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Structural Engineers Report

166 Regent's Park Road, London NW1 8XN

Basement Impact Assessment and Structural Feasibility Study

Reference: 5576 12 160706
Date: 12th August 2016

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Document Verification

Job title	166 Regent's Park Road, London N3 3HR	**Job Number** 5576
Document title	Basement Impact Assessment Structural Feasibility Study	**Document Ref.** 5576 12 160706

Revision	Date		
P1	11.08.16	Filename:	5576 12 160706
		Description:	Draft issued for coordination
		Author:	Ben Bradshaw BEng CEng MIStructE
P2	15.08.16	Filename:	5576 12 160706
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		Author:	Ben Bradshaw BEng CEng MIStructE
P3	16.09.16	Filename:	5576 12 160916
		Description:	Issued for planning approval, Site investigation report added
		Author:	Ben Bradshaw BEng CEng MIStructE

1.0 Introduction

1.1 Packman Lucas was commissioned by Brian O'Reilly Architects to carry out a Basement Impact Assessment (BIA) for a proposed development at 166 Regent's Park Road, in the London Borough of Camden. The proposed development works comprise the addition of a rear extension at existing basement level at this address.

1.2 This BIA is prepared in accordance with the guidance offered in the Camden Council Planning Guide CP4 – Basements and Lightwells [1], and makes use of other pertinent guidance as described following.

1.3 The following BIA report document has been prepared as a systematic check through the points highlighted in the planning guidance, to ensure the proposals do not; cause undue harm to the amenity of neighbouring properties; have a detrimental impact on the groundwater environment; have any effects on surface water run-off or ground permeability.

1.4 The proposed development is located at 166 Regent's Park Road, London NW1 8XN. The site falls within the "Rest of the Borough" designation on the basis of geology according to the Camden Geological, Hydrogeological and Hydrological Study [2]. The location plan and site plan are shown in [Figure 1] and [Figure 2] respectively.

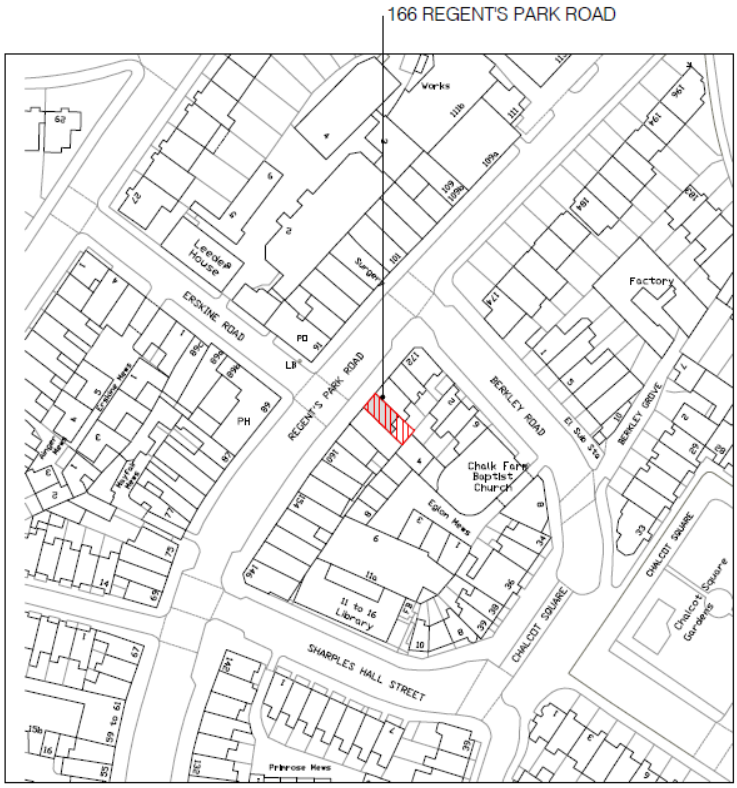


Figure 1 - Location Plan

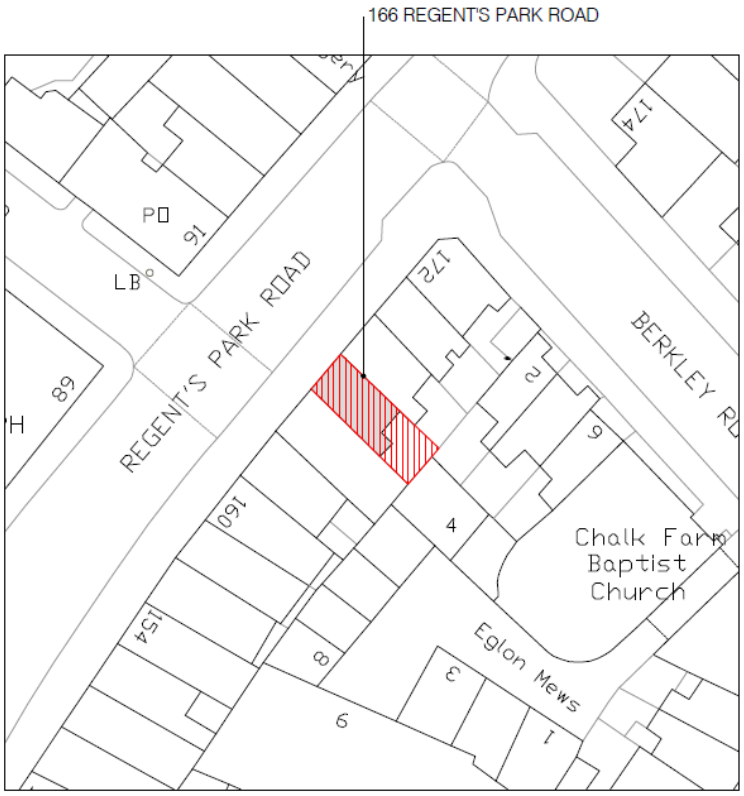


Figure 2 - Site Plan

2.0 Proposed Development

2.1 The existing building at 166 Regents Park Road currently consists of a four storey structure with a basement over the full footprint of the building. The

building is understood to be constructed using traditional media; including carcass timber floors

2.2 and roof, with load bearing exterior and party masonry walls, likely with a load bearing cross wall.

2.3 Historic ordnance survey mapping [3] of the area indicates that the building was originally constructed between 1850 and 1870, but is first shown clearly on Ordnance survey map dated 1893-1896, shown in [Figure 3].

Figure 3 - 1893-1896 Local Ordnance survey map

2.4 The London County Council bomb damage maps [4] indicate that the local church and some adjacent properties where badly damaged, but that number 166 Regents Park Road was unaffected, shown in [Figure 4].

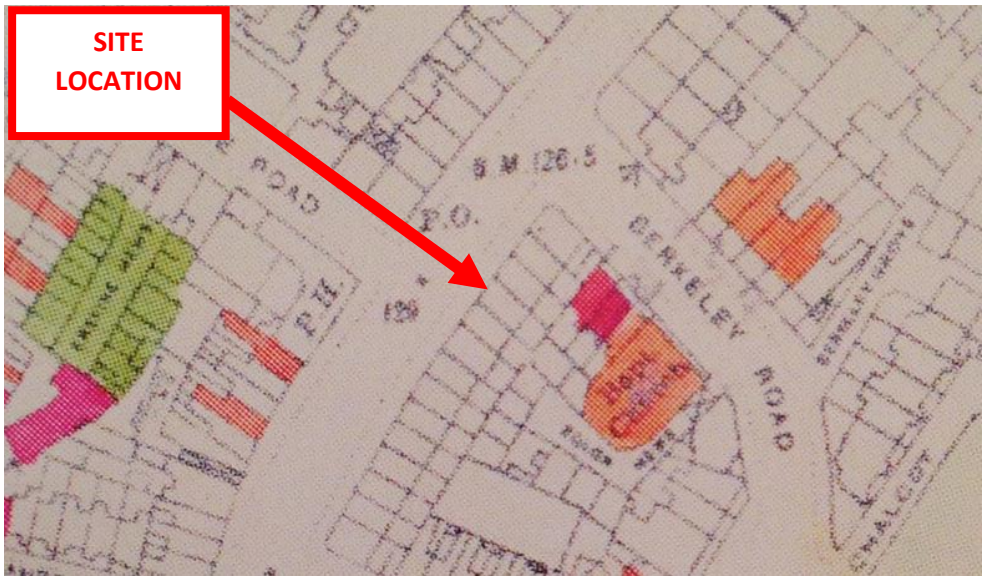


Figure 4 - LCC Bomb Damage Map extract

2.5 The proposed development consists of a single storey extension at the rear into the existing garden terrace at basement level [5], which would necessitate the excavation of a raised rear garden terrace area. The rear garden terrace currently consists of a paved area approximately 20m^2 in size. The proposal

includes the introduction of a green roof above the proposed ground floor extension, with an approximate area of 14m^2. The remaining roof area shall consist of a terrace, skylights and lightwell to service the proposed extension.

3.0 Screening

3.1 The initial screening phase concentrates on the following three items:

- Subterranean (Groundwater) Flow;
- Land Stability;
- Surface Flow and Flooding

3.2 The three Screening issues described above are addressed within in Table 1, Table 2 and Table 3 respectively below, in accordance with Camden Planning Guidance document CP4 [1].

3.3 All additional observations are provided in Section [3.6 Further observations not covered in the tables above are provided here:].

Table 1 - Subterranean (Groundwater) Flow

Question	Answer	Explanation	Ref.
1a) Is the site located directly above an aquifer?	No	The British Geological Survey (BGS) Aquifer map [Figure 5] of the area indicates no local aquifer. See [Figure 6] for information regarding groundwater protection zones.	[6] [7]
1b) Will the proposed basement extend beneath the water table surface?	No	The proposed basement extension is approximately 500mm deeper than the existing basement. BGS Historical borehole log TQ28SE410 taken approximately 250m from the site in March 1950 indicates a water level of 30m below the surface. Site investigation was undertaken on 9th August 2016, and results are described in the Site Investigation preliminary findings. This data includes initial borehole observations which describe no water strikes. A standpipe was installed to monitor ground water levels, and the results of this investigation will be reviewed on completion of ongoing monitoring.	[8]

2) Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	No	The local Ordnance Survey (OS) map does not indicate any immediately local water features. Historical borehole log TQ28SE410 taken approximately 250m from the site in March 1950 indicates a water level of 30m below the surface. The BGS Aquifer map [Figure 6]of the area indicates no local aquifer. *The Lost Rivers of London* [9] book indicates that the site is located between the ancient rivers Fleet and Tyburn but is approximately 1km away from each. We conclude that there are no local spring lines expected, given the site and larger general vicinity is located in an area of impermeable strata. There is an overlying layer of made ground which may act to harvest rainwater, but this may not be considered a spring line. Rain water migration is considered separately.	[10] [9] [8] [7]
3) Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site location [Figure 1] is not within the Hampstead Heath ponds catchment area.	[10]
4) Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	No	The existing hardstanding patio of the garden terrace is laid to falls and serviced by an existing rainwater gully. The proposal will replace the existing rainwater catchment area only.	[11] [5]
5) As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at the present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	The proposed single storey extension will divert rainwater to the existing building drainage via an existing manhole.	[5]

6) Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?	No	There are no local ponds or potential spring lines in the vicinity of the proposed development.	[10]

3.4 [Figure 5] is taken from the Environment Agency interactive map for ground water [7]. The red zone indicates an area with an estimated 50 day travel time from any point below the water table to the source. The green zone indicates an area with an estimated 400 day travel time from any point below the water table to the source, and shows that the property at 166 Regents Park Road lies approximately 175m outside the protected areas. [Figure 6] is an expanded view which describes the most local Aquifer map of the area, and describes and grades any permeable strata which may feature as a strategic water storage course.

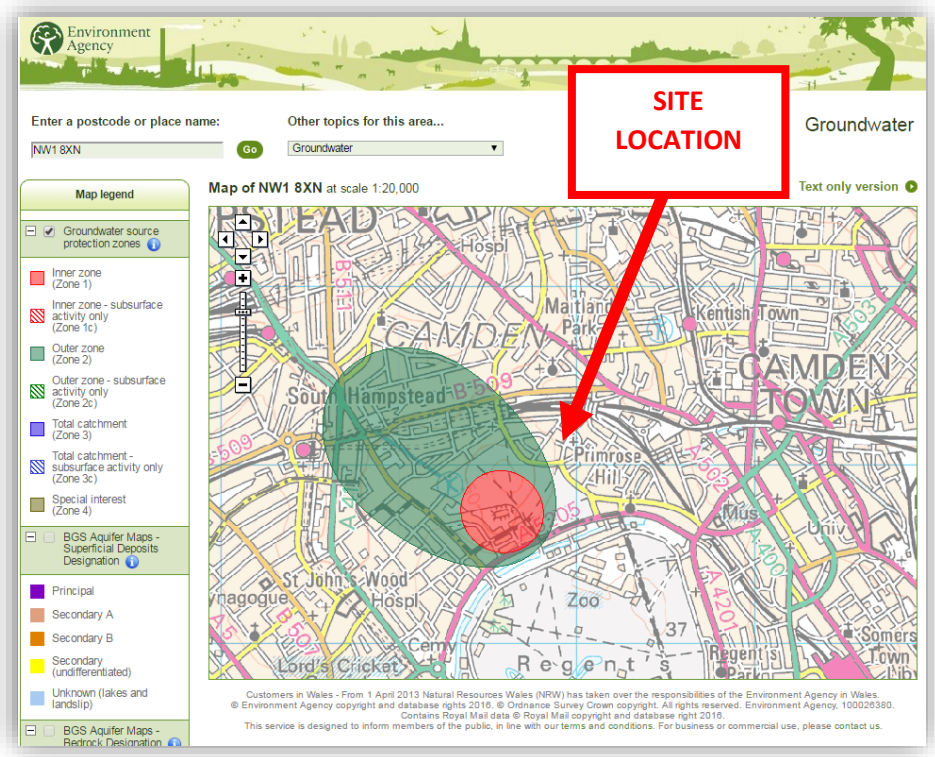


Figure 5 – Environment Agency Groundwater Source Protection Zones [7]

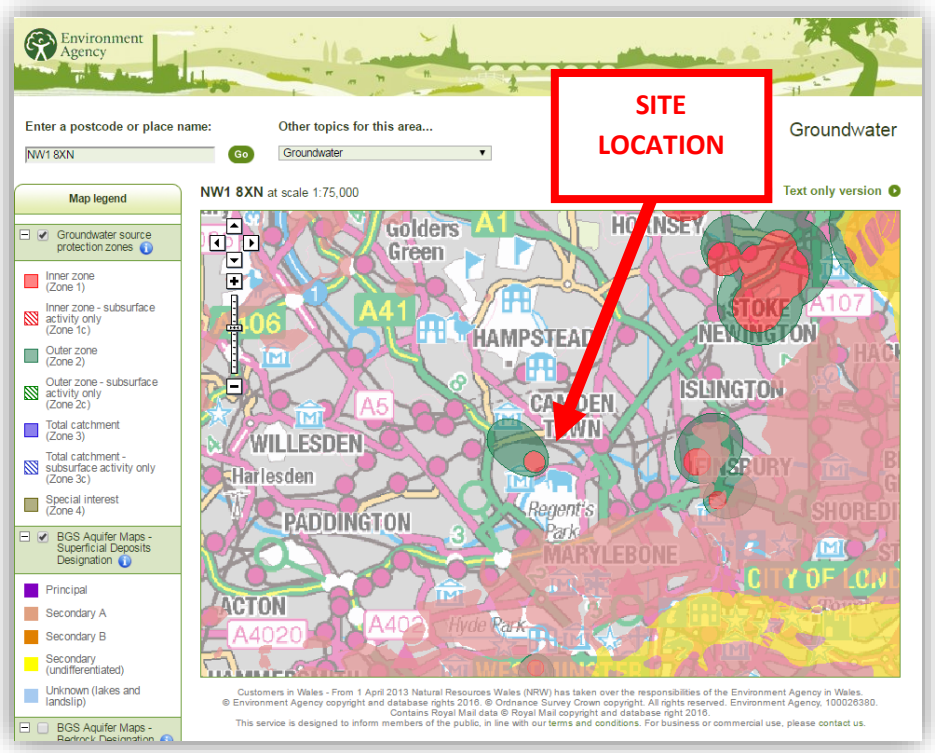


Figure 6 - BGS Aquifer map [7]

Table 2 - Land Stability

Question	Answer	Explanation	Ref.
1) Does the existing site include slopes, natural or manmade, greater than 7°?	No	The site does not include any slopes greater than 7°. This can be seen from the architect's 'existing' drawings.	[11]
2) Will the proposed re-profiling of landscaping at site change slope at the property boundary to more than 7°?	No	The proposal does not introduce any slopes greater than 7°. This can be seen from the architect's proposal drawings.	[5]
3) Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No	The proposal does not neighbour any slopes more than 7°. This can be seen from aerial photography maps of the local area.	[12]
4) Is the site within a wider hillside setting in which the general slope is greater than 7°?	No	The proposed development is located in an urban location away from a wider hillside setting.	[12]
5) Is the London Clay the shallowest strata at the site?	Yes	BGS mapping indicates the site overlays London Clay. Site investigation findings and subsequent reporting confirm the local drift geology as London Clay, which may be categorised as a Very High Shrinkability soil (plasticity index of 40-60%).	[6]
6) 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? (Note that consent is required from LB Camden to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).	No	There are no trees locally present in the area of proposed development.	[12] [13]

7) Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No	Photos taken during a site visit on 30th June 2016 do not show any signs of subsidence in the local area in the form of damaged or cracked masonry. A local walkover survey of the area also indicates no evidence of shrink-swell subsidence in the local area.	[13]
8) Is the site within 100m of a watercourse or a potential spring line?	No	See Question 2 of Table 1.	
9) Is the site within an area of previously worked ground?	Yes	The proposed development is contained within the rear garden terrace of the existing property, which would likely have been re-graded as part of the original construction. The site is bounded by a mews property at the rear.	[7]
10) 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	See Question 2 of Table 1.	[7]
11) Is the site within 50m of the Hampstead Heath ponds?	No	The site location [Figure 1] is not within 50m of the Hampstead Heath ponds.	[10] [12]
12) Is the site within 5m of a highway or pedestrian right of way?	No	The development is within a row of terraced properties. The proposed structural alterations are located at the rear of the property approximately 9m from Regent's Park Road. The rear of the property is adjoined 4 Elgon Mews.	[12] [10]

13) Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The existing site contains a basement at the front of the property, and so will not significantly increase the foundation depth to the existing property. However, the proposed basement at the rear is at a reduced depth of 500mm. There are three neighbouring properties, and it is anticipated that the existing foundations to these properties are shallow relative to the raised garden terrace area.	[5]
14) Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	The site does not overlay any recorded TFL [Figure 8] rail lines. The site is situated approximately 50m away from recorded national rail and London Overground lines.	[14]

3.5 [Figure 7] describes the local bedrock and superficial drift geology local to the proposed development. [Figure 8] shows the recorded local TfL assets in the region of the proposed development.

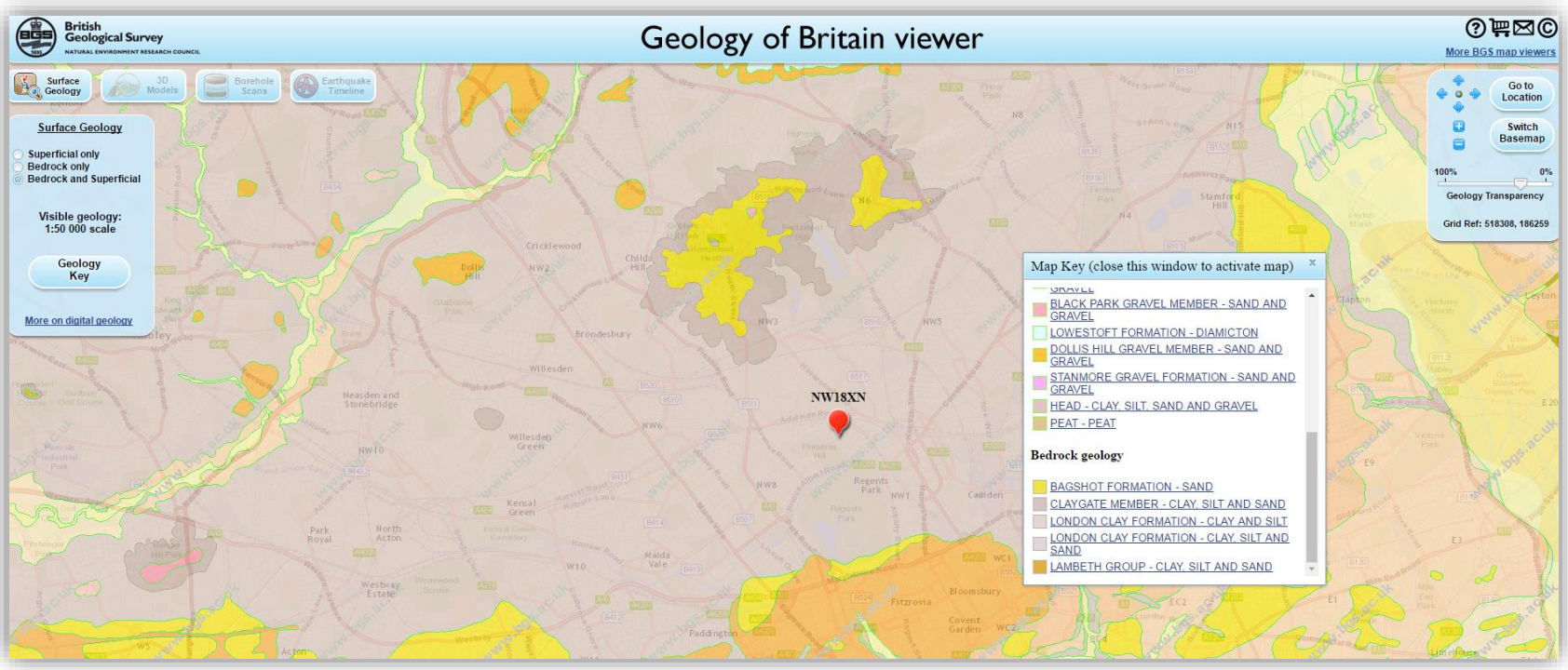


Figure 7 - BGS Interactive Geology Mapping

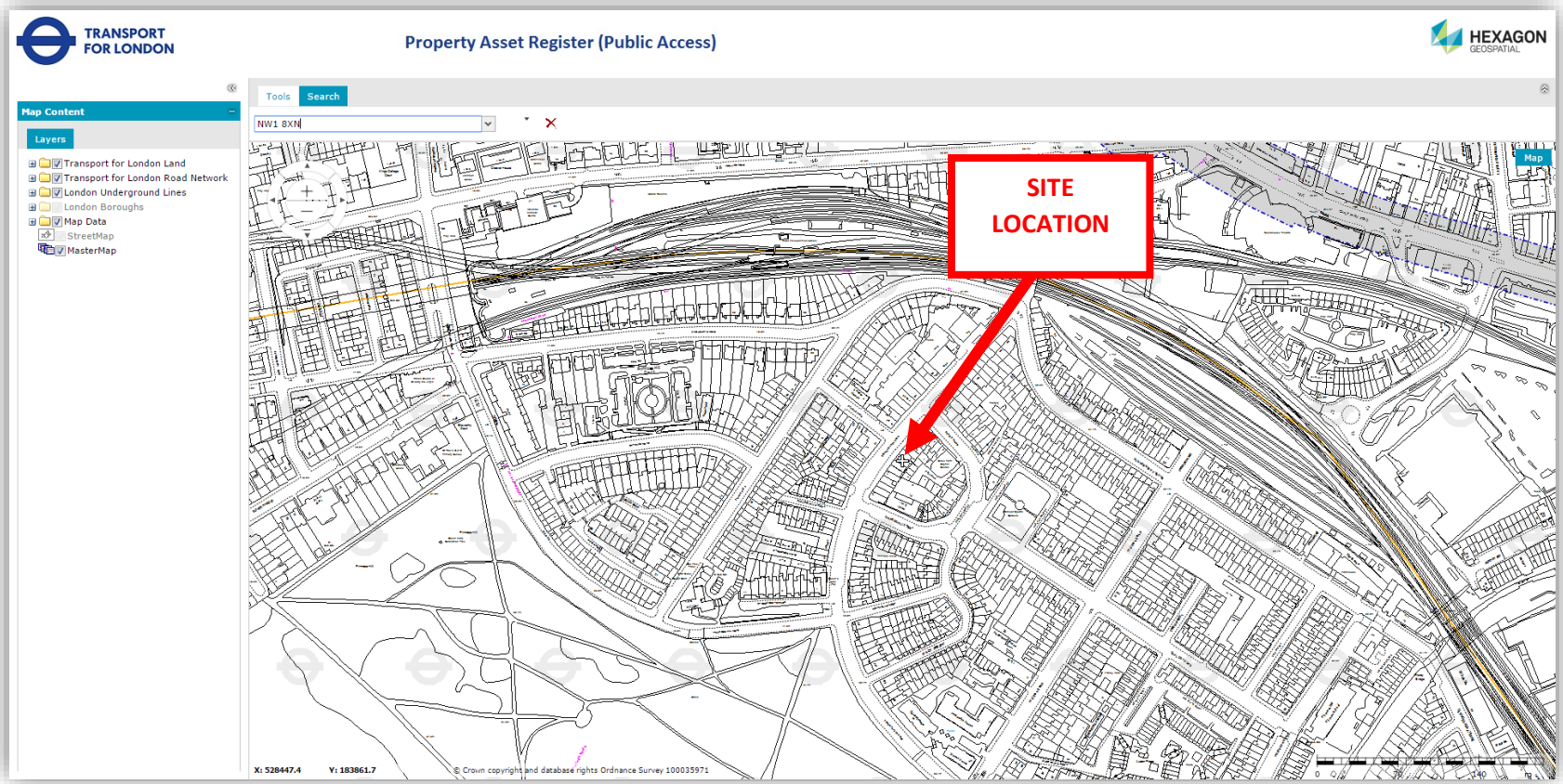


Figure 8 - TfL Interactive Asset Mapping

Table 3 – Surface Flow and Flooding

Question	Answer	Explanation	Ref.
1) Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site location [Figure 1] is not within the Hampstead Heath ponds catchment area.	[10] [12]
2) As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	See Questions 4 and 5 of Table 1	
3) Will the proposed basement development result in a change in the proportion of hard surfaced/paved external areas?	No	See Questions 4 and 5 of Table 1	
4) Will the proposed basement results in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	No	No other properties discharge rainwater into the existing garden terrace.	
5) Will the proposed basement result in in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	See Question 4 of Table 3	
6) Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of the nearby surface water feature?	No	Environment Agency regional mapping indicates that the area is not in an area of flood risk. Site investigation findings indicates that there is not an expected high water table.	[7]

3.6 Further observations not covered in the tables above are provided here:

- Architects investigation regarding neighbouring properties confirm that there are no existing basements adjacent the proposed development.
- Limited trial pitting has been undertaken to the neighbouring foundations. The formation level of neighbouring foundations has been adversely assumed to be consistent with the shallow stepped brick foundations as noted in trial pit exploration.

4.0 Scoping

4.1 Groundwater flow

4.1.1 Site investigation results allow us to reasonably conclude that groundwater will not be encountered by the proposed development, even though some perched groundwater was observed. Perched groundwater is therefore deemed to be rainwater migration through the shallow permeable made ground layer, as transient groundwater seepage. Hence a detailed hydrology report is not considered necessary.

4.1.2 There is no anticipated high water table and body of the local strata is impermeable; as such there will be no discernible damming effect on groundwater flow, and any further consideration is not considered necessary.

4.1.3 The top 0.5m – 1.0m of soil understood to be made ground or similar permeable material. As such, it will be necessary to consider any effect on rainwater migration as transient groundwater seepage.

4.2 Slope stability

4.2.1 There are three surrounding properties which bound the proposed development. Given the absence of existing basements, the assumed foundation depth / formation level of these properties is assumed to be shallow relative to the upper terraced garden level. This has been confirmed by trial pit exploration. As such detailed structural proposals will be required to ensure stability of adjacent properties in both the temporary and permanent conditions.

4.2.2 As part of the design proposals the perimeter Party Walls which bound the garden terrace will be underpinned, and will leave the Party Walls with a deeper footing than the neighbours other walls; the design will consider the available bearing capacity as described in the site investigation report. As part of the Party Wall agreement a precondition survey will be carried out. The design must consider the impact of the deeper footings.

4.2.3 The local soil strata are reported in site investigation findings as London Clay with a very high shrinkability rating. As such foundation proposals are required to ensure the new extension foundations are located suitably below the shrinkable soil zone.

4.3 Surface flow and flooding

4.3.1 The proposed development is not located in an area considered at risk of flooding. As such no mitigation measures are considered necessary.

4.3.2 A drainage scheme must be developed which ensures the roof rainwater catchment will be diverted into the existing rainwater management drainage system.

5.0 Site Investigation and Study

5.1 The interpretative site investigation report is included at the end of this report.

Site record findings, including borehole logs and trial pit findings are included at the end of this report.

6.0 Impact Assessment

6.1 Groundwater flow

6.1.1 Rain water typically may pass into the top 0.5m – 1.0m of local made ground where overlying impermeable strata; in this case London Clay. In such a situation it is prudent to consider the migration of rain water and the damming effect of new retaining walls. We can discern that the introduction of new perimeter retaining features in this situation will not affect the local migration of rain water, because the site is 'land locked' by building structures on all perimeter elevations, which will inhibit rainwater migration through the permeable layer. This is effectively the existing condition.

6.2 Slope stability

6.2.1 Following at the end of this report is a set of structural calculations which explain the stability of the proposed new perimeter underpin foundations. The design of the retaining walls is completed to service lateral design stress values which are confined by the gravity loads of the overlying superstructure. This method ensures stability of the perimeter retaining features without the need for special foundations, specialist temporary works, or propping to be provided by the permanent new floor slabs. Underpinning the perimeter Party Walls will remove the risk of the movement to the adjacent property.

6.2.2 It is not expected that any cracking will occurring during the works. However, our experience informs us that there is a risk of movement to the neighbours during construction stages. As such the works will be carried out in accordance with the Party Wall Act, and condition surveys will be necessary at the beginning and end of the works, and a regimen of movement monitoring will be agreed prior to works commencing.

6.2.3 With the above the maximum level of cracking anticipated is Hairline cracking (Burland scale [15] damage category zero), which can be remediated with minor decorative repairs. To mitigate this risk, The

Party Wall Act is to be followed and a Party Wall Surveyor will be appointed.

6.3 Surface flow and flooding

6.3.1 Rainwater drainage proposals are indicated on the architectural layout drawings, and describe the method by which all surface water will divert to the existing building drainage, which in turn connects to Thames Water drainage assets. The proposals therefore have a similar impact as the existing condition.

7.0 Structural scheme proposal

7.1 Refer to structural scheme proposal drawings located at the end of this report.

References

[1] Camden, "CP4 - Basements and Lightwells".

[2] Camden, "Camden Geological, Hydrogeological and Hydrological Study".

[3] G. Edition, "Old Ordnance Survey Maps".

[4] L. C. Council, Bomb Damage Maps 1939-1945.

[5] B. O. Architects, "Proposed Drawings".

[6] BGS, " BGS Map".

[7] E. Agency, "Groundwater Map".

[8] BGS, "Borehole TQ28SE410".

[9] N. B. a. S. Myers, "The Lost Rivers of London," 2016.

[10] O. Survey, "OS Map".

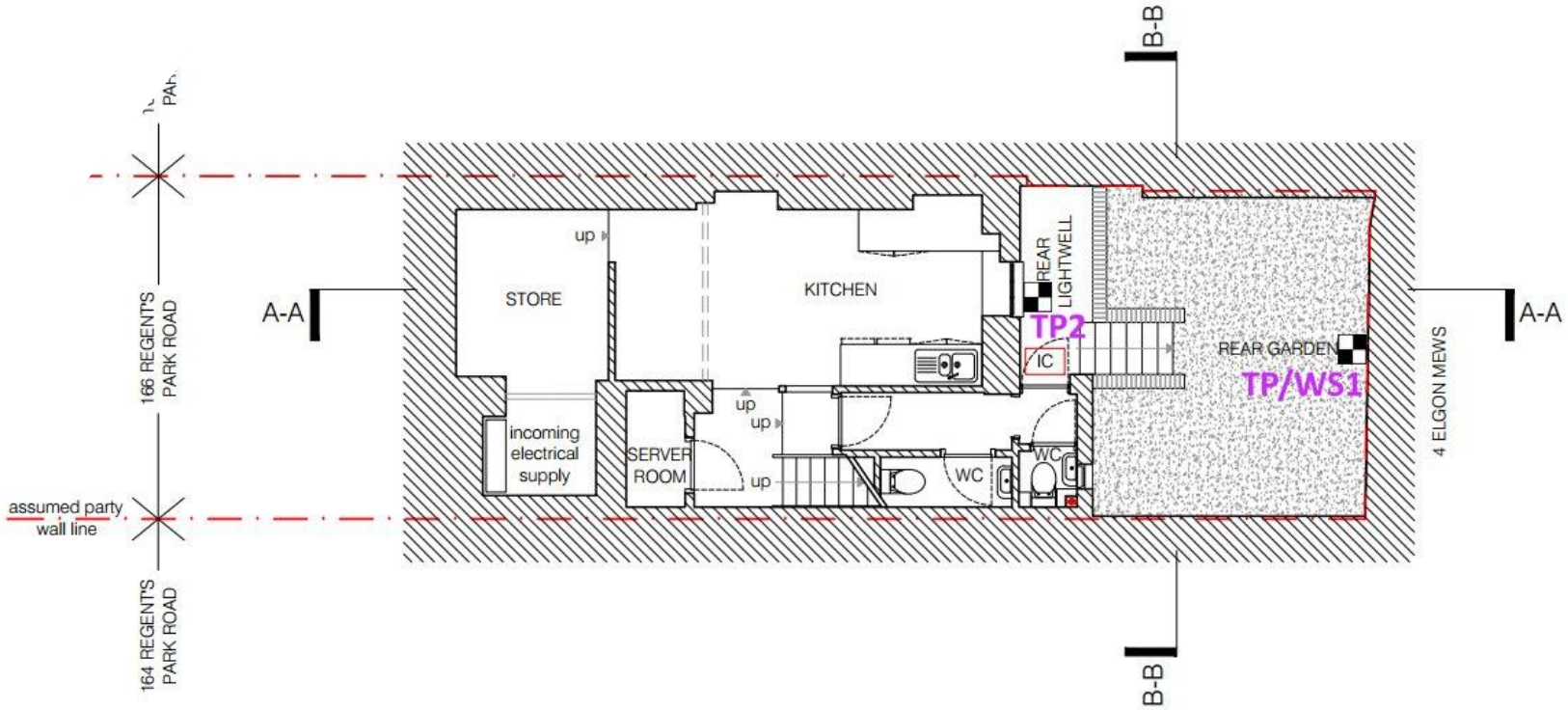
[11] B. O. Architects, "Existing Drawings".

[12] Google, "Maps".

[13] PackmanLucas, "Site Photos," 30thJune2016.

[14] T. f. L. TfL, "Asset register," [Online].

[15] B. R. Establishment, "Digest 251 Assessment of damage in low-rise buildings".



EXISTING LOWER GROUND FLOOR

Title:	Site Plan
Dwg No:	16/10774/1
Drawn by:	GO
Client:	Pixielink Ltd
Site:	166 Regents Park Road, Primrose Hill
Job Ref:	16/10774/GO
Scale:	NTS
Revision:	0
Issue Date:	18/07/2016

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ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH	*PRELIMINARY*	**Trial Pit**	**1**
Contract	Regents Park Road, Primrose Hill	**Report Ref**	16/10774/GO
Client	Packman Lucas	**Date**	08/08/2016
Site Address	166 Regents Park Road, London NW1 8XN	**Ground Level**	

Type of excavator	Manual/WS	Water level after completion, m	dry
Water strikes, m	Pit Dimensions, m	Ease of excavation, m	
1 2.30 (seepage)	Length 0.50	Very easy	Difficult
2	Breadth 0.40	Moderate GL-5.10	Very hard

Remarks **Standpipe installed to 5m.**

Descriptions based on site notes

Samples or tests		Shear Strength kPa	PID TVOC ppm	Depth m	Legend	Strata Description
Type	Depth, m					
D	0.10					MADE GROUND (shingle over brown sandy CLAY with occasional gravcel and brick fragments)
D	0.50			0.60		MADE GROUND (grey-brown sandy CLAY with occasional gravel and brick)
D	1.00	80		1.10		
D	1.20					MADE GROUND (dark grey-brown CLAY with occasional gravel and black staining)
D	1.50	120		1.40		MADE GROUND (grey-brown CLAY with occasional brick particles)
D	2.00	160		1.80		Brown fissured CLAY with grey veining and selenite crystals
D	2.50					
D	3.00					
D	3.50					
D	4.00					
D	4.50					

Sample Code: ***U*** *- 100mm diameter* ***B*** *- Large Disturbed* ***D*** *- Small Disturbed* ***W*** *- Water Sample* ***T*** *- Tube Sample*

Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH

Contract	Regents Park Road, Primrose Hill	Report Ref	16/10774/GO

Samples or tests		Shear Strength kPa	PID TVOC ppm	Depth m	Legend	Strata Description
Type	Depth, m					
D	5.00					Brown fissured CLAY with grey veining and selenite crystals
				5.10		END OF BOREHOLE/TRIAL PIT

Sample Code: ***U*** *- 100mm diameter* ***B*** *- Large Disturbed* ***D*** *- Small Disturbed* ***W*** *- Water Sample* ***T*** *- Tube Sample*

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PRELIMINARY

		Trial Pit	**2**
Contract	Regents Park Road, Primrose Hill	**Report Ref**	16/10774/GO
Client	Packman Lucas	**Date**	08/08/2016
Site Address	166 Regents Park Road, London NW1 8XN	**Ground Level**	

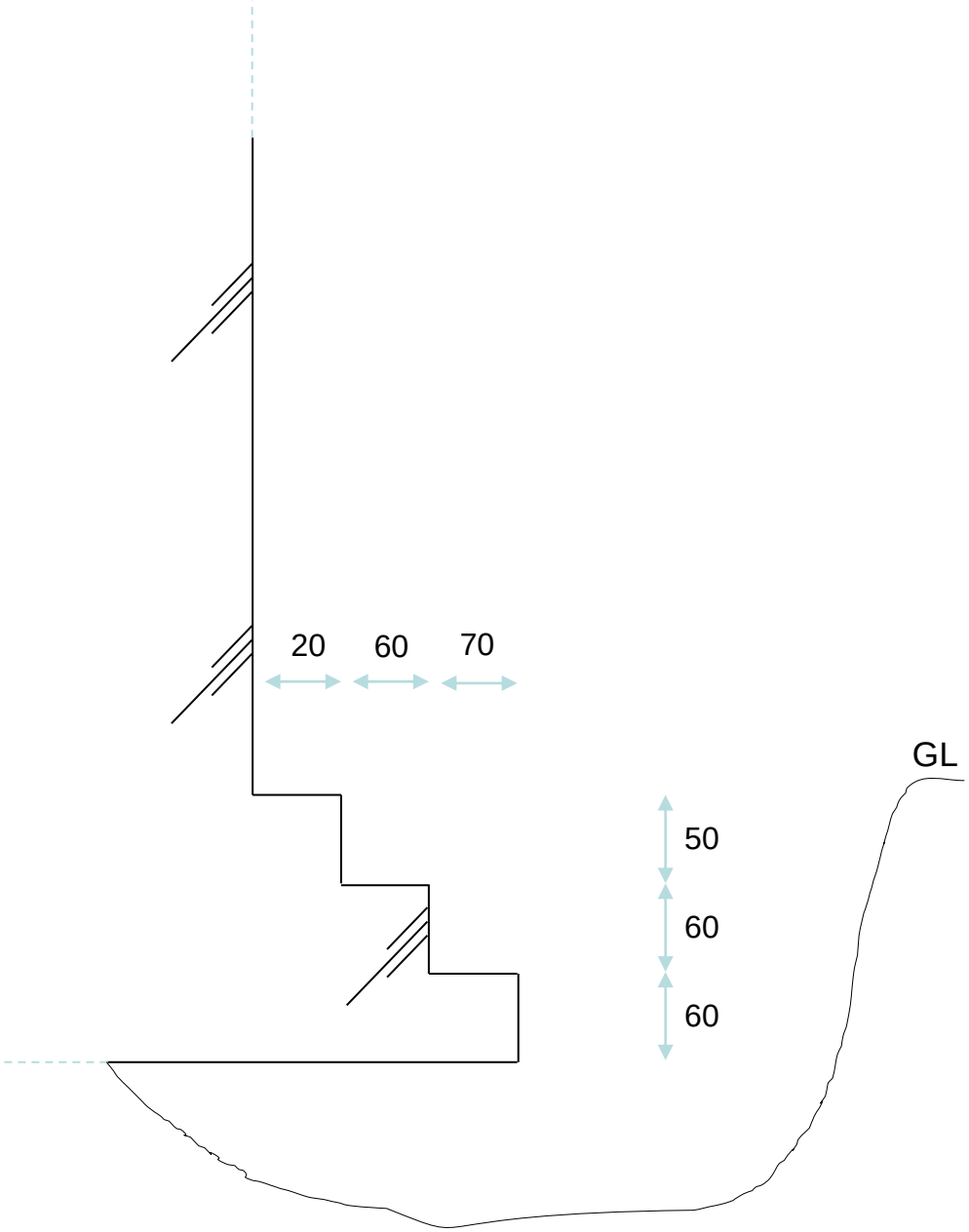
Type of excavator	Manual/WS	Water level after completion, m	dry
Water strikes, m	Pit Dimensions, m	Ease of excavation, m	
1 none	Length 0.50	Very easy	Difficult
2	Breadth 0.40	Moderate GL-3.10	Very hard

Remarks GL 1.20m below that of TP2 GL.

Descriptions based on site notes

Samples or tests		Shear Strength kPa	PID TVOC ppm	Depth m	Legend	Strata Description
Type	Depth, m					
				0.10		MADE GROUND (concrete over bricks)
D	0.20					
						MADE GROUND (brown silty SAND with extensive crushed brick)
D	0.50					
D	0.60	100		0.55		Brown fissured CLAY with grey veining
D	1.00	140				
				1.40		
D	1.50	220				Brown fissured CLAY with grey veining and selenite crystals
D	2.00	240				
D	2.30					(root remains)
D	2.50					
D	3.00					
				3.10		END OF BOREHOLE/TRIAL PIT

Sample Code: ***U*** *- 100mm diameter* ***B*** *- Large Disturbed* ***D*** *- Small Disturbed* ***W*** *- Water Sample* ***T*** *- Tube Sample*



Site:	REGENTS PARK ROAD, PRIMROSE HILL
Drawing No:	16/10774/2
Title:	Trial Pit 1 Section
Scale:	NTS – all dimensions in mm
Revision:	0
Issue Date:	11/08/2016

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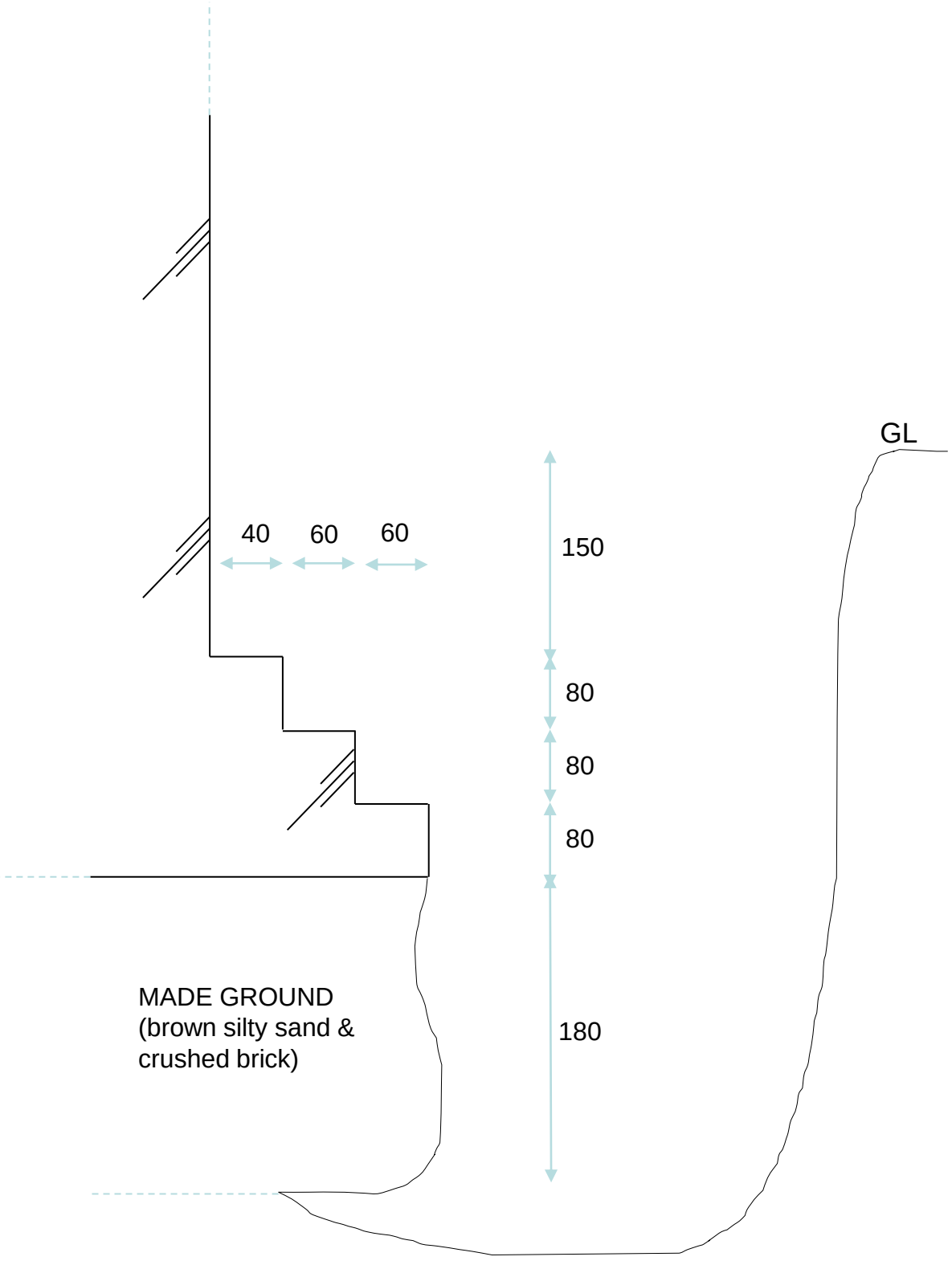

Site:	REGENTS PARK ROAD, PRIMROSE HILL
Drawing No:	16/10774/3
Title:	Trial Pit 2 Section
Scale:	NTS – all dimensions in mm
Revision:	0
Issue Date:	11/08/2016

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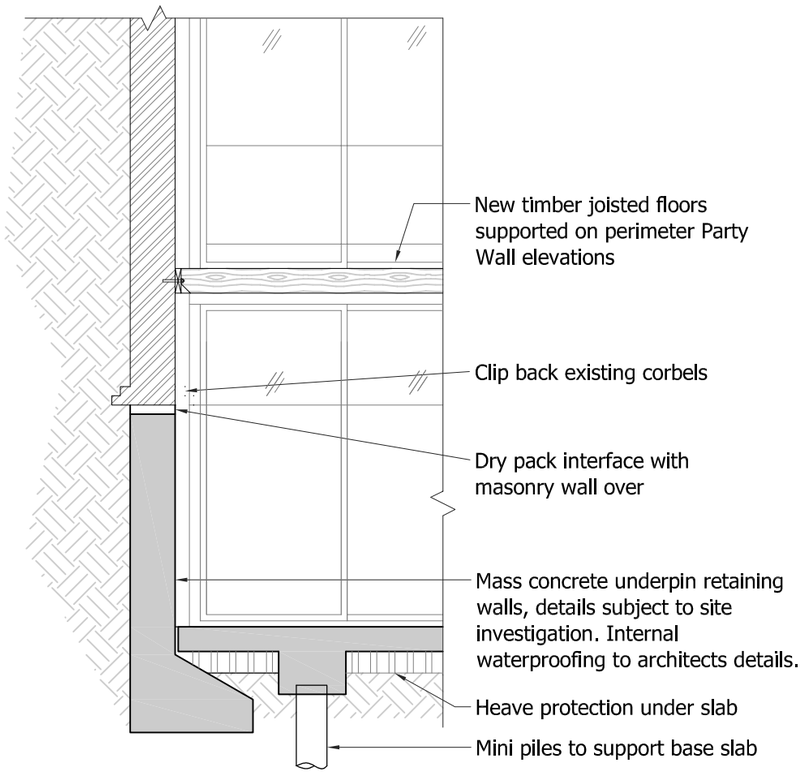

TYPICAL RETAINING WALL DETAIL SECTION

SCALE: 1:50

REV	DATE	DESCRIPTION	DRAWN	CHKD
P1	15.08.16	ISSUED FOR DISCUSSION	BB	BB

REVISIONS

The contractor is to verify all dimensions on site before commencing work. All errors and omissions are to be reported to the Engineer. This drawing is to be read in conjunction with all relevant Architects, Services Engineers and Engineers drawings and specifications.

Project
166 Regents Park Road

Title
Preliminary Structural Proposals

Client
Brian O'Reilly Architects

Scale	Drawn	Date	Checked
1:50 @ A3	B	Aug-16	BB

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T: +44(0)20 7378 7391
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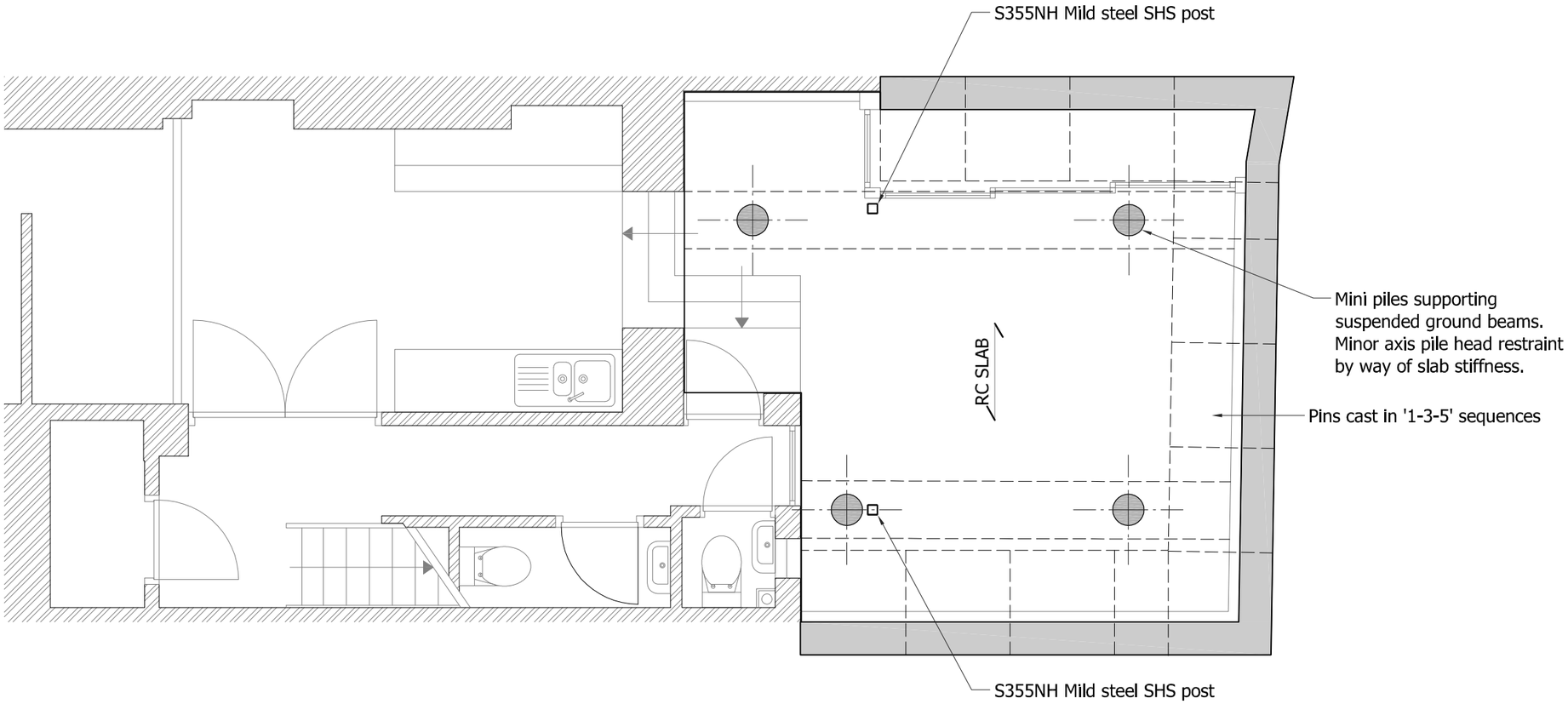
Drawing No. 5576 - SK - 01

Revision P1

Drawing Status
☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ FINAL CONSTRUCTION

A3

DO NOT SCALE



PROPOSED LOWER GROUND FLOOR PLAN GA

SCALE: 1:50

REV	DATE	DESCRIPTION	DRAWN	CHKD
P1	15.08.16	ISSUED FOR DISCUSSION	BB	BB

REVISIONS

The contractor is to verify all dimensions on site before commencing work. All errors and omissions are to be reported to the Engineer. This drawing is to be read in conjunction with all relevant Architects, Services Engineers and Engineers drawings and specifications.

Project
166 Regents Park Road

Title
Preliminary Structural Proposals

Client
Brian O'Reilly Architects

Scale	Drawn	Date	Checked
1:50 @ A3	B	Aug-16	BB

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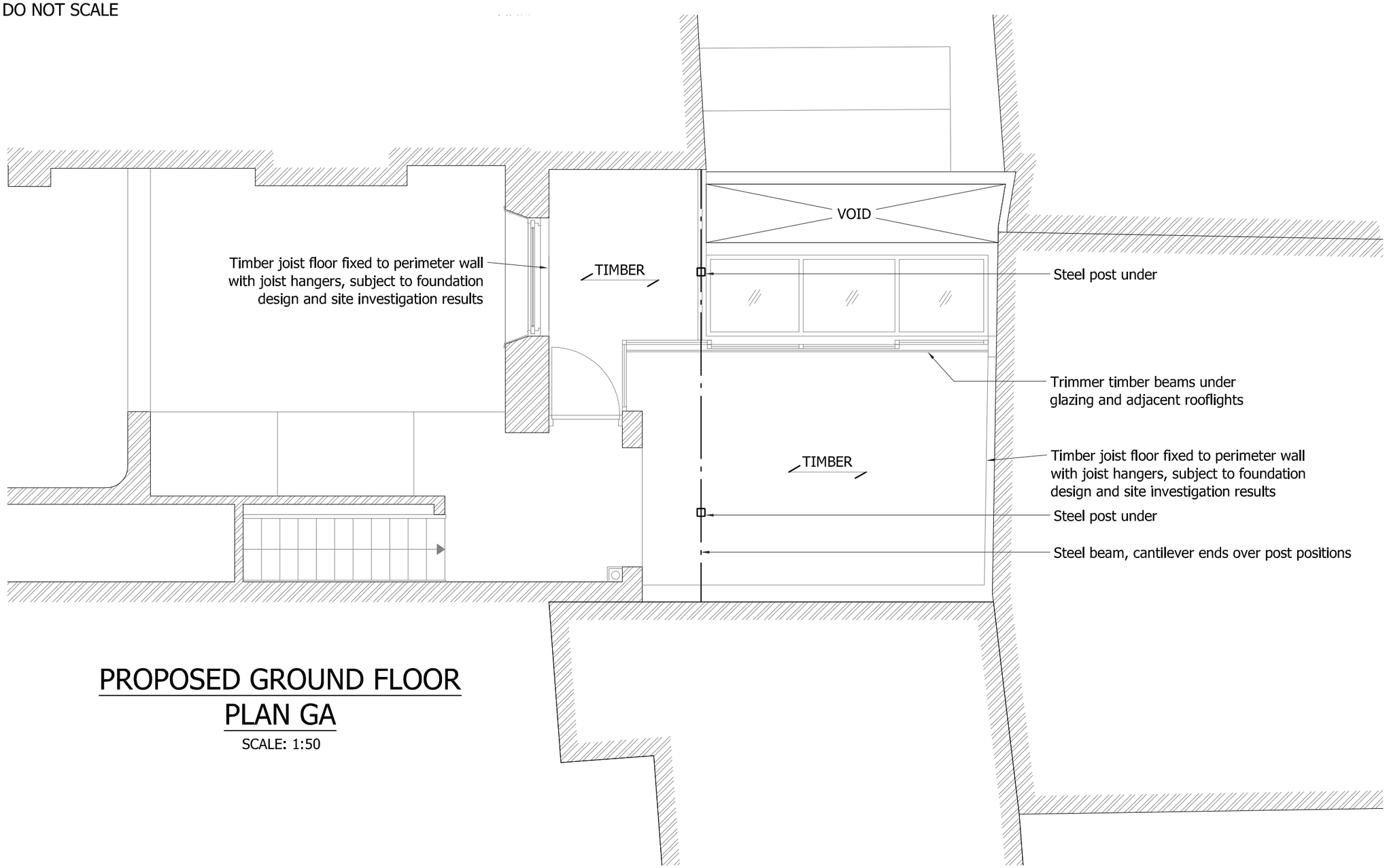
Drawing No.	Revision
5576 - SK - 02	P1

Drawing Status
☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ FINAL CONSTRUCTION

A3

DO NOT SCALE



PROPOSED GROUND FLOOR PLAN GA

SCALE: 1:50

REV	DATE	DESCRIPTION	DRAWN	CHKD
P1	15.08.16	ISSUED FOR DISCUSSION	BB	BB

REVISIONS

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Preliminary Structural Proposals

Client
Brian O'Reilly Architects

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Drawing No.	Revision
5576 - SK - 03	P1

Drawing Status
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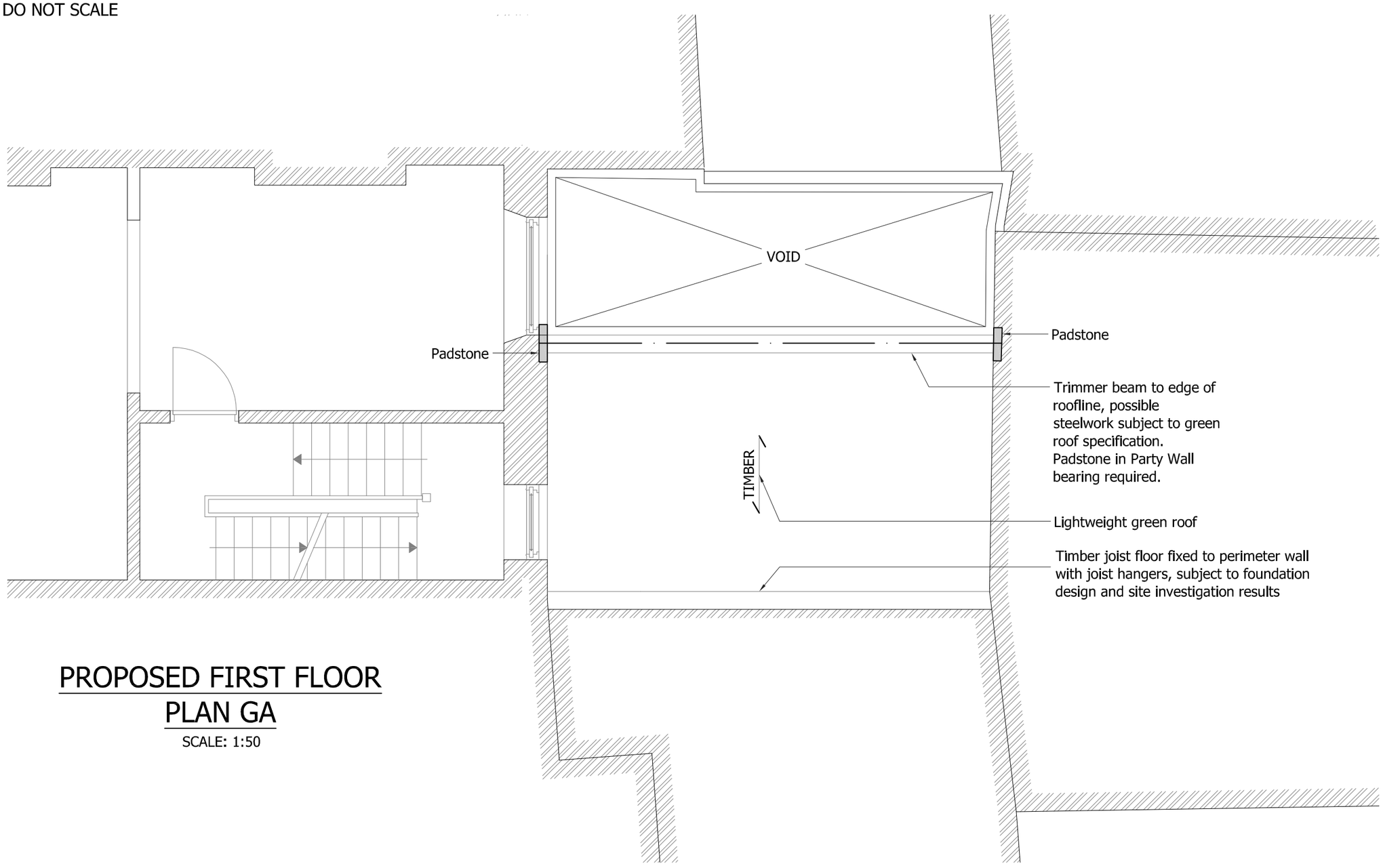
A3

DO NOT SCALE



PROPOSED FIRST FLOOR PLAN GA

SCALE: 1:50

REV	DATE	DESCRIPTION	DRAWN	CHKD
P1	15.08.16	ISSUED FOR DISCUSSION	BB	BB

REVISIONS

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Project
166 Regents Park Road

Title
Preliminary Structural Proposals

Client
Brian O'Reilly Architects

Scale	Drawn	Date	Checked
1:50 @ A3	B	Aug-16	BB

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5576 - SK - 04

Revision
P1

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A3

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Project	Job Ref.
166 REGENTS PARK ROAD	5576
Section	**Sheet No./Rev**
UNDERPINS DESIGN	1
Originator / **Date**	**Chk'd by**
BB / AUG-16	

ASSUMED ALLOWABLE BEARING PRESSURE = 100 kPa

TO BE CONFIRMED ON SITE INVESTIGATION REPORT.

ASSUMED SOIL PROPERTIES, COHESIVE STRATA:

$K_R = 0.75$, $K_0 \sim 0.7$ (TBC), $\gamma_{soil} \sim 20\ kN/m^3$

∴ USE AT REST PRESSURE, NO MOBILISATION PERMITTED.

EXCAVATION/PIN HEIGHT = 1125 + 500 = 1625mm O/A

∴ @ 1/3 POINT ON PIN, $\Sigma P = 0.5 \times 0.7 \times 20 \times 1.625^2$

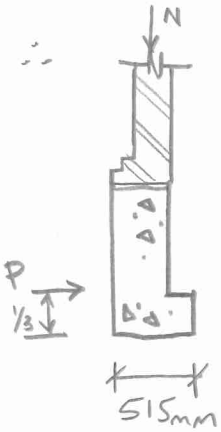
$= 18.5\ kN\ m^{-1}$

∴ EQUIV. MOMENT $= 18.5 \times (1.625/3)$

$= 10.0\ kNm/m$

∴ ASSUME MASONRY LOAD OVER ONLY AS CONFINING FORCE, FOR ADVERSE LOAD CASE IN OVERTURNING.

$Q_K = 5.1m \times (0.215 \times 21) = 23.0\ kN\ m^{-1}$



∴ $\frac{P}{A} \pm \frac{M}{Z} \not< 0 \sim \frac{23.0}{0.515 \times 1.0} \pm \frac{10.0}{(1.0 \times 0.515^2/6)}$

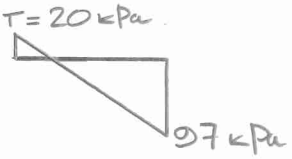
∴ $= 44.7\ kPa \pm 226\ kPa.$

∴ OVERTURNS, SPEC MIN. BASE. INSTEAD.

SAY, 1.0m BASE: ADD SW IN VERT. LOAD.

∴ $\frac{23 + 13.6}{1.0 \times 1.0} \pm \frac{10}{(1.0 \times 1.0^2/6)}$

$= 36.6 \pm 60.0$ ∴ =



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Project	Job Ref.
166 REGENTS PARK ROAD	5576
Section	**Sheet No./Rev**
UNDERPIN DESIGN	2
Originator / **Date**	**Chk'd by**
BB / AUG-16	

TO OVERCOME 20 kPa UPLIFT, WE MAY ADD DEAD LOAD MASS BY DESIGN TO MASS CONCRETE UNDERPINS BASE, RAISING BEARING PRESSURE to A PEAK VALUE OF 117 kPa.

ALL VALUES TO BE CONFIRMED BY SITE INVESTIGATION.