

22011 69 Cromwell Avenue, N6 5HS
September 2022 Basement Impact Assessment (BIA)

22011-MHA-ZZ-ZZ-RP-S-001

Rev	Description	Date
P01	Information	26 September 2022
P02	SI Report Extracts Added	01 December 2022

Prepared Michael Hadi BEng (Hons) CEng MStructE
 & Robert Dean BEng (Hons) CEng MStructE

Authorised Michael Hales BEng CEng MStructE FICE

Issued Robert Dean BEng (Hons) CEng MStructE

London
+44 (0) 20 7375 6340

Cambridge
+44 (0) 1223 776340

mhastructuraldesign.com

Registered in England & Wales
Company No. 04718155

Non-Technical Summary

This note forms a Basement Impact Assessment (BIA), as set out by Haringey Council's Basement Development Guidance Note.

The construction of the basement is feasible and will not have an adverse impact on flooding, surface water flow, groundwater flow, ground stability or adjacent structures.

A safe method and sequence of construction using normal reinforced concrete construction techniques and traditional underpinning has been identified.

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This note has been prepared for the benefit of the Client and others can take no reliance without written consent from MHA Structural Design Ltd.

1.0 Introduction

69 Cromwell Avenue is a semi-detached three storey residential property, presumably constructed during the Victorian period. It is located in the Highgate Conservation Area and is not Listed.

It is proposed that a full-storey basement be provided under the footprint of the majority of the existing property, as shown on the indicative section below (superseded drawing, refer to Edencoast Ltd's latest).



An existing ground floor single storey extension is to be demolished and replaced by a shallower (in terms of depth down the rear garden) single storey construction and side extension.

New lightwells are to be created and at the rear this is combined with an access staircase.

Number 67 Cromwell Avenue, which is semi-detached to #69, does not have a basement.

The information contained in this note is based upon:

- Haringey Council's Basement Development Guidance dated June 2012.
- Site Visits
- Edencoast's architectural drawings.
- Site trial pit findings
- British Geological Survey (BGS) Maps and borehole logs.
- Environment Agency's Flood Maps.
- Haringey Council's Strategic Flood Risk Assessment dated February 2015.
- London Underground's Property Asset Register website.
- Ciria C760 – Guidance on embedded retaining wall design
- Groundwise Utilities Report (including Thames Water and LUL data)
- Soil Consultants' ground investigation report – 21/11/22 (ref. 10769/JM)

Relevant extracts from these documents may be found in the appendices accompanying this note.

Michael Hadi Associates was formed in 1998 (rebranded to MHA Structural Design in 2022) and have undertaken numerous basement projects in the London region.

For ease of reference, the text summarising what a BIA should include, from Haringey Council's Basement Development Guidance (9.3.4), is pasted below:

- Groundwater flow
- Land Stability
- Surface flow and flooding
- Cumulative development and
- Construction management

And should include the following stages:

- Stage 1 – Screening
- Stage 2 – Scoping
- Stage 3 – Site investigation and study
- Stage 4 – Impact assessment
- Stage 5 – Review and decision making (by Haringey).

2.0 The Existing Site and Structure

The site is generally level, but it is located near the top of Highgate Hill. London Underground's Property Asset Register website shows the spot level in the road of Cromwell Avenue to be 104.8m. The level of Hornsey Lane, to the south backing onto the site, is 99.6m. A large retaining wall forms the rear boundary to the site (this is to remain untouched).

The structure to the original main house is traditional with a timber roof, load-bearing masonry external walls, load-bearing stud internal walls, some steel transfer beams, timber joisted floors and spread footings with brick corbels.

The property is unoccupied, and a soft strip has taken place to clearly reveal the structure.

The existing structure is not exhibiting any visual signs of distress.

3.0 Nearby Structures

The existing structures near the proposed basement are as described below.

67 Cromwell Avenue is semi-detached to the north of #69 and appears to be of the same construction. A front basement was not visible to #67.

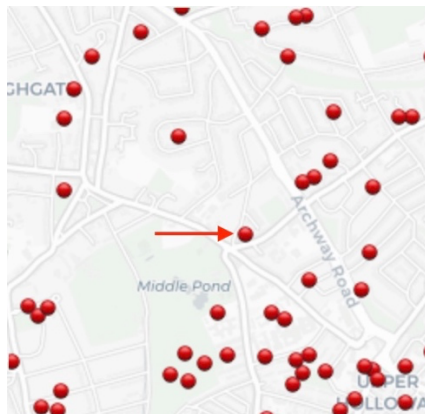
71 Cromwell Avenue to the south of #69 is separated by an access alleyway and also appears to be of the same construction and constructed at the same time. A front basement was also not visible to #71. A Haringey planning portal search has shown that permission was granted for a basement extension in 2010 (ref. HGY/2010/1453), with a scheme that would not be visible from the front of the property, but we are informed that this has not been constructed.

As described above, a large retaining wall (>4m) forms the rear boundary at the end of the garden to #69.

There are no LUL or TfL tunnels under the site or nearby. An extract from TfL Property Asset Register Map can be found in Appendix F.

4.0 Bomb Damage

The London County Council Bomb Damage Maps indicate that the property did not sustain any damage during the bombing raids of the Second World War, although it is possible that their survey terminated at the borough edge nearby. The Bomb Sight website shows a hit near the site (extract below).



5.0 Geology & Hydrogeology

British Geological Survey (BGS) maps (see Appendix C) indicate the site to be located along the boundary of the Claygate Member (clay, silt & sand) and the Bagshot Formation (sand).

A BGS borehole log 190m to the northeast shows the top 4.5m to be soft yellow sandy clay over hard blue clay.

A BGS borehole log 175m to the northwest shows made ground to a depth of 0.75m; over medium dense yellowish brown slightly clayey silty fine sand to a depth of 1.3m; over medium dense yellowish brown slightly clayey silty fine sand with occasional subrounded gravel to a depth of 2m; over soft to firm

yellowish brown and grey mottled silty sandy clay with lenses of silty fine sand to a depth of 6.6m.

Extensive trial pit investigations have been undertaken (6 No) and the results are presented in Appendix D. The yellow sandy clay, described in the nearby borehole logs, was located in all of the trial pits.

The Claygate Member is classified as a secondary aquifer, but all trial pits, some 2m deep, were found to be dry upon completion and during a subsequent visit a month later.

A specialist site investigation by Soil Consultants, including boreholes, has been undertaken and extracts are contained in Appendix G. The investigations show that the basement formation level will be within the Bagshot Formation, a competent bearing material, and groundwater was not observed in the boreholes (max depth 5m) or in subsequent monitoring visits.

In Haringey Council's Strategic Flood Risk Assessment (SFRA) it states that it was concluded in the North London SFRA that Haringey was not at risk of groundwater flooding. This is demonstrated by Map 12 of London Regional Flood Risk Appraisal Draft December 2017.

6.0 Site Hydrology and drainage

The last known course of the Cholmeley Brook, a culverted tributary of the Moselle river, is approximately 175m to the northwest at its closest point (see Appendix E).

The Environment Agency's (EA) Flood Map (Appendix E) shows the site to be located in Flood Zone 1, defined as land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%) and is therefore considered to be at low risk of flooding (see Appendix G). No flood mitigation measures are deemed to be required.

Haringey's SFRA (figure 6-7) shows the site location not to be in an area at risk of surface water flooding.

It is proposed that the basement be protected from water ingress by meeting the requirements of BS 8102:2009 – Code of practice for protection of below ground structures against water from the ground. Combined protection (2-systems) is proposed, probably using a drained cavity system and structurally integral protection (controlling reinforced concrete crack-widths and water bars at day-joints).

The proposed basement extension will not result in an increase in the area of impermeable surface finishes within the site. Most of the existing site has hard-standing.

7.0 Outline Basement Structural Method Statement

It is proposed to construct the reinforced concrete basement retaining walls for the basement using a hit and miss (appropriately spaced) stripped underpinning sequence in order to minimise disturbance to the existing adjacent structures. The width of the strips and pins will generally be around 1.2m. The basement floor slabs will also be constructed from insitu reinforced concrete to provide a rigid connection to restrain and stiffen the retaining walls and to resist the applied moments.

This form of construction, with relatively rigid propped-cantilever retaining walls, is well known by ground-works contractors and there are many examples of where it has been successfully used. The technique will maintain the lateral support of the soil and therefore adjacent structures, by the provision of sheeting and props during the construction of the pin and then by the pin itself upon completion. Reinforcement is to be continuous across adjacent pins and therefore limiting relative movement. To facilitate construction, areas of the ground floor are to be temporarily removed and temporary propping is to be provided at ground floor level to restrain the masonry walls, along with some permanent full-width steel propping sections.

The ratio of the distance from the Party Wall to the return walls of #69 is to the excavation depth is approximately 0.05 (0.1m/2m) at the closest point, noting that the existing top of soil level has been found to be around 0.7m below the internal ground finished floor level (therefore 2.6m excavation required). With reference to figure 6.16 in CIRIA publication C760 'Guidance on embedded retaining wall design' (extract below), the lower-bound curve predicts settlement to be 0.22% of excavation depth (i.e. 5.7mm). This figure maybe considered to be highly conservative, as most case-history suggests expected settlements of around 0.1% (i.e. 2.6mm). The settlement resulting from properly executed underpinning, undertaken by a member of The Association of Specialist Underpinning Contractors (ASUC), will be within acceptable limits and at worst may result in minor cracking to applied plaster or paintwork. Based on our engineering judgement and experience we do not expect any damage to exceed Category 2 – Slight (after Burland et al). It is recommended that a condition survey be taken of the adjacent walls prior to any works being undertaken as part of the Party Wall Agreement so that the effects of any minor movement that may occur can be more easily monitored and rectified.

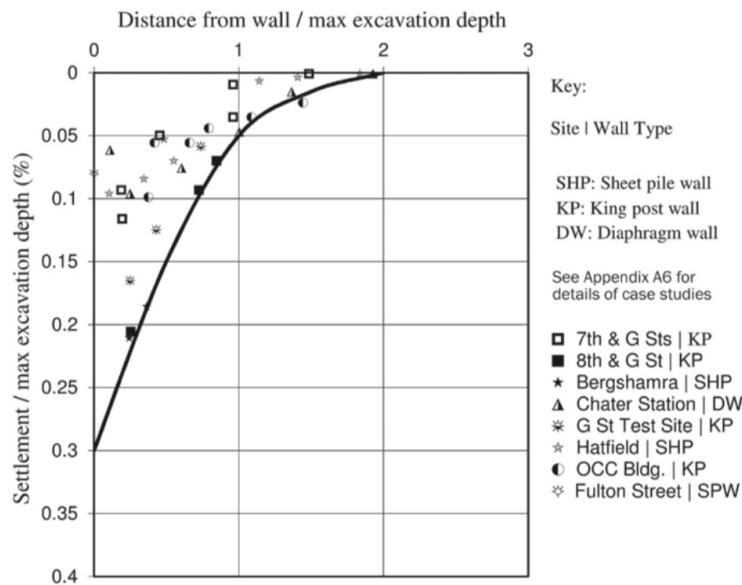


Figure 6.16 Ground surface settlement due to excavation in front of wall in sand

8.0 Cumulative Development

Beyond the existing coal-cellars to the relatively uniform Victorian properties on the street, basements are not present in the vicinity of #69. Cumulative effects are therefore not deemed to be significant.

We are not aware of other nearby basement schemes in construction or submitted for planning approval.

In terms of groundwater flow, Arup's Residential Basement Study, Report of Findings, dated April 2016, for Lambeth states '*A solitary, isolated basement which intersects the groundwater table is unlikely to affect the groundwater flows in the wider area: the water will simply flow around the obstruction. The effects on water level are likely to be small and less significant than seasonal or other existing variations in the groundwater table.*'

Ground water has not been found in the deep trial pits or the boreholes investigations. We conclude that the proposed basement will have minimal impact on groundwater flow and there is unlikely to be an increase in the level of the groundwater profile. The groundwater is unlikely to be impeded by the basement development or possible surrounding future basements, as gaps between basements will prevent a significant backing up of groundwater.

9.0 Construction Management

As is normal the Construction Management Plan (CMP) will be developed by the contractor appointed to carry out the works and will be subject to review and amendment during the course of the works.

The construction of the property is feasible, without significantly disturbing local residents or local traffic flows.

The key contact will be the Site Manager; their name and address will be provided. 24 hour emergency contact details will be displayed at the site.

Adjoining occupiers likely to be affected by proposals and any local amenity society or residents group will be kept informed about the programme of works and any significant changes to the programme or changes to the key contact details.

A complaints process and log will be in place on site.

The Site Manager will be made aware of and take all reasonable measures to comply with any conditions attached to the planning permission and notify the relevant council officers of any changes during the course of works. The Site Manager will be made aware of the relevant contacts in the council's Building Control, Environmental Health and Highways teams.

Party Wall Awards will be agreed with all neighbours who are required to be notified under the act.

Under the construction contract the site manager will take responsibility for managing the site according to best practice, the contract documents and Haringey's guidelines.

Working hours will comply with Haringey Council's standard requirements, i.e. Monday to Friday 8am – 6pm and Saturdays 8am – 1pm.

The site manager will maintain a dialogue with adjoining occupiers in relation to working hours and where practicable seek to avoid any particularly noisy operations at any sensitive times.

The Contractor will adhere to and respect any restrictions on working hours or the enforcement of silent periods throughout the day, which may be imposed by the Local Authority, Contract Documents or the Party Wall requirements.

Demolition and excavation dust on site will be controlled by the watering of work at basement level. Water will not be used at ground floor level or above so as to protect the fabric. Inlets to the drainage system will be protected with filters banded with sandbags to prevent slurry runoff entering the system.

Skips to collect excavated soil will be placed on the driveway to #69.

All deliveries will be made on a just-in-time basis with calls made to the site manager with an expected time of arrival so the driveway and space outside can be made clear ahead of arrival. The stacking of vehicles or parking within residents' parking bays will not be allowed. Vehicles will mainly be skip lorries and concrete trucks during the basement works and then reducing to smaller vehicles for the later construction phases.

All waste substances from the site shall be disposed of offsite, under the appropriate Duty of Care and subject to approvals/consents from the relevant statutory bodies. Recycling is to be undertaken wherever appropriate. All vehicles leaving site carrying potentially dust-generating demolition or construction waste are to be completely sheeted with tarpaulin or netting, in good condition.

All site activities will be placed behind hoarding to limit the effect of the works on the public.

All live emergency exits and access routes on site will be maintained at all times.

10.0 Stage 1 - Screening

The purpose of the screening stage is to identify Issues of Concern and which require further investigation and analysis. The screening is also a process to determine whether or not a full Basement Impact Assessment is required. Answers of 'No' indicate that no further investigation is generally required.

#	Criteria	Issue of Concern ?	Notes
	Groundwater Flow		
1	Is the site located directly above an aquifer?	No	Site is located above Claygate Member which is classified as a secondary aquifer. However, the soils investigation has not found groundwater. The underlying London Clay is defined as non-aquifer or unproductive strata.
2	Will the proposed basement extend beneath the water table surface?	No	The lower (chalk) aquifer is estimated to be more than 70m below the proposed formation level of the basement. Perched water was not found in the made ground above the London Clay during trial pit investigations.
3	Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	No	The last known course of the Cholmeley Brook, a tributary of the Moselle river, is approximately 175m to the north west at its closest point.

4	Will the proposed basement development result in an increase in the proportion of hard surfaced or paved areas?	No	The site is currently hard-paved.
5	As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	No drainage will be discharged directly into the ground, only into the sewer system.
	Surface Flow & Flooding		
6	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	The site is currently hard-paved.
7	As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be increased or materially changed from the existing route?	No	The site is currently hard-paved and therefore water flows will not increase or materially change.
8	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	There will be no changes to the nature of surface water discharged from site.
9	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	No	See 7 above.

10	Is the site in an area known to be at risk from surface water flooding or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?	No	The site is in Flood Zone 1 of the Environment Agency Flood Map for Planning.
	Land Stability		
11	Does the existing site include significant slopes, natural or manmade.	No	The site is generally level.
12	Will the proposed works significantly change slopes at the site boundary.	No	Slopes at the site boundary will remain unchanged.
13	Does the development neighbour land, including railway cuttings and the like, with a significant slope.	No	There is a significant change in level at the south eastern boundary with a substantial retaining wall, the land on the site being highest. The surcharge on the retaining wall will be unaffected or nominally reduced by the proposed works.
14	Is the London Clay the shallowest strata at the site.	No	The British Geological Survey (BGS) and investigations indicate the Bagshot Formation (Sand) and overlying the London Clay at this location. BGS shows the site to be at the border with the Claygate Member (Clay, Silt and Sand).
15	Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	No trees will be felled.
16	Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No	The clay fraction of the nearby Claygate Member is susceptible to seasonal shrink-swell subsidence. There is however no evidence of such effects on the site. The formation level of the deepened lower ground floor is deeper than the zone of influence of nearby trees.

17	Is the site within an area of previously worked ground?	No	There is likely to be worked ground behind the retaining wall mentioned at 13 above. However, the proposed works are remote from the wall and the likely area of worked ground.
18	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No	Site is located above Claygate Member and London Clay, defined as non-aquifer or unproductive strata.
19	Is the site within 5m of a highway or pedestrian right of way?	No	The deepened basement and minor lightwell are approximately 3.5 and 2.5m, respectively from the front garden wall bounding the public footpath. The construction sequence and method of basement construction (using tried and tested underpinning techniques) will minimise effects on adjacent structures.
20	Will the proposed basement significantly increase the risk of differential foundation movement relative to neighbouring properties?	No	The existing basement footings are formed between approx. 1.5 and 3.0m below ground level. Thus the depth of underpinning required is some 0.35 to 1.85m. The clay portion in the Bagshot Formation at basement formation level is low, limiting the risk of significant heave or differential settlement. The risk of damage with the works undertaken by an ASUC member is low and will not exceed , at worst, Category 2 (Slight – Burland et al).

21	Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	The TfL Asset Register indicates the Northern Line tunnel is some 250m to the north east at it's closet point. The site is not within the tunnel's exclusion zone.
Cumulative Development			
22	Are nearby basements under construction or have been submitted for planning approval?	No	A site visit and planning portal search has not revealed nearby basements under construction or in planning.
23	Will the groundwater flow be significantly affected?	No	Refer to section 8.0 of text.
Construction Management			
24	Are there any unusual site constraints that prevent safe execution of the works.	No	A competent contractor to be appointed to carry out the Works. To see safe execution of the works, competent contractor to develop Construction Management Plan (CMP) for design team and LPA approval prior to commencement of the works.
25	Are there any unusual site conditions that would cause excessive disruption to the neighbours during execution of the works (noise, vibration, dust).	No	A competent contractor to be appointed to carry out the Works. To see minimal disruption to neighbours arising from the works, competent contractor to develop Construction Management Plan (CMP) for design team and LPA approval prior to commencement of the works.
26	Are there any unusual site conditions that would give rise to risk of harm to pedestrian, cycle, vehicular and road safety, adversely affect bus or other transport operations, significantly increase traffic congestion or place unreasonable inconvenience on the day to day activities of those living, working or visiting nearby.	No	A competent contractor to be appointed to carry out the Works. To prevent harm arising from the works, competent contractor to develop Construction Management Plan (CMP) for design team and LPA approval prior to commencement of the works.

11.0 Stage 2 – Scoping

The purpose of Stage 2 is to assess the potential impacts arising from the proposed scheme that the Stage 1 Screening has indicated are Issues of Concern.

Note that site investigations (Stage 3) have been undertaken in parallel with the screening assessment.

Issues of Concern arising from the Screening and mitigating actions are as follows:

Groundwater Flow	None
Surface Flow and Flooding	None
Land Stability	None
Cumulative Development	None
Construction Management	Competent contractor to be appointed to carry out the Works. Competent contractor to develop Construction Management Plan (CMP) for design team and Haringey Council approval prior to commencement of the works.

12.0 Stage 4 - Impact Assessment

Issues of Concern have not been identified during the Scoping Stage in relation to Groundwater Flow; Surface Flow and Flooding; Land Stability; and Cumulative Development.

Under Construction Management, the need for a competent contractor to undertake the works has been highlighted and for them to develop an appropriate Construction Management Plan.

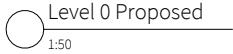
Appendix A – MHA's Structural Drawings for the Basement

22011-MHA-ZZ-B1-DR-S-100 - Lower Ground Floor Proposed GA

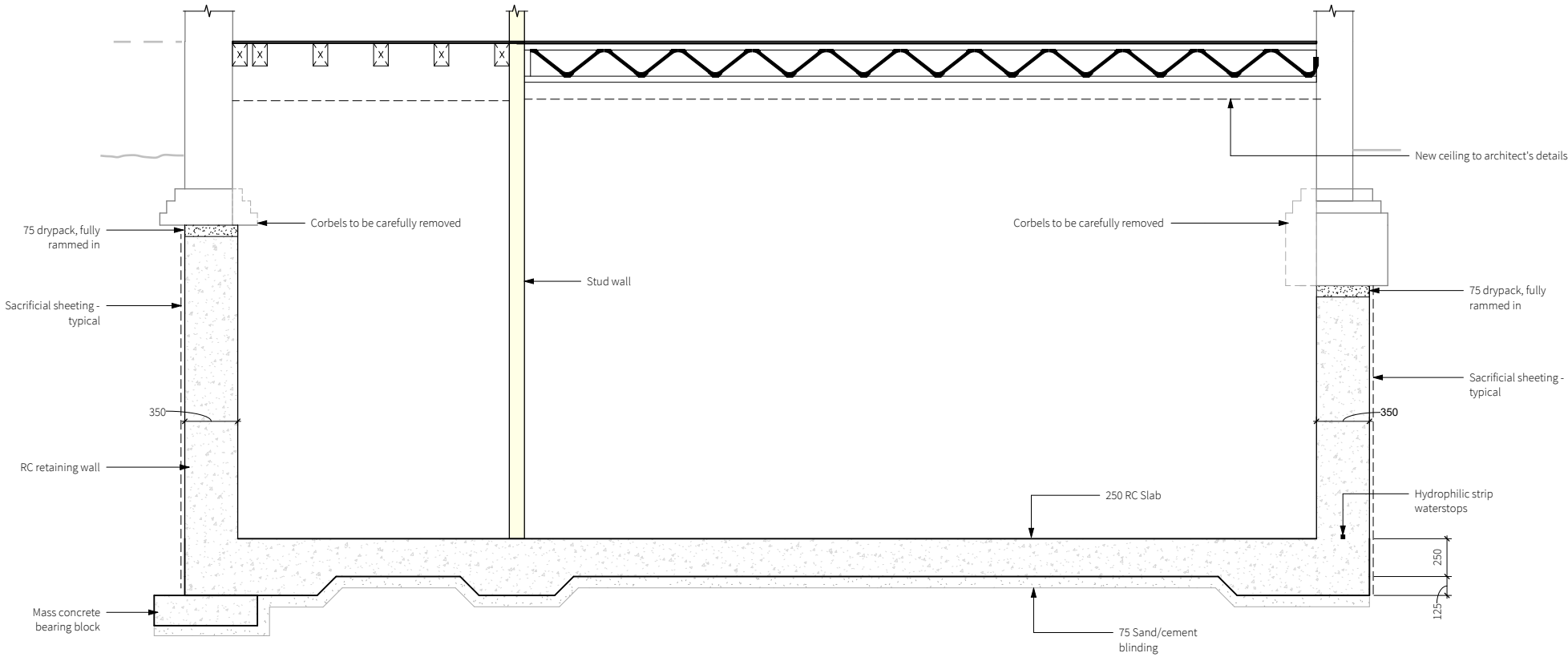
22011-MHA-ZZ-00-DR-S-101 - Ground Floor Proposed GA

22011- MHA-ZZ-ZZ-DR-S-300 - Lower Ground Section

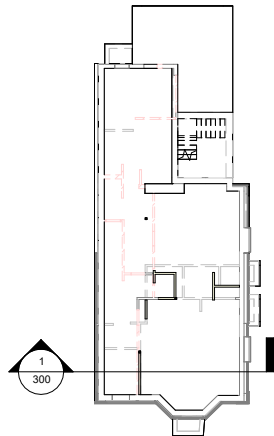




Rev	Date	Drawn	Amendments
Status			
Preliminary			
MHA STRUCTURAL DESIGN		MHA Structural Design LTD 14-18 Old Street London, EC1Y 9BH +44 (0)207 375 6340 Cambridge +44 (0)1223 776340 mhastructuraldesign.com	
Project Title			
69 Cromwell Avenue, N6 5HS			
Drawing Title			
Ground Floor Proposed GA			
Drawing No.			
22011- MHA-ZZ-00-DR-S-101			
Scale	Drawn	Checked	
1 : 50	FC	RD	
Project No.	Drawing No.	Revision	
22011	101		



1 Section 1
1:20



- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 2. Do not scale off this drawing.
 3. All dimensions are to be confirmed on site by the contractor.

Rev	Date	Drawn	Amendments
Status			
Preliminary			
Project Title			
69 Cromwell Avenue, N6 5HS			
Drawing Title			
Lower Ground Section			
Drawing No.			
22011- MHA-ZZ-ZZ-DR-S-300			
Scale	Drawn	Checked	
As indicated	FC	RD	
Project No.	Drawing No.	Revision	
22011	300		

Appendix B – Site Photographs



Photo 1 – The Front of the Property



Photo 2 – The Rear of the Property



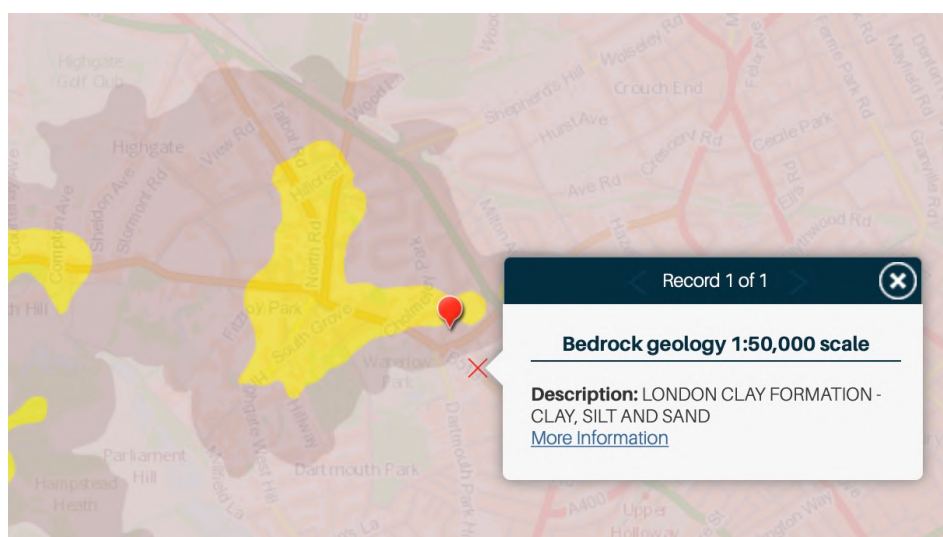
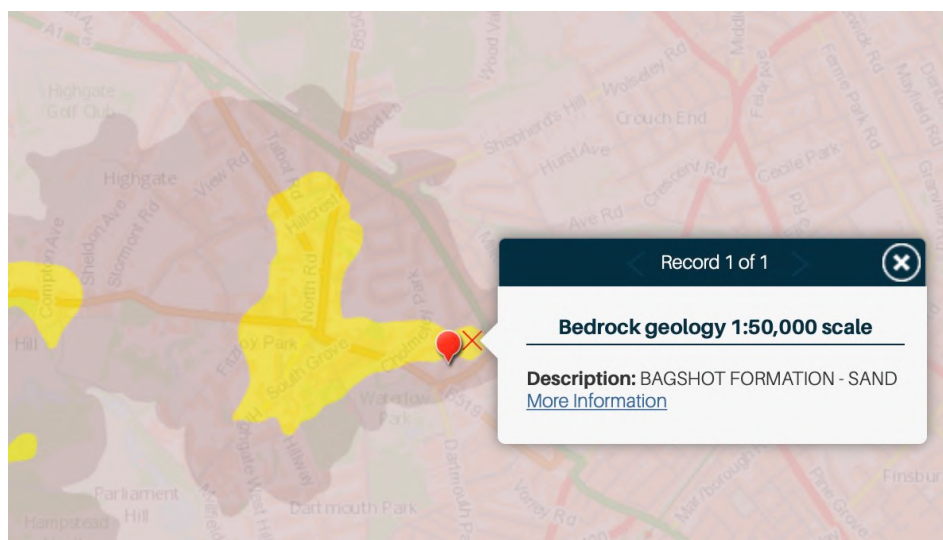
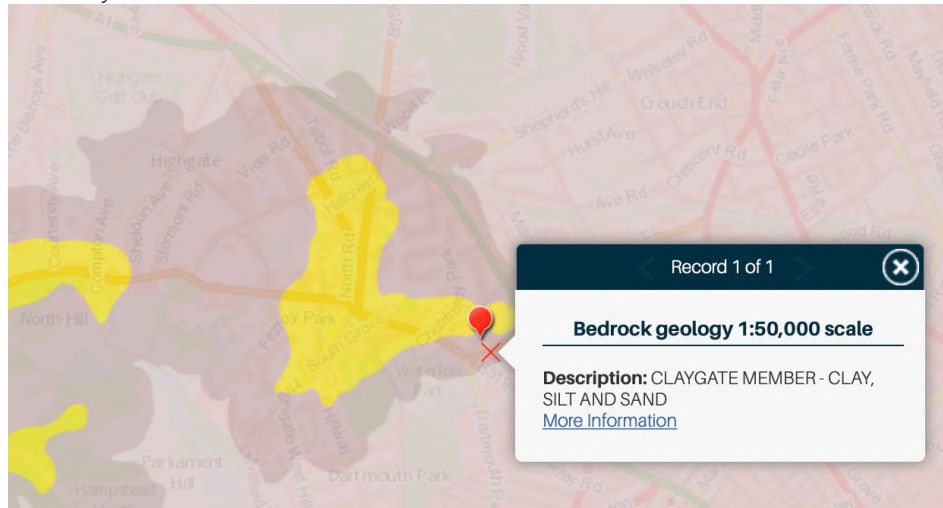
Photo 3 – Ground Floor looking towards the rear



Photo 4 – Ground Floor looking down the hallway to the front

Appendix C – British Geological Survey (BGS) maps and borehole logs

Only bedrock without any superficial deposits shown on the maps. Site is on the boundary between recorded bands.



GEOLOGICAL SURVEY OF GREAT BRITAIN RECORD OF SHAFT OR BORE FOR MINERALS		(For Survey use only) 6-inch Map Registered No.						
Name of Shaft or Bore given by Geological Survey:		TQ28NE/15						
Name and Number given by owner: C.2. Reservoir, Hornsey Lane N 6.		Nat. Grid Reference 2908. 8739						
For whom made		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; padding: 5px;"> 1" N.S. Map No. </td> <td style="width: 33%; padding: 5px;"> 1" O.S. Map No. </td> <td style="width: 33%; padding: 5px;"> Confidential or not </td> </tr> <tr> <td colspan="3" style="padding: 5px; text-align: center;"> 256 </td> </tr> </table>	1" N.S. Map No.	1" O.S. Map No.	Confidential or not	256		
1" N.S. Map No.	1" O.S. Map No.		Confidential or not					
256								
Town or Village <i>Wood Green Hornsey</i> county								
Exact site		Attach a tracing from a map, or a sketch-map if possible.						
Purpose for which made <i>Hampstead Tube</i>								
Ground Level at shaft bore relative to O.D. <i>306.99</i>								
Made by		Date of sinking						
Information from		Date received						
Examined by								

(For Survey use only) GEOLOGICAL CLASSIFICATION	DESCRIPTION OF STRATA	THICKNESS		DEPTH	
		FT.	IN.	FT.	IN.
CB LC	Soft yellow sandy clay Hard blue clay	15	-	-	16.0
		50	-	65	15.0

22056 – 69 Cromwell Avenue
Basement Impact Assessment

RECORD OF BOREHOLE 1

NGR: 2880 8744

OD + 106.07m

APPENDIX
JOB NO 025/607
MADE BY P.R.
DATE MADE 29.1.96.

DAILY PROGRESS	DEPTH TO WATER	DEPTH OF CASING	SAMPLES		TYPE	LEG- END	DEPTH	REDUCED LEVEL	DESCRIPTION OF STRATA
			FROM	TO					
	m	m	m	m			m		
									GROUND LEVEL 11.54 m Datum
		NONE	0.30	0.60	B		0.07	11.47	MADEGROUND (Tarmacadam)
		NONE	0.75	1.20	U(102)		0.75	10.79	MADEGROUND (soft brown clayey silty sand with bricks and gravel)
13.12.85	Nil.	1.00			D				Medium dense yellowish brown slightly clayey silty fine SAND.
16.12.85		1.00	1.25		D				
		1.30	1.30	1.75	B		1.30	10.24	
	Nil.	1.30	1.45	1.75	C(15)				Medium dense yellowish brown slightly clayey silty fine SAND with occasional subrounded gravel.
							2.00	9.54	
	Nil.	1.90	2.00	2.45	U(102)				
			2.50		D				
			2.65		D				
	Nil.	1.80	2.65	2.95	S(10)				
		3.00	3.00		D				
		3.20	3.26		W				Soft to firm yellowish brown and grey mottled silty sandy CLAY with lenses of silty fine sand, some unstained surfaces at lower levels.
	Nil.	3.20	4.00	4.45	U(102)				
	+4.50	3.20	4.50		D				
		3.20	4.65		D				
	Nil.	3.20	4.65	4.95	S(8)				
		5.50	5.50	5.95	U(102)				
			6.00		W				
	+6.00	5.50	6.00		D				
		5.50	6.15		D				
		5.50	6.15	6.45	S(14)		6.60	4.94	
		6.50	6.60		D				
	Nil.	6.70	6.70	7.15	U(102)				
			7.20		D				
			7.35		D				
16.12.85	Nil.	6.70	7.35	7.65	S(14)				Firm to stiff dark greyish brown silty sandy CLAY
17.12.85	7.10								
		7.35	8.20	8.65	U(102)				
			8.70		D				
			8.95		D				
	Nil.	7.35	8.95	9.15	S(23)		8.70	2.84	
	+8.70								
		7.35	9.70	10.15	U(102)				Firm dark greyish brown silty sandy CLAY with bands of greenish grey clayey silty sand.

REMARKS

- Water struck at 4.50m rose to 3.26m in 30 mins. inflow sealed at 5.0m.
- Water struck at 6.00m rose to 5.40m in 10 mins. inflow sealed at 6.7m.
- Water struck at 8.70m did not rise.
- Water struck at 10.20m rose to 9.20m in 1hr. inflow sealed at 13.20m.
- Water level observation tube installed to 5m.
Gravel filter material from 0.0m to 3.50m.
Grout (bentonite/cement) 15.00m to 5.50m and 3.50m to 1.00m.
Bentonite grout 5.50m to 3.0m.
Concrete 1.00m to 4.4.
- Water level in observation tube 18.12.85 16.30hrs 4.30m.
- Ground levels relative to site datum M.W.B. stopcock cover in road opposite Cromwell Lodge. given arbitrary value 10.00m.

TYPE OF BORING

Light cable percussive

DIAMETER OF BORING

200 mm. to 15.20m.

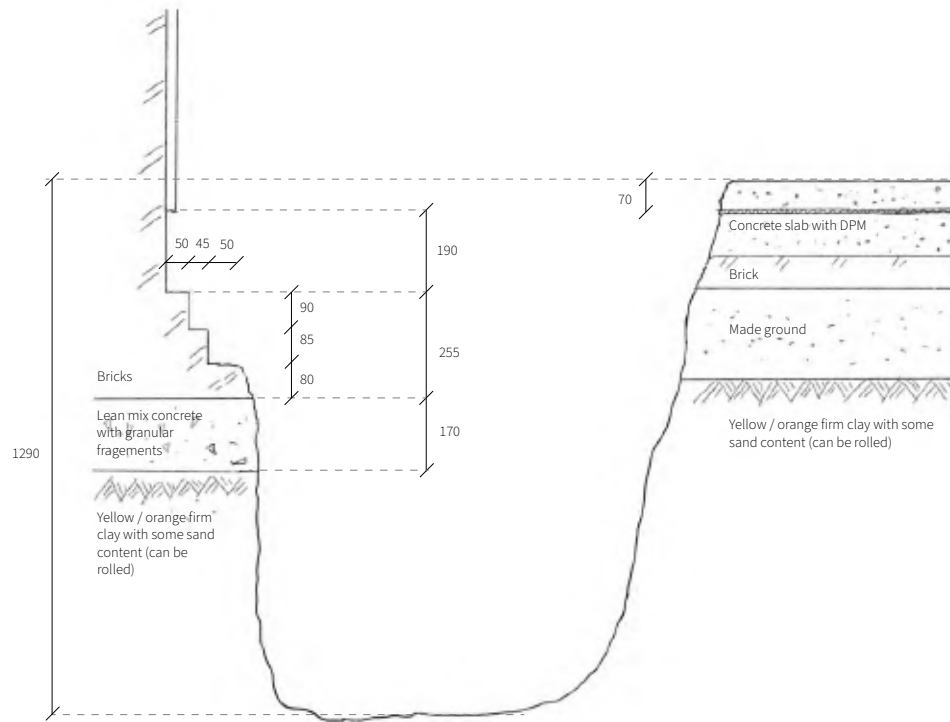
CASING TUBES

200 mm to 14.70m.

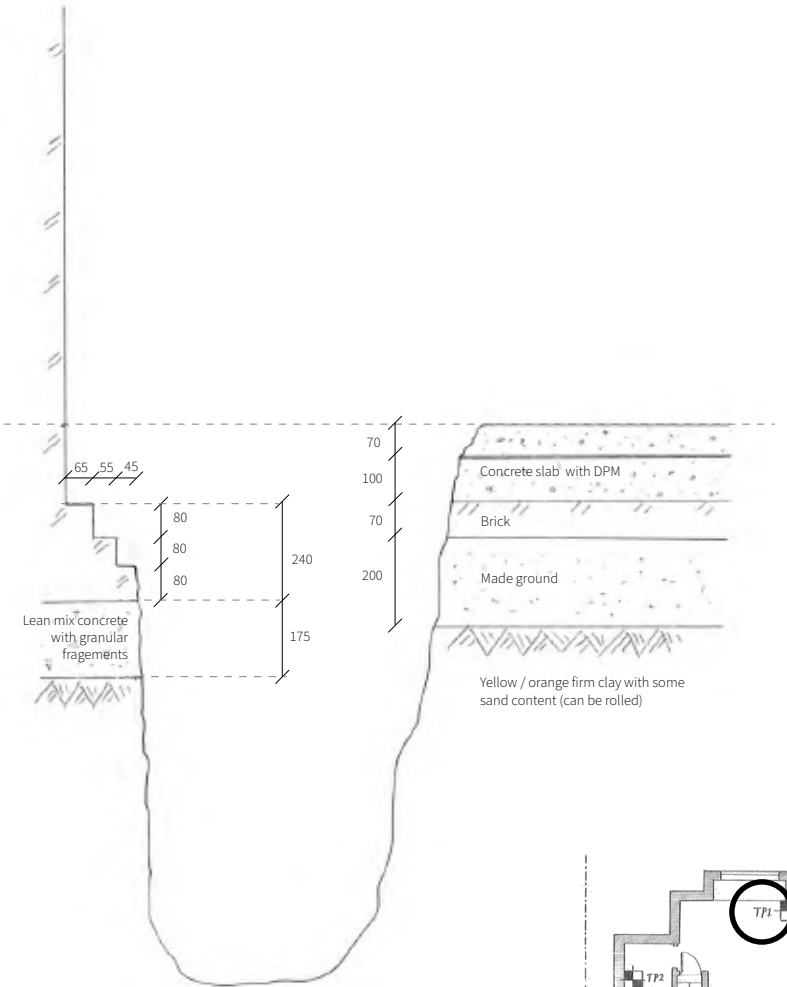
BOREHOLE 1

Appendix D – Trial Pit Logs

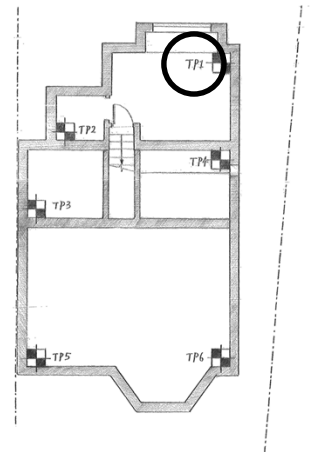
22011 / 69 Cromwell Avenue N6, Trial Pit Logs - 18/08/22



TP1 Section Through Rear Wall



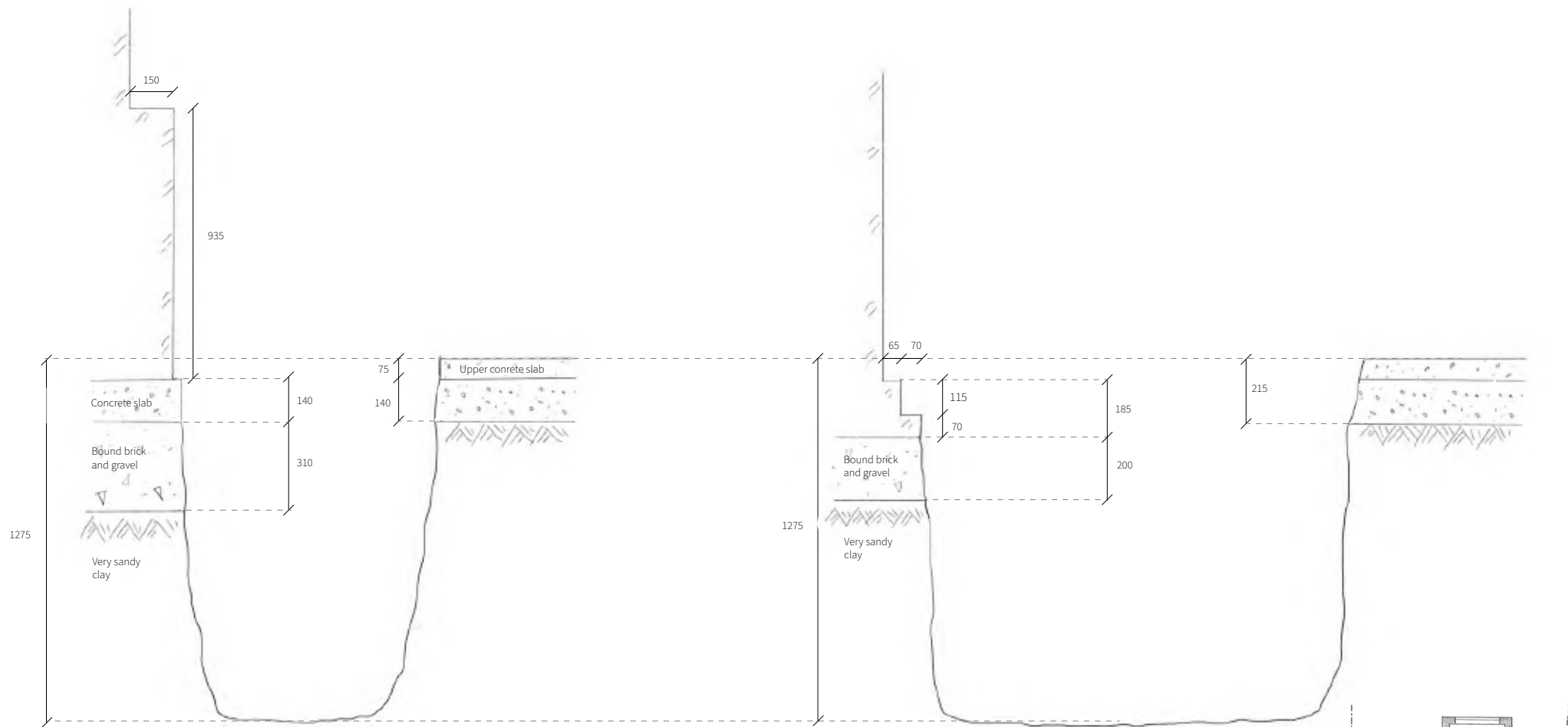
TP1 Section Through Flank Wall



TP1

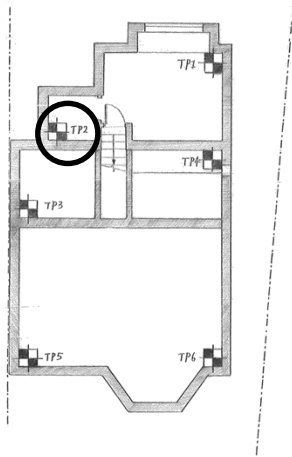


22011 / 69 Cromwell Avenue N6, Trial Pit Logs - 18/08/22



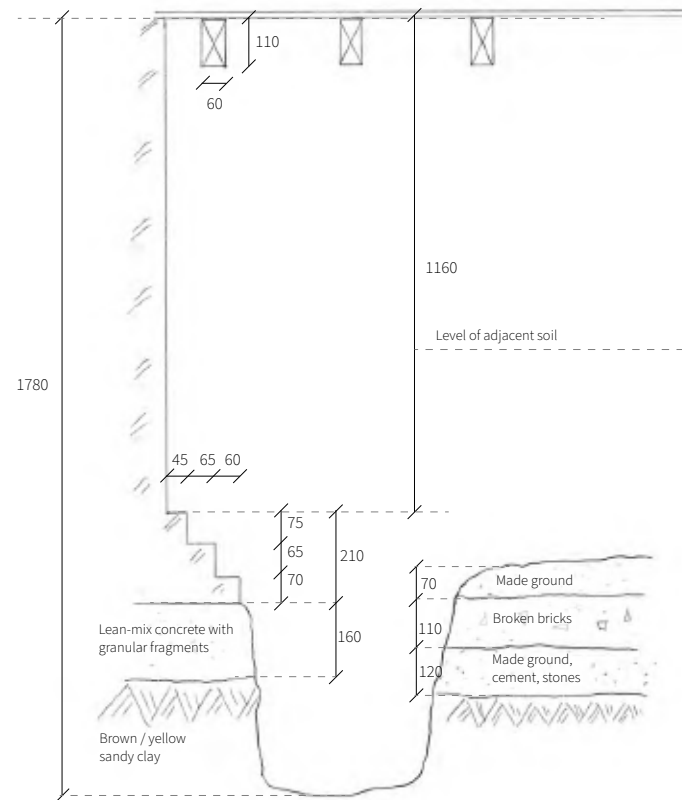
TP2 Section Through Internal Wall Parallel to Party Wall

TP2 Section Through Internal Wall Perpendicular to Party Wall

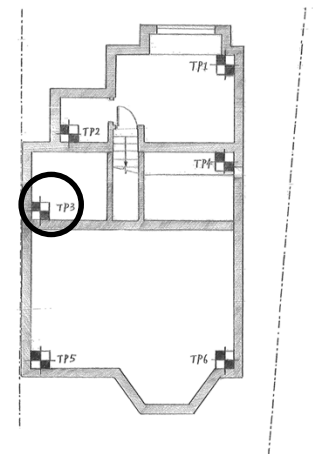




22011 / 69 Cromwell Avenue N6, Trial Pit Logs - 21/09/22



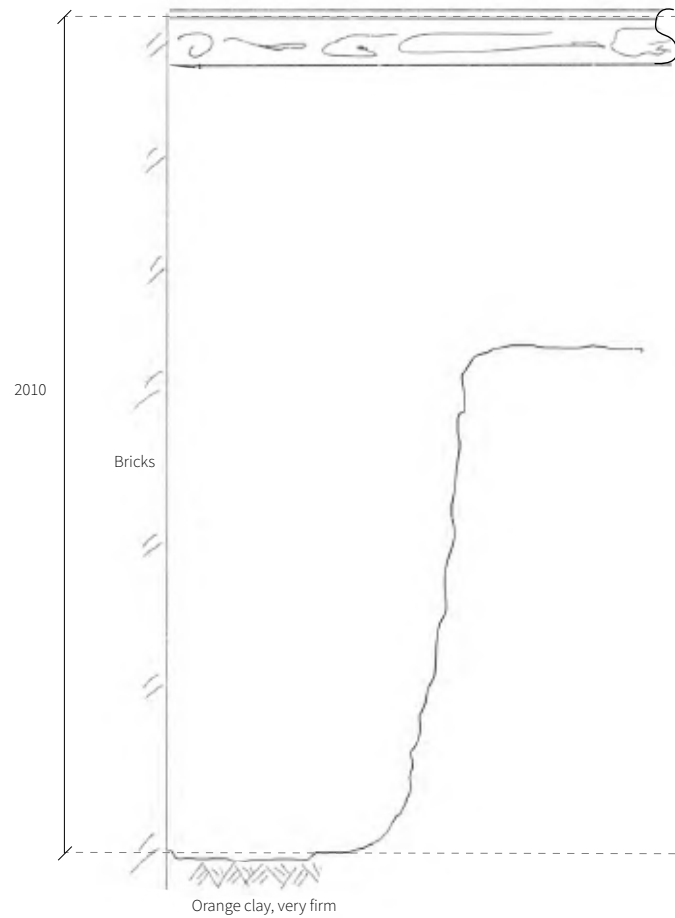
TP3 Section Through Party Wall



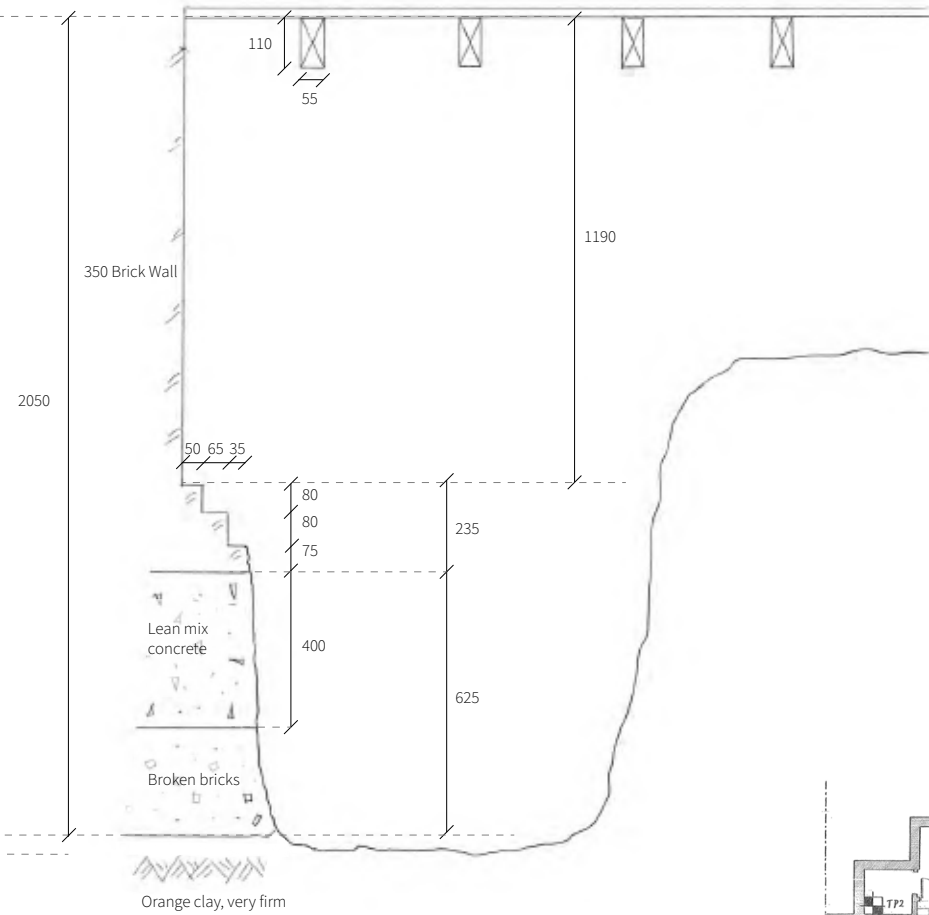
TP3



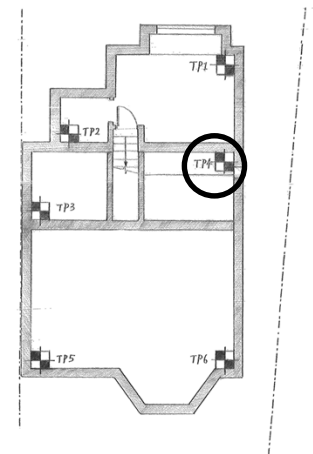
22011 / 69 Cromwell Avenue N6, Trial Pit Logs - 18/08/22



TP4 Section Through Internal Wall



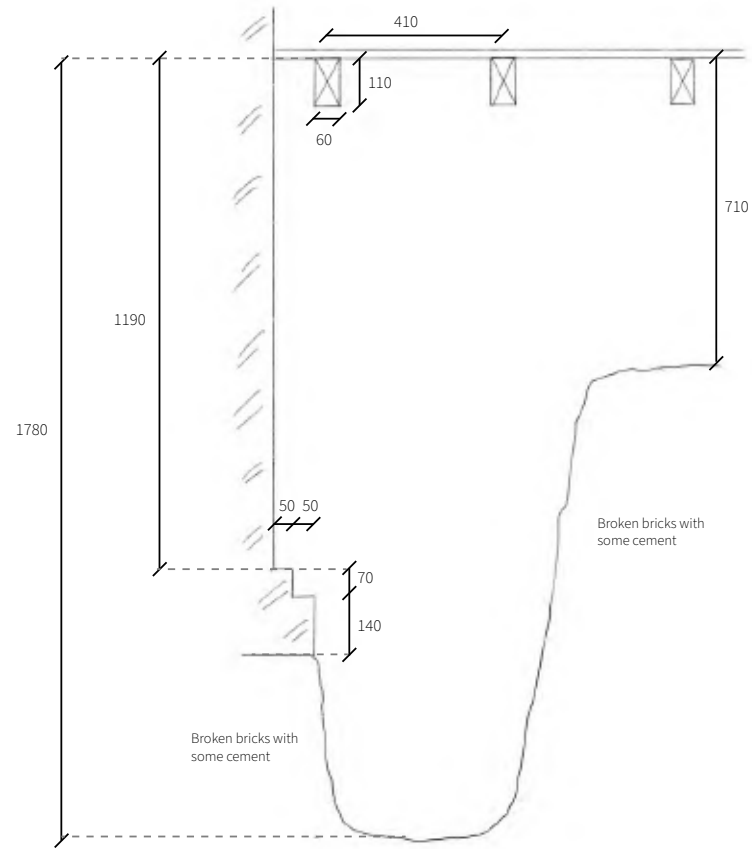
TP4 Section Through Flank Wall



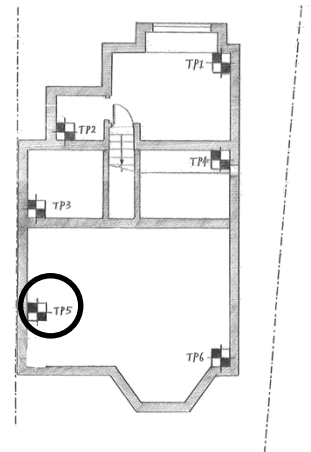
TP4



22011 / 69 Cromwell Avenue N6, Trial Pit Logs - 21/09/22



TP5 Section Through Party Wall



TP5

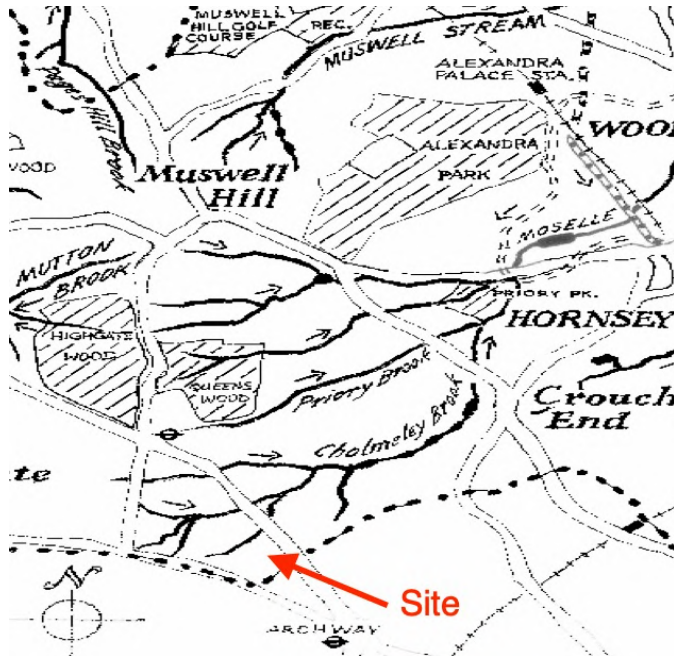


Architectural cross-section drawing of a wall and foundation. The wall is 1930 units high. The top section is 710 units high and contains four windows with widths of 415, 380, 390, and 62 units. The lower section is 1870 units high and contains a brickwork section 580 units high and a sandier soil section 520 units high. The foundation is made of yellow/orange sandy clay. The wall is made of bricks with mortar and cement. The ground is made of made ground and broken bricks.

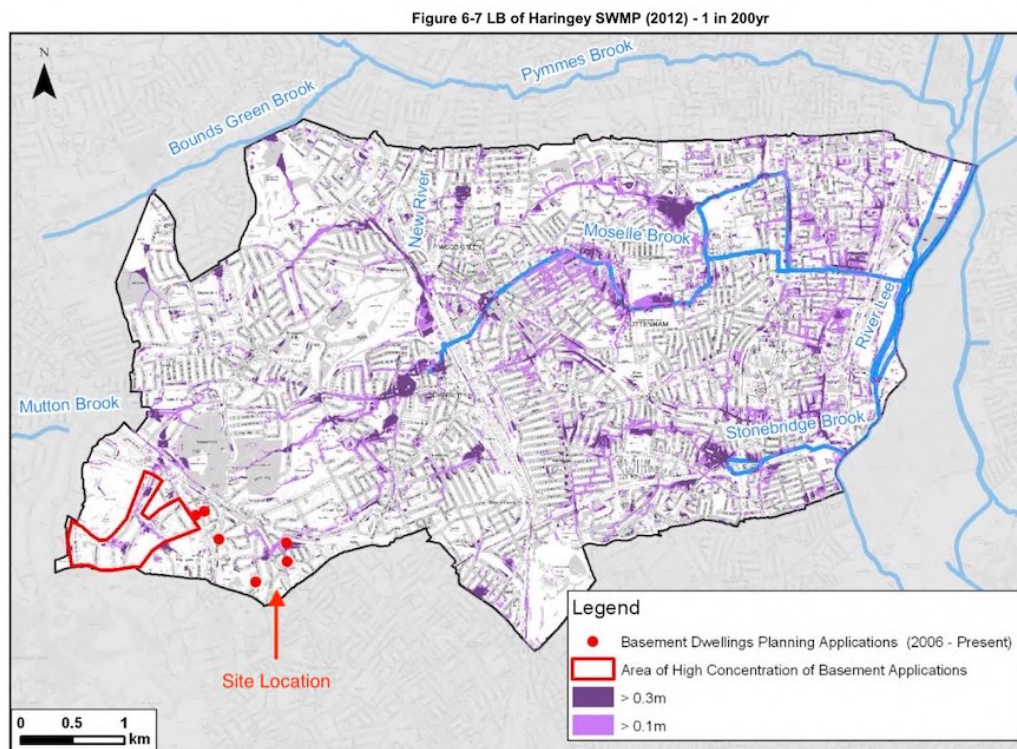
TP6



Appendix E – EA Flood Risk Map, Haringey's SWMP & Haringey's Streams

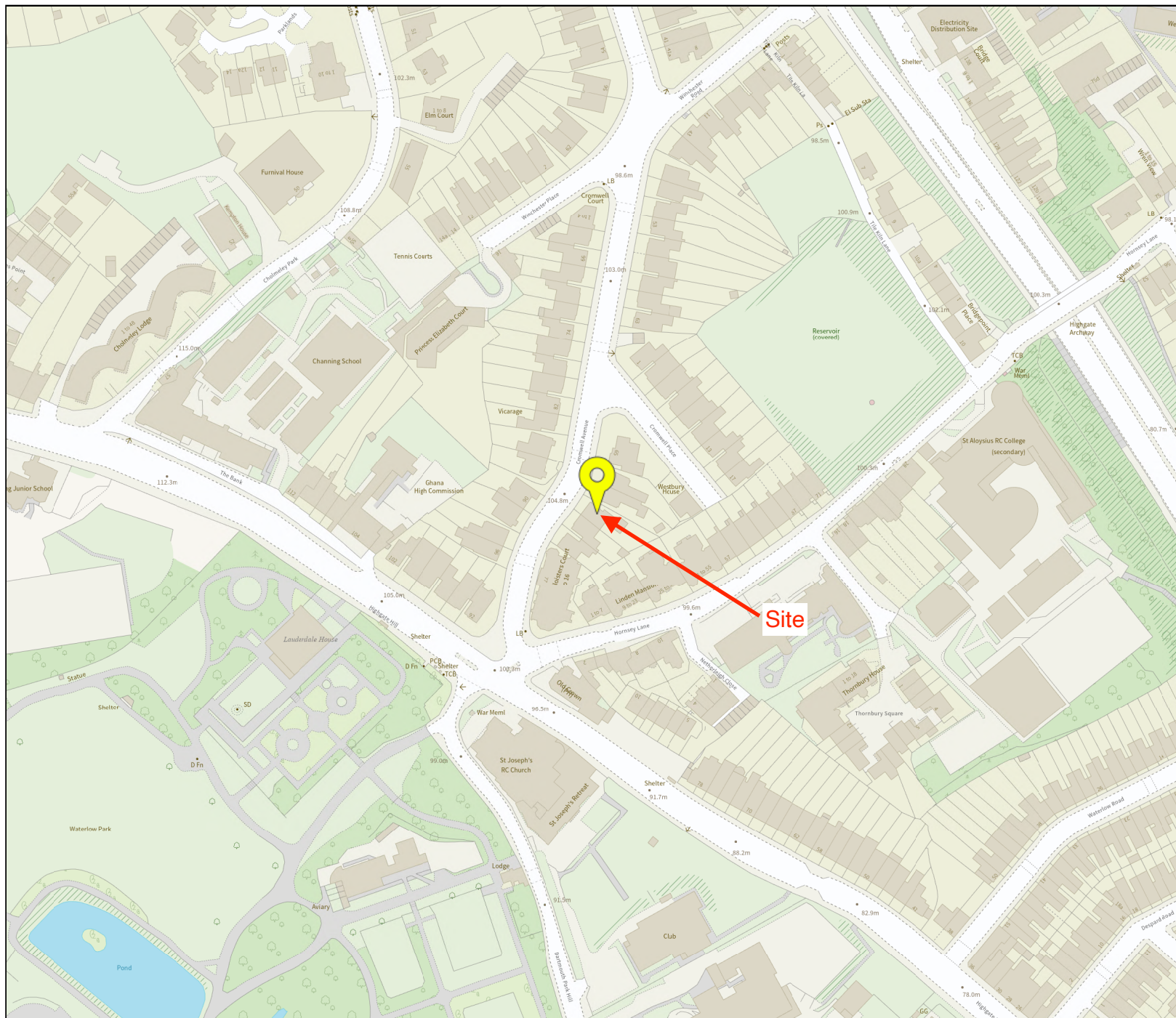


Marked up extract showing streams from Haringey Council's Basement Guidance Note



Contains Ordnance Survey data © Crown copyright and database right 2012

Marked up extract from Haringey Council's Strategic Flood Risk Assessment showing the Surface Water Management Plan (SWMP) [no surface water flooding concerns]



Flood map for planning

Your reference

22011 - 69 Cromwell Ave

Location (easting/northing)

528904/187296

Scale

1:2500

Created

25 Aug 2022 9:31



Selected point



Flood zone 3



Flood zone 3: areas
benefitting from flood
defences



Flood zone 2



Flood zone 1



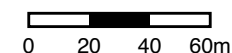
Flood defence



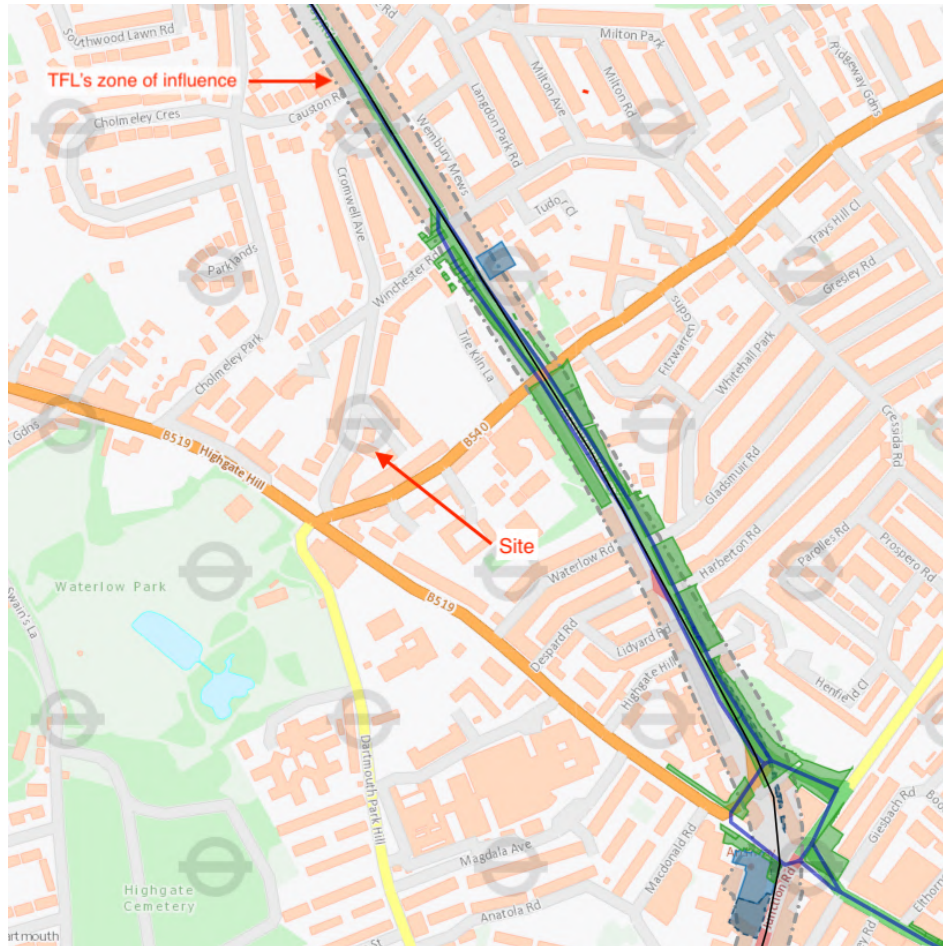
Main river



Water storage area



Appendix F – TfL's Asset Register



Appendix G – Extracts from Soil Consultant's Ground Investigations

Note, Soil Consultants' full ground investigation report was submitted to Haringey Council on 25/11/22.

SITE INVESTIGATION REPORT

PROPOSED REDEVELOPMENT:

69 CROMWELL AVENUE, LONDON N6 5HS



Client: ANDREAS WEISKAM

**Consulting Engineers: MHA STRUCTURAL DESIGN Ltd
14 – 18 Old Street
London EC1V 9BH**

Report ref: 10769/JM

Date: 21st November 2022

SITE INVESTIGATION REPORT

PROPOSED REDEVELOPMENT:

69 CROMWELL AVENUE, LONDON N6 5HS

DOCUMENT ISSUE STATUS:

Issue	Date	Description	Author	Checked/approved
Rev 0	21/11/22	First issue	Jonathan Mahoney BSc (Hons), MSc, FGS	John Bartley BSc, MSc, CGeol, FGS

This investigation has been undertaken within the constraints of the client's instruction/contract, together with those set out in the 'General information, limitations and exceptions' section at the end of this report. The SCL 'Standard Terms of Appointment' are also included at the end of this report and these identify the contractual arrangements for the investigation. Conclusions or recommendations made in this report are limited to those which can be reasonably based upon the research and/or intrusive investigation work carried out. Any comments which rely on third-party information which has been provided to us are made in good faith and on the assumption that such information is accurate. SCL have not carried out independent validation of any third-party information.

Soil Consultants Ltd (SCL) has prepared this Report for the Client in accordance with the Terms of Appointment under which our services were performed. With respect to third parties, no other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by us. This Report may not be relied upon by any other party without the prior and express written agreement of SCL.

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General Information, Limitations and Exceptions
Standard Terms of Appointment

APPENDIX A

Fieldwork, in-situ testing and monitoring

-  Foreword
-  Dynamic Sampler borehole records
-  Standard Penetration Test results
-  SPT hammer calibration certificate
-  Groundwater and gas monitoring results

Laboratory testing

-  Index property testing
-  Plasticity chart
-  Particle size distribution tests

Contamination and chemical testing

-  Foreword
-  General soil suite
-  WAC test results
-  Sulphate/pH suite

Plans, drawings & photographs

-  Site photographs
-  Proposed development plans
-  Site Plan
-  Location Plan

APPENDIX B

-  GroundSure historical maps (Ref SCL-9094614)
-  GroundSure Geo+EnviroInsight Report (Ref SCL-9094615)

APPENDIX C

-  Trial pit logs from MHA Basement Impact Assessment (Ref: 22011-MHA-ZZ-ZZ-RP-S-001, dated 26/09/22)

1.0 INTRODUCTION

Consideration is being given to the construction of a new single storey basement beneath part of this existing residential property, together with a rear extension. In connection with the proposed works, Soil Consultants Ltd (SCL) were commissioned by MHA Structural Design Ltd (MHA), on behalf of the client Andreas Weiskam, to carry out a ground investigation to include the following elements:

-  Stage 1 Tier 1 Preliminary Risk Assessment (Desk Study) including initial Conceptual Site Model (CSM)
-  Intrusive investigation to identify the ground sequence and groundwater conditions
-  Geotechnical and geo-environmental sampling and laboratory testing
-  Review of existing trial pit findings
-  Provision of advice on basement construction, foundations and ground floor slabs
-  Provision of a Stage 1 Tier 2 generic quantitative risk assessment and refined Conceptual Site Model (CSM)

This report includes a summary of the findings and conclusions of the Desk Study research and Preliminary Risk Assessment. It then describes the intrusive investigation undertaken, gives a summary of the ground conditions encountered and discusses various foundation options. The Stage 1 Tier 2 generic environmental appraisal is then provided, including a revised CSM.

A Basement Impact Assessment has previously been carried out by MHA Structural Design (Ref: 22011-MHA-ZZ-ZZ-RP-S-001, dated 26th September 2022) and this should be read in conjunction with this report.

2.0 SITE DESCRIPTION

A summary description of the site and its general setting is as follows:

Site location and setting	- Located in London Borough of Haringey - Residential property on east side of Cromwell Avenue - Predominantly residential area - NGR 528915E 187300N
Site dimensions	40m (NW-SE) x 10m (NE-SW)
Site boundaries	- Residential housing to the north (Photo 1) - Residential flats to the east (Photo 2) - Residential housing to the south (Photo 3) - Cromwell Avenue to the west (Photo 4)
Site description	- Existing 3-storey semi-detached house with a single storey rear extension (Photos 5 & 6). At the time of the investigation the interior of the property had been stripped - A small block paved driveway at the front of the house (Photo 5) - A small wooden gate leads to a passageway along the southern boundary forming access to the rear garden - Partial undercroft basement (Photo 7) - An outbuilding/shed is located to the rear of the garden (Photo 8)
Topography and site levels	- Topographical drawing not available at the time of reporting - LIDAR data used to infer ground levels, although heavily vegetated site obscures imagery - Cromwell Avenue lies at about +104.8mOD - The front driveway slopes up from Cromwell Avenue at about +105mOD to +105.5mOD adjacent to the house - The rear garden level is inferred to be about +105.5mOD
Existing vegetation within site and adjacent properties	- Numerous shrubs/vegetation present along the southern boundary - Cypress tree (15m) located along this boundary (Photo 9) along with a yew tree (6m) towards the rear of the garden (Photo 10) - Small cypress (6m) located close to the front door of the property along unknown red berry trees up to 3m high (Photo 11) - Along the pavement of Cromwell Avenue, a number of mature trees are present, thought to be lime and sycamore (Photo 12)

The current site features are shown on the Site Plan and Site Photographs which are included in Appendix A.

3.0 STAGE 1 TIER 1 PRELIMINARY RISK ASSESSMENT (DESK STUDY)

This assessment is generally based upon current UK guidance, primarily the Environment Agency's "Land contamination: risk management" 2020. The scope of the assessment is as follows:

- ✚ A review of historical and current land-use and potential contaminated land risks
- ✚ Development of an outline conceptual model, identifying potential sources, pathways and receptors
- ✚ Development of a strategy for intrusive investigation

3.1 Review of historical mapping

The following summary of the history of the site and surrounding area has been compiled from a series of historical maps (Groundsure Ref: SCL-9094614, 03/10/22) obtained from a commercially available database; these are included in Appendix B.

Historical development of site and surrounding area		
Map date	The site	Significant development / features in surrounding area
✚ 1864 to 1879	✚ The site lies within the grounds of ether Linden House, Farquhar House or Winchester Hall (boundaries of these properties unclear) ✚ Site footprint partially occupied by a large glasshouse	✚ Linden House located immediately S ✚ Extensive grounds of adjacent properties surround the site ✚ Pumps located 75m WSW and 100m N ✚ Ponds located 150m N and NE and 260m SW ✚ Brick field located 170m SE and 350m N ✚ Small Pox hospital 350m S ✚ Highgate Cemetery 500m SW ✚ Great Northern Railway 600m N
✚ 1894 to 1938	✚ Linden House, Farquhar House and Winchester Hall no longer present ✚ The site and buildings now recognisable in present day configuration	✚ Residential housing replaces much of the larger houses in the surrounding area ✚ Cromwell Avenue and Cromwell Place roads built ✚ Brick Fields no longer marked ✚ Covered reservoir present 80m NE ✚ Cromwell House Children's Hospital 90m W ✚ Nurseries located 250m NW ✚ Small Pox hospital now labelled Islington Infirmary on 1920 map

Historical development of site and surrounding area		
Map date	The site	Significant development / features in surrounding area
1951 to 1992	No significant changes apparent	- Nurseries no longer marked - Cromwell House Children's Hospital no longer marked - Garage located 250m NW (from 1970) - Electricity substation 250m NE
1992 to present day	No significant changes apparent	No significant changes apparent

3.2 Database information

The database report includes information of local activities encompassing a range of subjects related to land use, pollution, and geological/hydrological conditions. Our assessment of contaminative uses and other environmental issues relevant to the site and its surroundings is provided below. The full database report (Groundsure Ref: SCL-9094615, 03/10/22) is included as Appendix B and this should be read and understood fully in conjunction with this summary.

Past land use

- Historical industrial land uses (within 250m): nearest is a hospital 45m W. Others include unspecified heap 65m NE (this presumably refers to the covered reservoir), unspecified shaft 102m NE (thought to be associated with a reservoir), unspecified tank 146m SW, cuttings 168m NE, brick field 177m, cuttings 180m N/NE, hospital 217m SE, nursery 217m NW and brick fields 276m NE
- Historical tanks: unspecified tanks 205m SW, 321m SW, 412m S and 446m SE
- Historical energy features: nearest is an electricity substation 194m NE (dated 1991)
- Historical garages: nearest is 252m NW (dated 1986-1991). Others at 291m NE, 297m NW, 310m W and 329m NE

Waste and landfill

- Active and historical landfills: none within 500m
- Historical waste sites: Furnival House 152m NW (recycling centre, new recycling and refuse store/condenser)
- Waste exemptions: none within 250m. Nearest is Highgate Mental Health Centre, 277m S, treating waste exemption. Others at 356m S, Dartmouth Park Hill, treating waste exemption

Current industrial land use

- Recent industrial land uses: nearest is shaft 105m NE. Others within 250m are electricity substation 198m NE and gas governor 247m SE
- Current or recent petrol stations: none within 500m
- Electricity cables: nearest is 85m SW, Finchley – Islington, DC decommissioned cable section
- Licensed pollutant release: none within 250m. Nearest is dry cleaning 321m W
- Radioactive substance authorisations: none within 250m. Nearest is 331m SE, Whittington Hospital

Hydrogeology

- Superficial aquifer: none on site or within 500m
- Bedrock aquifer: Secondary A
- Groundwater vulnerability: High vulnerability on site. Leaching class 'Intermediate'
- Groundwater abstractions: no records within 2000m
- Source Protection Zones: no source protection zones within 500m

Hydrology

- Water Framework Directive (WFD): on site is 'Coastal Catchment', not part of a river WB catchment. Land area part of London Management Catchment draining to the Tidal Thames
- Surface water features/bodies: none within 250m

River and coastal flooding

- Risks of flooding (RoFRaS), historical flooding and flood defences: none identified within 250m
- No Zone 2 or 3 floodplains or flood defences within 50m

Surface water and groundwater flooding

- Surface water flooding: the highest risk on site is negligible. Highest risk within 50m is 1 in 30 year – 0.1m-0.3m
- Groundwater flooding: the highest risk on site (and within 50m) is 'negligible'

Environmental designations

- SSSI: Hampstead Heath Woods 1503m W
- Local Nature Reserves: Parkland Walk 543m N and Queen's Wood 974m N
- Designated Ancient Woodland: Queen's Wood 971m N and Ken Wood 1033m NW

Visual and cultural designations

- ✚ Listed buildings: 29 records within 250m
- ✚ Conservation areas: on site, Highgate, Haringey
- ✚ Registered parks and gardens: Waterlow Park 104m SW

Agricultural and Habitat designations

- ✚ Agricultural land classification: on site, urban
- ✚ Habitat networks: Network Enhancement Zone 2 171m S

Geology

- ✚ Artificial and made ground: nearest is 171m SE 'worked ground (undivided)
- ✚ 'Superficial geology: not recorded on site or within 500m
- ✚ Bedrock geology: Claygate Member on site, high to very low permeability. Bagshot Sand Formation shown to overlie the Claygate 32m NW. Underlying London Clay Formation outcrops 94m S
- ✚ BGS boreholes: six identified within 250m
- ✚ Natural ground subsidence: moderate risk from shrink/swell clays. Very low to negligible risks for all categories where identified. Landslide risk increases to low 3m SE

Mining, ground workings and natural cavities:

- ✚ Surface ground workings: nearest is a reservoir 54m NE (year of mapping 1920). Others include an unspecified heap 65 NE (1958), pond 140m N (1879), cuttings 168m NE (1996), brick field 177m SE (1879)
- ✚ Underground workings: nearest is unspecified shaft 102m NE (1965 to 1995). Others include tunnels greater than 700m away
- ✚ No mining risks identified

Radon

- ✚ Less than 1% of properties affected, Radon protection measures not required

Soil chemistry

BGS estimated urban soil chemistry, extract as follows:

Location	Arsenic (mg/kg)	Bioaccessible Arsenic (mg/kg)	Lead (mg/kg)	Bioaccessible Lead (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Nickel (mg/kg)	Tin (mg/kg)
On site	15	2.6	208	143	0.6	75	53	20	19
On site	16	2.8	228	157	0.7	76	56	22	20
On site	16	2.8	237	163	0.8	76	63	24	21
3m SW	15	2.6	178	122	0.4	75	42	17	18

Railway infrastructure and projects

- Underground railways: Northern Line tunnel 208m NE
- Historical railway and tunnel features: none within 250m
- Railways/Crossrail: none within 500m

3.3 Other information

The London Borough of Haringey have been contacted in relation to the site, but at the time of writing no information has been received.

3.4 Unexploded ordnance risk assessment

Zetica UXO risk map indicated low risk:



3.5 Walk-over survey

A site walk-over survey was undertaken on 30th September 2022. A description of the general features of the site and the topography is provided in Section 2.0 above. From inspection of visible and accessible areas, a summary of specific features relevant to the land quality assessment is as follows:

Feature	Commentary
Electricity substations and transformers	✚ Located off-site, approximately 200m to the north-east
Fuel storage tanks	✚ None observed
Fuel interceptors	✚ None observed
General chemical storage/waste	✚ None observed
Invasive species	✚ None observed
Evidence of gas protection	✚ None observed
Surface water contamination	✚ None observed
Waste storage	✚ Some wood stored on site close to the outbuilding/shed (Photos 8 & 10)
ACMs	✚ None observed

3.6 Potential pollution linkages and Initial Conceptual Site Model

The information in the preceding sections has been used to undertake the Preliminary Risk Assessment and to compile the Initial Site Conceptual Model below. The assessment follows a risk-based approach, with the potential risks determined qualitatively using the 'source-pathway-receptor' linkage concept; a risk of harm may only exist where a plausible linkage is present. The assessment has been formulated based on the following table:

		Consequences			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Definitions of the risks are summarised as follows:

-  **Very high:** high probability that severe harm could occur, or there is evidence that it is currently occurring. If realised, the risk could result in substantial liability. Urgent investigation/remediation
-  **High:** harm is likely to occur, realisation is likely to present substantial liability. Urgent investigation required. Remedial works may be required in short-term, will be in long-term
-  **Moderate:** possible that harm could arise, but unlikely to be severe. Investigation normally required to clarify risk and liability. Remedial works may be necessary in long-term
-  **Low:** possible that harm could occur, but this would at worst be mild
-  **Very low:** low possibility of harm, unlikely to be severe

The assessment has been carried out by identifying and evaluating the potential sources of contamination, the potential receptors and the plausible pathways for contamination migration are summarised as follows:

Potential sources of contamination

A summary of potential sources identified by our review of the above information is as follows:

-  **Electricity substation:** the nearest identified substation is approximately 200m from the site and not expected to pose a significant risk to the end-user

It should be noted that any developed, non-greenfield land is likely to contain made ground. This will probably be of uncertain or unknown origin and may contain contaminants that have not been specifically identified.

The assessed risks from these potential sources are summarised in the Initial Conceptual Site Model below.

Potential receptors

In the context of the proposed development, the following potential receptors have been identified:

-  Human health: inhabitants/users of building, construction workers, adjacent site users
-  Controlled waters: Bedrock Secondary 'A' aquifer beneath site. The site is assessed as being of **low environmental sensitivity**
-  Building fabric and services: buried foundations, basement wall, potable water pipes

Plausible pathways

-  Ingestion of soil, dust or water
-  Inhalation of dust, gas or vapours
-  Direct physical contact with contaminated soil/water
-  Vertical and lateral migration of contamination including leaching
-  Chemical attack of building infrastructure, including water supply pipes
-  Migration of ground gas/vapour through permeable soils or open pathways

The Initial Conceptual Site Model and an estimate of the risk associated with each potential linkage is shown in the following table:

Source	Pathway	Receptor	Assessed risk and commentary/justification
On-site: contaminated soil and groundwater	Ingestion, contact, inhalation	End user, construction workers and infrastructure	Low risk: no significant contamination sources identified on site. Pre-2000 buildings and potential made ground giving potential asbestos risk
	Leaching from contaminated soils and migration in groundwater	Aquifer and surface water	Low risk: the bedrock aquifer classifies as Secondary A. There are, however, no abstraction points within 2000m and no source protection zones within 500m. No potential onsite contamination sources were identified and therefore the risk to the aquifer is expected to be low
Off-site: contaminated soil	Lateral migration of contaminants to site in groundwater	End user	Low risk: nearest electricity substations identified but the nearest was 200m from the site but this is not considered to present a risk to end users
On-site and off- site: ground gas and vapours	Lateral and vertical migration of gas/vapour	End-user and buildings	Low risk: The site is not in a radon affected area

The overall risk rating for the site is assessed as being **low**.

3.7 Recommendations for intrusive investigation

The Initial Conceptual Site Model did not identify any potential pollution linkages resulting in the overall assessed risk rating of low. The following programme of intrusive investigation is recommended:

-  Suitable intrusive investigation to confirm the ground sequence, allow soil/water sampling and the installation of monitoring pipes
-  No specific contamination sources were identified by the PRA so the investigation should provide general coverage of the site
-  Soil and groundwater samples should be recovered where relevant and be analysed for a range of general contaminants
-  A programme of groundwater and gas monitoring

The Initial Conceptual Site Model should then be revised to include complete pollution linkages and outline mitigation/remedial measures should be identified, together with any requirements for additional investigation.

4.0 EXPLORATORY WORK AND LABORATORY TESTING

The ground investigation was carried out in October 2022 and is described below.

4.1 Constraints of investigation

The investigation was carried out in general accordance with the site layout provided by MHA Structural Design Ltd (Ref: 326_EX_00, dated Feb 2022). This layout determined the locations of the exploratory points, though they were adjusted slightly taking into account some access restrictions. The existing house occupies the majority of the site and investigation was only possible in external areas.

4.2 Dynamic sampler boreholes

Two dynamic sampler boreholes (WS01 and WS02) were completed using a standard tracked rig under the supervision of an experienced geo-environmental engineer. Rotary auger techniques were employed from a depth of 2.50m in WS01 due to the nature and density of the soils. Representative samples were taken for geotechnical and environmental testing and PID headspace testing was carried out on all environmental samples. In-situ Standard Penetration Testing (SPT) were carried out at appropriate intervals. The hammer Energy Ratio (E_r) for the SPT equipment used was 87%; the relevant test certificate is appended. Monitoring pipes were installed in both boreholes.

4.3 Existing foundations

A series of six internal trial pits had previously been excavated by others within the existing undercroft and at ground floor level. The trial pit details were recorded by MHA and the logs are included as Appendix C. SCL reviewed the ground sequence within the pits (see Section 5.5 below).

4.4 Groundwater and gas monitoring

Groundwater/gas monitoring was carried out on two occasions following completion of the site works on 19th October and 27th October 2022.

4.5 Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

-  Index properties tests (Atterberg Limits)
-  Particle size distribution tests

4.6 Chemical and contamination testing

Selected soil samples were delivered to a specialist laboratory (DETS Ltd) and the following testing was carried out:

	General soil suite	-	3no samples
	Asbestos screening	-	3no samples
	Waste Acceptance Criteria (WAC)	-	1no sample
	Soluble sulphate/sulphur/pH analyses	-	5no samples

The engineering borehole logs and the laboratory testing results are included in Appendix A.

5.0 GROUND CONDITIONS

Published BGS information indicates that the site is underlain by the Claygate Member which rests upon the London Clay Formation. The Bagshot Formation is shown to overlie the Claygate Member nearby to the north.

The investigation encountered a variable sequence of natural sand and clay beneath a significant thickness of made ground. We have interpreted the natural soils as representing the Bagshot Formation, which extended to the full depth investigated.

Detailed descriptions are presented on the appended exploratory hole records and the overall ground sequence is summarised in the following sections. Note that all depths are relative to existing ground level unless otherwise stated.

5.1 Made ground

Surfacing at the borehole positions comprised block paving with either a bedding sand or concrete sub-base, with an overall thickness between 0.10m and 0.20m.

The underlying made ground was variable, comprising either brown silty clay, grey/black silty sand, orange/brown clayey silt or brown silty clayey sand. A variable content of brick/concrete fragments was present. In WS01, a possible old brick foundation was present between 1.20m and 1.60m.

Standard Penetration Tests (SPT) 'N' values of between 10 and 21 were measured.

5.2 Bagshot Formation

The Bagshot Formation was met at depths of between 1.60m and 1.80m, comprising a yellow/grey or yellow/white silty clayey sand with rare amounts of flint gravel. A thin layer of silty sand with occasional sandstone gravel was observed in WS02 at a depth of 2.30m.

PSD testing (sieve and hydrometer) of these granular soils indicate the sand to be predominantly fine to medium grained, with a highly variable fines (clay and silt) content between 6% and 35% (but generally >20%). SPT N values indicate the sand to be in a medium dense, locally dense state of compaction.

The granular soils extended to the full 5.45m depth in WS02. In WS01, however, a substantial layer of yellow/orange silty sandy clay was met at 3.40m depth extending to the base of the borehole (again 5.45m depth).

Liquid and plastic limit testing on the cohesive soils indicate the clay to be intermediate plasticity (BS scheme) and low to medium volume change potential (NHBC scheme). The clay was assessed as being of firm to stiff consistency and SPT N values indicate a medium to high strength.

5.3 Groundwater

Groundwater was not observed during drilling and both boreholes were dry on completion. Subsequent monitoring did not encounter any groundwater in the installations (maximum depth of 5.00m). Groundwater levels can of course vary seasonally and with prevailing weather conditions.

5.4 Environmental observations

No obvious olfactory or visual signs of soil or groundwater contamination were encountered in the boreholes. PID headspace testing (for VOC concentrations) was undertaken on samples of made ground and natural soils during the borehole exercise and during subsequent monitoring - no elevated levels were noted.

5.5 Review of trial pit ground conditions

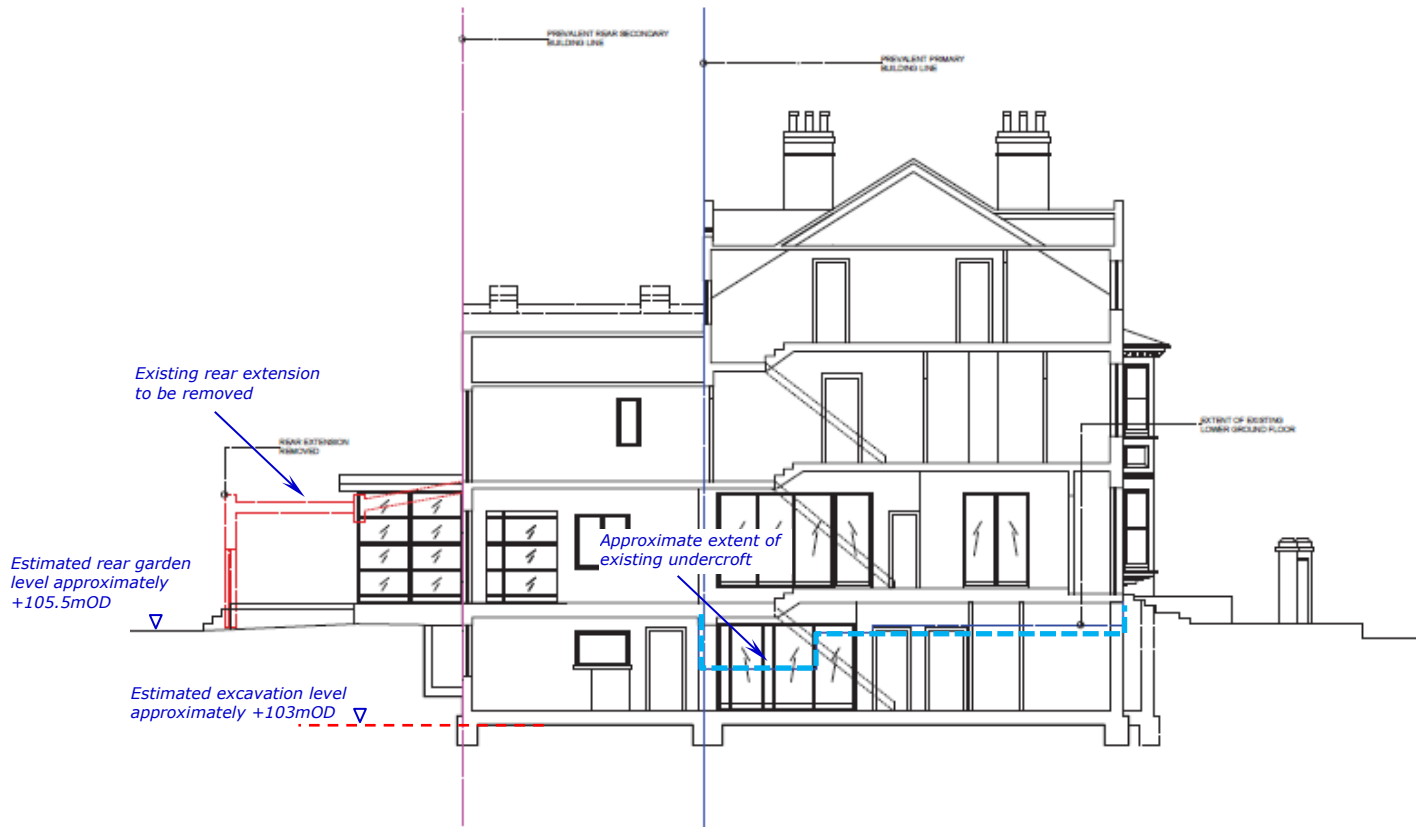
Six internal trial pits were dug by others prior to attendance from SCL. A review of the ground sequence which could be observed in the pits was undertaken as summarised below:

Trial pit	Soil at foundation level	Remarks
TP01	Yellow/grey/orange silty clayey SAND with rare gravel	- Disturbed sample at 1.00m - PSD test undertaken
TP02	Yellow/grey slightly clayey sandy GRAVEL. Gravel is fine to coarse subrounded flint/quartz	Disturbed sample at 1.00m
TP03	Brown/grey silty clayey SAND with rare fine subangular flint gravel	Disturbed sample at 1.50m
TP04	Firm orange slightly sandy CLAY	- Disturbed sample at 1.90m - Liquid/plastic limit test undertaken - Hand vane at 1.90m = 70kPa
TP05	Firm orange/yellow very sandy CLAY	- Disturbed sample at 1.80m - Hand vane at 1.80m = 60kPa
TP06	Yellow/orange slightly clayey SAND	Disturbed sample at 2.00m

6.0 GEOTECHNICAL ASSESSMENT

The proposed works at this site comprise the construction of a single level basement beneath the existing house and extension into the rear garden. Note that the proposed structure is variously described as either a lower ground floor or basement, and for the purposes of this report, we have referred to the construction as a basement.

A schematic section showing the proposals is as follows:



A topographical survey drawing was not available at the time of reporting. Scaling from the above section indicates that the excavation level for the new basement will be about 3.7m below the main internal ground floor level. We have estimated approximate OD levels from LIDAR data and on-site measurement, and these indicate the rear garden level to be about +105.5mOD (as shown above). The excavation level to the underside of the basement slab is inferred to be about +103mOD. It must be noted that these are preliminary estimates and accurate site levels will need to be surveyed at some stage.

The anticipated structural loads have been provided by MHA. They estimate that an equivalent uniformly applied pressure (gross) at basement level imposed by a raft would be approximately 55kN/m², including self-weight. The small rear extension is expected to apply loads of about 13kN/m run.

The investigation has revealed that beneath a significant thickness of made ground (up to 1.80m in the boreholes) the natural Bagshot Formation is present. We expect these natural soils to be capable of

supporting the structural loads at basement level using spread foundations. Current proposals envisage the use of underpinning of the existing structural loads at basement level and the boreholes have indicated that this should be feasible, with the excavation expected to remain dry.

6.1 Basement excavation and retaining wall

The excavation for the proposed basement is expected to encounter significant thicknesses of variable made ground and the Bagshot Formation. Groundwater was not encountered within the 5.45m depth of the boreholes which extended to about 3.5m below excavation level. It should be noted that groundwater levels can undergo significant seasonal variation and continued monitoring of the borehole installations should be carried out.

For the observed soil sequence and groundwater conditions, we consider that the proposed sequential RC underpinning should be feasible, supported by the natural soils at basement level. A robust arrangement of temporary internal bracings/props, including support near the top and base of the wall, will be required to maintain wall stability and assist in controlling ground movements during construction.

Careful selection of the appropriate design parameters will be needed, and the following table of coefficients may be used for the preliminary design of the basement retaining wall:

Stratum	Bulk density (Mg/m ³)	Effective cohesion, c' (kN/m ²)	Effective friction angle, ϕ' (degrees)
Made ground	1.80	0	22
Bagshot Formation (sand)	2.00	0	29
Bagshot Formation (cohesive)	1.90	0	23

Eurocode 7 stipulates that partial material factors must be applied to the best estimates of geotechnical soil properties during the design stage. The design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors. The determination of appropriate earth pressure coefficients and the pattern of earth pressure distribution should be carried out by the geotechnical designer; these will depend upon the type/geometry of the wall and the overall design approach. We recommend that a specialist contractor is consulted to confirm the most appropriate type of wall and to provide the final wall design.

6.2 Spread foundations

At basement level

The boreholes indicate that the natural Bagshot Formation soils should be expected at basement excavation level (ie about +103mOD). The two boreholes suggest that the soils will comprise medium dense sand, although the sequence is likely to be variable and clay layers may well be encountered. For preliminary

assessment of the feasibility and sizing of foundations placed within the natural soils, we envisage that an allowable bearing resistance of 140kN/m^2 would be appropriate; this would be applicable to moderate sized strip or pad foundations, say up to 2m width. As required by EC7, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design the bearing resistance should be determined, using undrained and/or drained analysis as appropriate, to calculate the degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice.

The depths of foundations at basement level are expected to be below the zones of influence of any existing trees and therefore risks due to clay swell/shrinkage should be low. Notwithstanding, we recommend that foundation depths are checked using the NHBC Standard ('Chapter 4.2, Building near trees'), based upon a medium volume change potential for the Bagshot Formation.

The excavations are expected to expose a variable sequence of clayey silty sand or sandy clay. Whilst the groundwater is low, we anticipate that these soils will be highly susceptible to disturbance/softening if exposed to rain or surface run-off. We therefore recommend that a blinding layer is placed when the desired depth is reached, or the foundations cast immediately.

At ground level (rear extension)

For the proposed rear extension, spread foundations at must bypass any made ground and be placed within the competent natural Bagshot Formation. WS02 indicates that an excavation depth of at least 1.80m will be required to bypass the made ground and expose competent natural soils, although it should be noted that deeper pockets of made ground may be present. Whilst WS02 encountered only granular soils in this location, we note the presence of a mature (presumed) cypress tree close to the proposed building line. The boreholes have shown that variable ground conditions can be expected with significant clay layers present within the Bagshot Formation. The cypress tree is a high water demand species, and we therefore recommend that the foundations are designed fully in accordance with the NHBC guidelines, assuming a clay soil of medium volume change potential; safe foundation depths of up to 2.5m may be required closest to the tree. This may be a conservative approach but the risk of shrink/swell effects with cypress trees can be high. The tree species should be confirmed by an experienced arboriculturalist; safe founding depths will be less for moderate or low water demand species.

An alternative approach would be to undertake additional boreholes along the foundation lines and within the footprint of the extension, and if these indicate that no cohesive soils are present (ie only non-shrinkable sand), then deepening of the foundation should not be required.

For preliminary assessment of the feasibility and sizing of these foundations, we envisage that an allowable bearing resistance of 150kN/m^2 would be appropriate. As discussed above, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design the bearing resistance should be determined, using undrained and/or drained analysis as appropriate, to calculate the

degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice.

The foundation excavations are expected to encounter variable non-engineered made ground and both granular and cohesive natural soils and provision for lateral support should be made. The excavations must be carefully inspected by an experienced foundation engineer and if root-infested or obviously desiccated clays are present, local deepening should be undertaken. The boreholes have indicated that the excavations should remain dry, but as discussed above, continued monitoring of the borehole installations should be carried out.

6.3 Basement slab performance and soil heave

The basement excavation is estimated to extend to about +103mOD. The existing ground level varies significantly due to the presence of the partial undercroft beneath the house. It is estimated that the maximum removal of soil (where there is no undercroft) will be about 3m, resulting in unloading of about 60kN/m², reducing to about 30kN/m² where the depth of excavated soils is less. Whilst the stress reduction could theoretically result in an element of heave in the cohesive deposits of the Bagshot Formation and underlying Claygate Member, we consider that when taking account of the magnitude of the overall reimposition of stress at basement level, soil heave affects should be minimal.

It will be necessary to consider uplift of the slab due to potential hydrostatic pressures and in this respect the guidelines incorporated in BS8102:2009 should be followed. The slab design will need to take account of potential seasonal fluctuations and/or accidental and flood conditions. We consider that a design water level at 1m depth below current ground level would be suitable for preliminary purposes and this would result in a hydrostatic uplift pressure of about 20kN/m² on the basement slab; this design water level may need to be agreed with the local building control.

6.4 Ground floor slab (rear extension)

The investigation has indicated that up to 1.80m of compressible, non-engineered made ground is present. We do not consider that these soils in their current state will be capable of supporting a ground-bearing slab and recommend that a fully suspended slab, supported by the main foundations, is adopted. Unless additional investigation is undertaken which proves that no cohesive soils are present (see 6.2 above), a suitable void should be incorporated beneath the slab in accordance with NHBC requirements.

6.5 Foundation concrete

Low concentrations of water-soluble sulphates (2:1 water/soil extract) were measured in selected soil samples. Near neutral pH values were also measured with the exception of a sample of the made ground in WS02/0.30m which was analysed as being alkaline. The results fall into Site Design Class DS-1 of Table C2 given in BRE Special Digest 1 (2005). We assess the site as having 'static' groundwater and this would result in an ACEC Site Class of AC-1.

7.0 STAGE 1 TIER 2 ENVIRONMENTAL ASSESSMENT

This appraisal is generally based on the Environment Agency's 'Land contamination: risk management', 2020, adopting current UK practice which uses the Source-Pathway-Receptor methodology to assess contamination risks. For a site to be designated as contaminated a plausible linkage between any identified sources and receptors must be identified, ie whether significant pollution linkages (SPLs) are present. In considering the potential for contamination to cause a significant effect, the extent and nature of the potential source are assessed and pathways/receptors identified; without an SPL there is theoretically no risk to the receptors from contamination. The assessed risks to the various potential receptors are summarised in the tabulated Conceptual Site Model which forms Section 7.5 of this report.

7.1 Environmental setting and context

The site is underlain by the Bagshot Formation which has a Bedrock Aquifer Designation of '**Secondary Aquifer – A**'. There are no abstraction points within 2000m and no source protection zones within 500m. The site is assessed as being of **Low** environmental sensitivity.

7.2 Contamination sources and testing

The Preliminary Risk Assessment is presented in Section 3.6 and this does not identify any significant risks. The testing therefore comprised analysis of three soil samples for a general suite of contaminants. Whilst no specific testing was undertaken based on historical/current site usages, PID headspace testing was carried out on all samples.

The soil test results have been assessed where relevant against the DEFRA Soil Guideline Values (SGV) and Category 4 Screening Levels (C4SLs), together with the LQM/CIEH Suitable 4 Use Level (S4UL) for Human Health Risk Assessment in which Generic Assessment Criteria (GACs) have been derived from the CLEA Model (2nd Edition, 2009). The contamination testing was carried out specifically for the purpose of providing a general guidance evaluation for the proposed development. Reference should be made to the foreword to the appended contamination test results in order to fully understand the context in which this discussion should be viewed.

We have used, where relevant, the trigger levels for **residential development (with home-grown produce)** to assess the results of the contamination testing. Using these criteria the following results are of note:

-  **Lead:** exceedances of lead occurred in all three samples of made ground, when compared to the C4SL threshold level of 200mg/kg; concentrations of between 258mg/kg and 580mg/kg were measured. The desk study has indicated a 'normal' background concentration of approximately 200mg/kg – 240mg/kg (BGS urban soil guidance)

The implications of these results are addressed in the revised Conceptual Site Model below.

Although Asbestos-Containing Materials (ACM) were neither observed on site nor identified in the samples examined, we note that buildings (especially those constructed before 2000) are a potential source of ACM. Furthermore, any made ground, construction or demolition materials on site may also contain ACM. These matters should be addressed in the Pre-construction H&S plan prior to any demolition or earthworks.

7.3 Ground gas/vapour monitoring

No specific gas generating uses/risks were identified by the PRA, but with 'made ground' being identified as a possible source. Gas monitoring was undertaken on two occasions following completion of the boreholes. No elevated levels of methane, carbon dioxide, carbon monoxide or hydrogen sulphide were measured. PID readings in the borehole installations were <1ppm. On the basis of these results, we consider that Characteristic Situation 1 (very low risk) is appropriate (as described in CIRIA C665 "Assessing risks posed by hazardous ground gases to buildings", 2007) and this suggests that no gas protection measures will be required; this should be re-assessed following any further monitoring.

7.4 Disposal of excavated soils

A rigorous hazard assessment of the results was not within the scope of our investigation, but our preliminary conclusion from the contamination and WAC testing is that the made ground and natural soils could classify as 'inert' material for disposal. The elevated lead levels in the made ground may, however, result in a more onerous classification of hazardous waste and early consultations should be made with appropriate waste facilities or regulators to confirm the off-site disposal requirements.

7.5 Refined Conceptual Site Model

Taking into account the above discussion, the assessed risks to potential receptors identified in the PRA are summarised in the refined Conceptual Site Model (CSM) below. This includes recommendations for appropriate mitigation measures to render any SPLs inactive and reduce the risks to receptors to acceptable levels:

Source	Pathway	Receptor	Assessed risk, justification and measures to mitigate the risk to acceptable levels
On site: contaminated direct contact soil/water	Ingestion & End user	End user	Moderate:  Elevations in lead were observed in samples from the made ground in boreholes WS01 and WS02. Where made ground is removed the risks will be removed but in garden areas the end-user may come into contact with the affected soils. For this end use, the presence of elevated lead may require a Stage 1 Tier 3 Detailed Quantitative Risk Assessment or Stage 2 Options Appraisal, and this will involve additional sampling/testing. Alternatively, it may be possible to agree appropriate remedial measures with the regulatory authority; these could include removal of an agreed thickness of made ground and replacement with certified clean imported topsoil in garden areas, together with provision of a geofabric separator  A careful watching brief should be kept during construction and if obvious or suspected contamination is encountered this should be dealt with prescriptively
	Ingestion, contact & inhalation	Construction workers and third parties	Low:  Elevated lead concentrations were measured in samples of made ground although appropriate PPE and working practices should mitigate any associated risks. Any residual risks to these receptors should be managed through health & safety procedures and CDM regulations
	Leaching from contaminated soils and migration in groundwater	Aquifer and surface water	Very low:  The majority of made ground (ie potential contamination source) will be removed during excavation for the basement. Where made ground remains, the likelihood of infiltration into the Secondary aquifer is deemed to be low, given the low solubility/mobility of lead  Groundwater not observed within the boreholes
	Direct contact with soil/water	Building fabric and infrastructure	 The effects of soluble sulphates and alkali/acidic ground are discussed in Section 6.5 of this report  Detailed assessment of soil/groundwater contamination with respect to water supply pipes is outside the scope of this report. The UKWIR publication 'Guidance for the selection of water supply pipes to be used in brownfield sites', 2010 states that if suitable barrier pipe is specified "there is no need to carry out soil sampling and analysis and this may be the most cost-effective solution". The validity of this approach will clearly be dependent upon the scale of the development and the quantity of pipe needed

Source	Pathway	Receptor	Assessed risk, justification and measures to mitigate the risk to acceptable levels
Off site: contaminated soil/water	Lateral migration of contaminants in groundwater	End-user and buildings	Low:  No contamination sources identified within the immediate vicinity of the site
On-site and off-site: ground gas & vapour	Lateral migration through strata, service runs and cracks in buildings	End-user and buildings	Very low:  No potential gas sources were identified by the PRA. Subsequent monitoring has revealed no elevated levels of ground gases. The SPL from ground gas is therefore considered to be inactive and CS1 (CIRIA 665) is deemed to apply, with no gas protection measures required  Less than 1% properties affected by radon, no radon protection measures required

In conclusion, based upon the information reviewed and the results of the investigation, our assessment is that with appropriate mitigation measures, it should be possible to reduce the risks to acceptable levels. The required mitigation measures identified above include characterisation of the elevated lead concentrations, or alternatively removal and replacement of made ground within garden areas.

A careful watching brief should be kept during construction to ensure that any potentially contaminated soil encountered is disposed of in a safe and controlled manner. Site workers should observe normal hygiene precautions when handling soils and if material suspected of being contaminated is identified during construction, this should be set aside under protective cover and further tests undertaken to verify the nature and levels of contamination present. If contamination is present, a full site re-assessment may be required and a contingency should be in place in this regard.



APPENDIX A

Fieldwork, in-situ testing and monitoring

- ✚ Foreword
- ✚ Dynamic Sampler borehole records
- ✚ Standard Penetration Test results
- ✚ SPT hammer calibration certificate
- ✚ Groundwater and gas monitoring results

Laboratory testing

- ✚ Index property testing
- ✚ Plasticity chart
- ✚ Particle size distribution tests

Contamination and chemical testing

- ✚ Foreword
- ✚ General soil suite
- ✚ WAC test results
- ✚ Sulphate/pH suite

Plans, drawings & photographs

- ✚ Site photographs
- ✚ Proposed development plans
- ✚ Site Plan
- ✚ Location Plan

Site & Location: 69 Cromwell Avenue London N6 5HS							Borehole No: WS01	
Client: Andreas Weiskam					Coordinates: 528902E, 187306N		Sheet 1 of 1	
Engineer: MHA Structural Design Ltd					Ground Level: +105.00mOD		Report No: 10769/JM	
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 13/10/22 BH diameter: 110mm reducing with depth				0.10	104.90		MADE GROUND: block paving over yellow gravelly sand (sub-base) MADE GROUND: firm brown silty clay with occasional brick fragments. Live roots observed to 0.90m	
Inspection pit to 1.20m	D	0.50	N=21	1.20	103.80		MADE GROUND: whole bricks (possible foundation)	
	D	1.00						
	SPT/S	1.20						
	D	1.40	N=15	1.60	103.40	Medium dense yellow/grey clayey silty predominantly fine SAND with rare fine subrounded flint gravel		
D	1.80							
SPT/S	2.00							
Rotary auger used from 2.50m depth	D	2.50	N=11	3.40	101.60	Firm to stiff yellow/orange silty sandy CLAY		
	D	3.00						
	SPT/S	3.00						
	50mm ID monitoring pipe installed to 5.00m	D	4.00	N=15				
SPT/S		4.00						
SPT/S		5.00	N=10					
BH complete: 13/10/22 BH depth: 5.45m Water depth: dry				5.45	99.55		End of hole at 5.45m	
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet								Borehole type: Dynamic Sampler
Remarks: Ground levels and coordinates inferred from LIDAR data - approximate only								Borehole No: WS01
								

Site & Location: 69 Cromwell Avenue London N6 5HS							Borehole No: WS02	
Client: Andreas Weiskam					Coordinates: 528919E, 187298N		Sheet 1 of 1	
Engineer: MHA Structural Design Ltd					Ground Level: +105.50mOD		Report No: 10769/JM	
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 13/10/22 BH diameter: 125mm Inspection pit to 1.20m				0.20	105.30		MADE GROUND: block paving over concrete	
	D	0.30					MADE GROUND: grey/black silty sand with occasional brick/ concrete fragments. Live roots	
				0.60	104.90			
	D	0.80					MADE GROUND: orange/brown slightly clayey silty sand with occasional brick fragments. Live roots	
				0.90	104.60			
	SPT/S	1.20	N=10				MADE GROUND: brown silty clayey sand with occasional brick fragments. Live roots observed to 1.50m	
	D	1.50						
				1.80	103.70			
	D	1.90					Dense yellow/grey slightly clayey slightly silty gravelly predominantly fine to medium SAND	
	SPT/S	2.00	N>50*					
				2.30	103.20			
	D	2.50					Dense orange/brown/red silty SAND with occasional fine gravel of sandstone	
				2.60	102.90			
							Medium dense yellow/grey silty fine to coarse SAND	
D	3.00							
SPT/S	3.00	N=18						
			3.30	102.20				
D	3.50					Medium dense yellow/grey clayey silty predominantly fine SAND with rare fine subrounded flint gravel		
			3.80	101.70				
D	4.00					Medium dense becoming dense yellow/white silty fine to medium SAND		
SPT/S	4.00	N=29						

Site & Location	69 Cromwell Avenue London N6 5HS	Report No:	10769/JM
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STANDARD PENETRATION TEST SUMMARY

BH ID	Depth (m)	Test type	N value (Note b)	Blow-counts and penetration						Casing depth (m)	Water depth (m)	Remarks
				Seating blows		Test blows						
WS01	1.20	S	N=21	4	4	5	5	5	6		Dry	
WS01	2.00	S	N=15	5	3	3	4	4	4		Dry	
WS01	3.00	S	N=11	3	4	3	3	2	3		Dry	
WS01	4.00	S	N=15	2	3	3	4	4	4		Dry	
WS01	5.00	S	N=10	2	2	2	2	3	3		Dry	
WS02	1.20	S	N=10	2	2	3	3	2	2		Dry	
WS02	2.00	S	(50)	8	9	17	25	8/30mm			Dry	
WS02	3.00	S	N=18	3	3	4	4	5	5		Dry	
WS02	4.00	S	N=29	5	6	7	7	7	8		Dry	
WS02	5.00	S	N=32	6	6	7	8	8	9		Dry	
		</										

- a) Standard Penetration Test : BS EN ISO 22476:2005 Part 3
- b) Where full penetration was not achieved, the total test blow-counts are reported
- c) Hammer Energy Ratio, Er = 87%

Site & Location	69 Cromwell Avenue London N6 5HS	Report No:	10769/JM
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SUMMARY OF CLASSIFICATION TEST RESULTS

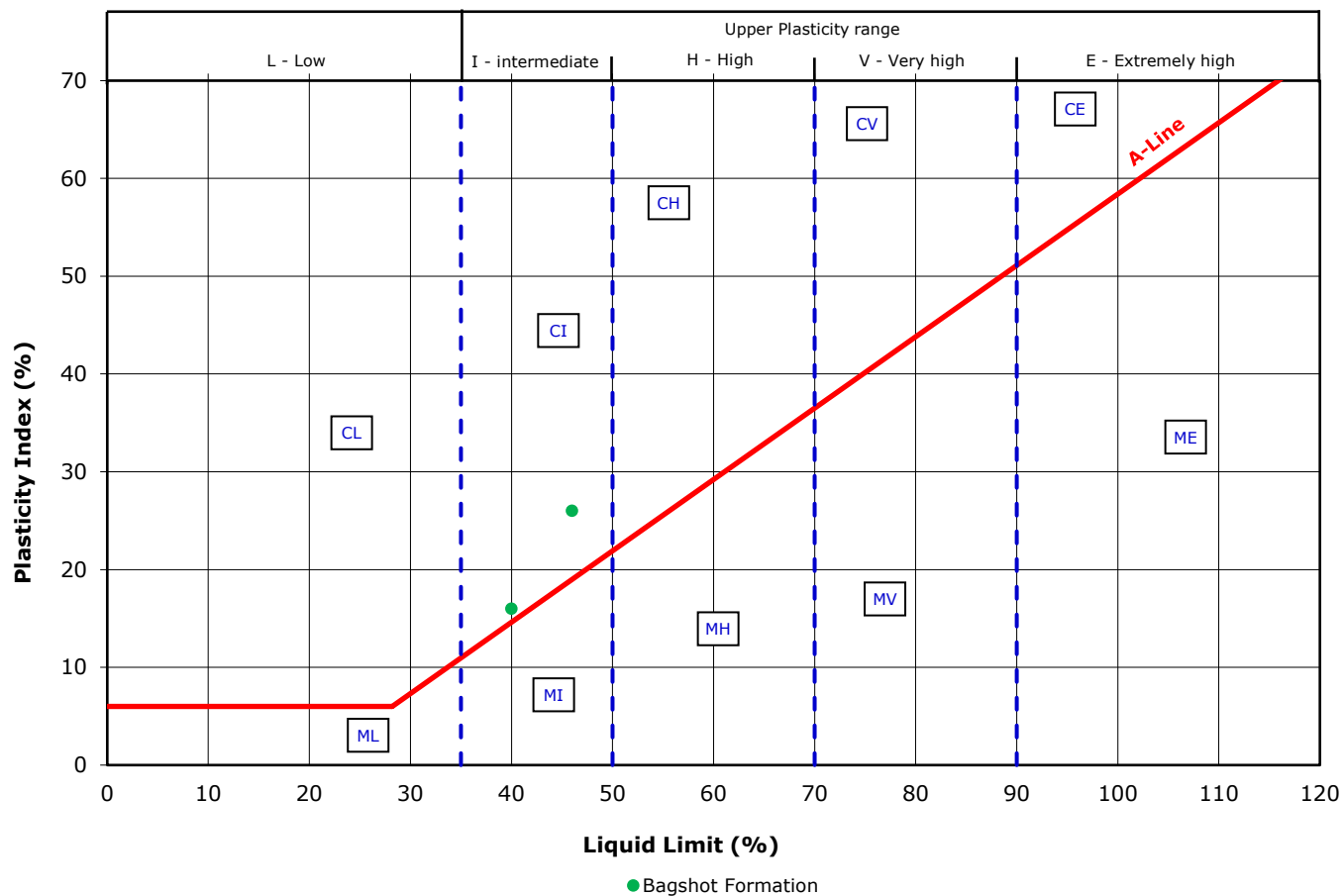
BH ID	Depth (m)	Type	w (%)	w _L (%)	w _p (%)	Pass 425 (%)	I _p (%)	Mod I _p (%)	I _L (%)	LOI (%)	Description
TP01	1.00	D	17								Yellow/grey/orange very sandy CLAY
TP04	1.90	D	16	46	20	>95	26		-0.17		Orange slightly sandy CLAY
WS01	1.80	D	15								Yellow/grey slightly clayey silty fine to coarse SAND
WS01	4.00	D	20	40	24	>95	16		-0.27		Yellow/orange silty sandy CLAY
WS02	1.90	D	4								Yellow/grey slightly clayey slightly silty fine SAND
WS02	3.50	D	11								Yellow/grey clayey silty fine SAND

Testing in accordance with BS EN ISO 17892 unless specified otherwise Date: 25 Oct 22

Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425µm: by estimation, by hand* or by sieving** (Classification Sheet 1 of 1)

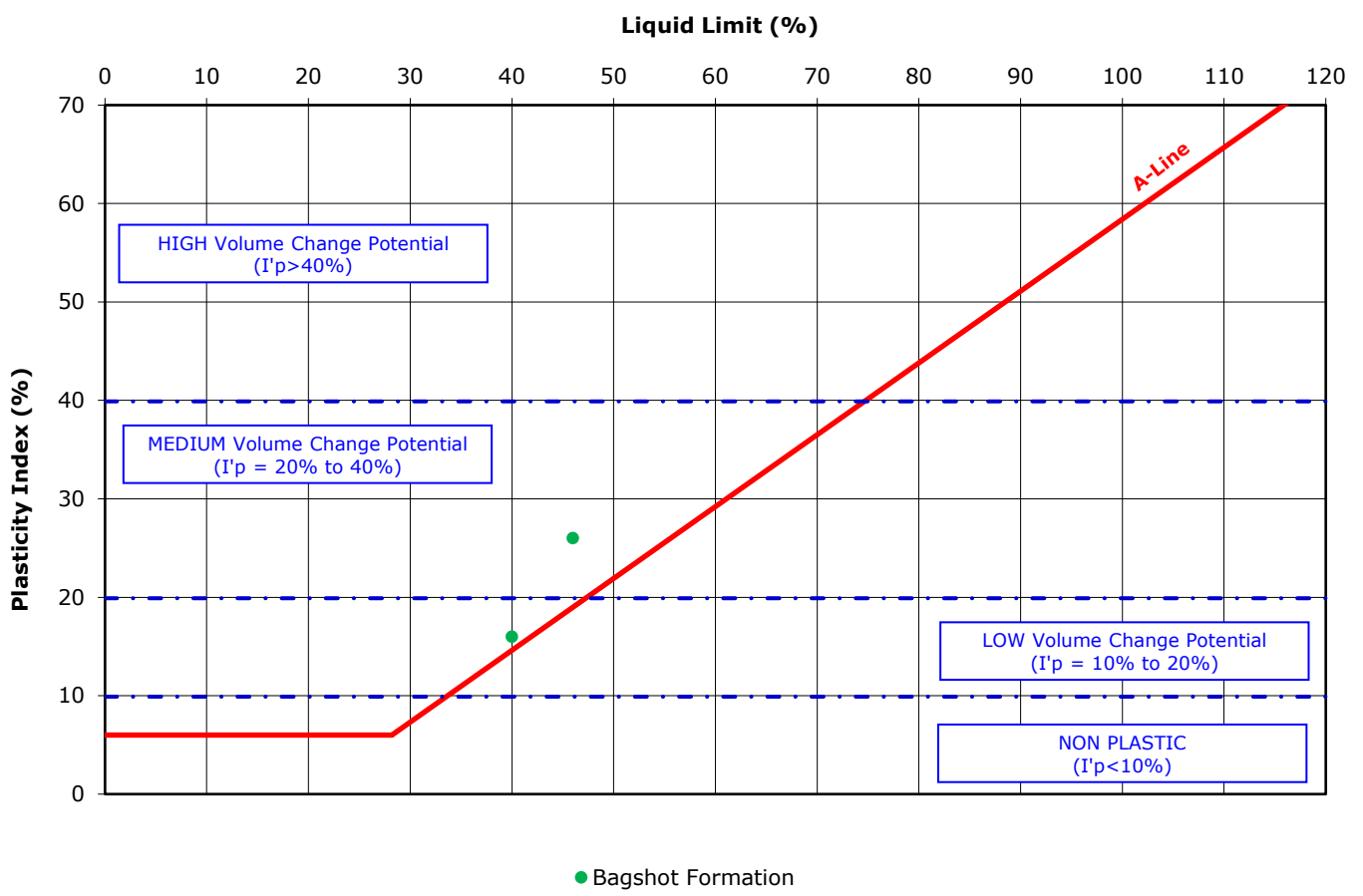
Plasticity Chart



M - SILT [plots below the A-Line]
C - CLAY [plots above the A-Line]

Classification in accordance with BS5930:2015 "Code of practice for site investigations"

Plasticity Chart



Modified Plasticity Index, I_p:

$$I'_p = \frac{I_p \times (\% \text{ passing } 425\text{mm})}{100\%} \quad (\text{where } I_p = \text{Plasticity Index})$$

Classification in accordance with NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

Site Plan

KEY

 Dynamic sampler borehole

(Fieldwork: October 2022)

