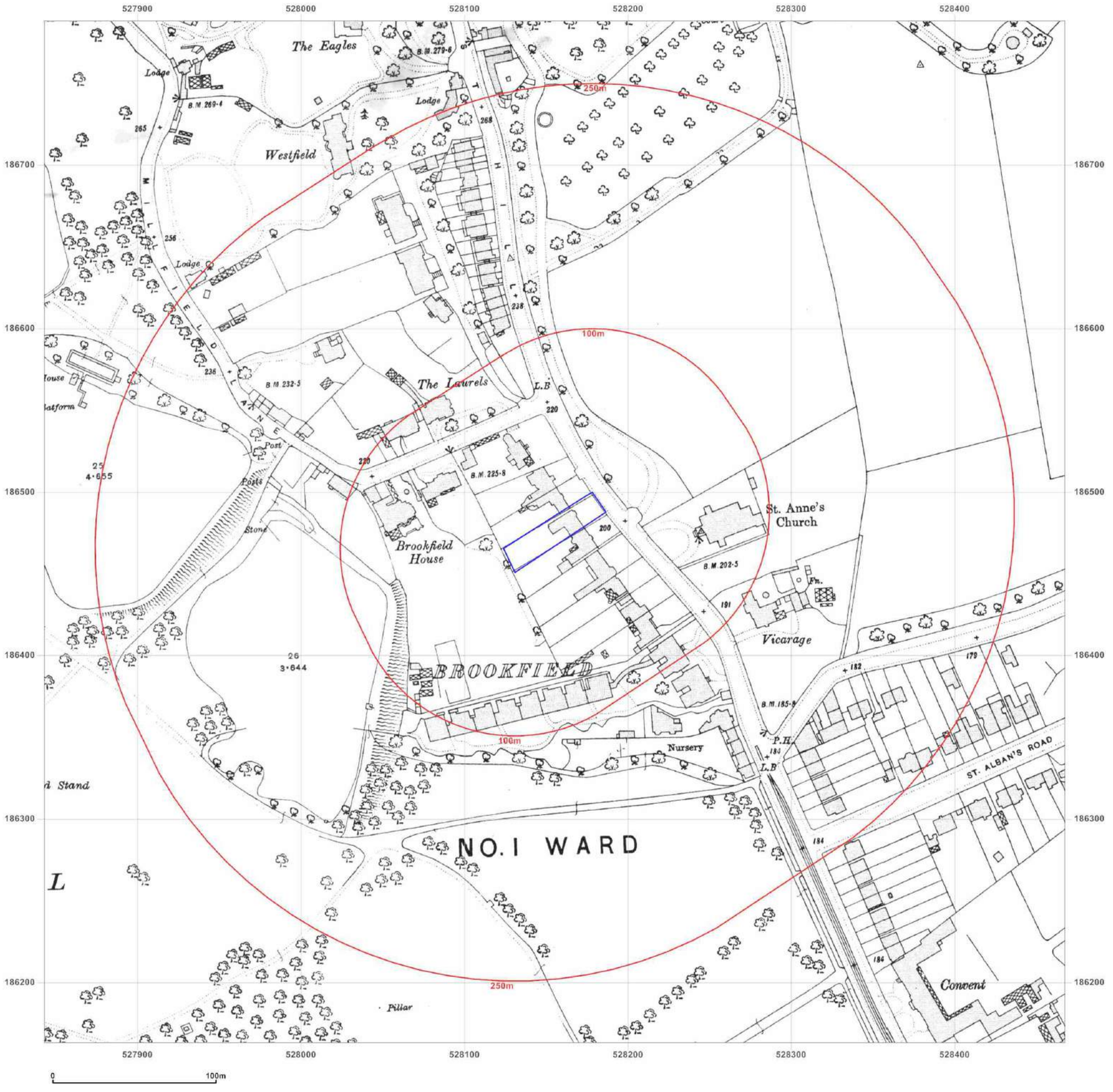

Groundsure INSIGHTS

Site Details:

11, HIGHGATE WEST HILL,
LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: County Series

Map date: **1915**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1915
Revised 1915
Edition N/A
Copyright N/A
Levelled N/A

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Map legend available at:
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Groundsure INSIGHTS

Site Details:

11, HIGHGATE WEST HILL,
LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: County Series

Map date: **1936**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1936
Revised 1936
Edition N/A
Copyright N/A
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Site Details:

11, HIGHGATE WEST HILL,
LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1951-1952**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed 1951
Revised 1951
Edition N/A
Copyright N/A
Levelled 1933

Surveyed 1951
Revised 1951
Edition N/A
Copyright N/A
Levelled 1933

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1952
Revised 1952
Edition N/A
Copyright N/A
Levelled 1933

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Site Details:

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Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid
Map date: **1951-1952**
Scale: 1:1,250
Printed at: 1:2,000

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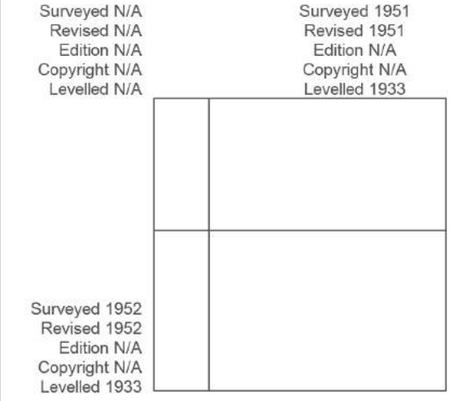

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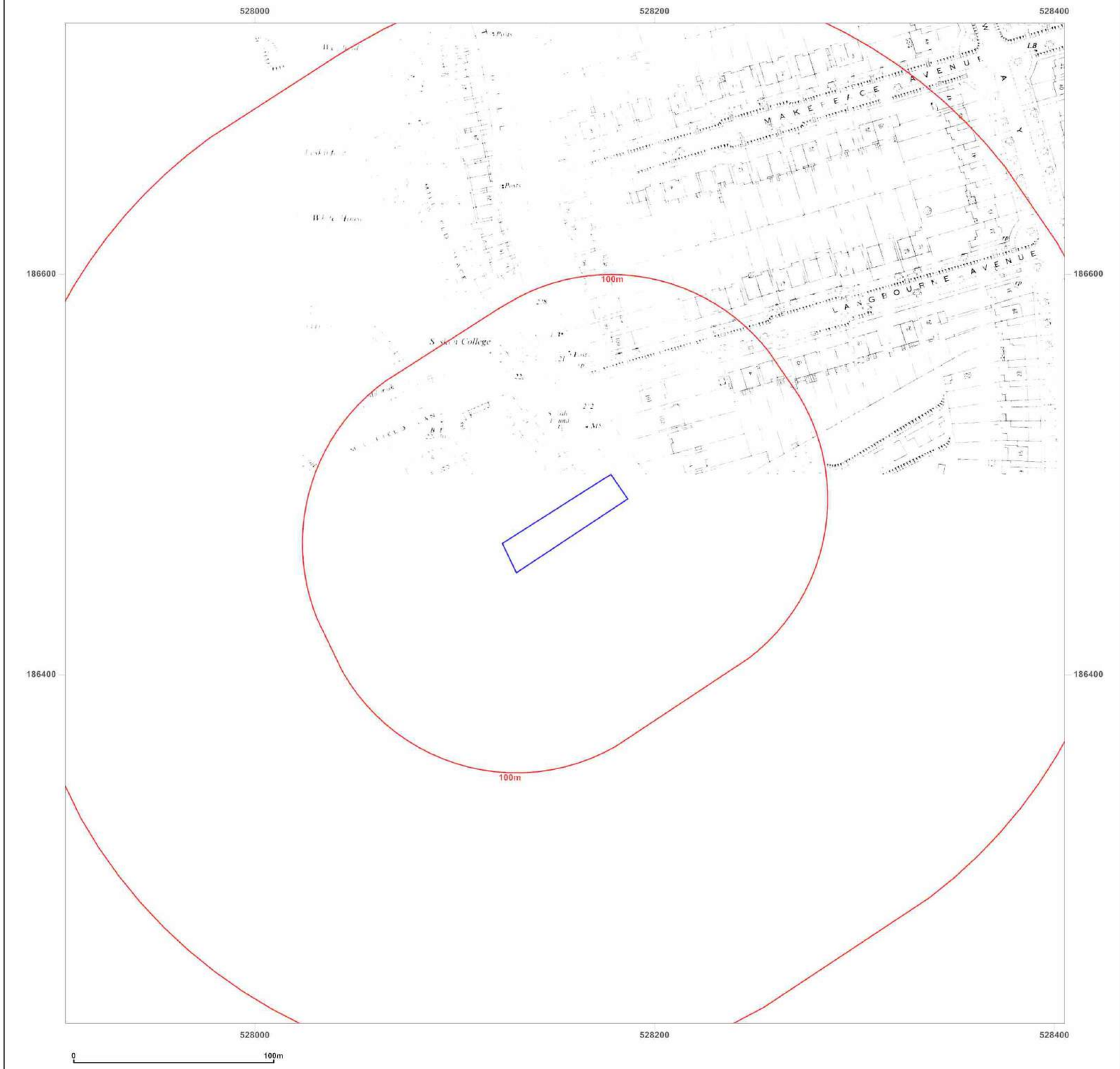

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Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid
Map date: **1952**
Scale: 1:1,250
Printed at: 1:2,000

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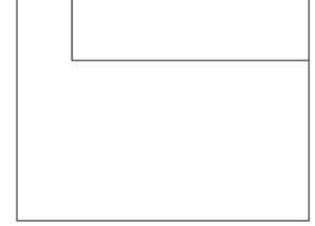
Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A



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Production date: 17 August 2020

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1952**

Scale: 1:1,250

Printed at: 1:2,000

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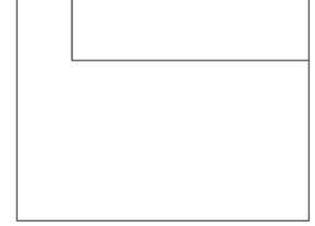
Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A



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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1952**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1952
Revised 1952
Edition N/A
Copyright N/A
Levelled N/A

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Revised 1952
Edition N/A
Copyright N/A
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Site Details:

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1962-1963**

Scale: 1:1,250

Printed at: 1:2,000

N
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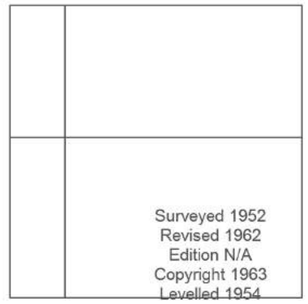
Surveyed 1951
Revised 1961
Edition N/A
Copyright 1962
Levelled 1954



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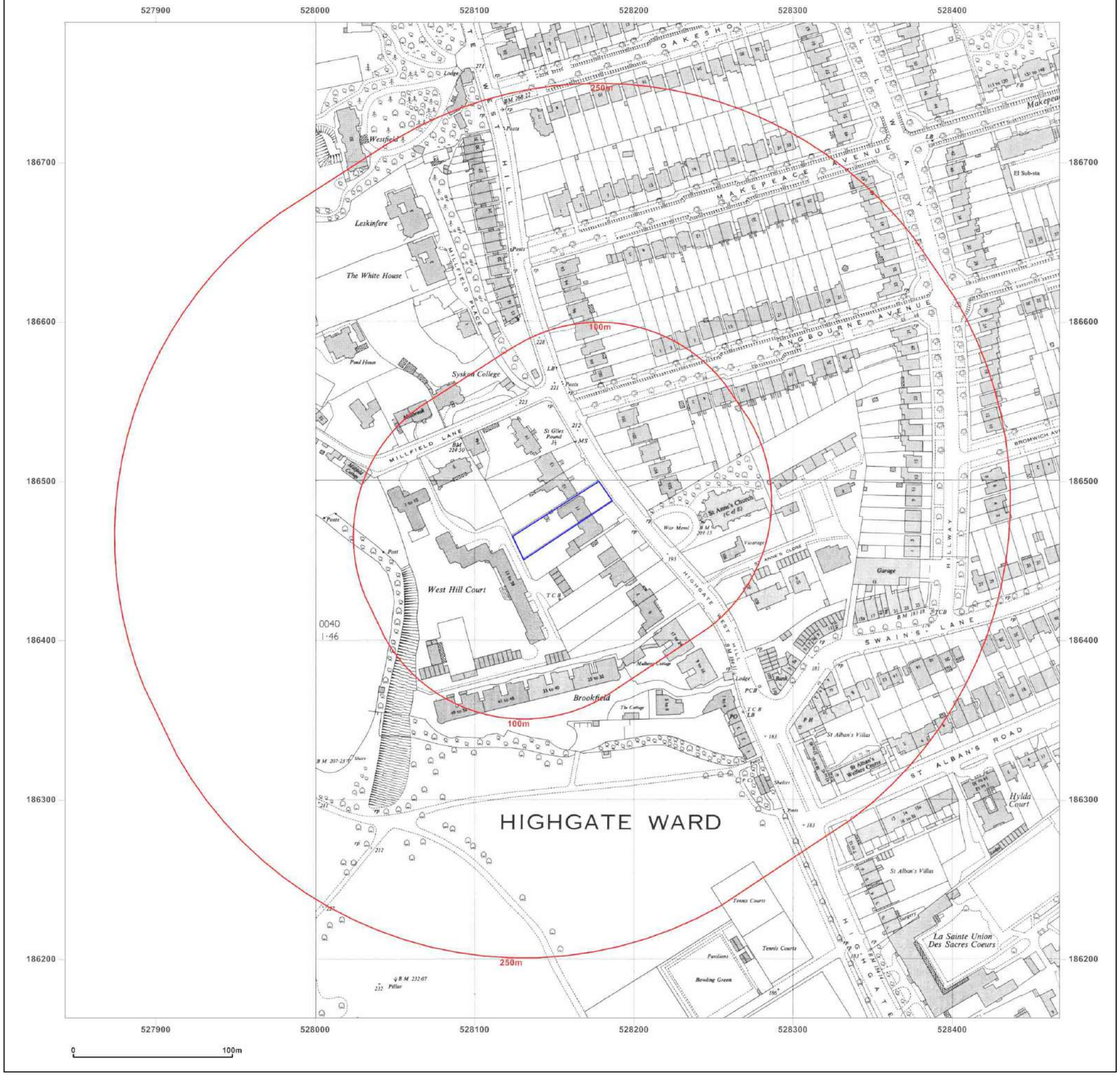

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1968**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1968
Revised 1968
Edition N/A
Copyright 1970
Levelled 1954

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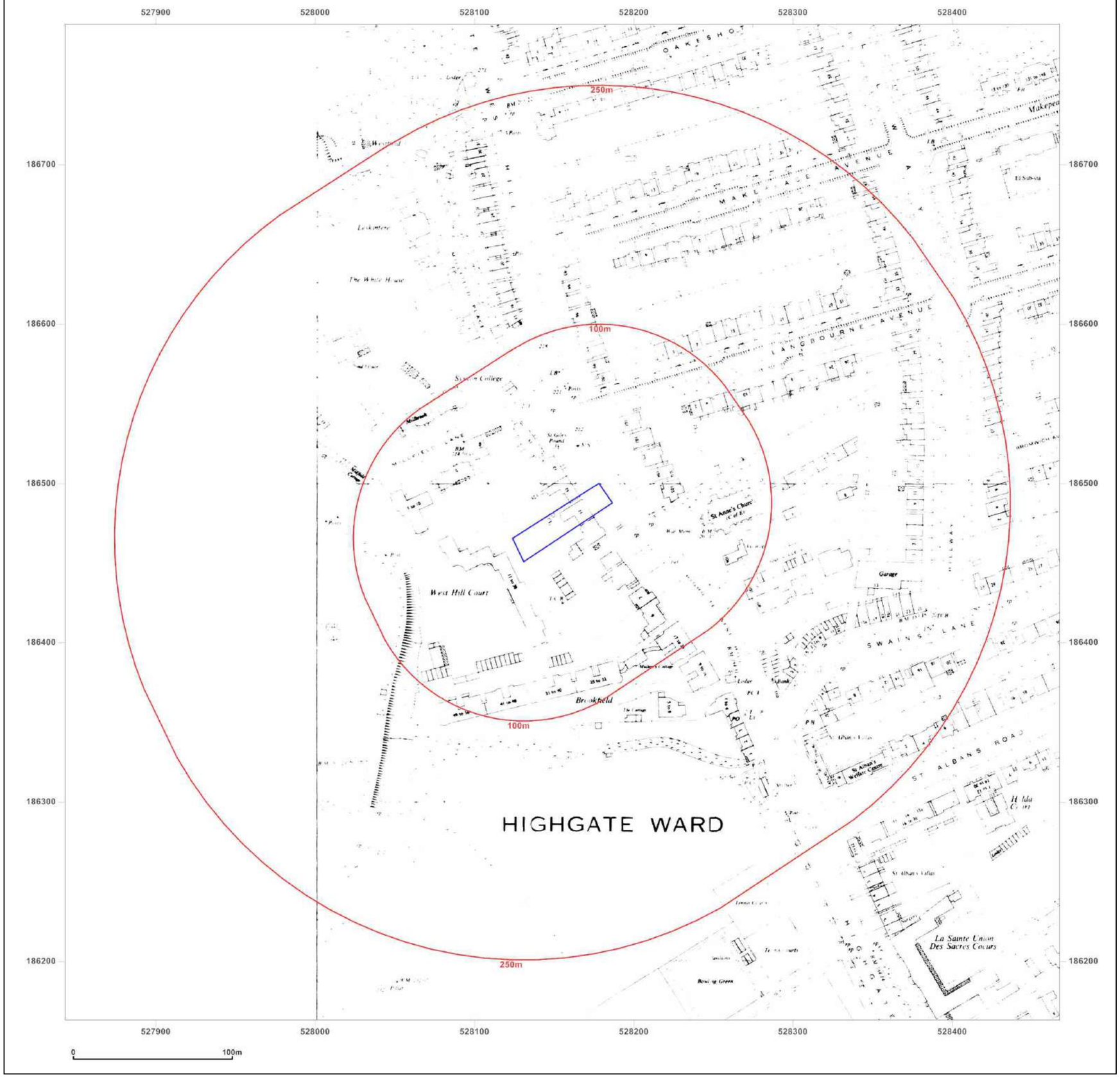

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1970**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1977**

Scale: 1:1,250

Printed at: 1:2,000

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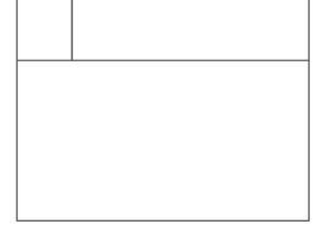
Surveyed 1977
Revised 1977
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1977
Revised 1977
Edition N/A
Copyright N/A
Levelled N/A



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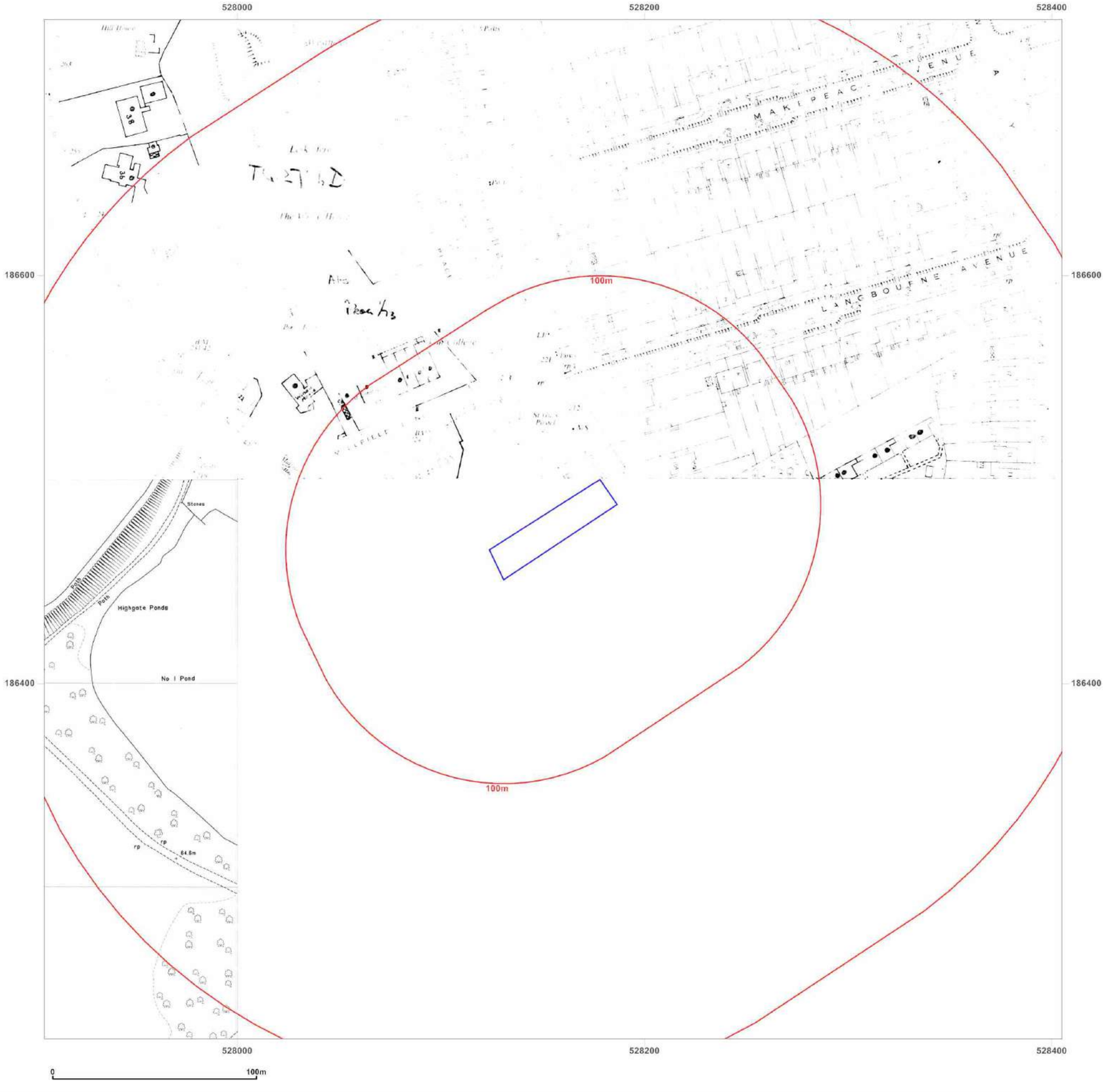

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid
Map date: **1974-1978**
Scale: 1:1,250
Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1952
Revised 1978
Edition N/A
Copyright 1979
Levelled 1975

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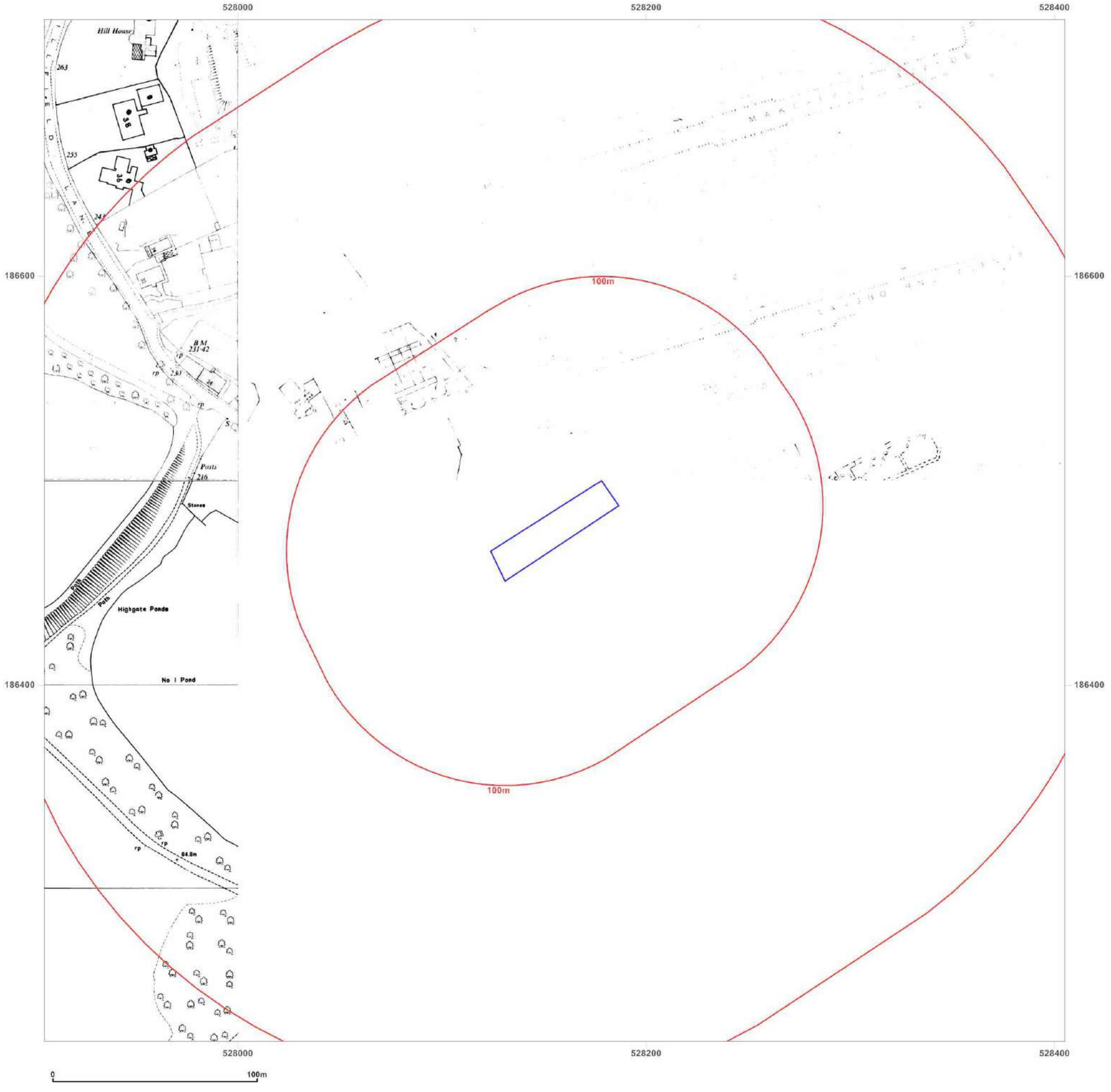

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Client Ref: 11_Highgate_West_Hill_
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Grid Ref: 528155, 186475

Map Name: National Grid
Map date: **1976-1979**
Scale: 1:1,250
Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
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Surveyed N/A
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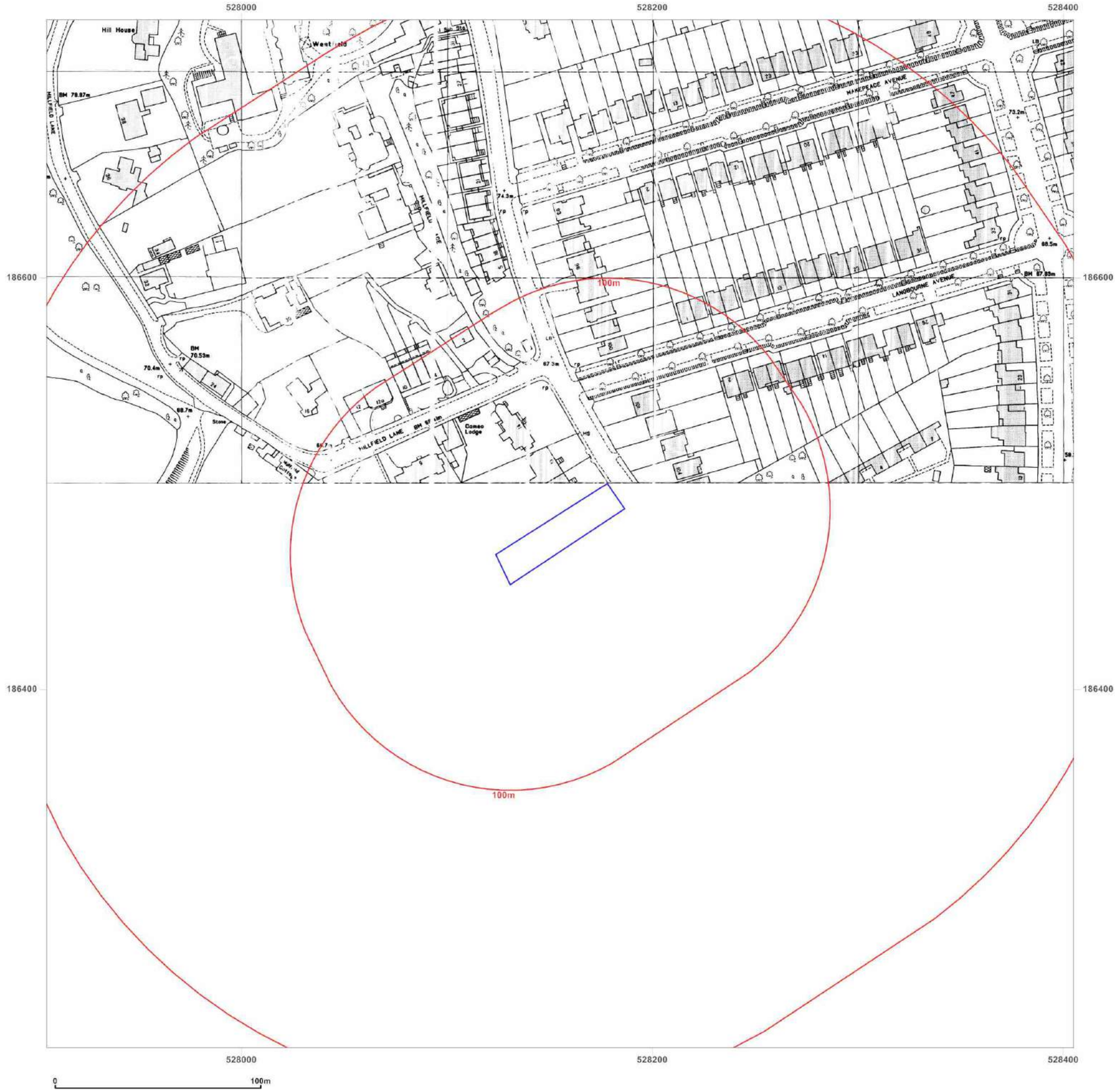

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Site Details:

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1979**

Scale: 1:1,250

Printed at: 1:2,000

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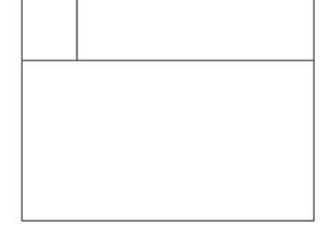
Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A



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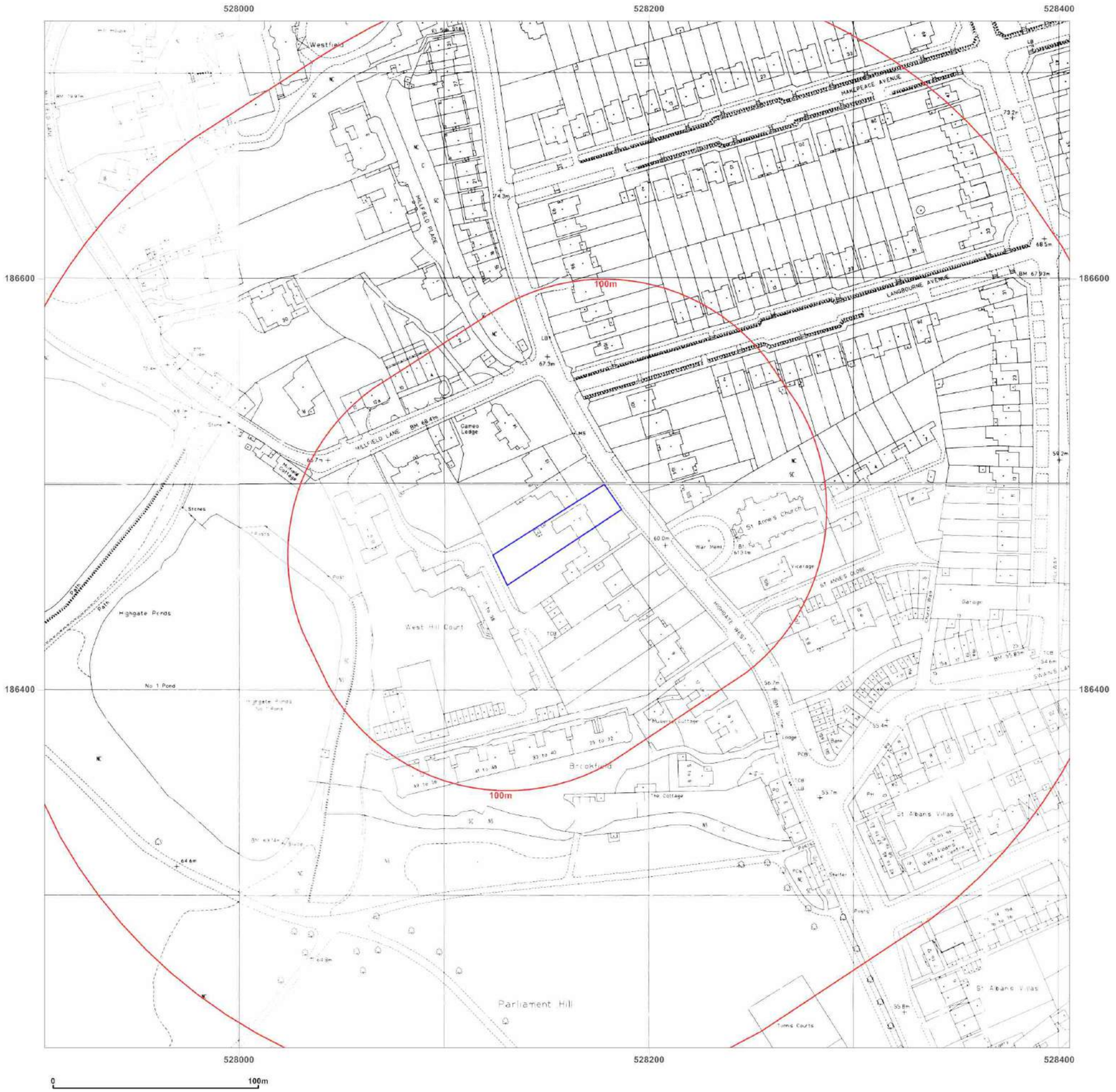

Groundsure INSIGHTS

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1991**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1991
Levelled N/A

Surveyed N/A
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Edition N/A
Copyright 1991
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Surveyed N/A
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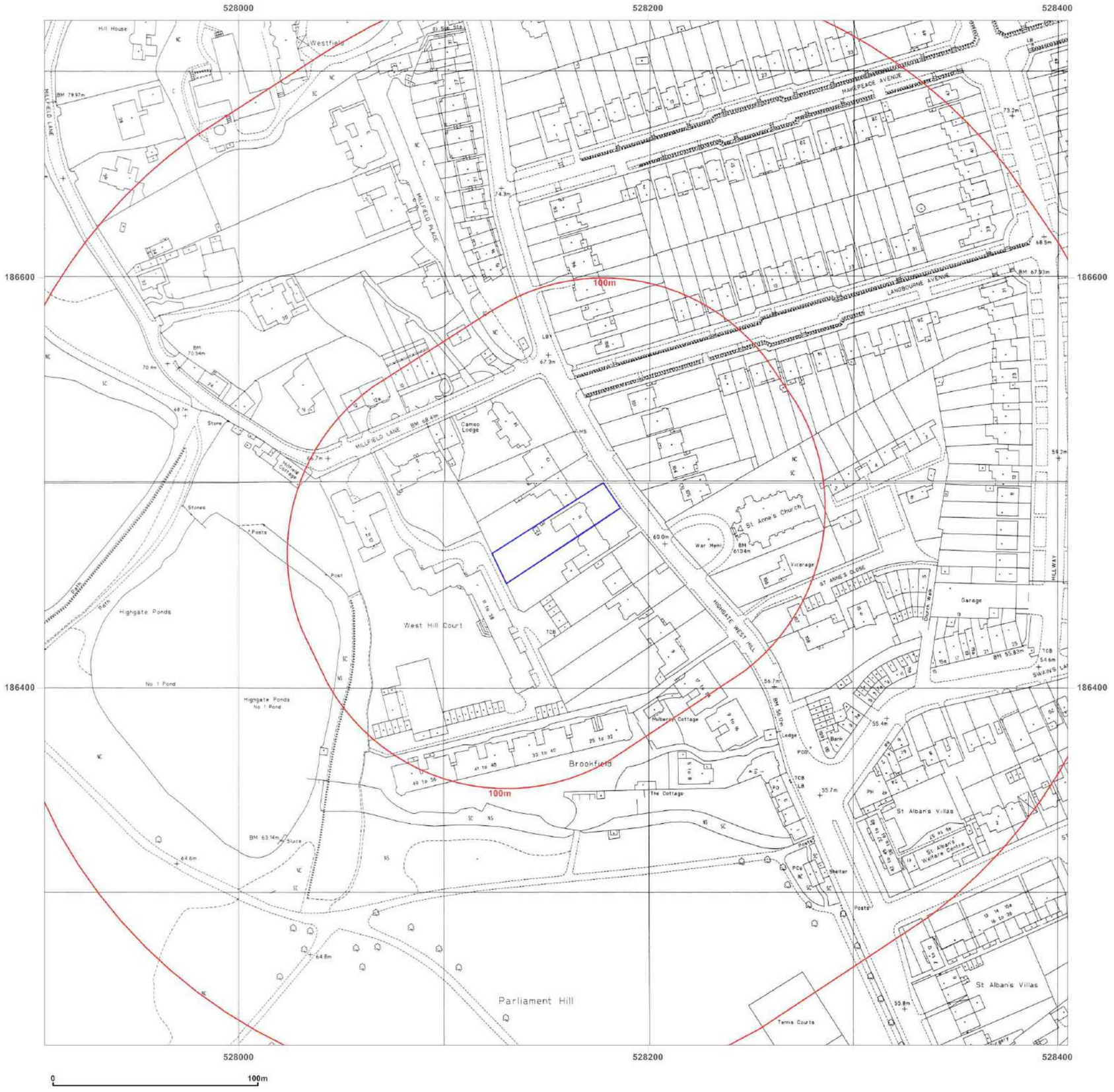

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Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1991**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed 1991
Revised 1991
Edition N/A
Copyright 1991
Levelled N/A

Surveyed 1991
Revised 1991
Edition N/A
Copyright 1991
Levelled N/A

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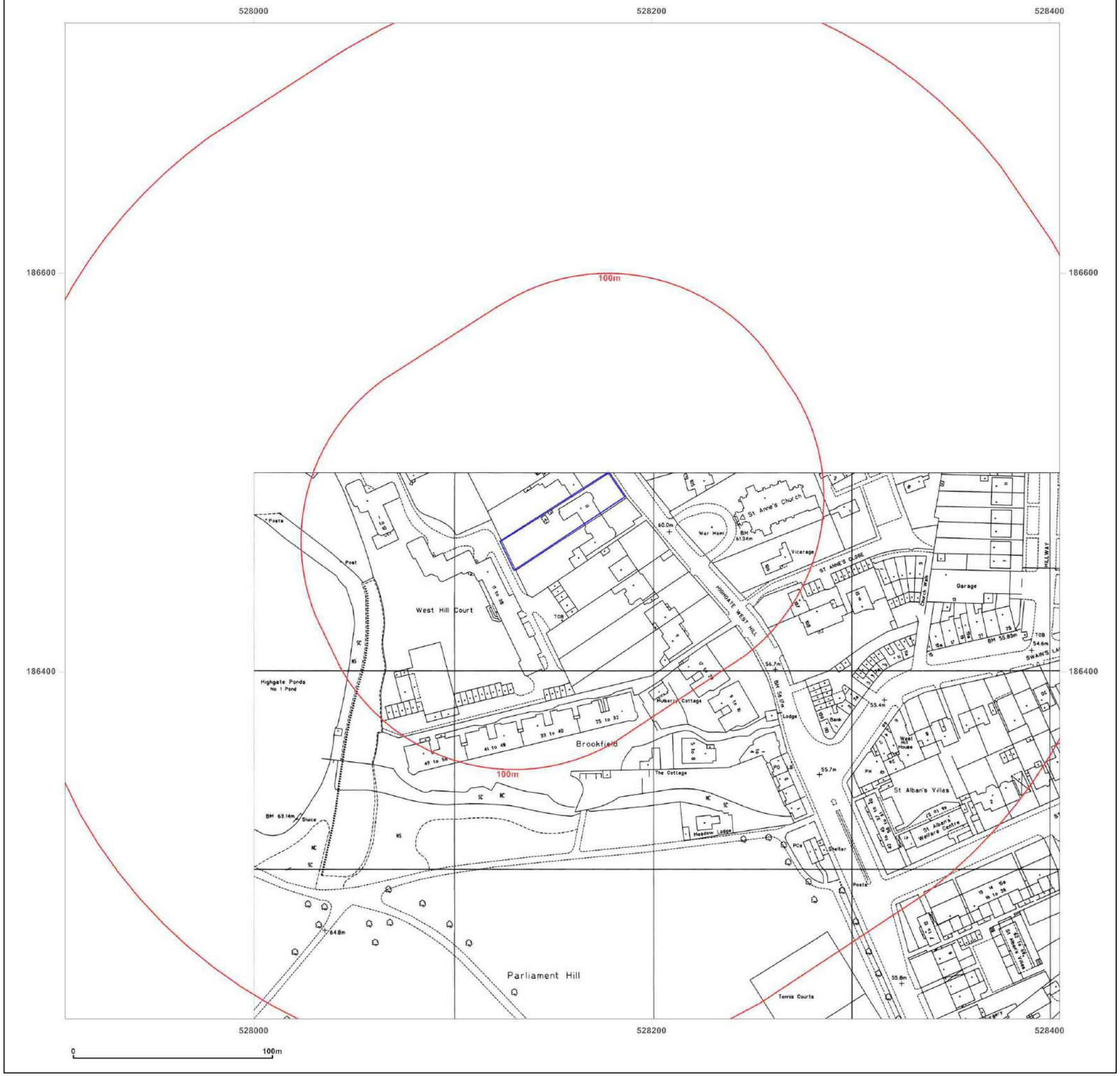

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Map date: **1991**

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Printed at: 1:2,000

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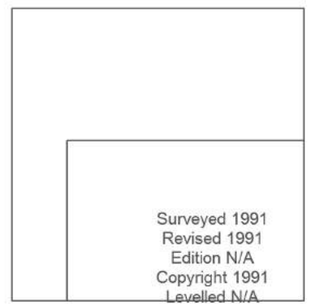

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Client Ref: 11_Highgate_West_Hill_
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Grid Ref: 528155, 186475

Map Name: National Grid

Map date: **1992**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1992
Levelled N/A

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Production date: 17 August 2020

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Groundsure INSIGHTS

Site Details:

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LONDON, N6 6JR

Client Ref: 11_Highgate_West_Hill_
Report Ref: GS-6973592
Grid Ref: 528155, 186475

Map Name: LandLine
Map date: **2003**
Scale: 1:1,250
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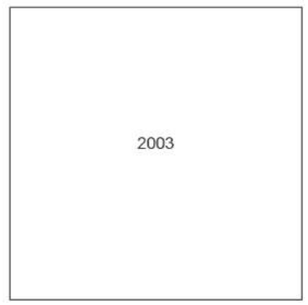

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APPENDIX C

Site investigation report

FACTUAL GROUND INVESTIGATION REPORT

for the site at

11 Highgate West Hill, Highgate, London N6 6JR

on behalf of

GROUND AND PROJECT CONSULTANTS LIMITED

Report Reference: GWPR3834/October 2020			Status: FINAL
Issue:	Prepared By:	Checked By:	Verified By:
V1.01 October 2020			
	Chris Gordon FGS, MSc, BSc (Hons) Geotechnical and Geo-Environmental Engineer	Alec Ovens MSci RSoBRA FGS Senior Engineer	Francis Williams MGeol (Hons) FGS CGeol CEnv AGS Director
File Reference: Ground and Water/Project Files/ GWPR3834 11 Highgate West Hill, Highgate, London N6 6JR			

CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by Ground and Project Consultants Ltd on Tuesday 25th August 2020, to undertake a Ground Investigation at 11 Highgate West Hill, Highgate, London N6 6JR (the site). The scope of the investigation was originally detailed within the Ground and Water Limited fee proposal ref. GWQ5616, dated 25th June 2020 and revised fee proposal ref. GWQ5616Rev2, dated 26th August 2020.

1.2 Aims of the Investigation

Ground and Water Limited understood the aim of the investigation was to provide the client with factual information relating to local ground conditions underlying the site to assist the preparation and design of the proposed development. The factual information is presented in this report.

A site investigation was undertaken to extract a series of soil samples representative of underlying ground conditions and preform in-situ and laboratory testing to inform foundation design of the proposed development.

A Desk Study or full-scale contamination and geotechnical assessment were not considered part of the remit of this Factual Report. The techniques adopted for the investigation were selected in conjunction with the anticipated ground conditions, limited historical development and scale of the proposed development.

1.3 Conditions and Limitations

This factual report has been prepared based on the terms, conditions and limitations outlined within Appendix A.

2.0 SITE SETTING

2.1 Site Location

The site occupied a total area of approximately ~800m^2 and was formed of a roughly rectangular shaped plot of land, orientated from east to west. The site was located in the Greater London area within an urban residential setting, approximately 900m south of central Highgate. Detached or Semi-detached large period properties neighbour the site to the north and south along Highgate West Hill and rear garden back onto rear gardens of properties of West Hill Close along its western boundary. Parkland of Hamstead Heath was ~200m west, Gospel Oak underground station ~800m south and Swain's Lane ~380m east. The site was located north of the River Thames under the Camden local authority within the residential area of Greater London, N6 6JR.

The approximate National Grid Reference for the centre of the site is TQ 28166 86475. A site location plan is provided within Figure 1. A plan showing the site development area is given within Figure 2.

2.2 Site Description

The site comprised a semi-detached 2 storey period property accessed from Highgate West Hill. The property was on a raised elevation ~2 – 3m above street level with stepped access and retaining walls forming the front facing eastern boundary. The enclosed front garden was largely soft landscaped and featured a number of mature trees and shrubbery. An existing cellar occupied part of the total building footprint underneath one of the two front reception rooms. A small conservatory provided access onto an enclosed rear garden at the rear of the property which had areas of hard and soft landscaping.

An aerial view of the site with a general indication of the proposed site boundaries is presented as Figure 3.

2.3 Proposed Development

Based on planning application 2019/5729/L submitted to Camden Borough Council on 13th November 2019, the proposed development was understood to comprise the demolition of an existing conservatory and erection of a single storey rear extension with partially glazed roof. A plan of the proposed development is presented as Figure 4.

2.4 Geology

The BGS Geological Map for the North London area (North London, Sheet No. 256, Bedrock and Superficial 1:50,000) indicated that the site was located on bedrock stratum of the London Clay Formation. No artificial ground or superficial deposits were recorded within 500m of the site.

London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of Gypsum (Selenite) are often found within the weathered part of the London Clay Formation, and precautions against sulphate attack to concrete are sometimes required. The lowest part of the formation is a sandy bed with black rounded gravel and occasional layers of sandstone and is known as the Basement Bed.

British Geological Record

A representative BGS borehole record ~650m east of the site (TQ28NE150) noted brick fill Made Ground to a depth of 2.50m bgl underlain by bedrock of the London Clay Formation to the base of borehole at a depth of 15.00m bgl. The London Clay Formation was described as stiff fissured

mottled brown grey silty clay with occasional gypsum crystals to 6.50m bgl then becoming very stiff fissured grey silty clay to the base of the borehole. No groundwater strikes were recorded. A groundwater strike was recorded in historical borehole TQ28NE14, located ~450m south of the site, at a depth of 56.6m bgl within the London Clay Formation.

2.5 Hydrogeology and Hydrology

A study of the aquifer maps on the Department for Environment, food and Rural Affairs (DEFRA) and Environment Agency (EA) websites revealed the site to be underlain with an **Unproductive Aquifer** comprising the bedrock deposits of the London Clay Formation. No designation was given for superficial deposits, due to their likely absence.

Unproductive Strata are rock layers with low permeability that have negligible significance for water supply or river base flow. These were formerly classified as non-aquifers.

Examination of the Defra records showed that the site did not fall within a Groundwater Source Protection Zone as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water feature to the site was a succession of public ponds within Hampstead Heath Parkland. The closest pond feature was Highgate No1. Pond ~100m west and Men's Bathing Pond ~200m west of the site boundary.

From analysis of hydrogeological and topographical maps, the site was noted to be located on the edge of a Heath at an elevation of ~110m above ordnance datum. This elevation attributed to a groundwater table at a depth of ~56.00m bgl (based on historical BGS borehole records) within the London Clay Formation. The site was topographically located in a depression between Hampstead Heath (west) and Highgate (east) with a considered groundwater flow direction to the southeast towards Regents Canal and the River Thames. Though the groundwater table is considered to be relatively low, the presence of perched water may be present at shallower depths, within any Topsoil/Made Ground strata and above more cohesive layers such as silty clays of the London Clay Formation.

Examination of the Government Flood Map for Planning website showed the site was in a **Flood Zone 1,** i.e. an area with a **very low** probability of flooding.

2.6 Radon

BRE 211 (2015) Map 5 of the London, Sussex and West Kent area revealed the site was located within an area where mandatory protection measures against the ingress of radon were **unlikely** to be required. The site was in an area where a risk assessment was **not required**.

Further investigation using www.ukradon.org showed that the site was located within the lowest band of radon potential where basic protection measures against the ingress of Radon were **unlikely** to be required as less than 1% of homes were above the action line. The nearest recording of elevated radon potential was located some ~7.0km east where a maximum radon potential of 1-3%.

3.0 FIELDWORK

3.1 Scope of Works

Site works were undertaken on Wednesday 9th September 2020 and comprised the drilling of 1No. demountable windowless sampler borehole to a depth of 8.45m bgl, referenced BH1. In-situ Standard Penetration Tests (SPTs) were undertaken at 1.00m bgl intervals to the base of the borehole. On completion, the borehole was installed with a ground gas/ groundwater monitoring standpipe with a response zone between 1.00m – 5.00m bgl.

Other works included the hand-digging of 6No. trial pits (TP/FE0 – TP/FE2 and TP/FE4 – TP/FE6) to expose existing foundation and party wall structures to the rear of the property and existing basement.

Prior to any intrusive works taking place, the area was scanned with a Cable Avoidance Tool (C.A.T. scanner and, where underground services and drainage were suspected or positively identified, the exploratory position was relocated to a safer position. As a further precautionary measure, a hand-dug pit was excavated to 1.20m bgl discounting the possible risk of striking any potential or undetectable shallow services.

The approximate borehole location is shown within the trial hole location plan presented as Figure 5, the full trial hole logs are presented as Appendix B.

Upon completion of the intrusive works, with the exception of those with monitoring standpipes, trial holes were reverse backfilled with arisings excavated during the drill, compacted and made good, in relation to the surrounding environs.

3.2 Sampling Procedures

A number of disturbed samples (D) were recovered from the trial hole arisings at depths shown in the trial hole records. Soil samples were generally retrieved from shallow ground, each change of strata and at approximately 1.00m intervals during broad homogenous soil horizons.

Selected disturbed samples were submitted for geotechnical testing purposes.

4.0 ENCOUNTERED GROUND CONDITIONS

4.1 Soil Conditions

The trial hole was logged by Chris Gordon of Ground and Water Limited, generally in accordance with BS EN 14688 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.

The ground conditions encountered within the trial hole constructed on the site conform to those anticipated from the geological mapping. A shallow capping of Made Ground overlay bedrock deposits of the London Clay Formation. Limited Made Ground deposits may be indicative of historical development and localised redevelopment of the site. The ground conditions encountered during the investigation are described in this section. The trial hole logs are presented as Appendix B and a trial hole location plan is presented as Figure 5.

For the purposes of discussion, the succession of conditions encountered in the trial hole in descending order can be summarised as follows:

Reworked Topsoil
Topsoil
Made Ground - Granular
Made Ground - Cohesive
Weathered London Clay Formation
London Clay Formation

Summary of Strata Encountered (Full logs provided within Appendix B)			
Strata	**Top Depth (m bgl)**	**Base Depth (m bgl)**	**Thickness (m)**
HARDSTANDING: CONCRETE PAVERS (TP0, TP1 & TP4 – TP6).	GL – 0.15	0.05 – 0.22	0.05 – 0.10
MADE GROUND: SHARP SAND (TP4 – TP6 only).	0.05	0.10	0.05
MADE GROUND: REWORKED TOPSOIL: (TP1 & TP2 only). Dark brown gravelly silty coarse SAND. Gravel is angular to rounded fine to medium flint, brick, slate and concrete.	GL	0.15 – 0.30	0.15
MADE GROUND (BH1, TP0, TP1, TP2 & TP4): Dark greyish brown or brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick and concrete.	GL – 0.70	0.40 – 2.70	0.20 – 2.00
TOPSOIL: (BH1 only): Dark grey and brown slightly sandy slightly gravelly silty CLAY. Sand is fine to medium. Gravel is angular to subrounded fine to coarse flint.	0.20	1.20	1.00
WEATHERED LONDON CLAY FORMATION: (BH1, TP2 & TP4): Multicoloured mottled silty CLAY with rare selenite crystals and occasional sand lenses. OR Multicoloured mottled bluish grey sandy or gravelly CLAY. Sand is fine to medium. Gravel is occasional angular to subrounded fine flint (TP0, TP1, TP2 & TP5).	*0.10 – 1.20	*0.40 – 7.00	5.80
LONDON CLAY FORMATION: (BH1 only) Dark greyish brown silty clay with frequent fine selenite crystals.	1.20	>8.45	>1.40

**Depth is taken from the surface of the trial hole excavation in a basement structure so below actual ground level.*

4.2 Roots Encountered

Fresh roots were observed in all external trial hole locations (BH1, TP0 – TP2 to a maximum penetrable depth of 1.70m bgl within the cohesive Weathered London Clay Formation.

It should be noted that the chance of determining actual depth of root penetration through a narrow diameter borehole is low and the maximum root penetration depth was not reached in the trial pit (TP0 – TP2); no roots were encountered in any internal basement trial holes (TP4 – TP6). Roots may be found to greater depths at other locations within the site boundaries, particularly where established boarder vegetation and mature tree are in proximity.

4.3 Groundwater Conditions

A groundwater strike was recorded in BH1 at 3.00m bgl and in all internal basement trial holes (TP4 – TP6) at 0.25m bgl. Groundwater noted in these locations was considered isolated perched water trapped within granular veins of the underlying impermeable strata.

It should be noted that the site investigation was conducted during the summer months where groundwater levels were falling to their annual low and the long-term groundwater elevation may well increase later in the year in response to seasonal fluctuations.

Isolated perched groundwater may be encountered in shallow Made Ground deposits, particularly after a period of prolonged or intense precipitation where surface water may infiltrate and perch on top of the impermeable underlying London Clay bedrock. Groundwater identified in published historic borehole logs reported groundwater levels of 56.60m bgl.

4.4 Obstructions

Buried concrete 0.07m thick was noted in TP1 approximately 0.15m bgl underlying shallow reworked topsoil deposits. No other artificial or natural sub-surface obstructions were noted during the intrusive works.

5.0 IN-SITU AND LABORATORY GEOTECHNICAL TESTING

5.1 In-Situ Geotechnical Testing

5.1.1 Standard Penetration Tests (SPTs)

Standard Penetration tests (SPTs) were undertaken in BH1 covering depth intervals of approximately 1.00m. The results of the SPT's have not been amended to account for hammer efficiency, rod lengths and overburden pressure in accordance with Eurocode 7. The test results are presented in the borehole logs within Appendix B.

Cable Percussion Boreholes provide samples of the ground for assessment, but they do not give any engineering data. The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50 mm and an inside diameter of 35 mm, and a length of around 610 mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5 kg falling a distance of 762 mm. The sample tube is driven 150 mm into the ground and then the number of blows needed for the tube to penetrate each 75 mm up to a depth of 450 mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value". Cohesive soils of the London Clay Formation were classified based on the table below.

Undrained Shear Strength from Field Inspection/ SPT Results Cohesive Soils (EN ISO 14688-2:2004 & Stroud (1974))		
Classification	**Undrained Shear Strength (kPa)**	**Field Indications**
Extremely High	>300	-
Very High	150 – 300	Brittle or very tough
High	75 – 150	Cannot be moulded in the fingers
Medium	40 – 75	Can be moulded in the fingers by strong pressure
Low	20 – 40	Easily moulded in the fingers
Very Low	10 – 20	Exudes between fingers when squeezed in the fist
Extremely Low	<10	-

An interpretation of the in-situ geotechnical testing results is given in the table below.

Interpretation of In-situ Geotechnical Testing Results in BH1				
Strata	**SPT "N" Blow Counts**	**Equivalent Undrained Shear Strength (kPa) Cohesive Soils**	**Soil Type** **Cohesive (Undrained Shear Strength)**	**Trial Hole/s**
Weathered London Clay Formation	6 - 21	30 - 105	**Very Low / Low** to **High**	BH1 (1.20 – 6.45m bgl)
London Clay Formation	17 -20	85 - 100	**High**	BH1 (7.00m – 8.45m bgl)

It must be noted that field measurements of undrained shear strength are dependent on a number of variables including disturbance of sample, method of investigation and also the size of specimen or test zone etc.

5.2 Laboratory Geotechnical Testing

A programme of geotechnical laboratory testing, scheduled by Ground and Water Limited and carried out by K4 Soils Laboratory and DETS Limited, was undertaken on samples recovered from the London Clay Formation. The results of the tests are presented as Appendix C.

The test procedures used were generally in accordance with the methods described in BS1377:2016/2018. Details of the specific tests used in each case are given below.

Standard Methodology for Laboratory Geotechnical Testing		
Test	**Standard**	**Number of Tests**
Atterberg Limit Tests	BS1377:2016: Part 2: Clauses 3.2, 4.3 & 5	5
Water Soluble Sulphate and pH test	BS1377:2018: Part 3: Clause 5	1
BRE Special Digest 1 (incl. pH, Total Sulphate, W/S Sulphate, Total Chlorine, W/S Chlorine, Total Sulphur, Ammonium as NH4, W/S Nitrate, W/S Magnesium)	BRE Special Digest 1 "Concrete in Aggressive Ground (BRE, 2005).	2

5.2.1 Atterberg Limit Tests

The results of the Atterberg Limit Tests are based on five cohesive samples of the London Clay Formation.

Atterberg Limit Tests Results Summary							
Stratum/Depth	**Moisture Content (%)**	**Passing 425 µm sieve (%)**	**Modified PI (%)**	**Soil Class**	**Consistency Index (Ic)**	**Volume Change Potential**	
						BRE	**NHBC**
Weathered London Clay Formation (BH1/1.50m bgl)	32	100	36	CH	Stiff	Medium	Medium
Weathered London Clay Formation (BH1/3.00m bgl)	32	100	38	CH	Stiff	Medium	Medium
Weathered London Clay Formation (BH1/5.00m bgl)	31	100	36	CH	Stiff	Medium	Medium
London Clay Formation (BH1/7.00m bgl)	29	100	40	CH	Stiff	High	High
London Clay Formation (BH1/8.00m bgl)	31	100	38	CH	Stiff	Medium	Medium

NB: NP – Non-plastic
BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
Soil Classification based on British Soil Classification System.
Consistency Index (Ic) based on BS EN IS0 14688-2:2018.

5.2.2 Comparison of Soil's Moisture Content with Index Properties

5.2.2.1 Liquidity Index Analyses

The results of the Atterberg Limit tests undertaken on five cohesive samples of the London Clay Formation are further calculated to determine the Liquidity Index of the samples. This gives an indication as to whether the samples recovered showed a moisture deficit and their degree of consolidation. The results are tabulated overleaf. The test results are presented as Appendix C.

Liquidity Index Calculations Summary					
Stratum/Trial Hole/Depth	**Moisture Content (%)**	**Plastic Limit (%)**	**Modified Plasticity Index (%)**	**Liquidity Index**	**Result**
Weathered London Clay Formation (BH1/1.50m bgl) Lab description: Brown slightly mottled bluish grey silty CLAY.	32	29	36.00	0.08	Heavily Overconsolidated
Weathered London Clay Formation (BH1/3.00m bgl) Lab description: Brown slightly mottled bluish grey silty CLAY.	32	28	38.00	0.11	Heavily Overconsolidated
Weathered London Clay Formation (BH1/5.00m bgl) Lab description: Brown slightly mottled bluish grey silty CLAY with scattered selenite crystals.	31	30	36.00	0.03	Heavily Overconsolidated
London Clay Formation (BH1/7.00m bgl) Lab description: Brown slightly mottled dark grey silty CLAY with scattered selenite crystals.	29	29	40.00	0.00	Heavily Overconsolidated
London Clay Formation (BH1/8.00m bgl) Lab description: Brown slightly mottled dark grey silty CLAY with scattered selenite crystals.	31	28	38.00	0.08	Heavily Overconsolidated

The results indicated that cohesive samples were representative of heavily overconsolidated silty clay of the London Clay Formation and was well distributed along the length of the borehole to a maximum depth of 8.00m bgl.

Liquidity Index testing revealed no evidence of moisture deficit in any of the five tested samples of the London Clay Formation.

5.2.2.2 Liquid Limit

A comparison of the soil moisture content and the liquid limit can be seen tabulated below.

Moisture Content vs. Liquid Limit				
Strata/Trial Hole/Depth/Soil Description	**Moisture Content (MC) (%)**	**Liquid Limit (LL) (%)**	**40% Liquid Limit (LL)**	**Result**
Weathered London Clay Formation (BH1/1.50m bgl) Lab description: Brown slightly mottled bluish grey silty CLAY.	32	65	26.0	MC > 0.4 x LL (No Significant Moisture Deficit)
Weathered London Clay Formation (BH1/3.00m bgl) Lab description: Brown slightly mottled bluish grey silty CLAY.	32	66	26.4	MC > 0.4 x LL (No Significant Moisture Deficit)
Weathered London Clay Formation (BH1/5.00m bgl) Lab description: Brown slightly mottled bluish grey silty CLAY with scattered selenite crystals.	31	66	26.4	MC > 0.4 x LL (No Significant Moisture Deficit)
London Clay Formation (BH1/7.00m bgl) Lab description: Brown slightly mottled dark grey silty CLAY with scattered selenite crystals.	29	69	27.6	MC > 0.4 x LL (No Significant Moisture Deficit)
London Clay Formation (BH1/8.00m bgl) Lab description: Brown slightly mottled dark grey silty CLAY with scattered selenite crystals.	31	66	26.4	MC > 0.4 x LL (No Significant Moisture Deficit)

Results of the above table recorded **no potential significant moisture deficit** in all five tested samples of the London Clay Formation. Testing results were consistent along the full borehole profile to a maximum depth of 8.00m bgl. Root penetration was relatively shallow to a maximum depth of 1.70m bgl and penetrating the underlying London Clay by ~0.20m bgl therefore was not considered a risk to potential water uptake.

5.2.4 Sulphate and pH Tests

Water Soluble Sulphate and pH tests were undertaken from one sample of Weathered London Clay Formation within BH1/4.00m bgl. The water-soluble sulphate concentration was found to be 2,370mg/l. A pH of 7.32 was recorded within the sample.

5.2.5 BRE Special Digest 1

In accordance with BRE Special Digest 1 'Concrete in Aggressive Ground' (BRE, 2005) two samples were scheduled for laboratory testing from the London Clay Formation (BH1/2.00m bgl and BH1/7.50m bgl) which were analysed to determine parameters for concrete specification. The laboratory results are presented as Appendix C and a summary is tabulated below.

Determinand	Unit	Weathered London Clay Formation (BH1/2.00m bgl)	London Clay Formation (BH1/7.50m bgl)
pH	-	7.6	7.2
Ammonium as NH_4	mg/kg	5.1	10
Total Sulphur	%	0.11	2.52
Chloride (water soluble)	mg/kg	23	113
Magnesium (water soluble)	mg/l	11	170
Nitrate (water soluble)	mg/kg	<3	<3
Sulphate (water soluble)	mg/l	102	3,310
Sulphate (total)	mg/kg	1,132	25,210

APPENDIX A
Conditions and Limitations

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared based on information, data and materials which were available at the time of writing. Accordingly, any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must consider any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment/contaminated land considerations.

The conclusions and recommendations relate to 11 Highgate West Hill, Highgate, London N6 6JR.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit,

borehole or window sampler borehole implies the specific technique used to produce a trial hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets, remain with Ground and Water Limited. Licence is for the sole use of the client and may not be assigned, transferred or given to a third party.

Only our client may rely on this report and should this report or any information contained in it be provided to any third party we accept no responsibility to the third party for the contents of this report save to the extent expressly outlined by us in writing in a reliance letter addressed from us to the third party.

Recipients are not permitted to publish this report outside of their organisation without our express written consent.

APPENDIX B
Trial Hole Logs

APPENDIX C
Geotechnical Laboratory Test Results

Percussion Drilling Log

Project Name: 11 Highgate West Hill	Client: Ground and Project Consultants Ltd	Date: 09/09/2020
Location: 11 Highgate West Hill, Highgate, London N6 6JR	Contractor: KDS Drillers	
Project No. : GWPR3834	Crew Name: Borehole Solutions Ltd.	Drilling Equipment: Modular Window Sampler

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
BH1	CP		CG	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.25	D		0.20			MADE GROUND: Dark greyish brown silty slightly sandy slightly gravelly clay with frequent root. Sand is fine to medium-grained. Gravel is angular to subrounded fine to coarse flint (85%) and brick (15%). Roots <1 - 10mm.
		0.50	D					
		0.80	D					TOPSOIL: Dark grey and brown silty slightly sandy slightly gravelly CLAY with frequent roots. Sand is fine to medium-grained. Gravel is angular to subrounded fine to coarse flint. Roots <1 - 5mm.
		1.20	D		1.20			
		1.20	SPT	N=6 (1,1/1,1,2,2)				Light brown mottled bluish grey silty fissured CLAY. WEATHERED LONDON CLAY FORMATION.
		1.50	D					
								Roots no longer present.
		2.00	D					
		2.00	SPT	N=9 (1,1/2,2,2,3)				*Rare fine selenite crystals.*
		2.50	D					*Occasional lenses of orangish brown fine-grained sand.*
	▼	3.00	D					
		3.00	SPT	N=21 (3,3/3,5,6,7)				
		3.50	D					
								Claystone banding.
		4.00	D					
		4.00	SPT	N=13 (1,2/3,3,3,4)				
		4.50	D					
		5.00	D					*Occasional fine selenite crystals.*
		5.00	SPT	N=18 (2,3/4,4,5,5)				
		5.50	D					
		6.00	D					
		6.00	SPT	N=15 (3,3/3,3,4,5)				
		6.50	D					
								Frequent fine selenite crystals.
		7.00	D		7.00			*Occasional fine selenite crystals.*
		7.00	SPT	N=17 (3,3/4,4,4,5)				Dark greyish brown silty fissured CLAY with frequent fine selenite crystals. LONDON CLAY FORMATION.
		7.50	D					
		8.00	D					
		8.00	SPT	N=20 (3,4/5,5,5,5)				
					8.45			End of Borehole at 8.450m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Goundwater strike at 3.00m bgl. Borehole terminated at 8.45m bgl as the targeted depth was reached. Borehole installed with monitoring standpipe to 5.00m bgl. Root proven to a maximum penetration depth of 1.70m bgl.

Trial Pit Log

Project Name: 11 Highgate West Hill	Client: Ground and Project Consultants Ltd	Date: 09/09/2020
Location: 11 Highgate West Hill, Highgate, London N6 6JR	Contractor: KDS Drillers	
Project No. : GWPR3834	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP/FE0	TP		CG	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			MADE GROUND: Concrete tiles.
		0.30	D					MADE GROUND: Dark brown slightly silty sandy gravelly clay. Sand is fine to coarse-grained. Gravel is angular to rounded fine to medium flint (20%), brick (40%) and concrete (40%) with frequent roots <1mm.
		0.50	D					
		0.80	D					
					0.84			Dark orangish brown mottled grey gravelly CLAY. Gravel is angular to subrounded fine flint. WEATHERED LONDON CLAY FORMATION.
					0.90			End of Borehole at 0.900m

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
0.50	0.50	Stable.					

Remarks

No groundwater encountered. Excavation terminated at 0.90m bgl as the foundation base was proven. Trial pit was reverse backfilled and compacted with arisings on completion. Root were proven to a maximum depth of 0.84m bgl. Membrane placed under concrete.

Trial Pit Log

Project Name: 11 Highgate West Hill	Client: Ground and Project Consultants Ltd	Date: 09/09/2020
Location: 11 Highgate West Hill, Highgate, London N6 6JR	Contractor: KDS Drillers	
Project No. : GWPR3834	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP/FE1	TP		CG	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15			MADE GROUND: REWORKED TOPSOIL: Dark brown silty gravelly coarse-grained sand. Gravel is angular to rounded fine to medium flint (80%), brick (15%) concrete (3%) and slate (2%) with frequent roots <1 - 5mm.
					0.22			MADE GROUND: Concrete.
		0.30	D					MADE GROUND: Dark brown sandy gravelly clay. Sand is fine to coarse-grained. Gravel is angular to subrounded fine to medium flint (85%), brick (10%) and concrete (5%) with frequent roots <1 - 5mm.
		0.50	D		0.60			Dark orangish brown mottled grey gravelly CLAY with frequent roots. Gravel is angular to subrounded fine flint. Roots <1 - 5mm. WEATHERED LONDON CLAY FORMATION.
		0.80	D					End of Borehole at 1.000m
		1.00	D		1.00			

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
0.50	0.50	Stable.					

Remarks

No groundwater encountered. Excavation terminated at 1.00m bgl as the foundation base was proven. Trial pit was reverse backfilled and compacted with arisings on completion. The maximum depth penetration of the roots was not proven at the trial pit base.

Trial Pit Log

Project Name: 11 Highgate West Hill	Client: Ground and Project Consultants Ltd	Date: 09/09/2020
Location: 11 Highgate West Hill, Highgate, London N6 6JR	Contractor: KDS Drillers	
Project No. : GWPR3834	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP/FE2	TP		CG	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	D		0.30			MADE GROUND: REWORKED TOPSOIL: Dark brown silty gravelly coarse-grained sand. Gravel is angular to rounded fine to medium flint (80%), brick (10%), concrete (5%) and slate (5%) with frequent roots <1 - 10mm.
		0.50	D					MADE GROUND: Dark brown sandy gravelly clay. Sand is fine to coarse. Gravel is angular to subrounded fine to medium flint (90%), brick (5%) concrete (5%) with frequent roots <1 - 5mm.
		0.80	D		0.80			Dark brown mottled bluish grey fissured CLAY with frequent roots <1 - 5mm. WEATHERED LONDON CLAY FORMATION.
		1.00	D					
					1.20			End of Borehole at 1.200m

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
0.50	0.50	Stable.					

Remarks

No groundwater encountered. Excavation terminated at 1.20m bgl as the foundation base was proven. Trial pit was reverse backfilled and compacted with arisings on completion. The maximum depth penetration of the roots was not proven at the trial pit base.

Trial Pit Log

Project Name: 11 Highgate West Hill	Client: Ground and Project Consultants Ltd	Date: 09/09/2020
Location: 11 Highgate West Hill, Highgate, London N6 6JR	Contractor: KDS Drillers	
Project No. : GWPR3834	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP/FE4	TP		CG	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼	0.30	D		0.05			MADE GROUND: Concrete Pavers.
					0.10			MADE GROUND: Sharp Sand.
					0.20			MADE GROUND: Dark reddish brown sandy gravel with occasional clay lenses. Sand is fine to coarse-grained. Gravel is frequent angular to subrounded fine to medium brick (60%) and concrete (40%).
					0.40			Dark brown mottled grey silty fissured CLAY with occasional sand lenses. WEATHERED LONDON CLAY FORMATION.
								End of Borehole at 0.400m

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
0.50	0.50	Stable.					

Remarks

Groundwater strike at 0.25m bgl Excavation terminated at 0.40m bgl as the foundation base was proven. Trial pit was reverse backfilled and compacted with arisings on completion. Membrane placed under concrete. No roots were encountered.

Trial Pit Log

Project Name: 11 Highgate West Hill	Client: Ground and Project Consultants Ltd	Date: 09/09/2020
Location: 11 Highgate West Hill, Highgate, London N6 6JR	Contractor: KDS Drillers	
Project No. : GWPR3834	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP/FE5	TP		CG	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼	0.30	D		0.05			MADE GROUND: Concrete Pavers.
					0.10			MADE GROUND: Sharp Sand.
								Dark greyish brown to brown sandy CLAY. Sand is fine to medium-grained. WEATHERED LONDON CLAY FORMATION.
					0.40			End of Borehole at 0.400m

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
0.50	0.50	Stable.					

Remarks

Groundwater strike at 0.25m bgl and water seepage from above ground wall. Excavation terminated at 0.40m bgl as the foundation base was proven. Trial pit was reverse backfilled and compacted with arisings on completion. Membrane placed under concrete. No roots were encountered.

Trial Pit Log

Project Name: 11 Highgate West Hill	Client: Ground and Project Consultants Ltd	Date: 09/09/2020
Location: 11 Highgate West Hill, Highgate, London N6 6JR	Contractor: KDS Drillers	
Project No. : GWPR3834	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP/FE6	TP		CG	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05			MADE GROUND: Concrete Pavers.
					0.10			MADE GROUND: Sharp Sand.
	▼	0.30	D					Light orangish brown to brown sandy CLAY. Sand is fine to medium-grained. WEATHERED LONDON CLAY FORMATION.
					0.40			End of Borehole at 0.400m

1
2
3
4
5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
0.50	0.50	Stable.					

Remarks

Groundwater strike at 0.25m bgl Excavation terminated at 0.40m bgl as the foundation base was proven. Trial pit was reverse backfilled and compacted with arisings on completion. Membrane placed under concrete. No roots were encountered.

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
28832	11 Highgate West Hill	Samples received	25/09/2020
		Schedule received	23/09/2020
Project No.	Client	Project started	28/09/2020
GWPR3834	Ground & Water Ltd	Testing Started	08/10/2020

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top m	Base m	Type		%	%	%	%	%	
BH1	-	1.50	-	D	Brown slightly mottled bluish grey silty CLAY	32	100	65	29	36	
BH1	-	3.00	-	D	Brown slightly mottled bluish grey silty CLAY	32	100	66	28	38	
BH1	-	5.00	-	D	Brown slightly mottled bluish grey silty CLAY with scattered selenite crystals	31	100	66	30	36	
BH1	-	7.00	-	D	Brown slightly mottled dark grey silty CLAY with scattered selenite crystals	29	100	69	29	40	
BH1	-	8.00	-	D	Brown slightly mottled dark grey silty CLAY with scattered selenite crystals	31	100	66	28	38	

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved
Initials **J.P**
Date: 09/10/2020

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results
Tested in accordance with BS1377 : Part 3 : 2018, Clause 7.6 & Clause 12

Job No.	Project Name	Programme	
28832	11 Highgate West Hill	Samples received	25/09/2020
		Schedule received	23/09/2020
Project No.	Client	Project started	28/09/2020
GWPR3834	Ground & Water Ltd	Testing Started	

Hole No.	Sample Ref	Top m	Base m	Type	Soil description	Dry Mass passing 2mm %	SO4 Content mg/l	pH	Remarks
BH1	-	4.00	-	D	Brown sandy silty CLAY with scattered selenite crystals	100	2370	7.32	

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved
Initials J.P
Date: 09/10/2020

2519 Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr) MSF-5-R29

Chris Gordon
Ground & Water Ltd
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Norton Farm
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Hampshire
GU34 3NB

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 20-11116

Site Reference:	11 Highgate West Hill
Project / Job Ref:	GWPR3834
Order No:	GWPR3834
Sample Receipt Date:	24/09/2020
Sample Scheduled Date:	24/09/2020
Report Issue Number:	1
Reporting Date:	05/10/2020

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

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Rose Lane
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Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate						
DETS Report No: 20-11116	**Date Sampled**	22/09/20	22/09/20			
Ground & Water Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: 11 Highgate West Hill	**TP / BH No**	BH1	BH1			
Project / Job Ref: GWPR3834	**Additional Refs**	None Supplied	None Supplied			
Order No: GWPR3834	**Depth (m)**	2.00	7.50			
Reporting Date: 05/10/2020	**DETS Sample No**	501147	501148			

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.6	7.2			
Total Sulphate as SO_4	mg/kg	< 200	NONE	1132	25210			
Total Sulphate as SO_4	%	< 0.02	NONE	0.11	2.52			
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	102	3310			
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.10	3.31			
Total Sulphur	%	< 0.02	NONE	0.04	0.97			
Ammonium as NH_4	mg/kg	< 0.5	NONE	5.1	10			
Ammonium as NH_4	mg/l	< 0.05	NONE	0.51	1			
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	23	113			
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	11.3	56.5			
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	MCERTS	< 3	< 3			
Water Soluble Nitrate (2:1) as NO_3	mg/l	< 1.5	MCERTS	< 1.5	< 1.5			
W/S Magnesium	mg/l	< 0.1	NONE	11	170			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 20-11116	
Ground & Water Ltd	
Site Reference: 11 Highgate West Hill	
Project / Job Ref: GWPR3834	
Order No: GWPR3834	
Reporting Date: 05/10/2020	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
501147	BH1	None Supplied	2.00	13.4	Light brown clay
501148	BH1	None Supplied	7.50	13.1	Brown sandy clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 20-11116

Ground & Water Ltd

Site Reference: 11 Highgate West Hill

Project / Job Ref: GWPR3834

Order No: GWPR3834

Reporting Date: 05/10/2020

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Not to Scale

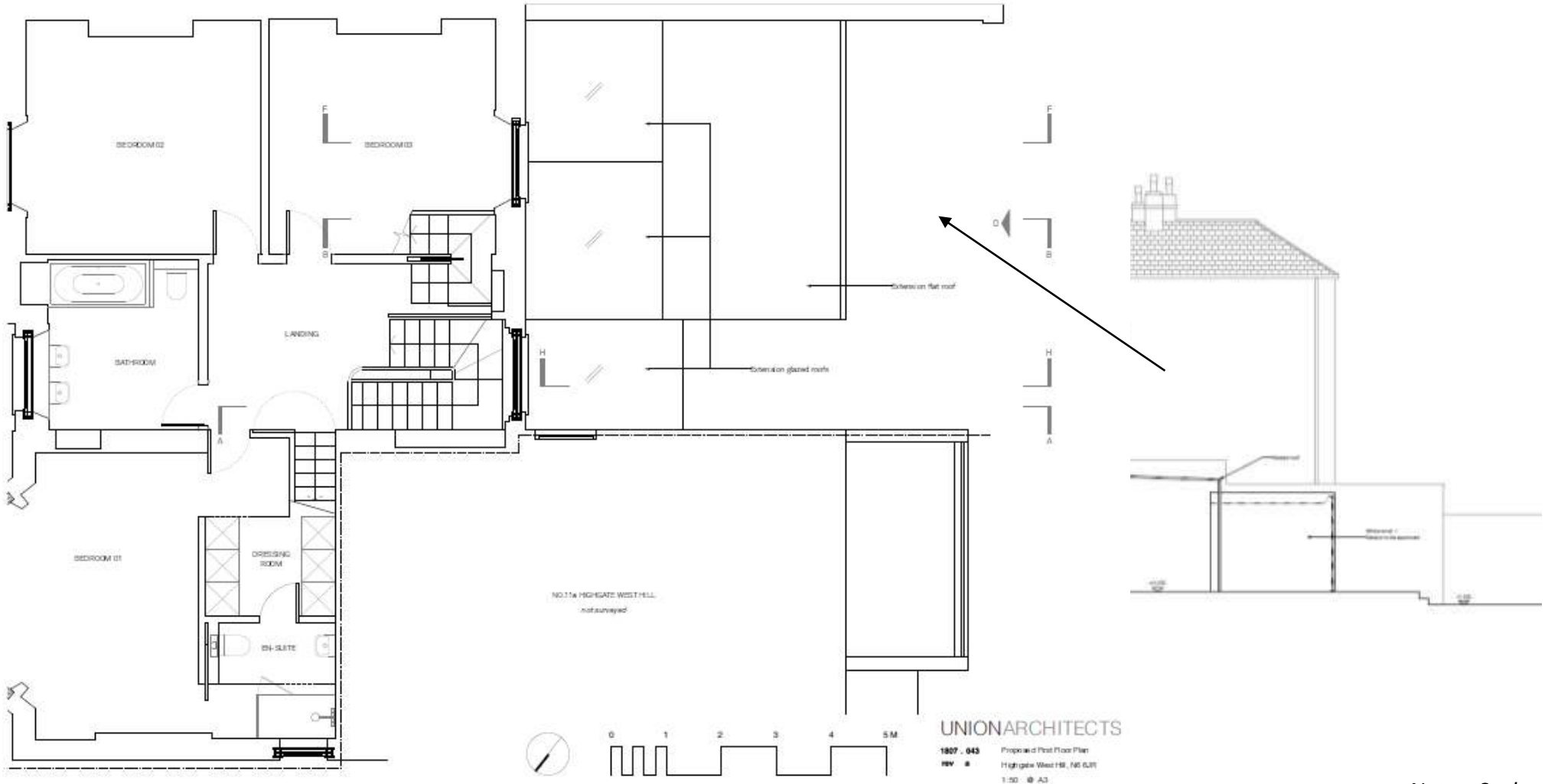
Project: **11 Highgate West Hill, Highgate, London N6 6JR**	**Figure 1**
Client: **Ground and Project Consultants Limited**	**Date:** **October 2020**
Site Location Plan	**Ref:** **GWPR3834**

Not to Scale

Project: **11 Highgate West Hill, Highgate, London N6 6JR**		**Figure 2**
Client: **Ground and Project Consultants Limited**	**Date:** **October 2020**	
Site Location Plan	**Ref:** **GWPR3834**	

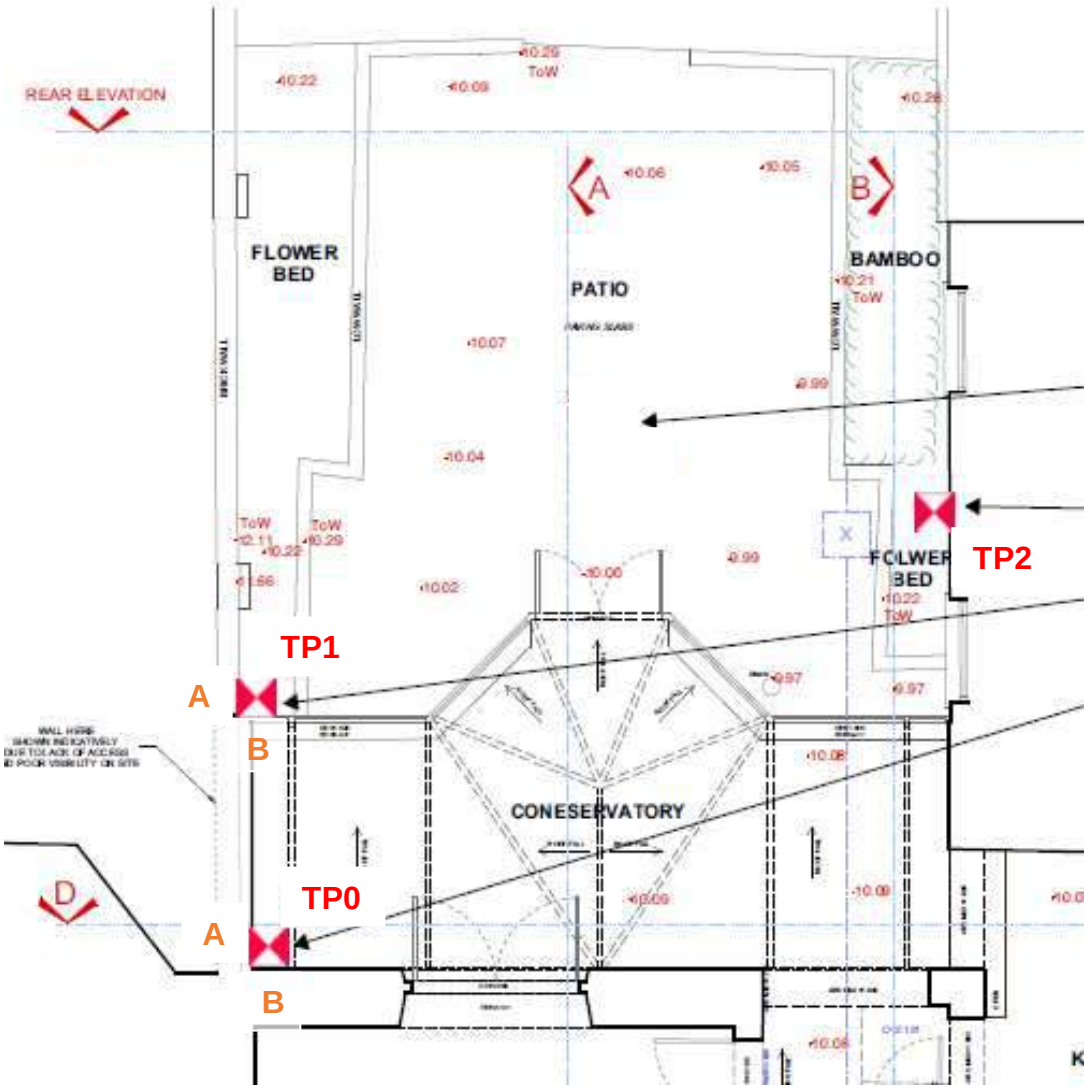
Not to Scale

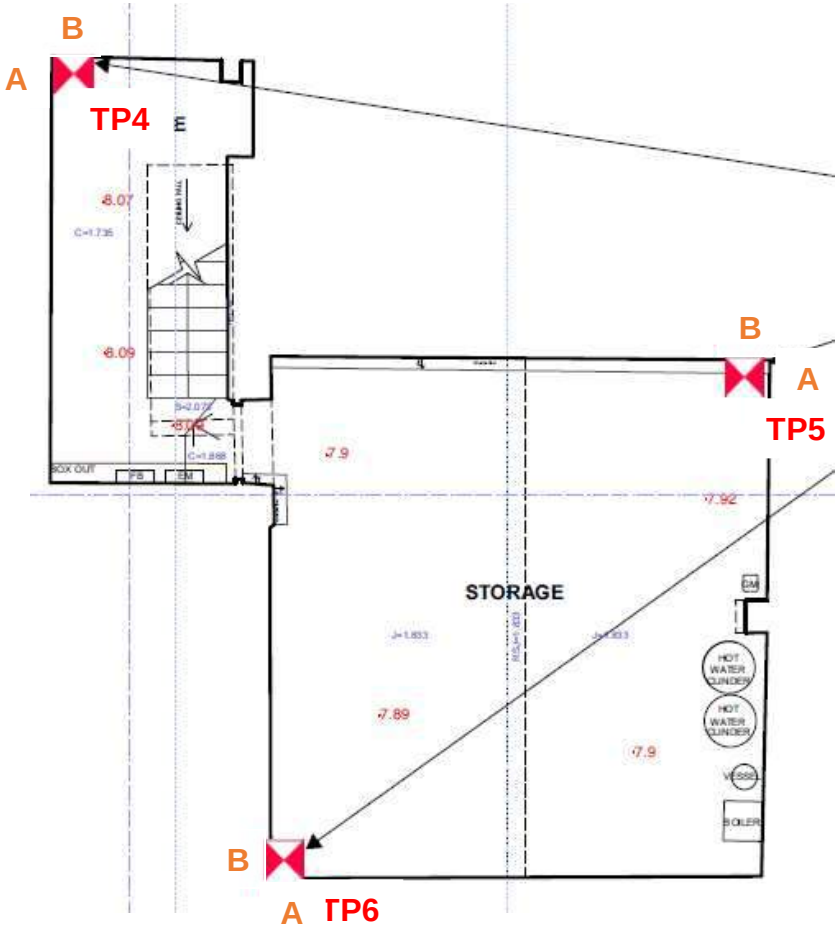
Project: **11 Highgate West Hill, Highgate, London N6 6JR**		**Figure 3**
Client: **Ground and Project Consultants Limited**	**Date:** **October 2020**	
Site Location Plan	**Ref:** **GWPR3834**	



Not to Scale

Project: **11 Highgate West Hill, Highgate, London N6 6JR**		**Figure 4**
Client: **Ground and Project Consultants Limited**	**Date:** **October 2020**	
Site Location Plan	**Ref:** **GWPR3834**	

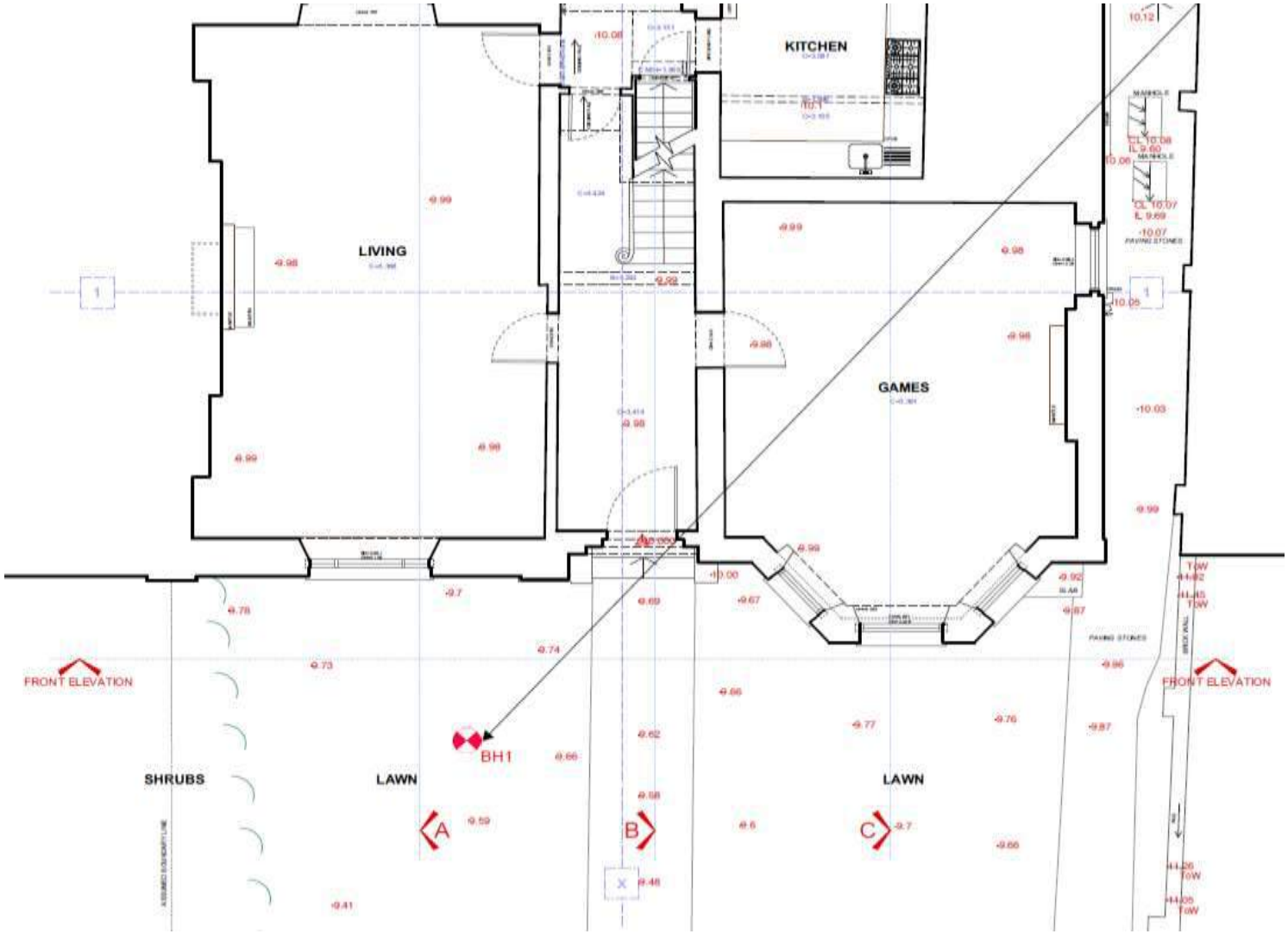




Not to Scale

Project: 11 Highgate West Hill, Highgate, London N6 6JR	**Figure 5**
Client: Ground and Project Consultants Ltd	**Date:** October 2020
Trial Hole Location Plan	**Ref:** GWPR3834

ground&water



Not to Scale

Project: **11 Highgate West Hill, Highgate, London N6 6JR**	**Figure 5**
Client: **Ground and Project Consultants Ltd**	**Date:** **October 2020**
Trial Hole Location Plan	**Ref:** **GWPR3834**

ground&water

APPENDIX D

Rainfall runoff results for the existing site (building area)

RUNOFF VOLUME ESTIMATION FOR EXISTING SITE WITHOUT & WITH CLIMATE CHANGE

Site: **11 Highgate West Hill, London, N6 6JR**

$V_R = C \times P \times A / 1000$

Where:

V_R	=	Volume of runoff (m^3)
C	=	Dimensionless runoff coefficient which is dependent on the nature of the drainage surface
P	=	Rainfall depth (mm)
A	=	Drainage surface area (m^2)

Climate change factor (CC) 40 % Upper end allowance. Total potential change for '2080s'.

Existing area A of impervious surface: 67 m^2
Runoff coefficient C impervious surface: 1.0

Design rainfall data (source: FEH Web Service)

Return period (years)	6-h rainfall (mm)	6-h rainfall + CC (mm)
1	22.97	32.16
30	63.98	89.57
100	88.79	124.31

Existing area A of pervious surface: 7 m^2
Runoff coefficient C pervious surface: 0.05

Total area: 74 m^2

1 in 1-year event

excluding Climate Change

Return period (years)	6-h rainfall (mm)	IMPERVIOUS AREA Area (m^2)	C	Volume (m^3)	PERVIOUS AREA Area (m^2)	C	Volume (m^3)	Total Volume (m^3)
1	22.97	67.0	1.0	1.54	7.0	0.05	0.01	1.55

including Climate Change

Return period (years)	6-h rainfall (mm)	IMPERVIOUS AREA Area (m^2)	C	Volume (m^3)	PERVIOUS AREA Area (m^2)	C	Volume (m^3)	Total Volume (m^3)
1	32.16	67.0	1.0	2.15	7.0	0.05	0.01	2.16

1 in 30-year event

excluding Climate Change

Return period (years)	6-h rainfall (mm)	IMPERVIOUS AREA Area (m^2)	C	Volume (m^3)	PERVIOUS AREA Area (m^2)	C	Volume (m^3)	Total Volume (m^3)
30	63.98	67.0	1.0	4.29	7.0	0.05	0.02	4.31

including Climate Change

Return period (years)	6-h rainfall (mm)	IMPERVIOUS AREA Area (m^2)	C	Volume (m^3)	PERVIOUS AREA Area (m^2)	C	Volume (m^3)	Total Volume (m^3)
30	89.57	67.0	1.0	6	7.0	0.05	0.03	6.03

1 in 100-year event

excluding Climate Change

Return period (years)	6-h rainfall (mm)	IMPERVIOUS AREA Area (m^2)	C	Volume (m^3)	PERVIOUS AREA Area (m^2)	C	Volume (m^3)	Total Volume (m^3)
100	88.79	67.0	1.0	5.95	7.0	0.05	0.03	5.98

including Climate Change

Return period (years)	6-h rainfall (mm)	IMPERVIOUS AREA Area (m^2)	C	Volume (m^3)	PERVIOUS AREA Area (m^2)	C	Volume (m^3)	Total Volume (m^3)
100	124.31	67.0	1.0	8.33	7.0	0.05	0.04	8.37

APPENDIX E

Rainfall runoff results for the proposed development (building area)

RUNOFF VOLUME ESTIMATION FOR PROPOSED SITE WITHOUT & WITH CLIMATE CHANGE

Site: **11 Highgate West Hill, London, N6 6JR**

$V_R = C \times P \times A / 1000$

Where:

V_R	=	Volume of runoff (m^3)
C	=	Dimensionless runoff coefficient which is dependent on the nature of the drainage surface
P	=	Rainfall depth (mm)
A	=	Drainage surface area (m^2)

Climate change factor (CC) 40 % Upper end allowance. Total potential change for '2080s'.

Proposed area A of impervious surface: 74 m^2

Runoff coefficient C impervious surface: 1.0

Design rainfall data (source: FEH Web Service)

Return period (years)	6-h rainfall (mm)	6-h rainfall + CC (mm)
1	22.97	32.16
30	63.98	89.57
100	88.79	124.31

Proposed area A of pervious surface: 0 m^2

Runoff coefficient C pervious surface: 0.05

Total area: 74 m^2

1 in 1-year event

excluding Climate Change		IMPERVIOUS AREA				PERVIOUS AREA			Total
Return period (years)	6-h rainfall (mm)	Area (m^2)	C	Volume (m^3)		Area (m^2)	C	Volume (m^3)	Volume (m^3)
1	22.97	74.0	1.0	1.7		0.0	0.05	0	1.70

including Climate Change		IMPERVIOUS AREA				PERVIOUS AREA			Total
Return period (years)	6-h rainfall (mm)	Area (m^2)	C	Volume (m^3)		Area (m^2)	C	Volume (m^3)	Volume (m^3)
1	32.16	74.0	1.0	2.38		0.0	0.05	0	2.38

1 in 30-year event

excluding Climate Change		IMPERVIOUS AREA				PERVIOUS AREA			Total
Return period (years)	6-h rainfall (mm)	Area (m^2)	C	Volume (m^3)		Area (m^2)	C	Volume (m^3)	Volume (m^3)
30	63.98	74.0	1.0	4.73		0.0	0.05	0.00	4.73

including Climate Change		IMPERVIOUS AREA				PERVIOUS AREA			Total
Return period (years)	6-h rainfall (mm)	Area (m^2)	C	Volume (m^3)		Area (m^2)	C	Volume (m^3)	Volume (m^3)
30	89.57	74.0	1.0	6.63		0.0	0.05	0	6.63

1 in 100-year event

excluding Climate Change		IMPERVIOUS AREA				PERVIOUS AREA			Total
Return period (years)	6-h rainfall (mm)	Area (m^2)	C	Volume (m^3)		Area (m^2)	C	Volume (m^3)	Volume (m^3)
100	88.79	74.0	1.0	6.57		0.0	0.05	0	6.57

including Climate Change		IMPERVIOUS AREA				PERVIOUS AREA			Total
Return period (years)	6-h rainfall (mm)	Area (m^2)	C	Volume (m^3)		Area (m^2)	C	Volume (m^3)	Volume (m^3)
100	124.31	74.0	1.0	9.2		0.0	0.05	0	9.20