Appendix D: Baement Impact Assessment

LMB GEOSOLUTIONS LTD

BASEMENT IMPACT ASSESSMENT

ROCHESTER SQUARE SPIRITUALIST TEMPLE, ROCHESTER SQUARE, LONDON NW1

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DOCUMENT RECORD

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	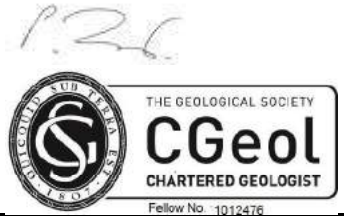

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INTRODUCTION

Introduction

AUTHORISATION

LMB Geosolutions Ltd (LMB) was instructed by Spacelab (Architects) on behalf of Camden Land Partnership Ltd (the Client) in November 2016 to complete a Basement Impact Assessment works in relation to the proposed development at Rochester Square Spiritualist Temple, Rochester Square, London NW1 9RY (the Site).

PROJECT AND SITE DETAILS

Site Address	Rochester Square Spiritualist Temple, Rochester Square, London NW1 9RY (the Site). A Site Location Plan is provided as **Figure 1.**
Proposed Development	The site currently comprises a former temple that is occupied by live in security. The main entrance is via gate located on the southern side of Rochester Square with the rear garden accessed from a gate on the northern side of Rochester Square. Information provided by the Architects and Symmetrys Ltd (Consultant Engineers) indicates that the proposed development involves demolition of the existing structure and construction of a new mixed use four storey structure that will include a single storey basement. Based on the information provided, the following assumptions have been made: • The development will comprise demolition of the existing building and construction of commercial space and residential flats; • The basement will comprise a single storey structure; • The basement will occupy most the footprint of the development (326m^2 of 426m^2); and • The basement will be utilised for office space (front) and residential units (rear). A development schematic is provided in **Appendix A.**
Previous Assessments	LMB are not aware of any previous reports and/or documents relating to the property or the proposed development at the site.

AIMS & OBJECTIVES

The information in this document aims to provide details of the local hydrological, geological and hydrogeological conditions beneath the site in the context of completing a Basement Impact Assessment suitable to support the planning application for the basement element of the proposed development.

INTRODUCTION

SCOPE OF WORKS

The following scope of works has been completed:

- an appraisal of the geological and hydrogeological conditions based on the ground investigation data and desk based literature information;
- consultation with potential below ground asset holders (e.g. Transport for London, Crossrail etc) to ascertain if the proposed basement development is in proximity to any of their below ground assets;
- an appraisal of potential land contamination issues based on the ground investigation data environmental search data (Environmental Health at London Borough of Camden);
- an appraisal of the hydrological conditions at the site based on literature information.

- A screening and scoping assessment in an appropriate form for submission to the London Borough of Camden (LBC).
- An appraisal of the potential impacts and provision of suitable mitigation measures.

CONTRIBUTORS

This report has been compiled by Philip Lewis a hydrogeologist and chartered Geologist with over nineteen years experience as a geoscience professional, including over fifteen years experience as a professional adviser (consultant) in hydrogeology, engineering geology and contaminated land.

Further specialist input has been provided in the form of a Flood Risk Assessment completed by Edward Bouet (Senior Flood Risk Consultant) and a Ground Movement Assessment completed by Corrado Candian (CEng, MICE).

LIMITATIONS

LMB has prepared this report solely for the use of the named Client and those parties with whom a warranty agreement and/or assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from LMB and the Client.

LMB accepts no responsibility or liability for:

a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and

b) issue of this document to any third party with whom an agreement has not been executed.

The risk assessment and opinions provided, among other things, take in to consideration currently available guidance and best available techniques relating to acceptable contamination concentrations and interpretation of these values. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, if applied.

Baseline Data & Criteria

INTRODUCTION

This section provides the baseline (desk study) data used to complete the Basement Impact Assessment (BIA) in relation to the proposed development. Reference information used for this purpose is outlined below:

- British Geological Survey – 1:50,000 Geological Sheet 256, North London (Solid & Drift);
- British Geological Survey borehole archive records.
- Environment Agency Groundwater Vulnerability Mapping (1:100,000 series) Sheet 40, Thames;
- Environment Agency Internet database (www.environment-agency.gov.uk);
- River Basin Management Plan (RBMP). Thames River Basin District (2009);
- Barton, N.J. (1982). Lost Rivers of London.
- London Borough Camden Flood Risk Management Strategy (2013).
- URS (2014). London Borough of Camden Strategic Flood Risk Assessment.
- Halcrow (2011). London Borough of Camden Surface Water Management Plan.

Guidance and Frameworks

The proposed development is located in the London Borough of Camden (LBC) and the guidance and policies outlined in the following documents are considered to be relevant:

- Camden Planning Guidance: Basements and Lightwells (CPG 4); and
- LBC: Camden geological, hydrogeological and hydrological study Guidance for subterranean development (Issue 01, November 2010).

The above documents provide information and a framework for undertaking a BIA within LBC. In summary, the key aim of the documents is to ensure that basement and underground development is only permitted where it does not:

- cause harm to the built and natural environment and local amenity;
- result in flooding; or
- lead to ground instability.

LBC require that a submission for a proposed basement development should include information relating to the above within a BIA which is site and development specific to the site.

BASELINE DATA & CRITERIA

About this Assessment

In the context of this assessment greatest emphasis has been placed on the requirements highlighted above relating to potential impacts on drainage, flooding from all sources, groundwater conditions and ground stability.

In accordance with the referenced guidance this report includes the following elements:

- Desk Study;
- Screening & Scoping;
- Site Investigation, monitoring, interpretation and ground movement assessment;
- Impact Assessment.

Regulatory Consultation

LBC Planning

The project planners (NTA Planning) consulted with LBC in November 2016 to gain pre-planning advice with a view to gaining an insight into the requirements for the proposed development. A pre-planning advice response was received on 5th October 2015 (ref. 2016/3442/PRE).

The pre-planning advice confirms that a Basement Impact Assessment is required in accordance with Camden guidance documents.

LBC Environmental Health

A representative of LBM contacted the Contaminated Land Officer at LBC in November 2016 with a view to obtaining pertinent information in relation to the current and historical site and surrounding land uses. A response was provided on 17th November 2016 and is discussed in more detail in the **Baseline Conditions** section of this report.

Copies of the regulatory correspondence are included in **Appendix B.**

SIGNIFICANCE CRITERIA

The assessment of potential effects from the proposed development has taken into account both the construction and operational phases. The significance level attributed to each effect has been assessed based on the magnitude of change due to the development proposals and the sensitivity of the effected receptor/receiving environment to change, as well as a number of other factors.

Assessment criteria developed from the guidance and frameworks referenced have been used to determine the significance of the potential effects as a result of construction and operation of the proposed development.

The significance of potential effects has been determined by considering the magnitude of the effect, in terms of a change in existing baseline conditions.

BASELINE DATA & CRITERIA

Significance Measures

The following terms have been used to define the significance of the effects identified:

- **Major effect**: where the proposed development could be expected to have a very significant effect (either positive or negative) e.g. significant risk of flooding effect, an improvement in water quality class, allowing new uses to be made of the water resource (e.g. potable water supply) or impacts from contamination issued e.g. risk to groundwater or future site users;
- **Moderate effect**: where the proposed development could be expected to have a noticeable effect (either positive or negative) e.g. moderate flooding effect;
- **Minor effect**: where the proposed development could be expected to result in a small, barely noticeable effect (either positive or negative), but where current uses could still be maintained; and
- **Negligible**: where no discernible effect is expected as a result of the proposed development.

Screening Assessment

The information presented within the LBC guidance provides decision-making matrices to enable an initial screening assessment to be made in relation to potential impacts and issues related to proposed basement development.

The matrices specifically focus on Land Stability, Groundwater Movement and Surface flow and Flooding. An example of the type of matrix is presented below:

Is the site located on an Aquifer?
Will the basement extend below the groundwater level?
Is the site within 100m of a water course?
Will the proposed development change the proportions of soft / hard surfaced areas?
Will the development result in an increase in surface water infiltration to ground (e.g. via soakway and/or SUDS)?
Will the development result in a change in slopes at the property boundary?
Is the site located in an area where the soils are known to have a high volume change potential?
Will the development result in the felling of any trees?
Is the site in a Flood Zone 2 or 3
Is the site in an area where there has been historical flooding from sewers or where surface water ponding is prevalent?

Yes → Carry forward to scoping stage.

No → Provide statement justifying decision not carry forward to scoping stage.

BASELINE CONDITIONS

Baseline Conditions

General

This section of the report uses **desk study** and site specific data to present the current conditions at the site (i.e. pre development) to enable a baseline to be established that can be used to predict the likely impact of the basement post construction.

SITE ENVIRONMENTAL SETTING

Relevant information relating to sites environmental setting, founded on desk based information and in the context of this assessment is summarised in the table below:

Site Description & Site Walkover	A site walkover was conducted by a representative of LMB on Monday 14th November 2016 and included external areas of the site. A photographic record is included as **Appendix C.** The site currently comprises a former spiritualist temple that is currently occupied by live in security. The temple comprises a main building of approximately three storey height with a rear single storey height extension. The main entrance is via a padlocked gate located on the southern side of Rochester Square (see Photo 1). However, access to the property is via the rear garden accessed from a gate on the northern side of Rochester Square (see Photo 2). During the walkover, the existing building and boundary walls were inspected to note any indicators of possible structural damage e.g. cracks. The existing structures appeared to be largely free of obvious defects, but a crack was observed along the facias and brick work on the south eastern corner of the building (see Photo 3). It was not clear whether this was associated with subsidence or vegetation (small tree) growing out of the roof of the property. No obvious sources of potential contamination were observed. The area immediately surrounding the site comprises residential properties, as follows: • Adjacent west: a two storey property with single storey basement (see Photo 4); • North west: a five storey block of residential flats (see Photo 5), possibly with an under croft car parking area; • East: a terrace of three storey residential buildings with lower ground floors and gardens that bound the site (see Photo 6); and

	• South: a six storey block of residential flats. In addition, discussions with site personnel working on the development adjacent to the west indicates that they encountered water ingress at approximately 2.0-3.0m bgl and had issues with preventing ingress. Please refer to **Appendix A** for details of the proposed development relative to surrounding buildings.
Geology & Aquifer Designations	Reference to British Geological Survey (BGS) mapping indicates that the site lies directly over the London Clay Formation (typically silty clay) with no superficial deposits present. The geological sequence progresses with depth into the Lambeth Group (Secondary A Aquifer), Thanet Sands (Secondary A Aquifer) and Chalk (Principal Aquifer).
Hydrology	The nearest known surface water feature to the site is the Grand Union Canal, which is located approximately 280m south of the site. In addition, Hampstead Ponds are located approximately 2.5km north west. Reference to the UK Hydrometric Register indicates that the annual average rainfall for the Thames region is 710mm. Reference to freely accessible information contained on the Environment Agency website along with reference to the LBC Strategic Flood Risk Assessment indicates that the site is not located in a Flood Risk Zone. Reference to CPG 4 indicates that the site is not located on a street that has been identified as being affected by historical localised flooding from surface water. However, reference to information contained on the Environment Agency website indicates that the site is located in an area at a low to medium risk from surface water flooding (due to local soil conditions and topography) during times of heavy rainfall when the local combined sewer system is unable to deal with the volume and rate of flow.
Resource Potential & Ecological Sensitivity	The groundwater in the London Clay Formation is designated Unproductive Strata and as such is not characterised as a groundwater body within the relevant River Basin Management Plan (RBMP). In addition, the Site is not located within an EA designated Source Protection Zone (SPZ). The Grand Union Canal is included within the relevant RBMP. It has been assigned a moderate ecological quality and good chemical quality.

BASELINE CONDITIONS

REGULATORY CONSULTATION

Although not specifically required within the BIA framework prescribed by LBC, a review of potentially contaminative historical land uses has been completed through enquiry with the Contaminated Land Officer at LBC.

A copy of the formal response to the enquiry is provided in **Appendix B** with the salient information summarised below:

- There are no records of historical industrial land uses at the site. However, the officer did identify a former electrical sub station approximately 50m south of the site.
- There are no IPPC or LAPPC industrial processes within 50m of the site.
- There are no records of pollution incidents in the area.
- The officer confirmed that the site has not been prioritised for inspection as part of its contaminated land inspection strategy and is unlikely to be inspected in the future.
- The council holds *'no information about the extent of made ground on subject site, however Camden soil profile tends to exhibit high levels of Lead (see BGS data).'*
- The council holds no information relating to private water supplies.

BELOW GROUND ASSETS

As part of the assessment the following organisations were contacted to ascertain if they held any below ground assets below or in close proximity to the site:

- Network Rail;
- Crossrail;
- London Underground Ltd / Transport for London.

Responses have been received from London Underground and Crossrail confirm they do not hold any below ground assets in the vicinity of the site. A response from Network Rail has not been received to date.

Copies of correspondence are included in **Appendix D.**

SUMMARY OF SITE & SURROUNDING HISTORICAL LAND USES

In addition, an appraisal of the historical site and surrounding land uses has been undertaken based on a review of historical maps.

The historical maps reviewed suggest that the site was part of a square and the rear gardens of residential houses until its development as Spiritualist Temple, which was opened in October 1926. The layout of the site and immediately surrounding area does not appear to have altered to present day.

BASELINE CONDITIONS

During the period of the site development (Spiritualist Temple), surrounding land uses were predominated by residential housing but also included a nursery approximately 40m east south east and a tramway associated with Camden Road approximately 60m west.

The historical map for c.1953 indicates that the area to the south of the site has been redeveloped to include a residential housing estate comprising several blocks of high rise flats which remain to present day. The electricity sub-station identified by LBC was present associated with this development. Other features of note include garages approx. 60m west north west and 130m south west, the Institute of Ray Therapy approximately 20m north and a Scientific Instrument Works approximately 90m west. These features of note were not present on historical maps c.1990 and appear to have been replaced by residential housing, government offices and commercial retail units.

Copies of selected historical maps are included in **Appendix D.**

LOCAL HYDROLOGY, GEOLOGY & HYDROGEOLOGY

Local Hydrology

As outlined the site is not shown to be located in a Flood Risk Zone and the closest known surface water courses in the area are >250m from the site. However, the site is located in an area at low to medium risk from surface water flooding.

Reference to Barton, NJ (Lost Rivers of London) indicates that the former River Fleet is located approximately 425m west of the site.

The local area is primarily urban (residential and commercial) and as such the majority of surface water run-off is likely to be directed to the surface water (and possibly combined) drainage system. However, where rear gardens exist and areas of green space (such as Rochester Square and the area to the north enclosed by Stratford Villas, Rochester Square and Camden Mews), rainfall run-off to drains is likely to be reduced and taken up by evapotranspiration and the soil moisture deficit with the remainder potentially infiltrating to ground (although this will also be largely in areas where the London Clay does not outcrop).

The site primarily comprises hard surfacing but there are areas of soft landscaping and paving within the rear garden area. On this basis, it has been assumed that currently the majority rainfall run-off is directed to the local drainage system with some potential infiltration in the rear garden area.

Local Ground & Groundwater Conditions

Details of the ground investigation works and findings are provided in the LMB Ground Investigation and Assessment Report (ref. LMB_16.12.07_REPPIL_GI_Rochester_v1.0), with a description of the local ground and groundwater conditions in the context of the baseline assessment provided below.

BASELINE CONDITIONS

The ground conditions vary from those described by the BGS and comprise Made Ground overlying soils interpreted as Head Deposits (clay over gravelly clay), which in turn overlie the London Clay Formation (firm to stiff clay, locally silty and sandy).

Observations of groundwater during the ground investigation works are summarised in the table below:

Location	Depth (m bgl)	Strata	Aquifer Designation	Comments
BH1	0.70	Made Ground	Not Applicable	Likely to be localised water perched above the clay of the Head Deposits.
BH2	3.40	Head Deposits	Secondary (Undifferentiated)	No water was recorded during drilling but ingress into the open hole (casing removed) occurred overnight. The hole collapsed back to 3.90m and the observations are considered reflective of slow seepage of groundwater via the Head Deposits.
BH1	7.00	London Clay Formation	Unproductive Strata	No water was recorded during drilling but ingress into the open hole occurred following removal of casing. It is not clear whether the observations are reflective of seepage of groundwater from the Head Deposits or ingress via the London Clay.

Ground Gas and Groundwater Monitoring

Groundwater monitoring wells were installed in both borehole locations. In BH1 the well was installed with a screened section in the London Clay Formation and in BH2 the well was installed within the Head Deposits.

Groundwater and ground gas levels were monitored on Wednesday 30th November 2016 and the results are summarised in the table below:

Location	Strata	Groundwater Depth (m bgl)	VOC (ppm)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	Flow Rate (l/hr)	Gas Screening Value (l/hr)
BH1	London Clay	6.58	0.7	0.10	1.40	18.2	0.2	0.0028
BH2	Head Deposits	1.64	-	-	-	-	-	-

The groundwater levels recorded during return monitoring confirm the observations during the ground investigation works and suggest that shallow groundwater is present within the Head Deposits.

The water recorded within BH1 may be reflective of groundwater within the London Clay but may also be water retained in the well from the ground investigation works i.e. seepage from the Head Deposits. Notwithstanding this, recording of groundwater in monitoring installations constructed within the London Clay is common. However, rather than being representative of a permanent and laterally continuous aquifer unit, the groundwater is present as discrete units within (for example) micro fissures and local mudstone horizons and the recorded groundwater level will most likely be reflective of the pore water pressure in these discrete features.

Soil Infiltration

The Head Deposits at the site comprise approximately 1.0m of clay over gravelly to very gravelly clay. The upper clay unit is interpreted to be low permeability and the underlying gravelly clay contains groundwater. The CIRIA SUDS Manual provides the following advice inter alia in relation to infiltration criteria: *'Groundwater levels must be checked to ensure that the infiltration surface is at least 1m above the maximum anticipated level. Infiltration systems require an unsaturated soil to provide effective pollution protection.'* As such the Head Deposits are likely to be unsuitable as a media for infiltration drainage

The London Clay Formation in this area comprises low permeability clay soils and reference to the CIRIA SUDS Manual and BGS data confirms that coefficients of infiltration through these soils are very low.

Summary

The information provided in the above sections has been used to compile a summary of the local conditions which are presented in the table below:

Strata	Proven Thickness Range (m bgl) (1)	Depth to Groundwater (m bgl) (2)	Aquifer Designation	Infiltration Coefficient Range (m/d) (3)
Made Ground	0.50 – 0.80	0.70 (only BH1)	Not Applicable	-
Head Deposits	2.85 – 3.25	1.64	Secondary (undifferentiated)	8.64E-03 – 8.64E-01
London Clay Formation	11.25 – 11.35	6.58	Unproductive Strata	2.60E-04 to 2.60E-06

(1) Site data.
(2) Site monitoring data.
(3) British Geological Survey (BGS), WN97/27. (Forster, 1997). The Engineering Geology of the London Area & SUDS Manual.

Screening & Scoping Assessment

SCREENING ASSESSMENT

The decision-making matrices presented in the Screening Assessment below have been completed based on the information presented in the previous sections.

Groundwater Flow

Is the site located on an Aquifer?	**Yes** The soils interpreted as Head Deposits are likely to be designated a Secondary (Undifferentiated) Aquifer
Will the basement extend below the groundwater level?	**Yes** Groundwater is present within the Head Deposits.
Is the site within 100m of a water course, well or potential springline?	No There are no known surface water courses within 250m of the site. The former coarse of the River Fleet is located approximately 425m west of the site.
Will the proposed development change the proportions of soft / hard surfaced areas?	**Yes** Based on observations during the site walkover and reference to development schematics the proportion of soft / hard surface cover will alter following development.
Will the development result in an increase in surface water infiltration to ground (e.g. via soakaway and/or SUDS)?	No The site is located over relatively low permeability Head Deposits and London Clay and surface water infiltration is unlikely to be a viable solution.
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 (not just the pond chains on Hampstead Heath) or spring line.	No There are no known surface water courses within 250m of the site.

Land Stability

Does the existing site include slopes, natural or manmade, greater than 7°?	No

	Observations during a site walkover and reference to proposed development schematics and information within Camden guidance confirms that there are no slopes > 7°.
Will the proposed re-profiling or landscaping at the site change slopes at the property boundary to more than 7°?	No Reference to proposed development schematics confirms that there will be no slopes > 7° following development.
Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No Observations during a site walkover and reference to proposed development schematics indicates that there are no slopes > 7°.
Is the site within a wider hillside setting in which the general slope is greater than 7°?	No Observations during a site walkover confirms that there are no slopes > 7°
Is the London Clay the shallowest strata at the site?	No Made Ground and Head Deposits have been recorded to 3.75m bgl.
Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	**Yes** Reference to the pre-planning advice indicates that a mature tree in the rear garden was recently felled (within permission) and that there is a requirement for this to be replaced as part of the development.
Is there a history of seasonal shrink swell subsidence in the local area and/or evidence of such effects at the site?	**Unknown** Visual evidence of cracking was limited to one section of the fascia on the existing structure and this is not considered to be related to. It was not clear whether this was associated with shrink/swell subsidence or vegetation (small tree) growing out of the roof of the property. The London Clay is known to have a high volume change potential on change of moisture content. However, Head Deposits extend to c.3.65-3.75m bgl and as such the potential for seasonal shrink/swell effects may not be as significant.
Is the site within 100m of a water course or potential springline?	No There are no known surface water courses within 250m of the site.
Is the site in an area of previously worked ground?	No Ground investigation identified Made Ground but no previous site uses such as 'old pit' have been identified.
Is the site within an aquifer?	**Yes** The soils interpreted as Head Deposits are likely to be designated a Secondary (Undifferentiated) Aquifer

Is the site within 50m of Hampstead Heath ponds?	No There are no known surface water courses within 250m of the site (including Hampstead Heath ponds).
Is the site within 5m of a highway or pedestrian right of way?	**Yes** Part of the site is directly adjacent to a pavement with a public highway beyond.
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	**Yes** The proposed basement will extend over most of the area of the development foot print and will be single storey. The depth to foundation is likely to be similar to the basement in the neighbouring property but lower than in the terrace houses to the east.
Is the site over any tunnels e.g. railway lines?	No Enquiries with assets holders have confirmed that they have no below ground assets in proximity to the site.

Surface Flow and Flooding

Is the site within the catchment if the pond chains on Hampstead Heath?	No
As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	**Yes** Although the drainage design is not finalised, the development will include green roofs which will provide attenuation of surface water run-off from the site.
Is the site within 100m of a water course, well or potential springline?	No
Will the proposed development change the proportions of soft / hard surfaced areas?	**Yes** There will be an increase in hard surfaced areas following development.
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?	**Unknown** Drainage design has not been finalised.
Is the site in an area known to be at risk from surface water flooding?	**Yes.** The site is located in an area at a low to medium risk from surface water flooding.

SCREENING & SCOPING ASSESSMENT

Summary

Based on the Screening Assessment presented above, the following potential issues have been carried forward to the scoping stage of the assessment:

- The site is located over an aquifer as the soils interpreted as Head Deposits are likely to be designated a Secondary (Undifferentiated) Aquifer.
- Based on observations during the site walkover and reference to development schematics the proportion of soft / hard surface cover will alter following development.
- The site is located in an area at a low to medium risk from surface water flooding.
- 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?
- The London Clay is known to have a high volume change potential on change of moisture content and as such there is potential for seasonal effects.
- Parts of the site are directly adjacent to a pavement with a public highway beyond.
- Reference to the pre-planning advice indicates that a mature tree in the rear garden was recently felled (within permission) and that there is a requirement for this to be replaced.
- The proposed basement will extend over most of the area of the development foot print and will be single storey. The depth to foundation is likely to be similar to the basement in the neighbouring property but lower than in the terrace houses to the east.

SCOPING ASSESSMENT

The potential issues identified within the screening assessment are considered within the following scoping sub-sections:

Groundwater

The site is located over soils that are consistent with Head Deposits and monitoring has confirmed the presence of groundwater within these deposits. The Head Deposits are likely to designated a Secondary (Undifferentiated) Aquifer.

The potential impact of the basement on this aquifer unit is considered to be minimal due to the limited areal extent of the basement i.e. it is considered likely that groundwater within the aquifer will flow around the basement and any increase in groundwater level will be localised.

Flooding & Drainage

The development will result in a net increase in hard surfacing over the area of the site. Given the relatively low permeability of the soils underlying the site it is likely that infiltration to ground would be minimal.

Although the drainage design has not been finalised, the development proposals include the use of green roofs which will provide some attenuation of the surface water run-off to the local drainage system.

The site is located in an area at a low to medium risk from surface water flooding and in accordance with LBC a Flood Risk Assessment is required.

Land Stability

Although the London Clay is known to have a high volume change potential on change of moisture content, the Made Ground and Head Deposits extend to depths of between 3.65 and 3.75m bgl with groundwater present within the Head Deposits. As such the potential for seasonal shrink/swell effects are not likely to be as significant.

In addition, the anticipated formation level for the proposed basement development is approximately 3.50m to 4.50m bgl which is within the firm to stiff London Clay i.e. this is likely to be beyond the depth profile of seasonal shrink/swell effects.

The site and proposed basement development are directly adjacent to pavements and public highways in a relatively flat lying area with a general slope to the south. The adjoining property to the west includes a single storey basement and the proposed basement is anticipated to be at a similar depth to this but will be lower than in the terrace houses to the east which have lower ground floor levels.

Notwithstanding this, the removal of overburden could result in inward yielding and the properties of the London Clay mean there is potential for short and long term heave. As such a Ground Movement Assessment (GMA) has been undertaken to appraise the potential impacts on neighbouring properties. The GMA is provided in the following section with the calculation worksheets provided in **Appendix F.**

Details of the structural design and construction sequencing will be provided under separate cover within a Construction Method Statement and related documents.

Ground Movement Assessment

INTRODUCTION

There is the potential for ground movements due to the proposed development from the wall installation and from the excavation process.

The magnitude and extent of ground movements resulting from installation of a wall and excavation in front of such a wall are typically estimated based on the guidance given in the CIRIA publication C580 Embedded Retaining Walls – Guidance for Economic Design. The guidance in the CIRIA publication is based on the behaviour of embedded walls at numerous sites in London, which are predominantly walls embedded in London Clay, though typically with some near surface deposits consisting of for example River Terrace Deposits and Made Ground.

BUILDING DAMAGE ASSESSMENT

For the installation of a bored contiguous/secant piled wall in stiff clay, the magnitudes of the movements are dependent on the overall wall depth (not excavation depth). Similarly, the distance from the wall to the point where negligible movements will occur is also related to overall wall depth.

Movements resulting from excavation in front of the wall are dependent on the depth of excavation. From the data provided, this is expected to be approximately 3.30m if a piled foundation is adopted and approximately 4.0m to 4.50m (including slab) if a raft or spread foundations is adopted. It is understood that the intended construction sequence will be bottom-up, with a temporary support system to the excavation.

C580 provides curves estimating horizontal and vertical ground surface movements due to piled wall installation and to excavation in front of wall. Total ground movements resulting from the excavation will be the combination of the installation movements and the excavation movements.

The method provided within Box 2.5 in CIRIA C580 has been used to in form the assessment. CIRIA 580 curves were used to make a prediction of ground movement considering a high support stiffness wall.

Using these predicted movements, estimates of possible damage have been made for the surrounding structures, based on the Damage Classification Scheme proposed by Burland and Wroth (1974).

Details of calculation are presented in **Appendix E.**

Raft / Spread Foundation

The results of the damage assessment on the surrounding structures for an assumed raft/spread foundation are summarised below:

Nearby Building / Structure	Estimated Damage Category No.	Category of Damage	Comments
Adjacent Building	2	Slight	Cracks easily filled. Redecoration probably required.
Julian Court	2		
29-36 Rochester Square	1	Very Slight	Fine cracks that can easily be treated during normal decoration.

Piled Foundation

The results of the damage assessment on the surrounding structures for an assumed piled foundation are summarised below:

Nearby Building / Structure	Estimated Damage Category No.	Category of Damage	Comments
Adjacent Building	2	Slight	Cracks easily filled. Redecoration probably required.
Julian Court	1	Very Slight	Fine cracks that can easily be treated during normal decoration.
29-36 Rochester Square	1		

Results

The ground movement assessment undertaken indicates that damage to surrounding properties will be Burland Category 2 (Slight) or less for both a piled foundation or raft/spread foundation. However, for a spread/raft foundation the damage to Julian Court I predicted to increase from Burland Category 1 (piled) to Burland Category 2 (spread/raft).

It should be noted that the predicted ground movements are indicative for long, straight walls, and take no account of the effects of corners to the excavation, which typically reduce excavation induced ground movements in their vicinity to about 50% of what is predicted. In addition, while C580 provides estimates of horizontal movement from pile installation, these are based on very limited data; more recent projects have shown that piling undertaken to current standards of quality and workmanship cause no significant horizontal movement.

Heave

The excavation of about 3.5m to 4.5m thickness of soil (taking into account the presence of groundwater in the Head Deposits) will generate an unloading of around 60kN/m^2 to 80kN/m^2. It is likely that the ground within the excavation will experience a net unload, rather than load, and will therefore heave rather than settle. Experience suggests that such heave movements tend largely to be restricted to within the site

boundary when excavations are created with contiguous/secant piled retaining walls, so it is not anticipated that the changes in loading at basement level will have a significant impact on any surrounding structures.

Ground Movements Monitoring

Movement monitoring should be undertaken. The surveying points should be set up using a total station prior to commencement of the works and it is recommended that monitoring be undertaken at weekly intervals.

Impact Assessment & Mitigation Measures

SUMMARY OF POTENTIAL IMPACTS & MITIGATION MEASURES

The table below provides a summary of the potential impacts and mitigation measures adopted to ensure that residual risks are minimised:

Description of Potential Impact		Significance of Impact	Summary of Mitigation Measures	Residual Effects following Mitigation
Land Stability	Seasonal subsidence.	Minor negative	• The basement foundation is assumed to be between approximately 3.50m (piled) to 4.50m bgl (spread/raft) and low plasticity Head Deposits extend to c.3.65-3.75m bgl. • Heave protection measures will be adopted. • Surveying and monitoring of surrounding buildings / structures will be undertaken.	Negligible
	Impact on local properties/structures	Moderate negative	• Adoption of appropriate management procedures for basement excavation/ construction within the Construction Method Statement. • Surveying and monitoring of surrounding buildings / structures will be undertaken. • Repair and maintenance in accordance with C580.	Negligible

IMPACT ASSESSMENT & MITIGATION MEASURES

Description of Potential Impact		Significance of Impact	Summary of Mitigation Measures	Residual Effects following Mitigation
Groundwater Flow	Impact on Secondary Aquifer	Minor negative	• The basement development will not prevent groundwater flow and any rise in groundwater elevation is likely to be localised.	Negligible
Surface water flooding & Drainage	Flooding from surface water	Moderate negative	• Completion of a Flood Risk Assessment.	Negligible
	Increase in run-off to drains	Moderate negative	• The proposed development includes green roofs which will provide some attenuation of the surface water run-off to the local drainage system.	Negligible

Conclusions and Recommendations

CONCLUSIONS

The proposed basement will comprise a single storey structure utilised as commercial and residential space and will extend over the majority of the development footprint (approximately 326m^2 of 426m^2).

The assessment completed indicates that there is potential for the proposed basement development to result in moderate impacts in relation to land stability and local surface water flooding.

However, following adoption of appropriate mitigation measures to be included within the design, the residual impacts of the proposed development are assessed to be negligible.

RECOMMENDATIONS

Based on the assessment completed and with regard to the proposed development in general it is recommended that the mitigation measures to minimise impacts associated with potential land stability and local surface water flooding are adopted within development design.

Further recommendations specific to the geotechnical appraisal, potential foundations options and in consideration of retaining wall design are provided in the LMB Ground Investigation and Assessment report (ref. LMB_16.12.07_REPPIL_GI_Rochester_v1.0).

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[1] This document has been withdrawn but is considered to remain useful in proving technical background for designing ground investigation works.

[2] This document has been withdrawn but is considered to remain useful in proving technical background for designing ground investigation works.

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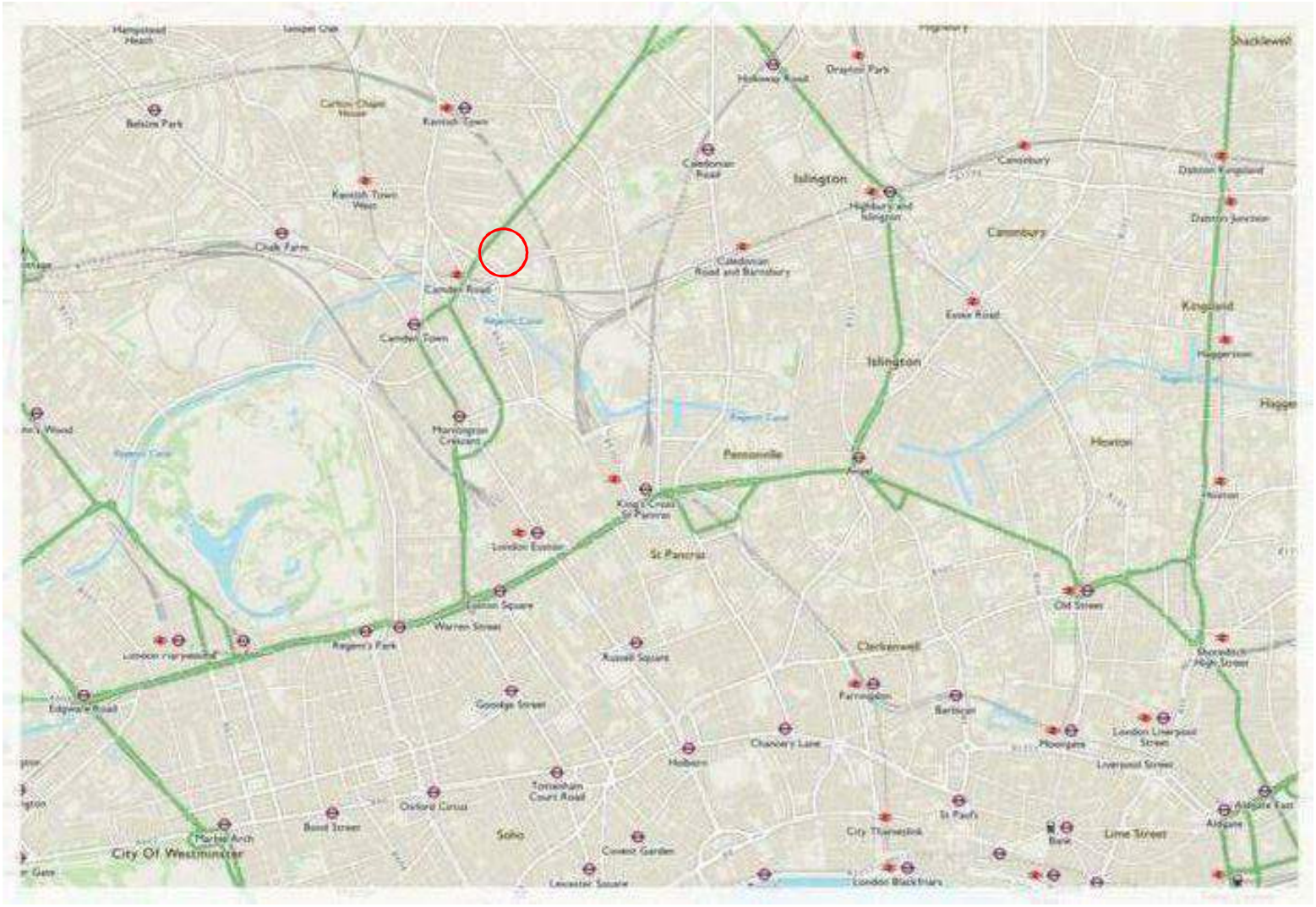
FIGURES



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Key:

Approximate site location

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LMB

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Site: Rochester Square, London NW1

Figure Number: Figure 1

Title: Site Location Plan

Project No:	Created By:	Date:
	PIL	Nov 2016

Client: Camden Land Partnership Ltd