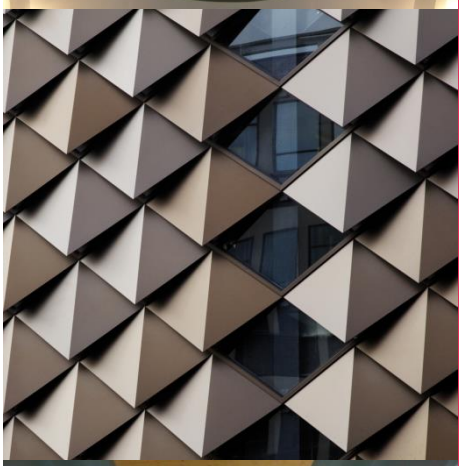

30-32 Chester Road, Northwood

Basement Impact Assessment

Curtins Ref: 080201-CUR-00-XX-RP-GE-001

Revision: V01

Issue Date: 15 June 2022

Client Name: Seymour Care Homes

Client Address: 34-38 Chester Road, Northwood, HA6 1BQ

Site Address: 30-32 Chester Road, Northwood, HA6 1BQ

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Rev	Description	Issued by	Checked	Date
V01	Report for Issue	LP	AS	16/06/2022

This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

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Table of Contents

1.0 Executive Summary

Site Location	**The site is located at 30-32 Chester Road, Northwood, HA6 1BQ, and is under the general authority of Hillingdon Council**
Site Arrangement	The overall site consists of an empty plot of land in between 28 and 34 Chester Road and is approximately 1,100m^2. The topography of the site is approximate 50m AOD at the front of the house, with a gentle slope down to 48m AOD at the rear of the garden.
Proposed Development	The proposed development consists of a 3-storey detached building with a basement to approximately 3m below current ground level.
Project Structure	The following assessments are provided: • Desk Study • Screening • Scoping • Ground Investigation (carried out by others) • Ground Movement Assessment • Basement Impact Assessment
Authors	Liam Pallett – BSc (Hons) MSc GMICE Andrew Smith – BSc (Hons) FGS CGeol MCIWEM RoGEP
Desk Study Findings	British Geological Survey data indicates the site is directly underlain by Made Ground and the London Clay Formation (designated unproductive strata). The site is considered very low risk from flooding due to rivers and seas, and low risk from surface water flooding. There has been residential housing on site and adjacent from the early 1900's, however the building on site was demolished in approximately 2015 and the land has been empty since.
Ground Investigation	A ground investigation has been undertaken by Soiltec Laboratories Ltd on 17th August 2021 which included 2 No. Window Samples down to 6.0 m bgl and in situ geotechnical testing.
Conclusions and Recommendations	On the basis of the information reviewed and subsequent settlement check it is concluded that the development is unlikely to result in any specific land or slope stability issues, groundwater or surface water issues. As the proposed basement is within the influence of proposed trees, a specific tree assessment should be undertaken by the appointed structural engineer following receipt of planning permission.

2.0 Introduction

2.1 Project Objectives

At the request of (The Client), a Basement Impact Assessment (BIA) and Ground Movement Assessment (GMA) has been carried out at the above site in support of a planning application at 30-32 Chester Road, Northwood, HA6 1BQ.

The purpose of this assessment is to consider the effects of a proposed basement construction on the local slope stability, surface water and groundwater regime at the existing residential property. Proposed development drawings are contained in **Appendix A** of this report.

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

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

2.2 Planning Policy Context

The information contained within this BIA has been produced to meet the requirements set out by London Borough of Hillingdon in order to assist with their decision-making process. The relevant policy from Hillington is stated below:

Policy DMHB24: Basement Development

A) When determining proposals for basement and other underground development, the Council require an assessment of the scheme's impact on drainage, flooding, groundwater conditions and structural stability. The Council will only permit basement and other underground development that does not cause harm to the built and natural environment and local amenity and does not result in flooding or ground instability. Developers will be required to demonstrate by methodologies appropriate to the site that their proposals:

- *i) avoid adversely affecting drainage and run-off or causing other damage to the water environment*
- *ii) avoid cumulative impacts upon structural stability or the water environment in the local area;*

and schemes should ensure that they do not:

- *i) harm the amenity of neighbours;*
- *ii) lead to the loss of trees of townscape or amenity value;*
- *iii) provide satisfactory landscaping, including adequate soil depth;*
- *iv) harm the appearance or setting of the property or the established character of the surrounding area;*
- *v) protect important archaeological remains.*

B) The Council will not permit basement schemes which include habitable rooms and other sensitive uses in areas prone to flooding.

2.3 Proposed Development

The proposed development includes the construction of a three storey with basement 29-bed residential care home (Use Class C2) on land at Nos. 30-32 Chester Road.

A proposed basement level of 47.425m AOD is to be constructed which is 3.07m below ground level (bgl). A plan view of the proposed basement is summarised in **Figure 2.1** whilst a section of the proposed building is contained in **Figure 2.2**.

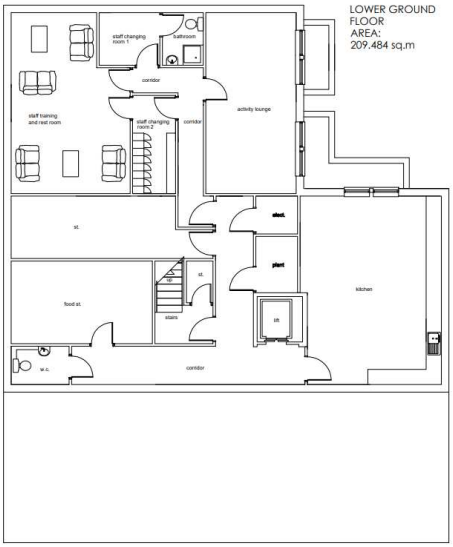


Figure 2.1: *Plan view of the proposed development at 30-32 Chester Road (extract from LF Design Enterprises Drawing Ref: SCH01_20-08)*

Figure 2.2: *Plan view of the proposed development at 30-28 Chester Road (extract from LF Design Enterprises Drawing Ref: SCH0718-14)*

3.0 Desk Study

3.1 Site Location

The site is located at 30-32 Chester Road, Northwood, HA6 1BQ and is approximately 450m southeast of Northwood Station. The site location is summarised in **Figure 3.1**.

Current Site Information

The overall site consists of an empty plot of land in between 28 and 34 Chester Road.

The overall site is approximately 1,100m^2 with a proposed basement footprint of approximately 210m^2. The topography of the site is approximate 50m AOD at the front of the house, with a gentle slope down to 48m AOD at the rear of the garden. The street level is approximately 50.05m AOD from available OS information.

Figure 3.1: *Location of Site on Google Maps* (2)

3.2 Site History

Using available online sources, the history of the site and its surroundings has been summarised in **Table 3.1** below.

Table 3.1: *History of the site and the surrounding area*

Map	Site	Surrounding Area
Hertfordshire XLIV.13 OS Map 1896	Empty Land but Chester Road present as it is today	Some residential housing but mainly empty land.
Hertfordshire XLIV.13 OS Map 1936	Residential housing	Residential Housing, similar to present day
Google Earth Satellite Image 1999	Residential housing	Residential housing, same as present day
Google Earth Satellite Image 2013	Residential housing	Residential housing, same as present day
Google Earth Satellite Image 2015	Demolition of existing residential housing now empty plot of land as it is today	Residential housing, same as present day

3.3 Geology

British Geological Survey (BGS) Data

The BGS 1:50,000 map of Beaconsfield Sheet 255 (3), indicates that there are no superficial deposits below the site. The site is underlain directly by bedrock of the London Clay Formation, which is further underlain by the Lambeth Group and Chalk at depth. The geology of the area is summarised on **Figure 3.2**.

The nearest historical BGS borehole, reference TQ19SW132, is located approximately 490m east from site, shows 1m of Made Ground, underlain by London Clay to a depth of 33m bgl, followed by the Lambeth Group to 40m bgl and then Chalk down to 75m bgl. The borehole encountered groundwater at approximately 54m bgl and rose to 44m bgl within the Chalk after a nominal 20-minute waiting period.

Figure 3.2: *Bedrock Geology of the site from BGS Geology of Britain Viewer 3D* (4)

3.4 Hydrogeology, Hydrology and Drainage

The London Clay Formation is a low permeability unit, which is classified by the Environment Agency (EA) as unproductive strata.

The closest water features to the site is the Ruislip Lido, approximately 1.6km south west of site, and Regent's Canal, approximately 1.9km south east of site.

The nearest water wells to site is approximately 400m northwest and 500m northeast.

The surrounding area is highly developed, and the surface mainly covered with hardstanding, so any rainfall in the area will run-off the hard surface areas and be collected by the local sewer network.

According to gov.uk (5), the site is at low risk of surface water flooding (area has a chance of flooding of between 0.1% and 1%) and is at very low risk of flooding from rivers and the sea (less than 0.1% chance of flooding).

4.0 Screening

4.1 Overview

A screening process has been undertaken in accordance with the most recent guidance from Hillingdon Council and the findings are described below.

4.2 Subterranean (Groundwater) Flow

Question		Response	Details
1a	Is the site located directly above an aquifer?	No	Reference to the data sources detailed in **Section 3.3** indicates that the site is underlain by the London Clay Formation, which is designated as unproductive strata.
1b	Will the proposed basement extend beneath the water table surface?	Unknown	To be confirmed by ground investigation and groundwater monitoring
2	Is the site within 100m of watercourse, well (used/disused) or potential spring line?	No	The site is not within a lost river of London or within 100m of a watercourse, also confirmed by GeoSmart SuDSmart Pro Report Ref: 71270R1
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No	The GeoSmart SuDSmart Pro Report Ref: 71270R1 shows that there is more planned paving, however its permeable paving. It is also stated that the Site has a low potential for infiltration, primarily due to the low permeability of the underlying geology (London Clay), and therefore with increased hardstanding there is no increased risk of surface water flooding.
4	As part of site drainage, will more surface water (e.g., rainfall and run-off) than at present be discharged to the ground (e.g., via soakaways and/pr SUDS).	No	The GeoSmart SuDSmart Pro Report Ref: 71270R1 states that the proposed drainage strategy will include SuDS features including rainwater harvesting butts, permeable paving and a GRP pumping chamber (to attenuate runoff from lower ground floor lightwells). However surface water will be discharged at a restricted rate of 2l/s (via a hydrobrake or similar) to the public surface water sewer. This would ensure surface water runoff is managed according to national and local policy in all events up to and including the 1% AEP event plus a 40% allowance for climate change, as preferred by DEFRA non-statutory guidance (DEFRA, 2015).

Question		Response	Details
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	There are no local ponds or spring lines within proximity to the site

4.3 Slope Stability

Question		Response	Details
1	Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8)?	No	There are no slopes greater than 7 degrees on site
2	Will the proposed re-profiling of landscaping at the site change slopes at the boundary to more than 7 degrees (approximately 1 in 8).	No	Re-profiling of landscaping on the site is not proposed.
3	Does the development neighbour land, including railway cuttings and the like, with a slope more than 7 degrees (approximately 1 in 8)?	No	There are steps down from the road/path down to the site but it is not at a slope of more than 7 degrees
4	Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)?	No	The surrounding area slopes are less than 7 degrees
5	Is the London Clay the shallowest strata at the site?	Yes	Reference to available information from BGS and previous investigations indicate that the London Clay Formation is the shallowest natural stratum on site although there is a variable depth of Made Ground across site.
6	Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	Yes	The development plans indicate that there new trees are to be planted within close proximity to the basement.
7	Is there a history of seasonal shrink-swell subsidence in the local area	No	No subsidence events at the site are known of at the time of preparing this report

	Question	Response	Details
	and/or evidence of such effects at the site?		
8	Is the site within 100m of a watercourse or a potential spring line?	No	There are no watercourses or spring lines within 100m of site
9	Is the site within an area of previously worked ground?	No	Reference to available information from the BGS indicates that the site is not in the vicinity of any worked ground.
10	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction.	No	Reference to the data sources detailed in **Section 3.3** indicates that the site is underlain by the London Clay Formation, which is designated as unproductive strata.
11	Is the site within 5m of a highway or pedestrian right of way?	Yes	The proposed basement is within ~5m of Chester Road.
12	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The basement depths within neighbouring properties are not known at the time of writing but for conservatism it has been assumed that the proposed basement foundation will be deeper than those of the existing neighbouring properties.
13	Is the site over (or withing the exclusion zone of) any tunnels, e.g., railway lines?	No	The nearest underground railway line is the Metropolitan Line ~320m south west based on google maps (2).

4.4 Surface Water and Flooding

	Question	Response	Details
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	On completion of the development the surface water flows will be routed similarly to the existing condition, with rainwater run-off collected in a surface water drainage system and discharged to a combined sewer. Any groundwater flows will not be impeded by the basement.
2	Will the proposed development result in a change in the proportion of hard surfaced / paved external areas?	No	The GeoSmart SuDSmart Pro Report Ref: 71270R1 shows that there is more planned paving, however its permeable paving. It is also stated that the Site has a low potential for infiltration, primarily due to the low permeability of the underlying geology (London Clay), and therefore with increased hardstanding there is no increased risk of surface water flooding.
3	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties?	No	All surface water for the site will be contained within the site boundaries and collected as described in the GeoSmart SuDSmart Pro Report Ref: 71270R1; hence there will be no change from the development on the quantity or quality of surface water being received by adjoining sites.
4	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	There will be no change in the quantity or quality of surface water being received by adjoining sites.
5	Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy of the Strategic Flood Risk Assessment or is at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water features?	No	According to gov.uk website, the site is at low risk of surface water flooding and low risk of flooding from rivers or seas. The proposed basement is 3.07m bgl, and there are no nearby surface water features.

4.5 Summary

The screening process identifies the following issues to be carried forward to scoping for further assessment:

Subterranean (Groundwater) Flow

- Will the proposed basement extend beneath the water table surface?

Slope Stability

- Is the London Clay the shallowest strata at the site?
- Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?
- Is the site within 5m of a highway or pedestrian right of way?
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?

5.0 Scoping

5.1 Subterranean (Groundwater) Flow

Question		Potential Impact	Action(s)
1b	Will the proposed basement extend beneath the water table surface?	Local restriction of groundwater flows (perched groundwater or below groundwater table).	Ground investigation required, then review.

5.2 Slope Stability

Question		Potential Impact	Action(s)
5	Is the London Clay the shallowest strata at the site?	The London Clay Formation is prone to seasonal shrink-swell (subsidence and heave). It is also prone to movement from unloading and reloading during the construction of basements.	Ground Investigation required and then review.
6	Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	The presence of trees can result in shrinkage or swelling which can cause subsidence or heave damage to foundations.	Ground Investigation required and then review
11	Is the site within 5m of a highway or pedestrian right of way?	Excavation of basement could cause loss of support to highway or pedestrian right of way	Ensure adequate temporary or permanent support by use of best practice working method
12	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Excavation for a basement may result in structural damage to neighbouring properties if there is a significant differential depth between adjacent foundations.	Ground Investigation required and then review

6.0 Ground Investigation

6.1 Introduction

A ground investigation has been undertaken by Soiltec Laboratories Ltd on 17th August 2021 which included the following:

- 2 Window Samples of 6.0 m bgl.
- In Situ geotechnical testing

Soiltec Laboratories Report Ref: 03875/14, dated August 2021, has the full details of the investigation. Borehole logs can be found in **Appendix B.**

It should be noted that Curtins have no legal reliance on this Soiltech Laboratories report and no liability can be accepted for inaccuracies in the factual data, information in other data sources or conditions not revealed by the sampling or testing.

6.2 Ground Conditions

Table 6.1: *Summary of the ground conditions encountered from the 2022 Curtins ground investigation.*

Strata	Depth to Top (m bgl)	Elevation (m AOD)	Thickness (m)	Description
Made Ground	0.00	50.05	0.8 to 0.9	Loose flint gravel over clay/brick/flint fill with abundant roots
London Clay Formation	0.8 to 0.9	49.15 to 49.25	5.10* to 5.20*	Soft to firm becoming stiff light brown slightly mottled grey silty CLAY.

*- maximum thickness of London Clay at the site recorded.

6.3 Groundwater

Groundwater was not encountered during the investigation. The nearest historical BGS borehole, reference TQ19SW132 located approximately 490m east from site encountered groundwater at approximately 54m below ground level (m bgl) within the Chalk.

Due to the non-aquifer status of the London Clay Formation below the site, it is likely that any shallow groundwater levels present below the site will be perched groundwater within the Made Ground rather than related to any large-scale subterranean groundwater flows below the site or surrounding area.

6.4 In-Situ and Laboratory Testing

Hand Shear Vanes

Hand Shear Vanes were carried out in the exploratory holes and gave 12 No. results, which are displayed in **Figure 6.1** below. These are further interpreted in **Section 7.2.3**.

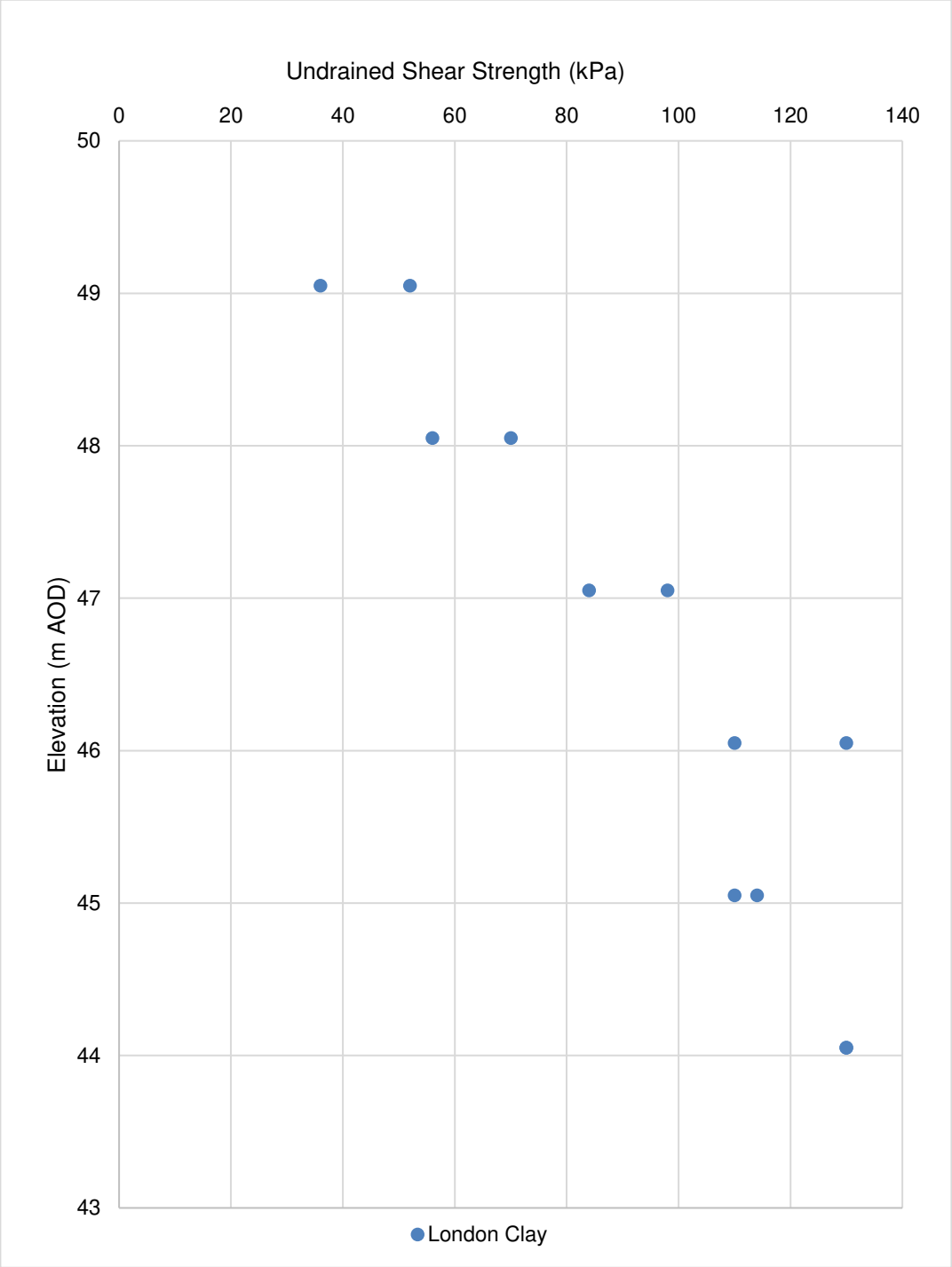


Figure 6.1: *Hand Shear Vane Test Results*

Moisture Content and Atterberg Limit Testing

4 No. samples underwent Atterberg Limit Testing with the results summarised in below and in Figure 6.2.

- Liquid Limits between 66% and 80%
- Plasticity Indices between 43% and 53%
- Moisture Contents between 22.3% and 38.4%.

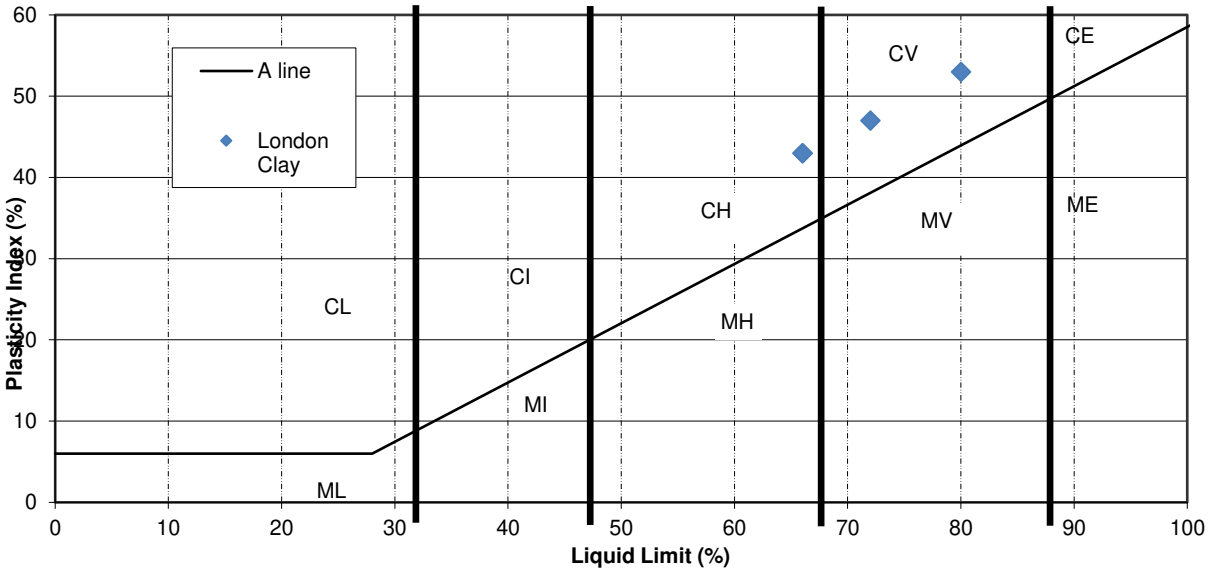


Figure 6.2: *Atterberg Limit Results*

7.0 Construction Methodology / Engineering Statements

7.1 Outline Temporary and Permanent Works Proposal

As part of the construction works, a 3-storey building is proposed with basement. These can be seen in **Figure 2.1** and **2.2**. The basement works are proposed to a depth of approximately 3.075m bgl (47.425m AOD). At this stage there are no details on the temporary and proposed works. Therefore in an absence of information, it has been assumed that the foundations are to be piled and the floor slab will be suspended.

If ground bearing slabs are proposed, it is recommended that all formation levels of ground bearing slabs are be inspected by a suitably qualified Geotechnical Engineer and any soft/loose spots within the natural bearing stratum are over excavated and replaced with engineered granular fill.

Foundation excavations should be protected from water and inclement weather (including hot weather and frost). Foundations should be extended below the zone of influence of existing or proposed trees on site using guidance from NHBC Chapter 4.2 (2021) (7). This may require some over excavation locally.

The Principal Designer and Principal Contractor should be informed of the site conditions and risk assessments should be undertaken to comply with the Construction Design and Management regulations (2015) (8).

7.2 Ground Movement and Damage Impact Assessment

7.2.1 Introduction

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

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

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

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

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

Ground movements within the area of the proposed excavations have been estimated using Geotechnical Software (PDISP by OASYS) whilst the expected movements and impact assessment of the area around the site and surrounding structures have been estimated using Geotechnical Software (XDISP by OASYS). The latter software relies on CIRIA report C580 Embedded Retaining Walls - Guidance for Economic Design (9) (superseded by C760, 2017 (10)) which is based on field measurements of movements from a number of basement constructions across London.

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

7.2.2 Adjacent Properties

The properties or structures more likely to be affected by ground movements associated with the proposed basement construction, are shown in **Table 7.1**, as well as the labelled walls under analysis in **Figure 7.1** below.

Table 7.1: *Summary of Adjacent Properties*

Building Name	Description	Approximate Height (from ground level to top of roof)	Closest Distance from Proposed Basement
28 Chester Road	2-storey residential building with roof conversion	11	3.85m
34 Chester Road	3-storey detached building (Residential care home)	11	2.1m

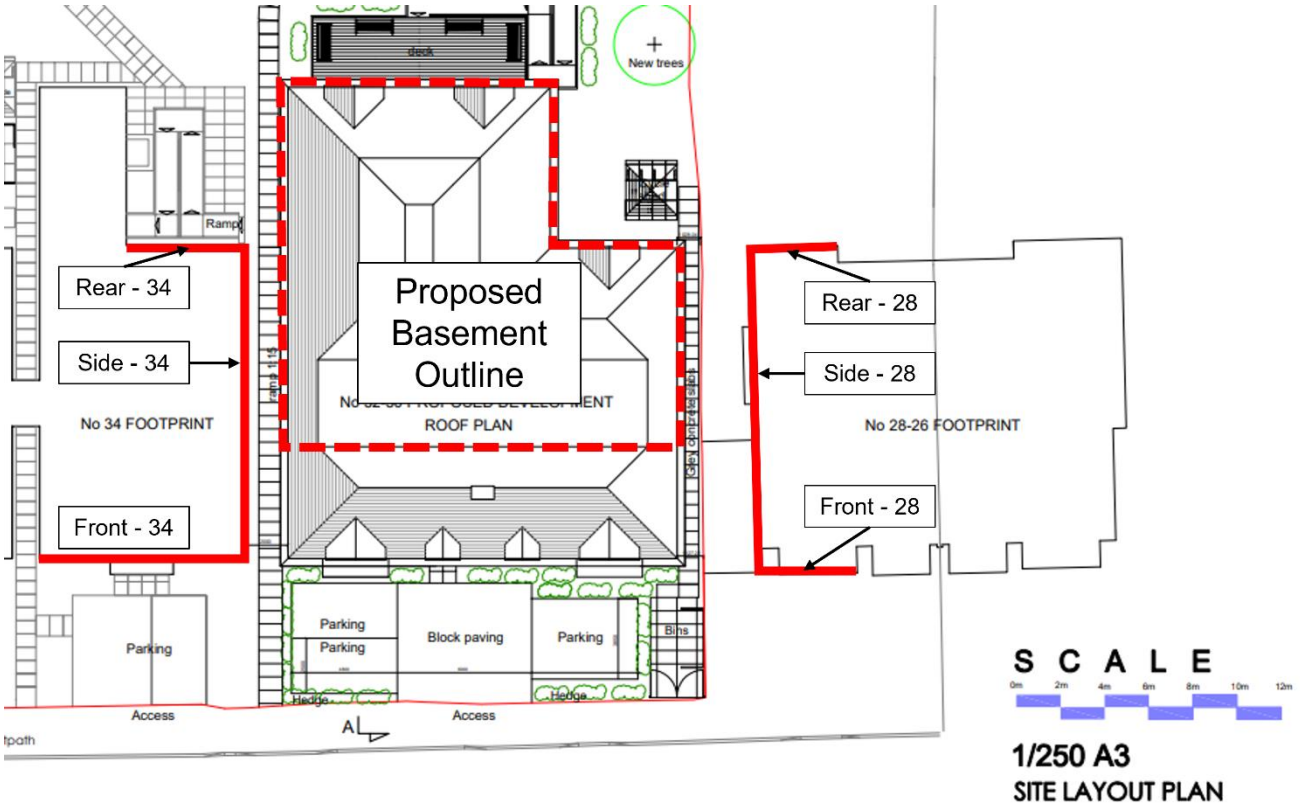


Figure 7.1: *Drawing from LF Design Enterprises Ref: SCH01_20-06 showing adjacent properties, the walls under analysis and the proposed basement*

7.2.3 Ground Model

The ground model utilised for this assessment is based on the site-specific ground investigation undertaken by Soiltec Laboratories at the site (August 2021). It should be noted that Curtins can take no liability for inaccuracies in the factual data from the site specific nor adjacent site investigations.

The ground conditions adopted within the model and analysis are in accordance with the ground conditions inferred from worst case boreholes across site as a conservative case and comprise:

- Made Ground to a depth of 0.9m bgl (49.15m AOD);
- London Clay to a depth of 6m bgl (40.5m AOD).

Ground level has been taken as 50.05m AOD based on available topographical information with an existing basement level of 47.425m AOD used for the model.

The method of Ground Movement Analyses undertaken requires soils stiffness parameters to be used. In accordance with BS8004:2015 (11) section 4.3.1.6 'Soil Stiffness' it is acknowledged that both the drained and undrained stiffness moduli of soils (E', E_u) are highly dependent on the strain level applicable to the engineering problem considered. The change in axial strain will directly influence the resultant stiffness of the soil, and in turn the stiffness of the soil will influence the strain exhibited.

Therefore, in order to define stiffness modulus applicable to the engineering problem considered, it is necessary to assess the magnitude of axial strain which the soil will be subjected to. In accordance with the recommendations made in BS8004:2015 (11) the strain generally applicable to foundations design is in the range of 0.075 to 0.2%.

The material properties used for the analysis of the ground movements have been interpreted. Where necessary, determination of characteristic parameters has been based on a cautious estimate of results derived from laboratory, published correlations and field tests, complemented with engineering judgement. The parameters are not considered to be absolute and should not be used for design.

<u>Made Ground</u>

No testing was carried out in the Made Ground on site. Therefore, to be conservative, design parameters for the Made Ground will be E' and E_u = 3MPa, and a Poisson's ratio of 0.2 following guidance from Burland, Standing, Jardine (2001). A bulk unit weight of 16kN/m^3 is considered appropriate for design based on guidance from BS5930:2015 (12).

London Clay

6 No. Hand Shear Vane Tests gave results between 36kPa and 130kPa between elevations of 44.05m AOD and 49.05m AOD. It should be noted that 130kPa is the limit of the equipment and the undrained shear strength values could be higher. The analysis is therefore conservative.

These results would classify the London Clay as a Low to High Strength Clay in accordance with BS5930:2015 (12). **Figure 6.2** displays the derived undrained shear strength results, and shows that a general trend of an increase in depth, and can be defined using the design line:

$s_u = 36 + 18.8z$ where z = depth below 49m AOD.

Based on the maximum (i.e. most conservative) axial strain of 0.2% prescribed in BS8004:2015 (11), the following correlation has been used to determine the Young's Modulus (E_u) of the London Clay Formation. The relation has been taken from ICE manual of geotechnical engineering (2012), Volume II, chapter 53.7.2 (Page 792) (13) and matches ratio of Young's Modulus/Undrained shear strength (E_u/s_u) at 0.2% axial strain recommended in Tomlinson (7th,2001) (14):

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

The ratio of end of construction (Undrained) settlement to total settlement (fully drained) was taken as 60% as specified in ICE manual of geotechnical engineering (2012), Volume II, chapter 53.6 (Page 783) (13). Therefore:

E' = 200 x s_u (kN/m^2)

A Poisson's ratio of 0.45 is typical for soils with an extremely high PI (>32%) in the short term, and 0.4 in the long term, based on guidance from Look, 2007 (15). A bulk unit weight of 20kN/m^3 is considered appropriate for design in the long term, based on guidance from Look, 2007 (15).

The strata depths and thickness' for the ground model have been taken as worst case (BH01) and are summarised in **Table 7.2** below. The base of the model has been taken as being 6m bgl (44.05m AOD).

Table 7.2: *Summary of Design Parameters*

Stratum		Level at Top (m AOD)	Unit Weight (kN/m^3)	Short Term (Undrained)		Long Term (Drained)	
				E_u (kPa)	ν	E' (kPa)	ν
Made Ground		55.05	16	3000	0.2	3000	0.2
London Clay	Top	49.15	20	11,880	0.45	7,200	0.4
	Base	44.05		42,900		26,000	

7.2.4 Ground Movement inside the proposed basements

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

The stress conditions and resultant settlement/heave have been assessed using the Boussinesq's method and geotechnical software PDISP by Oasys. PDISP calculates vertical movements due to a uniformly distributed load applied to a specified plane of geometry within a 3-D space. The Boussinesq analysis method is used in this analysis.

The following assumptions have been made within the PDISP analysis:

- Assumes Boussinesq stress distributions.
- Uniform pressure loading.
- No allowance is made for the stiffness of the structures (foundation slab).
- It is anticipated that there will be no delay in construction following the excavation of the basement due to the proposed piling construction method. Therefore drained parameters have been utilised to demonstrate 'worst case' settlements for the modelling.

Removal of the overburden calculated using assumed unit weights 16kN/m^3 for Made Ground and 20kN/m^3 for London Clay, and the thickness of strata, will cause maximum unloading stresses of up to 57.9kPa at the base of the basement slabs. As it has been assumed that the foundations will be piled and floor slab suspended, there has been no load given for the basement.

The vertical boundary of the model was fixed at 6m bgl (44.05m AOD). At this depth the effective vertical stress due to foundation unloading decreases to in excess of 20% of the effective overburden as required in EC7.

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

PDISP Results

The results show that in the long-term following construction of the basements, approximately 7mm heave and no settlement is detailed within the footprint of the basement excavation.

PDISP uses individual layer properties to calculate the displacements resulting from applied stresses. The heave values described are considered to be overestimated and therefore conservative. It should be noted, Bowles in his text (Foundation Analysis and Design-Fifth Edition) states that "In general, where heave is involved, considerable experience and engineering judgement are necessary in estimating probable soil response, for currently there are no reliable theories in for the problem".

Final designs for the basement retaining walls, basement slabs and internal load-bearing basement walls and columns should be designed to support heave movements. These movements should be driven into account particularly at party walls where additional loadings are proposed. Any proposed drainage system or pipe works within the vicinity should be designed to accommodate the predicted movements. The PDISP analysis output showing the movements for load case 1 are presented in **Figure 7.2**.

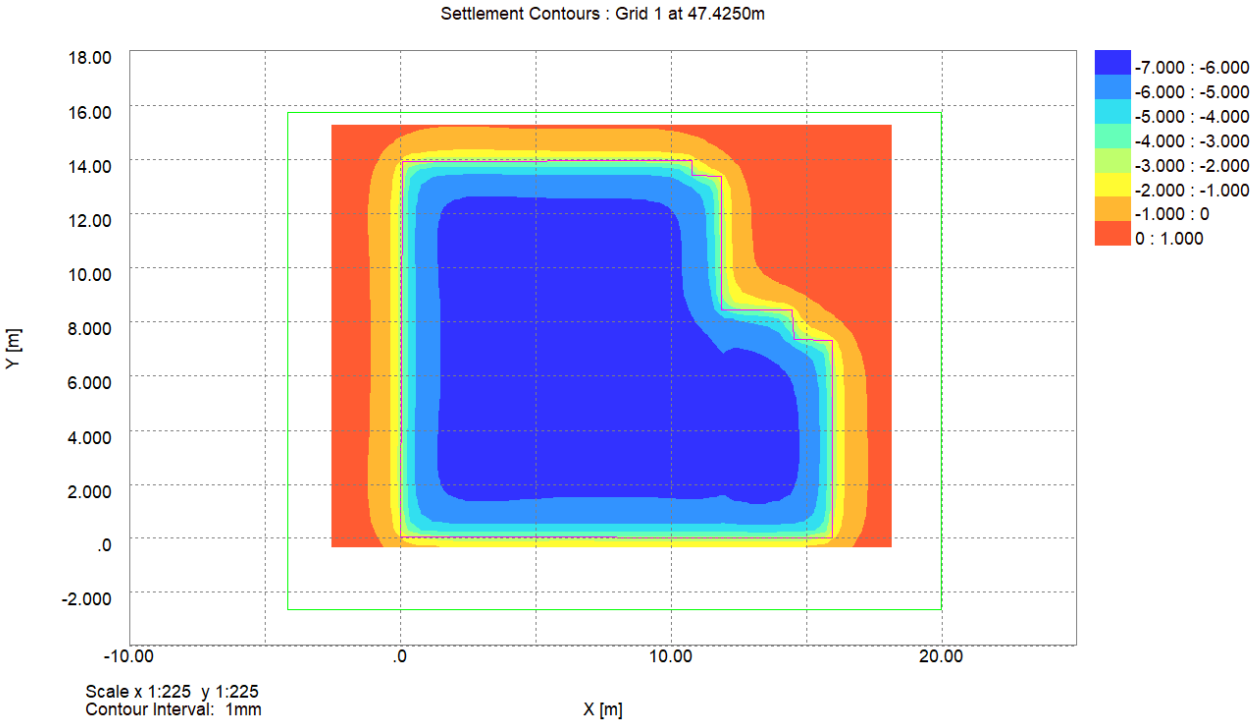


Figure 7.2: *Results of the drained PDisp model*

7.2.5 Ground Movement outside the proposed basement

Ground movements have been analysed using XDISP by Oasys and a building damage assessment has been undertaken based on the results of the analysis. Contours of vertical and horizontal ground movements are presented in **Figure 7.5**. As detailed in the proposal drawings in **Appendix A**, the new basements are to be constructed to a depth of approximately 3.075m bgl (47.425m AOD).

Currently, methods for construction of the basement are unknown, and therefore worst case has been analysed. The XDISP analysis considers 'installation of a contiguous bored pile wall in stiff clay' (CIRIA C760 Fig. 6.8 (10)) to simulate this worst case.

Stiffened walls have been used in the analysis which assumes adequate propping and workmanship.

Where necessary and due to the irregular shape of the proposed basement, several polygons or composite excavations have

The existing lower ground floors and basements beneath adjacent buildings have been ignored in modelling for conservatism.

Building Damage Assessment

The building damage assessment has been carried out on the relevant adjacent structures, as detailed in **Figure 7.1**.

Tensile strains induced within the building walls have been evaluated based on the deflection ratios Δ/L and horizontal extension mechanisms estimated from the analyses. The assessment considers the well-established Burland (1977) (16) damage classification method, as presented and summarised in **Figure 7.3** and **7.4** below. This method involves a relatively simple but robust means of assessment, which is widely adopted and is considered to comprise an industry standard/best practice basis for impact assessments of this typology.

Potential damage categories are directly related to the tensile strains induced by the proposed construction stages, arising from a combination of direct tension, and bending induced tensile mechanisms.

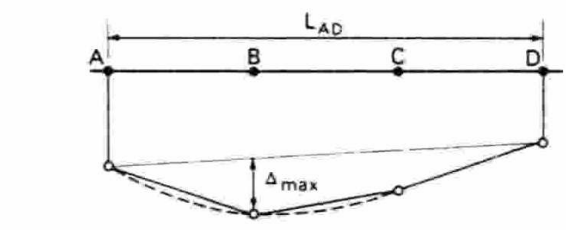


Figure 7.3: *Definition of relative deflection Δ and deflection ratio Δ/L*

Category of damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain ε_{lim} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible.	< 0.1	0.0–0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.	< 1	0.05–0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	< 5	0.075–0.15
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. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5–15 or a number of cracks > 3	0.15–0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 but also depends on number of cracks	> 0.3
5 Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	usually > 25 but depends on number of cracks.	

Figure 7.4: Building damage classification – relationship between category of damage and limiting strain ε_{lim} (After Burland et al. 1977 **(17)**, Boscardin and Cording 1989 **(18)**, and Burland 2001 **(19)**)

Results

A building impact/damage assessment has been undertaken, assuming the existing buildings walls to behave as equivalent beams subject to a combination of bending, shear, and axial extension/compression mechanisms, resulting from greenfield ground movements evaluated.

On the basis of the available information the predicted level of damage to surrounding houses arising from the excavation of a basement at 30-32 Chester Road is “negligible”. The above analyses assumes a high standard of workmanship.

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

Despite these results it is considered that appropriate consideration to the support and stability of neighbouring walls will be needed in the detailed structural design of the basement.

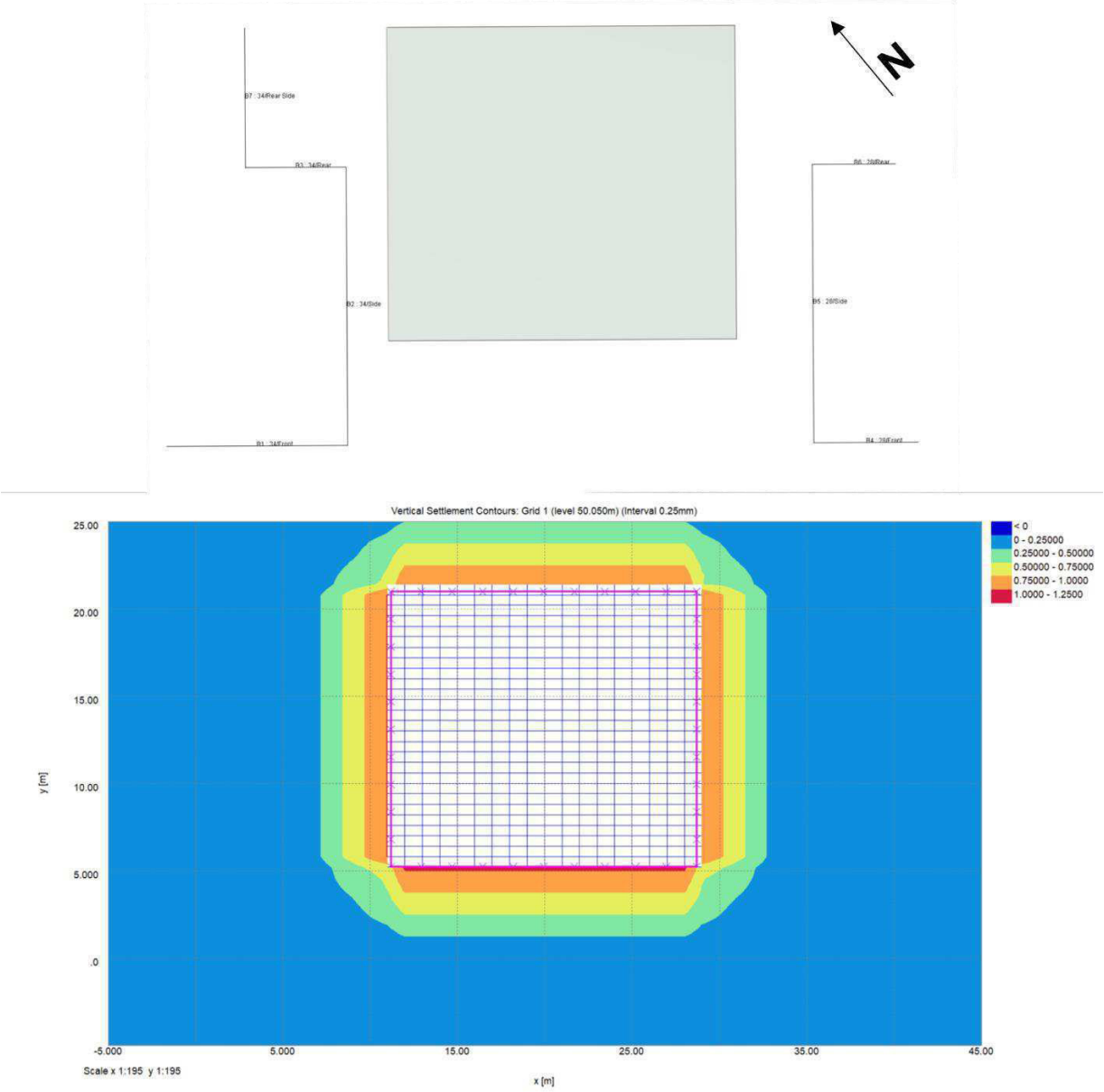


Figure 7.5: *Results of the XDISP model and the labelled walls under analysis*

7.3 Control of Construction Works

The predictions of ground movement based on the ground movement analysis could be checked by monitoring of the adjacent properties and structures if deemed necessary by the main contractor. Condition surveys of the above existing structures could be carried out before and after the proposed works.

Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure which is considered to be able to be managed through a conventional sump pump system.

8.0 Basement Impact Assessment

8.1 Conceptual Site Model

The Conceptual Site Model (CSM) is described below.

The exploratory boreholes revealed ground conditions that were generally consistent with the findings available from the British Geological Survey and known history of the area, comprising up to 0.9m of Made Ground, overlying the London Clay to a maximum proven depth of 6m bgl (44.05m AOD). The nearest BGS borehole shows that the London Clay Formation extends to a depth of 33m bgl whilst groundwater was encountered at 54m bgl within the Chalk.

8.2 Subterranean (Groundwater) Flow

An assessment of the subterranean flow with reference to the construction methodology and site-specific ground and water conditions is summarised in the table below.

Impact	Site Investigation Conclusions	Impact Sufficiently Addressed?
Will the proposed basement extend beneath the water table surface?	Groundwater was not encountered during drilling, and a nearby BGS borehole indicates presence of groundwater approximately 54m below ground level (m bgl) within the Chalk. Due to the non-aquifer status of the London Clay Formation below the site, it is likely that any shallow groundwater levels present below the site will be perched groundwater within the Made Ground rather than related to any large-scale subterranean groundwater flows. It therefore considered unlikely that the basement will extend below the existing groundwater level and will not alter current pathways of groundwater flow.	Yes

8.3 Slope Stability

An assessment of the land stability/slope stability with reference to the construction methodology and site-specific ground and water conditions is summarised in the table below.

Impact	Site Investigation Conclusions	Impact Sufficiently Addressed?
Is the London Clay the shallowest strata at the site?	The London Clay underlays a maximum thickness of 0.9m of Made Ground. For the purposes of this analysis it has been assumed that the building columns will be piled with a suspended floor slab however it is expected that heave protection (collapsible void former) will be provided to protect any ground bearing elements. The London Clay Formation is therefore not considered to represent a risk in terms of land stability to the foundations.	Yes
Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	The site investigation indicates that the London Clay is of high volume change potential. In terms of pre-existing trees, a tree survey was carried out by Arbtech in October 2020 and concludes no existing trees of significance will be affected by the proposed construction. In the proposed development plans, it can be seen that 3 No. new trees will be planted, with one within ~3.5m of the proposed basement, with the species of these trees being unknown. As the proposed basement is within the influence of proposed trees, a specific tree assessment should be undertaken by the appointed structural engineer following receipt of planning permission.	Yes
Is the site within 5m of a highway or pedestrian right of way?	The proposed basement is not to be extended below Chester Road and it is suggested that the impact on this access road is likely to be minimal. There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of the public highway.	Yes
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	A Ground Movement Assessment has been carried out as part of this analysis. On the basis of the available information the predicted level of damage to surrounding houses arising from the excavation of the basements is negligible.	Yes

8.4

8.4 Summary of Basement Impact Assessment

A Basement Impact Assessment has been carried out at 30-32 Chester Road following the information and guidance published by the London Borough of Hillingdon. Potential impacts have been sufficiently addressed and do not need further justification.

It is concluded that given good workmanship, the proposed basement can be constructed without imposing any damage more than limit sensitivity on adjacent properties.

The development is not likely to significantly affect the existing local groundwater regime. It is not considered that the proposed basement would result in a significant change to the groundwater flow regime in the vicinity of the proposal.

As the proposed basement is within the influence of proposed trees, a specific tree assessment should be undertaken by the appointed structural engineer following receipt of planning permission.

9.0 References

2Google Maps*Google Maps*google.com/maps

3**British Geological Survey***Geological Survey of England and Wales 1:63,360/1:50,000 geological map series, Beaconsfield, Solid and Drift* 2005

4**Geology of Britain 3Dhttp://mapapps.bgs.ac.uk/geologyofbritain3d/**

5Flood Risk Map - Gov.uk*Flood Risk Map - Gov.uk*https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=539085.41&northing=181720.32&map=RiversOrSea

7NHBCNHBC Chapter 4.2: Building Near Treeshttps://nhbc-standards.co.uk/4-foundations/4-2-building-near-trees/

8GOV.ukConstruction, Design and Management Regulations 2015https://www.legislation.gov.uk/uksi/2015/51/contents/made

9CIRIA*CIRIA C580 Embedded Retaining Walls - Guidance for Economic Design*CIRIA2003

10*CIRIA C760 Guidance on embedded retaining wall design*CIRIA2017

11BSI Standards Publication*BS 8004:2015+A1:2020 Code of Practice for Foundations*BSI Standards Publication2015

12*BS 5930:2015+A1:2020 Code of Practice for Ground Investigations*BSI Standards Publication2015

13*ICE manual of geotechnical engineering (2012), Volume II*ICE2012

14Foundation Design and ConstructionPearson200174

15*Hand Book of Geotechnical Investigation and Design Tables*Taylor & Francis2007978-0-415-43038-8

16*Behaviour of foundations and structures*

17*Burland, J., Broms, B. and de Mello, V. 1977. Behaviour of foundations and structures. Proc. 9th ICSMFE, State of-the-art Vol., 495-546*

18*Boscardin, M. D., & Cording, E. J. (1989). Building response to excavation-induced settlement. Journal of Geotechnical Engineering, 115, 1-21. doi:10.1061/(asce)0733-9410(1989)115:1(1)*

19*Burland, J.B. 2001. Building Response to Tunnelling: Case Studies from Construction of the Jubilee Line Extension. Report number: CIRIA Special Publication 200*

20*The Lost Rivers of London: A Study of Their Effects Upon London and Londoners, and the Effects of London and Londoners on Them*Historical Publications Ltd1992

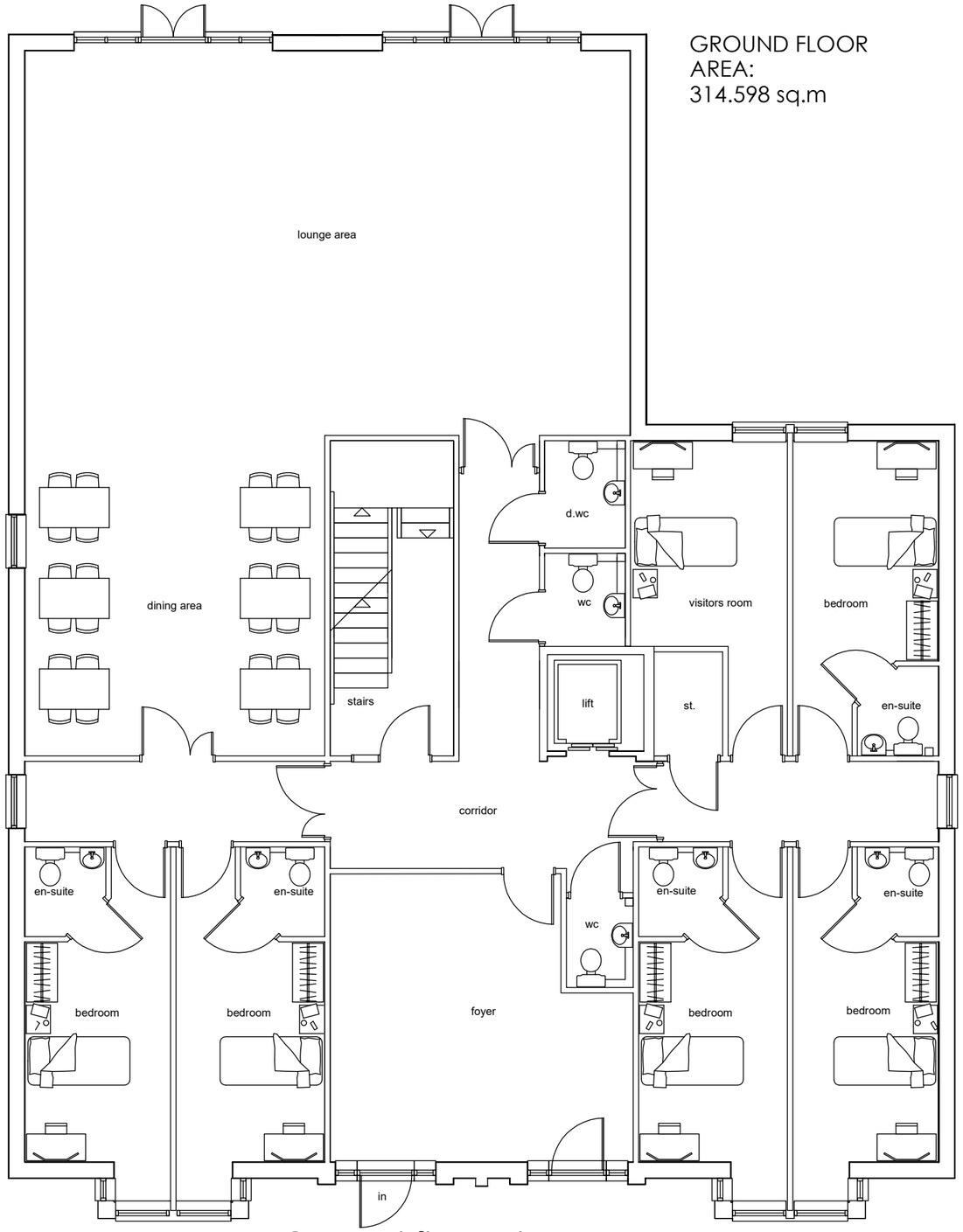
21 British Geological Society *North London, England and Wales Sheet 256, Bedrock and Superficial Deposits, 1:50,000* British Geological Society 2006

22 *The Standard Penetration Test in insensitive clays and soft rocks. Proceedings of he European Symposum on Penetration Testing* 1975

10.0 Appendices

Appendix A Proposed Development Plans

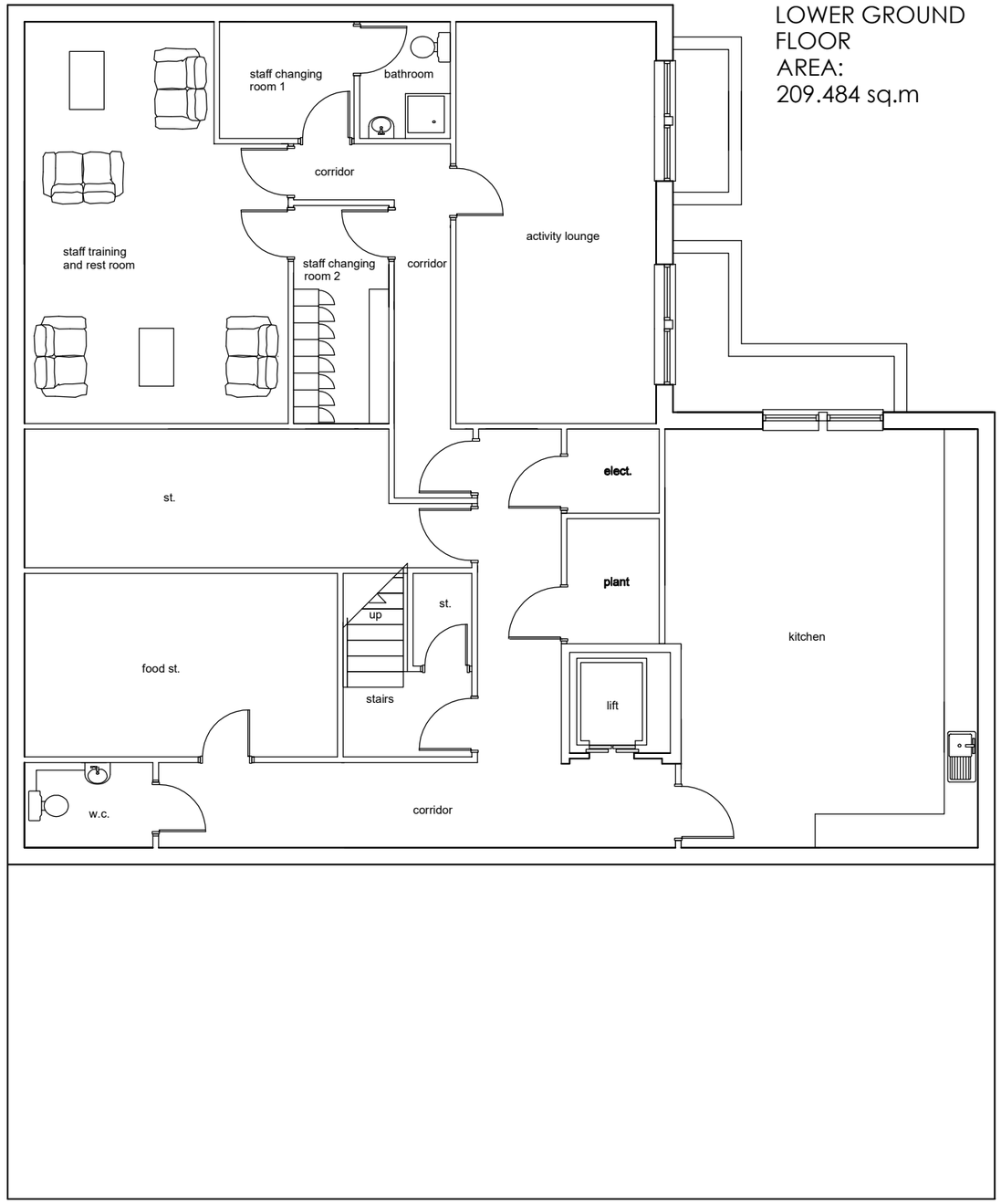
GROUND FLOOR
AREA:
314.598 sq.m



Ground floor plan

Proposed development
32-30 Chester road

LOWER GROUND
FLOOR
AREA:
209.484 sq.m



Lower ground floor plan

Proposed development
32-30 Chester road

SCHEDULE
Accommodation 29 bedrooms,
2 bathrooms,1wet/shower room

S C A L E
0m 1m 2m 3m

1/100 A3
GROUND / LOWER GROUND FLOOR PLANS

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URBAN DESIGN & ARCHITECTURAL SERVICES
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Mob: 07914 55-35-63
E-mail: info@art-gift.uk
www.fenwicks-design.co.uk

CLIENT Seymour House Residential Care Homes LTD		PROJECT NUMBER	**DATE** February 2020
PROJECT TITLE Proposed development, Residential Care Home 38 - 30 Chester Road, Northwood London	DRAWING TITLE **Ground /Lower Ground floor plans.** 32-30 Chester road		SCALE A3@1:100
	DRAWING № SCH01_20-08		**REV.**

Cross-section A-A

Proposed development 32-30 Chester road

S C A L E

0m 2m 4m 6m 8m 10m

1/200 A3

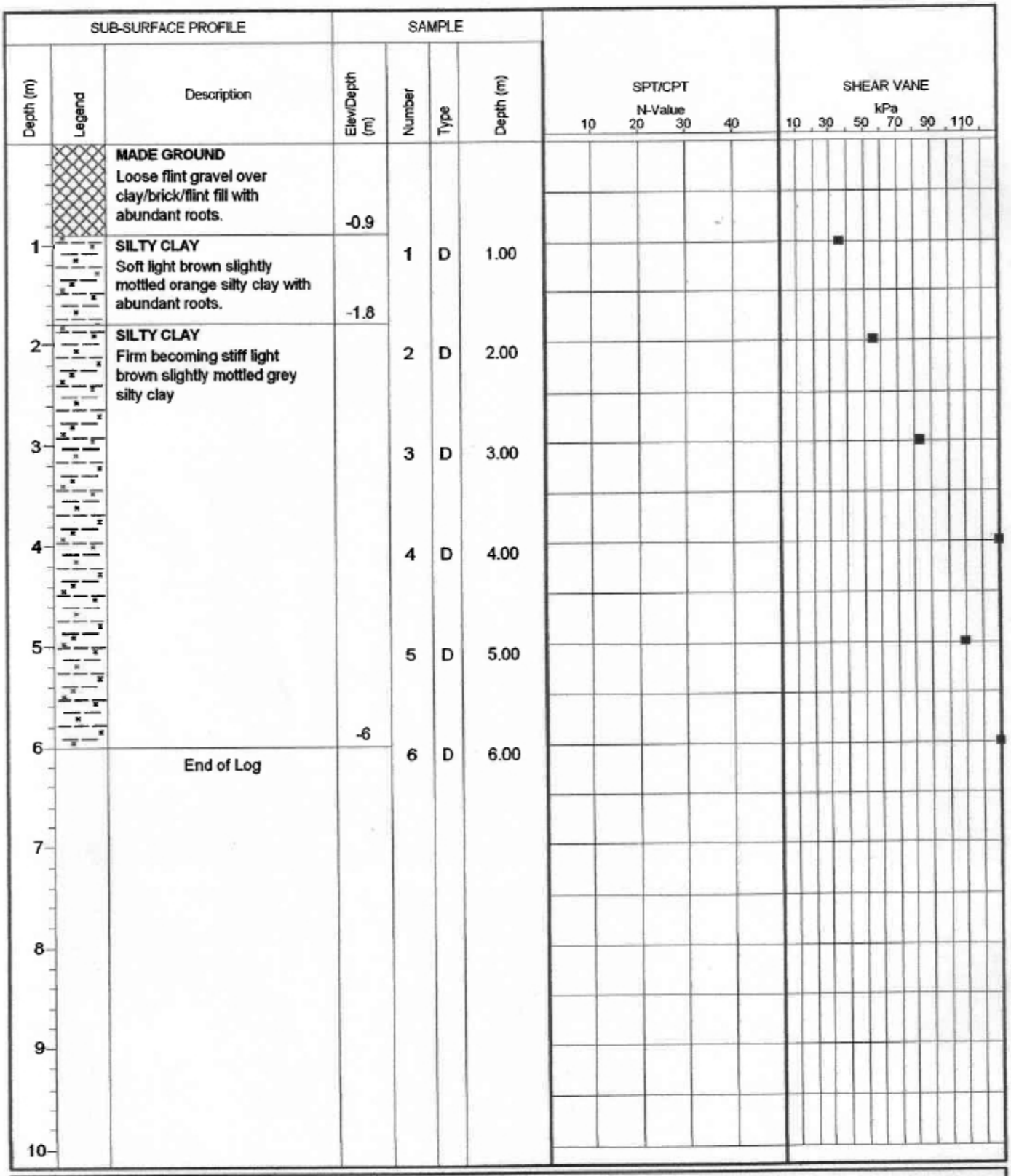
CROSS-SECTION A-A

LF DESIGN ENTERPRISES URBAN DESIGN & ARCHITECTURAL SERVICES 37 Douglas Av. ST4 5JY Stoke-on-Trent Tel: 01782 411 847 Mob: 07914 55-35-63 E-mail: info@art-gift.uk www.fenwicks-design.co.uk	**CLIENT** **Seymour House Residential Care Homes LTD** PROJECT TITLE Proposed development, Residential Care Home 38 - 30 Chester Road, Northwood London	PROJECT NUMBER DRAWING TITLE **Cross- section A-A** 32-30 Chester road **DRAWING №: SCH0718-14**	**DATE** February 2020 SCALE A3@1:200 REV.

Appendix B Borehole Logs

Client: Seymour House Residential Care Homes Limited
Project: 30 – 32 Chester Road, Northwood, Middlesex, HA6 1BQ
Project No: 03875/14
Date: 17/08/2021

Borehole No: 1



Water Strike : none

SOILTEC LABORATORIES LIMITED

Drill Method : Window Sampler

Water after 15mins :

Sheet : 1 of 1

Client: Seymour House Residential Care Homes Limited
Project: 30 – 32 Chester Road, Northwood, Middlesex, HA6 1BQ
Project No: 03875/14
Date: 17/08/2021

Borehole No: 2

Depth (m)	Legend	Description	Elev/Depth (m)	Sample Number	Sample Type	Sample Depth (m)
		MADE GROUND Loose flint gravel over clay/brick/flint fill with abundant roots.	-0.8			
1		**SILTY CLAY** Firm light brown slightly mottled orange silty clay with abundant roots to 1.80m.		1	D	1.00
2			-2.2	2	D	2.00
		SILTY CLAY Stiff light brown slightly mottled grey silty clay				
3				3	D	3.00
4				4	D	4.00
5				5	D	5.00
			-6			
6		End of Log		6	D	6.00
7						
8						
9						
10						

SPT/CPT N-Value: 10, 20, 30, 40

SHEAR VANE kPa: 10, 30, 50, 70, 90, 110

Water Strike : none

SOILTEC LABORATORIES LIMITED

Drill Method : Window Sampler

Water after 15mins :

Sheet : 1 of 1

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