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Ground Floor Flat
17 BRACKNELL GARDENS
LONDON NW3 7EE

Hydrological Assessment

Client
Mr. & Mrs. Weinberg

Architect
Hugh Cullum Architects Limited

Report No. 3733

5 April 2012

CONTENTS

Ground Floor Flat
17 BRACKNELL GARDENS
LONDON NW3 7EE

Hydrological Assessment

1

Introduction

It is proposed to construct a basement as part of the redevelopment plans for
No. 17 Bracknell Gardens. The purpose of this assessment is to consider the effect of the proposed basement on the local groundwater régime. For this assessment, a representative of AP Geotechnics Limited visited the property on 2 & 19 March 2012.

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 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 western side of Bracknell Gardens at the National Grid reference $^{5}257$ $^{1}855$. It forms one of a pair of semi - detached houses, possibly of Edwardian age, set in a plot about 46 m long by 13 m wide whose general layout as illustrated at Figure A1 of Appendix A.

It is of two storey construction, brickwork under a tiled and pitched roof as shown at Figure A2, with accommodation extending into the roof space. The house is essentially level from front to rear, the rear garden falling some ½ to ¾ m towards the back fence, the land then continuing to fall gently across the rear gardens of property fronting onto Finchley Road.

No. 19 Bracknell Gardens is the adjoining half of the semi - detached houses and is essentially identical in style and character.

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[1] *Report No. 3733v2; Basement Impact Assessment Screening Document; Ground Floor Flat, 17 Bracknell Gardens, London NW3 7EE*

Bracknell Gardens is an entirely residential road with many properties of similar age and style to the subject site although some newer development is present and many properties have been modified over the years.

The surrounding topography comprises undulating land to the north of the River Thames. Gradients in the vicinity of the property are detailed in the Screening Document; the road sloping down at about 1.2° to the north west and the site falling to the rear (south west) at about 1.7°. Properties on the opposite side of Bracknell Gardens are set at higher level, indicating a general gradient of about 5° to the north east.

The site lies between two tributaries of the Westbourne according to Barton[2], one being some 140 m west of the property and the other about 310 m east as shown at Figure A3. Both streams run more or less southwards and are fully culverted.

4

Development proposals

The proposal is to remodel the rear part of the ground floor flat to include a single level of basement as shown at Figures A4 & A5. The basement will extend approximately 2.2 m below the rear garden level, local excavation in the garden providing light to the basement window.

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

5

Ground conditions

Current digital mapping by the British Geological Survey indicates the property is directly underlain by the solid geology of the London Clay Formation. In its near surface weathered state, this formation typically comprises firm mottled brown clay of low permeability. No superficial deposits are mapped. The younger Claygate Member is mapped at outcrop on the higher ground to the north east and it is therefore implied that the property is located close to the top of the London Clay with a thickness of many tens of metres below the site.

However, records of the three bores that were sunk for the investigation on 2 & 19 March 2012 are provided at Appendix B herein. Their locations are shown on Figure A1 and the lithology revealed by the boreholes is summarised in Table 1.

Table 1: Lithology of the site

Stratum	Depth to base, m bgl	Description
Made Ground	0.85 beneath paving 0.55 - 0.7 beneath garden	Sand over soft clay and brick fragments. Silty clay and clay with brick fragments
London Clay Formation (weathered)	to base of bores at max. of 4.0	Firm mottled brown and grey CLAY, occasionally silty or with silt lenses. Soft in WS 2 1.6 - 2.2 m
Groundwater		Seepage observed only in WS 3 at 3.8

A standpipe was installed to the base of the bore in WS 3 to monitor groundwater levels and enable a permeability test to be carried out. A standing water level of 3.6 m was measured on 19 March 2012 prior to the permeability test. The effective permeability of the soil has been assessed by Hvorslev's Time Lag Method[3] as recommended in BS 5930[4]. Two falling head tests were conducted and the results are presented at Appendix C. The low permeability of London Clay was such that head ratio of 0.37 was not achieved, the test data therefore being extrapolated to yield coefficients of permeability of 4.85×10^{-7} and 2.89×10^{-7} m/s. These results are typical of weathered London Clay and confirms the low permeability of the soil.

6

Hydrogeology

Reference is made to Section 3.1 Questions 1a & 10 of the Screening Document[1] which confirms the Environment Agency classify the soil beneath the site as Unproductive; a non - aquifer which contains insignificant quantities of mobile groundwater. However, groundwater flow through such formations does take place through fissures and silt lenses but is often imperceptible. This is evidenced by the seepage in WS 3 which resulted in the standing level of 3.6 m below ground. Groundwater must therefore be considered in assessing the affect of the proposed development on the hydrogeological régime.

The test results have confirmed the very low permeability of the soil beneath the site and hence it has a very low leaching potential. It will thus have negligible ability to attenuate diffuse source pollutants. Non - absorbed diffuse source pollutants or liquid discharges do not have the potential to move rapidly to underlying strata or to shallow groundwater.

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

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

Environment Agency records confirm the site does not lie within a groundwater Source Protection Zone. The nearest such Zone is an Outer Protection Zone (Zone 2) some 1500 m to the south east.

7
Hydrology

Historically, it is expected that surface water drainage was predominantly by downslope run off. Given the very low permeability of the clay soil, it is expected that the potential for surface water infiltration is extremely limited and that ground water flow rates in the vicinity of the property will be extremely low. The historic development of the area for housing will have provided extensive hard cover and further limited surface water infiltration.

Section 3.3 of the Screening Document considers surface water flow and confirms the site lies well outside the catchment of any of the pond chains on Hampstead Heath. In addition, surface water flows will not be materially altered from the existing route as it is proposed to utilise the existing sewer.

8
Potential effects of proposed development

Monitoring of the standpipe on 19 March 2012 recorded a standing water level of 3.6 m below ground and thus below the level of the proposed basement. Construction of the basement is therefore not expected to result in significant changes to the groundwater régime around the property.

Even if long term seepage through the clay were within the depth of the proposed construction, the very low permeability of the soil is such that any changes will be very limited and confined to the immediate vicinity of the property. This can be illustrated by considering 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[5].

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 $\ngtr$ 0.5 m
> k is the coefficient of permeability in m/s from site specific data

Thus the Radius of Influence, $R_o = 3000 \times 0.5 \times \sqrt{(4.85\times10^{-7})} = 1.04$ 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 basement 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 basement. The membrane should be placed and connected in accordance with the manufacturer's instructions. A maintainable drainage channel should be

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5 *Report C515: Groundwater Control: design and practice; Construction Industry Research and Information Association, London 2007*

installed to collect water and divert it to a sump pump to remove the collected water for discharge to the sewerage network. In addition, it is recommended that the basement is designed in accordance with the requirements of BS 8102[6] to achieve and maintain the required conditions within the proposed basement.

A W Parr
AP GEOTECHNICS LTD.
5 April 2012

This report has been prepared for the sole and specific use of Mr & Mrs Weinberg for the purpose of the proposed development at 17 Bracknell Gardens, London NW3 7EE and should not be relied upon by any third party. Any other persons who use any information contained herein without the written permission of AP GEOTECHNICS LTD. do so at their own risk.

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

APPENDICES

A Figures

Figure A1: Existing ground floor plan showing approximate borehole locations
Figure A2: Site location relative to "lost" rivers
Figure A3: Front elevation
Figure A4: Proposed basement floor plan
Figure A5: Proposed basement section

B Borehole Records

Symbols & Abbreviations
Borehole Records

C In Site Permeability Test

APPENDIX A

FIGURES

17 Bracknell Gardens,
London NW3 7EE

Existing ground floor plan showing approximate borehole locations

Scale 1/200 at A4

Figure A1

17 Bracknell Gardens,
London NW3 7EE

Site location relative to "lost" rivers

Scale: Unknown

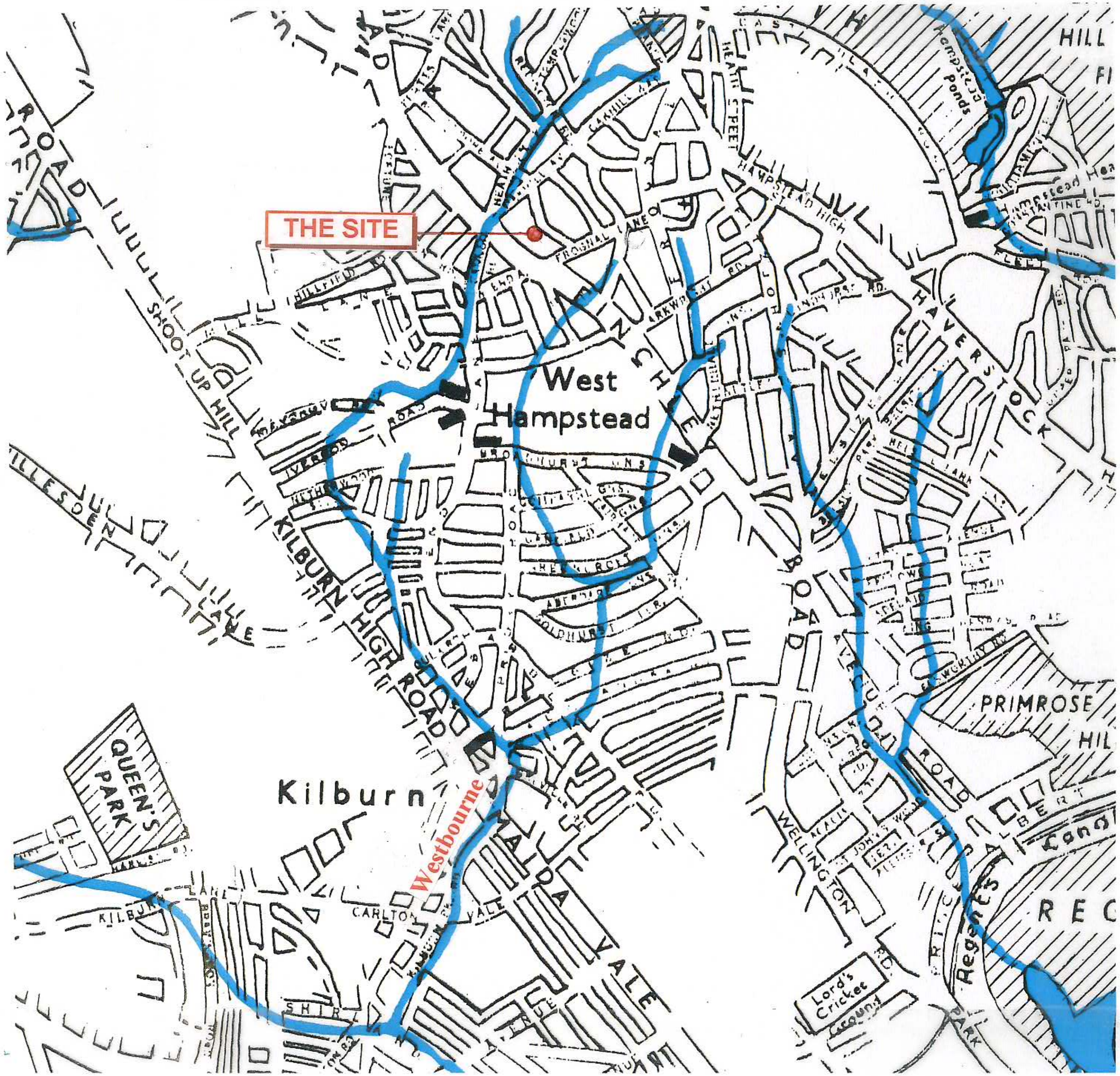


Figure A2

17 Bracknell Gardens,
London NW3 7EE

Front elevation

Scale: unknown

Figure A3

17 Bracknell Gardens, Camden

Proposed basement floor plan

Scale: Unknown

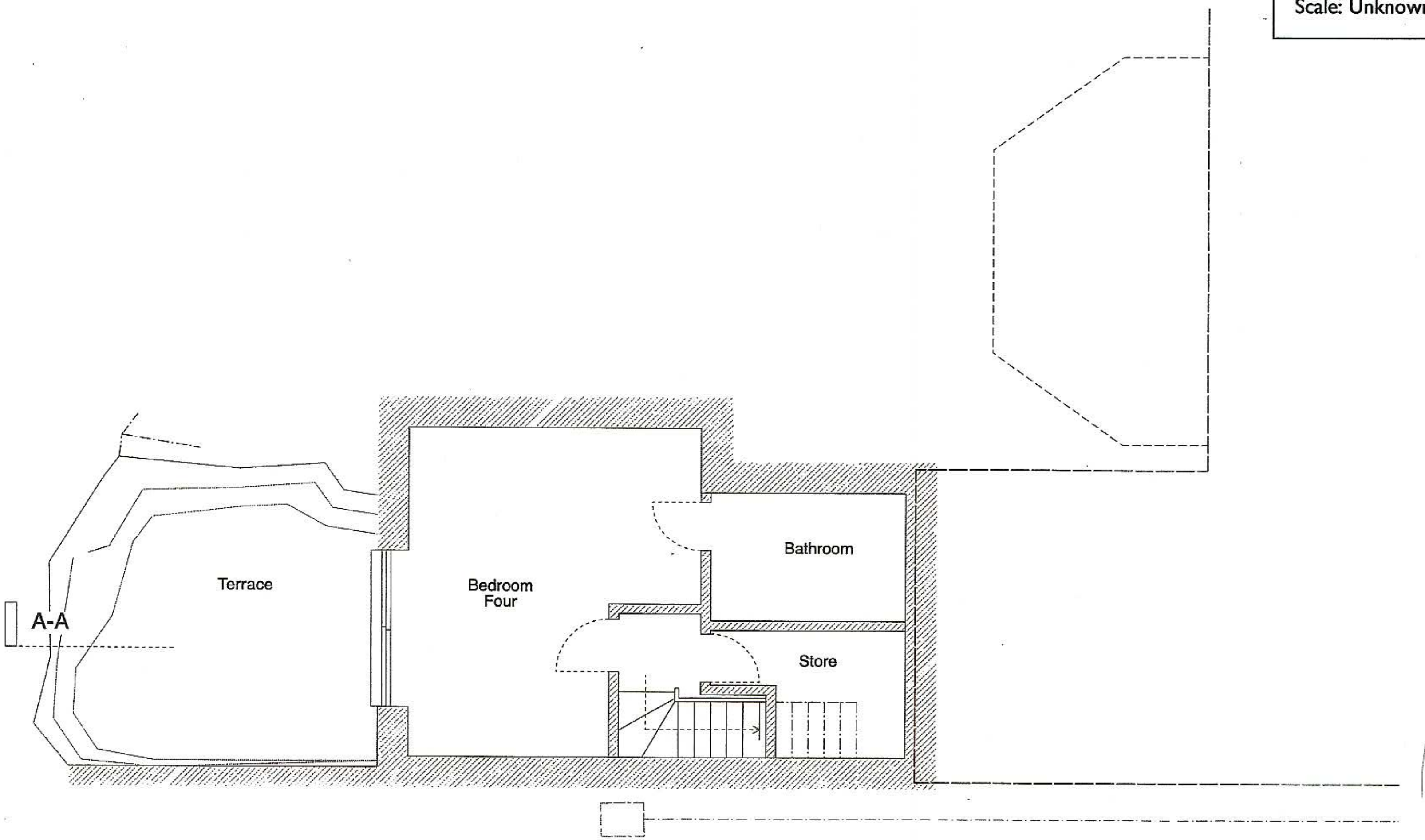
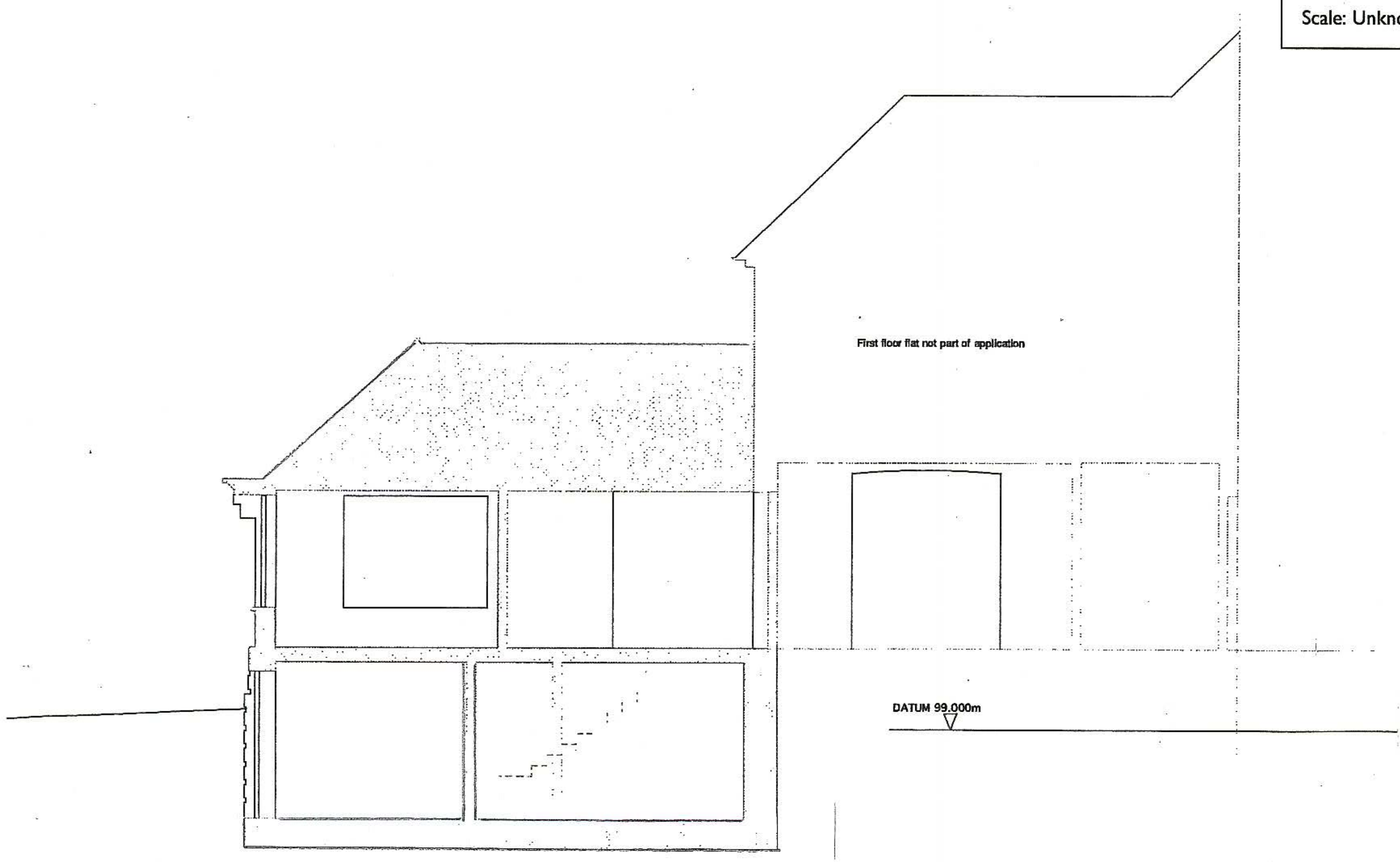


Figure A4



17 Bracknell Gardens,
Camden

Proposed basement section

Scale: Unknown

Figure A5

APPENDIX B

BOREHOLE RECORDS

SYMBOLS and ABBREVIATIONS

Samples

Undisturbed

U	Standard open drive "undisturbed" 102mm dia. in boreholes 38mm dia. in trial pits, window sampler and hand auger
T	Thin wall open drive
P	Piston
C	CBR mould

Disturbed

D	Small
B	Bulk
C	Contaminants: plastic tub
J	brown glass jar
W	Water

In situ tests

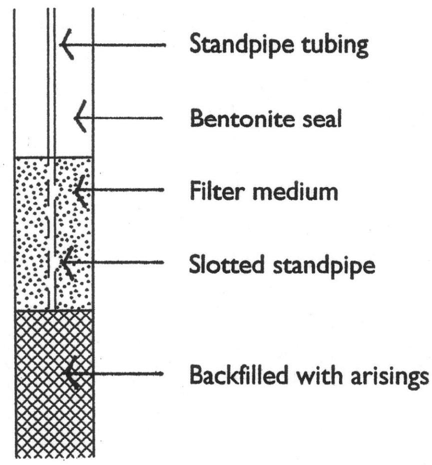
SPT	Standard Penetration Test, open shoe
CPT	solid cone
	N value is number of blows for 300mm penetration. Blow count also given as seating drive followed by four increments of 75mm.
V ( )	Vane test (c_u kPa)
P ( )	Hand penetrometer (c_u kg/cm^2)
M ( )	Mexe probe (CBR %)

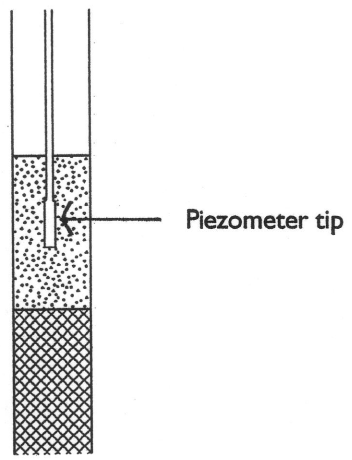
Water records

$\blacktriangledown_1$	Standing level
∇_1	Depth encountered

suffix identifies separate strikes

Standpipes





AP GEOTECHNICS	T 01932 848460 F 01932 851255 E mail@apgeotechnics.co.uk	Site 17 BRACKNELL GARDENS, LONDON NW3 7EE	Number **WS1**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Mr. & Mrs. Weinberg	3733
	Location	**Dates**	**Engineer**	**Sheet**
	See site plan	02/03/2012	Hugh Cullum Architects Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10)	MADE GROUND: Brown gravelly clay with brick fragments		
					0.10 (0.20)	MADE GROUND: Yellow orange coarse sand		
					0.30	MADE GROUND: Soft brown and orange brown clay with charcoal and brick fragments		
0.50	D1				(0.55)			
					0.85	Firm becoming stiff orange brown and grey CLAY with pockets of silt		
1.00	D2							
1.05	V1 63.33kPa		60, 66, 64/Av. 63.33					
1.50	D3							
					(2.15)			
2.00	D4							
2.50	D5							
3.00	D6				3.00			
						Terminated at 3.00m		

Remarks
Bore dry
Drive coupling sheared, sampler barrel abandoned in bore at 3 - 4 m depth.

Scale (approx)	Logged By
1:25	MM

Figure No. 3733.WS1

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Excavation Method	Dimensions	Ground Level (mOD)	Site	Number
Drive-in Window Sampler			17 BRACKNELL GARDENS, LONDON NW3 7EE	**WS2**
			Client: Mr. & Mrs. Weinberg	**Job Number**: 3733
	Location: See site plan	**Dates**: 02/03/2012	**Engineer**: Hugh Cullum Architects Limited	**Sheet**: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15) 0.15	TOPSOIL		
0.50	D1				(0.55) 0.70	MADE GROUND: Soft orange brown, brown and grey silty CLAY with rare brick fragments		
1.00	V1 63.33kPa		62, 68, 60/Av. 63.33					
1.00	D2							
1.50	D3				(0.90) 1.60	Firm orange brown and brown silty CLAY with some carbonaceous material		
1.70	D4				(0.60)	Soft blue grey carbonaceous CLAY		
2.20	D5				2.20			
						Terminated at 2.20m		

Remarks
Bore dry
Refusal at 2.2m

Scale (approx)	Logged By
1:25	MM

Figure No. 3733.WS2

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Site	Number
17 BRACKNELL GARDENS, LONDON NW3 7EE	**WS3**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Mr. & Mrs. Weinberg	3733
	Location	**Dates**	**Engineer**	**Sheet**
	See site plan	19/03/2012	Hugh Cullum Architects Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.15) 0.15	TOPSOIL			
					(0.40)	MADE GROUND: Soft to firm dark brown clay with roots, slate and brick fragments			
0.50	D1				0.55				
					(0.70)	Stiff mottled brown and blue grey CLAY with occasional roots			
1.00	V 122kPa		124, 120, 122/Av. 122.00						
1.00	D2				1.25				
					(0.50)	Firm mottled brown and blue grey CLAY with brown silt partings			
1.50	D3				1.75				
2.00	D4				(1.00)	Firm mottled brown and blue grey silty CLAY			
2.50	D5				2.75				
3.00	D6				(1.25)	Firm brown and grey CLAY with yellow brown silt lenses			
3.50	D7								
			seepage(1) at 3.80m.					∇1	
4.00	D8				4.00				
						Complete at 4.00m			

Remarks	Scale (approx)	Logged By
	1:25	
	Figure No. 3733.WS3	

APPENDIX C

IN SITU PERMEABILITY TEST

IN SITU PERMEABILITY

HVORSLEV'S TIME LAG

Project: 17 BRACKNELL GARDENS
Client: Mr & Mrs Weinberg
Agent: Hugh Cullum Architects

Project No: 2945
Sheet No: 1/2

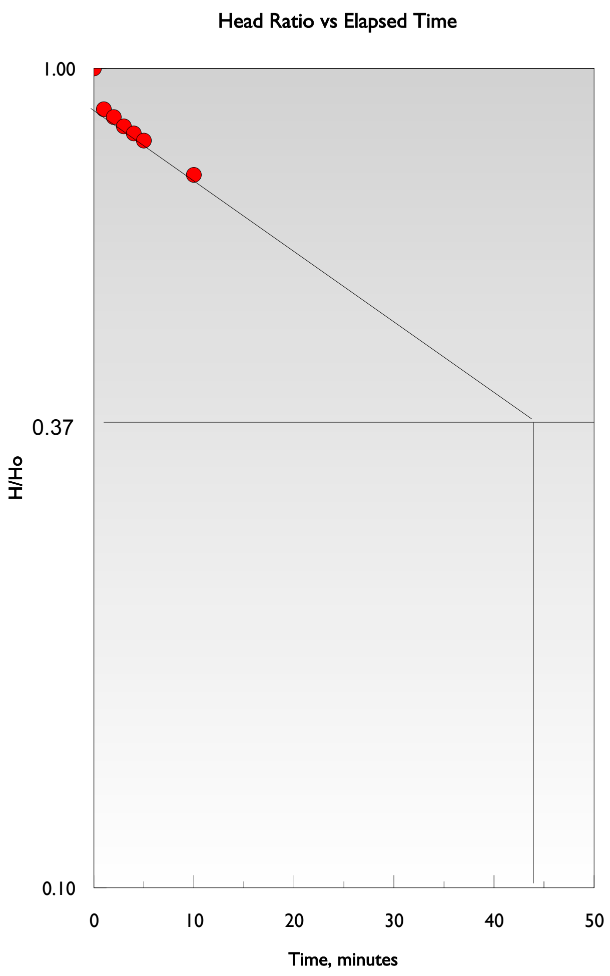
Location: WS3

Test deptl from 1.00 m
to 4.00 m in borehole

Height of casing above g.l., m	0.00
Depth of casing below g.l., m	1.00
Diameter of bore, m	0.085
Depth to water at start of test, m b.g.l.	3.60

Description of stratum under test
see Borehole Record

Elapsed Time min	Depth to Water, m from Casing	from GL	H	H / Ho
0.00	0.00	0.00	3.60	1.000
1.00	0.39	0.39	3.21	0.892
2.00	0.46	0.46	3.14	0.872
3.00	0.54	0.54	3.06	0.850
4.00	0.60	0.60	3.00	0.833
5.00	0.66	0.66	2.94	0.817
10.00	0.93	0.93	2.67	0.742



k = A/FT

A = 0.006 m^2
F = 4.428 m
T = 44 min extrapolated
k = 4.85E-007 m/s

IN SITU PERMEABILITY

HVORSLEV'S TIME LAG

Project: 17 BRACKNELL GARDENS
Client: Mr & Mrs Weinberg
Agent: Hugh Cullum Architects

Project No: 2945
Sheet No: 2/2

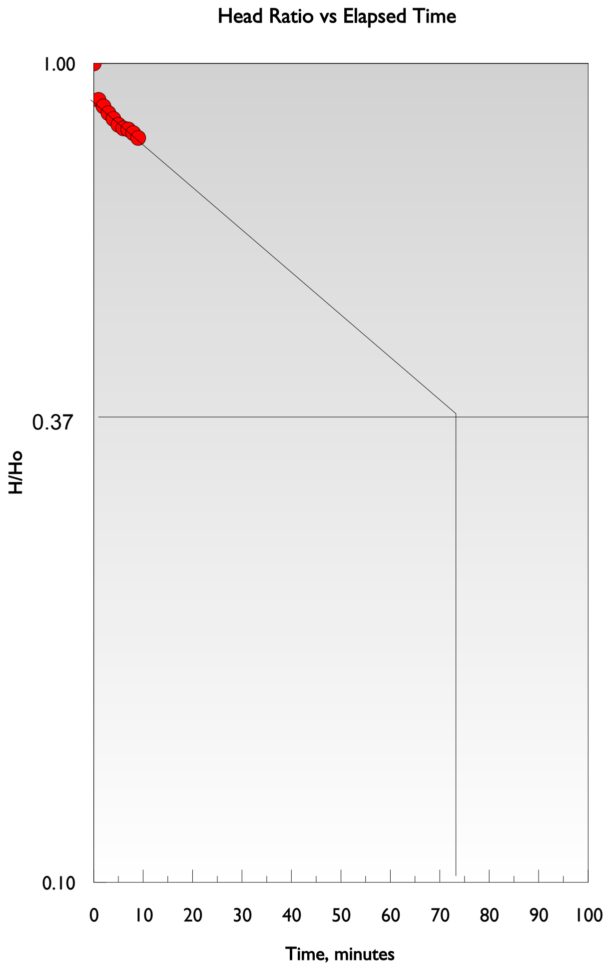
Location: WS3

Test deptl from 1.00 m
to 4.00 m in borehole

Height of casing above g.l., m	0.00
Depth of casing below g.l., m	1.00
Diameter of bore, m	0.085
Depth to water at start of test, m b.g.l.	3.60

Description of stratum under test
see Borehole Record

Elapsed Time min	Depth to Water, m from Casing	from GL	H	H / Ho
0.00	0.00	0.00	3.60	1.000
1.00	0.35	0.35	3.25	0.903
2.00	0.41	0.41	3.19	0.886
3.00	0.47	0.47	3.13	0.869
4.00	0.52	0.52	3.08	0.856
5.00	0.57	0.57	3.03	0.842
6.00	0.60	0.60	3.00	0.833
7.00	0.61	0.61	2.99	0.831
8.00	0.64	0.64	2.96	0.822
9.00	0.68	0.68	2.92	0.811



k = A/FT

A = 0.006 m²
F = 4.428 m
T = 74 min extrapolated
k = 2.89E-007 m/s