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Your Ref:

Our Ref: **Ref: 14/22068-2**
January 2015

Basement Impact Assessment

At

26 Netherhall Gardens, London, NW3 5TL

For

Atlas Property Letting & Services Limited

Original Submission – June 2014

Revised Submission – January 2016

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 groundwater regime at the residential property at 26 Netherhall Gardens, London, NW3 5TL. For this assessment a representative of SAS Limited visited the property on 23rd April 2014.

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

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

1.2 Planning Policy Context

Camden Planning Guidance for Basements and Lightwells has been recently revised (CPG4, 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 neighbouring property of the site or the water environment by way of changing the groundwater regime.

Camden Guidance CPG4 sets out 5 Stages:

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

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

This report also provides an impact assessment (4) of the geo-environmental impacts on adjacent structures and the surrounding area based on available site investigation data.

As part of this guidance a subterranean (groundwater) flow, slope stability and surface water and flooding screening chart is provided (CPG 4, Figures 1, 2 and 3 respectively). The completed charts in relation to this development are provided as Table 1, to this report.

1.3 Qualifications

The report has been prepared by Mr Andrew Smith, a Fellow of the Geological Society (FGS) with over 8 years post graduate experience in co-ordination with Mr Martin Redston, a Consulting Civil Engineer (CEng).

2.0 SITE DETAILS

(National Grid Reference: TQ 263 850)

2.1 Site Location

The site is situated on the east side of Netherhall Gardens in Hampstead, London at approximate postcode NW3 TTL. The site is currently occupied by a four storey detached property arranged over lower ground, raised ground, first and attic storeys. The property has been converted into flats.

The site covers an area of approximately 0.09 Hectares and the general area is under the authority of the London Borough of Camden.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) indicates the site to be underlain by the London Clay Formation with deposits of the Claygate Member located immediately to the north of the site.

2.3 Site Layout

The site was attended on 23rd April 2014 for the purposes of conducting the site walkover.

The site comprises of a large four storey detached property arranged over lower ground, raised ground, first and attic storeys, front and rear garden areas and side garage. The property has been converted into flats.

Access to the property is via steps up from the street. A grass area and concrete driveway is present to the south of the steps leading to the garage. To the north of the steps is an area of grass. A large mature tree is also present in this area.

The garden at the rear can be accessed by a small gated side passage. It comprises of a patio adjacent to the house and a large garden mainly set to a raised lawn with shrub beds along the sides and two large mature trees. The garden is bound by thick hedges.

The site and street is cut into the hillside which slopes generally east to west at angles of less than 7 degrees.

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

2.4 Proposed Development

Proposals for the site include the demolition of the existing property, construction of a new three storey apartment building and construction of a single storey basement and part sub basement below the new building extending out into the rear garden area.

2.5 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site 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 proposed basement floor level of 7.50m will be below the current water level of approximately 1.14 to 1.88m below ground level.
	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 surface water is recorded as being a pond 846m south-east of the site. However, according to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is within 100m of the tributaries of the former River Westbourne.
	3. Is the site within the catchment of the pond chains on Hampstead Heath.	No	The site is at least 100m south 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	The proposed development has more hard surfacing than presently on-site.
	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).	No	Existing drainage paths are to be utilised where possible. An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.
	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 or spring line.	No	The nearest surface water is recorded as being a pond 846m south-east of the site.
Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 1 in 8.	No	There is a small step up from the house level to the garden level, but this is less than 1 in 8 (approximately 7 degrees).

	2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 1 in 8.	No	Re-profiling of landscaping at the site is not proposed.
	3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 1 in 8.	No	The neighbouring areas are essentially flat.
	4. Is the site within a wider hillside setting in which the general slope is greater than 1 in 8.	No	There is a general slope across the wider area towards the west, but this is at angles of less than 1 in 8.
	5. Is the London Clay the shallowest strata at the site.	No	The investigation found that the site is underlain by Made Ground overlying the London Clay Formation.
	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 5.2 for scoping	It is understood that trees are to be felled as part of the development.
	7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	Yes - refer to Section 5.2 for scoping	The site lies above the London Clay Formation that is well known 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 4.3 for scoping	The nearest surface water is recorded as being a pond 846m south-east of the site. However, according to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is within 100m of the tributaries of the former River Westbourne.
	9. Is the site within an area of previously worked ground.	Yes - refer to Section 5.3 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 5m of a highway or pedestrian right of way.	Yes - refer to Section 5.4 for	The site lies adjacent to Netherhall Gardens.

		scoping	
	11. Is the site within 50m of the Hampstead Heath ponds.	No	The site is located over 50m from the pond chains on Hampstead Heath.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes - refer to Section 5.5 for scoping	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.
	13. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	Unknown / outside scope of report	Historical data indicates that the Thames Link Tunnels are at least 100m south of the site, however a full statutory service search was outside the scope of this report and must be completed prior to any excavations.
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	The amount of hardstanding on-site is changing therefore surface water will be impacted by the development.
	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 will 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.	No	There are no fluvial or tidal floodplains located within 1km of the site. According to CPG4, September 2013, Netherhall Gardens is not on the list of streets at risk from surface water flooding.

The Screening Exercise has identified 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 areas.

Slope Stability

- Is there a history of seasonal shrink-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.
- 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 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.

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 April, May and June 2014 (SAS Report References 14/22068 and 14/22068-1). 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 cover of concrete, concrete slabs or topsoil and brick rubble overlying a silty sandy clay with brick and tile fragments
London Clay Formation	0.12 to 1.50	Firm becoming stiff and then very stiff silty clay with some pockets and partings of silty fine sand

Groundwater was not encountered in Borehole 2 or Trial Pits 1, 2, 3, 4, 5 and 6 and the soils remained essentially dry throughout.

A groundwater strike was encountered in Borehole 1 at 3.00m below ground level.

Groundwater was found to have stabilised at a depth of 1.14m below ground level in the monitoring standpipe installed in Borehole 1 and at a depth of 1.88m below ground level in the monitoring standpipe installed in Borehole 2 after a period of approximately seven weeks post site works.

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 basement is estimated to be at a maximum depth of approximately 7.50m below ground level. In the boreholes drilled as part of the most recent investigation the encountered groundwater is approximately 1.14m to 1.88m below ground level and therefore above the level of the proposed basement. Groundwater in the site area is anticipated to flow in a generally westerly direction in accordance with the topography of the site area.

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 consideration could be given to conventional internal pumping methods from open sumps.

Groundwater is by its nature, hidden from view and unforeseen ground conditions can occur. It is therefore recommended that the water levels in the monitoring boreholes be periodically measured immediately prior to, and during the development. Should groundwater levels rise to within the excavation volume, or should significant groundwater inflow be observed during excavation, professional advice should be sought.

4.3 Springs, Wells and Watercourses

The nearest surface water is recorded as being a pond 846m south-east 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 of tributaries of the former River Westbourne, which ran in a southerly direction from Whitestone Pond on Hampstead Heath down through Hampstead, Kilburn, Paddington, Hyde Park, onto Knightsbridge and then out into the River Thames at Chelsea. The River Westbourne is now enclosed and flows through 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.

Current best practice with regards to the design and management of rainwater drainage measures is provided in DEFRA/EA document 'Preliminary Rainfall Runoff Management for Developments'' (January 2012). Section 6.2 of this report describes some options for drainage at the site using this document as a basis for design.

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 Ground movements

Atterberg Limit tests were conducted on three selected samples taken from the upper cohesive portion of the natural soils in Boreholes 1 and 2, and showed the sample tested to fall into Classes CH and CV according to the British Soil Classification System. These are fine grained silty clay soils of high and very high plasticity and as such generally have a low permeability and 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. 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.

The resulting removal of overburden due to excavation and subsequent reloading from the building may potentially cause some vertical ground movement in the underlying soils, the final magnitude depending on the net unloading applied at the same time. Consideration should, therefore, be given to providing heave protection measures to the floor slab and foundations to mitigate this.

5.3 Made Ground

In the boreholes and trial pits drilled at the site, Made Ground was found to extend down to depths of up to 1.50m below ground level.

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

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

Contamination testing of the Made Ground has been undertaken and is described in SAS Report Reference 14/22068.

5.4 Location of public highway

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

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

5.5 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. ASUC Plus Guidelines released in October 2013, on safe and efficient basement construction directly below or near to existing structures is seen as relevant for this site.

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.

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 and therefore the proposals may potentially affect the overall volume of surface water generated by the site unless mitigation is provided.

The current data indicates that surface water, like groundwater will flow in a general westerly direction across the site in accordance with the topography of the site area.

Based on the information available for the site, the London Clay Formation has a measured permeability of $1.0x10^{-7}$ 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, it is proposed that the additional site area drains 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 ensure the proposals would not cause an increase in peak runoff from the site.

6.3 Basement Construction and Groundwater Flow

British Standard (BS) 8102 (Code of Practice for Protection of Below Ground Structures Against Water from the Ground) offers guidance for the design and waterproofing of basements and defines 4 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.
- Grade 4. Special. Archives and stores requiring controlled environment. Totally dry environment. Active measures to control internal humidity probably essential

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

7.0 CONCLUSIONS AND NON TECHNICAL SUMMARY

1. Proposals for the site include a basement excavation. The maximum depth of the proposed basement is assumed to be approximately 7.50m below ground level.

2. Conditions at the site were investigated by Site Analytical Services Limited in November and April, May and June 2014 (SAS Report References 14/22068 and 14/22068-1). The exploratory holes revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised 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 and as a result, the construction of the proposed basements may result in some changes to the groundwater regime around the property.

4. The resulting removal of overburden due to excavation and subsequent reloading from the building may potentially cause some vertical ground movement in the underlying soils, the final magnitude depending on the net unloading applied at the same time. Consideration should, therefore, be given to providing heave protection measures to the floor slab and foundations to mitigate this.

5. Foundations may need to be taken deeper should they be within the zones of influence of either existing or recently felled trees

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

7. 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.

8. 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.

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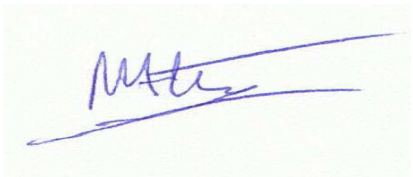

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