6 Nutley Terrace

Groundwater Impact Assessment

6 Nutley Terrace
London
NW3 5BX

Site NGR: TQ 2666 8499

Prepared for:

Mr & Mrs Shafi

Chord Environmental Ltd

Report no. 1103/R1

November 2011

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Document Control Sheet

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

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The report is confidential to Mr & Mrs Shafi. Chord Environmental Ltd. accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known.

Chord Environmental Ltd

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Contents

1 Introduction

1.1 Background

Mr & Mrs Shafi are applying for Planning Consent to demolish the existing house and construct two new three-storey houses with single level basements. The basements will extend to a depth of 4.2 m and will, it is understood, cover the existing building footprint and extend partly into the existing rear garden.

Site investigation works have been undertaken by Geotechnical and Environmental Associates (GEA) Ltd. The work comprised a detailed Ground Investigation[1] and this assessment should be read in conjunction with GEA's site investigation report.

Chord Environmental has been commissioned by Elliott Wood Partnership on behalf of Mr and Mrs Shafi, to carry out a groundwater assessment for the proposed development at 6 Nutley Terrace, London, NW3 5BX, to meet the requirements of London Borough of Camden's "Guidance for Subterranean Development"[2].

1.2 Scope and Approach

This report reviews the proposed development at 6 Nutley Terrace within the context of the conceptual understanding of its site setting which has been informed through site investigation findings. The report will identify potential groundwater impacts the development may have. Appropriate mitigating measures can then be developed and adopted to avoid or minimise these affects where identified.

This report is limited to the groundwater flow component of the Basement Impact Assessment, as specified by the London Borough of Camden's "Guidance for Subterranean Development". The Author of this report is a qualified Hydrogeologist, Chartered Geologist and Fellow of the Geological Society of London, as required by the Guidance.

[1] Desk Study and Ground Investigation Report – 6 Nutley Terrace, London NW3. Geotechnical and Environmental Associates Ltd. October 2011.

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

2 Proposed Development

The Site occupied by 6 Nutley Terrace, South Hampstead, London (National Grid Reference TQ 2666 8500) is a residential property approximately rectangular in shape and 30m by 60m in area. The existing two-storey, detached L-shaped house is located on the northern part of the site. A brick paved parking area is present to the front of the house, adjacent to Nutley Terrace. A small grassed area with planted borders and two deciduous trees approximately 20 m high are present to the east of the house.

The proposal is to demolish the existing house at 6 Nutley Terrace and construct two new three-storey houses with single level basements. The basements will extend to a depth of 4.2 m and cover the existing building footprint and extend partly into the existing rear garden.

The basement excavation will be up to 4.0m below the existing ground level. The existing building footprint is proposed to be increased from c.175m^2 to c.390m^2 and existing hardstanding areas of 180m^2 proposed to be increased to 270m^2 with the development of terraced patio areas to the rear of the property. A majority of the existing hardstanding is brick pavior to the front of the property which is anticipated to facilitate some surface drainage.

3 Site Setting

The Site is located on the eastern end of Nutley Terrace in the South Hampstead area of London, NW3 5BX.

3.1 Topography

The Site lies at an elevation of approximately 75m above ordnance datum (OD) on ground which falls away to c.40m OD at the River Thames, c.2km to the south and rises to an elevation of 134m OD on Hampstead Heath, c.1.5km north of the site. Within the Site itself the ground slopes gently down towards the south in a series of terraces, from a level of 75.47 m OD at the northern boundary to 73.58 m OD at the southern boundary.

To the south of the house the rear garden comprises a terraced lawn with a number of mature trees on the eastern and western boundaries; species include ash, beech and poplar.

3.2 Hydrology and Drainage

The Site lies within the surface water catchment of the upper Tyburn stream, a tributary of the River Thames, and outside of the catchment of the Hampstead Heath chain of ponds. The Tyburn is entirely covered and culverted and forms part of the sewerage system, running beneath South Hampstead to where it discharges into the Thames at Pimlico. According to historic maps[3], the Tyburn flows c.50m to the east of the Site beneath the eastern edge of Fitzjohns Avenue.

There are no surface water features marked on Ordnance Survey mapping (1:25,000 scale) within 1km of the Site. The site is not located within a Flood Zone as defined by the Environment Agency and Nutley Terrace has not been identified as a street at risk of surface water flooding as a result of sewer surcharging within the London Borough of Camden.

3.3 Geology

According to the British Geological Survey (BGS) 1:50,000 scale sheet for the area (Sheet 256, North London. 2006) and the associated geological memoir, The Geology of London (BGS 2004), the Site lies on the Eocene London Clay. The Eocene silts and sands of the London Clay Formation Claygate Beds outcrop c.50m over the London Clay to the north of the Site which are in turn overlain by the sands of the Bagshot Formation on Hampstead Heath.

The Site lies within an area denoted by the BGS as likely to be covered by Quaternary Head deposits. This is disturbed material which has been mobilised from higher ground.

[3] The Lost Rivers of London: a study of their effects upon London and Londoners, and the effects of London and Londoners upon them. N. Barton. 1962.

The London Clay is underlain by the Cretaceous Chalk at a depth of over 100m beneath the Site.

Site specific geological data from the GEA site investigation (October 2011)[1], has established the presence of between 0.2m and 1.20m thickness of made ground beneath the Site locally. London Clay was then proved to a depth of 20m below ground level comprising c.5m of soft to firm weathered silty sandy clay becoming firm to stiff grey fissured clay with lenses of fine grey sand toward the base. This material was determined to be London Clay corresponding to the published geology for the area.

3.4 Hydrogeology

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

The Cretaceous Chalk is classified as a Primary (formerly Major) Aquifer however it is highly confined beneath over 100m of London Clay. The Site lies approximately 300m north of a Source Protection Zone as designated by the Environment Agency. This is for a licensed public water supply abstraction from the Chalk.

Groundwater within the London Clay beneath the Site is considered to be dominated by fissure flow through Unit D of the upper London Clay. Due to the very low permeability of the London Clay, any groundwater flow will be at very low rates. Without evidence to the contrary, groundwater flow beneath the Site is anticipated to follow topographic contours toward the south. The Tyburn stream is considered to rise from springs and seepages from the Bagshot Formation sands on Hampstead Heath and is perched on the London Clay.

Piezometers were installed to 6m in three exploratory holes (BH1 to BH3) during the site investigation in August 2011 and these were monitored and found to be dry. Further monitoring was undertaken and is summarised in Table 3-1 below.

Table 3-1 – Summary of Monitored Groundwater Levels

Borehole	2-4/08/11	16/08/11	13/10/11
BH1	Dry	1.24m bgl	2.45m bgl
BH2	Dry	6.14m bgl	5.46m bgl
BH3	Dry	Dry	5.28m bgl

Note: m bgl – metres below ground level

The groundwater monitoring results reflect the very low permeability of the London Clay strata with groundwater entering the boreholes very slowly after completion. Similar levels have been recorded within boreholes BH2 and BH3 and these are considered to represent true groundwater levels within the London Clay beneath the site with the shallower level within BH1 likely to be perched and not continuous. Winter groundwater levels are anticipated to rise above those recorded in October 2011.

4 Screening

The London Borough of Camden's "Guidance for subterranean development" states that any development proposal which includes a subterranean basement should be screened in order to determine whether there is a requirement for a BIA to be carried out.

4.1 Screening Assessment

Appendix E of the guidance document details six Basement Impact Assessment screening questions, each of which is stated and answered below:

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

  No. The Site is underlain by the London Clay which is designated as Unproductive Strata by the Environment Agency and cannot store and transmit usable amounts of water.

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

  Based on the findings of the site investigation, the basement may extend beneath the winter water table surface (i.e. saturated London Clay). The proposed basement extends to a depth of approximately 4m below existing ground level. The monitoring standpipes installed during the site investigation indicated groundwater within the London Clay to be more than 5m below ground level during October 2011. In winter conditions, the groundwater level can be expected to rise. Refer to Section 3.4.

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

  According to historic maps[4], the Tyburn flows c.50m to the east of the Site beneath the eastern edge of Fiztjohns Avenue. The Tyburn is culverted and acts as a surface water sewer for the area. The London Clay does not support groundwater flows to the Tyburn and is effectively hydraulically isolated from it. The Site is not within a street which has been identified as being at risk of surface water flooding as a result of sewer surcharging within the London Borough of Camden. Refer to Section 3.2 and 3.4.

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

  No. The Site is outside the catchment of Hampstead Heath ponds. Refer to Section 3.

[4] The Lost Rivers of London: a study of their effects upon London and Londoners, and the effects of London and Londoners upon them. N. Barton. 1962.

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

  Yes. The proposed building footprint would increase by c.215m^2 over the current building footprint of 175m^2, an increase of approximately 120%. The areas of hardstanding would increase by 90m^2 to 270m^2, an increase of 50%. The drainage from the Site will be directed to public sewer as the ground conditions would not be suitable for a soakaway.

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

  No. The low permeability nature of the London Clay strata is unsuitable for receiving significant surface water discharge to ground.

- **Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?**

- No. There are no ponds or spring lines present within 100m of the Site.

4.2 Screening Conclusions

The screening exercise has identified the following potential issue which should be assessed:

1. The basement structure may extend into saturated London Clay formation during winter conditions.
2. The Site lies within 100m of the culverted Tyburn stream.
3. An additional c.300m^2 of hard surfaced area will be created in the form of increased building footprint and hard standing areas.

5 Scoping and Site Investigation

Scoping is the activity of defining in further detail the matters to be investigated as part of the impact assessment. Potential impacts should be ascertained for each of the matters of concern identified during the screening process.

The investigation of the potential impacts is undertaken through a site investigation. In this instance, a desk study and site investigation has been undertaken to establish ground conditions for geotechnical assessment purposes. The investigation included the installation of three groundwater monitoring installations to depths of 6m. This assessment relies upon the findings of the desk study and site investigation.

5.1 Potential Impacts

The following potential impacts have been identified:

Potential Impact	**Relevant Site Investigation conclusions**
The basement structure may extend into saturated ground during winter conditions. The groundwater flow regime may be altered by the proposed basement. Changing is flow regime could potentially cause the groundwater level within the zone encompassed by the new flow route to increase or decrease locally. For existing nearby structures the degree of dampness or seepage may potentially increase as a result of changes in groundwater level.	The ground investigation has confirmed the presence of London Clay beneath the Site. It has also identified groundwater levels within the London Clay formation, and that the basement may extend beneath this water table during winter conditions. The London Clay is not considered to be an aquifer and will not store or transmit significant quantities of groundwater.
The site lies within 100m of the Tyburn stream. The development may have the potential to impact on the watercourse by reducing groundwater baseflow. The watercourse could impact on the basement by causing surface and groundwater flooding.	The site investigation did not establish the presence of alluvial deposits beneath the Site which indicated any hydraulic continuity with the Tyburn stream. The London Clay is not able to support groundwater base flows to watercourses.
An additional c.300m^2 of hard surfaced area will be created in the form of increased building footprint and hard standing areas. The sealing of the ground surface by pavements and buildings to rainfall will result in decreased recharge to the underlying ground. In areas underlain by an aquifer, this may impact upon groundwater flow or levels. In areas of non-aquifer or Unproductive Strata (i.e. the London Clay), this may mean changes in the degree of wetness which in turn may affect stability.	The ground investigation has confirmed the presence of London Clay beneath the Site, designated Non Productive Strata or a “non-aquifer”. The lithological logs and site investigation findings indicate that soakaway drainage is not appropriate for the Site.

6 Groundwater Impact Assessment

The screening process identified three potential impacts. The results of the desk study and site investigation have been used below to address these concerns and assess the likelihood of a negative impact occurring. These are:

1. Altering of the groundwater flow regime as a result of the proposed basement development.

It has been established that the basements may extend into saturated London Clay during winter conditions. The potential impact of this is that the groundwater regime may be altered. However, it is apparent from the site investigation that the geological formation into which the basement will be constructed is not an aquifer as defined by the Guidance. The hydrogeological properties of the London Clay are such that groundwater is not present in significant quantities.

Additionally, based on the groundwater levels available, the basements are not likely to extend far (possibly 1m depending on winter water levels) into the saturated clay, which is in excess of 100m thick at this location. When considering the depth of the proposed basements and the relationship with the surrounding areas of private garden, it is considered very unlikely that the structure would cause damming of groundwater to occur.

It is therefore considered highly unlikely that the proposed development will result in significant changes to the groundwater regime beneath the Site.

2. The site is located within 100m of a watercourse.

A review of published data indicates that the Tyburn stream flows approximately 50m to the west of the Site. The Tyburn is culverted and acts as a surface water sewer. It flows over the London Clay and is not in significant hydraulic continuity with it. The Site is not within a street which has been identified as being at risk of surface water flooding as a result of sewer surcharging within the London Borough of Camden.

It is therefore considered highly unlikely that the proposed development will impact upon, or be impacted by, the culverted Tyburn stream.

3. Altering of the recharge rate or changes in the degree of wetness through the creation of additional hard surfaces.

As discussed above, the site investigation has demonstrated that the Site is located on a non-aquifer as defined within the Guidance[2]. Recharge to the London Clay is likely to be negligible. In addition, the properties of the London Clay negate the possibility of significant discharging of surface water drainage to ground.

Due to the nature of the soils beneath the site and the relatively small area of development, groundwater recharge (which is highly restricted due to the low permeability of the London Clay) is unlikely to be significantly affected by the proposed development. Drainage from the development will be directed to public sewer.

7 Review and Decision Making

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

No potential adverse impacts have been identified and it is concluded that the proposed development is unlikely to result in significant changes to the groundwater regime beneath the Site.