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Your Ref:

Our Ref:

Ref: 13/20821-3
January 2015

Basement Impact Assessment

At

50 Avenue Road, London, NW8 6HS

For

The Shri Krishna Trust C/O HSBC Trustee (C.I.) Limited

First Issued: July 2014

Amended and Re-Issued: January 2015

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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 and groundwater regime at the residential property at 50 Avenue Road, London, NW8 6HS. For this assessment a representative of SAS Limited visited the property on 31st July 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.

1.2 Planning Policy Context

Camden Planning Guidance for Basements and Lightwells has been recently revised (CPG4, September 2013) and requires proposed developments to mitigate against the effects of ground and surface water flooding and to include drainage systems that do not impact neighboring 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 the Mr Andrew Smith, a Fellow of the Geological Society (FGS) and Member of the Chartered Institute of Water and Environmental Management (MCIWEM) in coordination with Mr Mike Brice of Applied Geotechnical Engineering, a Chartered Geologist (CGEOL), Neil Smith of Applied Geotechnical Engineering, a Chartered Civil Engineer (CEng), Antony Clothier of Water Environment Limited, a Chartered Civil Engineer (CEng) and Member of the Chartered Institute of Water and Environmental Management (MCIWEM) and Mr Gary Povey of Mann Williams Structural Engineers, a Chartered Structural Engineer (CEng).

2.0 SITE DETAILS

(National Grid Reference: TQ 270 837)

2.1 Site Location

The site is situated at an existing residential property at 50 Avenue Road, London, NW8 6HS. The existing usage of the site is an existing large detached house and extensive rear garden and covers an area of approximately 0.13 hectares with the general area being under the authority of Camden Council.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid & Drift Edition) indicates the site to be underlain by the Eocene London Clay Formation. However, Superficial Head Deposits are located to the east and west 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. 13/20821-1 and 13/20821) dated August 2013. The findings from these reports are described in this basement impact assessment.

2.4 Site Layout and History

The site was attended on 31st July 2013 for the purposes of conducting the site walkover.

The site comprises of an extensive three-storey detached house with a large rear garden and gated driveway from Avenue Road. The rear garden is mainly set to lawn, with flower beds and small shrubs. The garden is bordered by a low brick wall with some large trees present at the end of the garden. A small wooden summer house is present at the rear of the garden. The main house has a large gated driveway at the front, including a small raised lawn and hedge.

The site itself is essentially flat, although there is a general slight slope across the site from north-west to south-east away from Primrose Hill down towards the Thames Basin.

From a review of the historical maps it would appear that the site was occupied by a large detached building with front and rear gardens from 1871 (the date of the earliest available OS map) and has not changed in use to the present day, although rebuilding and/or extensions are evident to the main building circa 1954-1967.

2.5 Proposed Development

It is proposed to construct a two storey basement beneath the footprint of the existing property and part of the garden. The majority of the basement is founded at approximately 8m below ground level with a deeper section containing a swimming pool at 10m 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:

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	The Bedrock geology underlying the site (solid permeable formations) associated with the London Clay Formation has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
	1b. Will the proposed basement extend beneath the water table surface.	Yes - refer to section 4.2 for scoping	The minimum depth of the proposed basement floor level of 8.0m will be below the current water level of approximately 3.49m below ground level as encountered in Borehole 1.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	Yes - refer to section 4.3 for scoping	The nearest existing surface water feature is recorded as a pond located 490m north-west of the site. However, according to the Lost Rivers of London the site is within 100m of the tributaries of the former River Tyburn.
	3. Is the site within the catchment of the pond chains on Hampstead Heath.	No	The site is away from this area.
	4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	Yes- refer to section 4.4 for scoping	It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas.
	5. 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).	Yes- refer to section 4.4 for scoping	It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas.
	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	The nearest surface water feature is recorded as a pond located 490m north-west of the site.
Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 1 in 8.	No	The site is essentially flat with only minor undulations present at angles of between 3° and 6°.
	2. Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 1 in 8.	No	The slope to the front boundary will be slightly changed, but will be kept close to 1:14, locally max. at 1:10
	3. Does the development neighbor land, including railway cuttings and the like, with a slope greater than 1 in 8.	No	The neighbouring land is essentially flat with only minor undulations present, sloping mainly towards the south east, at angles of between 3° and 6°.

	4. Is the site within a wider hillside setting in which the general slope is greater than 1 in 8.	Yes - refer to section 5.2 for scoping	There is a general slight slope in the wider hillside setting from north- west to south-east away from Primrose Hill down towards the Thames Basin up to approximately 8°.
	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.
	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 5.3 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 5.4 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 4.2 for scoping	The nearest surface water feature is recorded as a pond located 490m north-west 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 5.7 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	The Bedrock geology underlying the site (solid permeable formations) associated with the London Clay Formation has been classified as Unproductive Strata.
	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 5.8 for scoping	The site lies adjacent to Avenue Road.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes - refer to section 5.9 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	Communication with LUL Operational Property Division (attached as Appendix A to this report) indicates that the nearest tube line is located over 50m from the site and runs along Finchley Road towards the west of the site. A Map of the nearby Primrose Hill tunnels located 150m north of the site, is also

			attached as Appendix A to this report.
Surface Water and Flooding	1. Is the site within the catchment of the pond chains on Hampstead Heath.	No	The site is located over 50m from the pond chains on Hampstead Heath.
	2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	Yes - refer to Section 6.2 for scoping	It is proposed to increase hard standing surface on site by approximately 21 sq.m therefore surface water flows may be impacted
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	Yes - refer to Section 6.2 for scoping	The amount of hardstanding on-site is expected to increase
	4. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.	Yes - refer to Section 6.3 for scoping	The amount of hardstanding on-site is expected to increase therefore surface water may be impacted by the development.
	5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	Yes - refer to Section 6.3 for scoping	As changes are occurring above the ground, surface water will be impacted by the development.
	5. Is the site in an area known to be at risk from surface water flooding.	Yes - refer to Section 6.3 for scoping	There are no fluvial or tidal floodplains located within 1km of the site. However according to CPG4, September 2013, Avenue Road is on the list of streets at risk from surface water flooding.

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

Subterranean Groundwater Flow

- Will the proposed basement extend beneath the water table surface.
- Is the site within 100m of a watercourse, well (used / disused) or potential spring line
- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas
- 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).

Slope Stability

- Is the site within a wider hillside setting in which the general slope is 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

Surface Water and Flooding

- 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.
- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.
- 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.
- Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.
- Is the site in an area known to be at risk from surface water flooding.

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 June and July 2013 (Report Reference 13/20821). 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 topsoil underlain by a mixture of medium dense clayey silty sand and sandy silty clay with brick fragments and crushed concrete
London Clay Formation	1.10	Stiff becoming very stiff silty clay with occasional partings of silty fine sand, scattered gypsum crystals

Groundwater was not encountered in either borehole during drilling operations and the material remained essentially dry throughout. Water was subsequently recorded at a depth of 3.19m below ground level in the monitoring standpipe installed in Borehole 1 after a period of approximately five months, but was not recorded in the standpipe placed in Borehole 2 above a level of approximately 10.00m below ground level (i.e. the base of the standpipe) after the same period. These groundwater readings are included in this report as Appendix B.

3.2 Hydrological Context

During the latest monitoring visit on the 15th December 2014 a rising head permeability test was carried out in Borehole 1. The groundwater in the borehole was measured at 3.19m below ground level. Subsequently the well was purged and the water level reduced to 9.61m below ground level. During the subsequent 60 minute period the following recharge levels were recorded:

Time after purging well (minutes)	Water Level (mbgl)
0	9.61
5	9.40
10	9.27
15	9.17
30	8.99
60	8.82

These results indicate the apparent permeability of the materials at the site to be of the order of 6.81×10^{-8} m/sec. This value lies at the boundary between published data for fissured and weathered clays and / or silty sands and intact clays is classed as very low permeability material with poor to practically impervious drainage characteristics.

4.0 SUBTERRANEAN (GROUNDWATER FLOW) - SCOPING ASSESSMENT

4.1 Introduction

This section addresses outstanding issues raised by the screening process regarding the presence of an ancient watercourse within 100m of the site and the fact that groundwater was encountered in the ground investigation above the level of the proposed basement depth.

4.2 Groundwater Flow and Depth to Groundwater

The ground floor level of the proposed development is at a minimum depth of approximately 8.0m below ground level. In Borehole 1, located within the northern section of the site, the encountered groundwater during the groundwater monitoring period is at least approximately 4.81m above proposed floor level whilst, conversely in Borehole 2, located within the southern section of the site groundwater is at least 10.0m below ground level.

It is suggested that this large difference in groundwater level across the site is due to the presence of more permeable Made Ground soils at the location of Borehole 1 compared to those present at the location of Borehole 2 and that the water in Borehole 1 represents an accumulation of surface water in the Made Ground lying above the effectively impermeable London Clay soils below.

Given the presence of a non-aquifer below the site it is likely that groundwater within these soils is recharged via intermittent seepages from surface water associated with weather conditions rather than any large scale subterranean groundwater flow. As a result the impact from the basement development on the local groundwater regime is likely to be minimal.

However as it may be necessary to control this water during the construction period and consideration could be given to conventional internal pumping methods from open sumps.

4.3 Springs, Wells and Watercourses

The nearest surface water feature is recorded as a pond located 490m north-west of the site. There are no 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 Tyburn, which ran in a southerly direction from Hampstead to Pimlico and Westminster via Regents Park, Marylebone, Mayfair and Buckingham Palace. The River Tyburn is now completely enclosed and flows through underground conduits for its entire length.

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.

4.4 Hardstanding

It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas and therefore the proposals may potentially affect the overall volume of surface water generated by the site unless mitigation is provided.

However, in accordance with findings from the Flood Risk Assessment (FRA) for the site (Reference WE13066) by Water Environment Limited (August 2013) (included in this report as Appendix D) although the impermeable area on site will increase following the development, surface water runoff from all these areas will be formally collected and attenuated thereby reducing the risk of flooding from this source.

These attenuation measures are described in section 6.0 of this report and in the FRA for the site.

5.0 SCOPING ASSESSMENT - SLOPE AND GROUND STABILITY

5.1 Introduction

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

5.2 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 (Reference 19250-1) 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 itself is essentially flat with only minor undulations present, sloping mainly towards the south-east, at angles of between 3° and 6°. There is however, a greater slope angle across the site from north-west to south-east away from Primrose Hill down towards the Thames Basin up to around 8°, 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°.

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 described in Section 4.2.

5.3 Shrinking / Swelling Clays

A single Atterberg Limit Test was conducted on a sample taken from 6.00m depth in the essentially cohesive natural soils encountered in Borehole 1 and showed the sample 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. Given the minimum depth of the proposed basement floor is approximately 8.0m below ground level, foundations for the structure are unlikely to be affected by the removal of these trees. However, shallower foundations may need to be taken deeper should they be within the zones of influence of either existing or recently felled trees. 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.

5.4 Heave of underlying soils

The upward movement of the base of an excavation occurs as a result of unloading and may be considered as consisting of two parts:

1. A short term movement called heave which occurs as a result of elastic rebound and may typically occur during the construction period

2. A long term movement called swell which occurs as a result of the absorption of water into the pores of the soils as the ground adjusts to new stress conditions.

Heave and its magnitude depends on soil properties and the degree of load that is removed. At this site is understood that a suspended concrete slab over a compressible material (claymaster or similar) will be constructed at basement level and therefore heave is unlikely to be an issue. A heave assessment at the site has been carried out at the site and is referred to in the ground movement assessment report by Applied Geotechnical Engineering (Report Reference P2358) included as part of this BIA.

5.5 Compressible / Collapsible Ground

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

5.6 Springs, Wells and Watercourses

As discussed in Section 4.2 it is considered that the proposed development will have minimal impact on any nearby watercourses.

5.7 Made Ground

In the boreholes drilled at the site, Made Ground was found to extend down to depths of up to 1.50m below ground level and comprised of a surface layer of topsoil underlain by a mixture of medium dense clayey silty sand and sandy silty clay with brick fragments and crushed concrete.

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 30kN/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.

5.8 Location of public highway

The proposed basement is not to be extended below Avenue Road 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.

A ground movement assessment was carried out at the site by Applied Geotechnical Engineering under the instruction of Site Analytical Services Limited (Report Reference P2358). The report is provided as Appendix C. The predicted movement comprises a tilt of approximately 4.3mm over the 10m width of the road that has been analysed, equating to a tilt gradient of less than 1 in 2300. There is negligible predicted distortion.

5.9 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.

The ground movement assessment (Appendix C) concludes that given good workmanship, the basement excavations can be constructed without imposing more than a 'very slight' level of damage on the adjoining properties.

Further drilling is recommended following planning approval of the scheme to allow better design of the proposed foundations. The investigation should comprise a 20m cable percussive borehole which should be located towards the rear of the existing property where access permitted only a small diameter 15m CFA borehole the 2013 investigation.

6.0 SURFACE WATER AND FLOODING - SCOPING ASSESSMENT

6.1 Introduction

This section addresses outstanding issues raised by the screening process regarding surface water and flooding (see Table 1).

6.2 Surface Water Drainage

It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas by around 21 sq.m and therefore the proposals may potentially affect the overall volume of surface water generated by the site unless mitigation is provided.

However it is also understood that formal drainage is proposed for these new hard-standing areas with attenuation provided as required by detailed design and therefore it is unlikely that any increase in surface water generated will cause an increase in peak runoff from the site.

Based on the information available for the site, the London Clay Formation has a measured permeability of 6.81×10^{-8} m/s and a likely mass permeability several orders of magnitude higher. On this basis, infiltration drainage is not feasible as a drainage solution for the proposed basement and since there is no watercourse in the vicinity of the site, additional site area could be drained from the site via surface water sewer.

On the basis that the foul water sewage system for the proposed redevelopment meets the specifications of Thames Water this should ensure that the systems have sufficient capacity to prevent overloading under the normal range of operating conditions.

The implementation of these recommendations will further ensure the proposals would not cause an increase in peak runoff from the site.

6.3 Flood Risk

Information from the desk study and Environment Agency website indicates that the site does not lie within 250m of any Zone 2 or Zone 3 Environment Agency Flood Zones. Additionally, there are no Environment Agency floodplains, flood defenses, or areas benefitting from flood defences within 250m of the site. Reference to the Environment Agency website also indicates that the site does not lie within an area shown as being at risk from flooding from reservoirs.

However, with respect to potential flooding from surface water run-off, the site lies within an area known to have historically flooded in 2002 according to Figure 15 of the ARUP report (i.e. a primary area). In addition, CPG4 provides a list (p. 29) of streets in the London Borough of Camden that have historically been affected by surface water flooding and Avenue Road appears in this list and the Environment Agency's latest surface water flood risk mapping (available on their website since December 2013) shows a 'high' risk of flooding from surface water for the adjacent part of Avenue Road.

Based on this and, in accordance with CPG4, A Flood Risk Assessment (FRA) has been carried for the site (Reference WE13066) by Water Environment Limited (August 2013) which is included as Appendix D to this report.

The current data indicates that flood water, like groundwater will flow in a general south westerly direction across the site through the upper permeable made ground in accordance with the topography of the site area. Hence, there is a risk of groundwater flow into the proposed basement.

British Standard (BS) 8102 (Code of Practice for Protection of Below Ground Structures Against Water from the Ground) recommends that basements with a depth greater than 4m below ground level (bgl) as in the case of this site should be designed to allow for fluctuations in the water table of up to 1m. It also offers guidance for the design and waterproofing of basements and defines 3 grades as follows.

- Grade 1: Basic Utility. Car parking, plant rooms (excluding electrical equipment), workshops. Some seepages and damp patches tolerable;
- Grade 2. Better Utility. Workshops and plant rooms that require drier environments. No water penetration but moisture vapor tolerable.
- Grade 3. Habitable. Ventilated residential and working areas including offices. Dry environment. Active measures to control internal humidity may be necessary

The proposed basement excavation should be designed to the appropriate grade therefore reducing the risk posed to the basement from groundwater flow.

With respect to foul water drainage systems, on the basis that the foul water sewage system for the proposed redevelopment meets the specifications of Thames Water this should ensure that the systems have sufficient capacity to prevent overloading under the normal range of operating conditions.

7.0 CONCLUSIONS AND NON TECHNICAL SUMMARY

1. It is proposed to demolish the existing building on the site, construct a two storey basement beneath the footprint of the property and part of the garden and rebuild a three storey house above. The majority of the basement is founded at approximately 8m below ground level, with a deeper section containing a swimming pool at 10m below ground level.

2. Ground conditions at the site were investigated by Site Analytical Services Limited in June, July and August 2013 (Report Reference 13/20821). The exploratory holes revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised between up to 1.50m thickness of Made Ground overlying materials typical of the London Clay Formation.

3. Water levels in the immediate vicinity of the property have been recorded above floor level of the proposed basement. However given the presence of a non-aquifer below the site it is likely that groundwater within these soils is recharged via intermittent seepages from surface water associated with weather conditions rather than any large scale subterranean groundwater flow. As a result the impact from the basement development on the local groundwater regime is likely to be minimal.

4. The nearest surface water feature is recorded as a pond located 490m north-west of the site. The site lies within 100m and between two tributaries of the former River Tyburn, although the River Tyburn is now completely enclosed and flows through underground conduits for its entire length. As a result it is considered that the proposed development will have minimal impact on any nearby watercourses.

5. The implementation of the attenuation measures will ensure the proposals would not cause an increase in peak runoff from the site.

6. The proposed development does not include any remodeling of slopes to angles greater than 12.5° 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

7. It is understood that trees are to be removed from the site as part of the development. Given the proposed basement floor is up to 8.0m below ground level foundations for the structure are unlikely to be affected by the removal of these trees.

8. Further drilling is recommended following planning approval of the scheme to allow better design of the proposed foundations. Contamination testing of the Made Ground is likely to be required during any second phase of ground investigation.

9. 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

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

11. Although Avenue Road flooded in 2002 the site itself is raised above surrounding road levels of the road. Therefore the risk of surface water and sewer flooding to the site are considered to be low.

12. Given good workmanship, the basement excavations can be constructed without imposing more than a 'very slight' level of damage on the adjoining properties.

p.p. SITE ANALYTICAL SERVICES LIMITED

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8. Camden Planning Guidance, 2011. CPG 4; Basements and lightwells. London Borough of Camden

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

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

11. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

APPENDIX A.

Email Correspondence between SAS and LUL 25th July 2013

Date 25 July 2013
Our Ref 20878-SI-3-250713
Your Ref
To Andy Smith
Site Analytical Services
AndyS@siteanalytical.co.uk

London Underground Limited

Hello Andy,

50 Avenue Road London NW8 6HS

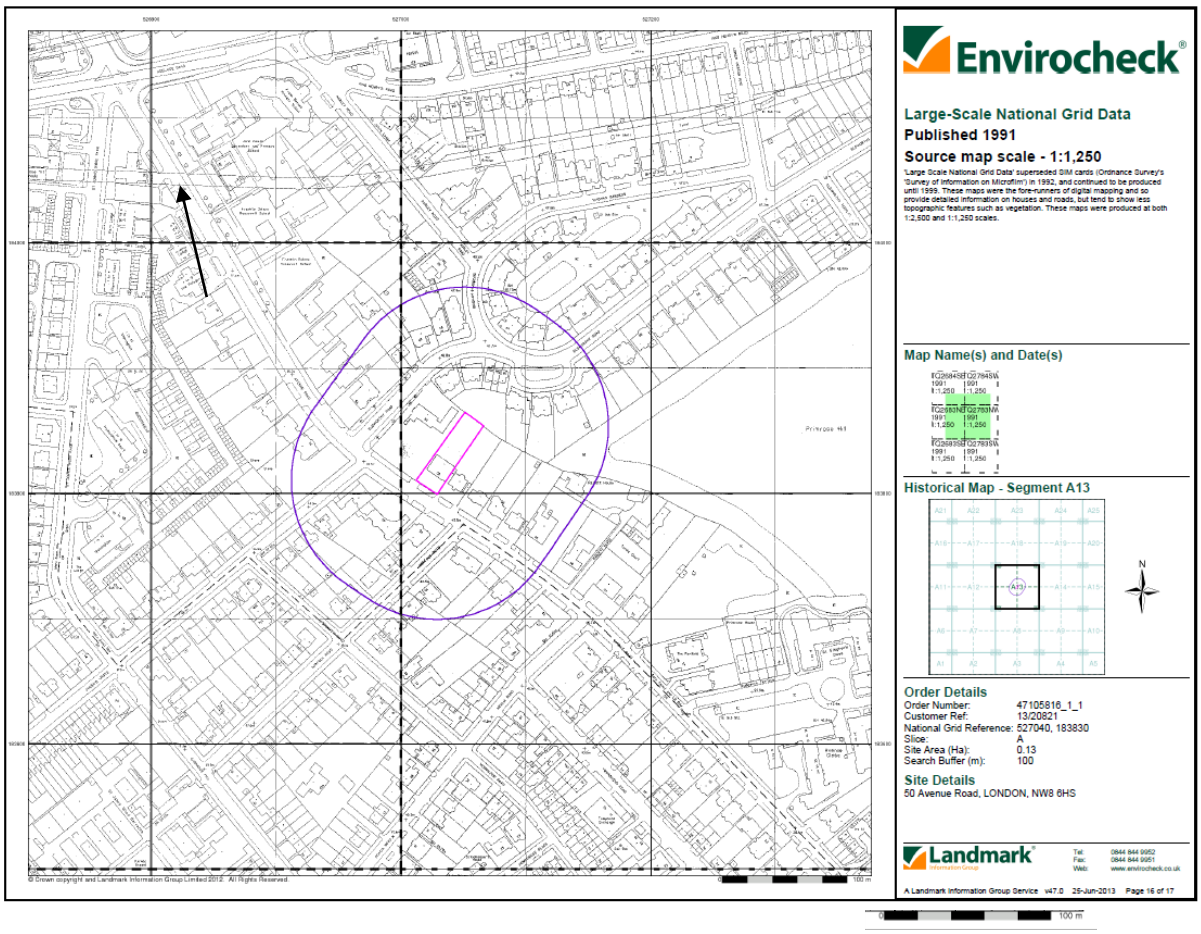
Thank you for your communication of 24th July 2013.

I can confirm that London Underground has no assets within 50 metres of your site as shown on the plan you provided.

Should you have any further enquiries, please do not hesitate to contact me.

Shahina Inayathusein
Information Manager
LUL Infrastructure Protection
E-mail: Locationenquiries@tube.tfl.gov.uk
Tel: 020 7918 0016

1:1,250 OS Scale map of site detailing the location of Primrose Hill Tunnels (arrowed).



Copyright. Ordnance Survey 1991. Included in Envirocheck Report dated

APPENDIX B – Groundwater monitoring results

Borehole	Installation Depth	Intallation Date	Date				
			11/07/2013	31/07/2013	08/08/2013	15/12/2014	23/12/2014
BH1	10	Jun-13	DRY	3.67	3.49	3.19	3.2
BH2	10	Jul-13	DRY	DRY	DRY	DRY	DRY

APPENDIX C - Ground Movement Assessment Report

APPENDIX D – Flood Risk Assessment

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 and groundwater regime at the residential property at 50 Avenue Road, London, NW8 6HS. For this assessment a representative of SAS Limited visited the property on 31st July 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.

1.2 Planning Policy Context

Camden Planning Guidance for Basements and Lightwells has been recently revised (CPG4, September 2013) and requires proposed developments to mitigate against the effects of ground and surface water flooding and to include drainage systems that do not impact neighboring 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 the Mr Andrew Smith, a Fellow of the Geological Society (FGS) and Member of the Chartered Institute of Water and Environmental Management (MCIWEM) in coordination with Mr Mike Brice of Applied Geotechnical Engineering, a Chartered Geologist (CGEOL), Neil Smith of Applied Geotechnical Engineering, a Chartered Civil Engineer (CEng), Antony Clothier of Water Environment Limited, a Chartered Civil Engineer (CEng) and Member of the Chartered Institute of Water and Environmental Management (MCIWEM) and Mr Gary Povey of Mann Williams Structural Engineers, a Chartered Structural Engineer (CEng).

2.0 SITE DETAILS

(National Grid Reference: TQ 270 837)

2.1 Site Location

The site is situated at an existing residential property at 50 Avenue Road, London, NW8 6HS. The existing usage of the site is an existing large detached house and extensive rear garden and covers an area of approximately 0.13 hectares with the general area being under the authority of Camden Council.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid & Drift Edition) indicates the site to be underlain by the Eocene London Clay Formation. However, Superficial Head Deposits are located to the east and west 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. 13/20821-1 and 13/20821) dated August 2013. The findings from these reports are described in this basement impact assessment.

2.4 Site Layout and History

The site was attended on 31st July 2013 for the purposes of conducting the site walkover.

The site comprises of an extensive three-storey detached house with a large rear garden and gated driveway from Avenue Road. The rear garden is mainly set to lawn, with flower beds and small shrubs. The garden is bordered by a low brick wall with some large trees present at the end of the garden. A small wooden summer house is present at the rear of the garden. The main house has a large gated driveway at the front, including a small raised lawn and hedge.

The site itself is essentially flat, although there is a general slight slope across the site from north-west to south-east away from Primrose Hill down towards the Thames Basin.

From a review of the historical maps it would appear that the site was occupied by a large detached building with front and rear gardens from 1871 (the date of the earliest available OS map) and has not changed in use to the present day, although rebuilding and/or extensions are evident to the main building circa 1954-1967.

2.5 Proposed Development

It is proposed to construct a two storey basement beneath the footprint of the existing property and part of the garden. The majority of the basement is founded at approximately 8m below ground level with a deeper section containing a swimming pool at 10m 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:

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	The Bedrock geology underlying the site (solid permeable formations) associated with the London Clay Formation has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
	1b. Will the proposed basement extend beneath the water table surface.	Yes - refer to section 4.2 for scoping	The minimum depth of the proposed basement floor level of 8.0m will be below the current water level of approximately 3.49m below ground level as encountered in Borehole 1.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	Yes - refer to section 4.3 for scoping	The nearest existing surface water feature is recorded as a pond located 490m north-west of the site. However, according to the Lost Rivers of London the site is within 100m of the tributaries of the former River Tyburn.
	3. Is the site within the catchment of the pond chains on Hampstead Heath.	No	The site is away from this area.
	4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	Yes- refer to section 4.4 for scoping	It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas.
	5. 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).	Yes- refer to section 4.4 for scoping	It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas.
	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	The nearest surface water feature is recorded as a pond located 490m north-west of the site.
Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 1 in 8.	No	The site is essentially flat with only minor undulations present at angles of between 3° and 6°.
	2. Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 1 in 8.	No	The slope to the front boundary will be slightly changed, but will be kept close to 1:14, locally max. at 1:10
	3. Does the development neighbor land, including railway cuttings and the like, with a slope greater than 1 in 8.	No	The neighbouring land is essentially flat with only minor undulations present, sloping mainly towards the south east, at angles of between 3° and 6°.

	4. Is the site within a wider hillside setting in which the general slope is greater than 1 in 8.	Yes - refer to section 5.2 for scoping	There is a general slight slope in the wider hillside setting from north- west to south-east away from Primrose Hill down towards the Thames Basin up to approximately 8°.
	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.
	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 5.3 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 5.4 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 4.2 for scoping	The nearest surface water feature is recorded as a pond located 490m north-west 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 5.7 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	The Bedrock geology underlying the site (solid permeable formations) associated with the London Clay Formation has been classified as Unproductive Strata.
	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 5.8 for scoping	The site lies adjacent to Avenue Road.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes - refer to section 5.9 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	Communication with LUL Operational Property Division (attached as Appendix A to this report) indicates that the nearest tube line is located over 50m from the site and runs along Finchley Road towards the west of the site. A Map of the nearby Primrose Hill tunnels located 150m north of the site, is also

			attached as Appendix A to this report.
Surface Water and Flooding	1. Is the site within the catchment of the pond chains on Hampstead Heath.	No	The site is located over 50m from the pond chains on Hampstead Heath.
	2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	Yes - refer to Section 6.2 for scoping	It is proposed to increase hard standing surface on site by approximately 21 sq.m therefore surface water flows may be impacted
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	Yes - refer to Section 6.2 for scoping	The amount of hardstanding on-site is expected to increase
	4. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.	Yes - refer to Section 6.3 for scoping	The amount of hardstanding on-site is expected to increase therefore surface water may be impacted by the development.
	5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	Yes - refer to Section 6.3 for scoping	As changes are occurring above the ground, surface water will be impacted by the development.
	5. Is the site in an area known to be at risk from surface water flooding.	Yes - refer to Section 6.3 for scoping	There are no fluvial or tidal floodplains located within 1km of the site. However according to CPG4, September 2013, Avenue Road is not on the list of streets at risk from surface water flooding.

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

Subterranean Groundwater Flow

- Will the proposed basement extend beneath the water table surface.
- Is the site within 100m of a watercourse, well (used / disused) or potential spring line
- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas
- 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).

Slope Stability

- Is the site within a wider hillside setting in which the general slope is 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

Surface Water and Flooding

- 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.
- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.
- 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.
- Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.
- Is the site in an area known to be at risk from surface water flooding.

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 June and July 2013 (Report Reference 13/20821). 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 topsoil underlain by a mixture of medium dense clayey silty sand and sandy silty clay with brick fragments and crushed concrete
London Clay Formation	1.10	Stiff becoming very stiff silty clay with occasional partings of silty fine sand, scattered gypsum crystals

Groundwater was not encountered in either borehole during drilling operations and the material remained essentially dry throughout. Water was subsequently recorded at a depth of 3.19m below ground level in the monitoring standpipe installed in Borehole 1 after a period of approximately five months, but was not recorded in the standpipe placed in Borehole 2 above a level of approximately 10.00m below ground level (i.e. the base of the standpipe) after the same period. These groundwater readings are included in this report as Appendix B.

3.2 Hydrological Context

During the latest monitoring visit on the 15th December 2014 a rising head permeability test was carried out in Borehole 1. The groundwater in the borehole was measured at 3.19m below ground level. Subsequently the well was purged and the water level reduced to 9.61m below ground level. During the subsequent 60 minute period the following recharge levels were recorded:

Time after purging well (minutes)	Water Level (mbgl)
0	9.61
5	9.40
10	9.27
15	9.17
30	8.99
60	8.82

These results indicate the apparent permeability of the materials at the site to be of the order of 6.81×10^{-8} m/sec. This value lies at the boundary between published data for fissured and weathered clays and / or silty sands and intact clays is classed as very low permeability material with poor to practically impervious drainage characteristics.

4.0 SUBTERRANEAN (GROUNDWATER FLOW) - SCOPING ASSESSMENT

4.1 Introduction

This section addresses outstanding issues raised by the screening process regarding the presence of an ancient watercourse within 100m of the site and the fact that groundwater was encountered in the ground investigation above the level of the proposed basement depth.

4.2 Groundwater Flow and Depth to Groundwater

The ground floor level of the proposed development is at a minimum depth of approximately 8.0m below ground level. In Borehole 1, located within the northern section of the site, the encountered groundwater during the groundwater monitoring period is at least approximately 4.81m above proposed floor level whilst, conversely in Borehole 2, located within the southern section of the site groundwater is at least 10.0m below ground level.

It is suggested that this large difference in groundwater level across the site is due to the presence of more permeable Made Ground soils at the location of Borehole 1 compared to those present at the location of Borehole 2 and that the water in Borehole 1 represents an accumulation of surface water in the Made Ground lying above the effectively impermeable London Clay soils below.

Given the presence of a non-aquifer below the site it is likely that groundwater within these soils is recharged via intermittent seepages from surface water associated with weather conditions rather than any large scale subterranean groundwater flow. As a result the impact from the basement development on the local groundwater regime is likely to be minimal.

However as it may be necessary to control this water during the construction period and consideration could be given to conventional internal pumping methods from open sumps.

4.3 Springs, Wells and Watercourses

The nearest surface water feature is recorded as a pond located 490m north-west of the site. There are no 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 Tyburn, which ran in a southerly direction from Hampstead to Pimlico and Westminster via Regents Park, Marylebone, Mayfair and Buckingham Palace. The River Tyburn is now completely enclosed and flows through underground conduits for its entire length.

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.

4.4 Hardstanding

It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas and therefore the proposals may potentially affect the overall volume of surface water generated by the site unless mitigation is provided.

However, in accordance with findings from the Flood Risk Assessment (FRA) for the site (Reference WE13066) by Water Environment Limited (August 2013) (included in this report as Appendix D) although the impermeable area on site will increase following the development, surface water runoff from all these areas will be formally collected and attenuated thereby reducing the risk of flooding from this source.

These attenuation measures are described in section 6.0 of this report and in the FRA for the site.

5.0 SCOPING ASSESSMENT - SLOPE AND GROUND STABILITY

5.1 Introduction

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

5.2 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 (Reference 19250-1) 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 itself is essentially flat with only minor undulations present, sloping mainly towards the south-east, at angles of between 3° and 6°. There is however, a greater slope angle across the site from north-west to south-east away from Primrose Hill down towards the Thames Basin up to around 8°, 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°.

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 described in Section 4.2.

5.3 Shrinking / Swelling Clays

A single Atterberg Limit Test was conducted on a sample taken from 6.00m depth in the essentially cohesive natural soils encountered in Borehole 1 and showed the sample 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. Given the minimum depth of the proposed basement floor is approximately 8.0m below ground level, foundations for the structure are unlikely to be affected by the removal of these trees. However, shallower foundations may need to be taken deeper should they be within the zones of influence of either existing or recently felled trees. 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.

5.4 Heave of underlying soils

The upward movement of the base of an excavation occurs as a result of unloading and may be considered as consisting of two parts:

1. A short term movement called heave which occurs as a result of elastic rebound and may typically occur during the construction period

2. A long term movement called swell which occurs as a result of the absorption of water into the pores of the soils as the ground adjusts to new stress conditions.

Heave and its magnitude depends on soil properties and the degree of load that is removed. At this site is understood that a suspended concrete slab over a compressible material (claymaster or similar) will be constructed at basement level and therefore heave is unlikely to be an issue. A heave assessment at the site has been carried out at the site and is referred to in the ground movement assessment report by Applied Geotechnical Engineering (Report Reference P2358) included as part of this BIA.

5.5 Compressible / Collapsible Ground

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

5.6 Springs, Wells and Watercourses

As discussed in Section 4.2 it is considered that the proposed development will have minimal impact on any nearby watercourses.

5.7 Made Ground

In the boreholes drilled at the site, Made Ground was found to extend down to depths of up to 1.50m below ground level and comprised of a surface layer of topsoil underlain by a mixture of medium dense clayey silty sand and sandy silty clay with brick fragments and crushed concrete.

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 30kN/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.

5.8 Location of public highway

The proposed basement is not to be extended below Avenue Road 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.

A ground movement assessment was carried out at the site by Applied Geotechnical Engineering under the instruction of Site Analytical Services Limited (Report Reference P2358). The report is provided as Appendix C. The predicted movement comprises a tilt of approximately 4.3mm over the 10m width of the road that has been analysed, equating to a tilt gradient of less than 1 in 2300. There is negligible predicted distortion.

5.9 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.

The ground movement assessment (Appendix C) concludes that given good workmanship, the basement excavations can be constructed without imposing more than a 'very slight' level of damage on the adjoining properties.

Further drilling is recommended following planning approval of the scheme to allow better design of the proposed foundations. The investigation should comprise a 20m cable percussive borehole which should be located towards the rear of the existing property where access permitted only a small diameter 15m CFA borehole the 2013 investigation.

6.0 SURFACE WATER AND FLOODING - SCOPING ASSESSMENT

6.1 Introduction

This section addresses outstanding issues raised by the screening process regarding surface water and flooding (see Table 1).

6.2 Surface Water Drainage

It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced paved external areas by around 21 sq.m and therefore the proposals may potentially affect the overall volume of surface water generated by the site unless mitigation is provided.

However it is also understood that formal drainage is proposed for these new hard-standing areas with attenuation provided as required by detailed design and therefore it is unlikely that any increase in surface water generated will cause an increase in peak runoff from the site.

Based on the information available for the site, the London Clay Formation has a measured permeability of 6.81×10^{-8} m/s and a likely mass permeability several orders of magnitude higher. On this basis, infiltration drainage is not feasible as a drainage solution for the proposed basement and since there is no watercourse in the vicinity of the site, additional site area could be drained from the site via surface water sewer.

On the basis that the foul water sewage system for the proposed redevelopment meets the specifications of Thames Water this should ensure that the systems have sufficient capacity to prevent overloading under the normal range of operating conditions.

The implementation of these recommendations will further ensure the proposals would not cause an increase in peak runoff from the site.

6.3 Flood Risk

Information from the desk study and Environment Agency website indicates that the site does not lie within 250m of any Zone 2 or Zone 3 Environment Agency Flood Zones. Additionally, there are no Environment Agency floodplains, flood defenses, or areas benefitting from flood defences within 250m of the site. Reference to the Environment Agency website also indicates that the site does not lie within an area shown as being at risk from flooding from reservoirs.

However, with respect to potential flooding from surface water run-off, the site lies within an area known to have historically flooded in 2002 according to Figure 15 of the ARUP report (i.e. a primary area). In addition, CPG4 provides a list (p. 29) of streets in the London Borough of Camden that have historically been affected by surface water flooding and Avenue Road appears in this list and the Environment Agency's latest surface water flood risk mapping (available on their website since December 2013) shows a 'high' risk of flooding from surface water for the adjacent part of Avenue Road.

Based on this and, in accordance with CPG4, A Flood Risk Assessment (FRA) has been carried for the site (Reference WE13066) by Water Environment Limited (August 2013) which is included as Appendix D to this report.

The current data indicates that flood water, like groundwater will flow in a general south westerly direction across the site through the upper permeable made ground in accordance

with the topography of the site area. Hence, there is a risk of groundwater flow into the proposed basement.

British Standard (BS) 8102 (Code of Practice for Protection of Below Ground Structures Against Water from the Ground) recommends that basements with a depth greater than 4m below ground level (bgl) as in the case of this site should be designed to allow for fluctuations in the water table of up to 1m. It also offers guidance for the design and waterproofing of basements and defines 3 grades as follows.

- Grade 1: Basic Utility. Car parking, plant rooms (excluding electrical equipment), workshops. Some seepages and damp patches tolerable;
- Grade 2. Better Utility. Workshops and plant rooms that require drier environments. No water penetration but moisture vapor tolerable.
- Grade 3. Habitable. Ventilated residential and working areas including offices. Dry environment. Active measures to control internal humidity may be necessary

The proposed basement excavation should be designed to the appropriate grade therefore reducing the risk posed to the basement from groundwater flow.

With respect to foul water drainage systems, on the basis that the foul water sewage system for the proposed redevelopment meets the specifications of Thames Water this should ensure that the systems have sufficient capacity to prevent overloading under the normal range of operating conditions.

7.0 CONCLUSIONS AND NON TECHNICAL SUMMARY

1. It is proposed to demolish the existing building on the site, construct a two storey basement beneath the footprint of the property and part of the garden and rebuild a three storey house above. The majority of the basement is founded at approximately 8m below ground level, with a deeper section containing a swimming pool at 10m below ground level.

2. Ground conditions at the site were investigated by Site Analytical Services Limited in June, July and August 2013 (Report Reference 13/20821). The exploratory holes revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised between up to 1.50m thickness of Made Ground overlying materials typical of the London Clay Formation.

3. Water levels in the immediate vicinity of the property have been recorded above floor level of the proposed basement. However given the presence of a non-aquifer below the site it is likely that groundwater within these soils is recharged via intermittent seepages from surface water associated with weather conditions rather than any large scale subterranean groundwater flow. As a result the impact from the basement development on the local groundwater regime is likely to be minimal.

4. The nearest surface water feature is recorded as a pond located 490m north-west of the site. The site lies within 100m and between two tributaries of the former River Tyburn, although the River Tyburn is now completely enclosed and flows through underground conduits for its entire length. As a result it is considered that the proposed development will have minimal impact on any nearby watercourses.

5. The implementation of the attenuation measures will ensure the proposals would not cause an increase in peak runoff from the site.

6. The proposed development does not include any remodeling of slopes to angles greater than 12.5° 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

7. It is understood that trees are to be removed from the site as part of the development. Given the proposed basement floor is up to 8.0m below ground level foundations for the structure are unlikely to be affected by the removal of these trees.

8. Further drilling is recommended following planning approval of the scheme to allow better design of the proposed foundations. Contamination testing of the Made Ground is likely to be required during any second phase of ground investigation.

9. 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

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

11. Although Avenue Road flooded in 2002 the site itself is raised above surrounding road levels of the road. Therefore the risk of surface water and sewer flooding to the site are considered to be low.

12. Given good workmanship, the basement excavations can be constructed without imposing more than a 'very slight' level of damage on the adjoining properties.

p.p. SITE ANALYTICAL SERVICES LIMITED

A P Smith BSc (Hons) FGS MCIWEM
Senior Geologist

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APPENDIX A.

Email Correspondence between SAS and LUL 25th July 2013

Date 25 July 2013
Our Ref 20878-SI-3-250713
Your Ref
To Andy Smith
Site Analytical Services
AndyS@siteanalytical.co.uk

London Underground Limited

Hello Andy,

50 Avenue Road London NW8 6HS

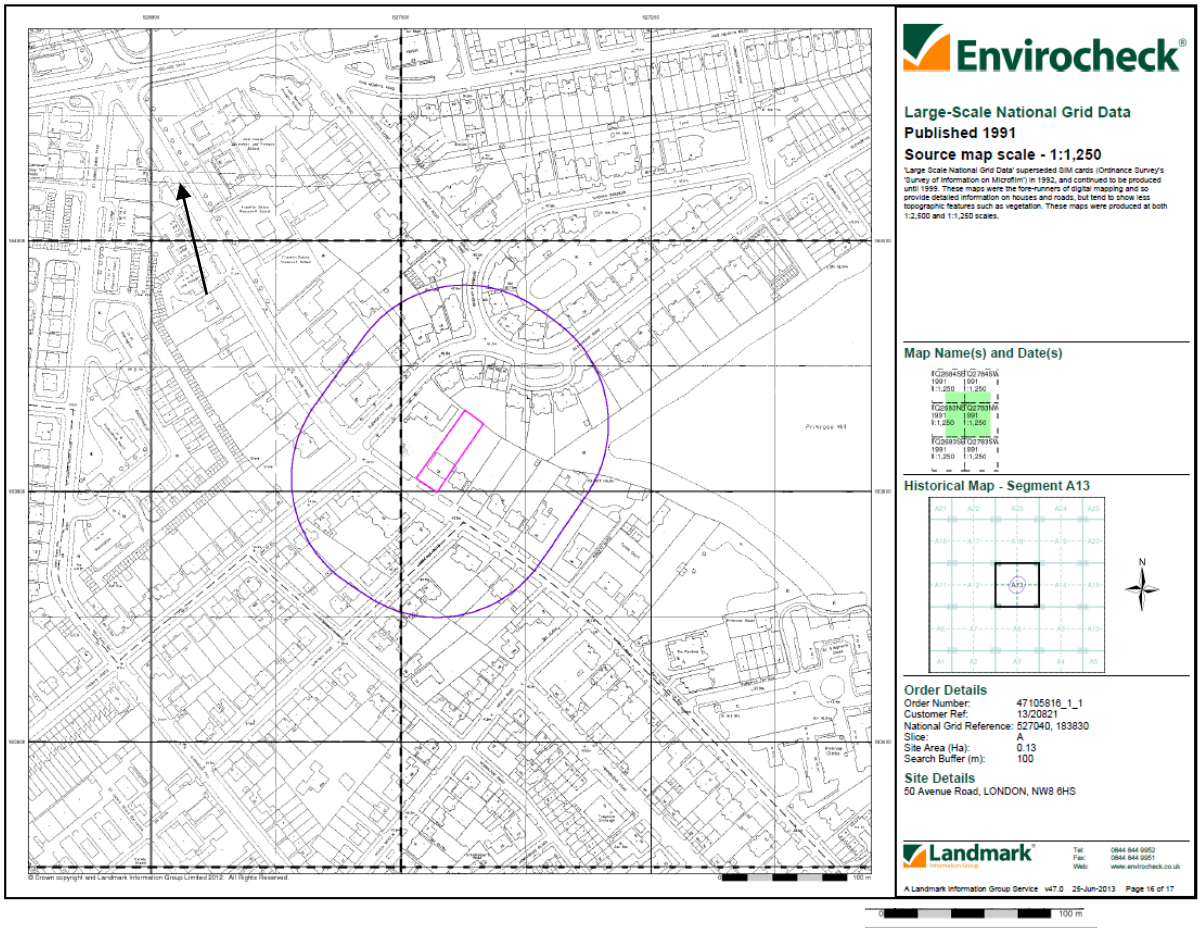
Thank you for your communication of 24th July 2013.

I can confirm that London Underground has no assets within 50 metres of your site as shown on the plan you provided.

Should you have any further enquiries, please do not hesitate to contact me.

Shahina Inayathusein
Information Manager
LUL Infrastructure Protection
E-mail: Locationenquiries@tube.tfl.gov.uk
Tel: 020 7918 0016

1:1,250 OS Scale map of site detailing the location of Primrose Hill Tunnels (arrowed).



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APPENDIX B – Groundwater monitoring results

Borehole	Installation Depth	Intallation Date	Date				
			11/07/2013	31/07/2013	08/08/2013	15/12/2014	23/12/2014
BH1	10	Jun-13	DRY	3.67	3.49	3.19	3.2
BH2	10	Jul-13	DRY	DRY	DRY	DRY	DRY

APPENDIX C - Ground Movement Assessment Report

1.0 Introduction

In connection with the proposal to construct a new basement at 50 Avenue Road, London NW8, Applied Geotechnical Engineering Ltd (AGE) has been instructed by Site Analytical Services Ltd (SAS) to provide information on the effect of basement construction on the neighbouring properties at 52/54 Avenue Road and 48 Avenue Road, and to predict the magnitude of heave within the basement excavation. A damage assessment on the walls of No 50 has also been requested.

No 50 Avenue Road is a detached property with front and rear gardens. The front garden borders Avenue Road. The property is bounded on the left by No 52/54 Avenue Road and on the right by No 48 Avenue Road (right and left are as viewed from the front of the property on Avenue Road). The arrangement of these properties is shown in Figure 1 (taken from KSR Architects drawing AND-002). It is required that a predicted-damage assessment be made on these neighbouring buildings, and on the building at No 50.

It is proposed to excavate a basement beneath the entire footprint of the existing No 50, and beneath a significant proportion of the rear garden, to a depth of approximately 7.4m. It is understood that the existing structure of No 50 will be retained, with the exception of the rear wall, which is to be removed to provide access to the works.

Figure 1 – Location Plan

2.0 Information Provided

The following relevant information has been used for these calculations:-
i) SAS. Report on site investigation. Report ref 13/20821 dated Aug 2013.
ii) SAS. Basement impact assessment. Ref 13/20821-2 dated Aug 2013.
iii) Elliot Wood drawings:- 213136 Loading PlanP1; 213136 Proposed Sequence of Works Plans 1-7 P1; 213136 Proposed Short Section P1.
iv) KSR Architects drawings:- AND-002-Proposed Site Plan; AND-100-Proposed ground floor plans; AND-130-Proposed Basement Floor Plans; AND-200-Proposed Section; AND-201-Cross Section B-B; AND-EO8-Existing Cross Section.
v) Email correspondence AGE/SAS between 27/5/14 and 2/6/14 regarding building loads.

3.0 Anticipated Ground Conditions

There is a rise in ground level of approximately 1.7m from the front boundary of the property on Avenue Road to the rear boundary some 67m distant, and a fall of broadly similar gradient from left to right across the 20m width of the property. These slopes do not affect the following calculations; a uniform existing ground surface level of 44.4mOD will be adopted unless stated otherwise below (based on drawing 'Existing Cross Section.pdf).

The published geological map (BGS 1:50 000 sheet 257: North London) indicates the site to be underlain by London Clay. On a developed site such as this Made Ground is also anticipated. On the basis of the published mapping the base of the London Clay is anticipated to lie at approximately –10mOD.

A ground investigation has been undertaken at the site (Item 'i' in Section 2 above). This comprised a 15m deep rotary auger borehole (BH1) in the back garden of the property, and a cable percussion borehole to 15m depth in the front garden (BH2). These confirmed Made Ground to approximately 1.1m depth, underlain by apparent Head deposits to 2m total depth, in turn underlain by London Clay. The base of the London Clay was not reached.

A single trial pit was excavated to 1.5m depth adjacent to the front-right corner of the house, but it did not expose the base of the existing foundations.

On the basis of the above, and in the context of the proposed works and this report, the Made Ground and apparent Head deposits are not considered likely to influence ground movements and will not be considered further. Therefore, for the purposes of this analysis only, London Clay is considered to be present from ground level at 44.4mOD to a level of –10mOD.

Standard penetration tests (SPT), and laboratory undrained triaxial tests were carried out on the London Clay. The SPT results have been related to undrained strengths using the method of Stroud (Ref 1), using a measured plasticity index of 51%. The SPT and triaxial undrained strength values so obtained are plotted against depth in Figure 2, from which an undrained strength profile has been derived, described by:-

$Cu = 45 + 7z$ (kPa) (Where z = depth below ground level).

A bulk unit weight of 20kN/m^3 has been adopted in the estimation of unloading due to excavation.

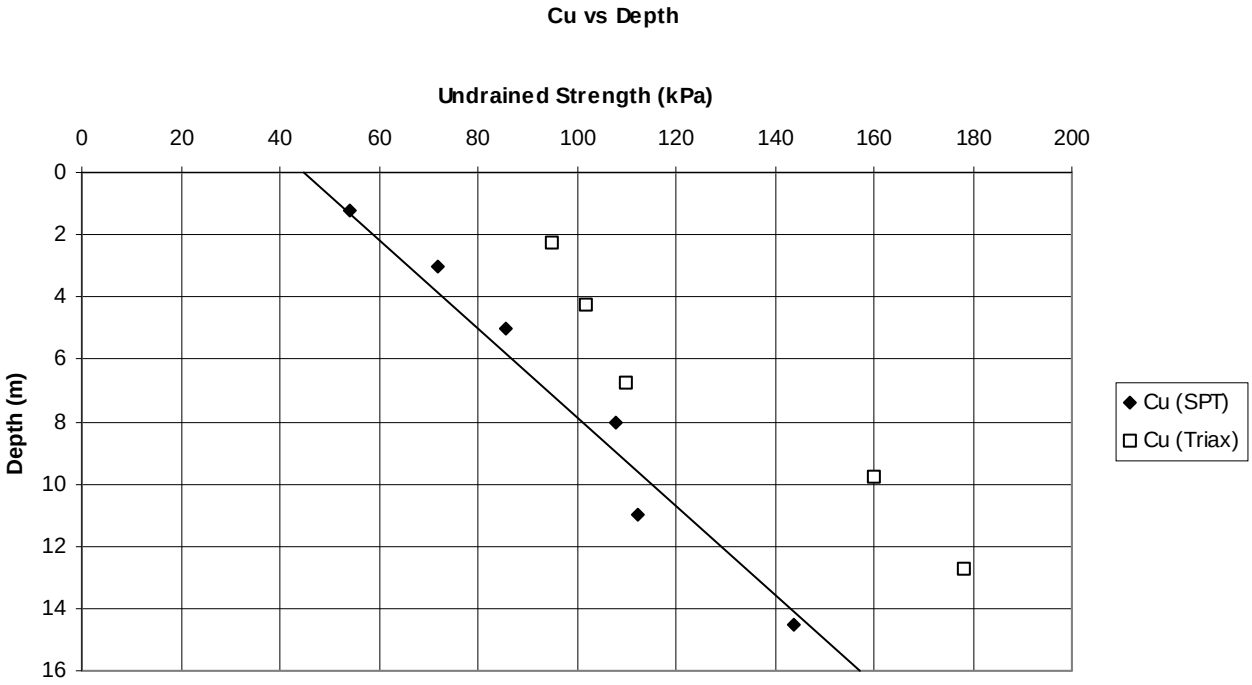


Figure 2 – Undrained strength vs Depth

4.0 Loads

4.1 General

Plans of the proposed basement are shown in Figure 3. Avenue Road runs along the left side of these figures.

Figure 3a shows the basement at the end of the excavation phase, with the external walls and internal structure of the existing house (with the exception of the demolished rear wall), supported on underpins. The excavations for the front light wells and the rear basement extension lie within bored pile walls. Figure 3b shows the internal walls of the completed lower level of basement (as well as the perimeter walls as described above).

The general dig level throughout the basement has been taken as 36.6mOD. The swimming pool running along the RHS wall of the garden basement extension is to be excavated to approximately 35.5mOD, and the car stacker (on the front LHS of the building) is to be excavated to approximately 40mOD.

The vertical load changes associated with the works have been provided by to AGE by SAS (Item ‘v’ in Section 2 above), and are summarised below.

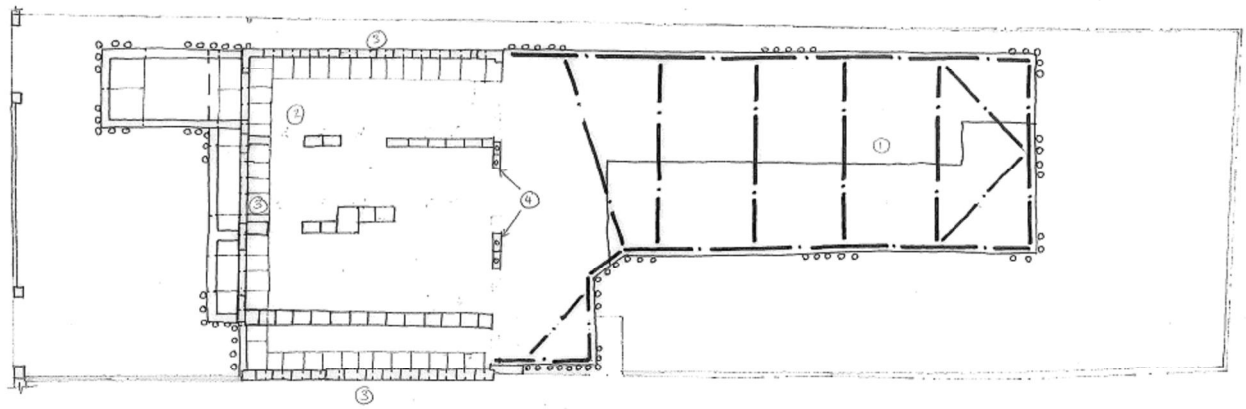


Figure 3a – Basement Plan (end of excavation)

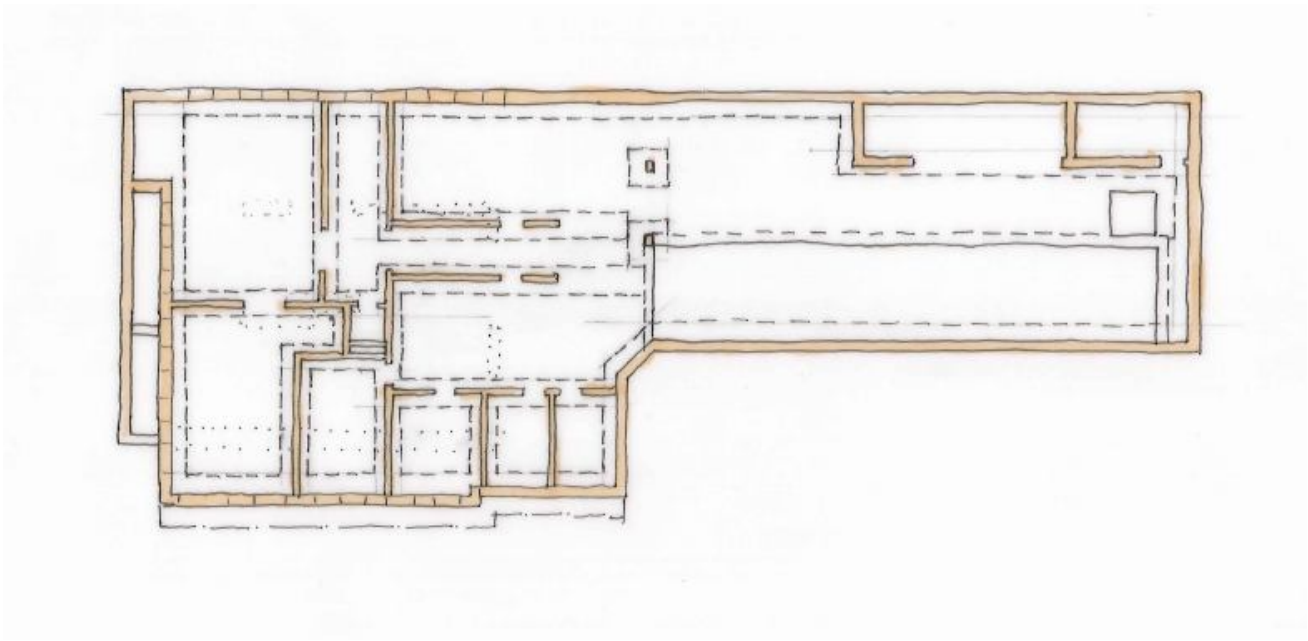


Figure 3b – Basement Plan (end of basement construction)

4.2 Demolition.
Rear wall of existing house – 75kN/m run unload, taken to be applied to 1m-wide footings at 1m bgl.

4.3 Underpinning.
LHS Flank wall – 100kN/m run unload from footing at 43mOD, reload on permanent footing at 36.3mOD.
RHS (main house) flank wall - 100kN/m run unload from footing at 43mOD, reload on temporary underpin footing at 36.3mOD.
RHS (garage) flank wall - 10kN/m run unload from footing at 43mOD, reload on permanent footing at 36.3mOD.
Front Wall – 70kN/m run unload from footing at 43mOD, reload on permanent footing at 36.3mOD.
Internal walls - 100kN/m run unload from footings at 43mOD, reload on temporary underpin footings at 36.3mOD.

In all cases the loads are understood to be those applied at existing footing depth; the self-weight of underpins has been added where appropriate.

4.4 Excavation.
Excavation has been modelled assuming a reduction of 20kPa per metre of reduced level. In general the excavation depth is taken as (44.4-36.6=) 7.8m, amounting to an unload of 156kPa. Different unloads have been applied to the swimming pool (178kPa) and the car stacker (88kPa) due to differing excavation levels as described above.

4.5 Construction.
LHS Flank wall – No change.
RHS (main house) flank wall - 100kN/m run unload from temporary underpin footing at 36.3mOD.
RHS (garage) flank wall - 100kN/m run new load on permanent footing at 36.3mOD.
Front Wall – No change.
Internal walls - 100kN/m run unload from temporary underpin footings at 36.3mOD, 70kN/m run new load onto all proposed internal walls.
Rear garden basement extension – 200kN/m run added to perimeter pile wall.
Front garden lightwell extension – no loads imposed on perimeter pile wall.

In all cases the loads are understood to be those applied at existing footing depth or existing ground level as appropriate; the self-weight of underpins/internal basement walls has been removed/added where appropriate.

5.0 Estimated movement outside the excavation

5.1 Temporary support to the basement walls.
It is assumed within the following calculations that the basement perimeter retaining walls will be stiffly and safely propped at all stages of construction in line with good practice. Inadequate propping is likely to result in increased ground movements, and therefore increased damage to adjacent properties, as well as increased risk of injury to personnel.

Stiff support to the basement walls is helped by pre-loading the props to a load approximating to their anticipated working load. The prop loads should be monitored during critical stages of excavation.

5.2 Soil stiffness values
An equivalent-elastic analysis has been carried out using the program PDisp. The program takes no account of structural stiffness. The soil stiffness parameters adopted for this analysis have been derived as follows:-

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 E_{uo} = 1940Cu, therefore for the purposes of the current analysis take:-

E_{uo} = 1550 × Cu; (Poisson's ratio = 0.5)
E'_o = 1240 × Cu; (Poisson's ratio = 0.2)

Yielding :-

E_{uo} = 69.7 + 10.85z (MPa)
E'_o = 55.8 + 8.68z (MPa)

Where z = depth below ground level in metres.

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

5.3 Causes of ground movement outside the excavation

The analysis considers three causes of ground movement, these are:-
i) Vertical ground movement due to vertical changes in load resulting from building works and excavation.
ii) Vertical and horizontal movement due to installation of underpins and pile walls
iii) Vertical and horizontal movement due to deflection of underpins and pile walls resulting from removal of support from in front of underpins and pile walls by excavation.

The first of these causes is investigated using equivalent-elastic analysis in the program PDISP. The second and third are based upon case-history data presented in Figures 2.8, 2.9 and 2.11 in CIRIA C580 (Ref 3) these data relate to installation in stiff clays. It is currently understood that the plots presented by CIRIA in the above figures include short-term movement arising from cause 'i' above. Therefore in this report short-term movements are calculated using the CIRIA data, and subsequent long-term movement is calculated using PDISP.

The CIRIA plots relate vertical and horizontal ground movement to the depth of the wall installed (for Cause 'ii' above), or to the depth of excavation within that wall (for Cause 'iii' above) as

appropriate. Data relating to the secant bored pile wall case history in Figure 2.8 is considered to be unreliable and has been ignored. In addition, data relating to counterfort diaphragm walls has not been taken into account in this analysis. No data are presented for underpinned walls, these are assumed to be similar in behaviour to plane diaphragm walls and bored pile walls. The CIRIA data indicate that:-

a) Adjacent to the pile wall or underpin, vertical ground settlement resulting from wall installation can be taken to equal 0.04% of wall depth, reducing linearly to zero at a distance of 2 x wall depth from the wall (Ref 3, Figures 2.8b and 2.9b).

b) Adjacent to the pile wall or underpin, vertical ground settlement resulting from wall deflection can be taken to equal 0.04% of excavation depth, increasing to 0.08% of excavation depth at a distance of 0.6 x excavation depth from the wall, then reducing approximately linearly to zero at a distance of 3 x wall depth from the wall. (Ref 3, Figure 2.11b).

c) Adjacent to the pile wall or underpin, horizontal ground movement resulting from wall installation can be taken to equal 0.04% of wall depth, reducing linearly to zero at a distance of 1.5 x wall depth from the wall (Ref 3, Figures 2.8a and 2.9a).

d) Adjacent to the pile wall or underpin, horizontal ground movement resulting from wall deflection can be taken to equal 0.15% of excavation depth, reducing linearly to zero at a distance of 4 x wall depth from the wall. (Ref 3, Figure 2.11a).

The above trends rely on good workmanship and stiffly-propped, stiff walls.

5.4 Predicted movement – 52/54 Avenue Road, right flank wall.

5.4.1 Vertical movement

Profiles of short- and long-term vertical ground movement along the right flank wall of No 52/54 have been calculated and plotted in Figure 4. This wall extends from Y=45.3m (front) to Y=67.4m (rear), and therefore lies opposite the rear part of the garden basement excavation in No 50, which extends only to Y=57.7m (see sketch in Figure 4). The wall lies parallel to, and approximately 6m back from, the LHS of the excavation in No 50.

At this location the excavation for the basement to No 50 will be carried out within a contiguous bored pile wall. The existing ground level at this location varies between approximately 45mOD and 45.6mOD, an average level of 45.3mOD will be adopted. The excavation depth within this wall is 36.6m (8.7mbgl), a pile-wall depth of 12m has been assumed.

The analysis indicates a short-term differential settlement of approximately 5.7mm over the 22m length of the wall, it is less in the long term. This equates to a whole-wall gradient of approximately 1 in 3800. This is considerably less than the 1:400 gradient recognised as requiring remedial action.

The maximum wall distortion (Delta – as defined by Burland, Ref 2) is 1.3mm within a 13.3m length of the wall. This occurs in the long term and equates to a deflection ratio of 1.3/13 300 = 0.01%. Taking the limiting tensile strain between the ‘very slight’ and ‘slight’ damage categories as being 0.075% (Ref 2) then the worst-case ratio of deflection ratio to limiting tensile strain = 0.01/0.075=0.13. By reference to Figure 13 (Ref 2 Figure 6) and taking the height of the No 52 flank wall as equal to half its width, a horizontal strain/limiting tensile strain ratio of 0.9 is

obtained, therefore a horizontal strain of 0.9 x 0.075% = 0.067% is acceptable for a 'very slight' category of damage.

5.4.2 Lateral movement.

Recognising that the nature of the works is such that there is not likely to be any significant horizontal strain along the plane of the wall, the damage to this wall is predicted, by inspection, to be 'very slight' or less.

5.5 Predicted movement – 52/54 Avenue Road, front wall RHS.

5.5.1 Vertical movement

Profiles of short- and long-term vertical ground movement along the RHS of the front elevation of No 52/54 have been calculated and plotted in Figure 5.

The movement of only the first 10.3m length at the right hand end of the front wall of No 52/54 Avenue Road has been considered. At 10.3m (X= -16.3m) there is a return on the wall, which would introduce a degree of movement-tolerance. So, given the modest levels of predicted distortion (see below) any predicted damage is likely to be limited to the 10.3m length under consideration.

This wall extends from X= –16.3m to X=-6m. The limit of the basement excavation at No 50 is at X=0m (see sketch in Figure 5).

At this location the excavation for the basement to No 50 will be carried out within a contiguous bored pile wall. The existing ground level at this location is approximately 45mOD. The excavation depth within this wall is 36.6m (8.4mbgl), a pile-wall depth of 12m has been assumed.

The analysis indicates a long-term differential settlement of approximately 5.5mm over the 10.3m length of the wall. This equates to a whole-wall gradient of approximately 1 in 1850. This is considerably less than the 1:400 gradient recognised as requiring remedial action.

The maximum wall distortion (Delta – as defined by Burland, Ref 2) is seen to be negligible.

On the basis of the above, and taking the limiting tensile strain between the 'very slight' and 'slight' damage categories as being 0.075% (Ref 2), a horizontal strain of 0.075% or less will limit damage to 'very slight' or less.

5.5.2 Lateral movement.

From Section 5.3 above, taking wall depth to be 12m and excavation depth to be 8.4m, the maximum lateral movement due to bored pile wall installation is calculated to be 4.8mm, reducing to zero at 18m distance (yielding a strain of 4.8/18 000 = 0.027%). It will be noted that the lateral ground strain predicted to result from wall installation extends only a short distance beyond the 10.3m length of wall under consideration (to X= -18m).

On the same basis, the ground movement due to the subsequent deflection of the bored pile wall following excavation of the basement is calculated as 12.6mm, reducing to zero at a distance of 33.6m (yielding a strain of 12.6/33600 = 0.038%).

The total lateral ground strain beneath the RHS of the front wall of No 52/54 is therefore assessed as (0.027+0.038) = 0.065%. This is less than the upper limit of 0.075% for 'very slight' damage derived above, and is therefore acceptable.

5.6 Predicted movement – 48 Avenue Road, Left flank wall.

Profiles of short- and long-term vertical ground movement along the left flank wall of No48 have been calculated and plotted in Figure 6. This wall extends from Y=15m (front) to Y=26m (rear) (see sketch in Figure 6). It lies parallel to, and approximately 2m back from, the RHS of the excavation in No 50.

At this location the basement excavation for No 50 will be carried out within underpins. The existing ground level at this location is taken to be 44.4mOD, and the dig level is 36.6mOD (7.8mbgl). It is understood that the underpins will be constructed to a level of 36.3mOD (8.1mbgl).

The analysis indicates negligible differential settlement, and negligible distortion, over the 11m length of the wall. Recognising that the nature of the works is such that there is not likely to be any significant horizontal strain along the plane of the wall, the damage to this wall is predicted, by inspection, to be 'very slight' or less.

5.7 Predicted movement – 48 Avenue Road, Front and rear elevations.

5.7.1 Vertical movement

Profiles of short- and long-term vertical ground movement along the front and rear elevations of No48 have been calculated and plotted in Figures 7 and 8 respectively.

These walls extends from X=20m to X=32m. The limit of the basement excavation at No 50 is at X=17.6m (see sketches in Figures 7 and 8). As in Section 5.6 above, that basement is taken to be excavated to 7.8m depth within underpin walls of approximately 8.1m depth.

The profiles of predicted movement given in Figures 7 and 8 are identical for practical purposes. The following analysis is based upon the front wall.

The analysis indicates a short-term differential settlement of approximately 4.1mm over the 12m length of the wall, it is less in the long term. This equates to a whole-wall gradient of approximately 1 in 2900. This is considerably less than the 1:400 gradient recognised as requiring remedial action.

The maximum wall distortion (Delta – as defined by Burland, Ref 2) is 2mm within the 12m wall length. This occurs in the long term and equates to a deflection ratio of 2/12 000 = 0.017%. Taking the limiting tensile strain between the 'very slight' and 'slight' damage categories as being 0.075% (Ref 2) then the worst-case ratio of deflection ratio to limiting tensile strain = 0.017/0.075=0.22. By reference to Figure 13 (Ref 2 Figure 6) and taking the height of the No 48 front wall as equal to its width, a horizontal strain/limiting tensile strain ratio of 0.85 is obtained, therefore a horizontal strain of 0.85 x 0.075% = 0.064% is acceptable for a 'very slight' category of damage.

5.7.2 Lateral movement.

From Section 5.3 above, taking wall depth to be 8.1m and excavation depth to be 7.8m, the maximum lateral movement due to underpin wall installation is calculated to be 3.2mm, reducing to zero at 12.2m distance (yielding a strain of 3.2/12 200 = 0.026%). On the same basis, the ground movement due to the subsequent deflection of the bored pile wall following excavation of the basement is calculated as 11.7mm, reducing to zero at a distance of 31.2m (yielding a strain of 11.7/31 200 = 0.038%.

The total lateral ground strain beneath the RHS of the front wall of No 52/54 is therefore assessed as 0.064%. This is the same as the upper limit of 0.064% for 'very slight' damage derived above. However, the above analysis is conservative as the stiffness of the front wall of No 48 is not taken into account, and the predicted mode of distortion is sagging which is significantly less damaging than the hogging mode that Burland considered in his original analysis (Ref 2). Therefore the predicted level of damage is 'very slight' and is acceptable.

5.8 Predicted damage summary – neighbouring properties.

On the basis of the above, the level of damage to Nos 52/54 and 48 Avenue Road is predicted to be 'very slight' or less, as defined in Ref 2. This conclusion assumes a high standard of workmanship and adequately stiff propping of the basement excavation.

Contours of the predicted vertical ground movement around the excavation for No 50 are presented in Figure 16.

5.9 Predicted Movement – Avenue Road pavement

Predictions of the short-term settlement of the public highway beyond the front boundary of No 50 are presented in Figure 9. The profiles are constructed over an arbitrary length of 10m, across the Avenue Road highway, starting at the front boundary of No 50 (note that the actual Avenue Road carriageway, as represented in Figure 16, commences at Ch4.5m on Figure 9) . Two profiles are presented, relating to the movement predicted from the main excavation for the basement (which lies approximately 11.5m inside the highway boundary), and relating to the car lift excavation (which lies approximately 5.5m inside the highway boundary). In both cases the maximum (plane-strain) movements are plotted, with no modification from the corners of the excavation taken into account. This is likely to be conservative in the case of the car-lift excavation, the width of which (5m) is likely to be too small for the development of plane-strain conditions.

It is seen that the main excavation results in the greatest predicted movement of the highway. It is important to note that these movements will not be cumulative; the car-lift excavation occurs within a body of ground that has already been (or will soon be) strained by the larger main excavation, so the lateral stress-relief that causes ground settlement is dictated by the main excavation, not by the car-lift excavation.

The predicted movement comprises a tilt of approximately 4.3mm over the 10m width of the road that has been analysed, equating to a tilt gradient of less than 1 in 2300. There is negligible predicted distortion.

It is considered that this magnitude of movement will be significantly less, perhaps an order of magnitude less, than the seasonal ground movement due to the trees which line the road.

6.0 Predicted movement – 50 Avenue Road

6.1 General

A prediction of the damage likely to be suffered by the property under redevelopment, due to ground movement, is required. In practice such damage is likely to be dwarfed by that arising from other construction activity on the site, and a significant degree of making-good should be expected. Nevertheless, with a high standard of workmanship, redevelopment of this nature has been undertaken successfully many times in London.

Ground movement has been predicted for three external walls, as follows:-
i) Left flank wall
ii) Front wall
iii) Right garage wall

Other major walls are to be removed during the development, and therefore will not transmit ground movements to the remaining superstructure.

6.2 Predicted movement – 50 Avenue Road left flank wall

Profiles of short- and long-term vertical ground movement along the left flank wall of No50 have been calculated and plotted in Figure 10. This wall extends from Y=15m (front) to Y=28.5m (rear). Figure 10 only presents heave movement as calculated in the PDISP analysis, separate vertical settlement of the order of 5-10mm would be expected to arise as a direct result of careful underpinning. The net result would therefore be expected to be a long-term settlement of the flank wall of the order of 5mm, given a good standard of workmanship.

The PDISP analysis indicates a long-term differential heave of approximately 0.7mm over the 13m length of the wall. This equates to a whole-wall gradient of 1 in 18 000, which is considerably less than the 1:400 gradient recognised as requiring remedial action. Within this length the maximum distortion as defined by Burland (Ref 2) is negligible.

Taking the limiting tensile strain between the ‘very slight’ and ‘slight’ damage categories as being 0.075% (Ref 2) and recognising that the nature of the works is such that there is not likely to be any significant horizontal strain along the plane of the wall, the damage to this wall arising from ground movement is predicted to be ‘very slight’ or less.

6.3 Predicted movement – 50 Avenue Road front wall

This wall extends from X=0m (left) to X=16.5m (right), however the left end of the wall (X=0 to 3.9m) is removed at basement level, thereby disconnecting that section of the wall from ground movement.

Profiles of short- and long-term vertical ground movement along the front elevation have been calculated and plotted in Figure 11. The plot presents the short and long-term heave profiles calculated in the PDISP analysis, separate vertical settlement of the order of 5-10mm would be expected to arise as a direct result of careful underpinning. The net result would therefore be expected to be a long-term heave of the front wall of the order of 3mm, dropping off at the ends to a settlement of similar magnitude, given a good standard of workmanship.

The PDISP analysis indicates negligible long-term differential settlement over the full 16m length of the wall.

The maximum wall distortion (Delta – as defined by Burland, Ref 2) is 8mm within the 16m wall length. This equates to a deflection ratio of 8/16 000 = 0.05%. Taking the limiting tensile strain between the 'very slight' and 'slight' damage categories as being 0.075% (Ref 2) then the worst-case ratio of deflection ratio to limiting tensile strain = 0.05/0.075=0.67. By reference to Figure 13 (Ref 2 Figure 6) and taking the height of the No 50 front wall as equal to its width, a horizontal strain/limiting tensile strain ratio of 0.45 is obtained, therefore a horizontal strain of 0.45 x 0.075% = 0.034% is acceptable for a 'very slight' category of damage. Recognising that the nature of the works is such that there is not likely to be any significant horizontal strain along the plane of the wall, the damage to this wall arising from ground movement is predicted to be 'very slight' or less.

6.4 Predicted movement – 50 Avenue Road right garage wall.

This wall extends from Y=19.5m (front) to Y=30m (rear). Profiles of short- and long-term vertical ground movement along the front elevation have been calculated and plotted in Figure 12. The plot presents the short and long-term heave profiles calculated in the PDISP analysis, separate vertical settlement of the order of 5-10mm would be expected to arise as a direct result of careful underpinning. The net result would therefore be expected to be a long-term settlement of the right garage wall of the order of 5mm, given a good standard of workmanship.

The PDISP analysis indicates long-term differential settlement of approximately 2mm over the 10.5m length of the wall. This equates to a whole-wall gradient of 1 in 5 000, which is considerably less than the 1:400 gradient recognised as requiring remedial action. Within this length the maximum distortion as defined by Burland (Ref 2) is approximately 1mm, which is considered negligible.

Taking the limiting tensile strain between the 'very slight' and 'slight' damage categories as being 0.075% (Ref 2) and recognising that the nature of the works is such that there is not likely to be any significant horizontal strain along the plane of the wall, the damage to this wall arising from ground movement is predicted to be 'very slight' or less.

6.5 Predicted damage summary – 50 Avenue Road

On the basis of the above, the level of damage to No50 Avenue Road arising only from ground movement is predicted to be 'very slight' or less, as defined in Ref 2. This conclusion assumes a high standard of workmanship.

It is considered very likely that more serious damage will accrue as a direct result of construction operations. Such damage can be moderated by careful construction practices and made good in line with standard practice.

7.0 Estimated vertical movement within the excavation.

An equivalent elastic analysis (using PDISP) has been carried out to predict vertical ground movement at the base of the basement excavation. Soil stiffness and load assumptions are as presented above in Sections 4.0 and 5.2. The case history data presented in Ref 3 are not relevant to this analysis.

The heave of the completed basement excavation has been calculated by PDISP for two conditions:-
i) the condition immediately after excavation (using short-term soil parameters and including only the demolition, underpinning and excavation load changes), and
ii) the condition long after completion of the works (using long term soil parameters and including all load changes).

The results of the two analyses have been used to estimate two alternative distributions of heave. The first is simply the heave which would occur if the ground is unrestrained by the basement slab, i.e., that the slab is fully flexible. This is the difference between conditions (i) and (ii). The second estimate is of the pressure that would be imposed on a fully rigid slab from the soil trying to expand. This assumes a linear relationship between the movement and the logarithm of pressure. In both cases the slab is assumed to bear directly on the ground.

For the flexible slab, a maximum heave value of 11mm is predicted, and heave gradients are not excessively large. Contours of heave in mm are presented in Figure 14. For the fully rigid slab, local high pressure of over 50kPa are predicted; the pressure contours are in Figure 15. Clearly, the slab will deform in response to the imposed heave pressure, so that the resulting movements and pressures will be less than the values indicated in the two figures.

8.0 Groundwater

It is proposed to excavate to a minimum level of approximately 36.3mOD within London Clay (with a veneer of Made Ground and assumed Head). No aquifers are anticipated at the site within the depth affected by the works therefore there will be no interference with local groundwater flows.

9.0 Conclusions and recommendations

From the above, it is clear that, given good workmanship, the basement to 50 Avenue Road can be constructed without imposing more than very slight damage on the adjoining properties. The development is not likely to affect local groundwater flows.

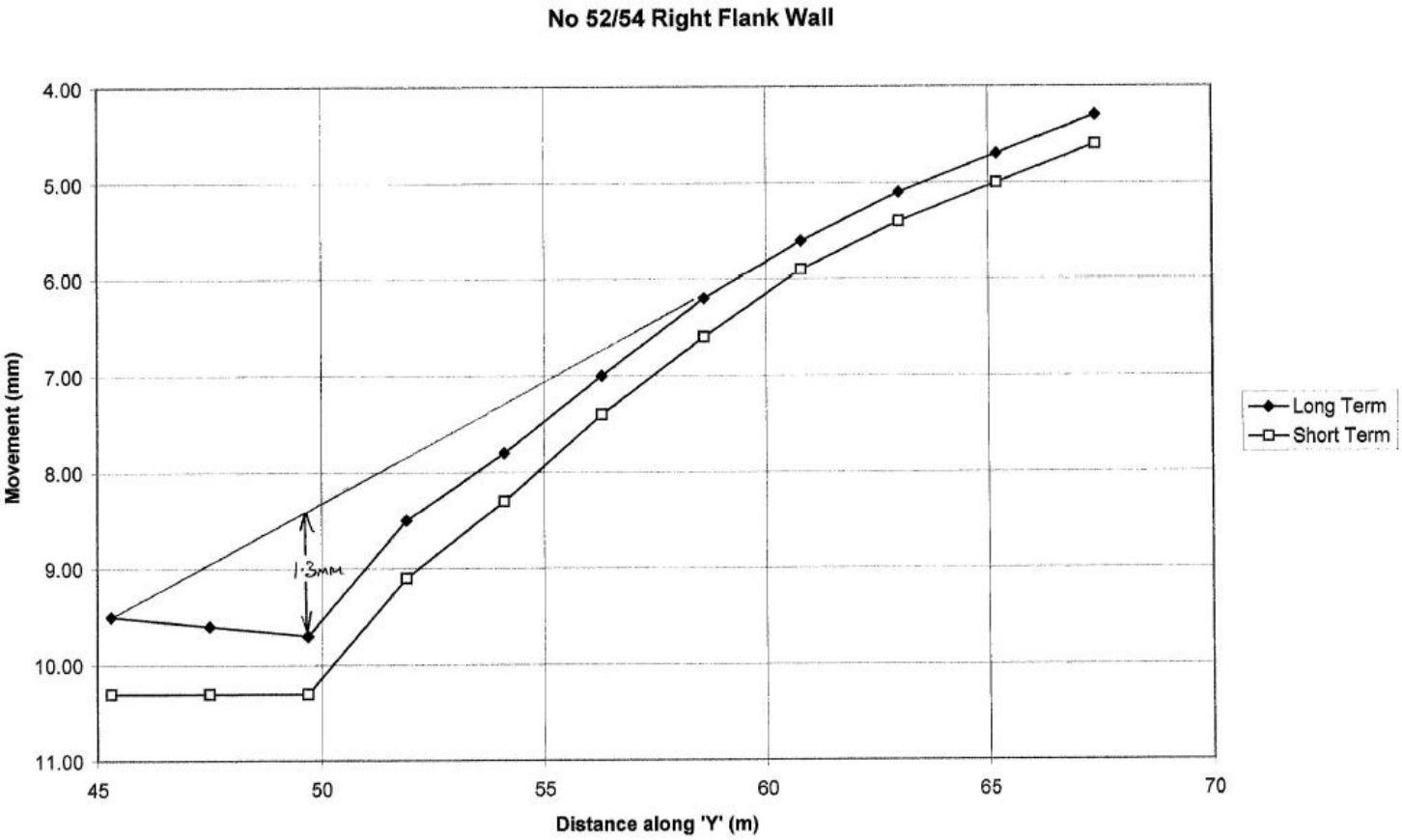
References:

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.

(Figures 4-16 follow below)


No 52/54 Right Flank Wall
Movement (mm)
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
45
50
55
60
65
70
Distance along 'Y' (m)
1·3mm
Long Term
Short Term

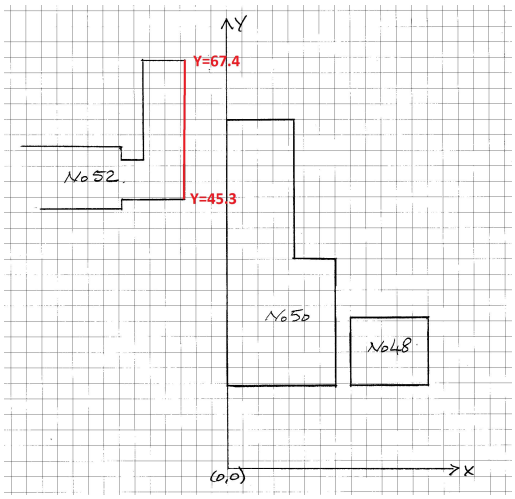
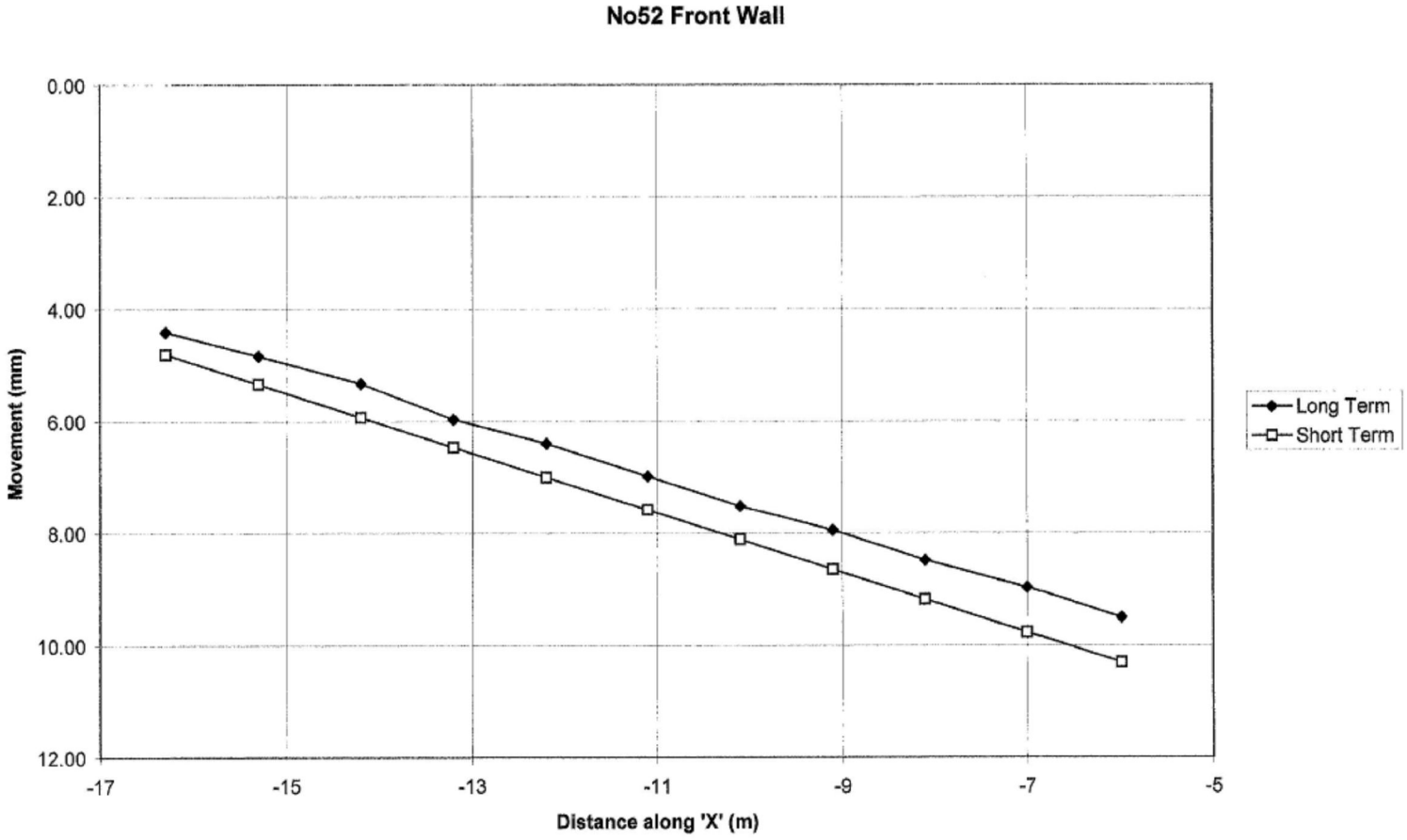

Y
Y=67.4
No 52
Y=45.3
No 50
No 48
(0,0)
X

Figure 4


No52 Front Wall
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Movement (mm)
-17
-15
-13
-11
-9
-7
-5
Distance along 'X' (m)
Long Term
Short Term

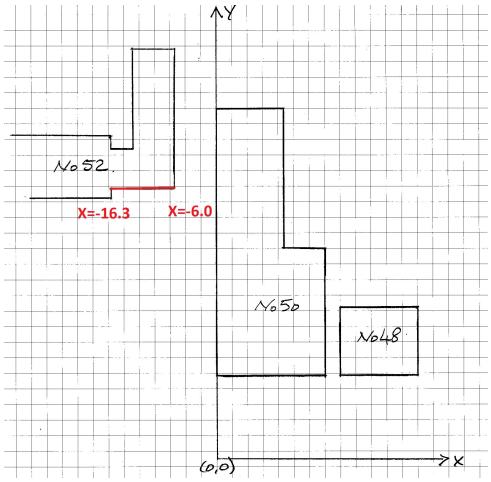
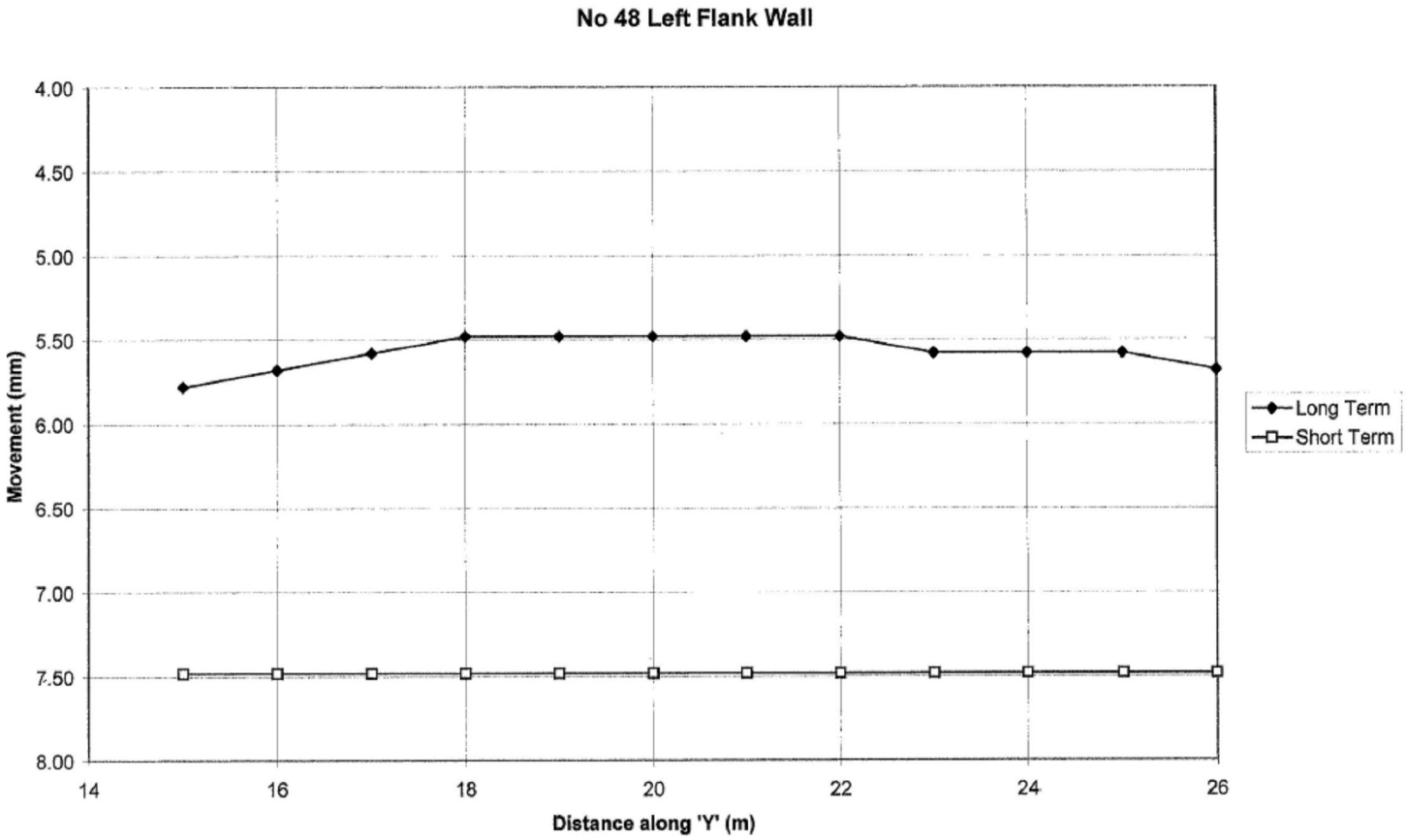

Y
No52
X=-16.3
X=-6.0
No50
No48
(0,0)
X

Figure 5


No 48 Left Flank Wall
Movement (mm)
4.00
4.50
5.00
5.50
6.00
6.50
7.00
7.50
8.00
14
16
18
20
22
24
26
Distance along 'Y' (m)
Long Term
Short Term

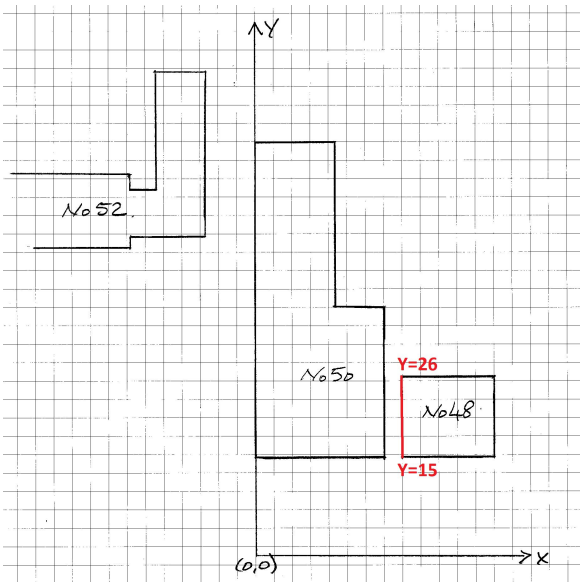

Y
No 52
No 50
Y=26
No 48
Y=15
(0,0)
X

Figure 6

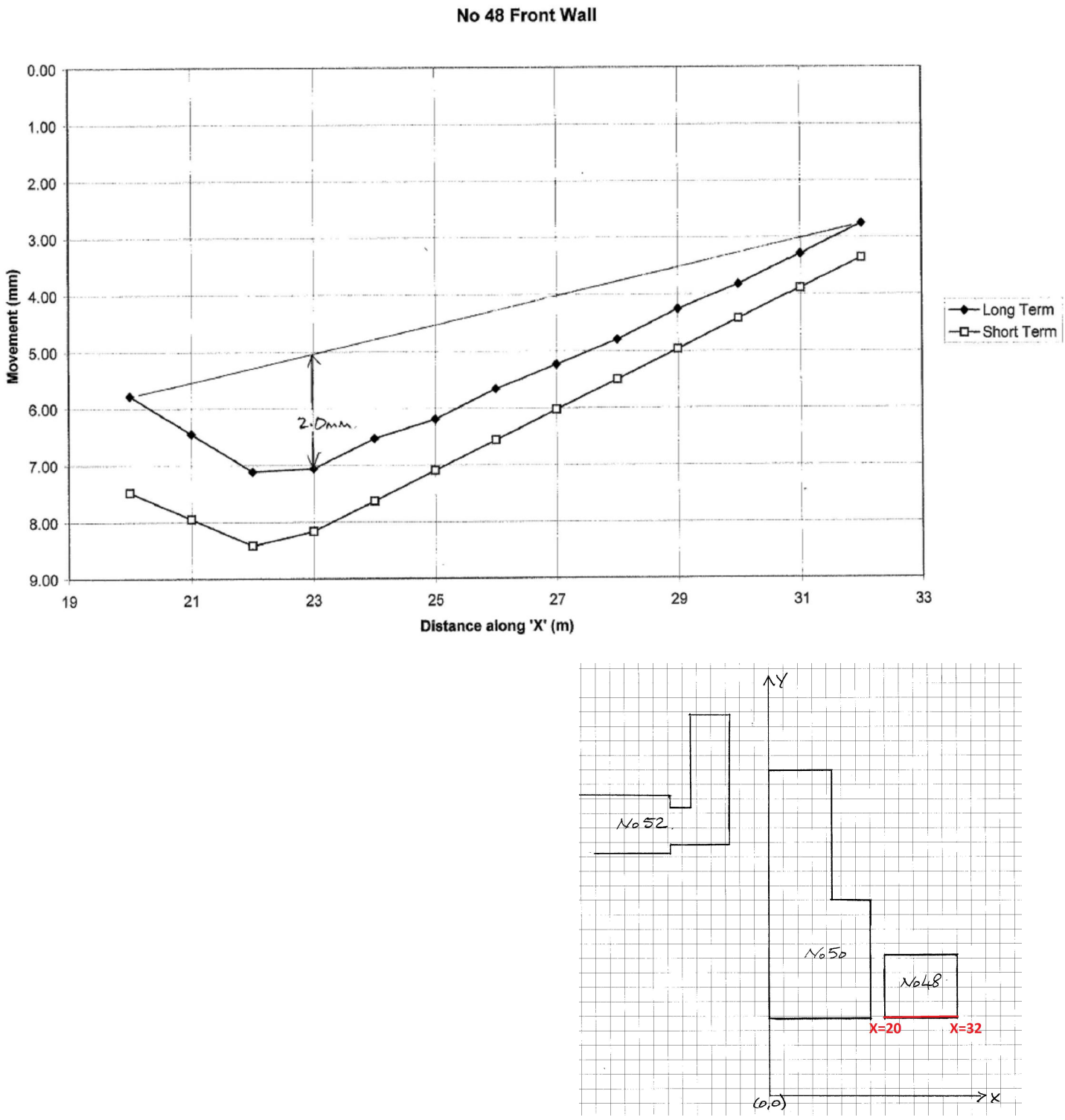
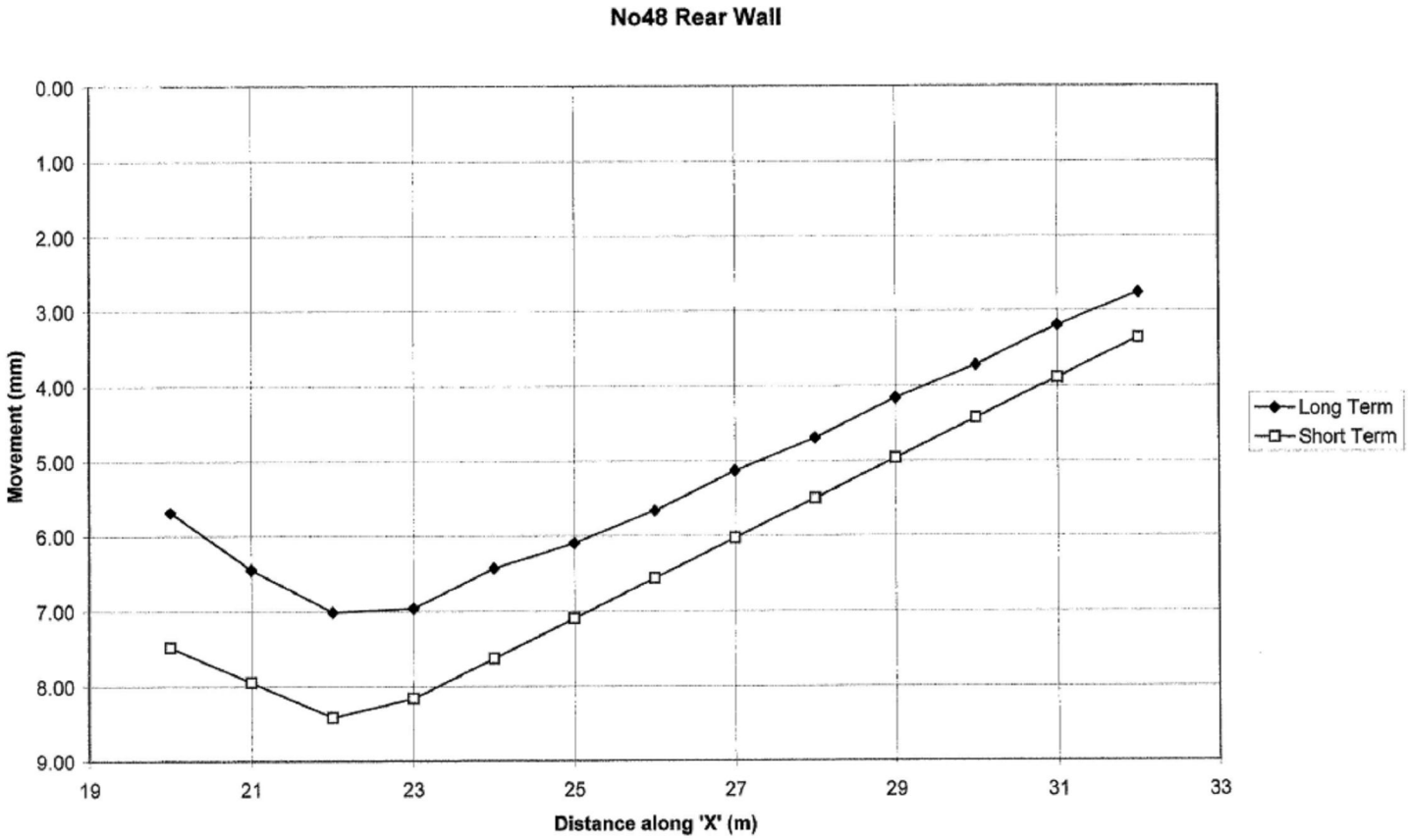

No 48 Front Wall
Movement (mm)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
19
21
23
25
27
29
31
33
Distance along 'X' (m)
2.0mm
Long Term
Short Term
No52
No50
No48
X=20
X=32
Y
X
(0,0)

Figure 7


No48 Rear Wall
Movement (mm)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
19
21
23
25
27
29
31
33
Distance along 'X' (m)
Long Term
Short Term

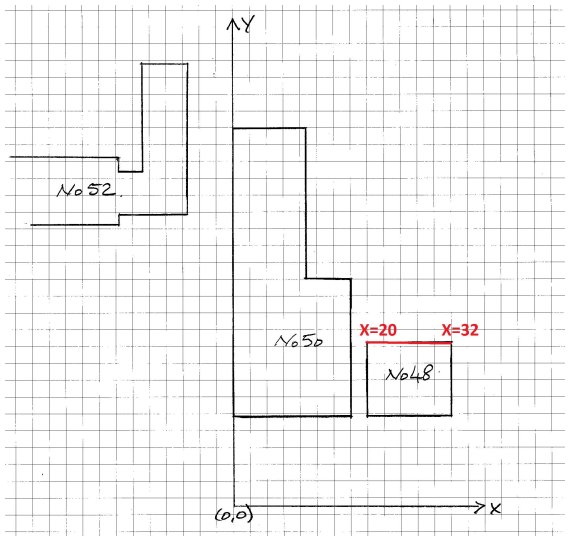

Y
No52
No50
X=20
X=32
No48
(0,0)
X

Figure 8

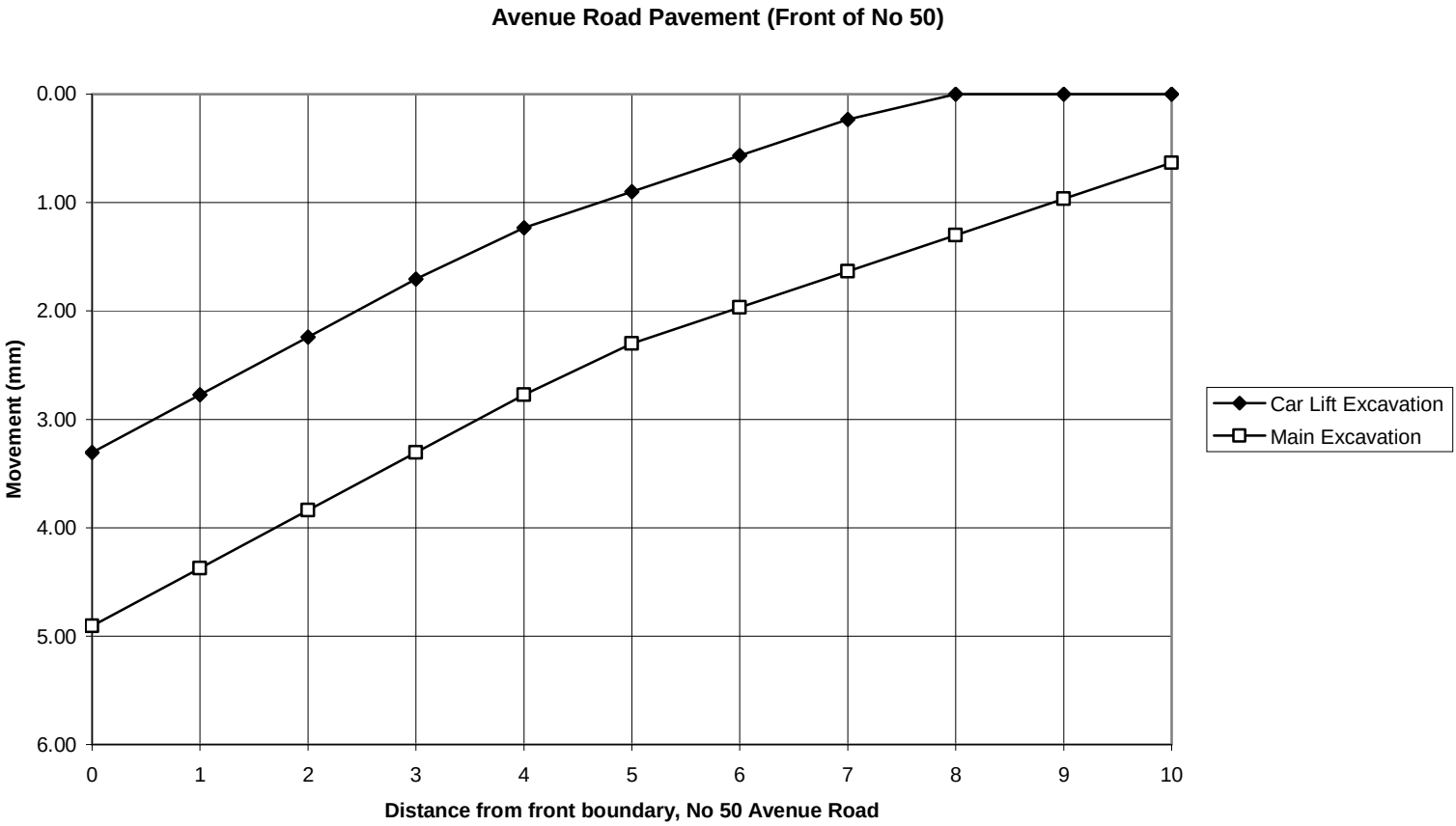

Avenue Road Pavement (Front of No 50)
Movement (mm)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
0
1
2
3
4
5
6
7
8
9
10
Distance from front boundary, No 50 Avenue Road
Car Lift Excavation
Main Excavation

Figure 9

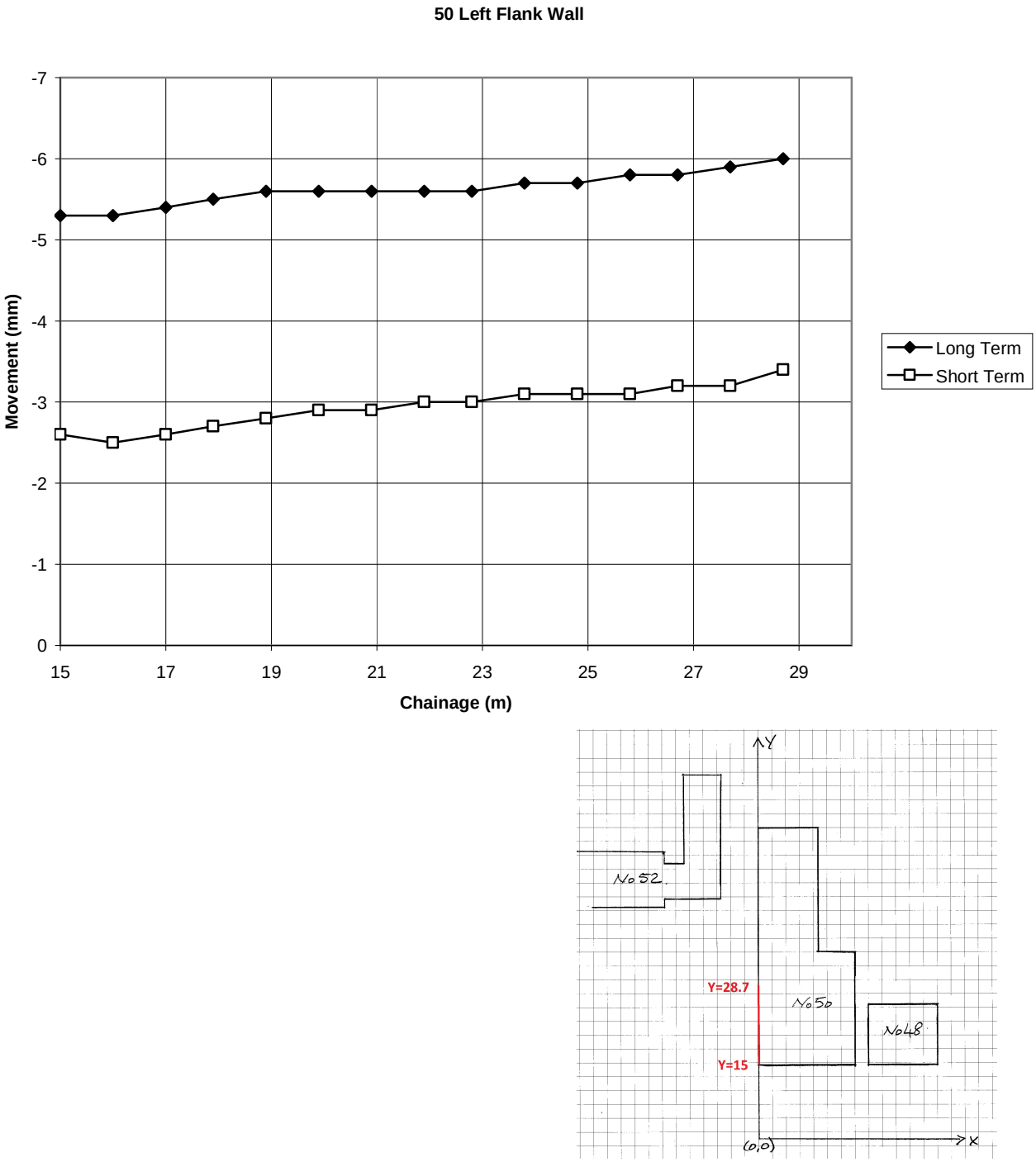

50 Left Flank Wall
Movement (mm)
-7
-6
-5
-4
-3
-2
-1
0
15
17
19
21
23
25
27
29
Chainage (m)
Long Term
Short Term
Y
No52
Y=28.7
No50
No48
Y=15
(0,0)
X

Figure 10

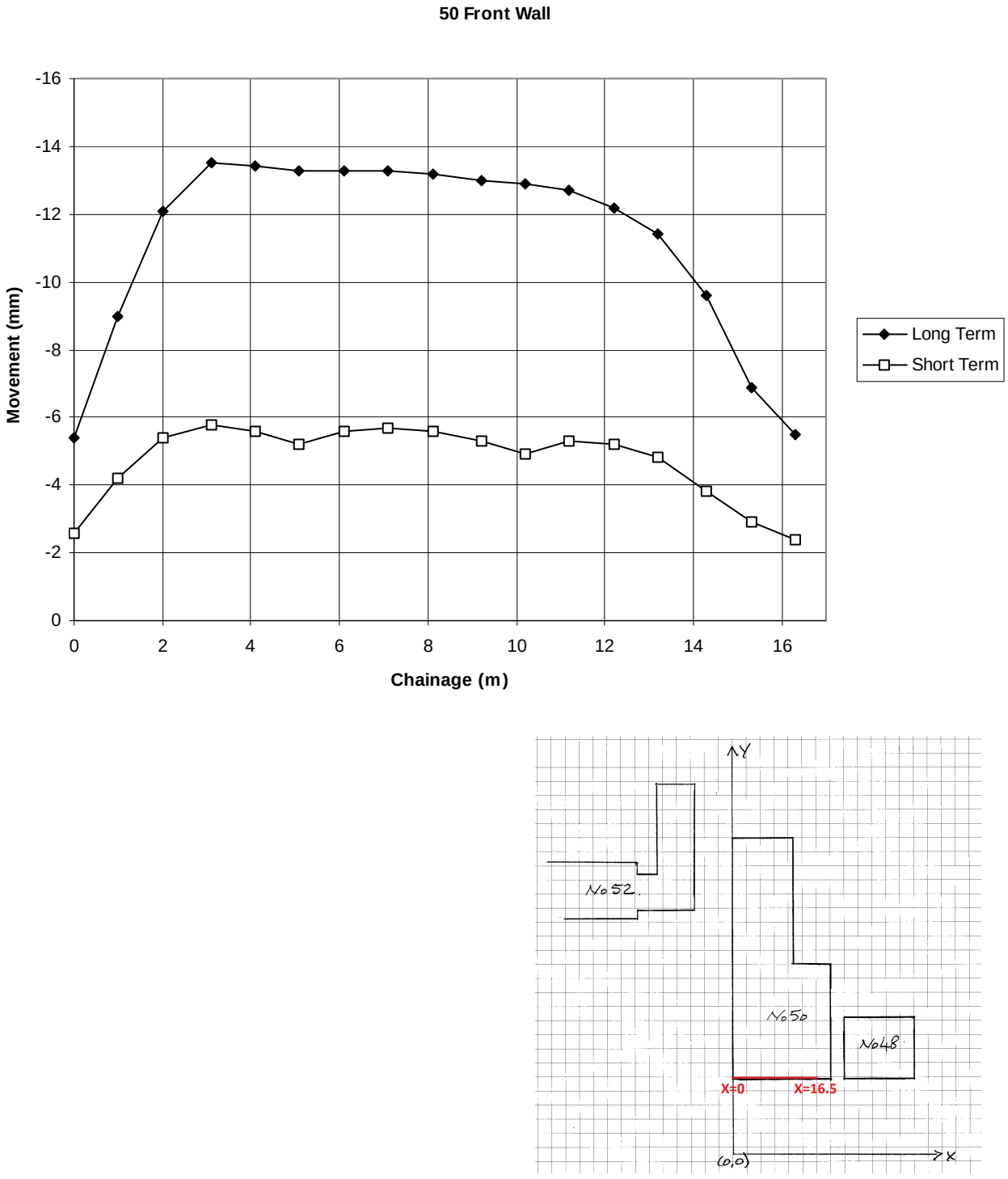
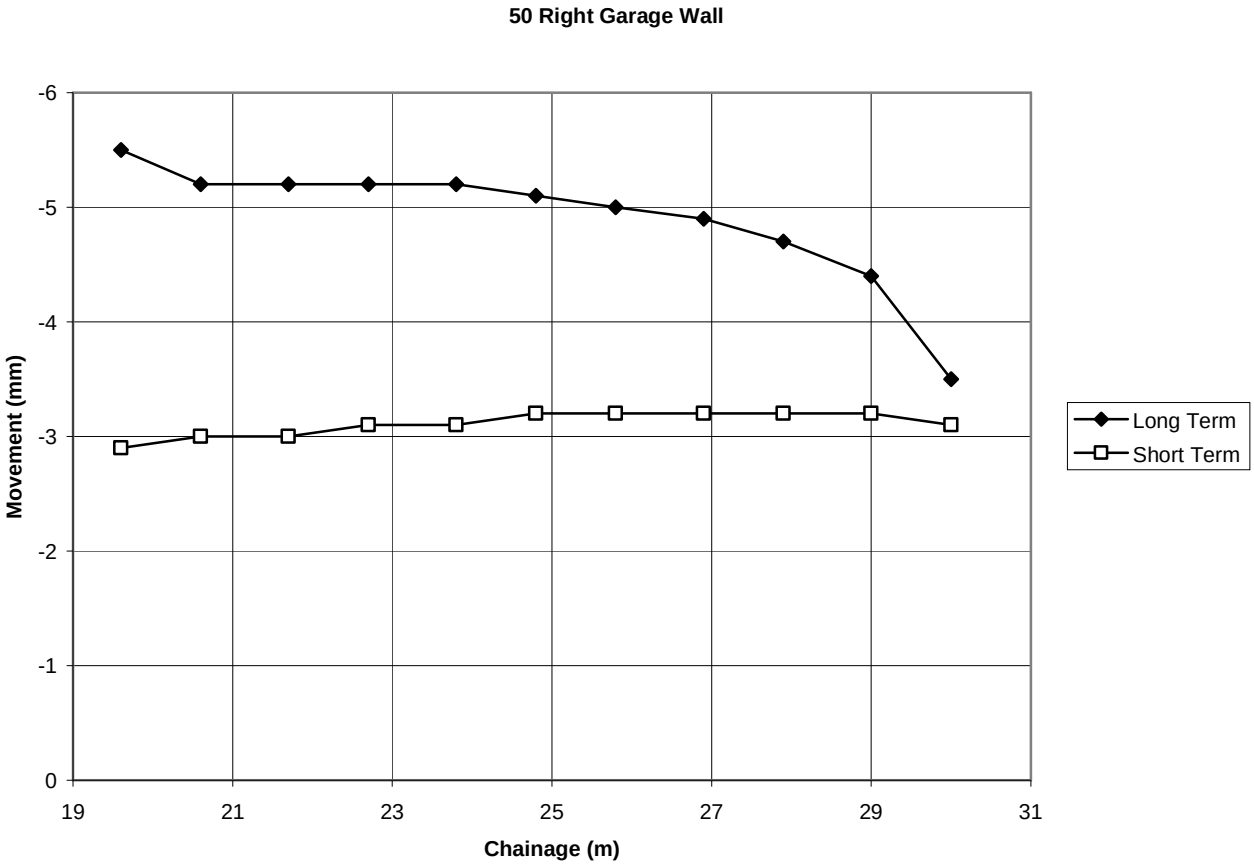

50 Front Wall
Movement (mm)
-16
-14
-12
-10
-8
-6
-4
-2
0
0
2
4
6
8
10
12
14
16
Chainage (m)
Long Term
Short Term
No 52
No 50
No 48
X=0
X=16.5
Y
X
(0,0)

Figure 11


50 Right Garage Wall
Movement (mm)
-6
-5
-4
-3
-2
-1
0
19
21
23
25
27
29
31
Chainage (m)
Long Term
Short Term

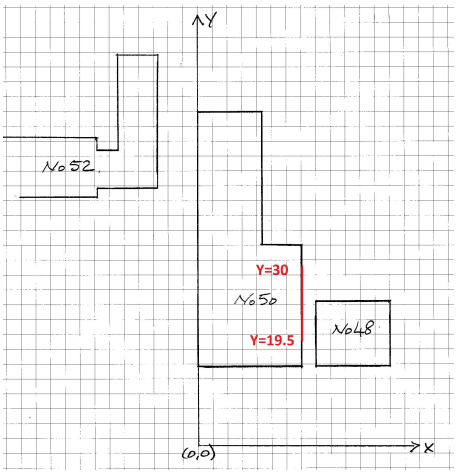

Y
No52.
Y=30
No50
Y=19.5
No48
(0,0)
X

Figure 12

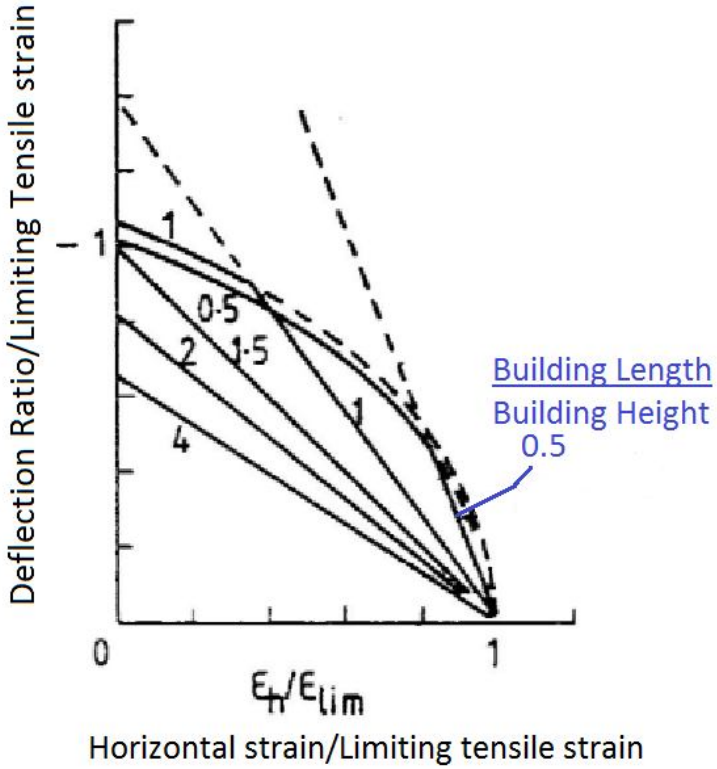


Figure 13
(Figure 6 in Ref 2)

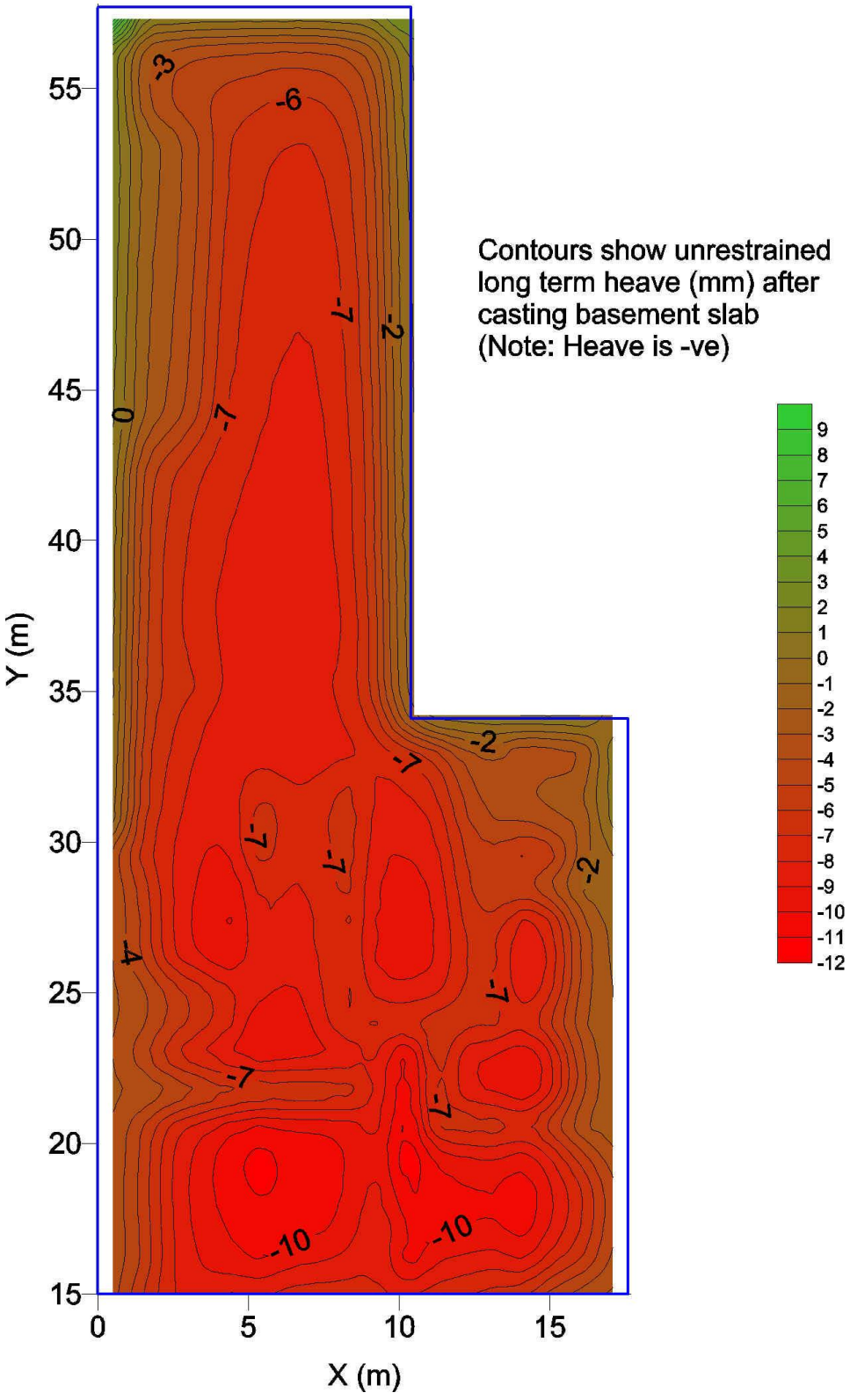


Figure 14
(Predicted heave (mm) for a fully flexible basement slab)

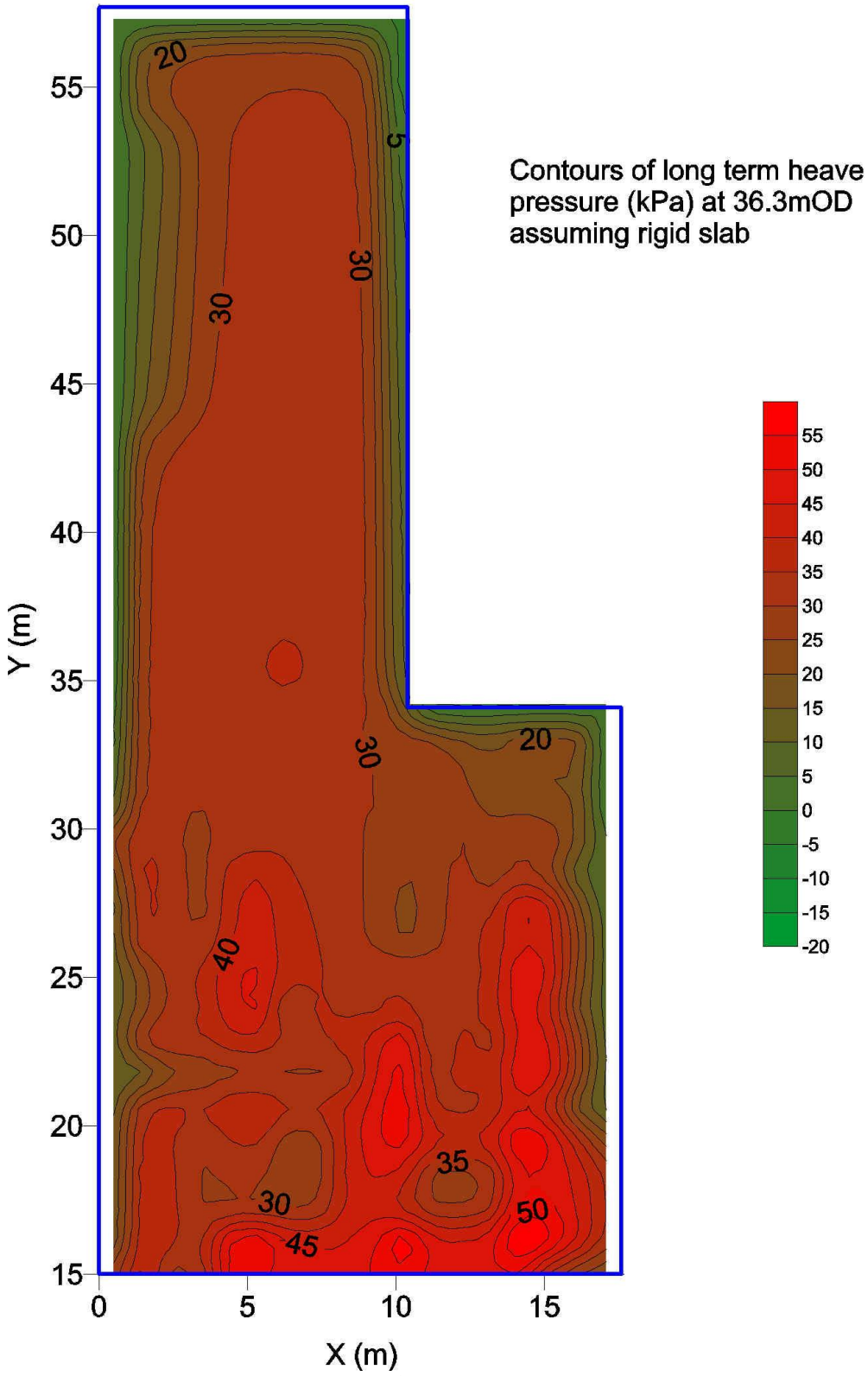


Figure 15
(Predicted heave pressure (kPa) for a fully rigid basement slab)

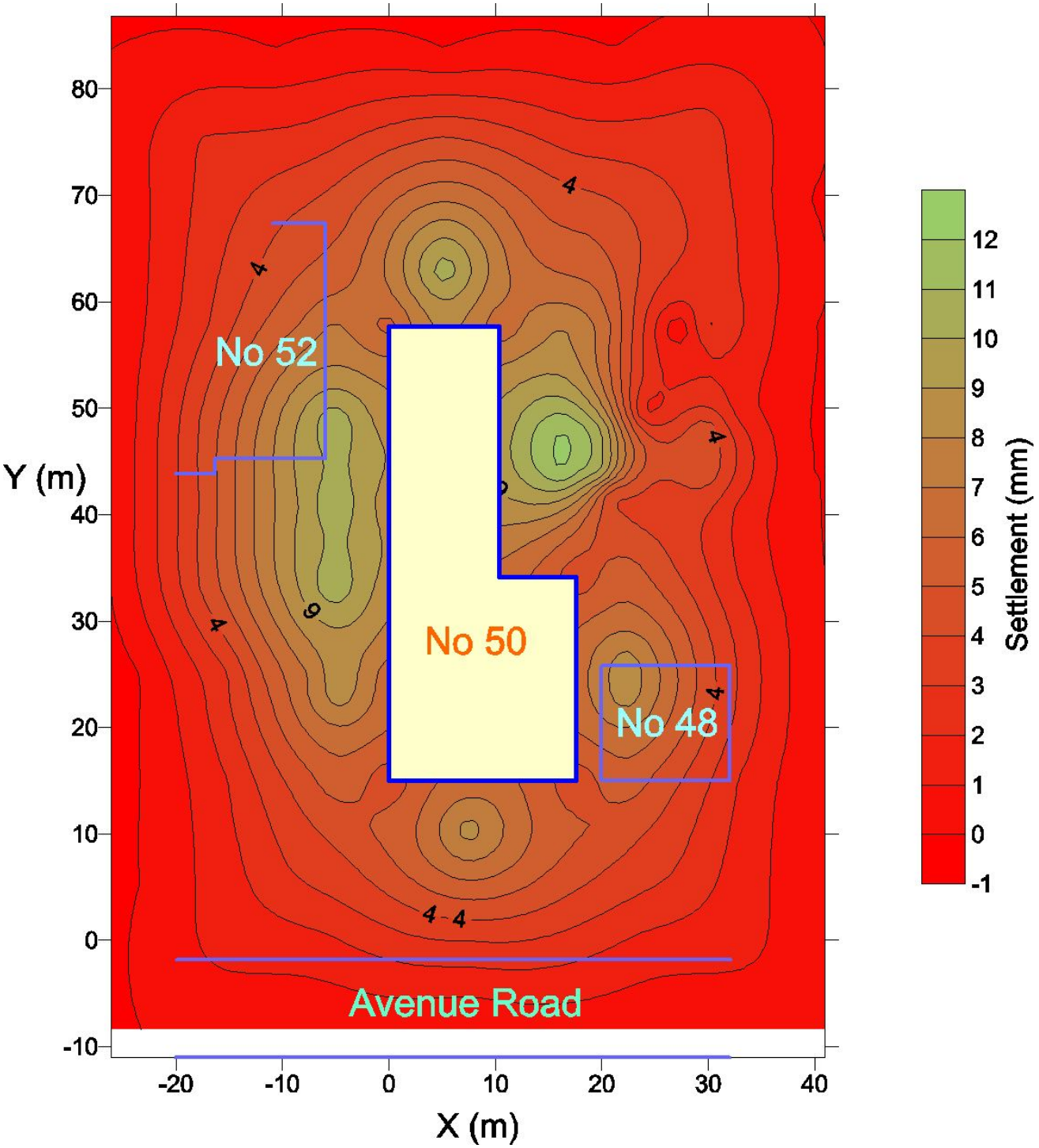


Figure 16
(Settlement contours)

APPENDIX D – Flood Risk Assessment

Surface water and flood risk assessment

elliottwood

50 Avenue Road

Camden

NW8 6HS

Surface Water and Flood Risk Assessment

project no. WE13066

revision: P1

Document Control

issue no.	01	remarks:	Planning application for development at 50 Avenue Road				
revision:	P1	prepared by:	Niall Greenan	checked by:	Guy Laister	approved by:	Guy Laister
date:	August 2013	signature:					

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Drawing 2 - Topographic Survey
Drawing 3 - Proposed Development
Drawing 4 - JBA (Pluvial) Surface Water Flooding Map
Drawing 5 - Asset Location Map

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Executive Summary

The site located at 50 Avenue Road is currently occupied by a detached dwelling and associated landscaped gardens. Proposals are to demolish the existing building and construct a new dwelling with two levels of basement which will extend under the existing rear garden area.

The Environment Agency flood zone maps indicate that the site is located in Flood Zone 1 (Low Risk). In accordance with the technical guidance document to the National Planning Policy Framework (NPPF), this zone comprises land assessed as having a less than 1 in 1000 annual probability of fluvial or tidal flooding (<0.1%). Local planning guidance on basement developments specifies that all new basement developments located in borough-defined areas at risk of surface water and sewer flooding need to be accompanied by a Flood Risk Assessment.

Avenue Road flooded in 2002 from surface water however the site itself is raised above surrounding road levels of Avenue Road. Therefore the risk of surface water and sewer flooding to the site are considered to be low. All other sources of flooding have been assessed in accordance with the NPPF and are considered to pose a low risk to the site.

The proposed basement extension is at low risk of flooding from all sources and is considered acceptable in the context of flood risk. Although the impermeable area on site will increase following development, surface water runoff from all these areas will be formally collected and attenuated thereby reducing the risk of flooding from this source.

1.0 Introduction

General Information

1.1 The site is located at 50 Avenue Road in the London Borough of Camden and is currently occupied by a single, detached dwelling. The site is less than 1ha in size and in its existing state comprises the building footprint and associated gardens.

1.2 The Environment Agency flood zone maps indicate that the site is located in Flood Zone 1. This zone comprises land assessed as having a less than 1 in 1000 annual probability of fluvial or tidal flooding (<0.1%).

1.3 The London Borough of Camden policy dictates that surface water and flood risk is considered in this case primarily due to basement construction. This Surface Water and Flooding Impact Assessment has been produced to assess the risks of flooding from other potential sources such as overland flow, groundwater, artificial water bodies and underground sewers. The impact of the proposed development on surface water infrastructure is considered, to form part of the Basement Impact Assessment.

Planning Policy

1.4 As part of the Local Development Framework (LDF), Camden adopted the Core Strategy and Development Policies in November 2010. Policy CS13 relates to flood risk and states:

"Water and surface water flooding"

We will make Camden a water efficient borough and minimise the potential for surface water flooding by:

- *protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;*
- *making sure development incorporates efficient water and foul water infrastructure;*
- *requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and down-stream flooding, especially in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross.'*

1.5 The Development Policies also include a policy specific to basements as follows:

DP27 – Basements and Lightwells

"...The Council will only permit basement and other underground development that does not cause harm to the built and natural environment and local amenity and does not result in flooding or ground instability...."

1.6 The London Borough of Camden has strict policies with regards to basement development within the Borough, therefore they have provided guidelines for 'New basement developments and extensions to existing basement accommodation[1]'. Formal planning guidance has also been released[2] setting out specific criteria for assessing the impact of basement construction. As part of the Basement Impact Assessment (BIA), it is necessary to consider 'Surface flow and flooding'. A screening flowchart (Drawing 1) addresses individual sources of potential flooding, and where a risk of flooding is present, a scoping and impact assessment need to be undertaken as appropriate. This report covers this component of the BIA.

[1] London Borough of Camden, Shaping Camden – Guidelines – New Basement Development and Extensions to Existing Basement Accommodation, February 2009

[2] London Borough of Camden – Camden Planning Guidance (CPG4) Basements and Lightwells.

1.7 In conjunction with ARUP, the London Borough of Camden produced a 'geological, hydrogeological and hydrological study for guidance on subterranean development[3]'.

Location

1.8 The site is situated on Avenue Road in the London Borough of Camden as shown in Figure 1.

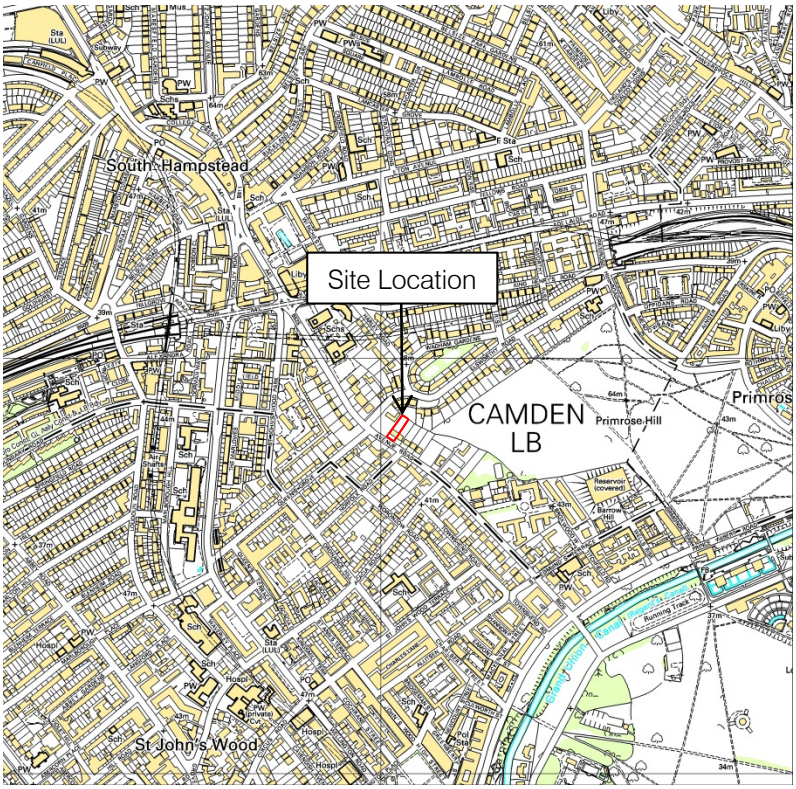


Figure 1 – Site Location

Existing Development

1.9 The existing site has an area of 1,246m^2 (0.1246ha) which comprises of a residential dwelling and associated gardens.

1.10 A topographic survey of the site has been carried out by Matrix Surveys in March 2013 and is included as Drawing 2. The survey shows the site falling in a south westerly direction towards Avenue Road, from 45.85m AOD at the rear of the site to 43.90m AOD in the front of the site.

Proposed Development

1.11 Proposals are to demolish the existing building and construct a new dwelling with two levels of basement which will extend under the existing rear garden area. The first basement floor level below ground will have a car stacker, a cinema, ancillary rooms, laundry room, store room, salon, bar and games room with the second basement floor level below ground containing an indoor swimming pool, sauna, steam room, gym, relaxation area and plant rooms (Drawing 3).

1.12 The new development will consist of landscaped rear garden over the proposed basement extension area and new lightwells to the front of the principal house.

[3] ARUP Geological, Hydrogeological and Hydrological Study – Guidance for Subterranean Development, November 2010

2.0 Surface Water and Flooding Impact Assessment

Stage 1: Screening

2.1 CPG4 includes a surface flow and flooding screening flowchart for assessing the impact of potential sources of flooding, as well as the impact of the development on flood risk elsewhere.

2.2 The flow chart is set out with six questions, which are addressed with reference to the site and proposed development at 50 Avenue Road as follows:

- Question 1: Is the site within the catchment of the pond chains on Hampstead Heath?

  Answer: No – The site is more than 2km from Hampstead Heath and not shown within the catchment area of the pond chains.

- Question 2: As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak runoff) be materially changed from the existing route?

  Answer: No – The current proposal is to re-use the existing connections to the Thames Water combined public sewer located in Avenue Road.

- Question 3: Will the proposed basement development result in a change in the proportion of hard surfaced/paved external areas?

  Answer: Yes – The proposed development will have an increase in the impermeable area post-development.

- Question 4: Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourse?

  Answer: No – The proposed development is deemed not to affect the profile of inflows to adjacent properties.

- Question 5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?

  Answer: No – The proposed basement will not result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses.

2.3 According to CPG4, it is necessary to carry forward to the scoping stage of the Basement Impact Assessment those matters of concern where the response is 'yes'. Therefore, as Questions 1 to 5 have a response of 'no', the scoping stage is not required.

2.4 In addition:

- Question 6: Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?

  Reference: The principles outlined in the NPPF should be followed to ensure that flood risk is not increased.

  Answer: Yes – see chapter 3 for details. Developer to undertake a Flood Risk Assessment in accordance with the NPPF.

Stage 2: Scoping

2.5 Increasing the area of hard standing on site as a result of development will increase the volume and peak flow rate of surface water generated. In order to ensure that development does not increase flood risk elsewhere, mitigation needs to be provided in the form of storage on site to attenuate the peak rate and volume of surface water runoff.

2.6 A new drainage system is proposed for the development, which will capture runoff from all hard standing surfaces post-development. The development will increase surface water runoff rates, and storage is required to attenuate flows before discharging to the public sewer at rates to be agreed with Thames Water. The detailed drainage design will calculate runoff rates for the pre- and post- development scenarios and quantify the storage required in the system to restrict the peak rate of runoff to the rates agreed with Thames Water and ensure that the peak rate of runoff does not increase following development.

3.0 Potential Flooding on Site

Historic Information

3.1 No records have been found of the site flooding in the past from any of the sources identified in the NPPF.

3.2 It is noted in the North London SFRA[4] that a large area in the north of Camden was affected by surface water flooding in August 2002, which was the result of heavy rainfall inundating the public sewer system. A similar region of Camden was affected by surface water/sewer flooding in 1975. In both instances, the floods that occurred are understood to have been the result of high intensity rainfall inundating the main sewer and causing manholes and gullies to surcharge.

3.3 Map 22 of the SFRA, and Figure 15 of the ARUP study show that Avenue Road has been recorded to have flooded in 2002.

Tidal and Fluvial Flooding

3.4 In October 2004, the Environment Agency released updated floodplain maps for the UK based on the 'JFLOW' project, a two-dimensional hydraulic modelling project. Figure 1 shows the latest 'Flood Zone Map' for the River Thames in central London.

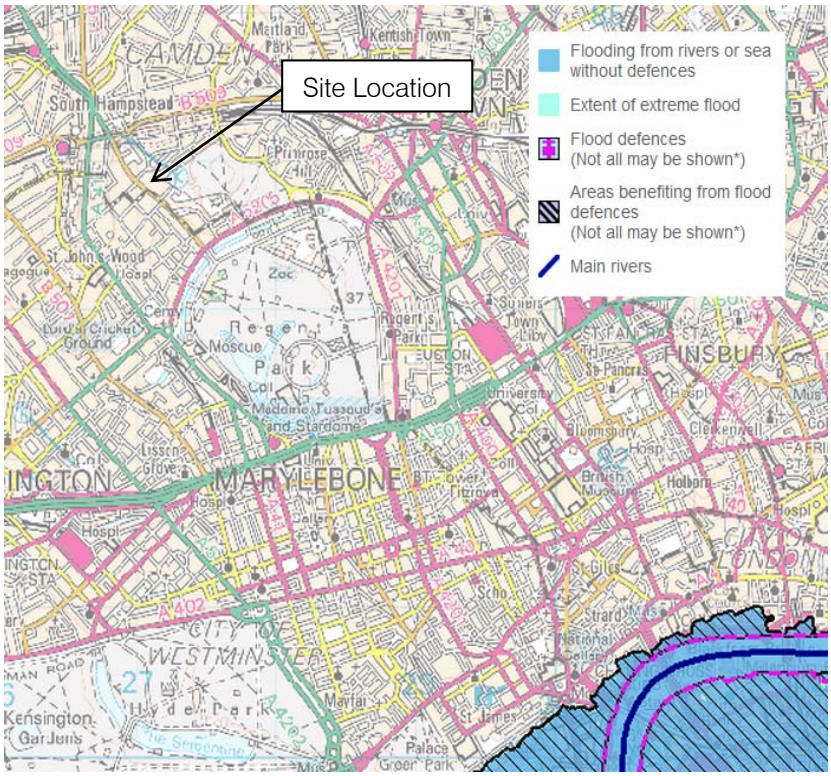


Figure 2 – Environment Agency Flood Zone Maps

3.5 The site is located in Flood Zone 1 and is approximately 5km north of the River Thames at its nearest location. As stated in the NPPF, "*this zone comprises land assessed as having a less than 1 in 1000 annual probability of fluvial and tidal flooding (<0.1%)".* Therefore the risk of flooding from tidal and fluvial sources is considered low.

[4] North London Strategic Flood Risk Assessment, (August 2008)

Flooding from Sewers and Overland Flow

3.6 Surface water flooding is typically the result of high intensity rainfall that is unable to infiltrate into the ground or enter the drainage system, ultimately following overland flow paths. In an urban environment such as Camden, surface water runoff is disposed of almost entirely via formal drainage systems, and consequently sewer flooding and surface water flooding (overland flow) need to be considered in tandem in this instance.

3.7 It is reasonable to assume that adopted sewers have been designed to the 1 in 30 year return period (in accordance with Sewers for Adoption 6th Edition[5]), which is considerably lower than the 100 year standard considered for fluvial flooding. As such, sewer flooding is often more frequent but less severe than fluvial flooding.

3.8 The North London SFRA has collected data from flooding events in 1975 and 2002 which have been used by Camden to map areas of the borough that are more susceptible to surface water flooding. This information was subsequently used to inform Camden's supplementary guidance document on basement developments[6]. In this document, roads having flooded in 1975 and 2002 are known as "primary areas" and those that flooded in only the 1975 or 2002 are known as 'secondary areas'. Any proposals for a basement development located in a primary or secondary area must include a flood risk assessment.

3.9 The London Borough of Camden experienced flooding in 1975 and 2002, which was attributed to overland flow and sewer flooding. Avenue Road is recorded as having flooded in the 2002 event, and the site is therefore located in a "secondary area". However the records are not detailed and entire roads have been highlighted without reference to specific locations or to which (if any) properties were flooded on these roads.

3.10 Drawing 4 shows a map produced by simulating a 1 in 200-year rainfall event over a 6.5 hour duration. The hydraulic modelling techniques used were to identify overland flow routes and areas where surface water will pond. The site lies outside an area of surface water flooding.

3.11 The Thames Water asset plan confirms that the site is connected to the combined public sewer located in Avenue Road with road levels falling from north west (approx. 47.5m AOD) to south east (approx. 42.8m). Drawing 5 shows the Thames Water asset plans with manhole 9801 located north of the site on Avenue Road. The manhole has a cover level of 44.68m AOD, however the road falls by approximately 3m from the manhole to the site. The topographic survey of the site shows that kerb levels (approx. 43.5m AOD) in Avenue Road are lower than ground levels on site (approx. 44.5m AOD), therefore any sewer surcharge will be contained in the carriageway of the road and pass the site in a south-easterly direction.

3.12 Therefore, despite the record of flooding on Avenue Road in 2002, the risk of flooding from sewers and overland flow is considered low.

Flooding from Groundwater

3.13 The online 1:50,000 BGS map indicates the site to be underlain by the London Clay formation. However, superficial head deposits are located to the east and west of the site.

3.14 A site investigation[7] was undertaken in June 2013 where groundwater seepage was encountered in BH1 at 12m b.g.l. The proposed basement will be approximately 10m b.g.l. The underlying geology of Camden

[5] WRc7 plc (March 2006) Sewers for Adoption – A Design and Construction Guide for Developers. 6th Edition.

[6] 3 London Borough of Camden, Shaping Camden – Guidelines – New Basement Development and Extensions to Existing Basement Accommodation, February 2009

[7] Site Analytical Services Ltd, Ground Investigation Report, Ref No. 13/20821, June 2013

and the majority of North London consists of London Clay, which typically has a very low infiltration rate. The North London SFRA notes that this clay is over 100m deep in high lying parts of Camden.

3.15 The North London SFRA also notes that there have been very few recorded incidents of groundwater flooding in North London, none of which are located in Camden. The risk of flooding from groundwater is therefore considered to be low.

Flooding from Reservoirs, Canals and Other Artificial Sources

3.16 The Regent's Canal and Regent's Park Lake are the nearest artificial water bodies to the site (reference Figure 12 of the ARUP Study). However at both locations water is not retained above natural ground level and flooding as a result of infrastructure failure is therefore not possible.

3.17 Figure 14 of the ARUP study shows the Hampstead Heath Surface Water Catchments and Drainage including the pond chains, in greater detail. The site is not located within the catchment of the pond chains on Hampstead Heath.

3.18 The risk of flooding from artificial water bodies is therefore considered extremely unlikely.

4.0 Conclusions and Recommendations

4.1 The site is located at 50 Avenue Road in the London Borough of Camden and is currently occupied by a detached dwelling and associated landscaped gardens. Proposals are to demolish the existing building and construct a new dwelling with two levels of basement which will extend under the existing rear garden area. The first basement floor level below ground will have a car stacker, a cinema, ancillary rooms, laundry room, store room, salon, bar and games room with the second basement floor level below ground containing an indoor swimming pool, sauna, steam room, gym, relaxation area and plant rooms.

4.2 The Environment Agency flood zone maps indicate that the site is located in Flood Zone 1 (Low Risk). In accordance with the technical guidance document to the National Planning Policy Framework (NPPF), this zone comprises land assessed as having a less than 1 in 1000 annual probability of fluvial or tidal flooding (<0.1%). Local planning guidance on basement developments specifies that all new basement developments located in borough-defined areas at risk of surface water and surface flooding need to be accompanied by a Flood Risk Assessment.

4.3 The North London SFRA has collected data from flooding events in 1975 and 2002 which have been used by Camden to map areas of the borough that are more susceptible to surface water flooding. This information was subsequently used to inform Camden's supplementary guidance document on basement developments. Any proposals for a basement development located in a primary or secondary area must include a flood risk assessment.

4.4 The site is located in a "secondary area" and therefore this surface water and flood risk assessment has been prepared to assess all the risks. The London Borough of Camden experienced flooding in 1975 and 2002, which was attributed to overland flow and sewer flooding. Avenue Road is recorded as having flooded in the 2002 event. Avenue Road flooded in 2002 from surface water however the site itself is raised above surrounding road levels of Avenue Road. Therefore the risk of surface water and sewer flooding to the site are considered to be low.

4.5 All other sources of flooding have been assessed in accordance with the NPPF and are considered to pose a low risk to the site.

4.6 The proposed basement extension is at low risk of flooding from all sources and is considered acceptable in the context of flood risk. Although surface water runoff from the site will increase following development due to additional hardstanding areas, all impermeable surfaces will be drained following development and surface water will be attenuated and discharged to the public sewer at rates agreed with Thames Water. Therefore there will be reduction in flood risk elsewhere as a result of the development.

Appendix

Drawing 1 - Surface Flow and Flooding Screening Flowchart

ARUP, Job No. 213923/KM
This flowchart is a guidance tool from the Camden geological, hydrogeological and hydrological study on subterranean development on how to complete a surface flow and flooding assessment.

Drawing 2 - Topographic Survey

Drawing Number 01
This drawing shows a topographic survey of the existing site.

Drawing 3 - Proposed Development

Section AA, Drawing Number AND – 200
This drawing shows the proposed development in side elevation.

Drawing 4 - JBA (Pluvial) Surface Water Flooding Map

JBA (Pluvial) Surface Water Flooding Map, Report Reference: 10384517
This map shows the 1 in 200-year rainfall event over a 6.5 hour duration.

Drawing 5 - Asset Location Map

Thames Water, Ref No. 212099
This map shows the Thames Water asset locations near the site.

DO NOT SCALE FROM DRAWING
ALL DIMENSIONS TO BE CHECKED ON SITE

NOTES:

ALL MEASUREMENTS TAKEN TO EXISTING SURFACE FINISHES UNLESS STATED OTHERWISE

ALL LEVELS IN METRES

ALL ARROWS POINT UP

GRID AND LEVELS RELATED TO ORDNANCE SURVEY BY GPS OBSERVATION

LEGEND:

20.00F	FLOOR LEVEL
20.00H	WINDOW HEAD LEVEL
20.00S	WINDOW SILL LEVEL
20.00C	CEILING LEVEL
20.00SC	SUSPENDED CEILING LEVEL
20.00B	BEAM LEVEL
20.00D	DOOR HEAD LEVEL
AB	AIRBRICK
B	BOLLARD
BH	HEIGHT TO BEAM UNDERSIDE
BW	BRICK WALL
BT	BRITISH TELECOM
CATV	CABLE TV
CB	CUPBOARD
CPS	CONCRETE PAVING SLABS
DK	DROP KERB
ER	EARTH ROD
FB	FLOWER BED
FH	FIRE HYDRANT
FW	FOUL WATER
G	GULLY
GV	GAS VALVE
IC	INSPECTION CHAMBER
IL	INVERT LEVEL
LP	LAMP POST
P	POST
RE	RODDING EYE
RG	ROAD GULLY
RS	ROAD SIGN
RWP	RAIN WATER PIPE
SVP	SOIL VENT PIPE
SW	SURFACE WATER
TL	TRAFFIC LIGHT
TOF	TOP OF FENCE LEVEL
TOW	TOP OF WALL LEVEL
TP	TELEGRAPH POLE
V	VENT
VP	VENT PIPE
WM	WATER METER
WP	WASTE PIPE
WSV	WATER STOP VALVE

FENCE TYPES

BW	Barbed Wire	CW	Chicken Wire
CB	Close Board	IW	Interwoven
CI	Corrugated Iron	IR	Iron Railing
CL	Chain Link	OB	Openboard
CPL	Conc Panel	PR	Post and Rail
CP	Chestnut Paling	PW	Post and Wire

REVISIONS	DATE	BY

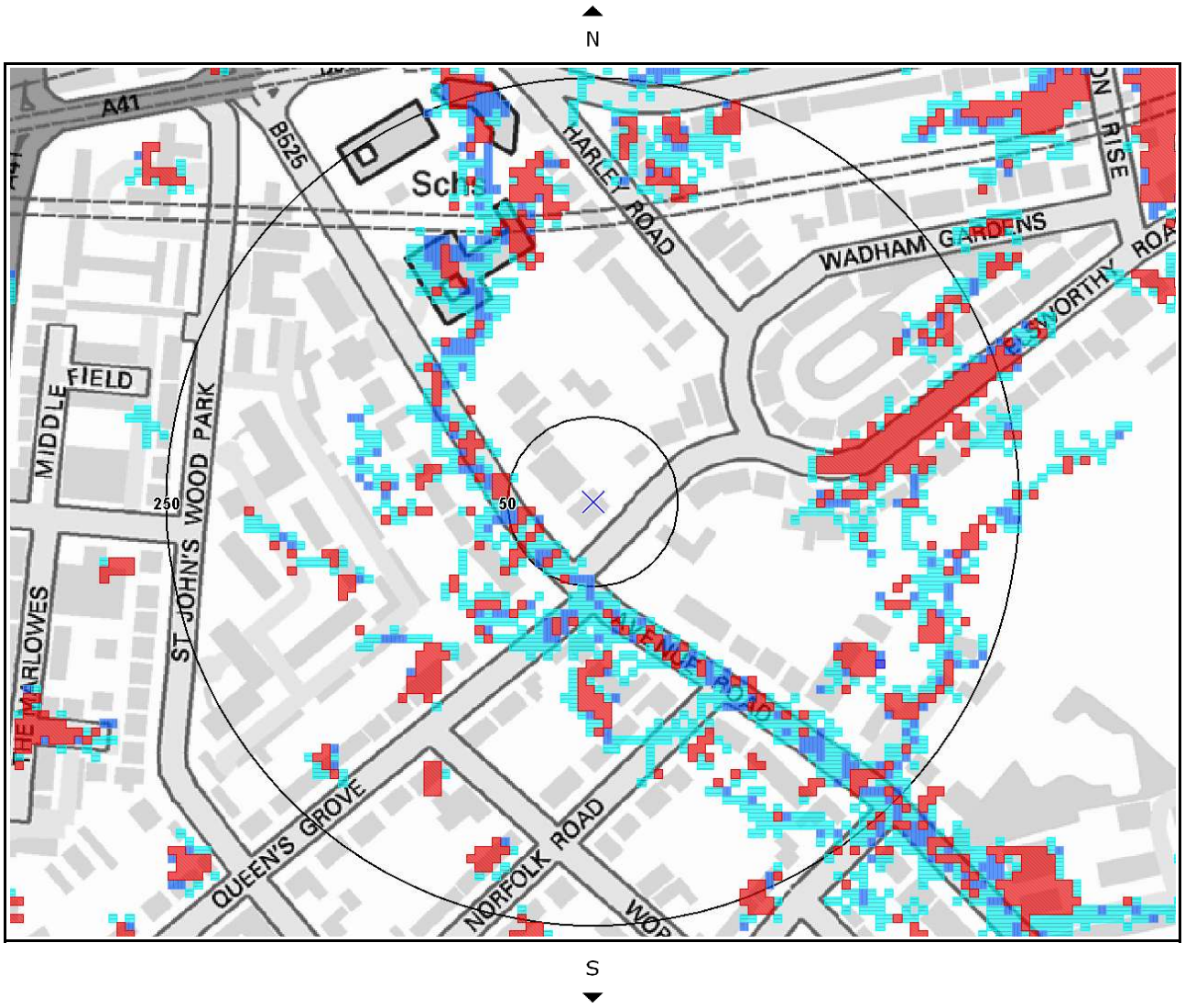
matrix
020-8994 0882

PROJECT
50 AVENUE ROAD
LONDON NW8

TITLE
TOPOGRAPHICAL SURVEY
AS EXISTING

SCALE 1/100@A0	DATE MARCH 2013
DRAWN BY KR	CHECKED BY SN
DRAWING No. 01	FILE No. 13/1730

3. JBA Surface Water Flooding Map



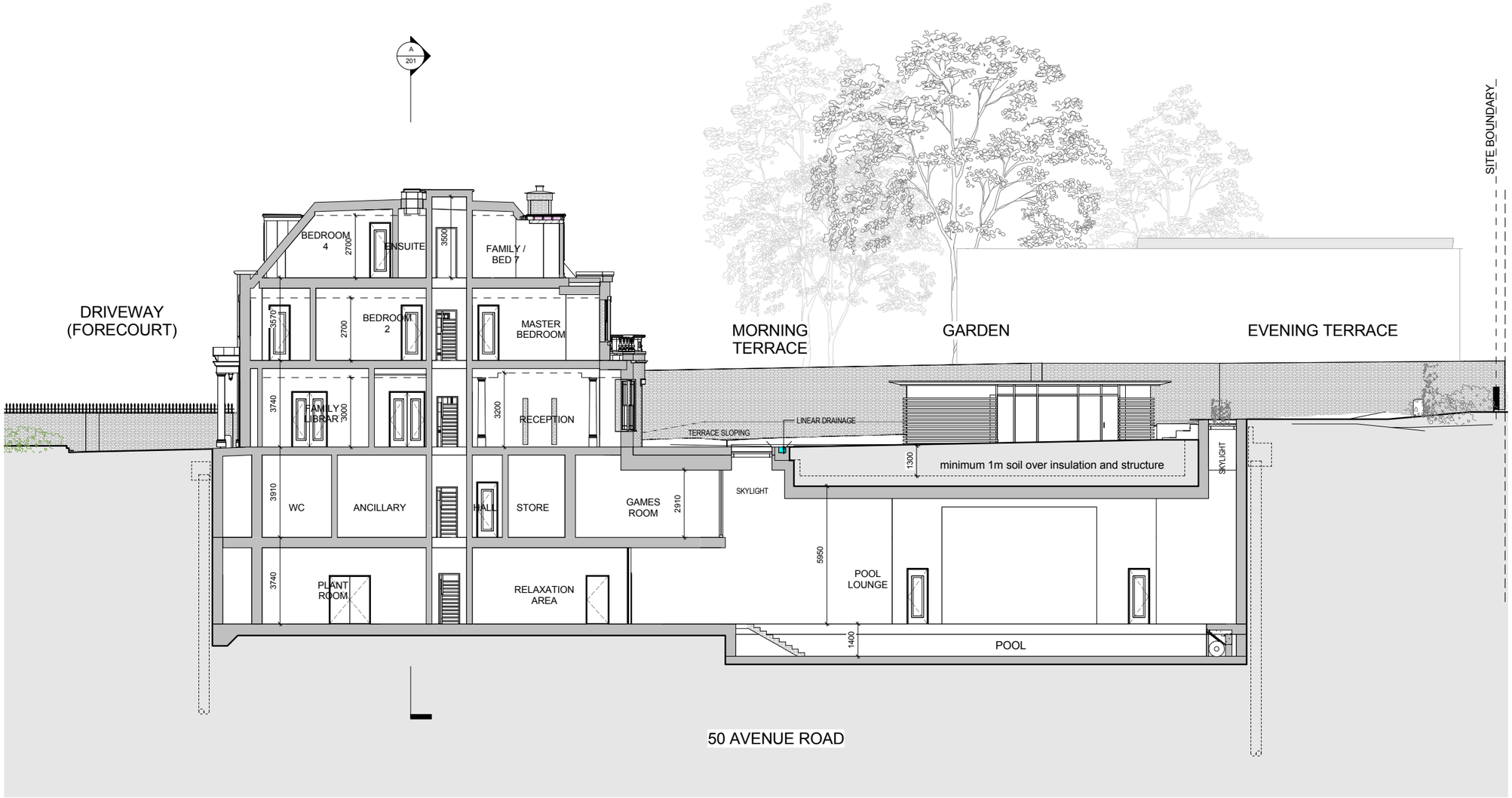
Flood Risk Legend

The data is provided by JBA Risk Management Limited, © Jeremy Benn Associates Limited and JBA Risk Management Limited 2008, 2009, 2010, 2011.

Site Outline

125
250
Search Buffers (m)

Significant
High
Moderate
Low to Moderate
Low



SECTION A (LONG SECTION)

0m 1m 2m 5m 10m

GRAPHIC SCALE

General notes:

This drawing must be read in conjunction with the designer's risk assessment, specification and all other relevant documentation and drawings. KSR architects accept no liability for any expense, loss or damage of whatsoever nature and however arising from any variation made to this drawing or in the execution of the work to which it relates which has not been referred to them and their approval obtained.
Do not scale from this drawing or the digital data, only figured dimensions are to be used. For Planning refer to linear scale.
Check all dimensions on site.

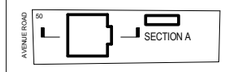
Notes/Legends

Rev	Notes	dd.mm.yy	By	Chkd

Stamp

PRELIMINARY
Work In Progress

Key Plan



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Project:
50 AVENUE ROAD

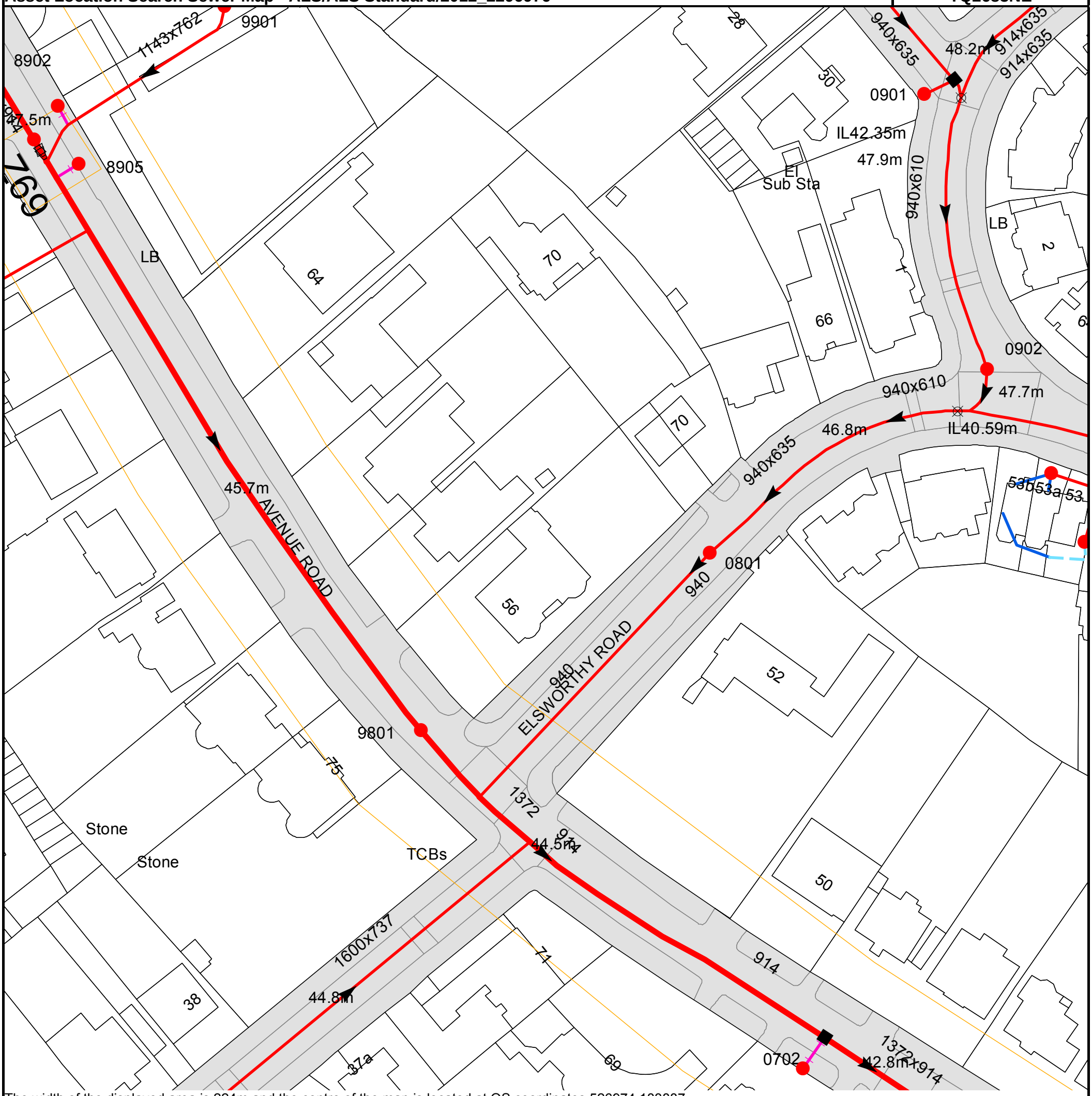
Title:
SECTION AA

Date: AUG 2013	Drawn By: SHY	Checked: RS

Scale: 1 : 100 @A1 / 1 : 200 @A3

Project Ref:	Drawing No:	Revision:
AND	AND - 200	

Asset Location Search Sewer Map - ALS/ALS Standard/2012_2296976 | **TQ2683NE**



The width of the displayed area is 224m and the centre of the map is located at OS coordinates 526974,183887

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
N/a	47.31	43.37
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	44.68	39.4
n/a	46.29	40.07
n/a	n/a	n/a
-	-	-
n/a	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0118 925 1504.