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Your Ref:

Our Ref: **17/27399-2**
April 2018

SOUTH LODGE, HEATHSIDE,

HAMPSTEAD, LONDON, NW3 1BL

BASEMENT IMPACT ASSESSMENT

Prepared for

Elliott Wood Partnership Limited

Acting on behalf of

Nick and Amanda Raphael

CONTENTS

1.0 NON-TECHNICAL SUMMARY

1.1 Project Objectives

At the request of Elliott Wood Partnership Limited, working on behalf of Nick and Amanda Raphael, a Basement Impact Assessment has been carried out at South Lodge, Heathside, Hampstead, NW3 1BL in support of a planning application for a proposed development which includes the refurbishment to the west side of the property and the extension of the existing basement footprint.

The Finished Floor Level (FFL) of the proposed new basement steps down from 92.85m AOD below the footprint of the original property (which equates to an approximately 0.90m excavation) to 92.00m AOD below the existing rear extension (a 3.50m excavation).

The 0.90m excavation below the building is referred to as the new basement in this document whilst the 3.50m excavation below the rear extension is referred to as the new sub-basement.

1.2 Desk Study Findings

From historical map evidence it would appear that the site was first built on prior to 1879, with extensions being constructed to the existing property between 1973 and 1985. The surrounding area has been predominantly residential throughout its history and was partly urbanised during the early 20th century.

1.3 Ground Conditions

The boreholes and trial pits revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness (unproven in TP6) resting on deposits of the Claygate Member. The Made Ground extended down to depths of between 0.70m and 0.90m in the boreholes and of between 0.20m and 1.00m below ground level in the trial pits (94.82 to 93.56mOD) and the material generally comprised a surface layer of grass/clay tiled floor / pea gravel overlying silty sandy gravelly clay with brick and concrete fragments. The Claygate Member was encountered below the Made Ground and consisted of soft becoming firm then stiff silty sandy clay with lenses of silty fine sand which extended to depths/levels between 6.70m (88.82mOD) in Borehole BH1 and 6.00m (88.46mOD) in Borehole WS1. This deposit extends down to the full depth of investigation of 6.00m below ground level in Borehole WS1. The London Clay Formation was encountered below the Claygate Member and consisted of stiff silty sandy clay with occasional pockets and partings of silty fine sand and scattered gypsum crystals. This deposit extends down to the full depths of investigation of 15.00m below ground level in Borehole 1 (80.524mOD). Following drilling operations groundwater monitoring piezometers were installed in Boreholes BH1 and WS1 to approximately 6.00m depth.

Groundwater was recorded at a depth of 2.51m (45.12mOD) within the standpipe located in Borehole BH1 and a depth of 3.62m (46.33mOD) within the standpipe in Borehole WS1 after a period of approximately three weeks.

1.4 Recommendations

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

2.0 INTRODUCTION

2.1 Project Objectives

At the request of Elliott Wood Partnership Limited, working on behalf of Nick and Amanda Raphael, a Basement Impact Assessment has been carried out at the above site in support of a planning application.

The purpose of this assessment is to consider the effects of a proposed basement construction on the local slope stability, surface water and groundwater regime at the existing residential property.

The recommendations and comments given in this report are based on the information contained from the sources cited and may include information provided by the Client and other parties, including anecdotal information. It must be noted that there may be special conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

This report does not constitute a full environmental audit of either the site or its immediate environs.

2.2 Planning Policy Context

The information contained within this BIA has been produced to meet the requirements set out by Camden Planning Guidance – Policy A5: Basements and CPG: Basements

As recommended by the Guidance for Subterranean Development (Ref 1) the BIA comprises the following steps

1. **Initial screening** to identify where there are matters of concern
2. **Scoping** to further define the matters of concern
3. **Site Investigation and study** to establish baseline conditions
4. **Impact Assessment** to determine the impact of the basement on baseline conditions
5. **Review and Decision Making** (to be undertaken by LBC)

3.0 SITE DETAILS

(National Grid Reference: TQ 268 860)

3.1 Site Location

South Lodge is a residential property, located on the north-western side of Heathside, Hampstead at approximate postcode NW3 1BL. The residential dwelling has five levels of accommodation; lower ground, upper ground, first, second and third floor. The site covers an approximate area of 0.19 Hectares with the general area being under the authority of the London Borough of Camden.

The site is located on the north-western side of Heathside with residential properties to the north-west, south-west and north-east and a roadway to the south-east.

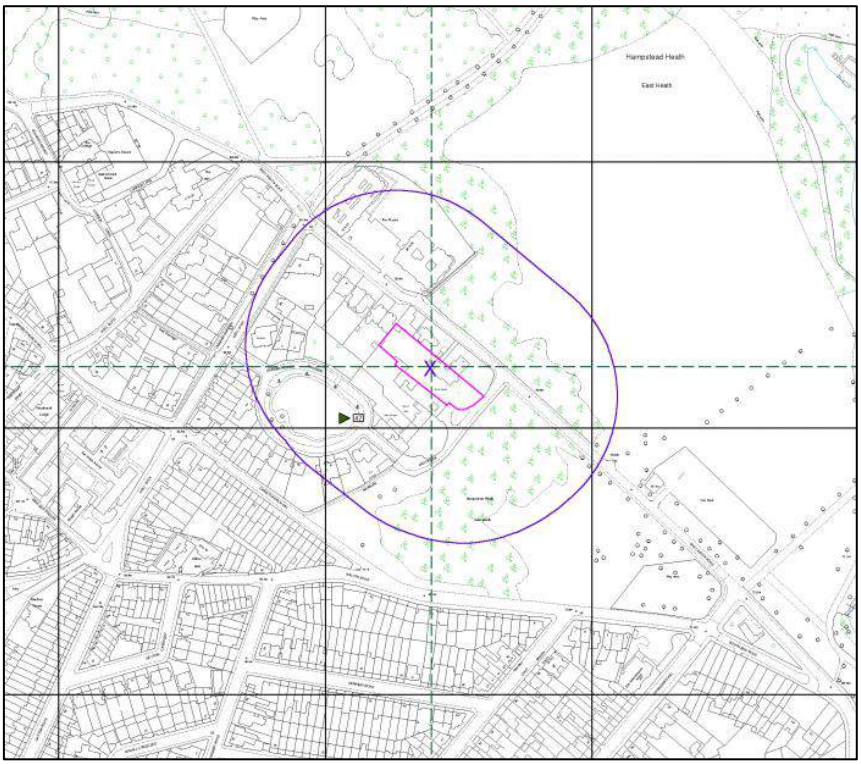

Figure 1. Site Location Plan

3.2 Site Layout and History

The site is accessed from Heathside located to the south-east and comprises of a five storey residential property, including rooms at roof level with front and rear garden areas.

The property is bound by Heathside to the south-east, with residential properties to the north-east, north-west and south-west.

The property contains a gravel driveway running along the side of the property up to a single storey garage. The property contains a large front and rear lawn with a small greenhouse to the rear of the site. There are multiple trees of varying sizes found within the grounds of the site.

The site slopes very gently to the south-east with levels of 96.60mOD recorded in the rear garden and 94.15mOD recorded in the front garden area. The slope angle is less than 7 degrees. Also with reference to the Camden Geological, Hydrogeological and Hydrological Study, (Figure 2 below), the neighbouring properties also have slopes less than 7 degrees.

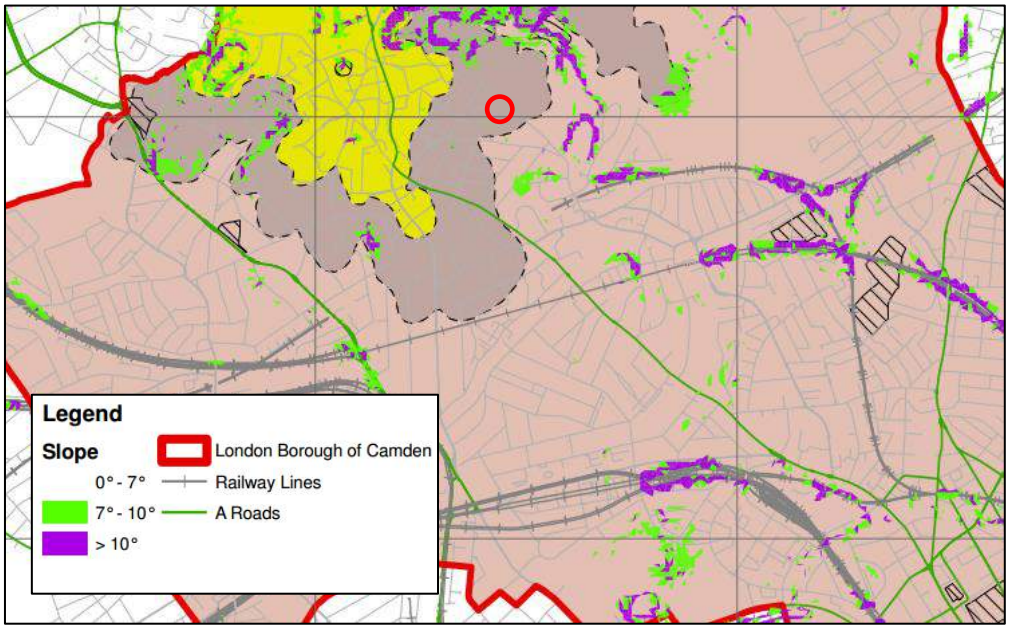

Figure 2. Exact from Figure 16 of the Camden CPG4 showing slope angles within the borough

The existing ground level in the area of the proposed basement is understood to be approximately 95.90mOD.

From historical map evidence it would appear that the site was first built on prior to 1879, with extensions being constructed to the existing property between 1973 and 1985. The surrounding area has been predominantly residential throughout its history and was partly urbanised during the early 20th century.

3.3 Previous Reports

A Phase 1 Preliminary Risk Assessment (PRA) (SAS Report Ref: 17/27399) and Phase 2 Site Investigation (SAS Report Ref: 17/27399-1) was undertaken across the site by Site Analytical Services Limited in November 2017 and the results are discussed in this BIA.

3.4 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) indicates the site to be underlain the Claygate Member.

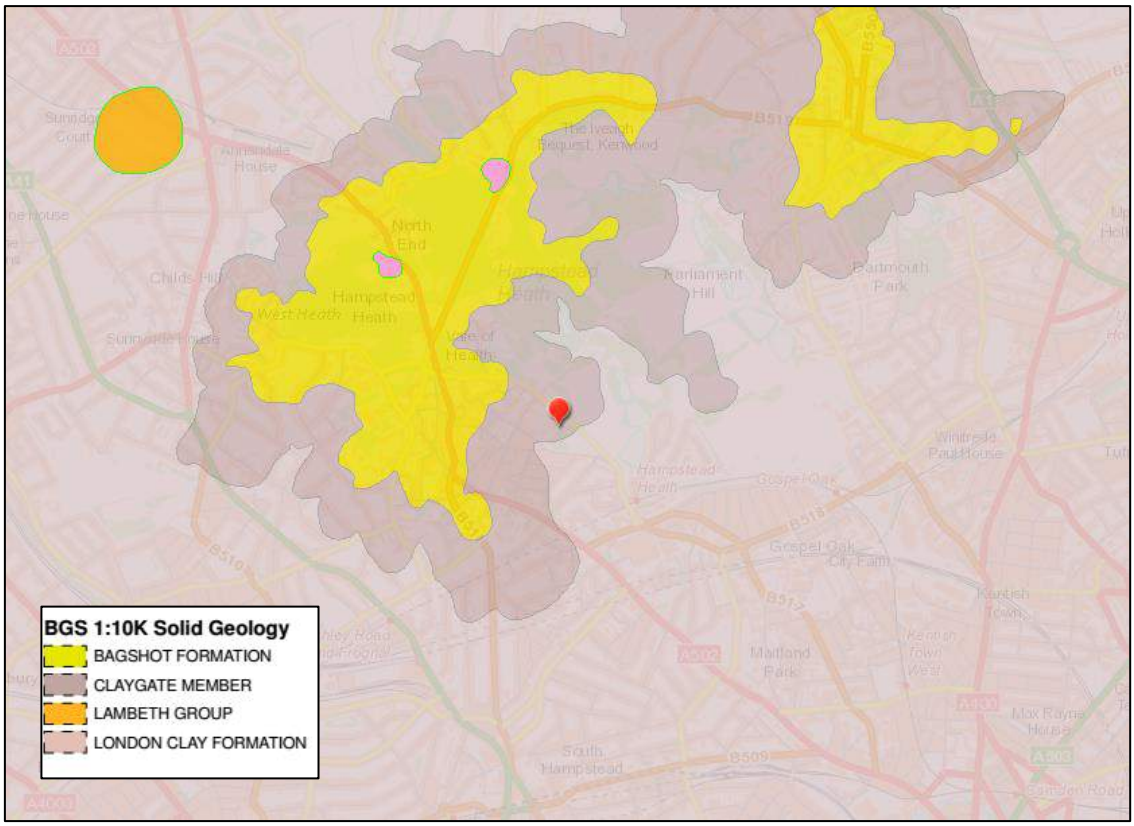

Figure 3. Geology of the Site (Ref. BGS Geoindex)

The British Geological Survey's online records indicate there is one borehole located within 250m of the site. This is located 111m to the north-west of the site and reveals Made Ground to a depth of 1.20m underlain by the Claygate Member to a depth of 1.5m with the London Clay at depth.

3.5 Hydrology and drainage

3.5.1 Surface Water

According to Mayes (1997) rainfall in the local area averages around 610mm and significantly less than the national average of around 900mm.

Evapotranspiration is typically 450mm/year resulting in about 160mm/year as 'hydrologically effective' rainfall which is available to infiltrate into the ground or run-off as surface water flow.

With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) springs that sourced tributaries of the 'lost rivers' River Fleet were located approximately 300m east of the site respectively (Figure 5).

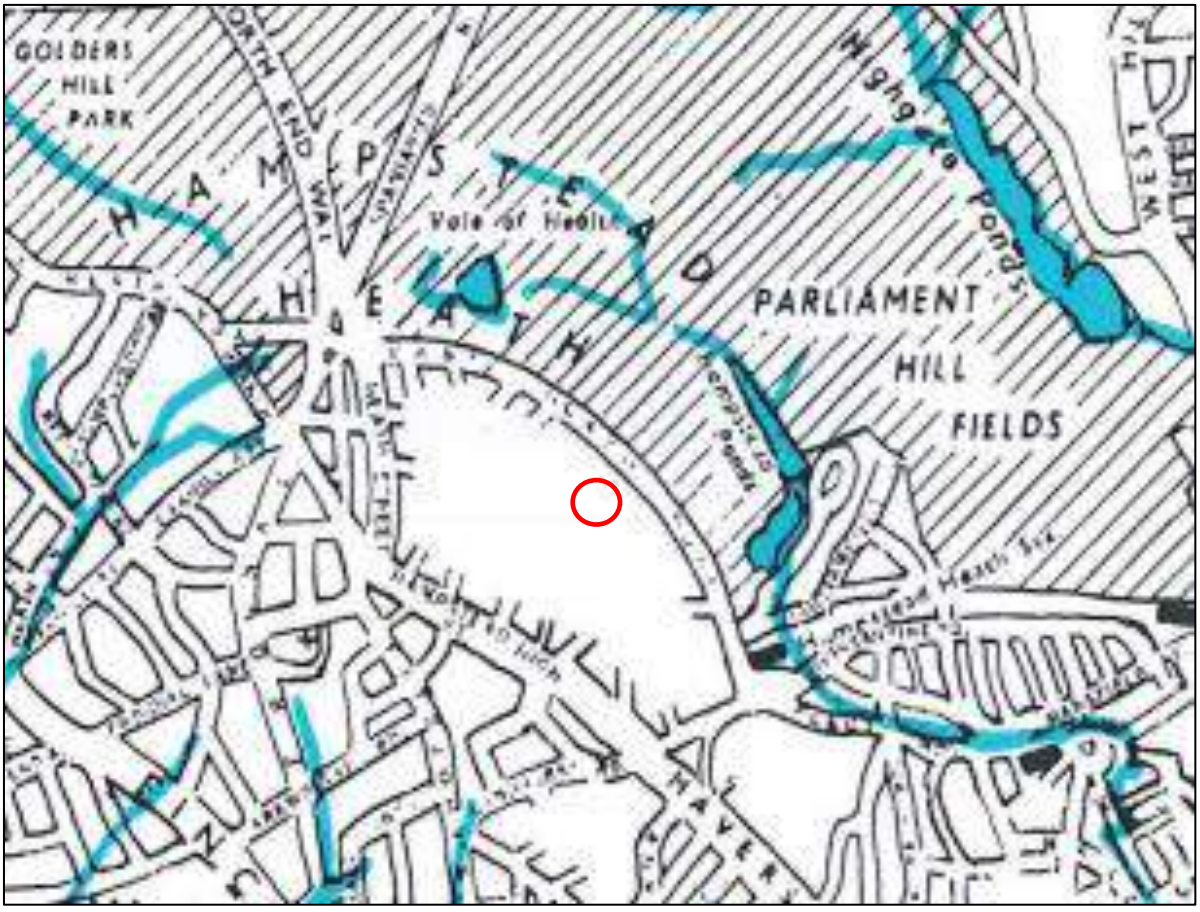

Figure 4. Location of site (circled) relative to the 'Lost Rivers' of London (Source: Barton, 1992)

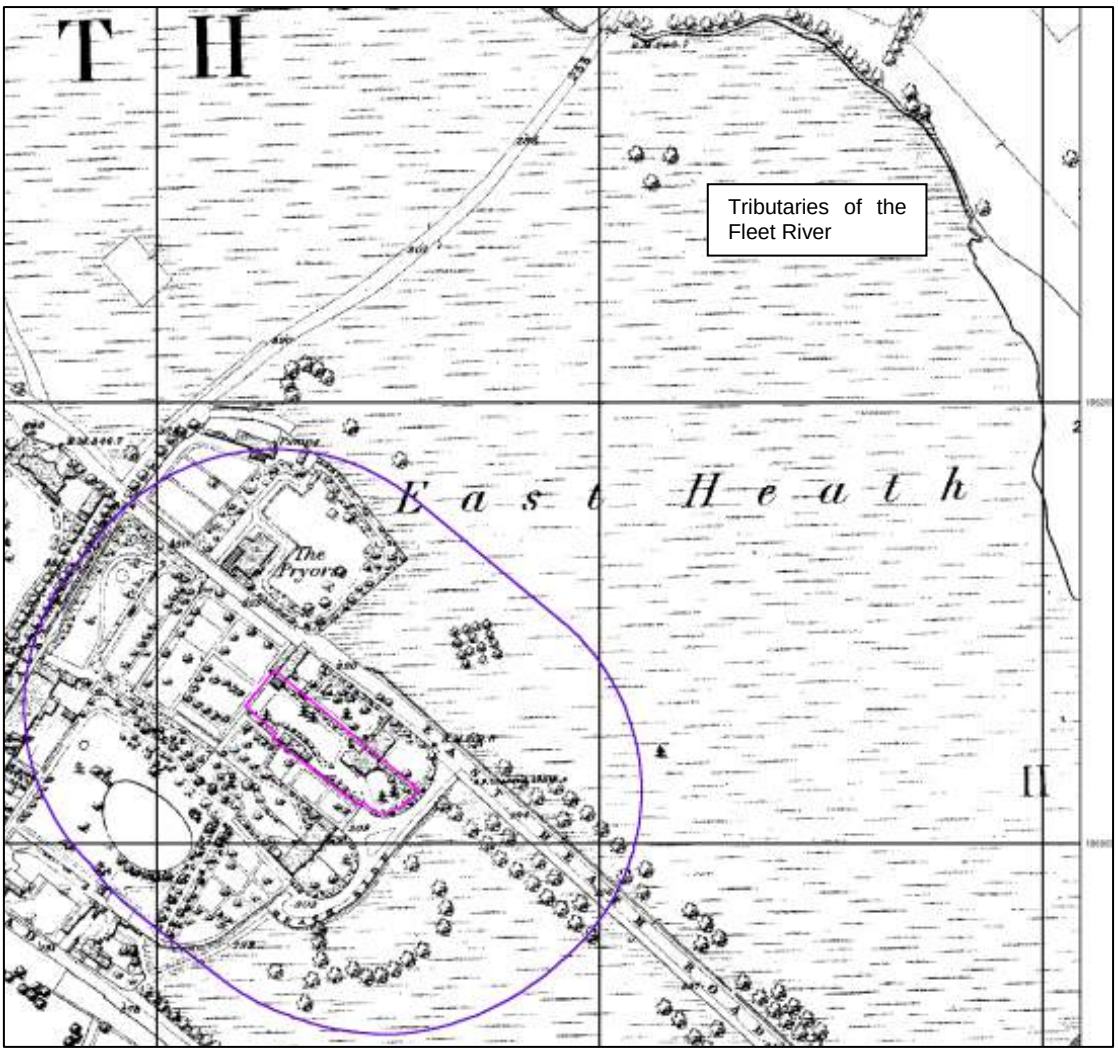

Figure 5. Location of River Westbourne with respect to the site from OS map dated 1879 (Purple boundary indicates >100m distance)

The River Fleet was the largest of London's lost rivers. The Fleet rises on Hampstead Heath by two heads separated by Parliament Hill. The Hampstead source (Western source) is near the Vale of Health and forms the Hampstead Ponds before going underground, near Hampstead Heath Station and running down Fleet Road towards Camden Town. The two main sources of the Fleet River unite just north of Camden Town, where it crosses Kentish Town Road, passes under Reagents Canals to Kings Cross. The river is then fed by two tributaries before feeding into the River Thames, close to Blackfriars Bridge.

The watercourses have since been largely lost through a culverting system as the urban extent of the borough has grown over time.

Envirocheck indicates that the closest surface water feature is the Hampstead Ponds located 305m east of the site.

The area located immediately around the site is highly developed with more than 80% of the surface covered with hardstanding. Most of the rainfall in the area will run-off hard surface areas and be collected by the local sewer network.

Surface drainage from the site is assumed to be directed to drains flowing downhill to the south-west along Heathside.

3.5.2 Flood Risk

3.5.2.1 River or Tidal flooding

According to Environment Agency Flood maps, the site lies within Flood Zone 1 which is defined as areas where flooding from rivers and the sea is very unlikely, with less than a 0.1 per cent (1 in 1000) chance of such flooding occurring each year. The EA's website also shows that this area does not fall within an area at risk of flooding from reservoirs. Based on this information a flood risk assessment will not be required.

3.5.2.2 Surface water flooding

Figure 6 shows that Heathside did not flood during either the 1975 or the 2002 flood events. The closest road to the property which flooded in either of these events is Willow Road located 155m to the east which flooded in 2002.

Figure 6. Exact from Figure 15 of the Camden CPG4 showing roads which flooded in 1975 (light blue), in 2002 (dark blue) and 'areas with potential to be at risk from surface water flooding' (wide light blue bands)

Further modelling of surface water flooding has been undertaken by the Environment Agency and was published on its website in January 2014; an extract from their model is presented in Figure 7. Whilst this map identifies four levels of risk (high, medium, low and very low) it is understood that it is based at least in part on depths of flooding. This modelling shows a 'Very Low' risk of flooding (the lowest category for the national background level of risk) for South Lodge and the surrounding area.

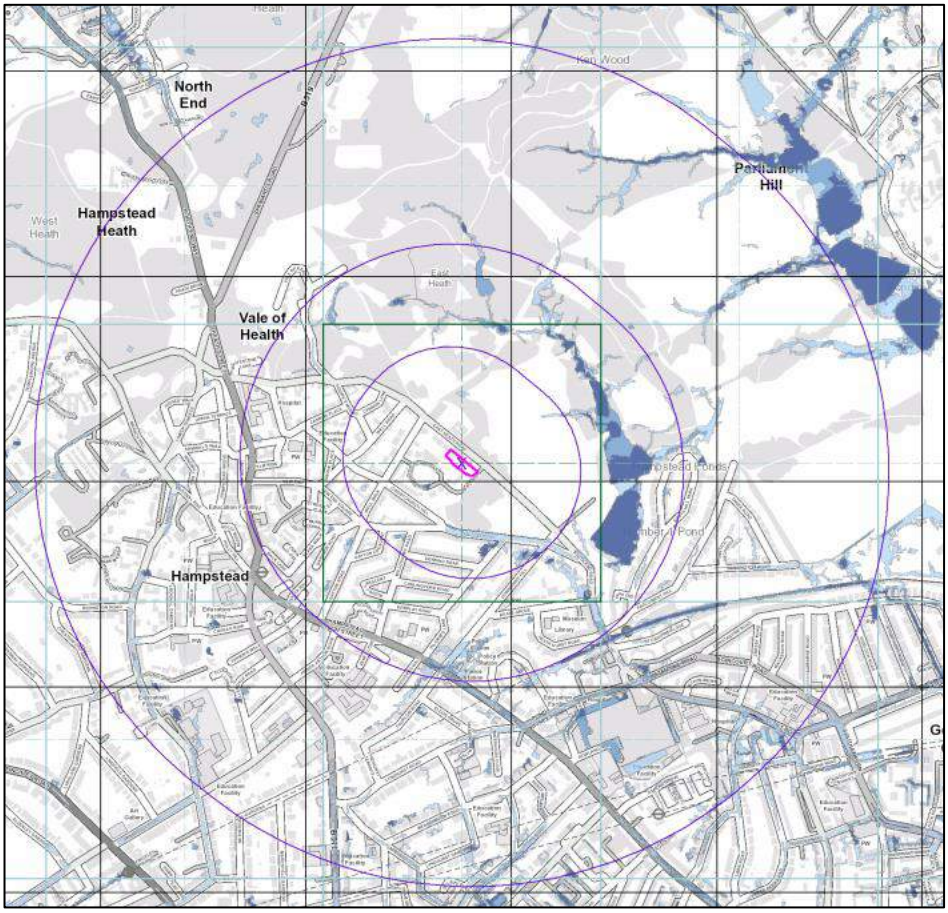

Figure 7. Extract from the Environment Agency's 'Risk of Flooding from Surface Water'. Ordnance Survey Crown copyright 2015. All rights reserved.

As detailed in Table 1 below, the scheme will result in a small increase in impermeable areas by 28.0m^2.

Element	Existing (m^2)	Proposed (m^2)
Impermeable (hardstanding - building footprint, concrete areas)	332	360
Permeable (softscaping - grassed areas, (including green roof), permeable and porous paving)	1535	1507
Total (should be the site area and remain the same)	1867	1867

Table 1. Existing and Proposed Permeable Areas.

3.5.2.3 Sewer flooding

The London Regional Flood Risk Appraisal (2009) advises that foul sewer flooding is most likely to occur where properties are connected to the sewer system at a level below the hydraulic level of the sewage flow, which in general are often basement flats or premises in low lying areas. There is no record of sewer flooding having occurred at South Lodge and therefore the risk of sewer flooding is considered low.

3.6 Hydrogeological setting

The Environment Agency Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) and also their role in supporting surface water flows and wetland ecosystems. The Claygate Member is permeable, capable of storing and transmitting groundwater and is considered to be a Secondary A Aquifer; The underlying London Clay Formation is classed as unproductive strata or a non-aquifer. These are deposits with a low permeability that have negligible significance for water supply or river base flow.

Groundwater within the silty sandy clays of the Claygate Member is considered to be dominated by fissure flow. The absence of any significant sand bed horizons reduces the water bearing potential of the Claygate Member to that similar to the underlying London Clay. Due to the very low permeability of the London Clay, any groundwater flow will be at very low rates. 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. However, the Claygate Member is sandier in composition and permeability is expected to be higher.

Local perched groundwater may occur near surface in Made Ground and possibly also in any Head deposits which overlie the Claygate Member, in at least the winter and early spring seasons.

The presence of interbedded sands, silts and clays of the Claygate Member gives rise to various springs. The River Fleet is located approximately 300m east of the site. The direction of groundwater flow within the Claygate Member beneath the site is likely to be controlled by the local topography and is therefore likely to be in a southerly direction, in the direction that the former river flowed.

Based on the available data, the site is in considered to be at low risk from all sources of flooding. The replacement dwelling and basement can be constructed and operated safely in flood risk terms without increasing flood risk elsewhere and is therefore considered NPPF compliant.

Other hydrogeological data obtained from the Phase 1 Preliminary Risk Assessment (PRA) (SAS Report Ref: 17/27399) for the site include:

- The underlying soil classification of the site is of high leaching potential.
- There are no source protection zones within 1 kilometre of the site.
- There are no groundwater abstraction licences listed within one kilometre of the site.
- There are no surface water abstraction licences within 1km of the site.
- There are no public potable water supply abstraction licences within 1km of the site.

3.7 Proposed Development

It is proposed to refurbishment to the west side of the property and the extension of the existing basement footprint.

The Finished Floor Level (FFL) of the proposed new basement steps down from 92.85m AOD below the footprint of the original property (which equates to an approx. 0.90m excavation) to 92.00m AOD below the existing rear extension (a 3.50m excavation).

Sections showing the proposed developments are detailed in Figure 8 below.

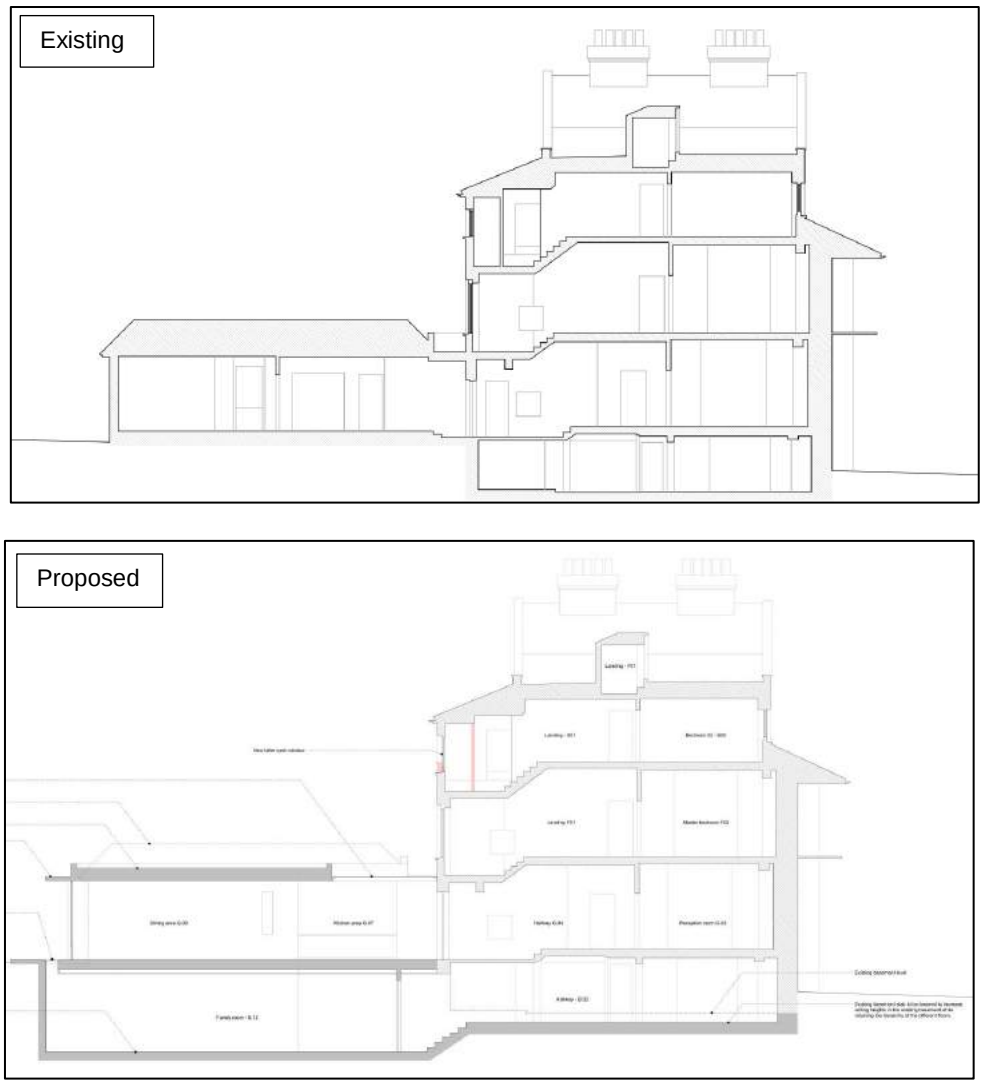

Figure 8. Sections of the proposed North and South Elevations of the property.

3.8 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site and the results are summarised in Table 2 below:

Table 2: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	Yes	The site lies above the Claygate Member. These deposits have been designated as Secondary A Class; 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. These are generally aquifers formerly classified as minor aquifers.
	1b. Will the proposed basement extend beneath the water table surface.	Unknown – to be confirmed by Ground Investigation	Given the presence of a non-aquifer below the site it is unlikely that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	No	The nearest surface water feature from mapping evidence is the Hampstead Ponds within Hampstead Heath located 305m east of the site. According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011) and Stanford (1868) the site is 300m west from the River Fleet (Figures 5 and 6 of this report). From the British Geological Society 'Geoindex' the nearest water well is located approximately 420m south-east of the site.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	Yes	The amount of hardstanding on-site is expected to increase.
	4. As part of site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS).	No	Existing drainage paths are to be utilised where possible. Whether soakaways/SUDS are used on the proposed development is to be confirmed (beyond the scope of this report). An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.
	5. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line.	No	The nearest surface water feature is recorded is located 305m east of the site.

Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8).	No	There is a slight slope from north to south across the site, but is below 7 degrees.
	2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8).	No	Re-profiling of landscaping at the site is not proposed.
	3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8).	No	The surrounding area drops to the south-east, but from survey information and with reference to Figure 16 from Camden CPG 4, this is at angles of less than 7 degrees.
	4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8).	No	There is a general slope in the area towards the south down to the south-west, but this is at an angle of less than 7 degrees.
	5. Is the London Clay the shallowest strata at the site.	No	The 1:50000 Geological Survey of Great Britain (England and Wales) indicates the site is underlain by the Claygate Member with the London Clay Formation at depth. Deposits of the overlying Bagshot Formation are indicated to be approximately 315m to the north-west of the site, whilst the boundary to the underlying London Clay Formation is approximately 100m to the south-east.
	6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.	No	It is understood that no trees are to be felled as part of the development.
	7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	Unknown – to be confirmed by Ground Investigation	The Claygate Beds do have cohesive layers which can be prone to shrinking and swelling.
	8. Is the site within 100m of a watercourse or a potential spring line.	No	The nearest surface water feature from mapping evidence is the Hampstead Ponds within Hampstead Heath located 305m east of the site. According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011) and Stanford (1868) the site is 300m west from the River Fleet (Figures 5 and 6 of this report).

	9. Is the site within an area of previously worked ground.	No	According to records from the BGS the site is not in the vicinity of any recorded areas of worked ground.
	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.	Yes	According to the results of the most recent ground investigation the site lies above a Secondary A Aquifer (Claygate Member). However, the depth to the groundwater level is unknown and will be determined by the site investigation.
	11. Is the site within 50m of the Hampstead Heath Ponds	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	12. Is the site within 5m of a highway or pedestrian right of way.	No	No, due to the nature of the site, the proposed development does not lie within 5m of Heathside.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Unknown – to be confirmed by Ground Investigation	It is unknown whether No. 1 to the north-east has a basement level, but for the purposes of this report it is assumed to have one.
	14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	Unknown / outside scope of report	A full statutory service search was outside the scope of this report and must be completed prior to any excavations. It is understood there are no railway tunnels within 100m of the site
Surface Water and Flooding	1. Is the site within the catchment of the ponds chains on Hampstead Heath	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	No	No – any additional surface water generated from an increased hardstanding area will be attenuated to ensure they are not increased or altered. The basement will be beneath the footprint of the new dwelling therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report, does not apply across these areas.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	Yes	Yes, there will be a small change in the area of hard surfacing. The surface permeability will be affected with a slight increase in the footprint of the new building and a small increase in the amount of paved surface in relation to the total site.

	4. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.	No	All surface water for the site will be contained within the site boundaries and collected as described above; hence there will be no change from the development on the quantity or quality of surface water being received by adjoining sites. The basement will be beneath the footprint of the dwelling therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report does not apply across these areas.
	5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	No	The surface water quality will not be affected by the development, as in the permanent condition collected surface water will be generally be from roofs, domestic hard landscaping or collected from beneath the landscaping layer over the basement.
	6. Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature	No	South Lodge did not flood during either the 1975 or the 2002 flood events. Also, according to modelling by the Environment Agency, there is a 'Very Low' risk of surface water flooding (the lowest category for the national background level of risk) for South Lodge and the surrounding area. There are no surface water features within 100m of the site which could create a flood risk for the proposed basement.

3.9 Non-Technical Summary of Chapter 3.0

The site is accessed from Heathside located to the south-east and comprises of a five storey residential property, including rooms at roof level with front and rear garden areas.

The site slopes very gently to the south-east with levels of 96.60mOD recorded in the rear garden and 94.15mOD recorded in the front garden area.

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by the Claygate Member with the London Clay Formation at depth. The Claygate Member is permeable, capable of storing and transmitting groundwater and is considered to be a Secondary A Aquifer; The underlying London Clay Formation is classed as unproductive strata or a non-aquifer.

With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) springs that sourced tributaries of the 'lost rivers' River Fleet were located approximately 300m east of the site respectively (Figure 5).

The nearest surface water feature from mapping evidence is located 305m east of the site.

According to Environment Agency Flood maps there are no flood risk zones within 1 kilometre of the site. The EA's website also shows that this area does not fall within an area at risk of flooding from reservoirs.

According to Environment Agency Flood maps the site lies within Flood Zone 1, which is defined as areas where flooding from rivers and the sea is very unlikely, with less than a 0.1 per cent (1 in 1000) chance of such flooding occurring each year. South Lodge did not flood during either the 1975 or the 2002 flood events. Modelling of surface water flooding by the Environment Agency shows a 'Very Low' risk of flooding (the lowest category for the national background level of risk) for South Lodge and the surrounding area.

The Screening Exercise has identified the following potential issues which will be carried forward to the Scoping Phase

Subterranean Groundwater Flow

- Is the site located directly above an aquifer
- Will the proposed basement extend beneath the water table surface.

Slope Stability

- Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.
- Is the site within 5m of a highway or pedestrian right of way.
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.
- Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.

Surface Water and Flooding

- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.

4.0 SCOPING PHASE

4.1 Introduction

This purpose of the scoping phase is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified impact factors and recommendations are stated.

A conceptual ground model is usually complied at the scoping stage however, because the ground investigation has already been undertaken for this project, the conceptual ground model including the findings of the ground investigation is described under Chapter 4.

Subterranean (Groundwater Flow)

Potential Issue (Screening Question)		**Potential impacts and actions**
1a	Is the site located directly above an aquifer	**Potential impact:** Infiltration could be reduced. **Action:** Ground Investigation required, then review.
1b	Will the proposed basement extend beneath the water table surface?	**Potential impact:** Local restriction of groundwater flows (perched groundwater or below groundwater table). **Action:** Ground investigation required, the review.

Slope Stability

7	Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	**Potential Impact:** Ground movements will occur during and after the basement construction. **Action:** Ground investigation required, then review.
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.	**Potential impact:** Infiltration could be reduced. **Action:** Ground Investigation required, then review.
11	Is the site within 5m of a highway or a pedestrian right of way?	**Potential impact:** Excavation of basement causes loss of support to footway/highway and damage to the services beneath them. **Action:** Ensure adequate temporary and permanent support by use of best practice working methods.
12	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	**Potential impact:** Loss of support to the ground beneath the new foundations to neighbouring properties if basement excavations are inadequately supported. **Action:** Ensure adequate temporary and permanent support by use of best practice methods.

Surface Water and Flooding

Potential Issue (Screening Question)		**Potential impacts and actions**
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	**Potential impact:** May increase flow rates to sewer, and thus increase the risk of flooding **Action:** Assess net change in hard surfaced/paved areas and, if required, recommend appropriate types of SUDS for use as site-specific mitigation.

These potential impacts have been further assessed through the ground investigation, as detailed in Section 4 below.

4.2 Non-Technical Summary of Chapter 4.0

The scoping exercise has reviewed the potential impacts for each of the items carried forward from Stage 1 screening, and has identified the following actions to be undertaken:

- A ground investigation is required (which has already been undertaken).
- Review of site's hydrogeology and groundwater control requirements.

All these actions are covered in Stage 3 or Stage 5 for the ground investigation.

5.0 SITE INVESTIGATION DATA

5.1 Records of site investigation

A site-specific ground investigation was undertaken by Site Analytical Services Limited (SAS) in October 2017 and included one rotary percussive borehole (Borehole BH1) one continuous flight auger borehole (WS1) and 7 trial pits (Trial Pits 1-7 inclusive) excavated to 1.5m depth.

The factual findings from the investigation are presented in Appendix A, including a site plan, exploratory hole logs, groundwater monitoring and laboratory test results.

5.2 Ground conditions

The boreholes and trial pits revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness (unproven in TP6) resting on deposits of the Claygate Formation with the London Clay Formation at depth.

5.2.1 Made Ground

The Made Ground extended down to depths of between 0.70m and 0.90m in the boreholes and of between 0.20m and 1.00m below ground level in trial pits (94.82 to 93.56mOD) and the material generally comprised a surface layer of grass/clay tiled floor / pea gravel overlying silty sandy gravelly clay with brick and concrete fragments.

5.2.2 Claygate Member

The Claygate Member consisted of soft becoming firm then stiff silty sandy clay with lenses of silty fine sand which extended to depths/levels between 6.70m (88.82mOD) in Borehole BH1 and 6.00m (88.46mOD) in Borehole WS1. This deposit extends down to the full depth of investigation of 6.00m below ground level in Borehole WS1.

5.2.3 London Clay Formation

The London Clay Formation was encountered below the Claygate Member and consisted of stiff silty sandy clay with occasional pockets and partings of silty fine sand and scattered gypsum crystals. This deposit extends down to the full depth of investigation of 15.00m below ground level in Borehole BH1 (80.524mOD).

5.3 Groundwater

Groundwater was not encountered in any of the trial pits during site works and the material remained essentially dry throughout. Groundwater was encountered in Boreholes BH1 and WS1, as detailed in Table A below.

Exploratory Hole	Depth (m)	Notes	Stratum
BH1	4.00	Rose to 3.80m in 20 minutes	Claygate Member
WS1	5.80	Slight Seepage	Claygate Member

Table A: Groundwater Strike Summary

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and hence be detected, particularly within more cohesive soils.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

Groundwater was encountered at a depth of 2.51m (93.01mOD) within the monitoring standpipe placed in Borehole BH1 and 3.62m (90.84mOD) below ground level within the monitoring standpipe placed in WS1 after a period of approximately three weeks.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (October and November 2017) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

5.4 Foundations

Trial Pits 1 to 7 inclusive were excavated adjacent to the wall of the existing property on the site in order to expose the foundations and founding soils. Trial Pits 1 to 7 inclusive showed the walls are supported on brick foundations resting on the Claygate at a depth of between 0.07m and over 1.50m.

5.5 In-Situ and Laboratory Testing

The results of the laboratory and in-situ tests are presented in the factual report contained in Appendix A.

5.5.1 Standard Penetration Tests

The results of the Standard Penetration Tests carried out in the natural soils are shown on the exploratory hole records in Appendix A.

5.5.3 Undrained Triaxial Compression Test Results

Undrained Triaxial Compression tests were carried out on two undisturbed 100mm diameter samples taken from within Borehole 1.

The test results are given in Table 1, contained in Appendix A.

5.5.4 Vane Testing

In the essentially cohesive natural soils encountered at the site, in-situ shear vane tests were made at regular depth increments in order to assess the undrained shear strength of the materials. The results indicate that the natural soils are of a generally high strength in accordance with BS 5930 (2015).

The results of the in-situ tests are shown on the appropriate exploratory hole records contained in Appendix A.

5.5.5 Classification Tests

Atterberg Limit tests were conducted on six samples taken at depth in Borehole 1 and Window Sampler 1 showed the samples tested to fall into Classes CI and CI/CH according to the British Soil Classification System.

These are fine grained silty clay soils of intermediate to high plasticity and as such generally have a low permeability and a medium susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values of between 21% and 25%, with all of the samples being below the higher 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential.

5.5.6 Sulphate and pH Analyses

The results of the sulphate and pH analyses show the natural soil samples to have water soluble sulphate contents of up to 0.19g/litre associated with near neutral to slightly alkaline pH values.

5.6 Non-Technical Summary of Chapter 5.0

A site-specific ground investigation was undertaken by Site Analytical Services Limited (SAS) in October 2017 and included one rotary percussive borehole (Borehole BH1) one continuous flight auger borehole (Borehole WS1) and 7 trial pits (Trial Pits 1-7 inclusive) excavated to 1.5m depth.

The boreholes and trial pits revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness (unproven in TP6) resting on deposits of the Claygate Formation with the London Clay Formation at depth.

Following drilling operations groundwater monitoring piezometers were installed in Boreholes BH1 and WS1 to approximately 6.00m depth.

Groundwater was encountered at a depth of 2.51m (93.01mOD) within the monitoring standpipe placed in Borehole BH1 and 3.62m (90.84mOD) below ground level within the monitoring standpipe placed in WS1 after a period of approximately three weeks.

6.0 FOUNDATION DESIGN

6.1 Introduction

It is proposed to refurbish the west side of the property and to extend the existing basement footprint.

The Finished Floor Level (FFL) of the proposed new basement steps down from 92.85mOD below the footprint of the original property (which equates to an approx. 0.90m excavation) to 92.00mOD below the existing rear extension (a 3.50m excavation).

6.2 Site Preparation Works

The main contractor should be informed of the site conditions and risk assessments should be undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions. It is recommended that extensive searches of existing man-made services are undertaken over the site prior to final design works.

6.3 Ground Model

On the basis of the fieldwork, the ground conditions at the site can be characterised as follows:

- The Made Ground extended down to depths of between 0.70m and 0.90m in the boreholes and of between 0.20m and 1.00m below ground level in trial pits (94.82 to 93.56mOD).

- The Claygate Member consisted of soft becoming firm then stiff silty sandy clay with lenses of silty fine sand which extended to depths/levels between 6.70m (88.82mOD) in Borehole BH1 and 6.00m (88.46mOD) in Borehole WS1. This deposit extends down to the full depth of investigation of 6.00m below ground level in Borehole WS1.

- The London Clay Formation was encountered below the Claygate Member and consisted of stiff silty sandy clay with occasional pockets and partings of silty fine sand and scattered gypsum crystals. This deposit extends down to the full depth of investigation of 15.00m below ground level in Borehole BH1 (80.52mOD).

- Groundwater was encountered at a depth of 2.51m (93.01mOD) within the monitoring standpipe placed in Borehole BH1 and 3.62m (90.84mOD) below ground level within the monitoring standpipe placed in WS1 after a period of approximately three weeks.

6.4 Basement Excavation

Groundwater may be encountered in the basement excavation, but at a low rate of seepage and it would be prudent for the chosen contractor to have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure. Trial excavations to the proposed basement depth could be carried by the main contractor to confirm the stability of the soil and to further investigate the presence of any groundwater inflows.

6.5 Conventional Spread Foundations

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should therefore, be taken through any Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Based on the ground and groundwater conditions encountered in the boreholes and trial pits, it should be possible to support the proposed new development on conventional strip or basement raft foundations taken down below the Made Ground and any weak superficial soils and placed in the natural firm sandy silty clay deposits which occur at depths of between approximately 0.20m and 1.00m below ground level over the site. Foundations should be placed in the natural deposits at a minimum depth of 1.00m below final ground level in order to avoid the zone affected by seasonal moisture content changes.

Using theory from Terzaghi (1943), strip foundations placed within natural soils may be designed to allowable net bearing pressures of approximately 70kN/m^2 at 3.00m depth increasing to 90kN/m^2 at 5.00m depth in order to allow for a factor of safety of 2.5 against general shear failure. The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from “Foundation Design and Construction”, Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

Any soft or loose pockets encountered within otherwise competent formations should be removed and replaced with well compacted granular fill.

In addition, foundations may need to be taken deeper should they be within the zones of influence of both existing or recently felled trees and any proposed tree planting. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, “Building near Trees" and it is considered that this document is relevant in this situation.

6.6 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required. In these ground conditions, it is considered that some form of bored and in-situ cast concrete piled foundation with reinforced concrete ground beams should prove satisfactory.

The construction of a piled foundation is a specialist activity and the advice of a reputable contractor, familiar with the type of soil and groundwater conditions encountered at this site should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of pile chosen and method of installation adopted.

To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

Driven piles could also be used and would develop much higher working loads approximately 2.5 to 3 times higher than bored piles of a similar diameter at the same depth. However, the close proximity of adjacent buildings will in all probability preclude their use due to noise and vibration.

6.7 Retaining Walls

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure's construction. The excavation of the basement must not compromise the integrity of adjacent structures.

The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following design parameters for each element of soil recorded in the relevant exploratory holes are provided in Table 3 below to assist the design of these structures.

Stratum	**Depth to top (mOD)**	**Bulk Density (Mg/m3) (ɣ)**	**Effective Angle of Internal Friction (Φ)**
Made Ground	-	2.00	28
Claygate Member	94.82 to 93.56	2.00	23

Table 3. Retaining Wall Design Parameters

The designer should use these parameters to derive the active and passive earth pressure coefficients ka and kp. The determination of appropriate earth pressure coefficients, together with factors such as the pattern of the earth pressure distribution, will depend upon the type/geometry of the wall and overall design factors.

6.8 Chemical Attack on Buried Concrete

The results of the chemical analyses show the natural soil samples tested to have water soluble sulphate contents of up to 0.19g/litre associated with near neutral to slightly alkaline pH values.

In these conditions, it is considered that deterioration of buried concrete due to sulphate or acid attack is unlikely to occur. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-1 conditions.

However, segregations of gypsum were noted within the London Clay and also are well known to occur within London Clay deposits. Consequently, it is considered that any buried concrete at depth may be attacked by such sulphates in solution and that it would be prudent to design any such concrete in accordance with full Class DS-2 conditions.

6.9 Non-Technical Summary of Chapter 6.0

On the basis of the fieldwork, the ground conditions at the site can be characterised as follows: Made Ground extends to depths of between 0.20m to 1.00m depth below ground level (94.82 to 93.56mOD). This rests upon the Claygate Member underlain by The London Clay Formation to the full depth of investigation of 15.00m below ground level (80.52mOD).

Groundwater may be encountered in the basement excavation, but at a low rate of seepage and it would be prudent for the chosen contractor to have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure's construction. The excavation of the basement must not compromise the integrity of adjacent structures.

Based on the water-soluble sulphate tests carried out as part of these works, it is considered that deterioration of buried concrete due to sulphate or acid attack is unlikely to occur. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-1 conditions.

However, segregations of gypsum were noted within the London Clay and also are well known to occur within London Clay deposits. Consequently, it is considered that any buried concrete at depth may be attacked by such sulphates in solution and that it would be prudent to design any such concrete in accordance with full Class DS-2 conditions.

7.0 BASEMENT IMPACT ASSESSMENT

7.1 Summary

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

Potential Impact	Site Investigation conclusions	Impact sufficiently addressed without further justification?
The site is directly above an aquifer.	The most recent soils investigation has proven that the site lies above the Claygate Member. These are generally aquifers formerly classified as minor aquifers.	No – see below for further details.
The proposed basement extends beneath the water table surface.	It is proposed to excavate to a maximum depth of approximately 3.50m (92.00mOD) through Made Ground into clay strata belonging to the Claygate Beds, which are underlain by a thick deposit of London Clay. Observations made in standpipe piezometers installed in these boreholes indicate a worst case groundwater level at approximately 90.84mOD. This is higher than the proposed dig level of 92.00mOD.	No – see below for further details.
There a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	The Claygate Member was proven below the site and was recorded as having a medium to high susceptibility to shrinkage and swelling. However, the base of proposed basement will extend well below the potential depth of root action.	Yes
The site is within 5m of a highway or pedestrian right of way.	The proposed basement is not to be extended below Heathside and therefore it is suggested that the impact on these access roads is likely to be minimal. There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.	Yes.
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.	The development will result in the extension of the foundation depth of the basement relative to neighbouring properties.	No – see below for further details.

7.2 Outstanding risks and issues

The Site is located directly above a Secondary A Aquifer/ The proposed basement extends beneath the water table surface.

The proposed founding depth for this basement is approximately 3.50m below ground level (92.00mSD). Thus, the basement is expected to be founded in the Claygate Member clays. Groundwater was recorded as being above the depth of the proposed basement at 93.01mOD although it would be recommended to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

The Claygate Member underlying the site is able to transmit small to medium quantities of groundwater and recharge would be by leakage and vertical infiltration across the aquifer outcrop area. Groundwater will also be able to flow through the largely granular Made Ground. Groundwater gradients will follow the local topography and flows and will generally be from north-west to south-east. The groundwater will eventually discharge from the aquifer at a series of small springs and wells located to the edge of its outcrop area around 80m south-east of the site.

The presence of sandy lenses within the Claygate Member means the natural flow of groundwater below the site will be able to continue to flow around the new basement. This behaviour is acknowledged in the Camden GHHS which noted that even extensive excavations for basements in the City of London have not caused any serious problems in 'damming' groundwater flow, with groundwater simply finding an alternative route (Arup, 2010, paragraph 205). On this basis, it is not considered that the proposed basement would result in a significant change to the groundwater flow regime in the vicinity of the proposal.

The results of the in-situ rising head permeability test in the October 2017 investigation (Appendix A) indicates an apparent permeability or soil infiltration rates of between 1.34 x 10^{-6} m/sec and 3.23 x 10^{-7} m/sec within the Claygate Member. This soil infiltration rate lies within the range of published data for fissured and weathered clays and intact clays and is classed as being low to very low permeability material and therefore corresponding flow rates are also expected to be very low. As an added precaution, once heavy machinery is on-site, trial excavations to the proposed basement depth could be carried by the main contractor to confirm the stability of the soil and to further investigate the presence of any groundwater inflows.

The proposed basement will need to be fully waterproofed in order to provide adequate long-term control of moisture ingress from the groundwater. Detailed recommendations for the waterproofing system are beyond the scope of this report, although it is noted that, as a minimum, it would be prudent for the system to be designed in compliance with the requirements of BS8102:2009.

Due care and attention should be paid to ensure that no contamination incidents occur as a result of the development. No change to the existing drainage arrangements is proposed and therefore existing rates of rainfall infiltration and groundwater recharge will remain unchanged.

The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. This will require close collaboration with the appointed contractor's temporary works coordinator.

The Party Wall Act (1996) will apply to this development because neighbouring houses lie within a defined space around the proposed building works. The party wall process should be followed and adhered to during this development.

A ground movement assessment was carried out at the site by Fairhurst under the instruction of Site Analytical Services Limited (Report Reference 125183/R0). The report is provided as Appendix B to this report and concludes that provided that appropriate consideration is given to the detailed design of party wall and return wall junctions with the basement in order to limit future movement, that good workmanship and construction sequences are used with appropriate support during excavations and that groundwater management is employed, then the proposed basement construction is unlikely to cause significant damage to the surrounding structures. Based on the predicted ground movements, the adjacent structures are expected to be within the CIRIA C760 Damage Category 1 (Very Slight).

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. Monitoring should take place in advance of the proposed works as a base-line survey, during the works and for a period following the completion of the works, to understand the long term effects.

Change in paved surfacing and surface water runoff.

As identified in the initial screening and scoping stages there will be a small change in the amount of hard surfacing at the site where the property will be constructed and as a result total surface water flows may decrease.

Overall it is concluded that the surface water flows will not materially change in response to the small increase in hardstanding. On completion of the development the surface water flows will be routed in a similar way to the existing condition, with rainwater run-off collected in a surface water drainage system and discharged to a combined sewer. It will not be necessary to consider additional mitigation measures such as SUDS or soft landscaping over to reduce the rate of any surface water run-off.

7.3 Advice on Further Work and Monitoring

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. Monitoring should take place in advance of the proposed works as a base-line survey, during the works and for a period following the completion of the works, to understand the long term effects.

It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

7.4 Non-Technical Summary of Chapter 7.0

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. It is not considered that the proposed basement would result in a significant change to the groundwater flow regime in the vicinity of the proposal. Also, given limited scope of the scheme and limited increase in impermeable areas, the scheme is also considered compliant with the surface water management and flood risk elements of NPPF and Camden policy.

Given good workmanship, the basement to South Lodge can be constructed without imposing more than Very Slight damage on the adjoining properties. The development is not likely to significantly affect the existing local groundwater regime.

It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations.

8.0 REFERENCES

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9. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

10. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

8.0 APPENDIX A. GROUND INVESTIGATION FACTUAL REPORT

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Your Ref:

Our Ref: **Ref: 17/27399-1**
April 2018

SOUTH LODGE, HEATHSIDE,

HAMPSTEAD, LONDON, NW3 1BL

FACTUAL REPORT ON A GROUND INVESTIGATION

Prepared for

Elliott Wood Partnership Limited

Acting on behalf of

Nick and Amanda Raphael

Site Analytical Services Ltd.

Project: South Lodge, Heathside, Hampstead, NW3 1BL
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Author: Aubrey Davidson BSc MSc DIC. Senior Environmental Engineer [redacted]

CONTENTS

1.0 INTRODUCTION

1.1 Outline and Limitations of Report

At the request of Elliott Wood Partnership Limited, acting on behalf of Nick and Amanda Raphael, a ground investigation was carried out in connection with a proposed residential basement development at the above site. A Phase 1 Preliminary Assessment (Desk Study) is presented under separate cover in Site Analytical Services Limited Report Reference 17/27399.

The information was required for the design and construction of foundations and infrastructure for the proposed development at the existing site.

The recommendations and comments given in this report are based on the ground conditions encountered in the exploratory holes made during the investigation and the results of the tests made in the field and the laboratory. It must be noted that there may be special conditions prevailing at the site remote from the exploratory hole locations which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

2.0 SITE DETAILS

(National Grid Reference: TQ 268 860)

2.1 Site Location

South Lodge is a residential property, located on the north-western side of Heathside, Hampstead at approximate postcode NW3 1BL. The residential dwelling has five levels of accommodation; basement, ground, first, second and third floor. The site covers an approximate area of 0.19 Hectares with the general area being under the authority of the London Borough of Camden.

The site is located on the north-western side of Heathside with residential properties to the north-west, south-west and north-east and a roadway to the south-east.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, ‘North London’, Solid and Drift Edition) indicates the site to be underlain the Claygate Member.

The British Geological Survey maintains an archive of historical exploratory borehole logs throughout the UK. SAS Limited has searched the database and have found that there is one borehole located within 150m of the site. This is located 111m to the north-west of the site and reveals Made Ground to a depth of 1.20m underlain by the Claygate Member to a depth of 1.5m with the London Clay at depth.

2.3 Previous Investigations

A Phase 1 Preliminary Assessment (PRA) (SAS Report Ref: 17/27399, dated April 2018) has been undertaken across the site by Site Analytical Services Limited.

3.0 SCOPE OF WORK

3.1 Site Works

The proposed scope of works was agreed by the client prior to the commencement of the investigations. To achieve this, the following works were undertaken:-

- The drilling of one rotary percussive borehole to a depth of 15.00m below ground level (Borehole 1).
- The drilling of one continuous flight auger borehole to a depth of 6.00m below ground level (WS1).
- The installation of a groundwater monitoring standpipes to a depth of approximately 6m below ground level in BH1 and WS1.
- The excavation by hand of seven trial pits to a maximum depth of 1.50m below ground level (Trial Pits 1 to 7 inclusive) to expose existing foundations on site.
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the boreholes and trial pits.
- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes.
- Factual reporting on the results of the investigation.

3.2 Ground Conditions

The locations of the exploratory holes are shown on the site sketch plan, Figure 1.

The boreholes and trial pits revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness (unproven in TP6) resting on deposits of the Claygate Formation with the London Clay Formation at depth.

These ground conditions are summarised in the following table. For detailed information on the ground conditions encountered in the boreholes, reference should be made to the exploratory hole records presented in Appendix A.

Strata	Depth to top of strata (mbgl)	Level to top of strata (mOD)	Depth to base of strata (mbgl)	Level to base of strata (mOD)	Description
Made Ground	0.00	95.52 to 94.46	0.20 to 1.00	94.82 to 93.56	Grass / Clay tiled floor/ pea shingle over silty sandy gravelly clay
Claygate Formation	0.20 to 1.00	94.82 to 93.56	6.00-6.70	88.82	Soft becoming firm then stiff silty sandy CLAY.
London Clay Formation	6.00-6.70	88.82	15.00 (base of BH 1)	80.52(base of BH 1)	Stiff silty very sandy clay with gypsum crystals

Table A: Summary of Ground Conditions in Exploratory Holes

3.3 Groundwater

Groundwater was not encountered in any of the trial pits during site works and the material remained essentially dry throughout. Groundwater was encountered in Boreholes BH1 and WS1, as detailed in Table B below.

Exploratory Hole	Depth (m)	Notes	Stratum
BH1	4.00	Rose to 3.80m in 20 minutes	Claygate Member
WS1	5.80	Slight Seepage	Claygate Member

Table B: Groundwater Strike Summary

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and hence be detected, particularly within more cohesive soils.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

Groundwater was encountered at a depth of 2.51m (93.01mOD) within the monitoring standpipe placed in Borehole BH1 and 3.62m (90.84mOD) below ground level within the monitoring standpipe placed in WS1 after a period of approximately three weeks.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (October and November 2017) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

4.0 IN-SITU TESTING AND LABORATORY TESTS

4.1 Standard Penetration Tests

The results of the Standard Penetration Tests carried out in the natural soils are shown on the exploratory hole records in Appendix A.

4.2 Undrained Triaxial Compression Test Results

Undrained Triaxial Compression tests were carried out on two undisturbed 100mm diameter samples taken from within Borehole 1.

The test results are given in Table 1, contained in Appendix B.

4.3 In-situ Tests

In the essentially cohesive natural soils encountered at the site, in-situ shear vane tests were made at regular depth increments in order to assess the undrained shear strength of the materials. The results indicate that the natural soils are of a generally high strength in accordance with BS 5930 (2015).

The results of the in-situ tests are shown on the appropriate exploratory hole records contained in Appendix A.

4.4 Classification Tests

Atterberg Limit tests were conducted on six samples taken at depth in Boreholes BH1 and WS1 showed the samples tested to fall into Classes CI and CI/CH according to the British Soil Classification System.

The test results are given in Table 2, contained in Appendix B.

4.5 Sulphate and pH Analyses

The results of the sulphate and pH analyses made on six samples are presented on Table 3, contained in Appendix B.

5.0 WASTE ACCEPTANCE CRITERIA TESTING

5.1 Waste Acceptance Criteria Analysis

Sample were obtained from 1.75m depth below ground level in Borehole 1 and 0.75m in Borehole WS1 made at the locations indicated on the site sketch plan (Figure 1).

The samples selected for analysis were sub-contracted to QTS Environmental Limited (a UKAS and MCERTS accredited laboratory) and their report is contained in Appendix B.

The samples were analysed using the Catwastesoil assessment tool, which concluded that the samples were not hazardous in nature.

The samples were analysed for Waste Acceptance Criteria Testing in order to classify soils on site for disposal purposes.

For the purpose of waste disposal, the soil samples would be classified as:

BH1 @ 1.75m	***Inert Waste***
WS1 @ 0.75m	***Inert Waste***

6.0 REFERENCES

1. British Standards Institution, 1986. Code of practice for foundations, BS 8004, BSI, London.

2. British Standards Institution, 1990. Methods for test for soils for civil engineering purposes, BS1377, BSI, London

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5. British Standards Institution, 2004. Geotechnical Design, BS EN 1997-1 BSI, London

6. Building Research Establishment Special Digest 1, 2005, "Concrete in Aggressive Ground – Third Edition."

7. Driscoll, R (1983) "The influence of vegetation on the shrinking and swelling of clay soils in Great Britain", Geo-technique 33, 93-107

8. Eurocode 1: Actions on structures – BS EN 1991-1-1:2002: General actions – Densities, self weight and imposed loads, BSI, London

9. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

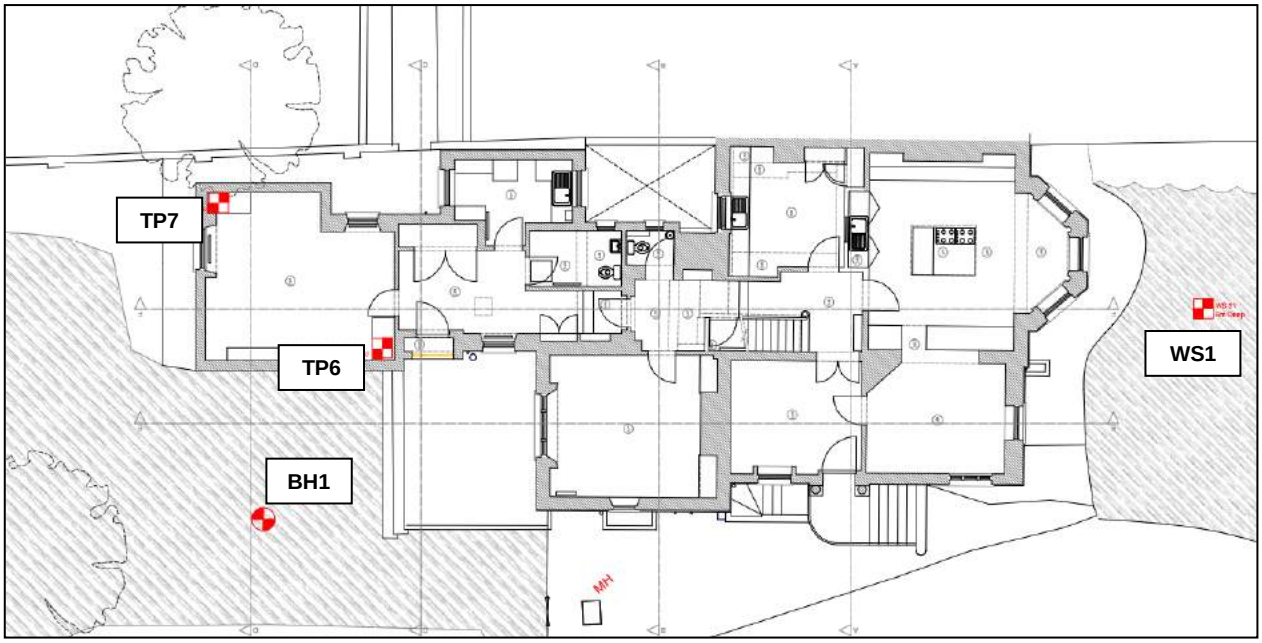
10. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

11. Stroud M.A. and Butler F.G. (1975) Symposium on the Engineering Behaviour of Glacial Materials; the Midland Soil Mechanics and Foundation Engineering Society; pgs 124 et seq.

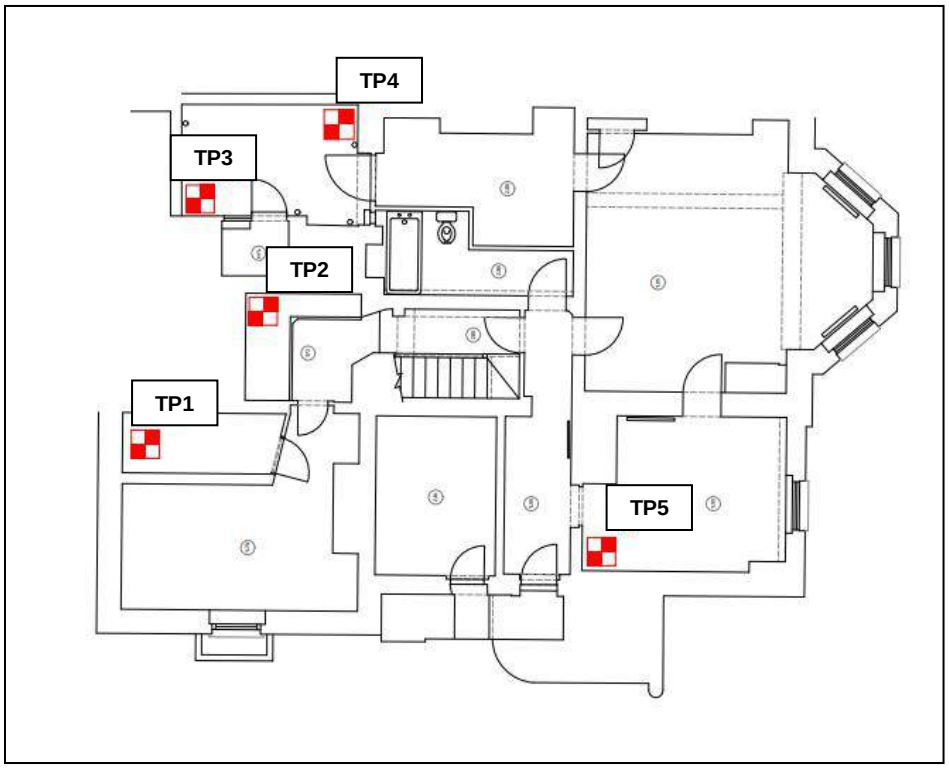
12. Tomlinson, M J, 2001. “Foundation Design and Construction”, Seventh Edition, Prentice Hall (ISBN 0-13-031180-4).

Site Analytical Services Ltd.				REF: 17/27399-1
LOCATION:	South Lodge, Heathside, Hampstead, NW3 1BL			FIG: 1
TITLE:	Site Sketch Plan	DATE:	April 2018	SCALE: NTS

Ground Floor Level



Basement Level



A P P E N D I X `A'

Borehole / Trial Pit Logs

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSIVE	128mm cased to 0.00m	95.52	NICK AND AMANDA RAPHAEL	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: Pea shingle over dark brown silty clayey sand with fragments of brick and concrete rubble		
0.25	D1				95.22	0.30			
0.50	D2					(0.40)	MADE GROUND: Light brown silty sandy clay with fragments of brick and concrete rubble		
0.75	D3				94.82	0.70			
1.00-1.45 1.00	SPT(C) N=5 D4		DRY	1,0/1,1,2,1			Soft becoming firm, mottled light brown orange grey silty sandy CLAY		
1.75	D5								
2.00-2.45	U1			45 blows		(2.80)			
2.75	D6								
3.00-3.45 3.00	SPT N=8 D7		DRY	1,2/2,2,2,2					
					92.02	3.50	Firm, blue grey silty sandy CLAY with lenses of silty fine sand		
3.75	D8								▼1 ▽1
				Slight Seepage(1) at 4.00m, rose to 3.80m in 20 mins.					
4.00-4.45	U2			30 blows					
4.75	D9								
5.00-5.45 5.00	SPT N=10 D10		3.80	2,2/3,2,2,3		(3.20)			
6.00	D11								
6.50-6.95	U3			55 blows					
					88.82	6.70	Stiff, brown orange very silty very sandy CLAY with partings of silty find sand and occasional gypsum crystals		
7.50	D12								
8.00-8.45 8.00	SPT N=14 D13		3.80	2,3/4,3,3,4		(3.30)			
9.00	D14								
9.50-9.95 9.50	SPT N=16 D15		3.80	3,3/4,3,4,5					

Remarks
D= Disturbed Sample
U= Undisturbed 100mm Diameter Sample
C= Dynamic Penetration Test - Cone
S= Standard Penetration Test - Cone
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 1727399.BH1

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSIVE	128mm cased to 0.00m	95.52	NICK AND AMANDA RAPHAEL	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					85.52	10.00	Stiff, brown orange very silty very sandy CLAY with partings of silty find sand and occasional gypsum crystals		
10.50	D16								
11.00-11.45	SPT N=18		3.80	3,4/4,4,5,5					
11.00	D17								
12.00	D18								
12.50-12.95	SPT N=19		3.80	4,3/4,5,5,5		(5.00)			
12.50	D19								
13.75	D20								
14.55-15.00	SPT N=23		3.80	4,5/5,6,6,6					
14.55	D21								
					80.52	15.00	Complete at 15.00m		

Remarks
D= Disturbed Sample
U= Undisturbed 100mm Diameter Sample
C= Dynamic Penetration Test - Cone
S= Standard Penetration Test - Cone

Scale (approx)	Logged By
1:50	EW

Figure No. 1727399.BH1

Site Analytical Services Ltd.

Standard Penetration Test Results

Site : SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL

Client : NICK AND AMANDA RAPHAEL

Engineer : ELLIOTTWOOD PARTNERSHIP LTD

Job Number 1727399

Sheet 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH1	1.00	1.15	1.45	CPT	1	0	1	1	2	1	N=5	
BH1	3.00	3.15	3.45	SPT	1	2	2	2	2	2	N=8	
BH1	5.00	5.15	5.45	SPT	2	2	3	2	2	3	N=10	
BH1	8.00	8.15	8.45	SPT	2	3	4	3	3	4	N=14	
BH1	9.50	9.65	9.95	SPT	3	3	4	3	4	5	N=16	
BH1	11.00	11.15	11.45	SPT	3	4	4	4	5	5	N=18	
BH1	12.50	12.65	12.95	SPT	4	3	4	5	5	5	N=19	
BH1	14.55	14.70	15.00	SPT	4	5	5	6	6	6	N=23	

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	BH1

Installation Type
Single Installation

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 128 mm

Client
NICK AND AMANDA RAPHAEL

Job Number
1727399

Location
TQ268860

Ground Level (mOD)
95.52

Engineer
ELLIOTTWOOD PARTNERSHIP LTD

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			94.52	1.00	Bentonite Seal
	▼1 ▽1				Slotted Standpipe
			89.52	6.00	Bentonite Seal
			88.52	7.00	
			80.52	15.00	General Backfill

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
16/10/17		4.00	0.00	Slight Seepage				3.80	

Groundwater Observations During Drilling

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

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Lockable cover set in cement

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	WS1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	128mm cased to 0.00m	94.46	NICK AND AMANDA RAPHAEL	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: Grass over dark brown sandy clay with fragments of brick and concrete rubble and small roots		
0.25	D1				94.16	0.30			
					94.06	0.40	MADE GROUND: Dark brown slightly gravelly sandy clay		
0.50	D2				93.86	(0.20) 0.60			
						(0.30)	MADE GROUND: Dark brown slightly gravelly fine to coarse grained sand		
0.75	D3				93.56	0.90			
1.00	D4						MADE GROUND: Brown fine to coarse grained sand with fragments of brick and concrete rubble		
1.00	V1 113								
							Stiff, brown slightly gravelly slightly silty sandy CLAY with lenses of silty fine sand		
1.50	D5					(1.40)			
1.50	V2 115								
2.00	D6								
2.00	V3 130+				92.16	2.30			
							Stiff, mottled brown grey orange silty sandy CLAY with lenses of silty fine sand		
2.50	D7								
2.50	V4 130+								
3.00	D8								
3.00	V5 125					(2.10)			
3.50	D9								
3.50	V6 122								
4.00	D10								
4.00	V7 115								
					90.06	4.40			
4.50	D11						Stiff, dark grey blue silty sandy CLAY with lenses of silty fine sand		
4.50	V8 128								
5.00	D12								
5.00	V9 130+					(1.60)			
									▽1
				Slight Seepage(1) at 5.80m.					
6.00	D13				88.46	6.00			
6.00	V10 130+						Complete at 6.00m		

Remarks
D= Disturbed Sample
V= Vane Test - Results in kPa
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 1727399.WS1

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	WS1

Installation Type
Single Installation

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 100 mm

Client
NICK AND AMANDA RAPHAEL

Job Number
1727399

Location
TQ268860

Ground Level (mOD)
94.46

Engineer
ELLIOTTWOOD PARTNERSHIP LTD

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			93.46	1.00	Bentonite Seal
	▽1		88.46	6.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
16/10/17		5.80	0.00	Slight Seepage					

Groundwater Observations During Drilling

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

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks

Remarks
Lockable cover set in cement

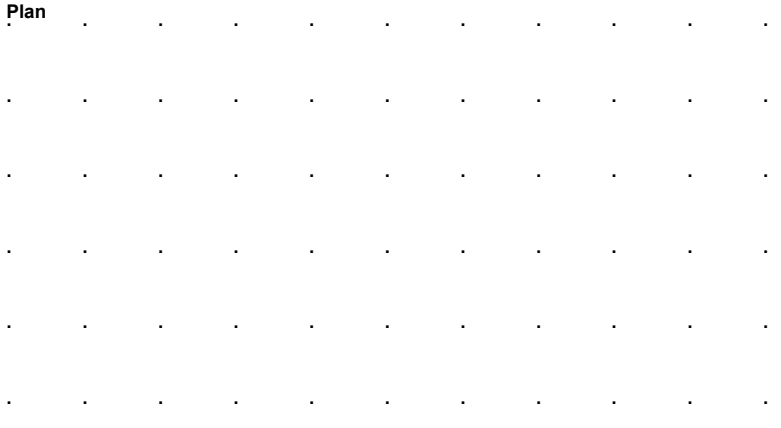
Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location	**Dates**	**Engineer**	**Sheet**
	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07			
					(0.13)	MADE GROUND: Red clay tiled floor over red brick		
					0.20			
0.25	D1					MADE GROUND: Dark brown gravelly sandy clay with fragments of brick		
0.50	D2				(0.80)			
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00			
						Complete at 1.00m		

Plan



Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

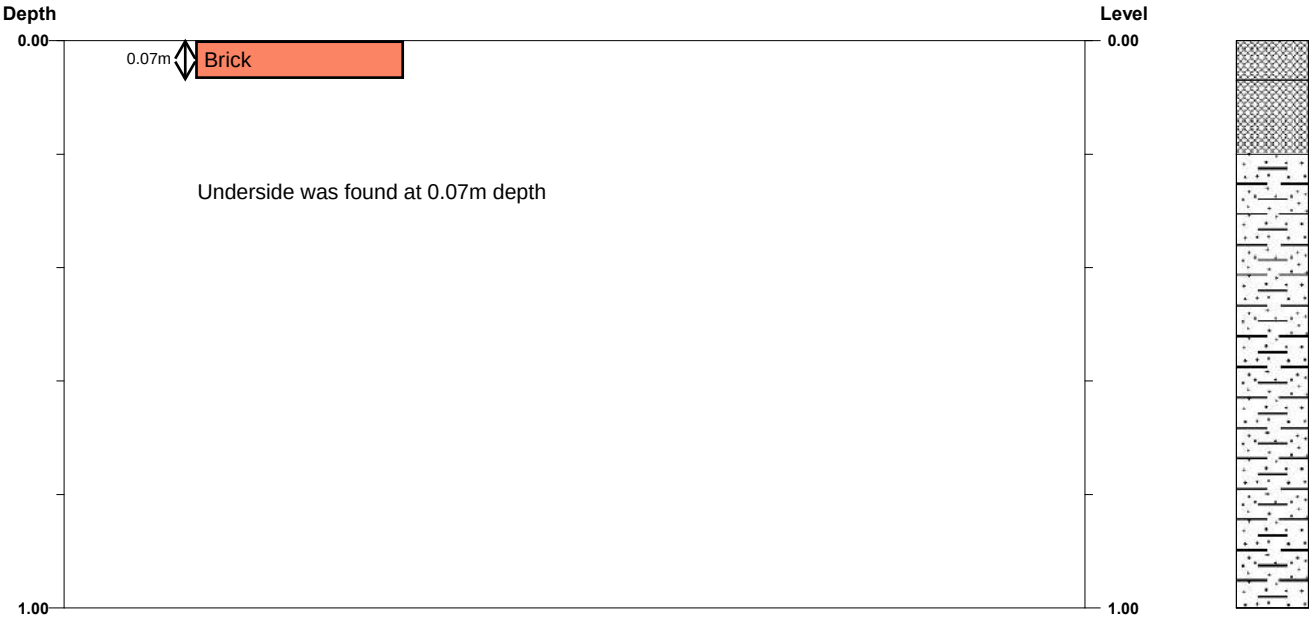
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP1A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Red clay tiled floor over red brick
0.07-0.20	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick
0.20-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP1A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location	**Dates**	**Engineer**	**Sheet**
	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07			
					(0.13)	MADE GROUND: Red clay tiled floor over red brick		
					0.20			
0.25	D1					MADE GROUND: Dark brown gravelly sandy clay with fragments of brick		
0.50	D2				(0.80)			
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00			
						Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

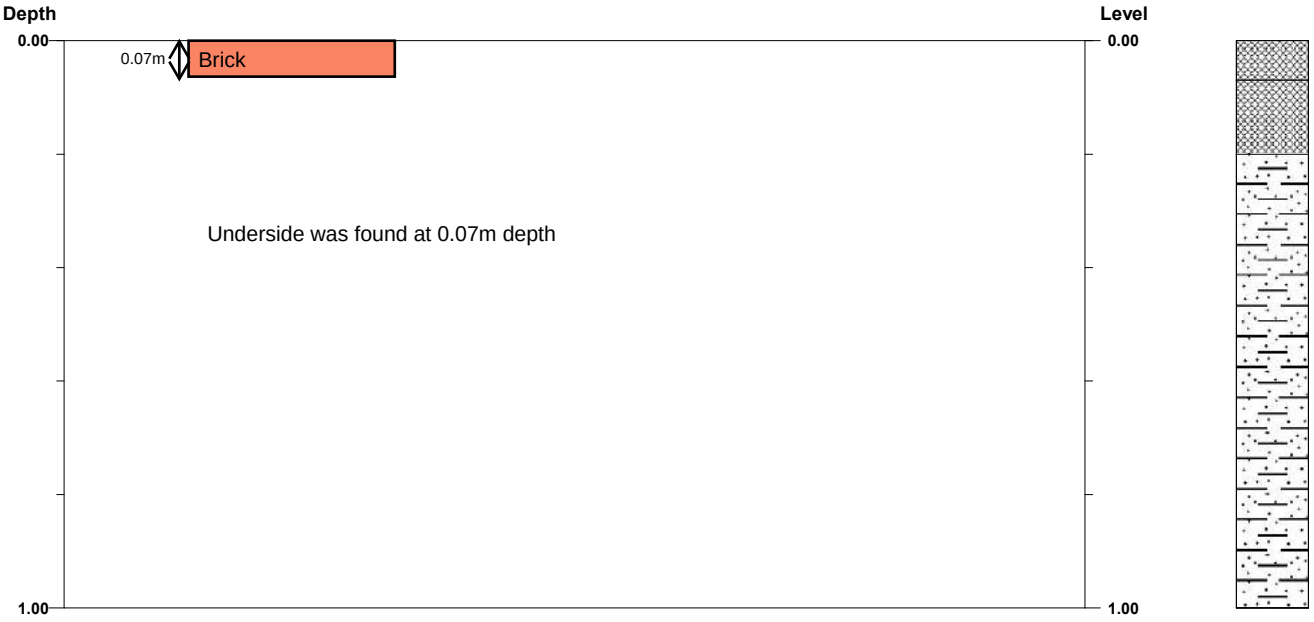
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP1B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Red clay tiled floor over red brick
0.07-0.20	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick
0.20-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP1B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Red clay tiled floor		
					0.16	MADE GROUND: Concrete		
0.25	D1				0.20	MADE GROUND: Hardcore		
0.50	D2				(0.80)	Mottled brown very sandy CLAY		
0.75	D3							
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

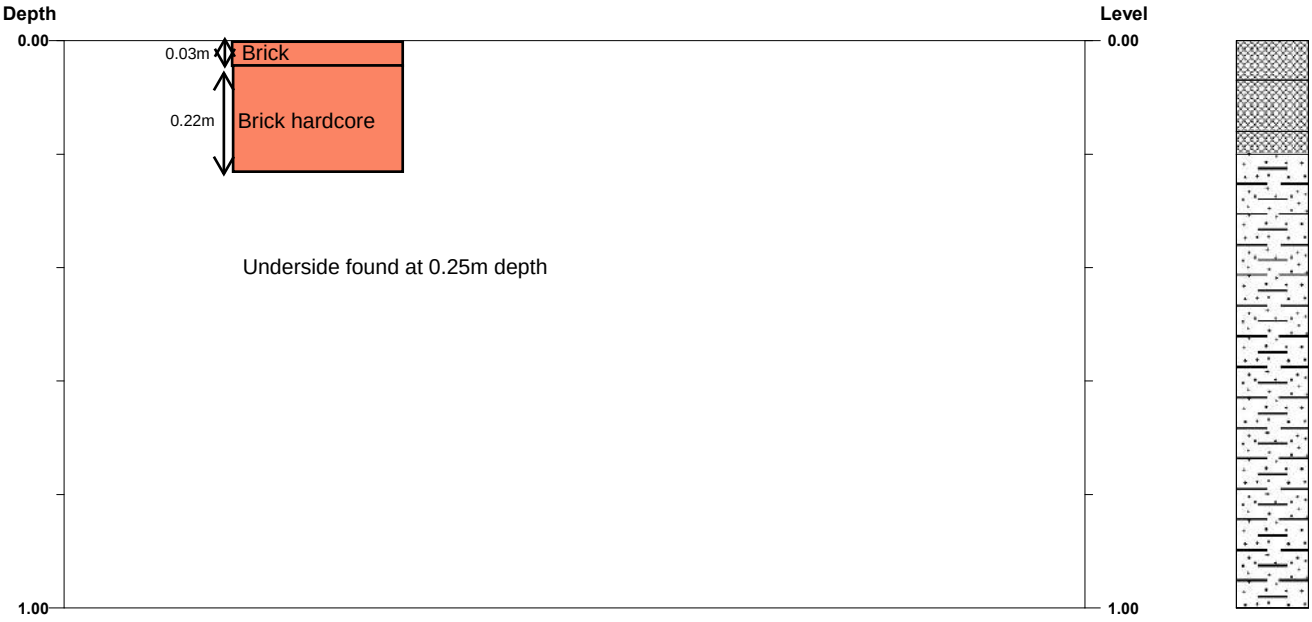
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP2

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP2

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Red clay tiled floor
0.07-0.16	2	MADE GROUND: Concrete
0.16-0.20	3	MADE GROUND: Hardcore
0.20-1.00	4	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP2

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location	**Dates**	**Engineer**	**Sheet**
	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.08	MADE GROUND: Red quarry tiles over sand and cement		
0.25	D1				(0.64)	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash		
0.50	D2				0.72			
0.75	D3				(0.28)	Mottled brown very sandy CLAY		
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

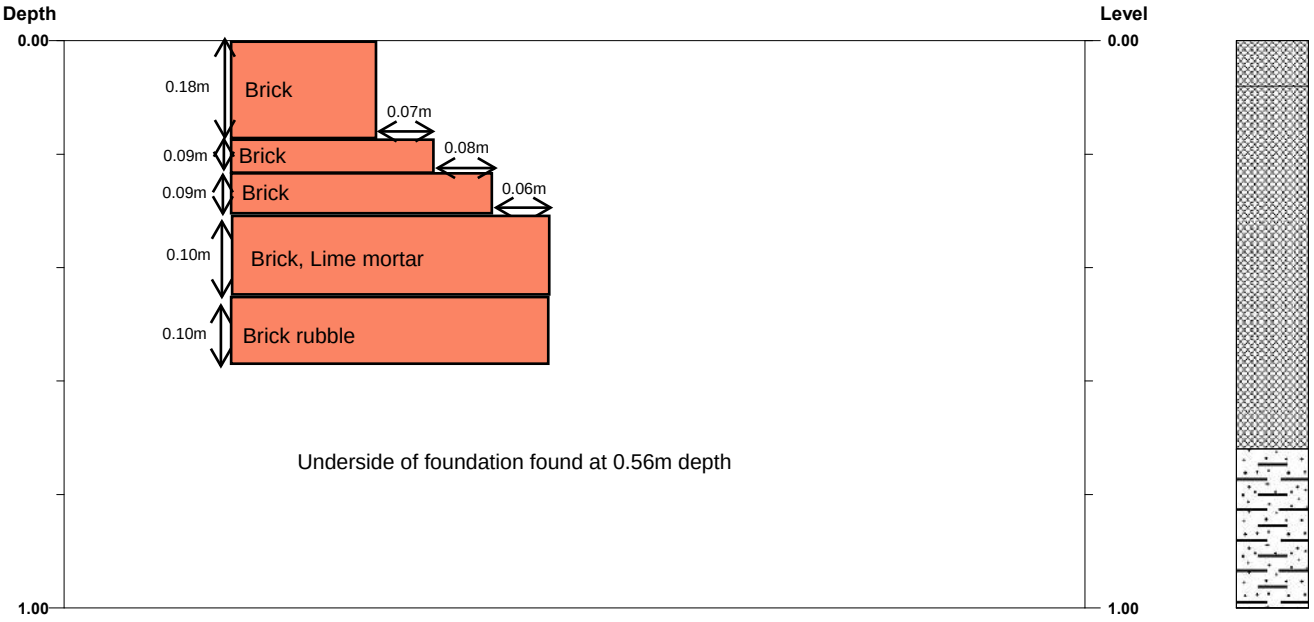
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP3

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A D B C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.08	1	MADE GROUND: Red quarry tiles over sand and cement
0.08-0.72	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash
0.72-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:

HAND EXCAVATION

Shoring / Support:

N/A

Stability:

GOOD

Backfill:

ARISINGS

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP4

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.12	MADE GROUND: Red quarry tiles over sand and cement		
					(0.18)			
0.25	D1				0.30	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash		
0.50	D2				(0.70)	Mottled brown very sandy CLAY		
0.75	D3							
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

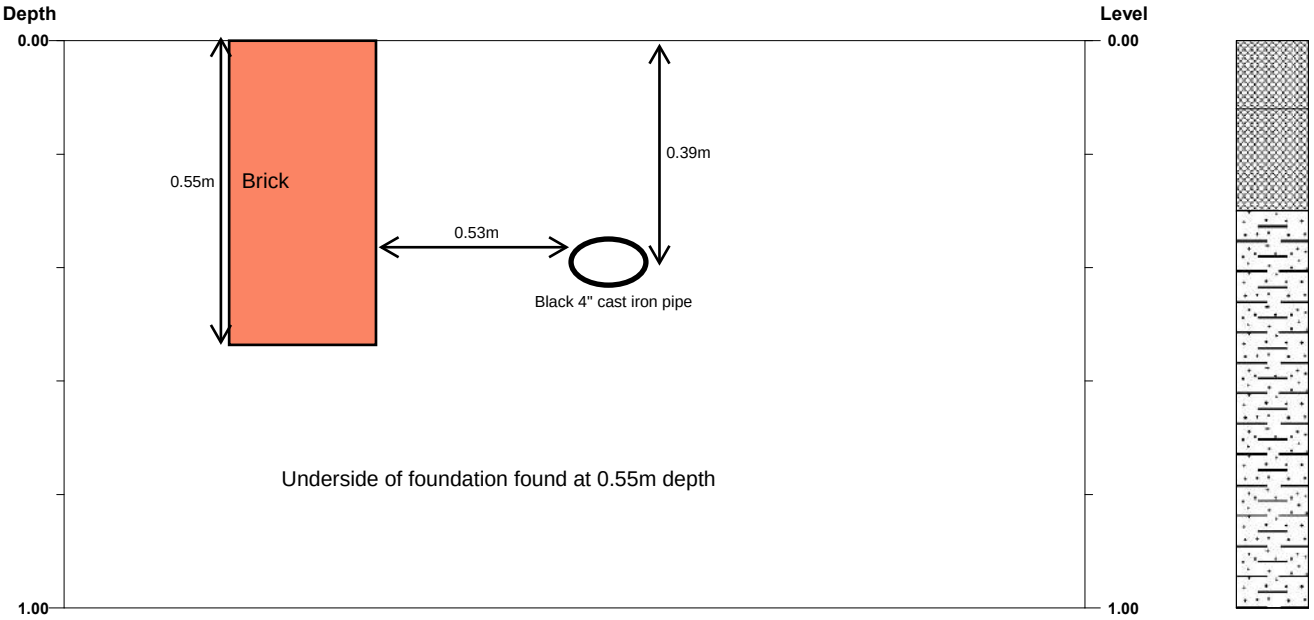
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP4

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.12	1	MADE GROUND: Red quarry tiles over sand and cement
0.12-0.30	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash
0.30-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07			
					(0.13)	MADE GROUND: Clay tiled floor		
					0.20			
0.25	D1				0.23	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints		
0.50	D2				(0.77)	MADE GROUND: Brick rubble		
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

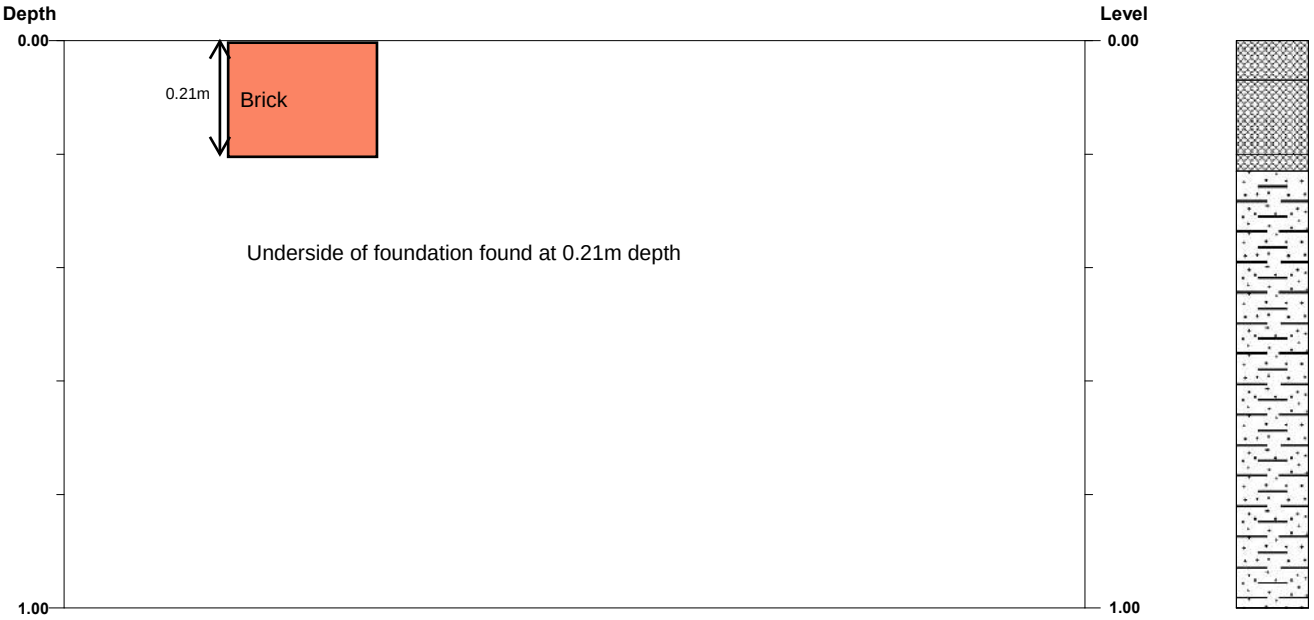
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP5A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Clay tiled floor
0.07-0.20	2	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints
0.20-0.23	3	MADE GROUND: Brick rubble
0.23-1.00	4	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP5A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Clay tiled floor		
					(0.13)			
					0.20	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints		
0.25	D1				0.23			
0.50	D2				(0.77)	MADE GROUND: Brick rubble		
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

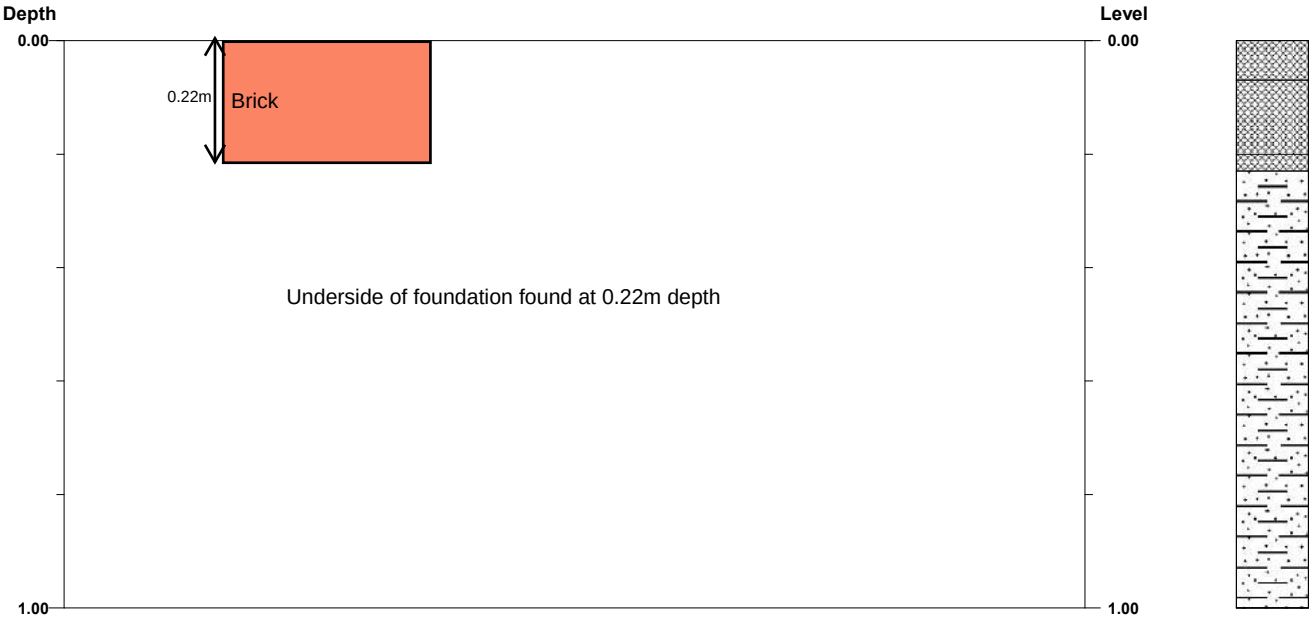
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP5B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Clay tiled floor
0.07-0.20	2	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints
0.20-0.23	3	MADE GROUND: Brick rubble
0.23-1.00	4	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP5B

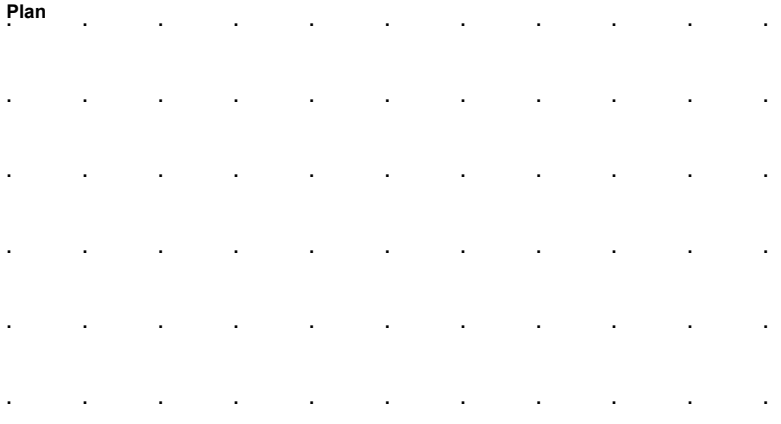
Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location	**Dates**	**Engineer**	**Sheet**
	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.25	D1				0.07 (0.24) 0.31	MADE GROUND: Timber floor boards		
0.50	D2				0.43 (0.20)	MADE GROUND: Timber joist		
0.75	D3				0.63 (0.37)	MADE GROUND: Concrete		
1.00	D4				1.00	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble		
						MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble		
						Complete at 1.00m		

Plan



Remarks

Groundwater is not encountered during boring/excavation
D= Disturbed Sample

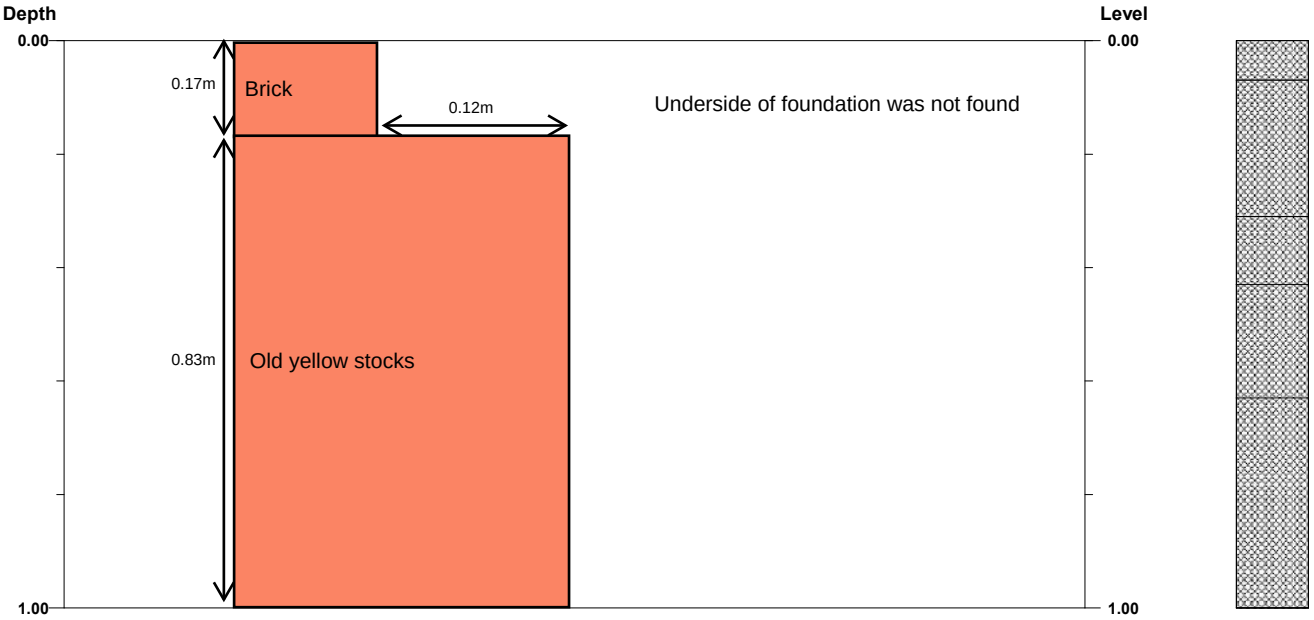
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP6A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A D B C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.31	2	MADE GROUND: Timber joist
0.31-0.43	3	MADE GROUND: Concrete
0.43-0.63	4	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble
0.63-1.00	5	MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
Groundwater is not encountered during boring/excavation
D= Disturbed Sample

Logged By : EW
Checked By :
Figure No. : 1727399.TP6A

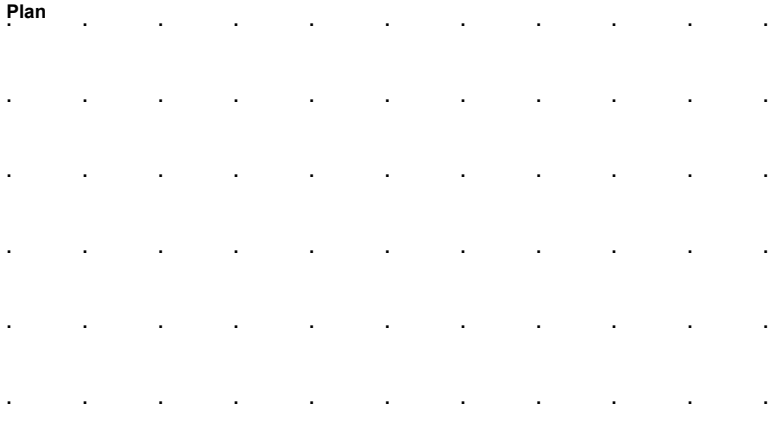
Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location	**Dates**	**Engineer**	**Sheet**
	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Timber floor boards		
					(0.24)			
0.25	D1				0.31	MADE GROUND: Timber joist		
					0.43			
0.50	D2				(0.20)	MADE GROUND: Concrete		
					0.63			
0.75	D3				(0.37)	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble		
1.00	D4				1.00	MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble		
						Complete at 1.00m		

Plan



Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

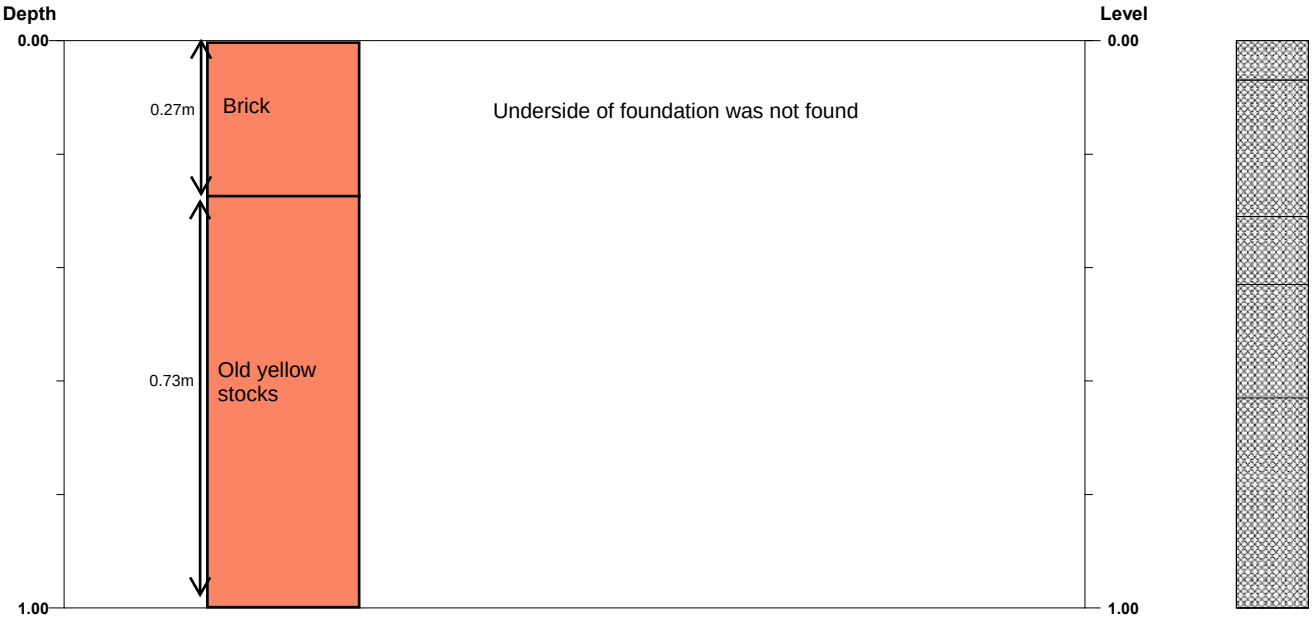
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP6B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.31	2	MADE GROUND: Timber joist
0.31-0.43	3	MADE GROUND: Concrete
0.43-0.63	4	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble
0.63-1.00	5	MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP6B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location	**Dates**	**Engineer**	**Sheet**
	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Timber floor boards		
					0.18			
0.25	D1				0.30	MADE GROUND: Timber joist		
0.50	D2				0.42	MADE GROUND: Concrete		
0.75	D3				(0.58)	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash		
1.00	D4				1.00	Mottled brown sandy CLAY		
						Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

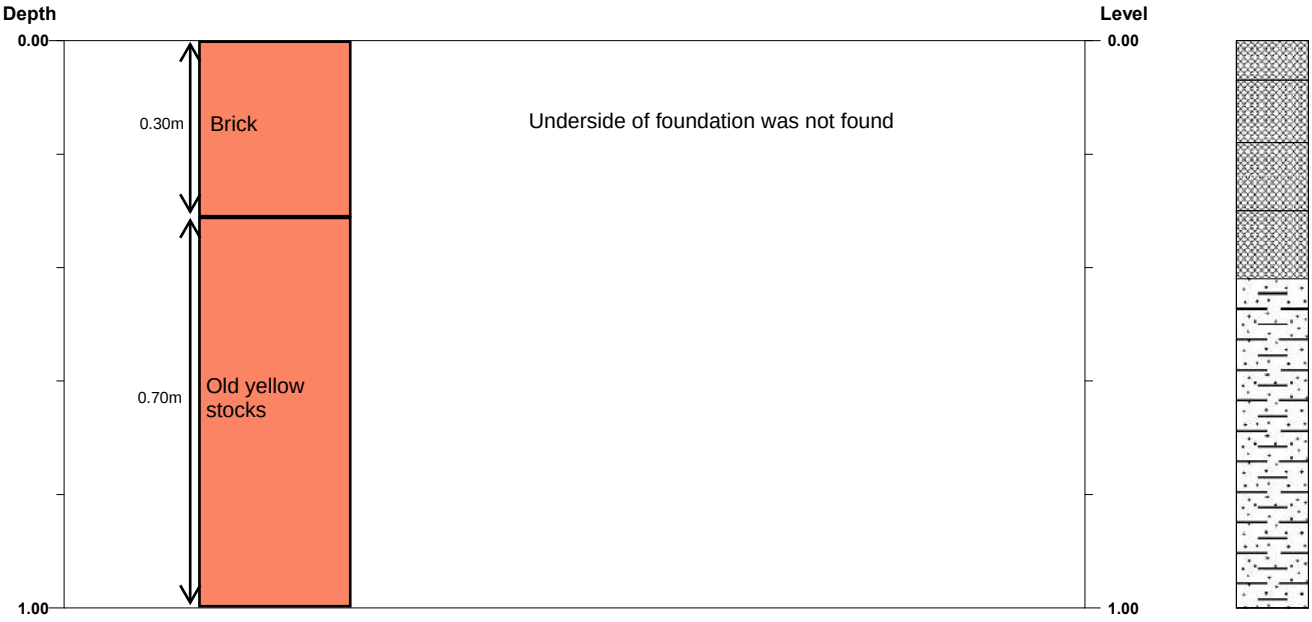
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP7A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.18	2	MADE GROUND: Timber joist
0.18-0.30	3	MADE GROUND: Concrete
0.30-0.42	4	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash
0.42-1.00	5	Mottled brown sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 1727399.TP7A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399
	Location	**Dates**	**Engineer**	**Sheet**
	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Timber floor boards		
					0.18			
0.25	D1				0.30	MADE GROUND: Timber joist		
0.50	D2				0.42	MADE GROUND: Concrete		
0.75	D3				(0.58)	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash		
1.00	D4				1.00	Mottled brown sandy CLAY		
						Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

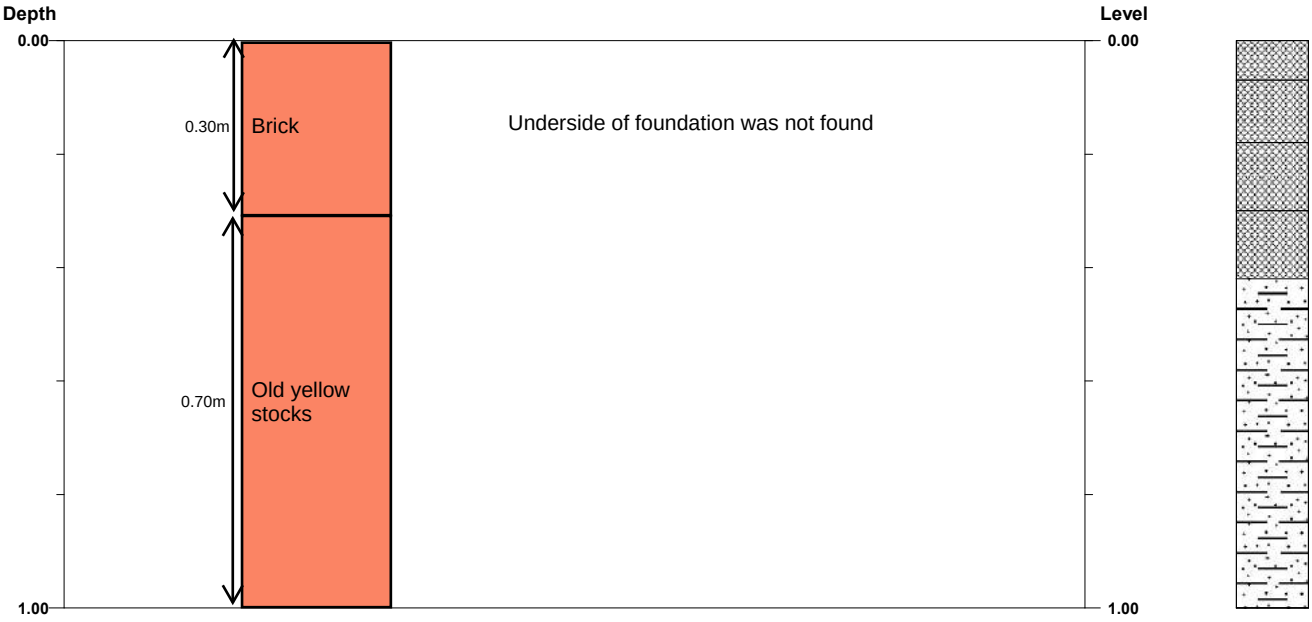
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP7B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		NICK AND AMANDA RAPHAEL	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017	ELLIOTTWOOD PARTNERSHIP LTD	1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.18	2	MADE GROUND: Timber joist
0.18-0.30	3	MADE GROUND: Concrete
0.30-0.42	4	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash
0.42-1.00	5	Mottled brown sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP7B

A P P E N D I X `B'

In-situ, Laboratory Test & Groundwater Monitoring Data

Site Analytical Services Ltd.

			Site SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	**Borehole Number** WS1
In Situ Permeability Type Falling Head	**Test No.** 1	**Ground Level (mOD)**	**Client** NICK AND AMANDA RAPHAEL	**Job Number** 1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 1/2

Height of casing above ground level:	0.00 **m**
Depth to Base of Borehole:	6.00 **m bgl**
Depth to Base of Casing:	1.00 **m bgl**
Depth to equilibrium water level:	5.80 **m btoc**
Test Length L:	5.00 **m**
Diameter of Test Length D:	0.05 **m**
Area of Test Section:	0.0020 **m2**
Intake Factor F: (after condition B, figure 6, BS 5930)	0.1375

PERMEABILITY (after Hvorslev, 1951)

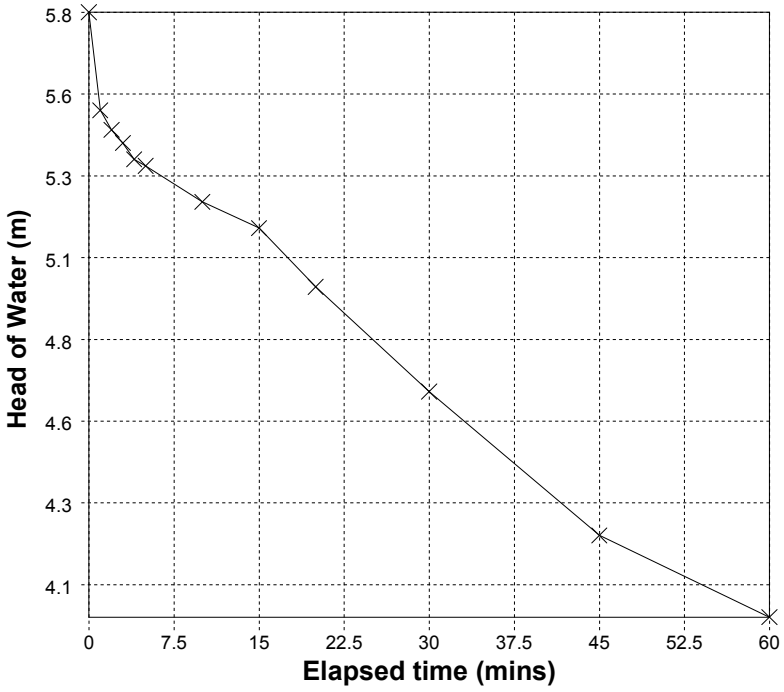
General Approach

H1 selected at t= 5.49 mins (=t1 = 60.6 secs)

H2 selected at t= 3.937 mins (=t2 = 3610.2 secs)

k = 1.34E-06 **ms-1**

Elapsed time (mins)	Depth to water (m btoc)	Head of Water, H (m)	Ht / Ho
0.0	0.000	5.800	1.000
1.0	0.300	5.500	0.948
2.0	0.360	5.440	0.938
3.0	0.400	5.400	0.931
4.0	0.450	5.350	0.922
5.0	0.470	5.330	0.919
10.0	0.580	5.220	0.900
15.0	0.660	5.140	0.886
20.0	0.840	4.960	0.855
30.0	1.160	4.640	0.800
45.0	1.600	4.200	0.724
60.0	1.850	3.950	0.681



Remarks

Key: bgl = Below Ground Level btoc = Below Top of Casing

Site Analytical Services Ltd.

			Site SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	**Borehole Number** WS1
In Situ Permeability Type Falling Head	**Test No.** 2	**Ground Level (mOD)**	**Client** NICK AND AMANDA RAPHAEL	**Job Number** 1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer** ELLIOTTWOOD PARTNERSHIP LTD	**Sheet** 2/2

Height of casing above ground level:	0.00 **m**
Depth to Base of Borehole:	6.00 **m bgl**
Depth to Base of Casing:	1.00 **m bgl**
Depth to equilibrium water level:	5.80 **m btoc**
Test Length L:	5.00 **m**
Diameter of Test Length D:	0.05 **m**
Area of Test Section:	0.0020 **m2**
Intake Factor F: (after condition B, figure 6, BS 5930)	0.1375

PERMEABILITY (after Hvorslev, 1951)

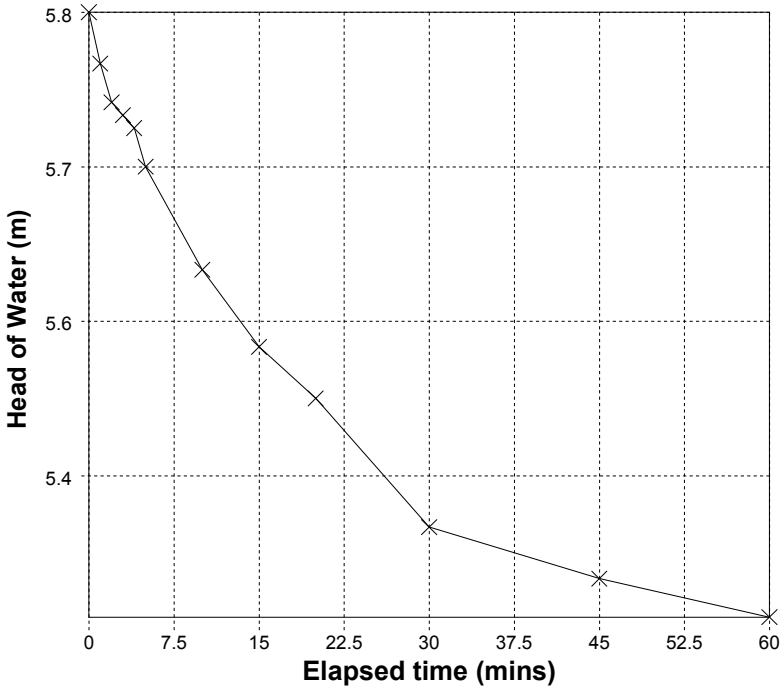
General Approach

H1 selected at t= 5.74 mins (=t1 = 55.2 secs)

H2 selected at t= 5.298 mins (=t2 = 3599.4 secs)

k = 3.23E-07 **ms-1**

Elapsed time (mins)	Depth to water (m btoc)	Head of Water, H (m)	Ht / Ho
0.0	0.000	5.800	1.000
1.0	0.040	5.760	0.993
2.0	0.070	5.730	0.988
3.0	0.080	5.720	0.986
4.0	0.090	5.710	0.984
5.0	0.120	5.680	0.979
10.0	0.200	5.600	0.966
15.0	0.260	5.540	0.955
20.0	0.300	5.500	0.948
30.0	0.400	5.400	0.931
45.0	0.440	5.360	0.924
60.0	0.470	5.330	0.919



Remarks

Key: bgl = Below Ground Level btoc = Below Top of Casing

Site Analytical Services Ltd.

Ref: 17/27399-1

UNDRAINED TRIAXIAL COMPRESSION TEST

LOCATION South Lodge, Heathside, Hampstead, London NW3 1BL

BH/TP No.	MOISTURE CONTENT %	BULK DENSITY Mg/m^3	LATERAL PRESSURE kN/m^2	COMPRESSIVE STRENGTH kN/m^2	COHESION kN/m^2	ANGLE OF SHEARING RESISTANCE degrees	DEPTH m
BH1	27	1.89	50	116	58		2.25
BH1	28	2.00	80	98	49		4.25

Table 1

Site Analytical Services Ltd.

Ref: 17/27399-1

PLASTICITY INDEX & MOISTURE CONTENT DETERMINATIONS

LOCATION South Lodge, Heathside, Hampstead, London NW3 1BL

BH/TP No.	Depth m	Natural Moisture %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing 425 μm %	Class
BH1	3.00	28	50	26	24	100	CI/CH
	3.75	32	49	28	21	100	CI
	4.75	27	48	23	25	100	CI
WS1	3.00	26	44	23	21	100	CI
	3.50	25	45	20	25	100	CI
	4.00	25	45	20	25	100	CI

Table 2

Site Analytical Services Ltd.

Ref: 17/27399-1

SULPHATE & pH DETERMINATIONS

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

BH/TP No.	DEPTH BELOW GL m	SOIL SULPHATES AS SO_4 TOTAL %	SOIL SULPHATES AS SO_4 WATER SOL g/l	WATER SULPHATES AS SO_4 g/l	pH	CLASS	SOIL - 2mm %
BH1	5.00		0.18		8.2	DS-1	100
	9.00		0.19		7.7	DS-1	100
WS1	4.50		0.14		7.1	DS-1	100
	6.00		0.19		7.2	DS-1	100

Classification – Tables C1 and C2 : BRE Special Digest 1 : 2005

Site Analytical Services Ltd.

Ref: 17/27399-1

GROUNDWATER MONITORING

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

GROUNDWATER MONITORING RECORD			
Date	**Weather Conditions**	**Ground Conditions**	**Temperature (°C)**
07/11/2017	Light Rain	Wet	9.4
Monitoring Point Location	**Depth to water (mBGL)**		**Depth to Base of well (mBGL)**
WS1	3.91		5.42
BH1	2.72		6.00

Table 4

Site Analytical Services Ltd.

Ref: 17/27399-1

GROUNDWATER MONITORING

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

GROUNDWATER MONITORING RECORD			
Date	**Weather Conditions**	**Ground Conditions**	**Temperature (°C)**
07/11/2017	Light Rain	Wet	9.4
Monitoring Point Location	**Depth to water (mBGL)**		**Depth to Base of well (mBGL)**
WS1	3.62		5.42
BH1	2.51		6.00

Table 4a

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River Road Business Park
33 River Road
Barking
Essex
IG11 0EA

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russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 17-66298

Site Reference:	South Lodge, Heathside
Project / Job Ref:	17/27399
Order No:	1525
Sample Receipt Date:	30/10/2017
Sample Scheduled Date:	30/10/2017
Report Issue Number:	1
Reporting Date:	03/11/2017

[redacted]

Russell Jarvis
Associate Director of Client Services

Dave Ashworth
Deputy Quality Manager

QTSE is the trading name of DETS Ltd, company registration number 03705645

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Soil Analysis Certificate						
QTS Environmental Report No: 17-66298	**Date Sampled**	27/10/17	27/10/17			
Site Analytical Services Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: South Lodge, Heathside	**TP / BH No**	BH1	WS1			
Project / Job Ref: 17/27399	**Additional Refs**	None Supplied	None Supplied			
Order No: 1525	**Depth (m)**	1.75	0.75			
Reporting Date: 03/11/2017	**QTSE Sample No**	298633	298634			

Determinand	Unit	RL	Accreditation					
Asbestos Screen (S)	N/a	N/a	ISO17025	Not Detected	Not Detected			
pH	pH Units	N/a	MCERTS	8.0	7.3			
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2			
Complex Cyanide	mg/kg	< 2	NONE	< 2	< 2			
Free Cyanide	mg/kg	< 2	NONE	< 2	< 2			
Total Sulphate as SO_4	mg/kg	< 200	NONE	256	294			
Total Sulphate as SO_4	%	< 0.02	NONE	0.03	0.03			
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	61	43			
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.06	0.04			
Sulphide	mg/kg	< 5	NONE	< 5	< 5			
Organic Matter	%	< 0.1	MCERTS	0.7	0.2			
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	0.4	0.1			
Arsenic (As)	mg/kg	< 2	MCERTS	5	6			
W/S Boron	mg/kg	< 1	NONE	< 1	< 1			
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2			
Chromium (Cr)	mg/kg	< 2	MCERTS	20	25			
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2			
Copper (Cu)	mg/kg	< 4	MCERTS	6	9			
Lead (Pb)	mg/kg	< 3	MCERTS	17	10			
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1			
Nickel (Ni)	mg/kg	< 3	MCERTS	6	8			
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3			
Zinc (Zn)	mg/kg	< 3	MCERTS	39	32			
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Subcontracted analysis (S)

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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 17-66298	**Date Sampled**	27/10/17	27/10/17			
Site Analytical Services Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: South Lodge, Heathside	**TP / BH No**	BH1	WS1			
Project / Job Ref: 17/27399	**Additional Refs**	None Supplied	None Supplied			
Order No: 1525	**Depth (m)**	1.75	0.75			
Reporting Date: 03/11/2017	**QTSE Sample No**	298633	298634			

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1	< 1			
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	< 1	< 1			
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6			
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7	< 1.7			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{o}C

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Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 17-66298	**Date Sampled**	27/10/17	27/10/17			
Site Analytical Services Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: South Lodge, Heathside	**TP / BH No**	BH1	WS1			
Project / Job Ref: 17/27399	**Additional Refs**	None Supplied	None Supplied			
Order No: 1525	**Depth (m)**	1.75	0.75			
Reporting Date: 03/11/2017	**QTSE Sample No**	298633	298634			

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10			
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21			
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3			
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10			
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	< 21			
Total >C5 - C35	mg/kg	< 42	NONE	< 42	< 42			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 17-66298	**Date Sampled**	27/10/17	27/10/17			
Site Analytical Services Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: South Lodge, Heathside	**TP / BH No**	BH1	WS1			
Project / Job Ref: 17/27399	**Additional Refs**	None Supplied	None Supplied			
Order No: 1525	**Depth (m)**	1.75	0.75			
Reporting Date: 03/11/2017	**QTSE Sample No**	298633	298634			

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2			
Toluene	ug/kg	< 5	MCERTS	< 5	< 5			
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2			
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2			
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2			
MTBE	ug/kg	< 5	MCERTS	< 5	< 5			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

QTS Environmental Report No: 17-66298	**Date Sampled**	27/10/17	
Site Analytical Services Ltd	**Time Sampled**	None Supplied	
Site Reference: South Lodge, Heathside	**TP / BH No**	BH1	
Project / Job Ref: 17/27399	**Additional Refs**	None Supplied	
Order No: 1525	**Depth (m)**	1.75	
Reporting Date: 03/11/2017	**QTSE Sample No**	298633	

Determinand	**Unit**	**MDL**		**Landfill Waste Acceptance Criteria Limits**		
				Inert Waste Landfill	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
TOC[MU]	%	< 0.1	0.4	3%	5%	6%
Loss on Ignition	%	< 0.01	1.70	--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05	6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1	1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10	500	--	--
Total PAH[MU]	mg/kg	< 1.7	< 1.7	100	--	--
pH[MU]	pH Units	N/a	8.0	--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	< 1	--	To be evaluated	To be evaluated

Eluate Analysis	**2:1 mg/l**	**8:1 mg/l**		**Cumulative 10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic[U]	< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]	< 0.02	< 0.02		< 0.1	20	100	300
Cadmium[U]	< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]	< 0.005	< 0.005		< 0.20	0.5	10	70
Copper[U]	< 0.01	< 0.01		< 0.5	2	50	100
Mercury[U]	< 0.005	< 0.005		< 0.01	0.01	0.2	2
Molybdenum[U]	0.004	0.002		< 0.1	0.5	10	30
Nickel[U]	< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]	< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]	< 0.005	< 0.005		< 0.06	0.06	0.7	5
Selenium[U]	< 0.005	< 0.005		< 0.1	0.1	0.5	7
Zinc[U]	< 0.005	< 0.005		< 0.2	4	50	200
Chloride[U]	4	3		27	800	15000	25000
Fluoride[U]	< 0.5	< 0.5		< 1	10	150	500
Sulphate[U]	25	5		65	1000	20000	50000
TDS	74	29		330	4000	60000	100000
Phenol Index	< 0.01	< 0.01		< 0.5	1	-	-
DOC	9.6	8.6		86.6	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.19						
Dry Matter (%)	93						
Moisture (%)	7.6						
Stage 1							
Volume Eluate L2 (litres)	0.34						
Filtered Eluate VE1 (litres)	0.15						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

QTS Environmental Report No: 17-66298		**Date Sampled**	27/10/17		**Landfill Waste Acceptance Criteria Limits**		
Site Analytical Services Ltd		**Time Sampled**	None Supplied		**Inert Waste Landfill**	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Site Reference: South Lodge, Heathside		**TP / BH No**	WS1				
Project / Job Ref: 17/27399		**Additional Refs**	None Supplied				
Order No: 1525		**Depth (m)**	0.75				
Reporting Date: 03/11/2017		**QTSE Sample No**	298634				
Determinand	**Unit**	**MDL**					
TOC[MU]	%	< 0.1	0.1		3%	5%	6%
Loss on Ignition	%	< 0.01	1.70		--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05		6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1		1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10		500	--	--
Total PAH[MU]	mg/kg	< 1.7	< 1.7		100	--	--
pH[MU]	pH Units	N/a	7.3		--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	< 1		--	To be evaluated	To be evaluated

Eluate Analysis	**2:1 mg/l**	**8:1 mg/l**		**Cumulative 10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic[U]	< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]	< 0.02	< 0.02		< 0.1	20	100	300
Cadmium[U]	< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]	< 0.005	< 0.005		< 0.20	0.5	10	70
Copper[U]	< 0.01	< 0.01		< 0.5	2	50	100
Mercury[U]	< 0.005	< 0.005		< 0.01	0.01	0.2	2
Molybdenum[U]	< 0.001	< 0.001		< 0.1	0.5	10	30
Nickel[U]	< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]	< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]	< 0.005	< 0.005		< 0.06	0.06	0.7	5
Selenium[U]	< 0.005	< 0.005		< 0.1	0.1	0.5	7
Zinc[U]	< 0.005	< 0.005		< 0.2	4	50	200
Chloride[U]	4	3		28	800	15000	25000
Fluoride[U]	< 0.5	< 0.5		< 1	10	150	500
Sulphate[U]	13	4		42	1000	20000	50000
TDS	58	26		276	4000	60000	100000
Phenol Index	< 0.01	< 0.01		< 0.5	1	-	-
DOC	11.6	8.1		82.8	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.21						
Dry Matter (%)	83.9						
Moisture (%)	19.2						
Stage 1							
Volume Eluate L2 (litres)	0.32						
Filtered Eluate VE1 (litres)	0.09						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepencies with current legislation
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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 17-66298	
Site Analytical Services Ltd	
Site Reference: South Lodge, Heathside	
Project / Job Ref: 17/27399	
Order No: 1525	
Reporting Date: 03/11/2017	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
298633	BH1	None Supplied	1.75	7	Light brown sandy clay
298634	WS1	None Supplied	0.75	16.1	Brown sandy clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

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Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 17-66298
Site Analytical Services Ltd
Site Reference: South Lodge, Heathside
Project / Job Ref: 17/27399
Order No: 1525
Reporting Date: 03/11/2017

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

9.0 APPENDIX B. GROUND MOVEMENT ASSESSMENT

Ground Movement Assessment

South Lodge, Heathside,
NW3 1BL

April 2018

FAIRHURST

CONTROL SHEET

CLIENT:	**SITE ANALYTICAL SERVICES LIMITED (SASL)**
PROJECT TITLE:	**SOUTH LODGE, HEATHSIDE, HAMPSTEAD NW3 1BL**
REPORT TITLE:	**GROUND MOVEMENT ASSESSMENT**
DOCUMENT NUMBER:	**125183/R0**
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Revision Record

Rev.	Date	Status	Description	Signature	

This document has been prepared in accordance with procedure OP/P02 of the *Fairhurst Quality and Environmental Management System.*

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FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Background

Fairhurst have been commissioned by Site Analytical Services Limited (SASL) to complete a Ground Movement Assessment (GMA) in connection with a proposed residential development at South Lodge, Heathside, Hampstead at approximate postcode NW3 1BL. The location of the site is detailed on Figure 1. The purpose of this assessment is to determine what effects the proposed permanent construction may have upon nearby structures.

A site specific Ground Investigation has previously been carried out by SASL in October 2017 at the site. The ground investigation was designed by SASL and the results have been used in the derivation of parameters utilised in this assessment. Fairhurst cannot be held responsible for any inaccuracy in the factual data provided. It is understood that this report will be included as part of a Basement Impact Assessment (BIA) to be submitted to Camden Council by the client.

1.2 Proposed Development

The development proposal at the site involves the extension of the existing lower ground floor (basement level) below the existing property and rear extension.

In accordance with the topographical survey and drawings provided by the Architects (Appendix A) the existing ground level of the existing property is at 95.50m AOD. The Finished Floor Level (FFL) of the proposed new basement steps down from 92.85m AOD below the footprint of the original property (which equates to an approx. 0.90m excavation) to 92.00m AOD below the existing rear extension (a 3.50m excavation).

The 0.90m excavation below the building is referred to as the new basement in this document whilst the 3.50m excavation below the rear extension is referred to as the new sub-basement.

Further information on the proposed construction is detailed on the architect drawings, presented in Appendix A whilst the existing and proposed structural loads determined by Elliot Wood are presented in Appendix C.

1.3 Limitations

The conclusions and recommendations made in this report are made on the basis of the site specific ground investigations undertaken by SASL undertaken in October 2017. The ground investigation was designed by SASL and the results of the work should be viewed in the context of the range of data sources consulted and the information provided along with the number of locations where the ground was sampled. No liability can be accepted for inaccuracies in the factual data, information in other data sources or conditions not revealed by the sampling or testing.

In addition to this SASL have recommended the use of third party data where appropriate, it is assumed that reliance on that data used in this report has been agreed by SASL.

The effect of the proposed construction on existing subterranean assets (including services and tunnels) is outside the scope of this report.

1.4 Qualifications

The report has been written by Mr Andrew Smith, a Chartered Geologist (CGeol) and Member of the Chartered Institute of Water and Environmental Management (MCIWEM) and approved by Mr Andrew Penrose, a Chartered Structural Engineer (CEng) and Member of the Institution of Structural Engineers (MIStructE).

2.0 BASELINE CONDITIONS

2.1 Site Description

The site is located at South Lodge, Heathside, Hampstead, NW3 1BL (National Grid Ref: 526895, 186040). A site location plan is included in this report as Figure 1.

The site is located on the western side of Heathside, covers an approximate area of 0.19 hectares and is under the authority of the London Borough of Camden. The semi-detached residential building comprises five levels of accommodation arranged over basement, ground, first, second and third floors. Details of the buildings located in close proximity to the property which have been considered in the analysis are described in Table 2-1 below and detailed on Figure 5.

From the topographical information provided by the Architects, the front (south eastern) garden of the property is at level of 94.46m AOD whilst the rear (north western) garden is at level 95.8m AOD. The driveway slopes north-westwards from 94.02m AOD from the entrance of the property located southeast of the site, to 94.93m AOD at South Lodge.

Table 2-1: Summary of buildings surrounding the site

Building Name	Description	Approximate Height (m)	Distance from the site
No.1 E Heath Road	3 storey semi-detached residential dwelling with roof space.	12m	Immediately Adjacent to the northeast
No.2 E Heath Road	1 storey detached residential outbuilding.	2.5m	Adjacent 1.5m to the Northeast

2.2 Geology

The British Geological Survey (BGS) map of the area (North London, Sheet 256) indicates that the site is underlain directly by the Claygate Member (ClgB) which is in turn underlain by the London Clay Formation. The site is also detailed by the BGS to be in an area locally likely to be covered by Superficial Head Deposits (Head Propensity). These deposits have not been formally mapped by the BGS and have been interpreted from slope analyses and borehole data only.

Superficial Head Deposits generally comprise clays, silts, sands and gravels and were formed up to 3 million years ago in the Quaternary Period in a local environment previously dominated by subaerial slopes.

According to the BGS Lexicon, the underlying London Clay (LC) Formation comprises “bioturbated or poorly laminated, blue-grey or grey brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. The Claygate Member (ClgB) comprises dark grey clays with sand laminae, passing up into thin alternations of clays, silts and fine-grained sand, with beds of bioturbated silt.

There are no available BGS historical boreholes within 100m of the site.

3.0 GROUD INVESTIGATION AND MONITORING

A site specific Ground Investigation (GI) was undertaken by SASL from the October to November 2017. The works undertaken at the site comprised of the following:

- One rotary percussive borehole (BH1) down to a depth of 15.0m bgl inclusive of Standard Penetration Testing (SPT) and U100 sampling;
- One continuous flight auger borehole (WS1) to a depth of 6.0m bgl. Shear vane testing was undertaken at regular intervals to enable in-situ testing for geotechnical purposes;
- Seven hand excavated Trial Pits (TP1 to TP7) to a depth of 1.0m bgl to determine existing foundation constructions and founding materials;
- Collection of disturbed soil samples for geotechnical and geo-environmental laboratory testing;
- Installation of two 50mm internal diameter groundwater monitoring wells to depths of 6m bgl in both boreholes;
- Two rounds of groundwater level monitoring following completion of the site works.

Full factual records of the ground investigation works, including the results of all laboratory analysis, groundwater monitoring and exploratory logs, are presented in the SASL Factual Report (refer Appendix B).

3.1 Ground Conditions

The boreholes and trial pits revealed ground conditions that were generally consistent with the geological records and known history of the area. A summary of the ground conditions encountered is presented below in Table 3-1.

Table 3-1: Summary of the SASL Ground Investigation

Strata	Depth (m bgl) and Elevation (m AOD)		Maximum Thickness (m)	Description
	Top	Base		
Made Ground	GL (95.52) to GL (94.46)	0.7 (94.82) to 0.9 (93.56)	0.9	MADE GROUND - Grass, over gravelly sandy CLAY with fragments of brick and concrete rubble.
Claygate Member (ClgB)	0.7 (94.82) to 0.9 (93.56)	6.7 (88.82) to 6.0 (88.46)	6.0	Soft silty sandy CLAY / stiff silty sandy CLAY with lenses of silty fine sand.
London Clay (LC)*	6.7 (88.82) to 6.0 (88.46)	15.0 (80.52) Base of BH1	8.3 (Base of BH1	Stiff very silty very sandy CLAY with lenses of silty fine sand.

**Maximum thickness of London Clay Formation not proven*

3.2 Foundation Inspection Pits

Seven number of foundation inspection pits (TP1 – TP7) were undertaken within the ground floor and within the basement floor of the existing building at positions shown in the SASL exploratory layout plan (refer Appendix B). The foundation pit schematics are presented within the SASL GI records as shown in Appendix B and the findings are summarised in Table 3-2.

Table 3-2: Summary of foundation inspection pits

Trial Pit No.	Founding Depth m bgl	TP limit of excavation m bgl	Comments
TP1	0.07	1.0	Located in existing basement. Tiled floor over brick foundation founded in MADE GROUND (Gravelly sandy clay with fragments of brick).
TP2	0.25	1.0	Located in existing basement. Tiled floor over brick and concrete foundation founded in the ClgB (very sandy CLAY).
TP3	0.56	1.0	Located in existing basement. Tiled floor over stepped brick and lime mortar foundation founded in MADE GROUND (gravelly sandy clay with fragments of brick and concrete rubble and ash).
TP4	0.55	1.0	Located in existing basement. Tiled floor over brick foundation founded in the ClgB (very sandy CLAY). 4" Cast iron pipe located 0.53m from the foundation at a depth of 0.39m bgl.
TP5	0.22	1.0	Located in existing basement. Tiled floor over brick foundation founded in MADE GROUND (Brick rubble).
TP6	*NP	1.0	Located in Ground Floor directly above the footprint of the proposed basement extension. Brick and old yellow stocks foundation proven to limit of excavation only. Underside of foundation was not found (assumed founded in the ClgB).
TP7	*NP	1.0	Located in Ground Floor directly above the footprint of the proposed basement extension. Brick and old yellow stocks foundation proven to limit of excavation only. Underside of foundation was not found (assumed founded in the ClgB)..

**GF = Ground Floor *NP: Denotes that the foundation depth was not proven during the foundation inspection*

3.3 Groundwater

Groundwater was encountered during the drilling works at approx. 4.0m and 5.8m bgl in BH1 and WS1 respectively within the Claygate Member. Groundwater was not encountered in any of the trial pits during the site works and the material remained essentially dry throughout.

Following completion of ground investigation works the monitoring well installed in BH1 and WS1 was monitored on 2 No. occasions in November 2017 with the results summarised in Table 3-3 below.

Table 3-3: Monitoring Summary

Date	Borehole ID	Ground Level	Response Zone			Groundwater Level	
		m AOD	m bgl	m AOD	(Strata)	m bgl	m AOD
7/11/2018	BH1	95.52	1.0 – 6.0	94.52 – 89.52	ClgB	3.91	91.61
7/11/2018	BH1	95.52	1.0 – 6.0	94.52 – 89.52	ClgB	3.62	91.90
16/11/2018	WS1	94.46	1.0 – 5.42	93.46 – 89.04	ClgB	2.72	91.74
16/11/2018	WS1	94.46	1.0 – 5.42	93.46 – 89.04	ClgB	2.51	91.95

**ClgB Claygate Member*

The water monitoring undertaken indicates that the groundwater level in BH1 and WS1 was recorded slightly below the maximum excavation depth of 92.0m AOD.

The above interpretation is based on two monitoring visits and it would be prudent to continue monitoring of the existing standpipe for as long as possible in order to determine equilibrium level and the extent of any seasonal variations.

3.4 In-situ and Laboratory Testing

A summary of laboratory and in-situ test results undertaken within the geological strata encountered during the SASL GI is presented below. Detailed results are available in the SASL Geotechnical Investigation records as shown in Appendix D and Figure 2 to 4.

In-situ Strength Testing

Eight in-situ SPTs were undertaken within BH1. The results are summarised in Table 3-4.

Table 3-4: Summary of SPTs

Lithology	No. Tests	Depth of testing (m bgl)	SPT N Value	Correlated Parameters*
				Undrained Shear Strength, Cu (kN/m^2)
Claygate Member (ClgB)	3	1.0 to 5.0	5 to 10 (Avg. 8)	23 to 45 (Avg. 35)
London Clay (LC)	5	8.0 to 14.6	14 to 23 (Avg. 18)	63 to 104 (Avg.81)

*Values of undrained shear strength (Cu) have been correlated from the results of SPTs using the following relationship: Cu = f_1 x N (Stroud and Butler, 1975). Based on the Plasticity Index results from the Atterberg Limit Testing of this material, an f_1 value of 4.5 has been used for the correlation.

In accordance with BS5930:2015, the ClgB is representative of a low to medium strength material. The LC is representative of a medium to high strength cohesive material.

The results of the in-situ strength testing have been plotted as undrained shear strength (Cu) against depth and are presented graphically as Figure 3. A trend of increasing strength with depth is observed within the ClgB and LC.

Shear Vane Testing

Ten Situ Borehole Shear Vane Tests were undertaken within WS1 in order to assess the undrained shear strength of the cohesive materials below the site. The results are summarised in Table 3-5 below.

Table 3-5: Summary of Shear Vane test results

Strata	No. Tests	Depth of testing (m bgl)	Undrained Shear Strength, Cu (kPa)
Claygate Member (ClgB)	10	1.0 to 6.0	113 to 130+* (Avg.124)

**130 kPa is the upper limit of the shear of the Hand Shear Vane apparatus*

Figure 2 shows a comparative plot of laboratory (Triaxial) Cu and in-situ (SPT & Shear Vane) converted Cu results against depth. The hand vane shear testing does not correlate with the strengths indicated by the standard penetration testing or triaxial testing with the shear vane test values being on average 50-70% higher than the corresponding values.

Triaxial testing has been performed on undisturbed samples collected from site and considers anisotropy and the fabric of the in-situ material during testing thus providing a more reliable determination of Cu than the vane testing. Emphasis on these results combined with those calculated indirectly from the standard penetration testing has therefore been used in this report rather than those from the shear vane testing.

Atterberg Limits and Moisture Contents

Six Atterberg Limit and Moisture Content determinations were undertaken on samples collected from BH1 and WS1. The results are summarised in Table 3-6.

Table 3-6: Summary of Atterberg Limits and Moisture Content

Lithology	No. Tests	Depth of testing (m bgl)	Moisture Content (MC)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
Claygate Member (ClgB)	6	3.0 to 4.75	25 to 32% (Avg. 27%)	44 to 50% (Avg. 47%)	20 to 28% (Avg. 23%)	21 to 25% (Avg. 24%)

**NP – Denotes the material as Non-Plastic*

According to Plasticity Chart (BS 1377-2:1990) the sample tested in the ClgB is representative of a Clay of Intermediate Plasticity (CI).

In accordance with the NHBC Standards (2018), a Modified Plasticity Index of 24% has been determined in the ClgB assuming 100% of particles are less than 425µm (worst case), representative of medium volume change potential.

Laboratory Strength Testing

A direct measurement of undrained shear strength (Cu) was undertaken in the laboratory via an Unconsolidated Undrained (UU) tri-axial compression test on two undisturbed samples from BH1. The results are summarised in Table 3-7.

Table 3-7: Summary of Tri-axial test results

Lithology	No. Tests	Depth of testing (m bgl)	Undrained Shear Strength, Cu (kN/m^2)
Claygate Member (ClgB)	2	2.25 to 4.25	49 to 58 (Avg. 54)

In accordance with BS5930:2015, the ClgB is representative of a medium strength material. Figure 2 shows a comparative plot of laboratory (Triaxial) Cu and in-situ (SPT & Shear Vane) converted Cu results against depth.

4.0 PREDICTION OF GROUND MOVEMENT AND DAMAGE ASSESSMENT

4.1 Introduction

In connection with the proposed basement construction, a ground movement and damage assessment has been undertaken at the site. The purpose of this assessment is to determine the effects of the proposed basement and sub-basement excavation upon the existing building and the neighbouring structures.

The soil behaviour over the footprint of the excavated area is different from the behaviour outside and the associated ground movements require assessment using different approaches.

In the area of the new basement the soil will tend to move as a result of change in vertical load on the ground due to excavation and demolition. Movements in the long term would also be expected as a result of changes in the pore pressure in the clay layer/cohesive band under the basement.

Around the site the construction activities that may result in ground movements during and after the works are mainly related to the excavation, which would induce a reduction of vertical and lateral stresses in the ground along the excavation boundaries.

The magnitude and distribution of ground movements inside and outside the excavated area are a function of changes of load in the ground and also, critically, are a function of workmanship.

Ground movements within the area of the proposed excavation have been estimated using Geotechnical Software (Settle3D by Rocscience) whilst the expected movements and impact assessment of the area around the site and surrounding structures have been estimated using Geotechnical Software (XDISP by OASYS). The latter software relies on CIRIA report C580 Embedded Retaining Walls - Guidance for Economic Design (superseded by C760, 2017) which is based on field measurements of movements from a number of basement constructions across London.

The calculations provided are specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

4.2 Adjacent Properties

The properties or structures more likely to be affected by the ground movements associated with the proposed basement construction are shown in Figure 5, summarised in Table 2-1 and include the following:

- No.1 E Heath Road (Immediately adjacent to the northeast);
- No.2 E Heath Road (adjacent 1.5m to the northeast).

4.3 Ground Model

The ground model utilised for this assessment is based on the site specific ground investigation undertaken by SASL at the site (October 2017). It should be noted that Fairhurst can take no liability for inaccuracies in the factual data from the SASL investigation and that reliance on this data has been sought by the client.

The ground conditions adopted within the model and analysis are in accordance with the results of borehole (BH1) located closed to the new basement extension at South Lodge, Hearthside and comprises:

- Made Ground to a depth of 0.7m bgl (94.82m AOD);
- Claygate Member to a depth of 6.7m bgl (88.826m AOD);
- London Clay to a depth of 15.00m bgl (80.52m AOD).

The method of Ground Movement Analyses undertaken requires soils stiffness parameters to be used. In accordance with BS8004:2015 section 4.3.1.6 ‘Soil Stiffness’ it is acknowledged that both the drained and undrained stiffness moduli of soils (E', E_u) are highly dependent on

the strain level applicable to the engineering problem considered. The change in axial strain will directly influence the resultant stiffness of the soil, and in turn the stiffness of the soil will influence the strain exhibited.

Therefore in order to define stiffness modulus applicable to the engineering problem considered, it is necessary to assess the magnitude of axial strain which the soil will be subjected to. In accordance with the recommendations made in BS8004:2015 the strain generally applicable to foundations design is in the range of 0.075 to 0.2%. The material stiffness values used for the analysis of the ground movements have been interpreted as follows:

Made Ground

Case history values were consulted where estimating the linear elastic parameters for Made Ground. Specifically values for the drained case were adopted from:

'Burland, Standing, Jardine (2001). Volume 1 – Projects and Methods. Building response to Tunnelling – Case Studies from construction of the Jubilee Line Extension, London. CIRIA Special Publication 200, Section 12.2.3, page 180'

Using the results of this paper it has been assumed that the Poisson's Ratio (υ') would slightly increase for the undrained case (υ) from 0.2 to 0.3 and the Shear Stiffness / modulus (*G*) would be the same in the Made Ground for both the drained and undrained cases (as the water would not add any shear stiffness, only compressional). It has also been assumed that the material is isotropic and therefore the shear modulus is related to the Young's Modulus (*E'*) via the equation $2G/(1+ \upsilon) = E$. Using equation 17.19 of ICE manual of geotechnical engineering (2012), Volume II, chapter 17.8.8, $E_u = 1.25.E'$.

Table 4-1 below shows the values for Made Ground adopted for this analysis.

Claygate Member (ClgB) / London Clay (LC)

Based on the maximum (i.e. most conservative) axial strain of 0.2% prescribed in BS8004:2015, the following correlation has been used to determine the Young's Modulus (*Eu*) of the cohesive Claygate member and London Clay. The relation has been taken from ICE manual of geotechnical engineering (2012), Volume II, chapter 53.7.2 (Page 792) and matches ratio of *Eu/Cu* at 0.2% axial strain recommended in Tomlinson (7th,2001) based on works by Jardine et al. (1986):

$$E_u = 330C_u \ (kN/m^2)$$

The ratio of end of construction (Undrained) settlement to total settlement (fully drained) was taken as 60% as specified in ICE manual of geotechnical engineering (2012), Volume II, chapter 53.6 (Page 783). Therefore:

$$E' = 220C_u \ (kN/m^2)$$

In addition a drained (υ') and undrained (υ) Poisson's ratio of 0.2 and 0.5 respectively were utilised as specified in Tomlinson 7th ed (page 74). Figure 3 shows SPT derived *E'* and *Eu* values plotted against depth.

Modulus of volume compressibility (m_v) parameters have been used for the calculation of primary consolidation settlements for the long term (drained) loading case. This is the process in which a reduction in soil volume occurs by the expulsion of water under static loads in the long term. These were determined with depth using the recommendations in Skempton and Bjerrum (1957) where the following relationship between m_v and *E'* is described:

$$M_v = \frac{1}{E'}$$

Figure 4 shows the corresponding SPT derived m_v values plotted against depth. Due to the transitional boundary between the ClgB and underlying LC, the same parameters have been used for these soil types.

A table summary of the stiffness and m_v values utilised in this analysis is presented in Table 4-1 below.

Table 4-1: Soil stratigraphy and stiffness parameters adopted

Lithology	Level at top (m bgl)	Short-term (undrained)		Long-term (drained)		
		E_u kPa	Poisson's Ratio (υ)	E' kPa	mv (m^2/MN)	Poisson's Ratio (υ')
Made Ground	GL	3000	0.3	3000	N/A	0.2
Claygate Member (ClgB)	0.7	7425+1848z	0.5	4500+1050z	2.2E-4 – 1.45E-5z	0.2
London Clay (LC)	6.7	7425+1848z	0.5	4500+1050z	2.2E-4 – 1.45E-5z	0.2

4.4 Construction and load cases

With reference to the proposed drawings presented within Appendix A, the existing lower ground floor is expected to be extended as follows:

1. Design of Temporary Works:
   - All temporary works should be designed by an appropriately qualified structural engineer. It is likely that the designs may require checking by a party wall surveyor on the neighbouring properties;
   - The chosen contractor should have a plan in place to deal with groundwater inflows;
2. Excavation for underpins & temporary foundations & installation of temporary works:
   - Excavate down and underpin/construct to proposed foundations formation level (approximately 92.0m AOD);
   - Insert temporary bases and propping as and where required during the excavation process.
   - Installation of appropriate temporary works and propping should occur simultaneously as excavation progresses;
3. Excavation down to underside of basement level and associated temporary works;
4. Reloading:
   - Construction of foundation slab to proposed basement FFL. Construct load-bearing external RC walls & internal walls/columns.
   - Construct new ground floor slab to provide permanent horizontal support to underpins as required
   - Removal of any temporary props once permanent supports are in place.

Structural Loading at foundation level for use in the ground movement analysis has been calculated by Elliot Wood as shown in Appendix C. This assessment is specific to the construction sequence and load case described above. If any changes are made to the proposed development then this assessment should be updated.

4.5 Ground movement inside the proposed basement

Following excavation to the proposed foundation formation levels the soil at this level and along the boundary of the excavation will tend to heave as a result of the change in the soil stress conditions. The magnitude and distribution of ground movements inside the excavated area are a function of the excavation size and shape.

The stress conditions and resultant settlement/heave have been assessed using the Boussinesq's method and geotechnical software Settle3D by Rocscience. This approach assumes linear elastic behaviour of the soil. Elastic vertical strains are calculated on the basis of the calculated stress changes and then integrated to obtain vertical movements.

Three stages have been set up to create a simplified model of the redevelopment. These are as follows:

1. **Stage 1:** A first stage has been analysed to simulate excavation across the site with unloading due to the removal of soil. Assuming that no delays occur during the construction process, this stage has been simulated using short term soil parameters only (i.e. undrained conditions).

   It is proposed to excavate down to a maximum depth of 3.50m bgl for the sub-basement and 0.90m bgl for the basement (although it should be noted that foundations may need to have deeper excavations locally due to additional excavations for temporary works). The undrained removal of the overburden, calculated using assumed unit weights (16kN/m^3 for Made Ground, 17kN/m^2 for the Claygate Member and 19kN/m^2 for the London Clay) and thickness of strata, will therefore cause a maximum unloading pressure of approximately -60kN/m^2 for the new sub-basement and -15kN/m^2 for the new basement. The Settle3D analysis outputs at ground level are presented in Appendix D.

2. **Stage 2:** A second stage has been analysed to simulate the conditions at the end of the construction phase when the site is to be re-loaded with the pressures from the proposed structures at the new formation level.

   Structural Loading at foundation level for use in the ground movement analysis has been calculated internally by the structural engineer (Elliot Wood) as shown in Appendix C.

   The Settle3D analysis outputs for this stage are presented in Appendix E.

3. **Stage 3:** A final third stage simulates a long term condition after construction, when the stress conditions within the soil have been allowed to equilibrate under the new pressures and pore pressures in the soil have stabilized (i.e. fully drained conditions). The model and tabular outputs for this stage are presented in Appendix F.

The elastic parameters for the soil have been chosen as appropriate for the short and long term conditions. A short term analysis has used undrained parameters and for long term assessments fully drained parameters were used. The vertical boundary of the model was fixed at 10m bgl where the effective vertical stress due to foundation unloading decreases to 20% of the effective overburden as required in EC7.

The results of the Settle3D analysis are based on an unrestrained excavation as the model is unable to take account of the mitigating effect of the temporary works bounding the excavation, which in reality will combine to restrict these movements within the basement excavation. The movements predicted at or just beyond the site boundaries are unlikely to be realised and should not therefore have a detrimental impact upon any nearby structures. It should be noted that the heave movements detailed below are not cumulative.

Settle 3D results

The results for each stage of the analysis are summarised in Table 4-2 below with the results detailed in Appendix D to Appendix F. The outputs have been represented at the level of the new sub-basement (92.00m AOD) where the magnitudes of movements are the greatest and therefore worst case.

Table 4-2: Settle 3D results

Stage	Maximum Settlement/Heave (mm)*			
	New Sub-Basement (3.50m excavation)		New Basement (0.90m excavation)	
	Centre	Edges	Centre	Edges
Stage 1 – Excavation (Unloading)	-5.5	-3.0	-1.0	-2.0
Stage 2 – Reloading (Undrained)	-6.0	1.5	1.0	-1.5
Stage 3 – Reloading (Drained)	-45.0	3.0	-8.0	-21.2

*Heave is denoted by -vet sign convention

Conclusions and recommendations

The results show that initially upon excavation and before construction the ground is expected to heave upwards by a maximum of -5.5mm and -2.0mm for the sub-basement and basement respectively.

Immediately after construction, heave movements are expected to increase to -6.0mm underneath the centre of sub-basement whilst settlements of up to 1.5mm are evident around the edges of this area underneath the location of the external walls. Settlements of up to 1.0mm are evident directly underneath the ground floor slabs of the new basement, whilst heave movements of up to 1.5mm are evident.

In the long term, heave is expected to increase to -45.00mm with settlement increasing to 3.0mm for the sub-basement. For the new basement, heave is expected to increase to -8.0mm in the centre of the lowered floor slab with heave increasing to -21.0mm in close proximity to the proposed sub-basement.

Final designs for the basement retaining walls, basement slabs and internal RC load-bearing basement walls and columns should be designed to support the heave and settlement movements predicted as indicated in Table 4-2 above. These movements should be taken into account particularly at party walls where additional loadings are proposed (party wall with No. 1). Further to this, the Elliot Wood basement plan (Appendix C) shows an assumed doweled joint at the junction between the new sub-basement and basement. To ensure the stability of both structures it is important that the magnitude of movements at this junction be taken into account in detailed design.

Proposed drainage system or pipe works underlying the ground floor should be designed to accommodate the predicted movements.

4.6 Ground Movements outside the Area of the New Basement

Excavations and Assessment Methodology

Ground movements due to basement excavations are typically estimated based on guidance given in the CIRIA publications and C760. These documents are based on the behaviour of deep excavations supported by embedded walls at numerous sites in the London area.

As detailed in the Elliott Wood proposed basement plan presented in Appendix C, a suspended floor slab is proposed as part of the new construction. It is understood that a reinforced concrete thickening will occur directly underneath the perimeter walls in the permanent case. Given that propping will generally be included in the temporary and permanent cases over the proposed structure, a low stiffness approach would not apply to this situation.

With this in mind, the XDISP analysis considers both ‘installation of contiguous bored pile wall in stiff clay’ (CIRIA 580 Fig. 2.8(b)) and ‘excavation in front of a high stiffness wall in stiff clay’ (CIRIA C760 Fig. 6.15(a)) to simulate the effects from the underpinning and excavation respectively on neighbouring structures. The combined cumulative movements resulting from

both the wall installation (underpinning) and basement excavation have been used to carry out an assessment of the likely damage to adjacent properties.

Ground movements have been analysed using XDISP by Oasys and a building damage assessment has been undertaken based on the results of the analysis. Contours of vertical and horizontal ground movement and tabular output of the analysis are presented in Appendix G. Summary tables are provided below.

Building Damage Assessment

The building damage assessment was carried out on the relevant adjacent structures, as detailed in Figure 5 and summarised below in Table 4-3.

Table 4-3: Summary of structures

Property	Structure (Refer Figure 5)	Structure ID (Shown in Appendix G)	Assumed Structural Height (m)	Approximate Line Length (m)
No. 2 E Heath Road	W1	Wall 1	2.5	4.6
	W2	Wall 2	2.5	2.4
	W3	Wall 3	2.5	4.5
	W4	Wall 4	2.5	0.8
	W5	Wall 5	2.5	4.5
	W6	Wall 6	2.5	4.03
	W7	Wall 7	2.5	4.5
	W8	Wall 8	2.5	0.7
No. 1 E Heath Road	W9	Wall 9	12.0	8.9
	W10	Wall 10	12.0	5.9
	W11	Wall 11	12.0	1.4
	W12	Wall 12	12.0	3.8
	W13	Wall 13	12.0	1.6
	W14	Wall 14	12.0	2.8
	W15	Wall 15	12.0	8.8
	W16	Wall 16	12.0	12.1

Results

Table 4-4 presents the damage assessments for the structures listed above. The table also presents the CIRIA C760 approximate crack widths corresponding to the damage categories. The tabular XDisp program output for the basement is presented as Appendix G.

Table 4-4: Ground movement / Building Damage Summary

Property	Structure (Refer Figure 5)	Maximum settlement (mm)	Highest Average Horizontal Strain (%)	Maximum Tensile Strain (%)	Damage Category*	Approximate Crack Width (mm) (CIRIA C760)
2 E Heath Road	W1	3.4751	0.055295	0.069553	Very Slight	<1mm
	W2	3.4751	705.78E-6	831.16E-6	Negligible	<0.1mm
	W3	3.4970	0.057270	0.073246	Very Slight	<1mm
	W4	2.0316	959.08E-6	961.70E-6	Negligible	<0.1mm
	W5	2.0318	0.036753	0.044361	Negligible	<0.1mm
	W6	0.29210	427.90E-6	474.68E-6	Negligible	<0.1mm
	W7	1.7451	0.037055	0.043812	Negligible	<0.1mm

Property	Structure (Refer Figure 5)	Maximum settlement (mm)	Highest Average Horizontal Strain (%)	Maximum Tensile Strain (%)	Damage Category*	Approximate Crack Width (mm) (CIRIA C760)
	W8	1.7913	407.21E-6	407.30E-6	Negligible	<0.1mm
1 E Heath Road	W9	**All settlements are less than the settlement Trough limit sensitivity.**				
	W10	0.59214	0.015669	0.015967	Negligible	<0.1mm
	W11	1.3954	-0.0050136	0.026759	Negligible	<0.1mm
	W12	3.3668	0.049596	0.051440	Very Slight	<1mm
1 E Heath Road	W13	3.3818	-0.012950	0.056622	Very Slight	<1mm
	W14	1.5026	-0.051594	0.026252	Negligible	<0.1mm
	W15	1.6983	0.015321	0.029241	Negligible	<0.1mm
	W16	0.59718	0.0027776	0.0067185	Negligible	<0.1mm

Based on these predicted ground movements, the properties surrounding the site are expected to be predominantly within CIRIA C760 Damage Category 0 (Negligible) although there are four instances where this is exceeded to a Damage Category 1 (Very Slight).

The results indicate that the greatest potential for damage (Category 1 – Very Slight) may be recorded at the following structures shown on Figure 5:

- W12 & W13 of No.1 E Heath Road;
- W1 & W3 of No.2 E Heath Road.

It should be noted however that these movements are likely to be affected by the quality of the workmanship and propping of the basement excavations. The construction details adopted at the junctions with the party walls and at return walls will also have a significant influence on the likelihood of any future movement at these locations. Extra care should be taken in these sections to provide appropriate support to the existing walls to prevent any excessive deflection.

Based on these results it is considered that appropriate consideration to the support & stability of neighbouring walls (especially party walls and party wall junctions/return walls) will be needed in the detailed structural design of the basement. Movement monitoring of these walls is recommended during the construction stage and trigger levels should be set in order to protect the neighbouring properties as a precautionary measure.

5.0 CONCLUSIONS

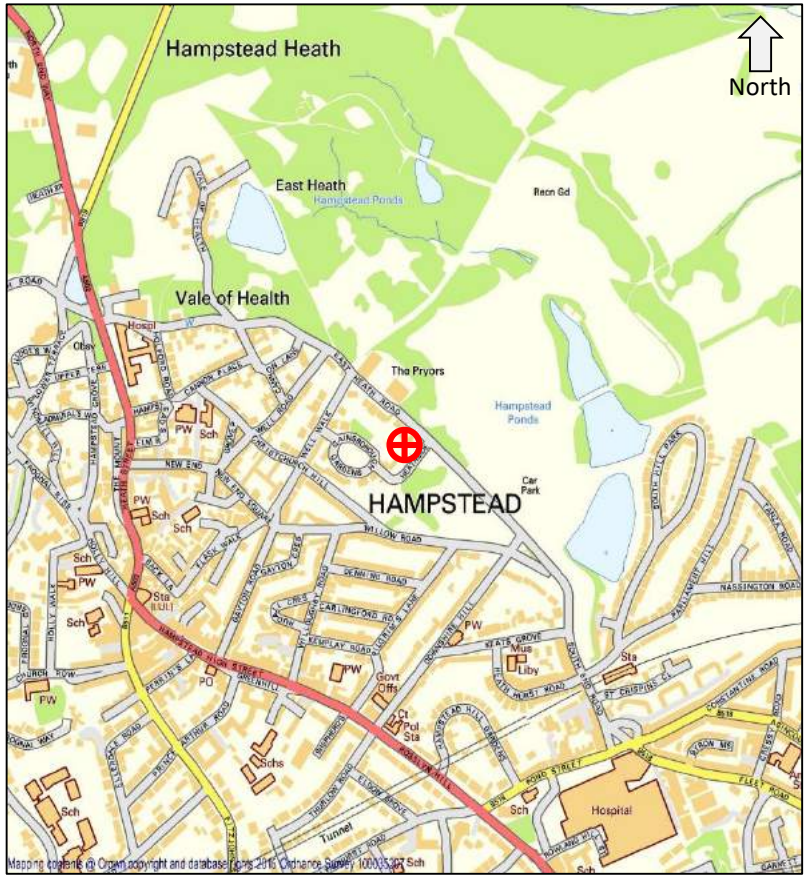
A Ground Movement Assessment has been carried out for South Lodge, Heathside, Hampstead, NW3 1BL to assist with pre-planning document submissions to the Camden Council.

Providing that appropriate consideration is given to the detailed design of party wall and return wall junctions with the basement in order to limit future movement, that good workmanship and construction sequences are used with appropriate support during excavations and that groundwater management is employed, then the proposed basement construction is unlikely to cause significant damage to the surrounding structures. Based on the predicted ground movements, the adjacent structures are expected to be within the CIRIA C760 Damage Category 1 (Very Slight).

Groundwater has been recorded approximately 0.50m below the proposed basement level and therefore groundwater may be encountered during the proposed excavations. The contractor should therefore demonstrate adequate control measures to ensure this risk is mitigated. It would also be prudent to continue to monitor the existing installed standpipe for as long as possible in order to determine equilibrium level and the extent of any seasonal groundwater variations. Trial excavations to the proposed basement depth could be carried by the main contractor to confirm the stability of the soil and to further investigate the presence of groundwater inflows.

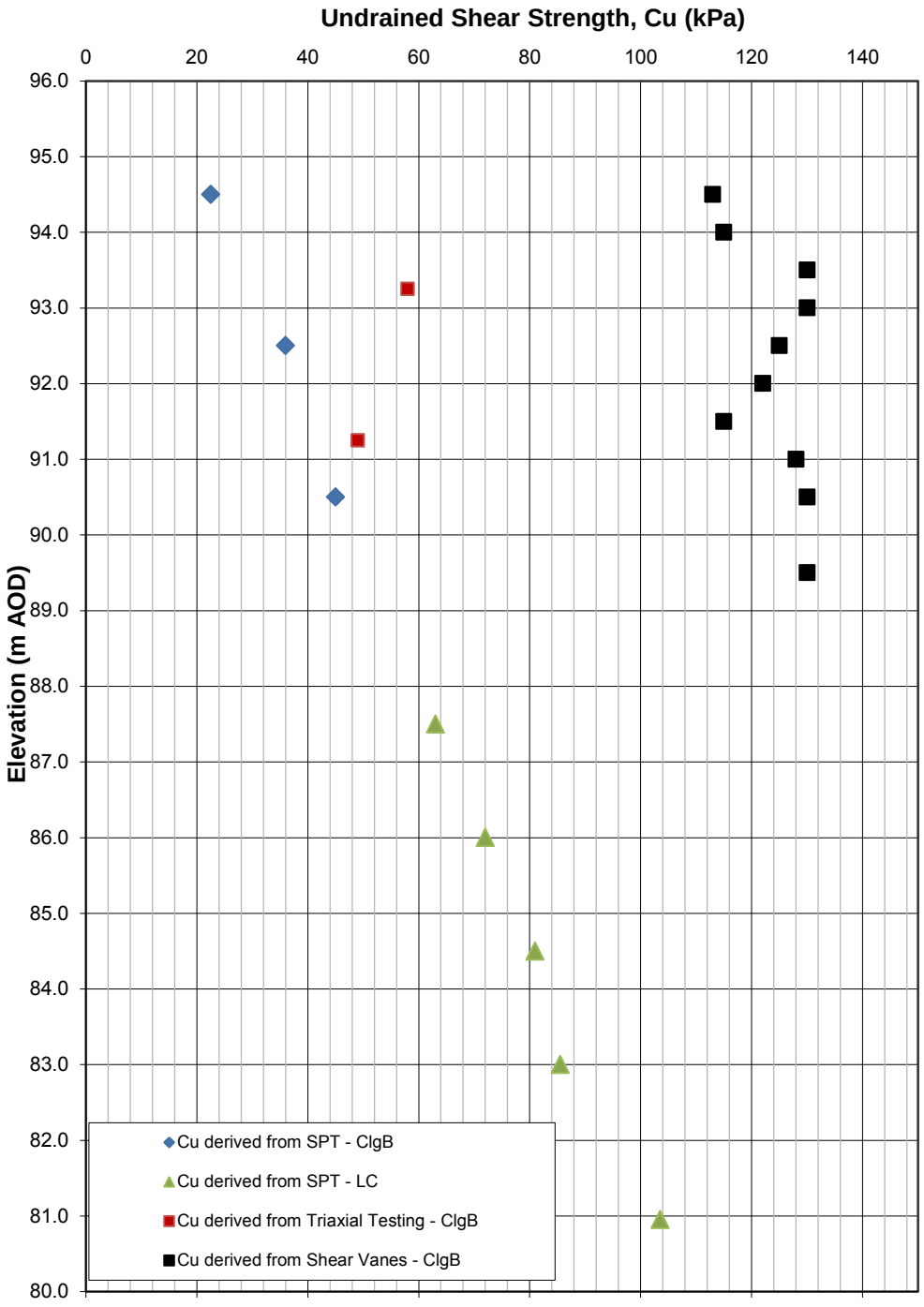
Early movement monitoring of the boundary walls to the neighbouring buildings is recommended during the construction stage and trigger levels should be set in order to protect the neighbouring properties as a precautionary measure (especially at the junctions between the property's). A specification for movement monitoring should be incorporated into the final construction scheme for the proposed development to monitor the adjacent properties and establish the extent of any future potential movement to the building. Any temporary and permanent works should be designed to limit eventual movement.

FIGURES

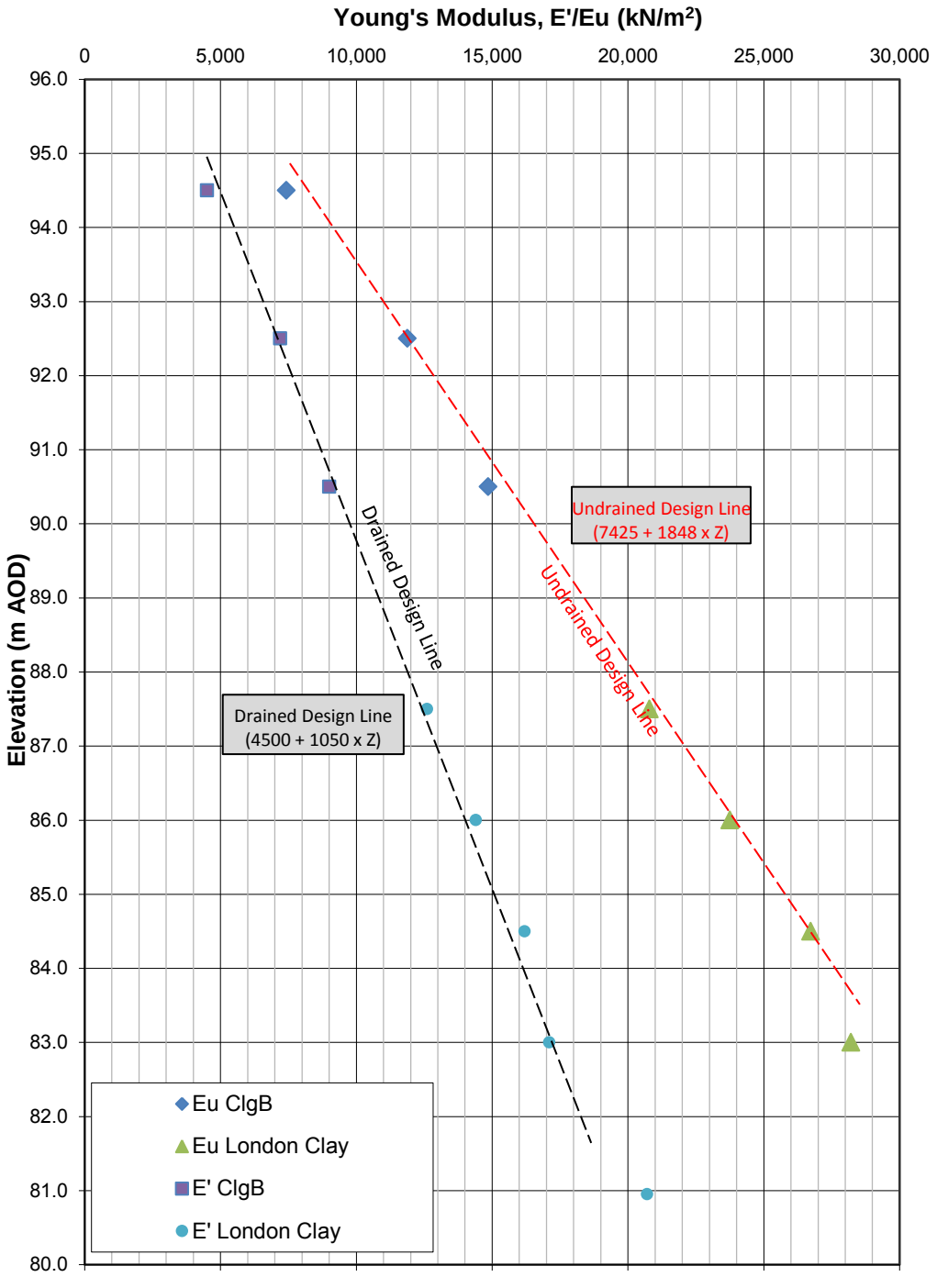


Note: *Screenshot taken from Google Maps (2018)*

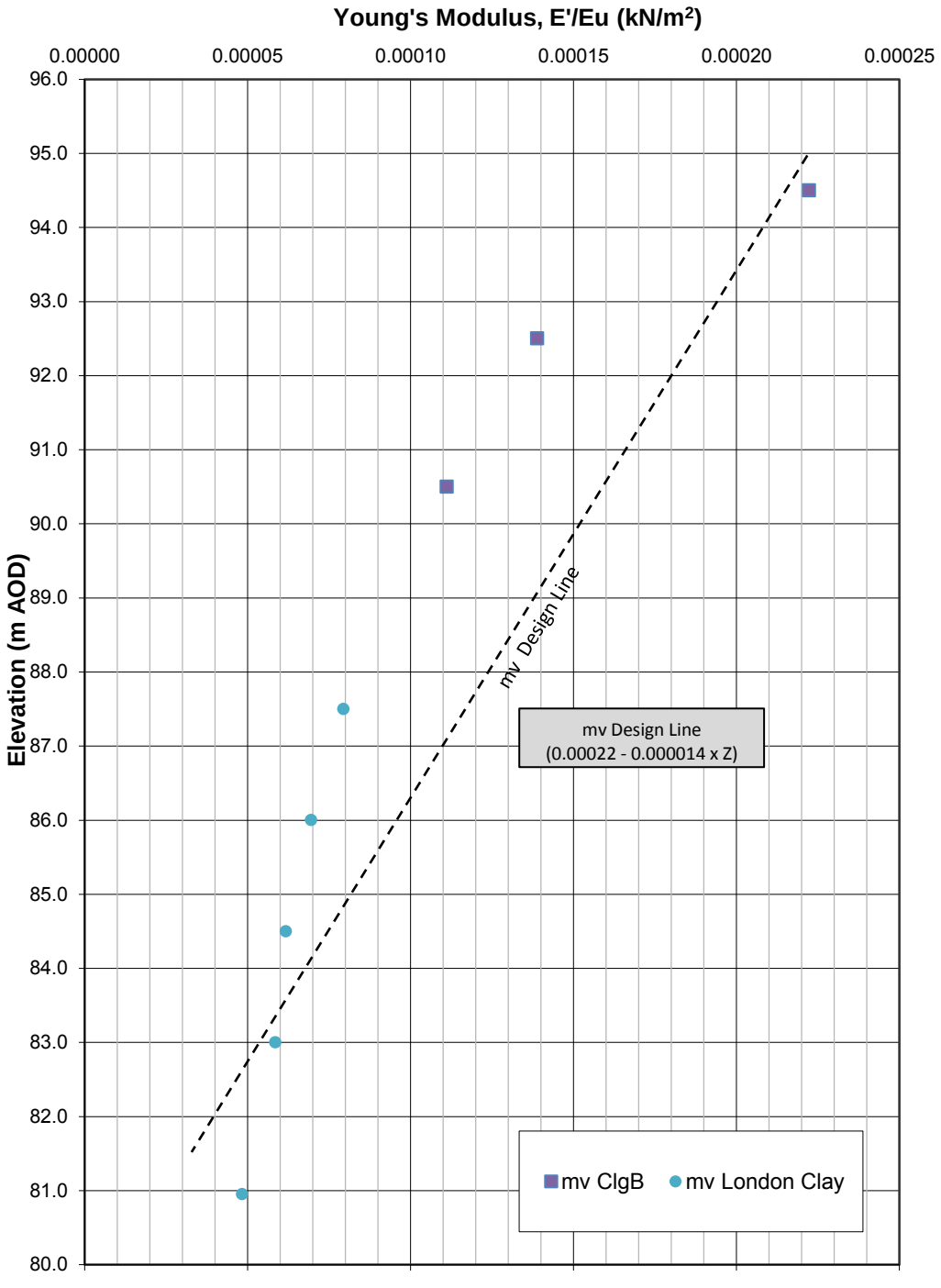
FAIRHURST	Ground Movement Assessment			
	Site Location Plan			
South Lodge, Heathside, NW3 1BL	Date: April 2018	Initials: JT	Figure: 1	



PROJECT TITLE:- **South Lodge, Heathside, Hampstead,**	ORIGINATOR:- FAIRHURST
FIG TITLE:- **Ground Investigation** Undrained Shear Strength versus Elevation	FIG No.:- **2**
	REPORT **125183**
	DATE: **April 2018**



PROJECT TITLE:- **South Lodge, Heathside, Hampstead,**	ORIGINATOR:- FAIRHURST
FIG TITLE:- **Ground Investigation** Young's Modulus (E'/Eu) versus Depth	FIG No.:- **3**
	REPORT **125836**
	DATE: **April 2018**



PROJECT TITLE:- **South Lodge, Heathside, Hampstead,**	ORIGINATOR:- FAIRHURST
FIG TITLE:- **Ground Investigation** Modulus of volume compressibility (mv) versus Depth	FIG No.:- **4**
	REPORT **125836**
	DATE: **April 2018**

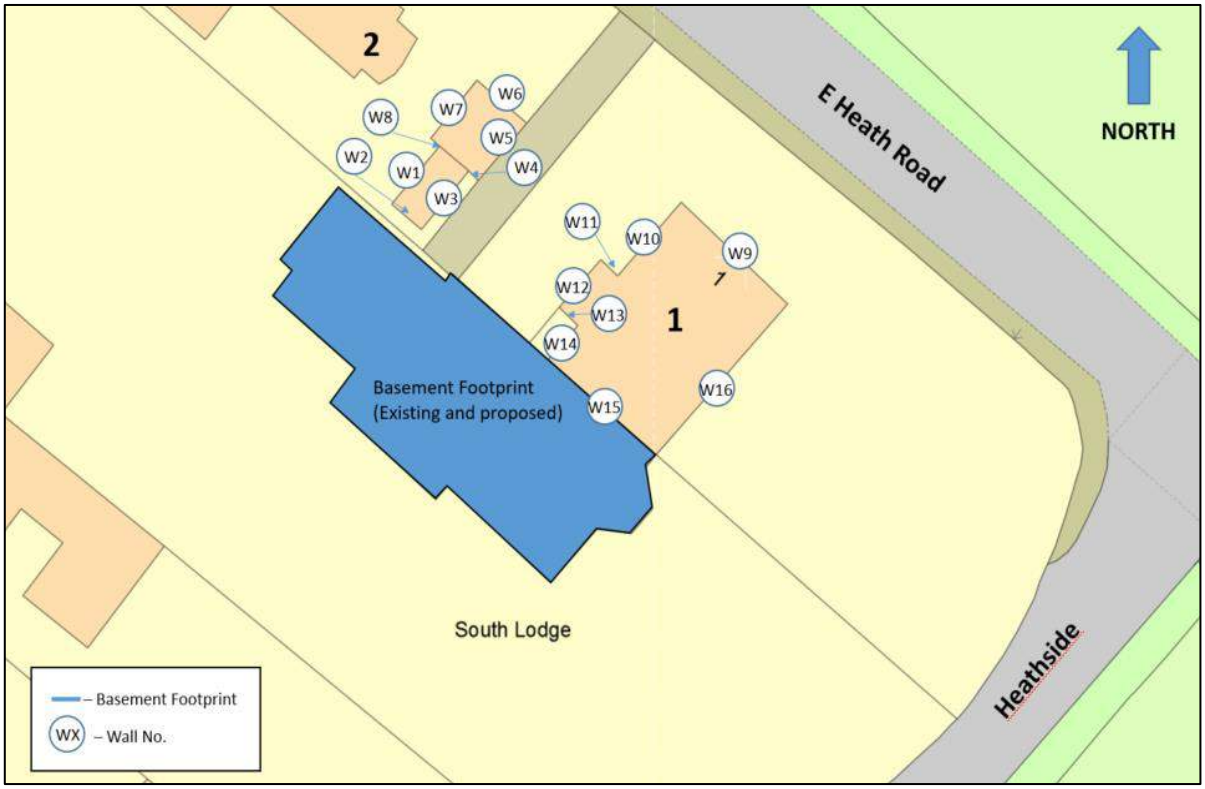
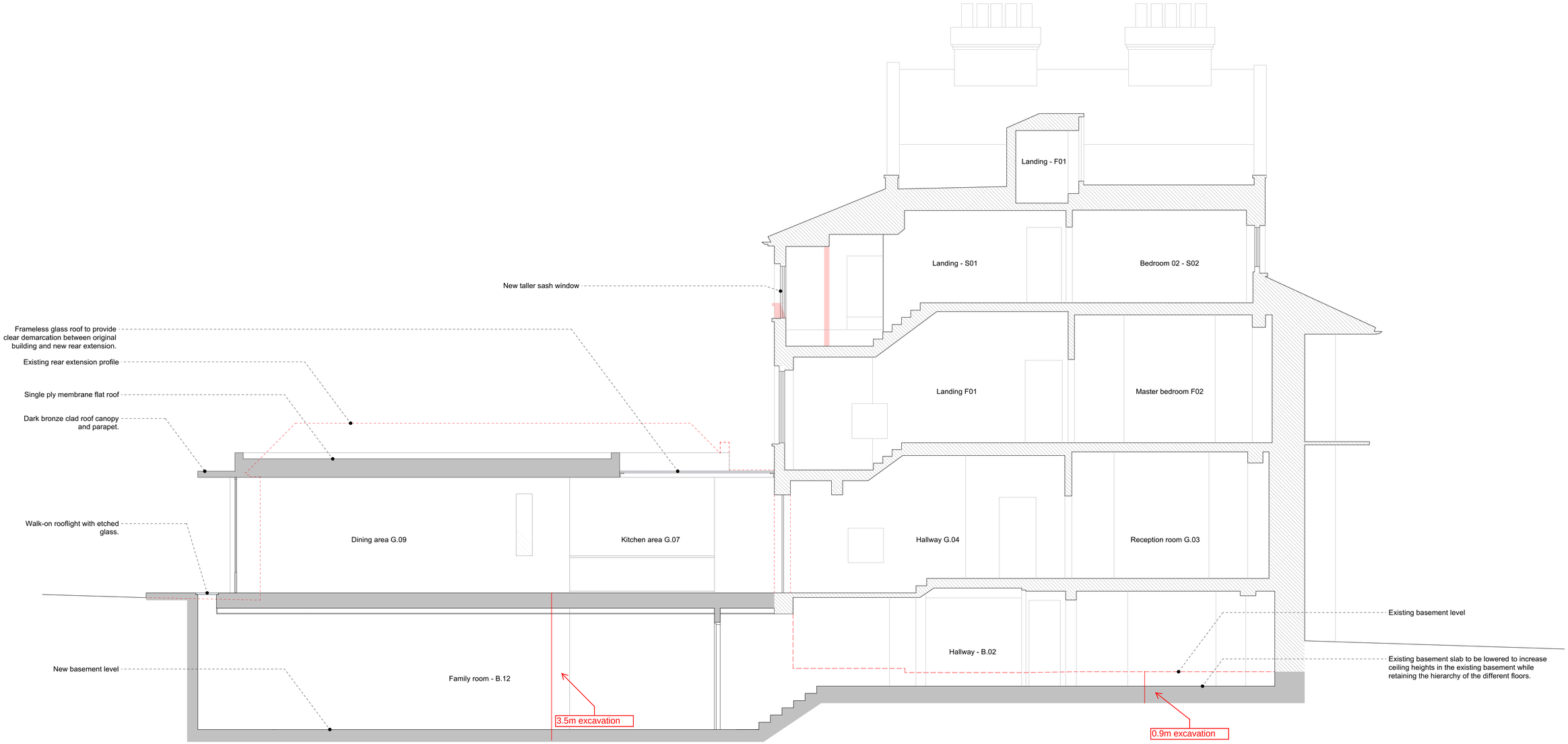


Figure 5: Ground Movement Assessment Wall Location Plan

APPENDIX A

DEVELOPMENT PLANS AND TOPOGRAPHICAL SURVEY



No.	Revision.	Date.

0 1 2.5m

Existing walls and structure

Proposed walls and structure

Existing walls and fixtures to be demolished or removed

PLANNING ISSUE

All dimensions must be confirmed on site and verified with the Architect. Any discrepencies on the drawing must be reported to the Architect prior to any works being carried out on site.

DO NOT SCALE OFF THIS DRAWING, only use stated dimensions for setting out purposes.

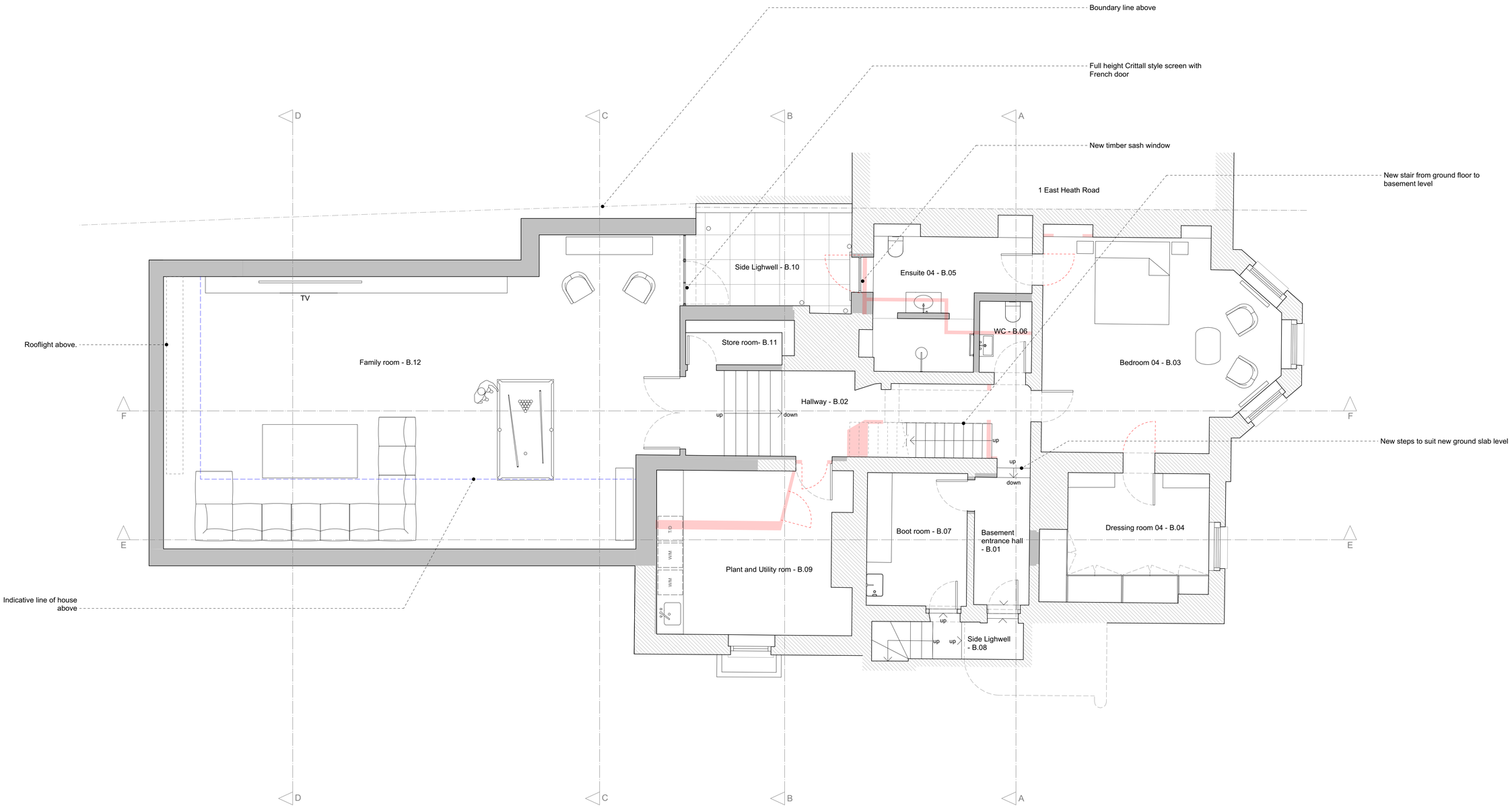
Project:
South Lodge, Heathside, London NW3

Drawing Title:
Proposed sections F-F

Drawing No.:
1938 - 223

Date	Scale
19/06/2017	1:100 @ A3 1:50 @ A1

greenwayarchitects
Branch Hill Mews, London NW3 7LT
Tel +44 (0)20 7435 6091
www.greenwayarchitects.co.uk



No.	Revision.	Date.

N

0 1 2.5m

Existing walls and structure

Proposed walls and structure

Existing walls and fixtures to be demolished or removed

PLANNING ISSUE

Project:
South Lodge, Heathside, London NW3

Drawing Title:
Proposed basement level

Drawing No.:
1938 - 206

Date	Scale
19/06/2017	1:100 @ A3 1:50 @ A1

greenwayarchitects
Branch Hill Mews, London NW3 7LT
Tel +44 (0)20 7435 6091
www.greenwayarchitects.co.uk

APPENDIX B

SASL GROUND INVESTIGATION RECORDS

Site Analytical Services Ltd.

Site Investigations, Analytical & Environmental Chemists, Laboratory Testing Services

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Consultants: G. Evans, BSc., M.Sc., P.G. Dip., FGS., MIEnvSc. A. J. Kingston, BSc C.Eng. MIMM
F. J. Gibbs, F.I.B.M.S. F.I.F.S.T., F.R.S.H. K. J. Blanchette

Your Ref:

Our Ref: **Ref: 17/27399-1**
April 2018

SOUTH LODGE, HEATHSIDE,

HAMPSTEAD, LONDON, NW3 1BL

FACTUAL REPORT ON A GROUND INVESTIGATION

Prepared for

Elliott Wood Partnership Limited

CONTENTS

1.0 INTRODUCTION

1.1 Outline and Limitations of Report

At the request of Elliott Wood Partnership Limited, a ground investigation was carried out in connection with a proposed residential basement development at the above site. A Phase 1 Preliminary Assessment (Desk Study) is presented under separate cover in Site Analytical Services Limited Report Reference 17/27399.

The information was required for the design and construction of foundations and infrastructure for the proposed development at the existing site.

The recommendations and comments given in this report are based on the ground conditions encountered in the exploratory holes made during the investigation and the results of the tests made in the field and the laboratory. It must be noted that there may be special conditions prevailing at the site remote from the exploratory hole locations which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

2.0 SITE DETAILS

(National Grid Reference: TQ 268 860)

2.1 Site Location

South Lodge is a residential property, located on the north-western side of Heathside, Hampstead at approximate postcode NW3 1BL. The residential dwelling has five levels of accommodation; basement, ground, first, second and third floor. The site covers an approximate area of 0.19 Hectares with the general area being under the authority of the London Borough of Camden.

The site is located on the north-western side of Heathside with residential properties to the north-west, south-west and north-east and a roadway to the south-east.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) indicates the site to be underlain the Claygate Member.

The British Geological Survey maintains an archive of historical exploratory borehole logs throughout the UK. SAS Limited has searched the database and have found that there is one borehole located within 150m of the site. This is located 111m to the north-west of the site and reveals Made Ground to a depth of 1.20m underlain by the Claygate Member to a depth of 1.5m with the London Clay at depth.

2.3 Previous Investigations

A Phase 1 Preliminary Assessment (PRA) (SAS Report Ref: 17/27399, dated November 2017) has been undertaken across the site by Site Analytical Services Limited.

3.0 SCOPE OF WORK

3.1 Site Works

The proposed scope of works was agreed by the client prior to the commencement of the investigations. To achieve this, the following works were undertaken:-

- The drilling of one rotary percussive borehole to a depth of 15.00m below ground level (Borehole 1).
- The drilling of one continuous flight auger borehole to a depth of 6.00m below ground level (WS1).
- The excavation by hand of seven trial pits to a maximum depth of 1.50m below ground level (Trial Pits 1 to 7) to expose existing foundations on site.
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the boreholes.
- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes.
- Factual reporting on the results of the investigation.

3.2 Ground Conditions

The locations of the exploratory holes are shown on the site sketch plan, Figure 1.

The boreholes and trial pits revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness (unproven in TP6) resting on deposits of the Claygate Formation with the London Clay Formation at depth.

These ground conditions are summarised in the following table. For detailed information on the ground conditions encountered in the boreholes, reference should be made to the exploratory hole records presented in Appendix A.

Strata	Depth to top of strata (mbgl)	Level to top of strata (mSD)	Depth to base of strata (mbgl)	Level to base of strata (mSD)	Description
Made Ground	0.00	95.52 to 94.46	0.20 to 1.00	94.82 to 93.56	Grass / Clay tiled floor/ pea shingle over silty sandy gravelly clay.
Claygate Formation	0.20 to 1.00	94.82 to 93.56	6.00-6.70	88.82	Soft becoming firm then stiff silty sandy CLAY.
London Clay Formation	6.00-6.70	88.82	15.00 (base of BH 1)	80.52(base of BH 1)	Stiff silty very sandy clay with gypsum crystals

Table A: Summary of Ground Conditions in Exploratory Holes

3.3 Groundwater

Groundwater was not encountered in any of the Trial pits during site works and the material remained essentially dry throughout. Groundwater was encountered in Borehole 1 & Window Sampler 1, as detailed in Table B below.

Exploratory Hole	Depth (m)	Notes	Stratum
BH1	4.00	Rose to 3.80m in 20 minutes	Claygate Member
WS1	5.80	Slight Seepage	Claygate Member

Table B: Groundwater Strike Summary

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and hence be detected, particularly within more cohesive soils.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

Groundwater was encountered at a depth of 2.51m (93.01mSD) within the monitoring standpipe placed in Borehole 1 and WS1 after a period of approximately four weeks and 3.62m (90.84mSD) below ground level within the monitoring standpipe placed in Window Sampler 1 after a period of approximately four weeks.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (October, November 2017) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

4.0 IN-SITU TESTING AND LABORATORY TESTS

4.1 Standard Penetration Tests

The results of the Standard Penetration Tests carried out in the natural soils are shown on the exploratory hole records in Appendix A.

4.2 Undrained Triaxial Compression Test Results

Undrained Triaxial Compression tests were carried out on three undisturbed 100mm diameter samples taken from within Borehole 1.

The test results are given in Table 1, contained in Appendix B.

4.3 In-situ Tests

In the essentially cohesive natural soils encountered at the site, in-situ shear vane tests were made at regular depth increments in order to assess the undrained shear strength of the materials. The results indicate that the natural soils are of a generally high strength in accordance with BS 5930 (2015).

The results of the in-situ tests are shown on the appropriate exploratory hole records contained in Appendix A.

4.4 Classification Tests

Atterberg Limit tests were conducted on six samples taken at depth in Borehole 1 and Window Sampler 1 showed the samples tested to fall into Classes CI and CH according to the British Soil Classification System.

The test results are given in Table 2, contained in Appendix B.

4.5 Sulphate and pH Analyses

The results of the sulphate and pH analyses made on six samples are presented on Table 3, contained in Appendix B.

p.p. SITE ANALYTICAL SERVICES LIMITED

T P Murray MSc BSc (Hons) FGS
Geotechnical Engineer

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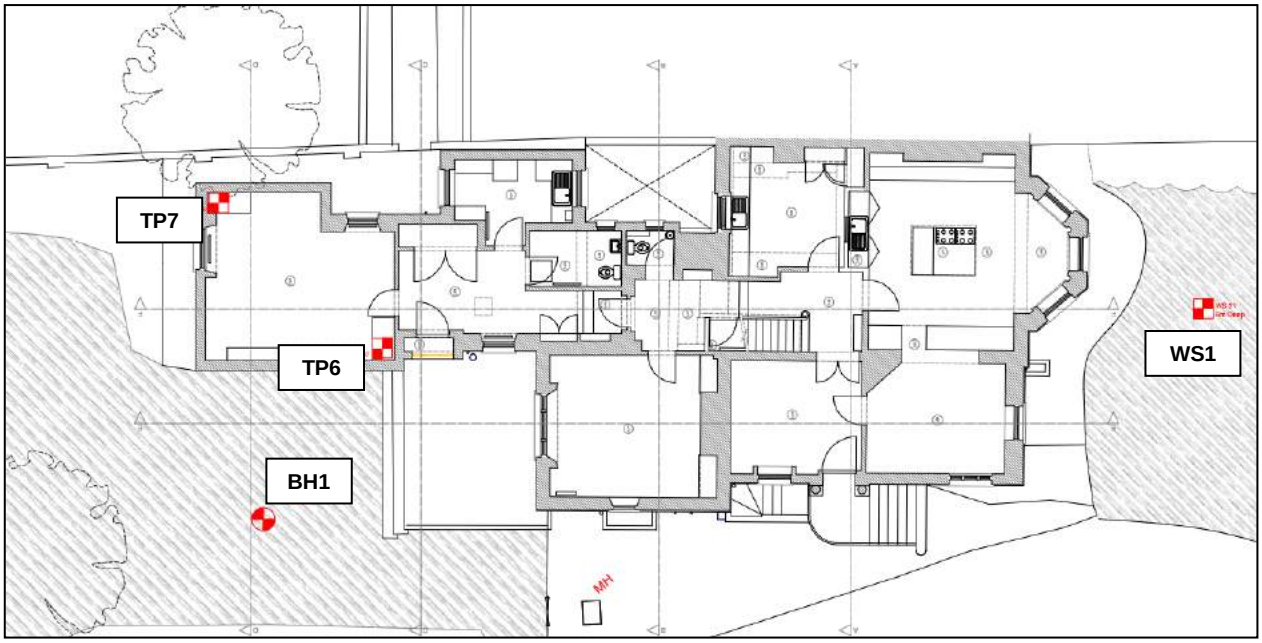
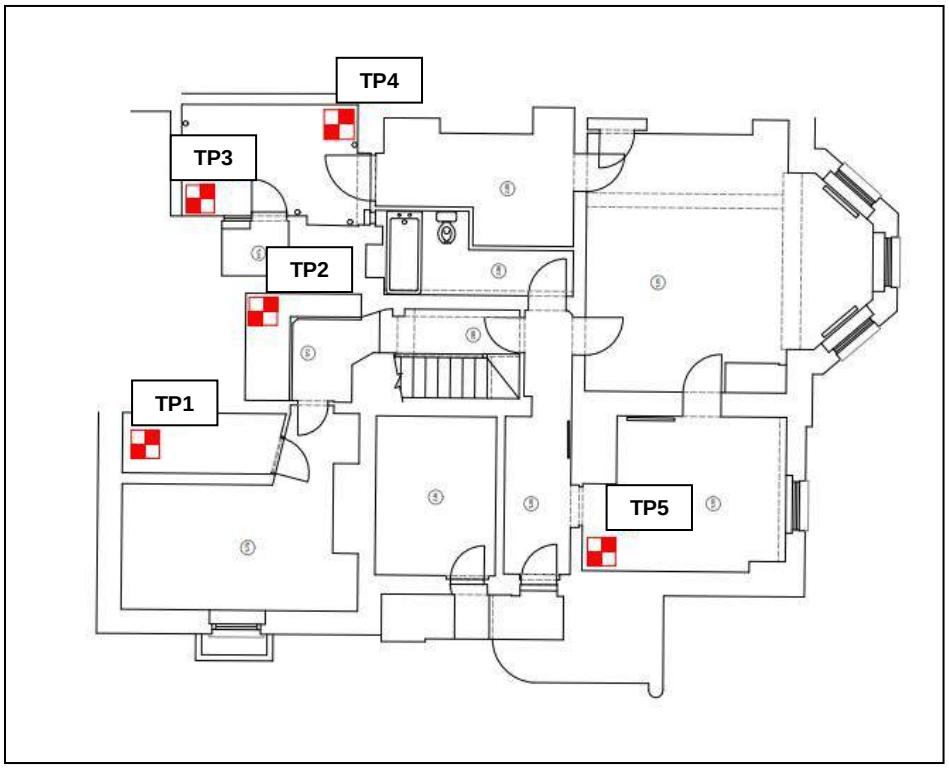
Site Analytical Services Ltd.				REF: 17/27399-1
LOCATION:	South Lodge, Heathside, Hampstead, NW3 1BL			FIG: 1
TITLE:	Site Sketch Plan	DATE:	April 2018	SCALE: NTS

Ground Floor Level



Basement Level



A P P E N D I X `A'

Borehole / Trial Pit Logs

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSIVE	128mm cased to 0.00m	95.52	ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: Pea shingle over dark brown silty clayey sand with fragments of brick and concrete rubble		
0.25	D1				95.22	0.30			
0.50	D2					(0.40)	MADE GROUND: Light brown silty sandy clay with fragments of brick and concrete rubble		
0.75	D3				94.82	0.70			
1.00-1.45 1.00	SPT(C) N=5 D4		DRY	1,0/1,1,2,1			Soft becoming firm, mottled light brown orange grey silty sandy CLAY		
1.75	D5								
2.00-2.45	U1			45 blows		(2.80)			
2.75	D6								
3.00-3.45 3.00	SPT N=8 D7		DRY	1,2/2,2,2,2					
					92.02	3.50	Firm, blue grey silty sandy CLAY with lenses of silty fine sand		
3.75	D8								▼1 ▽1
				Slight Seepage(1) at 4.00m, rose to 3.80m in 20 mins.					
4.00-4.45	U2			30 blows					
4.75	D9								
5.00-5.45 5.00	SPT N=10 D10		3.80	2,2/3,2,2,3		(3.20)			
6.00	D11								
6.50-6.95	U3			55 blows					
					88.82	6.70	Stiff, brown orange very silty very sandy CLAY with partings of silty find sand and occasional gypsum crystals		
7.50	D12								
8.00-8.45 8.00	SPT N=14 D13		3.80	2,3/4,3,3,4		(3.30)			
9.00	D14								
9.50-9.95 9.50	SPT N=16 D15		3.80	3,3/4,3,4,5					

Remarks
D= Disturbed Sample
U= Undisturbed 100mm Diameter Sample
C= Dynamic Penetration Test - Cone
S= Standard Penetration Test - Cone
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 1727399.BH1

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSIVE	128mm cased to 0.00m	95.52	ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					85.52	10.00	Stiff, brown orange very silty very sandy CLAY with partings of silty find sand and occasional gypsum crystals		
10.50	D16								
11.00-11.45	SPT N=18		3.80	3,4/4,4,5,5					
11.00	D17								
12.00	D18								
12.50-12.95	SPT N=19		3.80	4,3/4,5,5,5		(5.00)			
12.50	D19								
13.75	D20								
14.55-15.00	SPT N=23		3.80	4,5/5,6,6,6					
14.55	D21								
					80.52	15.00	Complete at 15.00m		

Remarks
D= Disturbed Sample
U= Undisturbed 100mm Diameter Sample
C= Dynamic Penetration Test - Cone
S= Standard Penetration Test - Cone

Scale (approx)	Logged By
1:50	EW

Figure No. 1727399.BH1

Site Analytical Services Ltd.

Standard Penetration Test Results

Site : SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL

Client : ELLIOTTWOOD PARTNERSHIP LTD

Engineer :

Job Number 1727399

Sheet 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH1	1.00	1.15	1.45	CPT	1	0	1	1	2	1	N=5	
BH1	3.00	3.15	3.45	SPT	1	2	2	2	2	2	N=8	
BH1	5.00	5.15	5.45	SPT	2	2	3	2	2	3	N=10	
BH1	8.00	8.15	8.45	SPT	2	3	4	3	3	4	N=14	
BH1	9.50	9.65	9.95	SPT	3	3	4	3	4	5	N=16	
BH1	11.00	11.15	11.45	SPT	3	4	4	4	5	5	N=18	
BH1	12.50	12.65	12.95	SPT	4	3	4	5	5	5	N=19	
BH1	14.55	14.70	15.00	SPT	4	5	5	6	6	6	N=23	

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	BH1

Installation Type
Single Installation

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 128 mm

Client
ELLIOTTWOOD PARTNERSHIP LTD

Job Number
1727399

Location
TQ268860

Ground Level (mOD)
95.52

Engineer

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			94.52	1.00	Bentonite Seal
	▼1 ▽1				Slotted Standpipe
			89.52	6.00	Bentonite Seal
			88.52	7.00	
			80.52	15.00	General Backfill

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
16/10/17		4.00	0.00	Slight Seepage				3.80	

Groundwater Observations During Drilling

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

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Lockable cover set in cement

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	WS1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	128mm cased to 0.00m	94.46	ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: Grass over dark brown sandy clay with fragments of brick and concrete rubble and small roots		
0.25	D1				94.16	0.30			
					94.06	0.40	MADE GROUND: Dark brown slightly gravelly sandy clay		
0.50	D2				93.86	(0.20) 0.60			
						(0.30)	MADE GROUND: Dark brown slightly gravelly fine to coarse grained sand		
0.75	D3				93.56	0.90			
1.00	D4						MADE GROUND: Brown fine to coarse grained sand with fragments of brick and concrete rubble		
1.00	V1 113								
							Stiff, brown slightly gravelly slightly silty sandy CLAY with lenses of silty fine sand		
1.50	D5					(1.40)			
1.50	V2 115								
2.00	D6								
2.00	V3 130+				92.16	2.30			
							Stiff, mottled brown grey orange silty sandy CLAY with lenses of silty fine sand		
2.50	D7								
2.50	V4 130+								
3.00	D8								
3.00	V5 125					(2.10)			
3.50	D9								
3.50	V6 122								
4.00	D10								
4.00	V7 115								
					90.06	4.40	Stiff, dark grey blue silty sandy CLAY with lenses of silty fine sand		
4.50	D11								
4.50	V8 128								
5.00	D12								
5.00	V9 130+					(1.60)			
									▽1
				Slight Seepage(1) at 5.80m.					
6.00	D13				88.46	6.00			
6.00	V10 130+						Complete at 6.00m		

Remarks
D= Disturbed Sample
V= Vane Test - Results in kPa
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 1727399.WS1

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	WS1

Installation Type
Single Installation

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 100 mm

Client
ELLIOTTWOOD PARTNERSHIP LTD

Job Number
1727399

Location
TQ268860

Ground Level (mOD)
94.46

Engineer

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			93.46	1.00	Bentonite Seal
	▽1		88.46	6.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
16/10/17		5.80	0.00	Slight Seepage					

Groundwater Observations During Drilling

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

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Lockable cover set in cement

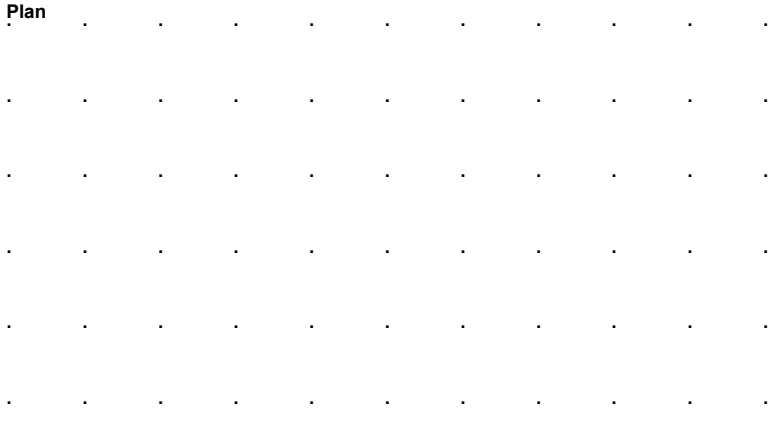
Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07			
					(0.13)	MADE GROUND: Red clay tiled floor over red brick		
					0.20			
0.25	D1					MADE GROUND: Dark brown gravelly sandy clay with fragments of brick		
0.50	D2				(0.80)			
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00			
						Complete at 1.00m		

Plan



Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

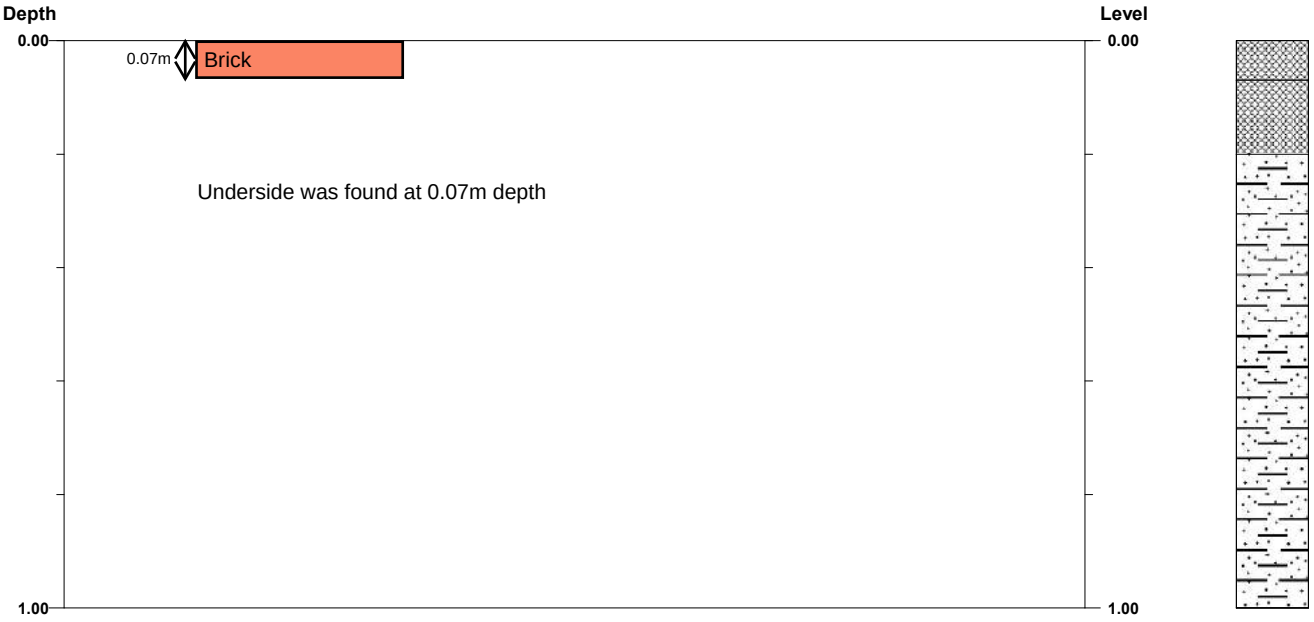
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP1A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Red clay tiled floor over red brick
0.07-0.20	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick
0.20-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP1A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07			
					(0.13)	MADE GROUND: Red clay tiled floor over red brick		
					0.20			
0.25	D1					MADE GROUND: Dark brown gravelly sandy clay with fragments of brick		
0.50	D2				(0.80)			
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00			
						Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

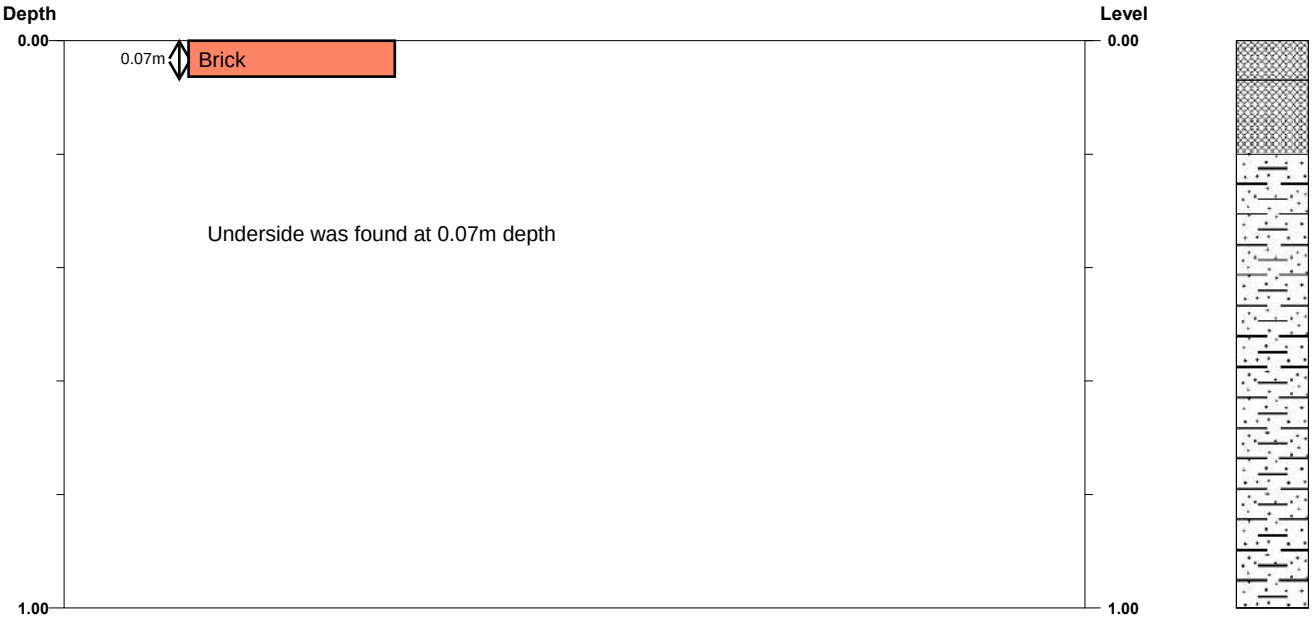
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP1B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP1B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Red clay tiled floor over red brick
0.07-0.20	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick
0.20-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP1B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Red clay tiled floor		
					0.16	MADE GROUND: Concrete		
0.25	D1				0.20	MADE GROUND: Hardcore		
0.50	D2				(0.80)	Mottled brown very sandy CLAY		
0.75	D3							
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

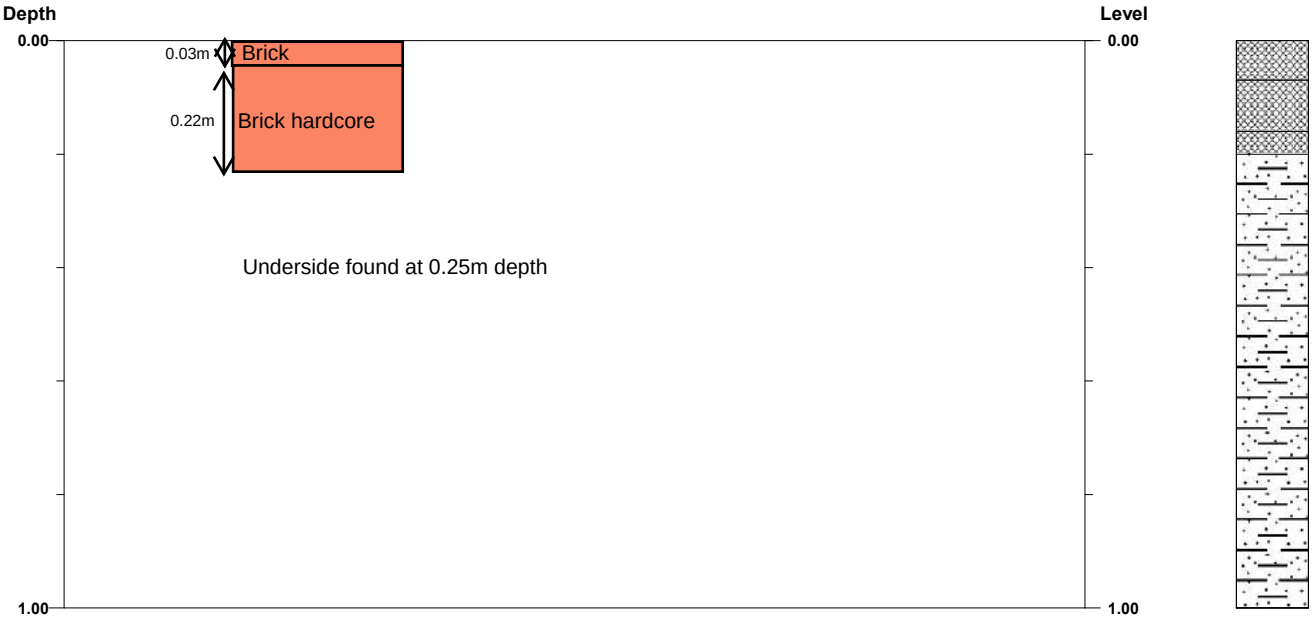
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP2

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP2

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Red clay tiled floor
0.07-0.16	2	MADE GROUND: Concrete
0.16-0.20	3	MADE GROUND: Hardcore
0.20-1.00	4	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP2

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.08	MADE GROUND: Red quarry tiles over sand and cement		
0.25	D1				(0.64)	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash		
0.50	D2				0.72			
0.75	D3				(0.28)	Mottled brown very sandy CLAY		
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

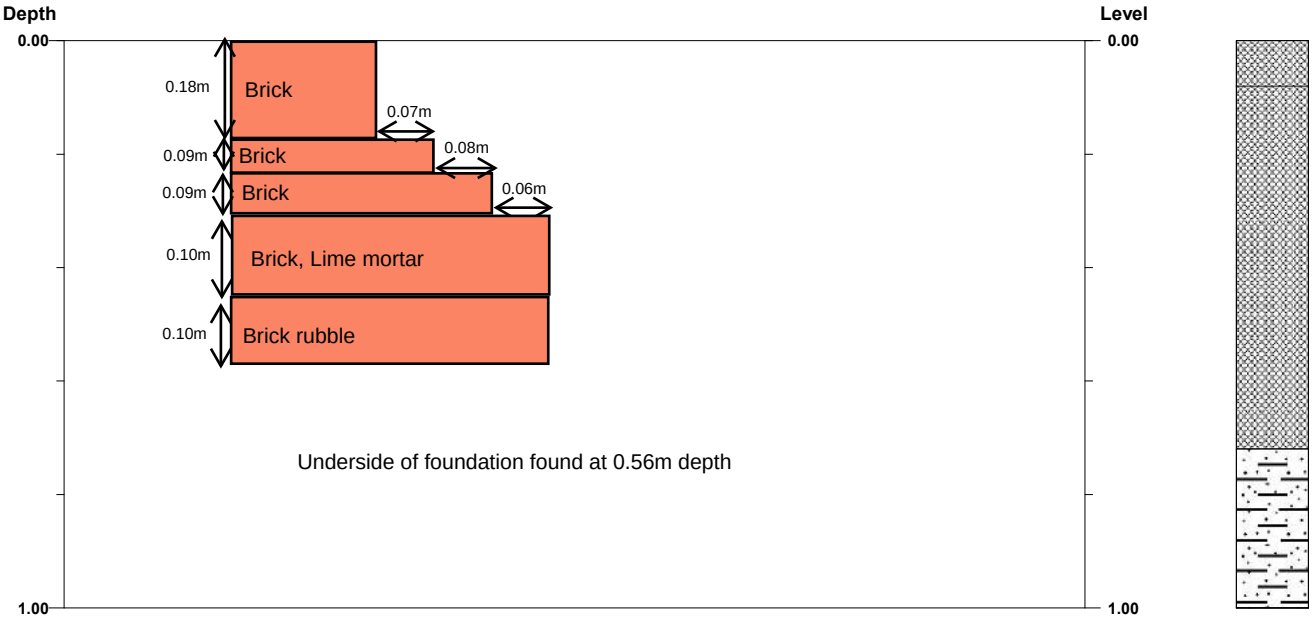
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP3

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.08	1	MADE GROUND: Red quarry tiles over sand and cement
0.08-0.72	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash
0.72-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP4

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.12	MADE GROUND: Red quarry tiles over sand and cement		
					(0.18)			
0.25	D1				0.30	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash		
0.50	D2				(0.70)	Mottled brown very sandy CLAY		
0.75	D3							
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

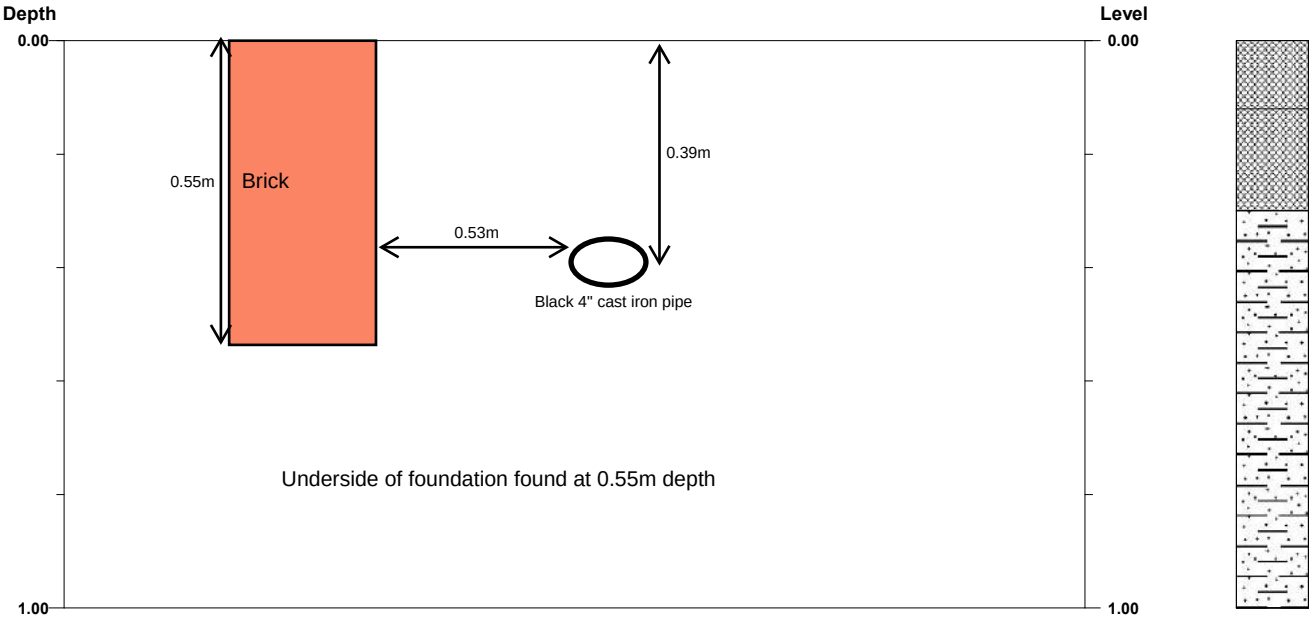
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP4

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.12	1	MADE GROUND: Red quarry tiles over sand and cement
0.12-0.30	2	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble and ash
0.30-1.00	3	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 1727399.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Clay tiled floor		
					(0.13)			
					0.20	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints		
0.25	D1				0.23			
0.50	D2				(0.77)	MADE GROUND: Brick rubble		
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00			
						Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

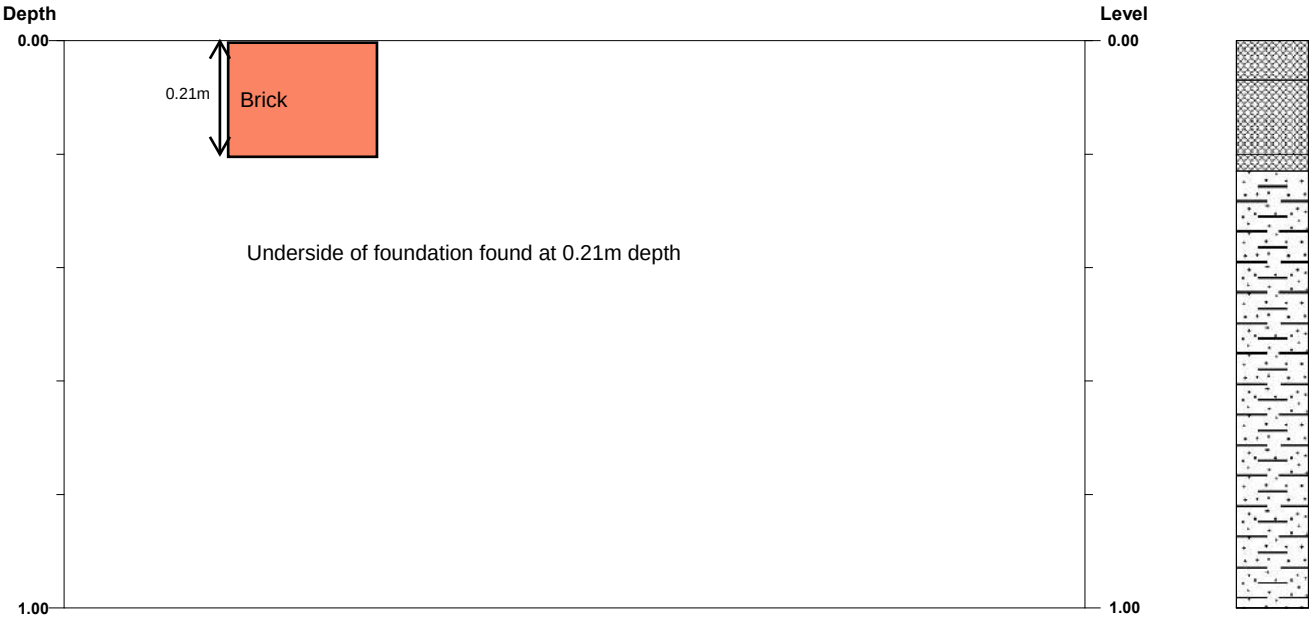
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP5A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Clay tiled floor
0.07-0.20	2	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints
0.20-0.23	3	MADE GROUND: Brick rubble
0.23-1.00	4	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 1727399.TP5A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Clay tiled floor		
					(0.13)			
					0.20	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints		
0.25	D1				0.23			
0.50	D2				(0.77)	MADE GROUND: Brick rubble		
0.75	D3					Mottled brown very sandy CLAY		
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

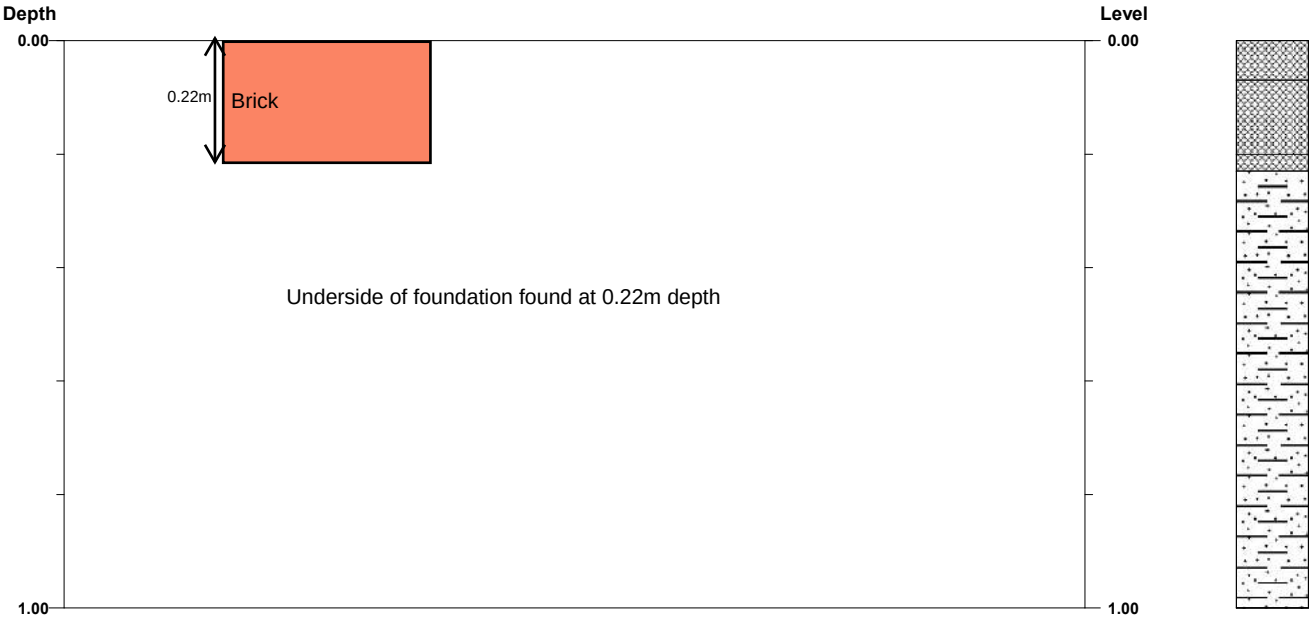
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP5B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP5B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Clay tiled floor
0.07-0.20	2	MADE GROUND: Concrete containing course sub-rounded to sub-angular flints
0.20-0.23	3	MADE GROUND: Brick rubble
0.23-1.00	4	Mottled brown very sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP5B

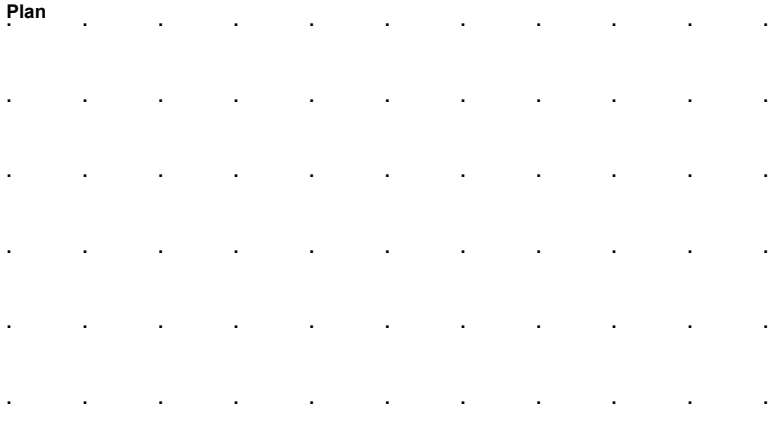
Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.25	D1				0.07 (0.24)	MADE GROUND: Timber floor boards		
0.50	D2				0.31 (0.20)	MADE GROUND: Timber joist		
0.75	D3				0.43 (0.37)	MADE GROUND: Concrete		
1.00	D4				0.63 (0.37)	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble		
					1.00	MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble		
						Complete at 1.00m		

Plan



Remarks

Groundwater is not encountered during boring/excavation
D= Disturbed Sample

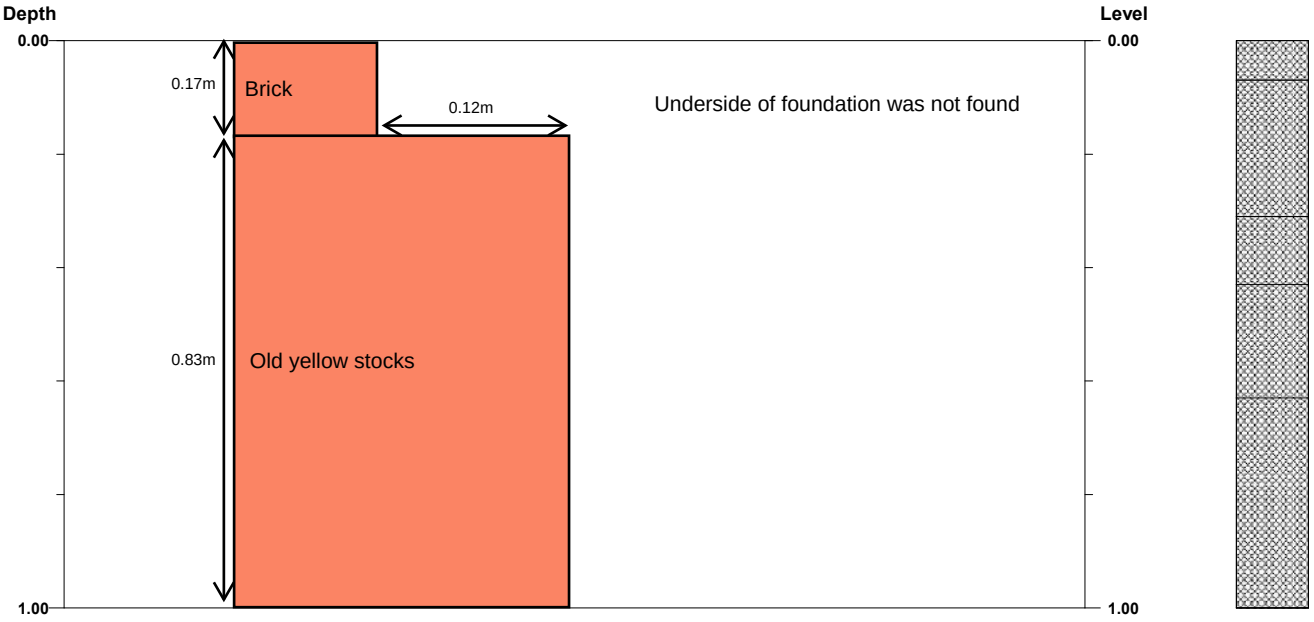
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP6A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.31	2	MADE GROUND: Timber joist
0.31-0.43	3	MADE GROUND: Concrete
0.43-0.63	4	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble
0.63-1.00	5	MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
Groundwater is not encountered during boring/excavation
D= Disturbed Sample

Logged By : EW
Checked By :
Figure No. : 1727399.TP6A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.25	D1				0.07 (0.24)	MADE GROUND: Timber floor boards		
0.50	D2				0.31 (0.20)	MADE GROUND: Timber joist		
0.75	D3				0.43 (0.37)	MADE GROUND: Concrete		
1.00	D4				0.63 (0.37)	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble		
					1.00	MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble		
						Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

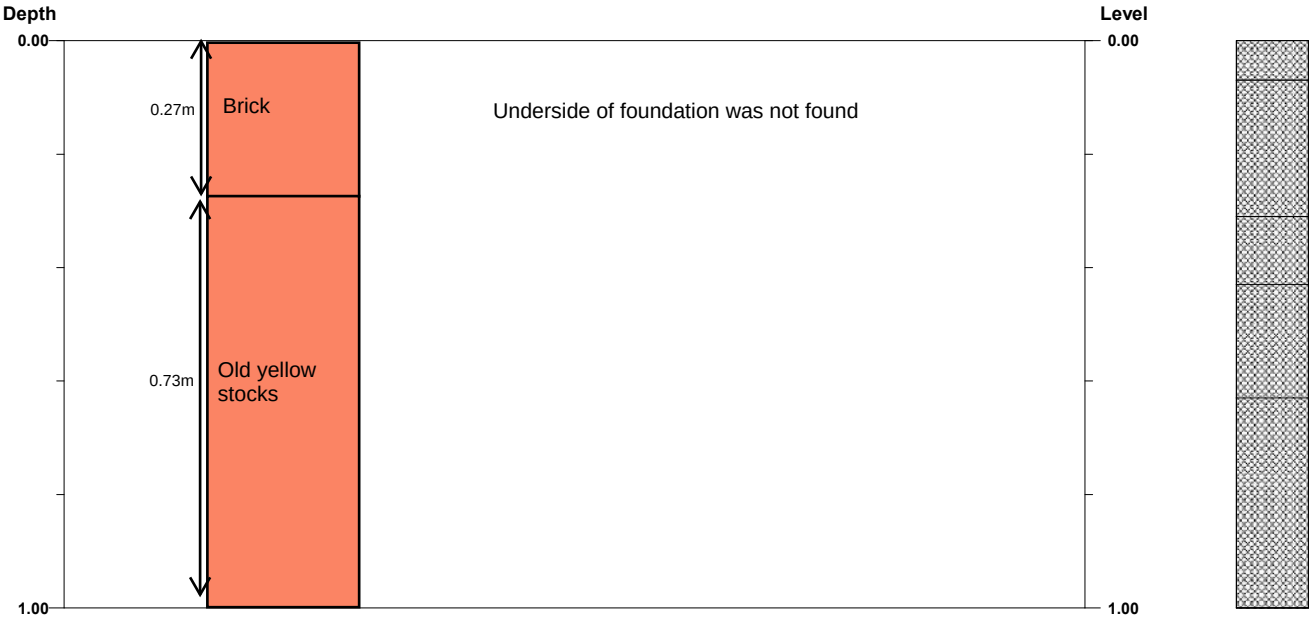
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP6B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP6B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.31	2	MADE GROUND: Timber joist
0.31-0.43	3	MADE GROUND: Concrete
0.43-0.63	4	MADE GROUND: Dark brown gravelly sandy clay with fragments of brick and concrete rubble
0.63-1.00	5	MADE GROUND: Mottled brown sandy clay with fragments of brick and concrete rubble

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP6B

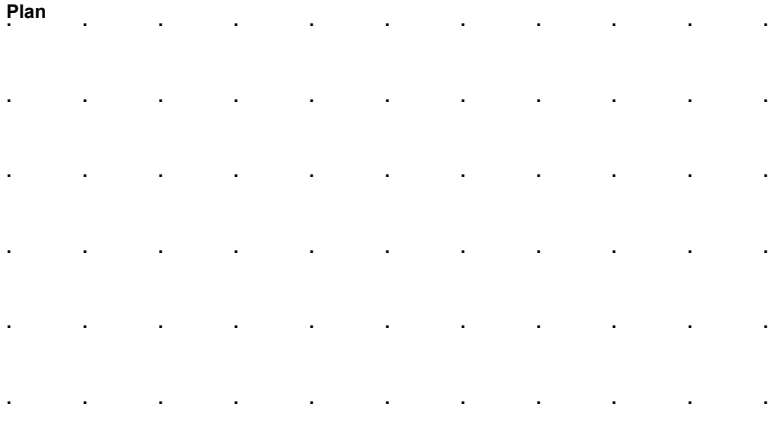
Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7A

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Timber floor boards		
0.25	D1				0.18	MADE GROUND: Timber joist		
0.50	D2				0.30	MADE GROUND: Concrete		
0.75	D3				0.42	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash		
1.00	D4				(0.58)	Mottled brown sandy CLAY		
					1.00	Complete at 1.00m		

Plan



Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

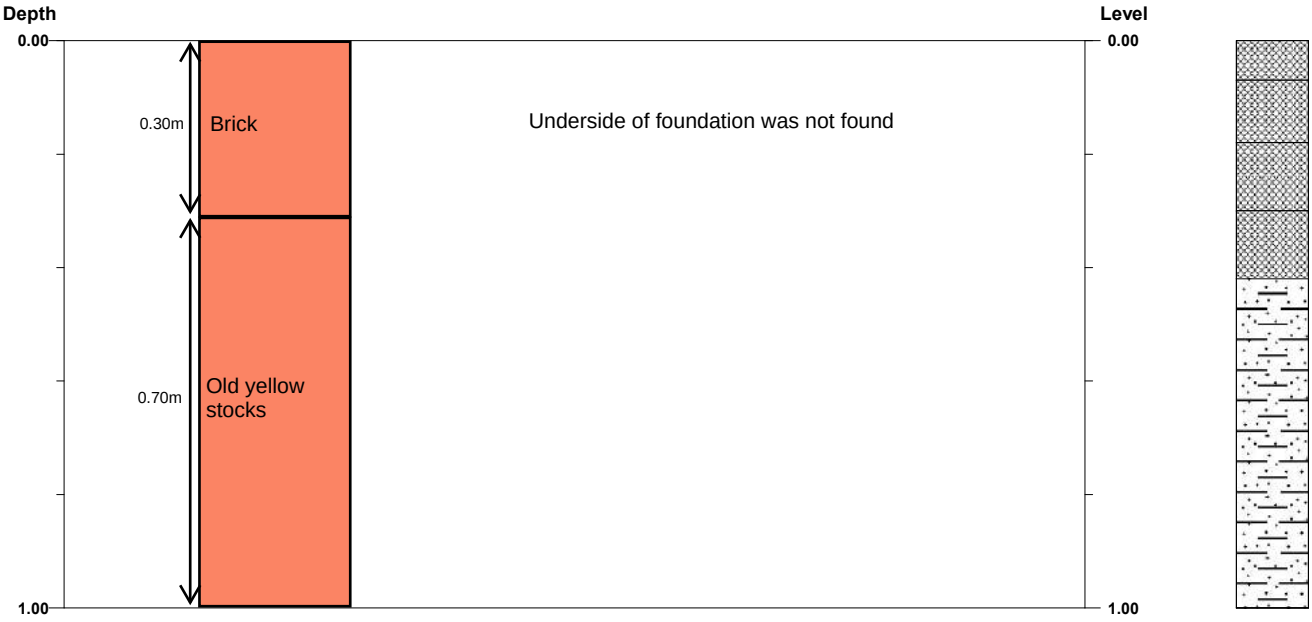
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP7A

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A D B C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.18	2	MADE GROUND: Timber joist
0.18-0.30	3	MADE GROUND: Concrete
0.30-0.42	4	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash
0.42-1.00	5	Mottled brown sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP7A

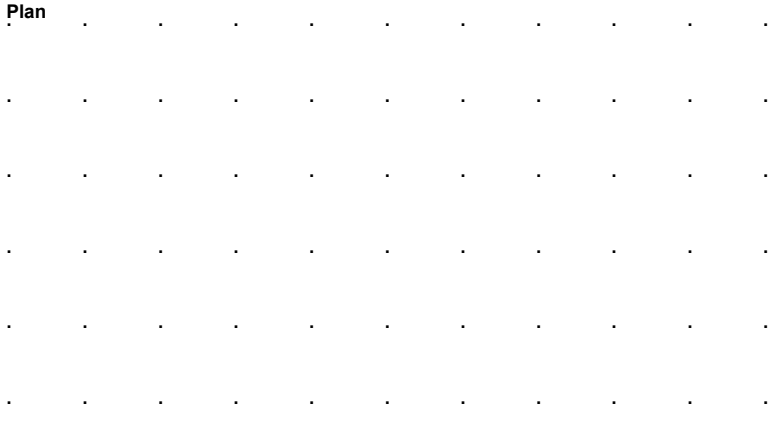
Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7B

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.07	MADE GROUND: Timber floor boards		
					0.18			
0.25	D1				0.30	MADE GROUND: Timber joist		
0.50	D2				0.42	MADE GROUND: Concrete		
0.75	D3				(0.58)	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash		
1.00	D4				1.00	Mottled brown sandy CLAY		
						Complete at 1.00m		

Plan



Remarks

D= Disturbed Sample
Groundwater is not encountered during boring/excavation

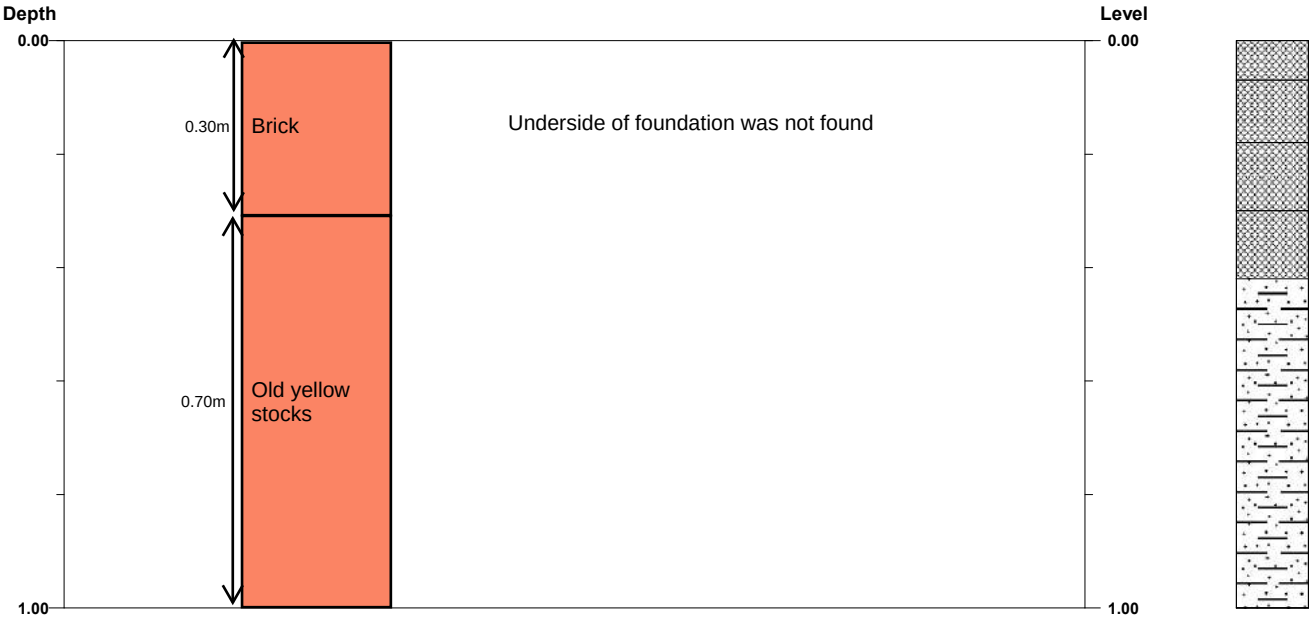
Scale (approx)	Logged By	Figure No.
1:50	EW	1727399.TP7B

Site Analytical Services Ltd.

Site	Trial Pit Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	TP7B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.00m(D)		ELLIOTTWOOD PARTNERSHIP LTD	1727399

Orientation	Location	Dates	Engineer	Sheet
A D B C	TQ268860	16/10/2017		1/1



Strata

Depth (m)	No.	Description
0.00-0.07	1	MADE GROUND: Timber floor boards
0.07-0.18	2	MADE GROUND: Timber joist
0.18-0.30	3	MADE GROUND: Concrete
0.30-0.42	4	MADE GROUND: Dark brown sandy clay with fragments of brick and concrete rubble and ash
0.42-1.00	5	Mottled brown sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	

Excavation Method:
HAND EXCAVATION

Shoring / Support:
N/A

Stability:
GOOD

Backfill:
ARISINGS

Remarks
D= Disturbed Sample
Groundwater is not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 1727399.TP7B

A P P E N D I X `B'

Laboratory Test & Gas Monitoring Data

Site Analytical Services Ltd.

Ref: 17/27399

UNDRAINED TRIAXIAL COMPRESSION TEST

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

BH/TP No.	MOISTURE CONTENT %	BULK DENSITY Mg/m^3	LATERAL PRESSURE kN/m^2	COMPRESSIVE STRENGTH kN/m^2	COHESION kN/m^2	ANGLE OF SHEARING RESISTANCE degrees	DEPTH m
BH1	27	1.89	50	116	58		2.25
BH1	28	2.00	80	98	49		4.25

Table 1

Site Analytical Services Ltd.

Ref: 17/27399

PLASTICITY INDEX & MOISTURE CONTENT DETERMINATIONS

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

BH/TP No.	Depth m	Natural Moisture %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing 425 μm %	Class
BH1	3.00	28	50	26	24	100	CI/CH
	3.75	32	49	28	21	100	CI
	4.75	27	48	23	25	100	CI
WS1	3.00	26	44	23	21	100	CI
	3.50	25	45	20	25	100	CI
	4.00	25	45	20	25	100	CI

Table 2

Site Analytical Services Ltd.

Ref: 17/27399

SULPHATE & pH DETERMINATIONS

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

BH/TP No.	DEPTH BELOW GL m	SOIL SULPHATES AS SO_4 TOTAL %	SOIL SULPHATES AS SO_4 WATER SOL g/l	WATER SULPHATES AS SO_4 g/l	pH	CLASS	SOIL - 2mm %
BH1	5.00		0.18		8.2	DS-1	100
	9.00		0.19		7.7	DS-1	100
WS1	4.50		0.14		7.1	DS-1	100
	6.00		0.19		7.2	DS-1	100

Classification – Tables C1 and C2 : BRE Special Digest 1 : 2005

Table 3

Site Analytical Services Ltd.

Ref: 17/27399

GROUNDWATER MONITORING

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

GROUNDWATER MONITORING RECORD			
Date	**Weather Conditions**	**Ground Conditions**	**Temperature (°C)**
07/11/2017	Light Rain	Wet	9.4
Monitoring Point Location	**Depth to water (mBGL)**		**Depth to Base of well (mBGL)**
WS1	3.91		5.42
BH1	2.72		6.00

Table 4

Site Analytical Services Ltd.

Ref: 17/27399

GROUNDWATER MONITORING

LOCATION South Lodge, Heathside, Hampstead, NW3 1BL

GROUNDWATER MONITORING RECORD			
Date	**Weather Conditions**	**Ground Conditions**	**Temperature (°C)**
07/11/2017	Light Rain	Wet	9.4
Monitoring Point Location	**Depth to water (mBGL)**		**Depth to Base of well (mBGL)**
WS1	3.62		5.42
BH1	2.51		6.00

Table 4a

Site Analytical Services Ltd.

Site	Borehole Number
SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	WS1

In Situ Permeability Type	Test No.	Ground Level (mOD)	Client	Job Number
Falling Head	1		ELLIOTTWOOD PARTNERSHIP LTD	1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 1/2

Height of casing above ground level:	0.00	**m**
Depth to Base of Borehole:	6.00	**m bgl**
Depth to Base of Casing:	1.00	**m bgl**
Depth to equilibrium water level:	5.80	**m btoc**
Test Length L:	5.00	**m**
Diameter of Test Length D:	0.05	**m**
Area of Test Section:	0.0020	**m2**
Intake Factor F: (after condition B, figure 6, BS 5930)	0.1375	

PERMEABILITY (after Hvorslev, 1951)

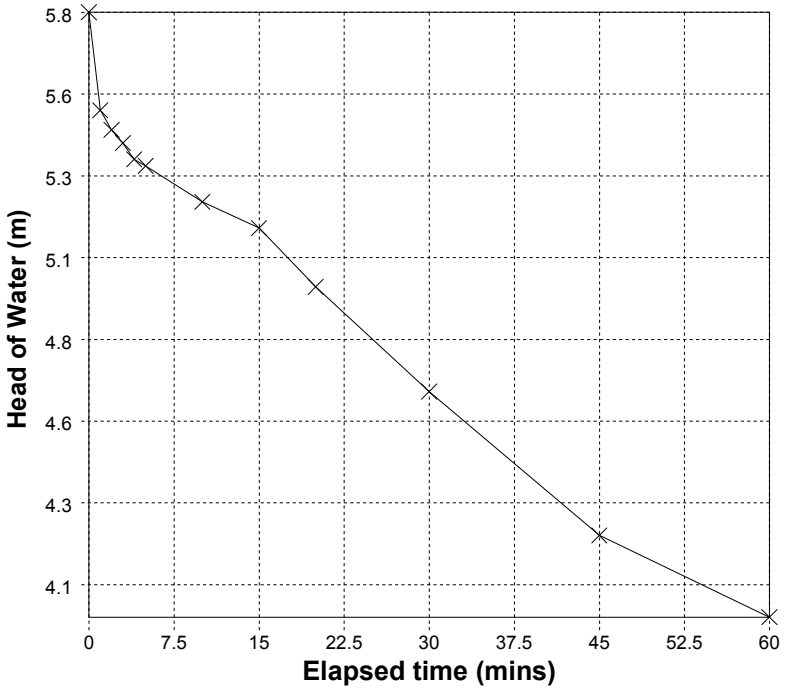
General Approach

H1 selected at t= 5.49 mins (=t1 = 60.6 secs)

H2 selected at t= 3.937 mins (=t2 = 3610.2 secs)

k = 1.34E-06 **ms-1**

Elapsed time (mins)	Depth to water (m btoc)	Head of Water, H (m)	Ht / Ho
0.0	0.000	5.800	1.000
1.0	0.300	5.500	0.948
2.0	0.360	5.440	0.938
3.0	0.400	5.400	0.931
4.0	0.450	5.350	0.922
5.0	0.470	5.330	0.919
10.0	0.580	5.220	0.900
15.0	0.660	5.140	0.886
20.0	0.840	4.960	0.855
30.0	1.160	4.640	0.800
45.0	1.600	4.200	0.724
60.0	1.850	3.950	0.681



Remarks

Key: bgl = Below Ground Level btoc = Below Top of Casing

Site Analytical Services Ltd.

			Site SOUTH LODGE, HEATHSIDE, HAMPSTEAD, NW3 1BL	**Borehole Number** WS1
In Situ Permeability Type Falling Head	**Test No.** 2	**Ground Level (mOD)**	**Client** ELLIOTTWOOD PARTNERSHIP LTD	**Job Number** 1727399
	Location TQ268860	**Dates** 16/10/2017	**Engineer**	**Sheet** 2/2

Height of casing above ground level:	0.00 **m**
Depth to Base of Borehole:	6.00 **m bgl**
Depth to Base of Casing:	1.00 **m bgl**
Depth to equilibrium water level:	5.80 **m btoc**
Test Length L:	5.00 **m**
Diameter of Test Length D:	0.05 **m**
Area of Test Section:	0.0020 **m2**
Intake Factor F: (after condition B, figure 6, BS 5930)	0.1375

PERMEABILITY (after Hvorslev, 1951)

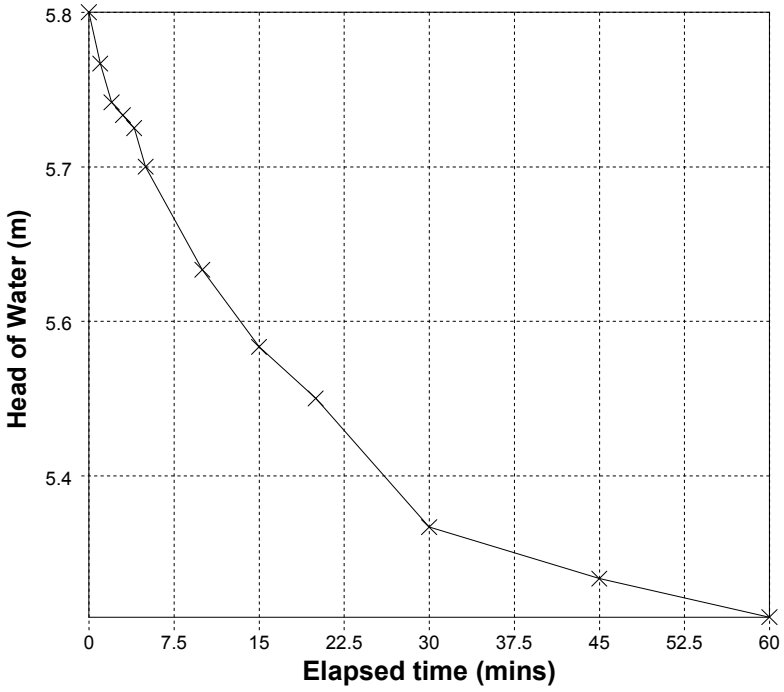
General Approach

H1 selected at t= 5.74 mins (=t1 = 55.2 secs)

H2 selected at t= 5.298 mins (=t2 = 3599.4 secs)

k = 3.23E-07 **ms-1**

Elapsed time (mins)	Depth to water (m btoc)	Head of Water, H (m)	Ht / Ho
0.0	0.000	5.800	1.000
1.0	0.040	5.760	0.993
2.0	0.070	5.730	0.988
3.0	0.080	5.720	0.986
4.0	0.090	5.710	0.984
5.0	0.120	5.680	0.979
10.0	0.200	5.600	0.966
15.0	0.260	5.540	0.955
20.0	0.300	5.500	0.948
30.0	0.400	5.400	0.931
45.0	0.440	5.360	0.924
60.0	0.470	5.330	0.919

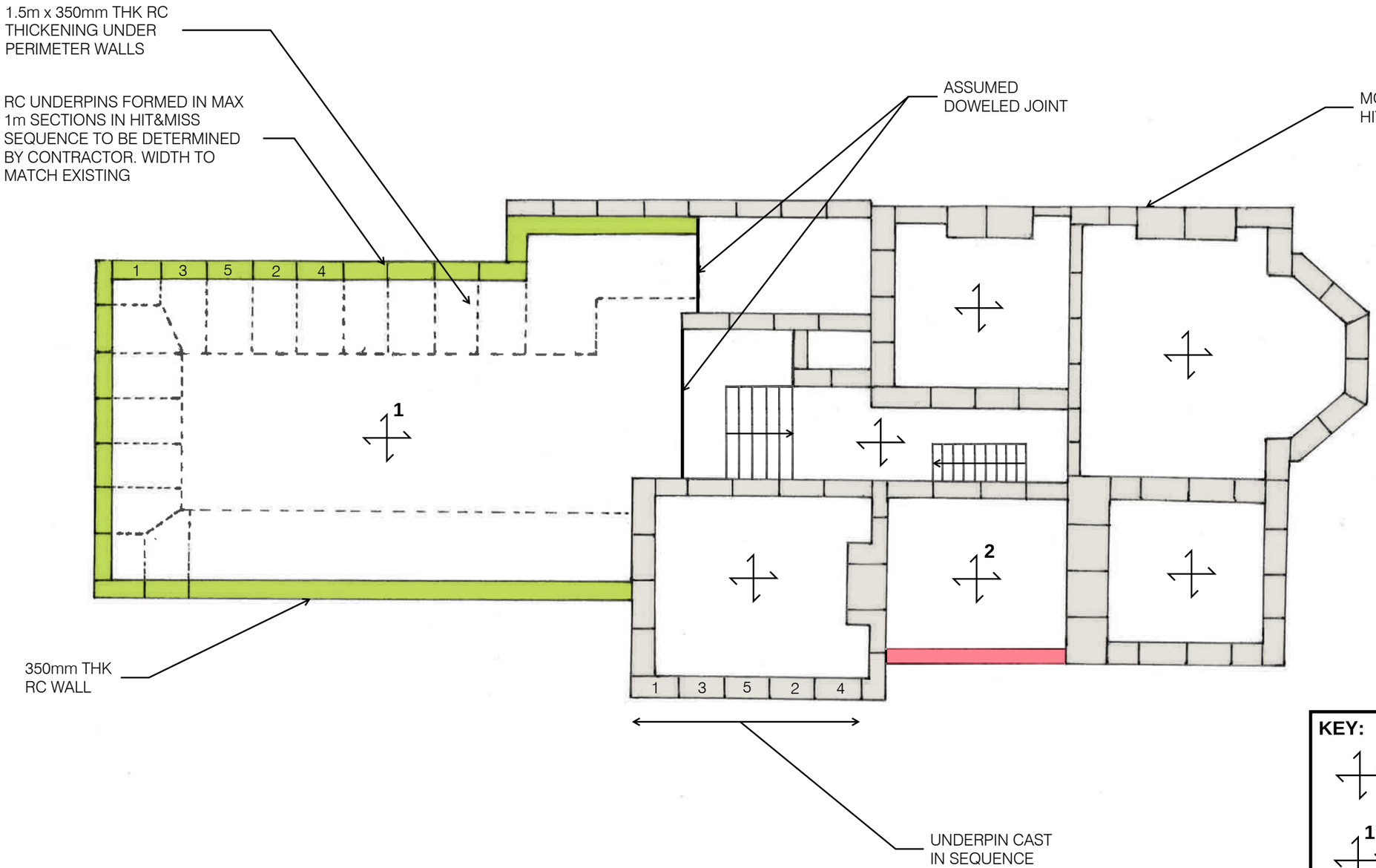


Remarks

Key: bgl = Below Ground Level btoc = Below Top of Casing

APPENDIX C

STRUCTURAL LOADINGS AND PROPOSED BASEMENT PLAN



KEY:

	150mm THK RC SLAB
1	250mm THK SUSPENDED RC SLAB ON CORDEK CELLCORE HXS ON BLINDING
2	EXISTING GROUND SLAB

rev	date	by	chk	description

sketch title
PROPOSED BASEMENT PLAN

SKETCH

scale (s)	date	drawn
1:100@A3	29/03/18	STh

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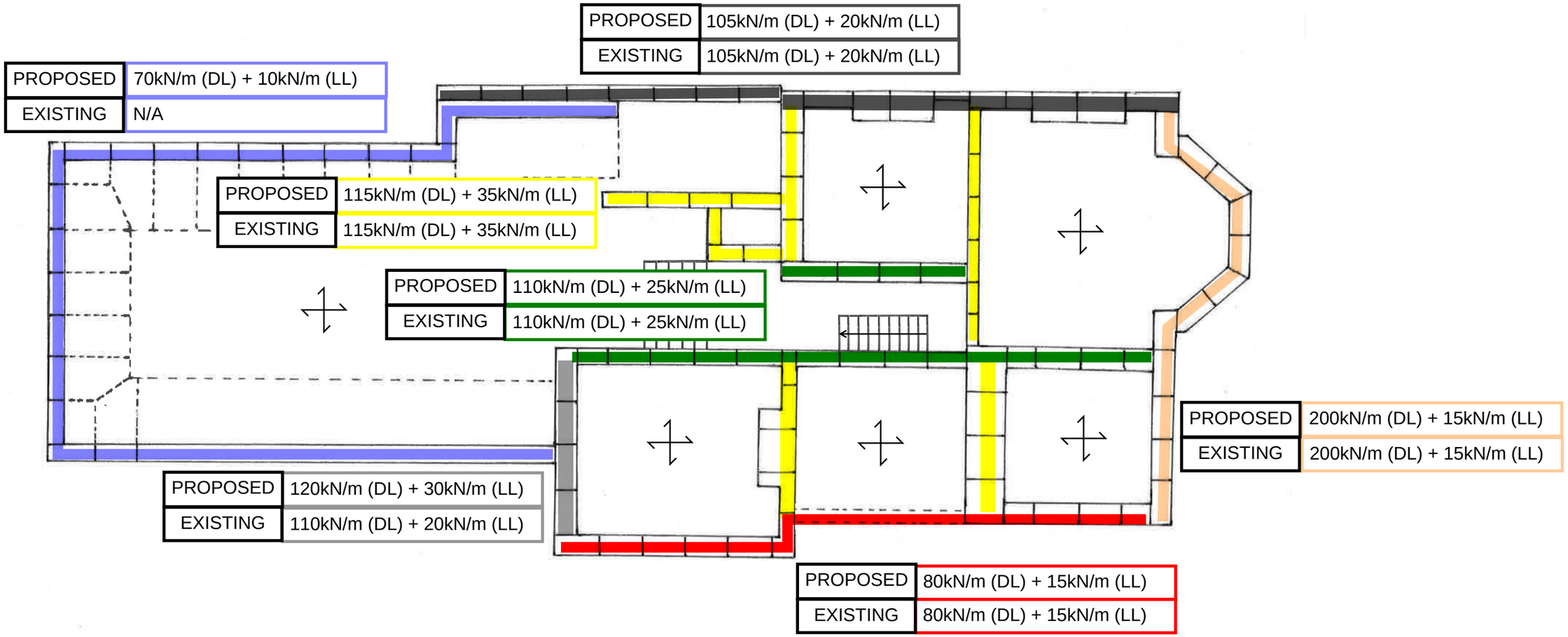
Elliott Wood Partnership Ltd
Wimbledon • Central London • Nottingham
Consulting Structural and Civil Engineers
tel: (020) 7499 5888. www.elliottwood.co.uk

project
SOUTH LODGE, HEATHSIDE, LONDON

Project no.	
2170605	
Sketch no.	revision
SK/01	P1

NOTE: ALL LOAD RUNS ARE SLS



rev	date	by	chk	description

sketch title
EXISTING + PROPOSED
BASEMENT LOAD TAKEDOWN

SKETCH

scale (s)	date	drawn
1:100@A3	29/03/18	STh

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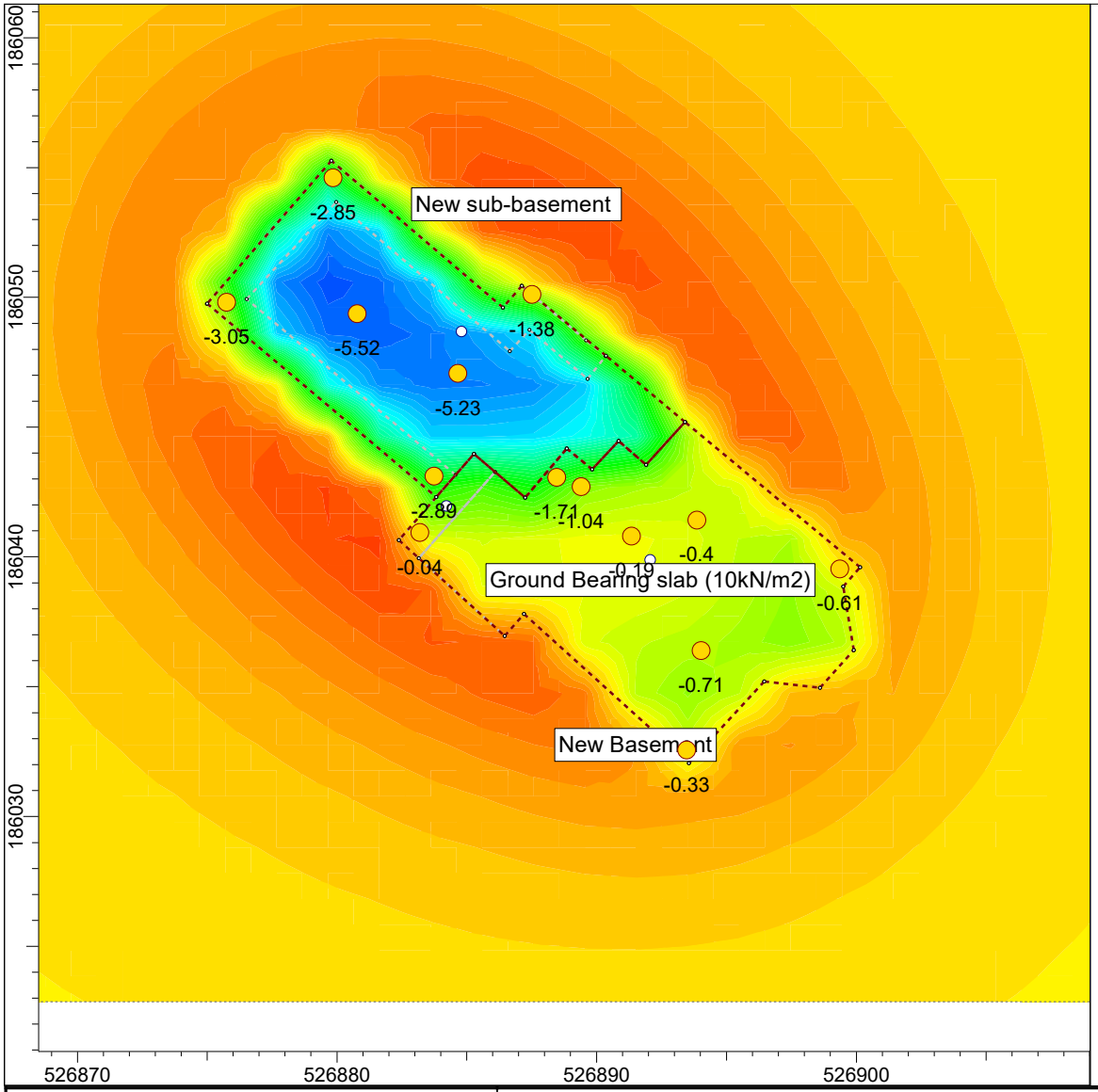
project
SOUTH LODGE, HEATHSIDE, LONDON

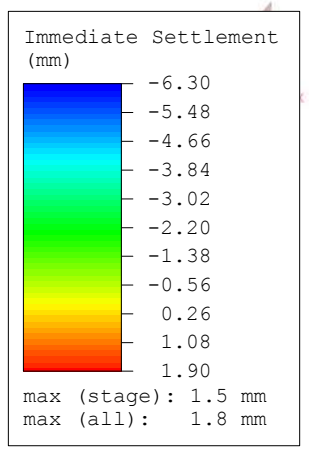
Project no.	
2170605	
Sketch no.	revision
SK/02	P1

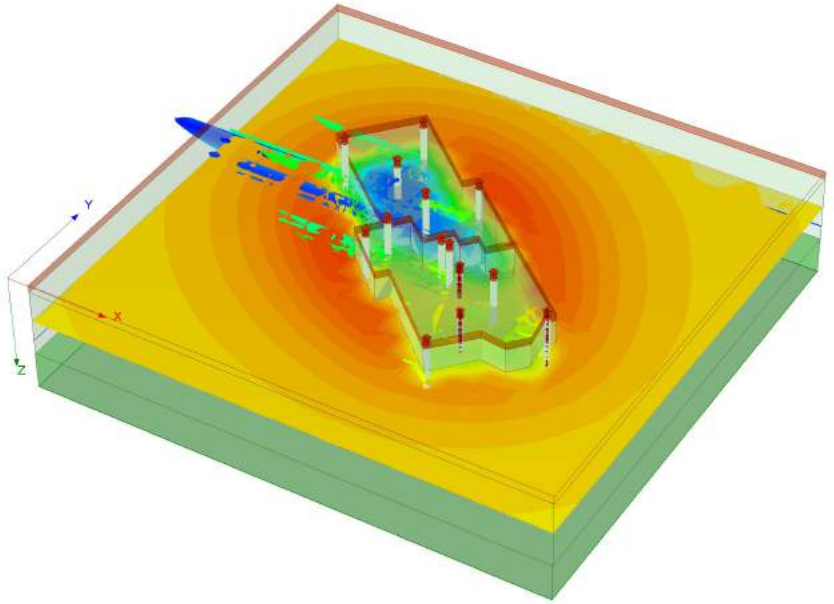
APPENDIX D

SETTLE 3D – STAGE 1 (UNDRAINED UNLOADING)

Stage 1 - Undrained Unloading





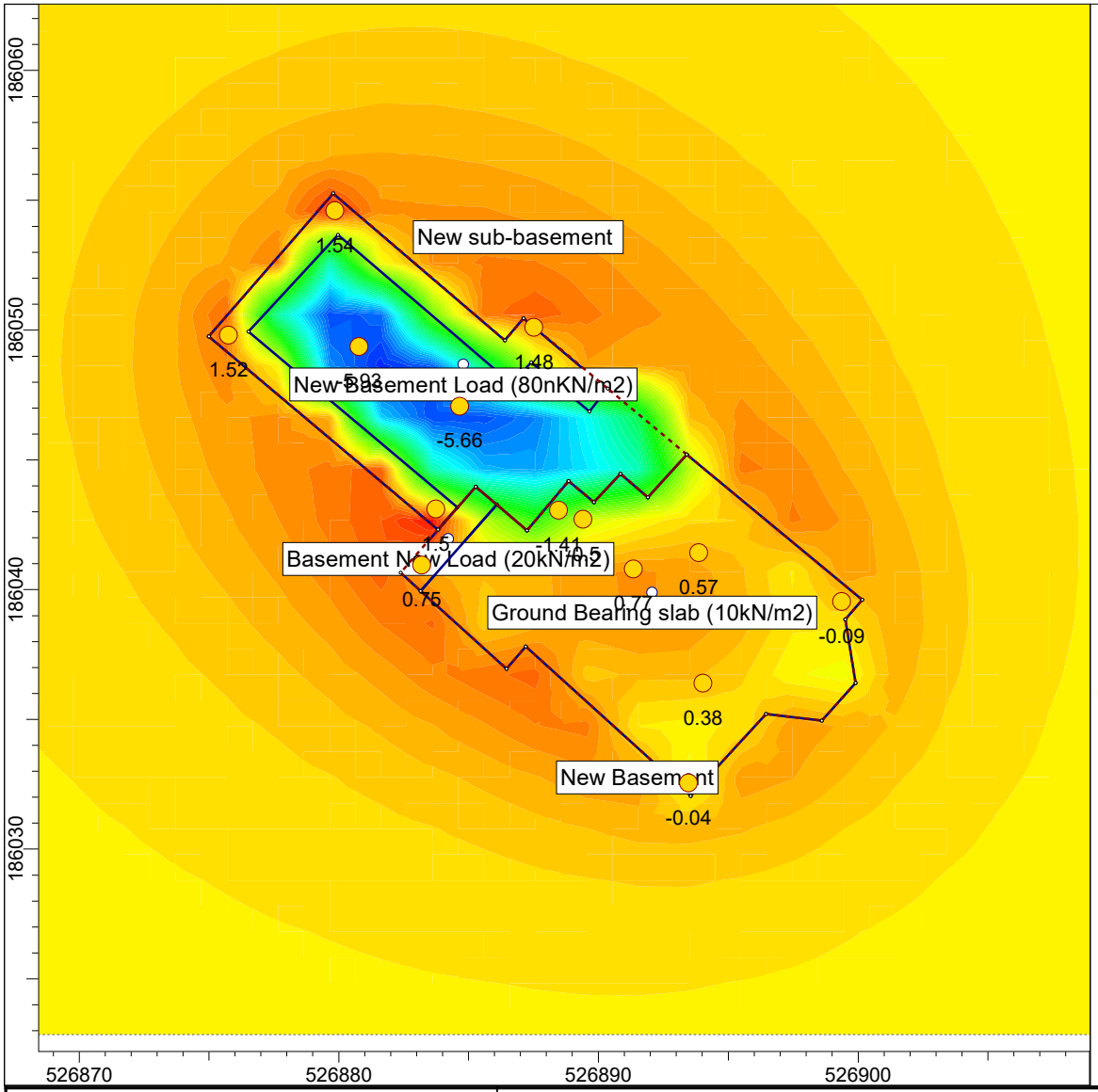


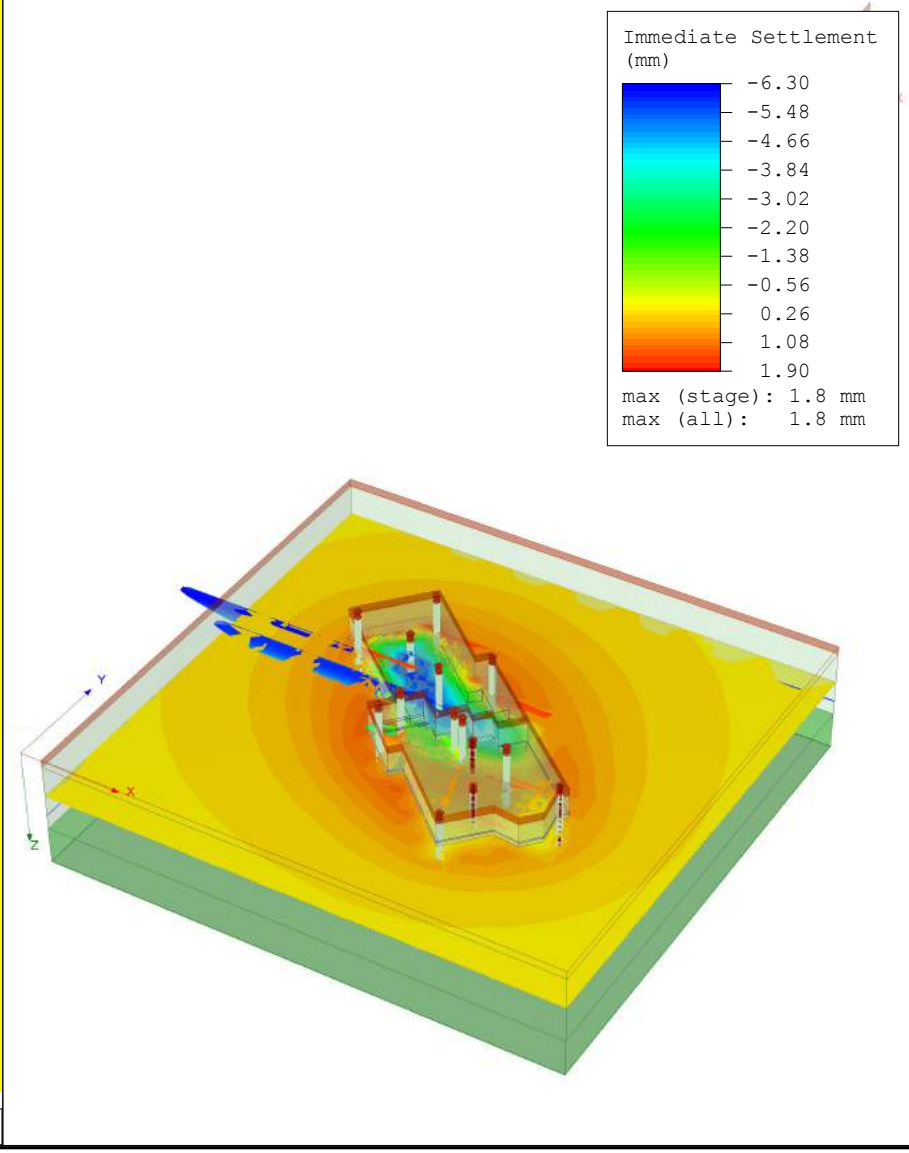
SETTLE3D 4.008	*Project*	South Lodge, Heathside Ground Movement Assessment	
	Analysis Description	Ground Movement Assessment	
	Drawn By	JT	*Company* Fairhurst
	Date	10/04/2018, 11:00:30	*File Name* Settle 3D - Stage 1,2 &3.s3z

APPENDIX E

SETTLE 3D – STAGE 2 (UNDRAINED RELOADING)

Stage 2 - Undrained Reloading



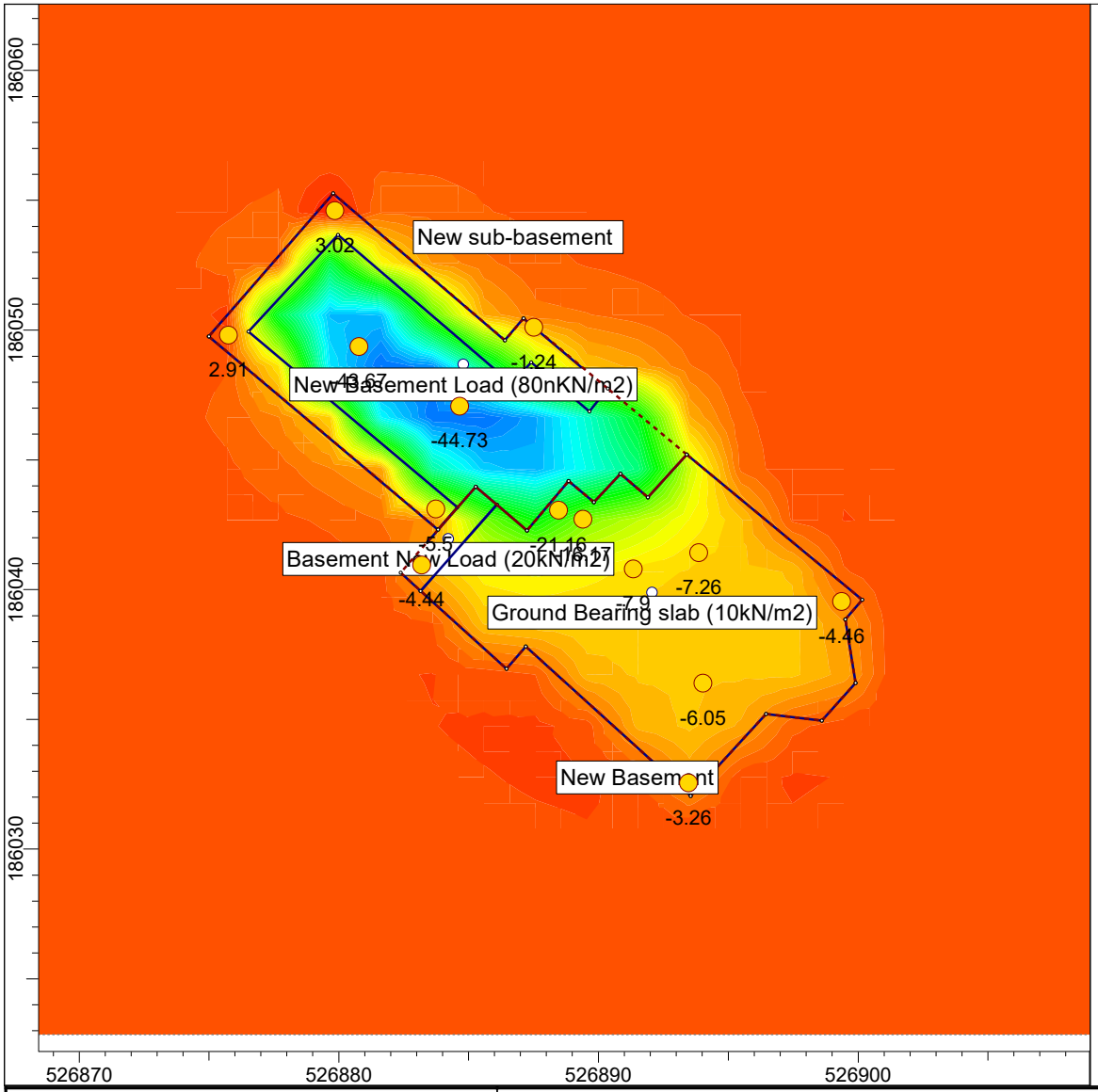


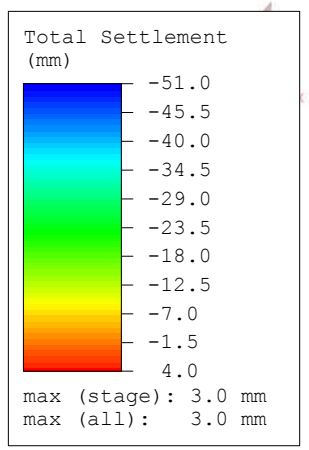
SETTLE3D 4.008	*Project*	South Lodge, Heathside Ground Movement Assessment	
	Analysis Description	Ground Movement Assessment	
	Drawn By	JT	*Company* Fairhurst
	Date	10/04/2018, 11:00:30	*File Name* Settle 3D - Stage 1,2 &3.s3z

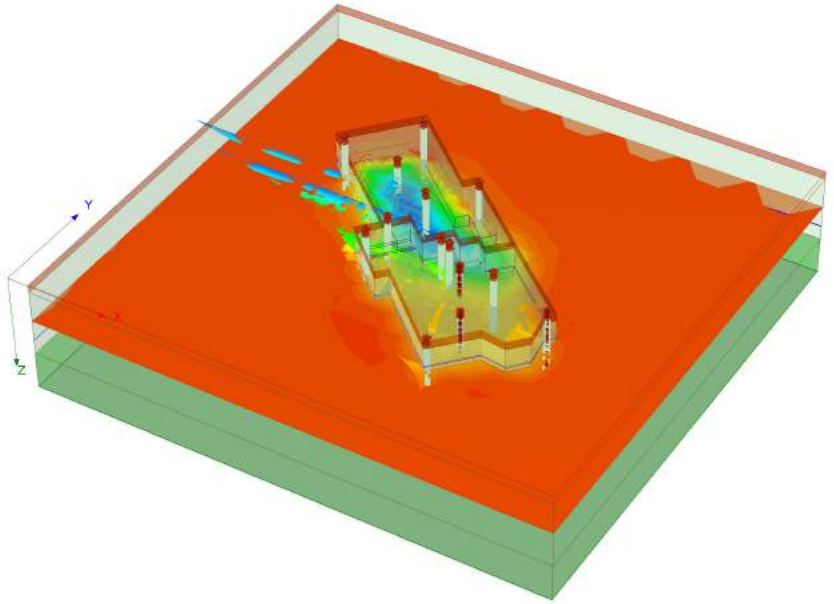
APPENDIX F

SETTLE 3D – STAGE 3 (DRAINED RELOADING)

Stage 3 - Drained Reloading







SETTLE3D 4.008	*Project*	South Lodge, Heathside Ground Movement Assessment	
	Analysis Description	Ground Movement Assessment	
	Drawn By	JT	*Company* Fairhurst
	Date	10/04/2018, 11:00:30	*File Name* Settle 3D - Stage 1,2 &3.s3z

Settle3D Analysis Information
South Lodge, Heathside Ground Movement Assessment

Project Settings

Document Name	Settle 3D - Stage 1,2 &3
Project Title	South Lodge, Heathside Ground Movement Assessment
Analysis	Ground Movement Assessment
Author	JT
Company	Fairhurst
Date Created	10/04/2018, 11:00:30
Stress Computation Method	Boussinesq
Minimum settlement ratio for subgrade modulus	0.9

Calculate settlement with mean stress

Use average properties to calculate layered stresses

Ignore negative effective stresses in settlement calculations

Stage Settings

Stage #	Name
1	Status Quo
2	Stage 1 - Undrained Unloading
3	Stage 2 & 3 - Undrained and Drained Reloading

Results (relative to Stage: Status Quo)

Time taken to compute: 4.1781 seconds

Stage: Status Quo

Data Type	Minimum	Maximum
Total Settlement [mm]	0	0
Total Consolidation Settlement [mm]	0	0
Virgin Consolidation Settlement [mm]	0	0
Recompression Consolidation Settlement [mm]	0	0
Immediate Settlement [mm]	0	0
Loading Stress ZZ [kPa]	0	0
Loading Stress XX [kPa]	0	0
Loading Stress YY [kPa]	0	0
Effective Stress ZZ [kPa]	0	0
Effective Stress XX [kPa]	0	0
Effective Stress YY [kPa]	0	0
Mean Stress [kPa]	0	0
Total Stress ZZ [kPa]	0	0
Total Stress XX [kPa]	0	0
Total Stress YY [kPa]	0	0
Modulus of Subgrade Reaction (Total) [kPa/m]	0	0
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	0
Total Strain	0	0
Pore Water Pressure [kPa]	0	0
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [kPa]	0	0
Over-consolidation Ratio	0	0
Void Ratio	0	0
Hydroconsolidation Settlement [mm]	0	0
Undrained Shear Strength	0	0

Stage: Stage 1 - Undrained Unloading

Data Type	Minimum	Maximum
Total Settlement [mm]	-50.85	0.449708
Total Consolidation Settlement [mm]	-45.5775	0
Virgin Consolidation Settlement [mm]	0	0.000948272
Recompression Consolidation Settlement [mm]	-45.5775	0
Immediate Settlement [mm]	-6.01194	1.52935
Loading Stress ZZ [kPa]	-65.416	8.74558
Loading Stress XX [kPa]	-69.5262	5.21162
Loading Stress YY [kPa]	-63.2756	7.14398
Effective Stress ZZ [kPa]	-65.416	8.74558
Effective Stress XX [kPa]	-69.5262	5.21162
Effective Stress YY [kPa]	-63.2756	7.14398
Mean Stress [kPa]	-81.4758	6.19525
Total Stress ZZ [kPa]	-65.416	8.74558
Total Stress XX [kPa]	-69.5262	5.21162
Total Stress YY [kPa]	-63.2756	7.14398
Modulus of Subgrade Reaction (Total) [kPa/m]	0	0
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	0
Total Strain	-0.0104347	0.00188989
Pore Water Pressure [kPa]	0	0
Degree of Consolidation [%]	-1.42109e-014	100
Pre-consolidation Stress [kPa]	0	0.00263321
Over-consolidation Ratio	-0.506096	2823.71
Void Ratio	0	0
Hydroconsolidation Settlement [mm]	0	0
Undrained Shear Strength	-0.000147341	0.000282014

Stage: Stage 2 & 3 - Undrained and Drained Reloading

Data Type	Minimum	Maximum
Total Settlement [mm]	-44.7323	3.02477
Total Consolidation Settlement [mm]	-39.0706	1.48069
Virgin Consolidation Settlement [mm]	0	3.73294
Recompression Consolidation Settlement [mm]	-39.0706	0.37742
Immediate Settlement [mm]	-6.20627	1.82062
Loading Stress ZZ [kPa]	-59.4119	27.2964
Loading Stress XX [kPa]	-63.9346	22.3547
Loading Stress YY [kPa]	-59.0847	21.857
Effective Stress ZZ [kPa]	-59.4119	27.2964
Effective Stress XX [kPa]	-63.9346	22.3547
Effective Stress YY [kPa]	-59.0847	21.857
Mean Stress [kPa]	-74.9755	26.9578
Total Stress ZZ [kPa]	-59.4119	27.2964
Total Stress XX [kPa]	-63.9346	22.3547
Total Stress YY [kPa]	-59.0847	21.857
Modulus of Subgrade Reaction (Total) [kPa/m]	-1.10342e+006	28570.3
Modulus of Subgrade Reaction (Immediate) [kPa/m]	-94412.4	575804
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	-98442.6	62731.4
Total Strain	-0.0106994	0.00438399
Pore Water Pressure [kPa]	0	0
Degree of Consolidation [%]	-1.42109e-014	100
Pre-consolidation Stress [kPa]	0	21.185
Over-consolidation Ratio	-0.351711	125.595
Void Ratio	0	0
Hydroconsolidation Settlement [mm]	0	0
Undrained Shear Strength	-0.0936249	0.747717

Loads

1. Polygonal Load: "New Basement Load (80nKN/m2)"

Label	New Basement Load (80nKN/m2)
Load Type	Flexible
Area of Load	34.3907 m^2
Load	80 kPa
Depth	3.5 m
Installation Stage	Stage 2 & 3 - Undrained and Drained Reloading

Coordinates

X [m]	Y [m]
526890	186048
526887	186050
526886	186050
526880	186055
526875	186050
526884	186042
526885	186043
526877	186050
526880	186054
526887	186048
526887	186049
526890	186047
526890	186048
526890	186048

2. Polygonal Load: "Basement New Load (20kN/m2)"

Label	Basement New Load (20kN/m2)
Load Type	Flexible
Area of Load	4.65865 m^2
Load	20 kPa
Depth	2.55 m
Installation Stage	Stage 2 & 3 - Undrained and Drained Reloading

Coordinates

X [m]	Y [m]
526882	186041
526883	186040
526886	186043
526885	186044

3. Polygonal Load: "Ground Bearing slab (10kN/m2)"

Label	Ground Bearing slab (10kN/m2)
Load Type	Flexible
Area of Load	121.352 m^2
Load	10 kPa
Depth	2.55 m
Installation Stage	Stage 2 & 3 - Undrained and Drained Reloading

Coordinates

X [m]	Y [m]
526883	186040
526886	186037
526887	186038
526894	186032
526896	186035
526899	186035
526900	186036
526900	186039
526900	186040
526893	186045
526892	186044
526891	186044
526890	186043
526889	186044
526887	186042
526886	186043

Excavations

1. Excavation: "New Basement"

Advanced Staging

Stage	Depth [m]
Status Quo	1.95
Stage 1 - Undrained Unloading	2.85
Stage 2 & 3 - Undrained and Drained Reloading	2.85

Coordinates

X [m]	Y [m]
526882	186041
526886	186037
526887	186038
526894	186032
526896	186035
526899	186035
526900	186036
526900	186039
526900	186040
526893	186045
526892	186044
526891	186044
526890	186043
526889	186044
526887	186042
526885	186044
526884	186042

2. Excavation: "New sub-basement "

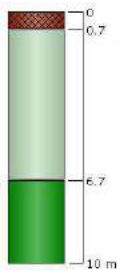
Depth 3.5 m
Installation Stage Stage 1 - Undrained Unloading

Coordinates

X [m]	Y [m]
526875	186050
526884	186042
526885	186044
526887	186042
526889	186044
526890	186043
526891	186044
526892	186044
526893	186045
526890	186048
526887	186050
526886	186050
526880	186055

Soil Layers

Layer #	Type	Thickness [m]	Depth [m]
1	Made Ground	0.7	0
2	Claygate Member	6	0.7
3	London Clay	3.3	6.7



Soil Properties

Property		Made Ground	Claygate Member	London Clay
Color				
Unit Weight [kN/m^3]		16	17	19
Saturated Unit Weight [kN/m^3]		16*	18*	20*
Poisson's Ratio		0.3*	0.49999*	0.49999*
K0		1	1	1
Immediate Settlement		Enabled	Enabled	Enabled
E [kPa]	top	3000	6871	17956
	bottom	-	17956	24053
Eur [kPa]	top	3000	6871	17956
	bottom	-	17956	24053
Primary Consolidation		Disabled	Enabled	Enabled
Material Type			Linear	Linear
mv [m^2/kN]	top	-	0.000224*	0.000142*
	bottom	-	0.000142	9.8e-005
mvur [m^2/kN]	top	-	0.000224*	0.000142*
	bottom	-	0.000142	9.8e-005
Undrained Su A [kN/m2]		0	0	0
Undrained Su S		0.2	0.2	0.2
Undrained Su m		0.8	0.8	0.8
Piezo Line ID		1	1	1

* Base value only. Refer to Stage Factor section.

Groundwater

Groundwater method Piezometric Lines
Water Unit Weight 9.81 kN/m^3

Piezometric Line Entities

ID	Depth (m)
1	5.42 m

Query Points

Point #	Query Point Name	(X,Y) Location	Number of Divisions
1	Query Point 1	526891, 186041	Auto: 75
2	Query Point 2	526885, 186047	Auto: 63
3	Query Point 3	526881, 186049	Auto: 63
4	Query Point 4	526888, 186050	Auto: 63
5	Query Point 5	526880, 186055	Auto: 63
6	Query Point 6	526876, 186050	Auto: 63
7	Query Point 7	526884, 186043	Auto: 63
8	Query Point 8	526883, 186041	Auto: 75
9	Query Point 9	526894, 186041	Auto: 75
10	Query Point 10	526899, 186040	Auto: 75
11	Query Point 11	526893, 186033	Auto: 75
12	Query Point 12	526888, 186043	Auto: 75
13	Query Point 13	526889, 186043	Auto: 75
14	Query Point 14	526894, 186036	Auto: 75

Field Point Grid

Number of points 506
Expansion Factor 2

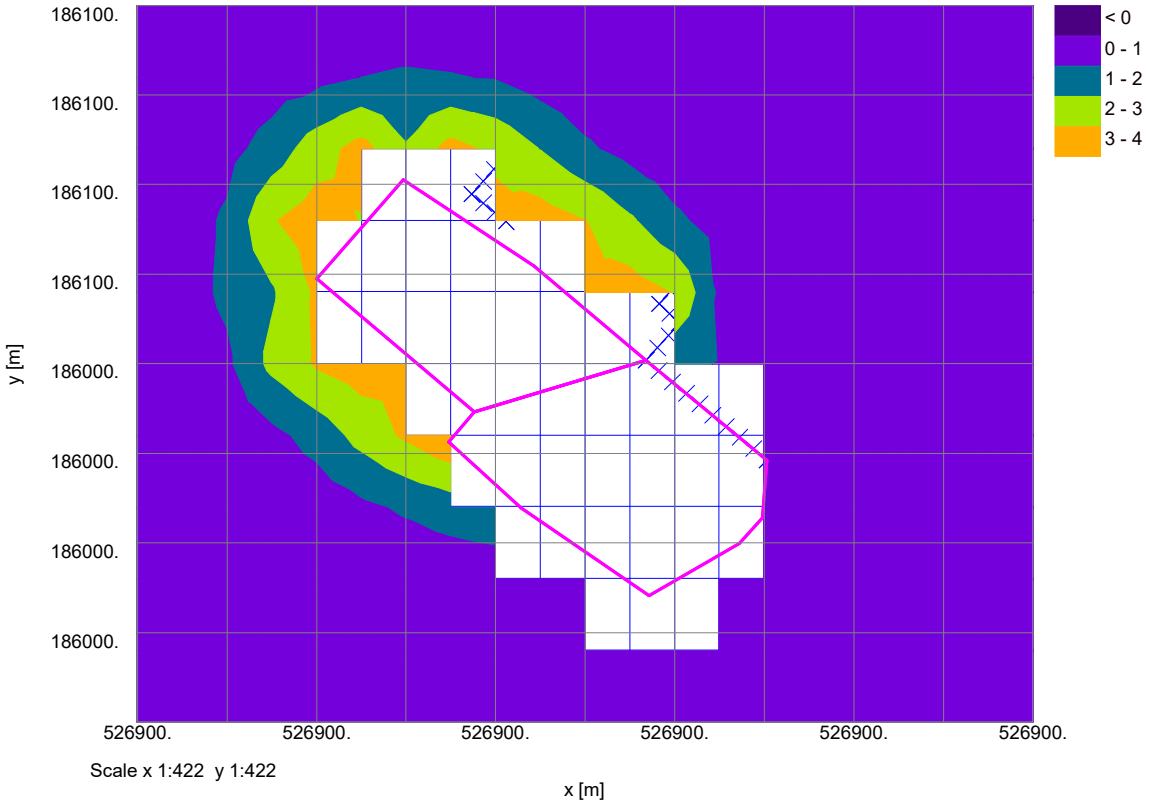
Grid Coordinates

X [m]	Y [m]
526909	186064
526909	186023
526866	186023
526866	186064

APPENDIX G

XDISP ANALYSIS

Vertical Settlement Contours: Grid 1 (level 0.000m) (Interval 1mm)



Scale x 1:422 y 1:422

Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

Displacement Data

Type	Name	Direction of extrusion	Point/Line/Line for extrusion						No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels
			First point			Second point							
			X [m]	Y [m]	Z(level) [m]	X [m]	Y [m]	Z(level) [m]		[m]			
Line	Line 1	-	526886.70000	186057.90000	0.00000	526883.70000	186054.45000	0.00000	5	-	-	Yes	Surface
Line	Line 2	-	526883.70000	186054.45000	0.00000	526885.55000	186052.95000	0.00000	3	-	-	Yes	Surface
Line	Line 3	-	526885.55000	186052.95000	0.00000	526888.50000	186056.40000	0.00000	5	-	-	Yes	Surface
Line	Line 4	-	526888.50000	186056.40000	0.00000	526889.10000	186055.85000	0.00000	2	-	-	Yes	Surface
Line	Line 5	-	526889.10000	186055.85000	0.00000	526892.10000	186059.25000	0.00000	5	-	-	Yes	Surface
Line	Line 6	-	526892.10000	186059.25000	0.00000	526889.00000	186061.80000	0.00000	4	-	-	Yes	Surface
Line	Line 7	-	526889.00000	186061.80000	0.00000	526886.15000	186058.35000	0.00000	5	-	-	Yes	Surface
Line	Line 8	-	526886.15000	186058.35000	0.00000	526886.70000	186057.90000	0.00000	2	-	-	Yes	Surface
Line	Line 9	-	526908.30000	186048.55000	0.00000	526901.70000	186054.55000	0.00000	9	-	-	Yes	Surface
Line	Line 10	-	526901.70000	186054.55000	0.00000	526897.75000	186050.20000	0.00000	6	-	-	Yes	Surface
Line	Line 11	-	526897.75000	186050.20000	0.00000	526896.70000	186051.15000	0.00000	2	-	-	Yes	Surface
Line	Line 12	-	526896.70000	186051.15000	0.00000	526894.10000	186048.35000	0.00000	4	-	-	Yes	Surface
Line	Line 13	-	526894.10000	186048.35000	0.00000	526895.25000	186047.25000	0.00000	2	-	-	Yes	Surface
Line	Line 14	-	526895.25000	186047.25000	0.00000	526893.40000	186045.20000	0.00000	3	-	-	Yes	Surface
Line	Line 15	-	526893.40000	186045.20000	0.00000	526900.15000	186039.60000	0.00000	9	-	-	Yes	Surface
Line	Line 16	-	526900.15000	186039.60000	0.00000	526908.30000	186048.55000	0.00000	12	-	-	Yes	Surface
Grid	Grid 1	Global X	526865.00000	186025.00000	0.00000	-	186065.00000	0.00000	10	50.00000	20	Yes	Surface

Polylines

Name	Coordinates x [m]	y [m]	z [m]
Southside Lodge	526880.	186040.	0.0
	526880.	186040.	0.0
	526890.	186040.	0.0
	526890.	186040.	0.0
	526890.	186030.	0.0
	526900.	186040.	0.0
	526900.	186030.	0.0
	526900.	186040.	0.0
	526900.	186040.	0.0
	526900.	186040.	0.0
	526890.	186050.	0.0
	526890.	186050.	0.0
	526890.	186050.	0.0
	526890.	186050.	0.0
	526890.	186050.	0.0
	526880.	186060.	0.0
	526880.	186060.	0.0
	526870.	186050.	0.0
	526880.	186040.	0.0
1 E Heath Road	526910.	186050.	0.0
	526900.	186050.	0.0
	526900.	186050.	0.0
	526900.	186050.	0.0
	526890.	186050.	0.0
	526900.	186050.	0.0
	526890.	186050.	0.0
	526900.	186040.	0.0
	526910.	186050.	0.0
2 E Heath Road	526890.	186060.	0.0
	526880.	186050.	0.0
	526890.	186050.	0.0
	526890.	186060.	0.0
	526890.	186060.	0.0
	526890.	186060.	0.0
	526890.	186060.	0.0
	526890.	186060.	0.0

Vertical Ground Movement Curves (Excavations)

Curve Name: **Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))**

Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z)(%)]
[0.000,0.000,0.040][2.000,0.000,0.000]

Curve Fitting Method: Polynomial

x Order: 1

y Order: 0

Polynomial: $z = -2.0E-2x + 4.0E-2$

Coeff. of Determination: 1.0

Curve Name: **Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)**

Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z)(%)]
[0.000,0.000,0.039][0.100,0.000,0.049][0.200,0.000,0.056][0.300,0.000,0.062]
[0.400,0.000,0.067][0.500,0.000,0.070][0.600,0.000,0.072][0.700,0.000,0.073]
[0.800,0.000,0.073][0.900,0.000,0.072][1.000,0.000,0.070][1.100,0.000,0.068]
[1.200,0.000,0.065][1.300,0.000,0.061][1.400,0.000,0.058][1.500,0.000,0.054]
[1.600,0.000,0.050][1.700,0.000,0.046][1.800,0.000,0.042][1.900,0.000,0.038]
[2.000,0.000,0.034][2.100,0.000,0.030][2.200,0.000,0.027][2.300,0.000,0.023]
[2.400,0.000,0.020][2.500,0.000,0.017][2.600,0.000,0.014][2.700,0.000,0.012]
[2.800,0.000,0.010][2.900,0.000,0.008][3.000,0.000,0.007][3.100,0.000,0.005]
[3.200,0.000,0.004][3.300,0.000,0.004][3.400,0.000,0.003][3.500,0.000,0.002]
[3.600,0.000,0.002][3.700,0.000,0.002][3.800,0.000,0.001][3.900,0.000,0.001]
[4.000,0.000,0.000]

Curve Fitting Method: Polynomial

x Order: 4

y Order: 0

Polynomial: $z = -2.6455E-3x^4 + 2.8495E-2x^3 - 1.0051E-1x^2 + 1.0569E-1x + 3.8990E-2$

Coeff. of Determination: 9.9991E-1

Horizontal Ground Movement Curves (Excavations)

Curve Name: **Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))**

Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z)(%)]
[0.000,0.000,0.041][0.050,0.000,0.039][0.100,0.000,0.036][0.150,0.000,0.034]
[0.200,0.000,0.032][0.250,0.000,0.030][0.300,0.000,0.029][0.350,0.000,0.027]
[0.400,0.000,0.025][0.450,0.000,0.023][0.500,0.000,0.022][0.550,0.000,0.020]
[0.600,0.000,0.019][0.650,0.000,0.018][0.700,0.000,0.016][0.750,0.000,0.015]
[0.800,0.000,0.014][0.850,0.000,0.013][0.900,0.000,0.012][0.950,0.000,0.010]
[1.000,0.000,0.009][1.050,0.000,0.008][1.100,0.000,0.007][1.150,0.000,0.006]
[1.200,0.000,0.005][1.250,0.000,0.004][1.300,0.000,0.004][1.350,0.000,0.003]
[1.400,0.000,0.002][1.450,0.000,0.001][1.500,0.000,0.000]

Curve Fitting Method: Polynomial

x Order: 3

y Order: 0

Polynomial: $z = -4.2486E-3x^3 + 1.9096E-2x^2 - 4.6221E-2x + 4.0729E-2$

Coeff. of 1.0000

Name	Coordinates x [m]	y [m]	z [m]

Determination:

Curve Name: **Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))**
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z)(%)]
[0.000,0.000,0.150][4.000,0.000,0.000]
Curve Fitting Method: Polynomial
x Order: 1
y Order: 0
Polynomial: z = -3.75E-2x + 1.50E-1
Coeff. of Determination: 1.00

Polygonal Excavations

Excavation Name: **New Basement (Excavation)**
Surface level [m]: 0.0
Contribution: Positive
Enabled: Yes

Corner	x [m]	y [m]	Base Level [m]	Stiffened	Previous Side d [m]	p1 [%]	p2* [%]	Next Side d [m]	p1 [%]	p2* [%]
1	526870.	186050.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	526880.	186040.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	526890.	186050.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
4	526890.	186050.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	526880.	186060.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000

Side	Corner 1 x [m]	y [m]	Corner 2 x [m]	y [m]	Ground Movement Curve Vertical	Horizontal
1	526870.	186050.	526880.	186040.	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))
2	526880.	186040.	526890.	186050.	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))
3	526890.	186050.	526890.	186050.	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))
4	526890.	186050.	526880.	186060.	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))
5	526880.	186060.	526870.	186050.	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))

Excavation Name: **New Basement (Underpin)**
Surface level [m]: 0.0
Contribution: Positive
Enabled: Yes

Corner	x [m]	y [m]	Base Level [m]	Stiffened	Previous Side d [m]	p1 [%]	p2* [%]	Next Side d [m]	p1 [%]	p2* [%]
1	526870.	186050.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	526880.	186040.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	526890.	186050.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
4	526890.	186050.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	526880.	186060.	-3.5000	Yes	0.0	67.000	25.000	0.0	67.000	25.000

Side	Corner 1 x [m]	y [m]	Corner 2 x [m]	y [m]	Ground Movement Curve Vertical	Horizontal
1	526870.	186050.	526880.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
2	526880.	186040.	526890.	186050.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
3	526890.	186050.	526890.	186050.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
4	526890.	186050.	526880.	186060.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
5	526880.	186060.	526870.	186050.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))

Excavation Name: **Exsiting Basement (Excavation)**
Surface level [m]: -1.9500
Contribution: Positive
Enabled: Yes

Corner	x [m]	y [m]	Base Level [m]	Stiffened	Previous Side d [m]	p1 [%]	p2* [%]	Next Side d [m]	p1 [%]	p2* [%]
1	526880.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	526880.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	526890.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
4	526890.	186030.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	526900.	186030.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
6	526900.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
7	526900.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
8	526890.	186050.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000

Side	Corner 1 x [m]	y [m]	Corner 2 x [m]	y [m]	Ground Movement Curve Vertical	Horizontal
1	526880.	186040.	526880.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
2	526880.	186040.	526890.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
3	526890.	186040.	526890.	186030.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
4	526890.	186030.	526900.	186030.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
5	526900.	186030.	526900.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
6	526900.	186040.	526900.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
7	526900.	186040.	526890.	186050.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
8	526890.	186050.	526880.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))

Excavation Name: **Existing Basement (Underpin)**
Surface level [m]: -1.9500
Contribution: Positive
Enabled: Yes

Corner	x [m]	y [m]	Base Level [m]	Stiffened	Previous Side d [m]	p1 [%]	p2* [%]	Next Side d [m]	p1 [%]	p2* [%]

	Level [m]	[m]	[m]		d [m]	p1 [%]	p2* [%]	d [m]	p1 [%]	p2* [%]
1	526880.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	526880.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	526890.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
4	526890.	186030.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	526900.	186030.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
6	526900.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
7	526900.	186040.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000
8	526890.	186050.	-2.5500	Yes	0.0	67.000	25.000	0.0	67.000	25.000

Side	Corner 1 x [m]	y [m]	Corner 2 x [m]	y [m]	Ground Movement Curve Vertical	Horizontal
1	526880.	186040.	526880.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
2	526880.	186040.	526890.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
3	526890.	186040.	526890.	186030.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
4	526890.	186030.	526900.	186030.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
5	526900.	186030.	526900.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
6	526900.	186040.	526900.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
7	526900.	186040.	526890.	186050.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
8	526890.	186050.	526880.	186040.	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))

Damage Category Strains

Name	0 (Negligible) to 1 (Very Slight)	1 (Very Slight) to 2 (Slight)	2 (Slight) to 3 (Moderate)	3 (Moderate) to 4 (Severe)
Burland Strain Limits	0.0	500.00E-6	750.00E-6	0.0015000

Specific Structures - Geometry

Structure Name	Sub-Structure Name	Displacement Line	Start Distance Along Line [m]	End Distance Along Line [m]	Vertical Offsets from Line for Vertical Movement Calculations [m]	Vertical Displacement Limit Sensitivity [mm]	Damage Category Strains	Poisson's Ratio	E/G
2 E Heath Road	Wall 1	Line 1	0.00000	4.57000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2 E Heath Road	Wall 2	Line 2	0.00000	2.38000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2 E Heath Road	Wall 3	Line 3	0.00000	4.53800	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2 E Heath Road	Wall 4	Line 4	0.00000	0.81200	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2 E Heath Road	Wall 5	Line 5	0.00000	4.53300	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2 E Heath Road	Wall 6	Line 6	0.00000	4.01300	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2 E Heath Road	Wall 7	Line 7	0.00000	4.47300	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2 E Heath Road	Wall 8	Line 8	0.00000	0.70900	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 9	Line 9	0.00000	8.91800	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 10	Line 10	0.00000	5.87400	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 11	Line 11	0.00000	1.41400	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 12	Line 12	0.00000	3.81900	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 13	Line 13	0.00000	1.59000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 14	Line 14	0.00000	2.76000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 15	Line 15	0.00000	8.76900	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
1 E Heath Road	Wall 16	Line 16	0.00000	12.10300	0.0	0.10000	Burland Strain Limits	0.20000	2.6000

Specific Structures - Bending Parameters

Structure Name	Sub-Structure Name	Height [m]	Default Properties	Hogging 2nd Moment of Area (per unit width) [m³]	Hogging Distance of Bending Strain from N.A. [m]	Hogging Distance of N.A. from Edge of Beam in Tension [m]	Sagging 2nd Moment of Area (per unit width) [m³]	Sagging Distance of Bending Strain from N.A. [m]	Sagging Distance of N.A. from Edge of Beam in Tension [m]
2 E Heath Road	Wall 1	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
2 E Heath Road	Wall 2	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
2 E Heath Road	Wall 3	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
2 E Heath Road	Wall 4	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
2 E Heath Road	Wall 5	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
2 E Heath Road	Wall 6	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
2 E Heath Road	Wall 7	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
2 E Heath Road	Wall 8	2.5000	Yes	5.2083	2.5000	2.5000	1.3021	1.2500	1.2500
1 E Heath Road	Wall 9	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
1 E Heath Road	Wall 10	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
1 E Heath Road	Wall 11	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
1 E Heath Road	Wall 12	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
1 E Heath Road	Wall 13	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
1 E Heath Road	Wall 14	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
1 E Heath Road	Wall 15	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
1 E Heath Road	Wall 16	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000

Building Segment Combinations

Structure Name	Sub-Structure Name	Vertical Offset from Line for Vertical Movement Calculations [m]	Segment Start [m]	Length [m]	Curvature	Combined Segment

No structures have segments combined.

Utility Strain Calculation Options

Neglect beneficial contribution of axial strains : No

Warnings

1 Multiple excavations have been specified. The displacements resulting from these excavations are calculated by summing the displacements resulting from each individual excavation. No account has been taken of the interactions between excavations (e.g. overlapping zones of influence or 'shielding' of one excavation by another).

2 Embedded Wall Excavation PE1 : New Basement (Excavation) intersects PE3 : Exsiting Basement (Excavation), and PE4 : Existing Basement (Underpin).

3 Embedded Wall Excavation PE2 : New Basement (Underpin) intersects PE3 : Exsiting Basement (Excavation), and PE4 : Existing Basement (Underpin).

4 Embedded Wall Excavation PE3 : Exsiting Basement (Excavation) intersects PE1 : New Basement (Excavation), and PE2 : New Basement (Underpin).

5 Embedded Wall Excavation PE4 : Existing Basement (Underpin) intersects PE1 : New Basement (Excavation), and PE2 : New Basement (Underpin).

6 If an embedded wall excavation is assigned a 'surface' ground movement curve then displacements induced by it can only be calculated for those points that are level with the embedded wall excavation's 'surface level'. Others are ignored. An example

Structure Name	Sub-Structure Name	Vertical Offset from Line for Vertical	Segment Start Length Curvature Combined Segment

of such a combination, for which displacements will not be calculated is Excavation XP3/Side 1/Grid 1/Vertical. This is an example only. There are 543 others.

Errors

None

Displacement and Strain Results

Type/No. Name	Dist.	Coordinates x	y	z	Displacements x	y	z	Horizontal displacement along Line	Horizontal displacement perpendicular to Line	Angle of Line to x Axis
	[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]
Line 1	Line 1	526886.70000	186057.90000	0.00000	-1.6468	-2.5063	1.7915	2.9719	0.40188	228.99
	0.91439	526886.10000	186057.21000	0.00000	-1.8487	-2.8136	2.3361	3.3362	0.45114	228.99
	1.8288	526885.50000	186056.52000	0.00000	-2.1252	-3.2343	2.8344	3.8351	0.51861	228.99
	2.7432	526884.90000	186055.83000	0.00000	-2.4115	-3.6701	3.2338	4.3519	0.58848	228.99
	3.6575	526884.30000	186055.14000	0.00000	-2.7162	-4.1338	3.4716	4.9018	0.66284	228.99
	4.5719	526883.70000	186054.45000	0.00000	-3.0479	-4.6385	3.4751	5.5002	0.74376	228.99
Line 2	Line 2	526883.70000	186054.45000	0.00000	-3.0479	-4.6385	3.4751	0.55390	-5.5225	320.96
	0.79390	526884.31667	186053.95000	0.00000	-3.0784	-4.6850	3.4617	0.55945	-5.5779	320.96
	1.5878	526884.93333	186053.45000	0.00000	-3.1092	-4.7319	3.4457	0.56506	-5.6337	320.96
	2.3817	526885.55000	186052.95000	0.00000	-3.1403	-4.7793	3.4272	0.57071	-5.6901	320.96
Line 3	Line 3	526885.55000	186052.95000	0.00000	-3.1403	-4.7793	3.4272	-5.6733	-0.71920	49.467
	0.90785	526886.14000	186053.64000	0.00000	-2.8022	-4.2647	3.4988	-5.0625	-0.64177	49.467
	1.8157	526886.73000	186054.33000	0.00000	-2.4930	-3.7940	3.3180	-4.5037	-0.57094	49.467
	2.7236	526887.32000	186055.02000	0.00000	-2.2041	-3.3545	2.9589	-3.9819	-0.50479	49.467
	3.6314	526887.91000	186055.71000	0.00000	-1.9274	-2.9334	2.4857	-3.4821	-0.44142	49.467
	4.5393	526888.50000	186056.40000	0.00000	-1.7014	-2.5894	1.9529	-3.0738	-0.38966	49.467
Line 4	Line 4	526888.50000	186056.40000	0.00000	-1.7014	-2.5894	1.9529	0.49551	-3.0585	317.49
	0.40697	526888.80000	186056.12500	0.00000	-1.7148	-2.6098	1.9924	0.49941	-3.0826	317.49
	0.81394	526889.10000	186055.85000	0.00000	-1.7283	-2.6302	2.0318	0.50331	-3.1067	317.49
Line 5	Line 5	526889.10000	186055.85000	0.00000	-1.7283	-2.6302	2.0318	-3.1157	-0.44430	48.576
	0.90686	526889.70000	186056.53000	0.00000	-1.5434	-2.3489	1.4856	-2.7824	-0.39677	48.576
	1.8137	526890.30000	186057.21000	0.00000	-1.3585	-2.0675	1.0356	-2.4491	-0.34924	48.576
	2.7206	526890.90000	186057.89000	0.00000	-1.1736	-1.7861	0.72647	-2.1158	-0.30171	48.576
	3.6275	526891.50000	186058.57000	0.00000	-0.98874	-1.5048	0.47624	-1.7825	-0.25419	48.576
	4.5343	526892.10000	186059.25000	0.00000	-0.80387	-1.2234	0.29210	-1.4492	-0.20666	48.576
Line 6	Line 6	526892.10000	186059.25000	0.00000	-0.80387	-1.2234	0.29210	-0.15637	1.4555	140.56
	1.0035	526891.32500	186059.88750	0.00000	-0.78179	-1.1898	0.27452	-0.15208	1.4155	140.56
	2.0070	526890.55000	186060.52500	0.00000	-0.75972	-1.1562	0.25784	-0.14778	1.3756	140.56
	3.0105	526889.77500	186061.16250	0.00000	-0.73764	-1.1226	0.24205	-0.14349	1.3356	140.56
	4.0140	526889.00000	186061.80000	0.00000	-0.71557	-1.0890	0.22714	-0.13919	1.2956	140.56
Line 7	Line 7	526889.00000	186061.80000	0.00000	-0.71557	-1.0890	0.22714	1.2953	0.14190	230.44
	0.89499	526888.43000	186061.11000	0.00000	-0.89877	-1.3678	0.37830	1.6270	0.17823	230.44
	1.7900	526887.86000	186060.42000	0.00000	-1.0820	-1.6467	0.59440	1.9586	0.21456	230.44
	2.6850	526887.29000	186059.73000	0.00000	-1.2652	-1.9255	0.87302	2.2902	0.25089	230.44
	3.5799	526886.72000	186059.04000	0.00000	-1.4484	-2.2043	1.2091	2.6219	0.28722	230.44
	4.4749	526886.15000	186058.35000	0.00000	-1.6316	-2.4831	1.7463	2.9535	0.32355	230.44
Line 8	Line 8	526886.15000	186058.35000	0.00000	-1.6316	-2.4831	1.7463	0.30962	-2.9550	320.71
	0.35532	526886.42500	186058.12500	0.00000	-1.6392	-2.4947	1.7689	0.31106	-2.9688	320.71
	0.71063	526886.70000	186057.90000	0.00000	-1.6468	-2.5063	1.7915	0.31251	-2.9826	320.71
Line 9	Line 9	526908.30000	186048.55000	0.00000	0.0	0.0	0.0	0.0	0.0	137.73
	0.99107	526907.56667	186049.21667	0.00000	0.0	0.0	0.0	0.0	0.0	137.73
	1.9821	526906.83333	186049.88333	0.00000	0.0	0.0	0.0	0.0	0.0	137.73
	2.9732	526906.10000	186050.55000	0.00000	-0.017694	-0.013739	0.0069630	0.0038507	0.022068	137.73
	3.9643	526905.36667	186051.21667	0.00000	-0.050683	-0.043004	0.015180	0.0085746	0.065914	137.73
	4.9554	526904.63333	186051.88333	0.00000	-0.080535	-0.074029	0.020799	0.0097936	0.10895	137.73
	5.9464	526903.90000	186052.55000	0.00000	-0.10636	-0.10508	0.025000	0.0080136	0.14930	137.73
	6.9375	526903.16667	186053.21667	0.00000	-0.12718	-0.13407	0.028200	0.0039199	0.18475	137.73
	7.9286	526902.43333	186053.88333	0.00000	-0.14197	-0.15861	0.030391	-0.0016426	0.21287	137.73
	8.9196	526901.70000	186054.55000	0.00000	-0.14975	-0.17619	0.031420	-0.0077122	0.23110	137.73
Line 10	Line 10	526901.70000	186054.55000	0.00000	-0.14975	-0.17619	0.031420	0.23111	0.0075799	227.76
	0.97930	526901.04167	186053.82500	0.00000	-0.24777	-0.29169	0.052788	0.38251	0.012657	227.76
	1.9586	526900.38333	186053.10000	0.00000	-0.34591	-0.40750	0.094082	0.53422	0.017861	227.76
	2.9379	526899.72500	186052.37500	0.00000	-0.44417	-0.52371	0.16470	0.68631	0.023230	227.76
	3.9172	526899.06667	186051.65000	0.00000	-0.54263	-0.64045	0.26835	0.83893	0.028821	227.76
	4.8965	526898.40833	186050.92500	0.00000	-0.64135	-0.75794	0.40307	0.99227	0.034720	227.76
	5.8758	526897.75000	186050.20000	0.00000	-0.74043	-0.87650	0.59248	1.1466	0.041063	227.76
Line 11	Line 11	526897.75000	186050.20000	0.00000	-0.74043	-0.87650	0.59248	-0.038996	1.1467	137.86
	0.70799	526897.22500	186050.67500	0.00000	-1.7648	-2.1150	1.3956	-0.11031	2.7524	137.86
	1.4160	526896.70000	186051.15000	0.00000	-1.7580	-2.1069	1.3785	-0.10989	2.7418	137.86
Line 12	Line 12	526896.70000	186051.15000	0.00000	-1.7580	-2.1069	1.3785	2.7401	0.14535	227.12
	0.9525	526896.05000	186050.45000	0.00000	-1.9872	-2.3815	1.9583	3.0973	0.16430	227.12
	1.9105	526895.40000	186049.75000	0.00000	-2.2707	-2.7213	2.5208	3.5393	0.18774	227.12
	2.8657	526894.75000	186049.05000	0.00000	-2.6137	-3.1324	3.0125	4.0739	0.21610	227.12
	3.8210	526894.10000	186048.35000	0.00000	-2.9740	-3.5641	3.3675	4.6354	0.24589	227.12
Line 13	Line 13	526894.10000	186048.35000	0.00000	-2.9740	-3.5641	3.3675	0.31447	-4.6312	316.27
	0.79569	526894.67500	186047.80000	0.00000	-2.9951	-3.5894	3.3820	0.31670	-4.6641	316.27
	1.5914	526895.25000	186047.25000	0.00000	-1.2507	-1.4641	1.4187	0.10820	-1.9225	316.27
Line 14	Line 14	526895.25000	186047.25000	0.00000	-1.2507	-1.4641	1.4187	1.9248	0.052375	227.94
	0.92045	526894.63333	186046.56667	0.00000	-1.4077	-1.6479	1.4655	2.1665	0.058950	227.94
	1.8409	526894.01667	186045.88333	0.00000	-1.5806	-1.8503	1.5027	2.4326	0.066193	227.94
	2.7613	526893.40000	186045.20000	0.00000	-1.2528	0.081226	1.3562	0.77901	-0.98447	227.94
Line 15	Line 15	526893.40000	186045.20000	0.00000	-1.2528	0.081226	1.3562	-1.0160	-0.73738	320.32
	0.97451	526894.15000	186044.57778	0.00000	-1.1107	0.80868	1.6972	-1.3712	-0.086831	320.32
	1.9490	526894.90000	186043.95556	0.00000	-0.70637	1.0479	1.2752	-1.2127	0.35546	320.32
	2.9235	526895.65000	186043.33333	0.00000	-0.93492	0.54785	1.6986	-1.0693	-0.17531	320.32
	3.8980	526896.40000	186042.71111	0.00000	-0.85760	0.43315	1.5623	-0.93660	-0.21422	320.32
	4.8725	526897.15000	186042.08889	0.00000	-0.47182	0.69994	0.89639	-0.81004	0.23743	320.32
	5.8470	526897.90000	186041.46667	0.00000	-0.72536	0.23697	1.1658	-0.70956	-0.28077	320.32
	6.8215	526898.65000	186040.84444	0.00000	-0.67596	0.16369	0.95094	-0.62475	-0.30562	320.32
	7.7960	526899.40000	186040.22222	0.00000	-0.31450	0.46655	0.32499	-0.53994	0.15826	320.32
	8.7705	526900.15000	186039.60000	0.00000	-0.58447	0.25818	0.59718	-0.61467	-0.17448	320.32
Line 16	Line 16	526900.15000	186039.60000	0.00000	-0.58447	0.25818	0.59718	-0.20262	0.60598	47.679
	1.0087	526900.82917	186040.34583	0.00000	-0.26478	0.30948	0.25734	0.050551	0.40415	47.679
	2.0175	526901.50833	186041.09167	0.00000	-0.25824	0.22627	0.17174	-0.0065680	0.34328	47.679
	3.0262	526902.18750	186041.83750	0.00000	-0.24549	0.14966	0.14140	-0.054631	0.28228	47.679
	4.0349	526902.86667	186042.58333	0.00000	-0.22682	0.084078	0.10977	-0.090550	0.22431	47.679
	5.0436	526903.54583	186043.32917	0.00000	-0.20505	0.032704	0.081331	-0.11388	0.17363	47.679
	6.0524	526904.22500	186044.07500	0.00000	-0.18412	-0.0025770	0.059494	-0.12587	0.13440	47.679
	7.0611	526904.90417	186044.82083	0.00000	-0.15465	-0.023713	0.042083	-0.12166	0.098383	47.679
	8.0698	526905.58333	186045.56667	0.00000	-0.11744	-0.031315	0.029760	-0.10222	0.065746	47.679
	9.0786	526906.26250	186046.31250	0.00000	-0.073285	-0.026378	0.020507	-0.068845	0.036425	47.679
	10.087	526906.94167	186047.05833	0.00000	-0.023010	-0.010070	0.0088758	-0.022937	0.010233	47.679
	11.096	526907.62083	186047.80417	0.00000	0.0	0.0	0.0	0.0	0.0	47.679
	12.105	526908.30000	186048.55000	0.00000	0.0	0.0	0.0	0.0	0.0	47.679
Grid 1	Grid 1	526865.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526867.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526870.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526872.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526875.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526877.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526880.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526882.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526885.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526887.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526890.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526892.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526895.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526897.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526900.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526902.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526905.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526907.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186025.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526867.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526870.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526872.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526875.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-

Type/No.		Coordinates			Displacements				Angle of Line
Name	Dist.	x	y	z	x	y	z	Horizontal displacement	Horizontal displacement	to x Axis
		526877.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526880.00000	186029.00000	0.00000	0.010651	0.034820	0.010148	-	-	-
		526882.50000	186029.00000	0.00000	0.011215	0.14720	0.028897	-	-	-
		526885.00000	186029.00000	0.00000	-0.020326	0.16550	0.030993	-	-	-
		526887.50000	186029.00000	0.00000	-0.015448	0.054534	0.013338	-	-	-
		526890.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526892.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526895.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526897.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526900.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526902.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526905.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526907.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186029.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526867.50000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526870.00000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526872.50000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526875.00000	186033.00000	0.00000	0.29048	0.34420	0.063889	-	-	-
		526877.50000	186033.00000	0.00000	0.44224	0.62042	0.11353	-	-	-
		526880.00000	186033.00000	0.00000	0.39407	0.87852	0.21601	-	-	-
		526882.50000	186033.00000	0.00000	0.13306	1.0522	0.29936	-	-	-
		526885.00000	186033.00000	0.00000	-0.19239	1.2136	0.32727	-	-	-
		526887.50000	186033.00000	0.00000	-0.43663	1.4456	0.31347	-	-	-
		526890.00000	186033.00000	0.00000	-0.35825	1.1861	0.20515	-	-	-
		526892.50000	186033.00000	0.00000			Point lies within an excavation.			
		526895.00000	186033.00000	0.00000			Point lies within an excavation.			
		526897.50000	186033.00000	0.00000	-0.051942	0.16645	0.048345	-	-	-
		526900.00000	186033.00000	0.00000	-0.0061284	0.016146	0.0050478	-	-	-
		526902.50000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526905.00000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526907.50000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186033.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186037.00000	0.00000	0.0	0.0	0.0	-	-	-
		526867.50000	186037.00000	0.00000	0.0	0.0	0.0	-	-	-
		526870.00000	186037.00000	0.00000	0.24988	0.29609	0.057616	-	-	-
		526872.50000	186037.00000	0.00000	0.63984	0.75817	0.13885	-	-	-
		526875.00000	186037.00000	0.00000	1.0298	1.2203	0.35681	-	-	-
		526877.50000	186037.00000	0.00000	1.4198	1.6823	0.78122	-	-	-
		526880.00000	186037.00000	0.00000	1.2591	1.6850	1.1357	-	-	-
		526882.50000	186037.00000	0.00000	0.48830	1.8867	1.4647	-	-	-
		526885.00000	186037.00000	0.00000	-0.56683	2.3512	1.7600	-	-	-
		526887.50000	186037.00000	0.00000			Point lies within an excavation.			
		526890.00000	186037.00000	0.00000			Point lies within an excavation.			
		526892.50000	186037.00000	0.00000			Point lies within an excavation.			
		526895.00000	186037.00000	0.00000			Point lies within an excavation.			
		526897.50000	186037.00000	0.00000			Point lies within an excavation.			
		526900.00000	186037.00000	0.00000	-0.61038	0.38637	0.54587	-	-	-
		526902.50000	186037.00000	0.00000	-0.088131	0.14096	0.031408	-	-	-
		526905.00000	186037.00000	0.00000	0.0	0.0	0.0	-	-	-
		526907.50000	186037.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186037.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186037.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186037.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186041.00000	0.00000	0.11070	0.11165	0.028302	-	-	-
		526867.50000	186041.00000	0.00000	0.39695	0.46730	0.083496	-	-	-
		526870.00000	186041.00000	0.00000	0.98921	1.1721	0.32487	-	-	-
		526872.50000	186041.00000	0.00000	1.3792	1.6342	0.72749	-	-	-
		526875.00000	186041.00000	0.00000	1.7691	2.0963	1.3770	-	-	-
		526877.50000	186041.00000	0.00000	2.1798	2.5829	2.3500	-	-	-
		526880.00000	186041.00000	0.00000	2.7656	3.2770	3.1667	-	-	-
		526882.50000	186041.00000	0.00000	3.6943	3.8011	3.9315	-	-	-
		526885.00000	186041.00000	0.00000			Point lies within an excavation.			
		526887.50000	186041.00000	0.00000			Point lies within an excavation.			
		526890.00000	186041.00000	0.00000			Point lies within an excavation.			
		526892.50000	186041.00000	0.00000			Point lies within an excavation.			
		526895.00000	186041.00000	0.00000			Point lies within an excavation.			
		526897.50000	186041.00000	0.00000			Point lies within an excavation.			
		526900.00000	186041.00000	0.00000	-0.31973	0.36329	0.39783	-	-	-
		526902.50000	186041.00000	0.00000	-0.21042	0.16434	0.10292	-	-	-
		526905.00000	186041.00000	0.00000	-0.089181	0.050298	0.026901	-	-	-
		526907.50000	186041.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186041.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186041.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186041.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186045.00000	0.00000	0.42289	0.27431	0.094331	-	-	-
		526867.50000	186045.00000	0.00000	0.76273	0.62059	0.33515	-	-	-
		526870.00000	186045.00000	0.00000	1.1107	1.1760	0.80211	-	-	-
		526872.50000	186045.00000	0.00000	2.1201	2.5122	2.2514	-	-	-
		526875.00000	186045.00000	0.00000	2.7026	3.2024	3.0976	-	-	-
		526877.50000	186045.00000	0.00000	3.3415	3.9595	3.5055	-	-	-
		526880.00000	186045.00000	0.00000	4.0931	4.8500	3.0652	-	-	-
		526882.50000	186045.00000	0.00000			Point lies within an excavation.			
		526885.00000	186045.00000	0.00000			Point lies within an excavation.			
		526887.50000	186045.00000	0.00000			Point lies within an excavation.			
		526890.00000	186045.00000	0.00000			Point lies within an excavation.			
		526892.50000	186045.00000	0.00000			Point lies within an excavation.			
		526895.00000	186045.00000	0.00000	-0.85339	0.016249	1.2589	-	-	-
		526897.50000	186045.00000	0.00000	-0.64197	-0.079193	0.94908	-	-	-
		526900.00000	186045.00000	0.00000	-0.46035	-0.072873	0.47315	-	-	-
		526902.50000	186045.00000	0.00000	-0.30657	-0.053271	0.16625	-	-	-
		526905.00000	186045.00000	0.00000	-0.15061	-0.027484	0.040160	-	-	-
		526907.50000	186045.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186045.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186045.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186045.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186049.00000	0.00000	0.51760	0.038571	0.15125	-	-	-
		526867.50000	186049.00000	0.00000	0.84665	0.099417	0.49476	-	-	-
		526870.00000	186049.00000	0.00000	1.2013	0.24119	1.2076	-	-	-
		526872.50000	186049.00000	0.00000	1.7721	0.76114	1.8577	-	-	-
		526875.00000	186049.00000	0.00000	4.0079	4.7491	3.1648	-	-	-
		526877.50000	186049.00000	0.00000			Point lies within an excavation.			
		526880.00000	186049.00000	0.00000			Point lies within an excavation.			
		526882.50000	186049.00000	0.00000			Point lies within an excavation.			
		526885.00000	186049.00000	0.00000			Point lies within an excavation.			
		526887.50000	186049.00000	0.00000			Point lies within an excavation.			
		526890.00000	186049.00000	0.00000	-3.8985	-4.6721	3.2505	-	-	-
		526892.50000	186049.00000	0.00000	-3.1842	-3.8161	3.4769	-	-	-
		526895.00000	186049.00000	0.00000	-2.5692	-3.0790	2.9559	-	-	-
		526897.50000	186049.00000	0.00000	-0.80564	-0.88858	0.83526	-	-	-
		526900.00000	186049.00000	0.00000	-0.54959	-0.49757	0.37028	-	-	-
		526902.50000	186049.00000	0.00000	-0.33361	-0.25788	0.12486	-	-	-
		526905.00000	186049.00000	0.00000	-0.13846	-0.094302	0.031978	-	-	-
		526907.50000	186049.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186049.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186049.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186049.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186053.00000	0.00000	0.55372	-0.26371	0.13292	-	-	-
		526867.50000	186053.00000	0.00000	0.96492	-0.56123	0.46080	-	-	-
		526870.00000	186053.00000	0.00000	1.4288	-1.0688	1.1548	-	-	-
		526872.50000	186053.00000	0.00000	2.9968	-2.6074	2.9240	-	-	-
		526875.00000	186053.00000	0.00000	3.8556	-3.3546	3.4997	-	-	-
		526877.50000	186053.00000	0.00000	4.8886	-4.2534	2.9521	-	-	-
		526880.00000	186053.00000	0.00000			Point lies within an excavation.			
		526882.50000	186053.00000	0.00000			Point lies within an excavation.			
		526885.00000	186053.00000	0.00000	-3.2446	-4.9379	3.3479	-	-	-
		526887.50000	186053.00000	0.00000	-2.7272	-4.1505	3.4761	-	-	-
		526890.00000	186053.00000	0.00000	-2.6175	-3.1369	3.0173	-	-	-
		526892.50000	186053.00000	0.00000	-2.0632	-2.4726	2.1492	-	-	-
		526895.00000	186053.00000	0.00000	-1.6784	-2.0115	1.1839	-	-	-
		526897.50000	186053.00000	0.00000	-1.2936	-1.5503	0.63143	-	-	-
		526900.00000	186053.00000	0.00000	-0.38211	-0.45607	0.11464	-	-	-
		526902.50000	186053.00000	0.00000	-0.18962	-0.20323	0.039679	-	-	-
		526905.00000	186053.00000	0.00000	-0.0019105	-0.0018552	0.0018387	-	-	-
		526907.50000	186053.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186053.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186053.00000	0.00000	0.0	0.0	0.0	-	-	-

Type/No. Name	Dist.	Coordinates x	y	z	Displacements x	y	z	Horizontal displacement	Horizontal displacement	Angle of Line to x Axis
		526915.00000	186053.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186057.00000	0.00000	0.30063	-0.23876	0.052555	-	-	-
		526867.50000	186057.00000	0.00000	1.0165	-0.88441	0.24362	-	-	-
		526870.00000	186057.00000	0.00000	1.5501	-1.3487	0.65922	-	-	-
		526872.50000	186057.00000	0.00000	2.0836	-1.8129	1.4073	-	-	-
		526875.00000	186057.00000	0.00000	2.6847	-2.3359	2.5354	-	-	-
		526877.50000	186057.00000	0.00000	3.5039	-3.0486	3.3687	-	-	-
		526880.00000	186057.00000	0.00000	-0.55684	-2.5179	2.1001	-	-	-
		526882.50000	186057.00000	0.00000	-2.5233	-3.8402	3.3457	-	-	-
		526885.00000	186057.00000	0.00000	-2.0862	-3.1749	2.7694	-	-	-
		526887.50000	186057.00000	0.00000	-1.7113	-2.6044	1.9818	-	-	-
		526890.00000	186057.00000	0.00000	-1.4286	-2.1741	1.1649	-	-	-
		526892.50000	186057.00000	0.00000	-1.2795	-1.5565	0.65318	-	-	-
		526895.00000	186057.00000	0.00000	-0.94054	-1.1272	0.29398	-	-	-
		526897.50000	186057.00000	0.00000	-0.55573	-0.66600	0.11503	-	-	-
		526900.00000	186057.00000	0.00000	-0.17091	-0.20482	0.044621	-	-	-
		526902.50000	186057.00000	0.00000	0.0	0.0	0.0	-	-	-
		526905.00000	186057.00000	0.00000	0.0	0.0	0.0	-	-	-
		526907.50000	186057.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186057.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186057.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186057.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526867.50000	186061.00000	0.00000	0.27369	-0.23813	0.055100	-	-	-
		526870.00000	186061.00000	0.00000	0.80727	-0.70237	0.15682	-	-	-
		526872.50000	186061.00000	0.00000	1.3408	-1.1666	0.46140	-	-	-
		526875.00000	186061.00000	0.00000	1.0332	-1.0934	0.67093	-	-	-
		526877.50000	186061.00000	0.00000	0.62931	-1.2412	1.0038	-	-	-
		526880.00000	186061.00000	0.00000	-0.15804	-1.3887	1.1325	-	-	-
		526882.50000	186061.00000	0.00000	-0.85623	-1.5753	1.0563	-	-	-
		526885.00000	186061.00000	0.00000	-1.3056	-1.9869	0.94188	-	-	-
		526887.50000	186061.00000	0.00000	-1.0229	-1.5567	0.51755	-	-	-
		526890.00000	186061.00000	0.00000	-0.74016	-1.1265	0.24381	-	-	-
		526892.50000	186061.00000	0.00000	-0.45746	-0.69620	0.10939	-	-	-
		526895.00000	186061.00000	0.00000	-0.17823	-0.23850	0.047660	-	-	-
		526897.50000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526900.00000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526902.50000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526905.00000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526907.50000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186061.00000	0.00000	0.0	0.0	0.0	-	-	-
		526865.00000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526867.50000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526870.00000	186065.00000	0.00000	0.035647	-0.033474	0.011730	-	-	-
		526872.50000	186065.00000	0.00000	0.26728	-0.30540	0.058347	-	-	-
		526875.00000	186065.00000	0.00000	0.31381	-0.50668	0.11459	-	-	-
		526877.50000	186065.00000	0.00000	0.17559	-0.61770	0.17367	-	-	-
		526880.00000	186065.00000	0.00000	-0.066351	-0.71018	0.20622	-	-	-
		526882.50000	186065.00000	0.00000	-0.28351	-0.73921	0.18302	-	-	-
		526885.00000	186065.00000	0.00000	-0.36401	-0.62158	0.11293	-	-	-
		526887.50000	186065.00000	0.00000	-0.33447	-0.50903	0.080097	-	-	-
		526890.00000	186065.00000	0.00000	-0.051765	-0.078781	0.020648	-	-	-
		526892.50000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526895.00000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526897.50000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526900.00000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526902.50000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526905.00000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526907.50000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526910.00000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526912.50000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-
		526915.00000	186065.00000	0.00000	0.0	0.0	0.0	-	-	-

Specific Building Damage Results - Horizontal Displacements

Structure: 2 E Heath Road | Sub-structure: Wall 1

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526886.70000	186057.90000	0.00000	-1.6468	-2.5063	2.9719	0.40188
0.91439	526886.10000	186057.21000	0.00000	-1.8487	-2.8136	3.3362	0.45114
1.8288	526885.50000	186056.52000	0.00000	-2.1252	-3.2343	3.8351	0.51861
2.7432	526884.90000	186055.83000	0.00000	-2.4115	-3.6701	4.3519	0.58848
3.6575	526884.30000	186055.14000	0.00000	-2.7162	-4.1338	4.9018	0.66284
4.5719	526883.70000	186054.45000	0.00000	-3.0479	-4.6385	5.5002	0.74376

Structure: 2 E Heath Road | Sub-structure: Wall 2

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526883.70000	186054.45000	0.00000	-3.0479	-4.6385	0.55390	-5.5225
0.79390	526884.31667	186053.95000	0.00000	-3.0784	-4.6850	0.55945	-5.5779
1.5878	526884.93333	186053.45000	0.00000	-3.1092	-4.7319	0.56506	-5.6337
2.3817	526885.55000	186052.95000	0.00000	-3.1403	-4.7793	0.57071	-5.6901

Structure: 2 E Heath Road | Sub-structure: Wall 3

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526885.55000	186052.95000	0.00000	-3.1403	-4.7793	-5.6733	-0.71920
0.90785	526886.14000	186053.64000	0.00000	-2.8022	-4.2647	-5.0625	-0.64177
1.8157	526886.73000	186054.33000	0.00000	-2.4930	-3.7940	-4.5037	-0.57094
2.7236	526887.32000	186055.02000	0.00000	-2.2041	-3.3545	-3.9819	-0.50479
3.6314	526887.91000	186055.71000	0.00000	-1.9274	-2.9334	-3.4821	-0.44142
4.5393	526888.50000	186056.40000	0.00000	-1.7014	-2.5894	-3.0738	-0.38966

Structure: 2 E Heath Road | Sub-structure: Wall 4

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526888.50000	186056.40000	0.00000	-1.7014	-2.5894	0.49551	-3.0585
0.40697	526888.80000	186056.12500	0.00000	-1.7148	-2.6098	0.49941	-3.0826
0.81394	526889.10000	186055.85000	0.00000	-1.7283	-2.6302	0.50331	-3.1067

Structure: 2 E Heath Road | Sub-structure: Wall 5

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526889.10000	186055.85000	0.00000	-1.7283	-2.6302	-3.1157	-0.44430
0.90686	526889.70000	186056.53000	0.00000	-1.5434	-2.3489	-2.7824	-0.39677

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the	Horizontal displacement perpendicular
1.8137	526890.30000	186057.21000	0.00000	-1.3585	-2.0675	-2.4491	-0.34924
2.7206	526890.90000	186057.89000	0.00000	-1.1736	-1.7861	-2.1158	-0.30171
3.6275	526891.50000	186058.57000	0.00000	-0.98874	-1.5048	-1.7825	-0.25419
4.5343	526892.10000	186059.25000	0.00000	-0.80387	-1.2234	-1.4492	-0.20666

Structure: 2 E Heath Road | Sub-structure: Wall 6

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526892.10000	186059.25000	0.00000	-0.80387	-1.2234	-0.15637	1.4555
1.0035	526891.32500	186059.88750	0.00000	-0.78179	-1.1898	-0.15208	1.4155
2.0070	526890.55000	186060.52500	0.00000	-0.75972	-1.1562	-0.14778	1.3756
3.0105	526889.77500	186061.16250	0.00000	-0.73764	-1.1226	-0.14349	1.3356
4.0140	526889.00000	186061.80000	0.00000	-0.71557	-1.0890	-0.13919	1.2956

Structure: 2 E Heath Road | Sub-structure: Wall 7

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526889.00000	186061.80000	0.00000	-0.71557	-1.0890	1.2953	0.14190
0.89499	526888.43000	186061.11000	0.00000	-0.89877	-1.3678	1.6270	0.17823
1.7900	526887.86000	186060.42000	0.00000	-1.0820	-1.6467	1.9586	0.21456
2.6850	526887.29000	186059.73000	0.00000	-1.2652	-1.9255	2.2902	0.25089
3.5799	526886.72000	186059.04000	0.00000	-1.4484	-2.2043	2.6219	0.28722
4.4749	526886.15000	186058.35000	0.00000	-1.6316	-2.4831	2.9535	0.32355

Structure: 2 E Heath Road | Sub-structure: Wall 8

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526886.15000	186058.35000	0.00000	-1.6316	-2.4831	0.30962	-2.9550
0.35532	526886.42500	186058.12500	0.00000	-1.6392	-2.4947	0.31106	-2.9688
0.71063	526886.70000	186057.90000	0.00000	-1.6468	-2.5063	0.31251	-2.9826

Structure: 1 E Heath Road | Sub-structure: Wall 9

Dist.	Coordinates x	y	z	x	Displacements y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526908.30000	186048.55000	0.00000	0.0	0.0	0.0	0.0
0.99107	526907.56667	186049.21667	0.00000	0.0	0.0	0.0	0.0
1.9821	526906.83333	186049.88333	0.00000	0.0	0.0	0.0	0.0
2.9732	526906.10000	186050.55000	0.00000	-0.017694	-0.013739	0.0038507	0.022068
3.9643	526905.36667	186051.21667	0.00000	-0.050683	-0.043004	0.0085746	0.065914
4.9554	526904.63333	186051.88333	0.00000	-0.080535	-0.074029	0.0097936	0.10895
5.9464	526903.90000	186052.55000	0.00000	-0.10636	-0.10508	0.0080136	0.14930
6.9375	526903.16667	186053.21667	0.00000	-0.12718	-0.13407	0.0039199	0.18475
7.9286	526902.43333	186053.88333	0.00000	-0.14197	-0.15861	-0.0016426	0.21287
8.9196	526901.70000	186054.55000	0.00000	-0.14975	-0.17619	-0.0077122	0.23110

Structure: 1 E Heath Road | Sub-structure: Wall 10

Dist.	Coordinates x	y	z	x	Displacements y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526901.70000	186054.55000	0.00000	-0.14975	-0.17619	0.23111	0.0075799
0.97930	526901.04167	186053.82500	0.00000	-0.24777	-0.29169	0.38251	0.012657
1.9586	526900.38333	186053.10000	0.00000	-0.34591	-0.40750	0.53422	0.017861
2.9379	526899.72500	186052.37500	0.00000	-0.44417	-0.52371	0.68631	0.023230
3.9172	526899.06667	186051.65000	0.00000	-0.54263	-0.64045	0.83893	0.028821
4.8965	526898.40833	186050.92500	0.00000	-0.64135	-0.75794	0.99227	0.034720
5.8758	526897.75000	186050.20000	0.00000	-0.74043	-0.87650	1.1466	0.041063

Structure: 1 E Heath Road | Sub-structure: Wall 11

Dist.	Coordinates x	y	z	x	Displacements y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526897.75000	186050.20000	0.00000	-0.74043	-0.87650	-0.038996	1.1467
0.70799	526897.22500	186050.67500	0.00000	-1.7648	-2.1150	-0.11031	2.7524
1.4160	526896.70000	186051.15000	0.00000	-1.7580	-2.1069	-0.10989	2.7418

Structure: 1 E Heath Road | Sub-structure: Wall 12

Dist.	Coordinates x	y	z	x	Displacements y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526896.70000	186051.15000	0.00000	-1.7580	-2.1069	2.7401	0.14535
0.95525	526896.05000	186050.45000	0.00000	-1.9872	-2.3815	3.0973	0.16430
1.9105	526895.40000	186049.75000	0.00000	-2.2707	-2.7213	3.5393	0.18774
2.8657	526894.75000	186049.05000	0.00000	-2.6137	-3.1324	4.0739	0.21610
3.8210	526894.10000	186048.35000	0.00000	-2.9740	-3.5641	4.6354	0.24589

Structure: 1 E Heath Road | Sub-structure: Wall 13

Dist.	Coordinates x	y	z	x	Displacements y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526894.10000	186048.35000	0.00000	-2.9740	-3.5641	0.31447	-4.6312
0.79569	526894.67500	186047.80000	0.00000	-2.9951	-3.5894	0.31670	-4.6641
1.5914	526895.25000	186047.25000	0.00000	-1.2507	-1.4641	0.10820	-1.9225

Structure: 1 E Heath Road | Sub-structure: Wall 14

Dist.	Coordinates x	y	z	x	Displacements y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526895.25000	186047.25000	0.00000	-1.2507	-1.4641	1.9248	0.052375
0.92045	526894.63333	186046.56667	0.00000	-1.4077	-1.6479	2.1665	0.058950

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the	Horizontal displacement perpendicular
1.8409	526894.01667	186045.88333	0.00000	-1.5806	-1.8503	2.4326	0.066193
2.7613	526893.40000	186045.20000	0.00000	-1.2528	0.081226	0.77901	-0.98447

Structure: 1 E Heath Road | Sub-structure: Wall 15

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526893.40000	186045.20000	0.00000	-1.2528	0.081226	-1.0160	-0.73738
0.97451	526894.15000	186044.57778	0.00000	-1.1107	0.80868	-1.3712	-0.086831
1.9490	526894.90000	186043.95556	0.00000	-0.70637	1.0479	-1.2127	0.35546
2.9235	526895.65000	186043.33333	0.00000	-0.93492	0.54785	-1.0693	-0.17531
3.8980	526896.40000	186042.71111	0.00000	-0.85760	0.43315	-0.93660	-0.21422
4.8725	526897.15000	186042.08889	0.00000	-0.47182	0.69994	-0.81004	0.23743
5.8470	526897.90000	186041.46667	0.00000	-0.72536	0.23697	-0.70956	-0.28077
6.8215	526898.65000	186040.84444	0.00000	-0.67596	0.16369	-0.62475	-0.30562
7.7960	526899.40000	186040.22222	0.00000	-0.31450	0.46655	-0.53994	0.15826
8.7705	526900.15000	186039.60000	0.00000	-0.58447	0.25818	-0.61467	-0.17448

Structure: 1 E Heath Road | Sub-structure: Wall 16

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	526900.15000	186039.60000	0.00000	-0.58447	0.25818	-0.20262	0.60598
1.0087	526900.82917	186040.34583	0.00000	-0.26478	0.30948	0.050551	0.40415
2.0175	526901.50833	186041.09167	0.00000	-0.25824	0.22627	-0.0065680	0.34328
3.0262	526902.18750	186041.83750	0.00000	-0.24549	0.14966	-0.054631	0.28228
4.0349	526902.86667	186042.58333	0.00000	-0.22682	0.084078	-0.090550	0.22431
5.0436	526903.54583	186043.32917	0.00000	-0.20505	0.032704	-0.11388	0.17363
6.0524	526904.22500	186044.07500	0.00000	-0.18412	-0.0025770	-0.12587	0.13440
7.0611	526904.90417	186044.82083	0.00000	-0.15465	-0.023713	-0.12166	0.098383
8.0698	526905.58333	186045.56667	0.00000	-0.11744	-0.031315	-0.10222	0.065746
9.0786	526906.26250	186046.31250	0.00000	-0.073285	-0.026378	-0.068845	0.036425
10.087	526906.94167	186047.05833	0.00000	-0.023010	-0.010070	-0.022937	0.010233
11.096	526907.62083	186047.80417	0.00000	0.0	0.0	0.0	0.0
12.105	526908.30000	186048.55000	0.00000	0.0	0.0	0.0	0.0

Specific Building Damage Results - Vertical Displacements

Structure: 2 E Heath Road | Sub-structure: Wall 1

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	526886.70000	186057.90000	0.00000	1.7915
0.91439	526886.10000	186057.21000	0.00000	2.3361
1.8288	526885.50000	186056.52000	0.00000	2.8344
2.7432	526884.90000	186055.83000	0.00000	3.2338
3.6575	526884.30000	186055.14000	0.00000	3.4716
4.5719	526883.70000	186054.45000	0.00000	3.4751

Structure: 2 E Heath Road | Sub-structure: Wall 2

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	526883.70000	186054.45000	0.00000	3.4751
0.79390	526884.31667	186053.95000	0.00000	3.4617
1.5878	526884.93333	186053.45000	0.00000	3.4457
2.3817	526885.55000	186052.95000	0.00000	3.4272

Structure: 2 E Heath Road | Sub-structure: Wall 3

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	526885.55000	186052.95000	0.00000	3.4272
0.90785	526886.14000	186053.64000	0.00000	3.4988
1.8157	526886.73000	186054.33000	0.00000	3.3180
2.7236	526887.32000	186055.02000	0.00000	2.9589
3.6314	526887.91000	186055.71000	0.00000	2.4857
4.5393	526888.50000	186056.40000	0.00000	1.9529

Structure: 2 E Heath Road | Sub-structure: Wall 4

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	526888.50000	186056.40000	0.00000	1.9529
0.40697	526888.80000	186056.12500	0.00000	1.9924
0.81394	526889.10000	186055.85000	0.00000	2.0318

Structure: 2 E Heath Road | Sub-structure: Wall 5

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	526889.10000	186055.85000	0.00000	2.0318
0.90686	526889.70000	186056.53000	0.00000	1.4856
1.8137	526890.30000	186057.21000	0.00000	1.0356
2.7206	526890.90000	186057.89000	0.00000	0.72647
3.6275	526891.50000	186058.57000	0.00000	0.47624
4.5343	526892.10000	186059.25000	0.00000	0.29210

Structure: 2 E Heath Road | Sub-structure: Wall 6

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	526892.10000	186059.25000	0.00000	0.29210
1.0035	526891.32500	186059.88750	0.00000	0.27452
2.0070	526890.55000	186060.52500	0.00000	0.25784
3.0105	526889.77500	186061.16250	0.00000	0.24205
4.0140	526889.00000	186061.80000	0.00000	0.22714

Structure: 2 E Heath Road | Sub-structure: Wall 7

Dist.	Coordinates x	y	z	Displacements z

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526889.00000	186061.80000	0.00000	0.22714
0.89499	526888.43000	186061.11000	0.00000	0.37830
1.7900	526887.86000	186060.42000	0.00000	0.59440
2.6850	526887.29000	186059.73000	0.00000	0.87302
3.5799	526886.72000	186059.04000	0.00000	1.2091
4.4749	526886.15000	186058.35000	0.00000	1.7463

Structure: 2 E Heath Road | Sub-structure: Wall 8

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526886.15000	186058.35000	0.00000	1.7463
0.35532	526886.42500	186058.12500	0.00000	1.7689
0.71063	526886.70000	186057.90000	0.00000	1.7915

Structure: 1 E Heath Road | Sub-structure: Wall 9

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526908.30000	186048.55000	0.00000	0.0
0.99107	526907.56667	186049.21667	0.00000	0.0
1.9821	526906.83333	186049.88333	0.00000	0.0
2.9732	526906.10000	186050.55000	0.00000	0.0069630
3.9643	526905.36667	186051.21667	0.00000	0.015180
4.9554	526904.63333	186051.88333	0.00000	0.020799
5.9464	526903.90000	186052.55000	0.00000	0.025000
6.9375	526903.16667	186053.21667	0.00000	0.028200
7.9286	526902.43333	186053.88333	0.00000	0.030391
8.9196	526901.70000	186054.55000	0.00000	0.031420

Structure: 1 E Heath Road | Sub-structure: Wall 10

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526901.70000	186054.55000	0.00000	0.031420
0.97930	526901.04167	186053.82500	0.00000	0.052788
1.9586	526900.38333	186053.10000	0.00000	0.094082
2.9379	526899.72500	186052.37500	0.00000	0.16470
3.9172	526899.06667	186051.65000	0.00000	0.26835
4.8965	526898.40833	186050.92500	0.00000	0.40307
5.8758	526897.75000	186050.20000	0.00000	0.59248

Structure: 1 E Heath Road | Sub-structure: Wall 11

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526897.75000	186050.20000	0.00000	0.59248
0.70799	526897.22500	186050.67500	0.00000	1.3956
1.4160	526896.70000	186051.15000	0.00000	1.3785

Structure: 1 E Heath Road | Sub-structure: Wall 12

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526896.70000	186051.15000	0.00000	1.3785
0.95525	526896.05000	186050.45000	0.00000	1.9583
1.9105	526895.40000	186049.75000	0.00000	2.5208
2.8657	526894.75000	186049.05000	0.00000	3.0125
3.8210	526894.10000	186048.35000	0.00000	3.3675

Structure: 1 E Heath Road | Sub-structure: Wall 13

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526894.10000	186048.35000	0.00000	3.3675
0.79569	526894.67500	186047.80000	0.00000	3.3820
1.5914	526895.25000	186047.25000	0.00000	1.4187

Structure: 1 E Heath Road | Sub-structure: Wall 14

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526895.25000	186047.25000	0.00000	1.4187
0.92045	526894.63333	186046.56667	0.00000	1.4655
1.8409	526894.01667	186045.88333	0.00000	1.5027
2.7613	526893.40000	186045.20000	0.00000	1.3562

Structure: 1 E Heath Road | Sub-structure: Wall 15

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526893.40000	186045.20000	0.00000	1.3562
0.97451	526894.15000	186044.57778	0.00000	1.6972
1.9490	526894.90000	186043.95556	0.00000	1.2752
2.9235	526895.65000	186043.33333	0.00000	1.6986
3.8980	526896.40000	186042.71111	0.00000	1.5623
4.8725	526897.15000	186042.08889	0.00000	0.89639
5.8470	526897.90000	186041.46667	0.00000	1.1658
6.8215	526898.65000	186040.84444	0.00000	0.95094
7.7960	526899.40000	186040.22222	0.00000	0.32499
8.7705	526900.15000	186039.60000	0.00000	0.59718

Structure: 1 E Heath Road | Sub-structure: Wall 16

Dist. [m]	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]

Vertical Offset 1

0.0	526900.15000	186039.60000	0.00000	0.59718
1.0087	526900.82917	186040.34583	0.00000	0.25734
2.0175	526901.50833	186041.09167	0.00000	0.17174
3.0262	526902.18750	186041.83750	0.00000	0.14140

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
4.0349	526902.86667	186042.58333	0.00000	0.10977
5.0436	526903.54583	186043.32917	0.00000	0.081331
6.0524	526904.22500	186044.07500	0.00000	0.059494
7.0611	526904.90417	186044.82083	0.00000	0.042083
8.0698	526905.58333	186045.56667	0.00000	0.029760
9.0786	526906.26250	186046.31250	0.00000	0.020507
10.087	526906.94167	186047.05833	0.00000	0.0088758
11.096	526907.62083	186047.80417	0.00000	0.0
12.105	526908.30000	186048.55000	0.00000	0.0

Specific Building Damage Results - All Segments

Structure: 2 E Heath Road | Sub-structure: Wall 1

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	4.5700	Sagging	0.0094134	0.055295	0.069553	-654.02E-6	-595.36E-6	3312.8	1 (Very Slight)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 2 E Heath Road | Sub-structure: Wall 2

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	2.3800	Sagging	105.51E-6	705.78E-6	831.16E-6	-7.1219E-6	23.295E-6	246900.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 2 E Heath Road | Sub-structure: Wall 3

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	4.5380	Sagging	0.010554	0.057270	0.073246	-672.35E-6	586.63E-6	3047.0	1 (Very Slight)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 2 E Heath Road | Sub-structure: Wall 4

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	0.81200	Sagging	5.3917E-6	959.08E-6	961.70E-6	-9.5908E-6	-97.010E-6	1.8679E+6	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 2 E Heath Road | Sub-structure: Wall 5

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	4.5330	Hogging	0.0066043	0.036753	0.044361	-367.39E-6	602.04E-6	7539.2	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 2 E Heath Road | Sub-structure: Wall 6

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	4.0130	Hogging	44.142E-6	427.90E-6	474.68E-6	-4.2790E-6	17.521E-6	1.1066E+6	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 2 E Heath Road | Sub-structure: Wall 7

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	4.4730	Hogging	0.0059169	0.037055	0.043812	-370.42E-6	-599.95E-6	3380.2	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 2 E Heath Road | Sub-structure: Wall 8

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	0.70900	Sagging	0.0	407.21E-6	407.30E-6	-4.0721E-6	-63.568E-6	62.337E+6	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 9

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	All settlements are less than the Settlement Trough Limit Sensitivity.										

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 10

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category

[m]		[m]	[m]		[%]	[%]	[%]			[m]			
0.0	1	2.9379	2.9361	Hogging	0.0015921	0.015669	0.015967	-157.62E-6	-193.39E-6	15814.		0 (Negligible)	

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 11

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	1.4140	Sagging	0.028709	-0.0050136	0.026759	100.74E-6	-0.0011344	610.24	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 12

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	3.8190	Sagging	0.0038634	0.049596	0.051440	-587.45E-6	-606.69E-6	5956.6	1 (Very Slight)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 13

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	1.5900	Sagging	0.061587	-0.012950	0.056622	262.10E-6	0.0024680	319.73	1 (Very Slight)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 14

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	0.36046	Hogging	0.0	0.026253	0.026252	-262.46E-6	-50.755E-6	24751.	0 (Negligible)
	2	0.36046	2.3995	Sagging	0.0048046	-0.051594	0.010682	0.0017998	159.46E-6	3717.2	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 15

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	1.7513	Sagging	0.019304	-0.013067	0.015512	364.60E-6	433.05E-6	814.96	0 (Negligible)
	2	1.7513	0.50368	Hogging	0.020635	0.015321	0.028717	-162.61E-6	-434.44E-6	10355.	0 (Negligible)
	3	2.2550	2.0755	Sagging	0.016178	0.013841	0.023612	-147.11E-6	683.29E-6	4730.2	0 (Negligible)
	4	4.3305	1.1837	Hogging	0.023649	0.011536	0.029241	-129.86E-6	683.29E-6	4467.8	0 (Negligible)
	5	5.5142	1.4547	Sagging	0.0097220	0.0090708	0.014738	-103.09E-6	642.27E-6	8553.0	0 (Negligible)
	6	6.9689	1.8001	Hogging	0.022673	-146.15E-6	0.022582	-87.023E-6	642.27E-6	774.61	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 1 E Heath Road | Sub-structure: Wall 16

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	4.0349	Hogging	0.0053929	0.0027776	0.0067185	-250.92E-6	336.82E-6	3348.9	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Specific Building Damage Results - Critical Values for All Segments within Each Sub-Structure

Structure: 2 E Heath Road | Sub-structure: Wall 1

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0094134	0.055295	-595.36E-6	3.4751	0.069553	-654.02E-6	-595.36E-6	-	3312.8	1 (Very Slight)

Structure: 2 E Heath Road | Sub-structure: Wall 2

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	105.51E-6	705.78E-6	23.295E-6	3.4751	831.16E-6	-7.1219E-6	23.295E-6	-	246900.	0 (Negligible)

Structure: 2 E Heath Road | Sub-structure: Wall 3

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.010554	0.057270	586.63E-6	3.4970	0.073246	-672.35E-6	586.63E-6	-	3047.0	1 (Very Slight)

Structure: 2 E Heath Road | Sub-structure: Wall 4

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	5.3917E-6	959.08E-6	-97.010E-6	2.0316	961.70E-6	-9.5908E-6	-97.010E-6	-	1.8679E+6	0 (Negligible)

Structure: 2 E Heath Road | Sub-structure: Wall 5

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0066043	0.036753	602.04E-6	2.0318	0.044361	-367.39E-6	602.04E-6	7539.2	-	0 (Negligible)

Structure: 2 E Heath Road | Sub-structure: Wall 6

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	44.142E-6	427.90E-6	17.521E-6	0.29210	474.68E-6	-4.2790E-6	17.521E-6	1.1066E+6	-	0 (Negligible)

Structure: 2 E Heath Road | Sub-structure: Wall 7

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0059169	0.037055	-599.95E-6	1.7451	0.043812	-370.42E-6	-599.95E-6	3380.2	-	0 (Negligible)

Structure: 2 E Heath Road | Sub-structure: Wall 8

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0	407.21E-6	-63.568E-6	1.7913	407.30E-6	-4.0721E-6	-63.568E-6	-	62.337E+6	0 (Negligible)

Structure: 1 E Heath Road | Sub-structure: Wall 9

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	

Structure: 1 E Heath Road | Sub-structure: Wall 10

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0015921	0.015669	-193.39E-6	0.59214	0.015967	-157.62E-6	-193.39E-6	15814.	-	0 (Negligible)

Structure: 1 E Heath Road | Sub-structure: Wall 11

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.028709	-0.0050136	-0.0011344	1.3954	0.026759	100.74E-6	-0.0011344	-	610.24	0 (Negligible)

Structure: 1 E Heath Road | Sub-structure: Wall 12

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0038634	0.049596	-606.69E-6	3.3668	0.051440	-587.45E-6	-606.69E-6	-	5956.6	1 (Very Slight)

Structure: 1 E Heath Road | Sub-structure: Wall 13

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.061587	-0.012950	0.0024680	3.3818	0.056622	262.10E-6	0.0024680	-	319.73	1 (Very Slight)

Structure: 1 E Heath Road | Sub-structure: Wall 14

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0048046	-0.051594	159.46E-6	1.5026	0.026252	0.0017998	159.46E-6	24751.	3717.2	0 (Negligible)

Structure: 1 E Heath Road | Sub-structure: Wall 15

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category

Movement Calculations						Curve				
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.023649	0.015321	683.29E-6	1.6983	0.029241	364.60E-6	683.29E-6	774.61	814.96	0 (Negligible)

Structure: 1 E Heath Road | Sub-structure: Wall 16

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0053929	0.0027776	336.82E-6	0.59718	0.0067185	-250.92E-6	336.82E-6	3348.9	-	0 (Negligible)

Specific Building Damage Results - Critical Segments within Each Structure

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	Start	End	Curvature	Max Slope	Max Settlement	Max Tensile Strain	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
				[m]	[m]			[mm]	[%]	[m]	[m]	
2 E Heath Road	Max Slope	Wall 5	1	0.0	4.5330	Hogging	**602.04E-6**	2.0318	0.044361	7539.2	-	0 (Negligible)
	Max Settlement	Wall 3	1	0.0	4.5380	Sagging	586.63E-6	**3.4970**	0.073246	-	3047.0	1 (Very Slight)
	Max Tensile Strain	Wall 3	1	0.0	4.5380	Sagging	586.63E-6	3.4970	**0.073246**	-	3047.0	1 (Very Slight)
	Min Radius of Curvature (Hogging)	Wall 7	1	0.0	4.4730	Hogging	599.95E-6	1.7451	0.043812	**3380.2**	-	0 (Negligible)
	Min Radius of Curvature (Sagging)	Wall 3	1	0.0	4.5380	Sagging	586.63E-6	3.4970	0.073246	-	**3047.0**	1 (Very Slight)
1 E Heath Road	Max Slope	Wall 13	1	0.0	1.5900	Sagging	**0.0024680**	3.3818	0.056622	-	319.73	1 (Very Slight)
	Max Settlement	Wall 13	1	0.0	1.5900	Sagging	0.0024680	**3.3818**	0.056622	-	319.73	1 (Very Slight)
	Max Tensile Strain	Wall 13	1	0.0	1.5900	Sagging	0.0024680	3.3818	**0.056622**	-	319.73	1 (Very Slight)
	Min Radius of Curvature (Hogging)	Wall 15	6	6.9689	8.7690	Hogging	642.27E-6	0.85628	0.022582	**774.61**	-	0 (Negligible)
	Min Radius of Curvature (Sagging)	Wall 13	1	0.0	1.5900	Sagging	0.0024680	3.3818	0.056622	-	**319.73**	1 (Very Slight)