DESK STUDY & GROUND INVESTIGATION REPORT

58a Redington Road
London
NW3 7RS

Client: Gwen McDougal & Daniel Belov

Engineer: Elite Designers Ltd

J18142

October 2018




GEA

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This report is intended as a Ground Investigation Report (GIR) as defined in BS EN1997-2, unless specifically noted otherwise. The report is not a Geotechnical Design Report (GDR) as defined in EN1997-2 and recommendations made within this report are for guidance only.

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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 carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Elite Designers Structural Engineers, on behalf of Gwen McDougal and Daniel Belov. The work has been carried out with respect to the redevelopment of the site through demolition of the existing house and subsequent construction of a new four-storey house with a single level basement. 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, to assess the extent of any contamination and to provide information to assist with the design of retaining walls and foundations. A Basement Impact Assessment will, it is understood, be carried out by others.

SITE HISTORY

The earliest map studied, dated 1871, shows the site to have been fields at this time, with tributaries of the River Westbourne flowing in a southerly direction around 100 m to the west and southeast of the site. At some time between 1879 and 1895, Redington Road was constructed in its present position. Between 1896 and 1915 many of the existing houses were constructed, including No 58, which extended across the southwestern half of the footprint of No 58a at that time. At some time between 1936 and 1954, No 58 was extended to the northeast, abutting the boundary, and it is assumed that the house was split into two separate properties, Nos 58a and 58b, during this period. The garages and access road at the southwestern corner of the site were constructed between 1968 and 1969. The historical maps show that No 58a was extended to the rear between 1972 and 1981, to the full extent of the present footprint, probably corresponding to the planning permission granted in January 1977 (ref 23543) for 'the retention of the basement level and porch front extensions, the means of access to the highway and alterations to the front fenestration'. By 1981, the rear garden had been extended to encompass its existing layout, the central part of the garden formerly having belonged to No 58b Redington Road, and the southernmost part having formerly been part of No 5 Templewood Avenue. The site and surrounding area have since remained essentially unchanged.

GROUND CONDITIONS

The investigation encountered a nominal thickness of made ground overlying the Claygate Member, underlain by the London Clay Formation. The made ground generally comprised silty sandy gravelly clay with flint gravel and fragments of brick, coal and concrete. It extended to depths of between 0.35 m and 1.00 m, and to the full depths of Trial Pit Nos 4 and 5 of 0.80 m and 1.07 m respectively. The Claygate Member comprised firm to stiff medium to high strength fissured brown mottled orange-brown and grey silty sandy gravelly clay and extended to depths of between 4.60 m and 9.00 m (40.65 m TBM and 38.99 m TBM, approximately 102.9 m OD and 101.2 m OD). The London Clay consisted of firm to stiff high strength becoming very stiff very high strength grey silty sandy clay with selenite, which was very silty and very sandy in parts, with pockets and laminations of light grey and dark grey silty fine sand. It extended to the maximum depth investigated, of 15.45 m (28.74 m TBM, approximately 90.94 m OD).
Groundwater is present within water-bearing layers in the Claygate Member from a shallowest depth of approximately 4.10 m, corresponding to a level of around 42.5 m TBM, but is not consistent across the site. Contamination testing has indicated the made ground in one location (Trial Pit No 5) to contain an elevated concentration of lead. Soil samples taken from Trial Pit Nos 4 and 5 were found to contain asbestos at concentrations of less than 0.001% and a fragment of ACM was recovered from the fill beneath the internal floor slab in Trial Pit No 5.

RECOMMENDATIONS

The new basement will extend to a depth of approximately 2.4 m beneath the basement level of the existing property, with a finished floor level of around 42.49 m TBM. Formation level for the proposed basement will therefore be within the firm to stiff clay of the Claygate Member, which will provide a suitable founding stratum for spread foundations. Groundwater is likely to be encountered close to the base of the basement excavation, but only at the front of the property, since it is appears to be in a series of water-bearing layers rather than present as a continuous table. The contamination is not considered to pose a risk to end users and the risk to site workers should be mitigated through use of the appropriate PPE and adherence to standard safe working practices. The measured contamination should not lead to the made ground being classified as hazardous waste.

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 Elite Designers Structural Engineers, on behalf of Gwen McDougal and Daniel Belov, to carry out a desk study and ground investigation 58a Redington Road, London NW3 7RS.

1.1 Proposed Development

It is understood that it is proposed to demolish the existing house and subsequently construct a new four-storey house, including a lower ground floor level, with a single level basement extending beneath the entire property. The existing room beneath the driveway, at lower ground floor level, will be retained and refurbished.

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

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 hydrogeology and their engineering properties;
- to determine the risk of encountering unexploded ordnance (UXO);
- 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 historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database;
- commissioning and review of a preliminary UXO report;
- a review of readily available geology maps; and
- a walkover survey of the site carried out in conjunction with the fieldwork.

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

- four boreholes advanced to depths of 10.45 m and 15.45 m using a dismantlable cable percussion rig;
- standard penetration tests (SPTs) carried out at regular intervals within the boreholes to provide quantitative data on the strength of the soils;
- installation of four groundwater monitoring standpipes to a depth of 6.00 m and a subsequent programme of groundwater monitoring;
- five manually excavated trial pits to depths of between 0.80 m and 1.20 m;
- 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.

The exploratory methods adopted in this investigation have been selected on the basis of the constraints of the site including but not limited to access and space limitations, together with any budgetary or timing constraints. Where it has not been possible to reasonably use an EC7 compliant investigation technique a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent where applicable and relevant published information.

1.4 Limitations

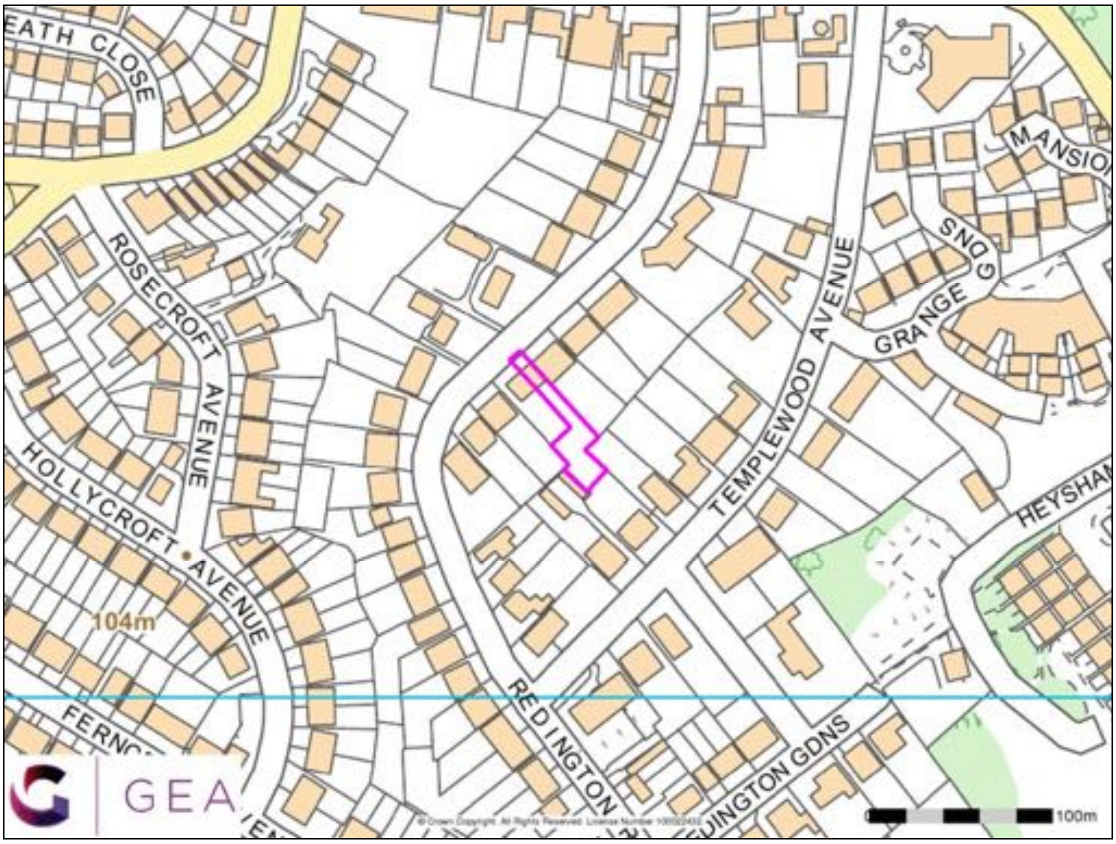
The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil,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

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

2.0 THE SITE

2.1 Site Description

The site is located in a residential area of Hampstead, in London Borough of Camden, approximately 830 m to the northwest of Hampstead London Underground Station. No 58a forms the eastern part of a larger four-storey residential building, the remainder of which is occupied by No 58b, and the building fronts onto Redington Road to the northwest. To the north the site is bounded by No 60 Redington Road, also a four-storey house with garden. The southern boundary of the site is formed by the rear garden of No 56 Redington Road, the rear gardens of two houses (Nos 5 and 7) fronting onto Templewood Avenue, and by a row of single storey garages accessed from Templewood Avenue. The site may additionally be located by National Grid Reference 525670, 186150 and is shown on the map extract below.



A walkover of the site was carried out by a geotechnical engineer from GEA at the time of the fieldwork. The site is irregular in shape and measures approximately 80 m northwest-southeast by between 9 m and 27 m northeast-southwest. It is occupied by a four-storey house with a single level basement, located at the northern end of the site, with an extensive garden to the rear, accessed from rear basement level. The site slopes down from an elevation of around 49.2 m TBM (around 111.4 m OD) at the northwestern boundary, to 44.8 m TBM (around 107.0 m OD) on the patio immediately to the south of the house, to 42.3 m (around 104.5 m OD) in the most southerly section of the rear garden, which contains a number of mature shrubs and trees. Most notably, the widest portion of the garden contains several trees of considerable age, of species including oak, copper beech, pine and yew, up to approximately 30 m in height.

2.2 Site History

The site history has been researched by reference to internet sources and historical Ordnance Survey (OS) maps obtained from the Envirocheck database.

The earliest map studied, dated 1871, shows the site to have been fields with a northeast-southwest orientated field boundary bisecting the centre of the site. On the map dated 1879, streams are shown around 100 m to the west and southeast of the site, flowing in a southerly direction; these were tributaries of the 'lost'[2] River Westbourne, which historically flowed southwards from Hampstead Heath, issuing into the River Thames close to Chelsea Bridge.

At some time between 1879 and 1895, Redington Road was constructed in its present position. The 1896 map shows only a single house located along it, around 100 m to the northwest of the site, but by 1915 most of the road was lined with houses, with the exception of the western side of the northern part of the road. No 58 Redington Road was constructed during this period, along with Templewood Avenue and many of the houses along it, such that the site was completely surrounded by houses and private gardens by 1915. No 58 extended across the southwestern half of the footprint of No 58a at that time.

At some time between 1936 and 1954, No 58 was extended to the northeast, abutting the boundary, and it is assumed that the house was split into two separate properties, Nos 58a and 58b, during this period. Reference to planning records held by Camden Council show that planning permission was granted in March 1954 (ref 47980/20878) for the conversion of No 58b into two self-contained maisonettes, indicating that No 58 was already divided into two properties at this time. In 1962, permission was granted for subdivision of the lower maisonette of 58b into two flats (ref 438 and TP47980/11916).

The garages and access road at the southwestern corner of the site were constructed between 1968 and 1969. The map dated 1969 is the first on which the northern part of the rear garden of No 58a is segregated from that of No 58b, and also shows that the plot on the opposite side of Redington Road was developed with houses at this time. In 1970, permission was granted for a single storey rear extension to 58b, at garden floor level (ref 8833(R)). No 58a is first positively annotated as a separate property on the map dated 1972.

Planning permission was granted in 1971 (ref 10442) for the erection of a kitchen extension and conservatory, although it is not clear from the records whether the permission relates to No 58a or 58b. For 58b, permission was also granted in 1971 for the erection of a balcony at first floor level (ref CTP/D5/3/3/10630), and for the installation of two dormer windows (ref 10848).

The historical maps show that No 58a was extended to the rear between 1972 and 1981, to the full extent of the present footprint. This probably relates to the planning permission granted in January 1977 (ref 23543) for 'the retention of the basement level and porch front extensions, the means of access to the highway and alterations to the front fenestration'. The decision notice includes the informative that: 'material alterations which have been carried out to the permitted two storey rear extension, are totally without planning permission and do not form part of this permission'.

By 1981, the rear garden had been extended to encompass its existing layout, the central part of the garden formerly having belonged to No 58b Redington Road, and the southernmost part having formerly been part of No 5 Templewood Avenue.

2 Barton, N and Myers S (2016). *The Lost Rivers of London* Historical Publications Ltd

Planning permission was granted in 1986 (ref 8601562) for the erection of a single storey extension in the rear garden at No 58b.

The site and surrounding area have since remained essentially unchanged.

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 that there are no registered landfill sites, historic landfill sites, registered waste transfer sites, licensed waste management facilities within 1 km of the site. The closest area of potentially infilled land is located 357 m to the west.

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, although the site is within the Redington and Frognal Conservation Area designated by Camden Council.

A single discharge consent is located within 500 m of the site, 355 m to the southwest. No pollution incidents to controlled waters are recorded within 500 m of the site; the nearest is located 884 m to the north.

The nearest fuel station is located 616 m to the west.

2.4 Preliminary UXO Risk Assessment

A Preliminary UXO Risk Assessment has been completed by 1st Line Defence (report ref EP6811-00, dated 28th June 2018), and the report is included in the appendix. The risk assessment has been carried out in accordance with the guidelines provided by CIRIA, which state that the likelihood of encountering and detonating UXO below a site should be assessed along with establishing the consequences that may arise. The first phase comprises a preliminary risk assessment, which should be undertaken at an early stage of the development planning. If such an assessment identifies a high level of risk then a detailed risk assessment should be carried out by a UXO specialist, which will identify an appropriate course of action with regard to risk mitigation.

The report indicates that, during World War II (WWII), the site was located within the Metropolitan Borough of Hampstead, which sustained a very high density of bombing. Despite this, the site does not appear to have been directly affected by bombing and is not labelled as damaged on available damage mapping. It is considered likely that the property would have remained occupied and subject to regular post-raid checks for signs of UXO and therefore a minimal risk of encountering unexploded ordnance has been identified for the site and no further action is recommend in this respect.

2.5 Geology

The British Geological Survey (BGS) map of the area indicates that the westernmost part of the site is underlain by the Bagshot Formation. Beneath this and otherwise underlying the site is the Claygate Member, which is in turn underlain by the London Clay Formation.

The geology in this area is generally horizontally bedded such that the boundary between the geological formations roughly follows the ground surface contour lines. A borehole drilled by the BGS on Hampstead Lane to the northeast of the site, generally referred to as the 'Hampstead Heath borehole', was advanced to a depth of 66.74 m (61.97 m OD) at National Grid Reference 526455, 186890. The borehole record indicates that the Bagshot Formation extended to a depth of 19.0 m (109.71 m OD) and penetrated the full thickness of the Claygate Member, which was found to extend to a depth of 35.0 m (93.71 m OD).

According to the British Geological Society memoir, the Bagshot Formation comprises yellow, brown and orange-brown fine-grained sand which is silty in parts with occasional laminae of pale grey clay. The Claygate Member comprises alternating beds of clayey silt, very silty clay, sandy silt and glauconitic silty fine sand. The lower part of the Claygate Member is generally more bioturbated. A bed of calcareous concretions is present near the base in many places. The London Clay Formation is homogenous, slightly calcareous silty clay to very silty clay, with some beds of clayey silt grading to silty fine grained sand. The boundaries between the Bagshot Formation and Claygate Member, and the Claygate Member and London Clay are often difficult to distinguish as the boundaries are transitional between the strata.

GEA has previous carried out a number of investigations at other properties along Redington Road and Templewood Avenue, the closest of which was carried out approximately 50 m to the southwest of the site. This encountered a variable thickness of made ground, extending to depths of between 0.30 m (107.0 m OD) and 1.50 m (104.6 m OD), beneath which the Claygate Member was encountered, overlying the London Clay, although a thin covering of Bagshot Beds was concluded to be present in the northerneastern corner of the site. Soils interpreted as Bagshot Beds were encountered in the highest, northeastern, part of the site, and comprised brown clayey sand or sandy clay with occasional gravel, which extended to depths of between 0.85 m (106.35 m OD) and 1.25 m (105.95 m OD). Elsewhere, the Claygate Member was encountered directly beneath the made ground and generally comprised brown mottled orange-brown and grey silty sandy clay interbedded with occasional layers of silty clayey fine sand, which extended to depths of 4.00 m (100.40 m OD) and 10.50 m (96.90 m OD). Below this depth, stiff high strength and very high strength dark grey silty sandy clay with occasional partings of light grey fine sand and silt were encountered, which was proved to the maximum depth investigated of 25.00 m (82.40 m OD) and was interpreted to be London Clay.

On the basis of the information from the Hampstead borehole, geology map and nearby previous investigations, a thin covering of Bagshot Beds may be expected in the highest western part of the site.

2.6 Hydrology and Hydrogeology

The Bagshot Formation and Claygate Member are classified by the Environment Agency as Secondary 'A' Aquifers, defined as 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. The Claygate Member is predominantly cohesive in nature and therefore groundwater flow is likely to be relatively slow, although horizons of sandier soils do occur in this stratum, resulting in the permeability ranging from "very low" to "high". The Claygate Member is only designated as a Secondary Aquifer because it contains such sand horizons, which provide more permeable layers for the storage of groundwater. Where such sand beds are not present, the Claygate Member behaves hydraulically more like the underlying London Clay, which accounts for the variable permeability described above. In this case it is not capable of storing and transmitting water in usable amounts and receives very low levels of annual recharge due to very low permeability.

Under the same classification system, the London Clay is designated as unproductive strata, which refers to deposits that have low permeability and negligible significance for water supply or river base flow. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x 10^{-10} m/s and 1 x 10^{-8} m/s, with an even lower vertical permeability.

Approximately 1.3 km to the northeast of the site, in Hampstead Heath and Parliament Hill, is a series of spring lines and ponds, which drain in a southerly direction, down the valley, towards both the Highgate and Hampstead Ponds. The positions of these springs are likely to mark the boundary between the Claygate Member and underlying essentially impermeable London Clay. Within the area of Hampstead and Highgate, existing and historical springs are also present at the interface between the Claygate Member and the overlying more sandy Bagshot Beds. The springs at both geological boundaries have been the source of a number of London's "lost" rivers, notably the Fleet, Westbourne and Tyburn. Historically, tributaries of the former River Westbourne are shown around 100 m to the west and southeast of the site, flowing in a southerly direction.

The nearest surface water feature is a river located approximately 403 m to the northeast of the site, within Golders Hill Park, flowing towards the northwest. The site is not within an area shown by the Environment Agency to be at risk from flooding from rivers or the sea, or from surface water.

Groundwater is likely to be present near the boundary between the relatively high permeability Bagshot Formation and the low permeability Claygate Member and is likely to flow in a generally southerly direction, with the local topography and towards the River Thames. Given the elevation of the site relative to the highest ground locally, the groundwater catchment area above the site is relatively limited.

The nearby previous GEA investigation encountered groundwater during drilling at depths of 9.00 m (95.40 m OD) and 8.00 m (99.40 m OD) and subsequent monitoring indicated groundwater to be present at depths of between 6.88 m (97.52 m OD) and 0.52 m (106.88 m OD). The results of the site-specific investigation are presented in Section 3.0 of this report.

The site is only partially covered by the existing building and hardstanding and therefore infiltration of rain water into the ground beneath the site is unhindered over the majority of the site. Only surface runoff from the front driveway is likely to drain into combined sewers in the road.

2.7 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.

2.7.1 Source

The desk study findings indicate that the site does not have a potentially contaminative history as it has apparently been developed with a house since prior to 1915, although several episodes of construction have since occurred. Fragments of asbestos building materials and lead paint may have been deposited in the near surface soils during refurbishment. No offsite potentially contaminative uses have been identified in close proximity to the site and no potential sources of ground gas have been identified.

2.7.2 Receptor

The proposed redevelopment of the building for residential purposes will result in the end users representing relatively high sensitivity receptors, as at present. As the site is underlain by a Secondary 'A' Aquifer, adjacent sites are considered to be a moderately sensitive receptors; however, due to the presence of the cohesive London Clay beneath the Bagshot Beds, the deep aquifer beneath the site is not considered to be a particularly sensitive receptor. Buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into contact with any contaminants present in the soils during construction works.

2.7.3 Pathway

The Bagshot Beds could allow the migration of contaminated groundwater through the shallow soils to surrounding sites. The Claygate Member and negligibly permeable London Clay will limit the potential for groundwater percolation into the underlying chalk, and thus a pathway is not considered likely to exist to the principal aquifer. Within the site, end users will be isolated from direct contact with any contaminants present within the made ground by the presence of the buildings and the extent of the hardstanding but will potentially be exposed in areas of soft landscaping, as at present. Buried services may be exposed to any contaminants present within the soil through direct contact and site workers will come into contact with the soils during construction works. There is thus considered to be a low potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.7.4 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.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, four boreholes were advanced to depths of 10.45 m and 15.45 m using a dismantlable cable percussion rig. Additionally, five trial pits were manually excavated to depths of between 0.80 m and 1.20 m to investigate the existing foundations of the boundary walls.

During boring, disturbed and undisturbed samples were obtained from the boreholes for subsequent laboratory examination and testing. Standard Penetration Tests (SPTs) were carried out at regular intervals to provide additional quantitative data on the strength of soils encountered.

Four groundwater monitoring standpipes have been installed to a depth of 6.00 m to facilitate a programme of groundwater monitoring.

A selection of the samples recovered from the boreholes 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 are appended, together with a site plan indicating the exploratory positions. The temporary bench mark (m TBM) levels on the borehole and trial pit records have been interpolated from levels on a survey drawing provided by the consulting engineers (Job 157, drawing ref. S01, dated July 2017). These were measured relative to a temporary bench mark which was attributed a value of +50 m and was located on the ground floor. Ordnance survey records indicate that street level outside No 56 Redington Road, around 25 m to the west of the site, is at 109.7 m OD, indicating that 50 m TBM may correspond to approximately 112.2 m OD.

3.1 Sampling Strategy

The trial pit and borehole locations were agreed with the consulting engineers, Elite Designers Structural Engineers, in an initial site meeting with GEA.

Four samples of the made ground have been tested for the presence of contamination. The analytical suite of testing was selected to identify a range of typical industrial contaminants for the purposes of general coverage. 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. Five samples were also screened for the presence of asbestos. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. A summary of the MCERTs accreditation and test methods are included with the attached results and further details are available upon request.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, beneath a nominal thickness of made ground, soils of the Claygate Member were encountered, over the London Clay Formation. The single borehole at the front of the site, where the geology map indicates that Bagshot Beds are present, was drilled from basement level, which probably accounts for the absence of the Bagshot Beds.

4.1 Made Ground

The made ground generally comprised silty sandy gravelly clay with flint gravel and fragments of brick, coal and concrete. The exception was Trial Pit No 5, where very loose rubble of brick and concrete fragments, with occasional glass and nails and fragments of suspected asbestos containing material (ACM) was encountered. The made ground extended to depths of between 0.35 m (44.22 m TBM) and 1.00 m (43.19 m TBM), and to the full depth of Trial Pit No 4 (0.80 m, 47.53 m TBM) and Trial Pit No 5 (1.07 m, 45.91 m TBM).

Four samples of the made ground have been analysed for a range of contaminants as a precautionary measure and a fragment of ACM taken from Trial Pit No 5 was also screened for asbestos; the results are detailed within Section 4.5.

4.2 Claygate Member

This material generally comprised firm to stiff fissured brown mottled orange-brown and grey silty sandy clay, with reddish brown mottling from around 41.4 m TBM, and extended to depths of between 4.60 m and 9.00 m (40.65 m TBM and 38.99 m TBM, or about 103 m OD and 101 m OD). The uppermost 1 m to 2 m of the soils was noted to contain gravel, suggesting that the upper levels of the Claygate have been naturally reworked.

The results of plasticity index tests indicate the clay to be of medium volume change potential, and the results of quick undrained triaxial compression tests indicate the clay to be of medium to high strength.

4.3 London Clay

The London Clay generally comprised firm to stiff becoming very stiff grey, brownish grey and greyish brown silty sandy clay with selenite, which was very silty and very sandy in parts, with pockets and laminations of light grey and dark grey silty fine sand. It extended to the maximum depth investigated, of 15.45 m (28.74 m TBM, approximately 90.9 m OD).

The results of quick undrained triaxial compression tests indicate the clay to be of high, becoming very high strength.

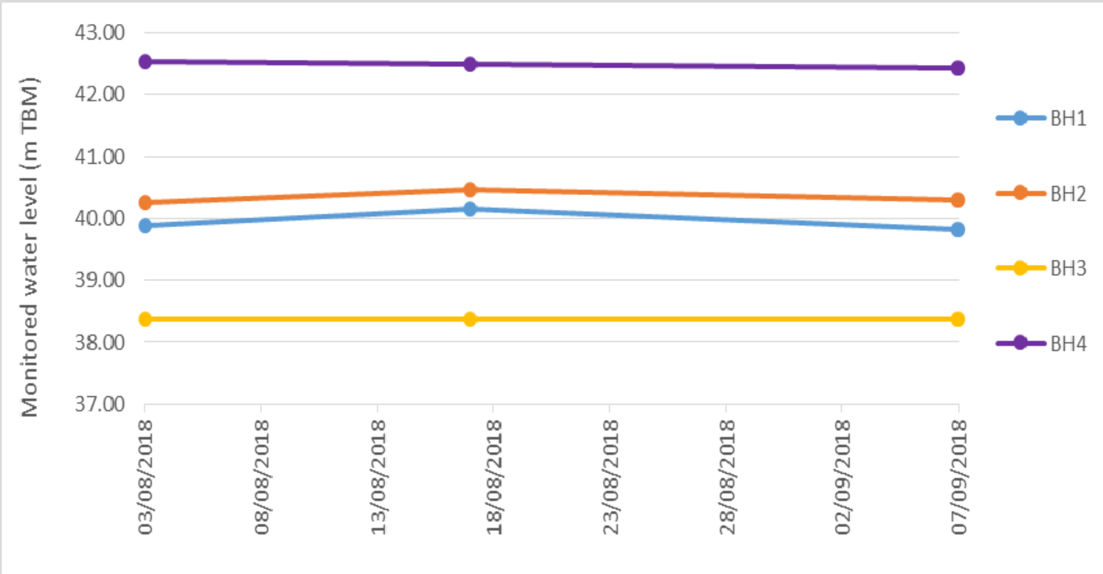
As previously stated, although concluded to be London Clay, it is often difficult to distinguish the boundary between the Claygate Member and Unit D of the London Clay as the boundaries are transitional between the strata. It is therefore possible that these soils are part of the Claygate Member.

4.4 Groundwater

Groundwater was repeatedly struck in each of the boreholes, as shown on the records in the Appendix. This pattern of repeated strikes indicates that, despite the sandy nature of the predominantly clay stratum, there is insufficient connectivity to support a uniform groundwater table and groundwater flow, with groundwater being sealed out within clay layers as the borehole casing progressed, and then struck again on encountering more permeable material. The shallowest strike was in Borehole No 3, at a depth of 3.45 m (40.74 m TBM). Standpipes were installed in each of the boreholes and the findings of three groundwater monitoring visits are presented in the table and graph below. An indication of the rainfall conditions prior to each monitoring visit is given in the Appendix.

Date	Borehole No	Depth to water (m) [Level (m TBM)]
03/08/2018	1	4.57 [39.88]
	2	4.31 [40.26]
	3	5.82 [38.37]
	4	7.12 [42.53]
17/08/2018	1	4.30 [40.15]
	2	4.11 [40.46]
	3	5.82 [38.37]
	4	7.15 [42.50]

Date	Borehole No	Depth to water (m) [Level (m TBM)]
07/09/2018	1	4.62 [39.83]
	2	4.28 [40.29]
	3	5.82 [38.37]
	4	7.22 [42.43]



The results indicate that the groundwater level has remained very consistent within each of the individual boreholes, with no obvious response to episodes of rainfall, and that it is not at a consistent level across the site. These findings indicate that a general groundwater table is not present.

4.5 Soil Contamination

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

Determinant	TP1 0.3 m	TP3 0.5 m	TP4 0.7 m	TP5 0.7 m
pH	8.1	8.1	8.9	9.4
Arsenic	8.0	11	12	13
Cadmium	< 0.2	< 0.2	< 0.2	1.5
Chromium	26	51	28	28
Lead	75	21	110	**260**
Mercury	< 0.3	< 0.3	< 0.3	0.6
Selenium	1.3	< 1.0	< 1.0	< 1.0
Copper	23	20	30	180

Determinant	TP1 0.3 m	TP3 0.5 m	TP4 0.7 m	TP5 0.7 m
Nickel	9.7	15	16	43
Zinc	47	49	77	230
Total Cyanide	< 1	< 1	< 1	2
Total Phenols	< 1.0	< 1.0	< 1.0	< 1.0
Total PAH	< 0.80	< 0.80	1.63	7.79
Sulphide	< 1.0	< 1.0	< 1.0	5.0
Benzo(a)pyrene	< 0.05	< 0.05	< 0.05	0.47
Naphthalene	< 0.05	< 0.05	< 0.05	< 0.05
TPH	< 10	< 10	64	74
Total Organic Carbon %	0.7	0.2	0.4	0.8

Note: Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report

In addition, four samples of made ground and a fragment of suspected ACM from Trial Pit No 5 were screened for the presence of asbestos. The fragment was confirmed to contain asbestos in the form of Chrysotile. Samples of the made ground from Trial Pit Nos 4 and 5 were also found to contain loose fibres of asbestos; chrysotile was present in the sample from Trial Pit No 4 and chrysotile and amosite were present in the sample from Trial Pit No 5. Quantification of the soil samples showed that they both contained less than 0.001 % asbestos.

4.5.1 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. Contaminants of concern are those that have a value in excess of a generic human health risk based guideline values, which is either the CLEA Soil Guideline Value where available, a Generic Screening Value calculated using the CLEA UK Version 1.06 software assuming a residential end use with plant uptake, or is based on the DEFRA Category 4 Screening value. 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 young female children aged zero to six years old;
- that the exposure duration will be six years;
- that the critical exposure pathways will be indoor dust ingestion, skin contact with indoor dust, and inhalation of indoor and outdoor 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. 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 chemical analyses have indicated the sample from Trial Pit No 5 to contain an elevated concentration of lead (260 mg/kg), relative to the screening value of 200 mg/kg. In addition, three samples from Trial Pit Nos 4 and 5 were found to contain asbestos, at concentrations of less than 0.001% within the soil samples.

The significance of these results is considered further in Part 2 of the report.

4.6 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	Garden wall, east side	2 No Brick corbels Top 0.56 m Base 1.12 m. Lateral projection 220mm	Orange-brown and light grey very silty slightly gravelly CLAY
2	Garden fence, west side	No foundation	N/A
3	Base of front lightwell	No foundation	N/A
4	House wall, east side	Mass concrete strip Top 0.70 m Base not proved Lateral projection 320 mm	Not proved; suspected services beneath slab
	Boundary wall, east side	Mass concrete strip Top 0.80 m Base not proved Lateral projection 550 mm	
5	Party wall, west side	Concrete corbel Top 0.98 m Base not proved; >1.07 m Lateral projection 20 mm	Not proved due to loose fill collapsing

A void was found beneath the floor slab in Trial Pit No 5, attributed to settlement of the very loose fill beneath.

Part 2: DESIGN BASIS REPORT

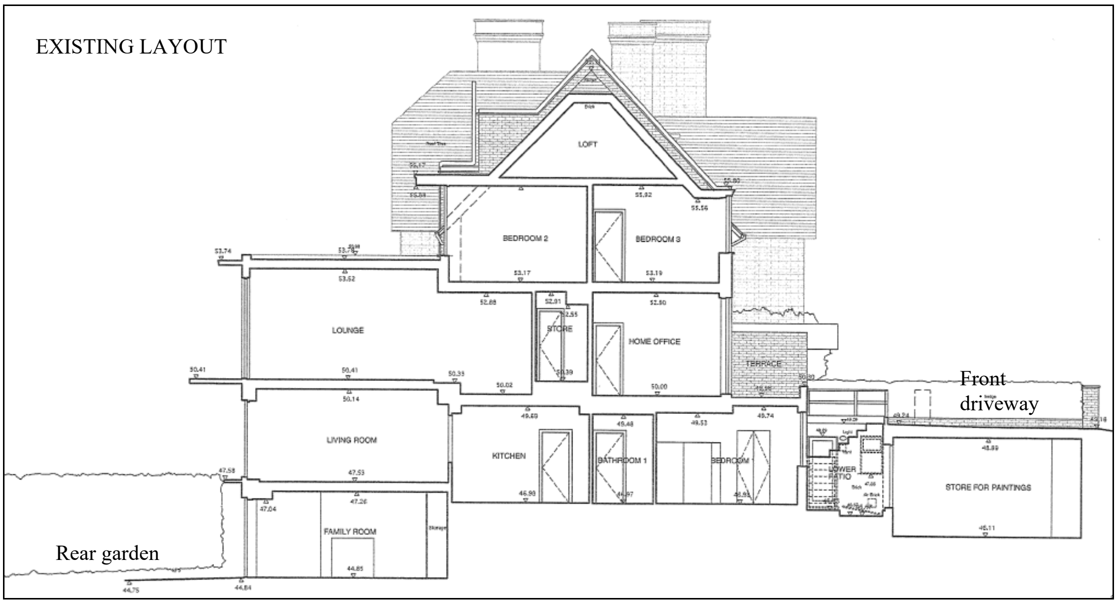
This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to the proposed development.

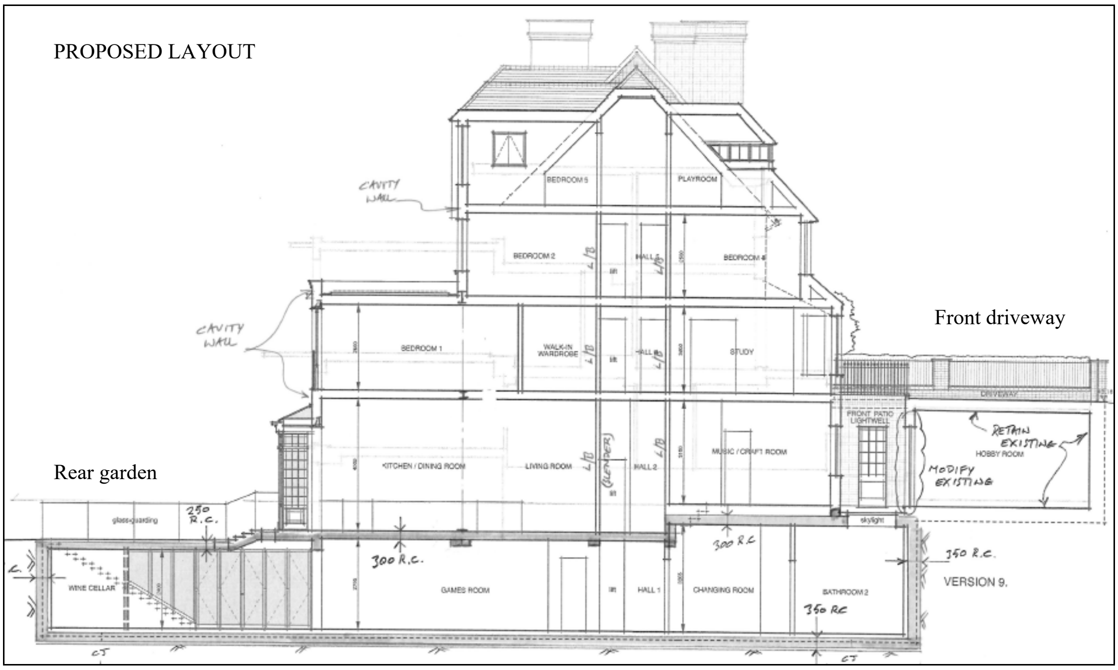
5.0 INTRODUCTION

It is understood that it is proposed to demolish the existing house and subsequently construct a new four-storey house, including a lower ground floor level, with a single level basement extending beneath the entire property. The existing room beneath the driveway, at lower ground floor level, will be retained and refurbished.

Following demolition of the existing house, the party wall will be underpinned with reinforced concrete. The new basement walls and slabs will also be formed using reinforced concrete, with the resultant box structure providing the foundation for the new house. The loads are not known but are anticipated to be moderate.

Sectional drawings showing the existing and proposed layouts are given below. Floor level in the existing family room at the rear of the property is stated as 44.85 m TBM. Floor level in the basement of the proposed house is approximately 42.49 m TBM; a reduction of 2.4 m beneath the level of the existing property.





6.0 GROUND MODEL

The desk study has revealed that the site has not had a potentially contaminative historical use as it has been developed with a house since prior to 1915, although several episodes of construction have occurred since. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- below a nominal thickness of made ground, soils of the Claygate Member are present, underlain by London Clay, which extends to the maximum depth of the investigation, of 15.45 m (28.74 m TBM, approximately 90.9 m OD);

- the made ground comprises silty sandy gravelly clay with flint gravel and fragments of brick and concrete and extends to depths of between 0.35 m and 1.00 m, and to the full depth of Trial Pit No 4 (0.80 m) and Trial Pit No 5 (1.07 m);

- the Claygate Member comprises firm to stiff medium to high strength fissured brown mottled orange-brown and grey silty sandy clay and extends to depths of between 4.60 m and 9.00 m (40.65 m TBM and 38.99 m TBM, approximately 102.9 m OD and 101.2 m OD). The uppermost portion of the soils contains gravel to a maximum depth of 1.7 m, suggesting it has been naturally reworked;

- the London Clay consists of firm to stiff high strength becoming very stiff very high strength grey, brownish grey and greyish brown silty sandy clay with selenite, which was very silty and very sandy in parts, with pockets, bands and laminations of light grey and dark grey silty fine sand. It extends to the maximum depth investigated, of 15.45 m (28.74 m TBM, approximately 90.9 m OD);

- contamination testing has indicated the made ground in one location to contain an elevated concentration of lead and samples taken from Trial Pit Nos 4 and 5 were found to contain asbestos; and

- groundwater is present within the Claygate Member from a minimum depth of approximately 4.1 m bgl; a level of around 42.5 m TBM (approximately 104.7 m OD). However, it is held in a series of water-bearing layers rather than present as a continuous table and the depth to groundwater thus varies across the site.

7.0 ADVICE AND RECOMMENDATIONS

It is understood that the new basement will extend to a depth of approximately 2.40 m beneath the level of the existing property, with a finished floor level of around 42.49 m TBM. Formation level for the proposed basement will therefore be within the firm to stiff soils of the Claygate Member, which will provide a suitable founding stratum for spread foundations. On the basis of the fieldwork and subsequent monitoring, groundwater is likely to be encountered towards the base of the basement excavation at the front of the site, held in a series of water-bearing layers rather than present as a continuous table.

7.1 Basement Construction

The formation level for the basement is likely to be within the firm to stiff soils of the Claygate Member at a level of around 41.5 m TBM. Inflows of groundwater were encountered from a level of 42.95 m TBM during drilling at the front of the property (Borehole No 4) and groundwater has subsequently been measured at a maximum level of 42.53 m TBM within the same standpipe; on this basis groundwater is likely to be encountered within the basement excavation. However, at the rear of the property, groundwater has been measured at a maximum level of 40.46 m TBM, and thus groundwater is only likely to be encountered at the front part of the basement; the recorded water levels are well below the formation level at the rear of the site. The groundwater is not present as a uniform water table but rather held within a series of frequent water-bearing layers.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by whether it is to be incorporated into the permanent works and have a load bearing function. It is understood that the preferred option for the formation of new retaining walls is to use underpin the party wall using reinforced concrete and to construct the remaining walls in an open cut with the walls formed in limited panel widths. In this respect, the presence of saturated more granular horizons within the clay will need to be taken into account when planning the works, as the presence of such layers means that unsupported ground is susceptible to collapse. Sump pumping should be sufficient to control the anticipated inflows of perched groundwater into the excavation.

Ideally a number of trial excavations should be carried out, to depths as close to the full basement depth as possible, to provide an indication of stability and the extent to which the excavation may be affected by groundwater inflows; this is however unlikely to be possible due to the access restrictions until the existing building has been demolished.

The design of basement support in the temporary and permanent conditions needs to take account of the necessity to maintain the stability of the surrounding structures and the probable requirement to control groundwater inflows.

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. An assessment of the movements will need to be carried out as a separate report.

7.1.1 Basement Retaining Walls

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

Stratum	Bulk Density (kg/m³)	Effective Cohesion (c′ – kN/m²)	Effective Friction Angle (ϕ′ – degrees)
Made ground	1700	Zero	27
Claygate	1900	Zero	24
London Clay	1950	Zero	24

Monitoring of the standpipes should be continued to assess the design water level but at this stage it would appear that groundwater may be assumed to be above basement level, but only at the front part of the basement; the advice in BS8102:2009[3] should also be followed in this respect.

7.1.2 Basement Heave

The approximately 2.4 m deep excavation of the basement will result in a differential net unloading of around 50 kN/m^2, which will result in differential heave of the underlying Claygate Member and London Clay. This will comprise immediate elastic movement, which will account for approximately 40 % of the total movement and be expected to be complete during the construction period, and long term movements, which will theoretically take many years to complete. These movements will, to some extent, be mitigated by the loads applied by the proposed development, however the ground movements associated with the proposed basement excavation and construction will need to be considered in more detail in a separate assessment.

7.2 Spread Foundations

Moderate width strip or pad foundations bearing on the firm Claygate Member should be placed at a minimum depth of 1.25 m. The depth of the basement will mean that the foundations are likely to be below the depth that may be affected by trees, but this should be checked once the levels are finalised. The foundations may be designed to apply a net allowable bearing pressure of 150 kN/m^2 at a level of around 41.5 m TBM. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits. The recommended bearing pressure takes account of the variable nature of the soils and any foundations should be nominally reinforced where they span clay and granular material to protect against differential settlement.

Foundations will need to be deepened in the vicinity of existing and proposed trees and National House Building Council (NHBC) guidelines should be followed in this respect. Medium shrinkability clays should be assumed. Where trees are to be removed the required founding depth should be determined on the basis of the existing tree height if it is less than 50% of the mature height and on the basis of full mature height if the current height is more than 50% of the mature height. Where a tree is to be retained the final mature height should be adopted. Notwithstanding NHBC guidelines, all foundations should extend beyond the zone of desiccation. In this respect it would be prudent to have all foundation excavations inspected by a suitably experienced engineer. Due allowance should be made for future growth of the trees.

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

The requirement for compressible material alongside foundations should be determined by reference to the NHBC guidelines.

Where the loads are such that spread foundations become uneconomic, pad or piled foundations should be considered as an alternative.

7.3 Hydrogeological Assessment

The results from the ground investigation have indicated that groundwater is likely to be encountered within the lowermost, front part of the basement excavation, and is present from a level of around 42.5 m TBM at the front of the site and from a level of around 40.5 m TBM at the rear of the site, held in a discontinuous series of water-bearing layers rather than as a uniform table.

The current development proposals include the construction of a basement level that will extend to a depth of about 42 m TBM, such that it is likely to intercept groundwater held within the Claygate Member. However, since the Claygate Member does not support groundwater flow, the new basement will not have any significant impact on surrounding groundwater levels.

Monitoring of the standpipes should be continued for as long as possible prior to construction to confirm this view.

7.4 Shallow Excavations

On the basis of the borehole findings it is considered that it will be generally feasible to form relatively shallow excavations terminating within the Claygate Member without the requirement for lateral support, although localised instabilities may occur where more granular material or groundwater is encountered.

Significant inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from perched water tables within the made ground. 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.

7.5 Basement Floor Slab

Following the excavation of the basement, formation level will be within the cohesive soils of the Claygate Member. In view of the moderate volume change potential of these soils and the presence of nearby trees, a fully suspended floor slab will need to be adopted over a void in accordance with NHBC guidelines.

7.6 Effect of Sulphates

Chemical analyses have revealed relatively low to moderate concentrations of soluble sulphate and near-neutral pH in accordance with Class DS-3 conditions of Table C2 of BRE Special Digest 1:SD Third Edition (2005). The measured pH values of the samples show that an ACEC class of AC-3 would be appropriate for the site. This assumes a mobile water condition at the site. The guidelines contained in the digest should be followed in the design of foundation concrete.

7.7 Contamination Risk Assessment

The desk study findings indicate that the site does not have a potentially contaminative history as it has apparently been developed with a house since prior to 1915, although several episodes of construction have since occurred. The results of the chemical analyses have indicated an elevated concentration of lead within one of the four samples of the made ground tested, and samples from Trial Pit Nos 4 and 5 have been found to contain asbestos, at concentrations of less than 0.001%. A solid fragment of ACM was also recovered from Trial Pit No 5.

The source of the lead contamination is unknown but the made ground was noted as containing fragments of extraneous material and it is possible that a fragment of such material, for example, coal or old paint fragments, could account for the elevated concentration. Information contained within the Envirocheck report for the site indicates that the measured urban soil chemistry lead concentration is particularly high, exceeding 900 mg/kg, and a value of 1130.6 mg/kg is indicated close to the site. Nevertheless, significantly lower levels of lead were detected in the other three samples of made ground and the sample found to contain an elevated concentration of lead was taken from beneath the internal floor slab. Accordingly, the elevated lead contamination is probably related to fragments within the made ground rather than background airborne pollution. The lead contamination is not likely to be in a soluble state and should not, therefore, pose a risk to adjacent sites, groundwater or buried services.

As asbestos is insoluble, it is not considered to pose any meaningful risk to groundwater, the development or to neighbouring sites through migration in the ground. It is however potentially hazardous to human health as airborne fibres and could thus pose a risk through inhalation. However, quantification of the samples containing asbestos showed that the concentration of asbestos was less than 0.001%. It is not therefore considered to pose a significant risk, although site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil.

As a result of the proposal to excavate a basement, the majority of the made ground will be removed. In addition, the footprint of the proposed building is to extend across the entire area where elevated concentrations of contaminants have been measured and no elevated concentrations of contaminants were detected in the areas of soft landscaping. Therefore, no risk is envisaged to end users. The contamination will however pose a risk to site workers during the ground works. These risks are further assessed below.

7.7.1 Asbestos

If left undisturbed, the presence of asbestos is unlikely to pose any significant risk as the fibres will be contained and not subject to dusting. The materials could however pose a risk to groundworkers involved in future work on site, during a future redevelopment, maintenance or installation of new buried services, or excavation for some other purpose.

If any asbestos is detected during groundworks it should be hand picked and removed from site. Cement bound asbestos may be excavated safely, as long as the material is kept wet at all times, workers wear appropriate PPE and the material is double bagged in clearly labelled heavy duty polythene bags. However, the local authority and / or HSE should be consulted prior to commencement of any excavations. The local authority or Environment Agency will also be able to provide information on the nearest suitable waste disposal facility licensed to accept asbestos.

7.7.2 Site Workers

Site workers should be made aware of the contamination 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 and CIRIA[4] and the requirements of the Local Authority Environmental Health Officer.

7.8 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[5] 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[6] 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 £88.95 per tonne (about £160 per m^3) or at the lower rate of £2.80 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 EA it is considered likely that the soils encountered during this ground investigation, as represented by the chemical analyses carried out, would be generally classified as follows;

Soil Type	Waste Classification (Waste Code)	WAC Testing Required Prior to Landfill Disposal?	Current applicable rate of Landfill Tax
Made ground	Non-hazardous (17 05 04)	No	£88.95/tonne (Standard rate)
Natural soils	Inert (17 05 04)	Should not be required but confirm with receiving landfill	£2.80 / tonne (Reduced rate for uncontaminated naturally occurring rocks and soils)

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[7] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated

4 CIRIA (1996) *A guide for safe working on contaminated sites* - Report 132, Construction Industry Research and Information Association
5 Environment Agency 2015. *Guidance on the classification and assessment of waste.* Technical Guidance WM3 First Edition
6 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2
7 Environment Agency 23 Oct 2007 *Regulatory Position Statement Treating non-hazardous waste for landfill - Enforcing the new requirement*

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.

8.0 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.

Ideally, trial excavations extending to as close to the full depth of the proposed basement as possible should be carried out to determine likely groundwater inflows into the basement excavation and the efficacy of sump pumping as a means of controlling groundwater levels therein. Monitoring of the standpipes should be continued for as long as possible prior to construction to confirm the hydrogeological conditions.

If during ground works any visual or olfactory evidence of contamination is identified it is recommended that further investigation be carried out and that the risk assessment is reviewed.

These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.