H Fraser CONSULTING
CONTAMINATED LAND AND HYDROGEOLOGY

Basement Impact Assessment: Groundwater
154 Iverson Road, NW6 2HH

Prepared for: Ground and Water Limited
15 Bow Street
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Hampshire
GU34 1NY

Date: 23/06/2016
Status: Draft
Reference: 30142R1D1

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NON TECHNICAL SUMMARY

The proposed development is to deepen an existing basement and create lightwells at the front and rear of the property.

Site investigation data confirm the presence of up to 1.6 m of clayey Made Ground overlying London Clay. The London Clay is classified as 'unproductive strata', and has low permeability. Groundwater flow within the London Clay is generally negligible, although some groundwater movement occurs on discrete sand partings or other discontinuities. Geological mapping indicates that there may be Head Deposits in the vicinity.

Groundwater was observed at 1.56 m bgl in a monitoring well at the site. The proposed basement depth is estimated as between 3.0 m bgl and 3.5 m bgl. On the basis of the available data, it is considered likely that the new basement will extend below the water table. It is also probable that at times of high groundwater levels, the existing basement extends below the water table.

There is the potential for groundwater ingress to the excavation, although volumes are likely to be minimal due to the low permeability of the London Clay. Higher flows may be encountered in Made Ground or Head deposits. Measures should be taken to protect the excavation against groundwater ingress during construction. The excavation should be kept dry.

There is also the potential for groundwater ingress to the finished basement development. The basement design should include protection against groundwater ingress to the finished development, and also against permeation of soil moisture. Design should include for seasonal fluctuation in groundwater levels, which may rise close to ground surface.

There is the potential for groundwater to back-up around the proposed basement structure. This has the potential to affect the basements of neighbouring properties. Engineering design of the subsurface structure should provide groundwater drainage to reduce backing up of groundwater around the structure, and to minimise the potential for groundwater flooding or impact on neighbouring properties. There are measures widely implemented in such situations and if correctly designed and constructed there should not be any significant groundwater back up around the new basement.

Neighbours' properties should be surveyed to establish whether there are basements or cellars. The condition of the basements or cellars, particularly with regard to damp and water ingress, should be noted. Ongoing groundwater level monitoring should be undertaken to assess the range in groundwater levels and provide a baseline against which to compare future groundwater levels. It is recommended that groundwater levels continue to be monitored before, during and after construction of the basement.

It is not anticipated that the development will significantly alter the proportion of hardstanding at the site, and effects on infiltration of rainfall to ground are therefore anticipated to be small.

Detailed drainage designs are not known at this stage, however it is not anticipated that significant volumes of water will be discharged to ground due to the low permeability of the Made Ground materials and London Clay. Changes to surfacing and drainage that might affect recharge to groundwater should be appropriately designed so that groundwater levels are not adversely affected, and to ensure that groundwater flooding is not caused. Design of drainage systems should consider the requirements of sustainable urban drainage.

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1 INTRODUCTION

Ground and Water Limited has instructed H Fraser Consulting Ltd (HFCL) to provide the hydrogeological aspects of a Basement Impact Assessment at the following property:

154 Iverson Road, NW6 2HH .

The site is in the London Borough of Camden.

1.1 Objective

The objective of this report is to provide the hydrogeological aspects of a Basement Impact Assessment to support a planning application for construction of a basement at 154 Iverson Road, NW6 2HH .

1.2 Scope of works

The following works have been undertaken:

- Desk study
- Screening assessment with regards to groundwater
- Scoping assessment to identify potential impacts
- Impact assessment with regard to groundwater attributes
- Reporting

The work has been undertaken in accordance with the requirements of London Borough of Camden's Planning Guidance CPG4 'Basements and Lightwells' (referred to as CPG4) and Arup's 'Geological Hydrogeological and Hydrological Study, Guidance for Subterranean Development' (Arup, 2012, referred to throughout this report as the GHHS).

This assessment is limited to an assessment of the hydrogeological aspects of the proposed development and does not purport to make any comment on surface water flooding, hydrology, contamination or pollution, engineering, land stability, design or construction issues.

The work has been undertaken by Hannah Fraser, Director of HFCL, who is a Chartered Geologist with 19 years' experience as a hydrogeologist and consultant.

2 BACKGROUND INFORMATION

Background information has been derived from a Groundsure report for a nearby site, approximately 15 m east (Appendix A); geological information has been derived from on-line BGS sources (Geology of Britain Viewer, GeoIndex, Lexicon); on-line mapping and aerial photography have been derived from Streetmap and GoogleEarth. Table 2.1 presents relevant background information for the site. The site location is shown in Figure 2.1.

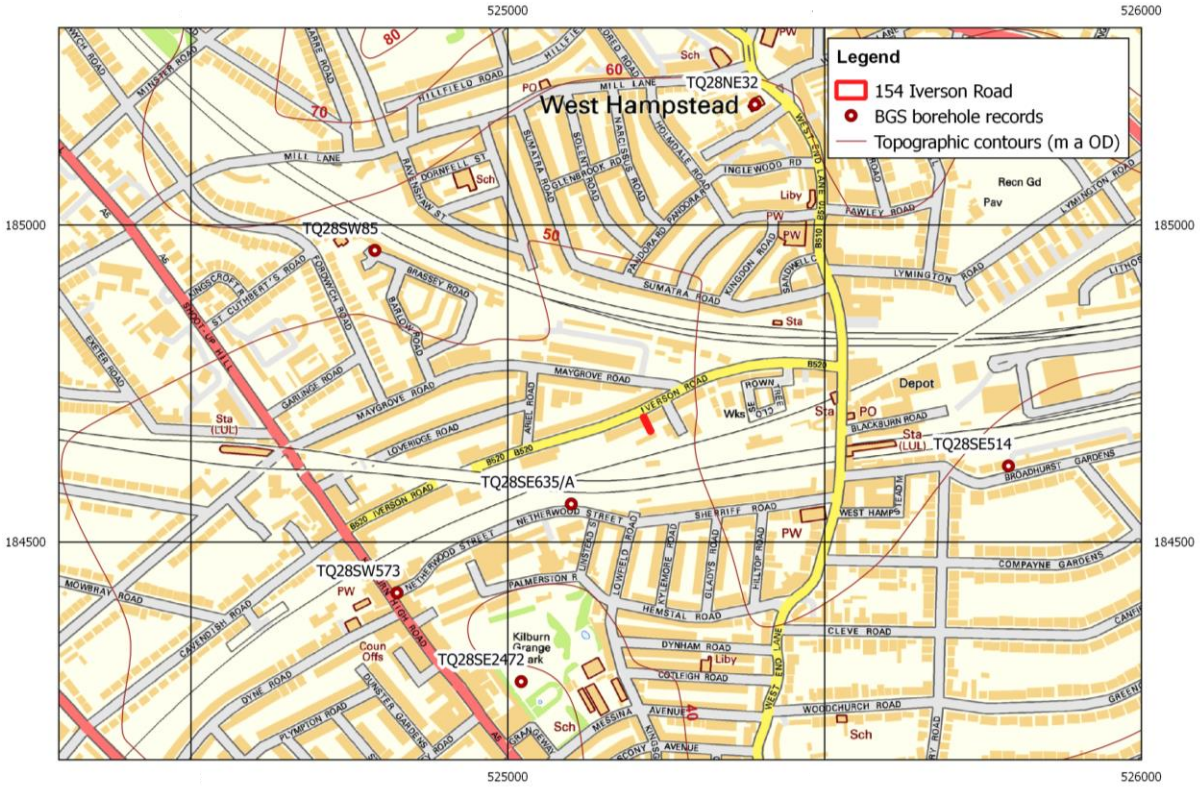

Figure 2.1 Site location

Contains Ordnance Survey data © Crown copyright and database right 2016

Table 2.1 Background information

Address	154 Iverson Road, NW6 2HH
NGR	525220 184695
Description	The existing property comprises a three storey brick built terraced house with a shallow basement. Flat 1 comprises the ground floor and basement levels, and Flat 2 comprises the first and second floors. The basement has a bay structure at the front, to support the bay windows in the floors above. There is a small front garden and a larger back garden. The back garden is predominantly gravel, with shrubs. Plans and sections are shown in Appendix B. Ordnance survey topographic data[1] show the site at around the 47 m OD contour, with ground elevations falling from the north and east to the south and west, as shown in Figure 2.1.

[1] www.streetmap.co.uk

Proposed development	The proposed development is to deepen the basement to create useable living space, and develop lightwells to the front and rear. Windows will be installed at basement level at the front. Site plans are shown in Appendix B.
Planning history at neighbouring properties	A search of the on-line planning records on www.camden.gov.uk for records held for neighbouring properties revealed the following: Planning permission was granted for conversion of 152 Iverson Road into 3 self-contained units in 1988. There is no mention of a basement and no drawings are available on the on-line portal. A planning application for extension of 156a Iverson Road in 2013 indicates that there is a basement at 156a, with 2 bedrooms and a bathroom.
Geology	Geological mapping[2] shows the area to be underlain by London Clay. The London Clay is extensive across the area, with the nearest superficial deposits mapped approximately 3.3 km southeast. The geological boundary with the Claygate Member, which overlies the London Clay, lies approximately 1 km northeast, forming the higher ground of Hampstead and Hampstead Heath. The London Clay mainly comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand, which commonly increase towards the base and towards the top of the formation. At the base, and at some other levels, thin beds of black rounded flint gravel occur in places. Glauconite is present in some of the sands and in some clay beds, and white mica occurs at some levels.[3] BGS 1:50, 000 Sheet No 256 (North London) indicates that the local area is likely to be covered with Quaternary Head deposits. These are poorly sorted and poorly stratified deposits formed mostly by solifluction and/or hillwash and soil creep, and may comprise gravel, sand and clay depending on the upslope source and distance from source.[4] Table 2.2 presents geological data from selected BGS borehole records[5], and Figure 2.1 shows the location of the boreholes. The local borehole records confirm the presence of Made Ground overlying London Clay, with some possible Head Deposits. A site investigation was undertaken by Ground and Water Limited on 25 April 2016. Two window sampler holes were drilled to 5 m and one trial pit excavated to 0.8 m. The investigation confirmed up to 1.6 m of clayey Made Ground overlying London Clay at the property. Site investigation data are provided in Table 2.3.
Aquifer status	The London Clay is classified by the Environment Agency as unproductive strata (rock layers with low permeability and negligible significance for water

[2] http://mapapps.bgs.ac.uk/geologyofbritain/home.html
[3] http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=LC
[4] http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=HEAD
[5] http://mapapps2.bgs.ac.uk/geoindex/home.html

	supply or river base flow). The London Clay holds water but does not transmit water readily due to its low permeability. Head Deposits, if present are likely to be fairly clayey but more heterogeneous than the London Clay, with the potential to transmit groundwater on more permeable zones. The site is not within a source protection zone of a public water supply. Groundwater was not recorded in any of the BGS borehole logs presented in Table 2.2. Groundwater was not recorded during drilling at the site. Due to the very low permeability of the London Clay, it can take several days or weeks for a water table elevation to be established within a water monitoring borehole. A groundwater level of 1.56 m bgl was observed in a borehole on a monitoring visit on 06/06/2016.
Watercourses	There are no detailed river network entries within c.500 m of the site, and no surface water features within c.250 m of the site. There are no surface water abstraction licences within c.2000 m of the site.[6] The site lies close to the historic location of a minor headwater of the River Kilburn. The River Kilburn is understood to have been diverted into combined sewers in the late 19th century. There are no indications that there is a water feature present on current mapping or aerial photography.
Spring lines	There are no springs shown on OS mapping, and no known local geological features that might give rise to springs.
Wells	The nearest groundwater abstraction licence is over 1570 m east of the site. There are no potable water abstractions within c.2000 m of the site. There are no source protection zones within c.500 m of the site.[7] The BGS well records indicate that there is a well approximately 540 m southwest of the site, on Kilburn High Street, abstracting from the Thanet Sands below the London Clay.
Groundwater flooding	There are no British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site. The area is not considered prone to groundwater flooding, based on rock type.[8]

[6] Groundsure report GS-2887114
[7] Groundsure report GS-2887114
[8] Groundsure report GS-2887114

Table 2.2 BGS borehole records

Ref	Name	Eastings	Northings	Description
TQ28SW85	Mapesbury Rd Willesden	524790	184960	Concrete to 0.23 m, stiff brown clay to 6.71 m, hard blue clay to 15.24 m. No movement of groundwater discovered during drilling operations.
TQ28SW573	320 Kilburn High Road 1	524825	184420	Made Ground (brick rubble and concrete) to 0.92 m, stiff brown mottled clay to 8.54 m, hard blue clay to 18.29 m. Water struck: none.
TQ28SE635/A	Netherwood St. Camden 1	525100	184560	Ground level at 44.97 m a OD. Made ground consisting of brick fragments, pieces of concrete, gravel and sandy silt to 5.3 m, stiff brown mottled blue in places fissured silty CLAY with some traces of crystals to 11.9 m, stiff blue/grey fissured silty CLAY to 12.2 m. No groundwater encountered.
TQ28NE32	Fire Station West End Lane W.Hampstead	525390	185190	Ground level at 60.15 m a OD. Vegetable mould to 0.33 m, vegetable mould mixed with stone gravel to 0.66 m, hard yellow clay to 1.27 m. No groundwater data.
TQ28SE514	Broadhurst Gardens BH1	525790	184620	Made Ground to 0.61 m; London Clay soft to firm red brown mottled clay changing to brown and grey mottled clay to 3.9 m. A few gypsum crystals at 3.9 m. Borehole dry
TQ28SE2472	Kilburn Grange Park	525021	184280	Ground level at 60.64 m a OD. Topsoil and grass to 0.1 m, possible Made Ground (firm brown silty clay with 1 mm pockets of yellow brown clay, occasional 5 - 6 mm brick fragments and some fine to medium flint gravel) to 0.9 m, possible made ground (stiff yellow brown silty clay with rare root traces infilled with topsoil and rare 1 mm - 2 mm pockets of topsoil) to 1 m, stiff yellow brown mottled greyish brown clay to 6 m, stiff fissured brown clay with some pockets and lenses of yellow brown silt to 9.8 m, stiff to very stiff fissured grey brown clay to 26 m. Further detailed records of clay to 80.45 m, sand to 96 m, chalk to 143.6 m. No groundwater data.

Geological data from site investigations undertaken by Ground and Water Limited in April 2016 are presented in Table 2.3.

Table 2.3 Site investigation data

Strata	Depth encountered (m bgl)	Thickness (m)
CONCRETE (WS1)	GL	0.06
MADE GROUND (WS1, WS2 and TP1): Mottled light to mid brown/grey, light to dark brown gravelly silty sandy CLAY. Sand is fine grained. Gravel is rare to occasional sub-angular fine grained flint, brick and lignite.	GL – 0.06	0.6-1.54
LONDON CLAY FORMATION (WS1 and WS2): Light brown to mid-brown with grey mottling slightly sandy silty CLAY. Selenite crystals noted from 2.5 m bgl.	0.6 – 1.6	3.4 – 4.4

No groundwater was observed during drilling. A groundwater level of 1.56 m bgl was measured on a groundwater monitoring visit on 6 June 2016.

3 SCREENING

A screening assessment has been undertaken in accordance with the methodology set out in Section 6.2 and Appendix E2 of the GHHS (Arup, 2012). The results are presented in Table 3.1.

Table 3.1 Screening assessment

Ref	Question	Answer (yes/no/unknown)	Action
Q1a	Is the site located directly above an aquifer?	No	No further action
Q1b	Will the proposed basement extend beneath the water table surface?	Yes	Take forward to scoping stage
Q2	Is the site within 100m of a watercourse, well (used/ disused) or potential spring line?	No	No further action
Q3	Is the site within the catchment of the pond chains on Hampstead Heath?	No	No further action
Q4	Will the proposed basement development result in a change in the proportion of hard surface/paved areas?	Unknown	Take forward to scoping stage
Q5	As part of the 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)	Unknown	Take forward to scoping stage
Q6	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	No further action

4 SCOPING

This section of the report summarises the pertinent information as a Conceptual Model, and then describes the matters of concern that need to be considered in the Impact Assessment.

4.1 Conceptual model

The proposed development is to deepen an existing basement to create useable living space, and create lightwells at the front and rear of the property.

Local topography falls to the south and southwest, and the site lies at an elevation of approximately 47 m OD. The depth of the basement excavation is assumed to be between 3.0 m bgl and 3.5 m bgl (Ground and Water, 2016). Planning records indicate that there is a basement at 156 Iverson Road; it is not known whether there is a basement at 152 Iverson Road. It is noted that the shallow basements seem to be an original feature of the buildings, and it is probable that there is a shallow basement at No 152.

The underlying geology comprises the London Clay. Site investigation data from the rear of the property confirm the presence of up to 1.6 m of clayey Made Ground overlying London Clay. The London Clay is classified as 'unproductive strata', and has low permeability. Groundwater flow within the London Clay is generally negligible, although some groundwater movement occurs on discrete sand partings or other discontinuities. Groundwater flow directions are likely to be in the direction of topography, to the south and west, but may vary due to local subsurface features. Geological mapping indicates that there may be Head Deposits in the vicinity.

Groundwater was observed at 1.56 m bgl in a monitoring well at the site. On the basis of the available data, it is considered likely that the new basement will extend below the water table. It is also probable that the existing basement extends below the water table, particularly when the water table is high.

The drainage arrangements for the site are not known. The development is not anticipated to significantly alter the proportion of hardstanding at the site. Recharge (rainfall infiltration to the water table) to the London Clay is not anticipated to be significant under the current site layout, due to the low permeability of the Made Ground materials and the underlying London Clay, and it is not anticipated that there will be significant changes to recharge under the new development.

4.2 Matters of concern

Five attributes are considered as potential matters of concern, as discussed below.

1. Groundwater level – groundwater was observed at 1.56 m bgl at the site. This is taken forward for further assessment.
2. Range of seasonal fluctuation in groundwater levels – the range of fluctuation in groundwater levels is not known. This is taken forward for further assessment.
3. Spring/stream hydrographs – there is no evidence that local streams or springs are likely to be affected. This is not considered further.
4. Soil moisture – there is the potential for soil moisture content to affect the development, and this is carried forward for further assessment.
5. Water quality – there is no evidence that the development will affect water quality, provided good practice is followed with regard to pollution management. This is not considered further.

5 IMPACT ASSESSMENT

The impact assessment has been undertaken by considering groundwater attributes, how these are likely to change under the proposed development and the consequence of any predicted changes. The assessment is qualitative at this stage. The results are presented in Table 5.1.

Table 5.1 Impact assessment

Groundwater Attribute	Predicted Change	Consequence of change and mitigation
Groundwater levels	Groundwater has been observed on site at 1.56 m bgl, indicating that the development may extend below the water table.	Measures should be taken to protect the excavation against groundwater ingress during construction. The excavation should be kept dry.
	There is the potential for groundwater ingress to the excavation, although volumes are likely to be minimal due to the low permeability of the London Clay. Higher flows may be encountered in Made Ground or Head deposits.	The basement design should include protection against groundwater ingress to the finished development.
	There is also the potential for groundwater ingress to the finished basement development.	Engineering design of the subsurface structure should provide groundwater drainage to reduce backing up of groundwater around the structure, and to minimise the potential for groundwater flooding or impact on neighbouring properties. There are measures widely implemented in such situations and if correctly designed and constructed there should not be any significant groundwater back up around the new basement.
	There is the potential for groundwater to back-up around the proposed basement structure. This has the potential to affect neighbouring properties if they have basements.	Neighbours' properties should be surveyed to establish whether there are basements or cellars. The condition of the basements or cellars, particularly with regard to damp and water ingress, should be noted. Ongoing groundwater level monitoring should be undertaken to assess the range in groundwater levels and provide a baseline against which to compare future groundwater levels.
	It is not anticipated that the development will significantly alter the proportion of hardstanding at the site, and effects on infiltration of rainfall to ground are therefore anticipated to be small.	Changes to surfacing and drainage that might affect recharge to groundwater should be appropriately designed so that groundwater levels are not adversely affected, and to ensure that groundwater flooding is not caused. Design of drainage systems should consider the requirements of sustainable urban drainage.
	Detailed drainage designs are not known at this stage, however it is not anticipated that significant volumes of water will be discharged to ground due to the low permeability of the Made Ground materials and London Clay.	

Groundwater Attribute	Predicted Change	Consequence of change and mitigation
Range of seasonal fluctuation in groundwater levels	The range of seasonal groundwater fluctuation is not known. The groundwater table has been measured at a relatively shallow depth, and seasonal fluctuations in groundwater combined with backing up of groundwater levels around the basement structure have the potential to cause daylighting of groundwater at the surface. The likelihood of this occurring is considered to be relatively low.	Structural design should allow for seasonal fluctuations in groundwater elevations, which may rise close to ground level. The basement design should include groundwater drainage systems to prevent groundwater backing up around the development, and thereby protect neighbouring properties from impact. There are measures widely implemented in such situations and if correctly designed and constructed there should not be any significant groundwater back up around the new basement. It is recommended that groundwater levels continue to be monitored before, during and after construction of the basement.
Soil moisture	Soil moisture has the potential to permeate the basement structure.	The proposed basement structure should be adequately protected against permeation of soil moisture.

6 CONCLUSIONS

The proposed development is to deepen an existing basement and create lightwells at the front and rear of the property.

Site investigation data confirm the presence of up to 1.6 m of clayey Made Ground overlying London Clay. The London Clay is classified as 'unproductive strata', and has low permeability. Groundwater flow within the London Clay is generally negligible, although some groundwater movement occurs on discrete sand partings or other discontinuities. Groundwater flow directions are likely to be in the direction of topography, to the south and west, but may vary due to local subsurface features. Geological mapping indicates that there may be Head Deposits in the vicinity.

Groundwater was observed at 1.56 m bgl in a monitoring well at the site. The proposed basement depth is estimated as between 3.0 m bgl and 3.5 m bgl. On the basis of the available data, it is considered likely that the new basement will extend below the water table. It is also probable that at times of high groundwater levels, the existing basement extends below the water table.

There is the potential for groundwater ingress to the excavation, although volumes are likely to be minimal due to the low permeability of the London Clay. Higher flows may be encountered in Made Ground or Head deposits. Measures should be taken to protect the excavation against groundwater ingress during construction. The excavation should be kept dry.

There is also the potential for groundwater ingress to the finished basement development. The basement design should include protection against groundwater ingress to the finished development, and also against permeation of soil moisture. Design should include for seasonal fluctuation in groundwater levels, which may rise close to ground surface.

There is the potential for groundwater to back-up around the proposed basement structure. This has the potential to affect the basements of neighbouring properties. Engineering design of the subsurface structure should provide groundwater drainage to reduce backing up of groundwater around the structure, and to minimise the potential for groundwater flooding or impact on neighbouring properties. There are measures widely implemented in such situations and if correctly designed and constructed there should not be any significant groundwater back up around the new basement.

Neighbours' properties should be surveyed to establish whether there are basements or cellars. The condition of the basements or cellars, particularly with regard to damp and water ingress, should be noted. Ongoing groundwater level monitoring should be undertaken to assess the range in groundwater levels and provide a baseline against which to compare future groundwater levels. It is recommended that groundwater levels continue to be monitored before, during and after construction of the basement.

It is not anticipated that the development will significantly alter the proportion of hardstanding at the site, and effects on infiltration of rainfall to ground are therefore anticipated to be small.

Detailed drainage designs are not known at this stage, however it is not anticipated that significant volumes of water will be discharged to ground due to the low permeability of the Made Ground materials and London Clay. Changes to surfacing and drainage that might affect recharge to groundwater should be appropriately designed so that groundwater levels are not adversely affected, and to ensure that groundwater flooding is not caused. Design of drainage systems should consider the requirements of sustainable urban drainage.

7 REFERENCES

British Geological Survey, 2006. North London, England and Wales Sheet 256. Bedrock and superficial deposits.1:50,000.

Arup, 2012. Geological Hydrogeological and Hydrological Study, Guidance for subterranean development

Ground and Water, 2016. Preliminary report. Ground investigation report for the site at 154 Iverson Road, West Hampstead, London NW6 2HH. Ref GWPR1660.

London Borough of Camden CPG4 'Basements and Lightwells'

APPENDIX A

Groundsure Report

APPENDIX B

Site Plans