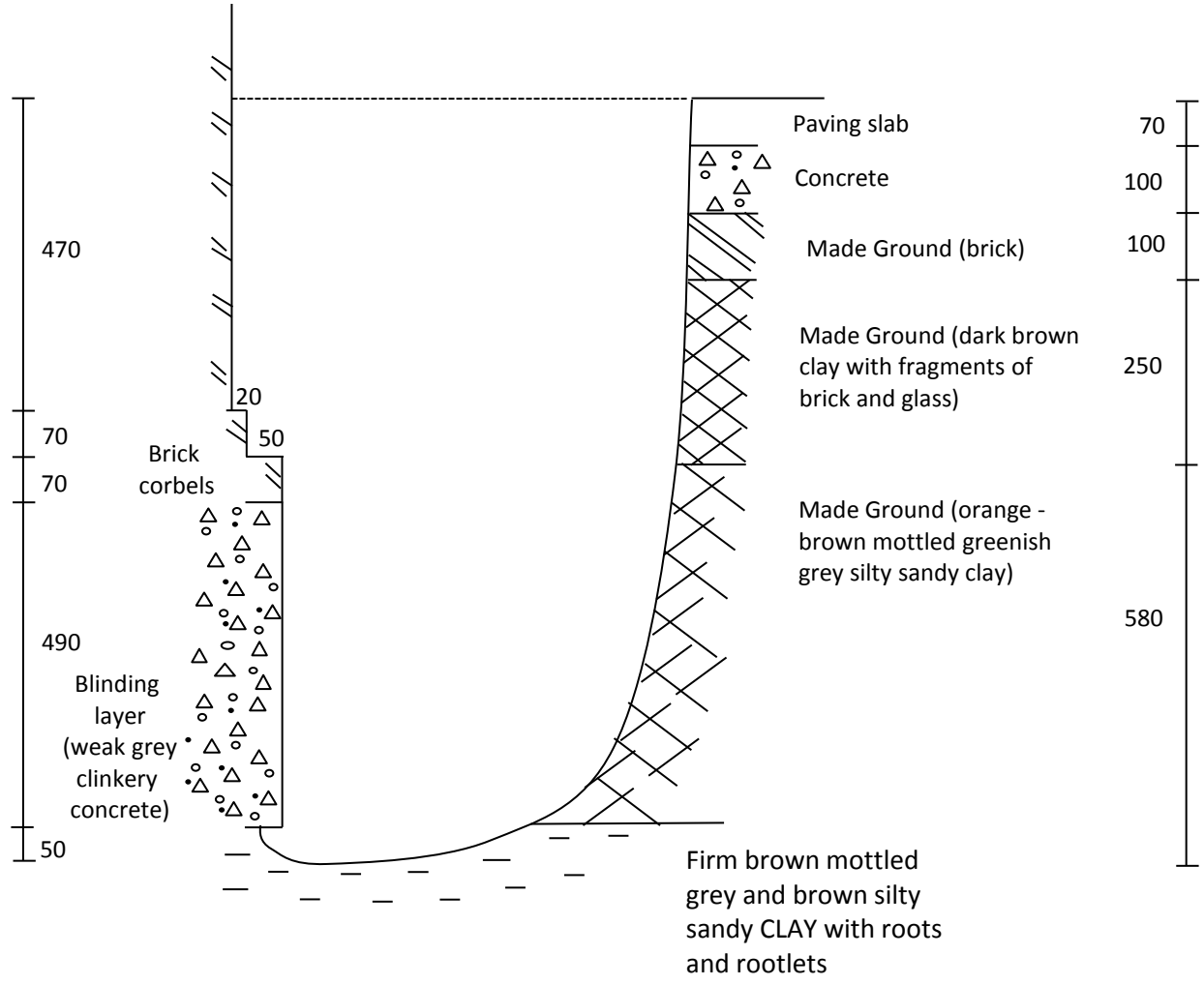


Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** 4

Excavation Method Manual	**Dimensions** 400 x 600 x 1150	**Ground Level (mTBM)** 49.97	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 14/20

SECTION A - A'



Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

Trial Pit No 4

Site	26 Rosecroft Avenue, London, NW3 7QB
Client	Vipul Panchal
Engineer	Hestia Developments

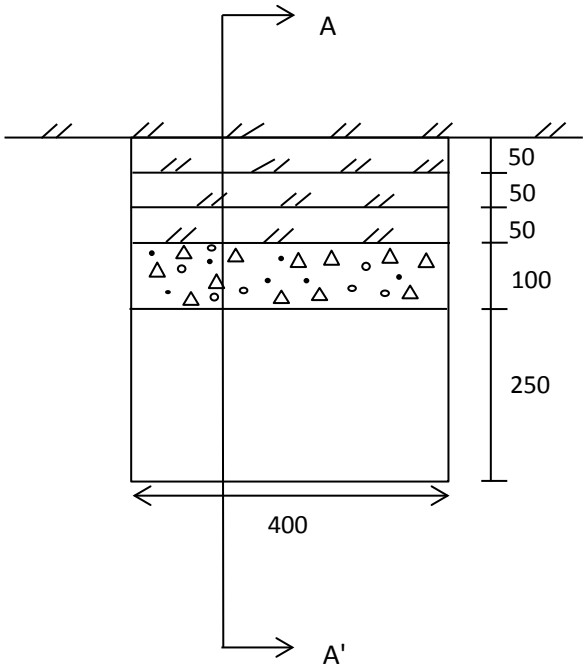
Job Number J15226

Sheet 15/20

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **5**

Excavation Method Manual	**Dimensions** 400 x 500 x 900	**Ground Level (mTBM)** 50.03	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 16/20

PLAN

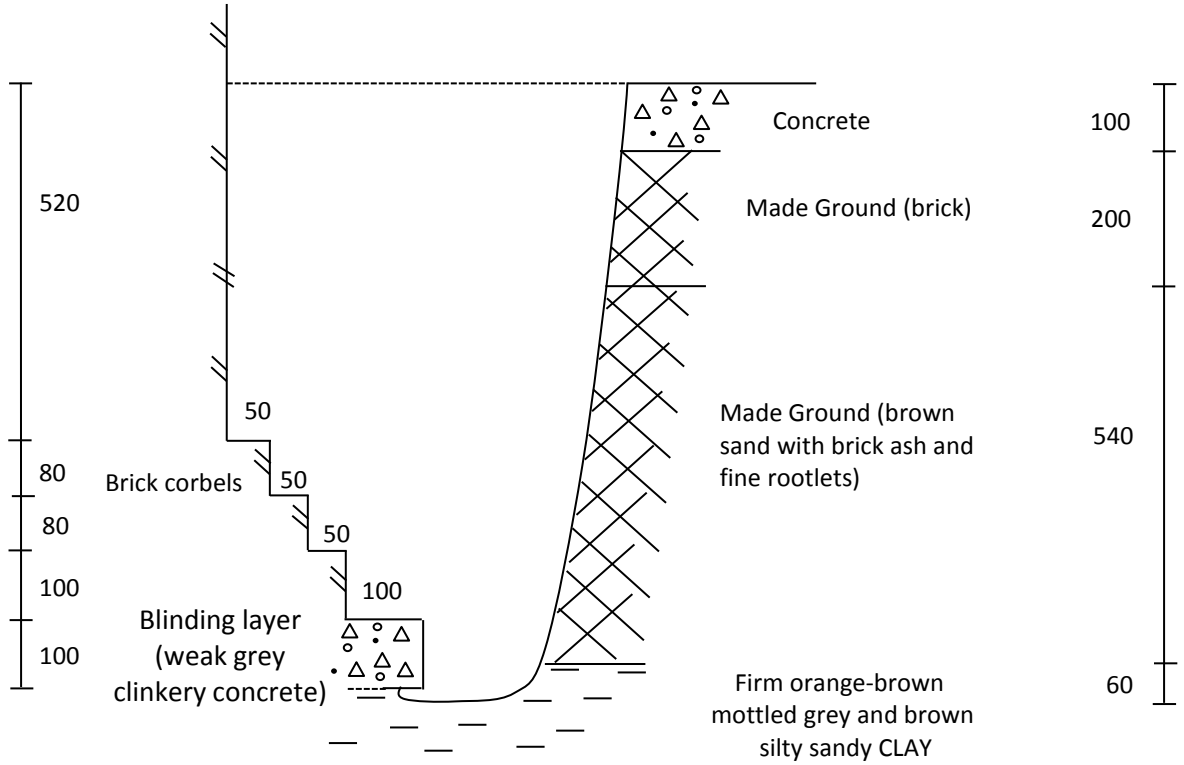


Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **5**

Excavation Method Manual	**Dimensions** 400 x 500 x 900	**Ground Level (mTBM)** 50.03	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 17/20

SECTION A - A'

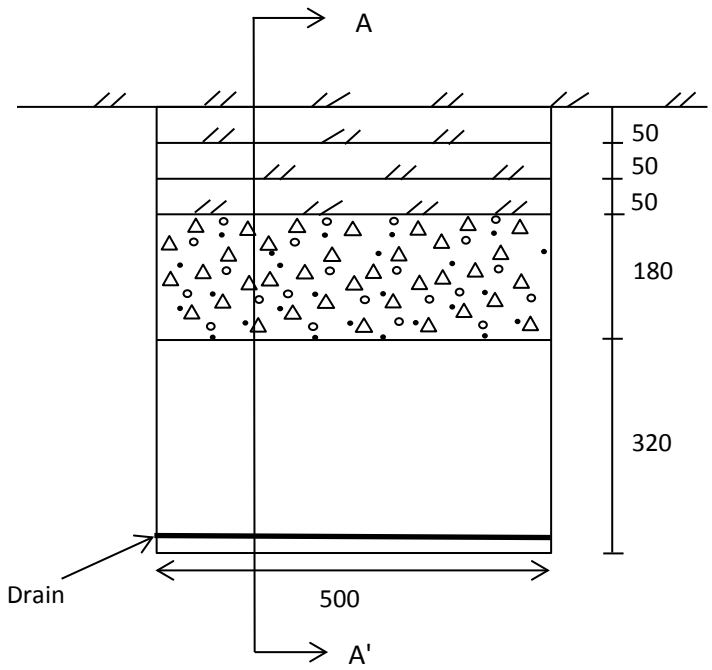


Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware Herts SG12 7QE	**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **6**

Excavation Method Manual	**Dimensions** 440 x 500 x 650	**Ground Level (mTBM)** 49.84	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 18/20

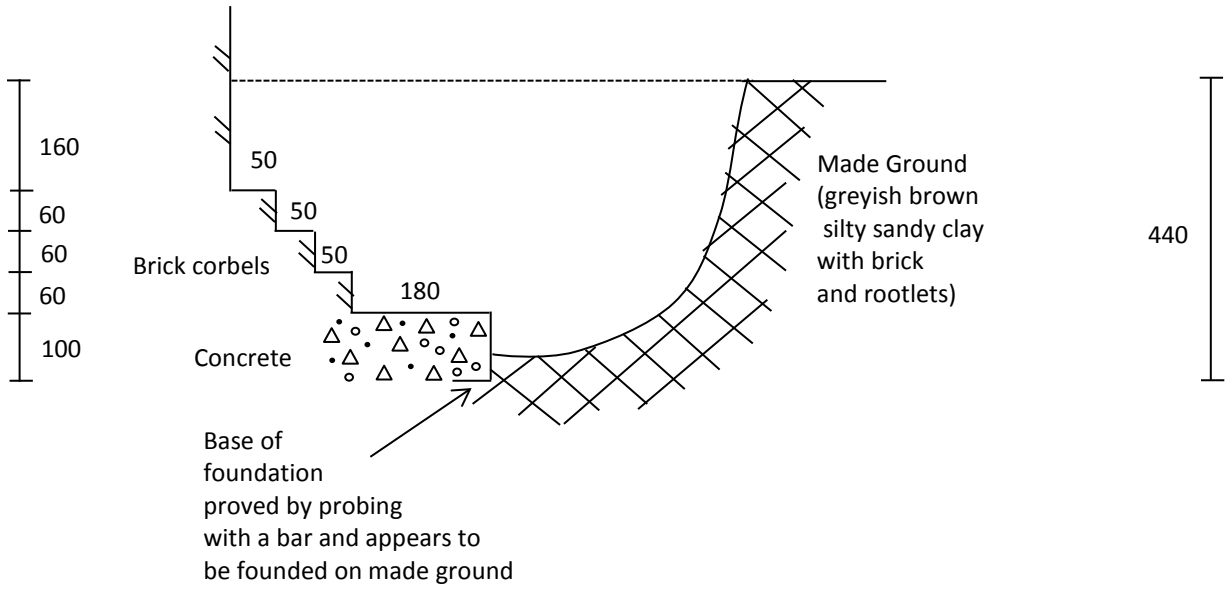
PLAN



Remarks:	Scale:
All dimensions in millimetres	1:10
Sides of trial pit remained relatively stable during excavation	Logged by:
Groundwater: Not encountered	HD

GEA Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware Herts SG12 7QE			**Site** 26 Rosecroft Avenue, London NW3 7QB	**Trial Pit Number** **6**
Excavation Method Manual	**Dimensions** 440 x 500 x 650	**Ground Level (mTBM)** 49.84	**Client** Vipul Panchal	**Job Number** J15226
	Location	**Dates** 09/10/2015	**Engineer** Hestia Developments	**Sheet** 19/20

SECTION A - A'



Remarks: All dimensions in millimetres Sides of trial pit remained relatively stable during excavation Groundwater: Not encountered	Scale: 1:10 Logged by: HD