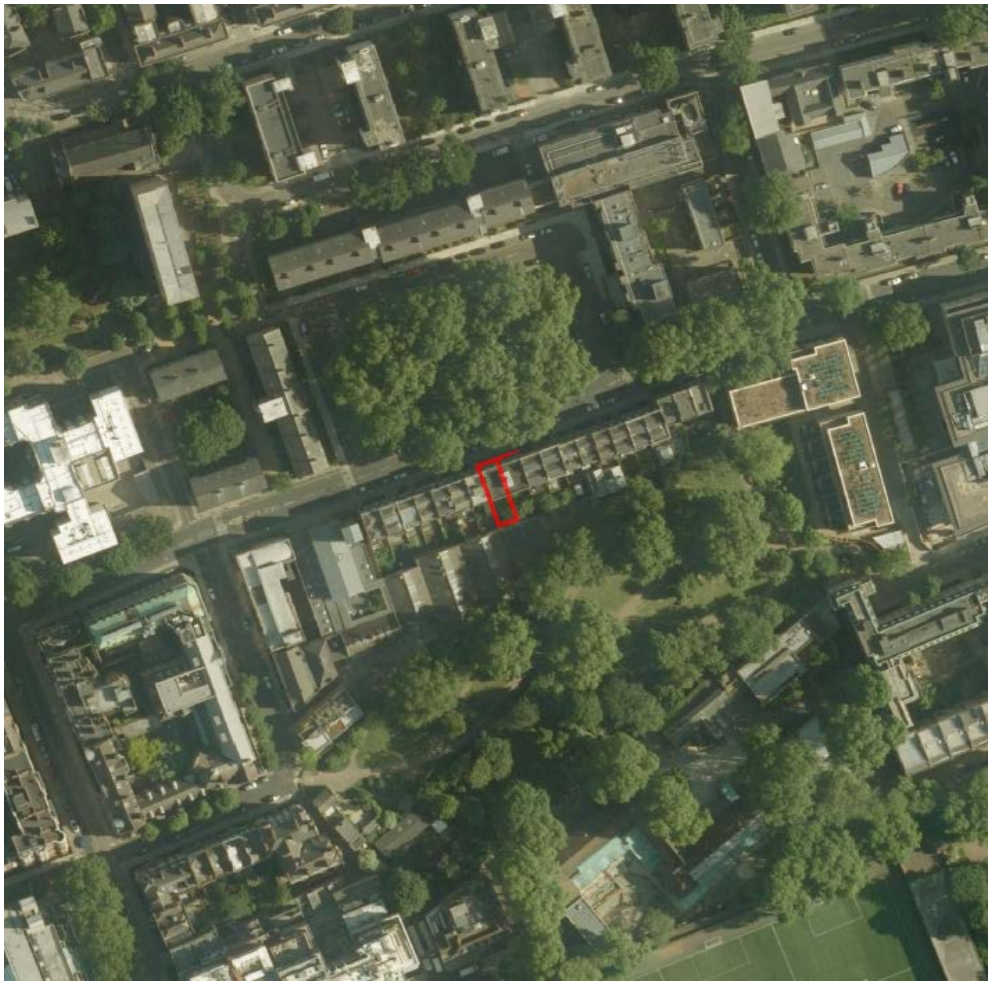
Ground and Project CONSULTANTS LTD

Report No. 40278

9/10 REGENT SQUARE

Basement Impact Assessment

July 2018



Mr Nick Bond
Flat 1, 9/10 Regent Square, London, WC1H 8HZ

This report has been prepared by Ground and Project Consultants Ltd, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client, and is provided by Ground and Project Consultants Ltd solely for the use of its client, Mr Nick Bond.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to Ground and Project Consultants Ltd at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. Unless otherwise agreed in writing by Ground and Project Consultants Ltd, no other party may use, make use of or rely on the contents of the report. No liability is accepted by Ground and Project Consultants Ltd for any use of this report, other than for the purposes for which it was originally prepared and provided.

Contents

Figures

Appendices

- Groundsure Enviro Insight, Report No. GS-5191320

1 Introduction

Ground and Project Consultants Ltd (GPCL) have been instructed by Mr Nick Bond to undertake a Basement Impact Assessment (BIA) at a site at Flat 1, 9/10 Regent Square, London, WC1H 8HZ. The proposals for the site comprise an extension to the existing lower ground and ground floor flat.

2 Scope and Objective

Ground and Project Consultant Ltd have been appointed to carry out a BIA to assess impacts of the proposed development following the methodology set out in the London Borough of Camden guidance, CPG4, November 2017. The scope of this report and approach are as follows:

- Review of freely available data, including:
  - Google Earth;
  - BGS maps and borehole data;
  - ARUP Camden Geological, Hydrogeological and Hydrological Study;
  - Historical maps from old-maps.co.uk;
  - UK Government interactive map websites including flood risk map, radon risk map and environmental data from MAGIC map;
  - Bomb Sight map.
- A review of the data supplied by the client, including:
  - The pre-application feasibility study including photos and plans;
  - Site survey and floor plans;
  - Bomb risk map.
- Obtain and review a Groundsure Enviro report.
- Screening of the information to identify any risks and subsequent scoping to identify the potential impacts.
- A review of the Ground & Water ground investigation data.
- Assessment of the data and development of a ground model including suggested geotechnical properties.
- An engineering interpretation and impact assessment of the land stability.

No assessment of contaminated land or ground movements is included in this report.

The report assumes the full involvement of a suitably qualified and experienced Structural Engineer in the design and supervision of the basement construction.

This report and the work to support it, have been carried out by Jon Smithson who is a Director of Ground and Project Consultants Ltd and is a Chartered Geologist (CGeol) with over 30 years' experience.

3 Desk Study Information

i. Site Location

The site is located at Flat 1, 9/10 Regent Square, Camden, London, WC1H 8HZ. The National Grid Reference for the site is 530415, 182517.

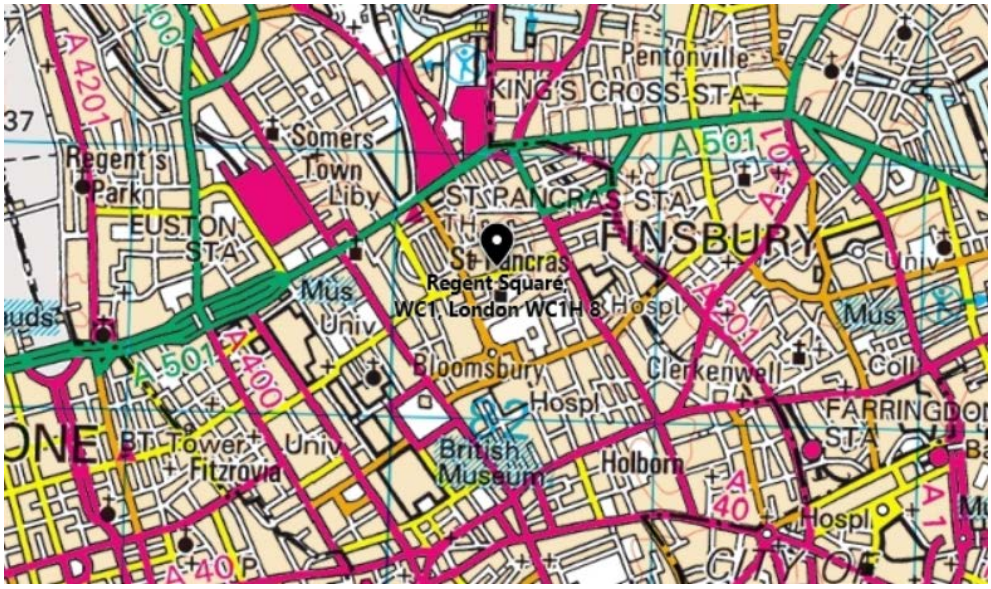


Figure 1: Site Location Plan (Ordnance Survey)

ii. Proposals

The proposals for the site comprise a two-storey extension to the flat which occupies the southwest half of the ground floor and lower ground floor (basement) of 9/10 Regent Square. The proposed extension is to the rear of the property into an existing courtyard at the proposed level and with part of the extension being proposed into a raised garden.

iii. Site Description and Topography

The site is currently a Grade-II listed five-storey brick-built terraced house which is divided into flats. The lower ground level, front external walkway and rear courtyard space is level with the landscaped portion of the site being raised above the lower ground level and steps (three terraces) up to the brick-built site boundary wall to the southeast. The total garden area has been measured to be approximately 63m^2, with a landscaped area of 18.5m^2.

The Ordnance Survey map indicates the property is at around 25m AOD, sloping gently to the south towards the River Thames and is indicated to be less than 7 degrees on the ARUP slope angle map (Ref 2). An extract is provided as Figure 2 below.

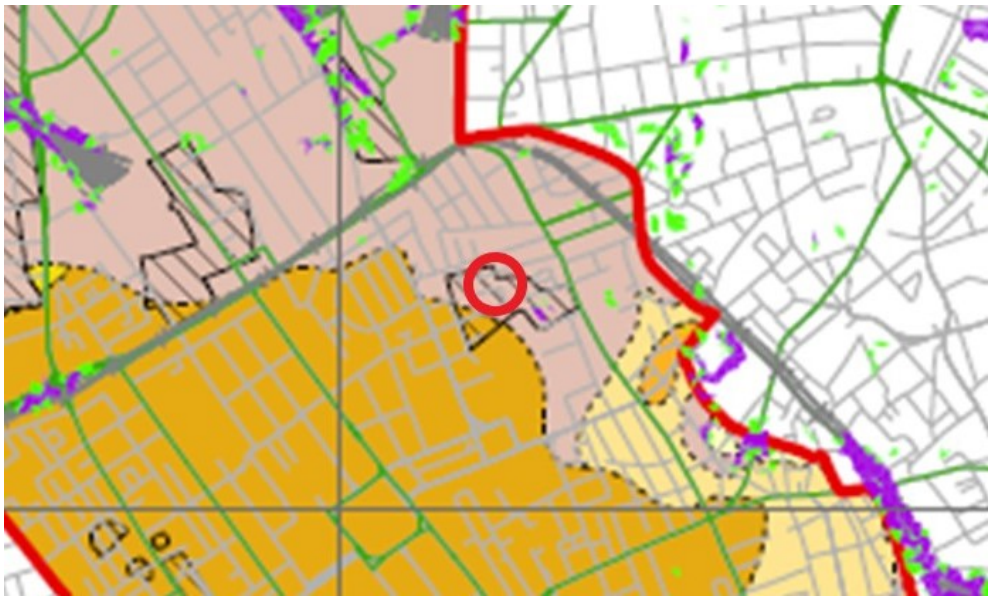


Figure 2: Slope Angle Map (ARUP Camden Geological, Hydrogeological and Hydrogeological Study)

Regent Square marks the northwestern boundary with Regent Square Gardens beyond and attached terraced houses to the northeast and southwest. It is noted that the terraces on the street are made of a darker brick to that of 9/10 Regent Square. The property to the southwest (11 Regent Square) has an extension which extends along the southwest boundary of half of the garden. It is understood from the Pre-Application Feasibility Study, dated 8th March 2018, by Atelier Brown that the site marking the southeastern boundary is currently under construction and has planning permission for ten residential units.

There are no underground railway lines beneath the site.

iv. Site History

Regent Square with terraced houses and garden is present on the first available map in 1851. By the 1949-1951 edition Ordnance Survey Plan a gap is shown in the middle of the terraced houses where the site lies and by 1953 No. 9 and No. 10 Regent Square is shown as being rebuilt as one building instead of two. The terraces on the other sides of Regent Square were redeveloped into apartment buildings between 1953 and 1962.

By 1911-1922 a works was present directly south of the current site boundary which was labelled as Milk Bottling Depot on the 1953 edition map.

Bloomsbury Cemetery is shown on the first edition map, 50m to the south of the site which was shown as disused by 1896 with the site being labelled St George's Gardens.

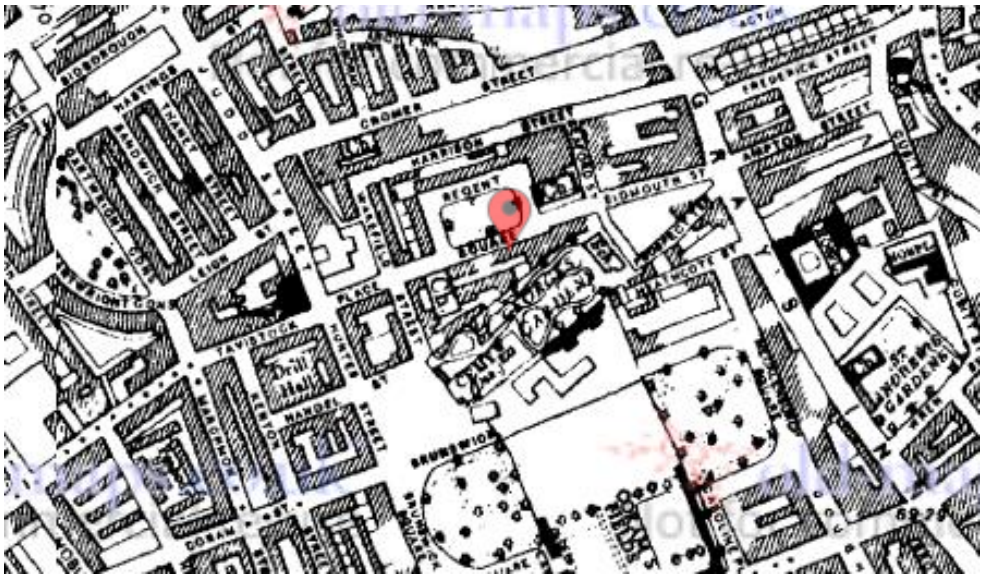


Figure 3: 1949-1951 OS Plan (old-maps.co.uk)

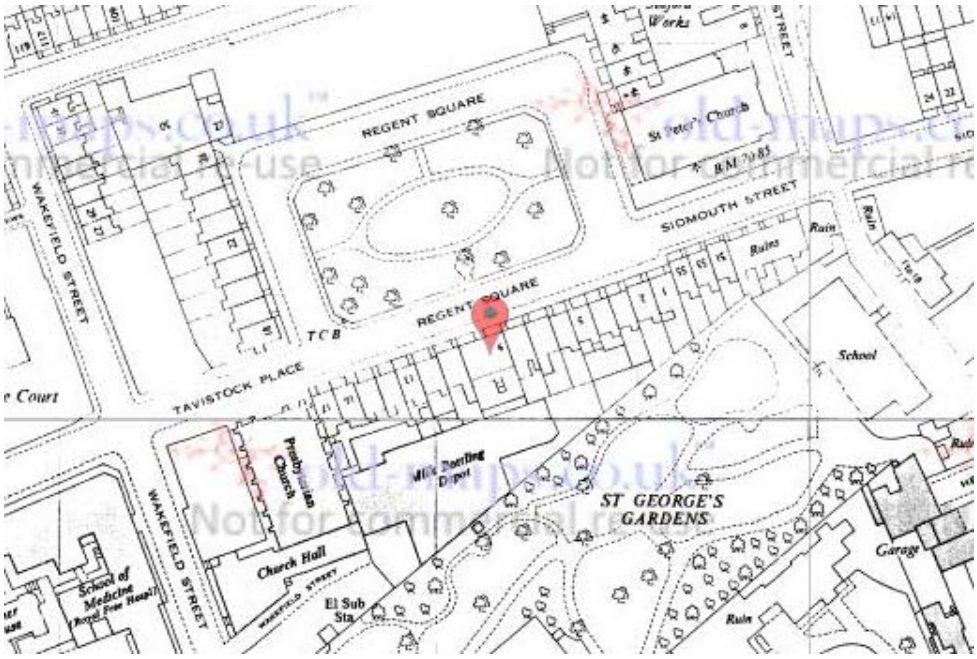


Figure 4:1953 OS Plan (old-maps.co.uk)

v. UXO risk

It is understood that the buildings occupying the site suffered bomb damage during WW2 and were subsequently rebuilt in a similar style to that of the original terraces. No bomb records are indicated on the Bomb Sight interactive map, however, a bomb damage map provided by the client highlights that the site was damaged beyond repair, with the north and east side of the square being designated as seriously damaged (doubtful if repairable) to total destruction. Due to the site being redeveloped the risk of UXO is likely to be low. Th extract of the map below shows the site as purple, meaning “damaged beyond repair”.

Figure 5: Bomb Damage Map

vi. Geology

The available geological maps and the ARUP Camden Geological, Hydrogeological and Hydrological Study indicate the site is located on Worked Ground and near the edge of the Lynch Hill Gravel Member, overlying the London Clay Formation.

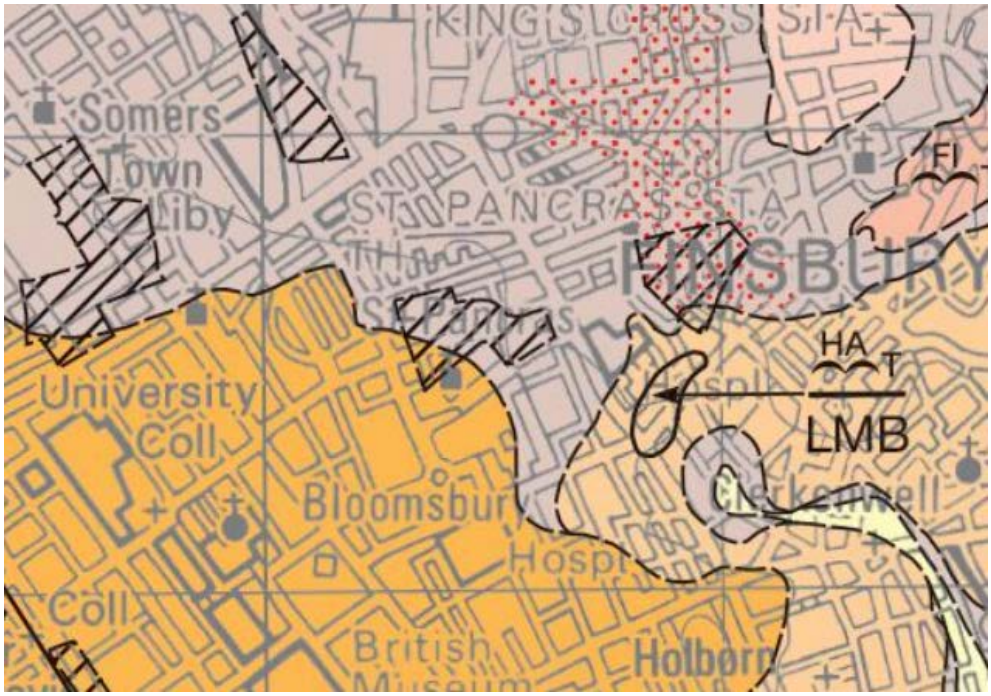


Figure 6: Geology Map (BGS sheet 256)

Lynch Hill Gravel Member is described by BGS as sand and gravel, locally with lenses of silt, clay or peat and London Clay Formation typically comprises a stiff grey fissured clay, weathering to brown near surface.

Groundsure indicate that the site is at a moderate risk of shrink swell hazard. The London Clay Formation typically has a high plasticity and volume change potential which indicates the soil may swell when unloaded or variations in moisture content occur.

The closest borehole located on the oppose side of Regent Square, approximately 65m to the north, encountered Made Ground to 4.7m bgl (16.6m AOD), overlying firm becoming very stiff with depth silty clay (London Clay Formation) to 21.90m bgl.

The site is not in a radon affected area, with less than 1% of properties being above the action level.

No mining related issues have been identified on the site.

vii. Hydrology and Hydrogeology

There are no surface water features within 250m of the site. The closest watercourse is Regent's Canal which is located approximately 820m to the north. Therefore, the site is not within a flood risk zone and there are no surface water abstraction licences within 250m of the site.

The Lynch Hill Gravel Member is a Secondary A Aquifer and the London Clay is designated as an unproductive aquifer. The closest active groundwater abstraction license is 406m to the northwest for a ground source heat pump with the closest potable water abstraction licence being 865m to the east. The site is not within a source protection zone.

viii. Environmental Data

Potentially contaminative industries within proximity to the site include the disused cemetery located 53m to the south and hospital 80m to the southeast. A Publishing company is located 9m to the east at Flat 1, 8 Regent Square.

4 Land Stability Screening and Scoping

The purpose of the screening stage is to identify any matters of concern via key questions in the CPG4 report and the scoping stage identifies the potential impacts of these.

Table 1: Land Stability Screening and Scoping Summary

Impact Question	Answer and Justification	Impact and Action
Question 1: Does the existing site include slopes, natural or manmade, greater than 7 degrees? (approximately 1 in 8)	No. The ground surface at site is predominantly level with the garden being stepped gently up to the south.	None
Question 2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degrees?	No. There are no planned significant changes in surface profile.	None
Question 3: Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees?	No. There are no railway cuttings in the immediate vicinity.	None
Question 4: Is the site within a wider hillside setting in which the general slope is greater than 7 degrees?	No. The slope in the area is less than 7 according to the slope angle map by ARUP.	None
Question 5: Is the London Clay the shallowest strata at the site?	Possibly. The geological maps indicate the site is close to the edge of the Lynch Hill Gravel Member, underlain by London Clay.	London Clay can have high volume change potential. A ground investigation should be carried out to determine the encountered depth of the London Clay beneath the site and sampling to allow Atterberg tests.
Question 6: Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No. It is understood that there is an existing tree within the back garden, however, this is not within the proposed development footprint.	This is further discussed in the Impact Assessment.
Question 7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	None known	None

Question 8: Is the site within 100m of a watercourse or a potential spring line?	No. The closest watercourse is over 800m to the north of the site.	None
Question 9: Is the site within an area of previously worked ground?	Yes. The BGS geology map indicates that the site is located on Worked Ground.	A ground investigation will prove the presence of any Made or Worked Ground. This will be further assessed in the Impact Assessment.
Question 10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes. Lynch Hill Gravel Member is designated as a Secondary (A) Aquifer.	A ground investigation will prove the presence of the Lynch Hill Gravel Member and record groundwater levels.
Question 12: Is the site within 5m of a highway or pedestrian right of way?	Yes. However, the proposed basement extension is further than 5m so no risks to buried services or roads are anticipated.	This is further discussed in the Impact Assessment. Health Safety and environmental measures will be required to be integrated into the building contractors methods of working
Question 13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No. A basement/lower ground floor already exists at the site and in the neighbouring properties, including an extension at No. 11 which is adjacent to the proposed extension.	None
Question 14: Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No.	None

5 Ground Investigation

A ground investigation was carried out at the site by Ground and Water Ltd on 2nd July 2018. The work comprised one borehole (BH1) drilled to 8.45m bgl using a window sampler rig with follow on dynamic probing to 15.10m bgl and two foundation inspection pits. The borehole was located and targeted to the furthest extent of the proposed extension with the foundation inspection pits to the rear of 9/10 Regent Square and to the extension of 11 Regent Square. A groundwater monitoring standpipe was installed in the borehole with a response zone between 1.0m and 6.0m bgl. The factual findings are summarised below.

Made Ground was encountered from ground level to depth of between 0.3m to 1.0m bgl as silty clayey gravelly sand with the gravel consisting of fine to medium brick, concrete, flint, chalk and glass. A 0.2m thick gravelly sandy silty clay band was encountered at the boundary between the Made Ground and London Clay Formation at BH1. Concrete hardstanding was encountered at TP/FE2, with a thickness of 0.15m.

The London Clay Formation was encountered beneath the Made Ground to the base of the borehole at 8.45m bgl. It is described as a brown silty sand clay, becoming less silty and grey from 3.0m bgl. SPT 'N' values are generally between 21 and 24 from 3m bgl, with SPT 'N' values of 7 and 13 at 1.2m and 2.0m bgl respectively. Roots were encountered to 3.0m bgl.

The foundation inspection pit targeted to the adjacent property extension detailed that the brick wall extends to greater than1.30m bgl. The foundation pit to the property under review detailed a brick wall to 0.42m bgl, on a concrete footing which stepped out at least 0.45m, the extent of which was not proven.

Groundwater was encountered during drilling at 4.0m bgl. Subsequent monitoring of the standpipes in the boreholes indicate the groundwater level to be at 5.05m bgl.

Four samples of the London Clay Formation were sent for Atterberg Limit testing with samples from 1.5m to 7.0m bgl. The tests indicate the London Clay to have a liquid limit of between 70% and 84%, a plastic limit of between 28% and 32% and a plasticity index of between 42% and 54%. These indicate a clay of very high plasticity. The moisture content recorded were between 26% and 32% with no discernible trend with depth. They were typically close to the plastic limit indicative of a stiff clay.

Sulphate testing on three samples of shallow London Clay Formation gave characteristic values of sulphate being 2.58g/l, total sulphur of 1.94% and pH of 7.5.

6 Ground Model

The investigation encountered Made Ground, overlying London Clay Formation. The Lynch Hill Gravel Member was not encountered. The Made Ground was consistent with typical Made Ground and no evidence of worked ground as indicated by the BGS map was encountered.

The London Clay Formation was encountered as firm brown silty sandy clay, becoming stiff grey slightly silty sandy clay from around 3.0m bgl. The results of the Atterberg tests indicate the soils to be clay of very high plasticity and high volume change potential. Liquidity Index results correspond to a stiff clay. The London Clay Formation has not been found to have elevated sulphates at typical founding depths and therefore the design sulphate class for the site is DS-4, with an ACEC of AC-4.

A ground model has been developed by interpreting the available data and is detailed below.

Table 2: Summary of Ground Conditions

Strata	Description	Encountered Depth (m bgl)	Geotechnical Properties	Comments
Hardstanding	Concrete	G.L	N/A	N/A
Made Ground	Brown silty clayey gravelly sand with the gravel consisting of fine to medium brick, concrete, flint, chalk and glass.	G.L. – 0.30	C′ =0 ϕ′ = 20^{o}	Made Ground is likely to be highly variable and compressible. Not suitable as a founding stratum. Thicker Made Ground will be encountered at and around existing foundations.
London Clay Formation	Brown silty sandy clay. Becoming grey and less silty from 3.0m bgl.	0.3 – 1.0	C′ =0 ϕ′ = 20^{o} Cu =35kN/m^{2} at 1.2m bgl, increasing steadily to 100 kN/m^{2} from 3.0m bgl	Due to shrinkable soils the minimum foundation depth is 1.0m bgl.
Groundwater	Strike at 4.0m bgl Monitored level at 5.05m bgl.	4.0	N/A	Shallow groundwater is not expected. Depths encountered will vary seasonally and with prevalent weather conditions. Note that fieldwork was carried out during a prolonged spell of dry weather

7 Impact Assessment

There are no apparent major issues which should seriously affect the viability of the construction of the new basement. However, the screening exercise and subsequent assessment of the geological environment of 9/10 Regent Square indicate some areas for further discussion in this report with suggested mitigation where appropriate.

Table 3: Updated Land Stability Screening and Scoping Summary

Impact Question	Answer and Justification	Impact
Question 5: Is the London Clay the shallowest strata at the site?	Yes	London Clay Formation has a high volume change potential.
Question 6: Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	Trees may impact the water content of the soil which will cause shrink and swelling of the clay.
Question 9: Is the site within an area of previously worked ground?	No. Limited Made Ground was encountered.	None
Question 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	None
Question 12: Is the site within 5m of a highway or pedestrian right of way?	Yes. However, the proposed basement extension is further than 5m so no risks to buried services or roads are anticipated.	This is further discussed in the Impact Assessment. Health Safety and environmental measures will be required to be integrated into the building contractors methods of working.

i. Basement Depth and Foundations

The proposals for the site include the construction of a 'basement' extension at the same level as the existing lower ground floor. The extension is adjacent to the existing retaining walls including the extension at No. 11 and the garden retaining wall to the southeast. The retaining wall for the garden will require removal and redesign as part of the development. It will be critical to prevent exposed faces

from collapse or significant ground loss into the new excavation and temporary face support should be provided where necessary.

An evaluation of allowable bearing pressures accounting for load distribution, foundation shape and size and settlement tolerances should be carried out as part of the design process. Bearing capacity and settlement issues are not within the remit of this report.

ii. Founding strata

Due to the highly variable nature of Made Ground, it is not considered an appropriate load bearing stratum. Therefore, the basement will be founded in the London Clay Formation. The London Clay Formation is a high plasticity clay and as such will have potential to heave, which will need to be accounted for in the design of the retaining walls and base slab. The design should also account for the influence of trees and seasonal variations in moisture content.

iii. Groundwater

Groundwater was encountered during the ground investigation at 4.0m bgl and therefore significant groundwater ingress is not expected, however, allowances for a sump pump for any superficial runoff during high rainfall is recommended.

Care should be taken to minimise disturbance to the formation and to avoid softening of the soils due to any rainwater. Softened soils should be excavated and replaced where practicable.

iv. Trees

The presence of trees will need to be accounted for in design and construction, with deepened foundations in proximity to any proposed or remaining trees as well as limiting root damage. If appropriate advice should be sought from an arboricultural expert.

v. Ground Movement

A number of factors will assist in limiting ground movements:

- Detailed foundation design to take into account the findings of the ground investigation data;
- Good workmanship;
- Ensuring that adequate support is in place where required at all times during construction;
- Minimise deterioration of the central soil mass by the use of blinding/ covering with a waterproof membrane.
- The underpinning method should use hit and miss panels with significant gaps between working panels.

vi. Construction near footpath and highway:

The close proximity of the front of the property to the pavement and highway, means that construction related activities will be carried out in areas adjacent to public access. A thorough assessment of risks to the public and the workforce will need to be developed and mitigation measures put in place where risks cannot be eliminated or managed appropriately.

8 Conclusions and Recommendations

The methodology and approach of CPG4 has been followed in developing this BIA with respect to Land stability. It is concluded that the construction of an extension at Flat 1, 9/10 Regent Square should not have significant impacts on land stability provided that:

- Design of the permanent and temporary works should be carried out by a competent and experienced Structural Engineer, who should assess and approve method statements as appropriate.
- The construction of the basement is carried out by competent and experienced contractors and precautions are taken to maintain the stability of the excavations. Anticipated conditions are such that the support of excavated ground will need to be carefully managed in order to provide adequate and good support to the ground to prevent excessive movements against the temporary and permanent support.
- Propping of the wall both in the temporary and permanent cases is critical and stiff props should be utilised.
- Care should be taken to minimise the disturbance and damage to trees and their roots.
- Concrete should be designed in accordance with BRE Special Digest 1 accounting for the sulphate pH and groundwater conditions anticipated.
- Monitoring of the building and its immediate neighbours for settlement is carried out before and during construction. The exact nature of this monitoring should be determined by the structural engineer.

9 References

1. BGS Geological Map Sheet 256, North London.
2. Arup: Camden Geological, Hydrogeological and Hydrological Study.
3. CPG4: Basements and Lightwells
4. Ground and Water Ground Investigation Report