Ground Investigation Report
and
Basement Impact Assessment

15a Parliament Hill
Hampstead Heath
London
NW3 2SY

Prepared for:

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15A PARLIAMENT HILL, HAMPSTEAD HEATH

NON TECHNICAL SUMMARY

This report presents the findings of a Ground Investigation undertaken to identify the ground conditions, presence, nature and extent of contaminants arising from potential sources of contamination at the site as well as providing a geotechnical appraisal of the ground conditions encountered. Pertinent findings and conclusions may be summarised as follows:

- The ground conditions consisted of a thin layer of Topsoil overlying Clay-with-Flints Formation and Chalk respectively.
- As expected, no evidence of made ground or visual / olfactory evidence of contaminated materials was encountered during the investigation and given the context of the sites former and proposed use no further environmental assessment or investigation is considered to be warranted at the site.
- The results of the Waste Acceptance Criteria analysis shows that all excavated soils removed as part of the proposed development at the site should be characterised as Inert Waste for the purposes of off-site disposal.

ENGINEERING SUMMARY

- The ground conditions are considered suitable for the use of conventional spread foundations, bearing on the Clay-with-Flints formation materials.
- An allowable bearing capacity of 100kN/m^2 may be adopted.
- Anti-heave precautions will be required when foundation depths exceed 1.5m due to the presence of trees, to control the effects of potential future ground movements.
- The Clay-with-Flints has been found to be of generally medium to high plasticity and therefore it is recommended that a full tree survey is undertaken in order that their effects on foundations can be fully taken into account in the design.

The above points represent a simplified summary of the findings of this assessment and should not form the basis for key decisions for the proposed development. A thorough review of the details contained within the following report, or discussion with EPS is recommended.

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1 INTRODUCTION

In August 2014, Environmental Protection Strategies Ltd (EPS) was commissioned by Gyoury Self Partnership on behalf of Katherine Woolacott to complete a Ground Investigation and Basement Impact Assessment at 15a Parliament Hill, Hampstead Heath, London, NW3 2SY (the 'site'); see Figure 1. Selected photographs and a photograph location plan are included in Appendix A.

This report presents the findings, conclusions, and recommendations of the investigation.

The development proposals for the site include removal of the existing dwelling and erection of four-storey dwelling with basement and rear extension to No. 15 with boundary alternations under planning application reference 2011/3676/P. A proposed development plan for the site is included within this report as Appendix B.

1.1 Objectives

The objectives of this investigation were as follows:

a) To compile a Phase 1 desk study and Conceptual Site Model (CSM) to evaluate the potential risks the site may pose to human and environmental receptors, both currently and in future.
b) To investigate potential contaminant linkages identified through the CSM by means of investigating shallow soils.
c) To determine the potential risks posed by the site and make recommendations for further work that may be required, to ensure safe development in accordance with the Model Procedures for the Management of Land Contamination - Contaminated Land Report 11.
d) To collect information on ground conditions and strength as well as adjacent building foundations in order to make appropriate recommendations for geotechnical design.
e) To undertake a Basement Impact Assessment for the proposed development.

1.2 Scope of Work

To perform an exploratory assessment of the site in accordance with the principles and requirements of BS EN 1997 'Geotechnical Design' the following tasks were undertaken:

Desk Study:

- Collection of site records.
- Study of existing geological, hydrogeological and historic maps of the area.
- Consultation of environmental databases, including records held by the local authority.
- Review of proposed development plans.
- Development of conceptual model and contaminant linkage assessment.

Intrusive Investigation:

- Site walkover, inspection of any visual evidence of contamination at the site, obtaining photographic records.
- Health and safety briefing / site supervision.
- Drilling of window sampling boreholes to a maximum depth of 6.0m at two locations.
- Forming of two trial pits to expose foundations of current/ neighbouring properties.

Reporting:

- Data collection and interpretation
- Reporting
- Basement Impact Assessment

The findings of these investigations and their conclusions are presented in the following sections.

1.3 Limitations and Constraints

The purpose of this report is to present the findings of a soil and water sampling investigation conducted at the location(s) specified. When examining the data collected from the investigations made during the assessment, Environmental Protection Strategies Ltd (EPS) makes the following statements:

No investigation method is capable of completely identifying all ground conditions that might be present in the soil or groundwater under a site. Where outlined in our report, we have examined the ground beneath a site by constructing a number of boreholes and/or trial pits to recover soil and/or groundwater samples. The locations of these excavations and sampling points are considered to be representative of the condition of the whole site subsurface however, ground conditions are naturally variable and it may be possible that the ground conditions encountered may differ to those encountered during the investigation.

No visible evidence of Japanese Knotweed was identified during the site walkover, however this plant can be difficult to identify in the early stages of growth and therefore it is not always possible to identify its presence at certain times of the year. For this reason EPS cannot confirm that Japanese Knotweed rhizomes do not exist and it is recommended that if it is suspected that this species, or other similarly invasive plants are present at the site, a specialist contractor should be commissioned to make a detailed assessment.

If third parties have been contracted / consulted during compilation of this report, the validity of any data they may have supplied, and which are included in the report, have been assessed as far as possible by EPS however, EPS cannot guarantee the validity of these data.

The report has been prepared for the client(s) listed on the report title page and has been subject to standard internal EPS review procedures. EPS accepts no liability or responsibility for use of, or reliance upon, this report and / or the information contained within it by third parties.

No part of this report, or references to it, may be included in published documents of any kind without approval from EPS.

This report and its contents, together with any supporting correspondence or other documentation, remain the property of Environmental Protection Strategies Ltd until paid for in full.

2 GEO-ENVIRONMENTAL SETTING

The following section provides a summary of the information collected in relation to the site location and history.

2.1 Site Location and Description

The site is situated to the north west of Parliament Hill, just to the south of its junction with Nassington Road, North West London, approximately 850m from Hampstead, Camden. The site covers an area of roughly 500m^2 and is centred on national grid reference 527385, 185770, (see Figure 1) with access obtained from Parliament Hill, to the south east. The surrounding land use is predominantly residential with Hampstead Heath public open space to the north and east with Royal London Hospital present to the south beyond the North London railway line. The area lies at an approximate topographic elevation of 75m Above Ordnance Datum (AOD) with local topography sloping steeply to the south and east.

A site walkover was undertaken on 20th August 2014 and the area was found to comprise a two storey brick built structure with a flat roof, with all neighbouring properties at least four storeys tall. The site also includes a small section of the adjacent property (No. 15) and the garden to the rear. To the front of the existing building lies a paved driveway with an area of formal garden including a mature Birch tree in excess of 10m in height. Further mature trees were noted in the pavement fronting the property as well as within the gardens to the rear, including species such as Oak.

A plan showing the site location is provided as Figure 1, a current layout plan is included as Figure 2, and an aerial photograph is provided as Figure 3. Selected site photographs are included as Appendix A, a Proposed Development Plan as Appendix B and relevant extracts of the Envirocheck report showing the surrounding land use are included as Appendix C.

2.2 Geology and Geological Hazards

Geological maps of the area (British Geological Survey 1:50,000 series, Sheet 256-Geological Map of North London-Solid and Drift Edition) report the site to be directly underlain by London Clay Formation materials comprising clay, silt and sand.

A summary of the geotechnical hazards in the area is provided in the table on the following page.

Hazard	On site Risk
Mining Activities	None
Collapsible Ground	Very Low
Compressible Ground	None
Ground Dissolution	None
Running Sand	Very Low (site), Low (5m south and 190m north west)
Landslide	Very Low
Shrinking/Swelling Clay	Moderate

The BGS and Health Protection Agency (HPA) report entitled '*Indicative Atlas of Radon in England and Wales*' (November 2007) shows the site to lie within a 10km grid section where the percentage of homes above the radon action level is between 0% and 1%.

The joint Building Research Establishment Ltd (BRE) report entitled '*Radon: Guidance on Protective Measures for New Buildings* - 2007' reports that the site does not lie within an area where basic or full construction protection methods need to be employed.

The geological context is presented as Appendix D.

2.3 Regional Hydrogeology

The Environment Agency (EA) groundwater vulnerability map of the area (Groundwater Vulnerability of West London-Sheet 39-1:100,000) indicates that the London Clay underlying the site is regarded as an unproductive aquifer.

A search of the Environment Agency (EA) public database reveals that the site does not lie within a groundwater source protection zone (SPZ).

Groundwater vulnerability maps are included as Appendix E.

2.4 Regional Hydrology

The nearest surface water feature lies roughly 70m to the north west and is a large pond which forms part of the Hampstead Pond chain that extends further to the north.

The EA does not regularly report on the water quality of any nearby watercourses within 1km.

There are no discharge consents reported within 1km.

2.5 Flood Risk

Review of the EA flood zone map for the area indicates that the site lies within flood zone 1 as defined within Table 1 of technical guidance to the National Planning Policy Framework (NPPF) which is the area with the lowest potential risk of flooding from fluvial or tidal sources.

The EA flood zone maps do not take into account flooding from other potential sources of flood water, such as from poor drainage, or groundwater.

EA Flood Zone Maps are also included within Appendix E.

2.6 Environmentally Sensitive Areas

Belsize Wood (located 450m south) is highlighted as a Local Nature Reserve.

No other sites of environmental sensitivity or significance have been identified within 1km.

2.7 Landfills & Sources of Industrial Pollution

No former active or historic landfills are highlighted within environmental databases within a 1km search radius of the site.

There are also no pollution incidents to controlled waters that have been reported within 1km.

2.8 Industrial Land Use

The Envirocheck report highlights seventy one currently active / obsolete potentially contaminative industrial sites within 1km, eight of which are present within 250m.

The closest lies around 105m to the west and relates to a now inactive catering equipment supplies service. Further land uses in the area include domestic cleaning services (165m south east, inactive), a laundry (205m south west, inactive) and a scaffolding service (210m south west, active).

2.9 Site History

As part of this investigation, a review of historical maps dating back to 1850 was undertaken in order to determine if previous site activities, or activities in the surrounding area, could have led to contamination of soil or groundwater. A summary of historical map data is provided below and copies of relevant historic maps and any others examined during the investigation are included in this report as Appendix F.

- The early historical maps show the site to remain undeveloped until the 1890's when the building occupying the site today appears to have been constructed, together with adjacent properties.

- Maps from roughly 1870 show a footpath to run along the northern site edge and ponds / lakes are evident to the west and north west. To the south at this time, a railway line, (constructed in a cutting) and Hampstead Heath Station also exist.
- With the construction of housing in the area the most southerly of the ponds has been in-filled. However there appear to be no further significant changes of note to the site throughout the remainder of the historical period.
- The surrounding area does generally become more built up over time, although this is predominantly for residential purposes and no significant industrial development is noted in the area other than an over ground railway, which lies down gradient of the site.

3 CONCEPTUAL MODEL

The following section provides a review of the contaminant linkages that may be active at the site through examination of the potential sources that may be present as a result of historic and / or current site activities and where potential interaction between these sources and the identified human / environmental receptors may occur.

3.1 Source Characterisation

The following potential contaminant sources have been identified at the site and in the surrounding area:

Potential Source	Source Description	Principal Contaminants of Concern
Current and Historic Site Use	Imported Made Ground materials used to level ground beneath the site.	Heavy Metals, PAH Compounds, Asbestos Containing Materials (ACM)
	Natural London Clay anticipated to directly underlie the site.	Sulphates

Notes: PAH Polycyclic Aromatic Hydrocarbons

3.2 Potential Receptors

A framework for the assessment of risks arising from the presence of contamination in soils has been produced by the Environment Agency and the Department for the Environment, Food and Rural Affairs (DEFRA) and is presented with the report '*Using Science to Create A Better Place: Updated Technical Background to the CLEA Model* – Science Report SC050021/SR3'. This guidance document defines a series of standard land-uses, which form a basis for the development of a Conceptual Site Model.

The development proposal includes the development of a residential property including basement level and landscaped garden areas. Therefore the land use has been considered as:

- Residential

In view of the environmental setting, current and potential future land use of the site and surrounding sites, the potential receptors for any contaminant impact are discussed on the following page.

Receptor	Site Specific Description
Human	Future site users, site workers involved in the site redevelopment and those working and living in the surrounding area have the potential to be at risk from exposure to potential contaminants of concern (CoCs).
Groundwater	The geology underlying the site comprises London Clay which is classified as an unproductive aquifer and no groundwater abstractions are noted within 1km. Therefore, groundwater is not considered to be at risk from site derived contaminants.
Surface Water Bodies	A large pond is located 70m north west, however, this lies up gradient of the site and the geology is anticipated to consist of low permeability London Clay. Therefore, surface water is not considered to be at risk from site derived contaminants.
Flora and Fauna	Some of the identified contaminants of concern are known to be phytotoxic and as such the potential for this impact should be considered.
Buildings & Infrastructure	The proposed development incorporates subsurface structures that may be adversely affected by the potential presence of the identified contaminants of concern. These include concrete used in building foundations, buried potable water supply pipes, and other service lines and pipes.
Adjacent Land	Given the likely nature and extent of contaminants identified, adjacent properties including nearby residential properties are unlikely to be at risk from site derived contaminants.

3.3 Potential Pathways

Where contaminants may be present in soil, there are a number of potential pathways that enable human receptors to come into contact with or be exposed to them. The most direct pathways, considered under current UK legislation, can be summarised as follows:

- Direct ingestion of contaminated soil
- Ingestion of household dust
- Ingestion of contaminated vegetables
- Ingestion of soil attached to vegetables
- Dermal contact with contaminated soil
- Dermal contact with household dust
- Inhalation of fugitive soil dust
- Inhalation of fugitive household dust
- Inhalation of vapours outside
- Inhalation of vapours inside

Clearly, not all of these potential pathways apply for every standard land-use; the simplest example for exclusions being a commercial / industrial site which is covered by concrete hardstanding. The concrete precludes the direct exposure of humans working at the site to any contaminated soils.

However in addition to direct exposure pathways, a number of physical transport mechanisms / pathways may also exist at a site that allow remote or less accessible contaminants in soil or groundwater to reach human or environmental receptors both at a site and beyond the site boundary. These include the following:

- Downward and lateral movement of contaminants in soil either by gravity or through being 'leached' by percolating rainwater
- Lateral migration of contaminants dissolved in groundwater.
- Direct seepage or leaching of contaminants from soil into subsurface drains or supply pipework.
- Volatilisation of contaminants from groundwater or unsaturated soils into buildings or outdoor air.

Through examination of the standard land use and environmental setting at each site, the presence of pathways and transport mechanisms described above must be considered when assessing whether a contaminant linkage may plausibly be active, and therefore be included in the conceptual site model.

3.4 Summary of Contaminant Linkages

Considering the site use and environmental setting, and proposed land use, the following plausible contaminant linkages have been identified through this Phase I investigation and require further investigation / assessment:

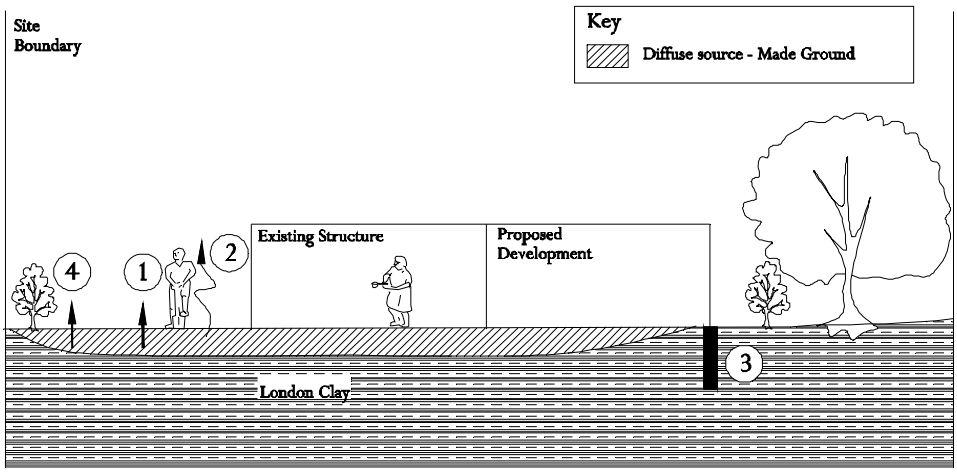
Source	Pathway	Receptor
Contaminated soil	Ingestion of soil through direct contact, inhalation of fugitive dusts, eating or smoking with dirty hands.	Site users including construction workers during redevelopment.
Contaminated soil	Ingress / diffusion through permeable potable water supply pipes.	Site users
Natural London Clay	Direct contact	Concrete used in foundations
Contaminated Soil	Direct uptake and / or adherence of contaminated soil to vegetation and subsequent ingestion.	Site users

The comments on the following page are made with respect to contaminant linkages which have been considered through development of the conceptual model, but have not been concluded as 'plausible' – i.e. through which a significant possibility of significant harm could occur to an identified receptor.

- Whilst a railway has been present to the south from at least the 1890's, historical mapping does not show this to have infringed on the site. Given the presence of low permeability geology the relatively low environmental mobility of the contaminants of concern identified, and the fact that the railway lies down gradient, this is not considered to pose a risk to the site and its future users.
- A number a relatively small and 'low risk' industrial land uses have been identified in the area and none of these have been within 100m. Therefore, industrial land uses identified are also not considered to pose a risk.

The following diagram provides an illustration of the plausible contaminant linkages that may be active at the site and which may need further investigation or control to ensure safe development:

Illustrative Environmental Conceptual Site Model



Potential Pathways

1 Direct Contact with / Ingestion of Soil

2 Ingestion of Fugitive Soil Dusts

3 Direct Contact with Subsurface Infrastructure

4 Direct Uptake by Vegetation

4 SUMMARY OF INVESTIGATIONS

The intrusive ground investigation was undertaken on the 20th August 2014 in accordance with EPS standard operating procedures, copies of which will be made available on request. A summary of all site activities is presented in the following sections:

4.1 Borehole and Trial Pit Locations

Borehole locations were selected through consideration of the proposed development layout, the location of below ground utilities as well as operational and health & safety considerations.

A total of two window-sampling boreholes (WS1 & WS2) were formed to assess the nature and quality of underlying soils to depths of up to 6.0m below ground level (bgl) using a track-mounted window sampling rig.

The overall objective in terms of borehole location was to provide an appropriate lateral and vertical coverage of the site with regard to the proposed development in order to provide information relating to the ground conditions and strength.

Furthermore, two foundation exposure pits (TP1 and TP2) were excavated by a third party contractor to investigate the nature of the existing and adjacent building foundations and what effect they may have on the proposed structure.

The boreholes were drilled in accordance with standard EPS drilling methodologies, and subcontractors were supervised at all times by an EPS engineer. After completion, each borehole was backfilled to ground level using suitable material. A detailed site layout plan showing the locations of the boreholes / trial pits formed during the investigation is presented as Figure 4.

4.2 Soil Sampling

Each borehole was logged for ground conditions encountered and inspected for any physical evidence of contamination, such as soil staining, odour and the presence of separate phase liquids on a precautionary basis.

Soil samples were obtained from throughout each borehole. The selection of samples for laboratory analysis focused on providing an assessment of the contamination of any made ground, (if present) and geotechnical properties of the soils encountered

A laboratory testing schedule is included as Table 1.

4.3 Laboratory Testing

4.3.1 Chemical Analysis

Samples obtained for analysis of identified contaminants of concern were submitted to Jones Environmental Laboratories, Flintshire, who hold appropriate UKAS / MCERT accreditation for the required testing. Samples were transported in laboratory supplied containers and delivered to the laboratory by approved courier.

4.3.2 Geotechnical Testing

Geotechnical testing was undertaken by Soil Property Testing, Huntingdon, a UKAS accredited laboratory.

Copies of chain of custody documentation are held by EPS and will be made available on request.

5 FINDINGS OF THE INVESTIGATION

This section of the report provides a summary of the findings of the various aspects of the ground investigation.

5.1 Ground Conditions

A total of two boreholes were formed at the site and the ground conditions encountered, from ground level, were found to comprise:-

- Topsoil/Made Ground
- London Clay Formation (LC)

A summary of the strata encountered across the site is provided below.

Geological Strata	Maximum Depth to Base of Strata(m bgl)	Strata Thickness (m)
Topsoil/Made Ground	1.0	0.35 to 1.00
London Clay Formation (LC)	>6.0	>5.65

5.1.1 Topsoil/Made Ground

A thin layer of Topsoil, described as sandy silt was recorded in WS1 only.

Beneath the Topsoil in WS1 and from the surface in WS2 Made Ground was recorded. In WS1 this was noted to comprise crushed concrete with brick fragments to 0.45m underlain by gravelly clay with further fine to coarse brick to roughly 1m. In WS2 the Made Ground was recorded to just 0.35m and consisted of paving and sub base materials overlying a thin layer of gravelly sand with brick inclusions.

5.1.2 London Clay Formation (LC)

LC was recorded beneath the Made Ground in both of the boreholes and extended beyond maximum depth (6.0m bgl). This was typically described as a firm becoming stiff silty clay with partings of silt.

5.1.3 Groundwater

Groundwater strike was only encountered within a thin sand lens at roughly 5.0m in WS2. However, upon the return monitoring visit groundwater surface was recorded at both monitoring points at rest level ranging between 3.365m bgl (WS2) and 3.562m bgl (WS1).

Site specific borehole logs are located within Appendix G and include results of in-situ testing.

5.1.4 Existing Foundations

The existing foundations were exposed at two locations relating to the front (TP1) and the rear (TP2) of the existing properties and adjacent buildings. Foundations to the rear of No.15 were generally found to comprise vertical brick course present to roughly 0.35m bgl which then progressively stepped away from the building face, (maximum of 0.26m) between 0.35 – 0.68m depth. This differed from the side wall for the current bedroom, (north west to south east orientation) where vertical brick course progressed to 0.35m and was founded on mass concrete strip foundation which extended to roughly 0.49m bgl and stepped 0.15m from the building line.

The trial hole formed at the front of the existing property (TP1) found the building to be founded on stacked concrete slabs present to 0.24m bgl, (and staggered 0.17m from building line) with an underlying mass concrete foundation present to 0.51m bgl. The adjacent property, (southern face) of No.15 was found to have vertical brick course to depths ranging from 1.05 – 1.34m with underlying mass concrete strip foundations which extended a further 0.2m depth from brick course and 0.1m from building line.

Surrounding materials were recorded to be consistent with materials recovered from exploratory boreholes. Sketches showing these are included to the rear of Appendix G.

5.2 Physical Evidence of Contamination

Other than the presence of Made Ground, no other palpable evidence of contamination was encountered in any of the boreholes formed during the investigation.

5.3 Laboratory Analysis

5.3.1 Chemical Testing

Sulphate contents and pH values determinations were carried out by the analytical laboratory, the results of which are summarised in section 7.4 below.

Furthermore, a sample of shallow subsurface soils, (made ground) recovered from WS1 was submitted for assessment of common contaminants of concern. The key results of the laboratory testing found minimal impacts of Heavy Metals including arsenic and lead with individual PAH compounds often not detected above minimum laboratory detection limits (MDL). No trace of asbestos containing materials (ACM) was identified within laboratory analysis of shallow subsurface soil.

All chemical laboratory results are included as Appendix H of this report.

5.3.2 Waste Disposal

Inert Waste Acceptance Criteria (WAC) testing was also carried out on a soil sample representative of the soil profile between 1.0-1.5m bgl (WS1), and typical of the natural cohesive soils identified across the site, to assist with waste handling and disposal of any excavated material from proposed building footings.

The results of the waste analysis for the representative sample obtained are provided within Appendix H and show that the sampled material should be characterised as **Non-Hazardous** for the purposes of off-site disposal. The material cannot be classified as Inert due to elevated concentrations of Sulphate and Total Dissolved Solids within leachate testing.

5.3.3 Geotechnical Testing

The results of geotechnical laboratory testing are summarised in the table below. All results obtained from the laboratory are included within Appendix I.

Strata	**Range of Parameters**					
	Moisture Content (%)		Plasticity Index (%)		Undrained Shear Strength (kPa)	
	Min	Max	Min	Max	Min	Max
London Clay	28	32	39	47	62	200

The natural moisture content was established for four samples of cohesive soil in accordance with BS1377 Part 1:7.3 and BS1377: Part 2:3.2.

Atterberg limit tests were undertaken on four samples of cohesive soils in accordance with BS1377: Part 1:7.4 and BS1377: Part 2:3.2&4.2.

A laboratory analysis testing schedule is presented as Table 1 and all geotechnical sample results obtained from the laboratory are included as Appendix I.

6 TIER 1 QUALITATIVE RISK ASSESSMENT

6.1 Tier 1 Screening – Generic Assessment Criteria (GAC)

6.1.1 Tier 1 Screening - Soils

In order to screen laboratory data for concentrations of contaminant in soil with potential to cause harm to human health in a residential setting, (seen as a conservative representation of the site based on the likely child / young adult receptor), UK Soil Guideline Values (SGVs) and an In-House Generic Assessment Criteria (GACs) for contaminants in soil have been used. The technical framework used to derive the assessment criteria and the documents in which they are published are summarised as follows:

- *EA Science Reports* (SC050021/SR2, SC050021/SR3, and SC050021/SR7)
- *EA Soil Guideline Value Science Reports*
- *Generic Assessment Criteria for Human Health Risk Assessment* – LQM and CIEH 2nd edition (2009).

For concentrations of Lead in soil, there are currently no published Tier 1 human health screening criteria available and EPS has used the new Category 4 Screening Values (C4SLs) for lead as an appropriate guide for professional judgement with respect to reasonable 'low risk' levels in the context of this site.

A summary of the screening criteria and the methodology used to derive them is included in Appendix J.

6.2 Assessment of Soil Results

The results of the screening process for on-site human receptors show that Generic Assessment Criteria, representative of minimal risk values for a residential setting were not exceeded for any contaminants of concern.

6.3 Environmental Conclusions and Recommendations

The ground conditions encountered comprised a relatively thin layer of Topsoil / Made Ground overlying London Clay formation materials. Made ground materials were noted as relatively 'low risk' and often comprised inert building materials placed to form sub base for existing structures and areas of hard standing. Furthermore, no unexpected visual or olfactory evidence of contaminated / waste materials including evidence of staining, odours or separate phase liquids were encountered during the forming of any boreholes or trial pits across the site.

Results of the Waste Acceptance Criteria analysis show that any natural cohesive soils to be removed as part of the proposed development at the site should be characterised as **Non-Hazardous Waste** for the purposes of off-site disposal.

Based upon the information obtained and reviewed in this report, it is concluded that there are currently no plausible contaminant linkages active at the site, which could cause harm to human or environmental receptors. Although shallow subsurface soils have been shown to be of sufficient quality for use within residential garden, it may be prudent to include suitable growth medium of **150mm** clean topsoil cover in future garden / landscaped areas. This could be achieved by removal and replacement of existing materials, or emplacement on existing made ground materials, (where present) if proposed site levels can accommodate for this. A summary of the approach outlined in CLR11, marking the work already completed under the risk assessment phase, is presented as a flow diagram in Figure 5 of this report.

It is expected that contractors involved in the development work will adopt standard safe systems of work which would prevent the cause of pollution from contaminants that may be present at an active development. Additionally, in the unlikely event that potentially polluting substances not identified through this assessment are encountered during site redevelopment, it is recommended that EPS personnel are contacted to assess the situation and provide appropriate advice. Construction workers should have a procedure in place for dealing with any previously unidentified contamination if it is encountered during their redevelopment activities and to this end an example method statement has been provided as Appendix K.

It is also recommended that a copy of this report be provided to Camden Borough Council so that the information may be incorporated into planning correspondence and their land quality records, as well as pursuance of the discharge of associated planning conditions regarding the proposed redevelopment of the site.

7 GEOTECHNICAL APPRAISAL

The ground conditions have been found to comprise a superficial layer of Made Ground overlying London Clay Formation.

7.1 Structural Foundations

The ground conditions are considered suitable for the use of conventional spread foundations, either strip footings or pad foundations bearing on the London Clay.

Allowable bearing capacities for the London Clay are provided in the table below:-

Depth (m bgl)	Allowable Bearing Capacity (kN/m^2)
1.0	85
2.0	115
3.0	145

At the above bearing pressure total settlements are unlikely to exceed approximately 25mm. Settlements in cohesive (clay) soils will comprise both immediate and long term, (consolidation) settlement and will take place over a long period of time.

A minimum foundation depth of 1m, below existing or proposed ground level is considered suitable for the site, subject to the following provisos:-

a) The London Clay is a cohesive soil and will be subject to volume change, (subsidence and / or heave) due to the presence of trees. Foundations will therefore need to take into account the presence of trees, both those to remain and those to be planted as well as to be removed from site. The London Clay should be considered as having a generally medium to high volume change potential in accordance with NHBC Standards Chapter 4.2 '*Building Near Trees*'.

b) Foundations also fully penetrate any made ground or disturbed ground arising from the removal of trees or existing foundations and should extend a minimum of 150mm in to undisturbed natural strata.

Anti-heave precautions will be required when foundation depths exceed 1.5m due to the presence of trees, to control the effects of potential future ground movements.

It is recommended that a full tree survey is undertaken in order that their effects on foundations can be fully taken into account in the design.

7.2 Ground Floor Construction

Given the likelihood that foundation depths will exceed 1.5m due to the presence of trees, the use of suspended ground floor construction is recommended. The ground floor should incorporate a sub-floor void suitable for a high volume change potential soil.

7.3 Groundworks

Any shallow excavations formed within the London Clay Formation materials may be stable for short periods but should not be relied upon over longer periods or for the basement excavation. It is likely the removal of existing foundations will produce loose areas of soil which will be unpredictable and liable to collapse.

Heavy plant and stockpiles of materials should not be permitted close to the edges of unsupported excavations.

Further reference may be made to CIRIA Report No. 97 '*Trenching Practice*' 1992.

On the basis of the findings of the ground investigation, it is unlikely that significant amounts of groundwater will be encountered in excavations for foundations and drainage. Inflows of groundwater are considered likely to be small and may be dealt with by sump pumping.

7.4 Concrete Grade

Sulphate contents and pH values determinations were carried out by the analytical laboratory. Sulphate contents were recorded as 0.0140g/l to 1.8341g/l SO_4. The pH values ranged from 7.39 to 7.66.

In accordance with Part 1 of the BRE Special Digest 1 '*Concrete in Aggressive Ground*' 2005, a design sulphate class of DS3 is considered suitable for the site, with an aggressive chemical environment for concrete (ACEC) of AC-2s.

8 BASEMENT IMPACT ASSESSMENT

8.1 Screening Process

The first stage in assessing the impact of a proposed basement development is to recognise issues that are relevant to the site. Screening is the process of determining whether or not a BIA is required for the project. The screening process takes the form of a number of questions relating to surface flow and flooding, groundwater flow and land stability, that are answered in the following sections.

8.1.1 Surface Flow and Flooding

This section considers drainage issues, including how surface water flow will be managed on site.

Question 1: Is the site within the catchment of the pond chains on Hampstead Heath?

No	

Question 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	No material change to the drainage is intended.

Question 3: Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?

No	The basement will extend beyond the current ground floor level footprint with an associated lightwell. However, this area is currently laid to patio and used as a paved driveway, therefore the final development shouldn't result in an increase in impermeable area due to the inclusion of basement.

Question 4: Will the proposed basement result in changes to the profile of the inflows, (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?

No	As for Q3 (above) no material change to the impermeable area is intended and therefore no changes to surface water inflows are anticipated.

Question 5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?

No	Surface water quality will not be affected by the basement proposals as this will remain as currently collected from roof tops and hardscaped areas.

Question 6: Is the site in an area known to be at risk from surface water flooding.

No	The London Borough of Camden Flood Risk Management Strategy does not show the site to be in an area at risk from surface water flooding.

8.1.2 Groundwater Flow

This section considers the groundwater regime beneath the site.

Question 1a: Is the site located directly above an aquifer?

No	London Clay materials are considered unproductive strata in terms of aquifer designation.

Question 1b: Will the proposed basement extend beneath the water table surface?

No	It is likely that the London Clay will contain perched or localised pockets of groundwater which may be encountered during basement construction. However, groundwater surface was struck at approximately 5.0m depth and found at rest level of approximately 3.5m below ground level (bgl) within monitoring standpipes installed at the site. Given basement formation level will be approximately 3.0 – 4.0m bgl groundwater strike may be avoided.

Question 2: Is the site within 100m of a watercourse, well (used / disused) or potential spring line?

Yes	A large pond is shown to exist within 70m to the rear (north west) of the property. No wells (used / disused) or potential spring lines have been noted.

Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?

No	

Question 4: Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?

No	Basement level won't result in increased area of hardstanding (see 'Surface Flow and Flooding' question 3).

Question 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	The local geology is not conducive to the use of infiltration drainage and therefore surface water will be discharged to existing municipal drainage networks.

Question 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?

Yes	Given the topography of the local area, it is likely the proposed basement will be below the level water level of the pond located 70m north west.

8.1.3 Land Stability

This section considers if the site may be prone to land stability issues and if the proposed development may be at risk of causing land instability.

Question 1: Does the existing site include slopes, natural or manmade, greater than 7° (approximately 1 in 8)?

Yes	The majority of the site appears to be founded on slope of 7°–10° with slope in areas adjacent to the south and east being >10°.

Question 2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°?

No	Proposed development should not significantly affect existing profiling of the site.

Question 3: Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 °?

Yes	Area between the site and Northern Line (overground), approximately 65m south shows slope profile of at least 7° – 10° up to the location of the cutting itself.

Question 4: Is the site within a wider hillside setting in which the general slope is greater than 7°?

Yes	See Question 3.

Question 5: Is the London Clay the shallowest strata at the site?

Yes	Has been proven to at least 6.0m bgl from intrusive investigation undertaken by EPS.

Question 6: Will any tree(s) 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?

Yes	All trees are to be retained as part of the proposed development, however works are present within tree protection zones, particularly those at the front of the existing property. Protection measures are planned to preserve trees and root protection areas.

Question 7: Is there a history of seasonal shrink-swell subsidence in the local area, and / or evidence of such effects at the site?

No	There is no significant evidence of such at the site or surrounding area, however British Geological Survey does highlight a moderate risk in the vicinity.

Question 8: Is the site within 100m of a watercourse or a potential spring line?

Yes	A large pond is present approximately 70m north west.

Question 9: Is the site within an area of previously worked ground?

No	There is no historical or current visible evidence of such.

Question 10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?

No	Underlying London Clay is classified as unproductive strata. However, intrusive investigation undertaken at the site encountered groundwater strike at approximately 5.0m bgl with rest level recorded between 3.3 – 3.6m depth upon return visit. This is considered to represent perched water. Any groundwater inflows are expected to be minimal / slow, and therefore could be dealt with limited controls put in place.

Question 11: Is the site within 50m of the Hampstead Heath ponds?

No	Hampstead Heath Pond No. 1 is present approximately 70m north west.

Question 12: Is the site within 5m of a highway or pedestrian right of way?

Yes	The site fronts onto Parliament Hill roadway to the east with pedestrian footpath present either side.

Question 13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?

Yes	Foundations for the existing property were noted to extend to roughly 0.51m (front) and between 0.49 - 0.68m (rear). It is understood that the neighbouring properties both comprise basement levels, which are anticipated to be present adjacent to the proposed basement section for No. 15a. Whilst taking account of the topographical gradient of the local area, it is projected that the proposed basement level for No. 15a will be formed approximately 150mm below that of No. 14 and 1,300mm deeper than basement level of No.15. The change in differential depth will be limited to those estimated, which would otherwise have been greater if not for the presence of the existing basements for neighbouring properties.

Question 14: Is the site over, (or within the exclusion zone of) any tunnels, e.g. railway lines?

No	

8.2 Scoping Stage

The purpose of the scoping stage is to define matters to be investigated as part of the BIA process. Potential hazards or risks identified by the screening process, in the previous section, are therefore summarised below so that they can be addressed in detail during the following investigation stage.

8.2.1 Surface Flow and Flooding

Potential impacts that require consideration

- An increase in the impermeable area is not intended solely through the development of the basement level. However, it is likely that the relative area will be increased when considering the development as a whole, given the planned extension of proposed building beyond the current building footprint to the rear of the existing property with potential small net increase in paving areas to the rear. This will be compensated for, to a degree by increase in soft landscaping areas indicated to the front of the property.

8.2.2 Groundwater Flow

Potential impacts that require consideration

- Potential for shallow groundwater.
- Presence of surface water bodies within 100m.

8.2.3 Land Stability

Potential impacts that require consideration

- The site and surrounding area have a general sloping topography.
- The presence of potentially shrinkable cohesive soils.
- Presence and influence of trees.

8.3 Impact Assessment

The purpose of this section is to evaluate the direct and indirect geotechnical and hydrological implications of the proposed development.

8.3.1 Surface Flow and Flooding

As indicated above, the increase in impermeable area will be only small. Any additional discharge will be possible to the existing surface water system subject to approval from the drainage operator

however, if the minor additional flow is not acceptable to local drainage operators, the use of attenuation measures, such as a hydrobrake, will enable surface water flow to be kept to current levels. It is however likely that any attenuation measures will need to be maintained in perpetuity of the development.
It is therefore concluded that the development will not have any adverse impact upon the existing surface water disposal system.

8.3.2 Groundwater Flow

Groundwater has been recorded at depth in the soils beneath the site. This is likely to represent perched water. As such, and given the low permeability of the cohesive soils present, groundwater flows will be slow.

Due to the topography of the site it is anticipated that any groundwater flow will be in a generally southerly direction across the property.

Groundwater was not encountered until around 5.0m below existing ground level, (although recorded at a rest level of approximately 3.5m upon return visit). It is considered that the groundwater recorded is representative of perched water within the thin silt / sand layers and is not representative of groundwater. However, this is only a relatively small structure and will be constructed with drainage around the perimeter of the structure to deal with the presence of perched water.

In the long term, it is considered that groundwater levels are not likely to be affected significantly by the construction of the basement.

8.3.3 Land Stability

The basement construction will be within London Clay formation materials. Due to the removal of overburden during basement excavation there is the potential for heave of the cohesive soils. Additionally, the presence of groundwater will create hydrostatic uplift of the basement slab. These factors will be addressed within the basement design to ensure uplift forces can be overcome.

Stability of excavations will need to maintained during the redevelopment. To this end, it is recommended that a method statement for the construction is prepared, detailing the processes that will take place. Appropriate excavation support should be provided at all times during construction to ensure the stability of the basement, other excavations and neighbouring properties. Monitoring is recommended for adjacent properties during the works.

As detailed previously, groundwater is present in the soils beneath the site, albeit probably beyond the formation level of the proposed basement. However, any water entering the basement excavation should be collected in temporary sumps and pumped out so as not to adversely affect the construction or neighbouring properties. It is recommended that the contractor should undertake some limited excavations in the area of the proposed basement to investigate the level of groundwater ingress and to ensure that any flows can be dealt with.

The potential for ground movement will also need to be taken in to account. Adjacent properties are sufficiently close to the site that significant ground movement may cause damage to those properties. Ground movements may occur as a result of removal of overburden on the sloping site, and these movements should be limited by the use of appropriately designed temporary and permanent works.

The basement will need to be waterproofed to ensure water ingress does not take place that may lead to dewatering of the general area, leading to consolidation of the cohesive soils and subsequently to foundation movement of on-site and surrounding structures.

There is also the potential for differential foundation movement, between old and new footings. Existing foundations will be underpinned to suitable depths in the vicinity of the basement to limit these effects and the structure should be monitored so that it does not suffer adverse effects due to the intended construction.

As detailed previously, the cohesive soils have been recorded as having a moderate to high volume change potential. The basement and any other new foundations and substructure will need to be designed to take into account the presence of trees and vegetation surrounding the site. Care will need to be taken in the vicinity of the mature Birch to the front of the property to ensure this is not adversely affected by the works.

If the above precautions are adhered to and the works designed in an appropriate manner, there is considered to be no particular reason why the stability of the land should be affected.