Appendix C

Chartered Geologist's Comments

Chord Environmental Ltd

Stephen Fisk
Soiltechnics Ltd
Cedar Barn
White Lodge
Walgrave
Northampton
NN6 9PY

Your Ref: 44 Goldhurst Terrace
Our Ref: 1127/LJE091117

For the attention of: Stephen Fisk

9th November 2017

44 Goldhurst Terrace: BIA Review

Dear Stephen,

Further to your instruction to proceed on behalf your clients (Ayelet Aperling and Nir Agam) I have undertaken a review of the Basement Impact Assessment (BIA) prepared by Soiltechnics Ltd for the proposed basement development at 44 Goldhurst Terrace (National Grid Reference TQ 2624 8436).

I have reviewed the design of the proposed basement development, together with the information presented within the above documents, against the requirements of the Camden BIA guidance set out within Policy A5 (Basements) of the Camden Local Plan (2017), Camden Planning Guidance (Basements and Lightwells CPG4) and the Camden geological, hydrogeological and hydrological study report 'Guidance for subterranean development ', produced by Arup on behalf of the London Borough of Camden.

Chord Environmental specialise in the provision of hydrogeological services with extensive experience in the UK supporting both private and public sector clients. I am a geologist and hydrogeologist and have a BSc. in geology from the University of Bristol, a MSc. in hydrogeology from the University of East Anglia and am also a Chartered Geologist and fellow of the Geological Society. I am Managing Director at Chord Environmental and was previously a Technical Director with Paulex Environmental Consulting and managed Hyder Consulting (UK) Ltd's groundwater team.

I have been a hydrogeologist for 20 years. During that time I have advised on over 150 basement developments. Much of my career has been spent assessing the impact of development on the quality and quantity of groundwater resources. I have worked for both promoters and regulators of schemes and have acted as an expert witness for the Highways Agency and on BIA schemes.

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Development proposal

The site is currently occupied by a four-storey terraced dwelling, comprising lower ground floor level, ground floor and two floors above within an urban area of Hampstead. Based on inspection of old Ordnance Survey maps the building was probably constructed in the late 1800s. The building is situated toward the east of the plot with front access from Goldhurst Terrace and rear garden to the west. External paved areas are located to the front/east and to the west within the garden area. General topographical levels fall in a southerly direction.

The proposal is for a single storey deep basement across the existing building footprint, and extending slightly into the rear garden area. The proposed scheme will include lightwells to the front and rear of the property. Underpinning will be required to perimeter load bearing walls to the existing building and new foundations below the existing lower ground floor allowing basement excavation.

Environmental Site Setting

The BIA screening assessment and site investigation interpretation has identified the 44 Goldhurst Terrace to be underlain by the Eocene London Clay as shown on the British Geological Survey 1:50,000 scale map (Sheet 256 – North London) to a depth of c.80m. The London Clay is classified as Unproductive Strata by the Environment Agency, strata with low permeability that have negligible significance for water supply or base flow to rivers. The very low permeability of the London Clay results in very low rates of rainfall infiltration and correspondingly, very high rates of rainfall runoff. The London Clay, together with the clays of the Lambeth Group, acts as an effectively impermeable confining layer over the Chalk which lies at a depth of over 100m beneath the site.

A ground investigation borehole established the presence of London Clay beneath a 1.1m covering of Made Ground. No groundwater or seepages were encountered within the London Clay within the entire 5.75m depth of the borehole. The well-known low permeability of the London Clay prevents it from transmitting groundwater flow or supporting a water table however localised pockets of groundwater may be encountered within impersistent relatively permeable horizons.

There are no surface water features within 500m of the site on the Ordnance Survey 1:25,000 scale map. Figure 11 of the "Camden Geological, Hydrogeological and Hydrological Study", shows headwater tributary of the former river Westbourne watercourse to have run approximately 80m to the west of the proposed development. The Westbourne is now culverted and discharges to the Thames.

The 44 Goldhurst Terrace was identified as being one of the roads affected by the surface water flooding events of the area which occurred during 2002 however it was not affected by the 1975 surface water flooding events and it does not lie within an area of fluvial or tidal flood risk as designated by the Environment Agency.

Surface Flow and Flooding Assessment

The BIA screening, scoping and risk assessments have followed the CPG4 guidance criteria and screening questions. The potential surface flow and flooding issue raised by the screening and scoping exercises have been appropriately addressed by Soiltechnics within the report and no areas of concern relating to the proposed development were identified.

Subterranean (Groundwater) Flow Screening Assessment

The BIA screening, scoping and risk assessments have followed the CPG4 guidance screening questions. I have commented on the answer to each question below.

- **Question 1a: Is the site located directly above an aquifer?**

  As the Site is mapped as being underlain by a significant thickness of London Clay, designated as Unproductive Strata by the Environment Agency, I agree it is not located above an aquifer. The geology of the areas is well understood and the ground investigation has confirmed the presence of London Clay.

- **Question 1b: Will the proposed basement extend beneath the water table surface?**

  No. No groundwater or seepages were encountered within the London Clay through the full depth of the site investigation borehole of 5.75m. The cohesive London Clay is not capable of transmitting groundwater flow or supporting a water table under normal hydraulic gradients. Monitoring boreholes drilled within the London Clay often fill slowly with groundwater over time or encounter isolated pockets within impersistent bands. However there is little or no hydraulic continuity between boreholes due to the very low permeability of the clay and ability of the clay matrix to hold or adsorb water.

- **Question 2: Is the site within 100m of a watercourse, well (used/disused) or potential spring line?**

  No mapped surface water features are present within 500m of the site. The London Clay is not capable of providing groundwater baseflow to watercourses and is classified Unproductive Strata. The proposed basement would therefore not act to prevent groundwater flow to any watercourses, wells or spring lines.

- **Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?**

  No. The Site is located more than 1.7km south, and down topographic gradient, of the Hampstead Heath ponds and therefore lies outside their hydrological catchment area (refer to Figure 14 of the Camden Geological, Hydrogeological and Hydrological Study).

- **Question 4: Will the proposed development result in a change in the proportion of hard surfaced / paved area?**

  Yes. The proposed basement development would result in a marginal increase in hard-standing. However, given the site is underlain by Unproductive Strata this is not considered important from a groundwater viewpoint.

- **Question 5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to ground (e.g. via soakaways and/or SUDS)?**

  No. The lowly permeable nature of the London Clay strata is unsuitable for receiving surface water discharge to ground due to extremely low infiltration rates.

- **Question 6: 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 (not just the pond chains on Hampstead Heath) or spring line?**

  No - I agree there are no mapped local groundwater dependent ponds or spring lines present within 100m of the Site. This is consistent with the geology and hydrogeology of the area.

Slope Stability Assessment

The BIA screening, scoping and risk assessments have followed the CPG4 guidance criteria and screening questions. The potential slope stability issues raised by the screening and scoping exercises have been appropriately addressed by Nigel Thornton (C.Eng) of Soiltechnics Ltd within the BIA report and no areas of concern relating to the proposed development were identified.

Conclusions

The BIA report has appropriately characterised 44 Goldhurst Terrace with respect to its geological and groundwater site setting. As the site is underlain by low permeability London Clay, the geological and hydrogeological setting of 44 Goldhurst Terrace is not sensitive with respect to groundwater resources or flow. Isolated pockets of groundwater may be encountered during excavation and some form of groundwater control may be required through sump pumping however significant inflows of groundwater are not anticipated.

The purpose of the Basement Impact subterranean or groundwater flow assessment is to identify the potential for the proposed basement development to cause groundwater impacts and subsequently identify areas which require further investigation. The proposed development would be sited within a significant thickness of London Clay and no potential adverse groundwater impacts have been established by these assessments.

Yours sincerely,

John Evans BSc MSc CGeol.

Director

THE GEOLOGICAL SOCIETY
CGeol
CHARTERED GEOLOGIST
Fellow No. 1012979

Appendix D

Borehole Records

Key to legends, columns & water observations
Driven tube sampling

soiltechnics
environmental and geotechnical consultants

Key to legends

Composite materials, soils and lithology

Topsoil	Made Ground	Boulders
Chalk	Clay	Coal
Cobbles	Cobbles & Boulders	Concrete
Gravel	Limestone	Mudstone
Peat	Sand	Sand and Gravel
Sandstone	Silt	Silt / Clay
		Siltstone

Note: Composite soil types are signified by combined symbols.

Key to 'test results' and 'sampling' columns

Test result

Depth	Records depth that the test was carried out *(i.e.: at 2.10m or between 2.10m and 2.55m)*
Result	PID - Photo Ionisation Detector result (ppm equivalent Isobutylene) PP – Pocket penetrometer result (kN/m^2) HVP – Hand held shear vane result (kN/m^2) *PP result converted to an equivalent undrained shear strength by applying a factor of 50. Where at least 3 results obtained at same depth then an average value may be reported.*
	SPT – Standard Penetration Test result (uncorrected) *SPT(c) – Standard Penetration Test result (solid cone) (uncorrected)*

Sampling

From (m) To (m)	Records depth of sampling	
Type	D	Disturbed sample
	B	Bulk disturbed sample
	ES	Environmental sample comprising plastic and/or glass container
	W	Water sample
	U (32)	Undisturbed sample 100mm diameter sampler with number of blows of driving equipment required to obtain sample

Water observations

Described at foot of log and shown in the 'water strike' column.

= water level observed after specified delay in drilling

= water strike

Standpipe details

Gravel filter
Arisings
Bentonite
Slotted pipe
Unslotted pipe

Density

Density recorded in brackets inferred from density testing and soil descriptions from across the site (i.e.: [Medium dense]).

WELL	STRATA				WATER STRIKES	SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	Scrub over soft dark grey gravelly CLAY with frequent rootlets. Gravel consists of angular brick. (MADE GROUND)											0.10	0.20	D
	Firm brown mottled orange brown slightly sandy silty CLAY and occasional black decomposed roots up to 2mm in diameter. Gravel consists of brick and occasional coal fragments. (MADE GROUND)	0.30										0.30	0.40	D
												0.50	0.60	D
												0.90	1.00	D
						S 1.00-1.38	(0) 7							
	Firm medium strength light brown silty CLAY with occasional coarse sand sized selenite crystals, and occasional black decomposed roots up to 2mm in diameter. (LONDON CLAY FORMATION)	1.10										1.10	1.20	D
										PP 1.20	PP=42			
										PP 1.30	PP=46			
										PP 1.40	PP=63	1.40	1.50	D
										PP 1.50	PP=63			
										PP 1.60	PP=50			
										PP 1.70	PP=46			
										PP 1.80	PP=54	1.80	1.90	D
										PP 1.90	PP=54			
	Stiff high strength brown mottled light grey silty CLAY with occasional coarse sand sized selenite crystals, and occasional decomposed roots up to 2mm in diameter observed up to 3m depth. (LONDON CLAY FORMATION)	2.00				S 2.00-2.45	(2) 10					2.10	2.20	D
												2.40	2.50	D
										PP 2.50	PP=117			
										PP 2.60	PP=104			
										PP 2.70	PP=88			
										PP 2.80	PP=104	2.80	2.90	D
										PP 2.90	PP=113			
	CONTINUED ON NEXT SHEET													

Key

D Small Disturbed Sample
B Bulk Disturbed Sample
ES Environmental Sample
W Water Sample
C Core sample
UT Undisturbed Sample

S Standard Penetration Test
C Standard Penetration Test (solid cone)

PP Pocket Penetrometer test
SV Shear Vane test
PID Photo Ionisation Detector test

Notes

Groundwater observations
No groundwater encountered.

Title
Driven tube sampler record

Recovery details	
Range (m)	Recovery (%)
0.00 - 1.00	100
1.00 - 2.00	100
2.00 - 2.80	100
2.80 - 3.50	100
3.50 - 4.50	100

Method Driven tube sampler	**Logged by** SJF	**Date(s)** 21/08/2017
Level (m OD)	**Compiled by** MC	**Sheet number** Sheet 1 of 2
Co-ordinates	**Checked by** SD	**DTS01**

Report ref: STP4007D-G01 **Revision:** 0

WELL	STRATA				WATER STRIKES	SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	Stiff high strength brown mottled light grey silty CLAY with occasional coarse sand sized selenite crystals, and occasional decomposed roots up to 2mm in diameter observed up to 3m depth. (LONDON CLAY FORMATION)									PP 3.00	PP=129			
										PP 3.10	PP=113	3.10	3.20	D
										PP 3.20	PP=133			
										PP 3.30	PP=129			
										PP 3.40	PP=133	3.40	3.50	D
						S 3.50-3.95	(4) 14			PP 3.50	PP=125			
										PP 3.60	PP=113			
										PP 3.70	PP=121			
		3.80								PP 3.80	PP=129	3.80	3.90	D
	Stiff high strength and very high strength finely laminated light brown occasionally mottled light grey silty CLAY with occasional coarse sand sized crystals of selenite. (LONDON CLAY FORMATION)									PP 3.90	PP=142			
										PP 4.00	PP=146			
										PP 4.10	PP=169	4.10	4.20	D
										PP 4.20	PP=146			
										PP 4.30	PP=158			
										PP 4.40	PP=163	4.40	4.50	D
						S 4.50-4.95	(4) 15			PP 4.50	PP=142			
										PP 4.60	PP=167			
										PP 4.70	PP=175			
										PP 4.80	PP=154	4.80	4.90	D
										PP 4.90	PP=183			
												5.00	5.10	D
										PP 5.10	PP=192			
										PP 5.20	PP=179	5.20	5.30	D
						S 5.30-5.75	(4) 18			PP 5.30	PP=196			
	BOREHOLE TERMINATED AT 5.75m	5.75												

Key

D Small Disturbed Sample
B Bulk Disturbed Sample
ES Environmental Sample
W Water Sample
C Core sample
UT Undisturbed Sample

S Standard Penetration Test
C Standard Penetration Test (solid cone)

PP Pocket Penetrometer test
SV Shear Vane test
PID Photo Ionisation Detector test

Notes

Groundwater observations

No groundwater encountered.

Title

Driven tube sampler record

Recovery details	
Range (m)	Recovery (%)
0.00 - 1.00	100
1.00 - 2.00	100
2.00 - 2.80	100
2.80 - 3.50	100
3.50 - 4.50	100

Method Driven tube sampler	**Logged by** SJF	**Date(s)** 21/08/2017
Level (m OD)	**Compiled by** MC	**Sheet number** Sheet 2 of 2
Co-ordinates	**Checked by** SD	**DTS01**

Report ref: STP4007D-G01 **Revision:** 0

Appendix E

Trial Pit Records

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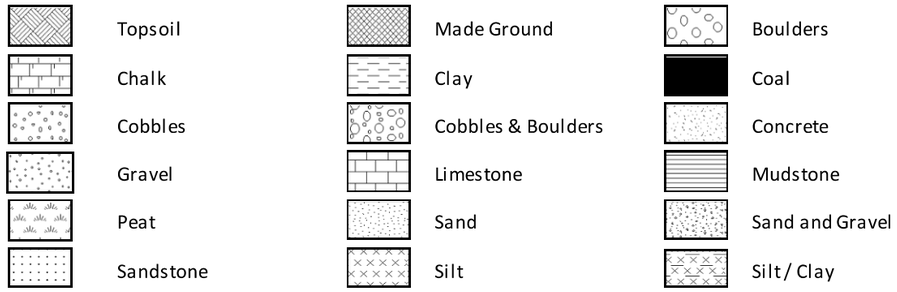
environmental and geotechnical consultants

Key to legends

Composite materials, soils and lithology



Note: Composite soil types are signified by combined symbols.

Key to 'test results' and 'sampling' columns

Test result

Depth	Records depth that the test was carried out (i.e.: at 2.10m or between 2.10m and 2.55m)
Result	PID - Photo Ionisation Detector result (ppm equivalent Isobutylene) PP – Pocket penetrometer result (kN/m²) HVP – Hand held shear vane result (kN/m²) *PP result converted to an equivalent undrained shear strength by applying a factor of 50. Where at least 3 results obtained at same depth then an average value may be reported.*

Sampling

From (m) To (m)	Records depth of sampling	
Type	D	Disturbed sample
	B	Bulk disturbed sample
	ES	Environmental sample comprising plastic and/or glass container
	W	Water sample
	CBR	Undisturbed sample in mould (California Bearing Ratio)

Water observations

Described at foot of log and shown in the 'water strike' column.

▼ = water level observed after specified delay in excavation

▽ = water strike

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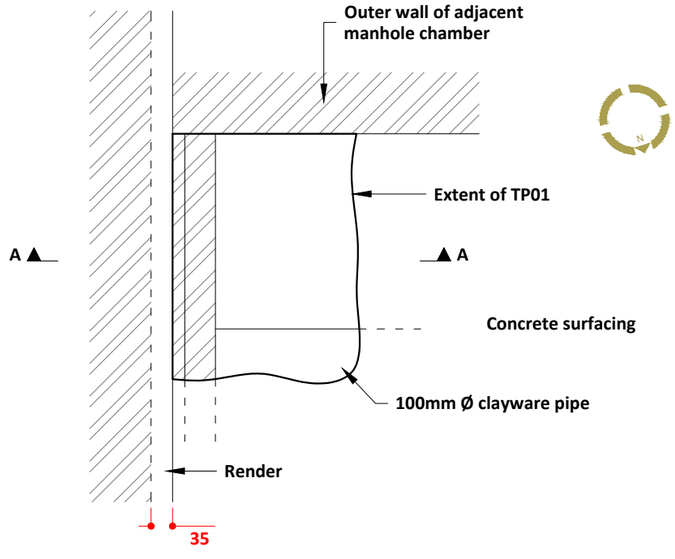
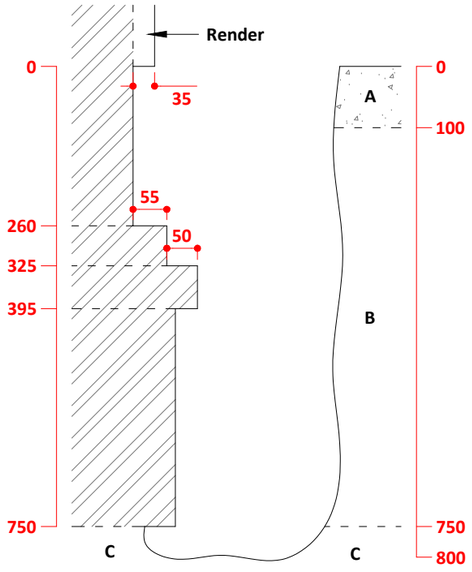
Plan



Section A-A



Photographic record

Key

A. CONCRETE.
(MADE GROUND)

B. Medium dense black, grey and red sandy GRAVEL. Gravel consists of brick, ash, coal, concrete and flint.
(MADE GROUND)

C. Firm to stiff brown grey silty CLAY.
(LONDON CLAY FORMATION)

Observed features
Assumed features

Denotes brickwork **Denotes concrete**

Notes

1. All dimensions shown in millimetres.

Method of excavation		Title	Location reference
Hand tools		Trial pit record	TP01
Dimensions		Date of works	Location plan on drawing number
As shown		21.08.2017	02
Groundwater observations		Scale	Appendix
No groundwater encountered		1:10 at A3	E

Appendix F

Masonry Strain Calculations

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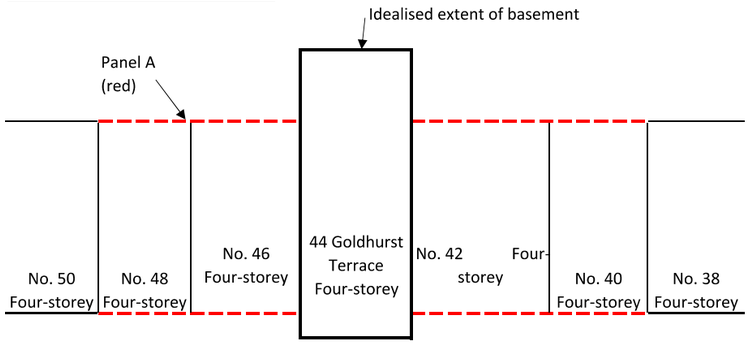
Calculation sheet - Masonry Panel A

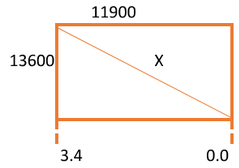


Dig depth (m)	3.4
Inward yield (mm)	5.1
Surface settlement (mm)	3.4

Vertical		horizontal	
Radius (m)	Settlement (mm)	Radius (m)	Settlement (mm)
0	3.4	0	5.1
2.975	2.55	3.4	3.825
5.95	1.7	6.8	2.55
8.925	0.85	10.2	1.275
11.9	0	13.6	0

Masonry Panel A (x 4)

Consider panel A for adjacent properties on Goldhurst Terrace as indicated above - all measurements in mm

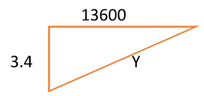


X= 18071
net settlement = 3.4

Tensile strain in vertical

$\frac{3.4}{18071} * 100$ = 0.0188144 % Burland Category 0

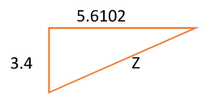
Tensile strain in horizontal



Y = 13600.0004

$\frac{0.00042}{11900} * 100$ = 0.0000036 % Burland Category 0

Tensile strain in diagonal



Z= 6.560023

$\frac{6.56}{18071} * 100$ = 0.0363009 % Burland Category 0

Tensile strain on adjusted horizontal diagonal

$\frac{6.56}{11900} * 100$ = 0.0551262 % Burland Category 1

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