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11 August, 2015

Mr Paul Chrysaphiades
Domus Architects and Project Managers Ltd
Rowlandson House
289-297 Ballards Lane
London
N12 8NP

Our ref: CG/08986B

Please reply to: Adam Cadman

Dear Paul,

20 Platt's Lane, Camden, London, NW3 7NS: Summary of supplementary ground investigation findings

Further to your instruction, we're pleased to provide below a summary of the findings of the recent ground investigation and groundwater monitoring visit undertaken at the above site.

Background

CGL was previously appointed to undertake a Base Impact Assessment[1] (BIA) for the proposed development, which was submitted to the London Borough of Camden to support a planning application. The BIA was independently reviewed by LBH Wembley and, together with the planners at Camden Council, additional ground investigation and groundwater monitoring was requested prior to granting planning permission for the development.

The BIA was based on the borehole excavated by Fastrack Limited. The ground conditions beneath the site were previously found to comprise brown gravelly clay to a depth of 5.0mbgl. No groundwater was noted on the exploratory hole records and no monitoring was undertaken subsequent to the intrusive works.

Supplementary ground investigation

The supplementary ground investigation comprised the excavation of two window sampler boreholes (WS1 and WS2) to a maximum depth of 5m below ground level (bgl), and one hand dug pit (HDP1) to a depth of 1.2m bgl. WS1 and WS2 were positioned to the front of the existing property, with WS1 in the southern area and WS2 in the southern section. HDP1 was posited in the rear courtyard area located in the north-eastern area of the site. It was not possible to undertake window sampling in this area due to access constraints.

Hand Shear Vane (HSV) tests and Standard Penetration Tests (SPT) were undertaken at regular intervals within WS1 and WS2.

Monitoring well standpipes were installed in each exploratory hole. An exploratory hole location plan is presented as Figure 1 and detailed logs are presented as Appendix A.

[1] CGL. (September 2014). *20 Platt's Lane, Camden, London*. Basement Impact Assessment. CG/08986.

Ground and groundwater conditions (Stage 3)

Summary

A summary of the ground conditions encountered during the supplementary ground investigation is presented in Table 1 below.

Table 1. Summary of ground conditions.

Stratum	Depth encountered (mbgl)	Typical thickness (m)
(Made Ground) Comprising turf/hardstanding/ timber decking over soft dark brown slightly gravelly sandy clay or medium dense dark grey brown clayey sandy gravel.	0.0	0.45 to 0.5
Soft to firm, locally stiff, light and dark orange brown slightly gravelly very sandy CLAY. [POSSIBLE HEAD DEPOSITS]	0.45 to 0.5	0.55 to 1.0 *Base on proven in HDP1 at 1.2mbgl*
Soft dark brown black gravelly sandy CLAY with frequent black organic inclusions. Organic odour noted. *Only in WS1.* [POSSIBLE ALLUVIUM]	1.5	1.0
Firm dark orange brown sandy CLAY with sand partings. Becoming dark grey and very sandy with depth. [CLAYGATE MEMBER]	1.0 to 2.5	Proven to 5.0m bgl.

The base of the possible Head Deposits was not encountered in HDP1, which was terminated within the possible Head Deposits are 1.2m bgl.

Groundwater

Groundwater strikes were recorded in WS1 and WS2 at depths around 4.0m bgl, with the Claygate Member. Subsequent groundwater monitoring indicated resting water levels of between 1.55m (WS1) and 1.8m (WS2) bgl, resting either within the possible Alluvium (WS1) or Claygate Member (WS2). HDP1 was dry, with the well installed to 1.2m bgl.

Variable head permeability testing was undertaken in each of the boreholes and the records are included as Appendix B. The water was bailed from the monitoring well installations and the response was recorded at regular intervals. Infiltration rates of between 1.6×10^{-6} m/s to 2.9×10^{-6} m/s were calculated. This corresponds to a low degree of permeability and is within the expected range for interlaminated silt/sand/clays[2]. The permeability test data and infiltration calculations are included as Appendix B.

Ground model

The supplementary ground investigation has identified more variable ground conditions than anticipated based on the available geological records and the previous ground investigation undertaken by Fastrack Limited. In particular, possible Head Deposits were recorded across the site and possible Alluvium was recorded at between 1.5m and 2.5m bgl in WS1, located in the southern area of the site.

The possible Head Deposits were distinguished from the Claygate Member by the presence of flint gravel, a soft to firm consistency, and the relatively low c_u values derived from HSV tests and SPTs. Possible desiccation, as defined by increased stiffness, was noted in the possible Head Deposits in WS2 to a depth of 1.0m bgl.

[2] CIRIA. (2000). *Groundwater control – design and practice*. CIRIA C515.

The possible Alluvium comprised soft, dark blackish brown, gravelly, sandy clay, and was 1.0m thick, extending to 2.5m bgl in the southern area of the site only (WS1). This material was not encountered in WS2, located a short distance to the north. It is likely that this material is a small stream channel, possibly associated with a former tributary for a local former water course. It is inferred that this feature trends in a broadly east to west direction and may be intercepted by the proposed basement.

The Claygate Member was encountered in WS1 and WS2 at depths between 1.0m and 2.5m bgl and comprised firm, dark orange brown sandy clay with sand partings. The Claygate Member became dark grey and very sandy with depth.

In-situ testing
Plots of SPT 'N' values and undrained shear strength (c_u) values versus depth are presented as Figure 2 and Figure 3, respectively.

The in-situ testing indicates c_u values in the range of 15kPa to 37kPa for the possible Head Deposits and 20kPa to 27kPa for the possible Alluvium. Values of c_u in the Claygate Member are in the range of 30kPa to 72kPa, with no clear increase with depth to 3.0m bgl, increasing linearly from this depth. The c_u values are lower within WS1, where possible Alluvium was overlying the Claygate Member, than WS2 where no Alluvial deposits were encountered. This suggests the presence of an increased weathered profile in that area.

The results indicate lower c_u values and relative consistencies than assumed within the BIA. For ease, the previous c_u design line is included on Figure 3. On this basis, the following geotechnical parameters are recommended.

A design c_u of 25kPa is recommended for the possible Head Deposits and Alluvium. Given the scatter of c_u values for the Claygate Member, a design c_u of 40kPa is recommended to 3.0m bgl, with the following design line recommended below 3.0m bgl:

$$c_u = 40+10z, \text{ Where } z = \text{depth below 3.0mbgl.}$$

On the basis that no site specific information is available for the London Clay Formation, the increase of c_u with depth (z) has been assumed as 5.7kPa for every metre below 7.0m bgl (i.e. $c_u = 75+5.7z$). E_u values should be based on $500c_u$ and E' $0.75E_u$.

Implications for BIA

Subterranean (groundwater) flow (Stage 4)
Shallow groundwater was recorded during a monitoring visit undertaken subsequent to the supplementary ground investigation. Additionally, a shallow alluvial channel was encountered in the southern area of the site. Whilst the alluvial channel may present a possible preferential pathway for groundwater flow, the variable head permeability testing suggests similar permeability rates for the Alluvium and the surrounding Claygate Member.

It is understood that the neighbouring properties do not have basements. On this basis, it is considered that the proposed basement will have not have a significant negative impact on groundwater flow or level in the vicinity of the site as groundwater may flow around the basement, within the Claygate Member. Filter drains may be considered to the perimeter of the basements should water ingress rates within the alluvial channel, if encountered, exceed those reported within this letter.

The basement will be constructed with hit and miss underpinning techniques. On this basis, only narrow excavations will be excavated at any one time. Groundwater is likely to be encountered during basement excavation as seepages, and observations during the CGL investigation and monitoring suggest that ingress is likely to be relatively slow, with infiltration rates of the order of $2x10^{-6}$ m/s. Should seepages or inflows be encountered during these works, then ground loss may be controlled by sacrificial trench sheeting to the rear of the underpin excavation and pumping from sumps.

Land stability (Stage 4)

The *VDisp* analysis undertaken as part of the BIA has been updated using the design parameters recommended above. On the basis that the alluvial channel is localised, the ground profile assumed in the model comprises possible Head Deposits to 1.0m bgl over Claygate Member. Whilst the results indicate a greater degree of movements (predominantly heave due to stress relief), the distribution of movements is similar to those reported previously and there no changes to the building damage category assessments provided within the BIA.

The basement impact assessment recommended an allowable bearing capacity of 100kPa at a depth of 2.5m bgl. Based on the available data, this value is considered appropriate for the Claygate Member. The proposed basement floor level is 2.6m bgl, with formation levels assumed to be some 0.3m below this. On this basis, foundations are likely to be within the Claygate Member. Notwithstanding this, lower values are recommended for the Alluvium, which may extend to similar depths. In this regard, an allowable bearing capacity of 50kPa is recommended for the Alluvium. However, it is recommended that foundations are placed a minimum of 0.3m into the Claygate Member, which may require some localised deepening of underpin foundations. All formations should be inspected by a suitably qualified engineer and the allowable bearing capacity should be confirmed by in-situ testing (i.e. HSVs).

Conclusions

Based on the available information, it is not considered necessary to alter the construction methodology, and classification of predicted damage to neighbouring structures (Category 1 – very slight damage) are not materially changed from those previously reported.

We recommend that a watching brief be put in place during underpin excavations and that CGL is immediately informed if ground or groundwater conditions are not as expected, or as previously reported.

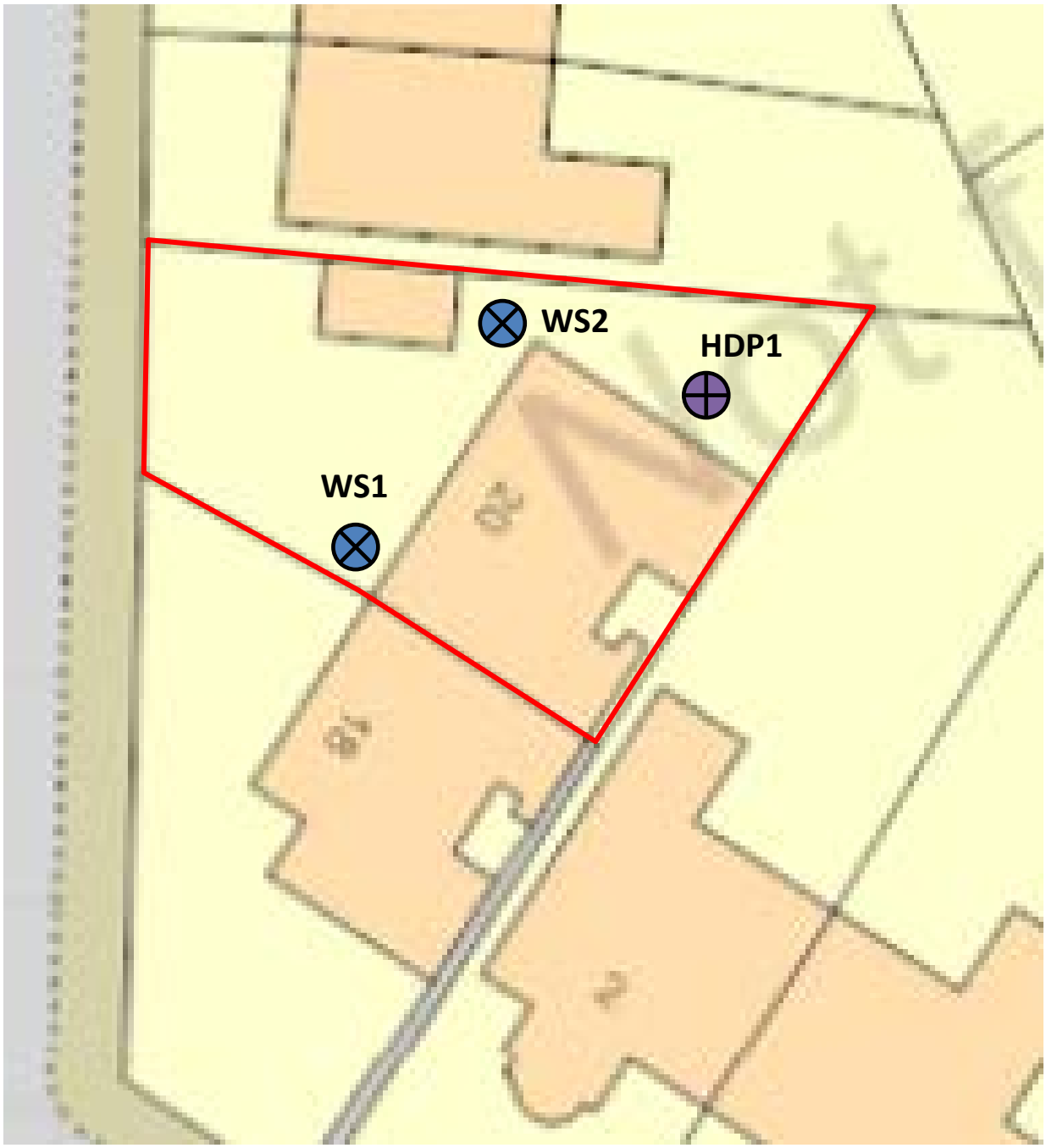
We trust this meets your current requirements, but should you have any queries, please do not hesitate to contact us.

Yours sincerely,

Adam Cadman, Chartered Senior Engineer
MSc BSc (Hons) CGeol FGS

Encl: *Figure 1 - exploratory hole location plan*
Figure 2 - SPT 'N' versus depth
Figure 3 - c_u versus depth
Appendix A - Exploratory hole records
Appendix B - Rising head test data

FIGURES

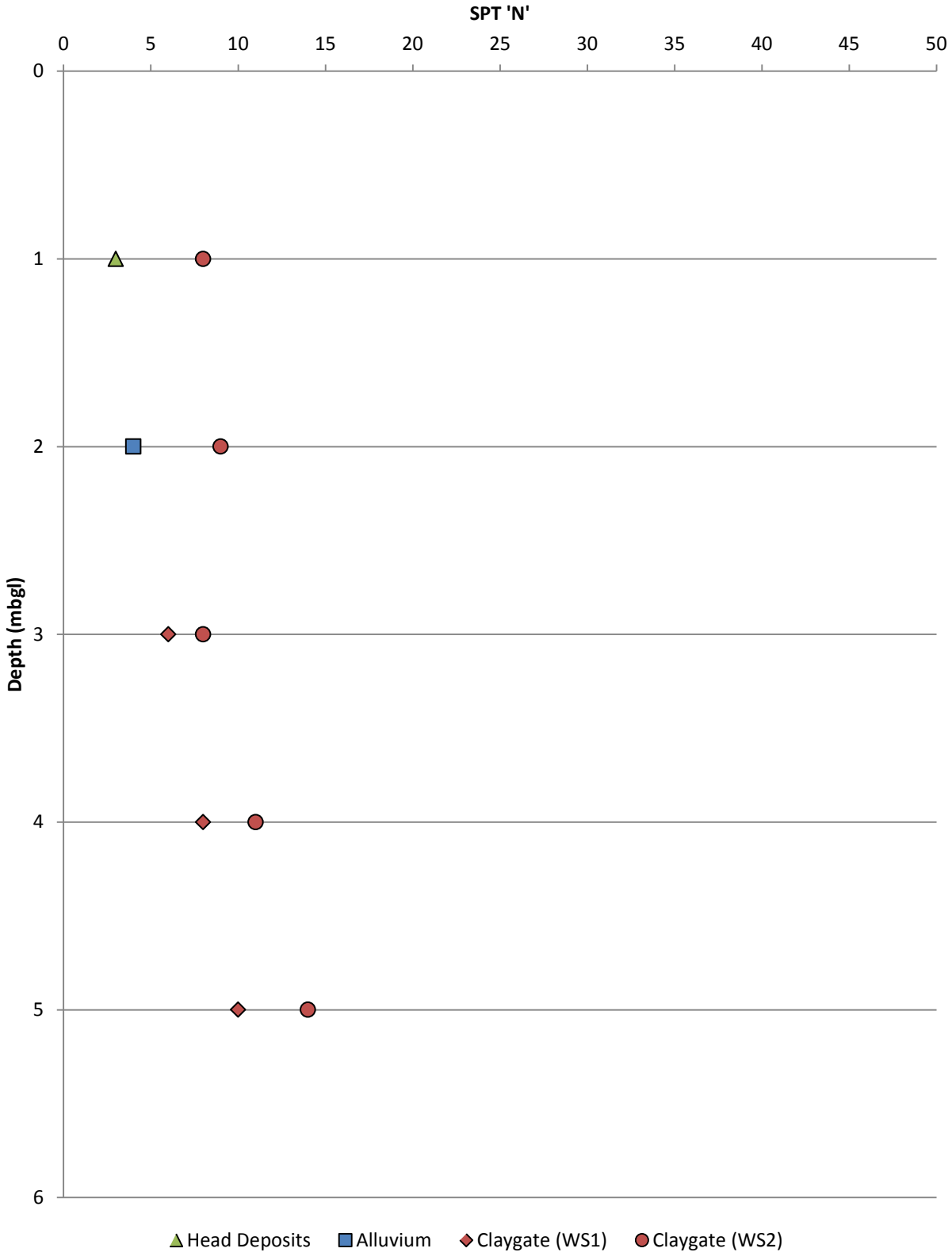


Windowless sampler borehole

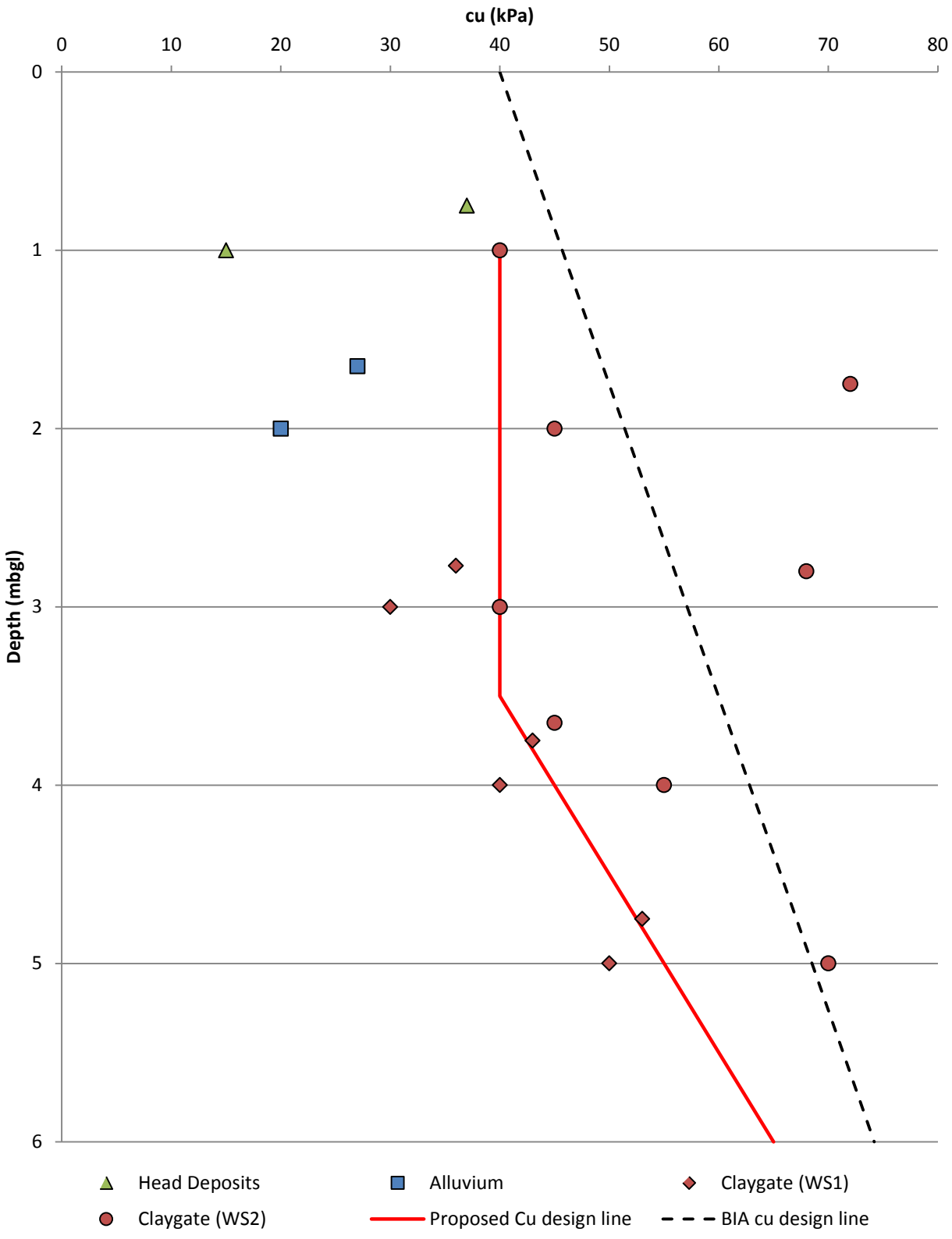
Hand dug pit

N

Client	Project	Job No
Mr and Mrs Fulton	**20 Platt's Lane, Camden, London**	**CG/08986B**
CGL	Title **Exploratory hole location plan**	**Figure 1**



Client	Project	Job No
Mr and Mrs Fulton	**20 Platt's Lane, Camden, London**	**CG/08986B**
CGL	Title: **SPT 'N' versus depth**	**Figure 2**



Client	Project	Job No
Mr and Mrs Fulton	**20 Platt's Lane, Camden, London**	**CG/08986B**
CGL	Title **c_u versus depth**	**Figure 3**

APPENDIX A

Exploratory hole records

WINDOW SAMPLE LOG

Project				HOLE No
20 Platts Lane				WS1
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/08986B	09-07-15			
Client				Sheet
Mr and Mrs Fulton				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
						(0.50) 0.50	Turf over soft dark brown slightly gravelly sandy clay with occasional rootlets. Sand is fine to coarse. Gravel is fine to medium, angular to subrounded of flint and brick. [MADE GROUND]	
0.75	HSV	37				(1.00) 1.50	Soft to firm light orange brown mottled light blue grey slightly gravelly very sandy CLAY with frequent black speckes of organic material and pseudo-fibrous plant material. Gravel is fine, rounded to subangular of flint. [POSSIBLE HEAD DEPOSITS]	
1.00	SPT	N3						
1.65	HSV	27				(1.00) 2.50	soft dark brown black gravelly sandy CLAY with frequent black speckes of organic material and inclusions of pseudo-fibrous oxidised organic material. Organic odour noted. [POSSIBLE ALLUVIUM]	
2.00	SPT	N4						
2.77	HSV	36				(1.50) 4.00	Firm dark orange brown sandy CLAY with closely spaced partings of fine yellow sand. [CLAYGATE MEMBER]	
3.00	SPT	N6						
3.75	HSV	43	1					
4.00	SPT	N8				(0.75) 4.75	Firm dark grey brown sandy CLAY. Sand is fine to coarse. [CLAYGATE MEMBER]	
4.75	HSV	53				5.00	Firm dark grey very sandy CLAY with frequent closely spaced partings of fine yellow sand, fine selenite crystals and broken shell fragments. [CLAYGATE MEMBER]	
5.00	SPT	N10					*(Window sample terminated at 5m)*	

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth
	4				

General Remarks

1. Borehole terminated at 5m bgl.
2. GPS data unobtainable due to height of existing structures and vegetation.
3. HSV = Hand Shear Vane result; SPT = Standard Penetration Test result.
4. Groundwater encountered at approximately 4.0m bgl.
5. Borehole installed to the base with a monitoring well. From 0.0m to 0.2m gas tap and bung; from 0.2m to 1.2m plain pipe with bentonite seal; from 1.2m to 5.0m slotted pipe with gravel backfill.

Method/ Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	RP Drilling	TOP	ADC

CGL WS LOG CG08986B.GPJ GINT STD AGS 3_1.GDT 11/8/15

WINDOW SAMPLE LOG

Project				HOLE No
20 Platts Lane				WS2
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/08986B	09-07-15			
Client				Sheet
Mr and Mrs Fulton				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
						0.08	Concrete paving slab. [CONCRETE]	
						0.18		
						0.35	Concrete with no reinforcement bar or aggregate. [CONCRETE]	
						0.45		
						(0.55)	Medium dense dark grey brown clayey sandy gravel. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded of brick, concrete and flint. [MADE GROUND]	
						1.00	Stiff dark grey brown mottled orange grey sandy clay. [MADE GROUND]	
1.00	SPT	N8				(0.50)	Firm to stiff possibly dessicated dark grey brown mottled dark orange brown very sandy slightly gravelly CLAY with occasional roots. Sand is fine to coarse. Gravel is fine to coarse, rounded to subangular of flint. [POSSIBLE HEAD DEPOSITS]	
						1.50	Firm light blue grey mottled dark orange brown sandy CLAY with occasional red roots. [CLAYGATE MEMBER]	
1.75	HSV	72						
2.00	SPT	N9				(1.15)	Firm light blue grey mottled dark orange brown very sandy CLAY with closely spaced partings of sand and occasional black speckes of dark purple weathered clay. [CLAYGATE MEMBER]	
						2.65		
2.80	HSV	68					Firm dark red brown mottled light blue grey very sandy CLAY with closely spaced partings of fine yellow sand. [CLAYGATE MEMBER]	
3.00	SPT	N8				(1.00)		
						3.65		
3.65	HSV	45	1				Firm dark grey silty slightly sandy CLAY with closely spaced pockets of grey fine to coarse silt, frequent fine selenite crystals, rare nodules of pyrite and occasional broken gastropod and bivalve shell fragments. [CLAYGATE MEMBER]	
4.00	SPT	N11				(1.35)		
						5.00		
5.00	SPT	N14					*(Window sample terminated at 5m)*	

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth
	4				

General Remarks

1. Borehole terminated at 5m bgl.
2. GPS data unobtainable due to height of existing structures and vegetation.
3. HSV = Hand Shear Vane result; SPT = Standard Penetration Test result.
4. Groundwater encountered at approximately 4.0m bgl.
5. Borehole installed to the base with a monitoring well. From 0.0m to 0.2m gas tap and bung; from 0.2m to 1.2m plain pipe with bentonite seal; from 1.2m to 5.0m slotted pipe with gravel backfill.

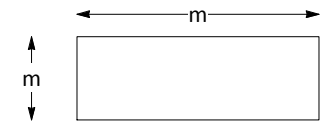
Method/ Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	RP Drilling	TOP	ADC

TRIAL PIT LOG

Project				TRIAL PIT No
20 Platts Lane				**HDP3**
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/08986B	09-07-15			
Client				Sheet
Mr and Mrs Fulton				1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION
						0.20	Soft dark brown slightly gravelly sandy clay with inclusions of wood and plant matter. Sand is fine to coarse. Gravel is fine to medium subangular to rounded of flint. [MADE GROUND]
						(0.80)	Firm dark grey brown mottled orange sandy very gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, well rounded to subangular of flint. [POSSIBLE HEAD DEPOSITS]
						1.00	
						1.20	Firm dark grey mottled orange brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is fine to medium, rounded to subangular of flint. [POSSIBLE HEAD DEPOSITS]
							(Pit terminated at 1.2m)

Plan



Stability: Good

General Remarks

1. Hand dug pit terminated at 1.2mbgl due to limit of toolage.
2. GPS data unobtainable due to height of existing structures and vegetation.
3. Groundwater encountered at approximately 4.0m bgl.
4. Borehole installed to the base with a monitoring well. From 0.0m to 0.2m gas tap and bung; from 0.2m to 0.7m plain pipe with bentonite seal; from 0.7m to 1.2m slotted pipe with gravel backfill.

Method/ Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	RP Drilling	TOP	ADC

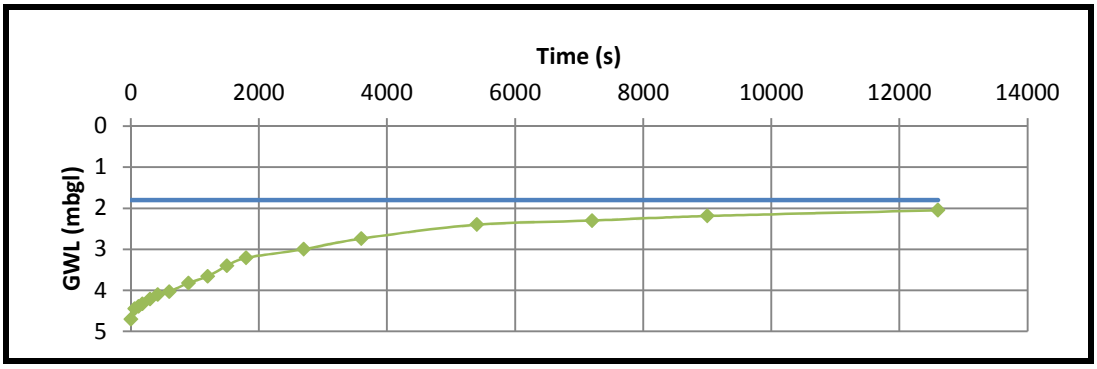
APPENDIX B

Rising head test data

Rising Head Test - WS1

20 Platt's Lane
CG/08986B
July 2015

Time (mins)	Time(s)	Depth (m)	H (m)	H/Ho
0	0	4.7	2.9	1
1	60	4.45	2.65	0.9137931
2	120	4.39	2.59	0.8931034
3	180	4.33	2.53	0.8724138
5	300	4.21	2.41	0.8310345
7	420	4.1	2.3	0.7931034
10	600	4.03	2.23	0.7689655
15	900	3.82	2.02	0.6965517
20	1200	3.66	1.86	0.6413793
25	1500	3.4	1.6	0.5517241
30	1800	3.21	1.41	0.4862069
45	2700	3	1.2	0.4137931
60	3600	2.74	0.94	0.3241379
90	5400	2.4	0.6	0.2068966
120	7200	2.3	0.5	0.1724138
150	9000	2.19	0.39	0.1344828
210	12600	2.05	0.25	0.0862069



General Approach (After Horvslev 1951)

Initial GW depth	1.8	mbgl
Well depth	4.95	mbgl
Well pipe diameter	52	mm
F	0.143	intake Factor - Fig 6 BS5930
D	0.052	m - Diameter of standpipe
H1	2.9	m
H2	0.25	m
t1	0	s
t2	12600	s
A	0.002123717	m2

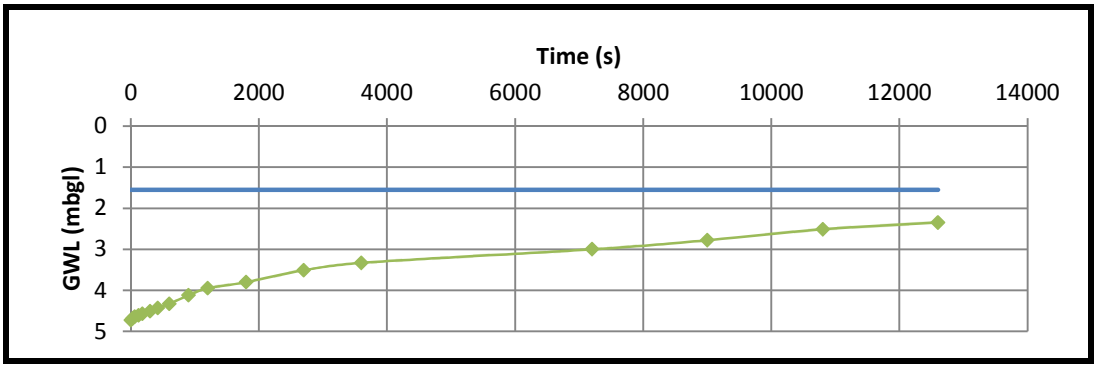
$$k = \frac{A}{F(t_2 - t_1)} \ln \frac{H_1}{H_2}$$

k = **2.89E-06** **m/s**

Rising Head Test - WS2

20 Platt's Lane
CG/08986B
July 2015

Time (mins)	Time(s)	Depth (m)	H (m)	H/Ho
0	0	4.73	3.18	1
0.5	30	4.68	3.13	0.9842767
1	60	4.64	3.09	0.9716981
2	120	4.61	3.06	0.9622642
3	180	4.57	3.02	0.9496855
5	300	4.51	2.96	0.9308176
7	420	4.43	2.88	0.9056604
10	600	4.33	2.78	0.8742138
15	900	4.12	2.57	0.8081761
20	1200	3.95	2.4	0.754717
30	1800	3.8	2.25	0.7075472
45	2700	3.51	1.96	0.6163522
60	3600	3.33	1.78	0.5597484
120	7200	3	1.45	0.4559748
150	9000	2.78	1.23	0.3867925
180	10800	2.51	0.96	0.3018868
210	12600	2.35	0.8	0.2515723



General Approach (After Horvslev 1951)

Initial GW depth	1.55	mbgl
Well depth	4.95	mbgl
Well pipe diameter	52	mm
F	0.143	intake Factor - Fig 6 BS5930
D	0.052	m - Diameter of standpipe
H1	3.18	m
H2	0.8	m
t1	0	s
t2	12600	s
A	0.002123717	m2

$$k = \frac{A}{F(t_2 - t_1)} \ln \frac{H_1}{H_2}$$

k = **1.63E-06** **m/s**