13 November 2020

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Your ref:
Our ref: J20209/JF/02

Kieron Taylor
AKT II
White Collar Factory
1 Old Street Yard
London
EC1Y 8AF

Dear Kieron

Re: 247 TOTTENHAM COURT ROAD

Further to your instruction, dated 8 October 2020, we have completed the preliminary ground investigation at the above site. This letter comprises our factual report of the findings along with limited interpretation of the ground conditions and hydrogeology.

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigations carried out. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or ground water samples tested. No liability can be accepted for conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from third parties are given in good faith on the assumption that the information is accurate; no independent validation of third party information has been made by GEA.

1.0 INTRODUCTION

It is proposed to redevelop the site for a mixed residential and commercial end-use, although exact details have not been provided. A rapid assessment of the ground conditions beneath the site was required to assist with a planning application.

The site is located at the southern end of Tottenham Court Road, in central London and is bounded by Bayley Street to the north, Morwell Street to the east, Tottenham Court Road to the west and No 248 Tottenham Court Road to the south. The main No 247 Tottenham Court Road building, which occupies the site, is a seven-storey reinforced concrete frame structure built between1968 and 1974.

London Underground tunnels of the Northern Line run beneath Tottenham Court Road at a depth of approximately 27 m below ground level, with a crown level at around -1.9 m OD. There is a 4 m wide exclusion zone around the tunnel.

The building on site was still occupied at the time of the investigation and the fieldwork was carried out in the basement car park, in agreement with the current tenants. The basement level is understood to be at 24.16 m OD currently and the development is to include deepening of the existing basement to levels of 22.50 m OD and 21.50 m OD. The section of basement in the southeast of the site will be locally deepened to around 19.0 m OD, to the level of the London Clay.

1.1 Geology, Hydrology and Hydrogeology

The geological map of the area indicates the site to be underlain by Lynch Hill Gravel over London Clay, with the gravel expected to extend to a depth of around 6 m below ground level. The London Clay is expected to extend to a depth of around 35 m.

The Lynch Hill Gravel is classified as a Secondary 'A' Aquifer, which is defined by the Environment Agency (EA) as permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers. The London Clay Formation is classified as Unproductive Strata.

Based on other investigations nearby, the permeability of the Lynch Hill Gravel is anticipated to be around 1 x 10^{-6} m/s, but varies depending on the ratio of sand and gravel in the stratum. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x 10^{-10} m/s and 1 x 10^{-8} m/s, with an even lower vertical permeability. Perched water may also be present within any overlying made ground.

The River Thames is located approximately 1.3 km south of the site and flows eastwards. Groundwater within the Secondary Aquifer is likely to be moving towards the south and southeast, towards the River Thames.

Reference to the Lost Rivers of London[1] does not indicate the presence of any lost rivers within 1 km of the site.

2.0 SCOPE OF WORK

The fieldwork was carried out from basement level. It was initially proposed to advance three opendrive sampler boreholes to the base of the Lynch Hill Gravel; however, the density and thickness of the gravel prevented sampling below a depth of 4.0 m. Ultimately, two opendrive sampler boreholes were advanced to a depth of up to 4.0 m, and the third borehole was advanced by means of a dismantlable cable percussion rig. The latter borehole was extended to a depth of 21 m below basement level, approximately 3.16 m OD, with the depth limited to ensure the borehole was terminated 4 m above the equivalent crown level of the nearby tube tunnel.

The opendrive sampler boreholes were logged on site by a geotechnical engineer from GEA. Disturbed and undisturbed samples were collected from the cable percussion borehole for subsequent laboratory analysis and logging. In addition, standard penetration tests (SPTs) were carried out at regular intervals in the cable percussion borehole to provide information on the in-situ strength of the soil. Geotechnical testing has not been completed to date and the results will be provided as an addendum.

Groundwater monitoring standpipes were installed to depths of 4.0 m, 5.5 m and 3.5 m in Borehole Nos 1, 2 and 3 respectively.

3.0 GROUND CONDITIONS

Beneath a layer of reinforced concrete, which extended to depths of between 0.37 m and 0.60 m, the boreholes encountered a moderate thickness of made ground over Lynch Hill Gravel, which was in turn underlain by London Clay.

Made ground was only encountered in Borehole No 2 and comprised brown sandy clay with brick and concrete fragments which extended to a depth of 1.60 m (22.56 m OD). Within Borehole Nos 1 and 3 the concrete slab was underlain by firm orange-brown silty sandy clay with rootlets which extended to a depth of 1.80 m (22.34 m OD) in each case; identified as possible made ground or a layer of "Brickearth". The underlying Lynch Hill Gravel comprised orange-brown very gravelly sand and SPTs indicate the sand to be dense. The base of the sand was only proved in Borehole No 2 at a depth

[1] Nicholas Barton & Stephen Myers (2016) *The Lost Rivers of London.* Historical Publications Ltd

of 5.10 m (19.06 m OD), whereupon, stiff brown mottled grey, becoming very stiff grey, fissured silty clay was encountered and extended to a depth of 21 m, the maximum depth investigated.

3.1 Groundwater

Groundwater inflows were recorded at depths of 3.50 m, 4.00 m and 3.24 m during drilling and standpipes were installed in each of the boreholes to depths of 4.00 m, 5.50 m and 3.06 m respectively. Monitoring observations are shown in the table below.

Date	Borehole No	Depth to water (m) [Level (m OD)]
12/10/2020	2	3.50 [20.66] (overnight level during drilling)
13/10/2020	1	Dry
	2	Not installed (casing extended though gravel)
	3	Dry
19/10/2020	1	3.20 [20.94]
	2	3.20 [20.96]
	3	Dry

4.0 CONCLUSIONS

The investigation has confirmed the presence of Lynch Hill Gravel comprising gravelly sand beneath the site which extends to a depth of 5.10 m (19.06 m OD). The gravelly sand is dense and we would recommend an SPT N60 value of between 35 and 40 for design purposes. The underlying London Clay comprised stiff, becoming very stiff, grey fissured silty clay which was proved to a depth of 21.00 m (3.16 m OD). Based on the measured SPT results and the updated SPT N60/cohesion relationship established by White et al[2], using a ratio of SPT N60:Cu = 5.5, the strength of the clay increases linearly from approximately 80 kPa at 5 m, to 220 kPa at 21 m.

The groundwater observations and monitoring indicate the groundwater level to be between 20.66 m OD and 20.95 m OD, which is below the proposed new basement level of 22.50 m OD and 21.50 m OD. Problematic groundwater inflows are not therefore anticipated at formation level.

4.1 Hydrogeological Assessment

It is proposed to deepen the existing basement by the construction of a secant pile retaining wall which will extend around the perimeter of the footprint of the new building. The piles will extend to the London Clay and hence create a localised cut-off which will prevent groundwater from flowing through the Lynch Hill Gravel beneath the site. Outside the basement excavation, there should be an approximately 4 m thickness of Lynch Hill Gravel, beneath any made ground, available to permit the flow of groundwater around the site beneath the roads to the north, east and west.

Beneath the existing basement, groundwater has been measured at a level of around 20.9 m OD and based on the investigation findings, there should be approximately 1. 5 m thickness of unsaturated gravel above the water level. There may be a localised build-up of groundwater behind the retaining wall on the northern side of the site, although there is sufficient thickness of unsaturated soils to accommodate this. The adjacent building to the south is understood to have a basement extending to between 20.75 m OD and 20.10 m, which is already below the measured water level. Groundwater will continue to flow southwards on the east and west sides of the basement structure, beneath the roadways. The new development will not alter the existing infiltration pathway as it is assumed that

2 *An update of the SPT-cu relationship proposed by M. Stroud in 1974,* White.F, Ingram.P, Ncholson.D, Stroud.M, and Betru.M. Proceedings of the XVII ECSMGE-2019

all existing surface water runoff is diverted to sewers, in any case, recharge of the groundwater is expected to be very limited due to the impermeable covering over the catchment. The basement will include a locally deepened area extending to the London Clay, although this area will lie inside the secant pile wall and will have no additional impact on the hydrogeology.

4.2 **Foundations**

Following the basement deepening, formation level will be in the Lynch Hill Gravel, above the groundwater table, and an approximately 2.5 m thickness of sand and gravel will remain over the London Clay. The suitability of a raft foundation will be governed by the net load of the development, taking into consideration the effects of removal of soil to form the basement excavation. Further analyses should be carried out once the proposed uniform distributed load has been determined. At this stage it is considered that the load applied by the new building will be sufficient to counteract the heave of the underlying clay and settlement should remain within tolerable limits.

We trust that we have provided sufficient information but if we can be of any further assistance please do not hesitate to contact us.

Yours sincerely
GEOTECHNICAL AND ENVIRONMENTAL ASSOCIATES

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Associate Director

John Evans MSc FGS CGeol
Consulting Hydrogeologist

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Managing Director

Encs

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Geotechnical & Environmental Associates

Project				BOREHOLE No
247 Tottenham Court Road, London W1T 7QX				**BH1**
Job No	Date	Ground Level (m OD)	Co-Ordinates ()	
J20209	06-10-20	24.14		
Client	Engineer			Sheet
	AKT II			1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument / Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
				23.54		(0.60) 0.60	CONCRETE	
				22.34		(1.20) 1.80	Soft becoming firm orange brown silty slightly sandy CLAY with rare decayed rootlets. Sand fine.	
			1	20.14		(2.20) 4.00	Very dense orange brown very gravelly SAND. Gravel fine to coarse, angular to sub rounded of flint. Sand medium to coarse grained.	

Boring Progress and Water Observations

Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth
4.00	06-10-20	16.00			3.00
3.57	07-10-20	16.00			3.35
3.57	13-10-20	16.00			Dry

GENERAL REMARKS

Borehole terminated at a depth of 4.00 m due to dense gravel.

All dimensions in metres Scale 1:50	Method/ Plant Used Opendrive Sampler	Logged By LS

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Project				BOREHOLE No
247 Tottenham Court Road, London W1T 7QX				**BH2**
Job No	Date	Ground Level (m OD)	Co-Ordinates ()	
J20209	09-10-20 13-10-20	24.16		
Client	Engineer		Sheet	
	AKT II		1 of 3	

SAMPLES & TESTS			Water	STRATA				Instrument / Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
				23.66		(0.50) 0.50	CONCRETE	
		2,3/4,5,6,7 N60 = 27		22.56		(1.10) 1.60	Possible MADE GROUND (Soft becoming firm orange brown silty slightly sandy CLAY with rare decayed rootlets. Sand fine).	
		5,8/9,10,10,10 N60 = 47					Very dense orange brown very gravelly SAND. Gravel fine to coarse, angular to sub rounded of flint. Sand medium to coarse grained.	
		6,7/9,10,11,10 N60 = 49	1			(3.50)		
		4,5/6,7,7,8 N60 = 34	2					
		4,3/2,3,3,4 N60 = 15		19.06		5.10	Stiff brown becoming grey and very stiff fissured locally silty CLAY.	
		3,3/4,4,4,5 N60 = 21						

Boring Progress and Water Observations

Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth
4.10	09-10-20	16.00	4.10		4.00
4.10	12-10-20	13.30	4.10		3.00

GENERAL REMARKS

Borehole complete at a depth of 21.00 m.

All dimensions in metres Scale 1:50	Method/ Plant Used Cut down cable percussion	Logged By Driller

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Project				BOREHOLE No
247 Tottenham Court Road, London W1T 7QX				**BH2**
Job No	Date	Ground Level (m OD)	Co-Ordinates ()	
J20209	09-10-20 13-10-20	24.16		
Client		Engineer		Sheet
		AKT II		2 of 3

SAMPLES & TESTS			Water	STRATA				Instrument / Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
		3,4/4,5,5,5 N60 = 23					Stiff brown becoming grey and very stiff fissured locally silty CLAY.(continued)	
		4,5/6,7,7,8 N60 = 34				(15.90)		
		4,5/6,7,8,8 N60 = 35						

Boring Progress and Water Observations

Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth
15.00	13-10-20	08.00	5.50		Dry

GENERAL REMARKS

Borehole complete at a depth of 21.00 m.

All dimensions in metres Scale 1:50	Method/ Plant Used Cut down cable percussion	Logged By Driller

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Project				BOREHOLE No
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Job No	Date	Ground Level (m OD)	Co-Ordinates ()	
J20209	09-10-20 13-10-20	24.16		
Client		Engineer		Sheet
		AKT II		3 of 3

SAMPLES & TESTS			Water	STRATA				Instrument / Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
		4,5/7,8,8,9 N60 = 39		3.16		21.00	Stiff brown becoming grey and very stiff fissured locally silty CLAY.(continued)	

Boring Progress and Water Observations

Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth

GENERAL REMARKS

Borehole complete at a depth of 21.00 m.

All dimensions in metres Scale 1:50	Method/ Plant Used Cut down cable percussion	Logged By Driller

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Project				BOREHOLE No
247 Tottenham Court Road, London W1T 7QX				**BH3**
Job No	Date	Ground Level (m OD)	Co-Ordinates ()	
J20209	07-10-20	24.12		
Client		Engineer		Sheet
		AKT II		1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument / Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
				23.75		0.37	CONCRETE (rebar at 100 mm, 160 mm and 230 mm depth below surface, diameter of all 70 mm).	
						(1.43)	Soft becoming firm orange brown silty slightly sandy CLAY with rare decayed rootlets. Sand fine.	
				22.32		1.80		
			1			(1.50)	Very dense orange brown very gravelly SAND. Gravel fine to coarse, angular to sub rounded of flint. Sand medium to coarse grained. 2.20 - 2.60 ...sand more abundant, gravel fine.	
				20.82		3.30		

Boring Progress and Water Observations

Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth
3.30	07-10-20	16.00			3.24
3.24	13-10-20	16.00			Dry

GENERAL REMARKS

Borehole terminated at a depth of 3.30 m due to dense gravel.

All dimensions in metres Scale 1:50	Method/ Plant Used Opendrive sampler	Logged By JW

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Site Plan

Site 247 Tottenham Court Road, London

Client

Engineer AKT II

Job Number J20209

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