BASEMENT IMPACT ASSESSMENT

Ref: 23/36419-2 | Date: March 2023

Revision 1 – August 2023

15 Howitt Road
Belsize Park
London
NW3 4LX

Prepared for:
Anese Investments Limited

Document Control

Project	15 Howitt Road, Belsize Park, London, NW3 4LX
Document Type	Basement Impact Assessment
Document Reference	SAS 23/36419-2
Document Status	Final
Revision	1
Changes	Update in line with comments from Campbell Reith
Date	August 2023
Document Version	V1.0 – 3/21

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1.0 NON-TECHNICAL SUMMARY

1.1 Project Objectives

At the request of Anese Investments Limited, a Basement Impact Assessment has been carried out at 15 Howitt Road, Belsize Park, London, NW3 4LX in support of a planning application for a proposed development which includes the extension of the existing cellar to cover the footprint of the existing property. It is understood that the proposed basement is at a level of approximately 2.50m (65.50mAOD) below existing ground level.

1.2 Desk Study Findings

From historical map evidence it would appear that the site was undeveloped land from 1871 to 1915, where a single terraced residential dwelling was constructed. There were no significant changes taking place to the property since its construction.

1.3 Ground Conditions

The borehole revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.30m in thickness resting on deposits of the London Clay Formation. The Made Ground extended down to depths of up to 1.30m below ground level and the material generally comprised a surface layer of concrete overlying silty sandy clay with brick and concrete fragments. The London Clay Formation was encountered below the Made Ground and consisted of stiff silty sandy clay with occasional pockets and partings of silty fine sand and scattered gypsum crystals. These deposits extended down to the full depth of investigation of 15.00m below ground level in Borehole 1. Following drilling operations, a groundwater monitoring piezometer was installed in Borehole 1 to a depth of approximately 7.40m. Groundwater was encountered at a depth of 7.34m below ground level in Borehole 1 after a period of approximately three weeks. As the geology is a non-aquifer, it is likely that this is surface water trapped within the standpipe.

1.4 Recommendations

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

2.0 INTRODUCTION

2.1 Project Objectives

At the request Anese Investments Limited, a Basement Impact Assessment has been carried out at the above site in support of a planning application.

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

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

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

2.2 Planning Policy Context

The information contained within this BIA has been produced to meet the requirements set out by Camden Planning Guidance – Basements and Lightwells (CPG4) including Camden Development Policies DP27 – Basements and Lightwells, March 2021 (Ref 1) in order to assist London Borough of Camden (LBC) with their decision-making process.

The BIA approach follows current planning procedure for basements and lightwells adopted by London Borough of Camden and comprises the following elements.

1. **Initial screening** to identify where there are matters of concern

2. **Scoping** to further define the matters of concern

3. **Site Investigation and study** to establish baseline conditions

4. **Impact Assessment** to determine the impact of the basement on baseline conditions

5. **Review and Decision Making** (to be undertaken by LBC)

2.3 Authors

The qualifications required by LBC are fulfilled as documented in Table 1 below. All assessors meet the qualification requirements of the Council guidance.

Table 1. Qualification summary

Subject	Qualifications Required by CPG4	Relevant person(s)
Surface flow and flooding	A Hydrologist or a Civil Engineer specialising in flood risk management and surface water drainage, with either: the "CEng" (Chartered Engineer) qualification from the Engineering Council; or the "C.WEM" (Chartered Water and Environmental Manager) qualification from the Chartered Institution of Water and Environmental Management. and either: a Member of the Institution of Civil Engineers ("MICE") or a Member; or Fellow (MCIWEM or FCIWEM) of the Chartered Institution of Water and Environmental Management.	Mr Thomas Murray MSc, BSc (Hons), FGS (9+ years' experience) Mr Andrew Smith BSc(Hons) FGS CGeol MCIWEM RoGEP (16+ years experience) Mr David Oates CEng BEng (Hons) MIStructE (20+ years' experience)
Subterranean (groundwater flow)	A Hydrogeologist with the "CGeol" (Chartered Geologist) qualification from the Geological Society of London and a Fellow of the Geological Society of London.	Mr Andrew Smith BSc(Hons) FGS CGeol MCIWEM RoGEP (16+ years experience) Mr Thomas Murray MSc, BSc (Hons), FGS (9+ years' experience)
Land Stability	A Civil Engineer with the "CEng" (Chartered Engineer) qualification from the Engineering Council and a Member of the Institution of Civil Engineers ("MICE") with either demonstrable evidence that the assessments have been made in conjunction with an Engineering Geologist with the "cGeol" (Chartered Geologist) qualification from the Geological Society of London or a Registered Ground Engineering Professional, Specialist or Advisor as defined by the Register of Ground Engineering Professionals (RoGEP).	Mr David Oates CEng BEng (Hons) MIStructE (20+ years' experience) Mr Andrew Smith BSc(Hons) FGS CGeol MCIWEM RoGEP (16+ years experience)

3.0 SITE DETAILS

(National Grid Reference: TQ 273 849)

3.1 Site Location

The site is located on the eastern side of Howitt Road and is approximately 136m to the south-west of Belsize Park Underground Station. The site is situated in the Belsize Park area of London at approximate postcode NW3 4LX. It is immediately bordered to north and south by residential properties and has more residential dwellings opposite to the west on the other side of Howitt Road.

The site is rectangular in shape covers an approximate area of 0.02 Hectares with the general area being under the authority of the London Borough of Camden.

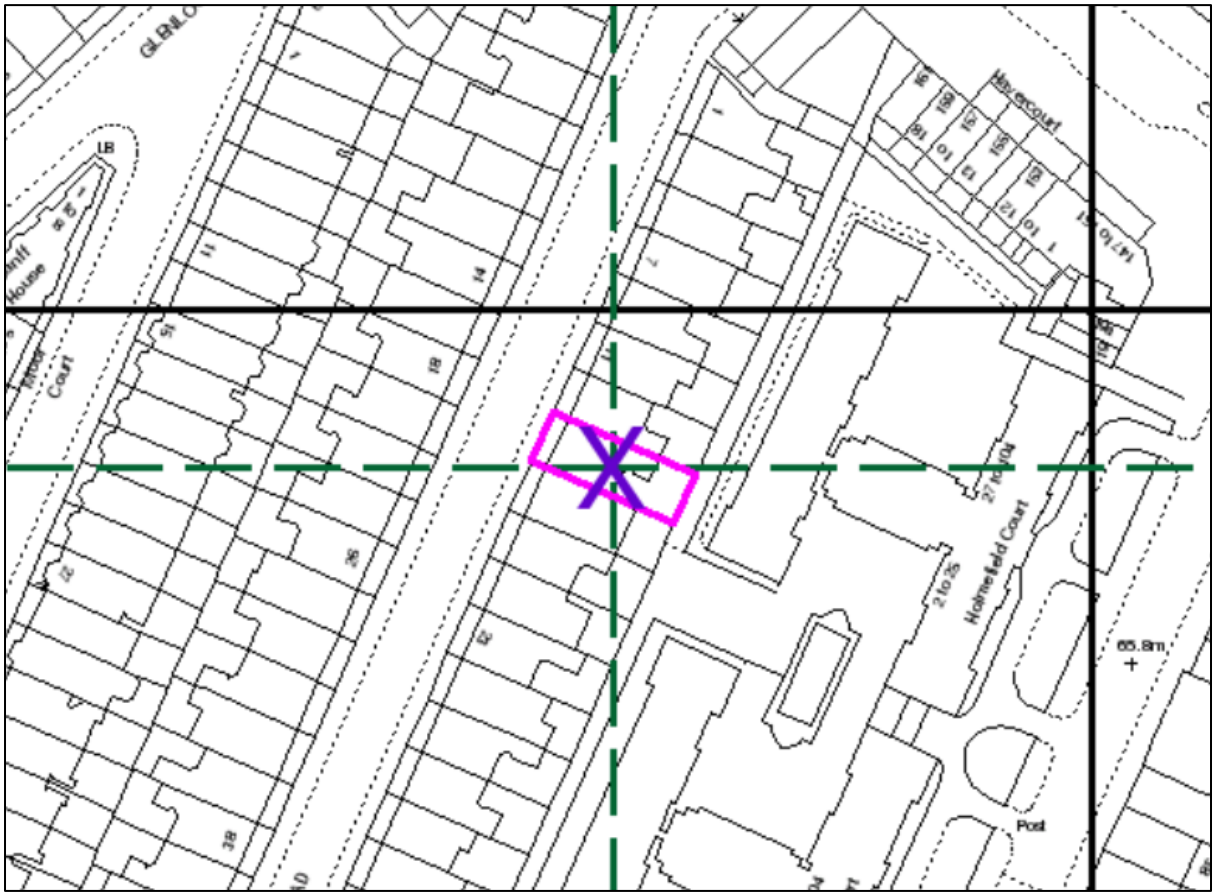


Figure 3-1. Site Location Plan

3.2 Site Walkover and History

A Walkover Survey was carried out on 21st February 2023 by Site Analytical Services Limited and is described below.

Access to the site	Open pedestrian access to the east of the site via a couple of steps to the front door off of a small front garden area.
Current And/or Former Use of the Site	The site is currently in use as a residential property.
Structures or Past Structures	The site comprises a 3-storey terraced residential property (with a converted attic and small cellar to 2.1m depth) with a private rear garden.
Ground cover	The majority of the site covering is in the form of hardstanding (buildings, concrete and tarmac). There are areas of soft landscaping in the form of soil (used for vegetation) located in the private rear garden on-site.
On-Site Vegetation	There is no significant vegetation on-site, however neighbouring gardens do have some medium and small trees.
Invasive Species	None observed during the site walkover.
Site Topography	The site is generally flat with no apparent sloping.
Visual or Olfactory Signs of Contamination	None observed during the site walkover.
Signs of Structural Instability	None observed during the site walkover.
Drainage/Services or Past Services/Buried Services	There are drainage features visible around the footprint of the site and within the hardstanding in the private rear garden. There is not considered to be a significant potential from on-site drainage / services to cause contamination on-site. There are no obvious preferential pathways resulting from the presence of services that may connect possible contamination on-site with receptors on and / off site.
Water Courses	There were no obvious water courses on site or adjacent to the site.
Standing Water	None observed during the site walkover.
General Comments	From the walkover, the site appears to be a well-maintained residential property.

The site in use as a residential property and comprises 2 storey terraced house, with a converted attic space, small basement and a private rear garden area.

The nearby surrounding areas to the site are mainly residential in all immediate directions.

The property consists of a small concrete covered front garden area and a slightly larger rear garden, covered in paving, with a small area to the rear covered in predominantly hard standing with a small area of soft landscaping.

Ground level has been taken as 68.0m AOD in the vicinity of the site from online sources (including Google Earth).

The site and surrounding arear slopes west. The slope angle is less than 7 degrees. Also, with reference to the Camden Geological, Hydrogeological and Hydrological Study, (Figure 3-2 below), the neighbouring properties also have slopes less than 7 degrees.

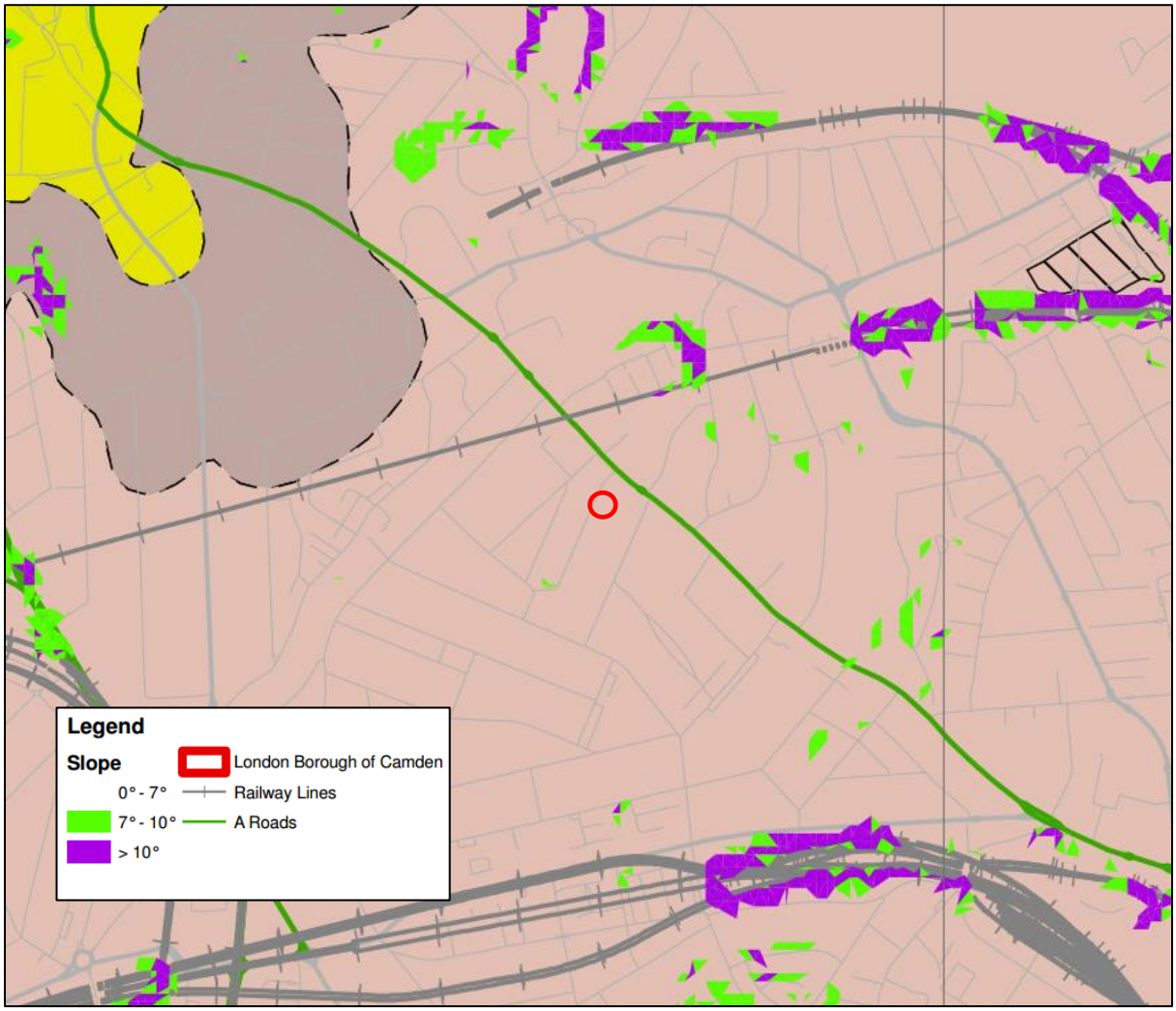


Figure 3-2. Exact from Figure 16 of the Camden CPG4 showing slope angles within the borough

From historical map evidence it would appear that the site was undeveloped land from 1871 to 1915, where a single terraced residential dwelling was constructed. There were no significant changes taking place to the property since its construction.

3.3 Services and Utilities

A Groundwise Searches Limited services survey (Ref: 2926DM-GWS, dated 06/02/23) has been obtained for the site. It can be seen that within a 25m radius of the proposed basement, there are 2No. low pressure gas mains and a Thames Water combined sewer along Howitt Road, with 1No. low pressure gas main running to the rear of site. The report is found within Appendix D.

3.4 Previous Reports

A Geotechnical Desk Study (SAS Report Ref: 23/36419) was undertaken across the site by Site Analytical Services Limited in March 2023 and the results are discussed in this report and can be made available if required.

3.5 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area is detailed in Figure 3-3 below and indicates the site to be underlain by the London Clay Formation. Deposits of the overlying Claygate Member are indicated to be over 400m to the north-west of the site.

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

The British Geological Survey maintains an archive of historical exploratory borehole logs throughout the UK. SAS Limited has searched the database and have found a borehole located 140m to the north of the site at 'Belsize Park Station' and shows 2.30m of Made Ground (ash and made up ground) over 0.30m of mud with water, over 4.90m of yellow clay, over 36.30m of blue clay.

3.6 Hydrology and drainage

3.6.1 Surface Water

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

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

With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) a tributary of the 'lost rivers' River Tyburn was located approximately 200m west of the site (Figure 3-4).

Figure 3-4. Location of site (circled) relative to the 'Lost Rivers' of London (Source: Barton, 1992)

The River Tyburn flowed in a southerly direction from Shepherds Well (or Conduit Well) located to the south of Spring Path. From the well it flowed southwards down Fitzjohn's Avenue, through Swiss Cottage and into Regent's Park, where it entered into a large lake. From the lake it flowed southwards through the West End and the City of Westminster, before issuing into the River Thames close to Vauxhall Bridge. The watercourses have since been largely lost through a culverting system as the urban extent of the borough has grown over time.

The closest surface water feature is located 678m to the north of the site. Due to the distance of the surface water feature from the site, it is not considered to be a risk to the development.

The area located immediately around the site is highly developed with more than 80% of the surface covered with hardstanding. Most of the rainfall in the area will run-off hard surface areas and be collected by the local sewer network. Surface drainage from the site is assumed to be directed to drains flowing downhill to the south-west along Howitt Road.

3.6.2 Flood Risk

3.5.2.1 River or Tidal flooding

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

3.5.2.2 Surface water flooding

Figure 3-5 shows that Gascony Avenue did not flood during either of the 1975 or 2002 flood events.

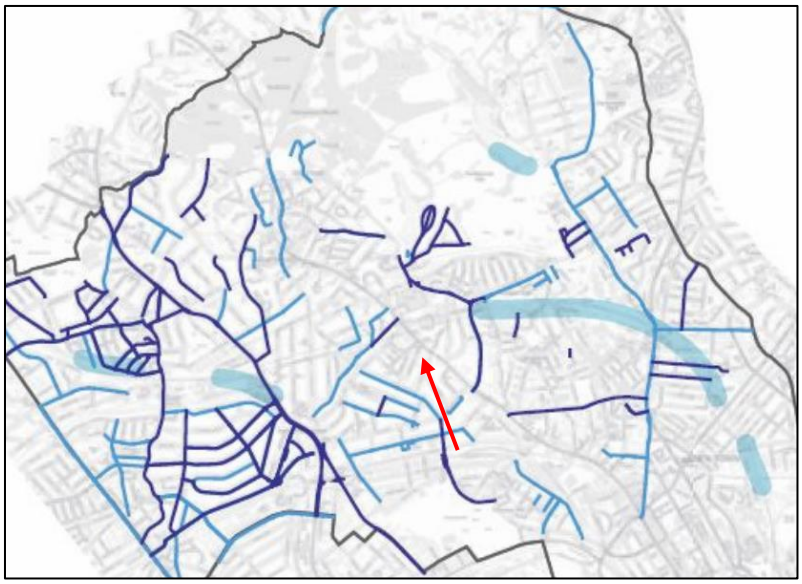


Figure 3-5. Exact from Figure 15 of the Camden CPG4 showing roads which flooded in 1975 (light blue), in 2002 (dark blue) and 'areas with potential to be at risk from surface water flooding' (wide light blue bands)

Further modelling of surface water flooding has been undertaken by the Environment Agency and was published on its website in January 2014; an extract from their model is presented in Figure 3-6. Whilst this map identifies four levels of risk (high, medium, low and very low) it is understood that it is based at least in part on depths of flooding. This modelling shows a 'Very Low' risk of flooding (the lowest category for the national background level of risk) for No.15 and the surrounding area.

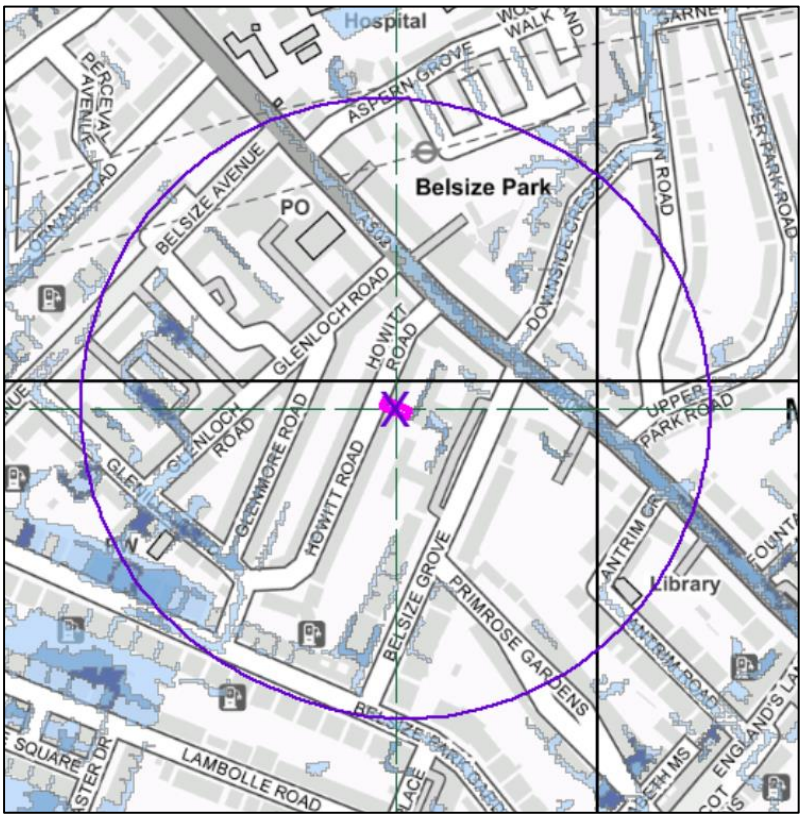


Figure 3-6. Extract from the Environment Agency's 'Risk of Flooding from Surface Water'. Ordnance Survey Crown copyright 2020. All rights reserved.

The site is not within a Local Flood Zone but is within a critical drainage area (Group 3005). The Belsize Park Swiss Cottage Hotspot, which has been investigated as part of the 2022 "London Borough of Camden Section 19 Flood Investigation Report" completed for the London Borough of Camden by Aecom, identified roads that were of risk to flooding within the area. Howitt Road has not been highlighted as at risk and as such no further assessments are required.

As detailed in Table 1 below, the scheme will result in a small decrease in impermeable areas by 2.9m^2, which is a 1.71% change to the site and as such is negligible.

Element	Existing (m^2)	Proposed (m^2)
Impermeable (hardstanding - building footprint, concrete areas)	109 m2	106.1 m2
Permeable (softscaping - grassed areas, (including green roof), permeable and porous paving)	59.8 m2	62.7 m2
Total (should be the site area and remain the same)	168.8 m2	168.8 m2

Table 1. Existing and Proposed Permeable Areas.

3.5.2.3 Sewer flooding

The London Regional Flood Risk Appraisal (2009) advises that foul sewer flooding is most likely to occur where properties are connected to the sewer system at a level below the hydraulic level of the sewage flow, which in general are often basement flats or premises in low lying areas. There is no record of sewer flooding having occurred at 15 Howitt Road and therefore the risk of sewer flooding is considered low.

3.7 Hydrogeological setting

The Environment Agency Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) and also their role in supporting surface water flows and wetland ecosystems.

The Bedrock geology underlying the site (London Clay) has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Other hydrogeological data obtained from the Geotechnical Desk Study (Report Ref: 23/36419) for the site include:

- The underlying soil classification of the site is of high leaching potential.
- There is a Groundwater Source Protection Outer Zone (Zone 2) located 373m to the south of the site.
- There are 4 water abstraction licences within 1 kilometre of the site, with the closest being located 871m to the south-west of the site.

3.8 Proposed Development

It is proposed to extend the existing small basement underneath the footprint of the existing property on site. It is understood that the proposed basement is at a level of approximately 2.5m below ground level (65.50mAOD).

Sections showing the proposed developments are detailed in Figure 3-7:

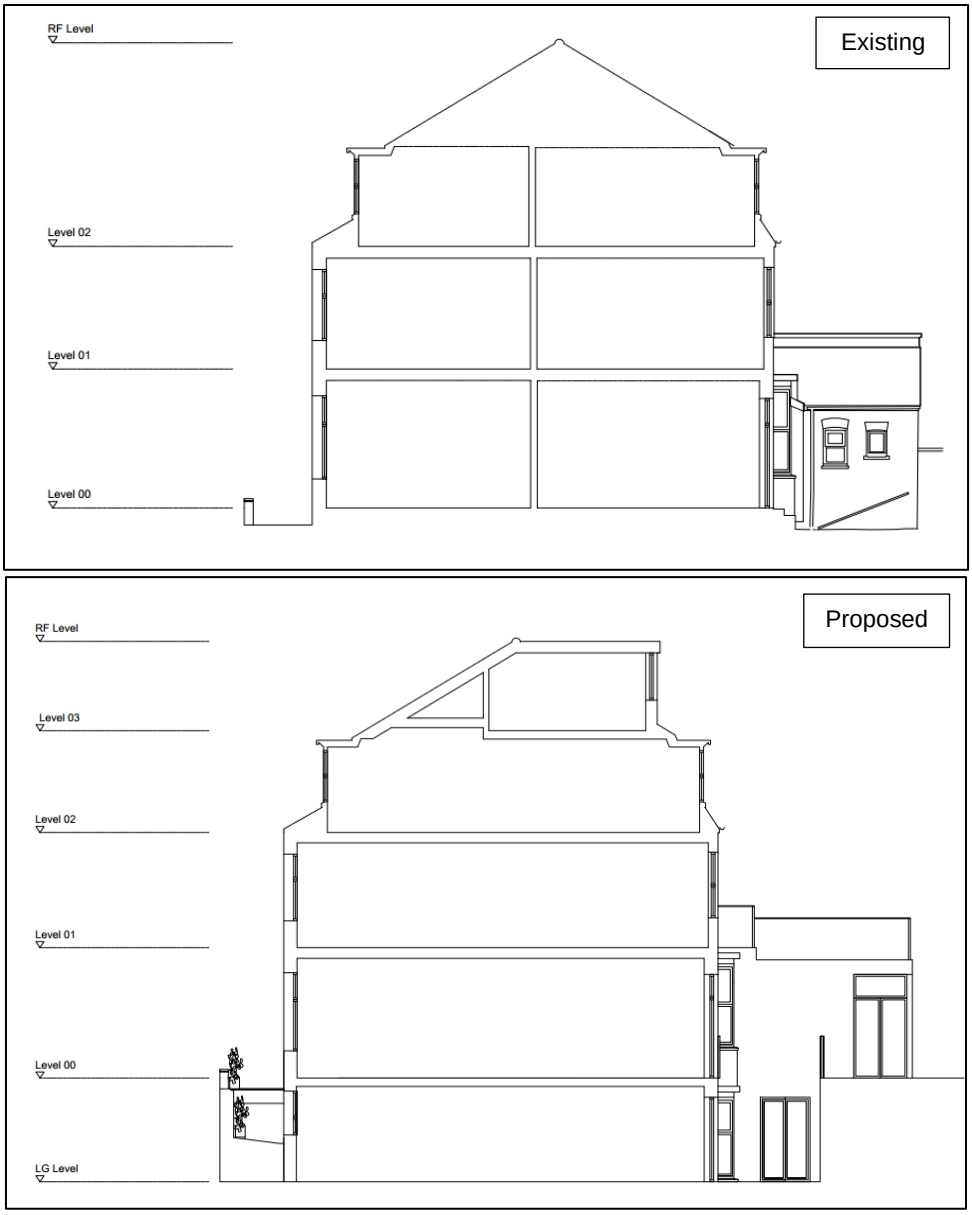


Figure 3-7. Sections of the proposed elevations of the property.

3.9 Results of Basement Impact Assessment Screening

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

Table 2: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	No	The site has been classified as being situated above an unproductive (negligibly permeable) formation (London Clay) that is generally regarded as containing insignificant quantities of groundwater.
	1b. Will the proposed basement extend beneath the water table surface.	Unknown – to be confirmed by Ground Investigation	Given the presence of a non-aquifer below the site it is unlikely that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	No	The closest surface water feature is located 678m to the north of the site. With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) a tributary of the 'lost rivers' River Tyburn was located approximately 200m west of the site. From the British Geological Society 'Geoindex' the nearest water well is located approximately 570m north of the site.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	Yes	The amount of hardstanding on-site is expected to decrease by 2.9m^2 for a 1.71% change on-site.
	4. As part of site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS).	No	Existing drainage paths are to be utilised where possible. Whether soakaways/SUDS are used on the proposed development is to be confirmed (beyond the scope of this report). An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.
	5. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line.	No	The closest surface water feature is located 678m to the north of the site. With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) a tributary of the 'lost rivers' River Tyburn was located approximately 200m west of the site. From the British Geological Society 'Geoindex' the nearest water well is located approximately 570m north of the site.

Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8).	No	The site is relatively flat with no noticeable slope on site.
	2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8).	No	Re-profiling of landscaping at the site is not proposed.
	3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8).	No	The surrounding area drops to the south-east, but from survey information and with reference to Figure 16 from Camden CPG 4, this is at angles of less than 7 degrees.
	4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8).	No	There is a general slope in the area towards the south down to the south-east, but from survey information and with reference to Figure 16 from Camden CPG 4, this is at angles of less than 7 degrees.
	5. Is the London Clay the shallowest strata at the site.	Yes	With reference to available BGS records, the London Clay Formation is expected to be encountered from ground level.
	6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.	No	It is understood that no trees are to be felled as part of the development.
	7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	Yes	The site lies above the London Clay Formation well known as having a high tendency to shrink and swell.
	8. Is the site within 100m of a watercourse or a potential spring line.	No	The closest surface water feature is located 678m to the north of the site. With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) a tributary of the 'lost rivers' River Tyburn was located approximately 200m west of the site.
	9. Is the site within an area of previously worked ground.	No	According to records from the BGS the site is not in the vicinity of any recorded areas of worked ground.

	10. Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction.	No	The site has been classified as being situated above an unproductive (negligibly permeable) formation (London Clay) that is generally regarded as containing insignificant quantities of groundwater.
	11. Is the site within 50m of the Hampstead Heath Ponds	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	12. Is the site within 5m of a highway or pedestrian right of way.	Yes	The site lies within 5m of Howitt Road.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.
	14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	No	The development is not within 200m of Network Rail tunnels.
Surface Water and Flooding	1. Is the site within the catchment of the ponds chains on Hampstead Heath	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	No	No – as there is only a 1.71% change on-site for a decrease in impermeable areas on-site, there will be negligible to no change to the surrounding surface water regime.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	Yes	The amount of hardstanding on-site is expected to decrease by 2.9m^2 for a 1.71% change on-site.

	4. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.	No	All surface water for the site will be contained within the site boundaries and collected as described above; hence there will be no change from the development on the quantity or quality of surface water being received by adjoining sites. The basement will be beneath the footprint of the dwelling therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report does not apply across these areas.
	5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	No	The surface water quality will not be affected by the development, as in the permanent condition collected surface water will generally be from roofs, domestic hard landscaping or collected from beneath the landscaping layer over the basement.
	6. Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature	No	Howitt Road did not flood during either the 1975 or 2002 flood events. According to modelling by the Environment Agency, there is a 'Very Low' risk of surface water flooding (the lowest category for the national background level of risk) for No.15 and the surrounding area. The site is not in a local flood risk zone or in a high-risk area of the CDA.

3.10 Non Technical Summary of Chapter 3.0

The site is accessed from Howitt Road located to the east and comprises of a three storey mid-terrace residential property with an existing cellar, including a small front garden and slightly larger rear garden areas.

The property is constructed on relatively flat ground with no noticeable slope.

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by the London Clay Formation. The London Clay Formation is classed as unproductive strata or a non-aquifer.

The closest surface water feature is located 678m to the north of the site. With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) a tributary of the 'lost rivers' River Tyburn was located approximately 200m west of the site.

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

The site is not within a Local Flood Zone but is within a critical drainage area (Group 3005). The Belsize Park Swiss Cottage Hotspot, which has been investigated as part of the 2022 "London Borough of Camden Section 19 Flood Investigation Report" completed for the London Borough of Camden by Aecom, identified roads that were of risk to flooding within the area. Howitt Road has not been highlighted as at risk and as such no further assessments are required.

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

Subterranean Groundwater Flow

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

Slope Stability

- Is the London Clay the shallowest strata at the site.
- Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.
- Is the site within 5m of a highway or pedestrian right of way.
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.

Surface Water and Flooding

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

4.0 SCOPING PHASE

4.1 Introduction

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

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

Subterranean (Groundwater Flow)

Potential Issue (Screening Question)		Potential impacts and actions
1b	Will the proposed basement extend beneath the water table surface?	**Potential impact:** Local restriction of groundwater flows (perched groundwater or below groundwater table). **Action:** Ground investigation required, the review.

Slope Stability

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

Subterranean (Surface Water Flooding)

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

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

4.2 Non-Technical Summary of Chapter 4.0

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

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

All these actions are covered in Stage 4 or Stage 3 for the ground investigation.

5.0 SITE INVESTIGATION DATA

5.1 Records of site investigation

A site-specific ground investigation was undertaken by Site Analytical Services Limited (SAS) in February 2023 and included one continuous flight auger borehole (BH1) to 15.00m maximum depth and two foundation pits (TP1 and TP2).

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

5.2 Ground conditions

The borehole revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.30m in thickness resting on deposits of the London Clay Formation.

5.2.1 Made Ground

The Made Ground extended down to a depth of up to 1.30m below ground level in Borehole 1 and the material generally comprised a surface layer of concrete overlying silty sandy clay with brick and concrete fragments.

5.2.2 London Clay Formation

The London Clay Formation was encountered below the Made Ground and consisted of stiff silty sandy clay with occasional pockets and partings of silty fine sand and scattered gypsum crystals. These deposits extended down to the full depth of investigation of 15.00m below ground level in Borehole 1.

5.3 Groundwater

Groundwater was not encountered within the borehole or trial pits and the soils remained essentially dry throughout.

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

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

Following drilling operations, a groundwater monitoring pipe was installed in Borehole 1 to approximately 7.0m depth.

Water was encountered at a depth of 7.34m below ground level in Borehole 1 after a period of approximately three weeks. The water encountered was purely surface water trapped in the cap at the base of the standpipe and not true groundwater.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (February 2023) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

5.4 In-Situ and Laboratory Testing

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

5.5.1 In-Situ Tests

In the essentially cohesive natural soils encountered at the site, in-situ shear vane tests were made at regular depth increments in order to assess the undrained shear strength of the materials. The results indicate that the natural soils are of a generally high strength in accordance with BS 5930 (2015+2020).

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

5.5.4 Classification Tests

Atterberg Limit tests were conducted on two selected samples taken from the cohesive portion of the natural soils in Borehole 1 and showed the samples tested to fall into Classes CI and CH according to the British Soil Classification System.

These are fine grained silty clay soils of medium to high plasticity and as such generally have a low permeability and an intermediate to high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values of between 27% and 46%, with one sample being above the 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential.

5.5.5 Sulphate and pH Analyses

Using the results contained in Appendix B, the following table provides the highest values encountered for the BRE SD1 Suite D specification and the equivalent DS and ACEC classes, based on a static groundwater:

Strata	pH	2:1 Water Soluble SO_4 (g/l)	2:1 Water Soluble Chloride (mg/l)	2:1 Water Soluble Nitrate (mg/l)	Total Sulphate (%)	Magnesium (mg/kg)	DS Class	ACEC Class
London Clay Formation	7.7-7.8	2.9	140	<2.0	1.47	840	DS-3	AC-2s

Worst case DS and ACEC classes based on the BRE SD1 Suite D results

5.5 Non-Technical Summary of Chapter 5.0

A site-specific ground investigation was undertaken by Site Analytical Services Limited (SAS) in February 2023 and included one continuous flight auger borehole (BH1) to 15.00m maximum depth and two foundation pits.

The borehole revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.30m in thickness resting on deposits of the London Clay Formation.

Following drilling operations, a groundwater monitoring piezometer was installed in Borehole 1 to approximately 7.4m depth.

Groundwater was encountered at a depth of 7.34m below ground level in Borehole 1 after a period of approximately three weeks. As the geology is a non-aquifer, it is likely that this is surface water trapped within the standpipe and is not representative of any subterranean groundwater flow.

6.0 FOUNDATION DESIGN

6.1 Introduction

It is proposed to extend the existing small basement underneath the footprint of the existing property on-site. It is understood that the proposed basement is at a level of approximately 2.5m below ground level (65.50mAOD).

6.2 Preliminary Bearing Capacity

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

A conservative and preliminary bearing capacity check has been undertaken for the stiff London Clay Soils at approximately 2.50m below the existing ground level to confirm feasibility using the prescriptive methods detailed in BS 8004 (2015). The bearing resistance determined from this check was in the region of 150-200kPa for simply loaded foundations assuming a factor of safety of approximately 3.0. The final foundation design should be undertaken at detailed design stage, once the final loads are known, in compliance with the requirements of BS8004 and EC7 and by a suitably qualified Geotechnical Engineer and accounting for foundation type, shape, depth and any load inclination.

It is recommended that all formation levels should be inspected by a suitably qualified engineer. Foundation excavations should be protected from water and inclement weather (including hot weather and frost).

In addition, foundations may need to be taken deeper should they be within the zones of influence of both existing or recently felled trees and any proposed tree planting. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2021, “Building near Trees" and it is considered that this document is relevant in this situation.

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

Groundwater is not expected to be encountered in the basement excavation, but it would be prudent for the chosen contractor to have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure. Trial excavations to the proposed basement depth could be carried by the main contractor to confirm the stability of the soil and to further investigate the presence of any groundwater inflows.

6.3 Retaining Walls

The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following design parameters for each element of soil recorded in the relevant exploratory holes are provided in Table 6-1 below to assist the design of these structures.

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

Further Geotechnical Parameters are provided within Section 6.8 related to the Ground Movement Assessment.

Table 6-1. Retaining Wall Design Parameters

Stratum	Depth to top (mbgl)	Bulk Density (kN/m^2) (ɣ)	Effective Angle of Internal Friction (Φ)
Made Ground	-	16	28
London Clay Formation	0.50 – 1.30	20	24

6.6 Ground Movement and Damage Impact Assessment

Introduction

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

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

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

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

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

Ground movements within the area of the proposed excavation have been estimated using Geotechnical Software (PDISP by OASYS) whilst the expected movements and impact assessment of the area around the site and surrounding structures have been estimated using Geotechnical Software (XDISP by OASYS). The latter software relies on CIRIA report C580 Embedded Retaining Walls - Guidance for Economic Design (5) (superseded by C760, 2017 (6)) which is based on field measurements of movements from a number of basement constructions across London.

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

Building Damage Assessment

The building damage assessment has been carried out on the relevant adjacent structures, as detailed in Appendix C.

Tensile strains induced within the building walls have been evaluated based on the deflection ratios Δ/L and horizontal extension mechanisms estimated from the analyses. The assessment considers the well-established Burland (1977) damage classification method, as presented and summarised in Figure 6-1 and Figure 6-2 below.

This method involves a relatively simple but robust means of assessment, which is widely adopted and is considered to comprise an industry standard/best practice basis for impact assessments of this typology.

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

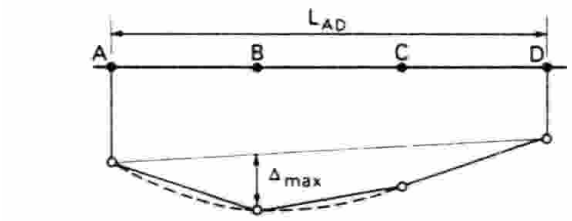


Figure 6-1 Definition of relative deflection Δ and deflection ratio Δ/L

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

Figure 6-2 Building damage classification – relationship between category of damage and limiting strain ε_{lim} After Burland et al. 1977, Boscardin and Cording 1989, and Burland 2001

Results

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

On the basis of the available information the predicted level of damage to the houses at Nos. 13 and 17 Howitt Road and Holmefield Court arising from the excavation of a basement at No. 15, is ‘very slight’ or less. The above assumes a high standard of workmanship.

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

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

Movement monitoring of the walls is recommended during the construction stage and trigger levels should be set in order to protect the neighbouring properties as a precautionary measure.

6.7 Non-Technical Summary of Chapter 6.0

It is proposed to extend the existing cellar underneath the footprint of the existing property on-site. It is understood that the proposed basement is at a level of approximately 2.50m below ground level (65.50m AOD).

Based on the fieldwork, the ground conditions at the site can be characterised as follows: Made Ground extends to a depth of up to 1.30m below ground level. The London Clay Formation extends to the full depth of investigation of 15.00m below ground level. Groundwater was encountered at a depth of 7.34 below ground level in Borehole 1 after a period of approximately two to three weeks. As the geology is a non-aquifer, it is likely that this is surface water trapped within the standpipe.

Groundwater is not expected to be encountered in the basement excavation, but it would be prudent for the chosen contractor to have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

Based on the water soluble sulphate tests carried out as part of these works, it is considered that deterioration of buried concrete due to sulphate or acid attack is likely to occur. The final design of buried concrete according to Tables C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-3 and AC-32s conditions.

On the basis of the available information the predicted level of damage to the houses at Nos. 13 and 17 Howitt Road and Holmefield Court arising from the excavation of a basement at No. 15, is ‘very slight’ or less. The above assumes a high standard of workmanship.

7.0 BASEMENT IMPACT ASSESSMENT

7.1 Summary

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

Potential Impact	Site Investigation conclusions	Impact sufficiently addressed without further justification?
The proposed basement extends beneath the water table surface.	The maximum proposed dig level for the basement excavation (understood to be 2.50mbgl) lies above the minimum indicated groundwater level of 7.34m in BH1 and therefore groundwater will not be affected by the development. As the geology beneath the site is a non-aquifer, it is likely that this is surface water trapped within the standpipe and is not representative of any subterranean groundwater flow. Based on the basement being located above a non-aquifer, the construction is not expected to impact the wider hydrological environment.	Yes
There is a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	The London Clay Formation proven below the site in the ground investigation was recorded as having a medium to high susceptibility to shrinkage and swelling. However, in terms of the new basement, the base of proposed basement slab will extend well below the potential depth of root action in accordance with guidance from NHBC Standards, Chapter 4.2 (2019). Desiccation of the shallow soils has also not been found in the investigation and the adjacent land does not have a known history for land instability.	Yes
The site is within 5m of a highway or pedestrian right of way.	The proposed basement is not to be extended below Howitt Road and therefore it is suggested that the impact on these access roads is likely to be minimal. Temporary works to address potential instability are to be incorporated into the design and construction sequence. There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.	Yes.
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.	The development will result in the extension of the foundation depth of the basement relative to neighbouring properties.	Yes – See Ground Movement Assessment (Chapter 6) for details.
Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	There is a small decrease in impermeable area on-site following development for a 1.71% negligible change, which equates to a minor decrease in the rate of run-off from the site.	Yes

7.2 Outstanding risks and issues

There are no outstanding risks to the site as all possible issues have been address within the report.

7.3 Advice on Further Work and Monitoring

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

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

7.4 Non-Technical Summary of Chapter 7.0

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

On the basis of the available information the predicted level of damage to the houses at Nos. 13 and 17 Howitt Road and Holmefield Court arising from the excavation of a basement at No. 15, is ‘very slight’ or less. The above assumes a high standard of workmanship.

The development is not likely to significantly affect the existing local groundwater regime.

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

8.0 REFERENCES

1. LB Camden, 2021, Basements and Lightwells (CPG4) including Camden Development Policies DP27 – Basements and Lightwells

2. CIRIA Special Publication 69, 1989. The engineering implications of rising groundwater levels in the deep aquifer beneath London

3. Environment Agency, 2006. Groundwater levels in the Chalk-Basal Sands Aquifer in the London Basin

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

5. British Standards Institution, 2015. Code of Practice for Site Investigations, BS5930, BSI, London

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

7. British Standards Institution, 2009. Code of Practice for Protection of Below Ground Structures Against Water from the Ground. BS 8102, BSI, London

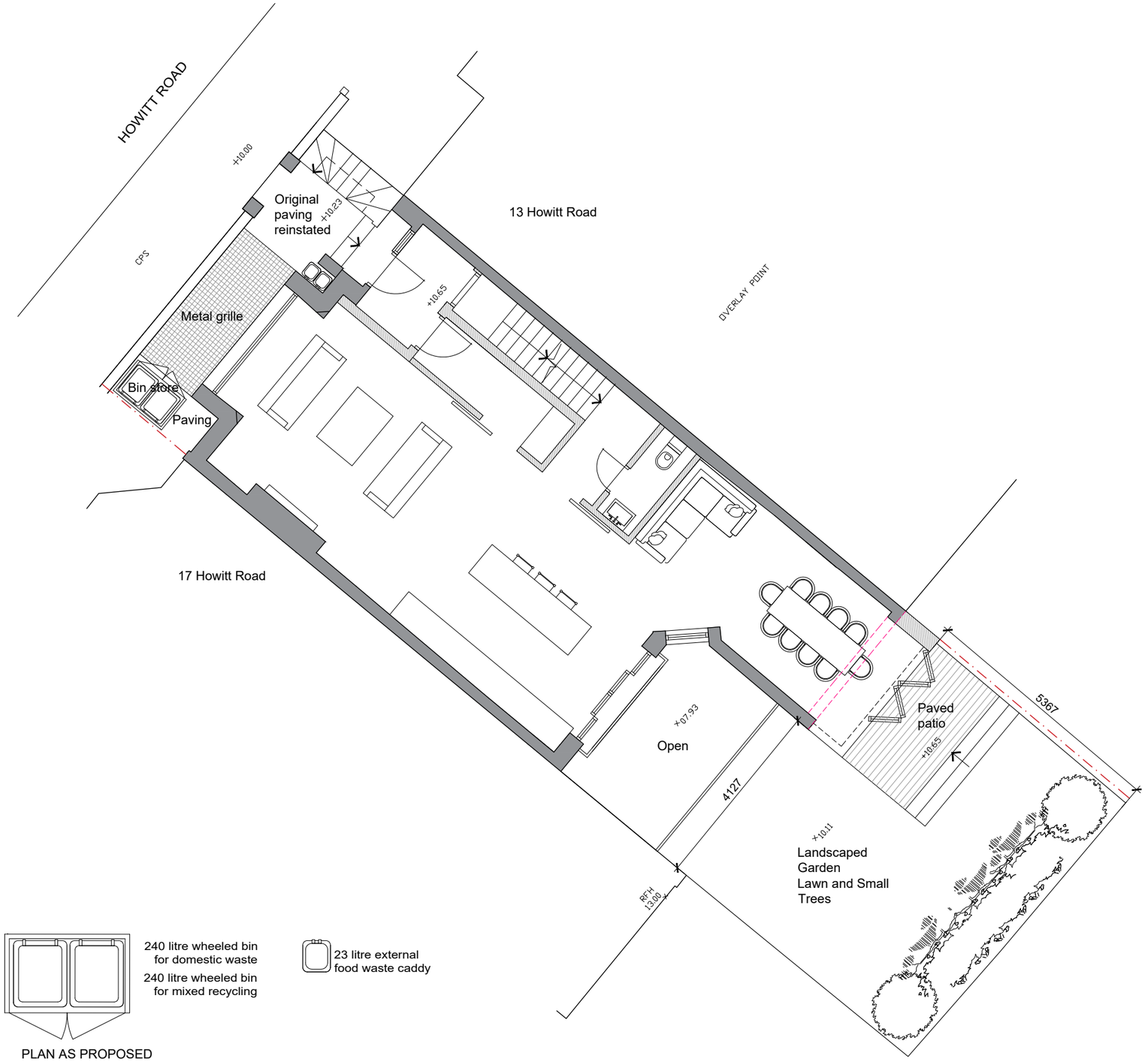
8. CIRIA, 2000. Sustainable Urban Drainage Systems: Design Manual for England and Wales. CIRIA C522, Construction Industry Research and Information Association, London

9. Environment Agency Status Report 2010. Management of the London Basin Chalk Aquifer. Environment Agency

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

11. NHBC Standards, Chapter 4.2, "Building near Trees", 2021.

Appendix A. Development Drawings

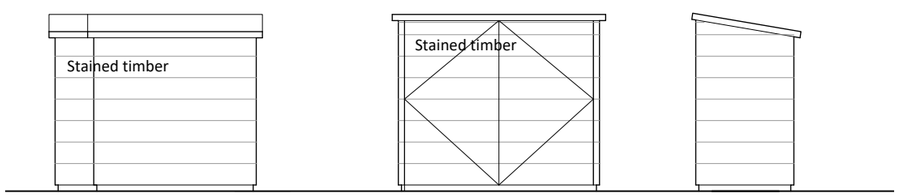


240 litre wheeled bin for domestic waste

240 litre wheeled bin for mixed recycling

23 litre external food waste caddy

PLAN AS PROPOSED



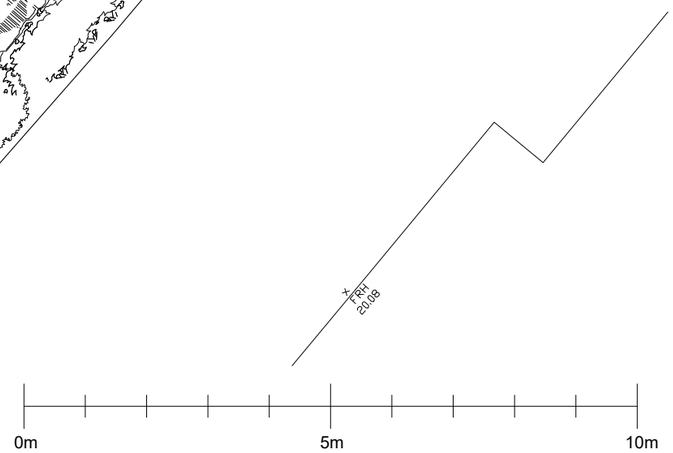
SIDE ELEVATIONS AS PROPOSED

STREET ELEVATION AS PROPOSED

FLAT 1 AND 2 BIN STORE

0m 1m 2m

Scale 1:50



Scale 1:100 @ A3

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REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

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PROJECT
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DRAWING TITLE
Proposed Site Plan

DRAWING NO. IHR-226_PL200

REV.

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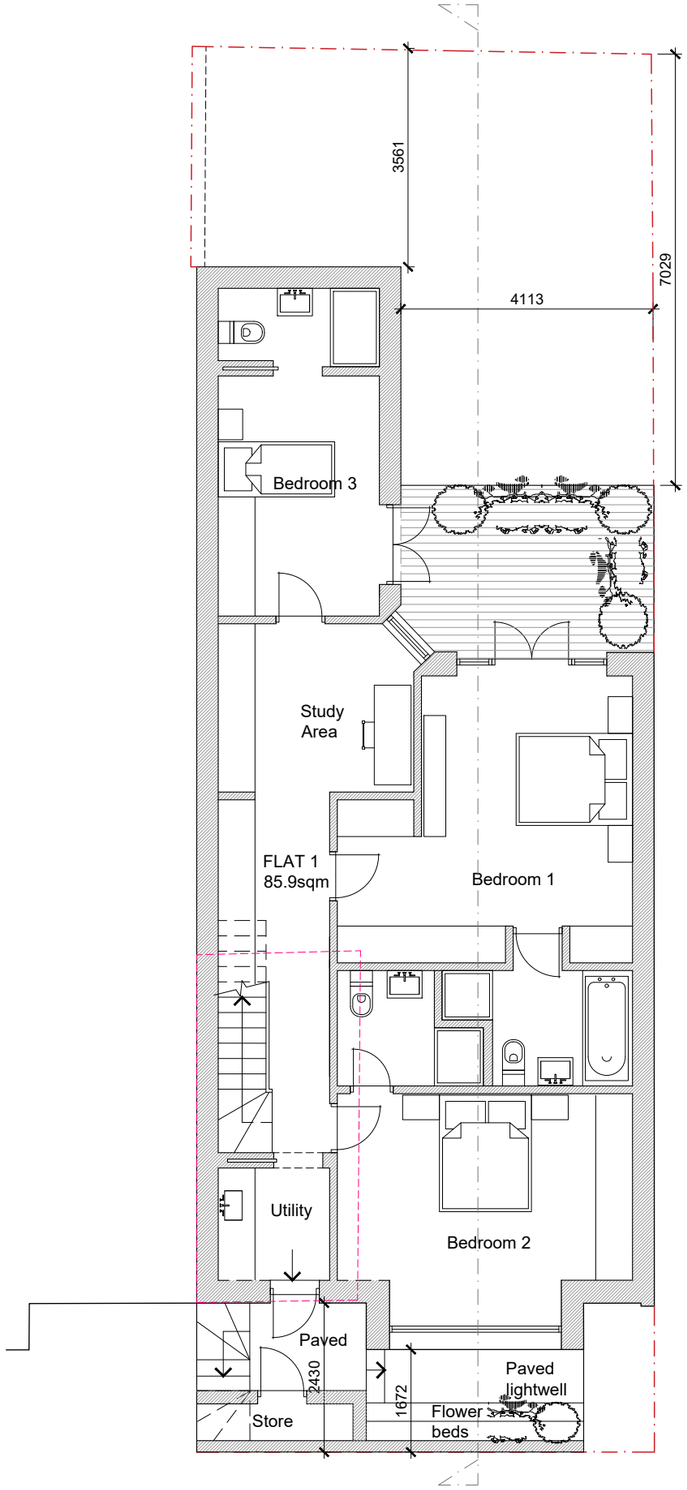
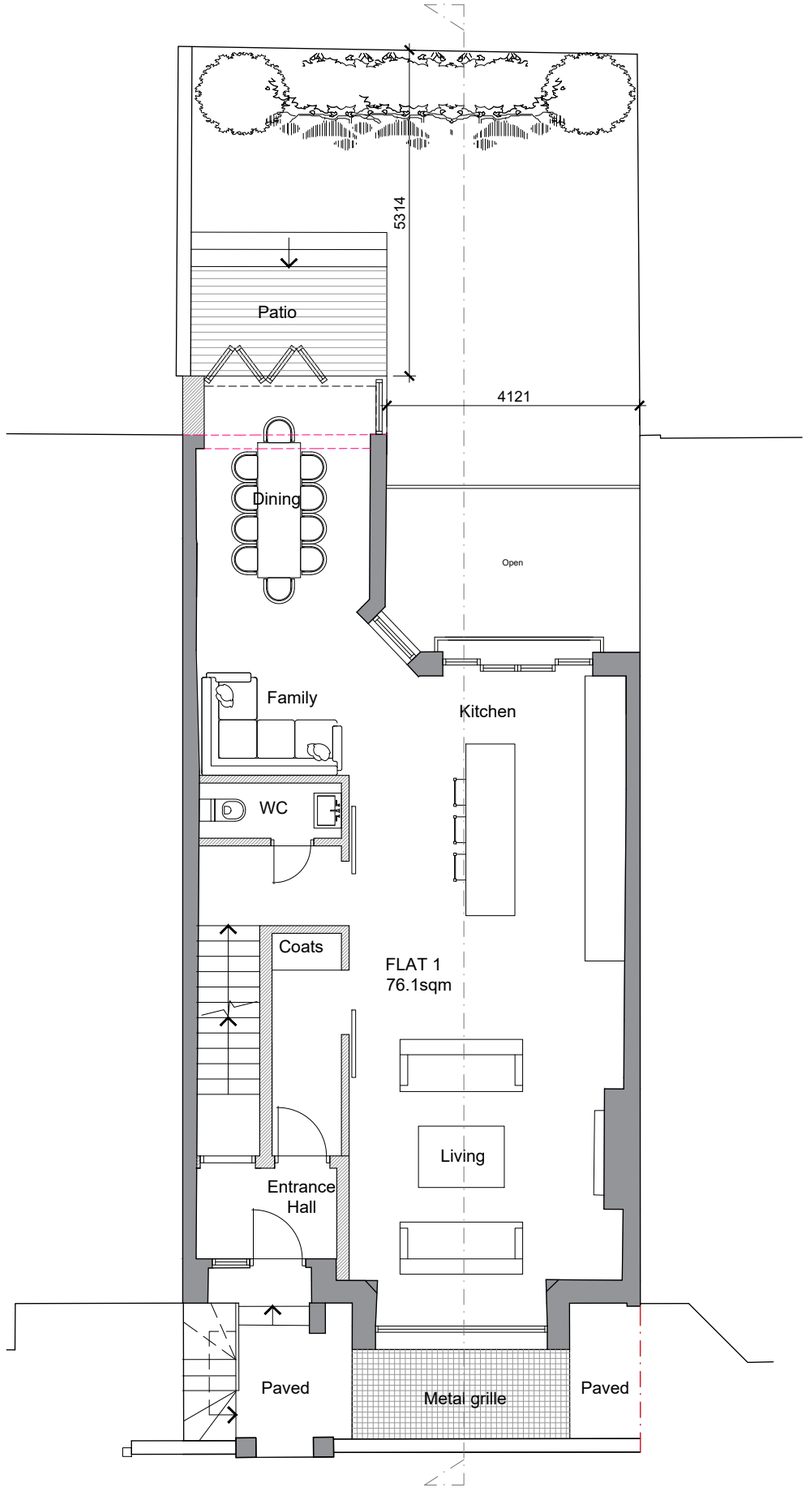


Proposed Basement Plan



Proposed Ground Floor Plan

Scale 1:100 @ A3

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LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

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DRAWING TITLE
Proposed Plans

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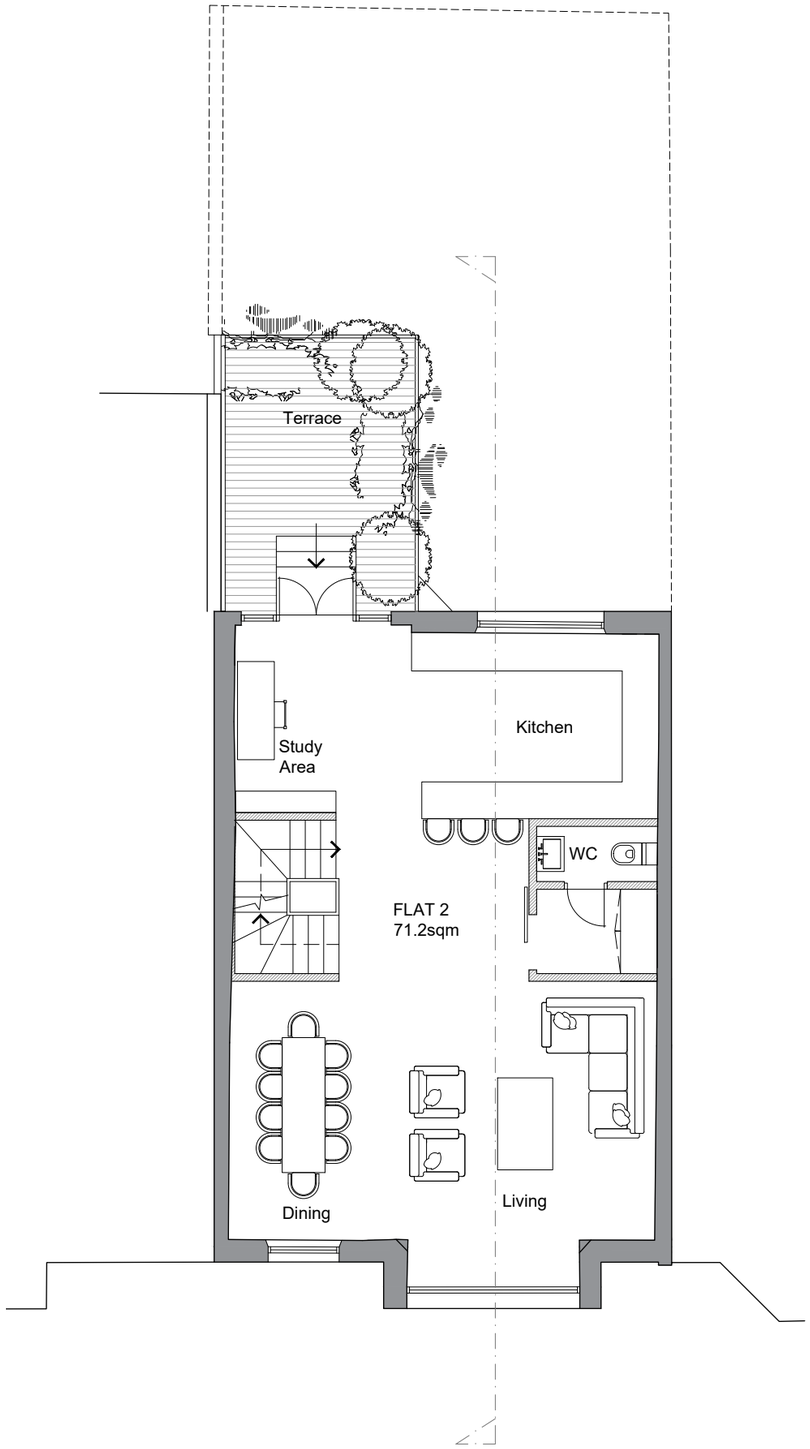
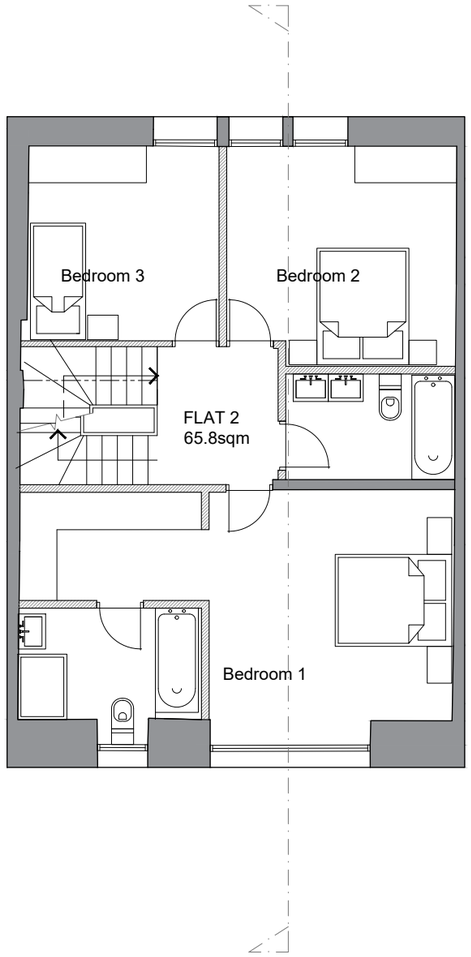


Proposed First Floor Plan



Proposed Second Floor Plan

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LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

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DRAWING TITLE
Proposed Plans

DRAWING NO. IHR-226_PL202

REV.

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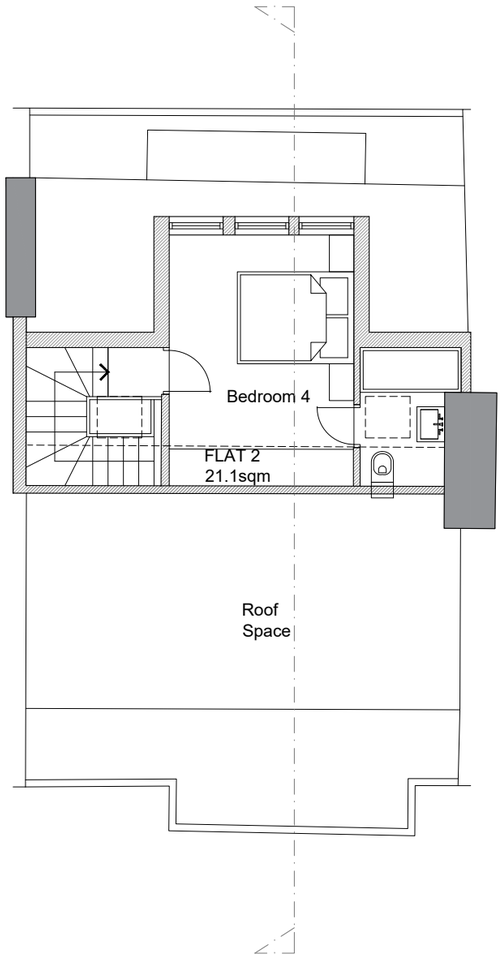
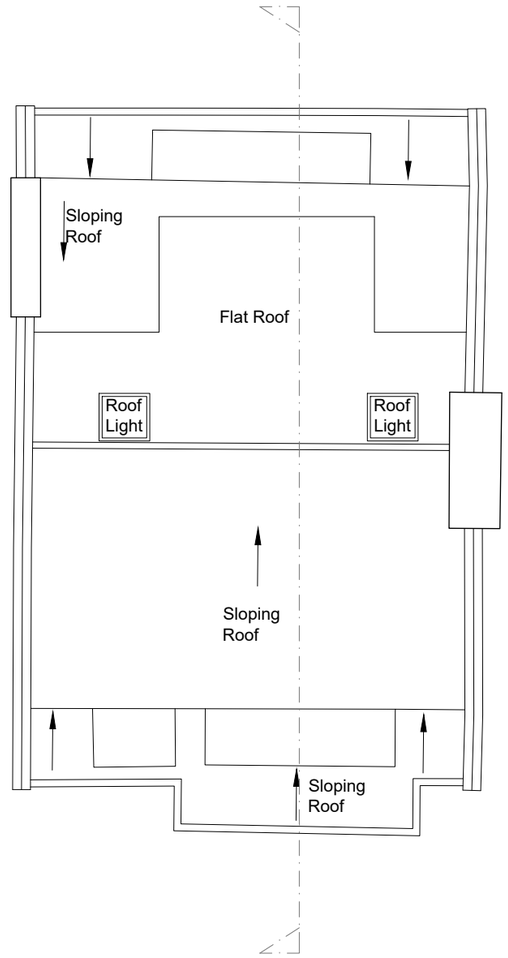


Proposed Third Floor Plan



Proposed Roof Plan

Scale 1:100 @ A3

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-	-	-	-

LEGEND

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- Demolition

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PROJECT
Extensions and Alterations

DRAWING TITLE
Proposed Plans

DRAWING NO.
IHR-226_PL203

REV.

SCALE	DATE	DRAWN	CHECKED
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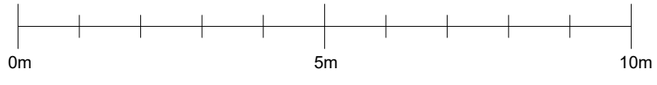
Proposed Street Elevation

Proposed Rear Elevation

MATERIALITY LEGEND

1. Slate roof
2. Painted timber front, lead cheeks
3. Double glazed UPVC window
4. Painted timber fascia
5. Brick to match existing
6. Powder coated aluminium doors
7. Timber slats privacy panel
8. Metal balustrade
9. Timber refuse bin store
10. Balustrade with glass infill
11. Double glazed timber sash windows original design reinstated
12. Double glazed timber sash windows to match above
13. Timber door to matchNo 13



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DRAWING TITLE
Proposed Elevations

DRAWING NO.
IHR-226_PL211

REV.

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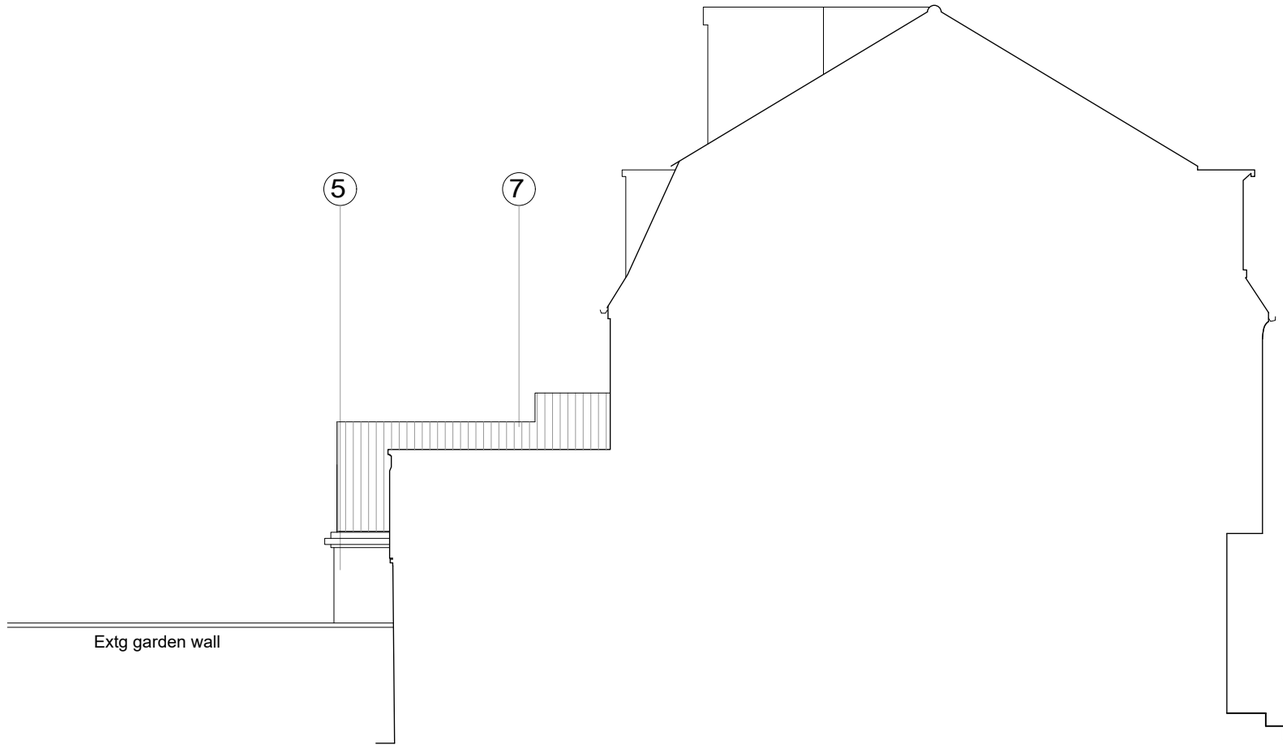

Proposed View from No 13

MATERIALITY LEGEND

1. Slate roof
2. Painted timber front, lead cheeks
3. Double glazed UPVC window
4. Painted timber fascia
5. Brick to match existing
6. Powder coated aluminium doors
7. Timber slats privacy panel
8. Metal balustrade
9. Timber refuse bin store
10. Balustrade with glass infill
11. Double glazed timber sash windows original design reinstated
12. Double glazed timber sash windows to match above
13. Timber door to matchNo 13

0m 5m 10m

Scale 1:100 @ A3

NOTE
This drawing is copyright.
~~Do not scale~~, use figured dimensions only.
The contractor is to check all dimensions on site before commencement of the works.
Discrepancies must be reported immediately to the architect before proceeding.

REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

PLANNING

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The Old Warehouse
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janeduncanarchitects.co.uk

CLIENT
Anese Investments Ltd.

ADDRESS
15 Howitt Road, Belsize Park, London, NW3 4LT

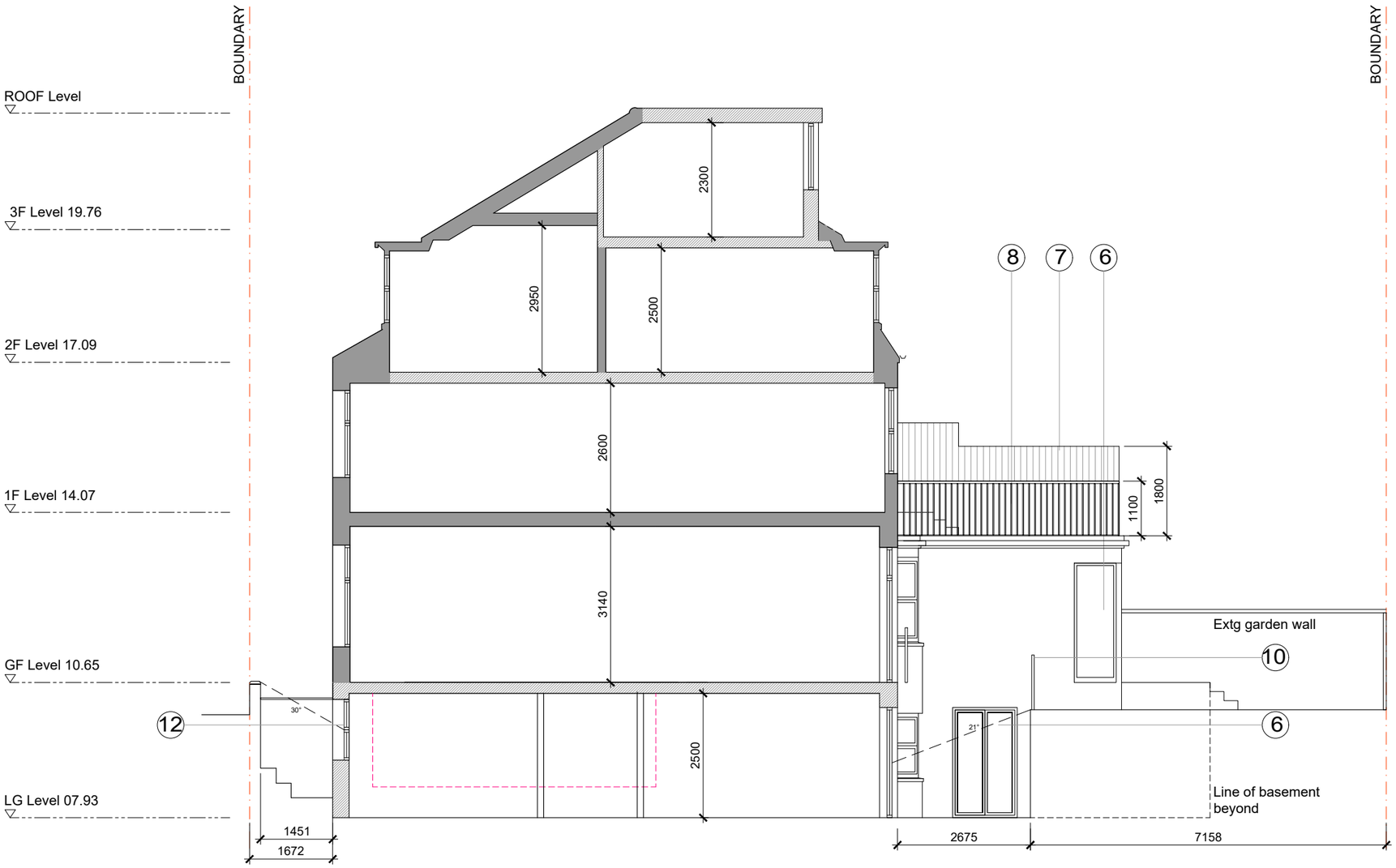
PROJECT
Extensions and Alterations

DRAWING TITLE
Proposed View From No 13

DRAWING NO. IHR-226_PL221

REV.

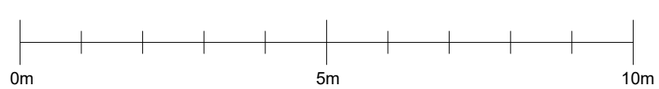
SCALE	DATE	DRAWN	CHECKED
1:100@A3	03.23	LT	ADB



Proposed Section / Side Elevation

MATERIALITY LEGEND

1. Slate roof
2. Painted timber front, lead cheeks
3. Double glazed UPVC window
4. Painted timber fascia
5. Brick to match existing
6. Powder coated aluminium doors
7. Timber slats privacy panel
8. Metal balustrade
9. Timber refuse bin store
10. Balustrade with glass infill
11. Double glazed timber sash windows original design reinstated
12. Double glazed timber sash windows to match above
13. Timber door to matchNo 13



Scale 1:100 @ A3

NOTE
This drawing is copyright.
~~Do not scale~~, use figured dimensions only.
The contractor is to check all dimensions on site before commencement of the works.
Discrepancies must be reported immediately to the architect before proceeding.

REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

PLANNING

jane duncan architects+ interiors

The Old Warehouse
Chalfont Station Road
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CLIENT
Anese Investments Ltd.

ADDRESS
15 Howitt Road, Belsize Park, London, NW3 4LT

PROJECT
Extensions and Alterations

DRAWING TITLE
Proposed Section/Side Elevation

DRAWING NO. IHR-226_PL220

REV.

SCALE	DATE	DRAWN	CHECKED
1:100@A3	03.23	LT	ADB

Appendix B. Factual Ground Investigation

Factual Report on a
GEOTECHNICAL GROUND INVESTIGATION

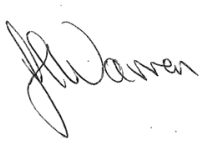
Ref: 23/36419-1 | Date: March 2023

15 Howitt Road
Belsize Park
London
NW6 4NE

Prepared for:
Anese Investments Limited

DOCUMENT CONTROL

Project	15 Howitt Road, Belsize Park, London, NW3 4LX
Document Type	Factual Report on a Ground Investigation
Document Reference	SAS 23/36419-1
Document Status	Final
Revision	0
Changes	-
Date	March 2023
Document Version	V1.0 – 3/21

Checked	Author
	
Jim Warren MRSC Managing Director	Thomas Murray BSc (Hons) MSc FGS Geotechnical Engineer

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33 River Road, Barking, Essex IG11 0EA
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CONTENTS

1.0 Introduction

1.1 Outline and Limitations of Report

At the request of Anese Investments Limited, a ground investigation was carried out in connection with a proposed basement development at the above site. A Geotechnical Desk Study is presented under a separate cover in Site Analytical Services Limited Report Reference 23/36419, dated March 2023.

The information was required for the design and construction of foundations and infrastructure for the proposed development at the existing site which includes the construction of a basement level.

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

2.0 Site Details

(National Grid Reference: TQ 273 849)

2.1 Site Location

The site is located on the eastern side of Howitt Road and is approximately 136m to the south-west of Belsize Park Underground Station. The site is situated in the Belsize Park area of London at approximate postcode NW3 4LX. It is immediately bordered to north and south by residential properties and has more residential dwellings opposite to the west on the other side of Howitt Road.

The site is rectangular in shape covers an approximate area of 0.02 Hectares with the general area being under the authority of the London Borough of Camden.

2.2 Published Geology

The Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by the London Clay Formation at depth.

3.0 Scope of Work

3.1 Site Works

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

- The drilling of one Continuous Flight Auger borehole to a depth of 15.00m below ground level (Borehole 1).
- The installation of a groundwater monitoring standpipe to an approximate depth of 7.0m in Borehole 1, together with two return monitoring visits.
- The excavation by hand of two trial pits, to 1.50m maximum depth to expose existing foundations on-site (Trial Pits 1 and 2).
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the exploratory holes.
- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes.

3.2 Ground Conditions

The approximate locations of the exploratory holes are illustrated on the site sketch plan, Figure 1 below.

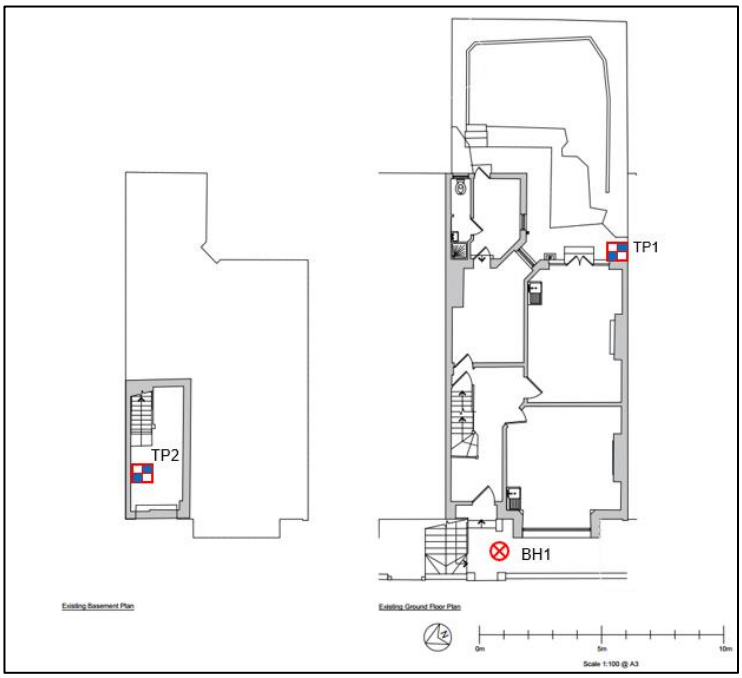


Figure 1. Site Sketch Plan

The borehole and trial pits revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 1.30m in thickness resting on the London Clay Formation at depth.

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

Strata	Depth to top of strata (mbgl)	Depth to base of strata (mbgl)	Description
Made Ground	0.00	0.50 to 1.30	Concrete slab over sandy clay with brick fragments
London Clay Formation	0.50 to 1.30	15.00	Silty sandy CLAY containing partings of silty fine sand and gypsum crystals.

Summary of Ground Conditions in Exploratory Holes

3.3 Groundwater

Groundwater was encountered in the borehole during site works and remained dry throughout.

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

Water was encountered at a depth of 7.34m below ground level in Borehole 1 after a period of approximately three weeks. The water encountered was purely surface water trapped in the cap at the base of the standpipe and not true groundwater.

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

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (February 2023) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

3.1 In-Situ Tests

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

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

3.2 Classification Tests

Atterberg Limit tests were conducted on two selected samples taken from the cohesive portion of the natural soils in Borehole 1 and showed the samples tested to fall into Classes CI and CH according to the British Soil Classification System.

These are fine grained silty clay soils of medium to high plasticity and as such generally have a low permeability and an intermediate to high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values of between 27% and 46%, with one sample being above the 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential.

The results of the tests are presented on Table 1, contained in Appendix B.

3.3 Chemical Attack on Buried Concrete

Using the results contained in Appendix B, the following table provides the highest values encountered for the BRE SD1 Suite D specification and the equivalent DS and ACEC classes, based on a static groundwater:

Strata	pH	2:1 Water Soluble SO_4 (g/l)	2:1 Water Soluble Chloride (mg/l)	2:1 Water Soluble Nitrate (mg/l)	Total Sulphate (%)	Magnesium (mg/kg)	DS Class	ACEC Class
London Clay Formation	7.7-7.8	2.9	140	<2.0	1.47	840	DS-3	AC-2s

Worst case DS and ACEC classes based on the BRE SD1 Suite D results

4.0 List of Appendices

Appendix A – Borehole and Trial Pit Logs

Appendix B – Laboratory Test & Groundwater Monitoring Data

5.0 References

1. British Standards Institution, 2015. Code of practice for foundations, BS 8004, BSI, London.

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

3. British Standards Institution, 1994. Code of practice for earth retaining structures, BS8002, BSI, London

4. British Standards Institution, Code of Practice for Site Investigations, BS5930: 2015, BSI, London

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

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

APPENDIX A

Borehole & Trial Pit Logs

Site Analytical Services Ltd.

Site	Borehole Number
15 HOWITT ROAD, BELSIZE PARK, LONDON NW3 4LX	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m		ANESE INVESTMENTS LIMITED	2336419
	Location TQ272848	**Dates** 02/02/2023	**Engineer**	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						0.08	MADE GROUND: Concrete		
0.25	D1						MADE GROUND: Brown silty sandy clay containing brick and concrete fragments		
0.50	D2					(0.87)			
0.75	D3								
						0.95			
1.00	D4					(0.35)	MADE GROUND: Firm, brown orange silty clay containing occasional brick fragments		
1.00	V1 73					1.30			
							Stiff, brown orange silty CLAY		
1.50	D5								
1.50	V2 86								
2.00	D6								
2.00	V3 106								
2.50	D7								
2.50	V4 130								
3.00	D8								
3.00	V5 140+								
						(5.00)			
4.00	D9								
4.00	V6 140+								
4.50	D10								
4.50	V7 140+								
5.00	D11								
5.00	V8 140+								
6.00	D12								
6.00	V9 140+					6.30	Stiff, dark brown grey silty CLAY		
7.00	D13								
7.00	V10 140+								
8.00	D14					(3.70)			
8.00	V11 140+								
9.00	D15								
9.00	V12 140+								

Remarks
D= Disturbed Sample
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation
Excavating from 0.00m to 1.00m for 1 HOUR hour.

Scale (approx)	Logged By
1:50	SB

Figure No. 2336419.BH1

Site Analytical Services Ltd.

Site	Borehole Number
15 HOWITT ROAD, BELSIZE PARK, LONDON NW3 4LX	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m		ANESE INVESTMENTS LIMITED	2336419
	Location TQ272848	**Dates** 02/02/2023	**Engineer**	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00 10.00	D16 V13 140+					10.00	Stiff, dark brown orange silty CLAY		
11.00 11.00	D17 V14 140+								
12.00 12.00	D18 V15 140+					(5.00)			
13.00 13.00	D19 V16 140+								
14.00 14.00	D20 V17 140+								
15.00 15.00	D21 V18 140+					15.00	Complete at 15.00m		

Remarks
D= Disturbed Sample
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation

Scale (approx)	Logged By
1:50	SB

Figure No. 2336419.BH1

Site Analytical Services Ltd.

Site	Borehole Number
15 HOWITT ROAD, BELSIZE PARK, LONDON NW3 4LX	BH1

Installation Type
Single Installation

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

Client
ANESE INVESTMENTS LIMITED

Job Number
2336419

Location
TQ272848

Ground Level (mOD)

Engineer

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
					Bentonite Seal
				1.00	
					Slotted Standpipe
				7.00	
					Bentonite Seal
				8.00	
					General Backfill
				15.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

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

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

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

Remarks
Lockable cover set in cement

Site Analytical Services Ltd.

Site	Trial Pit Number
15 HOWITT ROAD, BELSIZE PARK, LONDON NW3 4LX	TP1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.40m(D)		ANESE INVESTMENTS LIMITED	2336419
	Location TQ272848	**Dates** 03/02/2023	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	MADE GROUND: Dark brown sandy topsoil containing hardcore		
					(0.95) 1.20	MADE GROUND: Dark brown silty sandy clay containing brick fragments		
1.20 1.20	D1 V1 76				(0.20) 1.40	Stiff, dark brown grey silty CLAY		
						Complete at 1.40m		

Plan

Remarks

Excavating from 0.00m to 1.00m for 1 HOUR hour.
D= Disturbed Sample
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation

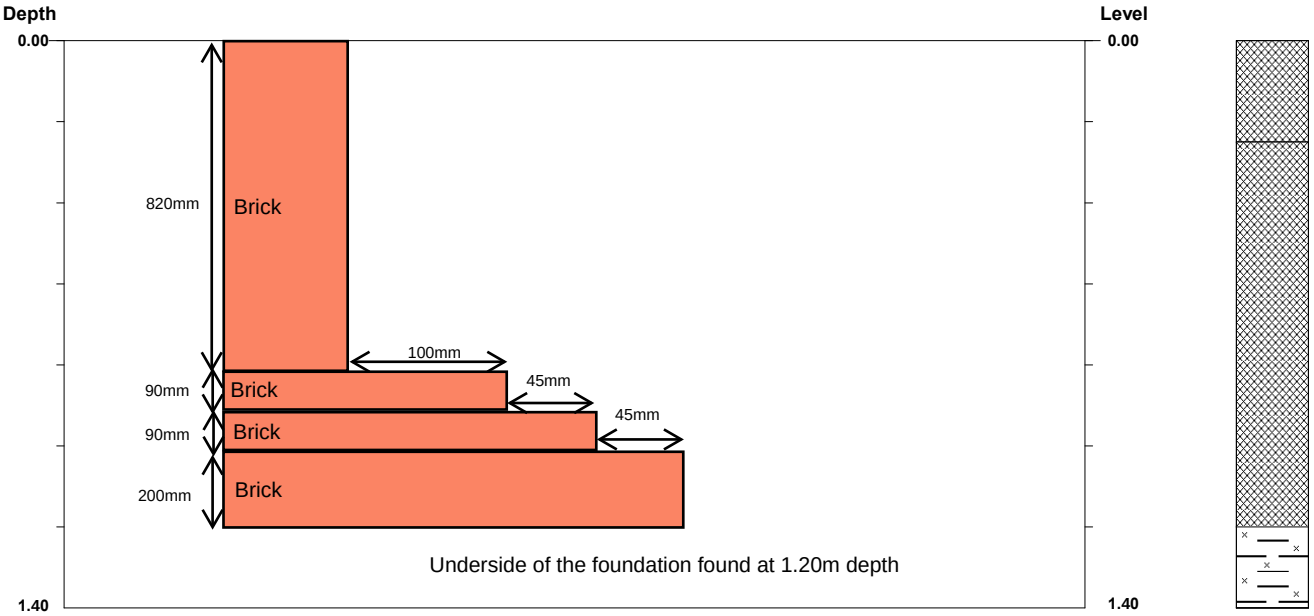
Scale (approx)	Logged By	Figure No.
1:50	SB	2336419.TP1

Site Analytical Services Ltd.

Site	Trial Pit Number
15 HOWITT ROAD, BELSIZE PARK, LONDON NW3 4LX	TP1

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.40m(D)		ANESE INVESTMENTS LIMITED	2336419

Orientation	Location	Dates	Engineer	Sheet
A D B C	TQ272848	03/02/2023		1/1



Strata

Depth (m)	No.	Description
0.00-0.25	1	MADE GROUND: Dark brown sandy topsoil containing hardcore
0.25-1.20	2	MADE GROUND: Dark brown silty sandy clay containing brick fragments
1.20-1.40	3	Stiff, dark brown grey silty CLAY

Samples and Tests

Depth (m)	Type	Field Records
1.20	V1 76	
1.20	D1	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
D= Disturbed Sample
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation
Excavating from 0.00m to 1.00m for 1 HOUR hour.

Logged By : SB
Checked By :
Figure No. : 2336419.TP1

Site Analytical Services Ltd.

Site	Trial Pit Number
15 HOWITT ROAD, BELSIZE PARK, LONDON NW3 4LX	TP2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 0.70m(D)		ANESE INVESTMENTS LIMITED	2336419
	Location TQ272848	**Dates** 03/02/2023	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50 0.50	D1 V1 140+				0.05 (0.45) 0.50 (0.20) 0.70	MADE GROUND: Concrete MADE GROUND: Dark brown silty sandy clay containing brick and concrete fragments Stiff, brown orange silty CLAY Complete at 0.70m		

Plan

Remarks

Excavating from 0.00m to 1.00m for 1 HOUR hour.
Groundwater was not encountered during boring/excavation
V= Vane Test - Results in kPa
D= Disturbed Sample

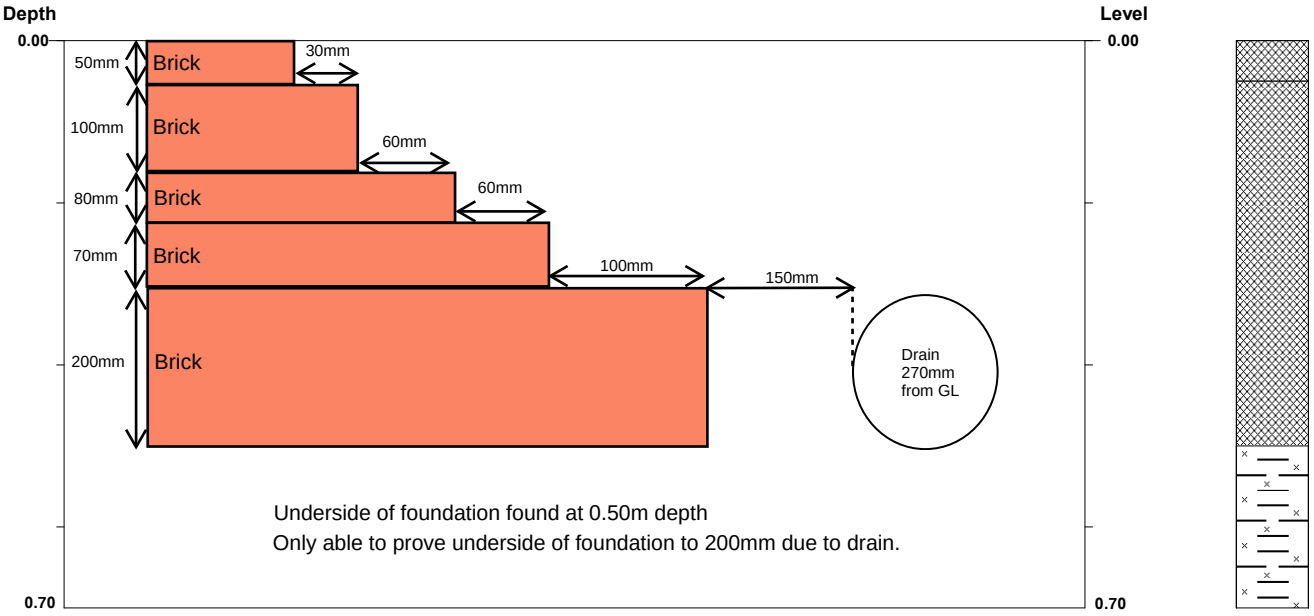
Scale (approx)	Logged By	Figure No.
1:50	SB	2336419.TP2

Site Analytical Services Ltd.

Site	Trial Pit Number
15 HOWITT ROAD, BELSIZE PARK, LONDON NW3 4LX	TP2

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 0.70m(D)		ANESE INVESTMENTS LIMITED	2336419

Orientation	Location	Dates	Engineer	Sheet
A D B C	TQ272848	03/02/2023		1/1



Strata

Depth (m)	No.	Description
0.00-0.05	1	MADE GROUND: Concrete
0.05-0.50	2	MADE GROUND: Dark brown silty sandy clay containing brick and concrete fragments
0.50-0.70	3	Stiff, brown orange silty CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.50	V1 140+	
0.50	D1	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
Groundwater was not encountered during boring/excavation
V= Vane Test - Results in kPa
D= Disturbed Sample
Excavating from 0.00m to 1.00m for 1 HOUR hour.

Logged By : SB
Checked By :
Figure No. : 2336419.TP2

APPENDIX B

Laboratory Test & Groundwater Monitoring Data

PLASTICITY INDEX & MOISTURE CONTENT DETERMINATIONS

BH/TP No.	Depth (m)	Natural Moisture (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 μm (%)	Modified Plasticity Index (%)	Class
BH1	1.50	20	47	20	27	100	27	CI
	3.00	29	68	22	46	100	46	CH

Table 1

Steve Barrett
Site Analytical Services Ltd
Units 14 -15
River Road Business Park
33 River Road
Barking
Essex
IG11 0EA

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f: 0208 5948072
e: SAS -

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 : 23-16433

Project / Site name:	15 Howitt Road, Belsize Park, London NW3 4LX	**Samples received on:**	08/02/2023
Your job number:	23-36419	**Samples instructed on/ Analysis started on:**	08/02/2023
Your order number:	11396	**Analysis completed by:**	15/02/2023
Report Issue Number:	1	**Report issued on:**	15/02/2023
Samples Analysed:	5 soil samples		

Signed:

Adam Fenwick
Technical Reviewer
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.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-16433
Project / Site name: 15 Howitt Road, Belsize Park, London NW3 4LX
Your Order No: 11396

Lab Sample Number				2578213	2578214	2578215	2578216	2578217
Sample Reference				BH1	BH1	BH1	BH1	BH1
Sample Number				6	10	13	17	20
Depth (m)				2.00	4.50	7.00	11.00	14.00
Date Sampled				02/02/2023	02/02/2023	02/02/2023	02/02/2023	02/02/2023
Time Taken				None Supplied	None Supplied	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	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	20	20	19	18	19
Total mass of sample received	kg	0.001	NONE	1.5	1.5	1.5	1.5	1
Whole Sample Crushed		N/A	NONE	Crushed	Crushed	Crushed	Crushed	Crushed

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.7	7.7	7.8	7.8	7.7
Total Sulphate as SO4	%	0.005	MCERTS	0.025	1.47	0.858	0.987	0.841
Water Soluble SO4 16hr extraction (2:1 Leachate Equivale	g/l	0.00125	MCERTS	0.11	2.9	2.9	2.9	2.9
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	6.9	140	110	100	110
Total Sulphur	%	0.005	MCERTS	0.017	0.421	0.488	0.803	0.746
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Heavy Metals / Metalloids

Magnesium (water soluble)	mg/kg	5	NONE	28	820	840	840	820

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 23-16433
Project / Site name: 15 Howitt Road, Belsize Park, London NW3 4LX

* 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 *
2578213	BH1	6	2	Light brown clay.
2578214	BH1	10	4.5	Light brown clay.
2578215	BH1	13	7	Brown clay.
2578216	BH1	17	11	Brown clay.
2578217	BH1	20	14	Brown clay.

Analytical Report Number : 23-16433
Project / Site name: 15 Howitt Road, Belsize Park, London NW3 4LX

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	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
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Crush Whole Sample	Either: Client specific preparation instructions - sample(s) crushed whole prior to analysis; OR Sample unsuitable for standard preparation and therefore crushed whole prior to analysis.	In house method, applicable to dry samples only.	L019-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.	L038-PL	D	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' 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
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

GROUNDWATER MONITORING

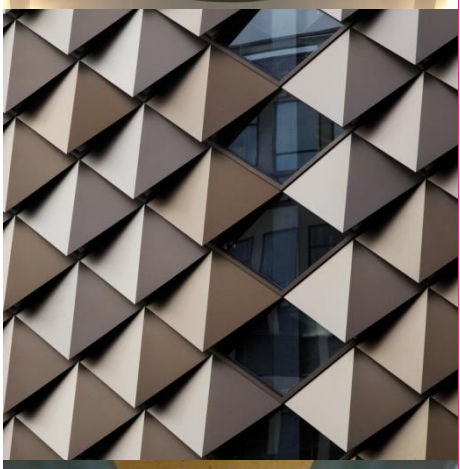
GROUNDWATER MONITORING RECORD		
Date	**Monitoring Position**	**Depth to Water m below ground level**
14/02/2023	BH1	Dry

Table 2

GROUNDWATER MONITORING RECORD		
Date	**Monitoring Position**	**Depth to Water m below ground level**
21/02/2023	BH1	7.34

Table 2a

Appendix C. Ground Movement Assessment



15 Howitt Road, Belsize Park

Ground Movement Assessment

Curtins Ref: 083353-CUR-XX-XX-T-GE-0001

Revision: P02

Issue Date: 25 August 2023

Client Name: Site Analytical Services Limited

Client Address: River Road Business Park, River Road, Barking, IG11 0EA

Site Address: 15 Howitt Road, Belsize Park, London NW3 4LX

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Rev	Description	Issued by	Checked	Date
P01	Report for Issue	LP	AS	08/03/2023
P02	Amendments following external comments	AS	LP	25/08/2023

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

Author	Signature	Date
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Table of Contents

1.0 Introduction

1.1 Brief

Curtins have been commissioned by Site Analytical Services Limited (SASL) to complete a Ground Movement Assessment (GMA) in connection with a proposed residential development at 15 Howitt Road, Belsize Park, NW3 4LX. The location of the site is detailed on **Figure 1.1**. The purpose of this assessment is to determine what effects the permanent construction may have on permanent structures which surround the property.

A site-specific Ground Investigation was carried out by Site Analytical Services in February 2023 and is summarised in Factual Report Ref: 23/36419-1, dated March 2023. The ground investigation was designed by Site Analytical Services, and results have been used in the derivation of parameters utilised in this assessment. Curtins cannot be held responsible for any inaccuracy in the factual data provided.

Figure 1.1: *Location of 15 Howitt Road*

1.2 Development Proposals

The new development includes the construction of a basement below the ground floor of the property. Based on the proposed development drawings contained within **Appendix A**, it is understood that the existing ground floor is 68m AOD and the proposed basement excavation is to be constructed a maximum of 2.5m below ground floor level (65.5m AOD) across the length of the existing property including a lightwell at the front. A plan section can be seen in **Figure 1.2**, and a side section view can be seen in **Figure 3.1** with the level of the ground investigation.

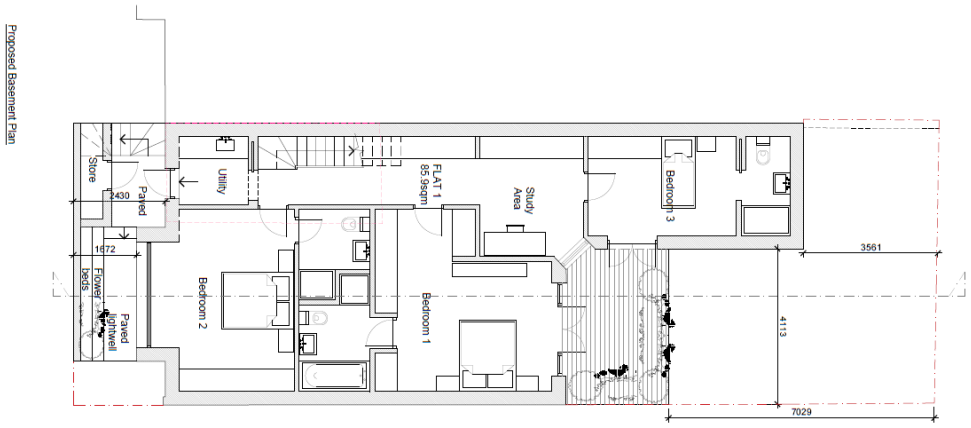

Figure 1.2: *Proposed basement plans*

1.3 Limitations

The conclusions and recommendations made in this report are made on the basis of the site-specific ground investigations undertaken by Site Analytical Services undertaken in February 2023. The ground investigation was designed by Site Analytical Services, and the results of the work should be viewed in the context of the range of data sources consulted and the information provided along with the number of locations where the ground was sampled. No liability can be accepted for inaccuracies in the factual data, information in other data sources or conditions not revealed by the sampling or testing.

The effect of the proposed construction on existing subterranean assets (including services and tunnels) are outside the scope of this report and may be required under a separate assessment. In addition this analysis does not take account of any dewatering measures required to facilitate the basement development.

It should be noted that the movements described in this report are indicative only for the purposes of providing pre-planning guidance with regards to the development and should not be relied upon for detailed design. It is anticipated the actual movement observed on site will be heavily affected by the level of workmanship and therefore should be reviewed at detailed design following discussions with the structural engineer and appointed contractor.

2.0 Baseline Conditions

2.1 Site Description

The site is located at 15 Howitt Road, Belsize Park, NW3 4LX, London, approximately 120m southwest of Belsize Park Station. The building is currently a 3-storey building, with a small cellar at the front of the property (at 2.1m bgl). This can be seen in the existing drawings in **Appendix B**. The property is under the authority of the London Borough of Camden

The street level in the area of the site is estimated from proposed drawings (**Appendix A**) to be at a level of approximately c.68m AOD with both garden level and ground floor also at approximately 68m AOD. Therefore existing cellar level will be at 65.9m AOD.

Details of the buildings located in close proximity to the property which have been considered in the analysis are summarised in **Table 2.1** below.

Table 2.1: *A summary of the neighbouring properties in close proximity to 15 Howitt Road*

Building Name	Description	Approximate Height (from lower ground floor level to top of roof)	Distance from Proposed Basement
13 Howitt Road	3-storey terrace residential building	12m	Shares party wall
17 Howitt Road	3-storey terrace residential building	12m	Shares party wall
Holmefield Court, 12 Belsize Grove	4-storey block of flats	16m	11m south east of basement

2.1 Geology

British Geological Survey (BGS) Data

The BGS Geology Viewer (1) and the 1:50,000 Geological Survey of Britain (England and Wales) map 256 (North London) (2) shows that the site is underlain directly by London Clay Formation. No superficial deposits are expected across site.

There are no BGS boreholes within 100m of the site. The closest BGS borehole, Ref: TQ28NE48, is 130m north of site, and includes 3.65m of Made Ground and then London Clay to 44.2m bgl. Groundwater level is not noted in this borehole, although the Made Ground between 2.4m and 2.75m bgl is describes as “Mud with Water”.

Historical Ground Investigations

On 7th May 2013, a ground investigation was carried out at 21 Howitt Road, by Fastrack, consisting of 1 No. Flight Auger borehole down to 5m bgl, which is summarised in Geotechnical Survey Report Ref: 7940, dated May 2013. This ground investigation was carried out at the front of the property, on street level, ~20m southwest of 15 Howitt Road, and consisted of 1.1m of Made Ground, followed by London Clay to 5m bgl.

A ground investigation was carried out by Albury S.I. LTD at 41 Howitt Road, 94m southwest of site. This is summarised in Report on a Site Investigation Ref: 14/10166/NAM, dated July 2014. On 5th June 2014, 1 No. probehole and showed Made Ground to 0.9m, followed by London Clay down to 4.2m bgl. Groundwater was not encountered in this investigation.

2.2 Hydrogeology

According to online information (https://magic.defra.gov.uk/ (2)), the London Clay bedrock is designated as unproductive strata, which are defined as rock layers with low permeability that have negligible significance for water supply or river base flow.

3.0 Ground Investigation

3.1 Encountered Ground Conditions

Between 2nd and 3rd February 2023, Site Analytical Services conducted an intrusive Ground Investigation comprising:

- 1 No. Continuous Flight Auger borehole to a maximum depth of 15m bgl.
- 2 No. hand dug foundation pits to a maximum depth of 1.4m bgl.

The location of the borehole and trial pits can be found in the SAS Ltd Factual Report Ref: 23/36419-1, dated March 2023 in in **Appendix C** whilst the results of the investigation are summarised in **Table 3.1** below. It has been assumed that BH01 was carried out at the same elevation as street level (68m AOD).

Table 3.1: *Summary of Ground Conditions*

Strata	Depth to top (m bgl)	Elevation at Top (m AOD)	Thickness (m)	Description
Made Ground	0	68	1.3	Concrete Firm, brown orange silty clay containing occasional brick fragments
London Clay	1.3	66.7	13.7	Stiff, dark brown orange silty CLAY

3.2 Groundwater

Groundwater was not encountered during the ground investigation.

Following a groundwater monitoring visit on 14th February 2023, no groundwater was encountered within the standpipe placed in BH1. On a groundwater monitoring visit on 21st February 2023, groundwater was encountered at 7.34m bgl (60.66m AOD) within the London Clay Formation.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (February 2023) and that changes in the groundwater level could occur due to seasonal effects and changes in drainage conditions.

3.3 In Situ and Laboratory Testing

A summary of laboratory and In-Situ test results undertaken within the geological strata encountered during the Site Analytical Services Ground Investigation is presented below and available in **Appendix C**.

3.3.1 Hand Shear Vanes

Within the London Clay, 17 No. Hand Shear Vane tests were carried out, ranging from 86kPa to 140kPa which is the limit of the equipment, between depths of 1.5m and 15m bgl (53m and 66.5m AOD). These are displayed in **Figure 3.1**.

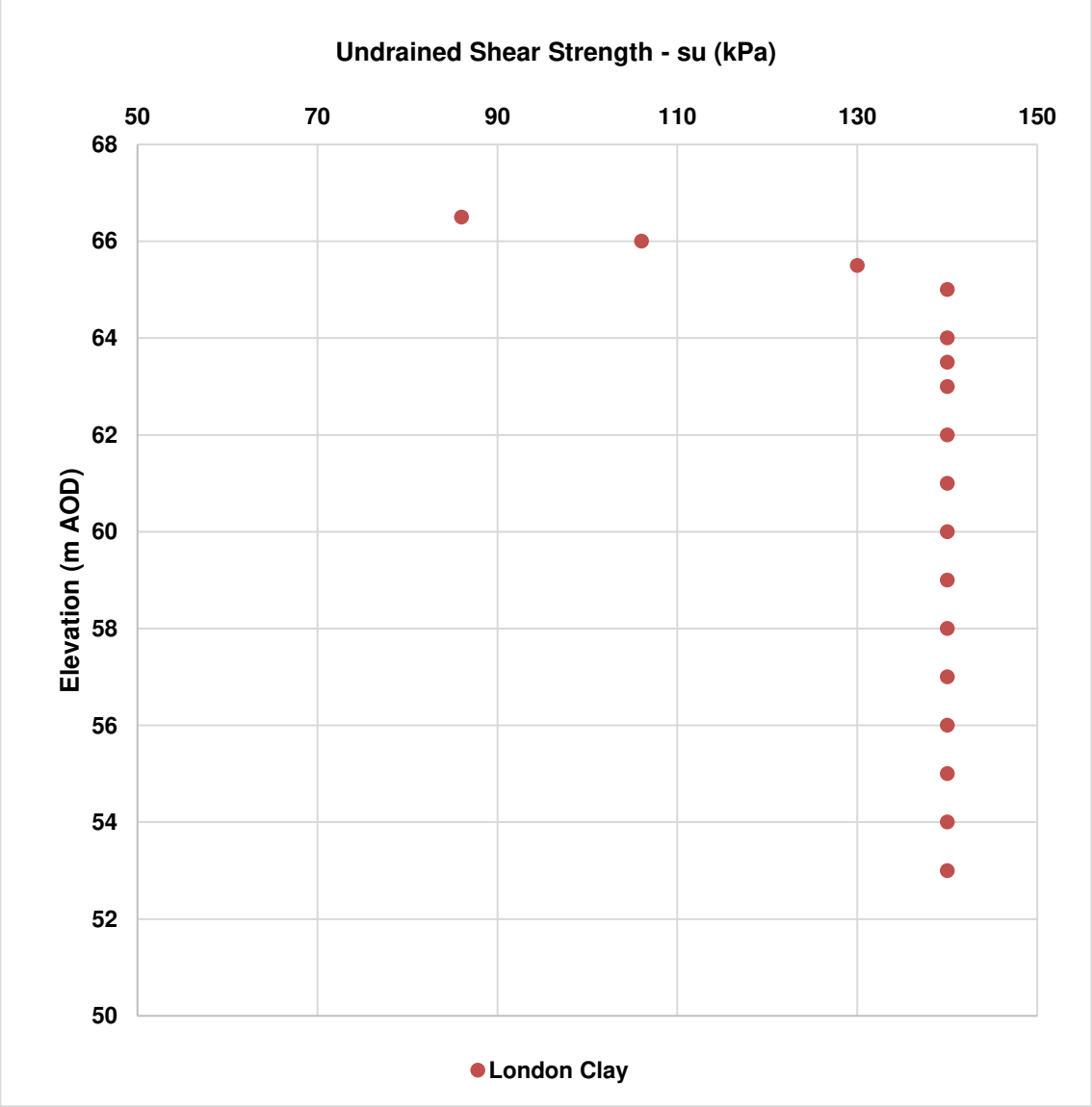

Figure 3.1: *Summary of Undrained Shear Strength values from BH01*

3.3.2 Atterberg Limit Testing

2 No. Atterberg Limit tests were carried out within the London Clay at 1.5m and 3m bgl, with the summary of results below and in **Figure 3.2**.

- Natural Moisture Contents between 20% and 29%
- Liquid Limits between 47% and 68%
- Plasticity Indices between 27% and 46%.

This classifies the London Clay as a intermediate to high plasticity clay.

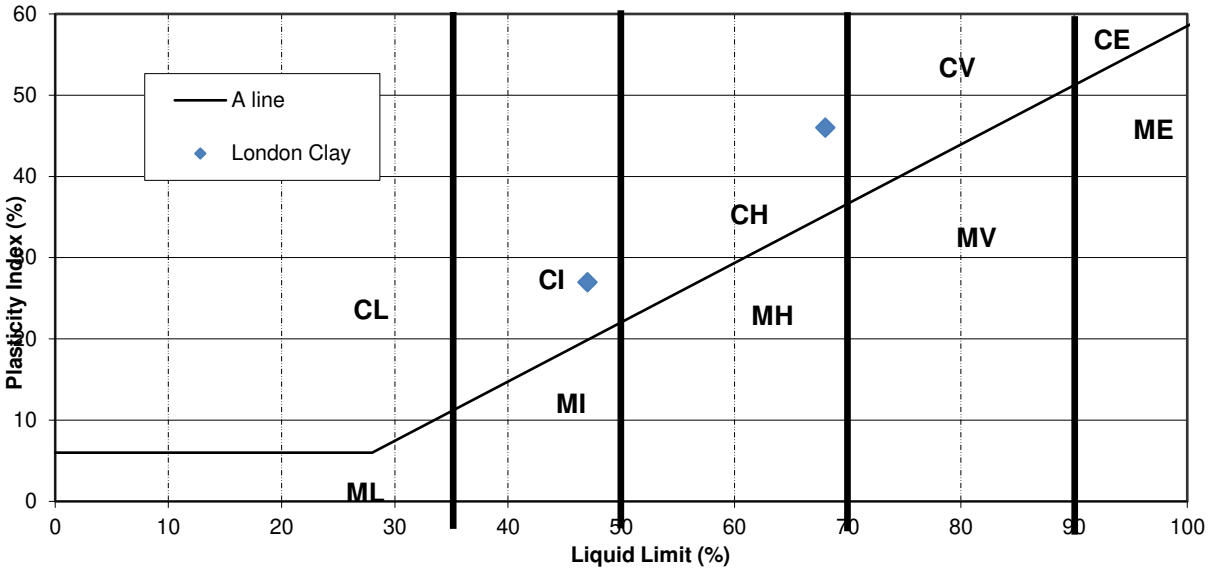

Figure 3.2: *Atterberg Limit Test results for the London Clay*

4.0 Prediction of Ground Movements and Damage Assessment

4.1 Introduction

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

It is understood that the proposed basement will be constructed using underpinning techniques.

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

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

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

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

Ground movements within the area of the proposed excavation have been estimated using Geotechnical Software (PDISP by OASYS) whilst the expected movements and impact assessment of the area around the site and surrounding structures have been estimated using Geotechnical Software (XDISP by OASYS). The latter software relies on CIRIA report C580 Embedded Retaining Walls - Guidance for Economic Design (3) (superseded by C760, 2017 (4)) which is based on field measurements of movements from a number of basement constructions across London.

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

4.2 Adjacent Properties

The properties or structures more likely to be affected by ground movements associated with the proposed basement construction, are shown in **Table 2.1**, as well as the labelled walls under analysis in **Figure 4.1 below** and include the following:

- No. 13 Howitt Road (Shares party wall with No.15)
- No 17 Howitt Road (Shares party wall with No. 15)
- Holmefield Court, 12 Belsize Grove (12m southeast of No.15)

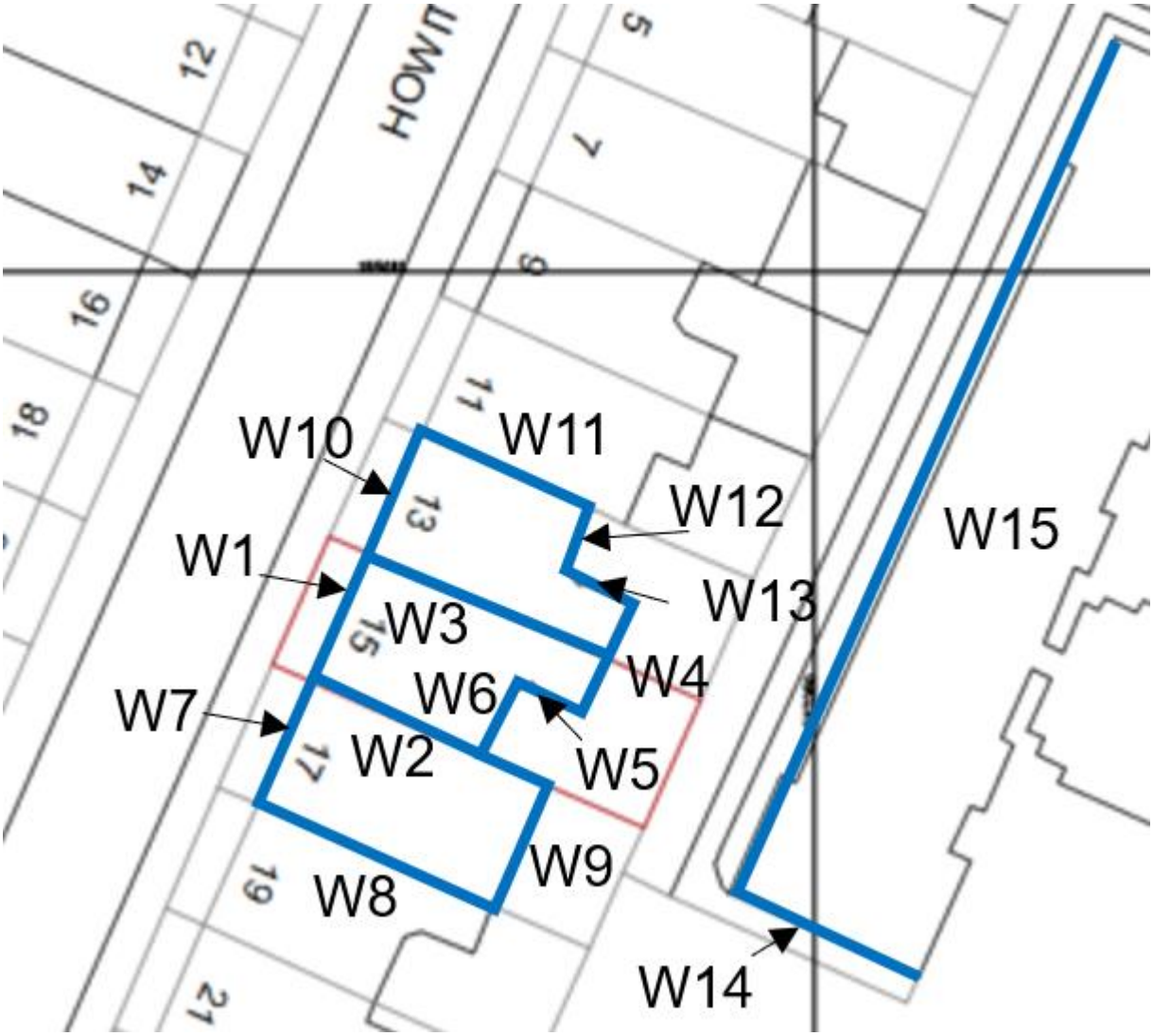

Figure 4.1: *OS Map of 15 Howitt Road, with labelled walls under analysis*

4.3 Ground Model

The ground model utilised for this assessment is based on the site-specific ground investigation undertaken by SASL at the site (February 2023) along with historical site investigations carried out within proximity to the site. It should be noted that Curtins can take no liability for inaccuracies in the factual data from the site specific nor adjacent site investigations.

The ground conditions adopted within the model and analysis are in accordance with the ground conditions inferred from borehole BH1 as a conservative case and comprise:

- Made Ground from ground floor/street level (68m AOD) to a depth of 1.3m below ground level (66.7m AOD).
- London Clay from 1.3m bgl down to 15m bgl (66.7m AOD down to 53m AOD)
- During groundwater monitoring, groundwater was encountered at 7.34m bgl (60.66m AOD).

Ground floor/street level has been taken as 68m AOD from online information, with a proposed basement level of 2.5m bgl (65.5m AOD), based on the plans within **Appendix A**.

The method of Ground Movement Analyses undertaken requires soils stiffness parameters to be used. In accordance with BS8004:2015 section 4.3.1.6 'Soil Stiffness' (5) it is acknowledged that both the drained and undrained stiffness moduli of soils (E', Eu) are highly dependent on the strain level applicable to the engineering problem considered. The change in axial strain will directly influence the resultant stiffness of the soil, and in turn the stiffness of the soil will influence the strain exhibited.

Therefore, in order to define stiffness modulus applicable to the engineering problem considered, it is necessary to assess the magnitude of axial strain which the soil will be subjected to. In accordance with the recommendations made in BS8004:2015 (5) the strain generally applicable to foundations design is in the range of 0.075 to 0.2%.

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

Made Ground

To be conservative, design parameters for the Made Ground will be E' and Eu = 3MPa, and a Poisson's ratio of 0.2 following guidance from Burland, Standing, Jardine (2001). A bulk unit weight of 16kN/m^3 is considered appropriate for design based on guidance from BS8002 (2015) (6).

London Clay

17 No. Hand Shear Vane tests were carried out, ranging from 86kPa to 140 which is the limit of the equipment, between depths of 1.5m and 15m bgl (53m and 66.5m AOD). Based on these results (in **Figure 3.1**) the London Clay has been split into two units:

- Upper London Clay: s_u increasing from 86kPa to 130kPa between 66.5m AOD and 65m AOD.
- Lower London Clay: s_u = 140kPa between 65m AOD and 53m AOD.

These s_u would classify the both the Upper and Lower London Clay as a high strength clay in accordance with BS5930:2015 and therefore a bulk unit weight of 20kN/m^2 is considered appropriate for the London Clay based on guidance from BS 8002 (2015) (6).

Based on the maximum (i.e., most conservative) axial strain of 0.2% prescribed in BS8004:2015, the following correlation has been used to determine the Young's Modulus (E_u) of the London Clay Formation. The relationship (**Equation 1**) has been taken from ICE manual of geotechnical engineering (2012), Volume II, chapter 53.7.2 (Page 792) (7) and matches ratio of Young's Modulus/Undrained shear strength (E_u/s_u) at 0.2% axial strain recommended in Tomlinson (7th, 2001) (8):

$$Eu = 330s_u \text{ (kN/m}^2\text{)} \qquad \textbf{Equation 1}$$

The ratio of end of construction (Undrained) settlement to total settlement (fully drained) (**Equation 2**) was taken as 60% as specified in ICE manual of geotechnical engineering (2012), Volume II, chapter 53.6 (Page 783) (7). Therefore:

$$E' = 200s_u \text{ (kN/m}^2\text{)} \qquad \textbf{Equation 2}$$

For the Upper London Clay, this gives E_u values ranging of 28.38MPa increasing to 46.2MPa, and E' values increasing from 17.2m AOD to 28MPa. For the Lower London Clay, this gives an E_u of 46.2MPa and an E' of 28MPa.

A Poisson's ratio of 0.5 is typical for cohesive soils in the short term (undrained), and 0.3 in the long term (drained), based on guidance from Tomlinson (2001) (8).

Table 4.1: *The ground model and design parameters adopted for this analysis.*

Stratum		Bulk Density (kN/m³)	Level at Top (m AOD)	Short Term (Undrained)		Long Term (Drained	
				Eu (kPa)	Poisson's Ratio	E' (kPa)	Poisson's Ratio
Made Ground		16	68	3000	0.2	3000	0.2
Upper London Clay	Top	20	66.7	28,380	0.5	17,200	0.3
	Base		65	46,200		28,000	
Lower London Clay		20	65	46,200	0.5	28,000	0.3

4.4 Construction and Load Cases

The structural loading at foundation level for use in the ground movement analysis has been calculated by the structural engineer with reference **Appendix D**. This assessment is specific to this load case. If any changes are made to the proposed development, then this assessment should be revised and updated accordingly. It has been assumed for the purposes of this assessment, that the internal loads are spread over a width of 1.00m to represent the underpinned walls.

4.5 Ground Movement inside the proposed basement

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

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

The following assumptions have been made within the PDISP analysis:

- Assumes Boussinesq stress distributions.
- Uniform pressure loading.
- No allowance is made for the stiffness of the structures (foundation slab).

Structural loading at foundation level and calculations for use in the ground movement analysis have been provided by the structural engineer (**Appendix D**).

The vertical boundary of the model was fixed at 15m bgl (53m AOD) At this depth, the effective vertical stress due to foundation unloading decreases to in excess of 20% of the effective overburden as required in EC7.

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

Excavation unloading

Undrained removal of the overburden calculated using assumed unit weights in the ground model (**Table 4.1**), and the thickness of strata, 2.5m of soil removal is expected to locally cause maximum unloading stresses of up to **-44.8Pa** at the base of the basement slab.

Loading, long term drained conditions

The results show that in the long-term following construction of the basement and taking account of the unloading pressures detailed above settlements of up to 4mm and heave of up to 5mm are detailed locally.

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

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

Roads and Utilities

The proposed basement is adjacent to Howitt Road. In order to analyse the effect upon the road due to the construction of the basement, the roads have been modelled as displacement lines within PDISP. The settlement at these points can then be estimated.

From the results in **Figure 4.2**, it can be seen that <5mm of settlement is estimated on Howitt Road.

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

Following receipt of the Groundwise Searches Ltd services survey (Ref: 32926DM-GWS, dated 02/03/23), it can be seen that within a 25m radius of the proposed basement, there are 2 No. low pressure gas mains and a Thames Water combined sewer along Howitt Road, with 1 No. low pressure gas main running to the rear of site. **The effect of the basement construction on services is out of the scope of this report and must be assessed separately.**

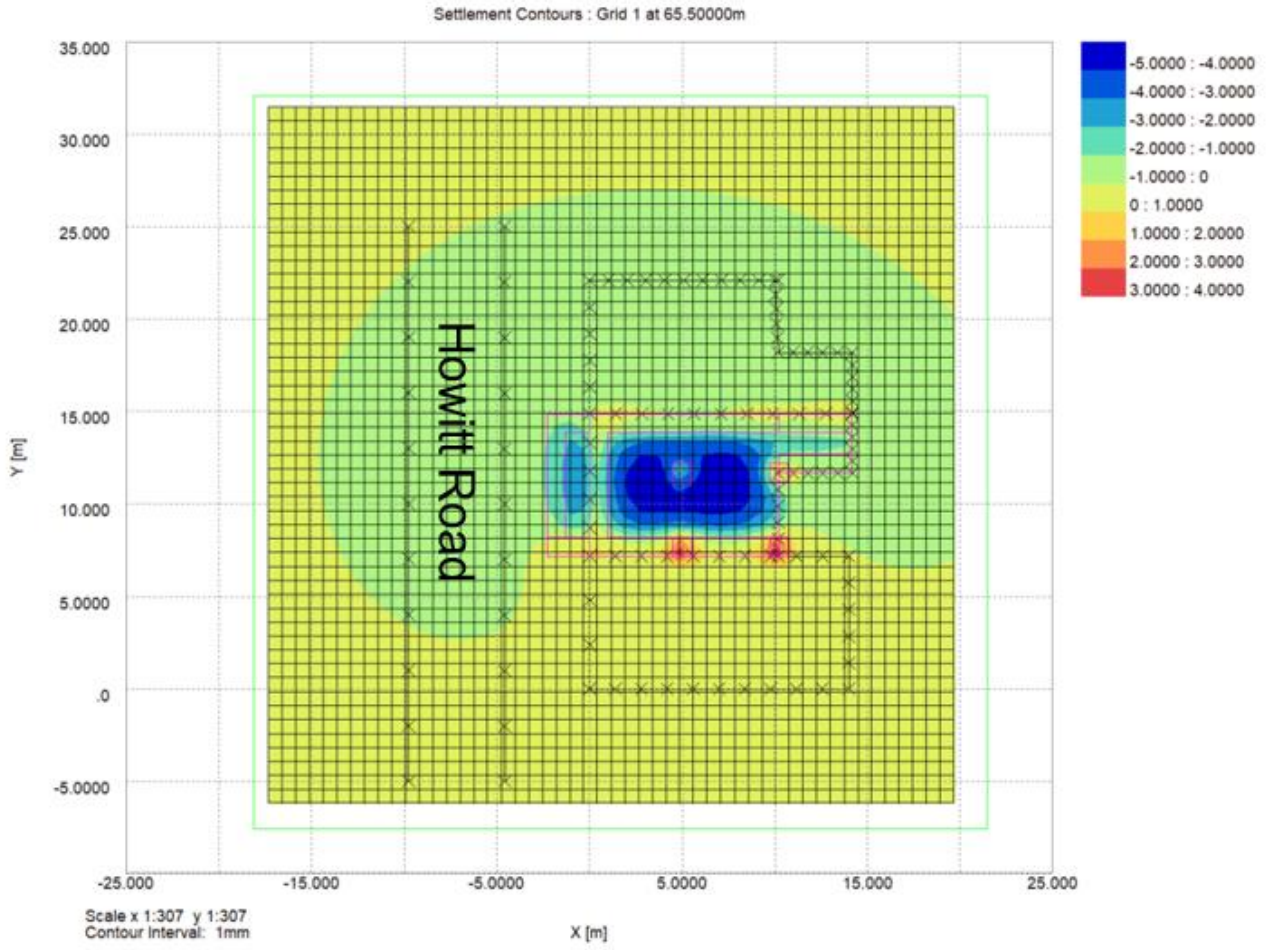

Figure 4.2: *Drained PDisp results displaying the estimated immediate settlement in the proposed basement and Howitt Road*

4.6 Ground Movement outside the proposed basement

Ground movements have been analysed using XDISP by Oasys and a building damage assessment has been undertaken based on the results of the analysis. Contours of vertical and horizontal ground movements are presented in **Appendix F**. As detailed in the proposal drawings in **Appendix A**, the basement is to be constructed to a maximum depth of 2.5m bgl (65.5m AOD).

The basement is to be constructed using traditional underpinning techniques. A basement floor slab is also proposed. It has been assumed for the purposes of this analysis that propping will be included in the temporary and permanent cases over the proposed structure and therefore a low stiffness approach would not apply to this situation. The exception is the sunken rear garden/patio and lightwell which are not propped by the ground floor in the permanent case and therefore a low stiffness approach has been applied to this element of the excavation.

It is important to note that vertical wall movement related to underpinning is not defined by the CIRIA C580 / C760 data. Instead, the short-term settlement will be controlled by movements occurring during the underpin construction process.

On this basis the XDISP analysis considers both 'excavation in front a high stiffness wall in stiff clay' (CIRIA C760 Fig. 6.15(a)) (4) and 'installation of a secant bored pile wall in stiff clay' (CIRIA C760 Fig. 6.8(a) (4)) to simulate the effects from the underpinning on neighbouring structures. The combined cumulative movements resulting from the wall installation (which includes the underpinning) and basement excavation have been used to carry out an assessment of the likely damage to adjacent properties as a conservative approach.

Due to the irregular shape of the proposed basement, the basement has been simplified into one polygon in XDISP to replicate the basement as a whole. In accordance with guidance from Oasys (https://www.oasys-software.com) and to avoid re-entrant corners, no movements have been modelled to those sides of the excavations that form attachments within the centre of the proposed basement but cannot be eliminated.

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

Building Damage Assessment

The building damage assessment has been carried out on the relevant adjacent structures, as detailed in **Figure 4.1**.

Tensile strains induced within the building walls have been evaluated based on the deflection ratios Δ/L and horizontal extension mechanisms estimated from the analyses. The assessment considers the well-established Burland (1977) (9) damage classification method, as presented and summarised in **Figure 4.2** and **4.3** below. This method involves a relatively simple but robust means of assessment,

which is widely adopted and is considered to comprise an industry standard/best practice basis for impact assessments of this typology.

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

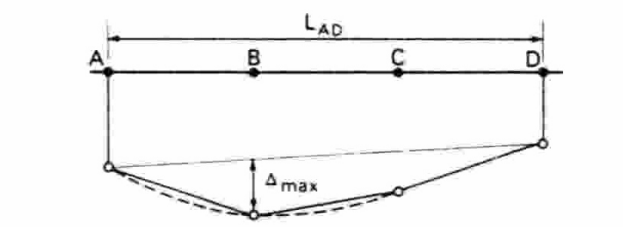

Figure 4.2: *Definition of relative deflection Δ and deflection ratio Δ/L*

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

Figure 4.3: *Building damage classification – relationship between category of damage and limiting strain ε_{lim} (After Burland et al. 1977* **(9)***, Boscardin and Cording 1989* **(10)***, and Burland 2001* **(11)***)*

Results

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

On the basis of the available information the predicted level of damage to the house at 13 and 17 Howitt Road, and Holmefield Court, 12 Belsize Grove, arising from the excavation of a basement at 15 Howitt Road is "very slight" or less, as defined in **Figure 4.3**. The above analyses assumes a high standard of workmanship. The results of the assessment are presented in **Table 4.2** below, with the wall reference relating to the labels in **Figure 4.1**.

Table 4.2: *Evaluated Damage Categories from XDISP*

Wall	Details	Damage Category and Detail	
W1	Front Wall – 15 Howitt Road	0	Negligible
W2	Party Wall – 15/17 Howitt Road	0	Negligible
W3	Party Wall – 15/13 Howitt Road	0	Negligible
W4	Rear Extension Wall – 15/13 Howitt Road	1	Very Slight
W5	Side Extension Wall – 15 Howitt Road	0	Negligible
W6	Rear Wall – 15 Howitt Road	0	Negligible
W7	Front Wall – 17 Howitt Road	1	Very Slight
W8	Side Wall – 17 Howitt Road	0	Negligible
W9	Rear Wall – 17 Howitt Road	0	Negligible
W10	Front Wall – 13 Howitt Road	1	Very Slight
W11	Side Wall – 13 Howitt Road	0	Negligible
W12	Rear Wall – 13 Howitt Road	Displacements less than limit sensitivity	
W13	Side Extension Wall – 13 Howitt Road	Displacements less than limit sensitivity	
W14	Side Wall – Holmefield Court	Displacements less than limit sensitivity	
W15	Rear Wall - Holmefield Court	Displacements less than limit sensitivity	

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

Despite these results it is considered that appropriate consideration to the support and stability of neighbouring walls will be needed in the detailed structural design of the basement. Movement monitoring of the walls is recommended during the construction stage and trigger levels should be set in order to protect the neighbouring properties as a precautionary measure.

5.0 Conclusions

A Ground Movement Assessment has been carried out for 15 Howitt Road, London to assist with pre-planning document submissions to the London Borough of Camden.

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

Groundwater has been recorded below the proposed basement levels at the site at levels of approximately 60.66m AOD, which is approximately 4.84m below the proposed basement level. Groundwater levels should be taken into account with the final design.

A specification for movement monitoring should be incorporated into the final construction scheme for the proposed development to monitor the adjacent properties and establish the extent of any future potential movement to the building. Any temporary and permanent works should be designed to limit eventual movement.

A geotechnical/structural review of the underpinning method should be undertaken to ascertain the requirements for stability of the walls in the long term with consideration of likely earth pressures and any potential live loading behind the walls.

6.0 References

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7.0 Appendices

Appendix A **Proposed Plans**

Appendix B **Existing Plans**

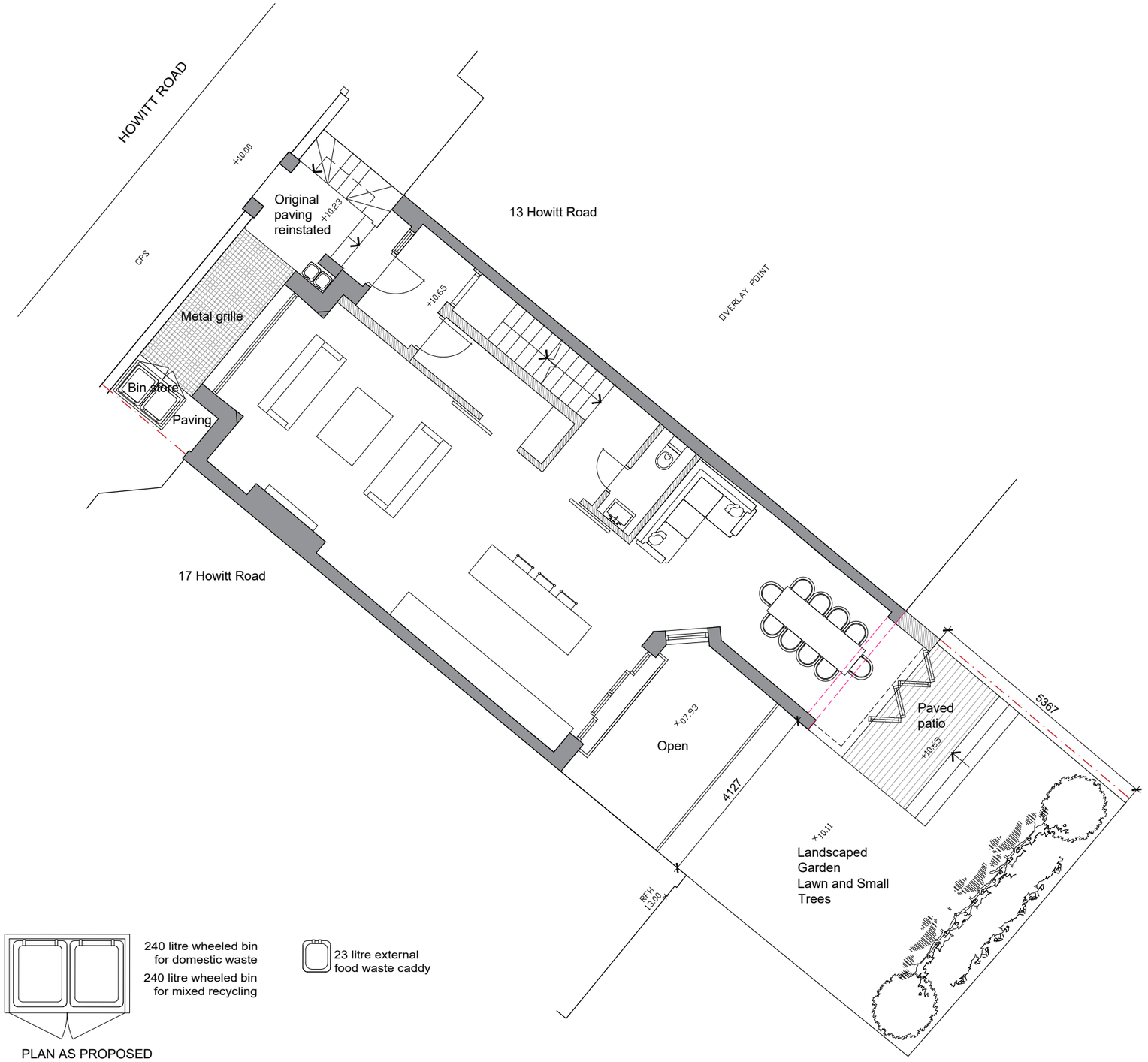
Appendix C **SAS Ltd Factual Report**

Appendix D **Structural Loadings**

Appendix E **Oasys PDisp Input and Output**

Appendix F **Oasys XDisp Input and Output**

Appendix A Proposed Plans

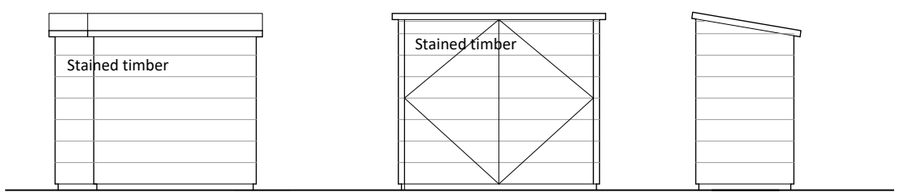


240 litre wheeled bin for domestic waste

240 litre wheeled bin for mixed recycling

23 litre external food waste caddy

PLAN AS PROPOSED



SIDE ELEVATIONS AS PROPOSED

STREET ELEVATION AS PROPOSED

FLAT 1 AND 2 BIN STORE

0m 1m 2m

Scale 1:50

N

0m 5m 10m

Scale 1:100 @ A3

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REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

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PROJECT
Extensions and Alterations

DRAWING TITLE
Proposed Site Plan

DRAWING NO. IHR-226_PL200

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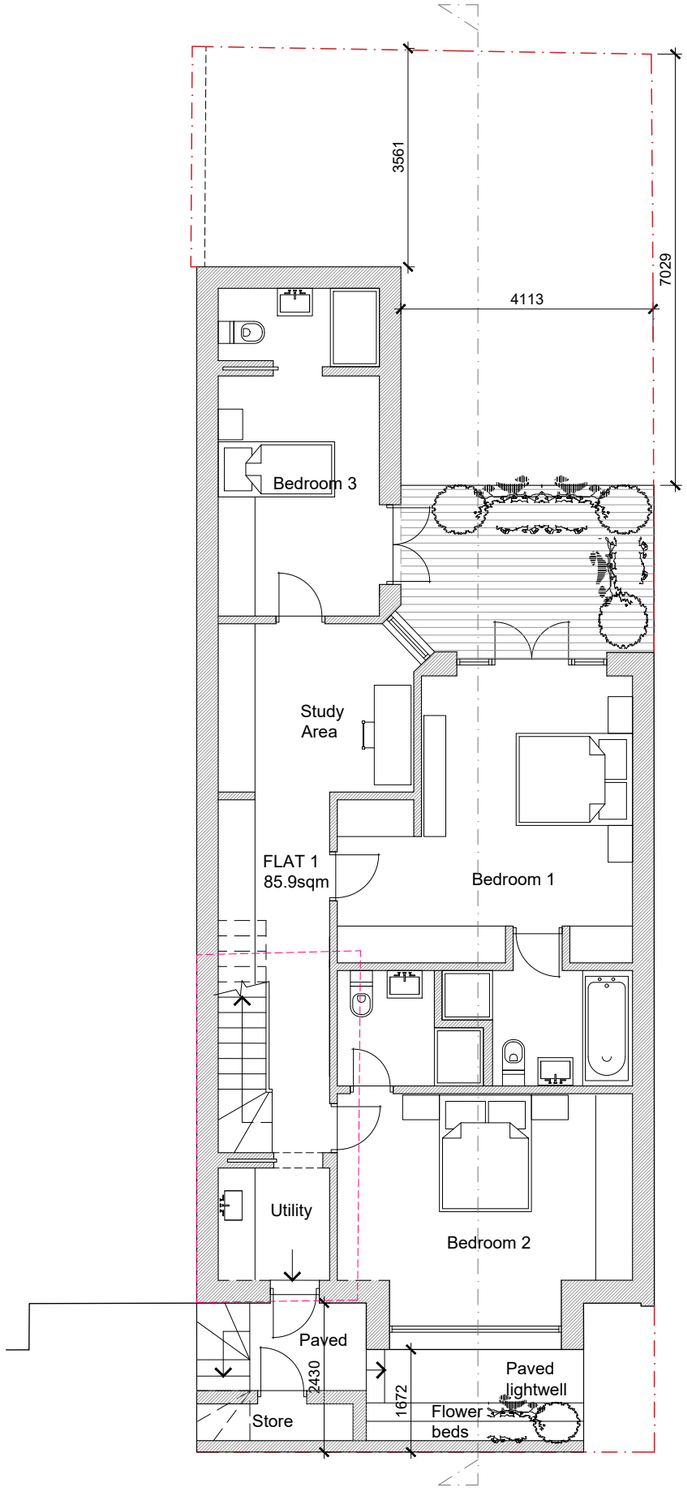
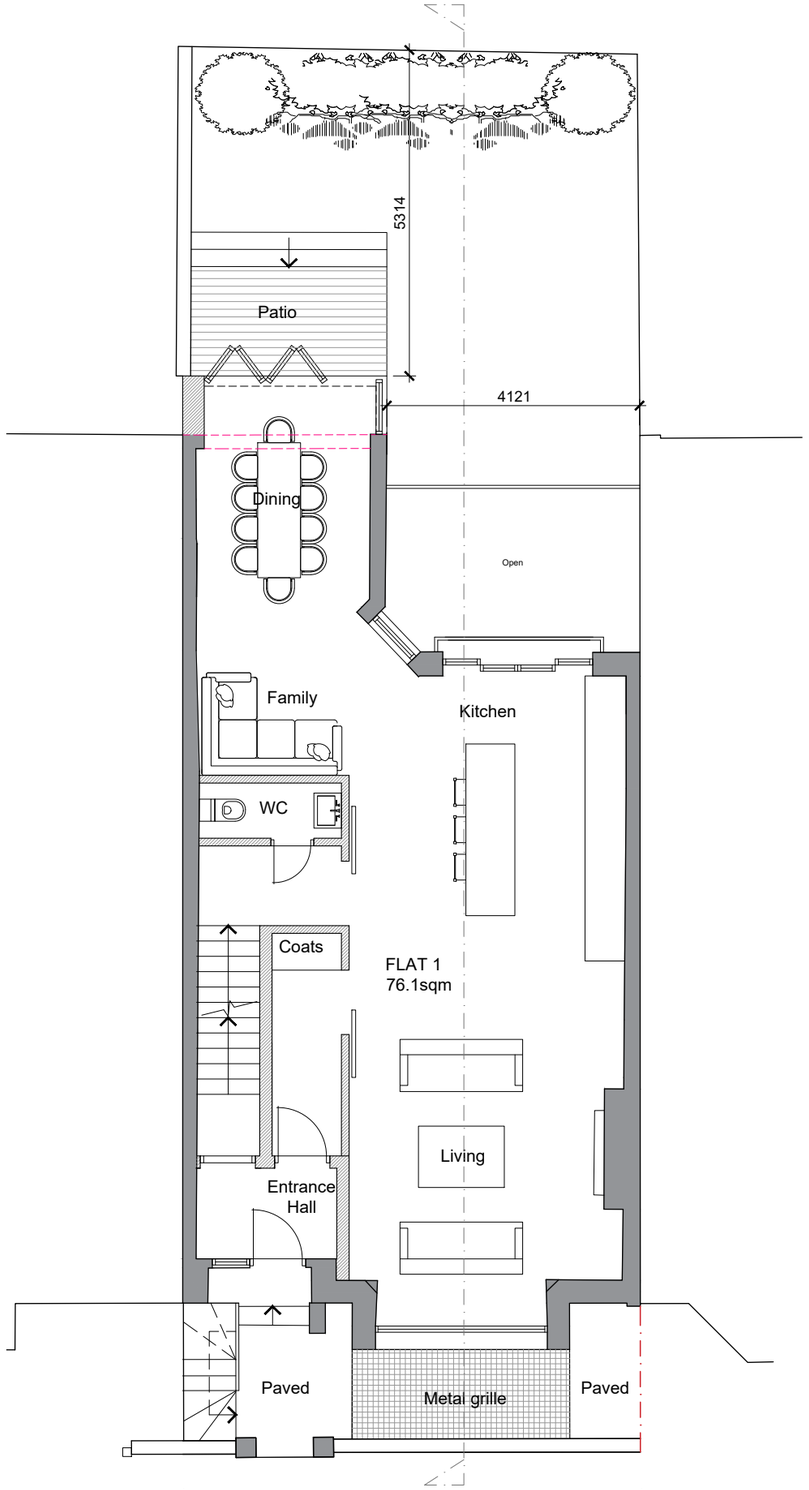


Proposed Basement Plan



Proposed Ground Floor Plan

Scale 1:100 @ A3

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LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

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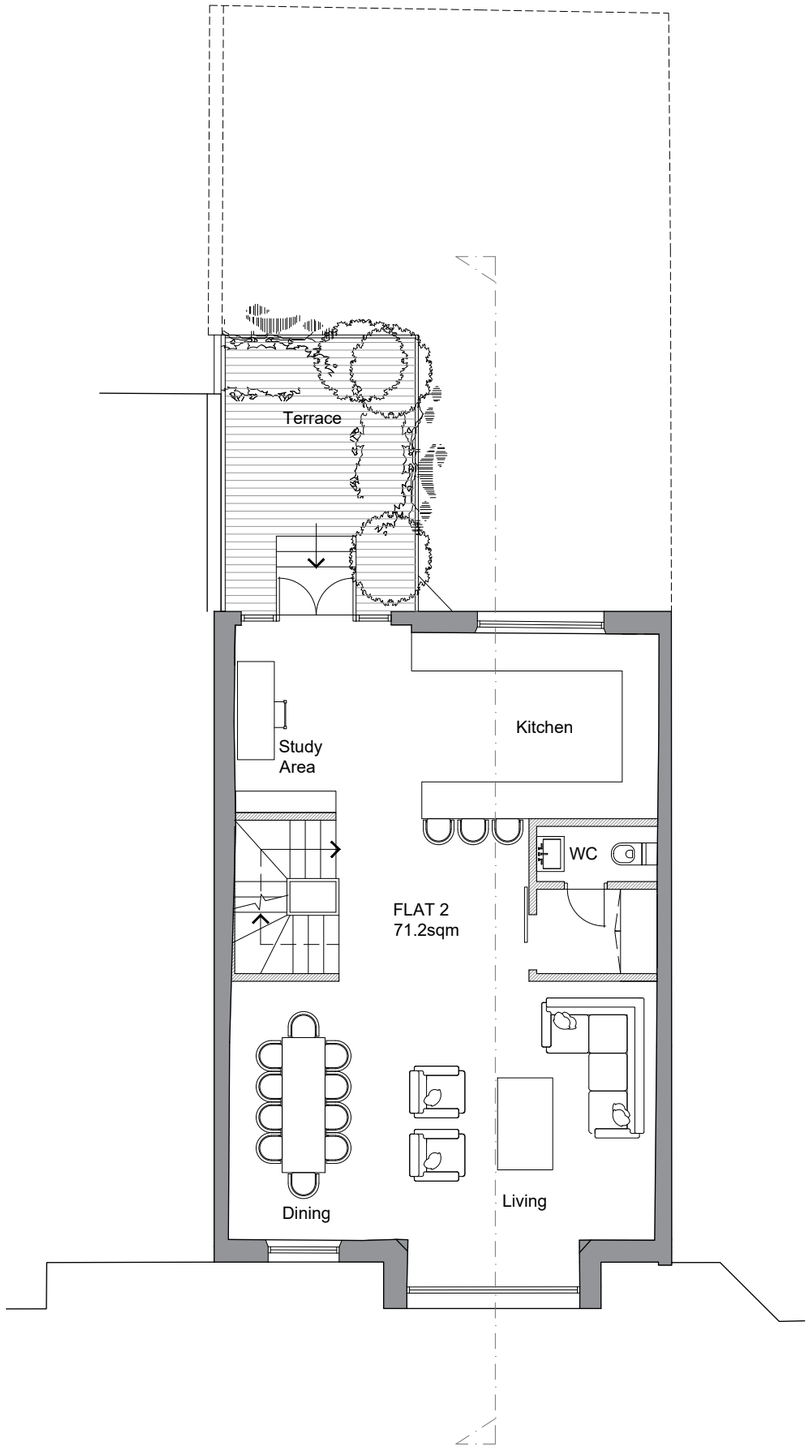
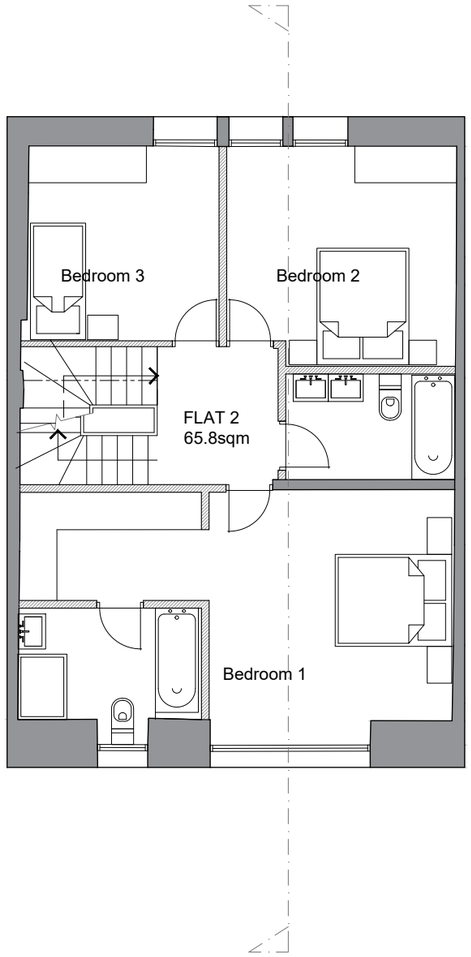


Proposed First Floor Plan



Proposed Second Floor Plan

Scale 1:100 @ A3

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LEGEND

- Existing Construction
- New construction
- Boundary Line
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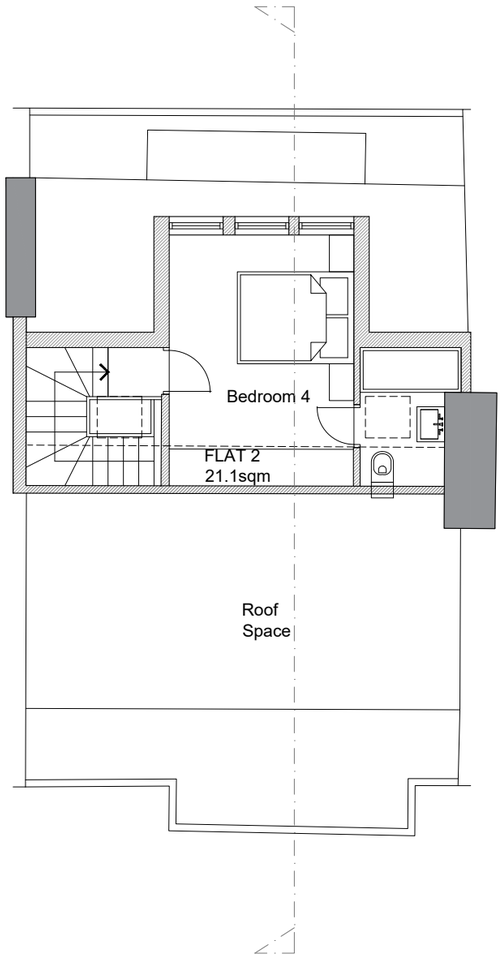
LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

PLANNING



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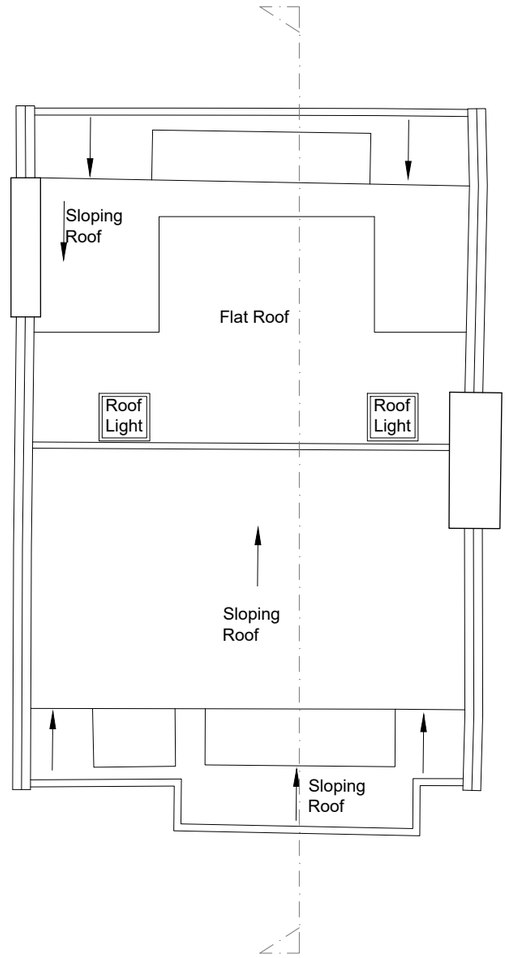

Proposed Roof Plan

Scale 1:100 @ A3

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REV.

SCALE	DATE	DRAWN	CHECKED
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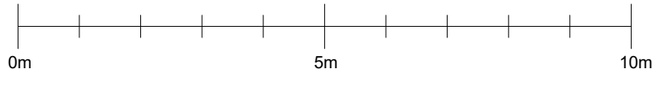
Proposed Street Elevation

Proposed Rear Elevation

MATERIALITY LEGEND

1. Slate roof
2. Painted timber front, lead cheeks
3. Double glazed UPVC window
4. Painted timber fascia
5. Brick to match existing
6. Powder coated aluminium doors
7. Timber slats privacy panel
8. Metal balustrade
9. Timber refuse bin store
10. Balustrade with glass infill
11. Double glazed timber sash windows original design reinstated
12. Double glazed timber sash windows to match above
13. Timber door to matchNo 13



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DRAWING TITLE
Proposed Elevations

DRAWING NO. IHR-226_PL211

REV.

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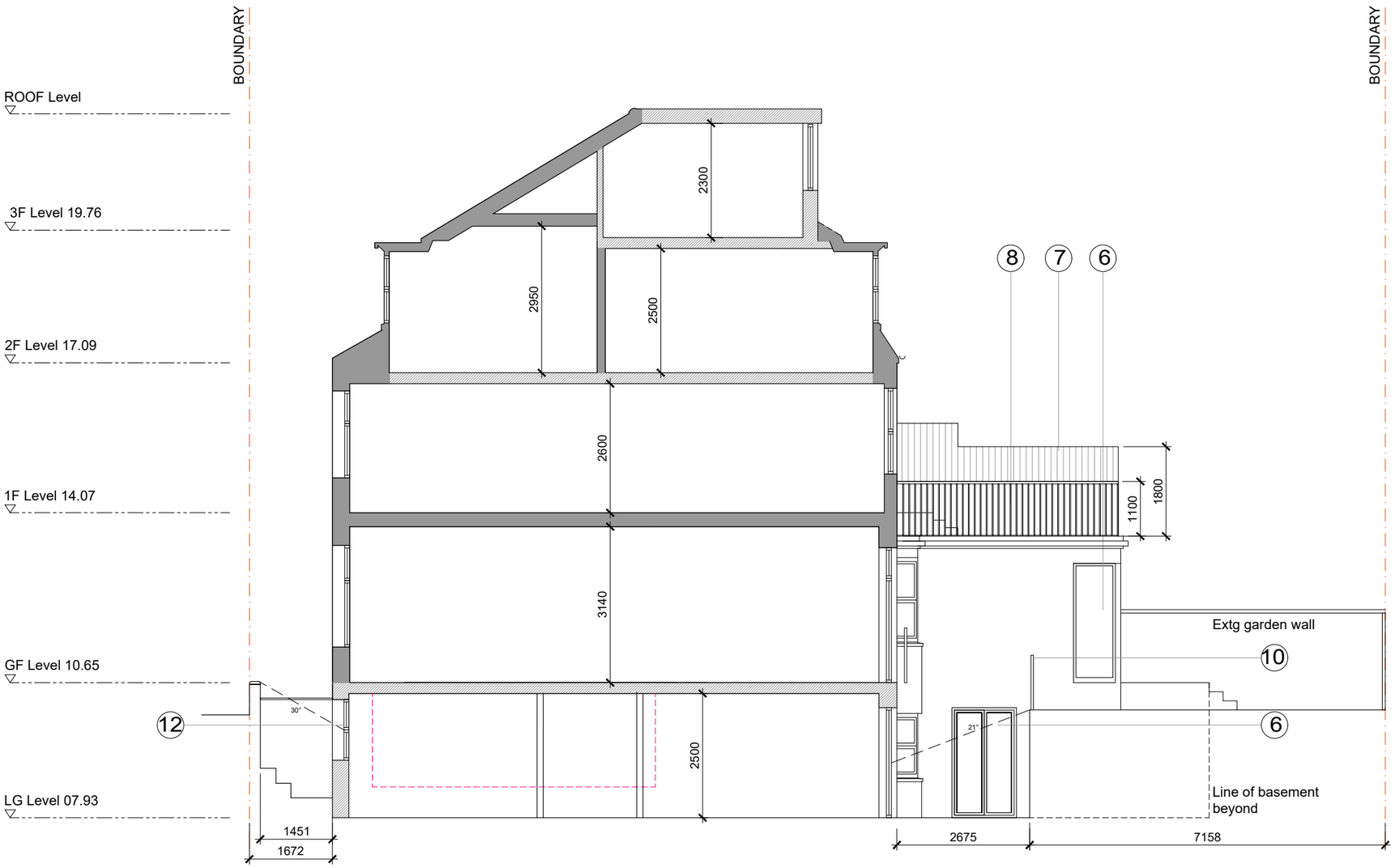
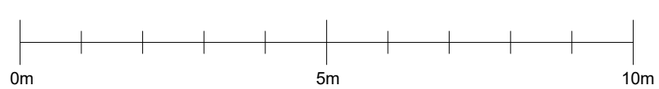


Proposed Section / Side Elevation

MATERIALITY LEGEND

1. Slate roof
2. Painted timber front, lead cheeks
3. Double glazed UPVC window
4. Painted timber fascia
5. Brick to match existing
6. Powder coated aluminium doors
7. Timber slats privacy panel
8. Metal balustrade
9. Timber refuse bin store
10. Balustrade with glass infill
11. Double glazed timber sash windows original design reinstated
12. Double glazed timber sash windows to match above
13. Timber door to matchNo 13



Scale 1:100 @ A3

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REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

LEGEND

- Existing Construction
- New construction
- Boundary Line
- Demolition

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DRAWING TITLE
Proposed Section/Side Elevation

DRAWING NO. IHR-226_PL220

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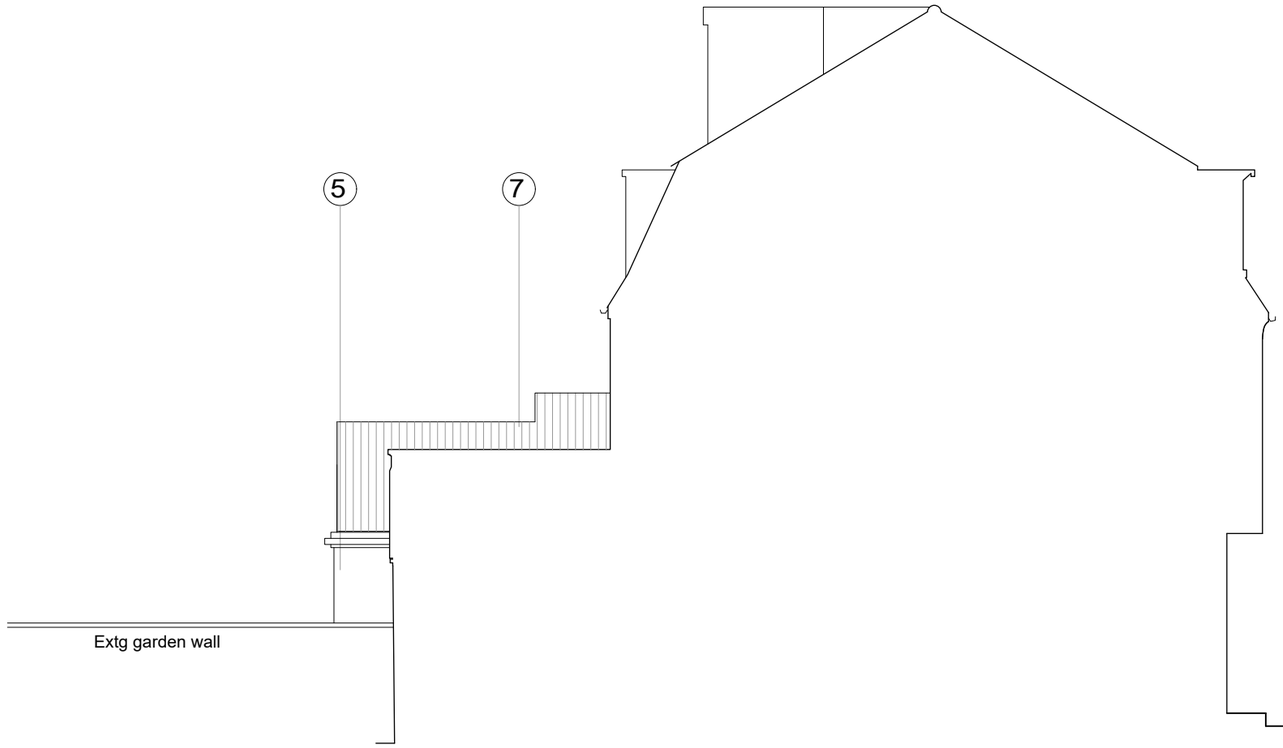

Proposed View from No 13

MATERIALITY LEGEND

1. Slate roof
2. Painted timber front, lead cheeks
3. Double glazed UPVC window
4. Painted timber fascia
5. Brick to match existing
6. Powder coated aluminium doors
7. Timber slats privacy panel
8. Metal balustrade
9. Timber refuse bin store
10. Balustrade with glass infill
11. Double glazed timber sash windows original design reinstated
12. Double glazed timber sash windows to match above
13. Timber door to matchNo 13

0m 5m 10m

Scale 1:100 @ A3

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REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

LEGEND

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- New construction
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DRAWING TITLE
Proposed View From No 13

DRAWING NO. IHR-226_PL221

REV.

SCALE	DATE	DRAWN	CHECKED
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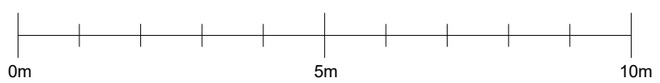
Appendix B Existing Plans

Existing Street Elevation

Existing Rear Elevation



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DRAWING TITLE
Existing Elevations

DRAWING NO. IHR-226_PL111

REV.

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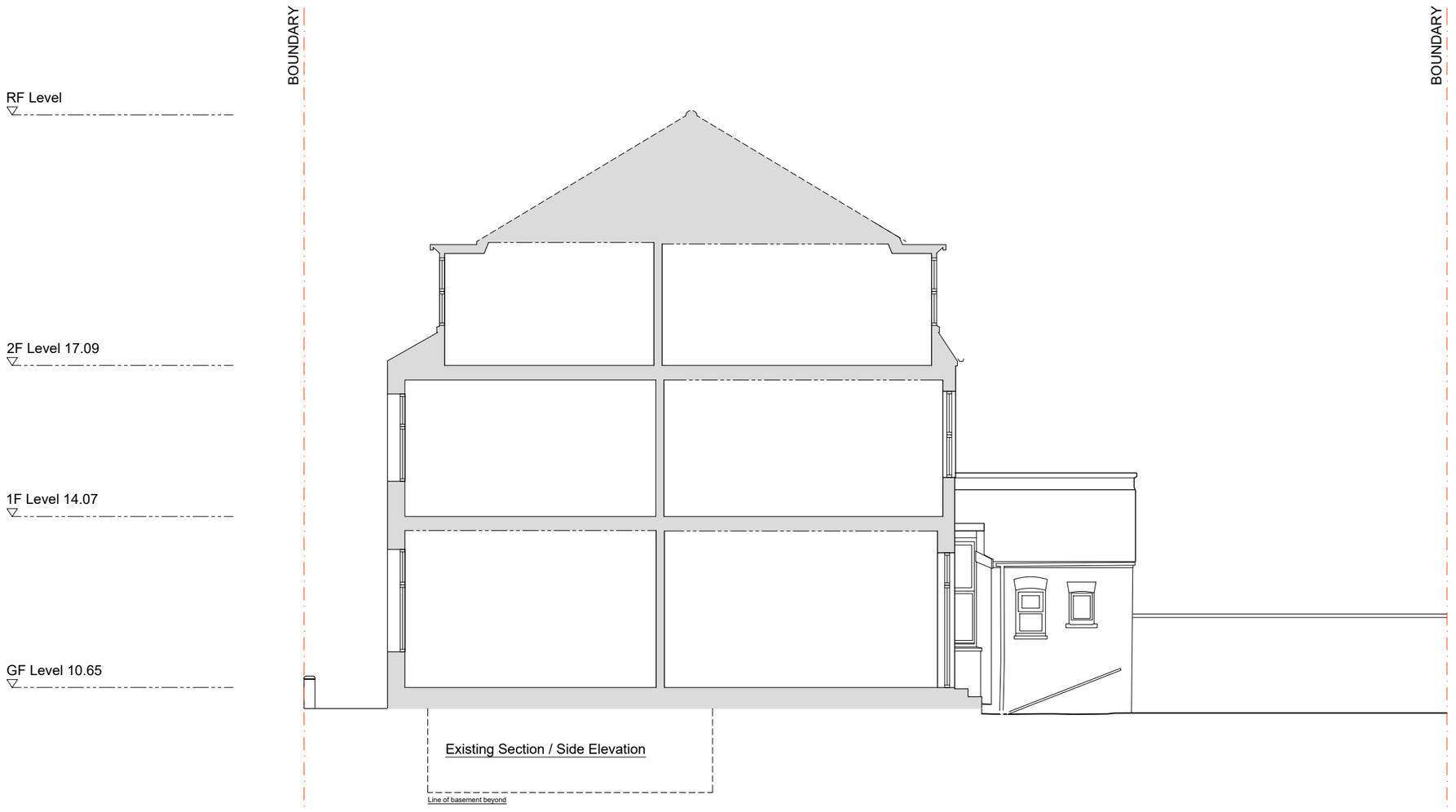

0m 5m 10m

Scale 1:100 @ A3

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REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

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PROJECT
Extensions and Alterations

DRAWING TITLE
Existing Section / Side Elevation

DRAWING NO. IHR-226_PL120

REV.

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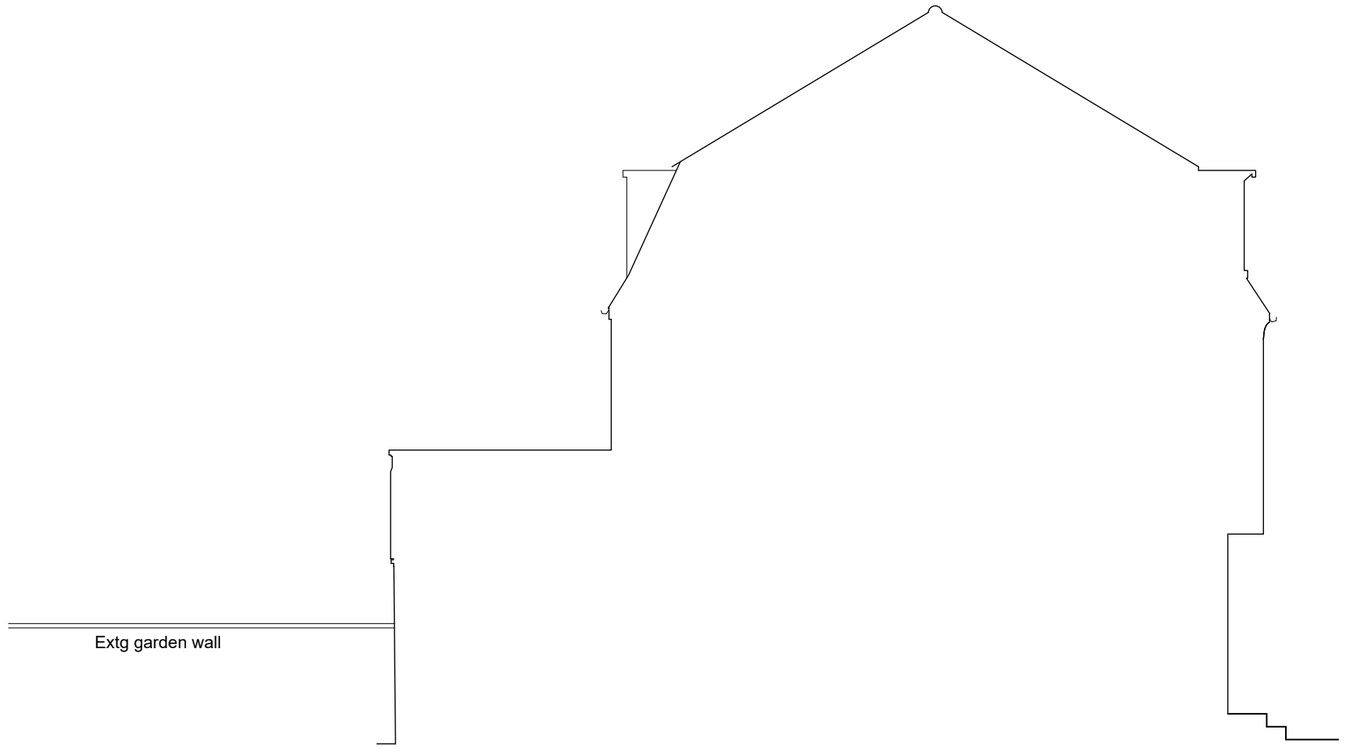

Existing View From No 13

Scale 1:100 @ A3

NOTE

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REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

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PROJECT
Extensions and Alterations

DRAWING TITLE
Existing View From No 13

DRAWING NO.
IHR-226_PL121

REV.

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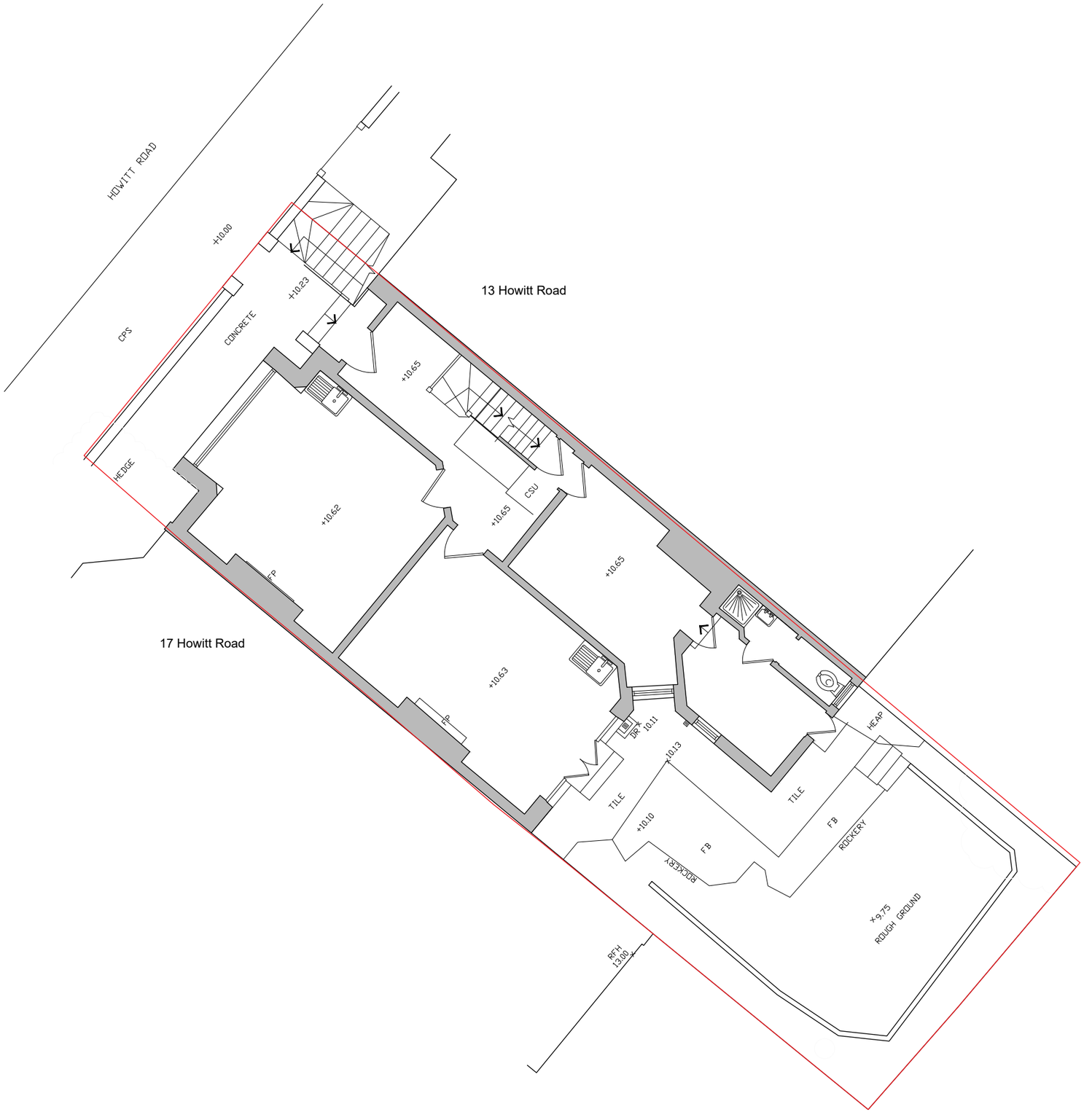

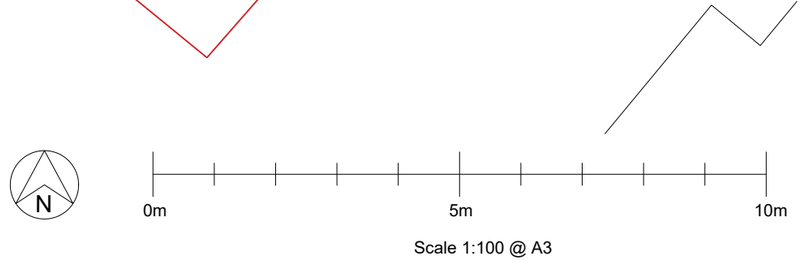

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REV	DATE.	DESCRIPTION.	CHK.
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DRAWING TITLE
Existing Site Plan

DRAWING NO.	REV.
IHR-226_PL011	

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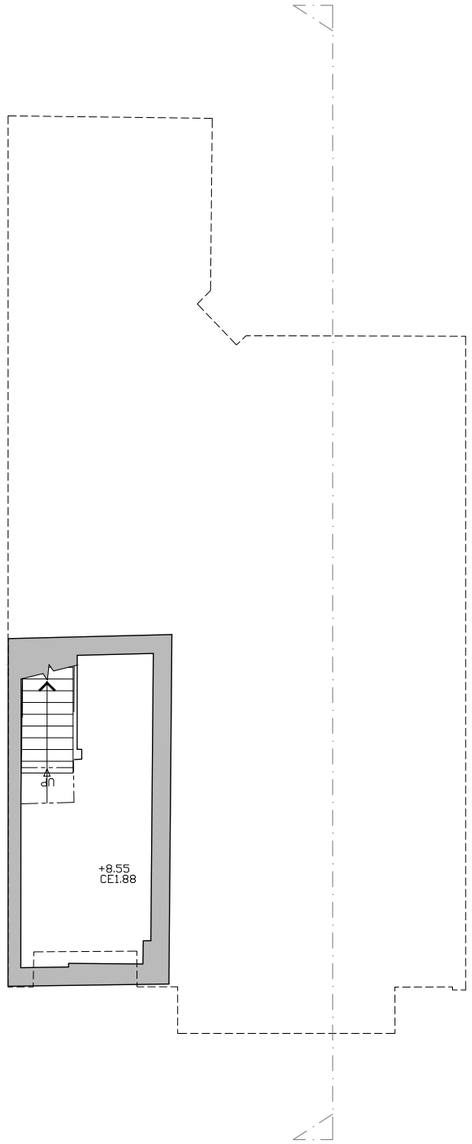

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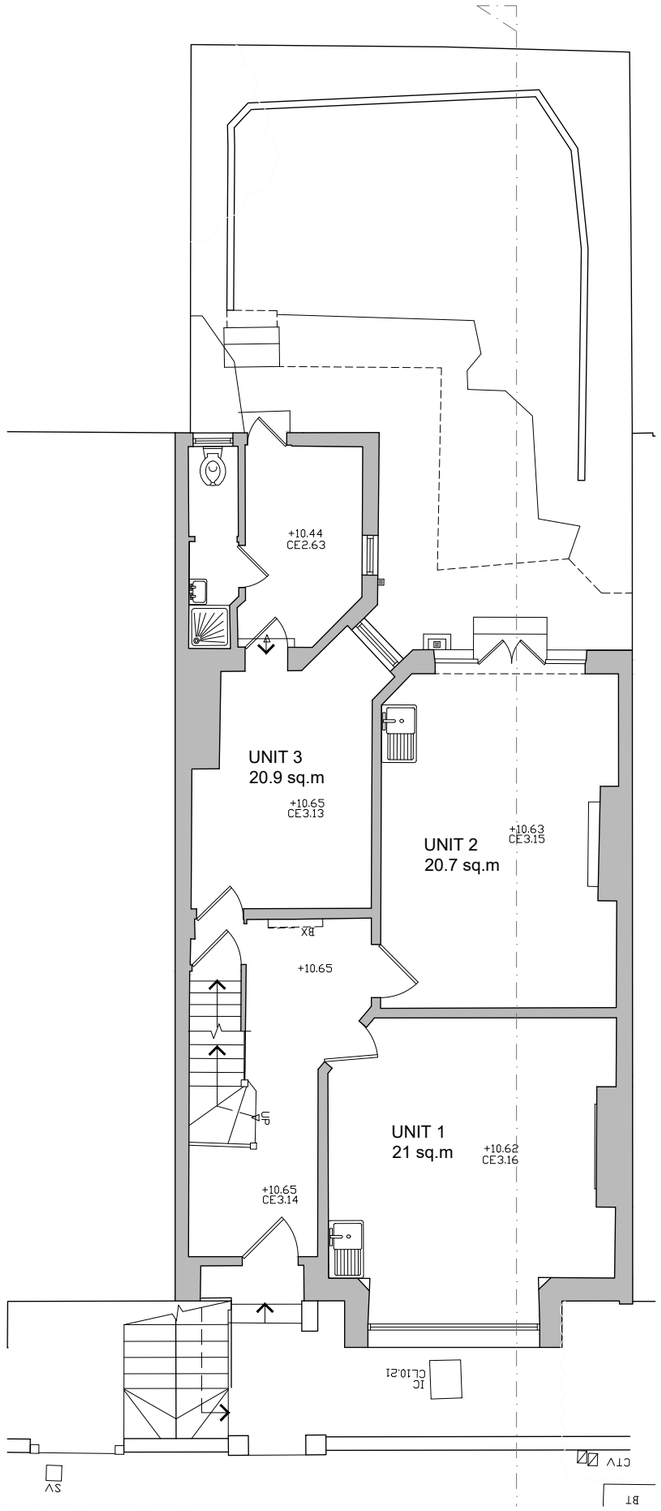

Existing Ground Floor Plan

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REV	DATE.	DESCRIPTION.	CHK.
-	-	-	-

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PROJECT
Extensions and Alterations

DRAWING TITLE
Existing Plans

DRAWING NO. IHR-226_PL101

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REV	DATE.	DESCRIPTION.	CHK.
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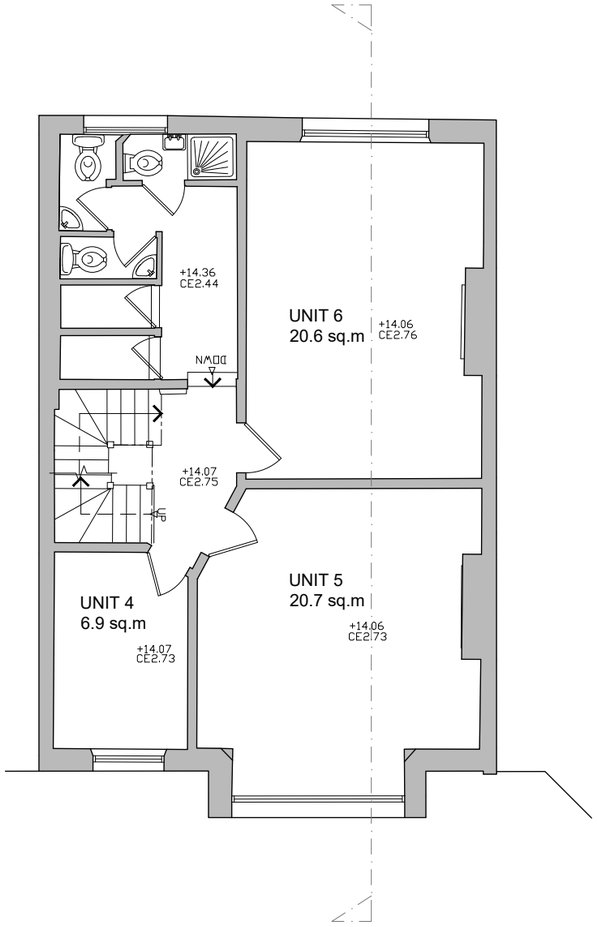

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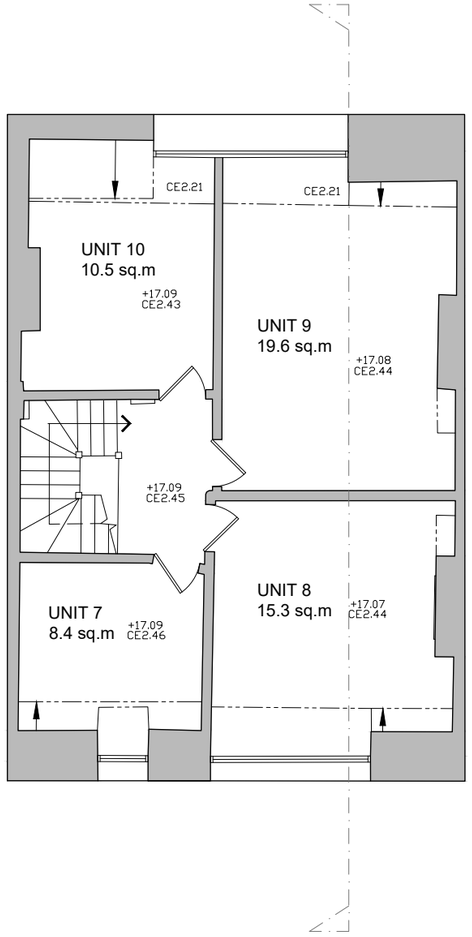

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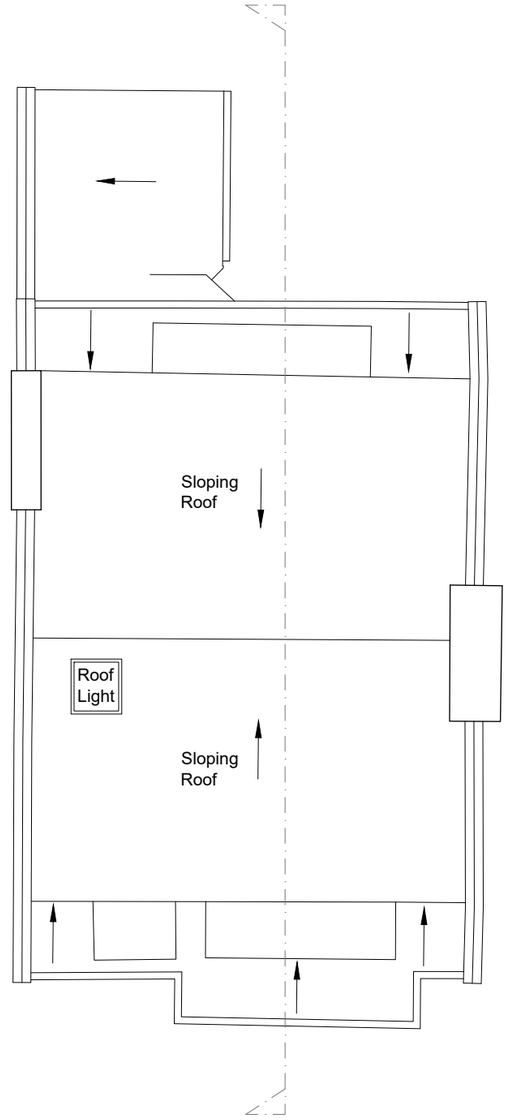

Existing Roof Plan

Scale 1:100 @ A3

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DRAWING TITLE
Existing Plans

DRAWING NO. IHR-226_PL102

REV.

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Appendix C SAS Ltd Factual Report

Factual Report on a
GEOTECHNICAL GROUND INVESTIGATION

Ref: 23/36419-1 | Date: March 2023

15 Howitt Road
Belsize Park
London
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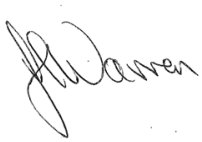
Prepared for:
Anese Investments Limited

DOCUMENT CONTROL

Project	15 Howitt Road, Belsize Park, London, NW3 4LX
Document Type	Factual Report on a Ground Investigation
Document Reference	SAS 23/36419-1
Document Status	Final
Revision	0
Changes	-
Date	March 2023
Document Version	V1.0 – 3/21

Checked	Author
	
Jim Warren MRSC Managing Director	Thomas Murray BSc (Hons) MSc FGS Geotechnical Engineer

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CONTENTS

1.0 Introduction

1.1 Outline and Limitations of Report

At the request of Anese Investments Limited, a ground investigation was carried out in connection with a proposed basement development at the above site. A Geotechnical Desk Study is presented under a separate cover in Site Analytical Services Limited Report Reference 23/36419, dated March 2023.

The information was required for the design and construction of foundations and infrastructure for the proposed development at the existing site which includes the construction of a basement level.

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

2.0 Site Details

(National Grid Reference: TQ 273 849)

2.1 Site Location

The site is located on the eastern side of Howitt Road and is approximately 136m to the south-west of Belsize Park Underground Station. The site is situated in the Belsize Park area of London at approximate postcode NW3 4LX. It is immediately bordered to north and south by residential properties and has more residential dwellings opposite to the west on the other side of Howitt Road.

The site is rectangular in shape covers an approximate area of 0.02 Hectares with the general area being under the authority of the London Borough of Camden.

2.2 Published Geology

The Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by the London Clay Formation at depth.

3.0 Scope of Work

3.1 Site Works

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

- The drilling of one Continuous Flight Auger borehole to a depth of 15.00m below ground level (Borehole 1).
- The installation of a groundwater monitoring standpipe to an approximate depth of 7.0m in Borehole 1, together with two return monitoring visits.
- The excavation by hand of two trial pits, to 1.50m maximum depth to expose existing foundations on-site (Trial Pits 1 and 2).
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the exploratory holes.
- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes.

3.2 Ground Conditions

The approximate locations of the exploratory holes are illustrated on the site sketch plan, Figure 1 below.

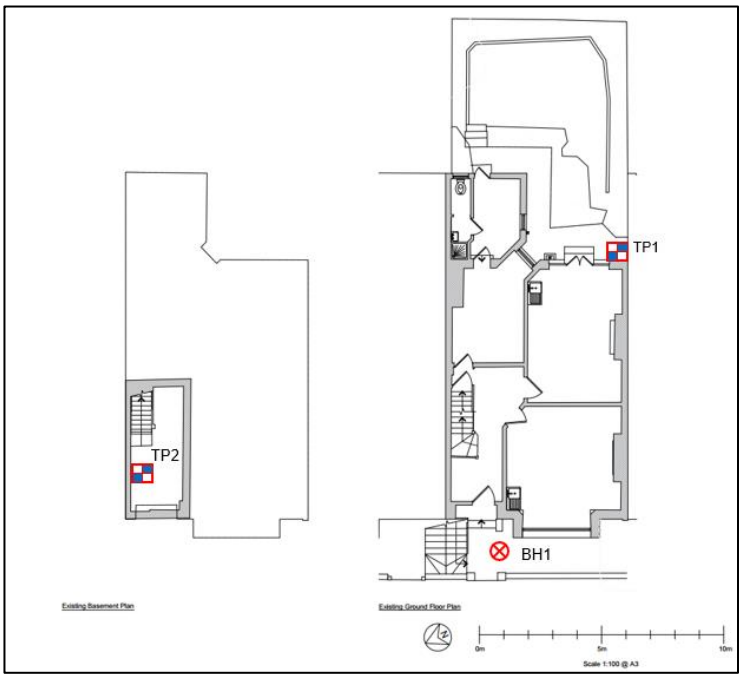

Figure 1. Site Sketch Plan

The borehole and trial pits revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 1.30m in thickness resting on the London Clay Formation at depth.

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

Strata	Depth to top of strata (mbgl)	Depth to base of strata (mbgl)	Description
Made Ground	0.00	0.50 to 1.30	Concrete slab over sandy clay with brick fragments
London Clay Formation	0.50 to 1.30	15.00	Silty sandy CLAY containing partings of silty fine sand and gypsum crystals.

Summary of Ground Conditions in Exploratory Holes

3.3 Groundwater

Groundwater was encountered in the borehole during site works and remained dry throughout.

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

Water was encountered at a depth of 7.34m below ground level in Borehole 1 after a period of approximately three weeks. The water encountered was purely surface water trapped in the cap at the base of the standpipe and not true groundwater.

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

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (February 2023) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

3.1 In-Situ Tests

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

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

3.2 Classification Tests

Atterberg Limit tests were conducted on two selected samples taken from the cohesive portion of the natural soils in Borehole 1 and showed the samples tested to fall into Classes CI and CH according to the British Soil Classification System.

These are fine grained silty clay soils of medium to high plasticity and as such generally have a low permeability and an intermediate to high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values of between 27% and 46%, with one sample being above the 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential.

The results of the tests are presented on Table 1, contained in Appendix B.

3.3 Chemical Attack on Buried Concrete

Using the results contained in Appendix B, the following table provides the highest values encountered for the BRE SD1 Suite D specification and the equivalent DS and ACEC classes, based on a static groundwater:

Strata	pH	2:1 Water Soluble SO_4 (g/l)	2:1 Water Soluble Chloride (mg/l)	2:1 Water Soluble Nitrate (mg/l)	Total Sulphate (%)	Magnesium (mg/kg)	DS Class	ACEC Class
London Clay Formation	7.7-7.8	2.9	140	<2.0	1.47	840	DS-3	AC-2s

Worst case DS and ACEC classes based on the BRE SD1 Suite D results

4.0 List of Appendices

Appendix A – Borehole and Trial Pit Logs

Appendix B – Laboratory Test & Groundwater Monitoring Data

5.0 References

1. British Standards Institution, 2015. Code of practice for foundations, BS 8004, BSI, London.

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

3. British Standards Institution, 1994. Code of practice for earth retaining structures, BS8002, BSI, London

4. British Standards Institution, Code of Practice for Site Investigations, BS5930: 2015, BSI, London

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

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

APPENDIX A

Borehole & Trial Pit Logs