CampbellReith
consulting engineers

Flat 3, 269 Goldhurst Terrace, NW6 3EP

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12066-65
Revision: D2

June 2016

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Contents

Appendix

1.0 NON-TECHNICAL SUMMARY

1.1. CampbellReith was instructed by London Borough of Camden, (LBC) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for Flat 3, 269 Goldhurst Terrace, London NW6 3EP (planning reference 2015/4513/P). The basement is considered to fall within Category B as defined by the Terms of Reference.

1.2. The Audit reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development in accordance with LBC's policies and technical procedures.

1.3. CampbellReith was able to access LBC's Planning Portal and gain access to the latest revision of submitted documentation and reviewed it against an agreed audit check list.

1.4. The BIA has been carried out by a Chartered Structural Engineer. Additional information has been provided which has been authored by a Chartered Geologist and a Chartered Civil Engineer which meet the requirements of CPG4.

1.5. A preliminary ground investigation has been carried out which confirms that the basement will be founded within the London Clay. The BIA proposes that a more detailed interpretative geotechnical report should be completed prior to the construction commencement, which should include standpipes to monitor groundwater. It is accepted that this could be produced as part of a Basement Construction Plan.

1.6. Additional information has verified that the basement depth will be around 2.9 metres and that the only existing basement adjacent to the proposed development is at No. 58 Priory Road. It is accepted that the proposed basement will have a negligible effect on the local hydrogeology.

1.7. There is an anomaly within different sections of the BIA concerning the methodology to carry out underpinning below the existing walls of the ground floor flat, which should be clarified as part of a Basement Construction Plan.

1.8. The geotechnical criteria required for the retaining wall and foundation design to the extension basement will need to be verified by the further soils investigation to be provided as part of a Basement Construction Plan, which should also include a temporary works scheme developed by the construction contractor to meet the requirements stated in the GMA.

1.9. An additional Ground Movement Assessment document has identified that Burland Damage Category 1 (Very Slight) will occur to No. 269 Goldhurst Terrace and to No.58 Priory Road on the basis of assumed criteria. This assessment should be verified once the competence of the soils is confirmed by the supplementary soils investigation. A risk assessment will also be required as part of the Basement Construction Plan due to the proximity of the front of the property to the pavement and highway.

1.10. The ground movement monitoring proposal contains Action Values that are not consistent with the current Damage Category assessment. A revised assessment should be provided as part of a Basement Construction Plan.

1.11. It is accepted that there are no concerns regarding slope stability, proximity of known ponds, wells or aquifers and the Hampstead Pond Chain catchment area.

1.12. It is also accepted that adequate measures to prevent basement flooding via the four new light wells have been identified in the BIA bearing in mind that Goldhurst Terrace flooded in 1975 and 2002 and No. 269 lies at the low point of the street.

1.13. The proposals indicate a net reduction in garden area which produces an increased discharge to the surface water drainage system. An additional document has been provided which provides acceptable mitigation measures to offset potential flooding issues.

1.14. Queries and matters requiring further information or clarification are summarised in Appendix 2.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 12 October 2015 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for Flat 3, 269 Goldhurst Terrace, NW6 3EP, Camden Reference 2015/4513/P.

2.2. The Audit was carried out in accordance with the Terms of Reference set by LBC. It reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development.

2.3. A BIA is required for all planning applications with basements in Camden in general accordance with policies and technical procedures contained within

- Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.
- Camden Planning Guidance (CPG) 4: Basements and Lightwells.
- Camden Development Policy (DP) 27: Basements and Lightwells.
- Camden Development Policy (DP) 23: Water

2.4. The BIA should demonstrate that schemes:

a) maintain the structural stability of the building and neighbouring properties;

b) avoid adversely affecting drainage and run off or causing other damage to the water environment; and,

c) avoid cumulative impacts upon structural stability or the water environment in the local area.

and evaluate the impacts of the proposed basement considering the issues of hydrology, hydrogeology and land stability via the process described by the GSD and to make recommendations for the detailed design.

2.5. LBC's Audit Instruction described the planning proposal as *"Erection of single storey side extension and creation of basement below existing dwelling and new extension, with 2 no. front and 2 no. rear light wells"* The Audit Instruction also confirmed the property was not, nor was a neighbour to, a listed building.

2.6. CampbellReith accessed LBC's Planning Portal on 21 October 2015 and gained access to the following relevant documents for audit purposes:

- Basement Structural Method Statement (BIA) dated June 2015
- Planning Drawings dated January 2015 - Existing
  - Proposed

2.7. In response to the initial CampbellReith audit (Revision D1), further documentation has been placed on LBC's Planning Portal on 14 December 2015 and 29 April 2016.

2.8. The documents deposited on 14 December 2015 consist of:

- Basement Structural Method Assessment dated 24 June 2015 by Jeff Walker of AND Designs Limited. This appears to be an identical document to the BIA (1 of 3) document deposited on 6 August 2015. This document will not be reassessed.
- Applicant comment on CampbellReith Audit Appendix 2, Audit Query Tracker, and consists of a minimalist single-line response to each query.
- Calculations. This appears to be an identical document to the BIA (2 of 3) document deposited on 6 August 2015. This document will not be reassessed.

2.9. The documents deposited on 29 April 2016 consist of:

- Basement Impact Assessment: Land Stability and Assessment of Ground Movement (GMA) dated March 2016 by Ground and Project Consultants Ltd.
- Supplementary Flooding Information (SFI) dated April 2016 by Kaya Consulting Limited.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	Additional documentation acceptable.
Is data required by Cl.233 of the GSD presented?	Yes	
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	
Are suitable plan/maps included?	Yes	
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	Various maps and plans throughout BIA and appendices
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	 Yes Yes	See BIA Section 2
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	 Yes Yes	See BIA Section 2
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	 Yes Yes	See BIA Section 2
Is a conceptual model presented?	Yes	See GMA
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes Yes	See BIA Section 4

Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes Yes	See BIA Section 4
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes Yes	See BIA Section 4
Is factual ground investigation data provided?	Yes	See BIA Appendix E
Is monitoring data presented?	No	
Is the ground investigation informed by a desk study?	Yes	
Has a site walkover been undertaken?	Yes	
Is the presence/absence of adjacent or nearby basements confirmed?	Yes	See GMA
Is a geotechnical interpretation presented?	Yes	GMA based upon assumed parameters
Does the geotechnical interpretation include information on retaining wall design?	Yes	See BIA Appendix C but based upon assumed parameters
Are reports on other investigations required by screening and scoping presented?	Yes	Ground Investigation and Flood Risk in BIA Section 7
Are baseline conditions described, based on the GSD?	Yes	
Do the base line conditions consider adjacent or nearby basements?	Yes	
Is an Impact Assessment provided?	Yes	See BIA Section 10
Are estimates of ground movement and structural impact presented?	Yes	See GMA

Item	Yes/No/NA	Comment
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	See BIA Section 10
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	See BIA Sections 7 and 10
Has the need for monitoring during construction been considered?	Yes	See BIA Section 10
Have the residual (after mitigation) impacts been clearly identified?	Yes	See BIA Section 10
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	See GMA
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	GMA identifies Burland Category 1 damage category.
Are non-technical summaries provided?	No	But the report is well written and easily understood

4.0 DISCUSSION

4.1. The Basement Structural Method Statement is assumed to be a Basement Impact Assessment (BIA) for the requirements of a London Borough of Camden planning application.

4.2. The BIA has been carried out by Chartered Structural Engineer acting for AND Designs Limited but no evidence of expertise in engineering geology and hydrogeology has been provided as required by CPG4.

4.3. The authors of the additional GMA document and SFI document are a Chartered Geologist (cGeol) and a Chartered Civil Engineer (MICE), which meet the requirements of CPG4.

4.4. Flat 3, 269 Goldhurst Terrace comprises an existing ground floor flat which has a first floor flat above it and has a communal circulation space to one side. It is proposed to construct a side extension on the opposite side to the circulation area, up to the property's boundary wall and create a basement below the new increased ground floor footprint. This also requires the creation of four light wells, two at the front of the property and two at the rear.

4.5. A ground investigation has been produced by Chelmer Site Investigations, included as Appendix E of the BIA. Unfortunately this only comprises one borehole to a depth of 15 metres but indicates the presence of the London Clay formation to approximately ground level. Although the borehole was noted as dry on completion, no standpipe was installed so no monitoring of groundwater levels could take place. It is accepted that the recommendation in section 8 of the BIA that *"a soil investigation with an extended brief and detailed interpretative geotechnical report should be completed"* should be carried out prior to construction commencement. This would also allow standpipe installation and monitoring to be carried out which would enable confirmation of likely groundwater inflows into the excavation to be determined, thus verifying whether sump pumping would be necessary.

4.6. The applicant has suggested that requested groundwater monitoring could be part of a Planning Condition. It is accepted that this soil investigation and detailed interpretative geotechnical report could be produced as part of a Basement Construction Plan.

4.7. The BIA in section 10 offers a pictorial description of how any groundwater would be able to flow around the 3.8 metre deep basement. The preamble to the structural calculations in Appendix C states *"some of the properties have had basement conversions and it is intended to construct a 2.9-3.0 metre basement…"* The anomaly regarding basement depth should be clarified and any affected calculations for retaining walls and heave pressures resubmitted. The number, depth and location of the basement developments in the vicinity of the proposal should be identified to allow a more refined assessment to be made of the effect on the local hydrogeology.

4.8. The additional GMA document identifies that "the basement depth will be around 2.9 metres" and verifies that the only adjacent property which has a basement is No. 58 Priory Rad, which is within 5 metres of the basement below Flat 3's proposed extension. It is accepted that the proposed basement will have a negligible effect on the local hydrogeology.

4.9. The basement below the existing ground floor flat walls is proposed to be constructed using conventional underpinning methods which are accepted as indicated on the AND Designs Basement Details drawing. However, alternative details contained within a construction methodology document by Dig For Victory Limited, included as Appendix D in the BIA, are at variance with the Structural Engineer's Proposal and clarification is required as to which apply.

4.10. The reissue of the BIA merely repeats previous information and clarification as to which underpinning construction methodology applies should be contained within the Basement Construction Plan.

4.11. The basement walls below the ground floor extension are to be formed using cantilever reinforced concrete retaining walls. Calculations contained in Appendix C of the BIA are acceptable but clarification regarding basement depth is required, see item 4.5. An indicative temporary works proposal should be provided showing an acceptable methodology for the construction of this portion of the basement.

4.12. Although geotechnical design parameters are proposed within the Conceptual Ground Model of the GMA, these are stated to be "tentative due to the lack of test data." The design criteria needed for the retaining wall and foundation design to the extension basement will need to be confirmed prior to construction and would be available through the soil investigation produced as part of a Basement Construction Plan. The Ground Movement Assessment states that "the adequacy of temporary support will be critical in limiting ground movements" and assumes a "high stiffness" to the propping system providing temporary restraint. A temporary works scheme developed by the construction contractor should be provided as part of the Basement Construction Plan.

4.13. Statements are made in section 10 of the BIA concerning likely cracking damage to adjacent properties but no Ground Movement Assessment has been provided. A formal assessment should be submitted along with justification for the statement that *"the basement does not lie within a 45° angle of the highway".* If the highway is within 5 metres of the basement, it should be included within a movement assessment to determine any potential effect on buried services.

4.14. It is accepted that the additional GMA document identifies that Burland Damage Category 1 (Very Slight) will occur to No. 269 Goldhurst Terrace and to No. 58 Priory Rad. Heave of the basement floor due to soil removal will also occur. The author clearly states that the extent of movement is dependent upon good workmanship, speed and adequacy of temporary support and competence of the clay substrata. It goes on to state that "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" due to "the close proximity of the front of the property to the pavement and highway." This assessment of movements should be confirmed once the competence of soils is confirmed by a supplementary investigation, the results of which should be provided as part of the Basement Construction Plan.

4.15. Once a formal Ground Movement Assessment has been produced, the ground movement monitoring proposal in section 10 of the BIA can be properly assessed for adequacy.

4.16. The ground movement monitoring proposal contained within section 10 identifies Action Values relating to a Burland Damage Category of 2 (Slight) whereas the additional GMA document assesses likely damage as Category 1 (Very Slight). The Action Values stated are, therefore, too high and should be reconsidered bearing in mind the lower assessment of damage. This information should be provided as part of the Basement Construction Plan.

4.17. It is accepted that there are no slope stability concerns regarding the proposed development, that no known ponds, wells or aquifers are in close proximity to the site and that the site is outside the Hampstead pond chain catchment area.

4.18. The BIA correctly identifies that Goldhurst Terrace has been subjected to flooding during both the 1975 and 2002 flood events and that the site is at an approximate low point within the street. It correctly identifies that each light well should be protected by integral upstands to prevent flood water potentially entering the basement.

4.19. Architect's drawings of the existing and proposed ground flood layouts show that there is a reduction in garden area associated with an increase in either roof rainfall discharge or hard surfacing to terraces. An assessment of areas should be provided together with proposals to attenuate the increased discharge to the surface water drainage system. Proposals to pump rainwater collected in each light well should also be provided.

4.20. A Supplementary Flooding Information (SFI) document has been provided in response to the request for information which verifies that the risk of flooding from surface water runoff is considered low. It identifies that an additional area of hardstanding of $20m^2$ will be created by the development proposals which will require $1.3m^3$ of storage to be incorporated into an attenuation tank prior to discharging into the existing drainage system. It also recommends the introduction of a FLIP (Flooding Local Improvement Process) device should also be able to pump any rainwater that may accumulate in the lightwells. These measures are acceptable in order to mitigate potential flooding problems.

5.0 CONCLUSIONS

5.1. The BIA has been carried out by a Chartered Structural Engineer. Additional information has been provided which has been authored by a Chartered Geologist and a Chartered Civil Engineer which meet the requirements of CPG4.

5.2. A preliminary ground investigation has been carried out which confirms that the basement will be founded within the London Clay. The BIA proposes that a more detailed interpretative geotechnical report should be completed prior to construction commencement, which should include standpipes to monitor groundwater. It is accepted that this could be produced as part of a Basement Construction Plan.

5.3. Additional information has verified that the basement depth will be around 2.9 metres and that the only existing basement adjacent to the proposed development is at No. 58 Priory Road. It is accepted that the proposed basement will have a negligible effect on the local hydrogeology.

5.4. There is an anomaly within different sections of the BIA concerning the methodology to carry out underpinning below the existing walls of the ground floor flat, which should be clarified as part of a Basement Construction Plan.

5.5. The geotechnical design criteria required for retaining wall and foundation design to the extension basement will need to be verified by the further soils investigation to be provided as part of a Basement Construction Plan, which should also include a temporary works scheme developed by the construction contractor to meet the requirements stated in the GMA.

5.6. An additional Ground Movement Assessment document has identified that Burland Damage Category 1 (Very Slight) will occur to No. 269 Goldhurst Terrace and to No. 58 Priory Road on the basis of assumed criteria. This assessment should be verified once the competence of the soils is confirmed by the supplementary soils investigation. A risk assessment will also be required as part of the Basement Construction Plan due to the proximity of the front of the property to the pavement and highway.

5.7. The ground movement monitoring proposal contains Action Values that are not consistent with the current Damage Category assessment. A revised assessment should be provided as part of a Basement Construction Plan.

5.8. It is accepted that there are no concerns regarding slope stability, proximity of known ponds, wells or aquifers and the Hampstead Pond Chain catchment area.

5.9. It is also accepted that adequate measures prevent basement flooding via the four new light wells have been identified in the BIA bearing in mind that Goldhurst Terrace flooded in 1975 and 2002 and No. 269 lies at the low point of the street.

5.10. The proposals indicate a net reduction in garden area which produces an increased discharge to the surface water drainage system. An additional document has been provided which provides acceptable mitigation measures to offset potential flooding issues.

Appendix 1: Resident's Consultation Comments

None

Appendix 2: Audit Query Tracker

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Audit Query Tracker

Query No	Subject	Query	Status/Response	Date closed out
1	BIA Author Credentials	Evidence of expertise in engineering geology and hydrogeology.	Additional information accepted	16.6.16
2	Ground Investigation	Detailed interpretative geotechnical report to include standpipes and monitoring.	To be provided as part of a Basement Construction Plan	
3	Stability	Basement depth and details of adjacent basements to be clarified.	Additional information accepted	16.6.16
4	Stability	Basement underpinning methodology to be clarified.	To be provided as part of a Basement Construction Plan	
5	Stability	Retaining wall soil design criteria and construction stage temporary works proposal required.	To be provided as part of a Basement Construction Plan	
6	Stability	Ground Movement Assessment of adjacent properties and highway to be reconfirmed	To be provided as part of a Basement Construction Plan	
7	Stability	Ground movement monitoring proposal to be reviewed and resubmitted	To be provided as part of a Basement Construction Plan	
8	Surface Water	Assessment of hard standing areas and attenuation proposals of surface water required. Details of light well pumping system is required.	Additional information accepted	16.6.16

Appendix 3: Supplementary Supporting Documents

Ground and Project CONSULTANTS LTD

FLAT 3, 269 GOLDHURST TERRACE, LONDON, NW6

3EPBasement Impact Assessment: Land Stability and Assessment of Ground Movement

March 2016

Client:

DIG FOR VICTORY LTD

20 MORTLAKE HIGH STREET,

LONDON

SW14 8JN

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, Dig For Victory Ltd.

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, Dig For Victory Ltd. 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.

1. Introduction

Ground and Project Consultants Ltd have been instructed by Dig For Victory Ltd (DFV) to undertake the land stability element of a Basement Impact Assessment, for Flat 3, 269 Goldhurst Terrace, London, NW6 2EP. The property is located in the London Borough of Camden, London in the Swiss Cottage ward, its location is indicated on Figure 1.

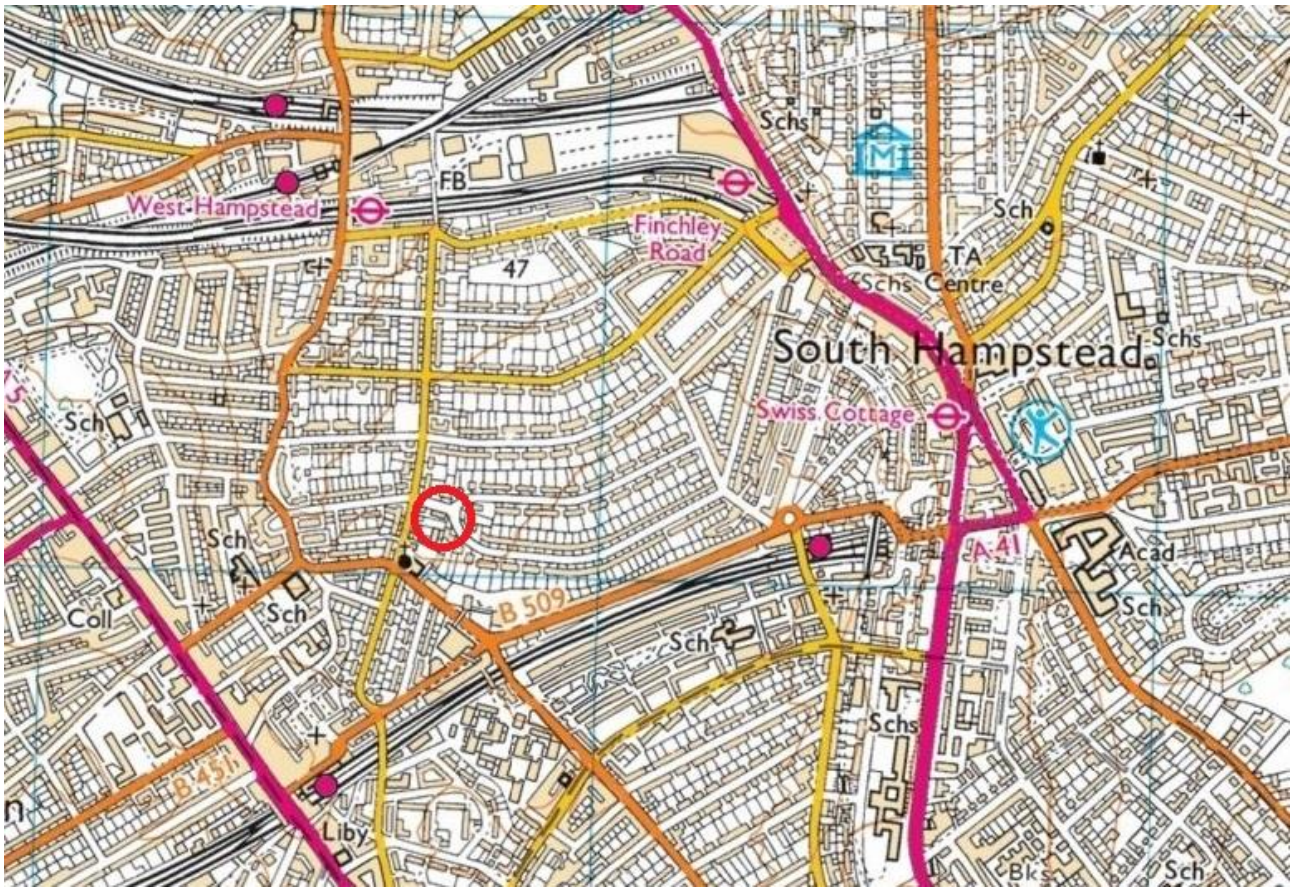

Figure 1: Site Location

2. Scope and Objective

The scope of this report and approach is as follows:

- A review of the existing data supplied by the client has been carried out, including the proposal drawings produced to date, Ground Investigation data, photos of the building and the background data available through London Borough of Camden's website and other freely available data such as BGS geological information and purchased environmental data.
- In line with the London Borough of Camden guidance, CPG4, latest revision:
- In line with the CPG4 guidance:
    - A detailed assessment of the published and encountered geology
    - Development of a ground model including an assessment of geotechnical properties
    - An engineering interpretation including an assessment of slope stability and commentary and assessment regarding ground movements.
- Recommendations for additional work/ monitoring and observation have been provided.
- An Assessment of Ground Movements due to the proposed basement construction has been carried out.

The report has not considered contaminated land aspects of the site.

This report and the work to support it has 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. BIA Screening for Slope/Land Stability

A screening exercise has been carried out as per the guidance in Camden's Guidance for Basements, CPG4 as follows:

Question	Answer	Action/ Comment
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 relatively level.	None
Question 2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7deg? (approximately 1 in 8)	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 7deg? (approximately 1 in 8)	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 7degrees? (approximately 1 in 8)	No, the slope in the area is around 1 in 40 (2^{o}) based on Ordnance Survey data. The site is some distance from Hampstead Heath and steeper ground	None
Question 5: Is the London Clay the shallowest strata at the site?	Yes: London Clay is indicated as the shallowest strata on the BGS maps. Head Deposits may be present.	The presence of London Clay close to surface is further discussed in the Impact Assessment.
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? (Note that consent is required from LB Camden to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).	It is understood that there will not be a need to fell trees. However the site sits within South Hampstead conservation area. Trees are present at site.	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. However London Clay is close to surface.	Further discussed in the Impact Assessment.

Question 8: Is the site within 100m of a watercourse or a potential spring line?	No: Figure 11 of the Arup report indicates a 'Lost River' some distance to the east of the property.	None
Question 9: Is the site within an area of previously worked ground?	None known or suspected.	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. The London Clay is classified by the Environment Agency as unproductive strata (rock layers with low permeability and negligible significance for water supply or river base flow). The site is not within a source protection zone of a public water supply. However the basement may extend into the water table.	This is further discussed in the Impact Assessment.
Question 11: Is the site within 50m of the Hampstead Heath ponds?	No	None
Question 12: Is the site within 5m of a highway or pedestrian right of way?	Yes	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?	It is understood that basements are not present in the adjacent neighbouring properties. It is understood that there is a basement in 58 Priory Road.	This is further discussed in the Impact Assessment.
Question 14: Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	None

4. Site Information

4.1 Existing Property and Basement Proposals

The property at 269 Goldhurst Terrace is located on the south side of the road, in between its junctions with Aberdare Gardens and Priory Road. 269 Goldhurst Terrace is a two storey brick built 1960's building. Flat 3 occupies the ground floor. Other flats at 269 Goldhurst Terrace adjoin to the West. The property is around 1.8km North West of Regents Park and around 500m south of

the Jubilee Line, 800m south west of Finchley Road and 600m south west of West Hampstead Stations. Swiss Cottage tube station is about 650m to the east.

The National Grid reference for the property is TQ 25712 84109. The location of the property is provided in Figure 1 above.

There are a number of trees and bushes in the garden and adjacent gardens and on the pavement in front of the property.

It is proposed to extend the property with a 3 wide extension to the west (i.e. towards no.58 Priory Road) and construct a single storey basement beneath the full footprint of the extended property. The basement depth will be around 2.9m. The basement footprint will be approximately 11m by 9m maximum dimensions with a footprint of approximately 85m^2. The descriptions and dimensions above have been estimated from drawings provided by DFV.

4.2 **Topography**

The OS map indicates the property is at around 42m AOD. The ground surface rises gently towards the North West at around 1 in 60 (less than 2^o). There is no significant change in elevation at the property.

4.3 **Geology**

The available geological mapping (Ref 1.) indicates that the site lies on London Clay which typically comprises a stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. The geological map (North London 256) indicates that the property is relatively close to an area of 'propensity' for Head Deposits (stippled area on the map in figure 2), associated with the higher ground of Highgate Hill. Typically these deposits are thin (<2m) and consist of soft, ocherous brown silty clay with blue-grey mottling in places and angular, frost-shattered fragments of flint occur sporadically throughout. The base of the London Clay is likely to occur significant depth below the property. See figure 2 below.

Figure 2: Geology

4.4 Hydrology and Hydrogeology

The OS Map indicates that there are no surface water bodies in the vicinity of the site. The Grand Union Canal forms the northern boundary of Regents Parks some 1.6km to the SE. The Hampstead Ponds are approximately 2.5km to the NE. There are no springs shown on OS mapping. There is a 'lost river' indicated approximately 100m to the northwest.

The London Clay is classified by the Environment Agency as unproductive strata (rock layers with low permeability and negligible significance for water supply or river base flow). The site is not within a source protection zone of a public water supply. There are no groundwater abstraction licenses within 2 km of the site and no source protection zones within 500 m of the site. (Ref 5. Groundsure Report).

4.5 Other Environmental Data

The Groundsure report for a nearby property gives a wealth of background data on local environmental issues and hazards. (See Appendix A). Some of the key issues relevant to land stability are summarised in the table below:

Local Waste/Landfill sites	There is a waste depot and transfer station 500m to the NE of the property
Drift Deposits	None are indicated on BGS mapping
Made Ground	None are indicated on BGS mapping
Groundwater Abstraction	There is a supply borehole less than 1km to the East
Flood Risk	There is some flood risk at the property. The area is not prone to groundwater flooding. (This is discussed separately in the FRA report)
Shrink/ Swell	There is a moderate Hazard of shrink and swell from the London Clay soils
Landslide	Very Low Risk
Soluble Rocks	Negligible Risk
Compressible Ground	Negligible Risk
Collapsible Ground	Very Low Risk
Running Sand	Very Low Risk
Mining	None recorded

A number of historic OS maps have been obtained, see figures 3-5 below. These show that the property was constructed as infill within the former rear garden of /land associated with 58 Priory Road.

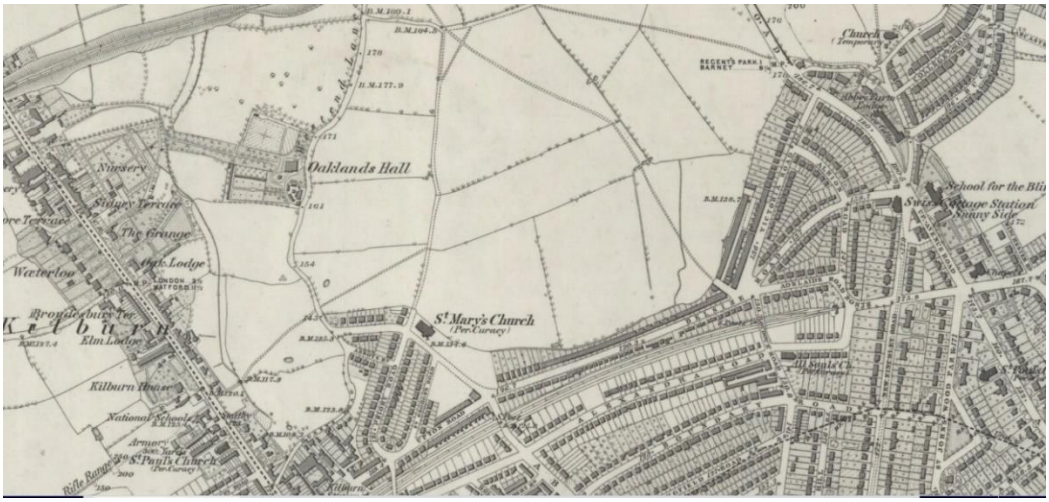

Figure 3: Historic Map 1866

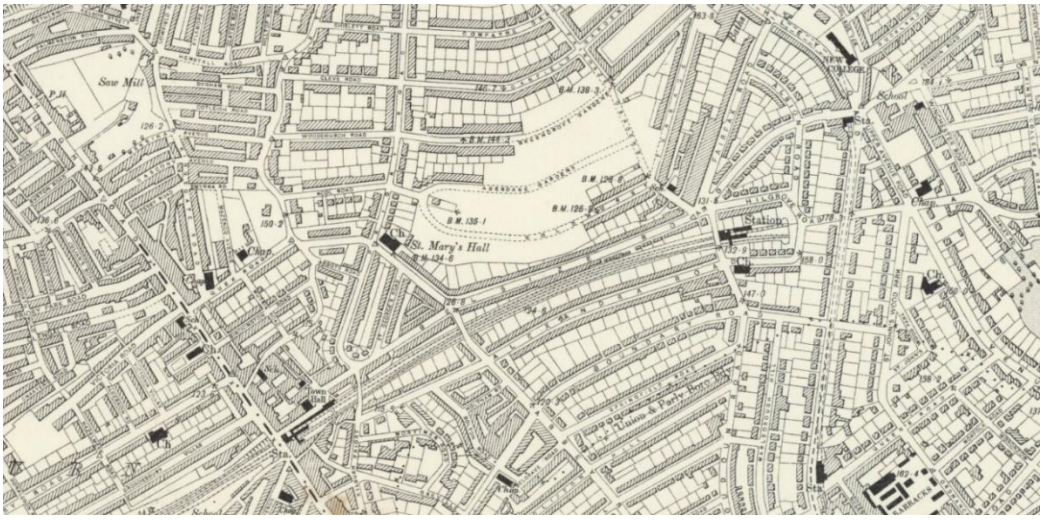

Figure 4: Historic Map 1894

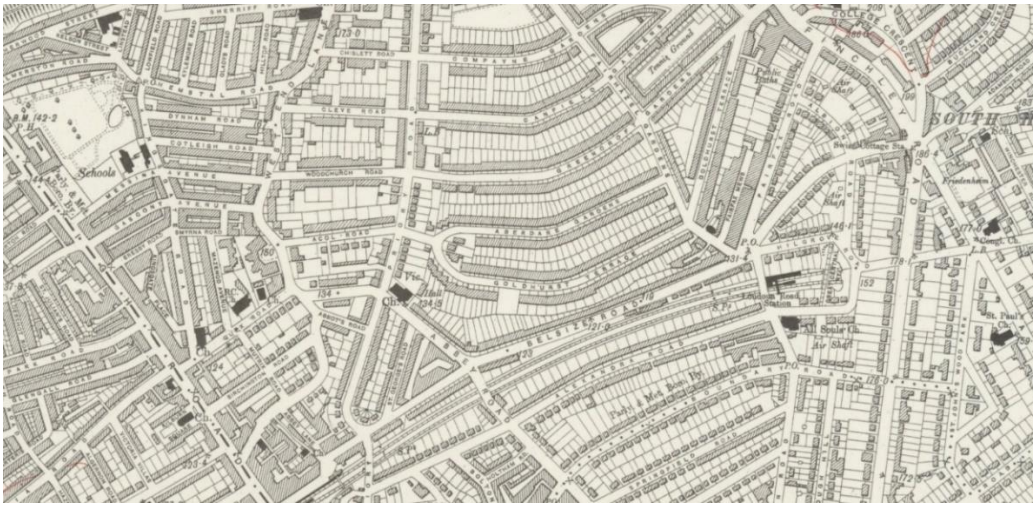

Figure 5: Historic Map 1912

5. Ground Investigation

A ground investigation (GI) has been carried out at the site by Chelmer Site Investigations for Dig For Victory Ltd (DFV) and results of these have been made available by DFV. The GI was carried out in April 2015.

The work comprised one borehole (BH1) to 15.00m bgl drilled using a CFA rig, in the rear garden area of the property. No groundwater monitoring was installed.

Below is a summary derived from the Ground Investigation report. The borehole encountered a thin cover of topsoil/turf, 0.20m thick. Below this the borehole encountered an 'upper' clay deposit described as 'Firm, brown, sandy silty CLAY with fine gravel'. This probably represents the Head Deposit, given the presence of gravel. At 2.5m this passes into a 'Stiff or very stiff, brown, silty CLAY with partings of brown and orange silt and fine sand, claystone nodules and crystals'. This is London Clay.

Groundwater was not encountered during drilling. No roots were noted in the borehole.

Hand shear vane testing was carried out in the clay deposits. In the Head Deposit, these gave undrained shear strength values of 72kN/m^2 increasing to 114kN/m^2. This correlates to the description of firm to stiff becoming stiff. The London Clay had a shear strength exceeding the shear vane's capability of 130kN/m^2 throughout, equating to stiff or very stiff.

Laboratory tests were carried out on the disturbed samples collected from the boreholes. Testing consisted of the following:

9 No. Atterberg Limit test including moisture content determination
3 additional moisture content determination
2 No. Soluble Sulphate, pH and related tests for Concrete Classification on soil samples

Two (2No) of the Atterberg tests were conducted in the Head Deposit. These are consistent with similar values both of water content and atterberg limits as follows:

- Moisture Content 29 to 30%
- Plastic Limit: 23%
- Liquid Limit: 64 to 68%
- Plasticity Index: 42 to 45%
- Liquidity Index 0.17 to 0.16 (decreases with depth)

The Head Deposit is classed as a clay of high plasticity. Seven (7No) Atterberg Limit tests were performed on London Clay. Again these are consistent with narrow ranges of values as follows:

- Moisture Content 27 to 32%
- Plastic Limit: 21 to 27%
- Liquid Limit: 67 to 79%
- Plasticity Index: 44 to 53%
- Liquidity Index 0.04 to 0.18 (decreases with depth)

The minimal variation in liquid, plastic limits and high plasticity index is indicative of London Clay, indicating a clay of high becoming very high plasticity. The water content and liquidity index are reflective of a firm to stiff/stiff clay which correlates reasonably with the shear vane results.

6. Conceptual Ground Model

From the above a conceptual Ground model has been developed and is presented in tabular form below:

Strata	**Typical Description**	**Depth at Property encountered in GI**	**Geotechnical Properties – Tentative Characteristic Values***	**Comments**
Head Deposit	Firm, brown, sandy silty CLAY with fine gravel'	Below topsoil to 2.5m	C' =0 ϕ' = 18^o Cu = 60kN/m^2 **	The undrained shear strength of the Head Deposit should be confirmed prior to construction
London Clay	Stiff, brown, silty CLAY with partings of brown and orange silt and fine sand, claystone nodules and crystals..	2.50 to 15.00m (base not proven).	C' =0 ϕ' = 20^o Cu = 80 increasing to 100kN/m^2 at formation. **	The undrained shear strength of the London Clay should be confirmed prior to construction
Groundwater		Not encountered: Local data available suggests groundwater levels between 1m and 2m bgl		Likely to be present but not found due to low permeability of Head Deposit and London Clay and speed of drilling. May significantly vary seasonally or after prolonged wet or dry periods.

Table 3: Summary of Strata Characteristics

*The determination of parameters is tentative due to the lack of test data.

**Strength should be verified by hand held shear vane/ inspection during ground excavation.

7. Impact Assessment

There are no apparent major issues which should seriously affect the viability of the construction of the new basement. However the assessment of the geological environment of Flat 3, 269 Goldhurst Terrace and the screening exercise indicate some areas for further discussion in this report with suggested mitigation where appropriate.

7.1 **London Clay/Shrink and Swell:** The basement will be founded in London Clay, with Head Deposits above. The soils are of high and very high plasticity and high volume change potential. The basement will be founded at around 2.9m bgl, therefore below any seasonal shrink and swell. The London Clay soils are known for their high levels of soluble sulphate. The concrete mix design should take appropriate account of sulphate levels in accordance with BRE Special Digest 1. The basement structure should be designed to account for swelling pressures.

7.2 **Trees:** Trees are located in the garden and vicinity and the property is within the South Hampstead conservation area. Although roots have not been noted in the ground investigation it is likely that they will be encountered during basement excavation and related excavation works. Care should be taken to minimise root damage during construction works. Should trees be removed there is potential for the soils to swell as a result which may affect this and neighbouring properties and this should be accounted for in design and further assessed as appropriate.

7.3 **Groundwater/Aquifer**: Groundwater was not encountered during the ground investigation. This lack of measurement will not necessarily be representative groundwater presence and levels within the London Clay. The low permeability of the London Clay and Head Deposit coupled with the speed of the drilling process means that any groundwater present in the soils will have not been observed. Typically Groundwater levels in this area have been observed at around 1m below ground level. It is recommended that a design level of ground surface is used, this accounts for seasonal variations and leaks from water supply, etc. Groundwater may be encountered during the works, particularly as seepages through sandy silty layers within the Head Deposit or London Clay or at the base of any Made Ground that may be encountered. (Some Made Ground can be expected particularly associated with past construction activities.) These should be managed carefully to prevent ground loss particularly through loss of fines. Softening of formation due to water ingress is a risk and softened soils should be excavated and replaced where practicable. Consideration should be given to limiting the size and time of face exposures during construction should significant flows be encountered during construction. Baseline and ongoing regular monitoring of the building and its immediate neighbours for settlement and movement/distress is highly recommended during building works and for a short period after completion. It is recommended that ongoing monitoring of groundwater levels is carried out during and up to the end of construction of the basement structure.

7.4 **Lost River:** There is a lost river indicated some distance from site. It is considered that this is unlikely to have an impact on the proposal.

7.5 **Basement Depth**: It is proposed to be construct the basement to a level of approximately 2.9m below the existing ground floor. The property adjoins a neighbouring property and the extended property will be within 5m of no.58 Priory Road. The proposals to construct the basement are understood to be via underpinning at the party wall. Underpinning proposals are understood to involve a 'hit and miss' approach in stages so each 'panel' is separated by 3-5 others from the next open one. It will be important that the building contractor is closely supervised and is experienced in this type of construction. It will be critical to prevent exposed faces from collapse or significant ground loss into the new excavation and temporary face support should be maintained where practicable. It is understood the there are no basements in adjoin/adjacent properties. Most ground movement should occur during wall installation, excavation of the basement and construction so the adequacy of temporary support will be critical in limiting ground movements.

A number of factors will assist in limiting ground movements:

- The speed of propping and support
- Good workmanship
- Ensuring that adequate propping is in place at all times during construction
- Installation of the first (stiff) support quickly and early in the construction sequence.
- Avoidance of ground loss through the gaps between the piles.
- Avoid leaving ground unsupported.
- Minimise deterioration of the central soil mass by the use of blinding/ covering with a waterproof membrane.
- Avoid overbreak
- Control dewatering to minimise fines removal and drawdown.

7.6 **Construction near footpath and highway:** The close proximity of the front of the property to the pavement and highway, means that works will be carried out in adjacent to areas of 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.

8. Assessment of Ground Movement

An assessment of ground movements has been carried out as follows:

- Movements have been assessed for the adjoining and closest properties (Adjoining property at 269 Goldhurst Terrace and 58 Priory Road) which are predicted to arise due to the excavation of the basement. Movements at 56 Priory Road have not been assessed.
- The magnitude of ground movements has been assessed for the excavation in front of the retaining structure.
- Movement due to Wall installation has been discounted at this stage as it is understood that the property will be underpinned, and as such a wall will not be installed into the ground. Rather the 'wall' will be installed into the excavation.
- It is important to note that CIRIA report C580 is written for embedded retaining walls. Therefore movement calculations for the excavation of soil and installation of underpins does not strictly apply to C580. There is no recognised method for calculating ground movements due to underpinned basements so C580 is used as a convenient and recognised approach. However it is recognised that settlements are generally small where care and appropriate measures are taken in construction.

Outline planning drawings developed by AND Designs, OMNIDE and DFV have been reviewed and used to inform this assessment.

The following key assumptions have been made:

- The maximum excavation depth is approximately 2.9m bgl.
- The method of basement construction will be via underpinning using a 'hit and miss' approach.
- A high wall stiffness has been assumed.
- In the permanent case the wall will always be propped at high level.
- The adjoining property (269 Goldhurst Terrace) is attached to the subject property.
- No.58 Priory Road is 4.5m from the property.
- For the purposes of the calculations, the width and height of the subject properties have been estimated to be as follows:
    - 269 Goldhurst Terrace: 8m and 6m respectively.
    - 58 Priory Road: 10m and 12 respectively
- A London Clay soil of at least stiff consistency has been assumed.

From figure 2.11 in C580 the following calculated assessments of ground movements have been developed due the excavation of soils in front of the wall. An excavation depth of 2.9m has been assumed.

No 269 Goldhurst Terrace

Distance from wall* (m)	**0 (Near side)**	**8 (Far side)**	**Max Vertical Movement**
Horizontal Movement (mm)	5	1-2	
Vertical Movement (mm)	1	1	~3mm at 1.8m from the basement

No. 58 Priory Road

Distance from wall*(m)	**4m (Near side)**	**14m (Far side)**	**Max Vertical Movement**
Horizontal Movement (mm)	3	<0.5	
Vertical Movement (mm)	2	<0.5	The near wall of no.58 is also the likely location of maximum vertical movement

This assumes that the wall is propped high and therefore a high stiffness can be assumed when reading from the graphs. It is understood that there will be adequate propping in the temporary case to justify this assumption and in the permanent case the structure will provide adequate support to the retaining walls and act as a high level prop.

There are a number of key points to note in using this assessment:

- Most ground movement will occur during wall installation, excavation of the basement and construction so the adequacy of temporary support will be critical in limiting ground movements.
- The speed of propping and support is key to limiting ground movements
- Good workmanship will contribute to minimising ground movements.
- The assessment assumes the wall is in stiff/competent clay.

- Larger movements will be expected where soft soils are encountered at, above and below formation.

Ground movement can be minimised by adopting a number of measures, including:

- Ensuring that adequate propping is in place at all times during construction
- Installation of the first (stiff) support quickly and early in the construction sequence.
- Avoidance of ground loss through the gaps between the piles.
- Avoid leaving ground unsupported.
- Minimise deterioration of the central soil mass by the use of blinding/ covering with a waterproof membrane.
- Avoid overbreak
- Control dewatering to minimise fines removal and drawdown.

It must be noted that the movements are calculated values based on the findings and methods of CIRIA C580. Larger movements may be generated if any one or any combination of the above recommendations and/or assumptions are not heeded or if ground conditions are different to a firm to stiff or stiff London Clay.

In terms of building damage assessment and with reference to Table 2.5 of C580 (after Burland et al, 1977), the 'Description of typical damage' given the *calculated* ground movements is likely to be:

- For adjacent part of no. 269 Goldhurst Terrace: 'Very Slight'
- For no. 58 Priory Road: 'Very Slight'.

Movement will also be experienced by Flat 3 and the Flat above. This has been calculated to be 5mm horizontal and around 1mm vertical, plus the heave as assessed below. Again the actual magnitude of these movements will depend upon a number of factors described above.

Heave

Heave of the ground will occur within the basement due to soil removal and consequent unloading of the soil. Using elastic and consolidation theories, both immediate and longer term heave movements have been calculated for within the basement. These are calculated figures and apply to the centre of the basement. The figures will be significantly lower at the edges and lower still at the corners and estimates are provided. The figures presented represent estimates and are based on a number of assumptions.

Immediate upward (elastic) movements have been calculated at around 6mm. These will be completed upon completion of soil excavation usually within about 7 days.

Longer term soil swelling will also occur. The rate of this longer term swelling will be determined largely by the availability of water and the low permeability of the London Clay. As a result this may take many years to reach full equilibrium. The basement slab will need to be sufficiently stiff to enable it to accommodate the swelling displacements/pressures developed underneath it. The amount of long term swelling has been calculated to be of the order of 6mm for the centre of the excavation with the centre of basement edges and corners having calculated values of the order of 3 to 4mm.

9. Conclusions

The methodology and approach of CPG4 has been followed in developing this BIA with respect to Land stability. It is concluded that with the construction of the new basement at Flat 3 269, Goldhurst Terrace should not have significant impacts on land stability provided that:

- Groundwater inflow, if encountered, is reduced to a minimum and properly controlled such that there is no significant wash out of fine material. Groundwater levels should be monitored before and during construction.
- The retaining wall should be appropriately designed.
- The construction of the basement is carried out by competent and experienced contractors and precautions are taken to maintain the stability of the excavations.
- Care should be taken to minimise the disturbance and damage to trees and their roots. Should tress be removed then an assessment of the potential for swelling of the London Clay and Head Deposit soils should be carried out.
- Concrete should be designed in accordance with BRE Special Digest 1 accounting for the sulphate conditions anticipated.
- Monitoring of the structures is carried out before and during construction. The exact nature of this monitoring should be determined by the structural engineer.

10. References

1. BGS Geological Map Sheet 256.
2. Ordnance Survey Map, Explorer 173, London North
3. Arup: Camden Geological, Hydrogeological and Hydrological Study.
4. AND Design Drawings and Method statements
5. OMNIDE Planning Drawings
6. DFV Method Statements
7. Chelmer Site Investigations: Report Ref FACT /5268 A: 269 Goldhurst Terrace
8. Groundsure EnviroInsight report for Priory Rd, GS-2103155

Our Ref: KC1062/SS
Your Ref: Planning Ref: 2015/4513/P

13 April 2016

Jon Smithson
Ground and Project Consultants
Langley House
1 Meole Hall Gardens
Shrewsbury
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Dear Sir,

Planning Ref: 2015/4513/P Proposed Works at Flat 3, 269 Goldhurst Terrace, London NW6 3EP Supplementary Flooding Information

A Flood Risk Assessment (FRA) for the proposed extension at 269 Goldhurst Terrace, London, was prepared by AND Designs Limited in June 2015 and submitted within their Basement Structural Method Statement (BIA) as part of the planning application for the development. A site location plan is shown in Figure 1. The planning proposal is described as the *"Erection of single storey side extension and creation of basement below existing dwelling and new extension, with 2 no. front and 2 no. rear light wells".*

Kaya Consulting were commissioned by Ground and Project Consultants to provide additional information related to flood risk, surface water runoff and flood risk management/mitigation measures, if required.

Kaya Consulting accessed the London Borough of Camden's (LBC) online planning portal on April 13 2016 and reviewed the latest documents related to the planning submission, as below:

- AND Designs Limited (2015) Basement Structural Method Statement: Planning Application for 269 Goldhurst Terrace, London, NW6 3EP, June 2015 (the BIA)
- Campbell Reith Consulting Engineers (2015) Flat 3, 269 Goldhurst Terrace, NW6 3EP Basement Impact Assessment Audit, November 2015 (Audit commissioned by LBC)
- OMNIDE (2015) N. 269 Goldhurst Terrace – Planning Presentation 1.3, showing existing and proposed planning drawings

This letter summarises the key findings of the BIA (AND 2015) and subsequent BIA Audit (Campbell Reith, 2015) with respect to flood risk, provides additional detail on the key flood risk issues identified at the site and provides responses to the audit queries raised in the BIA Audit relating to surface water runoff and flood risk.

Key findings of the BIA (AND 2015) and BIA Audit (Campbell Reith, 2015)

The BIA identified that parts of Goldhurst Terrace were flooded by surface water in the 1975 and 2002 floods and the following table summarises the potential sources of flooding identified in the screening assessment:

Potential Source	Potential Flood Risk at Site?	Justification
Fluvial flooding	No	EA Flood Mapping shows Flood Zone 1. Distance from nearest surface watercourse >1km
Tidal flooding	No	Site location is 'inland' and topography > 40m AOD.
Flooding from rising / high groundwater	No	Site is located on low permeability London Clay.
Surface water (pluvial) flooding	Yes	Recorded in unspecified part of Goldhurst Terrace in 1975 and 2002
Flooding from infrastructure failure	Yes	Drainage at or near the site could potentially become blocked or cracked and overflow or leak. Drainage of the basement terrace areas may rely on pumping.
Flooding from reservoirs, canals and other artificial sources	No	There are no reservoirs, canals or other artificial sources in the vicinity of the site that could give rise to a flood risk.

(Source: AND Designs, 2015)

The BIA Audit confirmed that the BIA correctly identified that Goldhurst Terrace was flooded during both the 1975 and 2002 flood events and that the site is at an approximate low point within the street. The Audit also notes that the BIA correctly identified that each of the 4 light wells should be protected by integral upstands to prevent flood water potentially entering the basement.

The BIA Audit also notes that the existing and proposed ground floor layouts show a reduction in garden area associated with an increase in either roof rainfall discharge or hard surfacing to terraces. The Audit recommends that an assessment of areas should be provided together with proposals to attenuate the increased discharge to the surface water drainage system. The Audit also notes that proposals to pump rainwater collected in each light well should be provided.

The key flood risks at the site are:

1. Surface water (pluvial) flooding. Surface water flooding was recorded in an unspecified part of Goldhurst Terrace in 1975 and 2002 (Appendix 4, Floods in Camden (2003) report). It is also understood that the surface water flooding in this area was due to the Thames Water relief sewer being overloaded. It is also understood that Thames Water have since increased the capacity of this relief system.

2. Flooding from infrastructure failure. The Thames NW relief sewer is located close to the site and a trunk sewer is believed to run along the road adjacent to the site.

Supplementary Information on Flood Risk

There are two potential sources of flooding risk identified; and these are from surface water and from infrastructure failure.

It is possible that excess surface water could enter the basement through the light wells at both the front and back of the building. LiDAR ground elevation data was obtained and was analysed for overland flow paths within the area. The results are shown in Figure 2, which indicate the land falls to the south and east.

Goldhurst Terrace level drops from about 41.7 m AOD in front of the site to 37.8 m AOD along the section of the road shown in Figure 2, over some 370m. Ground levels in the approximate location of the Thames relief sewer are around 39.1 m AOD, over 2 m below the site level.

The overland flow paths shown in Figure 2 indicates that the catchment area from which surface water runoff could drain towards the site is very small and therefore the risk of flooding of the site from surface water runoff is low. Most of the surface water runoff upslope of the site flows southwards along Priory Road away from the site.

Based on the LiDAR data, the site sits at approximately the same level as the road, but there is a raised kerb and pavement between the property and the road and given the very small area of surface water runoff draining towards the site (Figure 2), it is unlikely that water would reach depths high enough to overtop the pavement. Nevertheless, the BIA and BIA Audit recommends each of the 4 light wells should be protected by integral upstands to reduce any risk of flood water potentially entering the basement and this is recommended as a precautionary measure.

It is understood that an unspecified part of Goldhurst Terrace was subject to flooding in 1975 and 2002 due to surcharging from Thames Water relief sewer. It is understood that the capacity of this sewer has been increased since then. Figure 2 indicates that any flood waters surcharging from the sewer would tend to flow east. This indicates that the risk of flooding from flood waters surcharging from the Thames sewer appears low.

As the area is developed, it is served by a local sewer system. Any flood waters surcharging from the local sewer system would tend to flow east, following the indicative overland flow paths shown in Figure 2. Therefore, the risk of flooding of the site from surcharging local sewer system appears low.

In summary, giving the fall of the land to the east as shown in Figure 2 and the small upstream catchment area from which surface water runoff could drain towards the site, the risk of flooding from surface water runoff is considered low.

Attenuation of increased surface water runoff from site (due to increased areas of hardstanding)

Planning drawings of the proposed and existing ground floors, indicate that the proposals extend out into the existing terrace area west of the existing building. Hence an area of existing terrace will become a building with associated roof runoff. In addition, part of the garden area to the rear of the property will become a terrace area in the proposed plans. It is assumed that the terrace area is impermeable and is considered hardstanding. The additional area of hardstanding was measured to be

approximately 20 m^2 (i.e. 0.002ha), which will result in slightly increased runoff during high rainfall events compared to existing case.

The volume of runoff that is required to be attenuated to account for the increase in hardstanding compared to existing case was calculated using the Equation 8.6 in CIRIA (C635):

Volume of runoff to be attenuated (m^3) = 10 x RD x A x (0.8)

Where: RD = the rainfall depth for 100 year, 6 hour event (mm). This was calculated using the Flood Estimation Handbook (2009) CD as 84.1 mm and;
A = the additional area of site (ha) is hardstanding (i.e. 0.002 ha).

Thus, the volume that is required to be attenuated is 1.3 m^3. Therefore, it is recommended that the client incorporate a small storage tank to collect and attenuate additional surface water runoff prior to discharging to existing drainage system.

Flood Mitigation Measures

As recommended in the BIA and BIA Audit, each of the 4 light wells should be protected by integral upstands to reduce any risk of flood water potentially entering the basement and this is recommended as a precautionary measure. In this regard, upstands of the order of 0.2-0.3m high above existing ground level should be sufficient.

In addition, it is recommended that an appropriate pumped device is installed, for example a FLIP (Flooding Local Improvement Process) device. The device is a small self-contained pumping unit which is designed to transfer sewage and rainwater from the private drains in individual homes to the main sewer in the road, even during heavy rain. The device also contains a non-return valve, to prevent backflow from the sewer entering the property. A FLIP will significantly reduce the risk of sewer flooding and should be installed as part of the construction/basement extension works. This should also be able to pump any rainwater that may accumulate in the lightwells. The BIA method statement recommends the use of the Delta Dual V3 Sump.

In addition, to reduce the effects of increased surface water runoff from the loss of a small part of the garden to hardstanding, the client should consider installation a small attenuation storage tank, within the drainage system. The volume required to be attenuated is calculated above.

Yours faithfully,

Dr Yusuf Kaya CEng and MICE
Managing Director

<u>References</u>

AND Designs Limited (2015) Basement Structural Method Statement: Planning Application for 269 Goldhurst Terrace, London, NW6 3EP, June 2015 (the BIA)

ARUP (2010) London Borough of Camden: Camden geological, hydrogeological and hydrological study: Guidance for subterranean development, November 2010

Campbell Reith Consulting Engineers (2015) Flat 3, 269 Goldhurst Terrace, NW6 3EP Basement Impact Assessment Audit, November 2015 (Audit commissioned by LBC)

CIRIA (2006) C635 Designing for exceedance in urban drainage – good practice

Flood Estimation Handbook (FEH) (2009) CD-Rom Version 3;

London Borough of Camden (June 2003) Floods in Camden: Report of the Floods Scrutiny Panel

OMNIDE (2015) N. 269 Goldhurst Terrace – Planning Presentation 1.3, showing existing and proposed planning drawings

Figure 1: Site location plan also showing indicative line of Thames NW Sewer

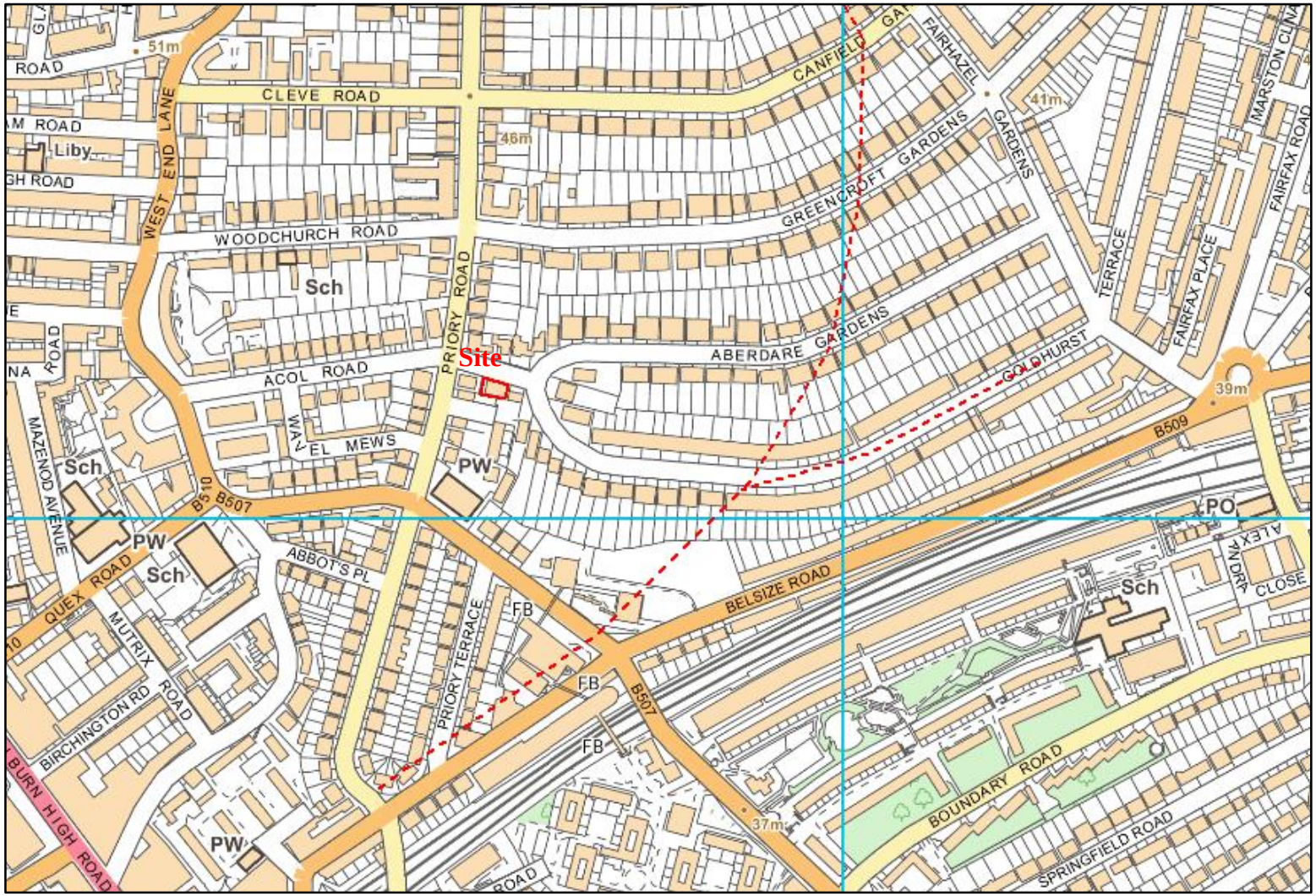
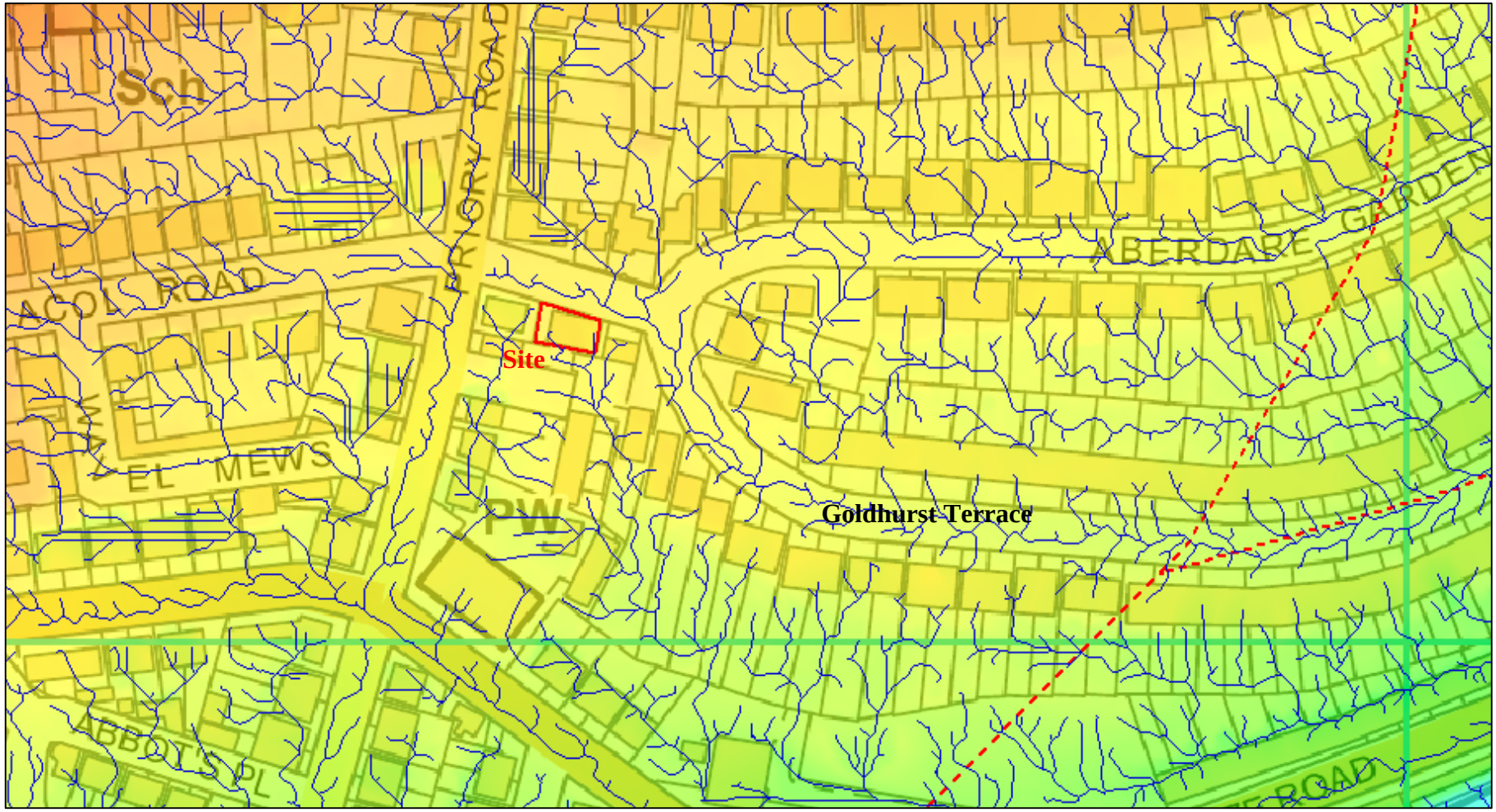


Figure 2: Indicative overland flow paths



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