



Basement Impact Assessment

at

103-107 North Hill, Highgate, London N6 4DP

for

Highgate Care Ltd.

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This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

Soils Limited was commissioned by Elite Designers on behalf of Highgate Care Ltd. to undertake an intrusive investigation and to produce a Basement Impact Assessment on land at 103-107 North Hill, Highgate, London N6 4DP. The scope of the investigation was outlined in the Soils Limited quotation reference Q24420 Rev.1, dated 29th September 2021.

This document comprises the Basement Impact Assessment Rev1.01 (BIA Rev1.01) and incorporates the results, discussion and conclusions to this intrusive works.

No Preliminary Investigation Report was undertaken on the above site by Soils Limited in respect to ground contamination, as this did not form part of the Client's brief. A limited number of tests, however, was undertaken to assist the Client for preliminary information on waste disposal purposes.

This revised document (Rev 1.01) supersedes all previous revisions of the BIA produced by Soils Limited.

Standards

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

- BS 5930:2015 and BS EN ISO 22476-2 2005+A1:2011
- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design
- BS EN ISO 14688-1:2002+A1:2013 - Geotechnical investigation and testing - Identification and description
- BS EN ISO 14688-2:2004+A1:2013 - Geotechnical investigation and testing - Principles for a classification
- BS 10175:2011+A1:2013 - Investigation of potentially contaminated sites
- BRE Digest 240, 241 and 242
- NHBC Standards 2020
- Stroud, M. A. 1974, "The Standard Penetration Test – its application and interpretation", Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.
- BSI Code of Practice for Foundations, BS8004: 2015
- CIRIA C760 – Guidance on embedded retaining wall design.
- Burland J.B., et al (2001). Building response to tunnelling. Case studies from the Jubilee line Extension, London. CIRIA Special Publication 200.

- Gaba A.R., et al (2003). Embedded retaining walls – guidance for economic design. CIRIA Report C580.
- Camden geological, hydrogeological and hydrological study, Guidance for subterranean development, Issue 01/November 2010
- Environment Agency Water Framework Directive
- Haringey Council Development Management DPD, Adopted July 2017
- Haringey Council Draft Basement Development Basement Guidance Note, June 2012
- Haringey Council Strategic Flood Risk Assessment (SFRA)
- Haringey Council Surface Water Management Plan (SWMP)
- Property Asset Register Public Web Map, Transport for London
- The Lost Rivers of London, Historical Publications Ltd, 1992, N Barton
- The London County Council Bomb Damage Maps 1939-1945, Thames and Hudson, 2018, Laurence Ward.

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses were undertaken by Derwentside Environmental Testing Services Limited (DETS) in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce a trial hole.

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Section I Introduction

1.1 Objective of Investigation

Soils Limited was commissioned by Elite Designers on behalf of Highgate Care Ltd. to undertake an intrusive investigation and to produce a Basement Impact Assessment (BIA). The objective of this investigation was to establish the impact and risk of the proposed basement at 103-107 North Hill, Highgate, London N6 4DP.

The report provides details on the ground and groundwater conditions on-site and presents calculations to determine the potential impact of the proposed development on neighbouring properties. In addition, the report provides a qualitative risk assessment of the potential impacts the proposed development might have on groundwater levels, surface water flows and flooding.

It is recognised that any Basement Impact Assessment is a live document and that further detailed assessments will be ongoing, if appropriate, as the design and construction progresses.

No Preliminary Investigation Report was undertaken on the above site by Soils Limited in respect to ground contamination, as this did not form part of the Client's brief. A limited number of tests, however, was undertaken to assist the Client for preliminary information on waste disposal purposes.

This revised document (Rev 1.01) supersedes all previous revisions of the BIA produced by Soils Limited.

1.2 Limitations and Disclaimers

This Basement Impact Assessment relates to the site located at 103-107 North Hill, Highgate, London N6 4DP and was prepared for the sole benefit of Highgate Care Ltd. (The "Client") and their appointed Engineer. The report was prepared solely for the brief described in Section 1.1 of this report.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot by plot basis prior to the construction of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data on any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping).

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. "Contaminated Land" is defined in Section 57 of the Environment Act 1995 as:

"Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being or is likely to be caused".

The investigation, analysis or recommendations in respect of contamination are made solely in respect of the prevention of harm to vulnerable receptors, using where possible best practice at the date of preparation of the report. The investigation and report do not address, define or make recommendations in respect of environmental liabilities. A separate environmental audit and liaison with statutory authorities is required to address these issues.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets remains with Soils Limited.

License is for the sole use of the client and may not be assigned, transferred or given to a third party

Section 2 Site Context

2.1 Location

The site was located at 103-107 North Hill, Highgate, London N6 4DP, had an approximate O.S Land Ranger Grid Reference of TQ 27997 88203 and fell within the administrative boundaries of the London Borough of Haringey.

The site location plan is given in Figure 1.

2.2 Site Description

The property of interest, the Mary Fielding Guild Care Home, was a care home comprising five, interconnected, three storey, masonry buildings (Truscott House, The Dean, Plowden Wing, The Garden Wing and Kekewich House) built circa 1920 with numerous small extensions to the sides and the rear. A basement was already present under the whole of the existing building. Dormer accommodation was provided in the roof space. The property, although not including either statutory or locally listed buildings, was located within the Highgate Conservation Area, was developed across an area of circa 0.36 hectares/0.9 acres and could be accessed from North Hill (pedestrian access) and View Road (vehicular access). The neighbouring building at 109 North Hill, to the north of Truscott House along North Hill was recorded as a statutory Grade II Listed Building. The site was predominantly soft landscaped with grassed grounds. The access driveway from View Road was surfaced with tarmacadam.

The L-shaped site is generally flat and level and includes a number of mature trees to the perimeter, particularly to the northern and western boundaries. No trees were present along the access from North Hill, to the east. The site was bounded by North Hill to the east and by View Road to the south. Brick built residential buildings, generally two to three storeys above ground, were recorded surrounding the site.

An aerial photograph of the site and its environs has been included in Figure 2.

2.3 Topography

The site itself was substantially flat and level but was located on the top of a hill at an elevation of circa 107m AOD (estimated from online available elevation data), with offsite topography sloping downwards in all directions. The average slope in a northerly direction was estimated as <4° immediately offsite using online available levelling data. The maximum average slope was observed in an easterly direction and was estimated as <9°, but at a distance of approximately 100m from the property.

2.4 Proposed Development

The proposed development considered the demolition of the existing building, the re-planning of the entire property in order to maintain the existing broadly L-shaped layout,

to improve the building functionality, to reduce the impact of the whole development and building mass, to provide an outlook from each resident bedroom and to ensure privacy to existing properties. The proposal included the demolition of the existing basement and the construction of a larger one to cover the maximum developable area, exceeding the footprint of the above ground floors, in particular within the main garden. The proposed basement formation level was anticipated by the Client's Engineers at a depth of circa 4.5m below ground level. Site drainage will include attenuation methods, not yet designed at current stage, with surface water discharged to public sewer.

In compiling this report reliance was placed on the Draft Conceptual Design Response for the Replacement of the Existing Building prepared by DWA Architects (London) Ltd and on drawings number 2021-0201 Rev.B to 2021-0206 Rev.B, dated 29th July 2021 and prepared by Elite Designers Structural Engineers. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plans provided by the client are presented in Appendix D.

2.5 Published Geological Data

The 1:50,000 BGS map showed the site to be located directly upon the bedrock Claygate Member, part of the London Clay Formation, with no overlying superficial deposits anticipated onsite. Given the previous development on the site Made Ground would be anticipated.

2.5.1 Made Ground

Made Ground comprises material that has been placed by man or spread by man. It can comprise demolition material from former structures on the site or imported material placed to raise levels. Its composition can be very variable both laterally and with depth and may contain putrescible matter and voids.

2.5.2 Claygate Member

The Claygate Member comprises a finely interbedded and thinly laminated sequence of clay, silt and fine grained sand with numerous interbeds of planar and lenticular bedded fine grained fine laminated sands up to 1m thick.

2.5.3 London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The upper boundary member of the London Clay Formation is known as the Claygate Member and marks the transition between the deep water, predominantly

clay environment and succeeding shallow-water, sand environment of the Bagshot Formation.

The lower boundary is generally marked by a thin bed of well-rounded flint gravel and/or a glauconitic horizon. The formation overlies the Harwich Formation or, where the Harwich Formation is absent, the Lambeth Group.

In the north London area the upper part of the London Clay Formation has been disturbed by glacial action and may contain pockets of sand and gravel.

2.6 BGS Published Geology

A review of historic boreholes within a radius of 300m around the site obtained from the BGS suggest the following sequence and final depth of strata.

Made Ground/Superficial Deposits: 0.3m to 1.3m

Claygate Member/London Clay Formation: >20.0m.

More remote boreholes, at more than 1000m to south and west of the site, showed the following deep stratigraphy:

Claygate Member/London Clay Formation: 114.3m to 129.0m

Lambeth Group: absent

Thanet Sand Formation: 131.1m to 147.0m

Chalk: >173.7m

2.6.1 Groundwater

BGS boreholes showed groundwater, where present, at depths of 1.30m to 8.50m below ground level. Groundwater was likely to have been associated with granular lenses within the Claygate Member and the London Clay Formation.

2.7 Hydrology

The site was recorded at an elevation of circa 107m AOD. The nearest surface water feature included in the Surface Water Management Plan (SWMP) prepared by Capita Symonds for the London Borough of Haringey was the Upper Mutton Brook, a culverted river, circa 1000m south-west of the site and at an elevation of circa 103m AOD. Information from the SWMP was presented in Figure 4.

The Highgate chain of ponds was recorded at >1000m to south-west, at elevations of between 100m and 75m AOD, and the River Thames was located at more than 7km to south-east.

2.8 Hydrogeology

The Environment Agency has produced an aquifer designation system consistent with the requirements of the Water Framework Directive. The designations have been set for superficial and bedrock geology and are based on the importance of aquifers for potable water supply and their role in supporting water bodies and wetland ecosystems.

The London groundwater model was generally split into three aquifers, the Upper, Intermediate and Lower Aquifer.

The Upper Aquifer was confined to River Terrace Deposits, which were not anticipated onsite, overlying the Claygate Member/London Clay Formation which acts as an aquiclude.

The Intermediate Aquifer was generally associated with granular layers within the Lambeth Group.

The Lower Aquifer was principally associated with the Chalk but can include the Thanet Sand Formation.

Information presented by the Environment Agency classifies the Claygate Member as a Secondary A Aquifer and the underlying London Clay Formation bedrock as unproductive strata.

Published geological data shows the site directly on the Claygate Member of the London Clay Formation, therefore the Upper Aquifer would not be present onsite.

The Claygate Member permits groundwater flow but can significantly vary in permeability due to the presence of clay horizons and laterally limited. Localised groundwater may exist within the sandy horizons of the Claygate Member, perched over the more clayey horizons or the London Clay Formation aquiclude.

Any water infiltrating the London Clay Formation will generally tend to flow either with the topography or vertically downwards at a very slow rate towards the Intermediate and subsequently Lower Aquifer. Due to the predominantly cohesive nature of the soils, the groundwater flow rate is anticipated to be very slow. Published permeability data for the London Clay Formation indicates the horizontal permeability to generally range between 10^{-10} m/s and 10^{-8} m/s, with an even lower vertical permeability. The permeability of the soils of the Claygate Member are likely to have slightly higher overall permeability in the presence of sand lenses.

The Upper Aquifer, if present, was considered to be relevant to the proposed development and basement impact assessment and must be confirmed via a ground investigation. The Intermediate and Lower Aquifers would not be affected in any way by the proposed works so were not considered further.

2.9 Flood Risk

The Surface Water Management Plan (SWMP) showed the site to be located within Flood Zone 1 and to fall outside of any Critical Drainage Area. The risk of flooding from sewers was low, with no incidents recorded by the Environment Agency in the immediate surroundings of the site. Similarly, the site was classified at negligible potential for elevated groundwater and the closest incident was recorded at >500m to the south. The area was recorded at risk of flooding for shallow surface water, considering a return period of 200 years. The risk of flooding for surface water was classified as moderate to significant. Information from the SWMP was reported in Figure 4 to Figure 9.

The Environment Agency (EA) recorded the site at negligible risk of flooding for the action of rivers and sea and for reservoirs failure. Medium risk was recorded for flooding from surface water. Information from the NFIS was reported in Figure 10 to Figure 12.

2.10 Underground Infrastructure

No underground features were recorded in the readily available data search. Information from the Property Asset Register Public Web Map prepared by transport for London was reported in Figure 13.

2.11 Unexploded Ordnance

The web-based service Bomb Sight was used to undertake a preliminary appraisal of the risk for unexploded ordnance from the Second World War. A map of the area was presented in Figure 14, where it can be observed that high-explosive bombs were deployed within circa 50m from the site during the heavy bombing of between 7th October 1940 and 6th June 1941.

The above results were compared with the information available on-line from Zetica UXO. The map in Figure 15 showed the site to be located within an area at low to moderate risk for the presence of UXO.

Considering the results of the preliminary appraisal, that the site already included a basement and that the proposed development comprised a certain degree of additional excavation, it is recommended to contact a UXO specialist for a Preliminary UXO risk assessment.

Section 3 Screening

3.1 Introduction

Soils Limited has adopted a screening process to meet the requirements of the London Borough of Haringey to identify potential risks to the ground, groundwater/surface water, land stability, adjacent properties and infrastructure.

The assessment is undertaken in the form of tabulated questions, based upon the Ove Arup 2008 Scoping Study prepared for the London Borough of Camden, setting out relevant considerations for conditions in the Borough. The assessment requires that any development proposal that includes a subterranean basement should be screened to determine whether or not a full BIA is required.

A number of screening tools are included in the Arup document (Ref: Camden geological, hydrogeological and hydrological study, Guidance for subterranean development, Issue01/November 2010), which includes a series of questions within a screening flowchart for three categories; surface water flow, groundwater flow and land stability. The above screening process was adapted to also take into account requirements from the Good Practice Guide on Basement Developments by the London Borough of Richmond Upon Thames. Responses to the questions are tabulated below.

3.2 Surface Flow and Flooding Screening Assessment

The response to the Surface Flow and Flood Screening Assessment is given in Table 3.1.

Table 3.1 – Surface Flow and Flooding Screening

Question	Response
1. 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 – The proposed drainage scheme was not anticipated to change significantly.
2. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Yes – The proposed basement will extend beyond the footprint of the existing building.
3. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	Yes – Impermeable areas will increase and attenuation methods will be installed, with surface water discharged to public sewer.
4. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No – The quality of surface water would not be affected.
5. Is the site in an area known to be at risk from surface water flooding?	Yes – The site was recorded by the EA at medium flood risk from surface water.

3.3 Subterranean (Groundwater) Screening Assessment

The response to the Subterranean (Groundwater) Screening Assessment is given in Table 3.2.

Table 3.2 – Subterranean (Groundwater) Screening

Question	Response
1a. Is the site located directly above an aquifer?	Yes – The BGS anticipated the presence of soils of the Claygate Member, which could be able to host local groundwater, perched over the London Clay Formation, which acts as an aquiclude. Information from the BGS boreholes showed that groundwater could be present.
1b. Will the proposed basement extend beneath the water table surface?	Unknown – Information from the BGS boreholes showed that groundwater could be present.
2. Is the site within 100 m of a watercourse, well (used/disused) or potential spring line?	No – The nearest Surface Water Feature was the Upper Mutton Brook, located circa 1000m 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 proposed basement will extend beyond the footprint of the existing building.
4. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No – Attenuation methods will be used at the site, with surface water discharged to public sewer.
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 was the Upper Mutton Brook, located circa 1000m south-east of the site.

3.4 Stability Screening Assessment

The response to the Stability Screening Assessment is given in Table 3.3.

Table 3.3 – Stability Screening

Question	Response
1. Does the existing site include slopes, natural or manmade, greater than 7°?	No – The site was substantially flat and level.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No – The proposed development would not alter the existing site landscaping elevations.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No – Neighbouring land topography did not present slopes greater than 7°.
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	Yes – Average slope angles greater than 7° were observed to the east, at a distance of circa 100m from the property.
5. Is the London Clay the shallowest strata at the site?	Yes – Soils of the Claygate Member, the youngest part of the London Clay Formation, were anticipated by the BGS.

Question	Response
6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	No – The proposed plans did not show any trees being removed.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	Unknown – Anticipated geology was Claygate Member of the London Clay Formation. The London Clay Formation would potentially be subject to shrink-swell subsidence. There was no visual evidence of subsidence at the site or properties in the vicinity.
8. Is the site within 100 m of a watercourse or potential spring line?	No – The nearest Surface Water Feature was the Upper Mutton Brook, located circa 1000m south-east of the site.
9. Is the site within an area of previously worked ground?	No - The relevant geological map did not show any Made Ground or Worked Ground within or in close proximity to the site.
10. Is the site within an aquifer?	Yes – The BGS anticipated the presence of soils of the Claygate Member, which could be able to host local groundwater tables, perched over the London Clay Formation, which acts as an aquiclude. Information from the BGS boreholes showed that groundwater could be present.
11. Is the site within 5 m of a highway or pedestrian right of way?	Yes – The site was adjoining North Hill.
12. Will the proposed basement be excavated under or adjacent to listed buildings?	Yes – The neighbouring building at 109 North Hill was recorded as a statutory Grade II Listed Building.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes – Basements were not present beneath all the neighbouring buildings, in particular beneath the Grade II Listed Building at 109 North Hill.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No – Underground infrastructures were not anticipated within the area of influence of the proposed development.

3.5 Summary

Based on the screening exercise, further stages of the basement impact assessment are required. A summary of the basement impact assessment requirements has been provided in Table 3.4, Table 3.5 and Table 3.6.

Table 3.4 – Surface Flow and Flooding Screening

Item	Description
Q2	Yes – The proposed basement could extend beyond the footprint of the existing building.
Q3	Yes – Impermeable areas will increase and attenuation methods will be installed, with surface water discharged to public sewer.
Q5	Yes – The site was recorded by the EA at medium flood risk from surface water.

Table 3.5 – Subterranean (Groundwater) Screening Assessment

Item	Description
Q1a	Yes – The BGS anticipated the presence of soils of the Claygate Member, which could be able to host local groundwater, perched over the London Clay Formation, which acts as an aquiclude. Information from the BGS boreholes showed that groundwater could be present.
Q1b	Unknown – Information from the BGS boreholes showed that groundwater could be present.
Q3	Yes – The proposed basement could extend beyond the footprint of the existing building.

Table 3.6 – Stability Screening Assessment

Item	Description
Q4	Yes – Average slope angles greater than 7° were observed to the east, at a distance of circa 100m from the property.
Q5	Yes – Soils of the Claygate Member, the youngest part of the London Clay Formation, were anticipated by the BGS.
Q7	Unknown – Anticipated geology was Claygate Member of the London Clay Formation. The London Clay Formation would potentially be subject to shrink-swell subsidence. There was no visual evidence of subsidence at the site or properties in the vicinity.
Q10	Yes – The BGS anticipated the presence of soils of the Claygate Member, which could be able to host local groundwater tables, perched over the London Clay Formation, which acts as an aquiclude. Information from the BGS boreholes showed that groundwater could be present.
Q11	Yes – The site was adjoining North Hill.
Q12	Yes – The neighbouring building at 109 North Hill was recorded as a statutory Grade II Listed Building.
Q13	Yes – Basements were not present beneath all the neighbouring buildings, in particular beneath the Grade II Listed Building at 109 North Hill.

Section 4 Scoping

4.1 Introduction

The purpose of scoping is to assess in more detail the issues of concern identified in the screening process (i.e. where the answer is “yes” or “unknown” to any of the questions posed) to be further investigated, mitigated or eliminated. Potential hazards are assessed for each of the identified potential impact factors.

The scoping stage is furthermore to assist in defining the nature of the investigation required to assess the impact of the issues of concern identified in the screening process. The scope of the investigation must comply with the prescriptions from the London Borough of Haringey, providing a suitable basis on which to assess the potential impacts.

4.2 Potential Impacts

The following potential impacts were identified in Table 4.1.

Table 4.1 – Potential Impacts

Screening Flowchart Question	Potential Impacts	Discussion
Is the site within a wider hillside setting in which the general slope is greater than 7°?	Basement excavation could destabilise the wider slope.	The existing development already included a basement of similar size to the proposed one, therefore the proposed development would not significantly alter the existing conditions. In addition, the proposal includes the installation of piled walls surrounding the basement, which must be designed to resist soil lateral pressure and avoid destabilising the slope. Effects mitigated at design stage.
Is the site in an area known to be at risk from surface water flooding?	Reduction of hard landscaping could increase surface water flooding risk.	The proposed development considered a slight increase of impermeable areas, but moreover the use of attenuation methods, with surface water discharged to public sewer. Surface water will be controlled by drainage. Effects mitigated at design stage.
Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Property damage due to surface water either in the form of flash flooding due to surface run-off, rising groundwater, inadequate drain/sewer capacity or inadequate drain/sewer maintenance.	
Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?		

Screening Flowchart Question	Potential Impacts	Discussion
Is the site located directly above an aquifer?	Basement could extend into an underlying aquifer and thus affect the groundwater flow regime.	The BGS anticipated the presence of soils of the Claygate Member (Secondary A Aquifer), which could host local groundwater perched above the London Clay Formation (Aquiclude). Water seeping through granular beds could enter the excavations during the construction phase and even during the lifetime of the structures. Appropriate mitigation measures for the ingress of water into basement excavations and then in the premises must be taken into account and designed by a specialist. Eventual alterations of the groundwater flow regime due to the construction of a basement could potentially cause the rise of groundwater levels to the upstream and a decrease to the downstream, favouring the ingress of water within the excavations or the premises. Ground investigation required to confirm site geology and monitoring of groundwater levels. Mitigation measures must be proposed at design stage.
Is the site within an aquifer?		
Will the proposed basement extend beneath the water table surface?	The proposed basement construction could require dewatering, which can cause ground subsidence. The proposed development could cause the alteration of an existing groundwater flow regime, which in turn could potentially cause local increase or decrease of groundwater levels.	
Is the London Clay the shallowest strata at the site?	Damage to foundation due to volume change potential.	Ground investigation to establish soil conditions and details of existing foundations by means of trial pits or boreholes. Effects mitigated at design stage.
Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	Changes to onsite vegetation could adversely affect foundations of adjoining structures.	
Is the site within 5 m of a highway or pedestrian right of way?	Excavation of a basement could result in structural damage to the roads/ footways or buried services.	Ground investigation to establish soil conditions. Effects mitigated at design stage.
Will the proposed basement be excavated under or adjacent to listed buildings?	Basement construction can result in undermining of foundations of neighbouring properties and cause excessive ground movements resulting in structural instability.	Basements were confirmed beneath some of the neighbouring buildings, but not under the neighbouring Grade II Listed Building at 109 North Hill. Foundations of neighbouring properties could range between 1.0m and 3.0m bgl. Ground investigation to establish soil conditions and foundation depth. Effects mitigated at design stage.
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?		

Section 5 Intrusive Investigation

5.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions and to aid the design of foundations for the proposed care home development. The intended investigation, outlined as Phase I within the Soils Limited quotation (Q24420 Rev.1, dated 29th September 2021), was to comprise the following items:

- 3No. up to 6.00m deep windowless sampler boreholes
- 1No. up to 10.00m deep dynamic probes, super heavy (DPSH)
- Installation of 3No. groundwater monitoring wells
- 8No. trial pits for foundation exposure up to 1.30m deep
- 1No. post site works groundwater level monitoring visit
- Geotechnical laboratory testing
- Contamination laboratory testing, including HazWaste classification

A second phase of the agreed investigation, named Phase II, will be undertaken at a later stage. No further reference to Phase II will be made within this report.

5.1.1 Actual Project Works

The actual project site works were undertaken between 18th and 29th October 2021, with subsequent sample logging, laboratory testing and reporting, and comprised:

- 3No. windowless sampler boreholes, 6.00m deep
- 3No. dynamic probes, super heavy (DPSH), 6.00m to 9.00m deep
- Installation of 3No. groundwater monitoring wells, 6.00m deep
- 8No. trial pits for foundation exposure, 0.30m to 1.30m deep
- 1No. post site works groundwater monitoring visit
- Geotechnical laboratory testing
- Contamination laboratory testing, including HazWaste classification

Three windowless sampler boreholes (WS1 – WS3) were installed with monitoring wells.

Eight trial pits (FE1 – FE8) were backfilled with arisings.

All trial hole locations have been presented in Figure 3.

Following completion of site works, soil cores were logged and sub sampled so that

samples could be sent to the laboratory for both contamination and geotechnical testing.

5.2 Ground Conditions

On 18th and 28th October 2021 three windowless sampler boreholes (WS1 – WS3) were drilled, using a Premier 110 Compact drilling rig, to a depth of 6.00m below ground level (bgl) at locations selected by Soils Limited using a development plan provided by the client.

Three standpipes were installed within the three window sample borehole locations to allow for continued monitoring of groundwater.

Three dynamic probes (DP1 – DP3), super heavy (DPSH), were driven prior and adjacent to their corresponding windowless sampler borehole to depths ranging between 6.00m (DP1 and DP3) and 9.00m bgl (DP2). The presence of obstructions did not allow further penetration at DP2 in order to preserve the safety of the operators.

Eight trial pits (FE1 – FE8) were hand excavated on 28th and 29th October 2021 to depths ranging between 0.30m (FE1) and 1.30m bgl (FE2 and FE3). The digging of trial pit FE1 was stopped at 0.30m bgl due to the presence of a reinforced concrete slab.

The maximum depths of the trial holes have been included in Table 5.1.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 5.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS1 (w)	6.00	FE1	0.30
WS2 (w)	6.00	FE2	1.30
WS3 (w)	6.00	FE3	1.30
DP1	6.00	FE4	1.10
DP2	9.00	FE5	0.60
DP3	6.00	FE6	1.25
		FE7	1.25
		FE8	1.00

Note: w - well installation

The approximate trial hole locations are shown on Figure 3.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised:

Made Ground (MG) Claygate Member (CLGB)

The ground conditions encountered in the trial holes are summarised in Table 5.2.

Table 5.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	GL	0.30 ¹ – 1.50	1.50	Soft to firm, greyish brown to brown slightly sandy, silty CLAY with concrete, clinker, brick, glass and flint gravel.
CLGB	Eocene	0.30 – 1.50	6.00 ¹ – 9.00 ¹	Not proven ²	Firm, orangish / yellowish / reddish / greyish mottled brown becoming brownish grey to grey, sandy, silty CLAY.

Note: ¹ Final depth of trial hole. ² Base of strata not encountered

5.3 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix A.1.

5.3.1 Made Ground

Soils described as Made Ground were encountered in all the trial holes from ground level to depths ranging between 0.30m (WS3 and FE1) and 1.50m bgl (WS1).

The Made Ground comprised soft to firm, greyish brown to brown slightly sandy, slightly gravelly, silty CLAY. Sand was fine to medium. Gravel was angular to sub-angular, locally rounded, fine to coarse, concrete, brick, clinker, glass and flint. Recovered as loose and re-worked. Occasional to frequent rootlets. Tarmac paving, concrete paving slabs and reinforced concrete slabs were often observed as part of the Made Ground within trial pits FE1 – FE8. The composition of the

Made Ground within the trial pits was very variable and also included brick rubble, brown to orange, coarse brown SAND and GRAVEL and very soft, dark grey to brown, very sandy CLAY with gravel to cobble sized sandstone, flint, brick and concrete.

The depths of Made Ground have been included in Table 5.3.

Table 5.3 Final Depth of Made Ground

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS1	1.50	FE1	0.30 ¹
WS2	0.50	FE2	1.30 ¹
WS3	0.30	FE3	1.30 ¹
		FE4	1.10 ¹
		FE5	0.60 ¹
		FE6	1.25 ¹
		FE7	1.25 ¹
		FE8	1.00 ¹

Note: ¹ Final depth of trial hole.

5.3.2 Claygate Member

Soils described as Claygate Member were encountered in all the three windowless sampler boreholes from directly below the Made Ground to the final investigated depth of 6.00m. Soils of the Claygate Member could not be encountered within the five trial pits because exceeding the final investigated depths.

The Claygate Member typically comprised firm, orangish/yellowish/reddish/greyish mottled brown becoming brownish grey to grey, sandy, silty CLAY. Sand was fine to medium and featured in frequent lenses and laminations. Localised, angular to rounded, flint gravel and fine to medium, gravel sized lignite inclusions. Roots and rootlets, both live and decomposing, frequently encountered to a maximum depth of 4.50m bgl.

The depth of Claygate Member has been included in Table 5.4.

Table 5.4 Final Depth of Claygate Member

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS1	6.00 ¹	FE1	-
WS2	6.00 ¹	FE2	-
WS3	6.00 ¹	FE3	-
		FE4	-
		FE5	-
		FE6	-
		FE7	-
		FE8	-

Note: ¹ Final depth of trial hole.

5.4 Roots

Roots / rootlets were encountered in six out of the eleven trial holes (WS1 – WS3, FE5, FE6 and FE8) at depths ranging between 0.50m (FE5) and 3.50m bgl (WS1).

Decomposing rootlets were also recorded within borehole WS1 to a maximum depth of 4.50m bgl.

The depths of root penetration have been included in Table 5.5.

Table 5.5 Depth of Root Penetration

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS1	3.50(4.50)	FE1	Not encountered
WS2	1.50	FE2	Not encountered
WS3	1.50	FE3	Not encountered
		FE4	Not encountered
		FE5	0.50
		FE6	1.20
		FE7	Not encountered
		FE8	1.00 ¹

Note: ¹ Final depth of trial hole. Depths in brackets are representative of decomposing rootlets.

Roots / rootlets may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

Borehole locations WS1 and WS2 were particularly close to the mature trees along the north boundary, as well as trial pit locations FE5 and FE8.

5.5 Groundwater

Groundwater was only encountered within two boreholes (WS1 and WS2) at the time of drilling and was struck at a depth of 3.00m bgl.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in October (2021), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September, towards the annual maximum (highest) elevation, which typically occurs around March.

Further groundwater monitoring was conducted within the standpipes installed on site following completion of site works and has been presented in Table 5.6.

Table 5.6 Groundwater Monitoring

Trial Hole	Well Depth (m bgl)	Depth to Water (m bgl) 29/10/2021
WS1	5.80	2.03
WS2	6.00 ¹	1.47
WS3	4.40	0.96

Note: ¹ Final depth of trial hole.

Groundwater equilibrium conditions may only be conclusively established, if a series of observations are made via groundwater monitoring wells.

5.6 Foundation Exposures

Foundations exposures were carried out in FE1 – FE8 at locations selected by Soils Limited and agreed with the Client prior to arriving to site. The full foundations sketched for FE1 – FE8 are presented in Appendix A.1.

5.6.1 Foundation Exposure FE1

Foundations were not encountered within location FE1. The excavation revealed a 0.15m thick tarmac layer overlying a 0.15m thick reinforced concrete slab. No further excavation was possible due to the presence of steel mesh and of an underground pipe. However, it was possible to observe that the concrete slab covered an underground service corridor, with brick walls extending to depths in excess of 3.00m bgl. The base of the brick walls could not be observed, but foundations are likely to be set on natural soils of the London Clay Formation.

5.6.2 Foundation Exposures FE2 and FE3

Foundations were not encountered within location FE2, with brick walls extending to depths in excess of 1.30m bgl. The hand dug pits could not safely be excavated below this depth without shoring.

5.6.3 Foundation Exposure FE4A and FE4B

Foundation exposure FE4 was undertaken at the corner of the building, therefore two foundation sketches were available, respectively identified as FE4A and FE4B and identified on the trial hole location plan in Figure 3.

In FE4A a stepped brick foundation, made up of 3No. steps each one extending out by 0.05m and 0.05m thick, was observed at a depth of 0.50m bgl. A concrete foundation was recorded beneath the brick steps at a depth of 0.65m bgl and extended out of the brick wall by 0.20m. The concrete foundation base was measured at 0.90m bgl, therefore set within the Made Ground.

In FE4B the brick wall was observed to a depth of 1.20m bgl, where a concrete foundation was recorded. The base of the foundation could not be identified, as the

concrete slab covered the entire width of the trial pit, therefore extended out of the brick wall by more than 0.30m.

5.6.4 Foundation Exposure FE5

The brick wall base enlarged at a depth of 0.20m bgl in the form of rough brick steps, which went down by further 0.20m. A stepped concrete foundation with rough finishing was observed underlying the brickwork. The first concrete step extended out from the brick wall by 0.27m and was 0.20m thick. The concrete base could not be observed because the foundation covered the entire width of the trial pit.

5.6.5 Foundation Exposure FE6

A concrete foundation was observed at a depth of 0.35m and extended out of the brick wall by 0.06m. The concrete foundation base was recorded at a depth of 1.20m bgl, therefore set within the Made Ground.

5.6.6 Foundation Exposure FE7

A concrete foundation was observed at a depth of 0.90m and extended out of the brick wall by 0.20m. The concrete foundation base was recorded at a depth of 1.20m bgl, therefore set within the Made Ground.

5.6.7 Foundation Exposure FE8

A concrete foundation was observed at a depth of 0.60m. It had an upper step, which extended out of the brick wall by 0.05m and was 0.05m thick. The lower step extended out by further 0.15m and was 0.25m thick. The concrete foundation base was recorded at a depth of 0.90m bgl, therefore set within the Made Ground.

Section 6 Discussion of Geotechnical In-Situ and Laboratory Testing

6.1 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at three locations (DP1 – DP3) adjacent and prior to the drilling of WS1 – WS3 to depths ranging between 6.00m (DP1 and DP3) and 9.00m bgl (DP2). The results were converted to equivalent SPT “N” values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Appendix B.1, Table B.1.1 and Table B.1.2.

The SPT “N60” values quoted within Table B.2.2, presented in Appendix B.2 and referred to within this report have been corrected in accordance with BS EN 22476 Part 3, to account for the rigs trip hammer efficiency, borehole depth, overburden factors etc. Further correction of the ‘N60’ values should therefore not be necessary. Raw field data is archived within the Soils Limited project file and can be provided on request. The energy ratio of the drilling rigs trip hammer efficiency was 82.11%. The energy ratio for each location is presented on the individual logs within Appendix A.1.

The cohesive soils of the Claygate Member recorded equivalent SPT “N60” values between 0 and 31, classifying the cohesive soils as extremely low to high strength and inferred undrained cohesive strength of <10kPa to 155kPa, generally increasing with depth.

A full interpretation of the DPSH tests are outlined in Appendix B.2, Table B.2.1.

6.2 Atterberg Limit Tests

Atterberg Limit tests were performed on four samples obtained from the Claygate Member. The results were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The cohesive soils of the Claygate Member were classified as medium to high volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the Atterberg Limit tests are outlined in Table B.2.2, Appendix B.2 and the laboratory report in Appendix B.3.

6.3 Sulphate and pH Tests

One sample was taken from the Made Ground (WS2: 0.30m bgl) and two from the Claygate Member (WS2: 2.10m bgl and WS3: 1.10m bgl) for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, ‘Concrete in Aggressive Ground’.

The tests recorded water soluble sulphate between <10mg/l and 21mg/l with pH values of 7.5.

The significance of the sulphate and pH test results are discussed in Section 7.4 and the laboratory report in Appendix B.3.

Section 7 Foundation Design

7.1 General

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the trial holes.

7.1.1 Made Ground

The terms *Fill* and *Made Ground* are used to describe material, which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:1986, Clause 2.2.2.3.5 Made Ground and Fill, includes the caveat that *'all Topsoil should be treated as suspect, because of the likelihood of extreme variability'*.

Soils described as Made Ground were encountered in all the trial holes from ground level to depths ranging between 0.30m (WS3 and FE1) and 1.50m bgl (WS1). The Made Ground comprised soft to firm, greyish brown to brown slightly sandy, slightly gravelly, silty CLAY. Sand was fine to medium. Gravel was angular to sub-angular, locally rounded, fine to coarse, concrete, brick, clinker, glass and flint. Recovered as loose and re-worked. Occasional to frequent rootlets. Tarmac paving, concrete paving slabs and reinforced concrete slabs were often observed as part of the Made Ground within trial pits FE1 – FE8. The composition of the Made Ground within the trial pits was very variable and also included brick rubble, brown to orange, coarse brown SAND and GRAVEL and very soft, dark grey to brown, very sandy CLAY with gravel to cobble sized sandstone, flint, brick and concrete. The depths of Made Ground have been included in Table 5.3.

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

7.1.2 Claygate Member

Soils described as Claygate Member were encountered in all the three windowless sampler boreholes from directly below the Made Ground to the final investigated depth of 6.00m. Soils of the Claygate Member could not be encountered within the five trial pits because exceeding the final investigated depths. The Claygate Member typically comprised firm, orangish/yellowish/reddish/greyish mottled brown

becoming brownish grey to grey, sandy, silty CLAY. Sand was fine to medium and featured in frequent lenses and laminations. Localised, angular to rounded, flint gravel and fine to medium, gravel sized lignite inclusions. Roots and rootlets, both live and decomposing, frequently encountered to a maximum depth of 4.50m bgl.

The results from DPSH testing inferred that the cohesive soils of the Claygate Member were of an **extremely low to high strength**, with undrained cohesions of between **<10kPa and 155kPa**, generally increasing with depth.

The results from Atterberg Limits tests confirmed that the cohesive soils of the Claygate Member had **medium to high volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the Claygate Member are overconsolidated and are expected to display moderate to high bearing capacities with low to moderate settlement characteristics. The soils of the Claygate Member were considered as a suitable foundation layer for the proposed development.

7.1.3 Roots

Roots / rootlets were encountered in six out of the eleven trial holes (WS1 – WS3, FE5, FE6 and FE8) at depths ranging between 0.50m (FE5) and 3.50m bgl (WS1). Decomposing rootlets were also recorded within borehole WS1 to a maximum depth of 4.50m bgl. The depths of root penetration have been included in Table 5.5.

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

7.1.4 Groundwater

Groundwater was only encountered within two boreholes (WS1 and WS2) at the time of drilling and was struck at a depth of 3.00m bgl. Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in October (2021), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September, towards the annual maximum (highest) elevation, which typically occurs around March.

Further groundwater monitoring was conducted within the standpipes installed on site following completion of site works and has been presented in Table 5.6. Groundwater equilibrium conditions may only be conclusively established, if a series of observations are made via groundwater monitoring wells.

7.2 Foundation Scheme

The proposed development considered the demolition of the existing building, the re-

planning of the entire property in order to maintain the existing broadly L-shaped layout, to improve the building functionality, to reduce the impact of the whole development and building mass, to provide an outlook from each resident bedroom and to ensure privacy to existing properties. The proposal included the demolition of the existing basement and the construction of a larger one to cover the maximum developable area, exceeding the footprint of the above ground floors, in particular within the main garden. The proposed basement formation level was anticipated by the Client's Engineers at a depth of circa 4.5m below ground level. Site drainage will include attenuation methods, not yet designed at current stage, with surface water discharged to public sewer.

In compiling this report reliance was placed on the Draft Conceptual Design Response for the Replacement of the Existing Building prepared by DWA Architects (London) Ltd and on drawings number 2021-0201 Rev.B to 2021-0206 Rev.B, dated 29th July 2021 and prepared by Elite Designers Structural Engineers. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plans provided by the client are presented in Appendix D.

7.2.1 Guidance on Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on 'best practice' for the design and construction of foundations on shrinkable soils.

The results from Atterberg Limits Tests showed that the cohesive soils of the Claygate Member had **medium to high volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

High volume change potential must therefore be adopted where foundations pass through the cohesive soils of the Claygate Member.

The BRE Digest 241 states: "An increasingly common, potentially damaging situation is where trees or hedges have been cut down prior to building. The subsequent long-term swelling of the zone of clay desiccated by the roots, as moisture slowly returns to the ground, can be substantial. The rate at which the ground recovers is very difficult to predict and if there is any doubt that recovery is complete then bored pile foundations with suspended beams and floors should be used".

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building. It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and cracking of brickwork might occur.

The BRE Digest 240 suggests: “Two courses of action are open:

Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.

Accept that swelling or shrinkage will occur and take account of it. The foundations can be designed to resist resulting ground movements or the superstructure can be designed to accommodate movement without damage.”

The design of foundations suitable to withstand movements is presented in BRE Digest 241 “Low-rise buildings on shrinkable clay soils: Part 2”

7.3 Foundation Scheme

Foundations **must not** be constructed within any Made Ground/Topsoil and Fill due to the likely variability and potential for large load induced settlements both total and differential.

Roots were encountered in six out of the eleven trial holes (WS1 – WS3, FE5, FE6 and FE8) at depths ranging between 0.50m (FE5) and 3.50m bgl (WS1). Decomposing rootlets were also recorded within borehole WS1 to a maximum depth of 4.50m bgl. If roots are encountered during the construction phase foundations must not be placed within any live root penetrated or desiccated cohesive soils or those with a volume change potential. Should the foundation excavations reveal such materials, the excavations **must** be extended to greater depth in order to bypass these unsuitable soils. Excavations must be checked by an experienced geotechnical engineer prior to concrete being poured.

Considering the type of development, a shallow foundation within the basement was considered the most suitable solution.

The proposed development is likely to be both light and brittle. It is therefore considered that foundation design is undertaken using NHBC Standards Chapter 4.2.

7.3.1 Shallow Foundations within Basement

Foundations constructed within the basement excavation could be considered and the bearing capacity of such foundations is given below. If the foundation is to include lateral load from retained soil, then the distribution of loads on the foundation will be trapezoidal and the maximum pressure will be at the toe of the foundation. In such cases additional analyses must be requested by the client such that the appropriate analyse is undertaken.

If the wall is to have backfill placed on both sides, the backfill must be placed in shallow rises on both sides to maintain similar lateral forces on both sides of the wall.

A proposed basement excavation 4.50m deep would remove an overburden pressure of 85kPa, based on a unit weight of circa 19kN/m³, for the overlying soil.

An “**net**” allowable bearing capacity of **110kPa** was calculated, founding at a minimum depth of 4.50m bgl within the Claygate Member, based on a 5m by 0.75m strip foundation.

Taking account of the removed overburden pressure the “**gross**” bearing value could be taken as **195kPa**.

For the allowable bearing value given above, settlements **should not** exceed **25mm**, provided that excavation bases are carefully bottomed out and blinded, or concreted as soon after excavation as is possible and kept dry. Settlements may be taken as proportional to the applied foundation pressure for the given size of the foundations.

The use of reinforced trench fill foundations must be used to reduce the potential of differential settlement across foundations, which was anticipated to be up to 10mm.

Settlements may be taken as proportional to the bearing capacity given for the same configuration of foundation i.e. halving the load the settlements would halve.

Special care **must** be taken during foundation excavation in order to establish that any soft/loose spots found within the soils are removed from the base of excavations.

Foundations must not be cast over foundations of former structures and other hard spots.

7.3.2 Basement and Stability Requirements

This report comprises a basement impact assessment (BIA) and calculations of the impact of the proposed works on the surrounding ground and/or structures was provided in Section 9 and Section 10. The following comments are of a very general non-specific nature.

The excavation of the proposed basement was estimated at 4.50m bgl. Groundwater was encountered at a minimum depth of 0.96m bgl during monitoring operations.

Groundwater levels could rise, particularly after prolonged periods of wet weather.

If the construction works take place during the winter months or during/after prolonged periods of wet weather perched water could accumulate or groundwater could be found migrating through more granular beds of the Made Ground and of

the Claygate Member. If any water ingress is not prevented by dewatering, the basement slab could become “buoyant” whilst empty. This must be taken into account in the design. Support of excavation and dewatering with pumps from sumps introduced into the floor of the excavation must be considered.

In the absence of robust long-term groundwater monitoring data from the well installed, full hydrostatic pressure (worst credible case) **must** be taken into account for the design of the proposed basement slab/walls or the worst credible levels as defined by EC – 7.

7.3.3 Stability Issues

The excavation of the basement **must not** affect the integrity of any adjacent land or structures beyond the site boundaries. Where there is a sufficient distance between the site boundary and the basement excavation, support may be permitted using a strip foundation to form an earth retaining structure. In other cases, the most suitable form of construction should be within a coffer dam structure using a sheet piles, secant or contiguous concrete piled wall around the periphery of the structure.

Generally cantilevered piled walls have an open face to embedded ratio of about one to two i.e. a supported face 4.50m in height would require a penetration into the ground, below the base of the excavation, of about 9.00m. Should the piled wall be purely an unsupported cantilever then it is likely that quite deep section sheet piles or large diameter bored piles would be required. Installing a braced waling to the wall could reduce the sheet section, or diameter of the piles.

Given the size of the site, the distance from the neighbouring properties and considered the demolition of the existing buildings, basement construction methods could include excavations retained by traditional retaining walls and/or by piled walls.

The use of a contiguous piled wall, however, is considered the most suitable solution and was already considered by the Client’s Engineers as the preferred solution, as presented on the drawings prepared by Elite Designers.

7.4 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class **DS-1** of the BRE Special Digest 1 2005, ‘Concrete in Aggressive Ground’. Table C2 of the Digest indicated ACEC (Aggressive Chemical Environment for Concrete) site classifications of **AC-1**. The pH of the soils tested was measured as 7.5. The classification given was determined using the mobile groundwater case, in the view of groundwater flowing within granular beds of the Claygate Member. The laboratory results are presented in Appendix B.3.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, '*Concrete in Aggressive Ground*' taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

7.5 Excavations

Shallow excavations in the Made Ground/Topsoil and Claygate Member are likely to be marginally stable in the short term at best.

Deeper excavations taken into the Claygate Member are unlikely to be stable in both the short and the long term and must be retained. Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose.

Excavations beneath the groundwater table are likely to be unstable and dewatering of foundation trenches may be necessary.

Section 8 Basement Impact Assessment

8.1 Mitigation of Adverse Effects

This section of the report addresses the potential impacts identified by the scoping study and the relevant findings of the ground investigation and mitigation measures, where required.

8.1.1 Groundwater Flooding

Is the site located directly above an aquifer?

And

Is the site within an aquifer?

And

Will the proposed basement extend beneath the water table surface?

Potential Impacts: Basement could extend into an underlying aquifer and thus affect the groundwater flow regime.

The proposed basement construction could require dewatering, which can cause ground subsidence.

Alteration of an existing groundwater flow regime, which in turn could potentially cause local increase or decrease of groundwater levels.

Ground Investigation Findings: The site investigation showed the proposed development to be set into the soils of Claygate Member. The Environment Agency classified the Claygate Member as a Secondary A Aquifer, therefore able to supporting local water supplies from groundwater tables perched over the underlying London Clay Formation, which acts as an aquiclude.

The soils of Claygate Member at this specific site, however, were identified as predominantly cohesive, with sandy fraction featured in pockets, partings, laminations and lenses.

Groundwater was encountered during monitoring at depths able to interact with basement excavation and construction and also with the structures during their lifetime.

A basement was already present at the site and further basements were likely present beneath some of the neighbouring buildings.

Mitigation: Dewatering is likely to be required to minimise the likelihood of constructing below groundwater levels.

In the short-time, water entering the excavations must be pumped out on a local basis, to allow a safe and comfortable development. In the long-term, the premises must be waterproofed and provided with pumps immersed into sumps. The pumping of water in both the short and the long term must not be intended as a dewatering exercise and no lowering of the groundwater table must be caused, if present, as this could induce the triggering of consolidation phenomena and the development of uncontrolled settlements in cohesive deposits within the wider area.

To minimise the risk of flooding from sewers during severe rainfall events the premises must be provided with anti-return valves and/or positive pumped devices.

8.1.2 Surface Water Flooding

Is the site in an area known to be at risk from surface water flooding?

And

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

And

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

And

Will the proposed basement extend beneath the water table surface?

Potential Impacts: Reduction of hard landscaping could increase the surface water flooding risk.

Property damage due to surface water either in the form of flash flooding due to surface run-off, rising groundwater, inadequate drain/sewer capacity or inadequate drain/sewer maintenance.

Ground Investigation Findings: The site was recorded at risk of surface water flooding. The proposed development considered an increase in impermeable areas, the use of attenuation measures and the collection of surface water into public sewer in main road.

Mitigation: Dewatering is likely to be required to minimise the likelihood of constructing below groundwater levels and premises to be actively and passively protected during their lifetime. The proposed development, however, was understood to reduce the risk of flooding from surface water and the use of attenuation measure was anticipated. Details of the proposed drainage scheme to be provided are to be provided by the drainage engineer. Details of dewatering and active and passive protection to comply with information in paragraph 8.1.1.

8.1.3 Shrink-Swell Subsidence

Is the London Clay the shallowest strata at the site?

And

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

Potential Impacts: Damage to foundation due to volume change potential.

Changes to vegetation on site could adversely affect foundations of adjoining structures.

Ground Investigation Findings: Predominantly cohesive soils encountered at the site. High volume change potential to be considered for design purposes for the soils of the Claygate Member. The Client's Consultants did not inform Soils Limited of any tree felling/pruning activities as part of the proposed development.

Mitigation: Basement structures to be designed according to high volume change potential, in accordance with the relevant BRE Digest 240 and NHBC Standards, Chapter 4.2. Changes to vegetation onsite and in the immediate surroundings must be avoided to avoid uncontrolled soil rehydration and consequential heave. Site drainage must prevent leakage of water through the ground, as this could cause soil rehydration and consequent swelling. Similarly, water storage (e.g. for attenuation tanks), foul drains, collected surface water and the like must be brought off-site and leakages must be avoided and promptly repaired.

8.1.4 Stability of Neighbouring Highways

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

Potential Impacts: Excavation of a basement could result in structural damage to the roads/ footways or buried services.

Ground Investigation Findings: A basement was already present at the site.

Mitigation: Design of permanent and/or temporary works to ensure induced ground movements are within tolerable limits and temporary works to prevent damage during construction.

8.1.5 Land and Structural Stability

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

And

Will the proposed basement be excavated under or adjacent to listed buildings?

And

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

Potential Impacts: The proposed development could destabilise the wider area and cause damages to the surrounding structures, with particular reference to neighbouring Listed Buildings.

Ground Investigation Findings: Predominantly cohesive soils encountered at the site. The existing building already had a basement underneath and some of the neighbouring structures were understood to have basements.

Mitigation: Overall, the presence of existing basements would suggest that the proposed development would not significantly alter the stability of the site. The construction must consider well established procedures, to be developed according to specifically designed interventions. The potential damage to surrounding buildings must be evaluated on the basis of a Ground Movement Assessment developed according to the procedures reported in CIRIA C760.

8.2 Cumulative Effects

Consideration must be given to the potential development of cumulative effects on shallow groundwater due to the presence of further basements surrounding the proposed one, as this could cause the rise of groundwater to the upstream and the lowering to the downstream of the basement (“damming effect”).

Although some of the neighbouring buildings were understood to have basements underneath, the distance from them would suggest that the proposed basement could be considered as substantially isolated and not interacting with them to potentially cause the rise of groundwater levels to the upstream. In addition, a basement was already located under the existing building, therefore the proposed development would not significantly change the existing conditions.

Finally, the soils encountered at the site were predominantly cohesive, with more granular fraction featured in pockets, partings, laminations and lenses. Similar ground conditions are not considered likely to be the seat for significant groundwater flows. Eventual groundwater flows would be extremely low to very low velocity and groundwater rise minimal even in the case of cumulative effects.

8.3 Surrounding Buildings

This section considers the potential effects of basement construction on nearby properties.

Detrimental effects would be manifested as cracking and more serious structural damage. Many old buildings in do exhibit signs of historic movement and repair. In practice, it is often difficult to attribute cracks visible in a structure to specific site construction activities unless a detailed survey of the affected structure and its founding strata had been undertaken before the construction works.

Any observed changes in the state of the building can then be causally linked to the works with more confidence and less debate than if no pre-works condition survey had been undertaken. Surveys require the cooperation of the property owners, as entry by surveyors into the property will be necessary. This would normally be undertaken in collaboration with the neighbour's party wall surveyors.

Close supervision will be made during the construction phase. Movement monitoring of neighbouring and nearby structures will be undertaken before construction starts and continued through the construction phase and for an appropriate period thereafter.

The data from the site investigation has established soil and groundwater conditions. The Client's Engineers can prepare working drawings and construction method statements that will mitigate adverse effects of nearby properties.

Section 9 Ground Movement Assessment

9.1 Introduction

This section provides calculations to determine ground movements that may result from the construction of the basement level and to assess how these may affect the conditions of neighbouring buildings. Movements are likely to occur through the following mechanisms:

9.1.1 Heave Movements

The excavation was anticipated to be developed within predominantly cohesive soils of Claygate Member. The unloading of the Claygate Member may cause a degree of heave and/or settlement after construction, depending on the final ground loading.

9.1.2 Settlement Movements

The imposition of loads on the new foundations, if in excess of the existing load on the ground will result in settlement of the foundations.

9.1.3 Foundation Construction

Construction of foundations can lead to movements due to retaining wall construction and net increase in loading.

The nature of final movements depends on the level of loading achieved. Downwards movements (settlements) must be expected when the applied load is greater than the weight of soil removed. On the contrary, a certain degree of heave will remain in the long term when the applied load is lower than the weight removed. Settlement may potentially also occur where foundation loads are transferred to deeper, previously unloaded soil.

Where foundations are not shared, or the properties linked, workmanship will not affect the adjoining structure and will not be considered within the ground movement analysis.

9.2 Site Model and Mechanical Properties

For the purpose of this BIA, a thickness of 1.50m of Made Ground was conservatively assumed at the site. The Made Ground was considered as predominantly cohesive.

The proposed basement was considered set within the underlying predominantly cohesive soils of the Claygate Member. Considering the results of Atterberg Limit Tests, high volume change potential was considered for the Claygate Member and assumed in the analyses in order to comply with potential risk of subsidence related to soil volume change potential, in agreement with BRE Digest 240 and NHBC Standards Chapter 4.2.

Groundwater was recorded within the boreholes at the time of drilling and measured at a minimum depth of 0.96m bgl on the occasion of the agreed monitoring visit, therefore above the proposed basement formation level of circa 4.50m bgl. Considering the results of the intrusive investigation, with the soils of the Claygate Member encountered as predominantly cohesive and with discontinuous granular beds, and the contents of the preliminary flood risk assessment in paragraph 2.9, the presence of proper groundwater table was considered unlikely. However, the observations from monitoring cannot be discarded and the presence of groundwater, being perched or the actual groundwater table, must be considered. For the purpose of this Basement Impact Assessment and subsequent Ground Movement Assessment, however, analyses were carried out considering groundwater at ground level to maximise ground movements and effects on the surrounding buildings. This therefore represent a conservative approach. Should further groundwater monitoring visits be required, they can be undertaken within the installed monitoring wells, but it must be clear that the worst-case scenario was already considered and more detailed information can only be intended to improve the expected ground movements.

The mechanical parameters to be adopted for the analyses under undrained and drained conditions were respectively presented in Table 9.1 and Table 9.2.

Table 9.1 – Soil Parameters – Undrained Conditions

Stratum	Depth to Top of Stratum (m bgl)	Undrained Cohesion (kPa)	Young's Modulus (MPa)	Poisson's Ratio
MG	0.00	20	6	0.50
CLGB ¹	1.50	40	10	0.50
CLGB ²	4.50	70	42	0.50

Note: ¹ Above basement formation level. ² Below basement formation level.

Table 9.2 – Soil Parameters – Drained Conditions

Stratum	Depth to Top of Stratum (m bgl)	Friction Angle (ϕ°)	Effective Cohesion (kPa)	Young's Modulus (MPa)	Poisson's Ratio
MG	0.00	20	0	4.5	0.35
CLGB ¹	1.50	22	0	7.5	0.35
CLGB ²	4.50	22	0	31.5	0.35

Note: ¹ Above basement formation level. ² Below basement formation level.

9.3 Ground Movement Arising from Basement Excavation

Ground movements at the proposed basement formation level will be caused by building demolition, excavation for reaching the desired depth and backfilling of the previously excavated areas external to the footprint of the proposed building. Building loads will be then applied at foundation formation level.

Following to consultation with the Structural Engineers, the stress relief caused by building demolition (unfactored) in correspondence of the four storey was estimated as dead load (DL) of 85kPa plus 15kPa live load (LL). The stress relief under the rest of the demolished building was estimated as 45kPa (dead load) plus 18kPa (live load). The mentioned loads were considered applied to 1.0m wide foundations.

The existing building had a lower ground floor, 2.40m deep, under the four storey section and undercroft space (circa 1.30m deep) underneath the rest of the building. The formation level was estimated circa 0.50m below lower ground floor finished floor level. Stress relief will be caused by the excavations to achieve a final excavated depth of 4.50m bgl and has been estimated as circa 30kPa under the four storey section and as circa 50kPa under the rest of the building, assuming an average soil unit weight of 18kN/m³ for the above soil. The proposed basement, however, will extend beyond the footprint of the existing building and, therefore, include areas with 4.50m deep excavations. The stress relief in those areas could be estimated as circa 80kPa. Differential heave and settlements could therefore develop especially at the junction between the portions of the buildings having different depths, which must be specifically designed out.

Some areas within the footprint of the existing building will be backfilled to match the surrounding ground level. The backfill load was evaluated as circa 35kPa considering the average soil unit weight of 18kN/m³.

The proposed structural scheme will consider the demolition of the existing building and the installation of a contiguous piled wall, with piles 450mm in diameter at 550mm centres. The piles will be used for retaining the excavations and as foundations for the building loads. Pile length will be derived from specific pile design, however, for the purpose of this BIA it was estimated as not less than 15.0m bgl, in order to allow the transmission of building loads to soil strata of suitable mechanical behaviour. The final pile length, however, will be defined by means of specialist design.

The proposed building loads applied to the contiguous pile wall were not yet available. Reasonable values were estimated by the Structural Engineers as presented in Figure 17 and ranged between 150kN/m (DL) plus 35kN/m (LL) and 270kN/m (DL) plus 95kN/m (LL). Pile behaviour was assumed to bear the mentioned loads by 40% using base resistance and 60% for shaft resistance.

A ground movement assessment has been undertaken using OASYS Limited PDISP (Pressure induced DISplacement analysis) analysis software. PDISP assumes that the ground behaves as an elastic material under loading, with movements calculated based on the applied loads and the soil stiffness (E_u and E'_v) for each stratum input by the user. PDISP assumes perfectly flexible loaded areas and as such tends to overestimate movements in the centre of loaded areas and underestimate movements around the perimeters. Strip footing, therefore, were considered in the analysis. In the case a different solution is adopted within the final design the ground movement assessment must be edited accordingly.

Excavations will take place within the predominantly cohesive soils of the Made Ground and of the Claygate Member. The mechanical properties of the soils involved in the analyses were defined in Table 9.1 and Table 9.2 of this report.

The neighbouring structures could be subjected to ground movements induced by demolition, retaining structure installation, basement excavation and application of the proposed building loads. The most sensitive building, as well as the closest one to the excavation, was the listed building at 109 North Hill. This was considered as the worst case scenario for the development of the Ground Movement Assessment (GMA) and the undertaking of the Damage Category Assessment (DCA) using the approach on CIRIA C760 and the Burland scale.

Critical scenario SC1, therefore, considered the effects of excavation and construction on the neighbouring building at 109 North Hill. The mentioned properties were separated by a distance of circa 2.08m, as observed on the Council's website from documents prepared by DWA Architects. The building at 109 North Hill was considered circa 5.35m wide. This length will be considered as the critical distance for the undertaking of the DCA.

Ground movements will not derive from workmanship error, as the construction method will not include the application of dry pack.

The structural details of the retaining structure and of the temporary works were not available at current stage. The construction sequence considered the installation of temporary props to prevent the development of ground movements and the application of permanent propping at the top and the base of the excavation, using beams applied at basement and ground floor slabs. This scheme is therefore considered characterised by "high stiffness" in agreement with the definition in CIRIA C760. The second moment of inertia for the undertaking of the GMA was evaluated as 365,794cm⁴. Loads can be applied to the piles only after the concrete has reached a prescribed strength or when the Structural Engineers specify.

It is the Client's responsibility to provide information on eventual changes to the layout and structural characteristics of the basement. Soils Limited must be immediately informed of any changes, as this could potentially invalidate the results of this Basement Impact Assessment.

Horizontal deflection at critical section SC1 should be calculated using 4.50m high basement walls, with the deflection caused by the excavation of 1.60m of soil, due to the presence of a 2.40m deep lower ground floor and 0.50m thick slab underneath. However, for the purpose of this GMA, the horizontal deflection was conservatively evaluated considering full depth excavation, with the removal of 4.50m of soil. The excavations from the existing ground floor level (from ground level in the GMA) to the proposed basement formation level must be carried out by retaining the passive resistance of the soils in place, with permanent propping considered applied at basement

and ground floor slab levels. Permanent propping must then be reinstated before removing the temporary one.

An accurate monitoring of ground and structural movements is recommended before, during and for a certain period after the completion of the construction process to avoid exceeding the movements presented in this report and allow the eventual design of remedial measures. If a different construction process is adopted, Soils Limited must be immediately informed and a reassessment of ground movements and expected damage on neighbouring structures must be carried out.

Horizontal movements rapidly dissipate with the distance from the excavation. The calculated horizontal movements were evaluated in correspondence of the section of maximum vertical deflection using information from Figure 6.15 of CIRIA C760.

The critical section considered in scenario SC1 was presented in Figure 18 and chosen in order to maximise the calculated damage category.

9.3.1 Short Term Heave

Calculated short term heave, due to the removal of soils above the formation level, was evaluated by adopting the parameters in Table 9.1 and intended as deriving from the unloading of the soils of the Claygate Member.

The largest short-term heave across the footprint of the proposed development was predicted to be of a maximum of -18mm (negative values indicate an upwards movement throughout this text). The movement decreases towards the boundaries of the excavation, along the boundary lengths of the basement. Heave was noted to occur within these areas ranging between -14mm and -4mm due to the net increase of surcharge load. A contour plot showing the variation of short-term movements across the entire basement footprint is presented in Figure 19, which showed that ground movements reduce to zero within 10m from the excavation.

9.3.2 Long Term Ground Movement

Long term movements generally depend on the development of the increase of heave (negative settlements) in the long-term due to the reduction in stiffness of the soils, with the dissipation of negative pore-water pressures, and the development of (positive) settlements due to the construction of the basement and the application of the loads from the upper structure to greater depths. Those movements develop contemporarily and generally cannot be distinguished, but an evaluation of the long-term heave, as independent values, was also reported for completeness on the contour plot in Figure 20. The maximum expected heave was calculated as circa -34mm and was caused by the high stress relief caused by 4.50m deep excavations. Ground movements dissipated to zero within <15m from the excavation.

The maximum overall long-term ground movements under the proposed building footprint were calculated as of a maximum of -34mm (residual upwards movement

due to applied load lower than the weight removed). Movements along the excavation boundaries ranged between -20mm and -6mm. A contour plot with the variation of long-term movements across the basement footprint is presented in Figure 21, which showed the ground movements reducing to zero within <15m from the excavation.

The above ground movements were cumulative and, therefore, included long-term heave and settlements caused by the structural loads. For the purpose of the GMA, however, the settlements caused by the structural loads were evaluated separately from the contribution of heave to maximise the effects on the neighbouring buildings and the vertical deflection. A contour plot with the variation of the ground movements induced by the application of the sole structural loads is presented in Figure 22, which showed maximum ground movements of <12mm in correspondence of the piled wall. The ground movements reduced to zero within <10m from the excavation.

9.3.3 Settlements Due To Workmanship

Settlements due to workmanship error, particularly with underpinning works, were not considered in this assessment, as the proposed construction did not consider the application of dry pack because of the complete demolition of the existing building.

9.4 Ground Movement Due to Retaining Wall Lateral Deflection

The excavation of the proposed basement will comprise the construction of retaining structures to preserve the stability of soils and of neighbouring structures. The excavations would be taken down to circa 4.50m. It must be noted that the existing basement formation level in correspondence of critical scenario SC1 was already at a depth of 2.40m bgl plus circa 0.50m of basement floor slab and concrete levelling. Lateral wall deflection at SC1, therefore, will be due to the removal of circa 1.60m of soil to the passive side of the wall. However, for the purpose of this GMA, the horizontal deflection was conservatively evaluated considering full depth excavation, with the removal of 4.50m of soil. The estimation of horizontal deflection considered that no basement was present under the neighbouring building at 109 North Hill.

The lateral wall deflection in the case of full depth excavation was calculated as circa 4mm in correspondence of the retaining structure. The basement walls were considered surcharged by the foundation loads of the neighbouring building, considered equal to 100kPa and located at a distance of 2.08m from the outer face of the excavation and applied at a depth of not less than 1.00m bgl. A further surcharge of 10kPa was also considered applied at ground level for taking into account the development of daily activities and eventual traffic loads.

Horizontal movements rapidly dissipate with the distance from the excavation, as presented in CIRIA C760, Figure 6.15. Based upon the plot for high stiffness structures, horizontal movements experience a linear reduction, becoming negligible at a distance of

4 times the maximum excavated depth. The horizontal movements at SC1 were therefore estimated as circa 3.2mm in correspondence of the section of maximum vertical deflection, located at a distance of 4m from the excavation as presented in Figure 23, i.e. 80% of the calculated value.

It is the Client's responsibility to provide information on eventual changes to the layout and structural characteristics of the basement. Soils Limited must be immediately informed of any changes, as this could potentially invalidate the results of this Basement Impact Assessment.

The analyses were developed considering information provided or discussed with the Client with regards to the final building layout, to construction sequence and loads. The results are therefore site specific and provide ground movements to be considered as limit values for a satisfactory development and must not be exceeded.

Different solutions could be adopted by the structural consultants or the contractor, but it is recommended to undertake the monitoring of ground and structure movements before, during and after the construction in order to avoid the limit values to be exceeded. Soils Limited must be immediately notified in the case of unexpected large movements, or movements in excess of those presented within this report.

Horizontal deflections were calculated using the dedicated software Wallap by Geosolve. The maximum calculated horizontal deflections were therefore not greater than 3.2mm for scenario SC1.

The movements calculated for scenario SC1 were summarised within Table 9.3 and the related ground movements identified on Figure 23 and Figure 24.

Table 9.3 – Summary of Estimated Movements

Scenario	Critical Distance (m)	Horizontal Deflection (mm)	Vertical Deflection (mm)
SC1	(2.08) + 5.35	3.2	1.0

Note: The distance in bracket represents the distance between the excavation and the closest point of the critical section.

Section 10 Damage Category Assessment

10.1 Introduction

The ground movements reported in Section 9, from both the detailed and the simplified approaches, were considered for assessing the expected potential damage category that the construction of a new basement was supposed to induce onto the adjoining properties. The assessment was carried out considering the method described in CIRIA Special Publication 200 (Burland et al., 2001) and CIRIA C760 (Gaba et al., 2017), based upon the method proposed by Burland et al. (2001) and taking into account the works by Burland and Wroth (1974) and Boscardin and Cording (1989).

The general categories of damage entity were summarised in Table 10.1.

Table 10.1 – Classification of Visible Damage To Walls

Category	Description
0 (Negligible)	Negligible – hairline cracks
1 (Very slight)	Fine cracks that can easily be treated during normal decoration (crack width <1mm)
2 (Slight)	Cracks easily filled, redecoration probably required. Some repointing may be required externally (crack width <5mm)
3 (Moderate)	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced (crack width 5 to 15mm or a number of cracks > 3mm).
4 (Severe)	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows (crack width 15mm to 25mm but also depends on number of cracks).
5 (Very severe)	This requires a major repair involving partial or complete re-building (crack width usually >25mm but depends on number of cracks).

10.2 Summary of Ground Movements and Evaluation of Relative Deflection

The analysis of the ground movements reported in Section 9 allowed to estimate the relative vertical and horizontal deflections on the property to the north of the building for the proposed development (SC1, 109 North Hill).

The results of the assessment carried out using PDisp and Wallap were reported within Table 10.2 and on Figure 25, that defined the expected damage categories on the neighbouring structures according to the classification by Burland (2001) reported within CIRIA SP200 and CIRIA C760.

Table 10.2 – Expected Damage Category

Section	Critical Distance (m)	Horizontal Deflection (mm)	Vertical Deflection (mm)	Horizontal Strain ϵ_h (%)	Deflection Ratio Δ/L (%)	Damage Category
SC1 (detailed)	(2.08) + 5.35	3.2	1.0	0.060	0.019	1 (Very Slight)
Note: The distance in bracket represents the distance between the excavation and the closest point of the critical section.						

The general approach from London Boroughs is to consider valid proposed developments inducing expected damage categories not greater than Category 2 (slight). However, when the expected damage exceeds a category damage 1 (very slight), mitigation measures must be applied in order to reduce this to a potential category damage 0 (negligible) to preserve the existing buildings, generally identified as brittle and extremely sensitive to ground movements. When suitable mitigation measures are applied, a further assessment must be carried out to confirm the improvement.

The analyses were developed considering the information provided by or discussed with the Client's Engineer with regards to the final building layout, to construction sequence and loads. The results are therefore site specific and provide ground movements to be considered as limit values for a satisfactory development and must not be exceeded.

Different solutions could be adopted by the structural consultants or the contractor, but it is recommended to undertake the monitoring of ground and structure movements before, during and after the construction in order to avoid the limit values to be exceeded or to eventually put in place suitable remedial measures. Soils Limited must be immediately notified in the case of unexpected large movements, or movements in excess of those presented.

The above was specifically determined for the case considered and can be invalidated if changes in the layout, structural characteristics or construction sequence are applied. In addition, the time between bays excavation, shoring and wall sections casting must be minimised to avoid the development of drained conditions.

10.3 Monitoring of Ground and Structures

Anticipated ground movements are expected to be minimal and suppressed by the stiffness of the above structure and those adjoining. It is recommended to appoint a specialist Surveyor for monitoring ground and structural movements at regular intervals to confirm limits presented in this report are not exceeded.

Movement monitoring of the property itself and nearby structures within a radius of 20m must be undertaken before construction starts, continued through the construction phase and for an appropriate period thereafter. The Surveyor will be required to monitor ground movements to check the validity of the ground movement analysis, the performance of the temporary works and working methods adopted by the chosen Contractor.

The proposed monitoring should also include:

- Visual inspection of relevant walls with a condition survey produced of each wall prior to work commencing
- vertical movement of each wall should be monitored using at least standard optical equipment

- lateral movement should be measured using laser systems

A traffic light system based on green, amber and red trigger levels must be set in order to confirm the total ground movements and deflections presented throughout this BIA will not be exceeded, with specific actions to be taken in function of the measured movements.

Soils Limited must be immediately notified in the case of unexpected large movements, or movements in excess of those presented. A reassessment of ground movements and expected damage to neighbouring structures should be then carried out to take into account evidence from construction stage.

Section 11 Conclusions and Recommendations of BIA

11.1 General

The findings of this report are informed by site investigation data and information regarding construction methods, sequence and loading provided by the client. The analysis is undertaken on the assumption of high quality workmanship.

Groundwater levels were recorded at depths able to interact with the excavation and construction of the proposed basement development. Groundwater could enter the excavations during excavation and construction stages and could require the localised use of pumps. This must be carried out on a local basis to avoid effects on the surrounding groundwater table, which could trigger consolidation phenomena and the uncontrolled development of ground movements.

Foundations must be constructed in accordance with a high volume change potential when passing through the Claygate Member, in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

An appropriate monitoring regime must be adopted to manage risk and potential damage to neighbouring structures, during construction onsite.

The basement construction is unlikely to act as a barrier to the groundwater flow, due to the reasons presented in paragraph 8.2. Groundwater flows could be channelled within granular beds, which could require dewatering, but should be discontinuous and not related to the presence of free flowing groundwater, as per the results of the intrusive investigation. Cumulative effects were therefore considered as negligible.

The permanent works must be designed to ensure induced ground movements surrounding the site are within tolerable limits and temporary works sufficiently design to prevent damage during construction. It was recommended monitoring of surrounding structure was undertaken before, during and for a certain period after the completion of the construction works.

Overall, it was considered the proposed development would have a limited impact on neighbouring properties provided a suitable basement construction was selected. This BIA was developed with reference to the information provided by the Client's Engineers within the Structural Engineer Statement presented in Appendix D. Soils Limited must be promptly informed in the case of different solutions be designed by the chosen contractor, as this could require the BIA to be redeveloped.

11.2 Non-Technical Summary

As the construction of basements in Central London becomes more frequent, the London Borough of Camden developed a procedure for the authorisation of the construction

based upon a series of stages for the estimation of the impact of the basement construction on the built environment.

A Basement Impact Assessment (BIA) must comprise five main stages:

1. Screening
2. Scoping
3. Site Investigation and study
4. Impact Assessment
5. Review and decision making

The screening stage was based on a series of queries regarding issues as groundwater flow, land stability and surface flow and flooding and related flowcharts allowing to clarify if the development of a full BIA was needed. The latter was considered as necessary and presented throughout this report.

The scoping stage was intended to evaluate the potential impact of the proposed scheme on the built environment in the surroundings sites.

The site investigation and study were intended to determine an understanding of the site and of its immediate surroundings. The understanding should also be based on the results of the screening and scoping stages, but in general comprises a desk study, site walkover, field investigation (including intrusive investigation), monitoring, reporting and interpretation. The site investigation must be able to determine the ground model to be used for further stages of the development of the site.

The basement impact assessment (BIA) was carried out as the proposed development introduced a considerable increase in the differential depth with regards to the foundations of the neighbouring buildings.

No basements were present underneath the neighbouring building at 109 North Hill. Cumulative effects on the rise of groundwater levels because of “damming effects” are considered as negligible due to the geometry of the development, the low permeability of the predominantly cohesive soils of Claygate Member and the distance to neighbouring buildings. In addition, the basement would be isolated and not part of a system of basements, therefore eventual flows could develop both around and beneath the structures in the eventual presence of more permeable beds of the Claygate Member.

The excavation and construction of the basement could potentially induce the development of damages on the neighbouring building due to the development of ground movements remote from the development site. The expected damage, however, was estimated to fall within the acceptable limits of Burland’s category 1 (very slight damage) fixed by the Council.

The geotechnical parameters of the soils involved in the development were evaluated on the basis of the results of the site investigation and compared with published data.

The geometry of the proposed development was provided by the Client and the loads considered with reference to the calculated bearing capacity. The reduction in load at formation level due to the removal of soils was calculated by applying the soil densities derived from the site investigation to the removed volume of soil derived from the geometry of the development.

The calculated ground movements, therefore, must be considered as limit values for a satisfactory development and must not be exceeded. Soils Limited must be immediately informed in case of changes to basement geometry and loads, as well as in the case of ground movements exceeding the expected ones, as this could invalidate the contents of this report and require a reassessment of the analyses.

It is recommended to undertake the monitoring of ground and structure movements for the properties within at least 20m from the excavation before, during and after the construction in order to avoid the limit values of ground movements to be exceeded. Soils Limited must be immediately notified in the case of unexpected large movements. Specific procedures must be put in place for properties which already experienced subsidence issues in the past.

The excavation of the basement will unload the soils at the formation level. The presence of overconsolidated clays implied the development of a certain degree of heave to develop in both the short (undrained conditions) and the long term (drained conditions).

As the construction proceeds, however, the application of the construction loads will interact with the heave developing in the long term.

The evaluation of heave and/or settlements in the long and in the short term was carried out using the commercial software PDISP by Oasys Limited. The maximum vertical deflection under the foundations of the neighbouring building was evaluated in accordance with CIRIA C580 and CIRIA C760.

The software Wallap from Geosolve was used to evaluate the horizontal movements induced on the retaining structures, which induced further vertical movements due to soil relaxation. The process for the evaluation of the horizontal deflection on adjoining buildings considers the stages needed for the construction sequence.

The horizontal strain and the vertical deflection ratio were then calculated according to the procedures reported in CIRIA C580 and CIRIA C760 and combined with reference to the method proposed by Burland (2001) to allow for the evaluation of the expected damage induced by the development on the neighbouring buildings.

The construction of basements is generally acceptable when a maximum category damage 2 (slight) was achieved. However, when the expected damage exceeds a

category damage 1 (very slight), mitigation measures must be applied in order to reduce this to a potential category damage 0 (negligible) to preserve the existing buildings, generally identified as brittle and extremely sensitive to ground movements. When suitable mitigation measures are applied, a further assessment must be carried out to confirm the improvement.

In the case assessed within this report, the expected damage induced on the neighbouring structures at 109 North Hill was estimated to a maximum Burland's Category 1 (very slight damage) and therefore no mitigation measures were needed. However, it was recommended the adoption of permanent propping and the undertaking of dedicated monitoring of ground movements and structures. Soils Limited must be informed of any changes to the layout or excessive ground movements, as this could invalidate the contents of this report.

It must be pointed out that the procedure is generally conservative and the real movements and damages induced by the development are typically lower than the calculated values.

Overall it was considered the proposed development could have a limited impact on neighbouring properties provided a suitable basement construction was selected and effective monitoring of ground movements put in place, to inform of eventual excessive movements that could require the undertaking of remedial measures. The statement is strictly related to the geotechnical results of this Basement Impact Assessment and refers to building structures being in good condition. No comments are or can be provided with regards to the structural conditions of the existing building and of the adjoining properties. A specific assessment must be undertaken by a Structural Engineer, who has to ensure the remaining structures are suitable to undergo the proposed development in safe conditions.

Section 12 Chemical Testing

12.1 General

The production of a Preliminary Investigation Report, or Desk Study, was outside of the scope of this investigation and nor was one provided by the client. Therefore, it was not possible to create, test or revise an existing conceptual site model in respect to ground contamination.

12.2 Chemical Testing

In lieu of a conceptual site model a single precautionary sample of Made Ground (FE8: 0.2m bgl) was sent for laboratory analysis and tested for a wide range of common brownfield contaminants including asbestos, metals, semi-metals, phenols, polyaromatic hydrocarbons and EPH (Texas Banded). In addition, a waste acceptance criteria test was undertaken for waste disposal purposes. The results of laboratory testing were presented in Appendix C1.

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Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Appendix B.2 Interpretation

Appendix B.3 Geotechnical In-Situ and Laboratory Results

Appendix C Chemical Laboratory Testing

Appendix C.1 Chemical Laboratory Results

Appendix C.2 Determination of Hazardous Waste Classification

Appendix D Information Provided by the Client

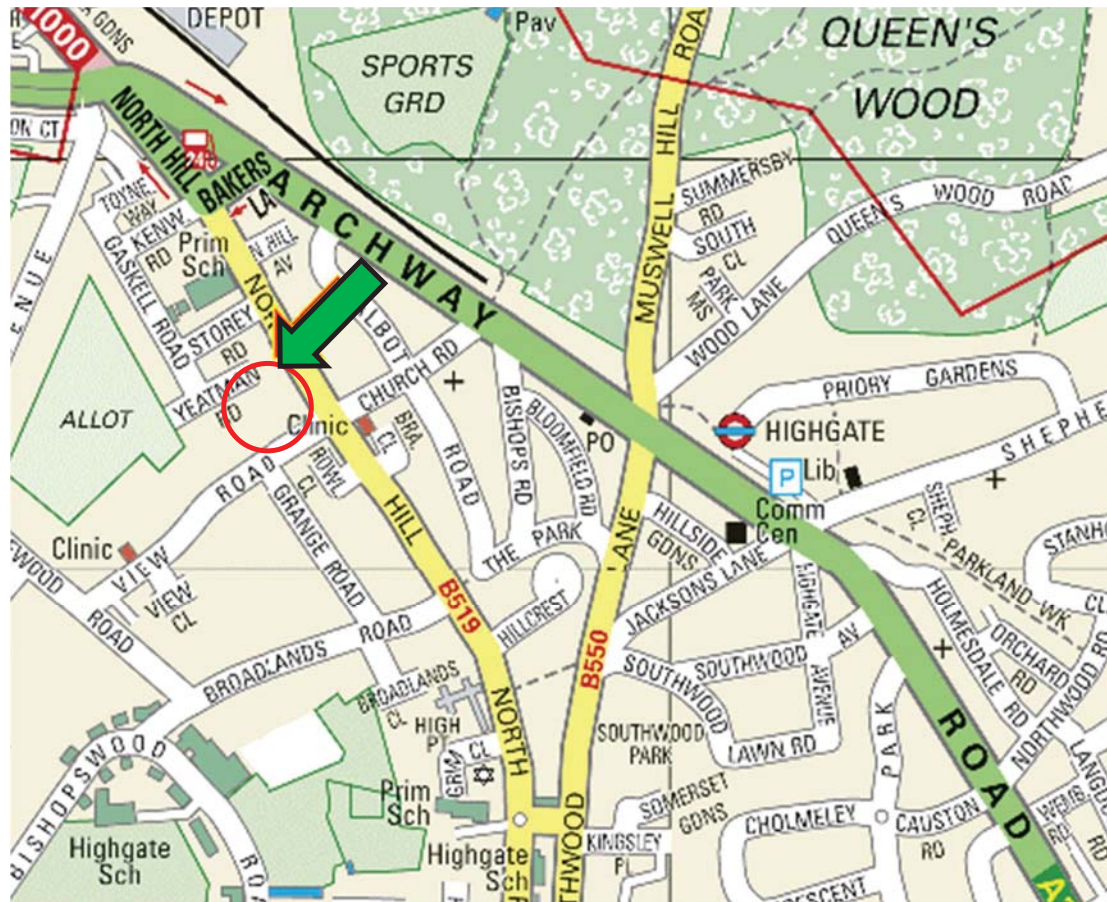


Figure I – Site Location Map



Job Number

19732

Project

103-107 North Hill, Highgate, London N6 4DP

Client

Highgate Care Ltd.

Date

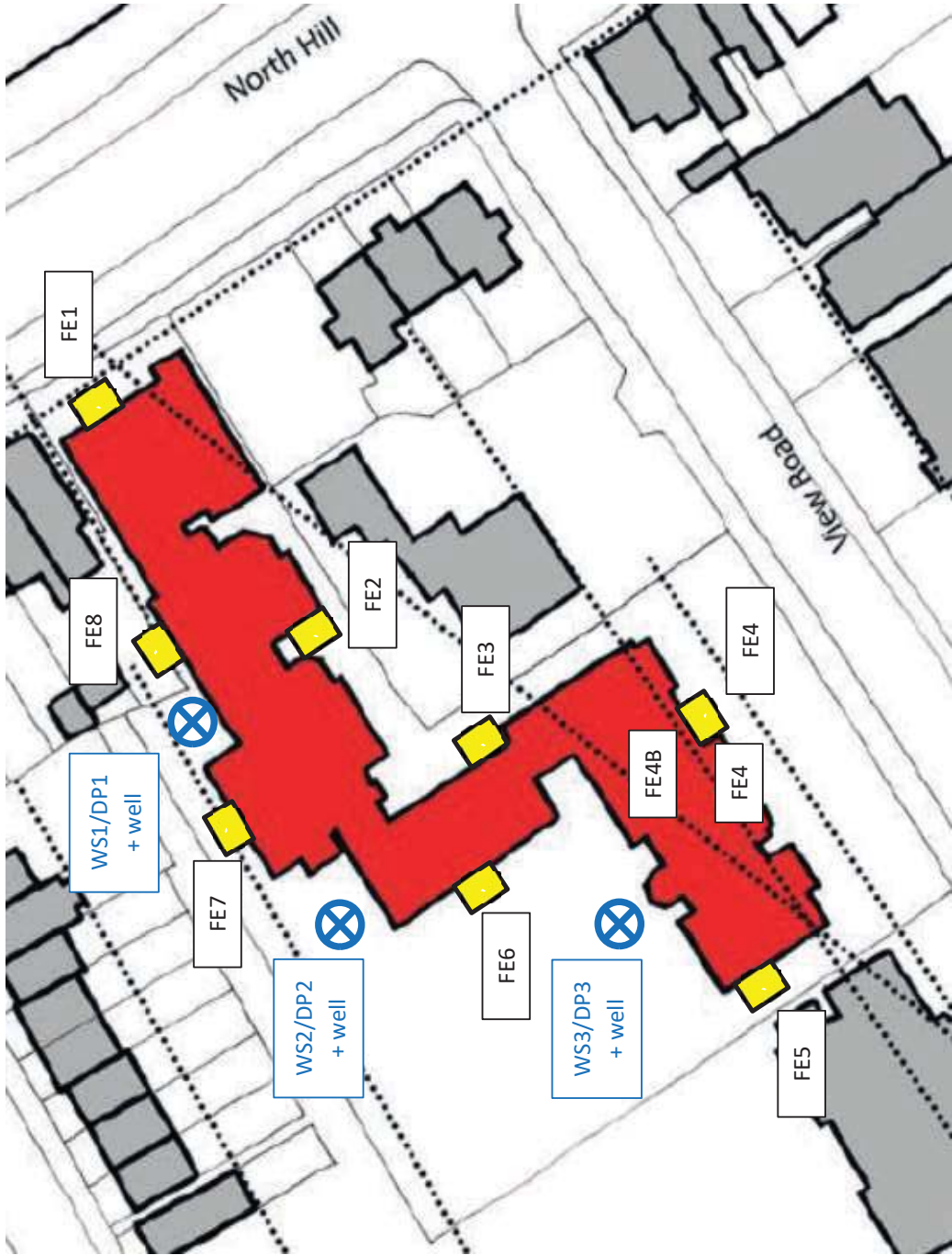
December 2022

Figure 2 – Aerial Photograph



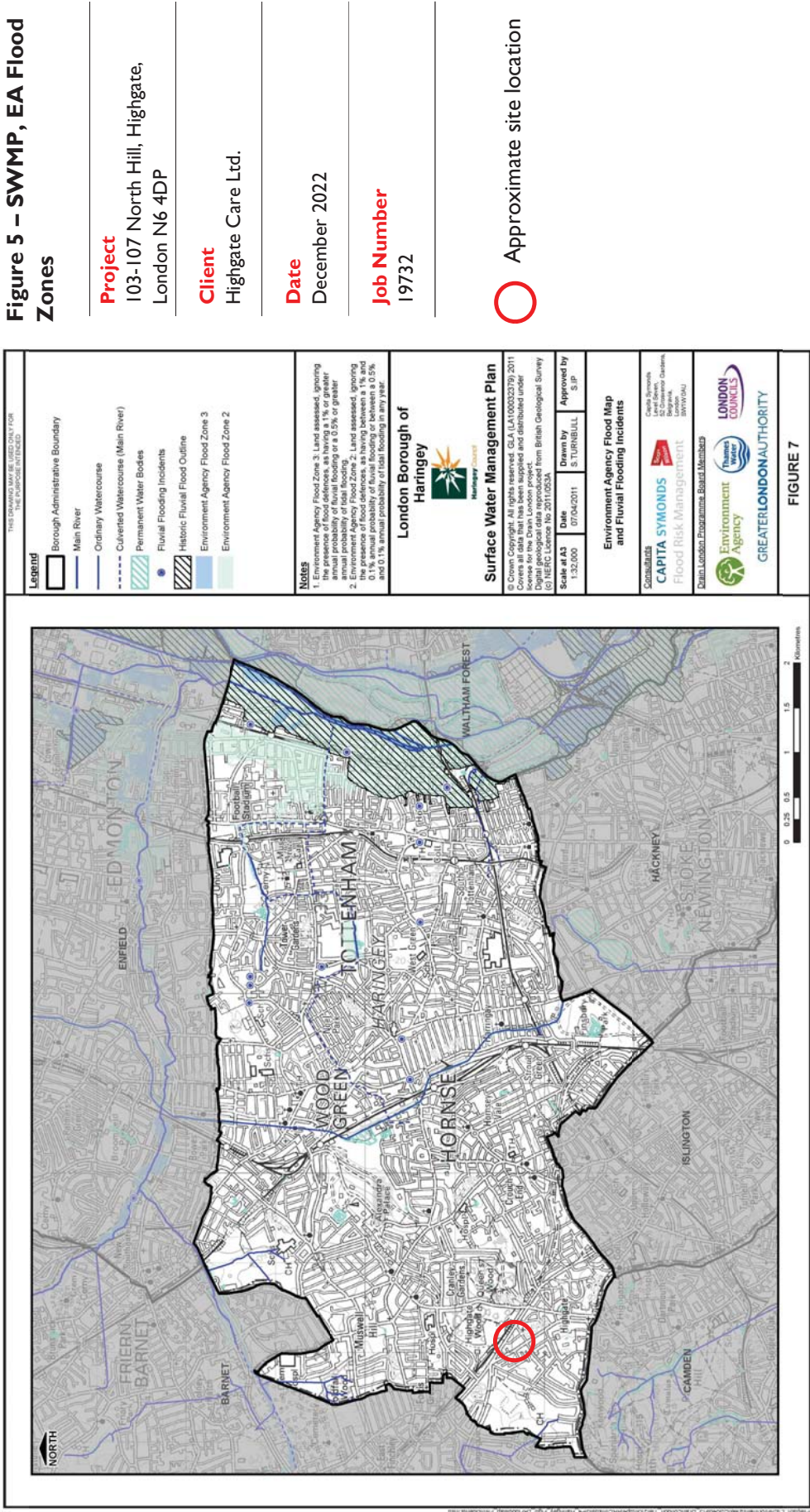
Figure 3 – Trial Hole Plan

Project	I03-I07 North Hill, Highgate, London N6 4DP
Client	Highgate Care Ltd.
Date	December 2022
Job Number	19732



Approximate site location





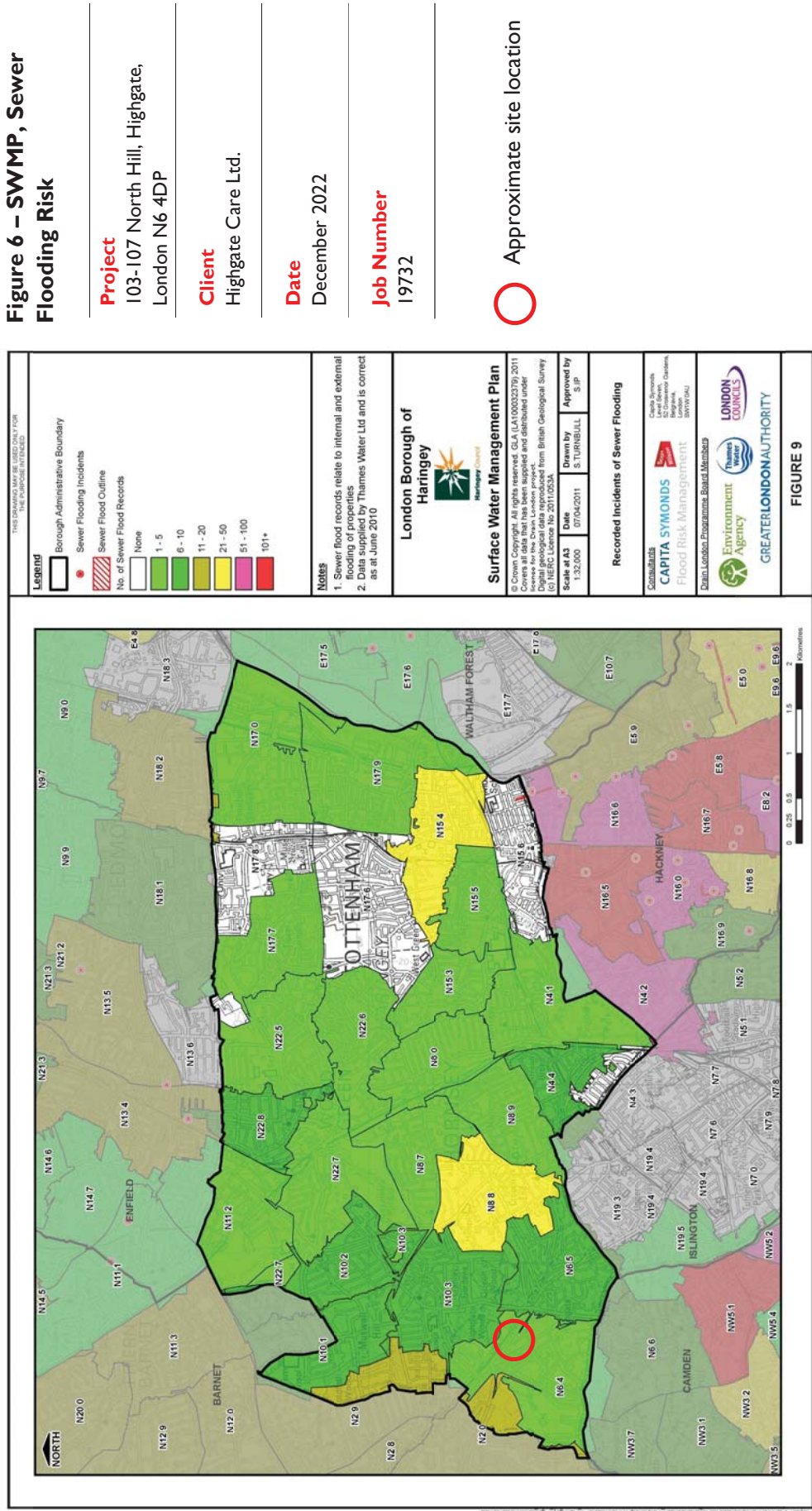


Figure 7 – SWMP, Risk for Elevated Groundwater

Project

103-107 North Hill, Highgate,
London N6 4DP

Client

Highgate Care Ltd.

Date

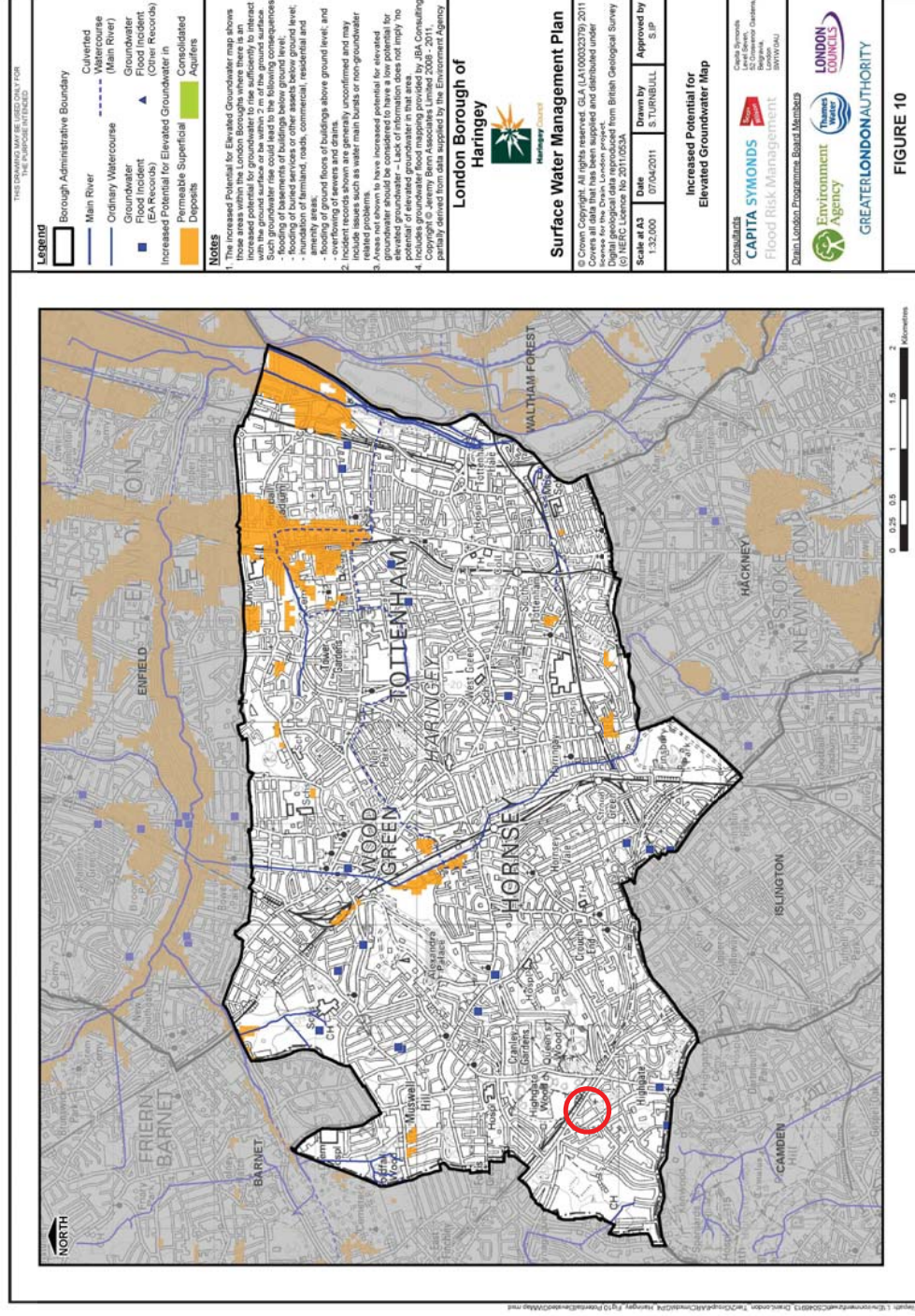
December 2022

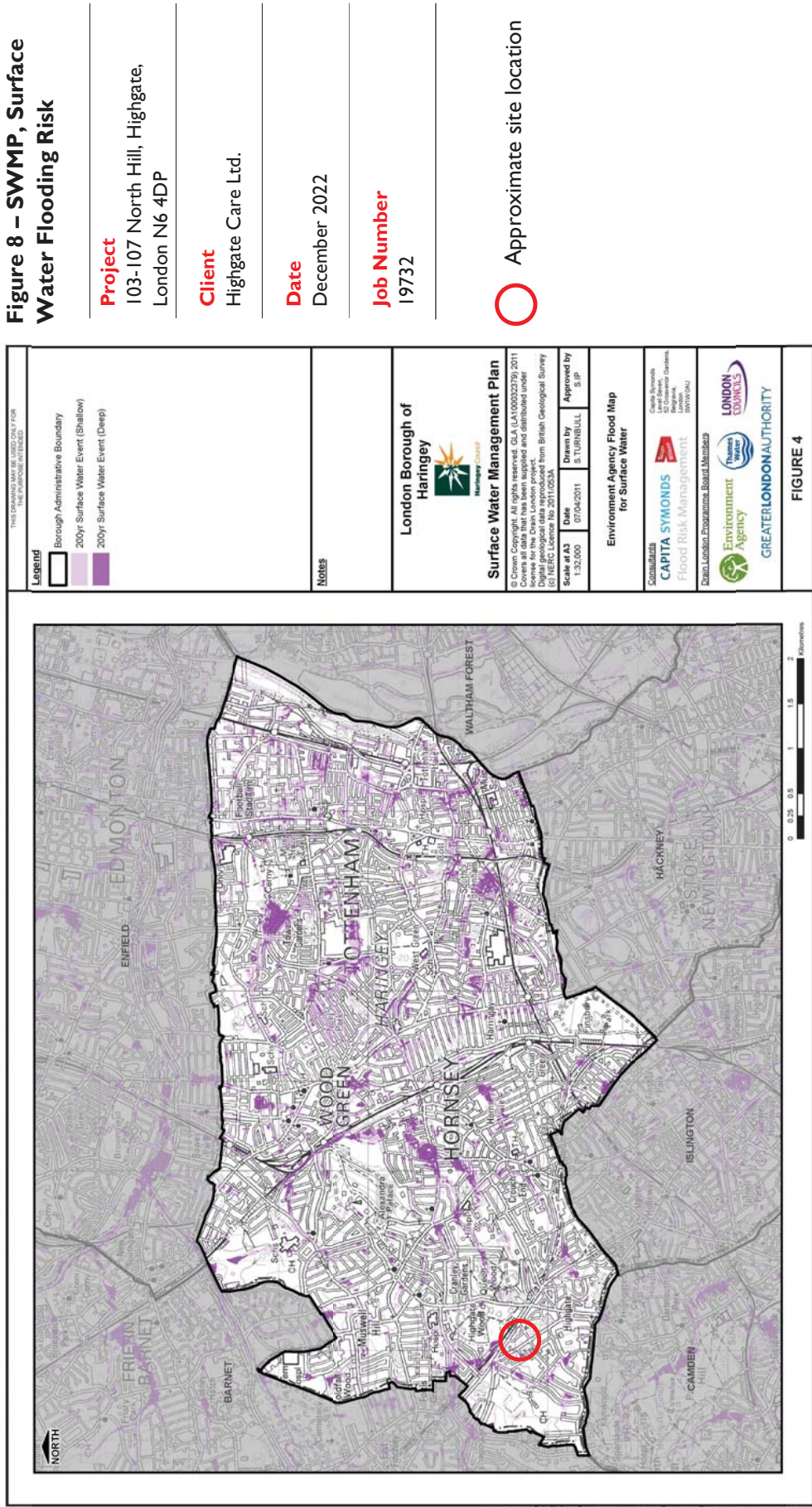
Job Number

19732



Approximate site location





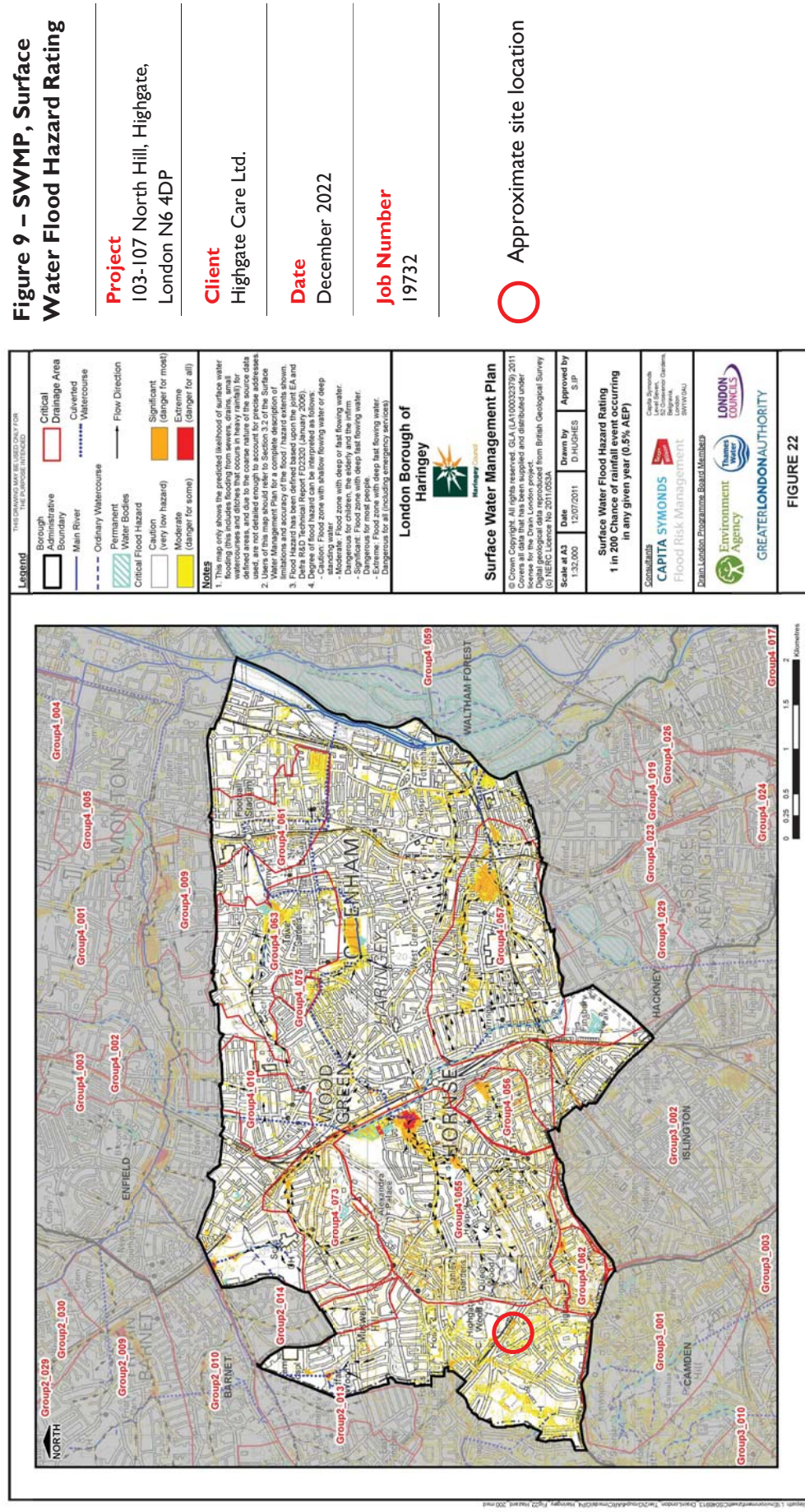


Figure 10 – EA, Flooding from Rivers and Sea

Project	103-107 North Hill, Highgate, London N6 4DP
Client	Highgate Care Ltd.
Date	December 2022
Job Number	19732

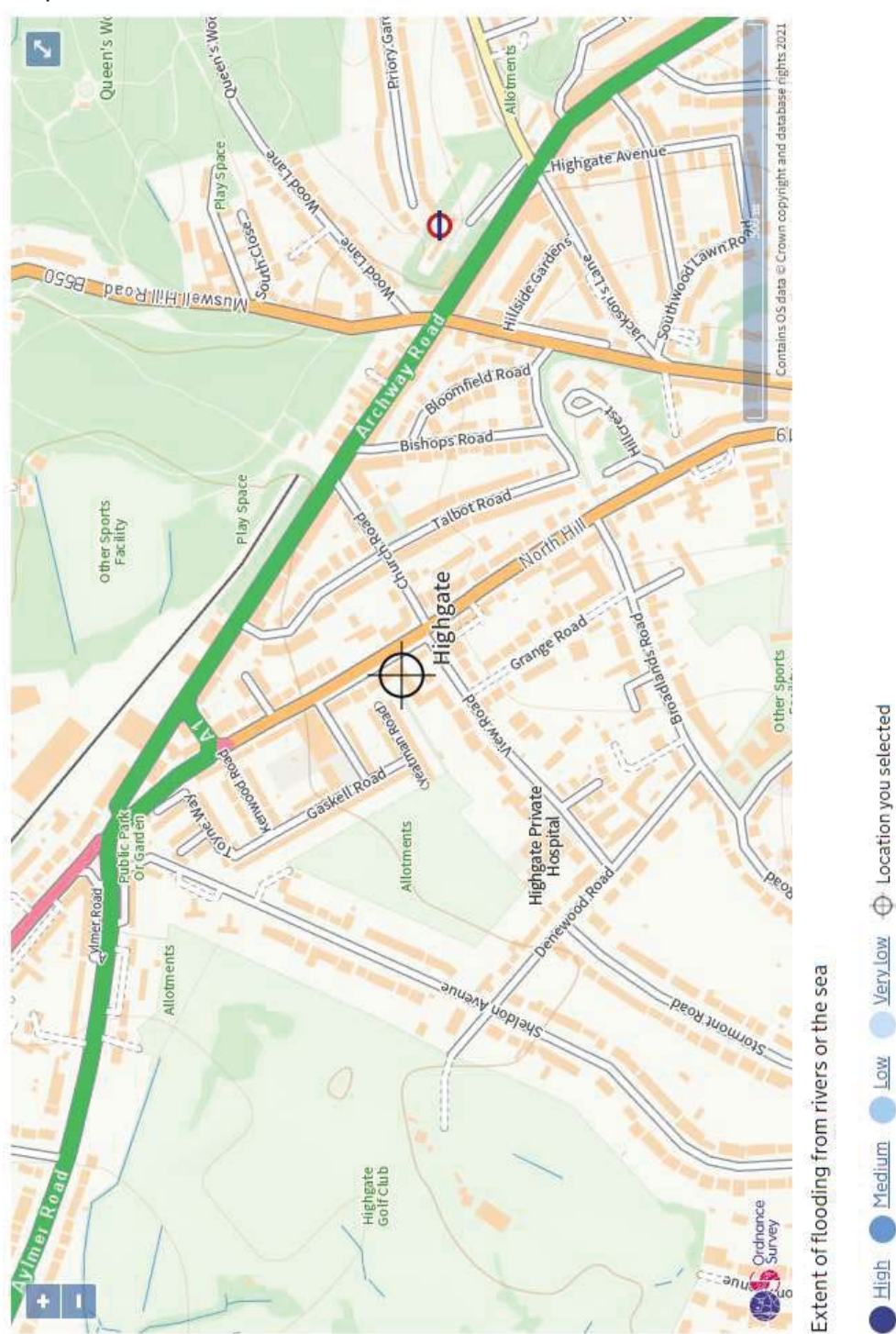
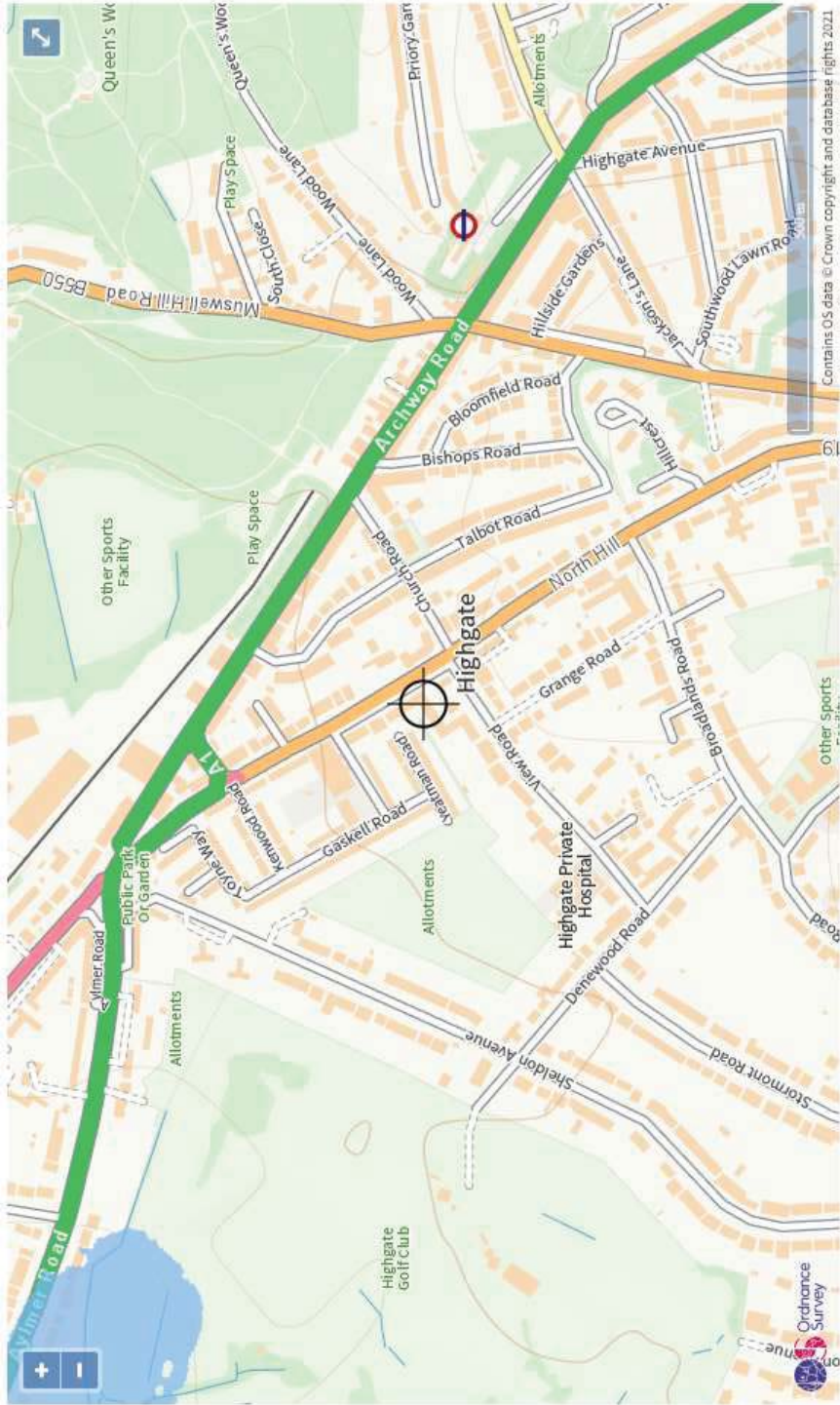


Figure 11 – EA, Flooding from Reservoirs

Project	103-107 North Hill, Highgate, London N6 4DP
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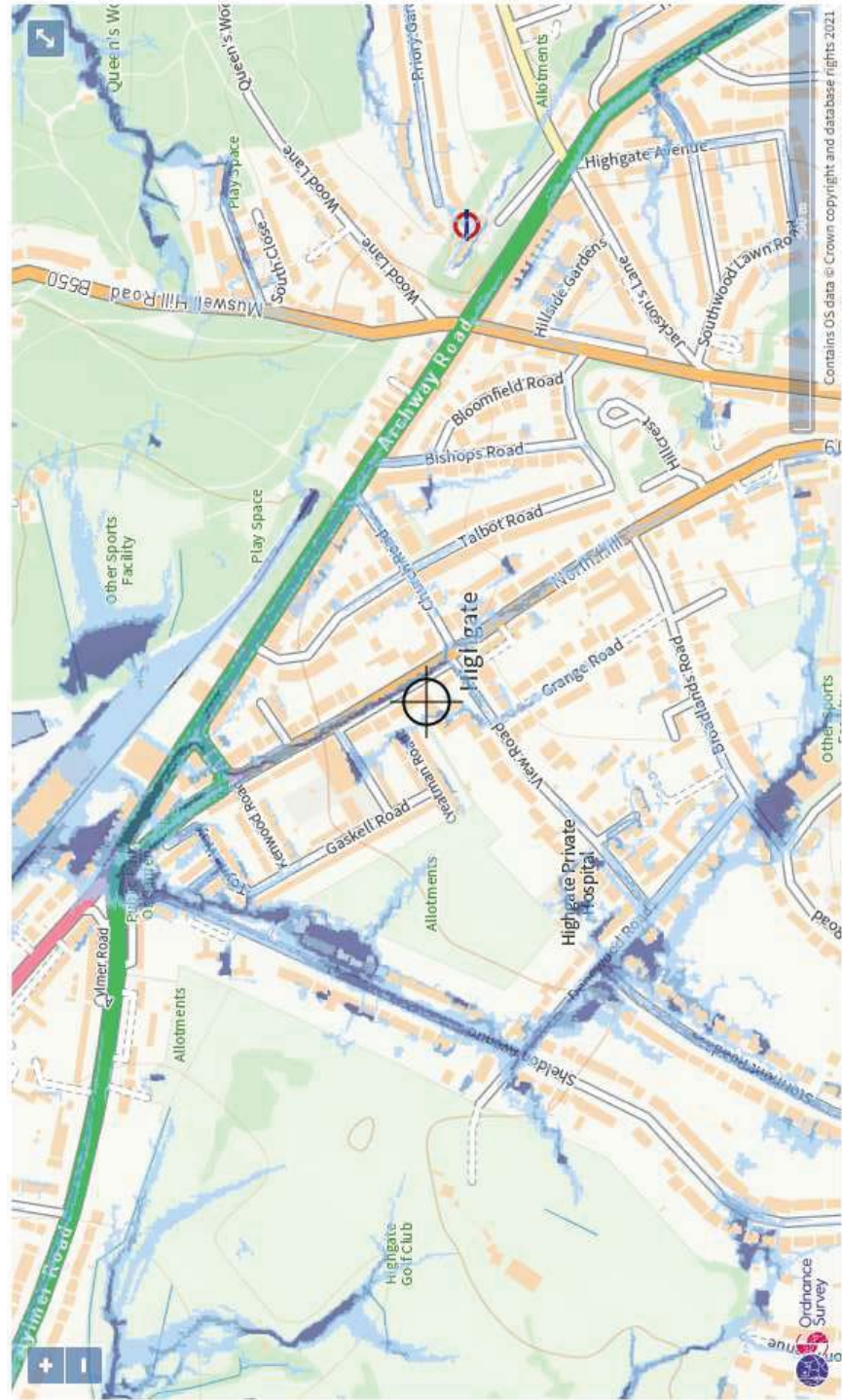


Maximum extent of flooding from reservoirs:

- when river levels are normal
- when there is also flooding from rivers
- Location you selected

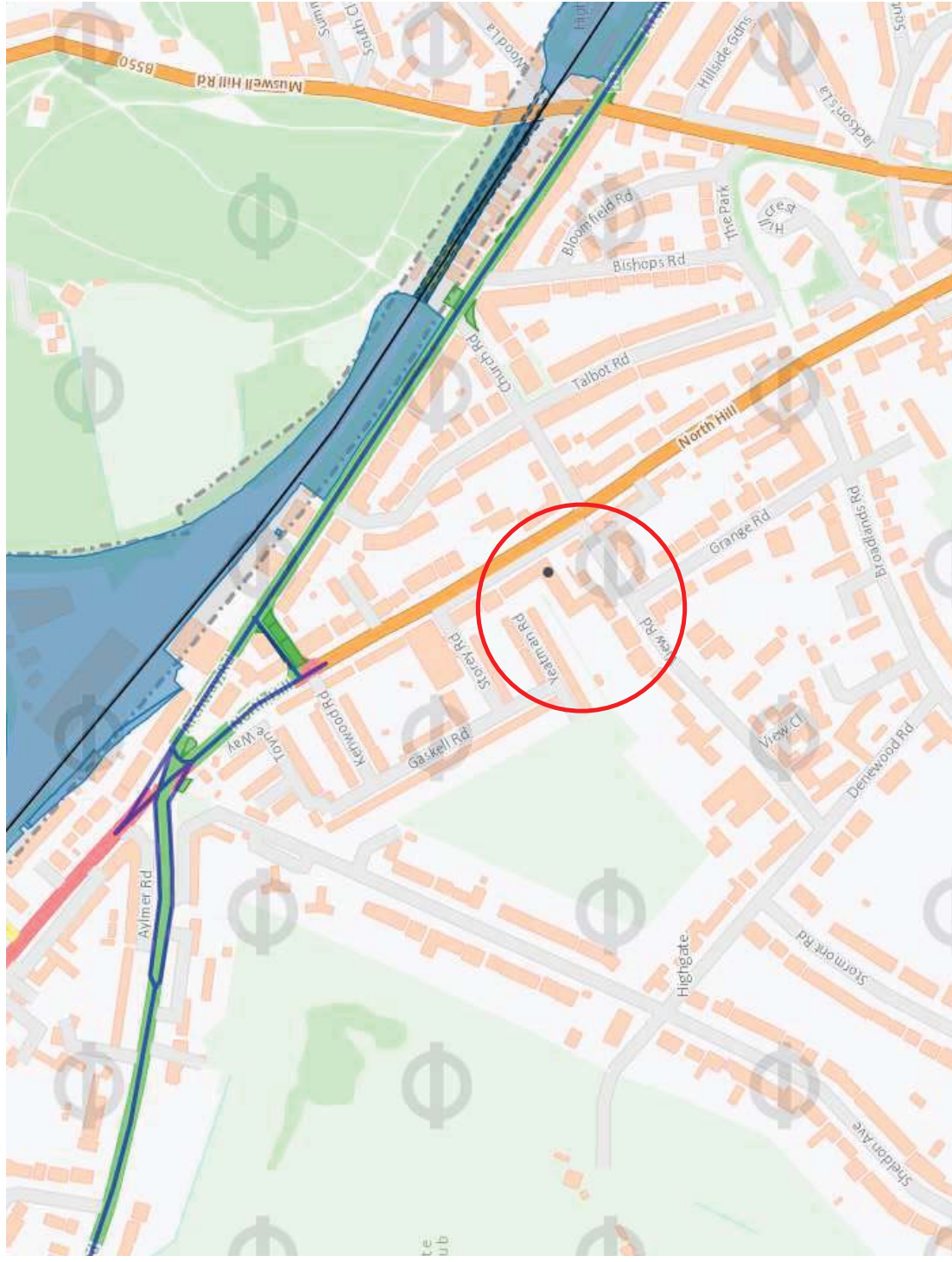


Figure 12 – EA, Flooding from Surface Water



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**Figure 13 – TFL,
Underground Infrastructures**

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Date	December 2022
Job Number	19732

○ Approximate site location



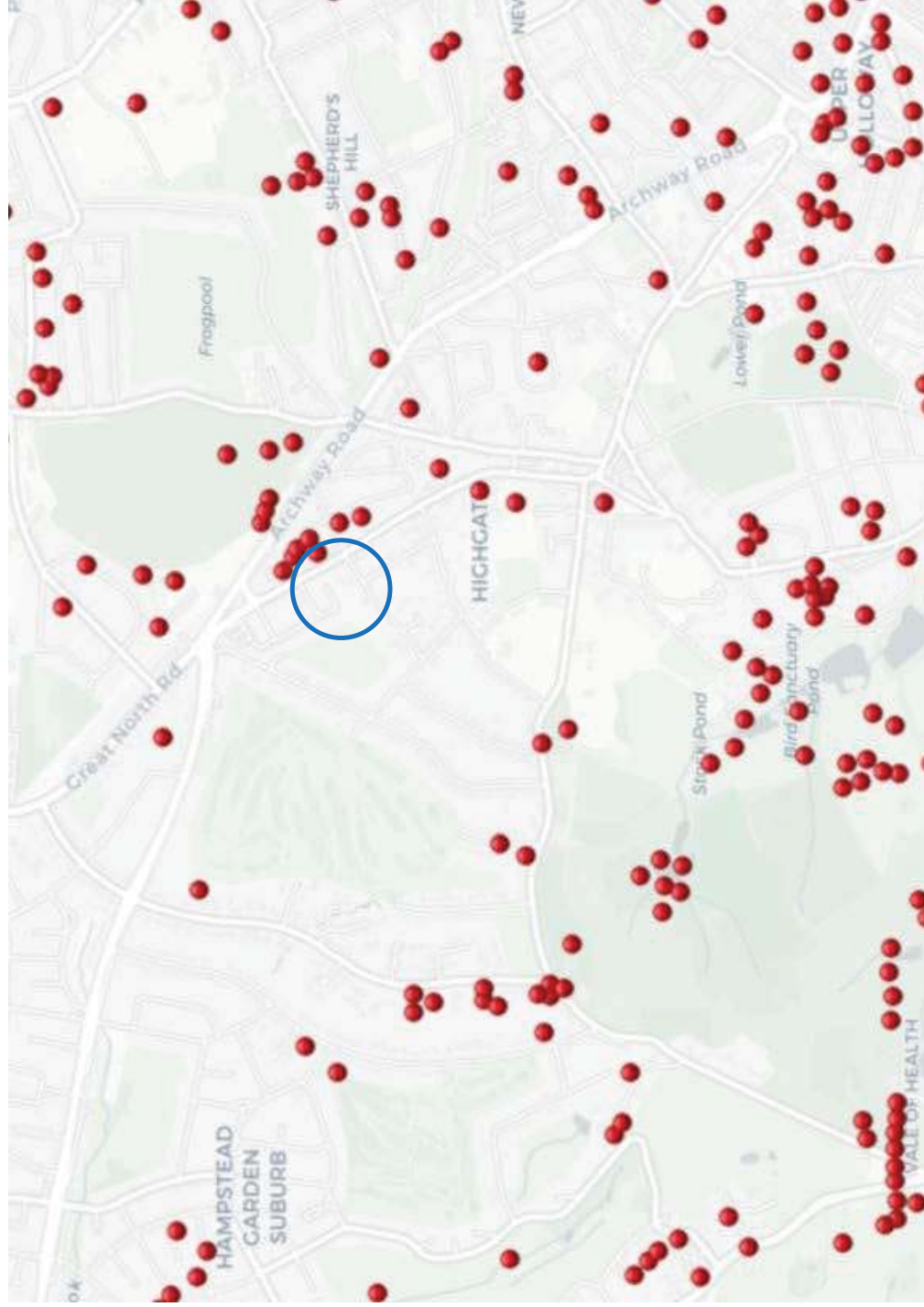


Figure I4 – Bomb Sight UXO Map

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 Approximate site location



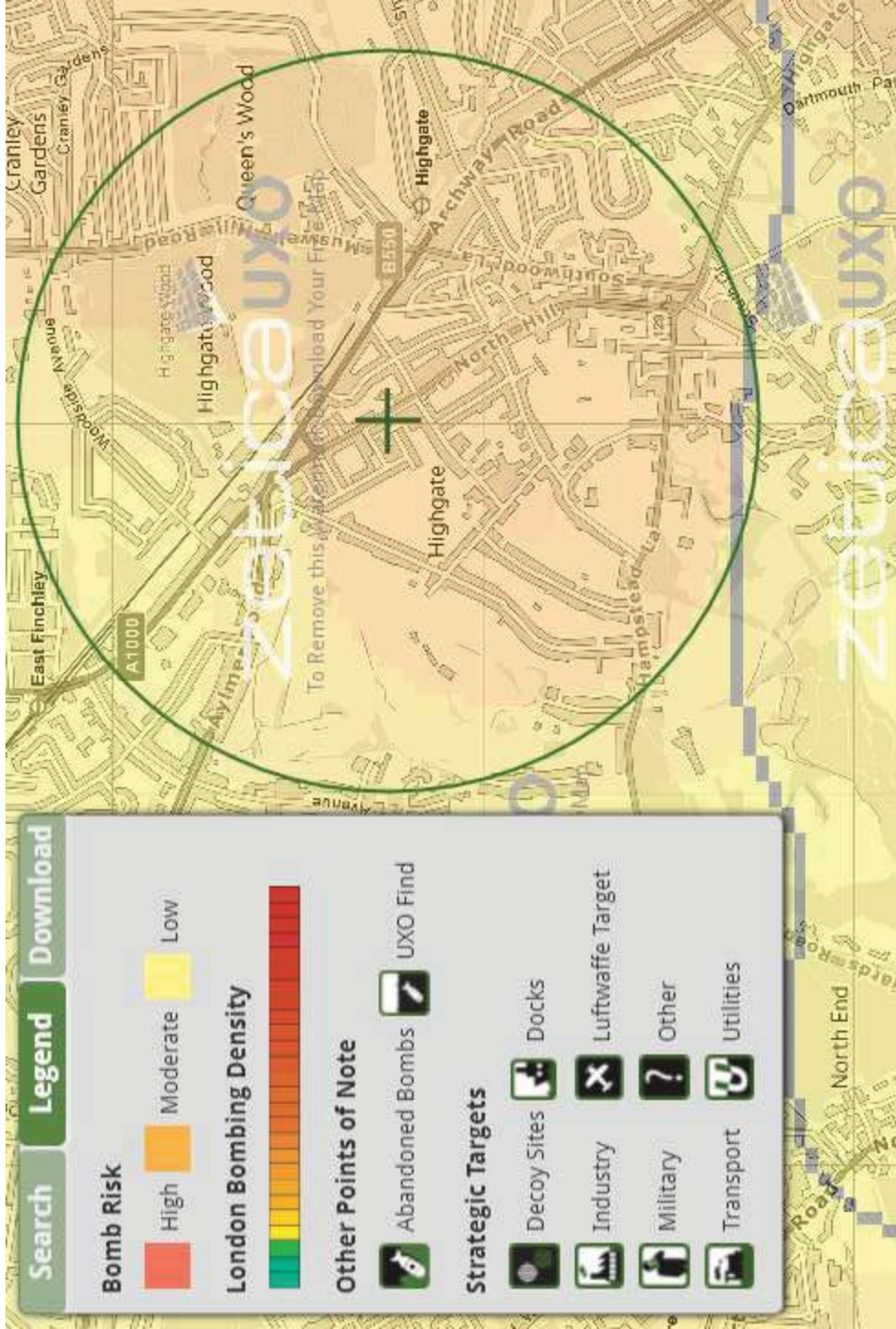


Figure 15 – Zetica UXO Map

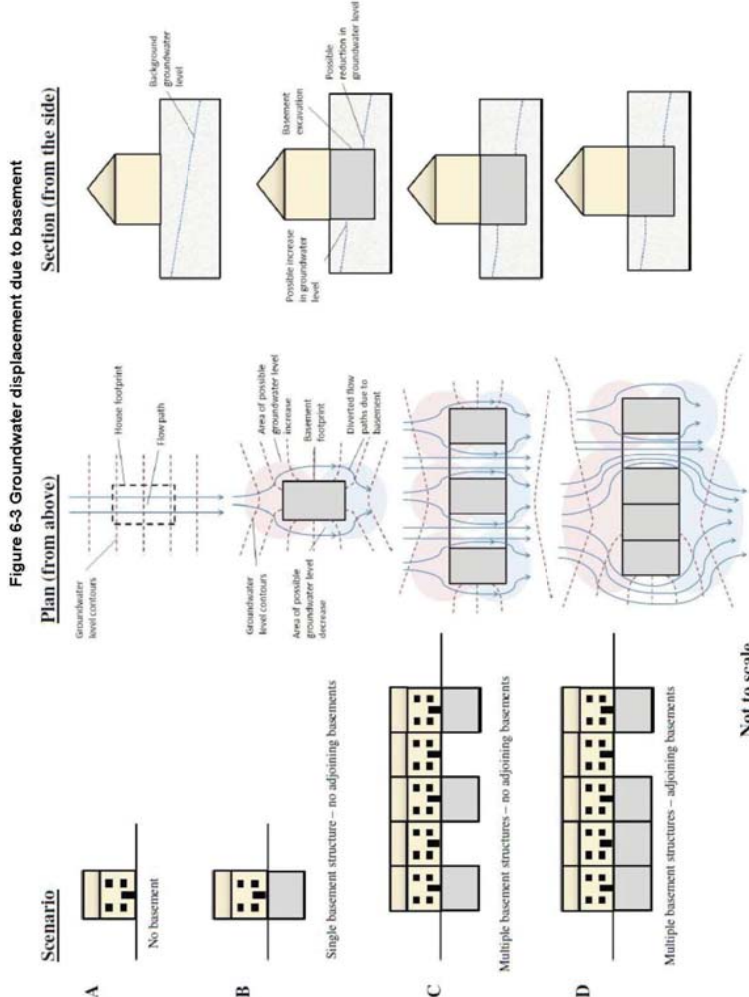
Project	I03-I07 North Hill, Highgate, London N6 4DP
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Figure 16 – Cumulative Effects

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Not to scale

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Job Number	19732



SC1
D = (2.08) + 5.35 m

109

2081

4841

5232

21644

NORTH HILL

WETH

Figure I9 – Short-Term
Heave Contour Plot

Project	I03-I07 North Hill, Highgate, London N6 4DP
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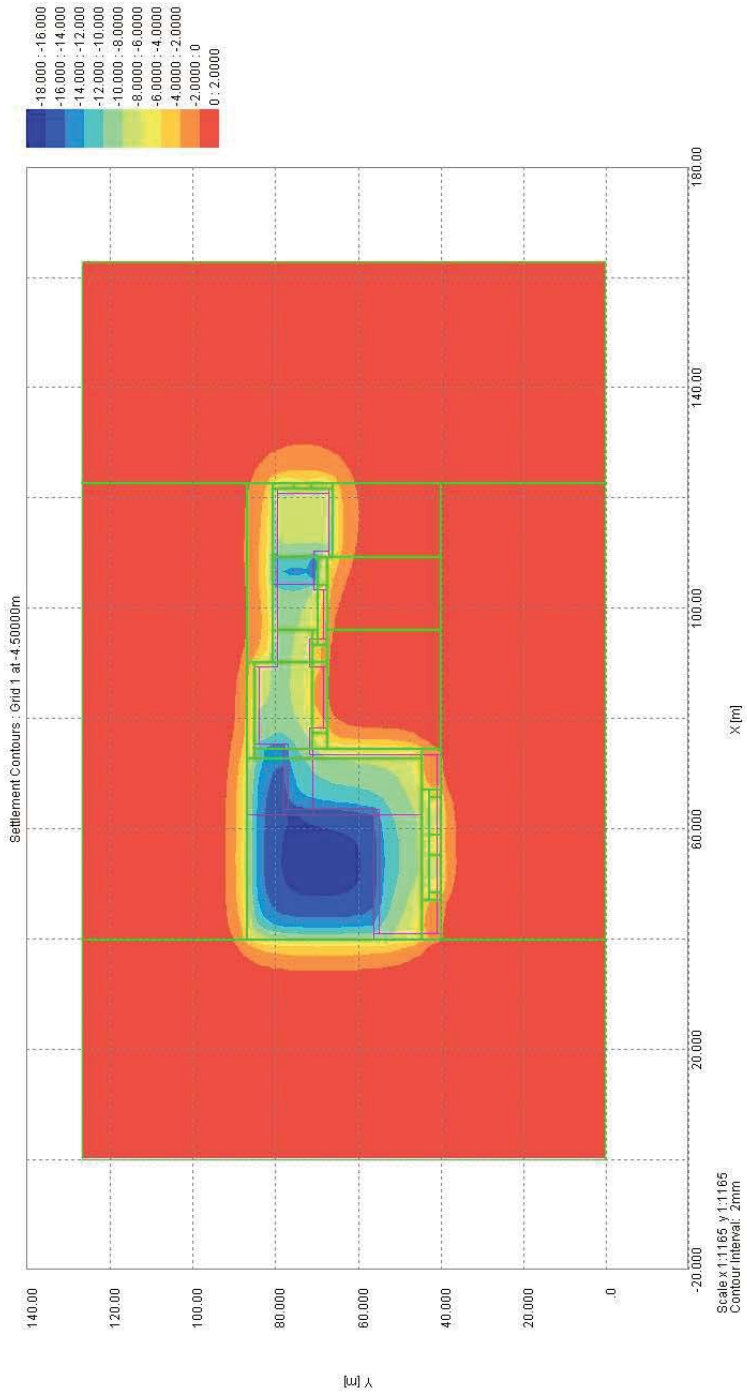


Figure 20 – Long-Term
Heave Contour Plot



Project	I03-I07 North Hill, Highgate, London N6 4DP
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Figure 2 I – Long-Term
Movements Contour Plot

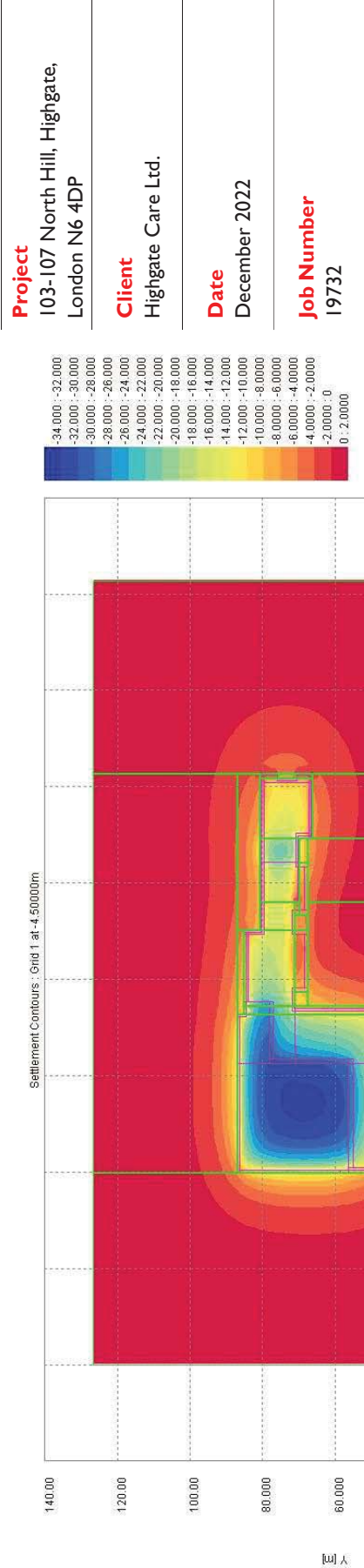
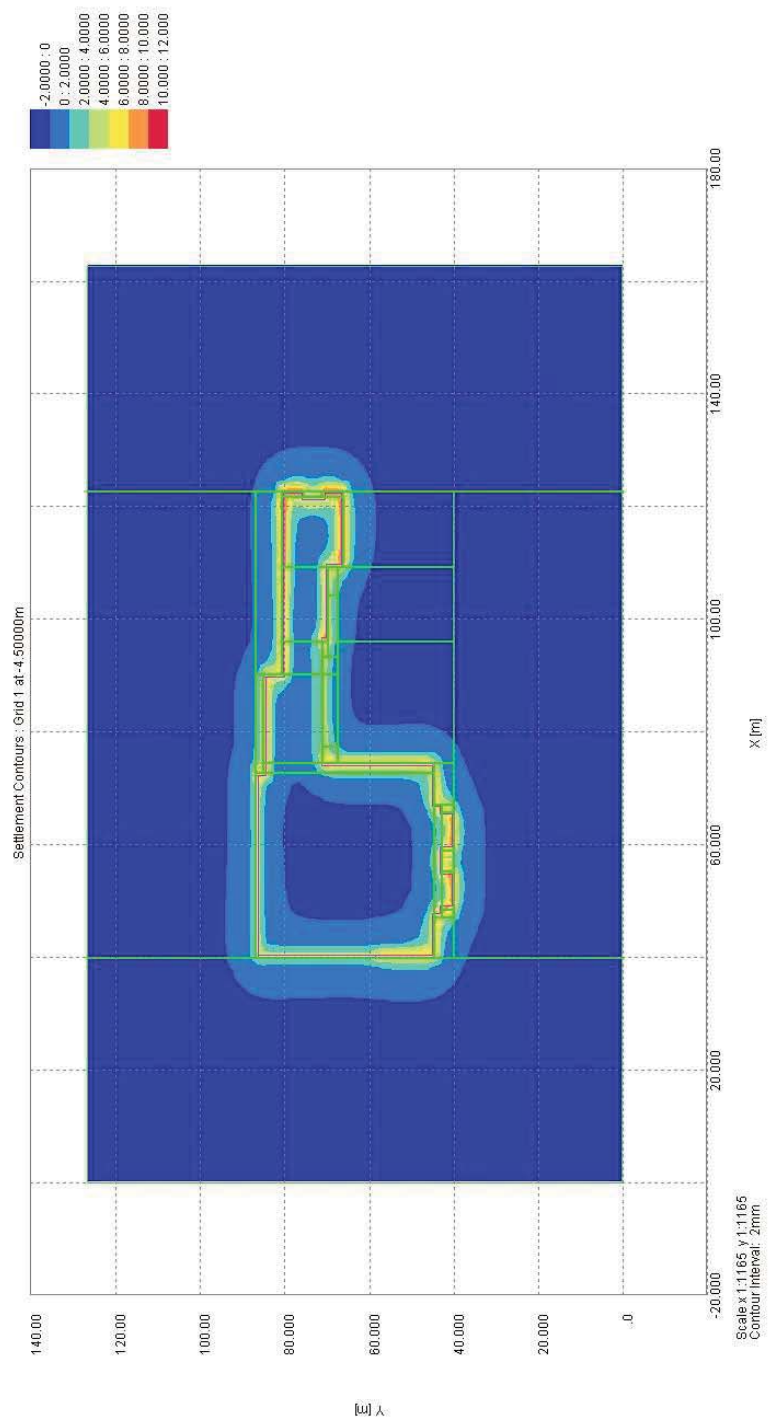


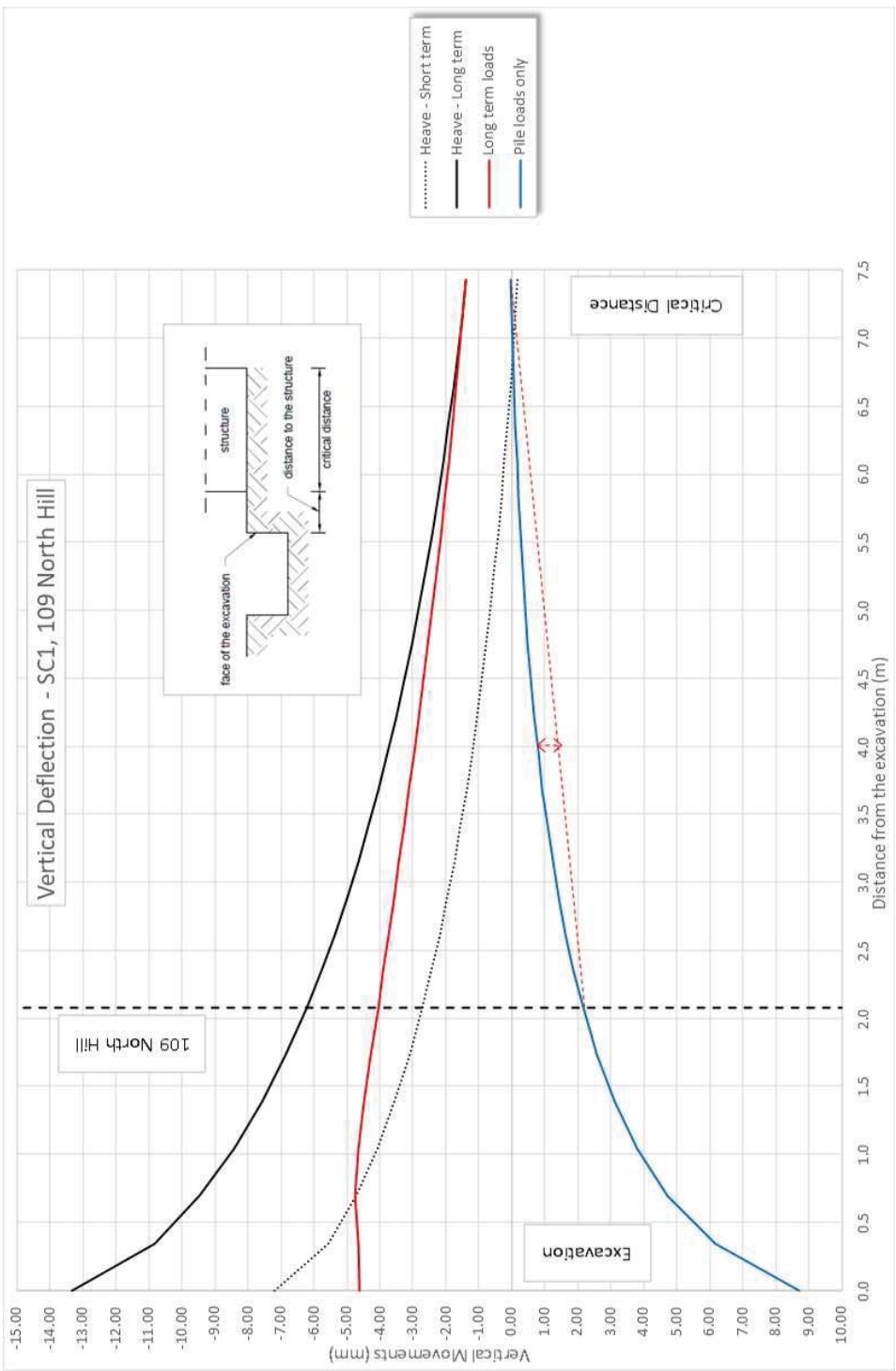
Figure 22 – Structural Loads
Movements Contour Plot



Project	I03-I07 North Hill, Highgate, London N6 4DP
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Date	December 2022
Job Number	I9732

Figure 23 – SCI, Vertical Deflection

Project	I03-I07 North Hill, Highgate, London N6 4DP
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Date	December 2022
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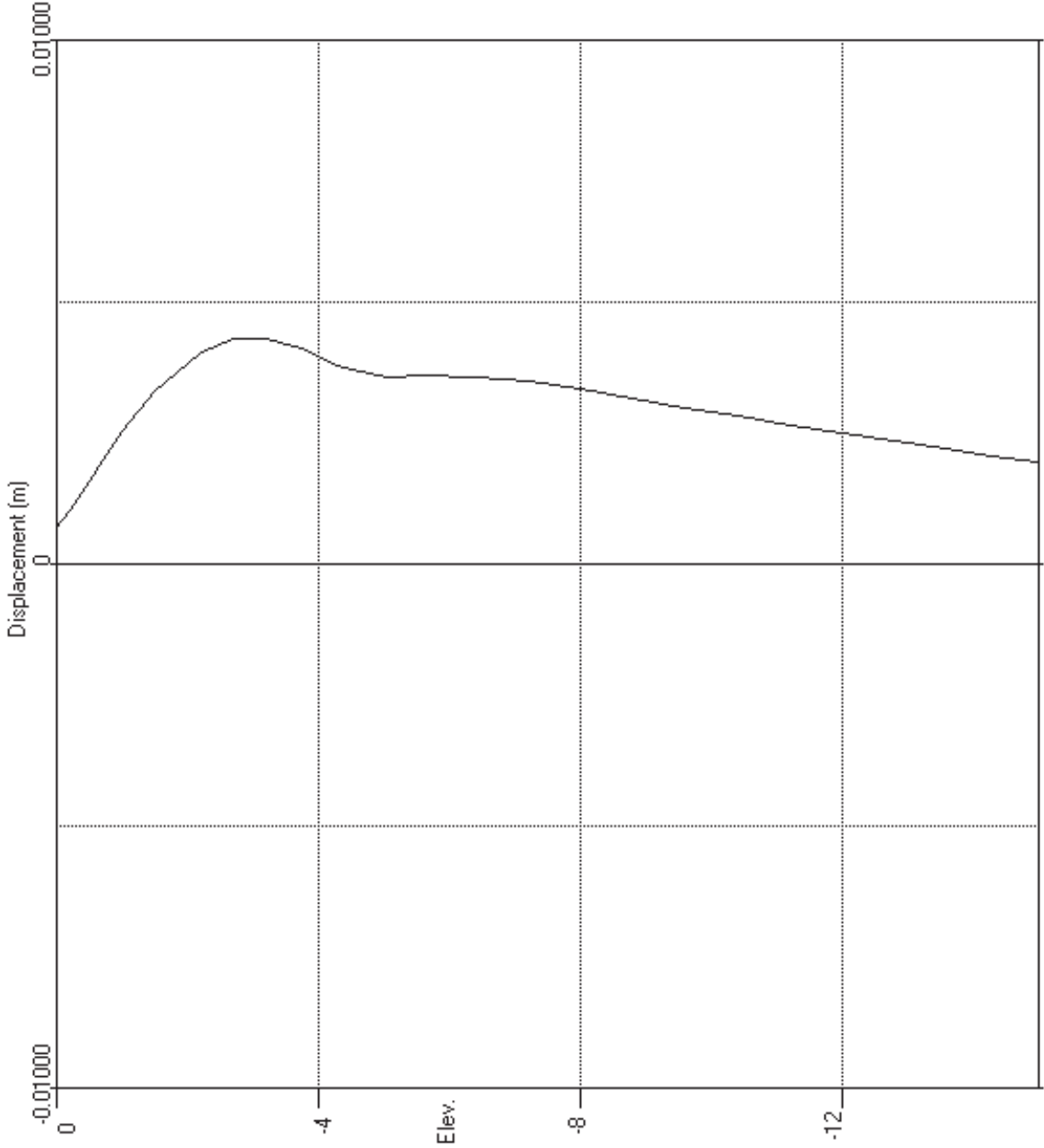
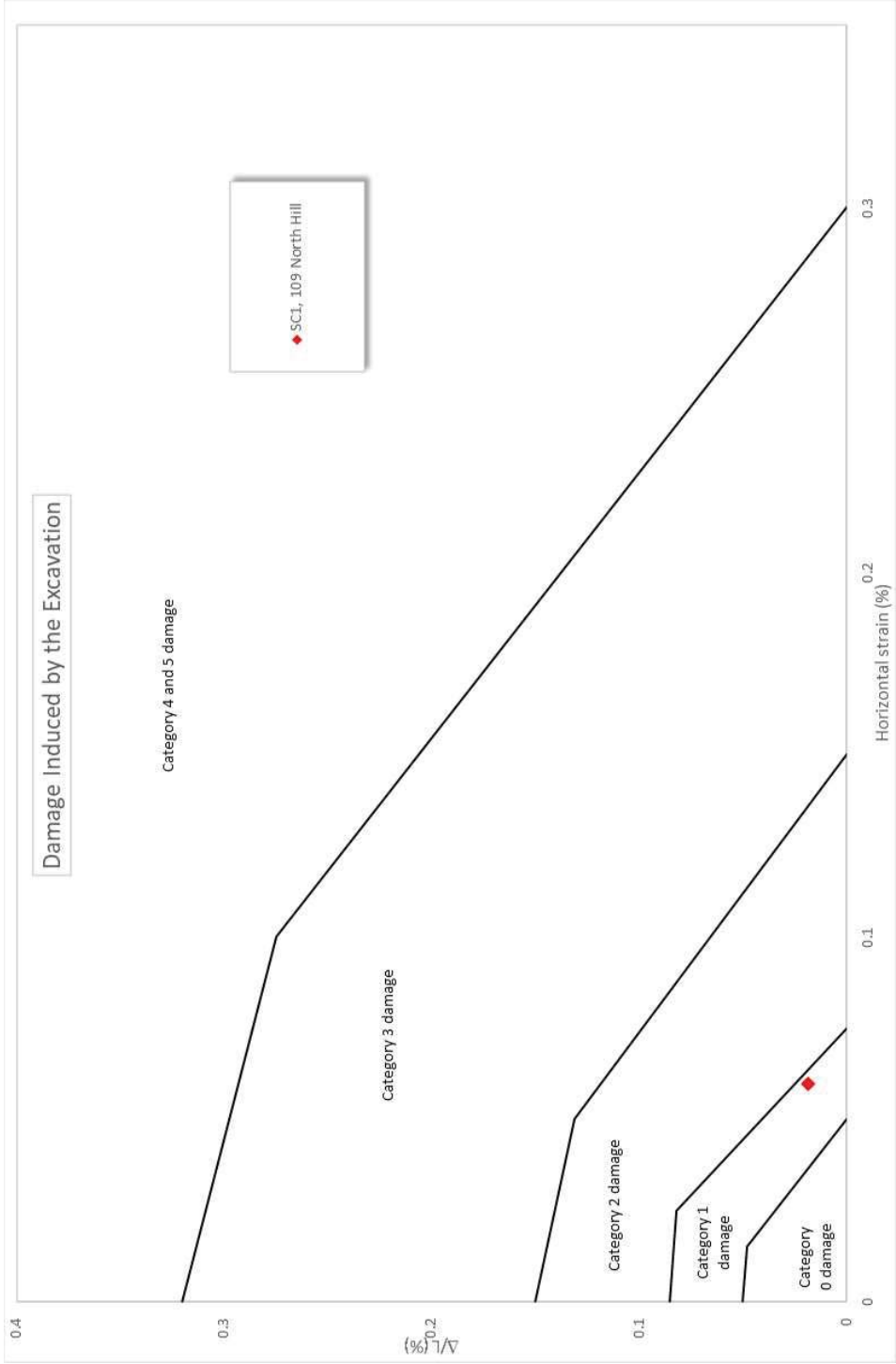


Figure 24 – SCL, Horizontal Movements	
Project	I03-I07 North Hill, Highgate, London N6 4DP
Client	Highgate Care Ltd.
Date	December 2022
Job Number	I9732

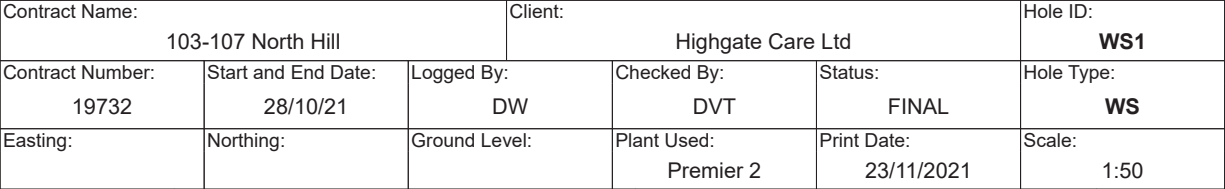
Figure 25 – SCI, Damage Category

Project	I03-I07 North Hill, Highgate, London N6 4DP
Client	Highgate Care Ltd.
Date	December 2022
Job Number	I9732



Appendix A Field Work

Appendix A.1 Engineers Logs



Weather:	Termination: EtOH	Sheet 1 of 1
----------	-------------------	--------------

Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks: No starter pit needed. Rootlets observed to 3.5m bgl. Desiccated/deomposing rootlets observed to 4.5m bgl.					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)						
Chiselling					Installation				Water Strikes					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
					0.00 1.00	1.00 6.00	PLAIN SLOTTED	33 33	3.00			0	3.00	After completion of drilling operations.
									Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.					

soils L I M I T E D				Contract Name: 103-107 North Hill				Client: Highgate Care Ltd				Hole ID: WS2							
				Contract Number: 19732		Start and End Date: 18/10/21		Logged By: DW		Checked By: DVT		Status: FINAL		Hole Type: WS					
				Easting:		Northing:		Ground Level:		Plant Used: Premier 2		Print Date: 23/11/2021		Scale: 1:50					
Weather:				Termination: EoH						Sheet 1 of 1									
Samples & In Situ Testing					Strata Details								Groundwater						
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/Installation						
0.10	D					Soft to firm dark brown mottled brown, slightly sandy silty CLAY. Frequent rootlets. Occasional sub-angular, fine to medium brick gravel. Recovered as loose and re-worked. MADE GROUND.													
0.30	ES			0.25								Soft to firm brown mottled greyish brown, slightly sandy silty CLAY. Sand is fine to medium. Occasional sub-angular, fine to coarse flint and rare fine clinker gravel. Occasional rootlets. MADE GROUND.							
0.60	D			0.50														Firm to stiff brown mottled orange and light greyish brown, slightly silty sandy CLAY. Sand is fine to medium. Occasional roots. 1cm thick fine to medium sand band at base of stratum. CLAYGATE MEMBER.	
	ES					Firm brown, orange and light greyish brown mottled and laminated, slightly silty sandy CLAY. Sand is fine to medium and features in frequent lenses and laminations. Very rare desiccated rootlets. CLAYGATE MEMBER.													
1.10	D			(1.00)								Firm brown mottled and laminated orangish brown and greyish brown, slightly silty sandy CLAY. Sand is fine to medium and features in frequent lenses and laminations. Occasional black speckling. CLAYGATE MEMBER.							
1.60	D			1.50		Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.													
2.10	D			(1.50)								Firm brown mottled and laminated orangish brown and greyish brown, slightly silty sandy CLAY. Sand is fine to medium and features in frequent lenses and laminations. Occasional black speckling. CLAYGATE MEMBER.							
2.60	D			3.00		Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.													
3.10	D			(1.00)								Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.							
3.60	D			4.00		Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.													
4.20	D			4.00								Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.							
4.70	D			(2.00)		Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.													
5.50	D			6.00								Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.							
5.90	D			6.00		Firm to stiff dark grey slightly silty sandy CLAY. Sand is fine to medium. Frequent black speckling. CLAYGATE MEMBER.													
												End of Borehole at 6.00m							
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:										
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Starter pit dug to 0.60m bgl. Rootlets observed to 1.5m bgl.										
Chiselling					Installation				Water Strikes										
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks					
					0.00	1.00	PLAIN	33	3.00			0	3.00	After completion of drilling operations.					
					1.00	6.00	SLOTTED	33											
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.																			

soils L I M I T E D					Contract Name: 103-107 North Hill					Client: Highgate Care Ltd					Hole ID: WS3	
					Contract Number: 19732		Start and End Date: 18/10/21		Logged By: DW		Checked By: DVT		Status: FINAL		Hole Type: WS	
					Easting:		Northing:		Ground Level:		Plant Used: Premier 2		Print Date: 23/11/2021		Scale: 1:50	
Weather:					Termination: EoH										Sheet 1 of 1	
Samples & In Situ Testing					Strata Details										Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description							Water Strike	Backfill/Installation		
0.20	D			(0.30)		Soft to firm dark brown mottled brown, slightly silty sandy CLAY. Frequent rootlets. Occasional sub-angular to rounded, fine to medium brick, flint and rare clinker gravel. Recovered as loose and re-worked. MADE GROUND.										
0.40	ES			0.30												
	D			(0.70)		Firm to stiff brown mottled orange and grey to light greenish grey with depth, slightly sandy silty CLAY. Sand is fine to medium and features in occasional laminations. Occasional rootlets. CLAYGATE MEMBER.										
	ES															
0.90	D			1.00		Firm to stiff brown mottled orange and light greyish brown, slightly sandy silty CLAY. Sand is fine to medium. Rare rootlets. CLAYGATE MEMBER.							1			
1.10	ES															
1.60	D			(1.60)												
2.10	D															
2.70	D			2.60		Fine to medium SAND band.										
				(0.40)												
3.00	D			3.00		Firm brown mottled and laminated orangish brown and greyish brown, slightly silty sandy CLAY. Sand is fine to medium and features in frequent lenses and laminations. Occasional black speckling. CLAYGATE MEMBER.							3			
3.20	D			3.10												
3.50	D			(0.60)		Brown mottled orangish brown and greyish brown, slightly silty fine to medium fine SAND. CLAYGATE MEMBER.										
3.80	D			3.70												
4.50	D					Firm brown mottled and laminated orangish brown and greyish brown to brownish grey with depth, slightly silty very sandy CLAY. Sand is fine to medium and features in frequent lenses and laminations. Occasional black speckling. CLAYGATE MEMBER.										
4.90	D			(2.30)												
5.50	D					Firm to stiff dark grey slightly silty very sandy CLAY. Sand is fine to medium and features in very frequent laminations and thin beds. Frequent black speckling. CLAYGATE MEMBER.							4			
5.90	D			6.00												
						End of Borehole at 6.00m							6			
													7			
													8			
													9			
													10			
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks: Rootlets observed to 1.5m bgl. Groundwater not encountered. Starter pit dug to 0.80m bgl.							
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)								
Chiselling					Installation				Water Strikes							
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks		
					0.00	1.00	PLAIN	33								
					1.00	6.00	SLOTTED	33								
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.																

**Soils Limited**

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Probe Log

Probe No.

DP1

Sheet 1 of 1

Project Name:	103-107 North Hill	Project No.	19732	Co-ords:		Hole Type	DP
Location:	103-107 North Hill, Highgate, London N6 4DP	Level:	m AOD			Scale	1:50
Client:	Highgate Care Ltd	Dates:	28/10/2021			Logged By	JO

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					10
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					20
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					30
3.1					
3.2					
3.3					
3.4					
3.5					
3.6					
3.7					
3.8					
3.9					
4.0					50
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5.0					80
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					
6.0					130
6.1					
6.2					
6.3					
6.4					
6.5					
6.6					
6.7					
6.8					
6.9					
7.0					
7.1					
7.2					
7.3					
7.4					
7.5					
7.6					
7.7					
7.8					
7.9					
8.0					
8.1					
8.2					
8.3					
8.4					
8.5					
8.6					
8.7					
8.8					
8.9					
9.0					
9.1					
9.2					
9.3					
9.4					
9.5					
9.6					
9.7					
9.8					
9.9					
10.0					

Remarks	Fall Height	760mm	Cone Base Diameter	50.5mm
	Hammer Weight	63.5kg	Final Depth	6m
	Probe Type	DPSH-B	Energy Ratio (Er)	82.11%



Project Name:	103-107 North Hill	Project No.	19732	Co-ords:		Hole Type	DP
Location:	103-107 North Hill, Highgate, London N6 4DP	Level:	m AOD			Scale	1:50
Client:	Highgate Care Ltd	Dates:	18/10/2021			Logged By	JO

Depth (m)	Blows/100mm				Torque (Nm)
	0	10	20	30	
0	0				
0.1	1				
0.2	1				
0.3	1				
0.4	1				
0.5	1				
0.6	1				
0.7	1				
0.8	1				
0.9	1				
1.0	1				30
1.1	1				
1.2	1				
1.3	1				
1.4	1				
1.5	1				
1.6	1				
1.7	1				
1.8	1				
1.9	1				
2.0	1				30
2.1	1				
2.2	1				
2.3	1				
2.4	1				
2.5	1				
2.6	1				
2.7	1				
2.8	1				
2.9	1				
3.0	1				60
3.1	1				
3.2	1				
3.3	1				
3.4	1				
3.5	1				
3.6	1				
3.7	1				
3.8	1				
3.9	1				
4.0	1				60
4.1	1				
4.2	1				
4.3	1				
4.4	1				
4.5	1				
4.6	1				
4.7	1				
4.8	1				
4.9	1				
5.0	1				90
5.1	1				
5.2	1				
5.3	1				
5.4	1				
5.5	1				
5.6	1				
5.7	1				
5.8	1				
5.9	1				
6.0	1				120
6.1	1				
6.2	1				
6.3	1				
6.4	1				
6.5	1				
6.6	1				
6.7	1				
6.8	1				
6.9	1				
7.0	1				170
7.1	1				
7.2	1				
7.3	1				
7.4	1				
7.5	1				
7.6	1				
7.7	1				
7.8	1				
7.9	1				
8.0	1				190
8.1	1				
8.2	1				
8.3	1				
8.4	1				
8.5	1				
8.6	1				
8.7	1				
8.8	1				
8.9	1				
9.0	1				210
9.1	1				
9.2	1				
9.3	1				
9.4	1				
9.5	1				
9.6	1				
9.7	1				
9.8	1				
9.9	1				
10.0	1				

Remarks	Fall Height	760mm	Cone Base Diameter	50.5mm
	Hammer Weight	63.5kg	Final Depth	9m
	Probe Type	DPSH-B	Energy Ratio (Er)	82.11%

**Soils Limited**

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Probe Log

Probe No.

DP3

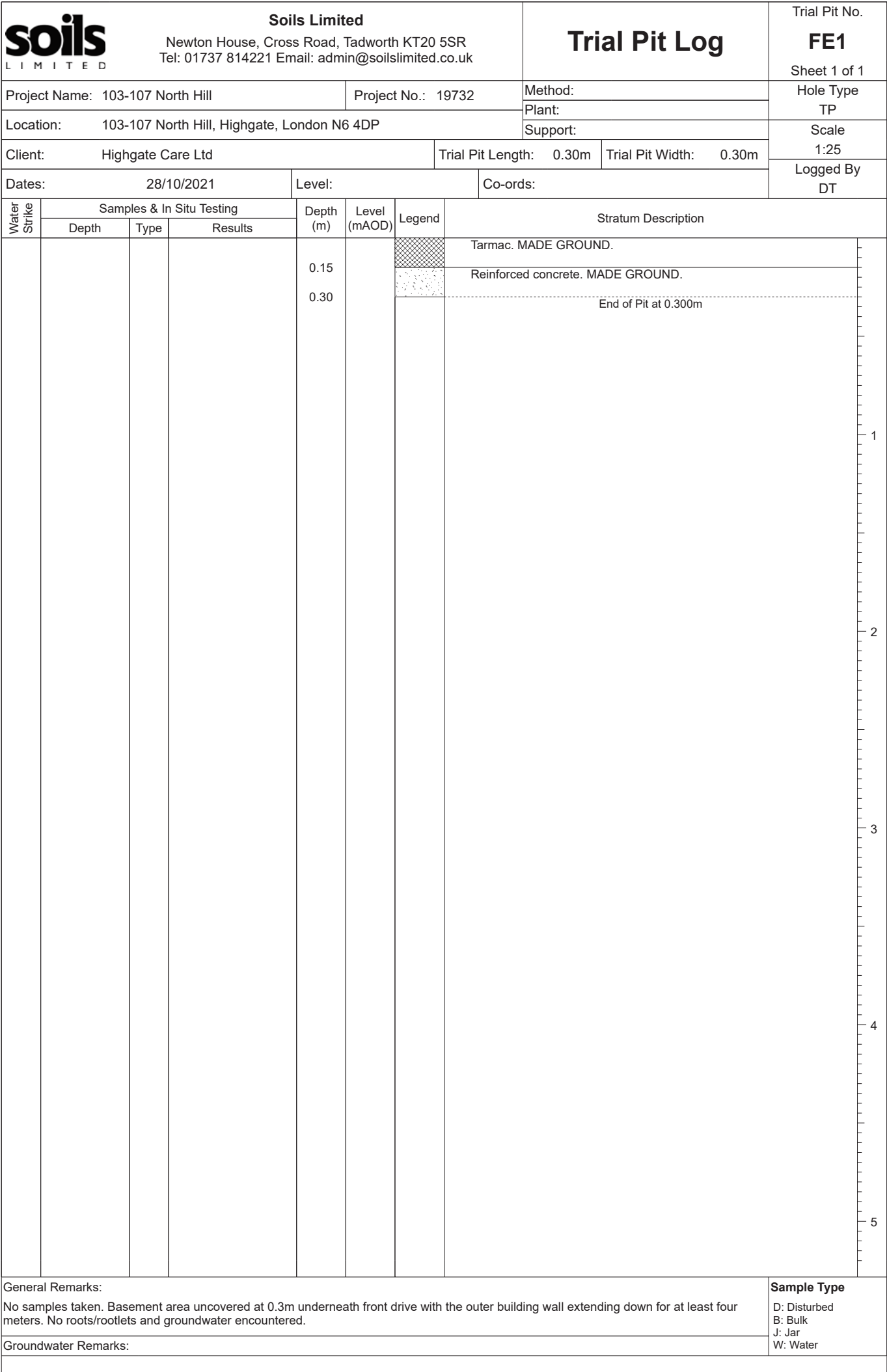
Sheet 1 of 1

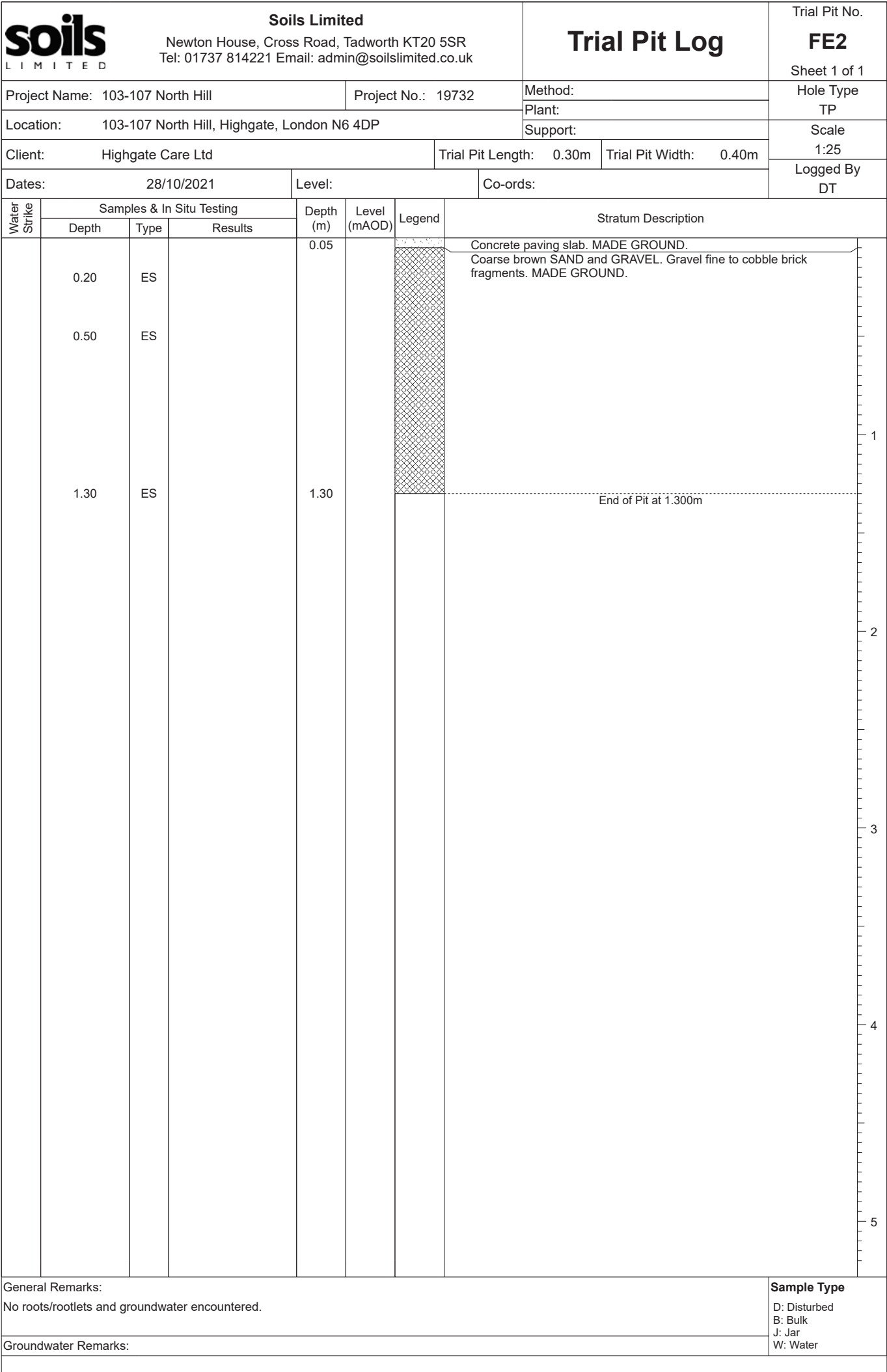
Project Name:	103-107 North Hill	Project No.	19732	Co-ords:		Hole Type	DP
Location:	103-107 North Hill, Highgate, London N6 4DP	Level:	m AOD			Scale	1:50
Client:	Highgate Care Ltd	Dates:	18/10/2021			Logged By	JO

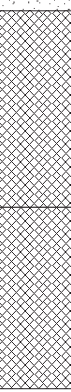
Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0					
1					20
2					30
3					30
4					60
5					60
6					80
7					
8					
9					
10					

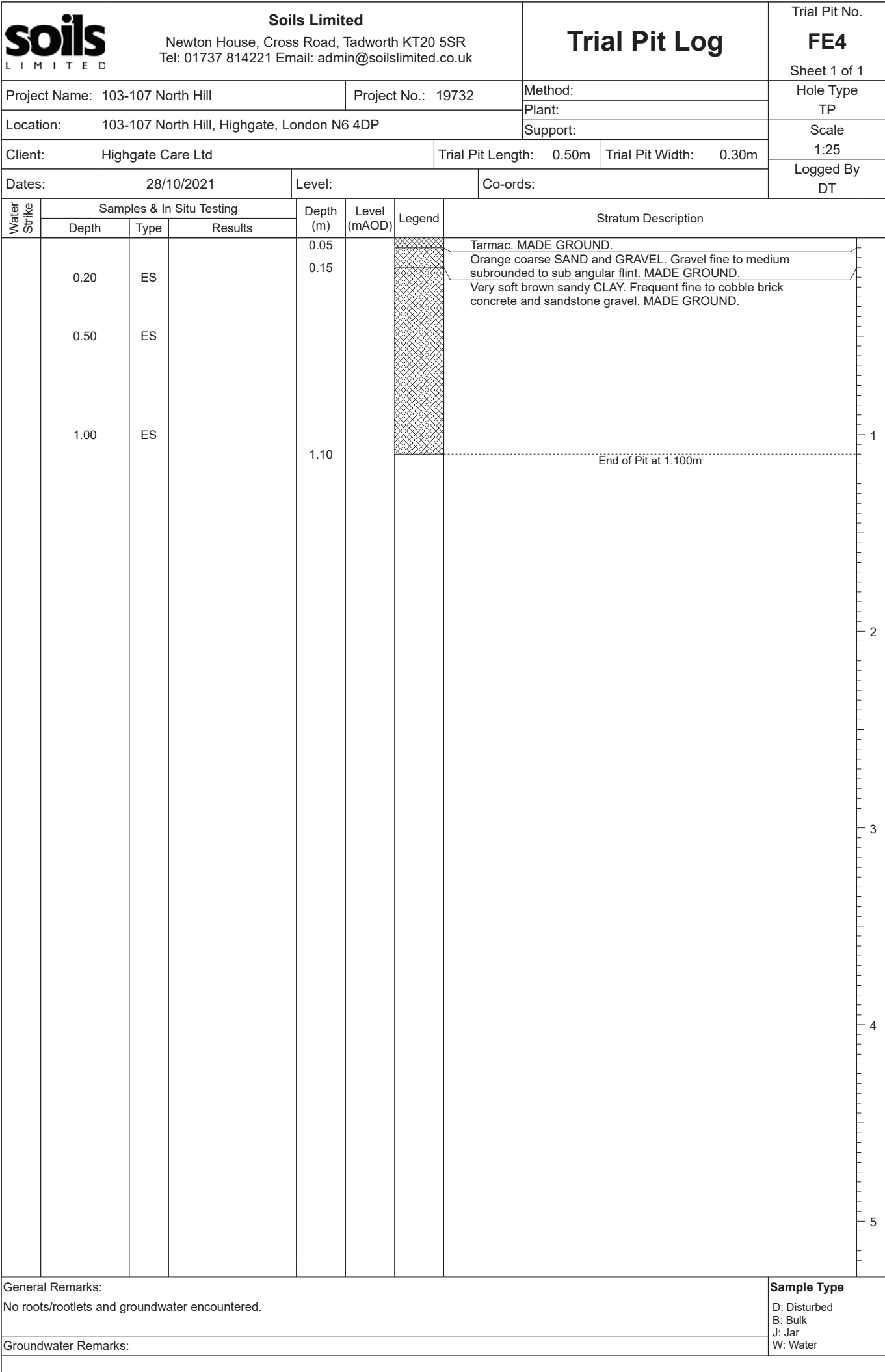
Remarks	Fall Height	760mm	Cone Base Diameter	50.5mm
	Hammer Weight	63.5kg	Final Depth	6m
	Probe Type	DPSH-B	Energy Ratio (Er)	82.11%



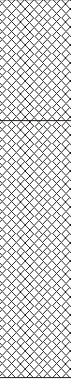




		Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk			Trial Pit Log		Trial Pit No. FE3 Sheet 1 of 1	
Project Name: 103-107 North Hill				Project No.: 19732		Method:		Hole Type TP
Location: 103-107 North Hill, Highgate, London N6 4DP						Plant:		
						Support:		Scale 1:25
Client: Highgate Care Ltd				Trial Pit Length: 0.30m		Trial Pit Width: 0.30m		Logged By DT
Dates: 28/10/2021			Level:		Co-ords:			
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		0.05			Concrete paving. MADE GROUND. Brick rubble. MADE GROUND.	
				0.70			Very soft dark grey sandy CLAY. Frequent fine to medium brick fragments up to 1mb/gl. MADE GROUND.	
				1.30			End of Pit at 1.300m	
1 2 3 4 5								
General Remarks: Starting depth of excavation at 0.35m above GL. No roots/rootlets and groundwater encountered.								Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:								



		Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk			Trial Pit Log		Trial Pit No. FE5 Sheet 1 of 1		
		Project Name: 103-107 North Hill		Project No.: 19732		Method:		Hole Type TP	
Location: 103-107 North Hill, Highgate, London N6 4DP				Plant:		Support:		Scale 1:25	
Client: Highgate Care Ltd				Trial Pit Length: 0.50m		Trial Pit Width: 0.20m		Logged By DT	
Dates: 28/10/2021		Level:		Co-ords:					
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	ES					Very sandy brown CLAY. Frequent fine to coarse subrounded to sub angular flint and brick gravel. Frequent rootlets. MADE GROUND.		
	0.50	ES		0.50 0.60			Crushed brick. MADE GROUND.		
							End of Pit at 0.600m		
General Remarks: Roots and rootlets encountered to 0.50m bgl.									
Groundwater Remarks:									
Sample Type D: Disturbed B: Bulk J: Jar W: Water									

		Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk			Trial Pit Log		Trial Pit No. FE6 Sheet 1 of 1	
Project Name: 103-107 North Hill				Project No.: 19732		Method:		Hole Type TP
Location: 103-107 North Hill, Highgate, London N6 4DP						Plant:		
						Support:		Scale 1:25
Client: Highgate Care Ltd				Trial Pit Length: 0.40m		Trial Pit Width: 0.40m		
Dates: 28/10/2021			Level:		Co-ords:			Logged By DT
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.40			Yellow orange clayey SAND. Occasional fine to medium subrounded to sub angular flint gravel occasional rootlets. Reworked. MADE GROUND.	1 2 3 4 5
	0.50	ES					Soft mottled yellow orange grey CLAY. Rare fine to medium subrounded to sub angular flint gravel. Occasional rootlets. Reworked. MADE GROUND.	
	1.00	ES					End of Pit at 1.250m	
General Remarks: Roots and rootlets encountered to 1.20m bgl.								Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:								

