Providing Ground Solutions

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13 Kylemore Road, Camden

Interpretative Site Investigation and Basement Impact Assessment Report

December, 2016

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1. INTRODUCTION

It is proposed to redevelop 13 Kylemore Road in the London Borough of Camden (LBC). The proposed redevelopment includes the deepening of the existing basement and the excavation of part of the front garden to create a lightwell and secondary access to the basement. Card Geotechnics Limited (CGL) has been instructed to undertake a *Basement Impact Assessment* (BIA), including a detailed ground movement analysis for the proposed development to determine its potential effect on nearby structures, services, surface water runoff and groundwater flow.

The London Borough of Camden's guidance document *"CPG4, Basements and Lightwells"*[1], requires a Basement Impact Assessment (BIA) to be undertaken for new basements in the Borough and sets out 5 stages for a BIA to "enable the Borough to assess whether any predicted damage to neighbouring properties and the water environment is acceptable or can be satisfactorily ameliorated by the developer". The five stages are set out below:

1. Screening
2. Scoping
3. Site investigation
4. Impact assessment
5. Review and decision making

This report is intended to address the screening, scoping, site investigation and impact assessment stages identified above. It identifies the key issues relating to land stability, hydrogeology and hydrology as part of the screening process (Stage 1) and includes a review and interpretation of existing site investigation data to establish a conceptual site model (Stages 2 and 3). The report provides an impact assessment (Stage 4) of potential ground movements on adjacent structures and the hydrogeology of the surrounding area for the purposes of planning. In addition, the report provides geoenvironmental recommendations with respect to human health and disposal of arisings from the basement excavations.

[1] Camden Planning Guidance, CPG4, Basements and Lightwells, July 2015.

2. SITE CONTEXT

2.1 Site location

The site is located at No.13 Kylemore Road, London, NW6 2PS. The National Grid Reference for the approximate centre of the site is 525273E, 184463N. The site location is shown in Figure 1.

2.2 Site description

The site currently comprises a mid-terrace residential property with two above-ground storeys and a single below-ground storey of reduced head height. The property includes a rear garden at lower ground floor level and a front garden at upper ground floor level. Ground level at the property is some 43.96 metres above Ordnance Datum (mOD) in the front garden and 42.94mOD in the rear garden. The existing basement is founded at some 42.79mOD.

The existing floor levels at the site are staggered between the front and rear elevations and for clarity, the existing floor at front garden level is referred to as the 'upper ground floor', the floor at rear garden level is referred to as the 'lower ground floor' and the floor beneath the upper ground floor, accessed from the lower ground floor, is referred to as the 'basement'. This is further detailed in Figure 2.

The property shares party walls with 11 and 15 Kylemore Road, to the north and south, respectively, and is bounded by the highway and pavement of Kylemore Road to the west and the rear garden of No.17 Gladys Road to the east.

Visual observations of the surrounding properties indicates the presence of lower ground floor or basement levels at the neighbouring properties, similar to the subject site. A review of local planning applications suggests that these properties have not been significantly modified from their original design with additional basement levels or similar.

2.3 Proposed development

The proposed development plans include above ground extensions at roof and lower ground floor levels and deepening of the existing basement level by some 0.6m to create a habitable space, with the deepened basement founded at some 41.66mOD. In addition, part of the front garden is to be excavated to basement level (41.66mOD), an excavation depth of some 2.3m, to create a lightwell and secondary access to the basement. Proposed development plans are presented as Appendix A.

2.4 Site history

A review of available historical mapping indicates that the site was constructed in the late 1800s or early 1900s, prior to which it comprised open farmland. The surrounding area was developed at a similar time, changing from a primarily rural environment to a residential area. A number of railways, and associated infrastructure, were also present to the north of the site.

A review of the London County Council Bomb damage maps[2] indicates that the site did not suffer bomb damage during the Second World War, however buildings on Gladys Road, some 50m east of the site, are noted to have suffered general blast damage, with two buildings 'damaged beyond repair'.

2.5 Topography

A spot height elevation of 44.7 metres above Ordnance Datum (mOD) is noted on Kylemore Road, to the immediate west of the site. A review of Ordnance Survey mapping indicates that the site slopes gently towards the west.

2.6 Published geology

The British Geological Survey (BGS) sheet[3] of the area indicates that the site to be underlain by the London Clay Formation with no record of superficial deposits on site.

The London Clay Formation is an over-consolidated firm to very stiff, becoming hard with depth, fissured, blue to grey silty clay of low to very high plasticity. The upper and lower parts may contain silty or fine grained sand partings. The stratum may also contain laminated, structured, nodular claystone and rare sand partings. Crystals of gypsum

[2] London Topographical Society (2005). *Bomb Damage Maps 1939-1945*. The London City Council.
[3] British Geological Survey Sheet 256 (1993) *North London – Solid and Drift Geology* 1:50,000. Keyworth, BGS.

(selenite) are often present within the weathered London Clay Formation. The stratum is generally horizontally bedded.

BGS basal contour mapping demonstrates the base of the London Clay Formation is present below the site to an elevation of approximately -20.0mOD, suggesting an overall thickness of approximately 50m on site.

2.7 Unpublished geology

Records of historical boreholes within 550m of the site have been reviewed and are presented as Appendix B. A summary of the information from these records is provided in Table 1.

Table 1. Summary of BGS borehole records

BH record reference	Distance (m)	Direction	Base of BH (mOD) [mbgl]	Ground water level (mOD) [mbgl]	Depth to top of stratum (mOD) [mbgl]		
					Made Ground or Topsoil	Weathered London Clay Formation	London Clay Formation
TQ28SE445	550	SE	25.53 [15.25]	DRY	40.78 [0.0]	40.33 [0.45]	32.38 [8.4]
TQ28SE446	550	SE	34.5 [7.6]	DRY	42.1 [0.0]	41.8 [0.3]	NP[1]
TQ28SE447	550	SE	35.72 [7.6]	DRY	40.35 [0.0]	38.45 [1.9]	NP
TQ28SE448	550	SE	26.21 [15.25]	DRY	41.46 [0.0]	41.1 [0.45]	31.26 [10.2]
TQ28SE449	550	SE	31.91 [6.1]	DRY	38.01 [0.0]	37.71 [0.3]	NP
TQ28SE450	550	SE	20.56 [15.25]	DRY	35.81 [0.0]	35.51 [0.3]	25.76 [10.05]
TQ28SE451	550	SE	28.25 [7.6]	DRY	35.85 [0.0]	35.4 [0.45]	NP
TQ28SE634	350	SW	25.76 [55]	NR[2]	42.55 [0.0]	41.63 [0.91]	37.52 [16.5]
TQ28SE635	190	NW	32.77 [12.2]	DRY	44.97 [0.0]	39.67 [5.3]	33.07 [11.9]
TQ28SE2063	530	SE	-[3] [-]	NR	- [1.3]	- [6.5]	- [-]
TQ28SE2472	300	SW	- [143.6]	NR	- [1.0]	- [9.8]	- [56.0]
TQ28SW72	420	SW	45.72 [3.05]	NR	42.67 [0.0]	42.22 [0.45]	33.07 [9.6]
TQ28SW573	430	W	- [18.23]	DRY	- [0.91]	- [8.5]	NP

Notes
1. Not proved in borehole
2. Not recorded
3. Not provided on borehole record

2.8 Hydrogeology and Hydrology

The Environment Agency[4] (EA) 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 surface water bodies and wetland ecosystems.

The site does not overlie a designated superficial or bedrock aquifer and is noted as being underlain by the London Clay Formation, designated a 'non-productive stratum' by the Environment Agency.

The site does not fall within a Groundwater Vulnerability Zone as indicated by EA mapping, nor is the site located within a groundwater source protection zone (GSPZ).

The closest significant bodies of surface water are the *Hampstead Ponds* located approximately 2300m north-east of the site. Environment Agency mapping indicates that the site is not located within a zone at risk of flooding by river or sea, reservoirs. It does however have a recorded medium risk of surface water flooding; this is defined as a 1% to 3.3% chance of flooding to a depth of 300mm annually. CPG4[1] indicates that *Kylemore Road* was not flooded during extreme rainfall events in 1975 and 2002 and therefore it is considered that the risk due to surface water flooding is relatively low. It is noted that *Kilburn High Road* and *Abbey Road* situated, approximately 360m west and 480m south of the site respectively, were both flooded during the 1975 extreme rainfall. In addition to this *West End Lane*, situated approximately 250m east, was subject to flooding during the 2002 extreme rainfall.

Reference to CGL archives and Barton's *Lost Rivers of London*[5] indicates a tributary of the historical *River Westbourne* is present some 85m southeast of the site. It is anticipated that groundwater, if present, will follow the local topography, which dips gently towards the southwest, and will flow towards the historical R*iver Westbourne.*

As the London Clay Formation is identified below the site, it is assumed this forms an impermeable boundary and will form the base of an overlying groundwater table where any permeable superficial deposits permit lateral groundwater flow. It is possible that this is shallow perched groundwater within Made Ground or resting upon the surface of the London Clay Formation that is not expected to be laterally pervasive.

[4] http://www.environment-agency.gov.uk (accessed November 2016)
[5] Barton, N. (1992) *The Lost Rivers of London*. Hertfordshire Historical Publications.

3. SCREENING – STAGE 1

3.1 Introduction

A screening assessment has been undertaken based on structured guidance presented in Camden Borough Council's CPG4[1]. Responses to the questions posed by the flowcharts are presented below and where 'yes' or 'unknown' may be simply answered with no analysis required, these answers have been provided.

3.2 Subterranean (Groundwater) flow

This section answers questions posed by Figure 3 in CPG4:

Table 2. Responses to Figure 3, CPG4

Question	Response	Action required
1a. Is the site located directly above an aquifer?	No. The site is directly underlain by the London Clay Formation, designated an unproductive stratum by the Environment Agency.	None
1b. Will the proposed basement extend beneath the water table surface?	No. The proposed basement is proposed to extend approximately 0.6m below present basement level. Local historical ground investigations have not encountered groundwater.	None
2. Is the site within 100m of a watercourse, well or potential spring line?	Possibly. Reference to Barton's *Lost Rivers of London*[5] indicates that a tributary of the historical *River Westbourne* may have passed some 85m southeast of the site.	Investigation
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No.	None
4. Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	Yes. The proposed basement and above ground structures will increase the proportion of hard-standing across the site. However, the underlying London Clay is relatively impermeable and therefore the development is not considered to significantly impact infiltration rates.	None (see below)
5. As part of site drainage, will more surface water than at present be discharged to ground (e.g. via soakaways and/or SUDS)?	No. Soakaways are not likely to prove effective in the London Clay due to low infiltration rates.	None

Question	Response	Action required
6. Is the lowest point of the proposed excavation close to or lower than, the mean water level in any local pond or spring-line?	No.	None

The proposed development is underlain by the London Clay Formation, designated an 'unproductive stratum' by the EA. A review of available data has been conducted to determine groundwater conditions on site and suggests shallow perched groundwater may be encountered within Made Ground or fine sand laminations within the London Clay Formation, however this is not expected to be laterally pervasive.

The proposed basement and new structures will increase the proportion of hard-standing across the site. Due to the relatively impermeable nature of the underlying London Clay, the development is not likely to significantly affect infiltration to groundwater.

3.3 Slope/land stability

This section answers questions posed by Figure 4 in CPG4.

Table 3. Responses to Figure 4, CPG4

Question	Response	Action required
1. Does the site include slopes, natural or man-made, greater than about 1 in 8?	No.	None
2. Will the proposed re-profiling of the landscaping at site change slopes at the property boundary to greater than about 1 in 8?	Possibly. Part of the front garden is to excavated to form secondary access to the basement.	Investigation and assessment
3. Does the development neighbour land including railway cuttings and the like with a slope greater than about 1 in 8?	No.	None
4. Is the site within a wider hillside setting in which the general slope is greater than about 1 in 8?	No.	None
5. Is the London Clay the shallowest strata on site?	Yes. The proposed development is part of a terrace of houses, and therefore the effect of heave in the underlying London Clay due to basement excavation will need to be considered.	Investigation and assessment

Question	Response	Action required
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.	None
7. Is there a history of shrink/swell subsidence in the local area and/or evidence of such at the site?	Unknown. The shallowest stratum beneath the site is the London Clay Formation and therefore the effect of heave in the underlying London Clay due to basement excavation will need to be considered.	Investigation and assessment
8. Is the site within 100m of a watercourse or a potential spring line?	Yes Reference to Barton's *Lost Rivers of London*[5] indicates that a tributary of the historical *River Westbourne* may be present some 85 southeast of the site.	Investigation
9. Is the site within an area of previously worked ground?	No.	None
10. Is the site within an aquifer?	No.	None
11. Is the site within 50m of the Hampstead Heath ponds?	No.	None
12. Is the site within 5m of a highway or pedestrian right of way?	Yes. The proposed works at Kylemore Road include the excavation of material from the front of the property down to basement level. However, the road is outside the zone of influence of the basement and will therefore not be impacted.	None
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes. The proposed works at Kylemore Road include the excavation of material from the front of the property down to basement level (some 2.3m), and the lowering of the property itself by 0.6m. The excavation in front of the property necessitates an Impact Assessment.	Impact Assessment
14. Is the site over (or within the exclusion zone of) any tunnels?	No.	None

A review of local topography suggests that local and wider hillslopes do not exceed a gradient of 1 in 8 or in an area of potential landslide.

In summary, an impact assessment is required to investigate the magnitude of ground movements resulting from excavations for the lightwell and for the deepening of the existing basement excavation. The basement excavation will result in unloading of the London Clay Formation at depth without significant structural reloading and may result in

heave movements. The construction of the basement will increase the differential depth of foundations between the site and neighbouring properties. The impact assessment will assess potential damage caused by ground movements to adjacent properties and will recommend measures to mitigate such potentially damaging movements.

3.4 Surface flow and flooding

This section covers the main surface flow and flooding issues as set out in Figure 5, CPG4.

Table 4. Responses to Figure 5, CPG4

Question	Response	Action required
1. Is the site within the catchment area of the pond chains on Hampstead Heath?	No.	None
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off), be materially changed from the existing route?	Yes, but minor. The proposed basement will involve the excavation of a small area of soft landscaping out the front of the property to be replaced by hardstanding material.	None
3. Will the proposed development result in a change in the proportion of hard surfaced/paved external areas?	Yes. The proposed basement and above ground structures will slightly increase the proportion of hard-standing across the site. However, the underlying London Clay is relatively impermeable and therefore the development is not considered to significantly impact infiltration rates.	None (see below)
4. Will the proposed basement result in a change to the profile of the inflows of surface water being received by adjacent properties or downstream watercourses?	No.	None
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No. The proposed excavation would remove most of the Made Ground that may be present on site and as such will not impact on water quality.	None
6. Is the site in an area known to be at risk from surface flooding, or is it at risk from flooding because the proposed basement is below the static water level of a nearby surface water feature?	EA surface water flooding maps indicate the site to be within a 'medium' risk area of surface water flooding with an annual probability of 1% to 3.3% of surface water flooding to a maximum depth of 300mm. It is noted that Kylemore Road did not flood during the significant flooding events of 1975 and 2002, and therefore the risk of flooding is considered to be relatively minor.	None

The proposed development is for the deepening of a basement by some 0.6m with a local extension in the front of the property with an excavation depth of 2.3m. The removal of pre-existing soft landscaping and replacing it with hardstanding may increase surface water discharge slightly, however it is noted that the underlying London Clay is relatively impermeable and the increase would be expected to be minor. Detailed drainage design will be undertaken by others.

3.5 Summary

Based on this screening exercise, further stages of basement impact assessment are required for this site. These should address the following:

Table 5. Summary of Basement Impact Assessment requirements

Item	Description
1.	*Groundwater flow* Investigation – reference to Barton's *Lost Rivers of London*[5] indicates that a tributary of the historical *River Westbourne* may have passed close to the eastern boundary of the site. Ground investigation will be required to confirm the presence of this historical river course. The basement will be constructed entirely within the London Clay and therefore groundwater is not expected to be encountered. Given the relatively impermeable nature of the London Clay, infiltration will be negligible.
2.	*Slope (land stability)* Investigation and assessment – The proposed development and neighbouring properties are potentially at risk from shrink/swell of the London Clay Formation. The impact of the basement construction on adjacent party walls and neighbouring structures requires consideration and an impact assessment is required.
3.	*Surface flow and flooding* None – the proposed basement and new structures will slightly increase the proportion of hard-standing across the site. However, due to the impermeable nature of the underlying London Clay Formation and small area of change, the run-off surface attenuation characteristics are not significantly affected. The site is not located in an area at risk from surface water flooding.
4.	*Cumulative impacts* As groundwater flow would not be expected within the London Clay, it is expected that cumulative impacts from the construction of the basement will be negligible. It is further noted that the basement development is minor in extent, consisting of deepening an existing basement by 0.6m with an extension to the front of the property.

The outcomes of the screening assessment are carried forward into the Basement Impact Assessment in the following report sections.

4. SCOPING – STAGE 2

On the basis of the screening report, an intrusive investigation is required on site.

The intrusive investigation should:

1. Determine the ground conditions on site and their variability;
2. Install groundwater monitoring standpipes to determine groundwater levels;
3. Undertake in-situ testing to assess the strengths of the ground and to support geotechnical assessment; and
4. Obtain soil samples for geotechnical laboratory testing in order to classify the soils on site, to determine where desiccation is present on site, and to support geotechnical design.

A site investigation has been undertaken by CGL and the findings are presented within Section 5

5. STAGE 3 - GROUND INVESTIGATION

5.1 Current site investigation

An intrusive investigation was undertaken by CGL in October 2016. The investigation comprised two window sampler boreholes (BH1 and BH2) to 8.45mbgl and 6.45mbgl (35.51mOD and 36.73mOD) . One borehole was excavated in the front garden and the second was excavated in the rear garden, some 0.8m below the level of the first borehole. In addition, four hand-excavated foundation inspection pits (TP1 to TP4) were excavated around the perimeter of the existing building. The ground investigation was undertaken in accordance with BS 1377:1990[6] and BS 5930:2015[7].

Standard Penetration Tests (SPTs) were undertaken within the boreholes and groundwater monitoring wells were installed within both window sampler boreholes.

The borehole logs and foundation inspection pit logs are presented as Appendix C and Appendix D, respectively, and the exploratory hole location plan is presented in Figure 2

5.2 Monitoring

Two ground gas and groundwater monitoring visits were undertaken on 1st and 18th November 2016 following completion of the site works. The results of the monitoring are summarised in Section 6.4 and the monitoring records are presented as Appendix E.

[6] British Standards Institution. (1990). *Methods of Test for Soils for Civil Engineering purposes*. BS1377:1990.
[7] British Standards Institution. (2015). *Code of practice for ground investigations*. BS5930:2015

5.3 Laboratory testing

5.3.1 Chemical

Three representative soil samples were submitted to i2 Analytical Limited (a UKAS and MCERTS accredited laboratory) for chemical testing. The analysis included the following determinants:

- Soil Organic Matter (SOM);
- Heavy metals including; arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc;
- Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH);
- Total Monohydric Phenols;
- Total Cyanide;
- Sulfate;
- pH determination and;
- Asbestos screen

The chemical results are included as Appendix F.

5.3.2 Geotechnical

Selected soil samples were submitted to an accredited laboratory for geotechnical testing including the following:

- Atterberg Limits tests;
- Undrained triaxial compression tests;
- Moisture content; and
- BRE analysis in accordance with BRE SD1.

The geotechnical analysis results are included as Appendix G.

6. STAGE 3 – GROUND AND GROUNDWATER CONDITIONS

6.1 Ground conditions

The ground conditions encountered during the intrusive investigation broadly corresponded to the published geology and are summarised in Table 6 below.

Table 6. Summary of ground conditions

Stratum	Depth to top of stratum (mOD) [mbgl]	Thickness (m)
[MADE GROUND] Firm to stiff grey orange brown slightly gravelly slightly sandy clay. Gravel is angular to sub rounded fine to coarse flint and brick. Sand is fine to coarse. Rare cobble of brick.	43.18 to 43.96 [0.00]	0.50 to 3.22
[WEATHERED LONDON CLAY FORMATION] Soft to firm orange brown CLAY. Fine to coarse selenite crystals observed.	42.46 to 42.68 [0.50 to 1.50]	Proved to 35.51mOD [8.45mbgl]

The ground conditions are discussed in the following sections together with the results of the in-situ and laboratory geotechnical tests.

6.2 Made Ground

Made Ground was found to comprise gravel overlying soft to firm grey orange brown gravelly clay to levels of between 42.46mOD to 42.68mOD. No visible or olfactory evidence of contamination was recorded.

6.3 Weathered London Clay Formation

The surface of the Weathered London Clay Formation was encountered at between 42.46mOD to 42.68mOD and the stratum was found to comprise soft to firm orange brown clay, with fine to coarse selenite crystals. The base of the Weathered London Clay was not encountered during the intrusive investigation, but was proven to be present at 35.51mOD (>8.45mbgl) in borehole BH1.

The results of the geotechnical laboratory analyses have indicated index properties for the Weathered London Clay in the following ranges:

- Moisture Contents between 25% and 37%;
- Liquid Limits between 73% and 85%;

- Plastic Limits between 30% and 33%; and
- Plastic Indices between 42% and 53%.

Based on the above data, the Weathered London Clay Formation may be classified as clay of 'very high' plasticity with a high-volume change potential, which is consistent with published data.

6.4 Groundwater

Groundwater was not encountered during the intrusive investigation. This is likely due to the relatively impermeable nature of the London Clay. It is possible that shallow perched groundwater is present within the Made Ground, although if present it is not expected to be laterally pervasive. Groundwater was noted during the second monitoring visit in BH2 at 2.3mbgl (40.88mOD). This is anticipated to be representative of perched water within the London Clay Formation, possibly as a result of inflow from ground level, and is not considered to be indicative of a continuous groundwater body.

6.5 Sulfate and pH conditions

Three samples of Weathered London Clay Formation were analysed for pH and sulfate. The laboratory results are included in Appendix F and are summarised in Table 7.

Table 7. Summary of pH and sulfate results

Sample location	Sample depth (mbgl)	Strata	pH	Total sulfate as SO_4 (mg/kg)	Water Soluble sulfate as SO_4 (2:1 leachate equivalent) (g/l)	Total sulfur (mg/kg)
BH2	1.00	Weathered London Clay	8.2	5400	2.7	2000
BH2	2.00	Weathered London Clay	8.2	7300	3.4	2400
BH1	4.00	Weathered London Clay	8.1	7200	3.3	2400

6.6 Geotechnical design parameters

Geotechnical design parameters are recommended based on the available information from the intrusive investigation and published information. These are summarised in Table 8. The values are unfactored (Serviceability Limit State) parameters and are considered to be characteristic values for the local soils.

Table 8. Geotechnical design parameters

Stratum	Design Level (mOD)	Bulk Unit Weight γ_b (kN/m³)	Undrained Cohesion c_u (kPa) [c']	Friction Angle ϕ' (°)	Young's Modulus E_u (MPa) [E']
[MADE GROUND]	43.96	19[b]	20 [5]	24	12[d] [9][e]
[WEATHERED LONDON CLAY FORMATION]	42.5	19	55+5.1z[c] [5]	24	33+3.06z[d] [24.75+2.3z][e]

a. BS 8002:2015 Code of practice for Earth retaining structures, British Standards institution.
b. Burland et. al (Eds) (2001) Building response to tunnelling, CIRIA Special Publication 200, CIRIA
c. z = depth below upper surface of the stratum
d. Based on 600 Cu - Burland, Standing J.R., and Jardine F.M. (eds) (2001), Building response to tunnelling, case studies from construction of the Jubilee Line Extension London, CIRIA Special Publication 200.
e. Based on 0.75Eu - Burland, Standing J.R., and Jardine F.M. (eds) (2001), Building response to tunnelling, case studies from construction of the Jubilee Line Extension London, CIRIA Special Publication 200.

As noted in Section 6.3 of this report, the SPT 'N' values for the Weathered London Clay Formation are lower than would be typical of the Weathered London Clay. The design shear strength for the London Clay has therefore been adjusted to match descriptions of the clay from the Foundation Inspection Pits and to correspond with published data for this well-studied stratum.

It is recommended that the formation level is inspected prior to casting foundations, particularly if soft or discoloured material is encountered.

7. STAGE 3 - CONTAMINATION ASSESSMENT

7.1 Introduction

This section evaluates risks to potential receptors at the site from identified chemical contamination. Potential receptors have been identified with reference to the Part 2A regime and associated DEFRA guidance[9]. As with the Part 2A regime, under the planning regime all receptors (humans, controlled waters, ecology, crops/livestock and buildings) have been considered if there is the potential for them to be adversely affected by exposure to contamination. CGL's approach and rationale to assessment criteria adoption for the site is presented in Appendix H.

7.2 Assessment of ground contamination

7.2.1 Risks to human health (long-term chronic risks)

A total of three soil samples, including two of Made Ground and one of natural soil (London Clay Formation) were analysed from across the site. The laboratory results have been compared against the published *Soil Guideline Values (SGVs)* for the *"Residential with home-grown produce"* land-use category.

The results of the Made Ground assessment are set out in Table 2 of Appendix H. The results indicate that the concentrations of some contaminants are above the assessment criteria and may pose a risk to human health. These samples are summarised in Table 9.

Table 9. Summary of contaminant exceedances – Made Ground

Sample location	Sample depth (mbgl)	Stratum	Contaminant	Measured concentration (mg/kg)	Assessment Criteria[a] (mg/kg)
BH2	0.2	Made Ground	Lead	3000	200
			Arsenic	41	32

Notes:
a) Based on C4SL values

[9] DEFRA (2012) *Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance.*

7.2.2 Risks to vegetation and plants

Three soil samples have been assessed against the British Standard for topsoil[10]. The results of the Made Ground assessment is presented as Table 4 of Appendix H and the contaminant exceedances are summarised in Table 10 below.

Table 10. Summary of contaminant exceedances – vegetation and plants

Sample location	Contaminant	Measured concentration (mg/kg)	Assessment Criteria (mg/kg)
BH2	Zinc	930	200

7.3 Ground gas assessment

Two ground gas visit was undertaken on 1st and 18th November 2016 during atmospheric pressures of 1018mb and 989mb, respectively. The air pressure was steady during the first visit and rising at the time of the second visit. The monitoring records are presented as Appendix E and the results of the monitoring are summarised below;

- Maximum carbon dioxide concentration: 9.6% v/v
- Maximum methane concentration: <0.1% v/v
- Maximum sustained flow rate: <0.1l/hr (after initial peak value of 1.5l/hr)
- Minimum oxygen concentration: 9.8% v/v

Based on the above results, a gas screening value (GSV) of 0.0l/hr has been calculated. It is noted that carbon dioxide levels in excess of 5% were recorded in BH2. The monitoring well was installed for the purposes of groundwater monitoring within the non-organic London Clay Formation. Reference to Annex D of BS:8485[11] demonstrates that as the total organic carbon of the London Clay Formation is less than 1%, the site may be characterised as Characteristic Situation 1 (NHBC 'Green'). Given the lack of a sustained flow and non-organic nature of the soil, it is considered that the carbon dioxide detected during the monitoring is representative of bacteria within the borehole as opposed to a true ground gas (i.e. a gas originating from organic decomposition).

[10] BSI (2007) Specification for topsoil and requirements for use. BS13882. Values taken for pH6-7
[11] British Standards (2007) *Code of Practice for the characterisation and remediation from ground gas in affected developments*. BS8485:2007

8. STAGE 3 - CONTAMINATION RISK ASSESSMENT

A semi-quantitative risk assessment has been undertaken based on the findings of the Conceptual Site Model and the potential pollutant linkages that may exist at the site in accordance with Contaminated Land Report (CLR) 11[12]. The risks identified are in accordance with the DEFRA and Contaminated Land Report (CLR) 6[13], site prioritisation and categorisation rating system, which is summarised below in Table 11.

Table 11 - Risk Rating Terminology

Risk Rating	Description
High Risk	Contaminants very likely to represent an unacceptable risk to identified targets Site probably not suitable for proposed use Enforcement action possible Urgent action required
Medium Risk	Contaminants likely to represent an unacceptable risk to identified targets Site probably not suitable for proposed use Action required in the medium term
Low Risk	Contaminants may be present but unlikely to create unacceptable risk to identified targets Site probably suitable for proposed use Action unlikely to be needed whilst site remains in current use
Negligible Risk	If contamination sources are present they are considered to be minor in nature and extent Site suitable for proposed use No further action required

Based on the above terminology an assessment of the risks posed by the potential pollutant linkages at the site are outlined in Table 12 below and shown on Figure 5.

[12] The Environment Agency (2004) Model Procedures for the Management of Land Contamination. CLR 11.
[13] M.J. Carter Associates (1995) Prioritisation and Categorisation Procedure for Sites which may be Contaminated. Department of Environment. CLR 6.

Table 12. Semi-quantitative risk assessment

Source	Receptor	Potential Exposure Route	Risk Rating
Made Ground, including ground gases	Future site occupants	Inhalation, direct contact or ingestion, including through home-grown produce. Migration of gases through the surface and via permeable soils.	Low to medium
	Construction workers	Ingestion, direct contact or inhalation	Medium
	Current and future buildings and services	Direct contact causing degradation of building materials including concrete and plastics in the ground. Migration of gases through the surface and via permeable soils.	Low to medium
	Vegetation and plants	Root uptake by vegetation/plants	Low to medium
	Controlled waters	Vertical and lateral migration	Negligible

8.1 Risks to human health

Overall, the risks to future site occupants are considered to be medium as although the majority of the Made Ground is to be removed from site during excavation of the proposed basements, areas of Made Ground are likely to remain outside of the basement perimeter.

No elevated contaminant concentrations were encountered in the natural soils and the site has been classified as Characteristic Situation 1 (NHBC 'Green'), with respect to ground gas conditions.

The risk to construction workers is considered to be medium due to the potential for direct contact with contaminated soils during excavation. It is anticipated that this risk may be mitigated through use of appropriate site working practices and PPE.

8.2 Risks to buildings and structures

The risk to future buildings and structures at the site is considered to be low to medium. The risk due to contamination in the Made Ground is considered to be low, however relatively high sulfate conditions were encountered on site and there is therefore a potential risk to concrete at the site.

8.3 Risks to vegetation and plants

The risk to vegetation and plants is considered to be low to medium due to the exceedances of zinc noted in the Made Ground. Given the contaminant exceedances recorded in the Made Ground, it is anticipated that the Made Ground outside the basement perimeter will be removed and that vegetation and plants will planted within the imported capping layer, thereby mitigating the potential risk from the Made Ground.

8.4 Risks to controlled waters

The London Clay is classified as an unproductive stratum and the site is not close to significant water bodies or within a source protection zone. The risk to groundwater is therefore considered to be negligible. Furthermore, there are no significant surface water bodies adjacent to the site.

9. STAGE 3 - GEOTECHNICAL AND GEOENVIRONMENTAL RECOMMENDATIONS

9.1 Geotechnical recommendations

9.1.1 Excavations

Based on the ground conditions encountered during the intrusive investigation, shallow excavations in the Made Ground material are likely to remain stable in the short term. Battering back or shoring of the Made Ground may be required for excavations which are required to remain open for longer periods of time (i.e. for casting of foundations) or where man entry is required.

Perched groundwater may be encountered during excavations within the Made Ground. Where groundwater ingress is encountered, groundwater control measures, such as a pump and sump dewatering system, should be adopted to keep excavations and formation levels dry.

No operatives should enter unshored or otherwise protected excavations identified as unstable by a competent person, however shallow they are, in accordance with the guidelines presented in CIRIA Report 97[14].

9.1.2 Foundations

It is understood that the existing property will be retained and the deepened basement will be supported by underpinning the existing foundations. The impact of this is further assessed in Section 10 of this report.

For the purposes of design, it is recommended that a presumed allowable bearing pressure of 100kPa is taken for the underlying London Clay Formation. The shear strength of the underlying soils should be confirmed as foundation formation levels are exposed.

[14] CIRIA (1992). *Trenching Practice (Second Edition).* Construction Industry Research and Information Association Report 97.

9.1.3 Concrete design

Based on the pH and sulfate testing undertaken on samples of London Clay Formation (see Table 7), a concrete design class of DS-4 / AS-3s has been calculated.

It is noted that the assessment indicates that the London Clay Formation is not pyritic and there is no significant potential sulfate in the London Clay Formation at the site. Given the relatively high design class calculated from the soil testing, it is therefore anticipated that the potential sulfate in the clay has already oxidised, most likely due to its shallow depth.

9.1.4 Drainage design

No permeability tests were undertaken during the ground investigation, however given the relative impermeability of the London Clay Formation in this area and the vertically and laterally heterogeneous composition of the Made Ground, soakaway drainage is not considered a viable option at the site.

9.2 Geoenvironmental recommendations

9.2.1 Contamination and remediation

No contaminant exceedances were noted within the natural soils on site. However, elevated concentrations of lead and arsenic were noted in the Made Ground in the rear garden of the site, likely associated with the historical disposal of fire ash and domestic waste during the Victorian era.

Proposed development plans indicate that an above-ground extension will be constructed to the rear of the property within the rear garden and it is anticipated that much of the Made Ground will be removed during the construction of this structure. A capping layer will be required in areas where Made Ground is to remain at surface level. This layer should comprise hardstanding or a geotextile membrane underlying a minimum of 450mm cohesive subsoil and 150mm topsoil. The suitability of the capping layer should be independently validated by a geoenvironmental engineer.

The risk to construction workers is anticipated to be mitigated through appropriate use of PPE during the works.

The site conforms to Characteristic Situation 1 (NHBC ‘Green) with respect to ground gas due to sustained elevated concentrations of carbon dioxide and no ground gas protection measures will therefore be required for the proposed development.

9.2.2 Material management

A preliminary assessment of the Made Ground for waste classification purposes indicates that the Made Ground in the front garden may be classified as 'not hazardous' with respect to waste disposal and may be disposed of in an inert or non-hazardous landfill, subject to confirmation by waste acceptance criteria (WAC) testing and agreement with the selected permitted facility. The Made Ground in the rear garden should be classified as 'hazardous' with respect to waste disposal and should be disposed of to a hazardous waste landfill.

Uncontaminated natural soils, as encountered at the site, can be disposed to an inert landfill as listed inert waste.

It should be noted that in May/June 2012 HMR&C issued Briefs 15/12 and 18/12 clarifying how construction spoil and excess soils will be assessed for landfill tax purposes. Detailed accurate descriptions of waste are required for all wastes to support the landfill tax assessment. Uncontaminated naturally occurring soils will remain inert by default and eligible for the lower rate of landfill tax. Similarly 'reworked soils' and demolition 'stone' comprising ONLY materials listed in the Schedule of the Landfill Tax (Qualifying Material) Order 2011 (SI 2011/1017) will also be eligible for the lower rate of landfill tax. However, Made Ground containing soil and foreign objects such as timber, plastic, rubber, metal, paper, plasterboard, asbestos, etc., regardless of the results of chemical analysis for waste classification purposes, will be eligible for the standard (higher) rate of landfill tax. Therefore, to maximise eligibility for lower rate landfill tax on waste construction spoil/ reworked ground, careful waste segregation and controls are necessary.

All material intended for offsite disposal should be transported and disposed in accordance with the Environmental Protection (Duty of Care) Regulations, 1991 and the Landfill (England and Wales) Regulations, 2002 (as amended). Waste legislation stipulates that hazardous and not hazardous waste should be pre-treated prior to disposal. Pre-treatment can be undertaken either at the site of origin or may be carried out at a licensed off-site facility and can include selective segregation of soils conducted on site.

9.2.3 Buried services

Based on the measured concentrations of contaminants within the Made Ground, it is anticipated that PE or PVC pipes will be suitable for use at the site. However, it is recommended that the water supply company is contacted to confirm this recommendation is acceptable to them.

9.2.4 Health and safety

Precautions should be taken to minimise exposure of workers and the general public to any potentially harmful substances during earthworks.

The risks to construction workers can be controlled through the implementation of site safety procedures and the use of suitable personal protective equipment (PPE). Attention should also be paid to restricting possible off-site nuisance such as dust and odour emissions. All work should be carried out in accordance with the Contractor's Construction Health and Safety Plan.

Precautions will include but not be limited to:

- Personal hygiene, washing and changing procedures.
- Adequate personal protective equipment.
- Dust and vapour suppression methods, including damping down, minimising the working face exposed and covering stockpiles, where required.
- Regular cleaning of all site roads, access roads and the public highway.
- Safe storage of fuel and other potentially polluting liquids and the provision of spill control and clean up facilities.
- Positive collection and disposal of on-site run-off.

10. STAGE 4 - BASEMENT IMPACT ASSESSMENT

10.1 Conceptual site model

A conceptual site model (CSM), relating to potential ground movement, has been developed based on the available data. The CSM comprises a section (Figure 6) and a plan (Figure 7) indicating the basement construction and the location of neighbouring properties in relation to the proposed development.

The roadway of Kylemore Road is outside the zone of influence of the basement, assuming that the ground movements dissipate linearly with distance from the basement, at a 45^{o} angle, and will therefore not be considered further in this assessment.

It is noted that the above-ground extension at lower ground floor level is separate from the neighbouring property of 15 Kylemore Road. No underpinning works will be undertaken along this section and this has therefore not been included in the basement impact assessment.

10.2 Groundwater

Groundwater was not encountered during the intrusive investigation, however a groundwater level of 2.3mbgl (40.88mOD) was encountered in BH2 in the rear garden during the second monitoring visit. This is anticipated to be representative of perched water within the London Clay Formation and is not considered to be indicative of a continuous groundwater body.

This perched water may result in localised groundwater ingress into the basement excavation, however given the cohesive nature of the soils on site, it is anticipated that inflows during the basement excavation will be readily controlled in the with groundwater control measures such as sump pumping. Groundwater flow rates through the London Clay would be expected to be very slow and a regional ‘water table’ would not be mobile and affected by the proposed development.

10.3 Land/slope stability

This section provides calculations to assess ground movements that may result from the construction of the basement and how these could affect the adjacent structures. It is understood that reinforced concrete underpinning will be used to construct the new basement walls and provide support to the existing perimeter foundations.

Ground movements are derived from:

- Heave movements: The London Clay is susceptible to short term heave and time dependant swelling on unloading, which will occur as a result of basement excavation, generating upward ground movements.

- Long term ground movement: The net loading on formation soils will generate ground movement, which could affect adjacent foundations. This takes into account existing stress conditions, additional loads from the basement structure and the weight of soil removed.

- Underpin deflection: Underpins act as stiff concrete retaining walls, which limits the potential for wall deflection. Appropriate temporary works are critical in controlling such deflections.

- Settlement: construction of underpins beneath existing foundations can lead to settlement. The amount of settlement depends primarily on the quality of workmanship in constructing the underpins, in particular in dry-packing between the existing foundation and the new underpins. In addition, there may be settlement as structural loads are transferred to greater depth, on to soils that have not previously been loaded.

10.4 Underpin construction sequence

The basement deepening beneath the existing property will be constructed using traditional staged underpinning techniques with pins excavated in sequence in bays typically 0.9m to 1.1m wide. The excavation will be undertaken in a single lift.

The underpins will be generally supported in the permanent condition by the floor slabs, which should be cast before removing the temporary propping.

10.5 Underpin loading

Structural loads have been provided by the structural engineer. These are provided as Appendix I and are summarised in Table 13.

The proposed development gives rise to a net unloading of the underlying strata both during construction and over the long term. Allowing for underpin thickness, the excavation beneath the existing building will unload the soils at the underpin formation level by a total of some 20kPa. This value assumes a total excavation depth for the basement of 1m and a typical bulk unit weight of 20kN/m^3 for the excavated soils. In the front garden area, the total excavation depth with be a maximum of some 2.3m, giving a total unloading in this area of some 46kPa.

Table 13. Summary of underpin loads and unloading due to excavation (assumes 1m wide underpins)

Load location	Underpin loading (kPa)	Unloading due to excavation (kPa)	Net loading (kPa)[a]
Party wall with No 11 Kylemore Road	80.5	20	60.5
Rear wall	75.5	20	55.5
Party wall with No 15 Kylemore Road	80.5	20	60.5
Front wall	75.5	20	55.5
Front garden	-	46	-46
Central basement area	-	20	-20

Notes
a. Positive numbers represent loading and negative numbers represent unloading

Based on the above figures, it is assumed that underpins 1m in width will be suitable to support the loads, based on a bearing capacity of the underlying soil of 100kPa.

10.6 Ground movements arising from basement excavation

A ground movement assessment has been undertaken using OASYS Limited *VDISP* (***V**ertical **DISP**lacement*) analysis software. *VDISP* 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') for each stratum input by the user. *VDISP* assumes perfectly flexible loaded areas and as such tends to overestimate movements in the centre of loaded areas and underestimate movements around the perimeter. To address this, the structure has not been modelled as an evenly loaded flexible raft and the loads from the underpins around the perimeter, as summarised in the previous sections, have been accounted for and modelled in the analysis.

A detailed temporary works strategy should be developed as part of the structural design to ensure the underpins are stable prior to casting of the basement and ground floor slabs.

The maximum short term ground movements are predicted to be of the order of 2mm of settlement around the eastern underpins and 2mm of heave in the front garden, decreasing to some 0.5mm of heave in the centre of the basement excavation.

Maximum long term ground movements within the basement are predicted to be some 4mm of heave in the front garden, decreasing to an average of 0mm in the centre of the basement excavation.

Contour plots showing the variation of both short and long term heave for the whole basement are presented in Figure 8.

The result of the settlement analysis along the northern and southern boundary walls with Nos. 11 and 15 Kylemore Road, respectively are summarised in Table 14.

Table 14. Summary of underpin settlements

Location	Predicted vertical displacement[a] (mm)			Allow workmanship settlement = 5mm (per lift)
	Short term conditions	Long term conditions	Total displacement (mm)	Total displacement (inc. workmanship) (mm)
No. 11 Kylemore Road	1.5	3	4.5	9.5
No. 15 Kylemore Road	2	4	6	11

a. A positive number denotes settlement and a negative number denotes heave

The heave/settlement assessment undertaken within *VDISP* assumes perfect workmanship in the underpin construction and does not allow for settlement of the dry pack between existing footings and the new concrete. With good construction practice, actual settlements would be expected to not exceed 5mm per lift. This value has been applied to the overall ground movement and corresponding impact assessment to calculate a predicted damage category for the adjacent properties.

Full *VDISP* output can be provided upon request.

10.7 Long term ground movement due to underpin wall deflection

Due to the relatively high stiffness of the reinforced concrete underpins, long term deflection is considered to be negligible (i.e. <2mm). This is based on CGL's experience with similar underpinned basement developments in the area.

During the works, lateral displacements will be resisted by sequential propping of the underpinned foundations. Trench sheeting will be employed where required to prevent localised collapse of the soil and will be supported with appropriate propping. As the underpin stems are cast, the props will be removed, ensuring that the excavation is continually controlled, and will be replaced whilst the concrete cures. Initially, the underpins will be propped against the central soil retained in the centre of the site. Once this has been excavated, the props should be relocated to a sacrificial thrust block constructed beneath the level of the proposed floor slab.

10.8 Damage category assessment

The calculated ground movements have been used to assess potential 'damage categories' that may apply to neighbouring properties due to the proposed basement construction. The methodology proposed by Burland and Wroth[16] and later supplemented by the work of Boscardin and Cording[17] has been used, as described in *CIRIA Special Publication 200*[18] and *CIRIA C580*[19]. General damage categories are summarised in Table 15 below:

[16] Burland, J.B., and Wroth, C.P. (1974). *Settlement of buildings and associated damage*, State of the art review. Conf on Settlement of Structures, Cambridge, Pentech Press, London, pp611-654

[17] Boscardin, M.D., and Cording, E.G., (1989). *Building response to excavation induced settlement*. J Geotech Eng, ASCE, 115 (1); pp 1-21.

[18] Burland, Standing J.R., and Jardine F.M. (eds) (2001), *Building response to tunnelling, case studies from construction of the Jubilee Line Extension London*, CIRIA Special Publication 200.

[19] CIRIA C580 (2003) *Embedded Retaining Walls – guidance for economic design*

Table 15. Classification of damage visible to walls (reproduction of Table 2.5, CIRIA C580)

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).

For the critical perimeter underpin wall sections, the combined impacts of short-term and long-term ground movements and assumed settlement due to workmanship have been combined to determine the overall ground movement of the underpins and adjacent properties due to the construction of the basement.

Table 16 incorporates superimposed horizontal and vertical movements derived from the underpin wall construction (i.e. 5mm settlement per lift due to workmanship) and short term movements due to excavation. The method of deriving these values and establishing an appropriate deflection ratio for the neighbouring structures is illustrated graphically in Figure 9 for Nos. 11 and 15 Kylemore Road.

The span between the footings of the adjacent party wall properties (Nos 11 and 15 Kylemore Road) have been taken as 5.5m, respectively. These spans have been taken as perpendicular to the basement footprint.

Based on the calculated maximum deflections, a maximum limiting value for the horizontal deflection of each underpin has been calculated to limit the predicted damage category for the adjacent properties to Category 1 'very slight' damage. Regular monitoring of the underpins should be undertaken during construction against these values. Good quality workmanship with staged propping of the underpins is essential in controlling horizontal movements and rotation. It is critical that the basement wall is propped over the long term (i.e. with the floor slab) to prevent long term deflection due to the surcharge of the adjacent property foundations.

Table 16. Summary of ground movements and corresponding damage category

Critical Section	Limiting horizontal movement [c] (mm)	Calculated maximum vertical deflection (mm)	Horizontal Strain ε_h [b] (%)	Deflection ratio Δ/L [a] (%)	Damage category
No. 11 Kylemore Road	2.3	0.8	0.042	0.015	Category 0 ('negligible')
No. 15 Kylemore Road	1.5	2.8	0.027	0.051	Category 1 ('very slight')

a. See Figure 2.18 (a) CIRIA C580 (2003) Embedded retaining walls guidance for economic design. (L = length of adjacent structure in metres, perpendicular to basement; Δ = relative deflection)

b. See Box 2.5 (v) CIRIA C580 (2003) Embedded retaining walls guidance for economic design. (δ_h = horizontal movement in metres

The predicted damage category imposed on the neighbouring properties due to the proposed basement developments, assuming a good standard of workmanship, is 'Category 0' to 'Category 1', corresponding to 'negligible' to 'very slight' damage, characterised by very small cracks that can easily be repaired during normal decoration. The building interaction chart, showing both critical sections, is presented in Figure 10. It is noted that that building interaction chart is plotted assuming limiting horizontal movement is fully realised.

11. STAGE 4 - SUBTERRANEAN (GROUNDWATER) FLOW

11.1 Introduction

This section provides a qualitative assessment of the effect the basement will have on the local hydrogeological regime and whether this will affect adjacent properties.

11.2 Groundwater conditions

No groundwater strikes were recorded during drilling, however groundwater was encountered at 2.3mbgl (40.88mOD) in one borehole during the second round of monitoring. Based on the available information, nearby historical BGS records and CGL's experience of groundwater conditions in the area, groundwater, if present, is likely to consist of perched water in granular bands within the Made Ground or London Clay Formation.

11.3 Impact on local groundwater conditions

Based on the available information, the single groundwater monitoring visit and CGL's experience of groundwater conditions in the area, groundwater is likely to be perched water and the basement formation level is therefore unlikely to be constructed below a consistent groundwater table. Because of a lack of regional groundwater, the basement would not be expected to obstruct groundwater flow or generate a rise in groundwater levels.

11.4 Recommendations for groundwater control

Given that perched groundwater may be encountered in the Made Ground during excavation of the basement, provision of groundwater control measures should be allowed for in order to maintain excavation stability. Observations on groundwater should be carefully recorded during excavation and appropriate mitigation strategies put in place in case of previously unidentified inflows.

12. MONITORING STRATEGY

The results of the ground movement analysis suggest that with good construction control, damage to adjacent structures generated by the assumed construction methods and sequence can be controlled to within Category 0 ('negligible') and Category 1 ('very slight') for No 11 and 15 Kylemore Road, respectively. To confirm that movements do not start to fall outside of those predicted, it is recommended that a formal monitoring strategy is implemented on site in order to observe and control ground movements during construction.

The monitoring system should operate broadly in accordance with the 'Observational Method' as defined in CIRIA Report 185[20]. Monitoring can be undertaken by using positional surveys compared to baseline values established before any excavation work is undertaken onsite. Regular monitoring of these positions will determine if any horizontal translation, tilt or differential settlement of the neighbouring structure is occurring as the construction progresses. Monitoring data should be checked against predefined trigger limits and can also be further analysed to assess and manage the damage category of the adjacent buildings as construction progresses.

As discussed previously, the horizontal deflection/translation of the underpins during construction should be limited 0.8mm and 2.0mm for 11 and 15 Kylemore Road, respectively, to restrict the damage category for the adjacent critical properties to within 'Category 0' to 'Category 1', corresponding to 'negligible' to 'very slight' damage, characterised by very small cracks that can easily be repaired during normal decoration. These values should form the basis of the 'traffic light' trigger levels established prior to underpinning works commencing onsite.

It is recommended that a condition survey is undertaken on all adjacent walls and property facades prior to the works commencing and ideally when monitoring baseline values are established. Existing cracks or structural defects should be carefully recorded, documented and regularly inspected as construction progresses.

[20] Nicholson, D., Tse, Che-Ming., Penny, C., The Observational Method in ground engineering: principles and applications, CIRIA report R185, 1999.

13. CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions of basement impact analysis

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

The construction of the basement will generate ground movements due to a variety of causes including heave, settlement and underpin deflection during and after excavation. Calculations indicate that these can be controlled to within a damage category within Category 0 ('negligible') for the adjacent property of No. 11 Kylemore Road and Category 1 ('very slight') for No.15 Kylemore Road. The above assumes a good standard of workmanship during construction.

It is recommended that a condition survey is undertaken and an appropriate monitoring regime is adopted to manage risk and potential damage to the neighbouring structures as construction progresses onsite.

The remaining neighbouring buildings and infrastructure surrounding the site are sufficiently distant from the basement development to not be considered to be susceptible to ground movements due to pile installation, deflection and heave due to excavation, assuming a typical 45^{o} load spread from the proposed development.

Whilst significant water is not anticipated, the contractor should make an allowance for sump pumping to keep the excavation dry, and should observe ground and groundwater conditions as the excavation proceeds.

FIGURES

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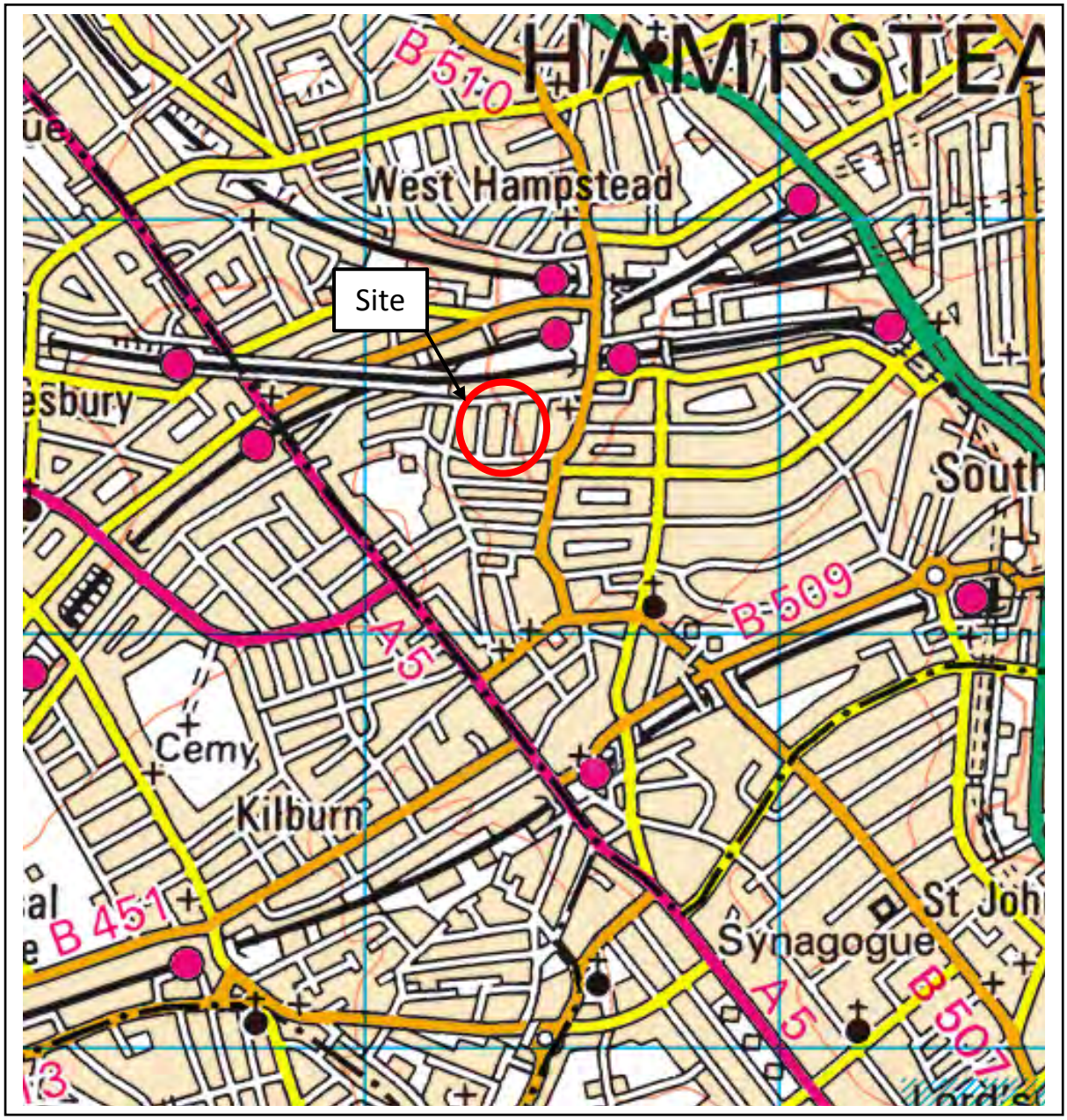

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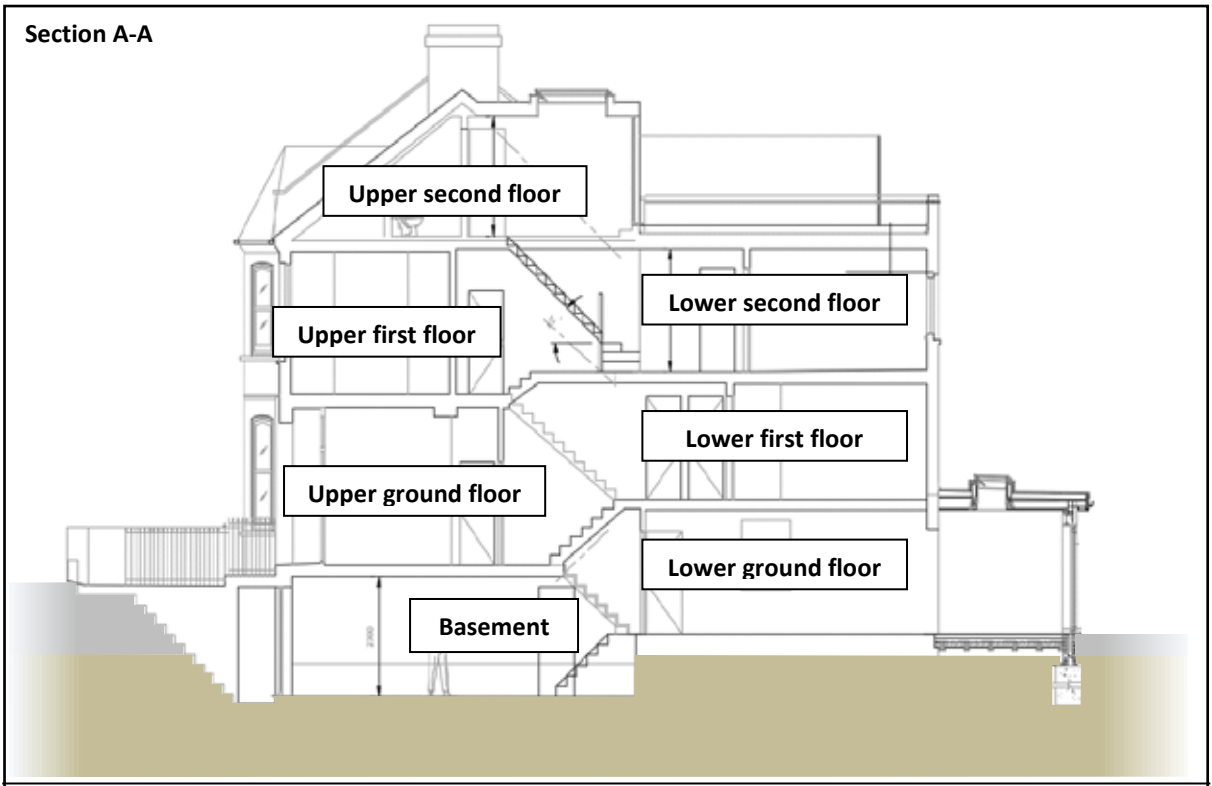
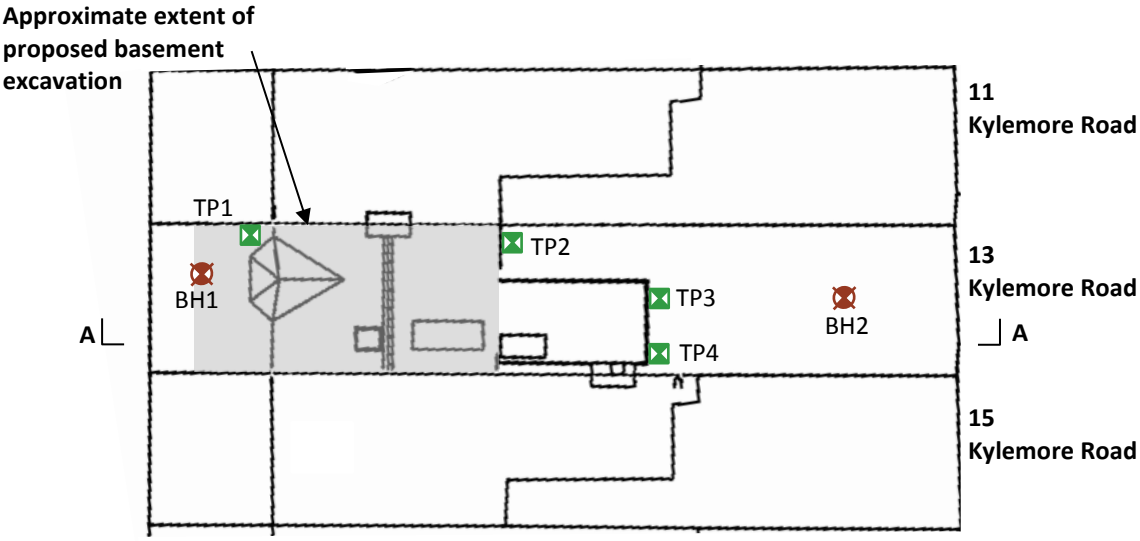
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title **Site location plan**	**Figure 1**

Section A-A





Base figures provided by the client.

Not to scale

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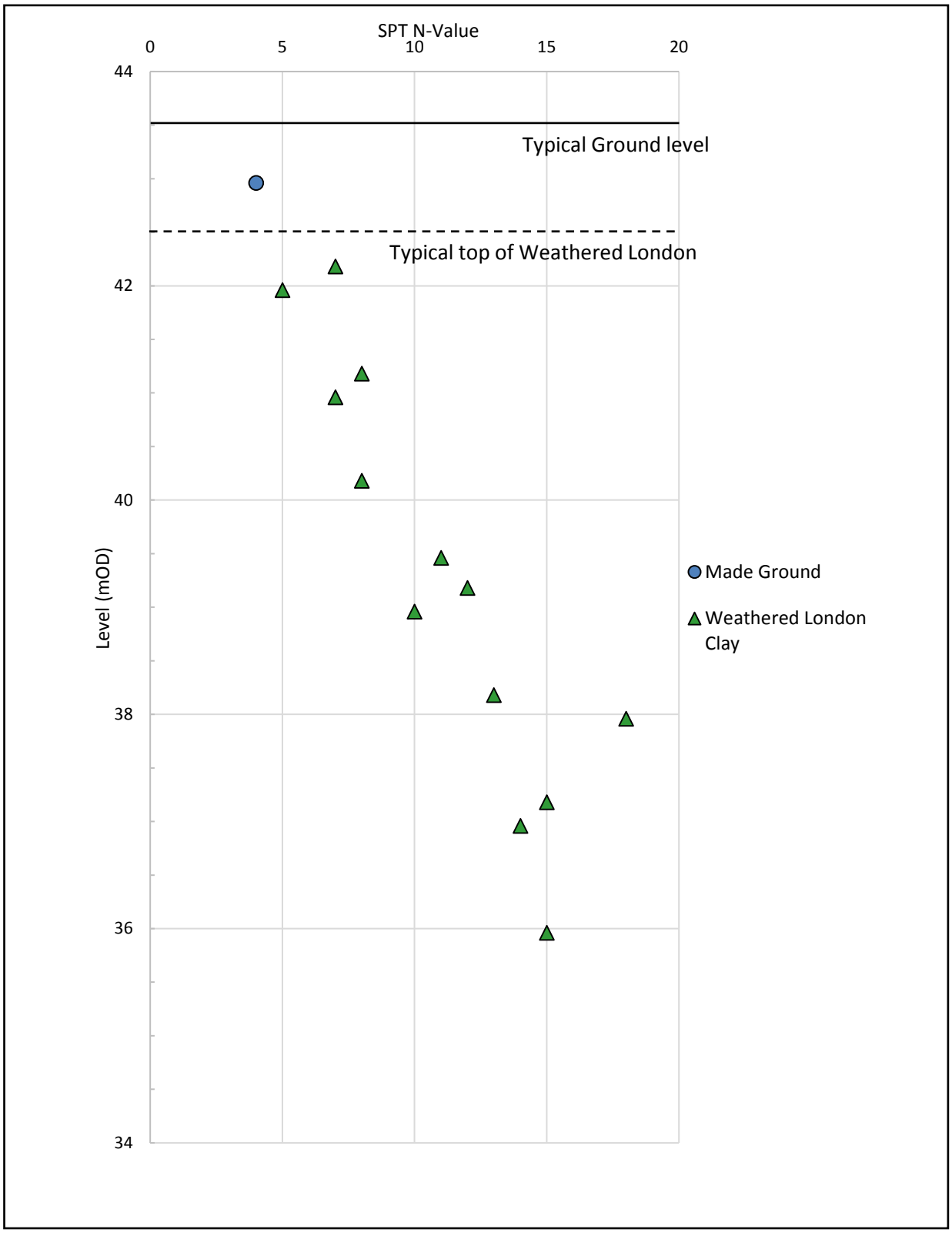
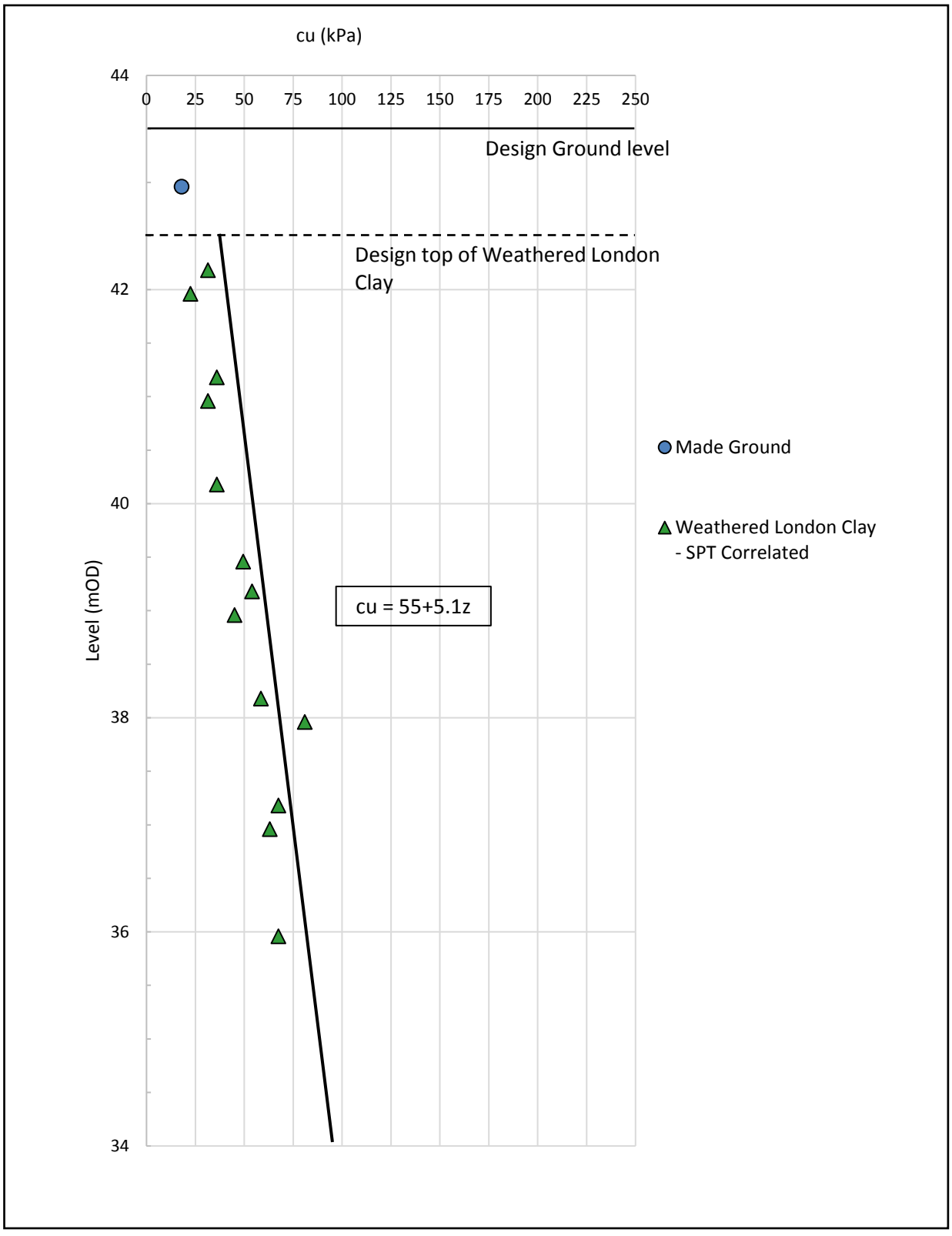
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title: **Site layout and exploratory hole location plan**	**Figure 2**



Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title **Plot of SPT 'N' value against level**	**Figure 3**

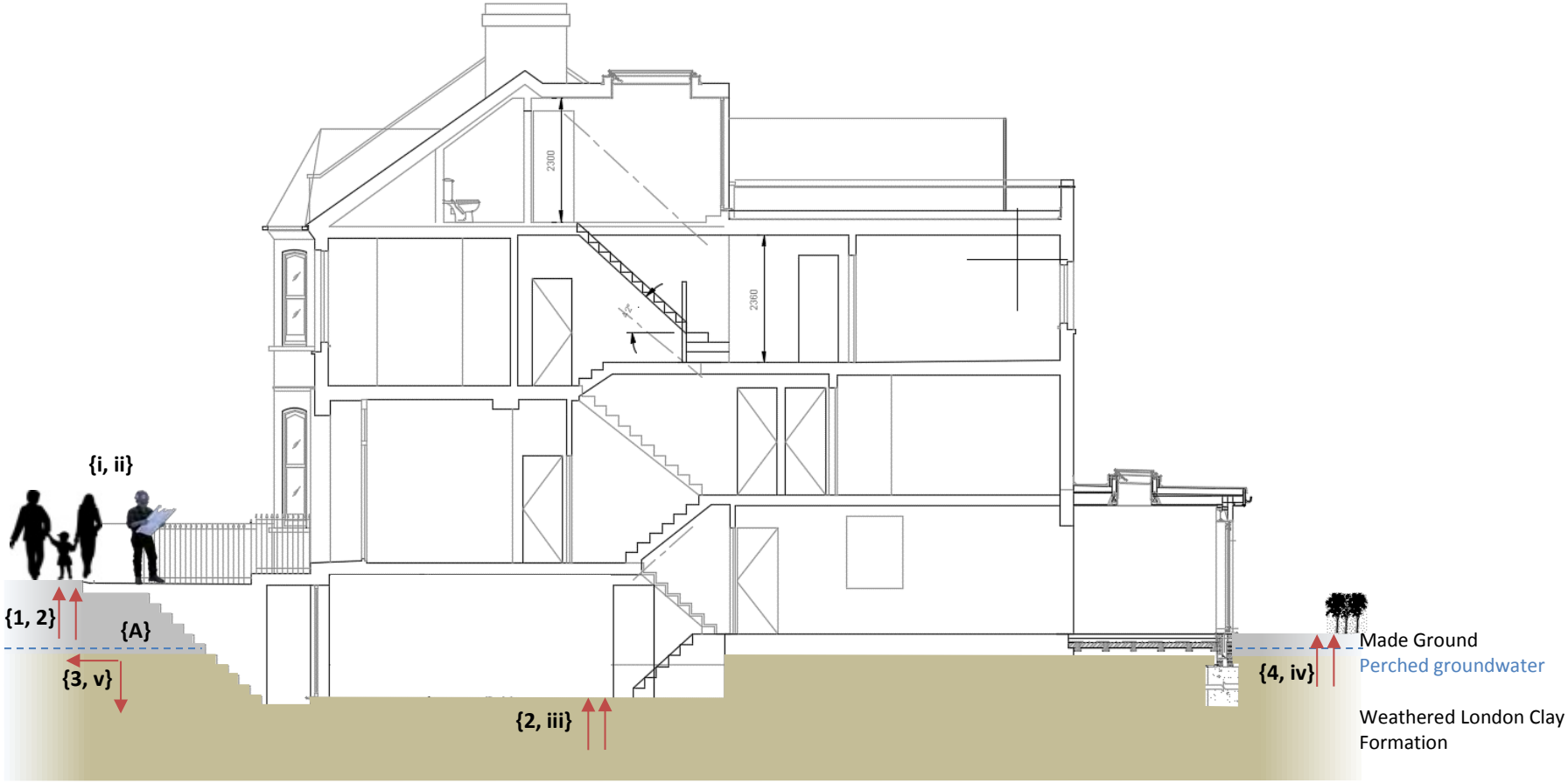


Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
	Title	
	Plot of c_u against level	**Figure 4**

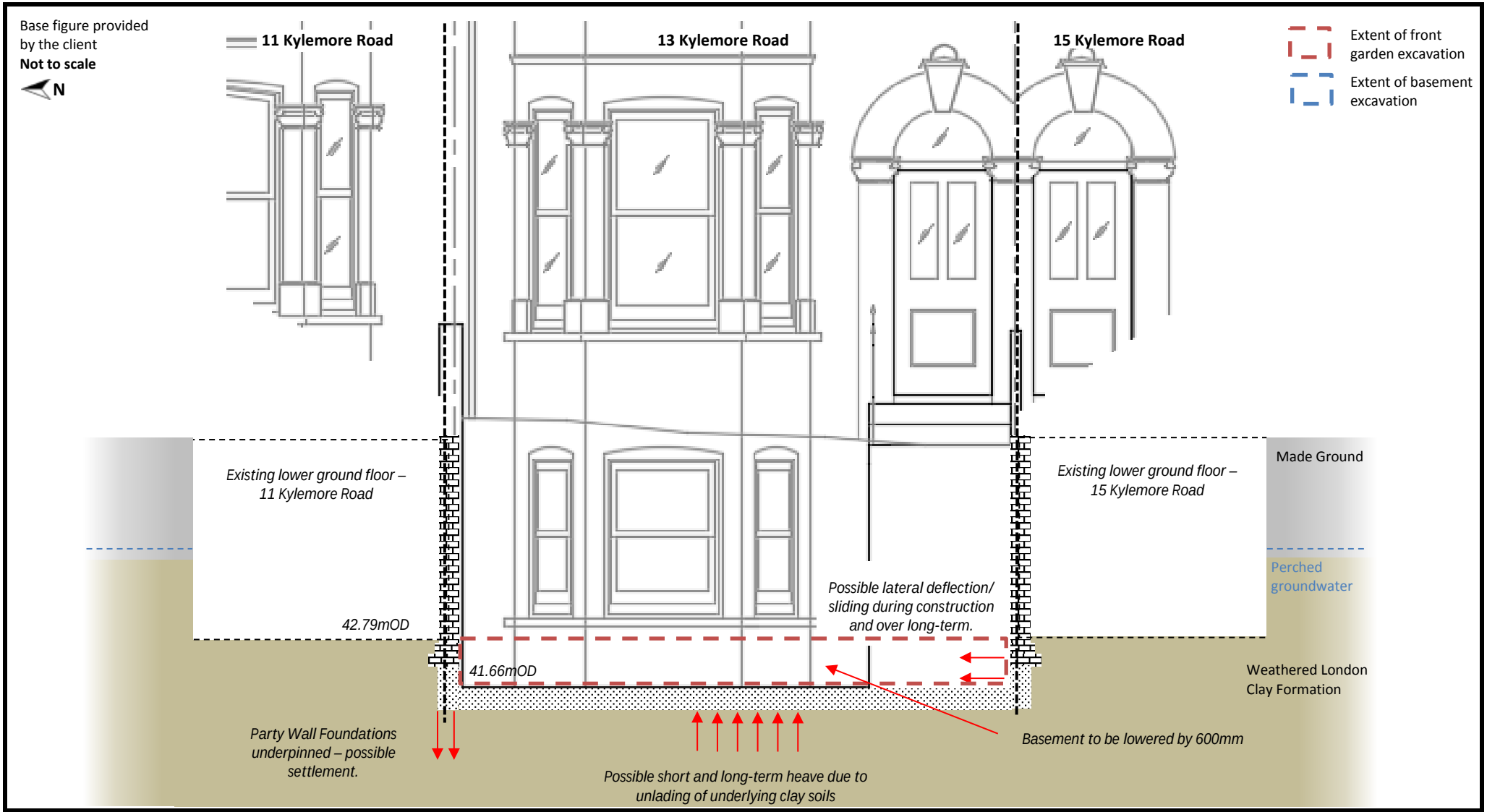
Sources
A. Contamination and ground gas within Made Ground

Pathways
1. Ingestion or inhalation
2. Direct contact
3. Vertical and lateral migration
4. Root uptake

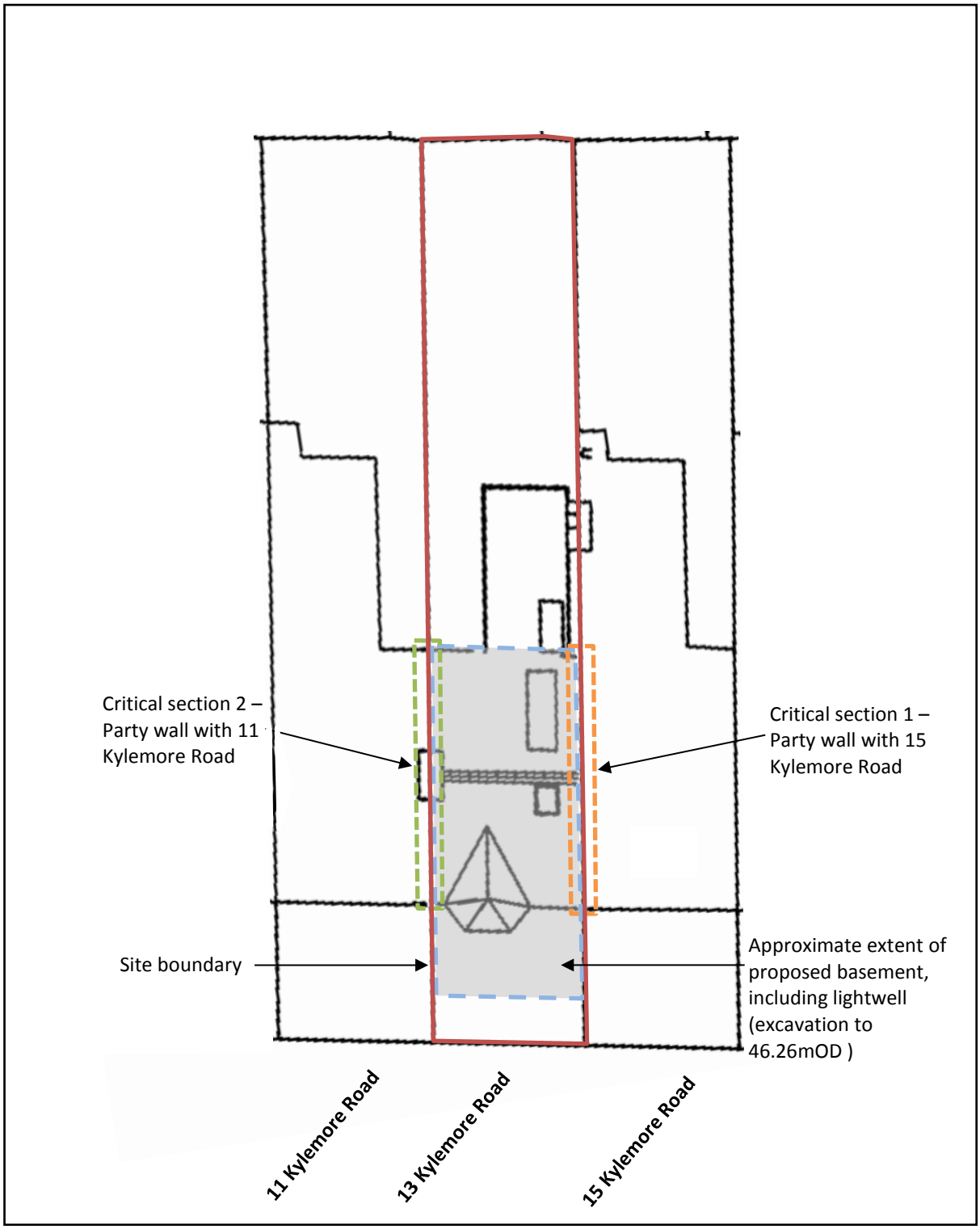
Receptors
i. Future site occupants
ii. Construction workers
iii. Current and future buildings and services
iv. Vegetation and plants
v. Groundwater



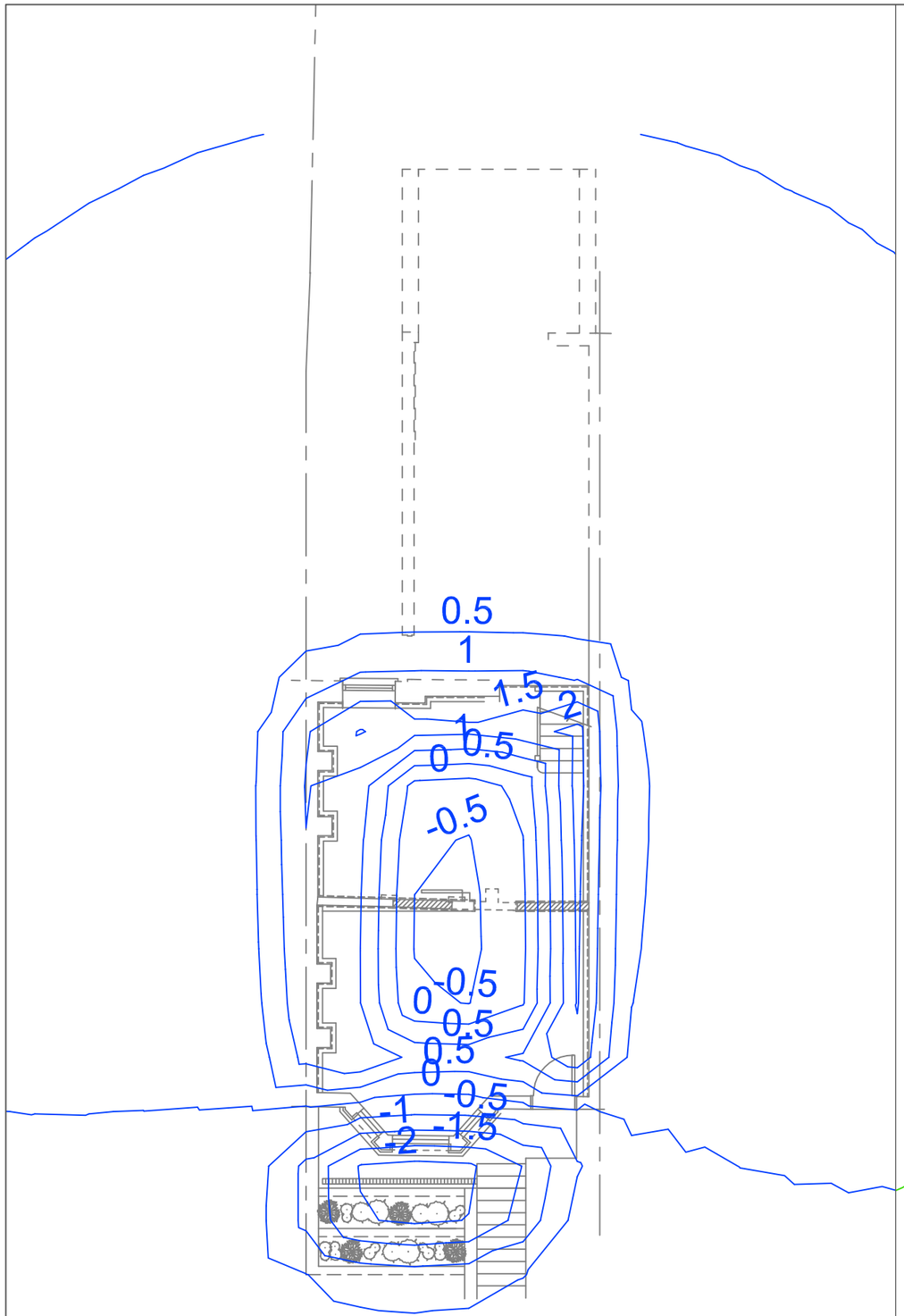
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title: **Conceptual site model (contamination)**	**Figure 5**



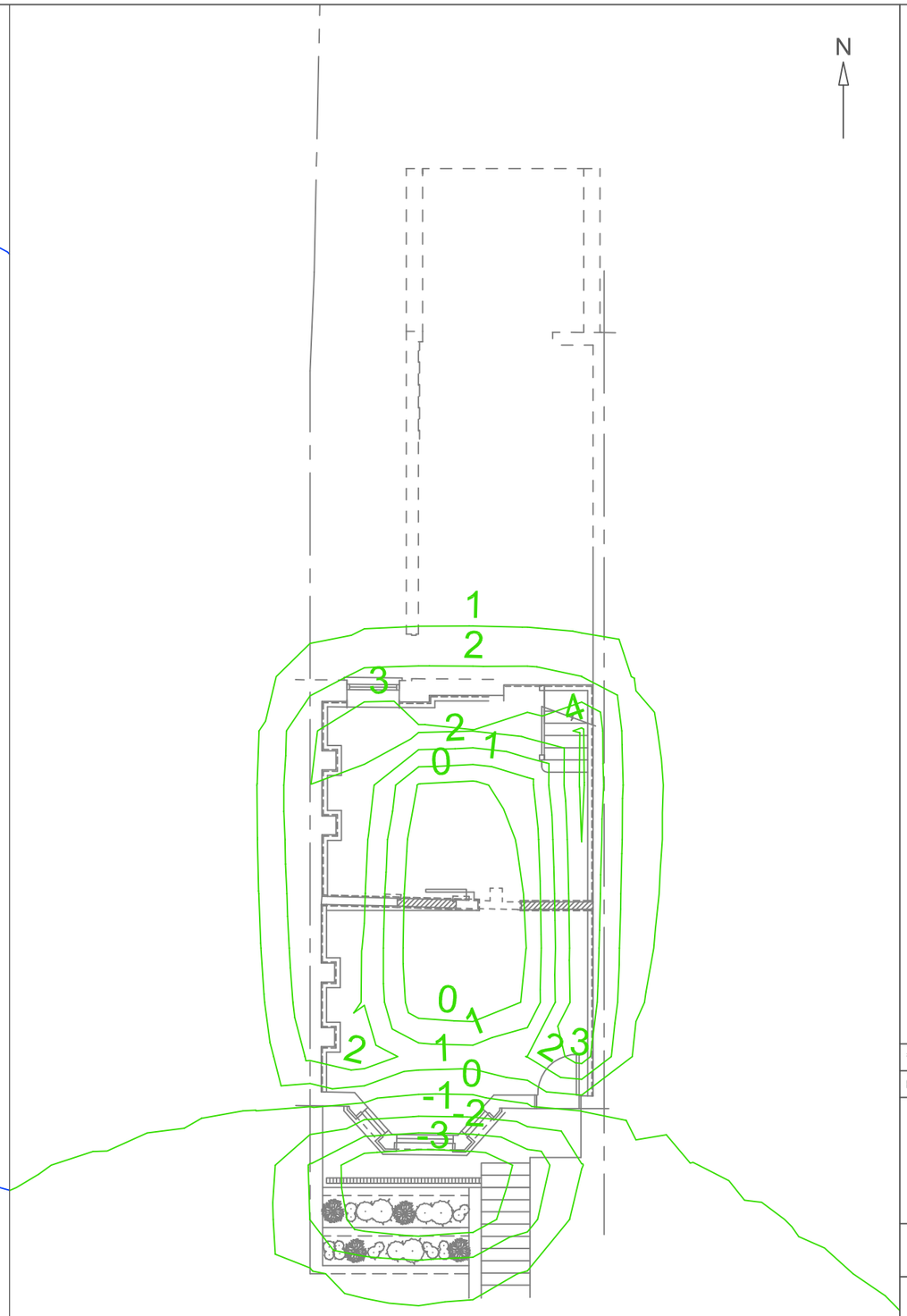
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title: **Conceptual site model (BIA - section)**	**Figure 6**



Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title: **Conceptual site model (BIA - plan)**	**Figure 7**



Short term (undrained) conditions



Long term (drained) conditions

KEY

Positive contours denote settlement and negative contours denote heave

*	*	*
Rev	Date	Comments

Card Geotechnics Ltd
4 Godalming Business Centre
Woolsack Way
Godalming
Surrey
GU7 1XW
T: 01483 310600

Project
13 Kylemore Road, Camden

Client
Mr Robert Hume

Drawing title
Contour plot of vertical displacements

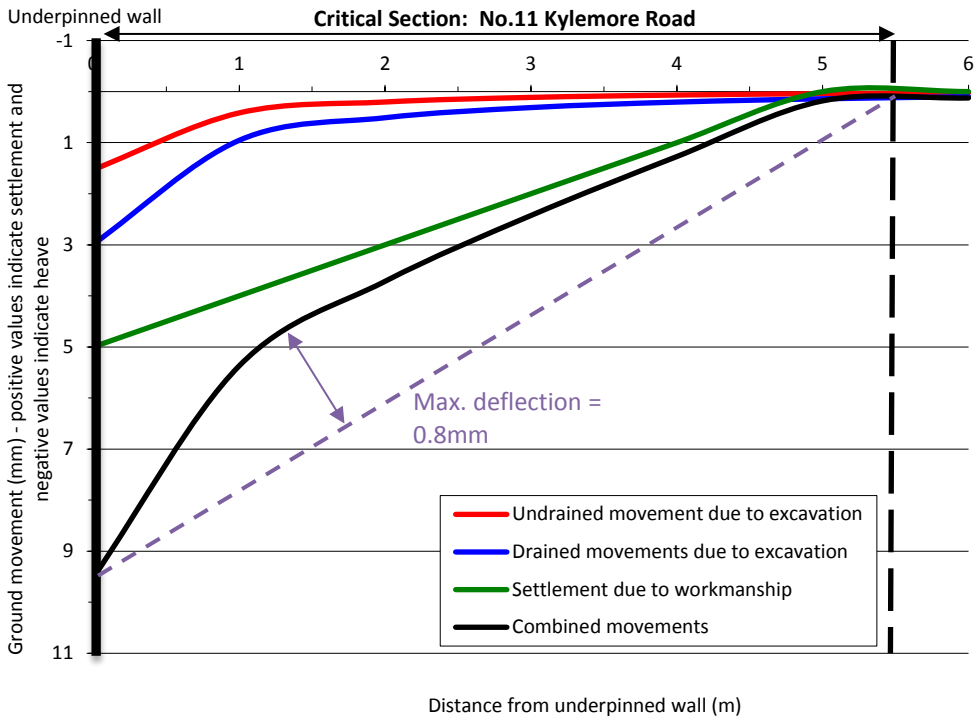
Scale(s)
NTS

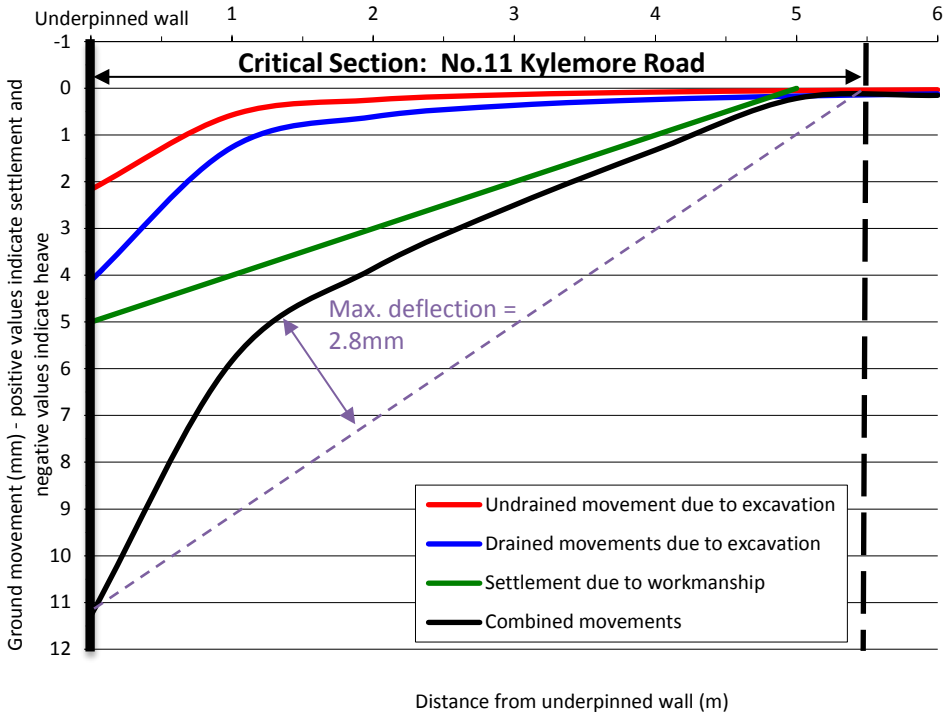
Job No.
CG/18952

Drawn	JJM	04/12/16
Checked	RJB	15/12/16
Approved		

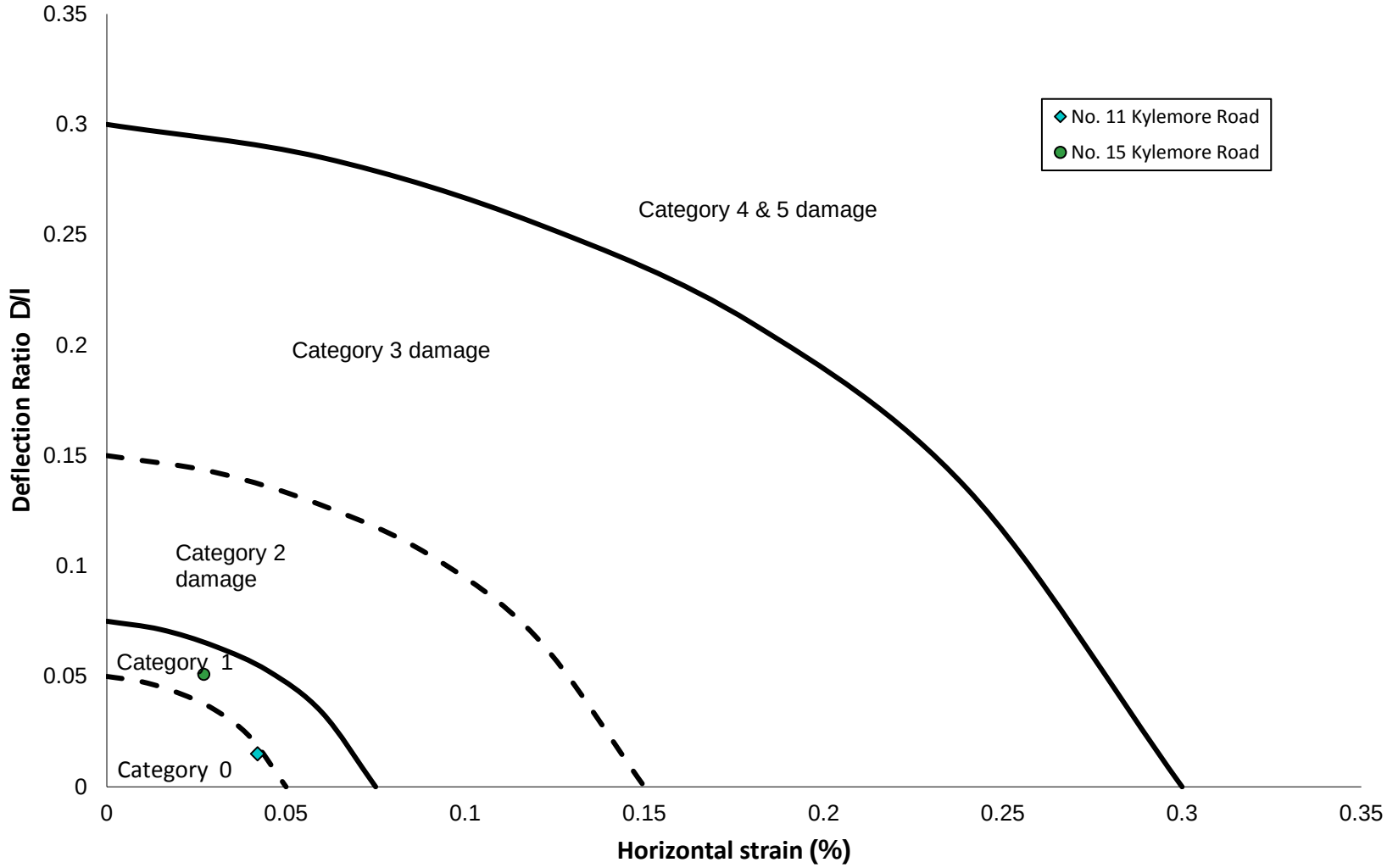
Dwg No.
Figure 8

Rev.
*





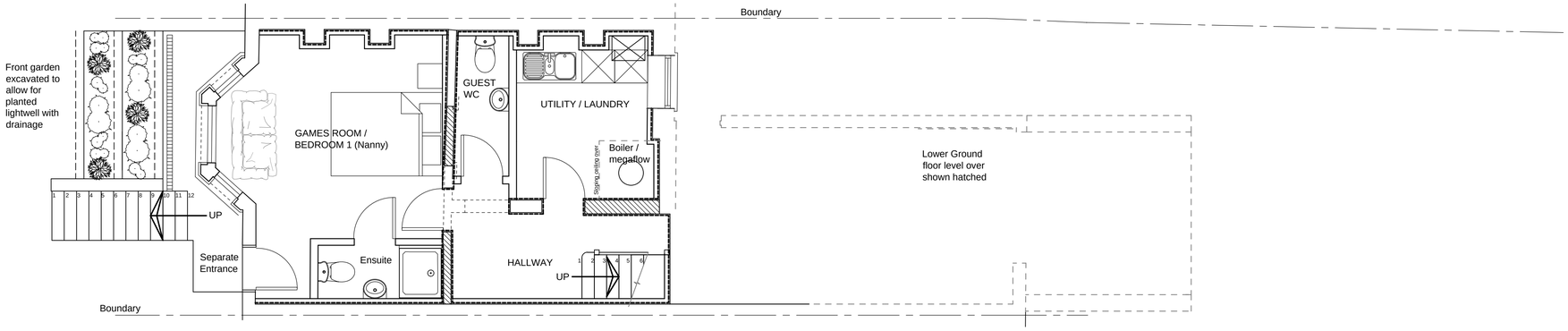
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title: **Combined vertical ground movements**	**Figure 9**



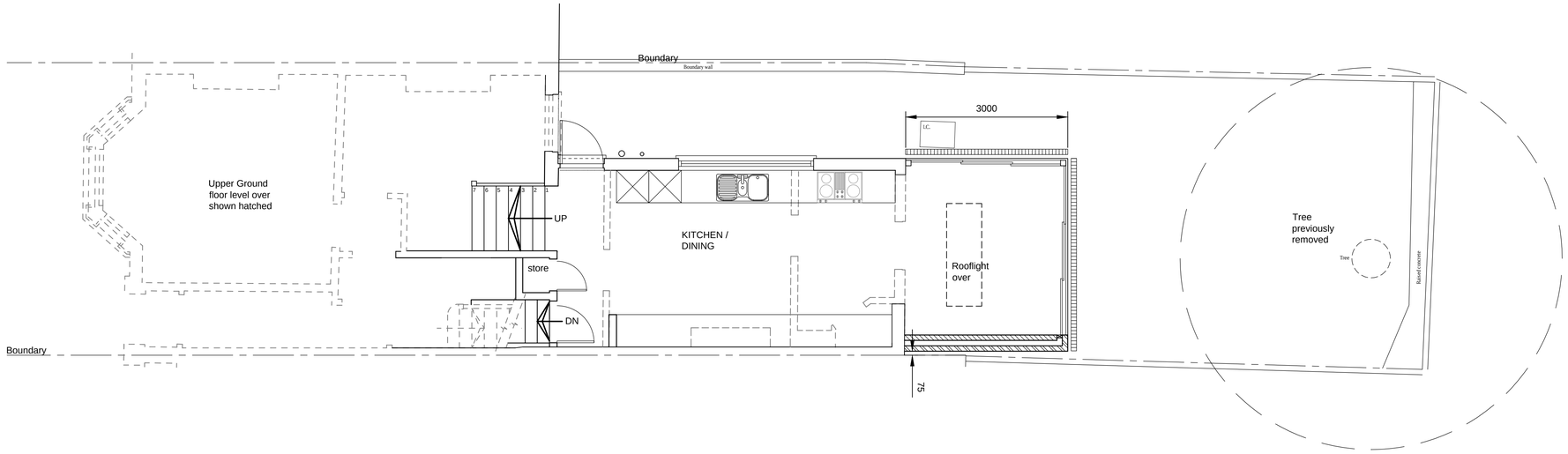
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title: **Building Interaction Chart**	**Figure 10**

APPENDIX A

Proposed development plans



PROPOSED BASEMENT FLOOR PLAN



PROPOSED LOWER GROUND FLOOR PLAN

SIZE A1

0m 1m 2m 3m 4m 5m

Rev.	Description	Drawn	Date
B	Revd to suit Clients comments	MPW	Nov 15
A	Revd to suit Clients comments	MPW	Nov 15

PROJECT
13 KYLEMORE ROAD, LONDON, NW6 2PS

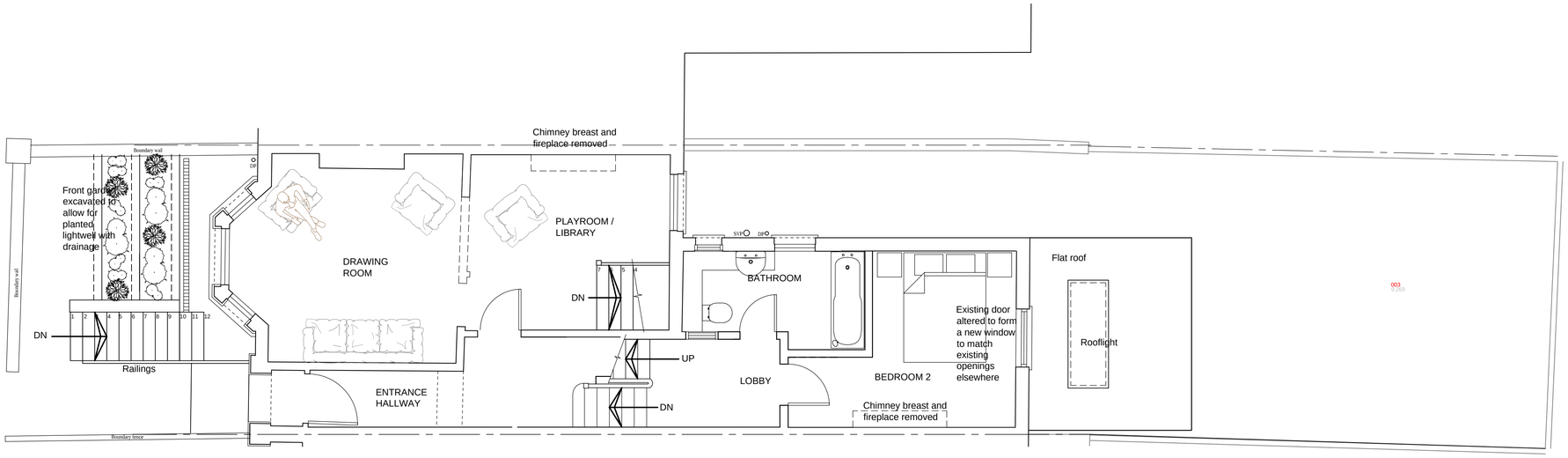
TITLE
PROPOSED PLANS

SHEET 1 OF 2

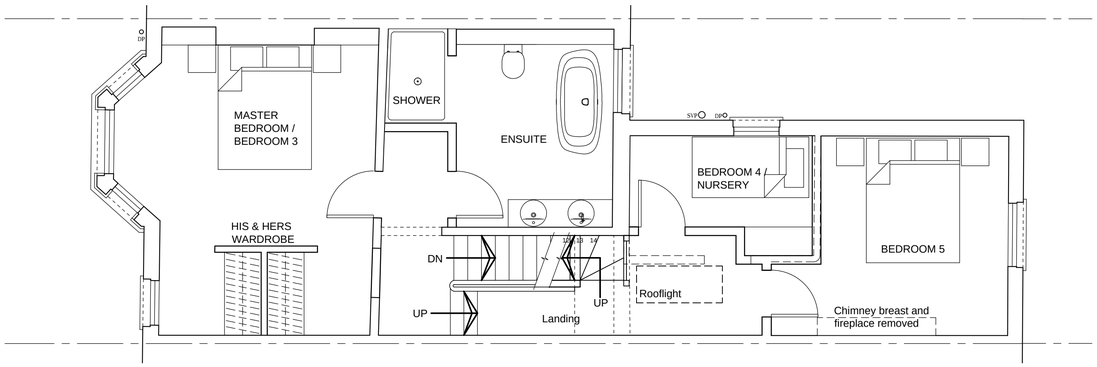
MW Design & Consulting Limited
Consulting Structural Engineer & Building Design Consultant
Churchfield House, Churchfield Road, Chalfont St Peter, Bucks, SL9 9EW
T 01753 888587 **M** 07528 462170 **E** enquiries@mwdesignconsult.co.uk

Scale	Date
1:50, at A1	SEP 15
	Drawn MPW

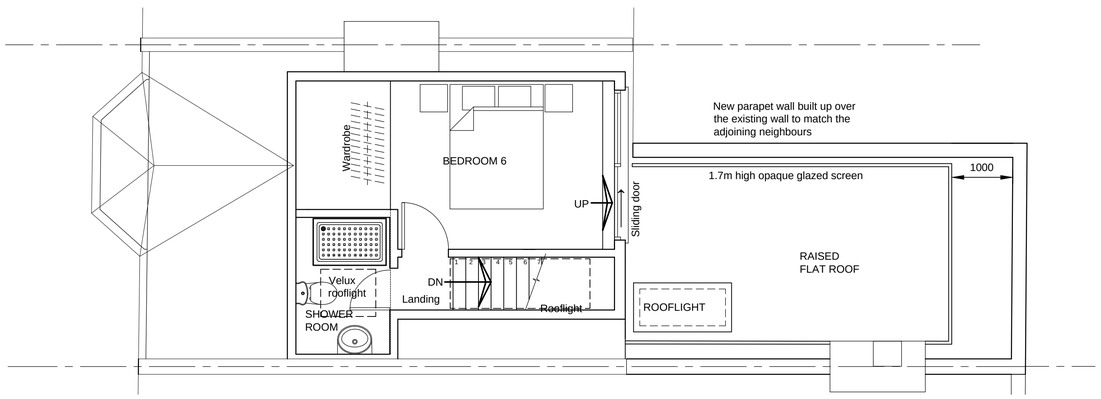
Drg No. 141040-04 Rev. B



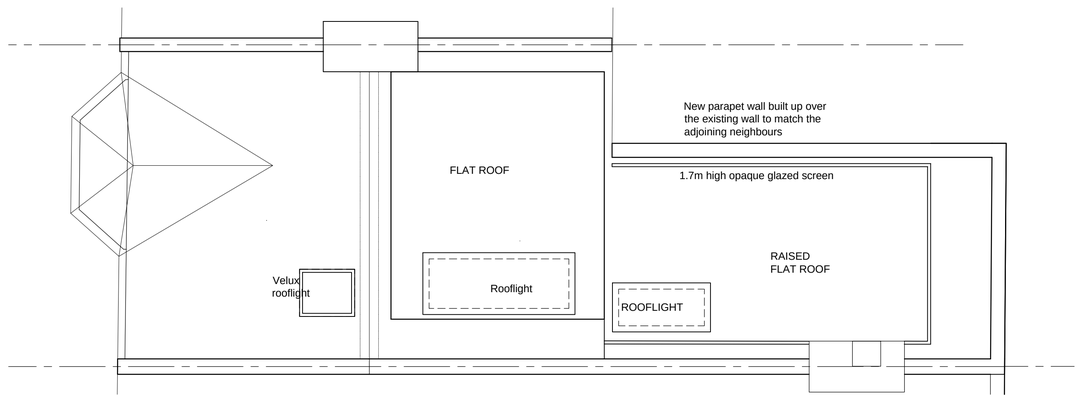
PROPOSED UPPER GROUND FLOOR PLAN / LOWER FIRST FLOOR PLAN



PROPOSED UPPER FIRST FLOOR PLAN / LOWER SECOND FLOOR PLAN



PROPOSED UPPER SECOND FLOOR PLAN



PROPOSED ROOF PLAN

SIZE A1

0m 1m 2m 3m 4m 5m

Rev.	Description	Drawn	Date
B	Revd to suit Clients comments	MPW	Nov 15
A	Revd to suit Clients comments	MPW	Nov 15

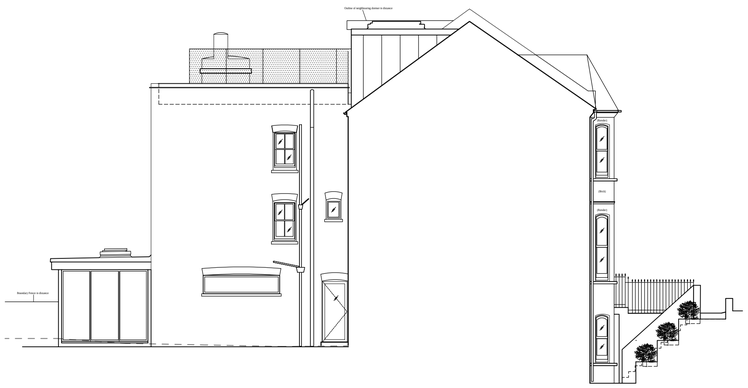
PROJECT
13 KYLEMORE ROAD, LONDON, NW6 2PS

TITLE
PROPOSED PLANS

SHEET 2 OF 2

MW Design & Consulting Limited
Consulting Structural Engineer & Building Design Consultant
Churchfield House, Churchfield Road, Chalfont St Peter, Bucks, SL9 9EW
T 01753 888587 **M** 07528 462170 **E** enquiries@mwdesignconsult.co.uk

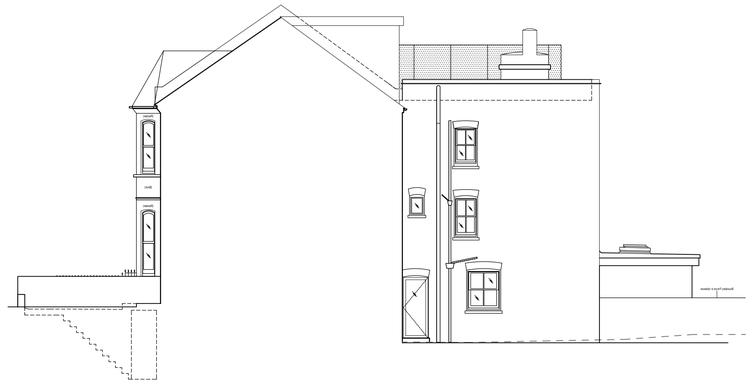
Scale: 1:50, at A1
Date: SEP 15
Drawn: MPW
Drg No.: 141040-05
Rev.: B



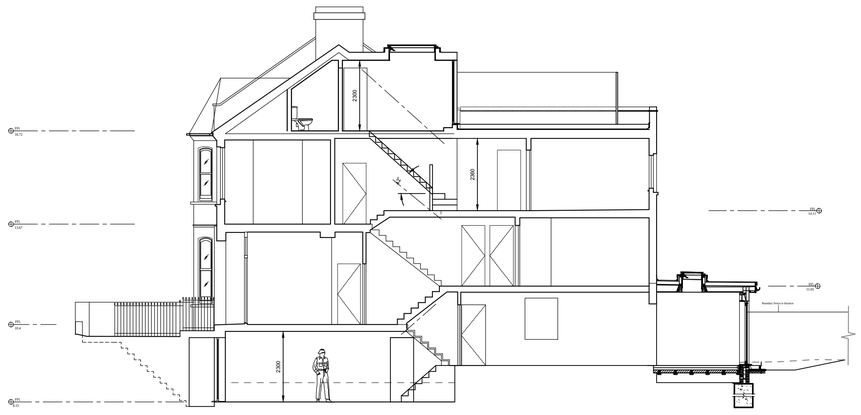
PROPOSED LEFT SIDE ELEVATION

PROPOSED FRONT ELEVATION

PROPOSED REAR ELEVATION



PROPOSED RIGHT SIDE ELEVATION



PROPOSED SECTION AA

Ordnance Survey (c) Crown Copyright 2015. All rights reserved. Licence number 100022432

SITE LOCATION PLAN

(SCALE 1:1250)

SITE BLOCK PLAN

(SCALE 1:500)

0m 25m

SCALE BAR AT 1:500

SIZE A1

0m 1m 2m 3m 4m 5m

Rev.	Description	Drawn	Date
B	Revd to suit Clients comments	MPW	Nov 15
A	Revd to suit Clients comments	MPW	Nov 15

PROJECT

13 KYLEMORE ROAD,
LONDON,
NW6 2PS

TITLE

PROPOSED ELEVATIONS AND SECTION
SITE LOCATION PLANS

MW Design & Consulting Limited
Consulting Structural Engineer & Building Design Consultant
Churchfield House, Churchfield Road, Chalfont St Peter, Bucks, SL9 9EW
T 01753 888587 **M** 07528 462170 **E** enquiries@mwdesignconsult.co.uk

Scale	Date
1:100, at A1	SEP 15
	Drawn MPW

Drg No. 141040-06 Rev. B

APPENDIX B

BGS borehole records

N

Figure taken from the BGS website

Not to scale

Borehole record included in appendix

Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**
CGL	Title **BGS borehole location plan**	**Appendix B**

AR.100C

Size A2 16½" x 23⅜"—420mm x 594mm

div	job no.	drg. no.	rev.
HO	746	01	

JOB
KILBURN VALE EST
BIRCHINGTON ROAD
CAMDEN

TITLE
TRIAL BORINGS 1–7
KEY PLAN & SECTIONS

scale VERTICAL 1 : 100

date	drawn	checked
18·8·1971	[illegible]	M.C.T.

GLC ILEA
Dept of Architecture and Civic Design

Architect Roger Coulter
01-633 5000 Ext. 8381

NOTES

1 Newlyn Datum Levels
2 -⊕- Denotes Trial Boring
3 Water was not encountered at the time of boring in March April 1971

REVISIONS

no.	date

COPY

reference

div.	job no.	drg. no.	rev.
HO	746	01	

Size A2 16½" x 23⅜"—420mm x 594mm

6 TQ128 SE/450
2545. 8385

+35·81m
0·3 Topsoil
9·75 Firm becoming stiff brown fissured silty clay with some grey clay in fissures occasional pockets of silt, some selenite crystals and carbon fragments
5·2 Stiff blue fissured silty clay.
15·25

5 TQ128 SE/449
2548. 8389

+38·01m
0·3 Made ground (Gravel, clay and sand)
5·8 Firm becoming stiff brown fissured silty clay with some grey clay in fissures occasional pockets of fine sand at depth. Selenite crystals occur throughout.
6·1m

4 TQ128 SE/448
2548. 8398

+41·46m
0·45 Made ground.
9·75 Firm, becoming stiff brown fissured silty clay with some grey clay in fissures occasional pockets of fine sand and some selenite crystals.
5·05 Stiff blue fissured silty clay with some silt in fissures
15·25m

3 TQ128 SE/447
2542. 8393

+40·35m
1·9 Made ground. (Clay and stones)
5·7 Firm becoming stiff brown fissured silty clay with some grey clay in fissures and some selenite crystals
7·6m

2 TQ128 SE/446
2544. 8399

+42·1m
0·3 Topsoil
7·3 Firm becoming stiff brown fissured silty clay with some grey clay in fissures and pockets of selenite crystals, occasional sand stones occur in upper levels.
7·6m

1 TQ128 SE/445
2540. 8395

+40·78m
0·45 Made ground
7·95 Firm becoming stiff brown fissured silty clay with some grey clay in fissures, occasional pockets of fine sand and selenite crystals
6·85 Stiff blue fissured silty clay becoming harder with depth
15·25m

7 TQ128 SE/451
2549 8384

+35·85m
0·45 Made ground
7·15 Firm, becoming stiff, brown fissured silty clay with some grey clay in fissures, some selenite crystals and pockets of silt
7·6m

KEY PLAN
Scale 1:1250

2584 SW

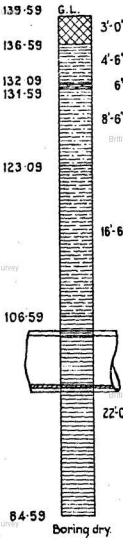
DETAILS OF BORINGS.

TQ/28SE/684

2502. 8428.

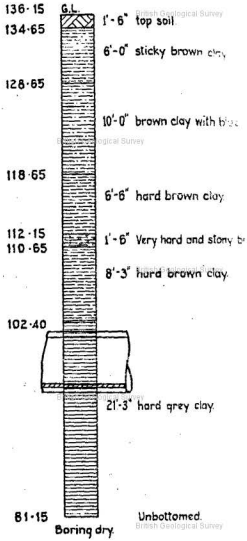
BORING Nº 3.

Made in 1955.



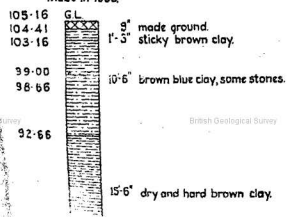
BORING Nº 4.

Made in 1955.



BORING Nº 10.

Made in 1955.



Investigation at NETHERWOOD STREET, CAMDEN Report No. 1/575/1969 TQ/285E/6854

B/H 1 2510. 8456.

Date of Boring 1-6 August 1969 Type of Boring Shell and Auger

Ground Level 44.97 m. O.D. (Newlyn) Diameter of Borehole 203mm

Scale ft / m	Depth m	Strata	O. D. Level	Description of Soil	Sample No.	Sample Type	'N' Value Blows ft.	Mean Shear Strength kN/m²
	G.L.		44.97		1	D		
				MADE GROUND consisting of brick fragments, pieces of concrete, gravel and sandy silt	2	D		
					3	D		
					4	D		
	5.3		39.67		5	D		
					6	U		117
				Stiff brown mottled blue in places fissured silty CLAY with some traces of crystals.	7	D		
					8	U		147
					9	D		
					10	D		
					11	U		118
					12	D		
	11.9		33.07	Stiff blue/grey fissured silty CLAY	13	U		174
	12.2		32.77		14	D		
				END OF BOREHOLE				

Notes

No groundwater encountered

U ... Undisturbed sample

D ... Disturbed sample

W ... Water sample

Scale: 1:100

Figure No. 1

BOREHOLE No

63 Priory Road, Hampstead

Date of boring 7th January, 1983

Diameter of boring : 200 mm

Lining tubes : 200 mm to 1.5 m.

Ground Level -

Description of Strata	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: Reduced Level	S.P.T. C.P.T. N-value	Samples: Depth	Samples: Type	Water Level	Depth of Casing
		m	m		m		m	m
MADE GROUND Soft to firm brown clay with broken bricks and de-composed mortar (very wet)		1.00						
					1.50-1.95	U100		1.50
LONDON CLAY Soft silty brown CLAY with extensive grey mottling. Very weathered		2.00						
Becoming soft-firm					2.50-2.95	U100		
Becoming firm with many partings of sand and occasional fine roots.		3.00						
Firm to stiff dark brown slightly silty mottled grey CLAY with some fissuring and sandy partings					3.50-3.95	U100		
Becoming stiff at 4.00m		4.00						
Very stiff to hard					4.50-4.95	U100		
Gypsum crystals from 5.00m		5.00						
		6.00		SPT28	6.00	J		
		7.00						
Very stiff to hard slightly silty blue-grey CLAY with many large fissures. Some silty and sandy partings.					7.50-7.95	U100		
		8.00		SPT39	8.50	J		
		9.00						
					9.50-9.95	U100	8.5m Dry	
Becoming very hard		10.00						

APPENDIX A

Report No. [illegible]

BOREHOLE LOG

D Strata log (Chilburn) cont'd.

Geological classification (BGS only)	Description of strata	Thickness m	Depth (to base of strata) m
	TOP SOIL + GRASS	0.10	0.10
	Possible MADE GROUND - Firm brown silty clay with 1mm pockets of yellow brown clay. occasional 5-6mm brick fragments and some fine to medium flint gravel	0.80	0.90
	Possible MADE GROUND - Stiff yellow brown silty clay with rare root traces infilled with topsoil and rare 1mm - 2mm pockets of topsoil	0.10	1.00
	Stiff yellow brown mottled grey/brown CLAY	5.00	6.00
	Stiff fissured brown CLAY with some pockets and lenses of yellow brown silt.	3.60	9.60
	Stiff to very stiff closely fissured grey brown CLAY	16.20	26.00
	Very stiff closely to very closely fissured dark grey brown CLAY	27.00	53.00
	Very stiff friable dark grey silty CLAY with abundant 3mm - 5mm pockets of light grey silt.	3.00.	56.00
	Dark grey CLAY - (recovered as clayey polymer slurry)	15.45	71.45
	Reddish brown CLAY (recovered as clayey polymer slurry)	9.00	80.45
	Grey fine SAND (recovered as sandy polymer slurry.	9.30	89.75
	Grey fine SAND, some flint fragments, medium sand of chalk. (recovered as sandy polymer slurry)	6.25	96.00
	White CHALK with flints - (recovered as white chalky polymer slurry) (continue on separate page if necessary)	47.60.	143.60
	Other comments (for example, gas encountered, saline water intercepted) Borehole commenced by cable Percussion boring to 56.00m and continued by Rotary Open hole techniques with polymer flush to 143.60m.		

E Completing this form

How long did it take you to fill in this form? 30 mins.

For Official use only

Date received (DD/MM/YYYY)	File	Consent number	BGS reference number
Accession number	**Wellmaster number**	**SOBI number**	**NGR**
LIC NO	**Purpose**		**EA reference number**
Copy number	**Entered by**		

GROUND LEVEL + 140·0 (42·67m) G.P.O. Willesden

NOMINAL B.H. DIA.: 8" to 150'

BOREHOLE No. 14

DATE OF BORING: 15th to 23rd June '61

GROUNDWATER LEVEL	DATE	SAMPLE DEPTH	B.H.	DEPTH	R.L.	DESCRIPTION OF STRATA
NIL.	18th to 23rd June			1'·8"	+138·0	Topsoil, with occasional rootlets
		5'·0"		4'·0"	+136·0	Soft to firm mottled brown clay
		10'·0"		11'·0"	+129·0	Stiff fissured brown clay containing gypsum crystals
		15'·0"		14'·0"	+126·0	Firm - stiff brown sandy clay
		20'·0"				Stiff fissured brown clay, containing gypsum crystals
		25'·0"				
		30'·0"		31'·6"	+108·6	
		35'·0"				Very stiff fissured blue silty clay, containing occasional claystone boulders
		40'·0"				
		45'·0"				
		50'·0"				
		55'·0"				
		60'·0"				
		65'·0"				
		70'·0"				
		75'·0"				
		80'·0"				
		85'·0"				
		90'·0"				
		95'·0"				
		100'·0"				
		105'·0"				
		110'·0"				
		115'·0"				
		120'·0"				
		125'·0"				
		130'·0"				
		135'·0"				
		140'·0"				
		145'·0"				
		150'·0"		150'·0" (45·72m)	-10·0	

CONFIDENTIAL.

TQ28SW/12

2498.8416

256

Page 1 of 2

REMARKS: Claystone boulders at 33'·0", 81'·0", 111'·6", 147'·0"

SAMPLES: ■ Undisturbed ● Disturbed

SCALE: 1" to 20'·0"

Appendix 1.

TERRESEARCH LIMITED

2482
8442

BOREHOLE NO. 1

Contract Name Kilburn — Report No. R. 629/64

Client John F. Farquharson & Partners — Site Address Adjoining Barclays Bank Ltd 320, Kilburn High Road, London, N.W.6.

Address Chartered Structural Engineers, 34, Queen Anne Street, London, W.1.

Standing Water Level — Diameter 8"

Water Struck NONE — Method of Boring Shell/Auger

Ground Level — Start 13.6.64 Finish 15.6.64

Remarks: Boring commenced from basement level.

Description of Strata	Thickness	Depth	Disturbed Samples	'U' Cores and 'N' P. Tests
Made ground (brick rubble and concrete)	3'0"	3'0"	J5101 3'0"	
SILTY brown mottled clay	25'0"	28'0"	J5102 5'0" J5103 7'6" J5105 12'6" J5106 15'0" J5107 17'6" J5109 22'6" J5110 25'0" J5111 27'6"	U5104 8'6" U5108 18'6"
Hard blue clay	32'0"	60'0"	J5113 32'6" J5114 35'0" J5115 37'6" J5117 42'6" J5118 45'0" J5119 47'6" J5121 52'6" J5122 55'0" J5123 57'6"	U5112 28'6" U5116 38'6" U5120 48'6" U5124 58'6"
TOTALS	60'0"	60'0"		

APPENDIX C

CGL borehole logs

WINDOW SAMPLE LOG

Project				HOLE No
13 Kylemore Road, Camden				**BH1**
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/18952	25-10-16	43.96	E 525,260.3 N 184,468.3	
Client				Sheet
Mr Robert Hume				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
0.40	ES1			43.46		(0.50) 0.50	Soft to firm dark grey brown slightly gravelly slighty sandy clayey silt. Gravel is angular to sub rounded fine to coarse of flint, brick and tile. Sand is fine to coarse. Occasional cobble of brick observed. Frequent rootlets observed. [MADE GROUND]	
1.00	ES2					(1.00)	Soft to firm dark grey yellow and brown slightly gravelly clay. Gravel is sub angular fine to coarse flint, coal and brick. [MADE GROUND]	
1.00	D6							
1.00-1.45	D11			42.46		1.50		
1.00		N4					Soft to firm dark orange brown and blue grey CLAY. Fine to coarse selenite crystals noted. [WEATHERED LONDON CLAY]	
2.00	D7							
2.00-2.45	D12							
2.00		N5						
3.00-3.45	D13							
3.00		N7						
4.00	ES3							
4.00	D8							
4.00-4.45	D14							
4.00		N11					4.50 Becoming firm to soft.	
5.00-5.45	D15					(6.95)		
5.00		N10						
6.00	ES4							
6.00	D9							
6.00-6.45	D16							
6.00		N18						
7.00-7.45	D17							
7.00		N14						
8.00	ES5							
8.00	D10							
8.00-8.45	D18			35.51		8.45		
8.00		N15					*(Window sample terminated at 8.45m)*	

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. Hole terminated at 8.45mbgl at target depth.
2. ES= Environmental sample, D= Disturbed sample, N= SPT result.
3. No groundwater encountered.
4. Installation: 0 to 0.5m: 50mm plain pipe with bentonite seal, 0.5 to 2.0m: 50mm slotted pipe with gravel filter pack. Bentonite seal 2.0 to 8.0m, gas tap, bung and flush cover.

Method/ Plant Used	Field Crew	Logged By	Checked By
Modular window sample rig	Topdrill	NDH	RJB

WINDOW SAMPLE LOG

Project				HOLE No
13 Kylemore Road, Camden				**BH2**
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/18952	24-10-16	43.18	E 525,282.8 N 184,467.0	
Client				Sheet
Mr Robert Hume				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
0.20	ES1			42.68		(0.50) 0.50	Soft to firm dark grey brown slightly gravelly slighty sandy clayey silt. Gravel is angular to sub rounded fine to coarse flint, brick and tile. Sand is fine to coarse. Occasional cobble of brick observed. Frequent rootlets observed. [MADE GROUND]	
							Soft to firm dark orange brown and blue grey CLAY. Fine to coarse selenite crystals observed. [WEATHERED LONDON CLAY]	
1.00	ES2							
1.00	D4							
1.00-1.45	D9							
1.00		N7						
2.00	D6							
2.00-2.45	D10							
2.00		N8						
3.00	D7							
3.00-3.45	D11							
3.00		N8				(5.95)		
4.00	D8							
4.00-4.45	D12							
4.00		N12					4.50 Becoming firm.	
5.00-5.45	D13							
5.00		N13						
6.00	ES3							
6.00	D5							
6.00-6.45	D14			36.73		6.45		
6.00		N15					*(Window sample terminated at 6.45m)*	

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

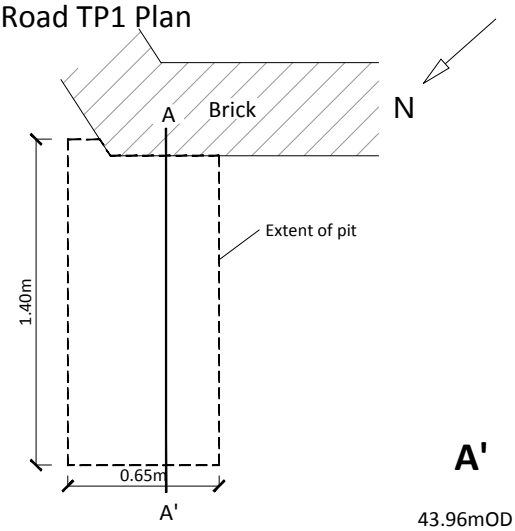
1. Hole terminated at 6.45mbgl at target depth.
2. ES= Environmental sample, D= Disturbed sample, N= SPT result.
3. No groundwater encountered.
4. Installation: 0 to 1.0m: 50mm plain pipe with bentonite seal, 1.0 to 6.0m: 50mm slotted pipe with gravel filter pack, gas tap, bung and flush cover.

Method/ Plant Used	Field Crew	Logged By	Checked By
Modular window sample rig	Topdrill	NDH	RJB

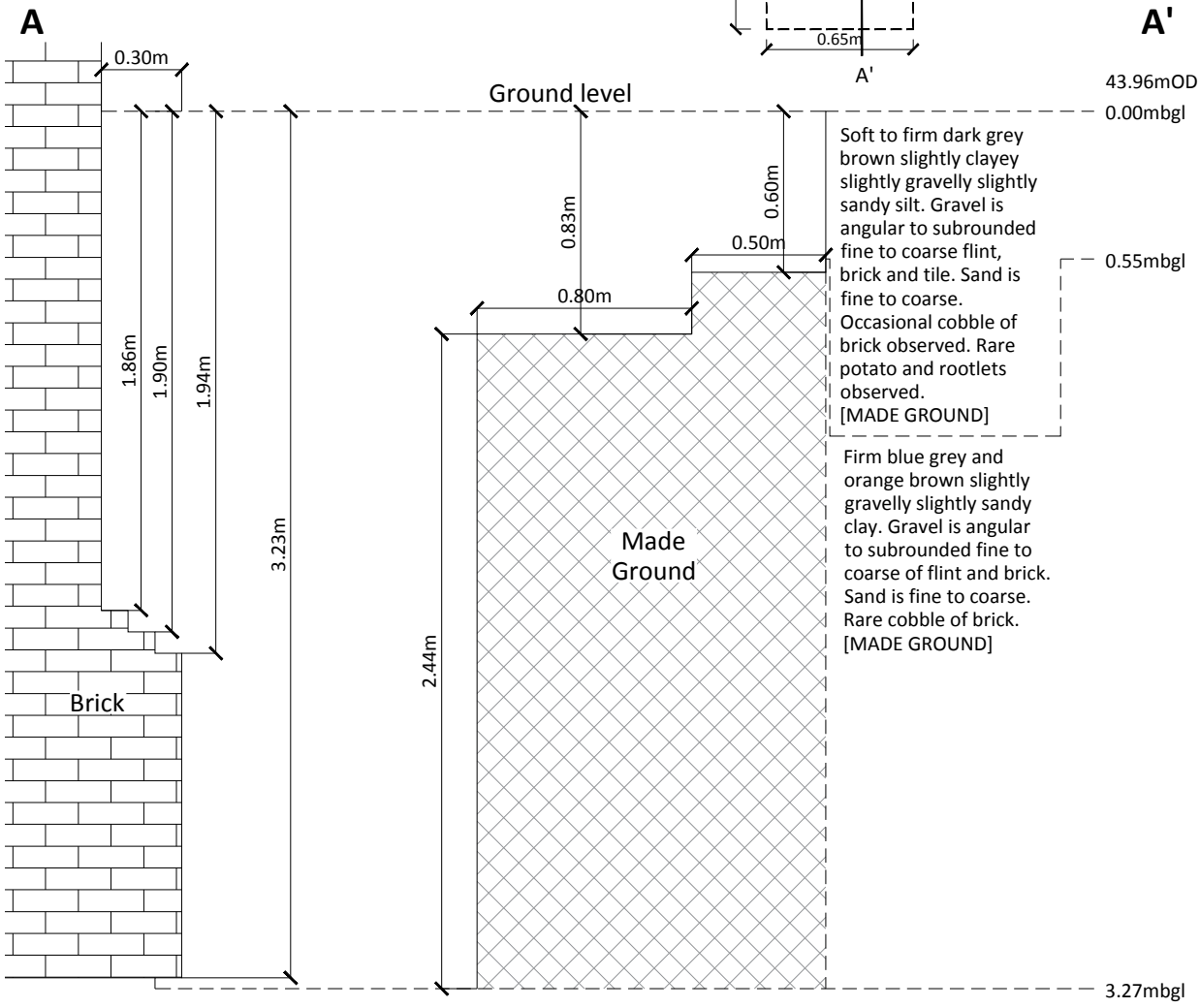
APPENDIX D

CGL foundation inspection logs

13 Kylemore Road TP1 Plan

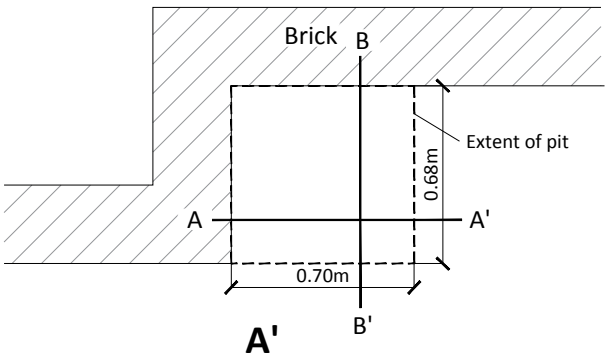


13 Kylemore Road
TP1
Section A-A'

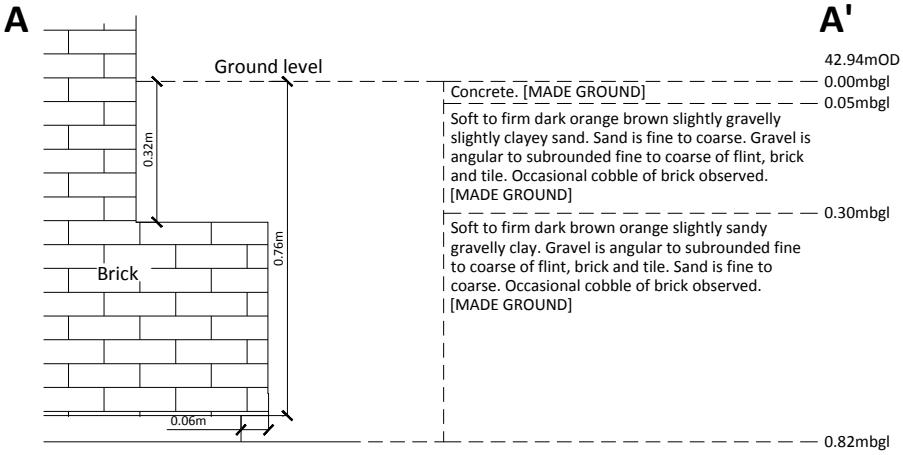


Client: **Mr Robert Hume**	Project: **13 Kylemore Road, Camden**	Job No: **CG/18952**
CGL	Title: **Foundation Inspection Pit TP1 Plan & Section**	Drawn by: TSB Checked by: RJB Approved by: XXX

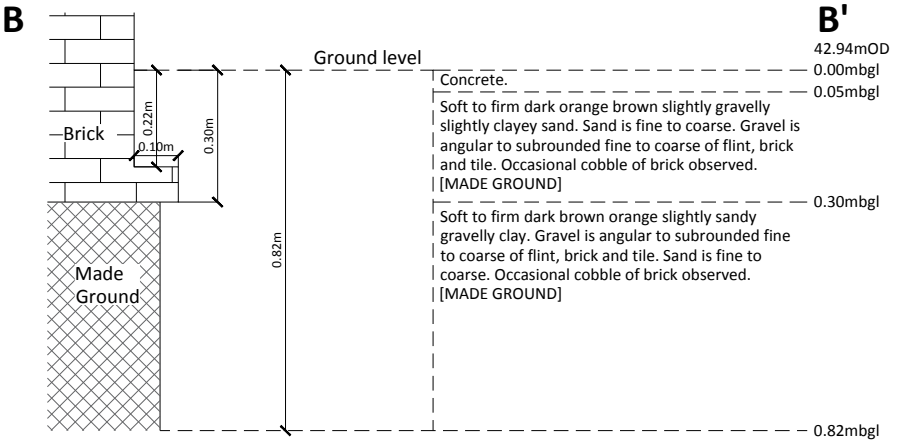
13 Kylemore Road TP2 Plan



13 Kylemore Road TP2 Section A-A'



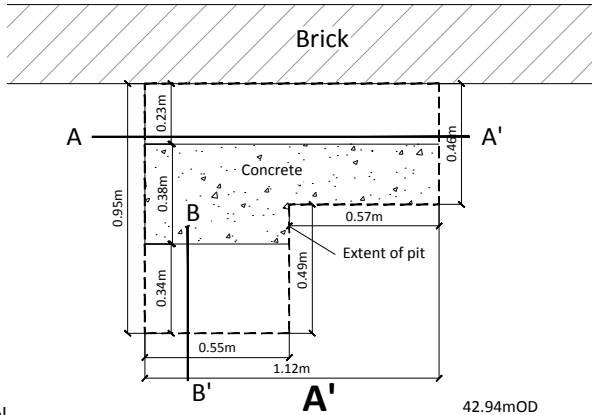
13 Kylemore Road TP2 Section B-B'



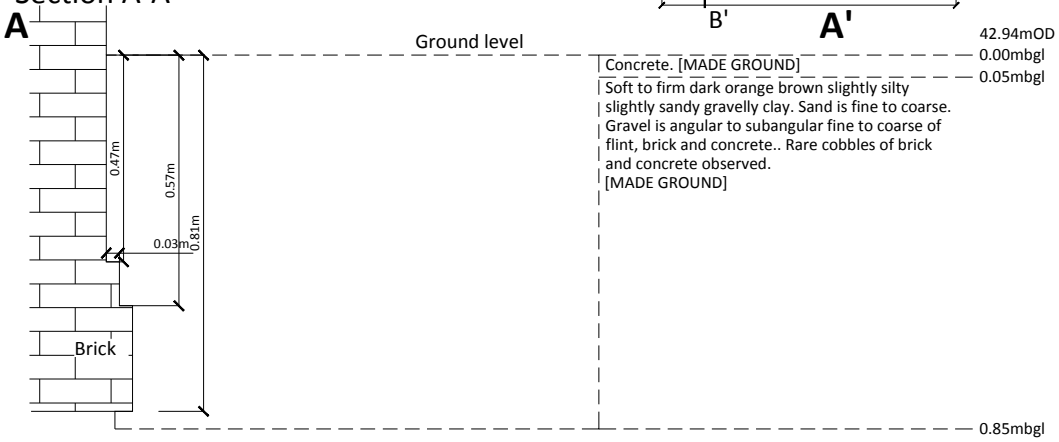
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**

	Title		
CGL	**Foundation Inspection Pit TP2 Plan & Section**	Drawn by	TSB
		Checked by	RJB
		Approved by	XXX

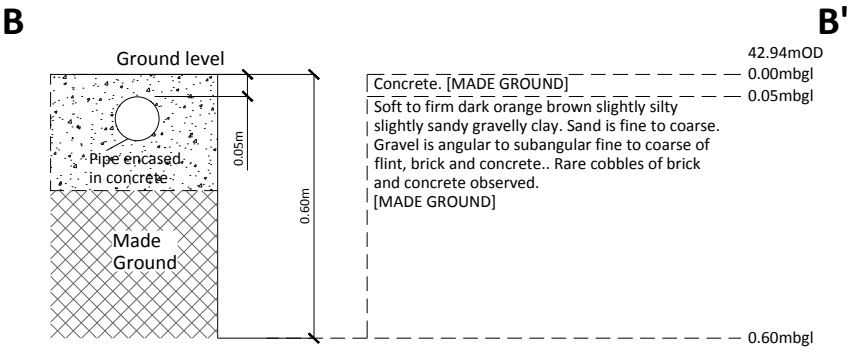
13 Kylemore Road TP3 Plan



13 Kylemore Road TP3 Section A-A'



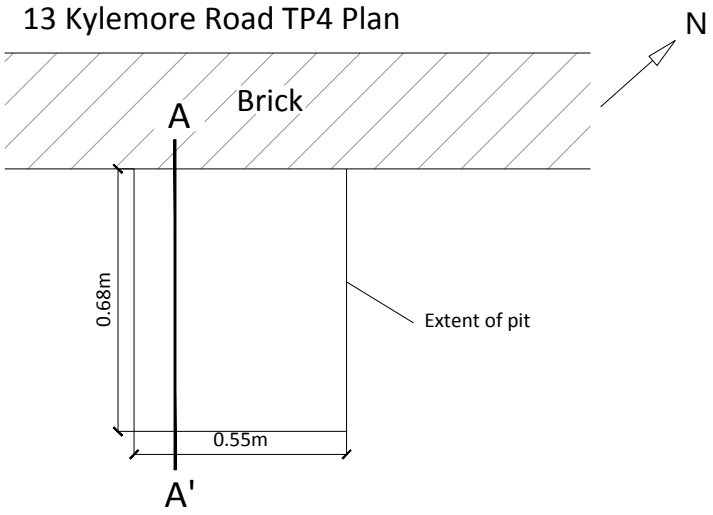
13 Kylemore Road TP3 Section B-B'



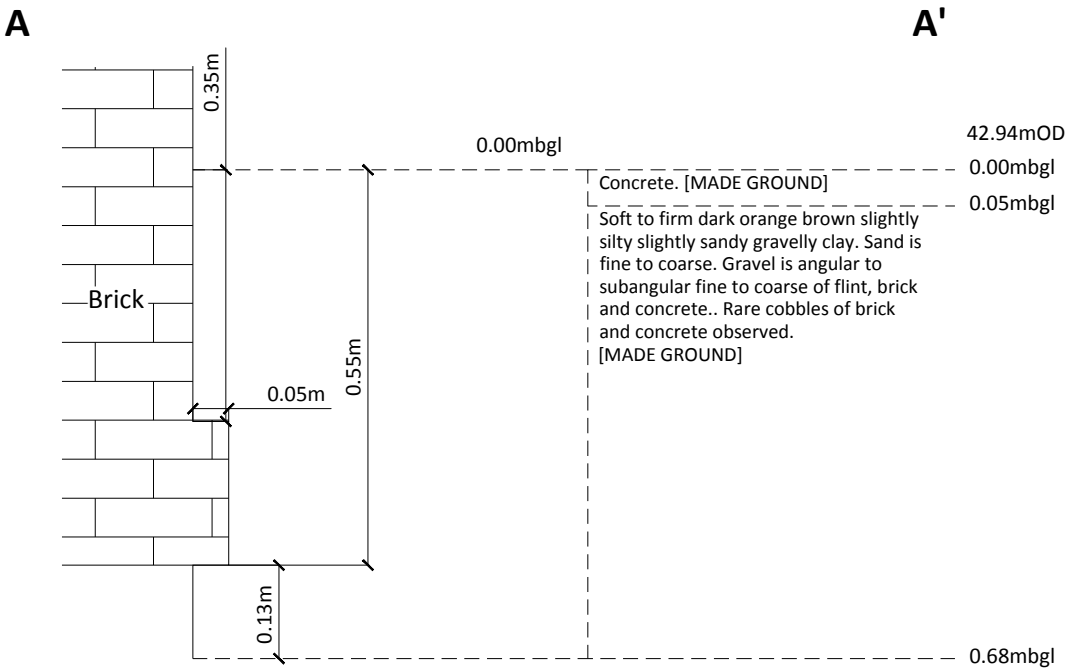
Client	Project	Job No
Mr Robert Hume	**13 Kylemore Road, Camden**	**CG/18952**

	Title		
CGL	**Foundation Inspection Pit TP3 Plan & Section**	Drawn by	TSB
		Checked by	RJB
		Approved by	XXX

13 Kylemore Road TP4 Plan



13 Kylemore Road
TP4
Section A-A'



Client **Mr Robert Hume**	Project **13 Kylemore Road, Camden**	Job No **CG/18952**
CGL	Title **Foundation Inspection Pit TP4 Plan & Section**	Drawn by: TSB Checked by: RJB Approved by: XXX

APPENDIX E

Ground gas and groundwater monitoring records

GAS MONITORING RECORD SHEET

JOB DETAILS			
Site:	13 Kylemore Road	Job No:	CG/18952
Date:	01/11/2016	Engineer:	NDH
Time:	09:00	Client	Mr Robert Hume

METEOROLOGICAL & SITE INFORMATION

State of ground:	Dry		Moist	X	Wet				
Wind:	Calm	X	Light		Moderate		Strong		
Cloud cover:	None		Slight	X	Cloudy		Overcast		
Precipitation:	None	X	Slight		Moderate		Heavy		

Barometric pressure (mb): 1018 Local pressure system*: Steady Air temperature (°C): 10

Well No.	Time (s)	Flow (l/hr)	dA (PA)	O_2 (% vol. in air)	CO_2 (% vol. in air)	CH_4 (% vol. in air)	PID (ppm)	Depth to Groundwater (mbgl)	Depth to Base (m)
BH1	0	0.3	1.0	20.5	<0.1	<0.1	<0.1	DRY	1.98m
	15	0.3	1.0	19.2	0.5	<0.1	<0.1		
	30	0.1	1.0	18.9	0.8	<0.1	<0.1		
	45	0.2	1.0	18.8	1.1	<0.1	<0.1		
	60	0.3	1.0	18.7	1.3	<0.1	<0.1		
	90	<0.1	0.0	18.7	1.5	<0.1	<0.1		
	120	0.1	1.0	18.7	1.5	<0.1	<0.1		
	150	<0.1	0.0	18.7	1.5	<0.1	<0.1		
	180	<0.1	0.0	18.7	1.5	<0.1	<0.1		
	240	<0.1	0.0	18.7	1.5	<0.1	<0.1		
	300	<0.1	0.0	18.7	1.5	<0.1	<0.1		
BH2	0	1.5	7.0	19.7	<0.1	<0.1	<0.1	DRY	5.98m
	15	1.1	5.0	16.7	3.3	<0.1	<0.1		
	30	0.8	5.0	14.6	7.1	<0.1	<0.1		
	45	0.5	3.0	14.4	7.2	<0.1	<0.1		
	60	0.3	1.0	14.2	7.2	<0.1	<0.1		
	90	<0.1	0.0	14.1	7.3	<0.1	<0.1		
	120	<0.1	0.0	14.1	7.3	<0.1	<0.1		
	150	<0.1	0.0	14.1	7.3	<0.1	<0.1		
	180	<0.1	0.0	14.1	7.3	<0.1	<0.1		
	240	<0.1	0.0	14.1	7.3	<0.1	<0.1		
	300	<0.1	0.0	14.2	7.3	<0.1	<0.1		

Notes:

The measurement of hydrogen sulphide and hydrocarbon free product is undertaken on a site specific basis, if deemed necessary.
** With reference to the Weather Underground rolling weather archive for Heathrow weather station.*
NR= Not recorded

GAS MONITORING RECORD SHEET

JOB DETAILS			
Site:	13 Kylemore Road	Job No:	CG/18952
Date:	18/11/2016	Engineer:	BMK
Time:	09:30	Client	Mr Robert Hume

METEOROLOGICAL & SITE INFORMATION

State of ground:	Dry	X	Moist		Wet				
Wind:	Calm	X	Light		Moderate		Strong		
Cloud cover:	None		Slight		Cloudy	X	Overcast		
Precipitation:	None	X	Slight		Moderate		Heavy		

Barometric pressure (mb): 989 Local pressure system*: Rising Air temperature (°C): 4

Well No.	Time (s)	Flow (l/hr)	dA (PA)	O_2 (% vol. in air)	CO_2 (% vol. in air)	CH_4 (% vol. in air)	PID (ppm)	Depth to Groundwater (mbgl)	Depth to Base (m)
BH1	0	<0.1	-2.0	17.2	3.3	<0.1	<0.1	DRY	1.99m
	15	<0.1	0.0	19.1	1.2	<0.1	<0.1		
	30	<0.1	0.0	19.2	1.2	<0.1	<0.1		
	45	<0.1	0.0	19.3	1.2	<0.1	<0.1		
	60	<0.1	0.0	19.2	1.2	<0.1	<0.1		
	90	<0.1	0.0	18.7	1.2	<0.1	<0.1		
	120	<0.1	0.0	19.2	1.2	<0.1	<0.1		
	150	<0.1	0.0	19.2	1.2	<0.1	<0.1		
	180	<0.1	0.0	19.2	1.2	<0.1	<0.1		
	240	<0.1	0.0	19.0	1.2	<0.1	<0.1		
	300	<0.1	0.0	19.2	1.2	<0.1	<0.1		
BH2	0	<0.1	0.0	18.9	1.7	<0.1	<0.1	2.30	5.96m
	15	<0.1	0.0	10.5	9.1	<0.1	<0.1		
	30	<0.1	0.0	10.0	9.4	<0.1	<0.1		
	45	<0.1	0.0	9.9	9.5	<0.1	<0.1		
	60	<0.1	0.0	9.9	9.5	<0.1	<0.1		
	90	<0.1	0.0	9.9	9.5	<0.1	<0.1		
	120	<0.1	0.0	9.8	9.4	<0.1	<0.1		
	150	<0.1	0.0	9.8	9.5	<0.1	<0.1		
	180	<0.1	0.0	9.8	9.5	<0.1	<0.1		
	240	<0.1	0.0	9.8	9.6	<0.1	<0.1		
	300	<0.1	0.0	9.9	9.5	<0.1	<0.1		

Notes:

The measurement of hydrogen sulphide and hydrocarbon free product is undertaken on a site specific basis, if deemed necessary.
** With reference to the Weather Underground rolling weather archive for Heathrow weather station.*
NR= Not recorded

APPENDIX F

Chemical laboratory results

Nick Hampson
Card Geotechnics Ltd
4 Godalming Business Centre
Woolsack Way
Godalming
Surrey
GU7 1XW

t: 01483 310600
f: 01483 527285
e: nickh@cgl-uk.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 16-31246

Project / Site name:	13 Kylemore Road	**Samples received on:**	26/10/2016
Your job number:	CG-18952	**Samples instructed on:**	27/10/2016
Your order number:	3693	**Analysis completed by:**	07/11/2016
Report Issue Number:	1	**Report issued on:**	07/11/2016
Samples Analysed:	3 soil samples		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 16-31246

Project / Site name: 13 Kylemore Road
Your Order No: 3693

Lab Sample Number				649712	649713	649714		
Sample Reference				BH2	BH1	BH1		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.20	1.00	4.00		
Date Sampled				24/10/2016	25/10/2016	25/10/2016		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	28	17	22		
Total mass of sample received	kg	0.001	NONE	1.3	1.6	1.6		
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	-		
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.1	7.8	8.3		
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1		
Total Sulphate as SO_4	mg/kg	50	MCERTS	2200	180	3200		
Organic Matter	%	0.1	MCERTS	8.5	0.8	0.2		
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	1.1	< 1.0	< 1.0		
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10		
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10		
Fluorene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10		
Phenanthrene	mg/kg	0.1	MCERTS	1.4	< 0.10	< 0.10		
Anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10		
Fluoranthene	mg/kg	0.1	MCERTS	3.0	< 0.10	< 0.10		
Pyrene	mg/kg	0.1	MCERTS	2.4	< 0.10	< 0.10		
Benzo(a)anthracene	mg/kg	0.1	MCERTS	0.87	< 0.10	< 0.10		
Chrysene	mg/kg	0.05	MCERTS	1.8	< 0.05	< 0.05		
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.64	< 0.10	< 0.10		
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	0.77	< 0.10	< 0.10		
Benzo(a)pyrene	mg/kg	0.1	MCERTS	1.1	< 0.10	< 0.10		
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	0.41	< 0.10	< 0.10		
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10		
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.67	< 0.05	< 0.05		
Coronene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05		
Total PAH								
Total WAC-17 PAHs	mg/kg	1.6	NONE	13	< 1.6	< 1.6		

Analytical Report Number: 16-31246

Project / Site name: 13 Kylemore Road
Your Order No: 3693

Lab Sample Number				649712	649713	649714		
Sample Reference				BH2	BH1	BH1		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.20	1.00	4.00		
Date Sampled				24/10/2016	25/10/2016	25/10/2016		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	28	< 1.0	1.5		
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	41	9.9	8.2		
Barium (aqua regia extractable)	mg/kg	1	MCERTS	1300	47	50		
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.4	0.49	1.2		
Boron (water soluble)	mg/kg	0.2	MCERTS	4.2	0.5	2.1		
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.7	< 0.2	0.2		
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2		
Chromium (III)	mg/kg	1	NONE	50	36	44		
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	51	36	44		
Copper (aqua regia extractable)	mg/kg	1	MCERTS	120	16	32		
Lead (aqua regia extractable)	mg/kg	1	MCERTS	3000	35	49		
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	2.0	2.2	1.4		
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	36	17	50		
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	56	52	97		
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	930	44	87		
Monoaromatics								
Benzene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1		
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1		
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1		
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	7.2		
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0		
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	36	< 8.0	62		
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	37	< 10	77		
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1		
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1		
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1		
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0		
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	13	< 10	< 10		
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	27	< 10	< 10		
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	42	< 10	< 10		

Analytical Report Number : 16-31246

Project / Site name: 13 Kylemore Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
649712	BH2	None Supplied	0.20	Brown loam and clay with gravel and vegetation.
649713	BH1	None Supplied	1.00	Light brown clay and sand.
649714	BH1	None Supplied	4.00	Brown clay.

Analytical Report Number : 16-31246

Project / Site name: 13 Kylemore Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated WAC-17 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Nick Hampson
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7 Woodshots Meadow,
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t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 16-32633

Project / Site name:	13 Kylemore Road	**Samples received on:**	26/10/2016
Your job number:	CG-18952	**Samples instructed on:**	11/11/2016
Your order number:	3693	**Analysis completed by:**	22/11/2016
Report Issue Number:	1	**Report issued on:**	22/11/2016
Samples Analysed:	1 10:1 WAC sample		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

i2 Analytical
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Croxley Green Business Park
Watford, WD18 8YS

Telephone: 01923 225404
Fax: 01923 237404
email:reception@i2analytical.com

Waste Acceptance Criteria Analytical Results

Report No:	**16-32633**						
					Client:	**CARDGEO**	
Location	**13 Kylemore Road**						
Lab Reference (Sample Number)	657429 / 657430				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	24/10/2016				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	BH2						
Depth (m)	0.20						
Solid Waste Analysis							
TOC (%)**	5.2				3%	5%	6%
Loss on Ignition (%) **	17				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.007				1	--	--
Mineral Oil (mg/kg)	56				500	--	--
Total PAH (WAC-17) (mg/kg)	16				100	--	--
pH (units)**	7.1				--	>6	--
Acid Neutralisation Capacity (mol / kg)	0.43				--	To be evaluated	To be evaluated
Eluate Analysis (BS EN 12457 - 2 preparation utilising end over end leaching procedure)	10:1 mg/l			10:01 mg/kg	Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	0.0098			0.0868	0.5	2	25
Barium *	0.0678			0.602	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0066			0.059	0.5	10	70
Copper *	0.026			0.23	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0051			0.0448	0.5	10	30
Nickel *	0.0047			0.042	0.4	10	40
Lead *	0.11			0.95	0.5	10	50
Antimony *	0.011			0.095	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.11			0.95	4	50	200
Chloride *	5.2			46	800	4000	25000
Fluoride	0.22			1.9	10	150	500
Sulphate *	5.2			46	1000	20000	50000
TDS	81			720	4000	60000	100000
Phenol Index (Monhydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	17.0			151	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	1.3						
Dry Matter (%)	72						
Moisture (%)	28						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and I2 cannot be held responsible for any discrepencies with current legislation

*= UKAS accredited (liquid eluate analysis only)
** = MCERTS accrediited

Analytical Report Number : 16-32633

Project / Site name: 13 Kylemore Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
657429	BH2	None Supplied	0.20	Brown loam and clay with gravel and vegetation.

Analytical Report Number : 16-32633

Project / Site name: 13 Kylemore Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance an Sampling and Testing of Wastes to Meet Landfill Waste Acceptance""	L046-UK	W	NONE
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
BTEX in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033-PL	W	NONE
Loss on ignition of soil @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L047-PL	D	MCERTS
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	in-house method	L076-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Speciated WAC-17 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by electrometric measurement.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-PL	W	NONE
Total organic carbon in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	MCERTS

Analytical Report Number : 16-32633

Project / Site name: 13 Kylemore Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH2		S	16-32633	657429	c	BTEX in soil (Monoaromatics)	L073B-PL	c
BH2		S	16-32633	657429	c	Organic matter in soil	L023-PL	c
BH2		S	16-32633	657429	c	Total BTEX in soil (Poland)	L073-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

APPENDIX G

Geotechnical laboratory results

TEST CERTIFICATE

Determination of Moisture Content

Tested in Accordance with BS 1377-2:1990: Clause 3.2

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	25/10/2016
		Date Received:	28/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

Test results

Laboratory Reference	Sample Reference	Location	Depth Top [m]	Depth Base [m]	Sample Type	Description	Moisture Content [%]
650887	Not Given	BH2	1	Not Given	D	Yellowish brown CLAY	35
650888	Not Given	BH2	2	Not Given	U	Brown CLAY	29
650889	Not Given	BH2	3	Not Given	U	Yellowish brown CLAY	30
650890	Not Given	BH1	1	Not Given	D	Yellowish brown slightly gravelly CLAY	31
650891	Not Given	BH1	2	Not Given	U	Yellowish brown CLAY	37
650892	Not Given	BH1	4	Not Given	U	Brown CLAY	25
650893	Not Given	BH1	6	Not Given	U	Brown CLAY	31
650894	Not Given	BH1	8	Not Given	U	Brown CLAY	32

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	24/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

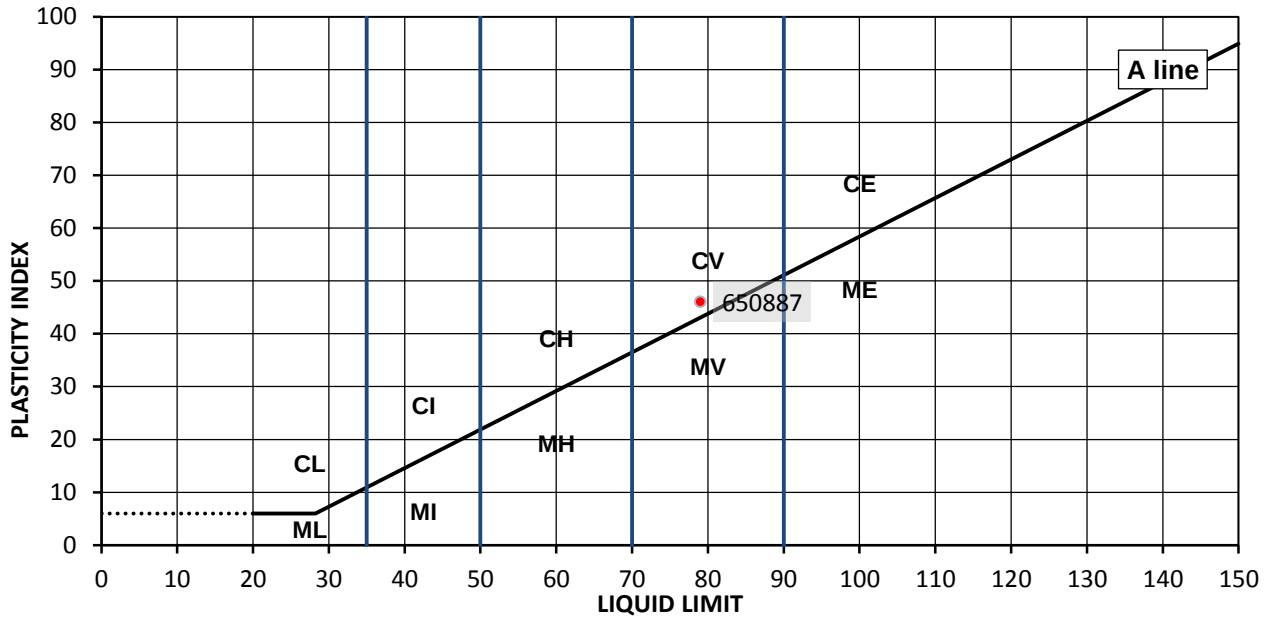
TEST RESULTS

Laboratory Reference: 650887
Sample Reference: Not Given

Description: Yellowish brown CLAY
Location: BH2
Sample Preparation: Tested in natural condition

Sample Type: D
Depth Top [m]: 1
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
35	79	33	46	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	24/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

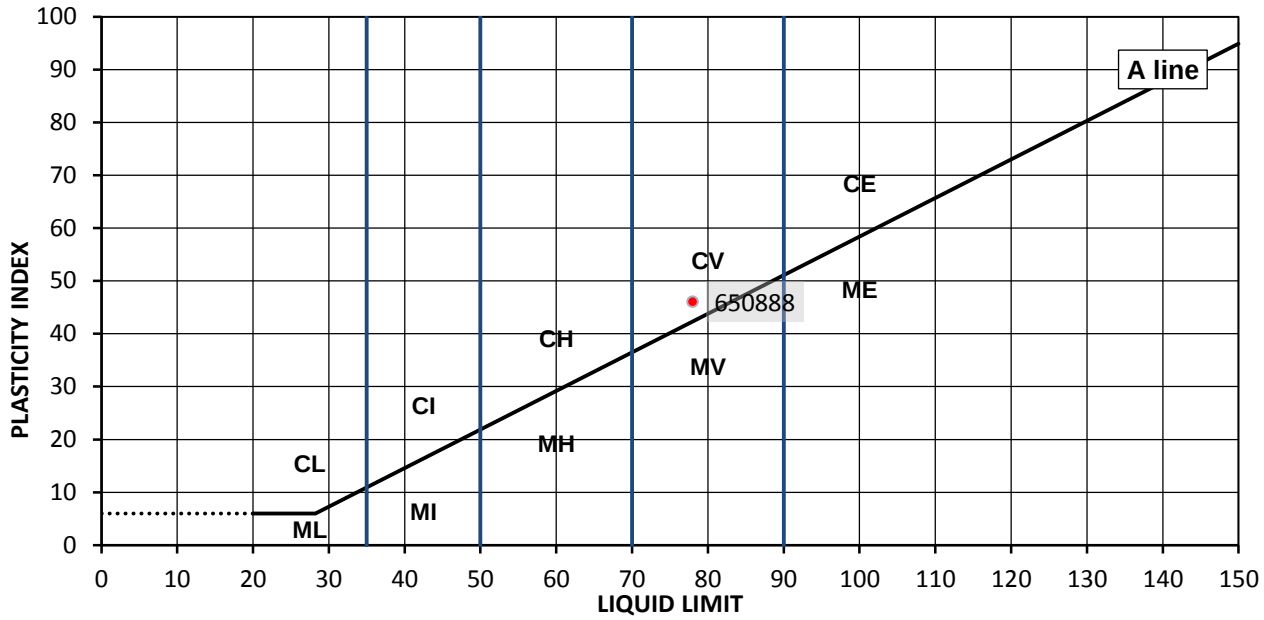
TEST RESULTS

Laboratory Reference: 650888
Sample Reference: Not Given

Description: Brown CLAY
Location: BH2
Sample Preparation: Tested in natural condition

Sample Type: U
Depth Top [m]: 2
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
29	78	32	46	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	24/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

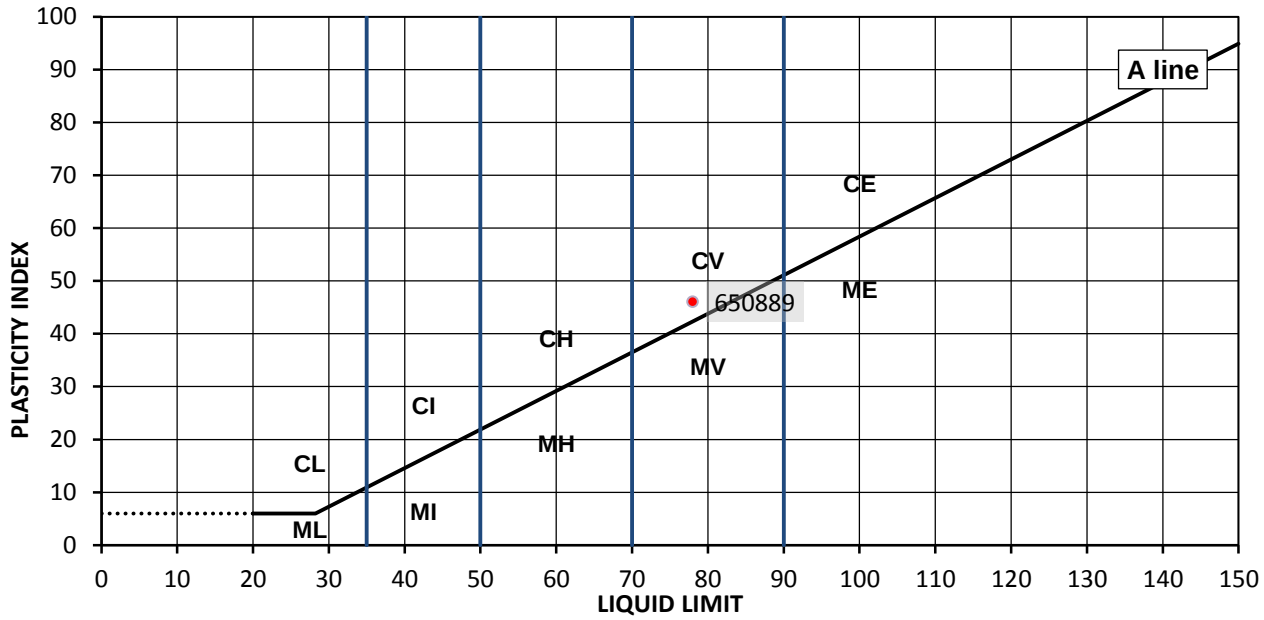
TEST RESULTS

Laboratory Reference: 650889
Sample Reference: Not Given

Description: Yellowish brown CLAY
Location: BH2
Sample Preparation: Tested in natural condition

Sample Type: U
Depth Top [m]: 3
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
30	78	32	46	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	25/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

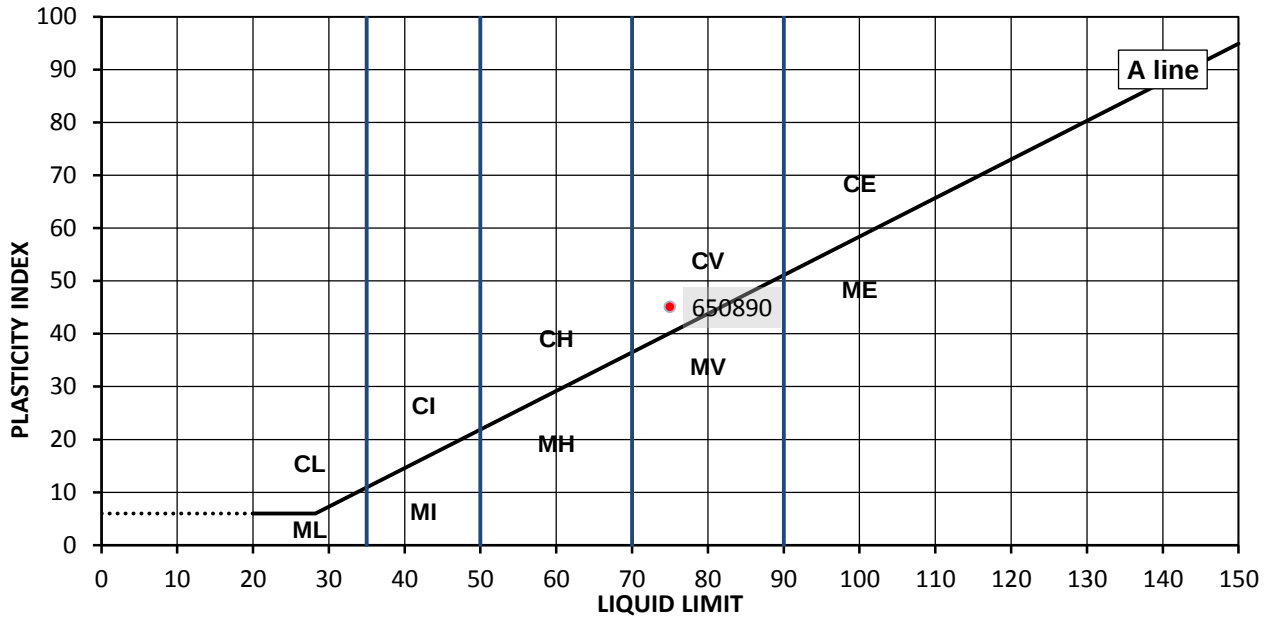
TEST RESULTS

Laboratory Reference: 650890
Sample Reference: Not Given

Description: Yellowish brown slightly gravelly CLAY
Location: BH1
Sample Preparation: Tested after >425um removed by hand

Sample Type: D
Depth Top [m]: 1
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
31	75	30	45	93



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	25/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

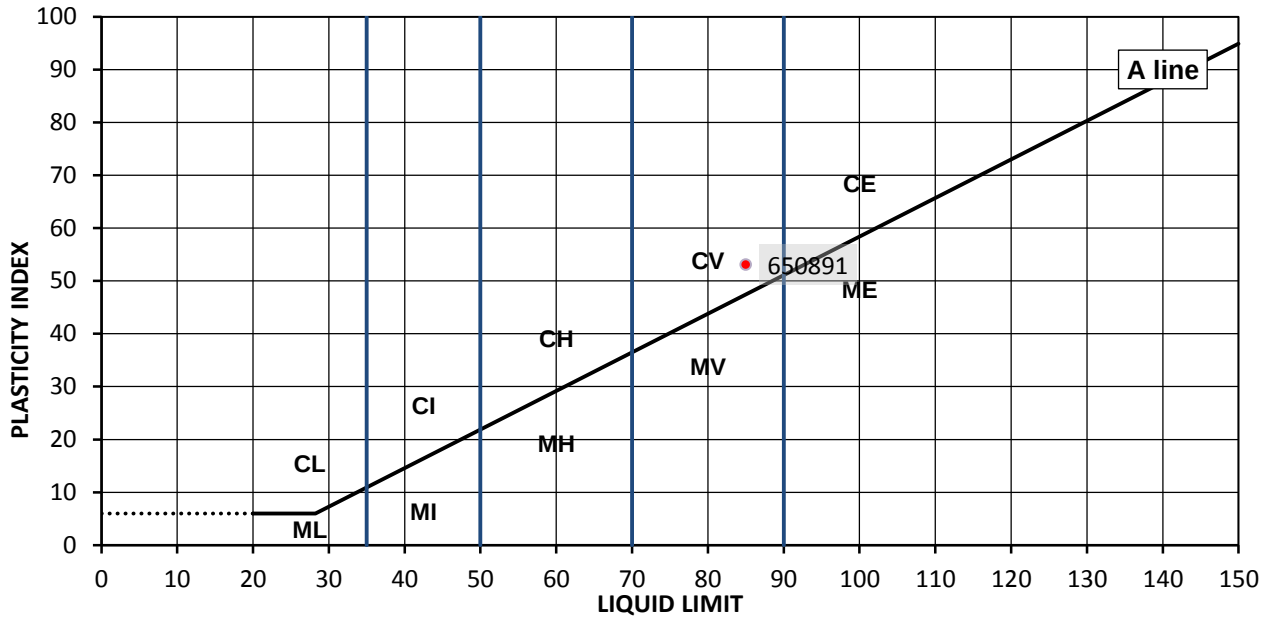
TEST RESULTS

Laboratory Reference: 650891
Sample Reference: Not Given

Description: Yellowish brown CLAY
Location: BH1
Sample Preparation: Tested in natural condition

Sample Type: U
Depth Top [m]: 2
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
37	85	32	53	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

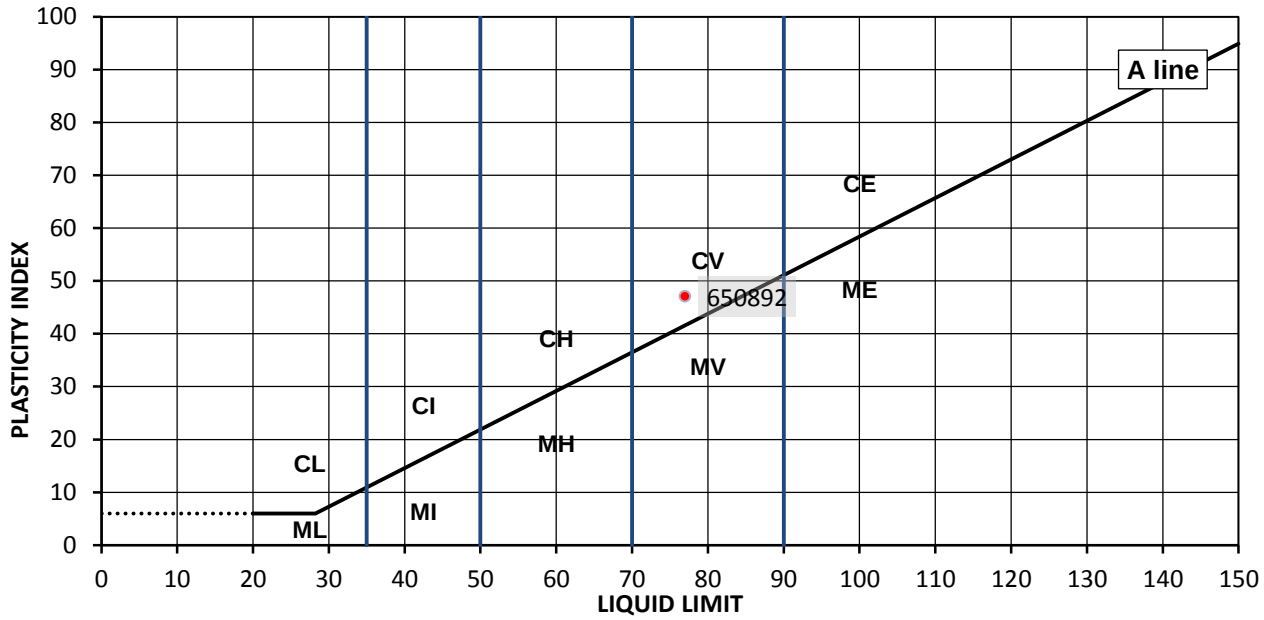
Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	25/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

TEST RESULTS

Laboratory Reference: 650892
Sample Reference: Not Given

Description:	Brown CLAY	Sample Type:	U
Location:	BH1	Depth Top [m]:	4
Sample Preparation:	Tested in natural condition	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
25	77	30	47	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	25/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

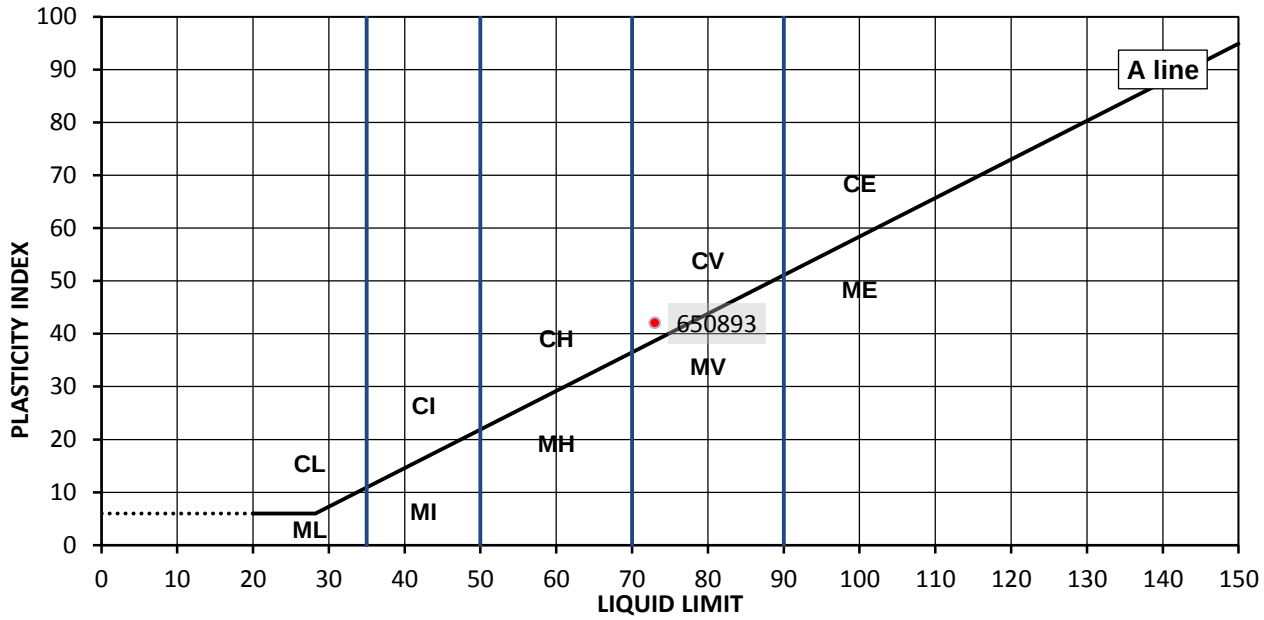
TEST RESULTS

Laboratory Reference: 650893
Sample Reference: Not Given

Description: Brown CLAY
Location: BH1
Sample Preparation: Tested in natural condition

Sample Type: U
Depth Top [m]: 6
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
31	73	31	42	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

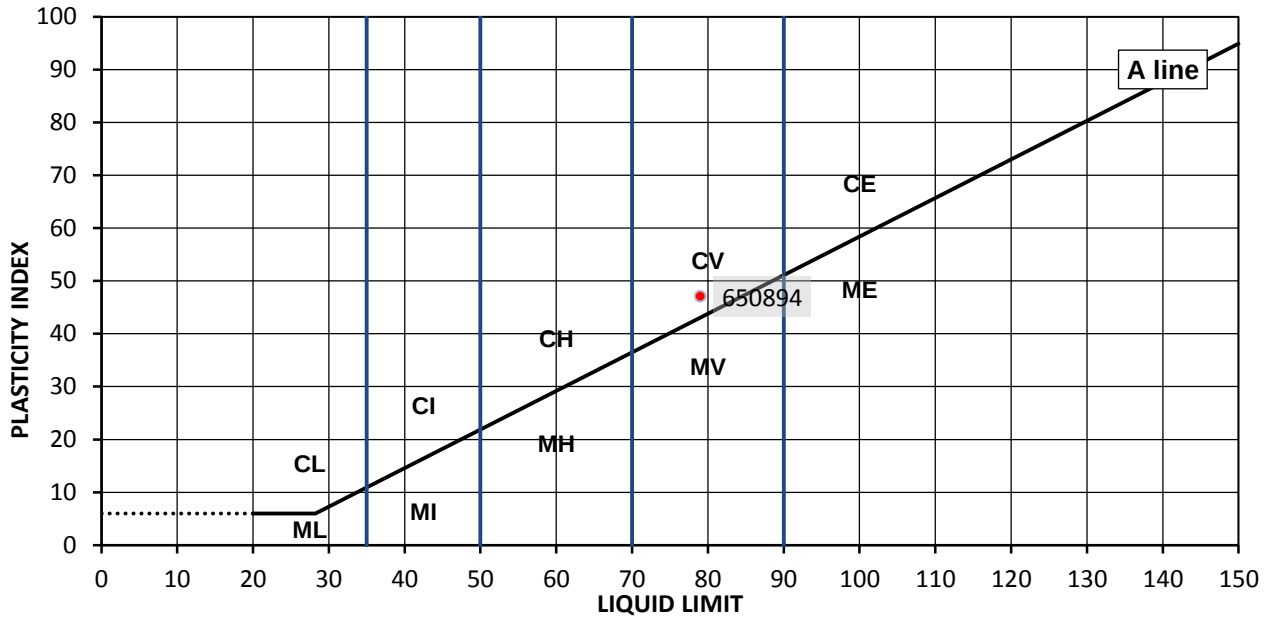
Client:	Card Geotechnics Ltd	Client Reference:	CG-18952
Client Address:	4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW	Job Number:	16-31420
		Date Sampled:	25/10/2016
		Date Received:	26/10/2016
Contact:	Nick Hampson	Date Tested:	08/11/2016
Site Name:	13 Kylemore Road	Sampled By:	Not Given
Site Address:	Not Given		

TEST RESULTS

Laboratory Reference: 650894
Sample Reference: Not Given

Description:	Brown CLAY	Sample Type:	U
Location:	BH1	Depth Top [m]:	8
Sample Preparation:	Tested in natural condition	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
32	79	32	47	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Mirosława Pytlik
PL Head of
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 10/11/2016

for and on behalf of i2 Analytical Ltd

GF 105.9

TEST CERTIFICATE

Summary of Classification Test Results

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Nick Hampson
Site Name: 13 Kylemore Road
Site Address: Not Given

Client Reference: CG-18952
Job Number: 16-31420
Date Sampled: 25/10/2016
Date Received: 26/10/2016
Date Tested: 08/11/2016
Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Soil Description	Density		M/C	Attenberg				PD
		Reference	Top depth [m]	Base depth [m]	Type		bulk Mg/m3	dry Mg/m3	%	% Passing 425um %	LL %	PL %	PI %	Mg/m3
650887	BH2	Not Given	1.00	Not Given	D	Yellowish brown CLAY			35	100	79	33	46	
650888	BH2	Not Given	2.00	Not Given	U	Brown CLAY			29	100	78	32	46	
650889	BH2	Not Given	3.00	Not Given	U	Yellowish brown CLAY			30	100	78	32	46	
650890	BH1	Not Given	1.00	Not Given	D	Yellowish brown slightly gravelly CLAY			31	93	75	30	45	
650891	BH1	Not Given	2.00	Not Given	U	Yellowish brown CLAY			37	100	85	32	53	
650892	BH1	Not Given	4.00	Not Given	U	Brown CLAY			25	100	77	30	47	
650893	BH1	Not Given	6.00	Not Given	U	Brown CLAY			31	100	73	31	42	
650894	BH1	Not Given	8.00	Not Given	U	Brown CLAY			32	100	79	32	47	

Comments:

Approved:

Mirosława Pytlik
PL Head of Geotechnical Section

Signed:

Sushil Sharda
Technical Manager (Geotechnical Division)

Date Reported: 10/11/2016

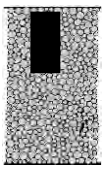
for and on behalf of i2 Analytical Ltd

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details



sketch showing specimen location in original sample

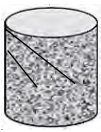
Depth	2.00		
Description	Brown CLAY		
Type	U		
Initial Sample Length	L_0	(mm)	75.2
Initial Sample Diameter	D_0	(mm)	36.2
Initial Sample Weight	W_0	(gr)	151.7
Bulk Density	ρ_0	(Mg/m3)	1.96
Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

Initial Cell Pressure	σ_3	(kPa)	40
Strain Rate	m_S	(mm/min)	1.50380
MembraneThickness	m_b	(mm)	0.24
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	29
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.53
Initial Voids Ratio	e_0	.	0.74
Initial Degree of Saturation	S_o	(%)	100

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	349
MembraneCorrection	m_C	(kPa)	1.673
Strain At Max Stress	$\varepsilon_f\%$	(%)	9.74
Shear Strength	c_U	(kPa)	175
Final Moisture	$\omega_f\%$	(%)	29
Final Dry Density	ρ_{df}	(Mg/m3)	1.52
Final Voids Ratio	e_f	.	0.74
Final Degree of Saturation	S_f	(%)	100.0



Failure Sketch

(surface inclination)

Notes

Triaxial at over bueden

Test Method	BS1377-7 : 1990 Clause 8			Test Name	650888
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	10/11/2016
Site Reference	13 Kylemore Road			Borehole	BH2
Jobfile	16-31420			Sample	650888
Client	CGL Godalming			Depth	2.00
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details

sketch showing specimen location in original sample

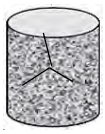
Depth	3.00		
Description	Yellowish brown CLAY		
Type	U		
Initial Sample Length	L_0	(mm)	142.3
Initial Sample Diameter	D_0	(mm)	69.0
Initial Sample Weight	W_0	(gr)	1015.8
Bulk Density	ρ_0	(Mg/m3)	1.91
Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

Initial Cell Pressure	σ_3	(kPa)	60
Strain Rate	m_S	(mm/min)	2.84600
MembraneThickness	m_b	(mm)	0.24
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	29
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.48
Initial Voids Ratio	e_0	.	0.80
Initial Degree of Saturation	S_o	(%)	98

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	195
MembraneCorrection	m_C	(kPa)	0.869
Strain At Max Stress	$\varepsilon_f\%$	(%)	8.48
Shear Strength	c_U	(kPa)	98
Final Moisture	$\omega_f\%$	(%)	30
Final Dry Density	ρ_{df}	(Mg/m3)	1.47
Final Voids Ratio	e_f	.	0.80
Final Degree of Saturation	S_f	(%)	98.1



Failure Sketch

(surface inclination)

Notes

Triaxial at over bueden

Test Method	BS1377-7 : 1990 Clause 8			Test Name	650889
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	10/11/2016
Site Reference	13 Kylemore Road			Borehole	BH2
Jobfile	16-31420			Sample	650889
Client	CGL Godalming			Depth	3.00
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details

sketch showing specimen location in original sample

Depth	2.00		
Description	Yellowish brown CLAY		
Type	U		
Initial Sample Length	L_0	(mm)	141.8
Initial Sample Diameter	D_0	(mm)	68.6
Initial Sample Weight	W_0	(gr)	988.5
Bulk Density	ρ_0	(Mg/m3)	1.89
Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

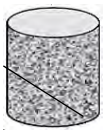
Initial Cell Pressure	σ_3	(kPa)	40
Strain Rate	m_S	(mm/min)	2.83580
MembraneThickness	m_b	(mm)	0.27
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	37
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.38
Initial Voids Ratio	e_0	.	0.92
Initial Degree of Saturation	S_o	(%)	100

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	85
MembraneCorrection	m_C	(kPa)	1.191
Strain At Max Stress	$\varepsilon_f\%$	(%)	11.64
Shear Strength	c_U	(kPa)	43
Final Moisture	$\omega_f\%$	(%)	37
Final Dry Density	ρ_{df}	(Mg/m3)	1.38
Final Voids Ratio	e_f	.	0.92
Final Degree of Saturation	S_f	(%)	100.0

Notes

Triaxial at over bueden



Failure Sketch

(surface inclination)

Test Method	BS1377-7 : 1990 Clause 8			Test Name	650891
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	10/11/2016
Site Reference	13 Kylemore Road			Borehole	BH1
Jobfile	16-31420			Sample	650891
Client	CGL Godalming			Depth	2.00
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

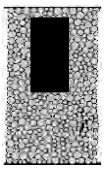
i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details



sketch showing specimen location in original sample

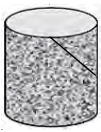
Depth	4.00		
Description	Brown CLAY		
Type	U		
Initial Sample Length	L_0	(mm)	75.4
Initial Sample Diameter	D_0	(mm)	36.9
Initial Sample Weight	W_0	(gr)	152.7
Bulk Density	ρ_0	(Mg/m3)	1.89
Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

Initial Cell Pressure	σ_3	(kPa)	80
Strain Rate	m_S	(mm/min)	1.50800
MembraneThickness	m_b	(mm)	0.25
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	25
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.52
Initial Voids Ratio	e_0	.	0.75
Initial Degree of Saturation	S_o	(%)	88

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	483
MembraneCorrection	m_C	(kPa)	1.586
Strain At Max Stress	$\varepsilon_f\%$	(%)	6.14
Shear Strength	c_U	(kPa)	242
Final Moisture	$\omega_f\%$	(%)	25
Final Dry Density	ρ_{df}	(Mg/m3)	1.52
Final Voids Ratio	e_f	.	0.75
Final Degree of Saturation	S_f	(%)	88.0



Failure Sketch

(surface inclination)

Notes

Triaxial at over bueden

Test Method	BS1377-7 : 1990 Clause 8			Test Name	650892
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	10/11/2016
Site Reference	13 Kylemore Road			Borehole	BH1
Jobfile	16-31420			Sample	650892
Client	CGL Godalming			Depth	4.00
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details

sketch showing specimen location in original sample

Depth	6.00		
Description	Brown CLAY		
Type	U		
Initial Sample Length	L_0	(mm)	140.8
Initial Sample Diameter	D_0	(mm)	68.6
Initial Sample Weight	W_0	(gr)	1007.7
Bulk Density	ρ_0	(Mg/m3)	1.94
Particle Density	ρ_s	(Mg/m3)	2.65

Initial Conditions

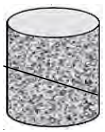
Initial Cell Pressure	σ_3	(kPa)	120
Strain Rate	m_S	(mm/min)	2.81640
MembraneThickness	m_b	(mm)	0.18
Displacement Input	L_{IP}	(mm)	CH 2
Load Input	N_{IP}	(N)	CH 1
Initial Moisture	$\omega_i\%$	(%)	31
Initial Dry Density	ρ_{d0}	(Mg/m3)	1.48
Initial Voids Ratio	e_0	.	0.79
Initial Degree of Saturation	S_o	(%)	100

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	(kPa)	287
MembraneCorrection	m_C	(kPa)	0.599
Strain At Max Stress	$\varepsilon_f\%$	(%)	8.29
Shear Strength	c_U	(kPa)	144
Final Moisture	$\omega_f\%$	(%)	31
Final Dry Density	ρ_{df}	(Mg/m3)	1.48
Final Voids Ratio	e_f	.	0.79
Final Degree of Saturation	S_f	(%)	100.0

Notes

Triaxial at over bueden



Failure Sketch

(surface inclination)

Test Method	BS1377-7 : 1990 Clause 8			Test Name	650893
Database: .\SQLEXPRESS \ 6171-I2 Analytical				Test Date	10/11/2016
Site Reference	13 Kylemore Road			Borehole	BH1
Jobfile	16-31420			Sample	650893
Client	CGL Godalming			Depth	6.00
Operator	palmowskia	Checked	pytlikm	Approved	pytlikm

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

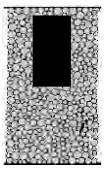
i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details



sketch showing specimen location in original sample

Depth	**8.00**		
Description	**Brown CLAY**		
Type	**U**		
Initial Sample Length	L_0	**(mm)**	**76.1**
Initial Sample Diameter	D_0	**(mm)**	**36.6**
Initial Sample Weight	W_0	**(gr)**	**151.7**
Bulk Density	ρ_0	**(Mg/m3)**	**1.89**
Particle Density	ρ_s	**(Mg/m3)**	**2.65**

Initial Conditions

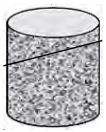
Initial Cell Pressure	σ_3	**(kPa)**	**160**
Strain Rate	m_S	**(mm/min)**	**1.52200**
MembraneThickness	m_b	**(mm)**	**0.27**
Displacement Input	L_{IP}	**(mm)**	**CH 2**
Load Input	N_{IP}	**(N)**	**CH 1**
Initial Moisture	$\omega_i\%$	**(%)**	**32**
Initial Dry Density	ρ_{d0}	**(Mg/m3)**	**1.44**
Initial Voids Ratio	e_0	**.**	**0.84**
Initial Degree of Saturation	S_o	**(%)**	**100**

Final Conditions

Max Deviator Stress	$(\sigma_1-\sigma_3)_f$	**(kPa)**	**422**
MembraneCorrection	m_C	**(kPa)**	**1.203**
Strain At Max Stress	$\varepsilon_f\%$	**(%)**	**4.97**
Shear Strength	c_U	**(kPa)**	**211**
Final Moisture	$\omega_f\%$	**(%)**	**32**
Final Dry Density	ρ_{df}	**(Mg/m3)**	**1.44**
Final Voids Ratio	e_f	**.**	**0.84**
Final Degree of Saturation	S_f	**(%)**	**100.0**

Notes

Triaxial at over bueden



Failure Sketch

(surface inclination)

Test Method	**BS1377-7 : 1990 Clause 8**	**Test Name**	**650894**
Database: .\SQLEXPRESS \ 6171-I2 Analytical		**Test Date**	**10/11/2016**
Site Reference	13 Kylemore Road	**Borehole**	**BH1**
Jobfile	**16-31420**	**Sample**	**650894**
Client	**CGL Godalming**	**Depth**	**8.00**
Operator	palmowskia	**Checked**	**pytlikm**
		Approved	**pytlikm**

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Nick Hampson
Card Geotechnics Ltd
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Surrey
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i2 Analytical Ltd.
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Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 16-31422

Project / Site name:	13 Kylemore Road	**Samples received on:**	26/10/2016
Your job number:	CG-18952	**Samples instructed on:**	28/10/2016
Your order number:	3694	**Analysis completed by:**	08/11/2016
Report Issue Number:	1	**Report issued on:**	08/11/2016
Samples Analysed:	3 soil samples		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 16-31422

Project / Site name: 13 Kylemore Road
Your Order No: 3694

Lab Sample Number				650903	650904	650905		
Sample Reference				BH2	BH2	BH1		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				1.00	2.00	4.00		
Date Sampled				24/10/2016	24/10/2016	25/10/2016		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	22	20	20		
Total mass of sample received	kg	0.001	NONE	0.30	1.6	2.0		
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.2	8.2	8.1		
Total Sulphate as SO_4	mg/kg	50	MCERTS	5400	7300	7200		
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	2.7	3.4	3.3		
Total Sulphur	mg/kg	50	MCERTS	2000	2400	2400		

Analytical Report Number : 16-31422

Project / Site name: 13 Kylemore Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
650903	BH2	None Supplied	1.00	Brown clay and sand.
650904	BH2	None Supplied	2.00	Brown clay and sand.
650905	BH1	None Supplied	4.00	Brown clay and sand.

Analytical Report Number : 16-31422

Project / Site name: 13 Kylemore Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

APPENDIX H

Chemical assessment tables

ASSESSMENT CRITERIA

Table 1, below, sets out CGL's rationale for generic assessment criteria (GAC) adoption in order to evaluate risks posed to potential receptors at 13 Kylemore Road from identified chemical contamination. Potential receptors have been identified with reference to the Part IIA regime and associated DEFRA guidance. As with the Part IIA regime, under the planning regime all receptors (humans, controlled waters, ecology, crops/livestock and buildings) have been considered if there is the potential for them to be adversely affected by exposure to contamination. The results of the assessment for 13 Kylemore Road are then presented in Tables 2 to 5 of this appendix.

Table 1. Rationale for Assessment Criteria Adoption

Source / Media	CGL's Approach & Rationale
Risks to Human Health (long-term chronic risks)	
Soil contaminants	· Laboratory test results have been compared against Generic Assessment Criteria (GACs) derived in-house by CGL using the Contaminated Land Exposure Assessment (CLEA) model and version 1.06 of the CLEA software. Where Soil Guideline Values (SGVs) have been published previously by the Environment Agency, the CGL GACs have updated these based on current exposure parameters (e.g. updated inhalation rates). · The GACs have been generated assuming a sandy loam soil type and a Soil Organic Material of 6% for the Made Ground (measured range 0.8 to 8.5%) and 1% for the natural soils (measured 0.2%). · In the event impacts are identified on a site above the GAC level for arsenic, cadmium, chromium VI, benzene or benzo(a)pyrene, the results have been compared to the applicable Category 4 Screening Level (C4SL) published by DEFRA to further assess risks. · The exception to the above relates to lead. The SGV for lead has been withdrawn and the C4SL for lead is used by CGL directly as a first tier of assessment. · The CGL GACs represent conservative screening criteria (set at acceptable or minimal risk) and have generally been calculated using the default parameters for the standard land use scenarios set out in the CLEA technical report and toxicological inputs in line with the requirements of Science Report SC050021/SR2 and, in the case of petroleum hydrocarbons, Science Report P5-080/TR3. · Where a CGL GAC has not been derived alternative assessment criteria will be sourced from current commercially-available sources (including international standards where no suitable UK assessment criteria exists). · Concentrations of cyanide above the laboratory reporting limit are assessed against a Soil Screening Value (SSV) developed by Atkins. Atkins have based this assessment criteria on acute exposure to a 0 to 6 year old child. · Where the dataset is of appropriate size, assessment against the applicable GAC or C4SL is carried out at the 95th percentile of the sample mean (designated US_{95}), which is considered to represent a reasonable worst-case scenario. An assessment of the normality of the data has been undertaken. Where datasets are normally distributed the one sample t-test has been applied to calculate the US_{95}. In the case of non-parametric datasets, the Chebychev Theorem has been applied. The Grubbs Test has also been used to identify potential outliers within datasets. · It is noted that the British Geological Survey has published background levels for a number of organic and inorganic constituents. In the event that the C4SL or a GAC is found to be exceeded, the risk may still be considered to be low, unlikely to meet the definition of contaminated land under Part IIA and potentially suitable for use from a development perspective, if the contaminant concentrations are below local background levels, assuming no other contributing factors. · At this time an authoritative GAC is not available for asbestos fibres in soil. A positive identification of asbestos fibres in a soil sample by the laboratory is considered sufficient to warrant additional assessment of risks. Laboratory identification and quantification by microscopy may be required subject to source of material.
Ground gas	· Concentrations and flow rates of carbon dioxide and methane in ground gas are converted to Gas Screening Values (GSVs) in accordance with CIRIA (2007). Potential risks associated with gas chemistry are evaluated in accordance with guidance presented in CIRIA (2007), NHBC (2007), BSI (2007).
Radon	· Risks from the radon content of soil gas are evaluated in accordance with BRE (2011).

Table 1 (continued). Rationale for Assessment Criteria Adoption

Risks to Vegetation & Plants	
Soil contaminants	· Risks to plant growth (i.e. phytotoxicity) have been assessed for specific contaminants where the limits for phytotoxic effect proposed (e.g. by BS 3882) are significantly lower than the health GAC.

Table 2. Soil risks to human health (residential land use with homegrown produce) – Made Ground

Determinand	GAC SOM = 6%	C4SL (based on 6% SOM)[1]	Note on SSL[2]	Measured range (mg/kg)	Measure Range > Assessment Criteria?
Antimony	*	*	-	<1 to 28	*
Arsenic	32	37	-	9.9 to 41	1 of 2
Barium	*	*	-	47 to 1300	*
Beryllium	56	*	-	0.49 to 1.4	0 of 2
Boron	*	*	-	0.5 to 4.2	*
Cadmium	11	22	-	0.2 to 0.7	0 of 2
Chromium (III)	3,200	*	-	36 to 50	0 of 2
Chromium (VI)	6.3	21	-	<1.2	0 of 2
Copper	4,200	*	-	16 to 120	0 of 2
Lead[3]	200	200	-	35 to 3000	1 of 2
Mercury (inorganic)	180	*	-	2.0 to 2.2	0 of 2
Nickel	130	*	-	17 to 36	0 of 2
Selenium	350	*	-	<1.0	0 of 2
Vanadium	720	*	-	52 to 56	0 of 2
Zinc	18,000	*	-	44 to 930	0 of 2
Benzene	0.43	0.87	-	<0.001	0 of 2
Toluene	720	*	-	<0.001	0 of 2
Ethyl benzene	490	*	-	<0.001	0 of 2
m-xylene[4]	580	*	-	<0.001	0 of 2
o-xylene	570	*	-	<0.001	0 of 2
p-xylene	550	*	-	<0.001	0 of 2
Phenol[5]	1,200	*	-	<1.0 to 1.1	0 of 2
Cyanide[6]	34	*	-	<1.0	0 of 2
TPH aliphatic EC5-6	260	*	-	<0.1	0 of 2
TPH aliphatic EC>6-8	750	*	-	<0.1	0 of 2
TPH aliphatic EC>8-10	190	*	-	<0.1	0 of 2
TPH aliphatic EC>10-12	5,500	*	(b)	<1.0	0 of 2
TPH aliphatic EC>12-16	6,300	*	(b)	<2.0	0 of 2
TPH aliphatic EC>16-35	130,000 [51]	*	(a)	36	0 of 2
TPH aromatic EC5-7	0.43	*	-	<0.1	0 of 2
TPH aromatic EC>7-8	720	*	-	<0.1	0 of 2
TPH aromatic EC>8-10	210	*	-	<0.1	0 of 2
TPH aromatic EC>10-12	390	*	-	<1.0	0 of 2
TPH aromatic EC>12-16	660	*	-	<2.0	0 of 2
TPH aromatic EC>16-21	990 [360]	*	(a)	<10 to 13	0 of 2
TPH aromatic EC>21-35	1,700 [29]	*	(a)	<10 to 42	0 of 2
Naphthalene	29	*	-	<0.05	0 of 2
Acenapthylene	1,100 [210]	*	(a)	<0.1	0 of 2
Acenaphthene	2,400	*	(b)	<0.1	0 of 2
Fluorene	2,400 [910]	*	(a)	<0.1	0 of 2
Phenanthrene	3,500 [100]	*	(a)	<0.1 to 1.4	0 of 2
Anthracene	25,000 [46]	*	(a)	<0.1	0 of 2
Fluoranthene	2,900 [110]	*	(a)	<0.1 to 3.0	0 of 2
Pyrene	2,000 [13]	*	(a)	<0.1 to 2.4	0 of 2
Benzo(a)anthracene	19 [10]	*	(a)	<0.1 to 0.87	0 of 2
Chrysene	190 [2.6]	*	(a)	<0.05 to 0.87	0 of 2
Benzo(b)fluoranthene	21 [7.3]	*	(a)	<0.1 to 0.77	0 of 2
Benzo(k)fluoranthene	21 [4.1]	*	(a)	<0.1 to 1.1	0 of 2
Benzo(a)pyrene	3.3	5	-	<0.1 to 0.41	0 of 2
Indeno(1,2,3-cd)perylene	20 [0.4]	*	(a)	<0.1 to 0.41	0 of 2
Dibenzo(a,h)anthracene	2.2 [0.02]	*	(a)	<0.1	0 of 2
Benzo(g,h,i)perylene	220 [0.1]	*	(a)	<0.05 to 0.67	0 of 2
Coronene	*	*	-	<0.05	*

[1] *= No value currently defined.

[2] -= green; (a) = amber i.e GAC set to model output, [SSL provided in square brackets]; (b) = red i.e SSL exceeded & considered to affect interpretation. GAC calculated in accordance with CLEA Software Handbook.

[3] Published C4SL.

[4] Concentrations for total xylenes should be compared against m-xylene for fresh spills and to o-xylene for all other cases.

[5] GAC relates to phenol (C_6H_5OH) only.

[6] Assessment criteria for cyanide derived by Atkins based on acute exposure for a 0-6 year old child.

Table 3. Soil risks to human health (residential land use with homegrown produce) – natural soil

Determinand	GAC SOM = 1%	C4SL (based on 6% SOM)[1]	Note on SSL[2]	Measured range (mg/kg)	Measured Range > Assessment Criteria?
Antimony	*	*	-	1.5	*
Arsenic	32	37	-	8.2	0 of 1
Barium	*	*	-	50	*
Beryllium	56	*	-	1.2	0 of 1
Boron	*	*	-	2.1	*
Cadmium	11	22	-	0.2	0 of 1
Chromium (III)	3,200	*	-	44	0 of 1
Chromium (VI)	6.3	21	-	<1.2	0 of 1
Copper	4,200	*	-	32	0 of 1
Lead[3]	200	200	-	49	0 of 1
Mercury (inorganic)	180	*	-	1.4	0 of 1
Nickel	130	*	-	50	0 of 1
Selenium	350	*	-	<1.0	0 of 1
Vanadium	720	*	-	97	0 of 1
Zinc	18,000	*	-	97	0 of 1
Benzene	0.10	0.87	-	<0.001	0 of 1
Toluene	140	*	-	<0.001	0 of 1
Ethyl benzene	90	*	-	<0.001	0 of 1
m-xylene[4]	110	*	-	<0.001	0 of 1
o-xylene	100	*	-	<0.001	0 of 1
p-xylene	100	*	-	<0.001	0 of 1
Phenol[5]	280	*	-	<1.0	0 of 1
Cyanide[6]	34	*	-	<1.0	0 of 1
TPH aliphatic EC5-6	80	*	-	<0.1	0 of 1
TPH aliphatic EC>6-8	160	*	-	<0.1	0 of 1
TPH aliphatic EC>8-10	34	*	-	<0.1	0 of 1
TPH aliphatic EC>10-12	4,300	*	(b)	<1.0	0 of 1
TPH aliphatic EC>12-16	6,200	*	(b)	7.2	0 of 1
TPH aliphatic EC>16-35	130,000 [8.6]	*	(a)	<62	0 of 1
TPH aromatic EC5-7	0.10	*	-	<0.1	0 of 1
TPH aromatic EC>7-8	140	*	-	<0.1	0 of 1
TPH aromatic EC>8-10	37	*	-	<0.1	0 of 1
TPH aromatic EC>10-12	75	*	-	<1.0	0 of 1
TPH aromatic EC>12-16	140	*	-	<2.0	0 of 1
TPH aromatic EC>16-21	290 [60]	*	(a)	<10	0 of 1
TPH aromatic EC>21-35	1,100 [4.8]	*	(a)	<10	0 of 1
Naphthalene	5	*	-	<0.05	0 of 1
Acenapthylene	210 [36]	*	(a)	<0.1	0 of 1
Acenaphthene	540	*	(b)	<0.1	0 of 1
Fluorene	670 [150]	*	(a)	<0.1	0 of 1
Phenanthrene	770 [17]	*	(a)	<0.1	0 of 1
Anthracene	9,300 [7.7]	*	(a)	<0.1	0 of 1
Fluoranthene	910 [19]	*	(a)	<0.1	0 of 1
Pyrene	620 [2.2]	*	(a)	<0.1	0 of 1
Benzo(a)anthracene	11 [1.7]	*	(a)	<0.1	0 of 1
Chrysene	100 [0.4]	*	(a)	<0.05	0 of 1
Benzo(b)fluoranthene	14 [1.2]	*	(a)	<0.1	0 of 1
Benzo(k)fluoranthene	16 [0.7]	*	(a)	<0.1	0 of 1
Benzo(a)pyrene	2.4 [0.9]	5	(a)	<0.1	0 of 1
Indeno(1,2,3-cd)perylene	13 [0.06]	*	(a)	<0.1	0 of 1
Dibenzo(a,h)anthracene	1.7 [0.004]	*	(a)	<0.1	0 of 1
Benzo(g,h,i)perylene	200 [0.02]	*	(a)	<0.05	0 of 1
Coronene	*	*	-	<0.05	*

[1] *= No value currently defined.

[2] -= green; (a) = amber i.e GAC set to model output, [SSL provided in square brackets]; (b) = red i.e SSL exceeded & considered to affect interpretation. GAC calculated in accordance with CLEA Software Handbook.

[3] Published C4SL.

[4] Concentrations for total xylenes should be compared against m-xylene for fresh spills and to o-xylene for all other cases.

[5] GAC relates to phenol (C_6H_5OH) only.

[6] Assessment criteria for cyanide derived by Atkins based on acute exposure for a 0-6 year old child.

Table 4. Soil risks to vegetation and plants – Made Ground

Determinant	Assessment Criteria	Measured range (mg/kg)	Measured Range > Assessment Criteria?
Copper[1]	135	16 to 120	0 of 2
Zinc[1]	200	44 to 930	1 of 2
Nickel[1]	75	17 to 36	0 of 2
Boron[2]	5	0.5 to 4.2	0 of 2

[1] BSI (2015) Specification for topsoil and requirements for use. BS 3882. Values taken for pH6-7

[2] Limit for phytotoxic effect. Nable, Banuelos and Paul. (1997). Boron Toxicity, Plant and Soil, Volume 193, pp1 81-198

Table 5. Soil risks to vegetation and plants – natural soil

Determinant	Assessment Criteria	Measured range (mg/kg)	Measured Range > Assessment Criteria?
Copper[1]	135	32	0 of 1
Zinc[1]	200	87	0 of 1
Nickel[1]	75	50	0 of 1
Boron[2]	5	2.1	0 of 1

[1] BSI (2015) Specification for topsoil and requirements for use. BS 3882. Values taken for pH6-7

[2] Limit for phytotoxic effect. Nable, Banuelos and Paul. (1997). Boron Toxicity, Plant and Soil, Volume 193, pp1 81-198

APPENDIX I

Information from Structural Engineer

Selina Adams

From: John Maguire <john.maguire@entuitive.com>
Sent: 23 November 2016 16:06
To: James Morrice
Subject: 4249 13 Kylemore Road
Attachments: Planning issued to client.dwg; 4249 S-L SK01.pdf

Follow Up Flag: Follow up
Due By: 24 November 2016 08:30
Flag Status: Flagged

Hi James,

Please see our response to your request for information in blue below;

- Proposed retaining wall construction methodology, including structural drawings if available; - At present we propose to form the basement via hit and miss reinforced concrete underpin walls.
- Party wall line loads and internal basement slab bearing pressures (if applicable); - See attached loading drawing assume weight of basement floor to be DL = 10.5 kN/sqm and LL = 1.5kN/sqm.
- Details of adjoining properties and basements, if present; - Assume that the adjoining buildings have similar basement layout to the current situation at no.13 i.e. 1.77m approx. floor to ceiling in the basement.
- Site and basement layout plans in CAD format. – Drawings attached.

Should you have any further queries please contact me to discuss.

Best regards
John

John Maguire BSc(Eng) Dip(Struct) CEng MIStructE
Senior Engineer

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From: James Morrice [mailto:JamesM@cgl-uk.com]
Sent: 22 November 2016 09:19
To: John Maguire <john.maguire@entuitive.com>
Subject: RE: 13 Kylemore Road

Hi John

Do you know when you will be able to forward me the information to start the BIA?

Best regards
James

James Morrice, Senior Engineer

Tel: 01483 310600
www.cgl-uk.com

From: John Maguire [mailto:john.maguire@entuitive.com]
Sent: 10 November 2016 09:30
To: James Morrice <JamesM@cgl-uk.com>
Subject: RE: 13 Kylemore Road

Hi James,

Just to give you a heads up with my current work load it looks like I should have those details you require probably on Tuesday of next week if that's ok.

If that proves to be a big problem please let me know.

Best regards
John

John Maguire BSc(Eng) Dip(Struct) CEng MIStructE
Senior Engineer

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From: James Morrice [mailto:JamesM@cgl-uk.com]
Sent: 09 November 2016 08:43
To: Robert Hume <robert.hume@virgin.net>
Cc: John Maguire <John@tallengineers.com>
Subject: Re: 13 Kylemore Road

Dear Robert

Many thanks for this. I'll check our availability and confirm the date to you.

Best regards
James

James Morrice, Senior Engineer

Tel: 01483 310600
www.cgl-uk.com

CGL's Harrogate office will hold a breakfast briefing on 'Managing Risks on Brownfield Sites' on Wednesday 16th November at 8:00am. Click on image for more information and to reserve a space.

From: Robert Hume
Sent: Tuesday, 8 November 2016 21:39
To: James Morrice
Cc: John Maguire
Subject: 13 Kylemore Road

Dear James,

Following on from John Maguire's email below Wednesday to Friday will all be okay next week (16-18th) for a site visit to 13 kylemore as long as after 10.30. With notification I can get there any of those days. I notice you actually wrote next week in your email on the 4th which would make it this week. Friday 11th is still possible as I will be on site but the work could only run from 3.00 as something may be happening there 12- 3, to be confirmed tomorrow.

Regards,
Robert

Begin forwarded message:

From: John Maguire <john.maguire@entuitive.com>
Subject: FW: 13 Kylemore Road
Date: 8 November 2016 18:07:20 GMT
To: Robert Hume <robert.hume@virgin.net>

Dear Robert,

Please note email below from CGL with a request to undertake another site visit to monitor the carbon dioxide levels. We suggest that this additional monitoring inspection be undertaken to see if we can design out the requirement for ground gas protection measures.

Please can you revert to James below to confirm a suitable day and time to undertake this work.

Should you have any queries please contact me to discuss.

Best regards
John

John Maguire BSc(Eng) Dip(Struct) CEng MIStructE
Senior Engineer

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From: James Morrice [mailto:JamesM@cgl-uk.com]
Sent: 04 November 2016 10:02
To: John Maguire <John@tallengineers.com>
Subject: 13 Kylemore Road

Dear John

Further to our conversation a few minutes ago, during our ground gas monitoring at 13 Kylemore Road, we detected carbon dioxide concentrations of 7.3% in the borehole in the rear garden. Based on current guidance, ground gas protection measures would therefore be required.

We would like to undertake an additional ground gas monitoring visit to confirm whether these readings are anomalous and will also undertake separate assessment to see if a risk assessment can be undertaken for the need for gas protection. Our fees for the additional monitoring visit and RB17 assessment will be **£300 +VAT**. We often have engineers monitoring in and around London, so should be able to get someone to site next week, if acceptable.

Best regards
James

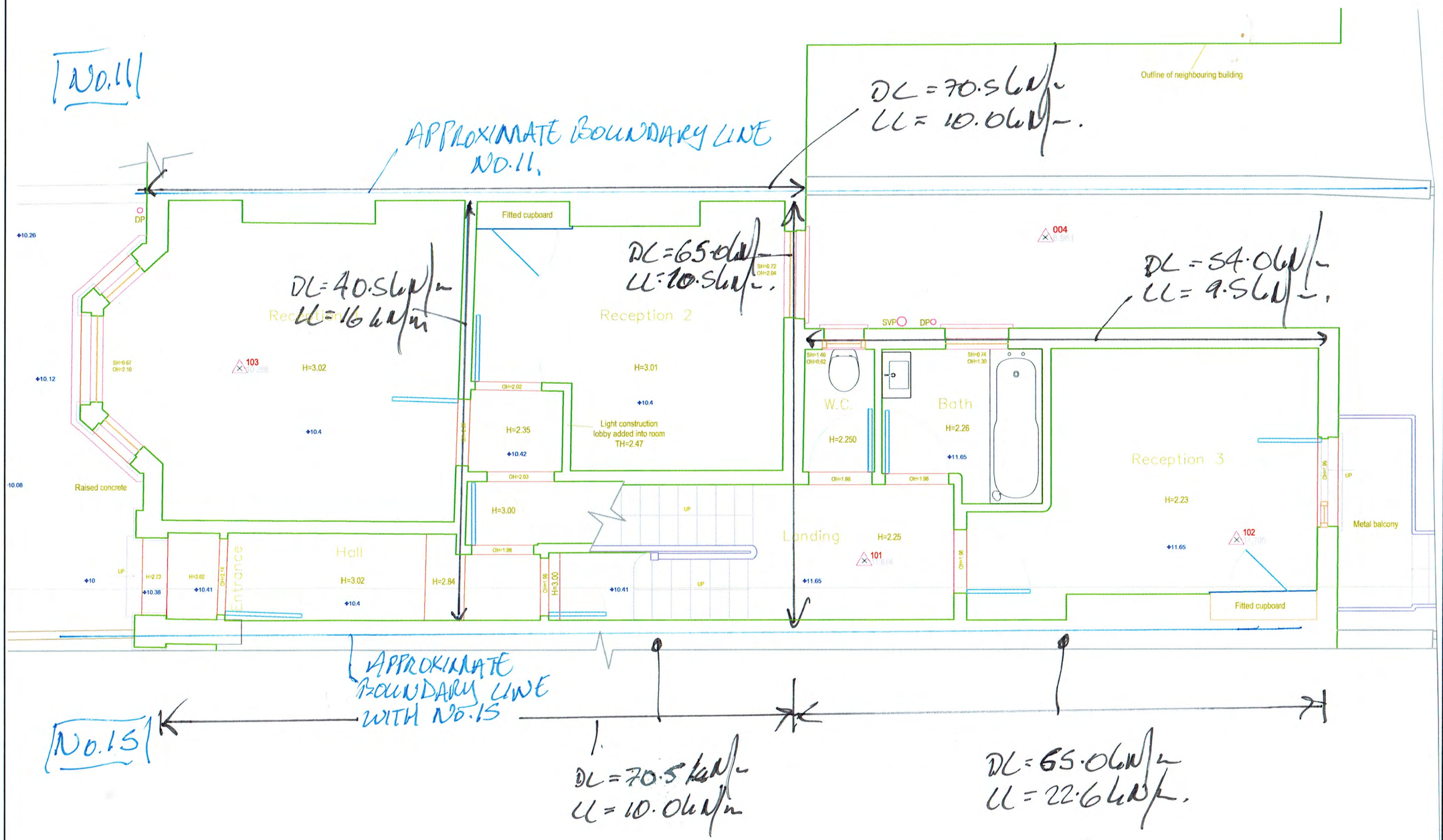
James Morrice, Senior Engineer

CGL
Providing Ground Solutions

Tel: 01483 310600

www.cgl-uk.com

CGL's Harrogate office will hold a breakfast briefing on 'Managing Risks on Brownfield Sites' on Wednesday 16th November at 8:00am. Click on image for more information and to reserve a space.



NOTES:

1) THIS DRAWING IS COPYRIGHT TALL ENGINEERS LTD.
2) DO NOT SCALE FROM THIS DRAWING; USE ANNOTATED DIMENSIONS ONLY.
3) THE CONTRACTOR IS TO VERIFY ALL DIMENSIONS ON SITE BEFORE STARTING WORK OR FABRICATION. ERRORS AND OMMISIONS TO BE REPORTED.
4) THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS BY ALL DESIGN DISCIPLINES. THE CONTRACTOR MUST ENSURE HE HAS COPIES OF ALL SUCH DOCUMENTS.
5) ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES UNLESS NOTED OTHERWISE.

FOR GENERAL NOTES SEE GN-01 & GN-02

Rev.	Date	Amendment	By

Status: PLANNING

Project Title:
13 Kylemore Road, NW6

Drawing Title:
Loading drawing

ENTUITIVE
143 Crownstone Road
London SW2 1NB
(t) 020 7733 6837
(e) mail@entuitive.com
(w) www.entuitive.com

Date:	Scale:	Drawn:
11-2016	1:50 AT A3	-

Project No.:	Drwg No.:	Rev.:
4249	S-L SK01	-