Soil Consultants
Ground Investigation
Geotechnical Analysis
Contamination Assessment

# GROUND INVESTIGATION REPORT AND BASEMENT IMPACT ASSESSMENT

PROPOSED REDEVELOPMENT:

8 DALEHAM GARDENS, LONDON NW3 5DA

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|---|---|
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## 1.0 INTRODUCTION

Consideration is being given to the extension of the lower ground floor area beneath this existing residential property. In connection with the proposed works, Soil Consultants Ltd (SCL) were commissioned by Michael Barclay Partnership (MBP), on behalf of the clients Lee and Gina Marks, to carry out a ground investigation to include the following elements:

- Identification of ground sequence and groundwater conditions
- Provision of advice on spread foundations, retaining walls and floor slabs
- Basement Impact Assessment (BIA) and Ground Movement Analysis (GMA)

The report describes the intrusive investigation carried out together with a summary of the ground conditions. The foundation options and basement construction are then discussed.

The Basement Impact Assessment consists of three main elements as follows:

Land stability: this assessment has been undertaken by SCL and its findings, which are presented in this report, include the screening, scoping and investigation phases, together with an outline impact assessment. The GMA, which addresses in detail the potential ground movements and the damage assessment is to be undertaken and reported on separately.

Hydrology and hydrogeology: this assessment has been undertaken by Stephen Buss Environmental Ltd (SBEC); whose report is included as Appendix B; we have included a summary of its findings in Section 6.5 of this report.

Flood Risk Assessment: this has been undertaken by Evans Rivers and Coastal. The report is included as Appendix C and we have included a summary of its findings in Section 6.5 of this report.

This investigation has been undertaken within the constraints of the client's instruction/contract, together with those set out in the 'General information, Limitations and exceptions' section at the end of this report. The SCL 'Standard Terms of Appointment' are also included at the end of this report and these identify the contractual arrangements for the investigation. Conclusions or recommendations made in this report are limited to those which can be reasonably based upon the research and/or intrusive investigation work carried out. Any comments which rely on third-party information which has been provided to us are made in good faith and on the assumption that such information is accurate. SCL have not carried out independent validation of any third-party information.

## 2.0 SITE DESCRIPTION

The site is located on the eastern side of Daleham Gardens in the London Borough of Camden, a roughly rectangular-shaped area measuring approximately 45m x 25m (at its widest and longest points) and with its centre at approximate NGR 526720E 184815N. Daleham Gardens forms the western boundary of the site and residential properties are present to the north, south and east.

No 8 is a large three-storey detached residential property which incorporates a lower ground floor/ basement level over part of its footprint. This lower level, which we will hereafter refer to as lower ground floor level (LGF), is generally present at the rear of the house, although its precise extent is not known. A cross section by the architect (GLStudio, ref: 0012/A100, 28/05/19), indicates that there is an existing undercroft beneath the ground floor in the north-western corner of the house; this drawing is appended.

There is a driveway and small garden at the front of the property and these are generally paved, with some planting in the garden area. A paved pathway along the northern boundary leads to the rear of the house to the large, mainly grassed garden.

The topography in the general area slopes gently down to the south/south-east. Whilst a topographical survey of the site was not available at the time of compiling this report, OS spot levels indicate that the front garden level is approximately +65.5mOD. In this report we have referred to an arbitrary Site Datum (SD) which has been assigned to the existing Ground Floor Level (GFL = 10.0mSD).

Using the GLStudio cross section together with site measurements, some observations on the relative existing levels are as follows:

- The existing ground floor level is taken as a local datum of +10.00mSD
- The undercroft is about 1.8m below ground floor level, ie about +8.2mSD
- The front garden lies at about +9.8mSD, slightly lower than ground floor level
- The pathway along the northern boundary steps down from the front garden by about 0.7m; the relative level of the pathway is therefore about +9.1mSD
- The rear garden level appears to be approximately the same as the pathway level, ie about +9.1mSD
- There is a small low-lying terrace area at the rear of the house at existing lower ground floor level. Assuming that this level is the same as the proposed lower ground floor level, this is about +6.8mSD

Vegetation is present within and around the site. The front garden contains well-maintained hedges and bedding areas, with ornamental trees. Along the northern boundary and within the rear garden, numerous trees and bushes are present, including bamboo, magnolia, lime, birch, beech, bay, laurel, privet and ornamental species. Of particular note are two large sycamore trees located in the north-eastern corner

of the property and along the eastern boundary; these range in height between 12m and 15m. Trees are also present in the neighbouring properties.

The current site features, together with the approximate location of the trees, their estimated heights and tentative identification of their species, are shown on the Site Plan which is included in Appendix A; selected photographs of the site are also appended.

## 3.0 EXPLORATORY WORK AND LABORATORY TESTING

The investigation was carried out in September 2019 and is described below.

### 3.1 Constraints of investigation

Insufficient headroom was present in the undercroft of the occupied house and potential exploratory points were therefore effectively limited to external areas. Incoming services were traced leading to the north-western corner of the house and this further limited the possible exploratory positions.

### 3.2 Window sampler boreholes

Two window sample boreholes (WS1 & WS2) were carried out using hand-held/operated equipment under engineer supervision. The boreholes were taken to a depth of 5.00m below existing ground level. Water monitoring pipes (35mm ID) were installed in both boreholes to depths of 4.65m and 5.00m.

### 3.3 Groundwater monitoring

Groundwater monitoring was carried out on three occasions following completion of the site works, on 18th September, 25th September and 2nd October 2019.

### 3.4 Geotechnical and chemical laboratory testing

The following laboratory testing was completed:

- Natural Moisture Content tests (NMCs)
- Index properties tests (Atterberg Limits)
- Soluble sulphate/sulphur/pH analyses

The engineering borehole logs and the laboratory testing results are included in Appendix A.

## 4.0 GROUND CONDITIONS

Published BGS information (1:50,000 and 1:10,000 scale maps and historical borehole database) indicates that the site is underlain by the London Clay Formation which extends to >25m in this area. The investigation encountered made ground and localised superficial/reworked soils overlying the natural strata, as summarised in the following table:

| Stratum | Depth to base | Thickness |
|---|---|---|
| Made ground | Varied between 1.70m and 2.65m | Up to 2.65m |
| Superficial/reworked clay | Present in WS1 only extending to 2.45m depth | 0.75m where present |
| London Clay | Extended to the full depth of both boreholes at 5.00m; base not proven | > 2.55m; base not proven |

Detailed descriptions are presented on the borehole records and the ground sequence is represented on a geological cross section; this information is appended.

### 4.1 Made ground

Topsoil was present at both borehole locations extending to depths of between 0.45m and 0.50m below ground level (bgl). The underlying made ground extended to depths of between 1.70m and 2.65m bgl and generally comprised orange brown silty clay with variable amounts of gravel and fragments of man-made materials such as brick, clinker and concrete fragments. Live and decayed roots were generally present throughout.

The clay was assessed as being soft to firm in consistency. In WS2, however, an upper zone of stiff friable clay was observed and this is attributed to desiccation which has occurred due to tree root action.

### 4.2 Superficial/reworked clay

This deposit comprised brown slightly silty clay with a small but variable proportion of flint gravel and was present between 1.70m and 2.45m bgl in WS1. The nature of the material suggests that it is a soliflucted soil derived from the London Clay which was probably naturally reworked by freeze-thaw action during the last periglacial period.

The clay was of a firm consistency and hand vane readings indicate the clay to be of medium strength. Plasticity index tests indicate the clay to be of very high plasticity (BS5930 classification) and high volume change potential (NHBC classification).

### 4.3 London Clay Formation

The 'undisturbed' London Clay was met at depths of between 2.45m and 2.65m bgl, comprising characteristic weathered brown fissured clay with blue grey gleying along fissure surfaces. The clay was locally silty and contained rare silt partings. Selenite crystals were present, characteristic of this weathered

zone, together with the presence of pyrite nodules. Evidence of claystones was noted at depths of 2.65m and 3.40m. There are some relic decayed roots but these are thought to be related to the current vegetation.

The clay was generally of a firm becoming stiff consistency. Hand vane testing indicated the clay to be initially 'medium' strength, increasing in strength with depth to become 'high' strength below about 3.00m depth.

Atterberg Limit tests classify the clay as very high plasticity (BS scheme) and high volume change potential (NHBC scheme).

### 4.4 Groundwater

Groundwater observations are detailed in the table below:

| Location ID | Depth during drilling (mbgl) | Groundwater monitoring results Water depth (with water level relative to site datum in brackets*) | | |
|---|---|---|---|---|
| | | 18 Sep 2019 | 25 Sep 2019 | 02 Oct 2019 |
| WS1 (+9.8mSD) | Dry | 3.06m (+6.74mSD) | 1.59m (+8.21mSD) | 1.90m (+7.90mSD) |
| WS2 (+9.1mSD) | Dry | 2.59m (+6.51mSD) | 2.30m (+6.80mSD) | 2.07m (+7.00mSD) |

(* assumes that existing ground floor level is +10mSD)

Thus, it appears as though groundwater from within the made ground has gradually accumulated in the monitoring pipes following completion of the fieldwork. It should be noted that groundwater levels can vary seasonally and can rise significantly following wet periods.

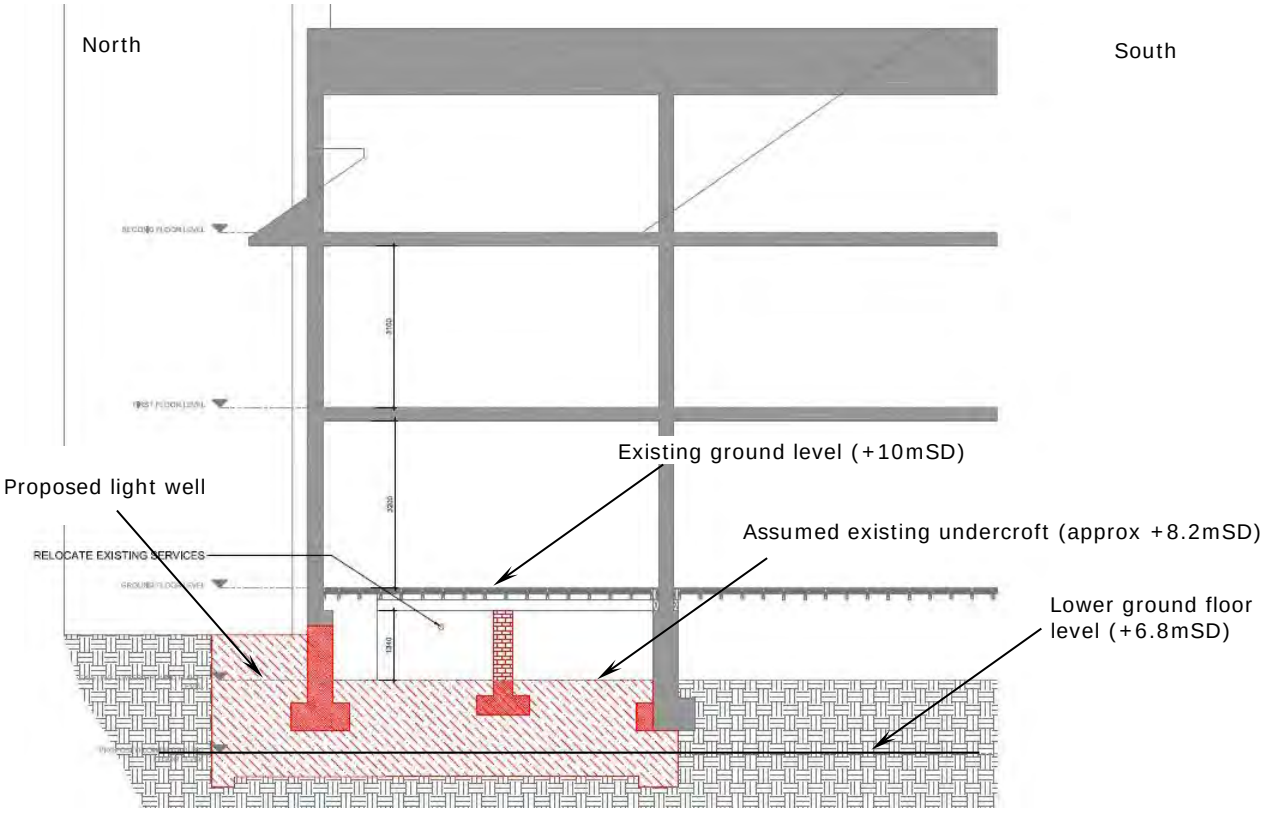
### 4.5 Environmental observations

No obvious olfactory or visual signs of soil or groundwater contamination were encountered in the boreholes. PID headspace testing (for VOC concentrations) was undertaken on samples of made ground and natural soils during the window sampling exercise and no elevated levels were noted.

## 5.0 GEOTECHNICAL ASSESSMENT

The proposed works comprise the lateral extension of the existing lower ground floor into the north-western corner of the property. The architect's plan and section of the proposals are included in Appendix A and these show that the footprint of the extension is to be about 7.90m x 6.35m. The proposed lower ground floor level is about 3.20m below ground floor level, and about 1.40m below the undercroft level. An external lightwell is proposed on the northern elevation. Underpinning of the existing internal and external walls will be required to transfer the structural loads to basement level. At the time of compiling this report, no details of the loads were available.

An extract of the cross section through the proposed lower ground floor extension is shown below:




The investigation encountered a significant thickness of made ground and localised superficial/reworked clay, with the underlying London Clay at depths of between 2.45m and 2.65m bgl (equivalent to between +6.45mSD and +7.35mSD). The London Clay is a relatively competent stratum and is expected to be capable of supporting the underpinning at lower ground floor level. The groundwater level measured in th standpipes is above the proposed excavation level and some control measures will be required. A number of trees are present and due consideration will need to be given to desiccation effects.

## 5.1 Basement excavation and retaining wall

The proposed excavation for the lower ground floor will extend to about +6.4mSD when taking into account a 400mm thick overall slab construction. The existing undercroft is about +8.2mSD (based upon the architect's cross section) and therefore approximately 1.8m of soil will be removed. The excavation is expected to encounter made ground, localised superficial clay and then expose the London Clay at formation level. Groundwater has been measured within the made ground at +8.2mSD, significantly above excavation leve, with higher levels possible during wet periods. We consider that conventional underpinning may still be possible, but it is self-evident that some groundwater control measures will be required. Localised sump pumping may well be sufficient, but this will depend on the flow rate into the excavation. Based upon observations during drilling, when the boreholes remained dry, we would not necessarily expect high flow rates. We would, however, recommend that advance trial excavations to formation level are carried out as early as possible in the programme to confirm the groundwater conditions and to allow appropriate control measures to be designed and implemented; a suitable contingency should be put in place.

A robust arrangement of temporary internal bracings/props will be required to maintain wall stability and assist in controlling ground movements during construction. In addition to the internal and external walls of No 8 Daleham Gardens, due consideration will need to be given to the effects of the excavation on No 10 Daleham Gardens and also any services/infrastructure within the pavement or road immediately to the west.

Careful selection of the appropriate design parameters will be needed, incorporating allowances for factors such as the presence of groundwater and the possibility of soil softening. The following table of coefficients may be used for the preliminary design of any new retaining wall:

| Stratum | Bulk density ($Mg/m^3$) | Effective cohesion, c' ($kN/m^2$) | Effective friction angle, $\phi'$ (degrees) |
|---|---|---|---|
| Made ground | 1.80 | 0 | 22 |
| Superficial clay | 2.00 | 0 | 22 |
| London Clay: | | | |
| <5m below basement level | 2.00 | 0 | 21 |
| >5m below basement level | 2.00 | 5 | 21 |

Eurocode 7 stipulates that partial material factors must be applied to the best estimates of geotechnical soil properties during the design stage. The design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors. The determination of appropriate earth pressure coefficients and the pattern of earth pressure distribution should be carried out by the geotechnical designer; these will depend upon the type/geometry of the wall and the overall design approach.

Potential desiccation due to the vegetation identified along the northern boundary (12m-15m high sycamore tree and 8m bay/laurel) will need to be addressed by the wall designer. This could result in higher than normal pressures on the active side of the wall if the clay soils swell. We recommend that the NHBC Standards (Chapter 4.2, 'Building near trees') are used to determine the zones of influence of the existing trees, assuming mature tree heights and taking into account group effects.

### 5.2 Spread foundations/underpinning at lower ground floor level

The investigation has indicated that the London Clay is likely to be exposed at lower ground floor excavation level. This is a relatively competent high strength clay and is expected to be capable of supporting the underpinned foundations. For preliminary assessment of the feasibility and sizing of foundations, we envisage that an allowable bearing resistance of 140kN/$m^2$ would be achievable; this would be applicable to moderate sized strip or pad foundations, say up to 2m width.

As required by EC7, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design, both drained and undrained bearing resistances should be determined as appropriate to calculate the degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice.

As discussed above, the London Clay is a highly shrinkable soil and there are a number of trees present within the vicinity of the new extension. Whilst it is likely that the foundations will be below the zones of influence of the trees, we recommend that all foundations are designed fully in accordance with the NHBC Standards (Chapter 4.2, Building near trees') and deepened if required. The design should be based upon a high volume change potential classification when determining the safe foundation depths.

All foundation excavations should be carefully inspected by an experienced engineer and local deepening should be carried out if unsuitable soils such as deep pockets of made ground, low strength clays or root-infested or desiccated clays are present.

### 5.3 Lower ground floor slab

The new slab will potentially be subject to soil heave pressures and hydrostatic pressures. The effects of these pressures will be addressed by the GMA which is to be reported separately.

### 5.4 Foundation concrete

Moderate to high concentrations of water-soluble sulphates (2:1 water/soil extract) were measured in selected soil samples, with near neutral pH values to slightly alkaline. The characteristic value falls into Site Design Class DS-3 of Table C2 given in BRE Special Digest 1 (2005). We assess the site as having 'mobile' groundwater and this would result in an ACEC Site Class of AC-3.

We have considered the potential oxidation of pyritic soils following the procedure recommended in the BRE digest. The amount of oxidisable sulphides is seen to be >0.3% in only one sample, suggesting that pyrite is not present in significant amounts.

## 6.0 BASEMENT IMPACT ASSESSMENT

This section of the report assesses the potential impact relating to the proposed subterranean development in terms of 'Land Stability' as required by the London Borough of Camden CPG 'Basements', March 2018. This guidance requires that the impact of the proposed development has been adequately considered using appropriate professional expertise, and that the structural stability of neighbouring buildings will not be put at risk by the proposals.

The hydrological/hydrogeological aspects of the BIA have been addressed in a report by Stephen Buss Environmental Consulting Ltd (Ref:2019-003-065-002, 09/10/19) which is included as Appendix B. A Flood Risk Assessment (FRA) has also been undertaken by Evans Rivers and Coastal (Ref: 2376/RE/10-19/01, October 2019) and this is included as Appendix C. Outline summaries of these two reports are presented in Section 6.5 below.

Five stages are used to allow a full assessment of the effects of the redevelopment on adjacent properties and groundwater and these are summarised as follows:

- Stage 1 - Screening
- Stage 2 - Scoping
- Stage 3 - Site investigation/study
- Stage 4 - Impact assessment
- Stage 5 - Review and decision making

SCL have carried out Stages 1 to 3 of the 'Land stability' element of the BIA. These are presented in the following sections, together with an outline Stage 4 assessment. The full Stage 4 impact assessment will be included within the GMA report.

To assist in the production of this BIA, we have used historical maps and information from Groundsure Enviro Insight report (Ref: SCL-6374110, 03/10/19) and selected figures from the Camden Geological, Hydrogeological and Hydrological Study (2010); this information is included as Appendix D to this report.

### 6.1 Stage 1 Land stability – Screening

The purpose of a screening stage is to determine whether a full Basement Impact Assessment is required. We have used the Camden flowchart for this purpose, answering a series of questions. An answer of 'Yes' or 'Unknown' will require progression to Stage 2 scoping. Answers of 'No' require no further action. The screening stage for land stability is shown in the table below.

| Impact question | Answer | Justification | Reference |
|---|---|---|---|
| 1) Does the existing site include slopes, natural or man-made greater than 7° (approximately 1 in 8)? | No | Site observations indicated that the site is relatively level. The general topography slopes gently to the south at <2° | • SCL site observations.<br>• OS mapping |
| 2) Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°? | No | No landscaping/re-profiling is proposed | • Proposed development plan and section |
| 3) Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°? | No | The neighbouring land is predominately residential and generally at a similar elevation/gentle slope to the site | • Site location plan<br>• OS mapping |
| 4) Is the site within a wider hillside setting in which the general slope is greater than 7°? | No | The site lies within an area with slope angle between 0° and 7° | • Camden slope angle map (Appendix C) |
| 5) Is the London Clay the shallowest stratum at the site? | No | The finding from the ground investigation indicates that made ground and superficial (reworked) clay are present above the London Clay | • SCL GIR (this report) |
| 6) Will any trees be felled as part of the proposed development and/or any works proposed within any tree protection zones where trees are to be retained? | Yes | Small trees/saplings are present along the northern side of the property and some of these will be cleared in order to facilitate basement/lightwell construction. We are not aware of any trees which are subject to a TPO | • SCL site observations<br>• Proposed development plans |
| 7) Is there a history of seasonal shrinkage/swelling subsidence to the local area, and or evidence of such effects at the site? | No | Whilst the London Clay is a highly shrinkable sol, we are not aware of any desiccation-related subsidence on site or in the general area. Relevant precautions have been recommended in this regard for basement/foundation construction (Sections 5.1 and 5.2) | • Visual observation<br>• SCL GIR (this report) |
| 8) Is the site within 100m of a watercourse or a potential spring line? | No | None identified during walk-over survey. Reference to Camden watercourses/surface water features maps plans | • Camden watercourses/ surface water features (Appendix C – Figs 11 & 12) |

| Impact question | Answer | Justification | Reference |
|---|---|---|---|
| 9) Is the site within an area of previously worked ground? | No | No ground workings identified on historical maps or Groundsure Enviro Insight report | • Appendix C of this report |
| 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 | Groundsure Enviro Insight indicates that there is no aquifer associated with superficial deposits and the London Clay is 'unproductive' | • Appendix C of this report |
| 11) Is the site within 5m of a highway or pedestrian right of way? | Yes | Daleham Gardens forms the western boundary of the site, about 5m from the proposed excavation | • Site measurement and online mapping |
| 12) Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties? | Yes | No 10 Daleham Gardens is the nearest adjacent property, immediately to the north. The building line is about 4m to 5m from the proposed excavation | • Proposed development plans<br>• Site measurement and online mapping |
| 13) Is the site over (or within) the exclusion zone of any tunnels, eg railway lines? | No | The site is >50m of any present day or historical railway lines. The nearest recorded tunnel, containing high voltage electricity cables, is > 80m from the site | • Groundsure Enviro Insight report (Appendix C) |

## 6.2 Stage 2 Land stability – Scoping

The purpose of Stage 2 is to assess the potential impacts of the proposed scheme that Stage 1 has indicated require further consideration. Potential issues identified are as follows:

- Question 6 (trees) is answered 'Yes'. Some small trees (3m to 7m height) located along the northern elevation will be removed for the lightwell construction. These do not appear to be substantial trees, as shown in Photograph 7 (Appendix A)
- Questions 11 and 12 (highway and differential foundation depth) are answered 'Yes'. The proposed excavation for the extended lower ground floor is approximately 5m from Daleham Gardens. The works will involve underpinning of the existing internal and external walls, with new foundations about 1.1m below assumed existing foundation level; the effects of both the underpinning and excavation on the highway and adjacent property will be assessed by the GMA

### 6.3 Stage 3 Land stability - Site investigation and study

This report describes the investigation undertaken to establish the ground sequence and groundwater levels. The boreholes have identified that a significant thickness of made ground and localised superficial clay is present overlying the London Clay. A detailed summary of the ground sequence and groundwater conditions is included in Section 5.0 and shown on the appended cross section. The new excavation for the enlarged lower ground floor is expected to expose the London Clay, which will support the underpinning. Groundwater is likely to be encountered and appropriate control measures will be required.

### 6.4 Stage 4 Land stability – Outline impact assessment and conclusion

The purpose of Stage 4 is to assess the potential impact of the 'risk' elements identified by the preceding stages. An outline assessment is as follows:

| Potential risk item | Assessed risk/impact |
|---|---|
| Felling of trees/TPOs (Question 6) | A number of small trees will be removed to facilitate construction of the mew lightwell. These are relatively small and are unlikely to be subject to TPOs. Remaining trees along the northern boundary in the vicinity of the works comprise bay and laurel trees which we do not anticipate will be adversely affected by the works; this should be confirmed by an arboriculturalist.<br><br>Desiccation effects due to tree root action will need to be addressed during the retaining wall and foundation design (see Section 5.2 of this report). |
| Highway/pedestrian right of way (Question 10) | The proposed building line is >5m from Daleham Gardens and is therefore theoretically not a risk item. Notwithstanding, potential ground movements within the pavement will be estimated during the GMA. |
| Differential foundation depths (Question 12) | The works will involve the underpinning of existing foundations, deepening them by about 1.1m relative to the assumed existing founding depth. There is an existing undercroft and the new excavation for the enlarged lower ground floor will involve about 1.8m excavation. No 10 Daleham Gardens is about 4m to 5m from the proposed line of excavation. A robust lateral support system will be needed to limit ground movements.<br><br>The likely movements will be assessed by the GMA, which will also provide damage assessment classification. As this stage, we conclude that when taking into account the relatively small amount of excavation needed (probably <2m due to the presence of an existing undercroft), and relatively shallow underpinning (single lift and probably <1.5m), it should be possible to complete the proposed excavation without adverse impact on the neighbouring property. It should be noted that most ground movement problems occur due to construction issues and therefore the works must be undertaken by reputable and experienced specialists. The temporary and permanent works will ned to be properly designed, with due consideration to the geology/hydrogeology of the site and surrounding areas. |

## 6.5 Summary of hydrology/hydrogeology and flood assessments

*Hydrogeology and hydrology assessment*

A full assessment has been carried out by Stephen Buss Environmental Consulting Ltd (SBEC) and the associated report is included as Appendix B. The conclusions of the report are as follows:

- There will be no increase in man-made impermeable area so the amount, timing and quality of surface water runoff will not be affected by the development. No water will go to ground as a result of the basement development
- There are no local surface water bodies or water wells that might be affected by the development
- While the geological conditions encountered cause springs to emerge elsewhere in Hampstead, this is not considered to be an issue at this site
- Available geological and hydrogeological information indicates that there is no permeable aquifer beneath the site that is capable of maintaining a significant groundwater body
- Water level measurements have been consistently above floor level of the new basement. These are considered to be representative of isolated pockets of water within the sub-surface and not of a continuous water table, and therefore basement construction is expected to have no impact on the water environment outside of the site boundary.

SBEC consider these conclusions to be robust and no further investigation is recommended.

*Flood Risk Assessment*

A full assessment has been carried out by Evans Rivers and Coastal (ERC) and the associated report is included as Appendix C. The conclusions of the report are as follows:

- A review of the relevant guidance documents and various types of data collected at the site has enabled a full assessment of the flood risks to be quantified
- The site is located within the Flood Zone 1 therefore all uses of land are appropriate in this zone
- This assessment has investigated the possibility of groundwater flooding and flooding from other sources at the site. It is considered that there will be a moderate risk of groundwater flooding to the basement/lower ground floor, and it is considered that the proposed basement/lower ground floor should be tanked as a precaution
- There is a low risk of flooding from other sources such as sewers, and as a precaution the risk from sewer flooding should be mitigated further by introducing a non-return valve and positive pumped device
- There is a very low to high risk of surface water flooding across the site which will be mitigated by flood resilience measures. As a precaution a warning and evacuation strategy has been developed; it is proposed that the occupants prepare a Family Flood Plan
- Safe access/egress will be available at all times via Daleham Gardens

- There will not be an increase in surface water runoff from the site and there will be no net increase in impermeable area. Existing impermeable hardsurfaces at the front of the property could be retrofitted using SUDS permeable paving which will lead to a net reduction in impermeable area and runoff

## GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition, Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

Comments made relating to ground-water or ground-gas are based upon observations made during our investigation unless otherwise stated. Ground-water and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as (but not limited to) areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report (anything above a 'low' risk rating), reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk (for example near-surface chalk strata) it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

We will identify tree and plant species if possible, but a suitably qualified arboriculturalist/botanist should be consulted to provide definitive identification

## STANDARD TERMS OF APPOINTMENT OF SOIL CONSULTANTS LTD FOR GEOTECHNICAL SERVICES

1 Unless previously withdrawn, our offer remains valid for a period of sixty days from date of offer. If an instruction is given after the sixty days we reserve the right to reasonably adjust any cost associated with the project to reflect any variance on the original offer. In placing an instruction to proceed with exploratory work, whether directly from the Client or Client's representative, the Client is deemed to have accepted our Terms of Appointment.

2 Our offer is on the basis that free, unhindered access and working conditions are available and that the investigation can be completed in one visit, if applicable. Delays beyond our control will incur additional charges. If additional works outside our offer are required to facilitate the investigation these will be advised and any costs will be passed on to the Client.

3 In our quotation we will provide an estimate of any mobilisation period following an instruction to proceed. This estimate will be accurate at the time of quotation, but it should be noted that the mobilisation period may vary at a later date due to factors such as sub-contractor availability and workload.

4 In commissioning this work, the Client has a responsibility for the health, safety and welfare of operatives invited to undertake work on their site. The Client shall indemnify us in respect of any failure to fulfil their obligations in connection with all relevant and current Health and Safety Regulations.

5 The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access, space and budgetary limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique, or where a non-compliant technique has been specified, we will adopt practical and appropriate techniques to obtain indicative soil parameters.

6 Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in BS EN1997-2. Any interpretation which is provided is for guidance only and must not be regarded as design or design recommendation.

7 Where excavation is required as part of the exploratory work, the Client shall provide drawings or plans showing accurate and complete locations of all underground services and structures. In performing our service, we shall take reasonable precautions to avoid damage to underground services or structures. We will not be responsible for any damage caused to underground services or structures and will not be liable for any claims for damage, expenses arising or losses unless the location of all underground services or structures are accurately shown on drawings and those plans have been provided to us in good time prior to commencement of the exploratory work. Risk to the Client can be further reduced by undertaking a scan of the site using a specialist underground scanning service which would be intended to identify traceable services at shallow depth.

8 With some sites, especially those in certain areas of London and other large towns and cities, there may be a risk of unexploded ordnance (UXO) being present. Unless otherwise stated our offer is on the basis that the Client or their representative provides a preliminary UXO risk assessment for the site. It should be noted that if the site is deemed to be in an area of risk then further measures will be required. These would normally comprise either a more detailed risk assessment and/or specialist site attendance by an EOD engineer. These measures can be commissioned either by the Client or Soil Consultants Ltd. If the Client requires, we would be pleased to obtain a preliminary risk assessment at cost+10%.

9 The Client will supply a site plan (to a rational scale), an indication of the scope and type of the proposed development and an indication of any relevant structural loading information.

10 Should the Client terminate the contract after instruction, we reserve the right to recover costs associated to work carried out between the time of instruction and the point of termination. Cancellation fees, and material costs shall be charged at cost plus 20% (+VAT). Engineer/technician time shall be charged at £95+VAT per hour and principal consultant/director time shall be charged at £125+VAT per hour.

11 The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during the investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

12 If and when instructed, an agreed number of contamination tests will be carried out to give an outline assessment of potential contaminants. In some circumstances it may be necessary to recommend further monitoring, contamination testing and assessment and the scope of this work would be agreed with the Client. Notwithstanding this additional scope, local regulatory authorities may have specific requirements which need to be addressed. Unless otherwise agreed or stated our reporting will constitute neither a Quantitative Risk Assessment nor a Remediation Statement or Strategy.

13 Our reports are counter-checked by one of our suitably qualified and experienced engineers/geologists.

14 Notwithstanding anything to the contrary contained in these terms, our liability under or in connection with these terms whether in contract or in tort, in negligence, for breach of statutory duty or otherwise (other than in respect of personal injury or death) shall not exceed the sum equivalent to ten times our contract fee or £100,000 whichever is less in the aggregate for geotechnical and environmental matters unless otherwise agreed.

15 Without prejudice to any other exclusion or limitation of liability, damages, loss, expense or costs our liability for any claim or claims under this agreement be further limited to such sum as it would be just and equitable for us to pay having regard to the extent of our responsibility for the loss or damage giving rise to such claim or claims ("the loss and damage") and on the assumptions that:

(a) All other consultants, contractors, sub-contractors, project managers or advisers engaged in connection with the Project have provided contractual undertakings to the Client on terms no less onerous than those set out in the original contracts in respect of the carrying out of their obligations in connection with the Project; and

(b) There are no exclusions of or limitations of liability nor joint insurance or co-insurance provisions between the Client and any other party referred to in this clause and any such other party who is responsible to any extent for the loss and damage is contractually liable to the Client for the loss and damage; and

(c) All such other consultants, contractors, sub-contractors, project managers or advisers have paid to the Client such proportion of the loss or damage which it would be just and equitable for them to pay having regard to the extent of their responsibility for the loss and damage.

16 Further and notwithstanding anything to the contrary contained in this agreement and without prejudice to any provision in this agreement whereby liability is excluded or limited to a lesser amount, our liability under or in connection with this agreement whether in contract or in tort, in negligence, for breach of statutory duty or otherwise for any claim shall not exceed the amount, if any, recoverable by us by way of indemnity against the claim in question under professional indemnity insurance taken out by us and in force at the time that the claims or (if earlier) circumstances that may give rise to the claim is or are reported to the insurers in question. The limitation shall not apply if no such amount is recoverable due to us having been in breach of our obligations or the terms of any insurance maintained in accordance therewith or having failed to report any such claim or circumstances to the Insurers in question timeously.

17 Whilst our investigation may include asbestos screening/quantification on selected samples, this must not be deemed to constitute a full asbestos survey or be taken as sufficient to definitively identify the presence or quantity of asbestos within or on the ground. We will not accept responsibility if asbestos is encountered during any subsequent construction or development works and in placing a contract with us the Client accepts this condition. Where the fabric of a building is to be disturbed, the Client shall provide an appropriate asbestos survey to us prior to exploratory work and make adequate provision to allow us to provide relevant protective/remedial measures to progress the work safely.

18 The Client agrees that they shall not bring any claim personally against any director/employee of Soil Consultants Ltd or consultant to us in respect of loss or damage suffered by the Client arising out of this contract.

19 Our appointment shall be under simple agreement and our liability under this contract shall be for a period of six years from date of appointment.

20 Our reports are non-assignable and are prepared for the benefit of the Client. No reliance can be assumed by others without written agreement from Soil Consultants Ltd. We will provide a letter of reliance at our discretion and this will be subject to payment of our fee, which will be 10% of contract value, subject to a minimum fee of £750 plus VAT. The terms of our letter of reliance are non-negotiable and the beneficiary should be aware that the information shall only apply to the scheme for which the report was originally produced and the original rights and benefits will apply.

21 A VAT invoice (at current rate) will be presented in respect of the work undertaken. Payment of our account is to be made within twenty-eight days of issue of our invoice unless otherwise agreed. On no account shall payment be on a 'pay-when-paid' basis. The information contained within our report remains the property of Soil Consultants Ltd and no reliance may be assumed by any party with an interest in the project until payment has been received in full. After one calendar month interest shall be chargeable at 10% above the Bank of England Rate and compensation claimed in accordance with 'Late Payments of Commercial Debts (Interest) Act 1998 and subsequent revisions. If the debt is referred to a debt collection agency then we have the right to recover associated fees under the terms of our contract.