5.0 Groundwater Impact Assessment

Groundwater Impact Assessment

8 Lindfield Gardens
London
NW3 6PX

Site NGR: **TQ 2608 8528**

Prepared for:

David & Karin Gillerman

March 2013

5 Richmond Hill Avenue, Bristol, BS8 1BG
+44 (0) 7595 023148 paul.thomson@onomatopia.net

Groundwater Impact Assessment

Site Address

8 Lindfield Gardens

London

NW3 6PX

Site NGR: TQ 2608 8528

Document Control Sheet

This report has been prepared with all reasonable skill, care and diligence within the terms of the contract with David and Karin Gillerman incorporating Terms of Agreed work and taking account of the manpower and resources devoted to it by agreement with the client.

Whilst every effort has been made to ensure that the information presented in this document is accurate and that the opinions expressed are sound, Paul Thomson cannot be made liable for any errors or omissions or for any losses or consequential losses resulting from decisions based on its contents.

The report is confidential to David and Karin Gillerman. Paul Thomson accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known.

Prepared by:	Paul Thomson BSc. MSc. DESS CGeol	[signature]

Report no:	R1	**Issue no:**	2	**Date:**	27th March 2013

Paul Thomson – Consultant Hydrogeologist
5 Richmond Hill Avenue, Bristol. BS8 1BG
+44 (0) 7595 023 148 paul.thomson@onomatopia.net

Contents

8 Lindfield Gardens
Groundwater Impact Assessment

1 Introduction

1.1 Background

David and Karin Gillerman are applying for Planning Consent to extend the existing part basement of 8 Lindfield Gardens (the Site). At the request of Finkernagel Ross Architects Limited, and working on behalf of David and Karin Gillerman, a groundwater impact assessment has been carried out in connection with the proposed development.

Site investigation works have been undertaken by Site Analytical Services (SAS) Ltd. The work has included a detailed ground investigation[1]. This assessment should be read in conjunction with the ground investigation report.

1.2 Scope and Approach

The London Borough of Camden's "Guidance for Subterranean Development"[2] (the Guidance) requires that developers undertake a Basement Impact Assessment, or "BIA" for all basement developments within the Borough. The BIA follows the format of an Environmental Impact Assessment, and uses a risk based approach with regard to hydrology, hydrogeology and land stability.

The stages are as follows:

- Screening
- Scoping
- Site investigation and study
- Impact assessment
- Review and decision making

This report sets out the findings of the groundwater flow (hydrogeology) component of the BIA. Site investigations have been completed separately to inform the design process for the development. These investigations have been used to inform this groundwater assessment.

The report will identify potential groundwater impacts the development may have. Appropriate mitigating measures can then be developed and adopted to avoid or minimise these affects.

The Author of this report is a qualified Hydrogeologist, Chartered Geologist and Fellow of the Geological Society of London, as required by the Guidance.

[1] "Report on a Ground Investigation" Site Analytical Services Ltd. Ref. 13/20316, March 2013.

[2] "Camden Geological, Hydrogeological and Hydrological study - Guidance for Subterranean Development" Ove Arup & Partners Ltd., November 2010

2 Proposed Development

Full details of the proposed development will be provided with the application. For the purpose of this groundwater impact assessment, the following brief description of the proposed development is given.

8 Lindfield Gardens is a large three-storey detached property with attic space which sits around 10 m back from the road. It has an existing part basement flat adjoining a basement level garage. The proposed development is to extend this basement level garage towards the rear of the property. Ground levels at the Site rise from the front of the property towards the rear (Northeast), and hence the deepest part of the basement will be at the rear where it will be up to 2.70 m below existing ground level.

It is proposed that the property's existing basement garage be extended towards the rear to accommodate the new basement area. Part of the basement will be excavated into area currently occupied by side and rear garden. The total area of additional basement will be approximately 90 m^2.

3 Site setting

3.1 Site location

The Site is situated on the east side of Lindfield Gardens in the Frognal are of Hampstead, London, NW 3 6PX within the Borough of Camden at National Grid Reference TQ 2608 8528. A site location plan is shown in Figure 1.

3.2 Topography

The Site lies at an elevation of approximately 85 mAOD on ground sloping at around 13% southeastwards.

Within the Site itself the ground slopes gently downward from the rear (northeast) to the front (southwest) of the property. The area to the immediate rear of the house where the basement is to be extended is at an elevation of approximately 5 m higher than the road.

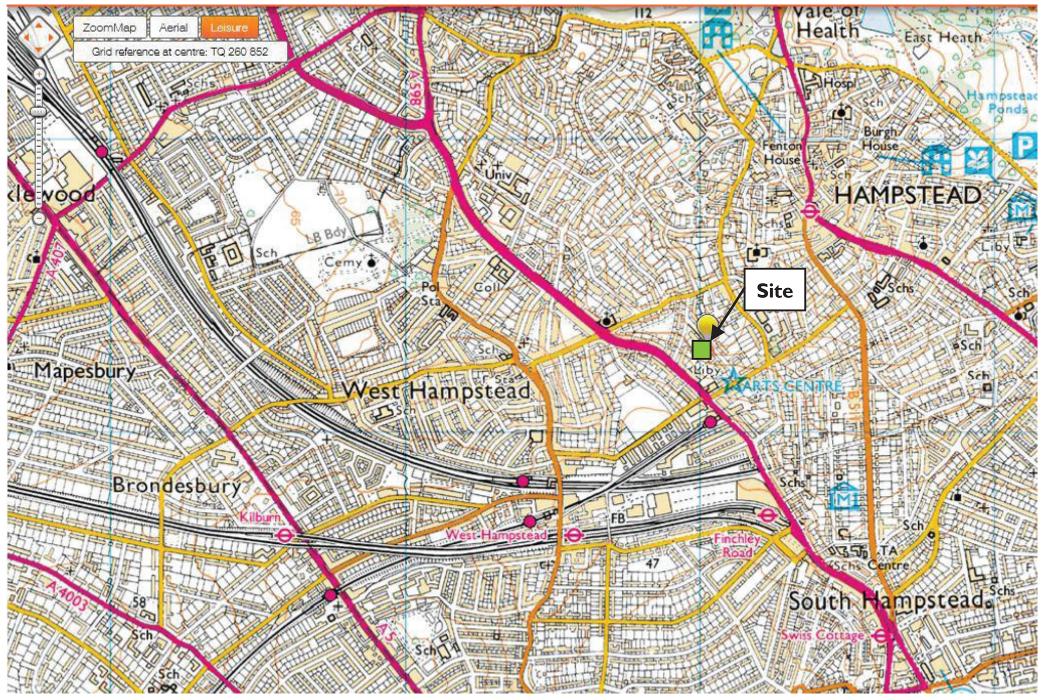


Figure 1 Site location

3.3 Hydrology and drainage

The Site lies within the surface water catchment of the lost Westbourne river. The river historically rose from springs on Hampstead Heath and has been culverted throughout its length. The site is more than 500 m to the East of the route of the culvert.

There are no other surface water features marked on Ordnance Survey mapping (1:25,000 scale) within 1km of the Site.

3.4 Geology

According to the British Geological Survey (BGS) 1:50,000 sheet for the area (Sheet 256, North London. 2006) and the associated geological memoir, The Geology of London (BGS 2004), the Site lies on the London Clay Formation. Approximately 300m north of the Site the sheet shows that Quaternary head deposits may be present. This is disturbed material which has moved downslope from higher ground in the area of Hampstead Heath.

The London Clay is underlain by the Cretaceous Chalk at a depth of over 150m beneath the Site.

The site investigation (March 2013)[1] established ground conditions to be generally consistent with the geological records and known history of the area and comprised between 0.25 m and 0.30 m thickness of made ground overlying materials typical of the London Clay Formation.

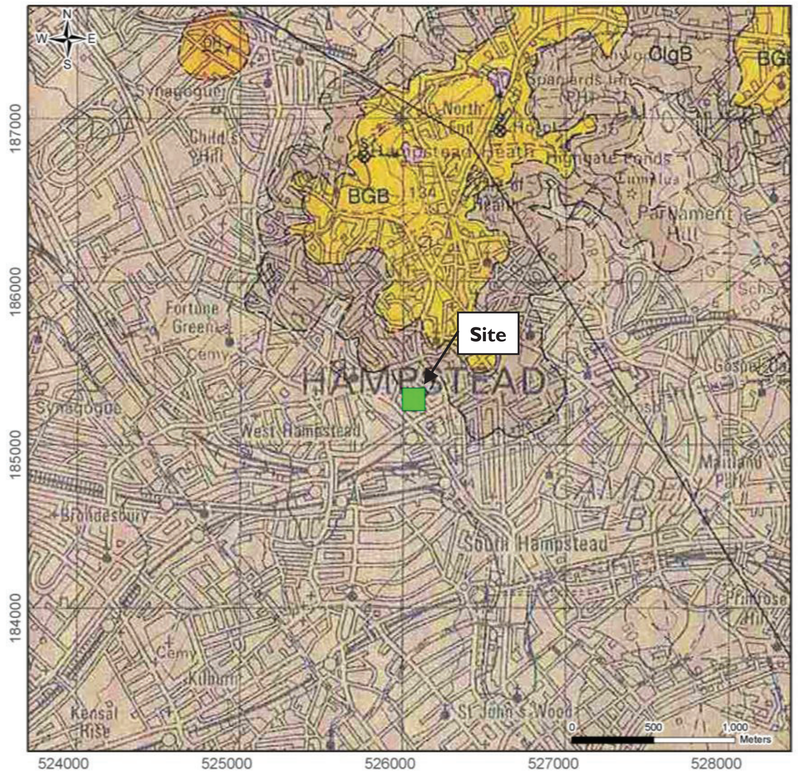


Figure 2 Geology

3.5 Hydrogeology

The Environment Agency classifies the London Clay as Unproductive Strata (formerly Non Aquifer), i.e. not capable of providing useable quantities of water; however this classification does not take into account local geological variations within the sandier upper London Clay Formation.

The Cretaceous Chalk is classified as a Primary (formerly Major) Aquifer however it is highly confined and not generally used for water supply in the central London area due to its poor water quality. Due to the thickness of London Clay at this location, the Chalk aquifer is not considered relevant to this assessment.

Groundwater vulnerability mapping for the area (Figure 3) shows the site to lie on the southern edge of secondary aquifer (previously known as "minor" aquifer). This aquifer is made up of the Bagshot Formation and Claygate Member which form the high ground of Hampstead Heath. However, the site investigation has demonstrated that the site lies on the London Clay, which is not part of the secondary aquifer.

The Site is not within any designated Source Protection Zones (Figure 3).

Any groundwater immediately beneath the Site will be within Unit D of the upper London Clay Formation. Due to the nature of the London Clay, any groundwater flow will be at very low rates and is likely to follow general topographic contours toward the southwest.

Groundwater was not encountered in any of the exploratory holes during boring and excavation and the material remained essentially dry throughout. Groundwater was subsequently recorded at a depth of 7.16 m below ground level in the monitoring standpipe installed in Borehole 1 after a period of approximately four weeks. This is several meters below the proposed excavation level, and is considered to represent a high (winter) groundwater level.

Geological logs show only occasional partings of silty fine sand within the clay. Falling head tests have confirmed the very low permeability of the clay at around 2.2×10^{-7}m/s.

The combination of desk based assessment and site investigation results demonstrate that the proposed development is unlikely to encounter any significant groundwater.

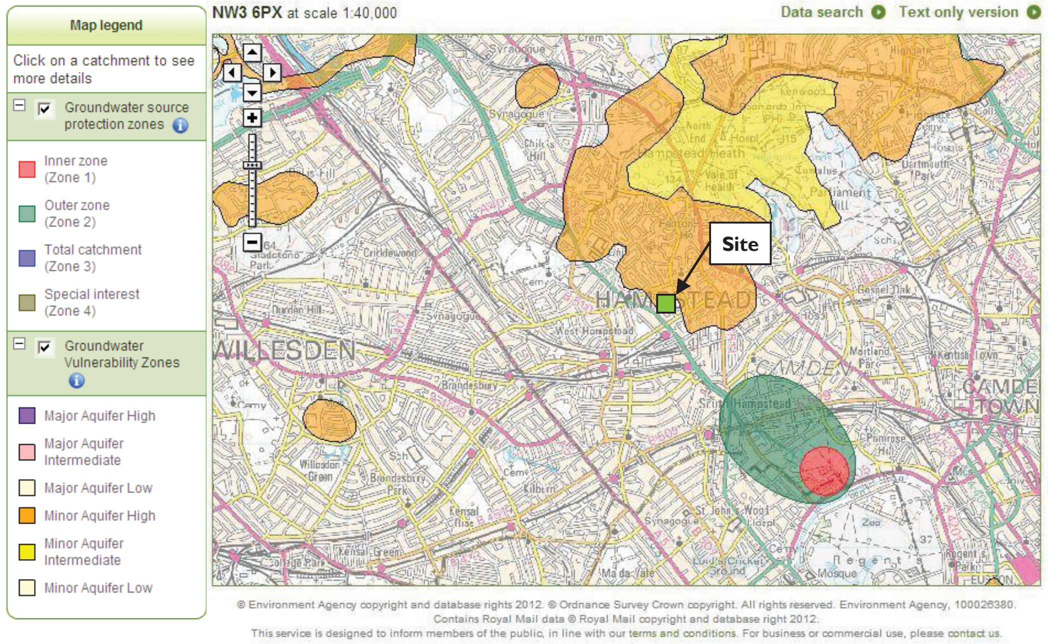


Figure 3 Groundwater vulnerability

4 Screening

The London Borough of Camden's "Guidance for subterranean development" suggests that any development proposal which includes a subterranean basement should be screened in order to determine whether there is a requirement for a BIA to be carried out. In this instance, the screening assessment is informed by results of the site investigation.

4.1 Screening discussion

Appendix E of the guidance document details the following six questions:

- **Question 1a: Is the site located directly above an aquifer?**

  No. London Clay is at outcrop, and this is not considered to be an aquifer. The Chalk aquifer is at great depth and is not considered relevant to this assessment.

- **Question 1b: Will the proposed basement extend beneath the water table surface?**

  No. Groundwater seepage has been observed at a depth of 7.16 m below ground level, and this is considered to represent a high (winter) water table. The maximum proposed excavation depth is 2.70 m below ground level.

- **Question 2: Is the site within 100m of a watercourse, well (used/disused) or potential spring line?**

  No. Refer to Section 3.2.

- **Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?**

  No. The Site is approximately 1km southeast and outside the catchment of Hampstead Heath ponds.

- **Question 4: Will the proposed development result in a change in the proportion of hard surfaced / paved area?**

  Yes. Additional roofing is proposed which represents a small area (approximately $110m^2$). This will comprise green roof. The drainage from the Site will be directed to public sewer.

- **Question 5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to ground (e.g. via soakaways and/or SUDS)?**

- No. The nature of the London Clay strata is unsuitable for receiving ground discharge.

- **Question 6: 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 local ponds or spring lines present.

4.2 Screening conclusions

Five of the six key screening questions required by the Guidance for assessment of subterranean (groundwater) flow can all be answered "no". The screening process has identified a single potential issue, in that the proposal will result in a change in the proportion of hard standing. This will be in the form of approximately 110 m^2 of green roof. This additional area will locally prevent recharge to the underlying ground.

5 Scoping and impact assessment

A single potential issue has been identified which is the change in proportion of hard standing. This could potentially result in decreased recharge to the underlying ground or changes to the degree of wetness which may in turn affect stability.

As discussed above, the site investigation has demonstrated that the Site is located on London Clay, which is a non-aquifer as defined by the Guidance. Recharge to the Formation is likely to be negligible and the proposal small in scale. As such, the proposal is unlikely to impact groundwater levels or flows.

Drainage from the green roof area will be directed to public sewer. The proposed basement is not expected to extend into saturated soils. Therefore, it is unlikely that the degree of wetness of local soils will be affected to any significant degree by the development. Issues related to ground stability are outside the scope of this report and will be dealt with by the slope and ground stability component of the BIA.

6 Review and decision making

A groundwater impact assessment of the proposed development has been undertaken. The assessment has been based on information and guidance published by the London Borough of Camden[2] and on site investigation information[1].

This assessment concludes that five of the six key screening questions required by the Guidance for assessment of subterranean (groundwater) flow can all be answered "no".

A single potential issue has been identified which is the change in proportion of hard standing. This issue has been assessed, and it is concluded that there will be no significant changes to the groundwater regime as a result of the proposal.

It is concluded that the proposed development is unlikely to result in significant changes to the groundwater regime beneath the Site.

Groundwater is by its nature, hidden from view and unforeseen ground conditions can occur. It is therefore recommended that the water levels in the monitoring boreholes be periodically measured immediately prior to, and during, the development. Borehole 2 is sited within the development footprint and will therefore be decommissioned prior to completion of the development. It is acknowledged that monitoring of this borehole will cease at this point. Should groundwater levels rise to within the excavation volume, or should significant groundwater inflow be observed during excavation, professional advice should be sought.

3.0 Slope and Ground Stability Assessment

Site Analytical Services Ltd.

Site Investigations, Analytical & Environmental Chemists, Laboratory Testing Services.

Units 14 + 15, River Road Business Park,
33 River Road, Barking, Essex IG11 0EA
Directors: J. S. Warren, M.R.S.C., P. C. Warren, J. I. Pattinson, BSc (Hons). MSc
Consultants: G. Evans, BSc., M.Sc., P.G. Dip., FGS., MIEnvSc. A. J. Kingston, BSc C.Eng. MIMM
F. J. Gibbs, F.I.B.M.S. F.I.F.S.T., F.R.S.H. K. J. Blanchette

Tel: 020 8594 8134
Fax: 020 8594 8072
E-Mail: services@siteanalytical.co.uk

Your Ref:

Our Ref: **13/20316-2**
April 2014

8 LINDFIELD GARDENS,

LONDON, NW3 6PX

BASEMENT IMPACT ASSESSMENT
(SLOPE AND GROUND STABILITY)

Prepared for

Elliott Wood Partnership LLP

Acting on behalf of

Mr & Mrs Gillerman

Reg Office: Units 14 + 15, River Road Business Park,
33 River Road, Barking, Essex IG11 0EA
Business Reg. No. 2255616

CONTENTS

1.0 INTRODUCTION

1.1 Project Objectives

The purpose of this assessment is to consider the effects of a proposed basement construction on the local slope stability at the residential property at 8 Lindfield Gardens, London, NW3 6PX. For this assessment a representative of Site Analytical Services Limited visited the property on 13th February 2013.

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

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

1.2 Planning Policy Context

Camden Planning Guidance for Basements and Lightwells has been recently revised (CPG4, April 2011) and requires proposed developments to mitigate against the effects of ground and surface water flooding and to include drainage systems that do not impact neighbouring property of the site or the water environment by way of changing the groundwater regime.

Camden Guidance CPG4 sets out 5 Stages:

1. Screening
2. Scoping
3. Site Investigation
4. Impact Assessment
5. Review and decision making

This report is intended to address the scoping process set out in CPG4 and the Camden Geological, Hydrogeological and Hydrological Study (CGHHS). It will review existing site investigation data and provide a preliminary assessment of the issues identified by the Site Analytical Services Limited screening process.

As part of this guidance a slope stability screening chart is provided. The completed chart in relation to this development is provided as Table 1, to this report.

1.3 Qualifications

The report has been prepared by Mr Andrew Smith, a Fellow of the Geological Society (FGS) with over 8 years post graduate experience in co-ordination with Mr Mike Brice of Applied Geotechnical Engineering, a Chartered Geologist (CGEOL) and Mr Gary Povey of Elliott Wood Partnerships, a Chartered Engineer (CEng).

2.0 SITE DETAILS

(National Grid Reference: TQ 260 852)

2.1 Site Location

The site is situated on the east side of Lindfield Gardens in the Frognal area of Hampstead, London, NW3 6PX. The site is currently occupied by a large three-storey residential property with attic space, a large rear garden and garage and driveway at the front of the property. The site covers an area of approximately 0.18 Hectares and the general area is under the authority of the London Borough of Camden.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) indicates the northernmost area of the site to be underlain by the Claygate Member, whilst the underlying London Clay Formation is detailed over the rest of the site.

The BGS 1:625000 Solid Geology Deposits indicate the site to be underlain by the Eocene London Clay Formation.

2.3 Previous Reports

The results from a Phase 1 Preliminary Risk Assessment and Phase 2 Intrusive Investigation are presented under separate cover in Site Analytical Services Limited reports (Project No's. 13/20316-1 and 13/20316 respectively) dated March 2013. The findings from these reports are described in this basement impact assessment.

2.4 Site Layout and History

The site was attended on 13th February 2013 for the purposes of conducting the site walkover.

The site comprises of a large three-storey detached house with further accommodation within the roof space and additional basement flat. The front of the property consists of a driveway and garage which slope up from the street. Access to the property is via steps up from the street, through a grass lawn and various medium size shrubs and a large tree. The garden at the rear can be accessed by a small gated side passage. The large rear garden consists of a patio adjacent to the house and a large garden mainly set to a raised lawn with shrub beds along the sides. The garden is bounded by thick hedges and brick walls and contains a trampoline, a small shed and an outbuilding at the end of the garden.

The site lies on ground sloping down to the south away from Hampstead Heath towards the Finchley Road. The site itself has a difference in level of approximately 9m from the road at the front of the property to the raised garden area at the rear.

From the site walkover there were no obvious potentially contaminating activities on the site.

From a review of historical maps it would appear that the site was mixed agricultural land and woodland until about 1915, when a residential property is evident. A small extension to the building is evident from this date until circa 1954, when it is shown to have been demolished. The area surrounding the site has been dominantly residential in use over the years.

2.5 Proposed Development

Proposals for the site include the construction of a new basement to the rear of the site in line with the existing garage structure. The basement floor is anticipated to be around 2.70m below ground level.

2.6 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site in accordance with CPG4 and the results are summarised in Table 1 below:

Site Analytical Services Ltd.

Table 1: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	No	Although the geological map shows the northern section of the site to be underlain by aquifer sustaining Bedrock Geology comprising permeable unconsolidated (loose) deposits (Claygate Member) these deposits were not encountered during the ground investigations at the site in March 2013 and 2014. The Bedrock geology underlying the site (London Clay Formation) is classified as Unproductive Strata; drift deposits or rock layers with low permeability that have negligible significance for water supply or river base flow.
	1b. Will the proposed basement extend beneath the water table surface.	No	The maximum depth of the proposed basement floor level of 2.7m below ground level will be above the current water level of approximately 3.88m below ground level as recorded in Borehole 1 and 5.24m below ground level as recorded in Borehole A.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	Yes - refer to Section 4.6 for scoping	There are no surface water features within 1km of the site. However, according to the Lost Rivers of London the site is within 100m of an ancient river.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	No	The amount of hardstanding on-site is not expected to change.
	4. As part of site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS).	No	Existing drainage paths are to be utilised where possible. Whether soakaways/SUDS are used on the proposed development is to be confirmed (beyond the scope of this report). An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.
	5. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line.	No	There are no surface water features within one kilometre of the site.

Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 1 in 8.	Yes - refer to section 4.2 for scoping	The site has a difference in level of approximately 9m from the road at the front of the property to the raised garden area at the rear and the length of the garden is approximately 75m giving a slope of approximately 1 in 8.
	2. Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 1 in 8.	No	Remodelling of the site elevations is not proposed.
	3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 1 in 8.	Yes - refer to Section 4.2 for scoping	The neighbouring land also has differences in level of approximately 9m from the road at the front of the property to the garden area at the rear.
	4. Is the site within a wider hillside setting in which the general slope is greater than 1 in 8.	Yes - refer to Section 4.2 for scoping	There is a general slope in the wider hillside setting from north to south down towards the Thames Basin up to approximately 9 degrees (approximately 1 in 6).
	5. Is the London Clay the shallowest strata at the site.	No	The site is underlain by Made Ground overlying the London Clay Formation; the London Clay is the shallowest natural strata below the site. The Claygate Beds as indicated by the geological records were not proven.
	6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.	Yes - refer to Section 4.3 for scoping	It is understood that trees are to be felled as part of the development.
	7. Is there a history of seasonal shink-swell subsidence in the local area and/or evidence of such effects at the site	Yes - refer to Section 4.3 for scoping	The site lies above the London Clay Formation that is well know to have a high tendency to shrink and swell.

	8. Is the site within 100m of a watercourse or a potential spring line	Yes - refer to Section 4.6 for scoping	There are no surface water features within 1km of the site. However, according to the Lost Rivers of London the site is within 100m of an ancient river.
	9. Is the site within an area of previously worked ground.	Yes - refer to Section 4.7 for scoping	Made Ground has been encountered at the site.
	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	According to the geological records the site lies above a Secondary A aquifer (Claygate Beds), although these beds were not proven in the exploratory holes. The basement will not extend below the current water depth of 7.16m below ground level.
	11. Is the site within 50m of the Hampstead Heath ponds.	No	The site is not located near Hampstead Heath.
	12. Is the site within 5m of a highway or pedestrian right of way.	Yes - refer to Section 4.8 for scoping	The site lies adjacent to Lindfield Gardens.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes - refer to Section 4.9 for scoping	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.
	14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	No	Verbal communication with LUL Operational Property Division indicates that the nearest tube line is located over 100m from the site and runs along Finchley Road towards the west of the site.
Surface Water and Flooding	1. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	No	The amount of hardstanding on-site is not changing therefore surface water will not be impacted by the development.

	2. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	No	The amount of hardstanding on-site is not expected to increase.
	3. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.	No	As no changes are occurring above the ground, surface water will not be impacted by the development.
	4. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	No	As no changes are occurring above the ground, surface water will not be impacted by the development.
	5. Is the site in an area known to be at risk from surface water flooding.	No	According to the Envirocheck Report obtained as part of the desk study for the site (Site Analytical Services Report Reference 13/20316) the site is not in an area at risk from flooding.

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

Slope Stability

- Does the existing site include slopes, natural or man-made greater than 1 in 8.
- Is the site within a wider hillside setting in which the general slope is greater than 1 in 8.
- Does the development neighbour land, including railway cuttings and the like, with a slope greater than 1 in 8.
- Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.
- Is there a history of seasonal shink-swell subsidence in the local area and/or evidence of such effects at the site.
- Is the site within 100m of a watercourse or a potential spring line.
- Is the site within an area of previously worked ground.
- Is the site within 5m of a highway or pedestrian right of way.
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.

3.0 EXISTING SITE INVESTIGATION DATA

3.1 Records of site investigations

Ground conditions at the site were investigated by Site Analytical Services Limited in February and March 2013 (SAS Report Reference 12/20316) and again in March 2014 as part of this basement impact assessment (Borehole log provided at the end of this report). The ground conditions revealed by the investigation are summarised in the following table.

Strata	Depth to top of strata, mbgl	Description
Made Ground	0.00	Surface layer of patio slabs, flower beds or concrete overlying very silty clay with gravel, brick fragments and roots
London Clay Formation	0.30 to 1.20	Soft to firm becoming stiff and then very stiff silty clay with occasional partings of silty fine sand, scattered gypsum crystals

Groundwater was not encountered during the drilling of the boreholes or excavation of Trial Pits 2, 3 and 4 and the material remained essentially dry throughout. Possible foul water was encountered during the excavation of Trial Pit 1. Groundwater was subsequently recorded at a depth of depth of 3.88m below ground level in the monitoring standpipe installed in Borehole 1 and 5.24m below ground level in the monitoring standpipe installed in Borehole A after periods of approximately fourteen months and four weeks respectively.

3.2 Hydrological Context

During the monitoring visit on the 5th March 2013 the groundwater in Borehole 1 was measured at 7.02m below ground level. Subsequently the well was purged and the water level reduced to 9.10m below ground level. During the subsequent 60 minute period the following recharge levels were recorded:

Time after purging well (minutes)	Water Level (mbgl)
0	9.10
5	8.85
10	8.77
15	8.72
30	8.64
60	8.59

4.0 SCOPING ASSESSMENT - SLOPE AND GROUND STABILITY

4.1 Introduction

This section addresses outstanding issues raised by the screening process regarding land stability (see Table 1).

4.2 Slope Stability

The 1:50,000 scale geological map for the area indicates that the site does not lie within an 'Area of Significant Landslide Potential'. No mapped areas of landslips are present in the vicinity of the site and the natural ground stability hazards dataset supplied by the BGS (present in the desk study report for the site (SAS Report Reference 13/20316-1) gives the hazard rating for landslides in the site area as 'very low'.

Information obtained from the site walkover, site plans and ordnance survey maps indicates that the site and neighboring properties have a difference in level of approximately 9m from the Lindfield Gardens at the front of the properties to the raised garden areas at the rear. There is also a general slope in the wider hillside setting from north to south down towards the Thames Basin up to approximately 9 degrees, although it should be noted that the immediate site area is heavily urbanised and slopes at the site and in the close vicinity may have been altered historically or as part of developments and landscaping.

The slope angle map produced as Figure 16 of the ARUP report indicates that slope angles in the site are less than 7° and that the site does not neighbour any land that contains cuttings / embankments or any other feature with slope angles in excess of 7°.

As part of the development it is proposed to cut the site by at least 2.70m, although excavation may locally be to a greater depth to facilitate floor slab and foundation construction. Discussions with the structural engineer indicate that construction is likely to take the form of a reinforced concrete underpinning scheme cast in a sequence around the whole perimeter in order to reduce the construction zone of the basement wall. It is anticipated that natural London Clay would be encountered at this depth and therefore 'running sand' conditions and ground instability is unlikely. In addition, the proposed development does not include any remodeling of slopes to angles greater than 7° that could potentially result in slope stability issues.

All risks related to the underpinning must be identified and managed in accordance with CDM legislation.

4.3 Shrinking / Swelling Clays

Atterberg Limit tests were conducted on four selected samples taken from the essentially cohesive natural soils encountered in the boreholes and showed the samples tested to have a high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2.

It is understood that trees are to be removed from the site as part of the development. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, "Building near Trees" and it is considered that this document is relevant in this situation.

4.4 Heave of underlying soils

The main phase of uplift or heave from the cohesive soils will come immediately following the excavation of the basement when the greatest elastic rebound of the soil (caused by the loss of the overburden pressure) will occur. Heave can be reduced by proceeding with the excavation in stages and observing and recording any movement that occurs over a set period of time. It may therefore be advantageous to delay the construction until an adequate proportion of the uplift has occurred. Once this monitoring period has elapsed and a suitably qualified engineer is confident that the majority of uplift has occurred, basement construction can commence. These processes and other ways of dealing with ground movements are described at length in BS8004 (British Standard Code of Practice for Foundations).

In addition, it is understood that a suspended concrete slab will be constructed at basement level and therefore heave is unlikely to be an issue at the site.

4.5 Compressible/Collapsible Ground

The natural ground stability hazards dataset supplied by the BGS gives the hazard rating for collapsible ground as 'very low' and compressible ground at the site is listed as 'no hazard'.

4.6 Springs, Wells and Watercourses

There are no nearest surface water features or fluvial or tidal floodplains located within 1km of the site.

With reference to 'The Lost Rivers of London' (Barton, 1992) and 'London's Lost River's' (Talling, 2011), the site lies within 100m and between two tributaries of the former River Westbourne, which ran in a southerly direction from a pond on Hampstead Heath (no longer present) through Hampstead, Kilburn, Paddington, Hyde Park, Knightsbridge and out into the River Thames at Chelsea.

Given the predominantly clayey and low permeability nature of the near-surface soils, it is expected that there is very limited surface water infiltration potential and groundwater flow rates in the vicinity of the property will be very low. The historic development of the area for housing will have further limited surface water infiltration.

As a result it is considered that the proposed development will have minimal impact on any nearby watercourses.

4.7 Made Ground

In the exploratory holes undertaken at the site, Made Ground was found to extend down to depths of between 0.30m and 1.20m below ground level and comprised of a surface layer of patio slabs, flower beds or concrete overlying very silty clay with gravel, brick fragments and roots.

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

The bearing capacity of the Made Ground should therefore be assumed to be less than $50kN/m^2$ because of the likelihood of extreme variability within the material.

Contamination testing of the Made Ground is likely to be required during any second phase of ground investigation.

4.8 Location of public highway

The proposed basement is not to be extended below Lindfield Gardens and therefore it is suggested that the impact on this local access road is likely to be minimal.

There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.

4.9 Structural Stability of Adjacent Properties

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures.

The proposed development may also result in differential foundation depths between the site and adjacent property and as such it is recommended that the Party Wall Act will be used and considered during the design phase. For basement developments in densely built urban areas, the Party Wall Act (1996) will usually apply because neighbouring houses would typically lie within a defined space around the proposed building works. Specifically, the Party Wall Act applies to any excavation that is within 3m of a neighbouring structure; or that would extend deeper than that structure's foundation; or which is within 6m of the neighbouring structure and which also lies within a zone defined by a 45° line from the foundation of that structure. The Party Wall process should be followed and adhered to during this development.

A ground movement assessment was carried out at the site by Applied Geotechnical Engineering under the instruction of Site Analytical Services Limited (Report Reference P2351). The report is provided as Appendix D to this report and concludes that given good workmanship including stiff bracing to the excavations, the basement to 8 Lindfield Gardens can be constructed without imposing more than a 'very slight' level of damage on the adjoining properties at 6 and 10 Lindfield Gardens.

5.0 CONCLUSIONS

1. Proposals for the site include the construction of a new basement to the rear of the site in line with the existing garage structure. The basement floor is anticipated to be around 2.70m below ground level.
2. Ground conditions at the site were investigated by Site Analytical Services Limited in February and March 2013 and March 2014. The exploratory holes revealed ground conditions that were slightly inconsistent with the geological records and known history of the area and comprised between 0.30m and 1.20m thickness of Made Ground overlying materials typical of the London Clay Formation. The Claygate Member as indicated to occupy only the northernmost part of the site was not encountered during the investigation.
3. Although the geological map shows the northern section of the site to be underlain by aquifer sustaining Bedrock Geology comprising permeable unconsolidated (loose) deposits (Claygate Member) these deposits were not encountered during the ground investigations at the site in March 2013 and March 2014. The Bedrock geology underlying the site (London Clay Formation) is classified as Unproductive Strata; drift deposits or rock layers with low permeability that have negligible significance for water supply or river base flow.
4. The proposed development does not include any remodeling of slopes to angles greater than 7° that could potentially result in slope stability issues. It is therefore considered that slope stability can be maintained through the proper design of any necessary mitigation measures
5. Given good workmanship including stiff bracing to the excavations, the basement to 8 Lindfield Gardens can be constructed without imposing more than a 'very slight' level of damage on the adjoining properties at 6 and 10 Lindfield Gardens.

p.p. SITE ANALYTICAL SERVICES LIMITED

A P Smith BSc (Hons) FGS
Senior Geologist

SAS Site Analytical Services Ltd.

REFERENCES

1. CIRIA Special Publication 69, 1989. The engineering implications of rising groundwater levels in the deep aquifer beneath London
2. Environment Agency, 2006. Groundwater levels in the Chalk-Basal Sands Aquifer in the London Basin
3. Site Analytical Services Report. Phase One Risk Assessment at 8 Lindfield Gardens. Reference 20316. March 2013.
4. Site Analytical Services Report. Report on Ground Investigation at 8 Lindfield Gardens. Reference 19316-1. March 2013.
5. Tomlinson, M J, 2001. "Foundation Design and Construction", Seventh Edition, Prentice Hall (ISBN 0-13-031180-4).
6. British Standards Institution, 2007. Code of Practice for Site Investigations, BS5930, BSI, London
7. British Standards Institution, 1986. Code of practice for foundations, BS 8004, BSI, London.
8. British Standards Institution, 2009. Code of Practice for Protection of Below Ground Structures Against Water from the Ground. BS 8102, BSI, London
9. CIRIA, 2000. Sustainable Urban Drainage Systems: Design Manual for England and Wales. CIRIA C522, Construction Industry Research and Information Association, London
10. Camden Planning Guidance, 2011. CPG 4; Basements and lightwells. London Borough of Camden
11. Environment Agency Status Report 2010. Management of the London Basin Chalk Aquifer. Environment Agency
12. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.
13. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

Site Analytical Services Ltd.

APPENDIX `A'

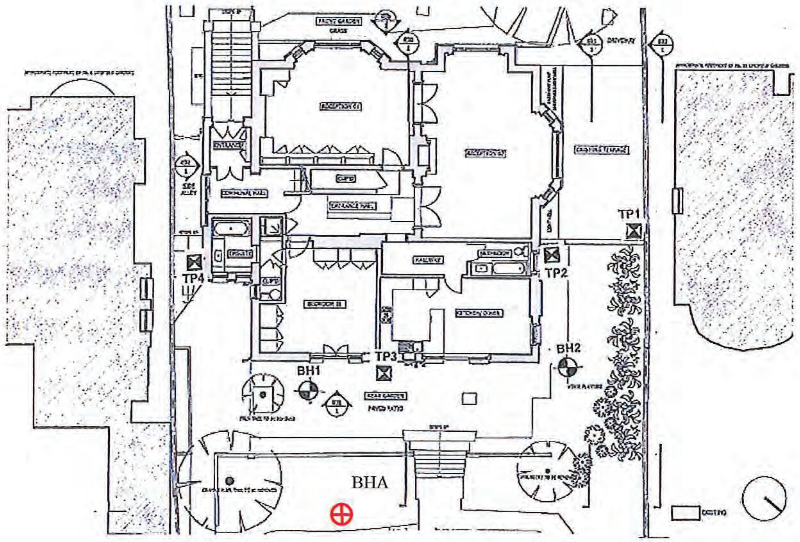
Borehole Logs

Site Analytical Services Ltd.			Site: 8 LINDFIELD GARDENS, LONDON, NW3 6PX	Borehole Number: BHA
Boring Method: CONTINUOUS FLIGHT AUGER	Casing Diameter: 100mm cased to 0.00m	Ground Level (mOD)	Client: MR AND MRS D GILLERMAN	Job Number: 1320316
	Location: TQ 260 852	Dates: 27/03/2014	Engineer: FINKERNAGEL ROSS ARCHITECTS LTD	Sheet: 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30) 0.30	MADE GROUND : Turf over topsoil with brick fragments		
0.25	D1						Firm becoming firm to stiff brown and mottled orange brown, veined blue grey silty CLAY with occasional partings of light brown silty fine sand and occasional small gypsum crystals		
0.50 0.50 0.75	D2 V1 64 D3								
1.00 1.00	D4 V2 72								
						(2.20)			
1.50 1.50	V3 86 D5								
2.00 2.00	D6 V4 97								
						2.50	Stiff becoming very stiff brown and mottled orange brown, veined blue grey silty CLAY with occasional partings of light brown silty fine sand and occasional small gypsum crystals		
2.50 2.50	D7 V5 104								
3.00 3.00	D8 V6 108								
3.50 3.50	D9 V7 113								
4.00 4.00	V8 130 D10								
4.50 4.50	D11 V9 132								
5.00 5.00	D12 V10 140+								
						(6.50)			
6.00 6.00	V11 140+ D13								
7.00 7.00	D14 V12 140+								
8.00 8.00	D15 V13 140+								
						9.00	Very stiff dark grey brown fissured silty CLAY with occasional partings of light brown silty fine sand and scattered small gypsum crystals 207		
9.00 9.00	D16 V14 140+								
						(1.00)			
10.00 10.00	V15 140+ D17			27/03/2014:DRY		10.00			

Remarks	Scale (approx)	Logged By
Groundwater was not encountered during the excavation D = Disturbed Sample V = In situ vane test (Result in kPa) Excavating from 0.00m to 1.20m for 2 hours.	1:50	APS
	Figure No. 1320316.BH1	

Appendix B – Exploratory Hole Location Plan



Boreholes drilled in March 2013 investigation

Trial Pits excavated in March 2013 investigation

Borehole drilled in March 2014 investigation

Appendix C – Monitoring Data from Borehole 1 and Borehole A March 2013 to April 2014

Date	Borehole	Water Level (m.bgl)	Depth to Base of Well (m.bgl)
5th March 2013	1	7.02	9.80
11th March 2013	1	7.16	9.81
25th April 2014	1	3.88	9.64
	A	5.24	9.77

Site Analytical Services Ltd.

Appendix D – Ground Movement Assessment Report

Ref: 13/20316-2
April 2014

Client: Mr + Mrs D Gillerman		Ref: P2351	
Project: 8 Lindfield Gardens, London		Page 1 of 19	
Section: Calculation of ground movement		By: MB	Date:13/5/14
		Chk:NS	Date: 13/5/14

1.0 Introduction

In connection with the proposal to construct a new basement and ground floor extension at 8 Lindfield Gardens, London NW3, Applied Geotechnical Engineering Ltd (AGE) has been instructed by Site Analytical Services Ltd (SAS), on behalf of the owners, Mr & Mrs D Gillerman, to provide information on the effect of basement construction on the existing and neighbouring properties. The neighbouring (detached) properties are No 10 Lindfield Gardens to the left and No 6 Lindfield Gardens to the right (right and left are as viewed from the front of the property on Lindfield Gardens).

With the exception of an access staircase, the extension is to be formed entirely outside the existing building footprint.

Site levels have been related to a datum (possibly Ordnance Datum).

It must be noted that a high standard of construction is assumed in these calculations.

2.0 Information Provided

The following information has been used for these calculations:-
i) SAS Report Ref 13/20316-2:- Basement impact assessment.
ii) SAS Report Ref 13/20316-1:- Phase 1 Preliminary risk assessment.
iii) SAS Report Ref 13/20316:- Report on ground investigation.
iv) Elliott Wood Report Ref 212685P2 Structural engineering report and subterranean construction method.
v) Canaway Fleming Architects Drawing Nos P13-100-A-P-00-E-003+004; P-01-E-003+004; X-AA-E-002.
vi) Topographical survey drawing (8 Lindfield Gardens 21012103.dwg).
vii) Email correspondence to AGE dated 3 and 4 April 2014 including level and load information.

3.0 Anticipated Ground Conditions

The site is understood to lie on a slope set at approximately 1v:8h overall, the ground rises from the front of the property to the rear. To the immediate rear and left side of the property, where the extension is to be formed, the existing ground can be considered essentially horizontal.

The published geological map (BGS 1:50 000 sheet 256: North London) indicates the site is underlain by London Clay, though the edge of the overlying Claygate Member is immediately adjacent. On a developed site such as this, Made Ground is also anticipated. The London Clay in this area is believed to be approximately 60m or more thick. The mapping indicates there is the propensity for the development of Head.

Ground investigations have been undertaken at the site comprising two borings and four trial pits (Item 'iii' in Section 2 above). These confirmed the presence of London Clay beneath Made Ground. It is considered that the Made Ground will not have a significant influence on the ground movements resulting from basement construction and it is not considered further in this report.

The trial pits indicate the foundations of the existing property bear at approximately 0.8m below existing ground level and consist of corbelled brickwork over concrete bearing on London Clay. The founding depth of the flank walls of the property are not clear as there are significant changes in ground level from front to rear; it has been assumed that middle part of the right flank wall is founded at 48mAD, and the middle and front parts of the left flank wall, adjacent to the garage, are founded at 46.5mAD.

In situ and laboratory test data from the ground investigation (Item 'iii' in Section 2 above) are plotted in Figure 1 and suggest an undrained strength (Cu) profile described by:-
Cu = 30 + 10z (kPa)
where z is the depth in metres below ground level.

Undrained strength values have been derived from SPT results using the method proposed by Stroud (Ref 1), adopting an f_1 coefficient of 4.5.

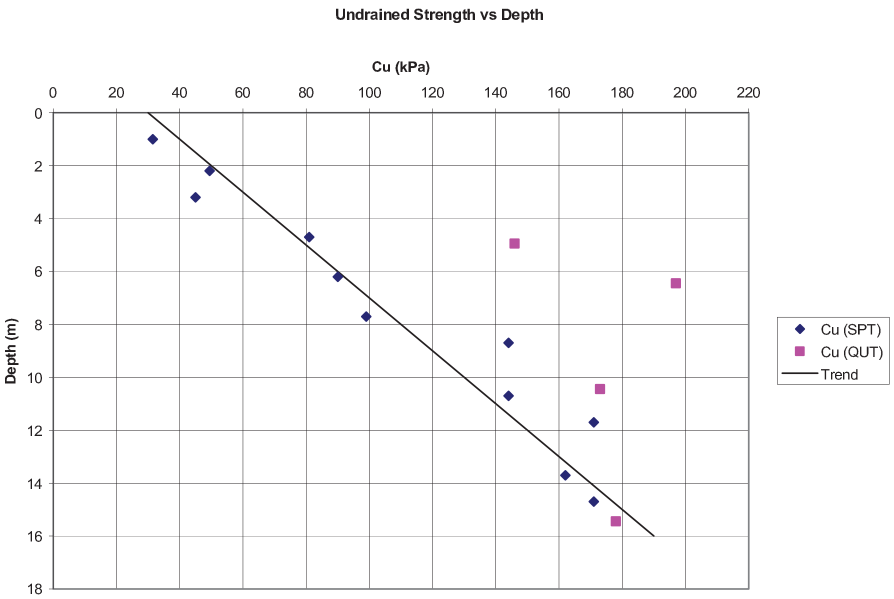


Figure 1 – Undrained strength vs Depth

4.0 Loads

4.1 General

The existing site layout is shown in Figure 2, which is an extract from Drawing P-01-E-003. The proposed extension is shown in Figure 3 (extract of drawing P-00-E-004).

4.2 Existing Loads

The existing load on the back wall of the main house is given as 67.5kN/m (Item 'vii' in Section 2 above).

For the purposes of this analysis the rear flank walls, returning from the rear wall, have been assumed to be subject to the same load. In all cases the load is assumed to act at existing foundation level.

Existing ground level is taken as 50.1mAD (Item 'vi' in Section 2 above). For the purposes of this analysis only the above loads are taken to act on an existing foundation width of 500mm at a depth of 800mm (49.3mAD).

No internal wall or column loads have been provided and none have been adopted in this analysis.

4.3 Proposed Loads

The proposed load on the back wall of the main house is given as 137kN/m (Item 'vii' in Section 2 above). For the purposes of this analysis the rear flank walls, returning from the rear wall, have been assumed to be subject to the same load.

The proposed load on the basement walls that do not lie beneath the existing house walls is given as 75kN/m.

These loads are taken to include the self-weight of the retaining wall/underpin concrete.

In all cases the load is assumed to act at proposed (underpin) foundation level. Therefore the above proposed wall loads are taken to be imposed uniformly on a 1.0m width of L-shaped retaining wall/underpin base at 46.5mAD (500mm below a FFL of 47mAD – item 'vii' in Section 2 above).

For the purpose of this calculation only, the new basement ground-bearing slab and floor construction is taken to impose 8kPa self-weight loading (250mm slab and 250mm floor construction; Item 'vii' Section 2 above).

Excavation unloads for the extension are taken to be due to excavation from 50.1mAD to 46.5mAD for most of the extension, but excavation from 49.7mAD to 46.5mAD for the Plant Room. Excavation for the new Terrace adjoining the rear of the new extension is taken to be 500mm deep on average.

The in situ bulk unit weight of the excavated soil is taken as 20kN/m^3.

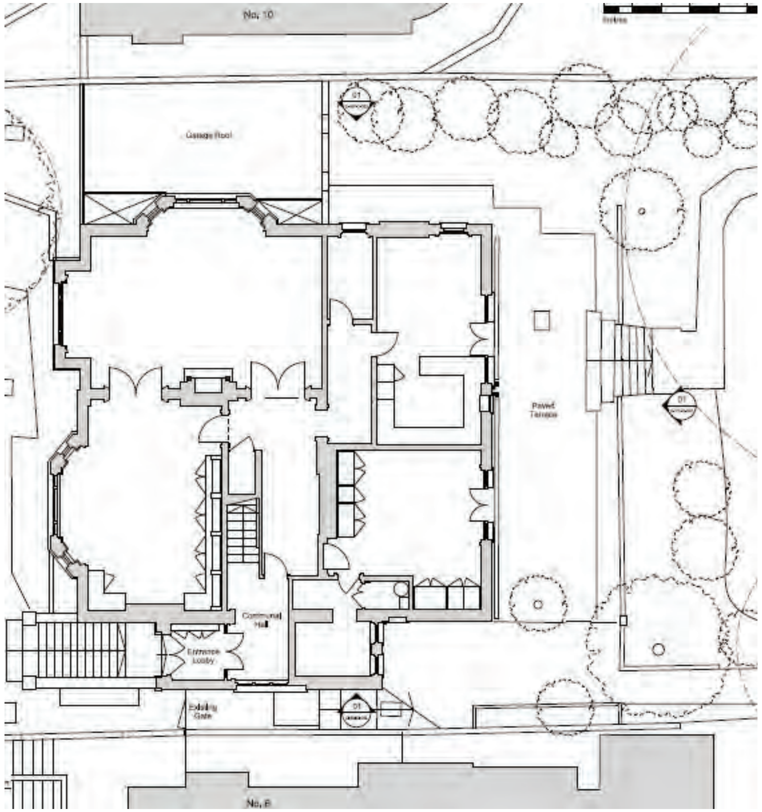


Figure 2 –Existing Plan

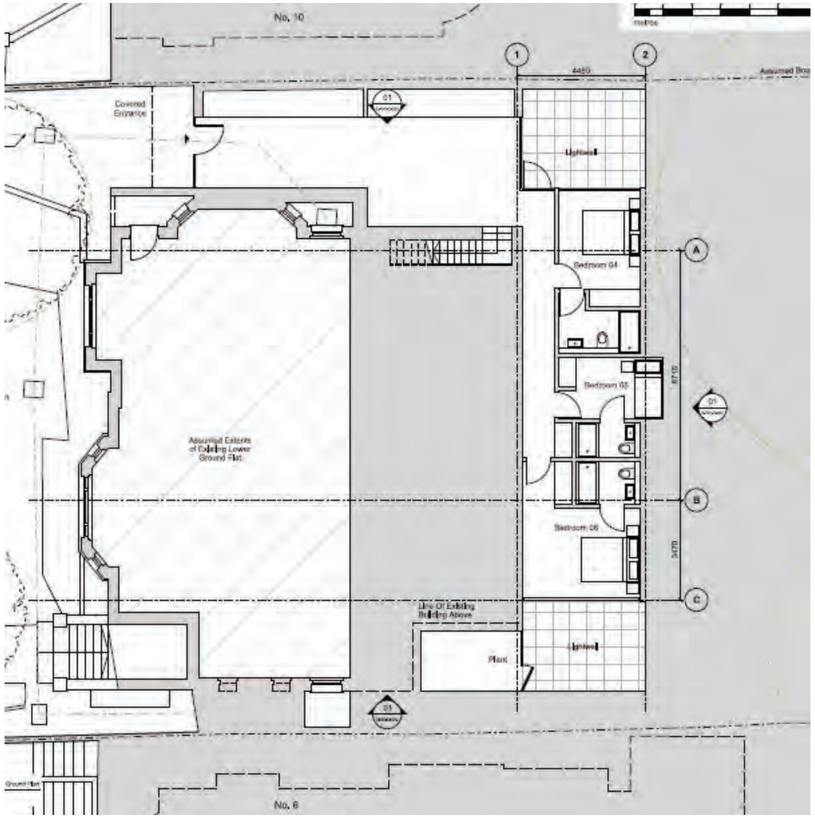


Figure 3 – Proposed Site Plan

5.0 Estimated movement

5.1 General

An equivalent-elastic analysis has been carried out using the program PDisp from Oasys. The program calculates the vertical ground movements in response to changes in vertical loading. Hence, loads that will remain unchanged through the development are not modelled. In essence, the principal load changes are the reduction in load from the excavated soil, the removal of structural loads from their existing relatively high levels and the imposition of structural loading at the new, lower foundation levels.

The program takes no account of structural stiffness.

It is understood that the predicted movement of both Nos 6 and 10 Lindfield Gardens (on the right and left of the site respectively), and the movement of the main house walls (of No 8) are to be analysed. For the purposes of this analysis the houses at Nos 6 and 10 Lindfield Gardens have been taken to be 15m wide (ie similar to No 8).

5.2 Soil stiffness values

The following soil stiffness parameters have been adopted for the purpose of this analysis:-

On the basis of trial pit records the existing foundations appear to bear on the London Clay. Proposed deepened foundations will also bear on the London Clay.

The London Clay has been treated as a non-linear material. The small-strain stiffness is taken as 80% of the small-strain stiffness calculated from recent high quality data (Bond Street Station). These data yielded an undrained small strain stiffness (E_{uo}) equal to 1940Cu therefore for the purposes of the current analysis take:-

$E_{uo} = 1550 \times Cu$;

Taking the Poisson's ratio as 0.5 in the undrained (short-term) case, and 0.2 in the drained (long-term) case, the drained small strain stiffness (E'_o) can be calculated as:-

$E'_o = 1240 \times Cu$;

The following stiffness profiles are therefore obtained from the undrained strength profile given in Section 3 above:-

$E_{uo} = 46.5 + 15.5z$ (MPa)

$E'_o = 37.2 + 12.4z$ (MPa)

Where z = depth below original ground level in metres.

A non-linear stiffness degradation curve based on published data for the London Clay has been used.

5.3 Predicted movement – No 6 Lindfield Gardens (to the right of the site).

5.3.1 Vertical movement in response to basement excavation.

Profiles of vertical ground movement along the rear wall and nearside flank wall of No 6 Lindfield Gardens have been calculated on the basis of the ground stiffness parameters and load conditions (at No 8) described above.

The calculated long-term vertical movement profiles are presented in Figure 4. At No 6 the analysis indicates a long-term differential heave of approximately 0.5mm along the left flank wall, and approximately 0.2mm along the rear wall, over the wall lengths. This equates to a maximum whole-wall gradient of less than 1 in 40 000. These movements are negligible.

The irregular form of the heave plots in Figure 4 (and Figure 7 etc) is due to the precision of the results calculated in PDISP; the heave is calculated to 0.1mm precision and the predicted movement is of a similar order of magnitude. Note also that heave is denoted by negative 'settlement' values on these plots.

5.3.2 Vertical movement due to wall construction and deflection

Construction of the excavation and retaining wall are accompanied by settlement of the ground close to the excavation as the retaining wall yields inwards slightly, this is distinct from the movement of the ground due to vertical load changes, as calculated above. Data in C580, Figure 2.11 indicate that the vertical settlement at the excavation boundary will be of the order of 0.1% of the excavated depth for a stiffly-propped wall, i.e. 3.6mm in this case. This settlement is predicted to decay linearly with distance from the excavation, to approximately zero at a distance of 3x excavated depth from the wall. Taking the distance from the excavation to the flank wall of No 6 as 2.6m, then a settlement at the flank wall of approximately 2.7mm is predicted, reducing to zero approximately 8m from the flank wall.

The heave due to excavation of the basement, as calculated in 5.3.1 above, will act to reduce the settlement above, however as the calculated heave magnitudes are negligible this is not taken into account in the analysis.

5.3.3 Effect of vertical movement on potential damage

It is seen above that the movement of the walls of No 6 is predicted to be significantly more affected by settlement due to slight yielding of the retaining wall, than by the heave that results from vertical unloading of the ground as the basement is excavated. As these two effects tend to cancel out, the heave will be ignored in the following. This is conservative.

The rear wall of No 6 suffers a maximum predicted distortion (as defined by Burland, Ref 2) of approximately 1.3mm due to the settlement predicted in Section 5.3.2 above; see Figure 5. This equates to a maximum deflection ratio of 1.3/15 000=0.0087%. Taking the limiting tensile strain between the 'very slight' and 'slight' damage categories as being 0.075% (Ref 2) then the ratio of deflection ratio to limiting tensile strain is 0.12. By reference to Figure 6 (Ref 2 Figure 6) and taking the height of the building as approximately half of its width, a horizontal strain/limiting tensile strain ratio of approximately 0.85 is obtained. Therefore, by this analysis, a horizontal strain of 0.85 x 0.075% = 0.064% marks the upper limit of the 'very slight' category of damage.

In fact the above analysis is conservative as the deflection calculation does not take into account the structural stiffness of the building, which is likely to reduce distortion considerably.

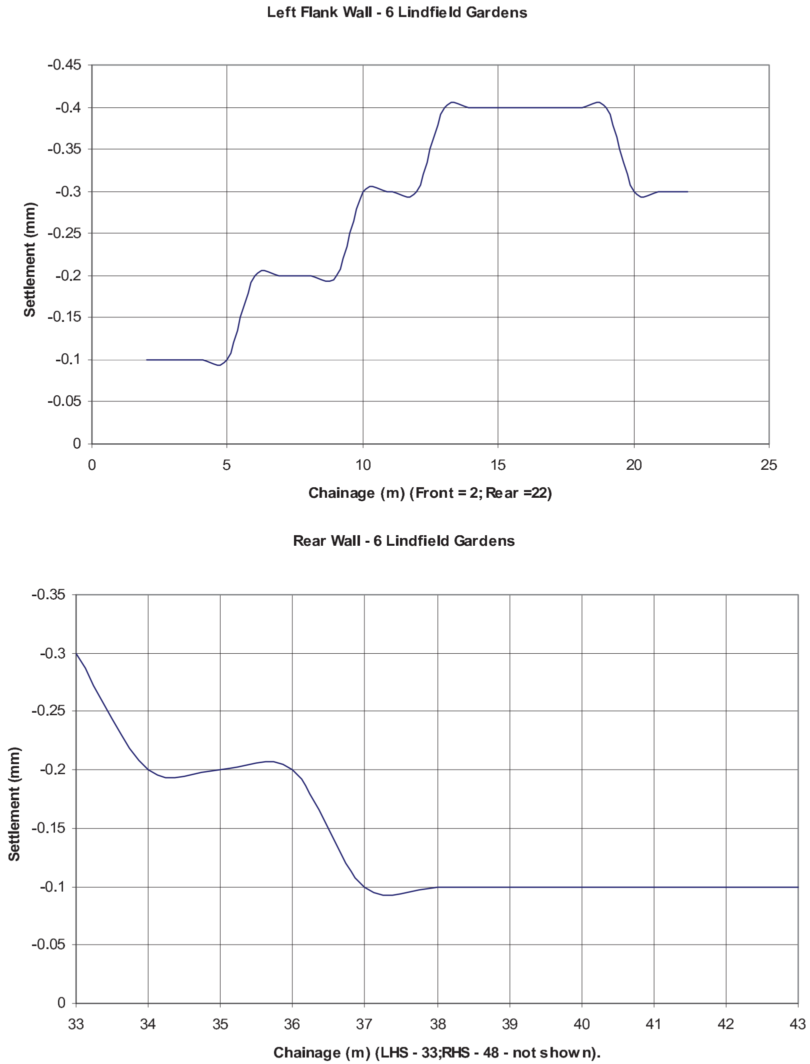
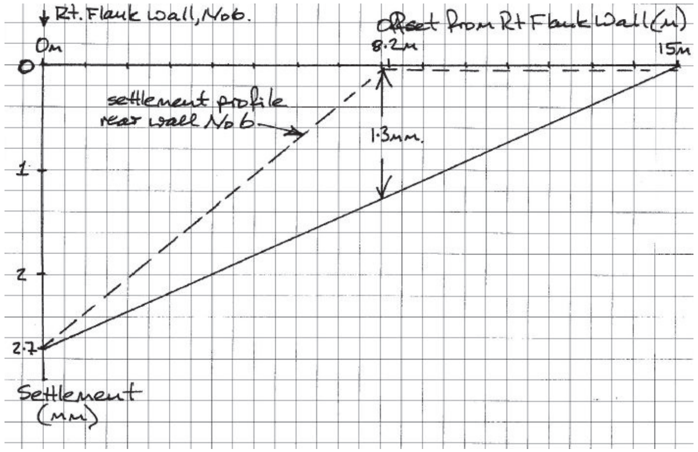
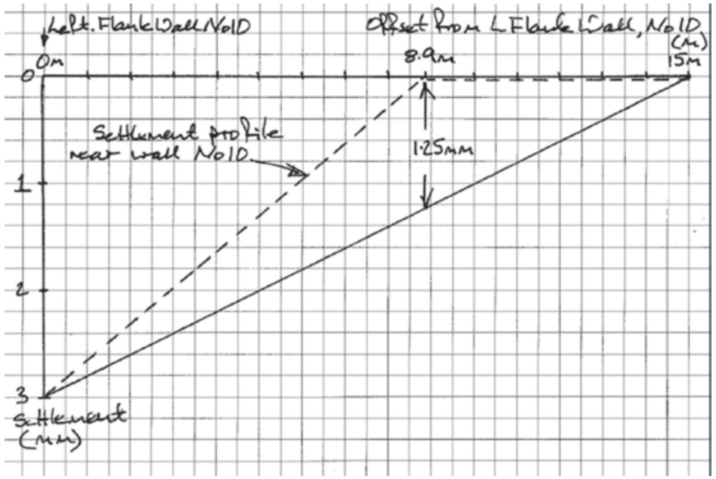


Figure 4 – Movement profiles No 6 Lindfield Gardens



Movement profile No 6 Lindfield Gardens



Movement profile No 10 Lindfield Gardens

Figure 5 – Movement profiles Nos 6+10 Lindfield Gardens

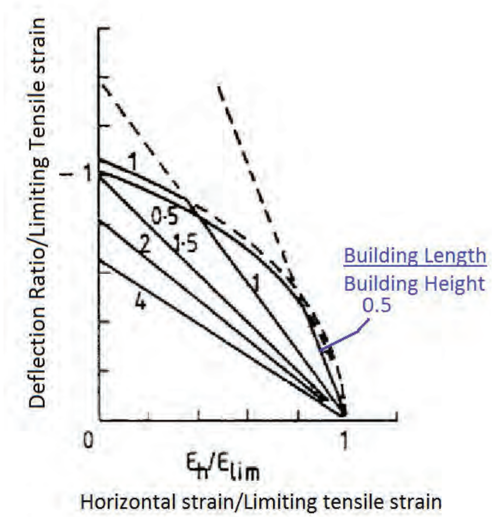


Figure 6 (from Ref 2)

5.3.4 Lateral movement due to wall construction and deflection

In CIRIA C580 (Ref 3) horizontal movements due to wall installation and subsequent bulk excavation are expressed as a function of wall height or excavation depth. At 8 Lindfield Gardens the maximum general excavation depth is taken to be of the order of 3.6m (50.1 to 46.5mAD).

There is no information in C580 about movement arising from underpin installation. Data are presented for bored pile wall (BPW) installation (Ref 3 Fig 2.8) and diaphragm wall installation (Ref 3 Fig 2.9). Both of these reportedly relate to installation in stiff clays, therefore the results are taken to be applicable to Victoria Road. Neglecting the data from the secant BPW case history in Ref 3 Figure 2.8 (which is considered to be unreliable), the pattern appears to be lateral movement of 0.04-0.05% of wall height adjacent to the wall, reducing to zero at a distance of 1.5x wall height back from the wall, the decay being roughly linear. For a wall height of 3.6m this corresponds to a maximum lateral movement of around 1.8mm, and a strain of 1.8/(1.5x3600) = 0.03% due to wall installation. This value assumes good workmanship.

Horizontal movement due to bulk excavation in 'stiff clay' is given in C580 Figure 2.11. This plot suggests that, for a stiff wall and propping arrangement, lateral movement is expected to be less than 0.15% of excavation depth at the excavation, reducing to zero at a distance of 4 x excavation depth back from the wall. For a 3.6m excavation therefore the max horizontal movement is anticipated to be 5.4mm, resulting in a lateral strain of 5.4/(4 x 3600) = 0.037%.

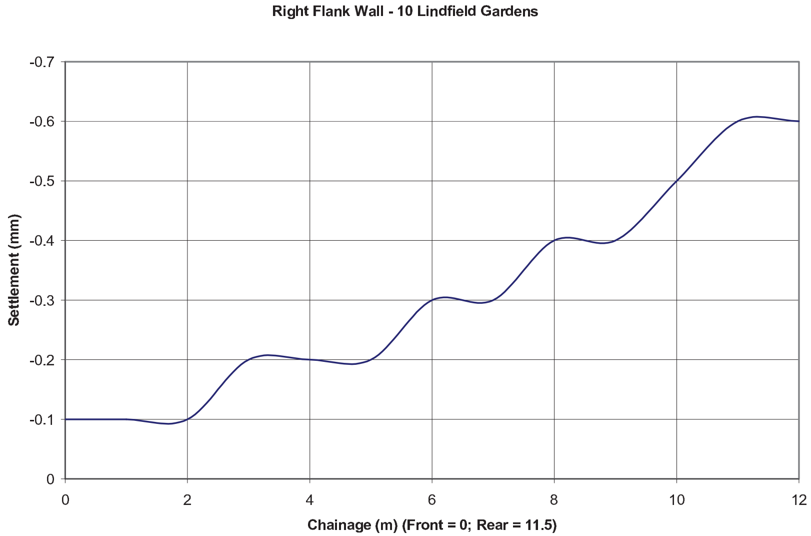
The total lateral strain across the width of Nos 18 and 22 is therefore assessed as 0.067%. This is slightly greater than the upper limit of 0.075% for 'very slight' damage derived above.

5.3.5 Predicted movement – No 6 Lindfield Gardens - summary

A conservative analysis of damage due to the settlement arising from the construction of the basement of No8 Lindfield Gardens indicates a damage classification at the low end of 'slight' for the rear wall of No 6. But taking into account the heave due to unloading as the basement is dug, and the stiffness of the walls and foundations of No 6, it is predicted that damage to the rear wall will fall well within the 'very slight' damage classification as defined in Ref 2. By inspection the damage to the flank wall, which would be stiffer than the rear wall, and the front wall, which is considerably further removed from the excavation, is also predicted to be very slight, or less.

5.4 Predicted movement – No 10 Lindfield Gardens (to the left of the site).

The predicted movement of the right flank and rear walls of No 10 Lindfield Gardens, arising from the vertical load changes at No8, is plotted in Figure 7. It will be seen that heave is predicted and the magnitude of that heave is approximately 0.5mm. This is of the same order as the heave calculated above for No 6, and again this heave is considered to be negligible. As was the case for No 10 (above) the movement of No 10 is predicted to be dominated by the settlement arising from inward yielding of the retaining wall as the wall is constructed and the basement excavated.



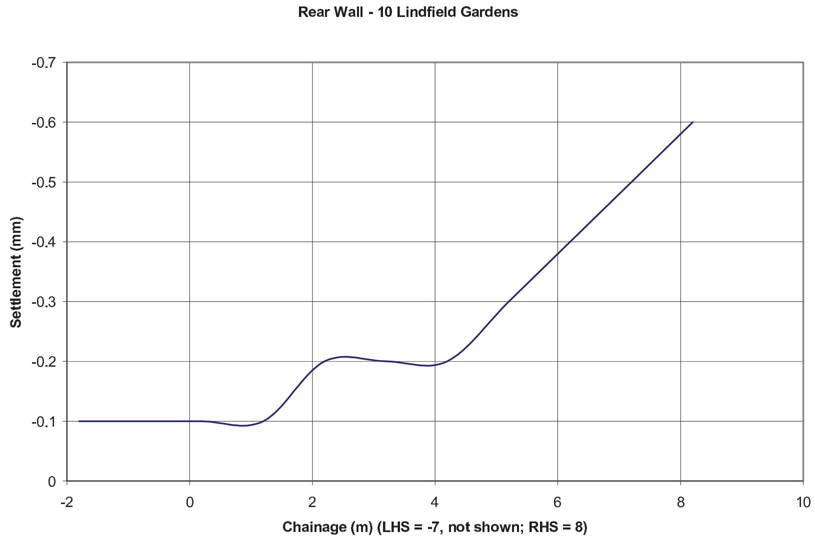


Figure 7 – Movement profiles No 10 Lindfield Gardens

The damage analysis for No 10 mimics that for No 6, save for the fact that No 10 is slightly closer, at approximately 1.9m, to the excavation. This suggests that at the flank wall of No 10 the settlement is predicted to be 3mm, decaying to zero some 8.9m from the flank wall. However, as seen from Figure 5, this does not significantly affect the maximum predicted distortion, which is 1.25mm; similar to that for No 6 (1.3mm).

The conclusions for No 10 are therefore the same as those for No 6, that is; the damage to the rear wall is expected to be very slight, and the damage to the flank wall and the front wall are expected to be very slight or less.

5.5 Predicted movement – Existing walls No 8 Lindfield Gardens

The predicted movements of the rear and flank walls, arising due to changes in vertical load associated with the basement works, are shown in Figures 8, 9 and 10.

It is seen that the maximum predicted displacement is predicted to be approximately 1.1mm heave in the rear right corner. Again the calculated settlement due to the inward yielding of the underpin/retaining walls is predicted to exceed this figure, however in reality the movement of the rear wall is likely to be dominated by movements associated with the practical aspects of the underpinning works. As load is transferred from the existing foundation to the underpin, movements of several millimetres are to be expected. These can only be minimised by a high standard of workmanship.

Based on the analysis in Section 5.3 above, the damage to be expected, from theoretical considerations of vertical load changes and inward yielding of the underpin/retaining wall alone, is likely to be very slight. However, due to the anticipated movement of the rear wall during the underpinning works a greater degree of damage may accrue, the actual degree of damage being controlled to a large extent by the quality of workmanship.

While there is a dearth of published information reporting the monitored movements of underpinned buildings, a large number of similar basement extension projects in Central London have been successfully completed without significant damage to the neighbouring properties. A relatively small number of incidents have been reported where damage and/or injury has been caused by poor workmanship. This emphasises the importance of maintaining high construction standards throughout the basement works.

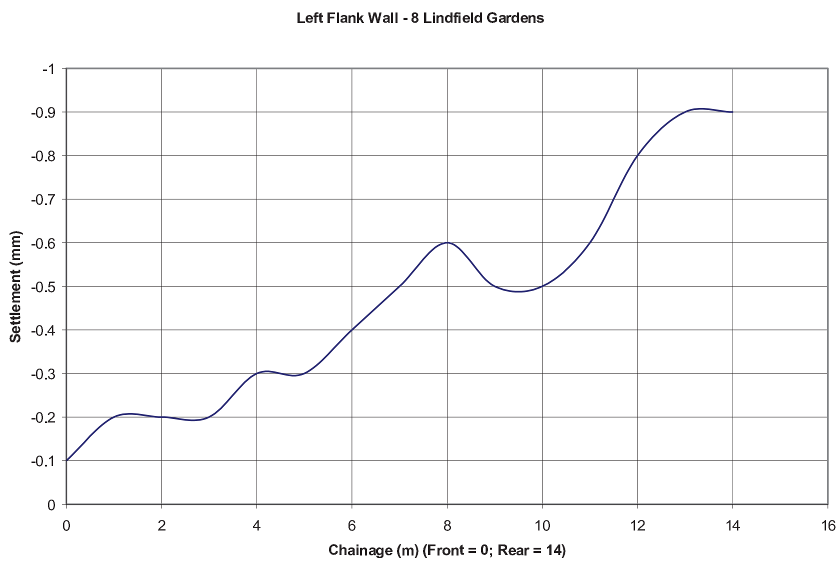


Figure 8 – Movement profile Left flank wall No 8 Lindfield Gardens

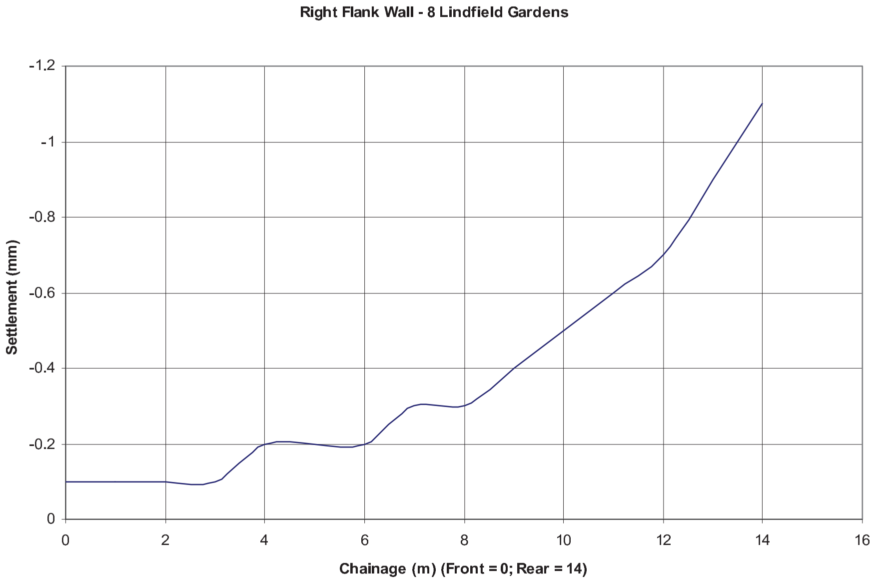


Figure 9 – Movement profile Right flank wall No 8 Lindfield Gardens

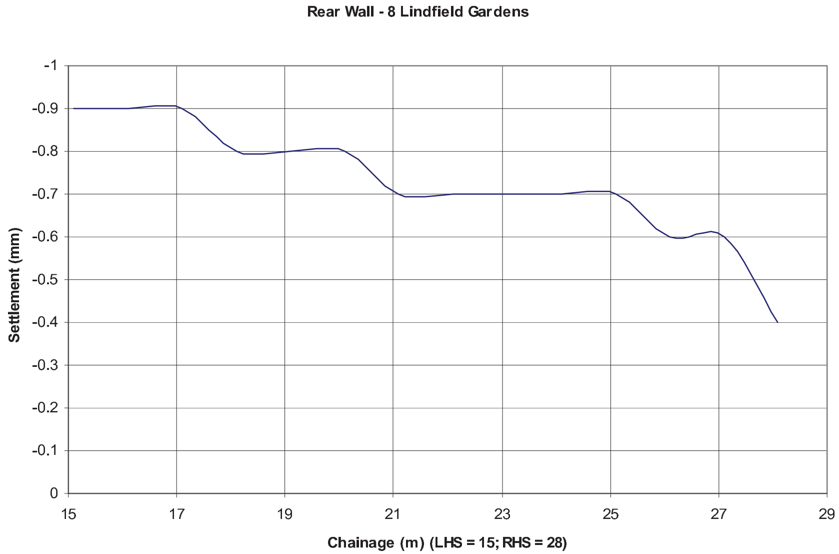


Figure 10 – Movement profile Rear wall No 8 Lindfield Gardens

5.6 Predicted heave to be suffered by new basement slab

In Figure 11 the ground movement at basement level, due to excavation, has been plotted as a left-right profile through the centre of the proposed basement. Both long-term and short-term profiles are presented. In the absence of more detailed information structural loads in the short term, following basement excavation, are taken to be the same as the long term loads, but the self-weight of the basement slab has not been taken into account in the short-term analysis.

The analysis indicates that the majority of the ground movement that is expected will occur in the short term during excavation. As a result, if heave pressures are developed in the long term they will be minimal. In fact, a small amount of settlement is predicted between short and long term conditions.

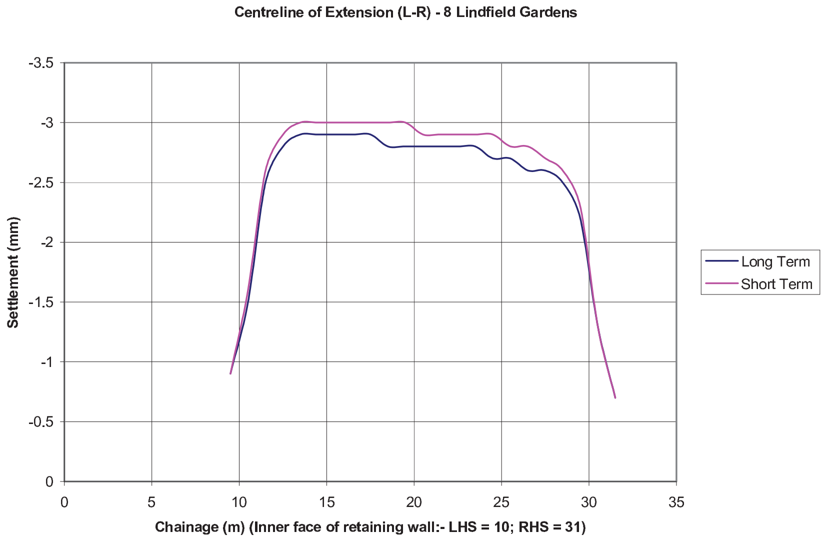


Figure 11 – Movement profile – proposed basement floor

7.0 Conclusions

From the above, it is concluded that, given good workmanship including stiff bracing to the excavation, the basement to 8 Lindfield Gardens can be constructed without imposing more than a 'very slight' level of damage on the adjoining properties at 6 and 10 Lindfield Gardens.

The predicted damage to the existing walls of No 8 Lindfield Gardens, from theoretical considerations of vertical load changes and inward yielding of the underpin/retaining wall alone, is also 'very slight'. However these walls, especially the existing rear wall of the property will be directly affected by the underpinning works, and as a result a greater degree of damage is likely to accrue, the actual degree of damage being controlled to a large extent by the quality of workmanship.

While there is a dearth of published information reporting the monitored movements of underpinned buildings, a large number of similar basement extension projects in Central London have been successfully completed without significant damage to the neighbouring properties. A relatively small number of incidents have been reported where damage and/or injury has been caused by poor workmanship. This emphasises the importance of maintaining high construction standards throughout the basement works.

Movement of the ground below the basement slab, following casting of that slab, is predicted to be negligible under the loading conditions as they are currently understood.

References:

1 Stroud M A (1989) 'The standard penetration test – its application and interpretation'. In 'Penetration testing in the UK', Thomas Telford pub.

2 Burland JB (1997). 'Assessment of risk of damage to buildings due to tunnelling and excavation'. In 'Earthquake Geotechnical engineering' Ishihara (Ed). Balkema pub.

3 Gaba A R, Simpson B, Powrie W, Beadman D R (2003) Embedded retaining walls - guidance for economic design, CIRIA Report C580, London. ISBN: 978-0-86017-580-3.