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40 FROGNAL LANE
CAMDEN
LONDON NW3 6PP

Hydrological Assessment

Client
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Report No. 3611

21 September 2011

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40 FROGNAL LANE
CAMDEN
LONDON NW3 6PP

Hydrological Assessment

1
Introduction

The purpose of this assessment is to consider the effects of a proposed underground swimming pool construction at the residential property of 40 Frognal Lane, Camden on the local groundwater régime. For this assessment, a representative of AP Geotechnics Limited visited the property on 14 June 2011.

2
Planning Policy Context

Where proposed basement developments extend beyond the footprint of the original building, Planning Guidance issued by the London Borough of Camden and Development Policies contained within the Camden Local Development Framework require the proposed development to do no harm to the built and natural environment or local amenity.

Consideration must be given to any history of flooding on site or in the vicinity, the presence of underground watercourses and surface water bodies. The proposed development should mitigate the any effects of ground or surface water flooding and include drainage systems that

do not impact neighbouring property or the water environment by changing the groundwater régime.

3
Site Description

The property lies on the south side of Frognal Lane at the National Grid reference [5]260 [1]855 with a general layout as illustrated at Figure 1 of Appendix A.

Frognal Lane is relatively flat in the vicinity of the existing property and to the east but falls at increasing gradient west of the property, reaching a slope of approximately 7° (1:8) at the western boundary.

The property is situated on the undulating land to the north of the River Thames. A tributary of the Westbourne rises about 200 m south south west of the site according to Barton[1]. This location is some 15 m lower than the site, the stream now being entirely culverted.

The general arrangement of the site is shown at Figure 2. The house is an established large detached residence on two storeys above a lower ground floor. Overall plan dimensions are about 20m by 10m. It is aligned on approximately level ground north north west to south south east and surrounded by similar residential property. Access is provided via a drive from Frognal Lane which leads to a detached garage on the Frognal Lane frontage and thence to the north end of the house. A patio and landscaped garden adjoin the west side of the house. The garden is laid to lawn with ornamental planting, a pergola and fountain; and is about half a

[1] *Lost Rivers of London, Nicholas Barton, Historical Publications Ltd., 1992*

storey height below the ground floor level. The western edge of the site is a little lower than the garden level and was somewhat overgrown at the time of inspection.

The proposed development is to construct an underground swimming pool beneath the garden as shown at Figures 3 & 4.

4
Ground Conditions

The British Geological Survey indicate the property is underlain by the Claygate Member, the upper part of the London Clay Formation, with the younger Bagshot Formation being present on the higher ground to the north and north east, and the London Clay itself at outcrop to the south east as shown at Figure 5.

Ground conditions at the property have been investigated by ourselves and two boreholes were drilled in July 2011. The lithology revealed by the investigation is summarised in Table 1.

Table 1: Lithology of the site

Stratum	Depth to base, m bgl	Description
Made Ground	0.9 to 1.3	Topsoil over brick rubble and clay with brick fragments
Head deposits	1.7 (BH 1 only)	Silty CLAY and silty gravelly CLAY
Claygate Member	5.3 to 5.6	Firm sandy CLAY with sand lenses
London Clay Formation	Weathered to 7.8 to 8.6	Stiff fissured brown CLAY
	Fresh to beyond base of boreholes at 18.0	Stiff becoming very stiff with depth fissured grey CLAY

Groundwater entry was noted as moderate inflows during drilling at 1.6 and 5.0 m depth in BH 1 and at 5.3 m in BH 2, rising 0.2 m during the 20 minute observational pause in drilling.

A standpipe has been installed into BH 1 and recorded water at 2.86 m depth on 20 September 2011.

A rising head test has been conducted in BH 1 and the effective permeability of the soils assessed by Hvorslev's Time Lag Method[2] as recommended in BS 5930[3]. The results are appended and indicate a coefficient of permeability of 4.18×10^{-7} m/s. This value is within the expected range for clay/silt laminae and unfissured clay and indicates that soil has a very low permeability.

Ponded water was not observed during our site visit although there had been little, if any, recent rainfall in the area.

5
Hydrogeology

The Environment Agency classify the Claygate Member as a Secondary A aquifer. These have permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers.

The underlying units of the London Clay Formation are classified as a non-aquifer, which is a formation that is generally regarded as containing insignificant quantities of mobile groundwater. However, groundwater flow through such formations, although imperceptible, does take place and needs to be considered in assessing the affect of any development on the hydrogeological régime.

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[2] *Hvorslev, M. J. , Time Lag and soil permeability in ground-water observations, Corps of Engineers, U. S. Army, Vicksburg, Mississippi, April 1951*

[3] *BS 5930: Code of practice of Site Investigations. British Standards Institute, London, 1999.*

The soil beneath the site will have a low leaching potential and thus little ability to attenuate diffuse source pollutants and in which non - absorbed diffuse source pollutants and liquid discharges do not have the potential to move rapidly to underlying strata or to shallow groundwater.

The site does not lie within a groundwater Source Protection Zone. The nearest such Zone is an Outer Protection Zone shown at Figure 6 whose nearest approach to the site is 1.25 km to the south east.

6
Hydrology

Historically, it is expected that surface water drainage was predominantly by downslope run off towards the valley of the former tributary of the Westbourne. Given the predominantly clayey and low permeability nature of the near-surface soils, it is expected that there is a very limited surface water infiltration potential, and ground water 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.

7
Potential effects of proposed development

Water levels in the immediate vicinity of the property have been recorded above the base level of proposed swimming pool and, as such, construction may result in some changes to the groundwater régime around the property. However, given the very low permeability of the

near - surface soils, it is considered that any changes will be very limited and confined to the immediate vicinity of the property. This can be illustrated by considered the theoretical steady state radius of influence of any groundwater level changes, either drawdown or raised. The radius of influence (R_0) can be estimated using an empirical relationship derived by Sichardt[4]. For linear features, $R_0 = C(H - h) \sqrt{k}$ where:-

C is an empirical correlation factor taken as 3000
H - h is the drawdown or rise in groundwater level, assumed $\geq$ 2 m

Thus the Radius of Influence, $R_o = 3000 \times 2 \times 4.18 \times 10^{-7} = 2.5$ m

This indicates that, even in extreme conditions, any changes to the groundwater table caused by the new structure will be very localised indeed and within the confines of the subject site. On this basis, it is considered that the proposed swimming pool can be constructed without a detrimental effect to the groundwater régime and adjacent properties subject to the mitigation measures outlined below. It is common, in such circumstances, to attach a condition to the Planning Permission to ensure that these measures are designed in detail and implemented to the full satisfaction of the local Planning Authority.

To mitigate any potential effects of the proposed construction on the groundwater régime it is recommended that a geocomposite studded drainage membrane is incorporated in the vertical face of the perimeter walls to the pool. A maintainable drainage channel should be installed to collect water and divert it to a sump pump to remove the collected water for discharge to the sewerage network. The membrane should be placed and connected in accordance with the manufacturer's instructions.

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[4] *Report C515: Groundwater Control: design and practice. Construction Industry Research and Information Association, London 2007*

In addition, it is recommended that the basement is designed in accordance with the requirements of BS 8102[5] to achieve and maintain the required conditions within the proposed basement.

A W Parr
AP GEOTECHNICS LTD.
21 September 2011

[5] *BS 8102: Code of practice for protection of below ground structures against water from the ground, British Standards Institute, London 2009*

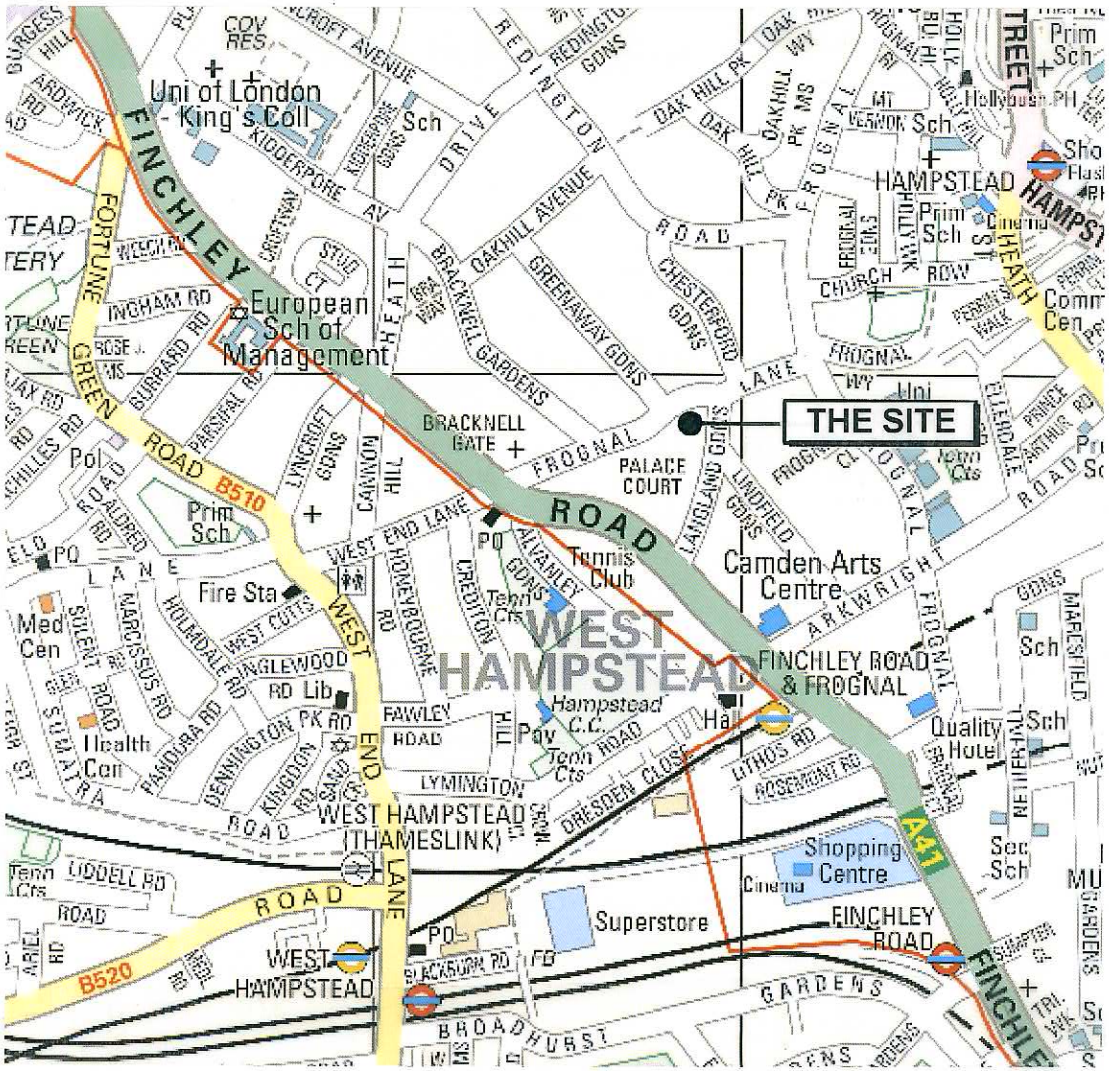
APPENDICES

A Figures

B In Situ Permeability Test

APPENDIX A

FIGURES

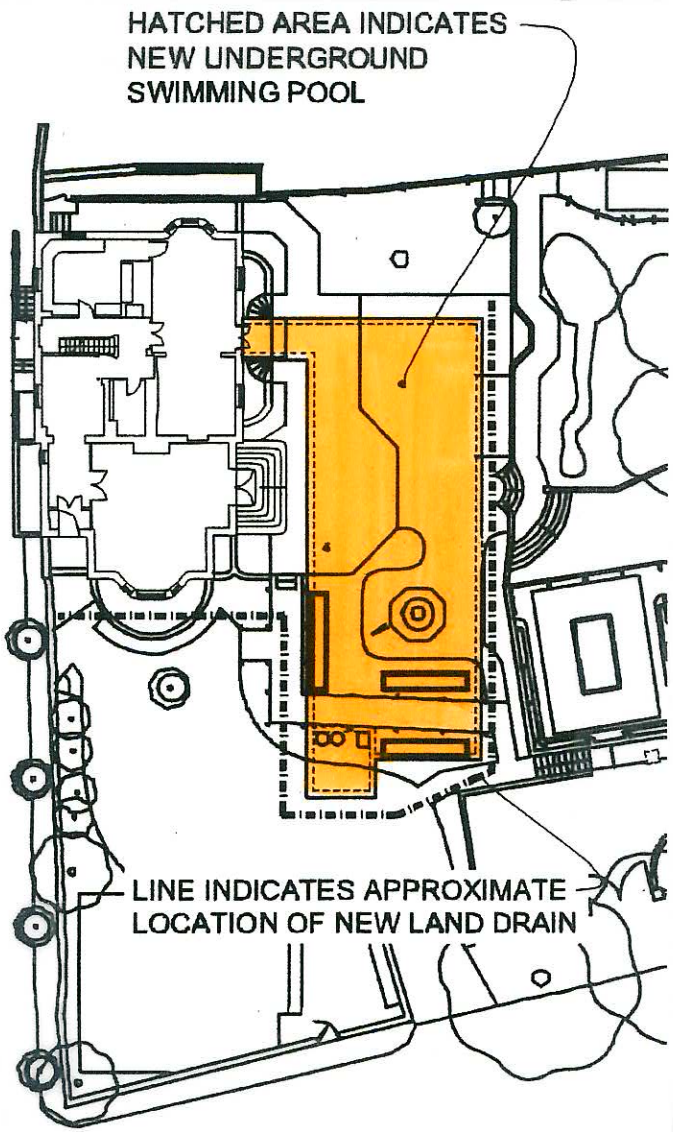


40 Frognal Lane, Camden

Site location

Scale unknown

Figure 1



40 Frognal Lane, Camden

Plan showing general arrangement of the site

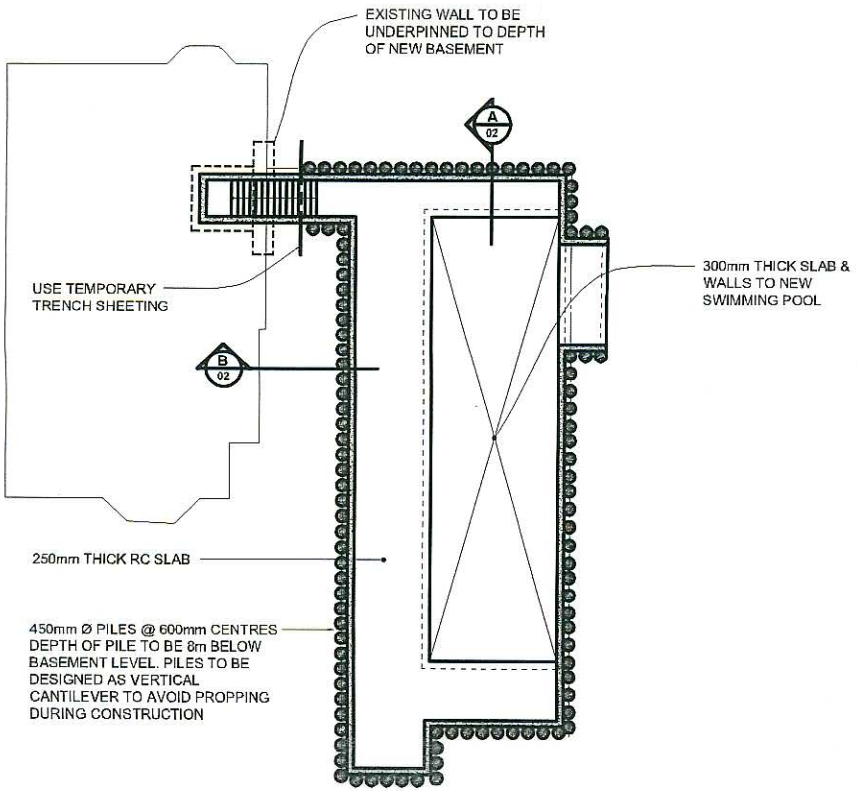
Scale unknown

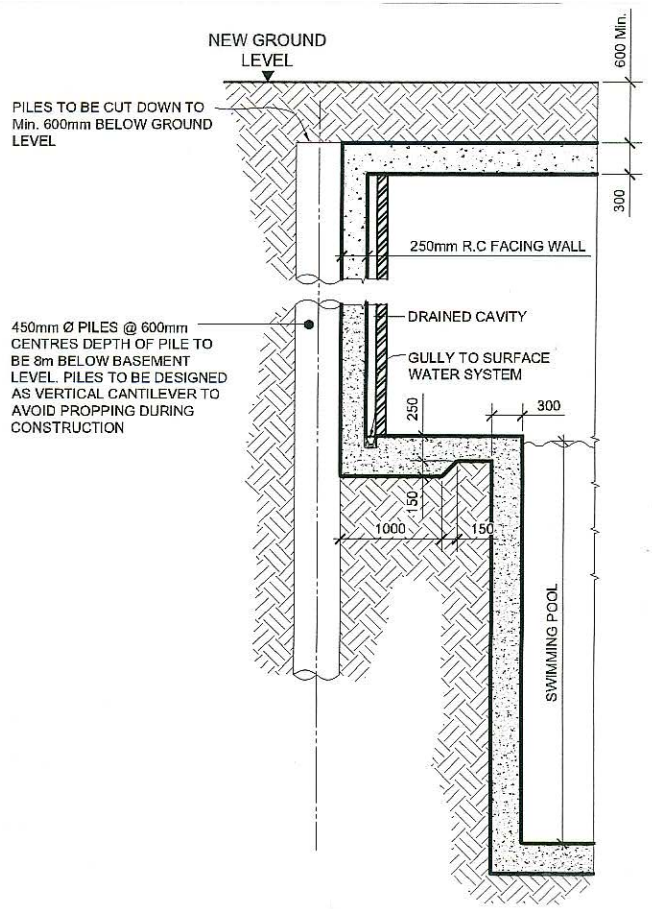
Figure 2

40 Frognal Lane, Camden

Development proposals
Plan and Section AA

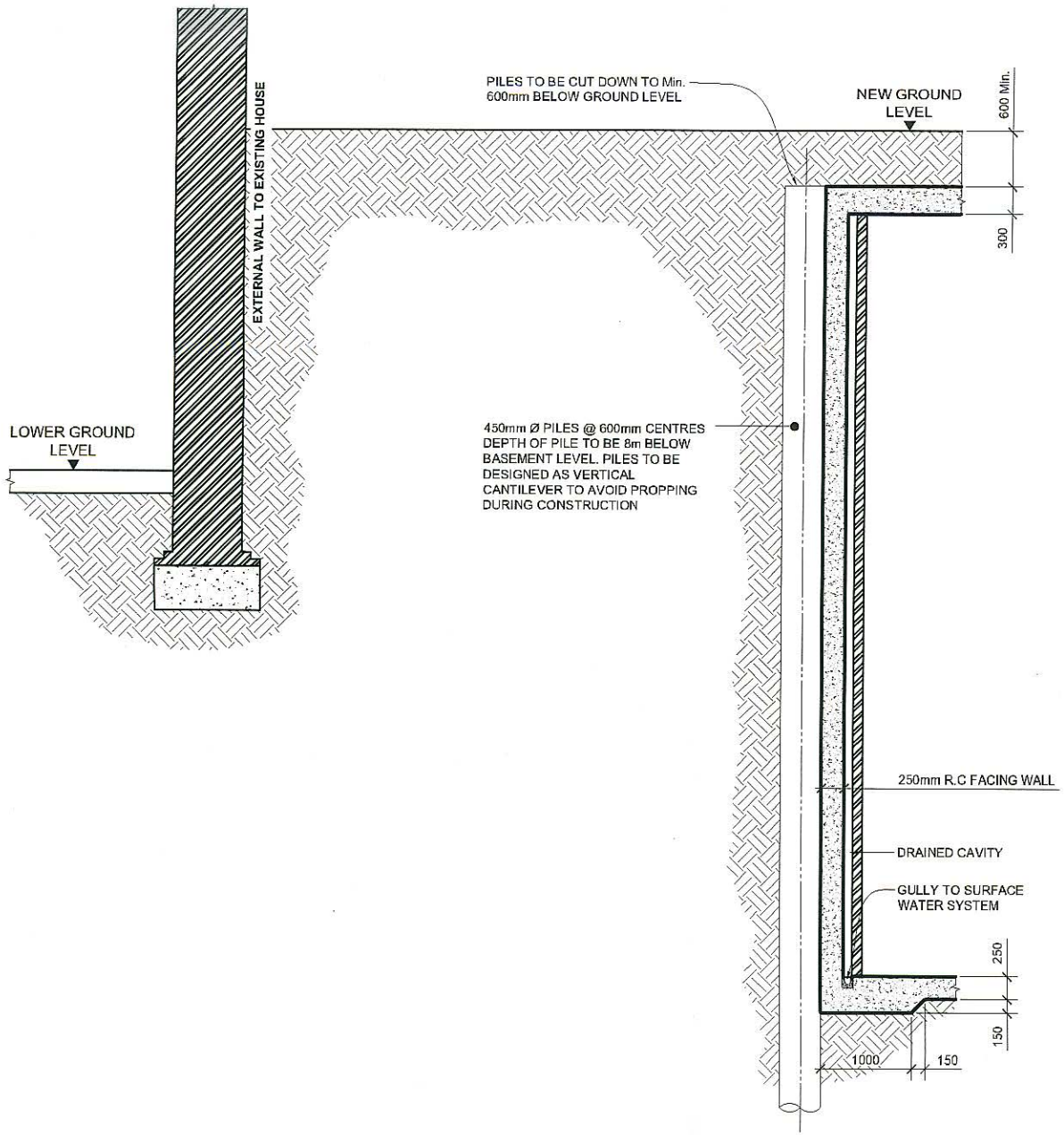
Scale unknown





SECTION A-A

Figure 3

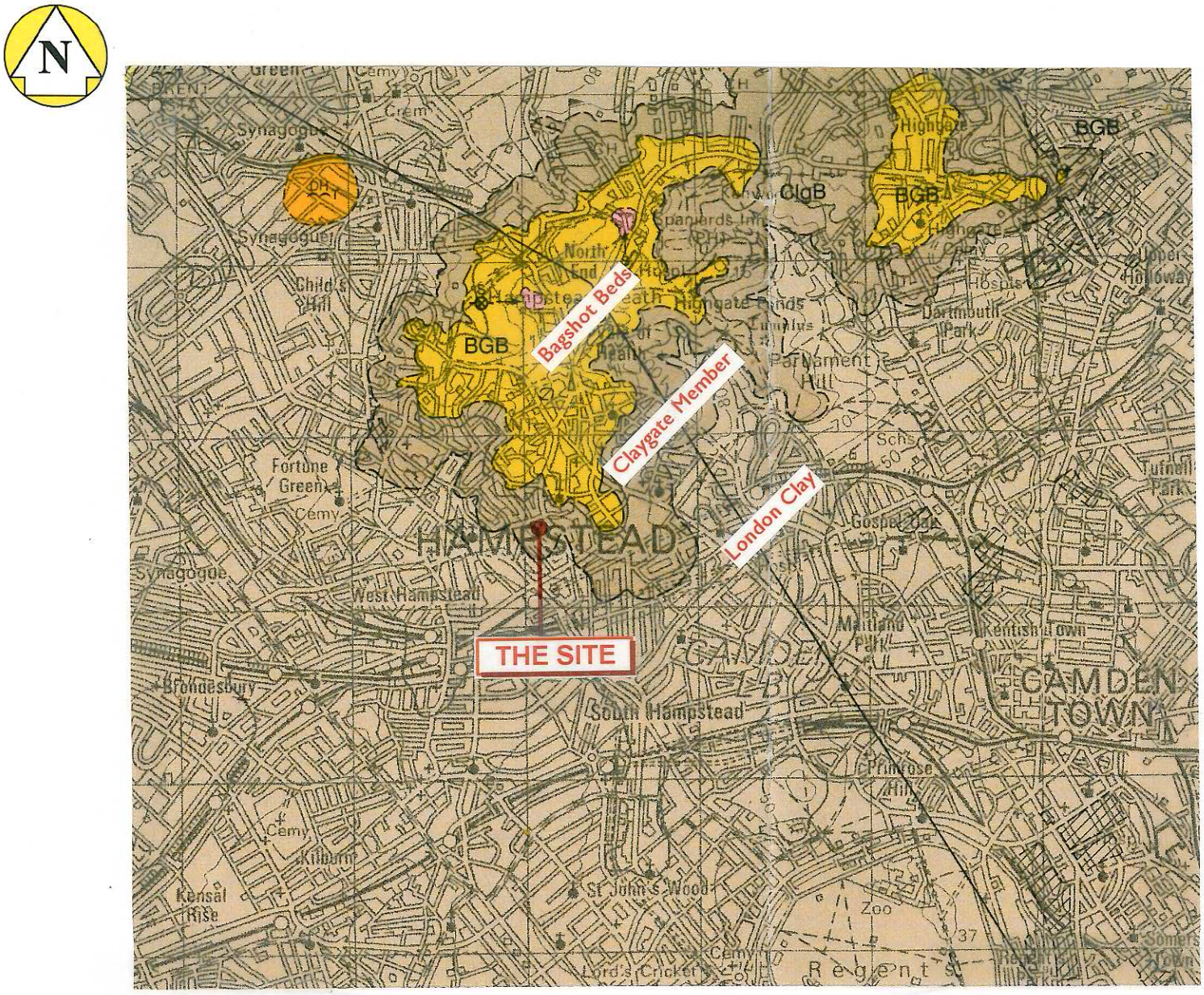


40 Frognal Lane, Camden

Development proposals
Section BB

Scale unknown

Figure 4



40 Frognal Lane, Camden

Geology

Scale unknown

Figure 5

40 Frognal Lane, Camden

Groundwater
Source Protection Zones

Scale unknown

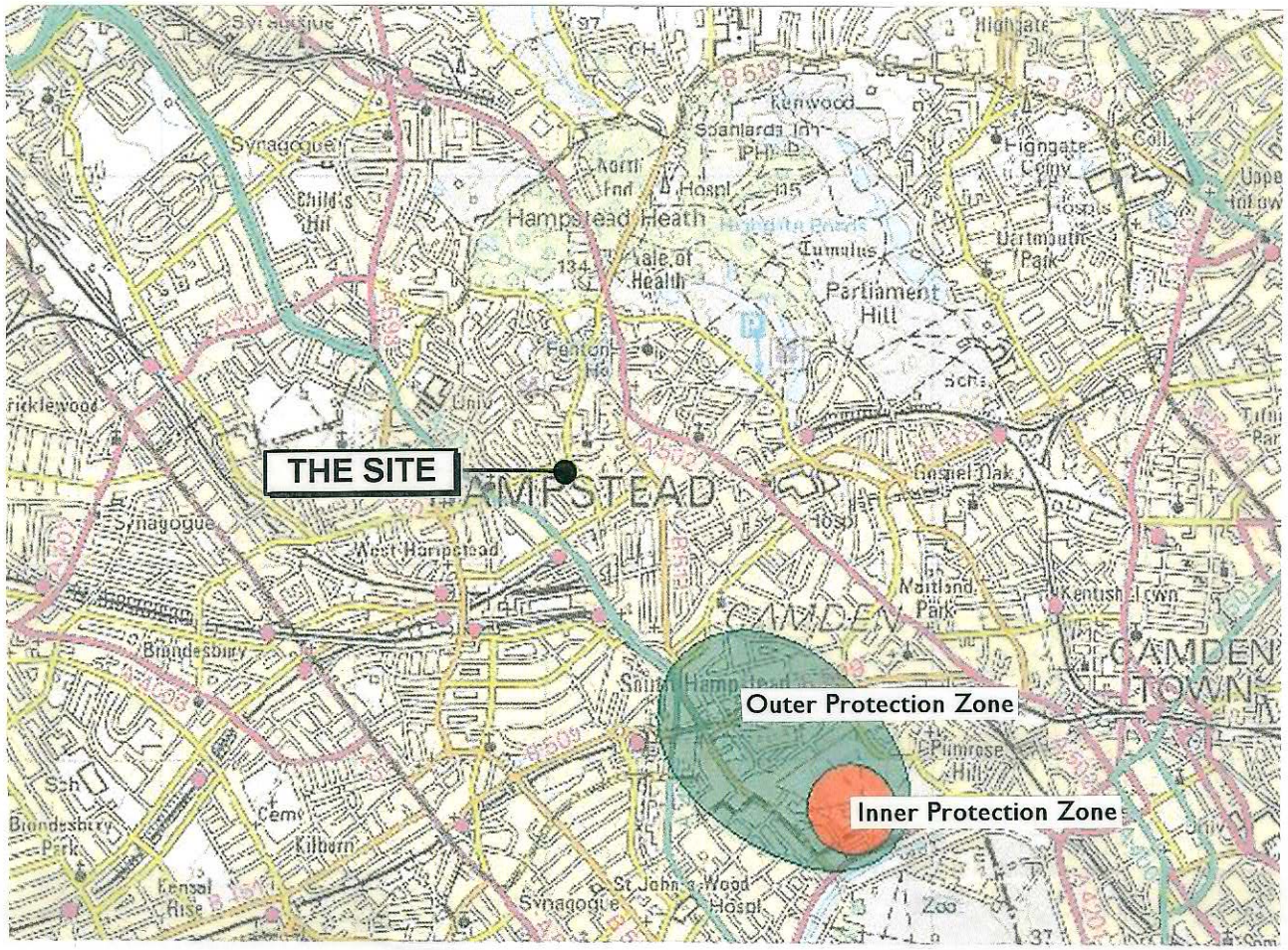


Figure 6

APPENDIX B

IN SITU PERMEABILITY TEST

IN SITU PERMEABILITY

HVORSLEV'S TIME LAG

Project: 40 FROGNAL LANE, CAMDEN
Client: Arlington Management Services Limited

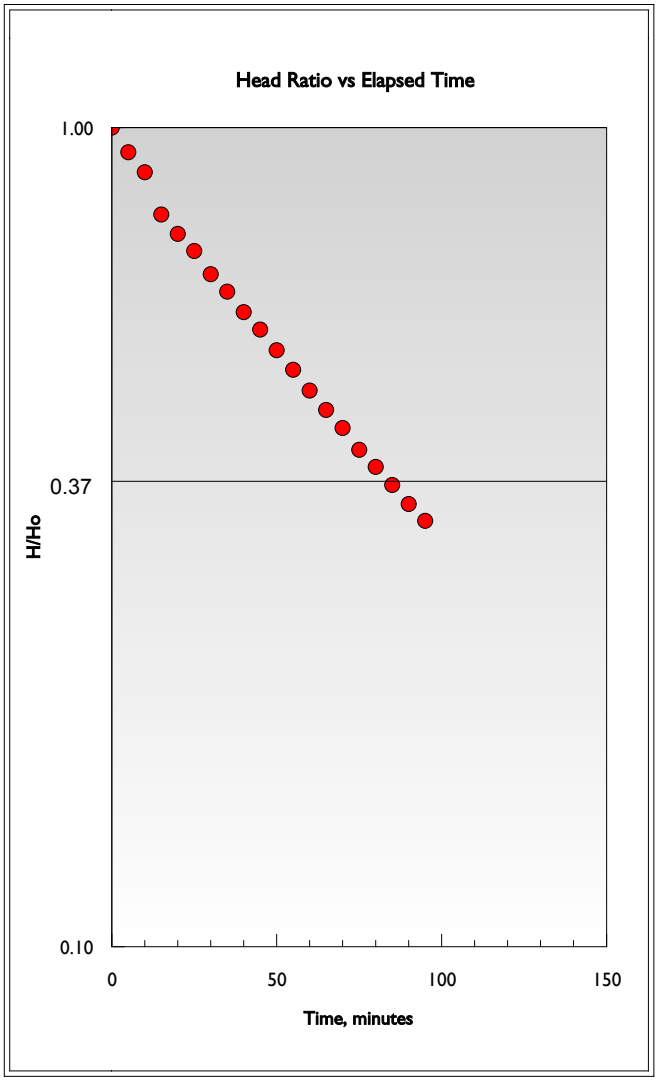
Project No: 3611
Sheet No: 1/1

Location: BH 1
Test deptl from 7.00 m
to 1.00 m

Height of casing above g.l., m	0.00
Depth of casing below g.l., m	1.00
Diameter of casing, m	0.15
Depth to water at start of test, m b.g.l.	2.86

Description of stratum under test
Claygate Member to 5.6m then London Clay

Elapsed Time min	Depth to Water, m from Casing	Depth to Water, m from GL	H	H/Ho
0	6.00	6.00	-3.14	1.000
5	5.79	5.79	-2.93	0.933
10	5.63	5.63	-2.77	0.882
15	5.32	5.32	-2.46	0.783
20	5.19	5.19	-2.33	0.742
25	5.08	5.08	-2.22	0.707
30	4.94	4.94	-2.08	0.662
35	4.84	4.84	-1.98	0.631
40	4.73	4.73	-1.87	0.596
45	4.64	4.64	-1.78	0.567
50	4.54	4.54	-1.68	0.535
55	4.45	4.45	-1.59	0.506
60	4.36	4.36	-1.50	0.478
65	4.28	4.28	-1.42	0.452
70	4.21	4.21	-1.35	0.430
75	4.13	4.13	-1.27	0.404
80	4.07	4.07	-1.21	0.385
85	4.01	4.01	-1.15	0.366
90	3.95	3.95	-1.09	0.347
95	3.90	3.90	-1.04	0.331



k = A/FT

A =	0.018	m²
F =	8.603	m
T =	82	min
k =	4.18E-007	m/s