Appendix 5: Site Investigation Data

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SITE INVESTIGATION REPORT

27 JOHN'S MEWS

LONDON WC1

Report Reference No. C14337

On behalf of:-

Mr Brendan O'Toole
27 John's Mews
London
WC1N 2NS

January 2018

MR BRENDAN O'TOOLE

ROSS & PARTNERS

CONSULTING ENGINEERS

REPORT ON A SITE INVESTIGATION

AT

27 JOHN'S MEWS

LONDON WC1

Report Reference No. C14337 **January 2018**

INTRODUCTION

Mr Brendan O'Toole, the client, intends to remodel the existing dwelling, No.27 John's Mews, London WC1. The proposed residential redevelopment will include the construction of a 3.50m deep basement beneath the footprint of the existing mews house.

Ground Engineering Limited was instructed by the client to carry out a site investigation comprising a desk study and ground investigation under the direction of Consulting Engineers, Ross & Partners. The ground investigation was to determine the nature and geotechnical properties of the underlying soils in relation to foundation/basement design and construction, and provide technical information to support the planning application for the proposed basement, as required by the London Borough of Camden Planning Guidance 'Basements and Lightwells' document CPG4 (2013). In addition, a contamination assessment was to be included within the scope of this investigation.

LOCATION, TOPOGRAPHY, GEOLOGY AND HYDROGEOLOGY OF THE SITE

Location/Description

No.27 John's Mews is situated on the eastern side of the road, some 10m south of its junction with Northington Street, and 150m west of Gray's Inn Road, within the Bloomsbury district of the London Borough of Camden, London WC1. The dwelling is centred at National Grid Reference TQ 30810 82000.

The approximately 9m long and 7m wide rectangular site extends east-north-eastwards from its frontage on John's Mews roadway. At the time of the investigation the two-storey with attic level, brick building occupied the whole of the plot.

The plot was bounded to the north by No.25 John's Mews/No.13 Northington Street, and to the south by a block of flats (Nos.29-31 John's Mews) with a basement level car park. The eastern end of the site was bounded by a single-storey rearward extension to No.30 John Street.

The site and immediate surrounding area was devoid of vegetation.

Topography

The site stands at an approximate elevation of 22mOD on locally gently northward and eastward falling ground, some 1.25km north of the eastward flowing River Thames.

Geology

The 1936 geological map for the area at 1:10,560 scale is based on the 1920 Ordnance Survey London Sheet V SW and shows the site to be covered by Taplow Gravel and underlain by the solid geology of the London Clay. This map also shows the culverted course of the River Fleet, flowing southwards, some 625m east of the site.

The 2006 geological map for the area at 1:50,000 scale, Sheet 256, also shows the site to be covered by the renamed superficial Lynch Hill Gravel Member and underlain by the solid geology of the London Clay Formation.

Well records on the 1936 geological map indicate that the surface cover of made ground and superficial deposits are together about 5m thick beneath this part of London.

A previous ground investigation close to the site, confirmed the presence of about 3m of made ground, underlain by sand and gravel, and then the London Clay at about 6m below ground level. The latter was found to at least 15m depth, and groundwater was recorded at about 3m below ground level.

Hydrogeology

The site is designated by the Environment Agency (EA) as being underlain by a Secondary (A) Aquifer, the Lynch Hill Gravel, which overlies the Unproductive stratum of the London Clay. Based on the local topography and geology of the site area, the direction of near surface groundwater and surface water flow would be expected to be from west to east, towards the culverted River Fleet.

Well records on the 1936 geological map indicate that the practically impervious Unproductive stratum of the London Clay Formation is 12m to 15m thick beneath this part of London and that the underlying Principal Aquifer of the White Chalk Subgroup lies about 40m below ground level, about -18mOD.

HISTORY OF THE SITE

Historical maps and photographs dating between 1720 and the present day have been reviewed as part of this desk study together with internet research. Selected map sheets and photographs are reproduced in Appendix 1 with relevant descriptions given below.

Stow's 'Survey of the Cities of London & Westminster' was published circa 1720 (Figure A), and shows the future site of No.27 John's Mews to lie within a bowling green immediately to the north-east of the Cock Pit Inn, on the northern side of The Kings Way (later Theobald's Road). It is unclear if a circular feature associated with the Inn is a small pond or a cock pit arena. The land to the west was developed with a terrace of townhouses and their associated rear gardens along both sides of Great James Street; the land to the north was open through to a ditch and was crossed by a track (later Northington Street) running between Great James Street and Gray's Inn Road; and the land to the immediate east and south, between the site and Gray's Inn Road/The Kings Way, was covered by gardens. The course of the River Fleet was indicated in the north-eastern corner of this map extract.

John Roque's 'Exact Survey of the City's of London, Westminster and Borough of Southwark', was published in 1747 (Figure B) and shows the site within gardens as before, at the northern edge of London. The Foundling Hospital, partially under construction, was depicted about 450m to the north-west within Lambs Conduit Fields, which locally contained small ponds and earthworks generally associated with small scale gravel workings. The course of the River Fleet is also depicted to the north and south of Mount Pleasant, to the north-east, on this survey.

The 1755 revision of Stow's 'Survey of the Cities of London & Westminster' (Figure C) still has the site within a bowling green and formal gardens set out to the immediate east of the plot. Buildings now partially lined the northern side of The Kings Way, to the south, otherwise little had changed.

The 1792, First Edition of Richard Horwood's 'Plan of London' (Figure D) shows the site to have been developed and apparently occupied by a mews building at the western end of the rear garden to one of the townhouses, at the northern end of the terrace on the western side of John Street. The unnamed mews buildings are not individually delineated on this survey, as seems typical for similar developments within the district, for example to the east along both sides of King's Mews. The former track to the north of the site was named Little James Street (now Northington Street), and The Kings Way was marked as Kings Road (now Theobald's Road). The Cock Pit Inn had been removed, but Cock Pit Yard remained to the west. The ditch to the north of Little James Street was no longer visible but its former route was marked as a parochial boundary.

The 1813, Third Edition of Richard Horwood's 'Plan of London' (Figure E) shows the site within the now named John's Mews; John Street to the east had been extended north of its junction with Little James Street; and a number of buildings were depicted lining both sides of Cock Pit Yard, to the west. Further residential development had taken place across parts of the former fields to the north, including the completion of the Foundling Hospital, and the construction of the Middlesex House of Correction (built 1788-94) on the eastern flank of the River Fleet. The latter remained above ground north of Mount Pleasant, to the south of which it was apparently culverted.

The 1827, First Edition of Greenwood's 'Map of London' (Figure F) shows the site and immediate surrounding area largely as before, and the further development of the former fields to the north. The 1830, Second Edition of this map (not reproduced) has the site unchanged.

Stanford's 'Library Map of London and its Suburbs' was published in 1862 (Figure G) and shows the site and surrounding area in little detail, though largely covered by development.

The 1874-75, O.S. Town Plans, at 1:1056 scale (Figure H) show the site in detail for the first time and wholly occupied by a mews building on John's Mews. The site was bounded to the west by the adjacent roadway; to the south by similar but generally slightly larger buildings, some with adjoining rearward extensions to the dwellings on John Street; to the north by a rectangular building extending eastwards along the southern side of Little James Street; and to the east by the adjoining rear garden.

The 1877-78 O.S. 1st Edition maps, London Sheets XXVI & XXXV at 1:2500 scale (Figure I) show the site and surrounding area as before, although some of the former rear gardens to the immediate south-east were now indicated as being covered by glass roofed structures.

The 1896, O.S. 2nd Edition London Sheets L & LXII at 1:2500 scale (Figure J) show the site and surroundings largely unchanged, although the glass roofed structures to the south-east had been removed and several larger buildings now extended through from John's Mews to link with the townhouses lining John Street to the east. The buildings on the eastern side of Cock Pit Yard, formerly accessed from Little Cock Pit Yard, now appeared to have been replaced by a single large rectangular building.

The 1901, Goad's Insurance Map (Figure K) for the immediate site area indicates that the brick building within the site comprises a stable at ground level with a dwelling (*D.*) on the floor above. Similar two-storey buildings were depicted to the immediate north and south of the site, although that to the south was extended eastwards and had a central glass skylight. The extended buildings adjacent to the south included stores and a clothing factory, the latter of which was of three-storeys and had a basement. The eastern two-thirds of the rectangular site to the north-east (now No.13 Northington Street) was a single-storey building occupied by a coach builder, whilst most of the dwellings along the western side of John Street were offices. The Cockpit Yard buildings to the west of John's Mews were detailed as including an upholstery and trimming factory; a steam works; and a sausage and shrimp paste factory.

The 1916, 3rd Edition O.S. maps (London Sheets V.6 & V.10) at 1:2500 scale (Figure L) have the site and surrounding area unchanged.

The 1938, Provisional Edition O.S. maps London V. SW & NW at 1:10,560 scale (Figure M) show the site unaltered. The Foundling Hospital to the north-west had latterly been partially removed, whilst the Middlesex House of Correction to the north-east had been removed in the late 1880s and replaced by The Post Office's Mount Pleasant Sorting Office.

The London Bomb Damage Maps (1939-1945) for the area (Figure N), show the site was unscathed by World War Two bombing. The nearby clothing factory to the south on John's Mews had been seriously damaged, whilst buildings on John Street to the east and Theobald Road to the south had suffered general blast damage (shaded orange), were damaged beyond repair (shaded purple) or had been totally destroyed (shaded black). Little James Street was renamed Northington Street on these maps.

The 1948, 1:10,560 scale O.S. map, Sheet TQ 38 SW (Figure O), shows the site as before, and extensive vacant areas where buildings had been destroyed by bombing and subsequently cleared.

The 1951, 1:1250 scale maps TQ 3081 NE and TQ 3082 SE (Figure P) show the site and buildings to the immediate north and south as before. The land between the southern end of John's Mews and Theobald's Road is indicated to be covered by ruins, whilst the former mews on the western side of John's Mews appear to have been removed and incorporated with the adjoining buildings of Cockpit Yard, where they are denoted as a council depot. Further occasional vacant plots and ruins are detailed within the district, including plots on John Street and King's Mews to the north and east, respectively.

The 1960, Goad's Insurance Map (Figure Q) has the site as it was detailed in 1901 although the ground floor stable was now marked as a garage. The adjacent building to the immediate south had been removed and was being replaced by a five-storey building with a full basement (car park) and a single-storey rearward extension. This building was mainly used as offices and had a dwelling on the highest level. The south-western corner of this basement was noted to contain an oil fuel tank and oil fire heaters. The neighbouring building to the south had also been redeveloped and was marked as having up to four-storeys and a full basement occupied by a photo developing and printing business. The building to the immediate north (No.13 Northington Street) was now shown as a single unit, with a garage on the ground floor and a second storey of dwellings now covered the whole footprint. The three-storey Holborn Borough Council buildings on the western side of John's Mews now contained an engineer's store; a cardboard box factory; an urban social centre; a salt store; offices; a paint shop and carpenters; a musical instrument factory and a small garage with oil fuel tanks in its basement. The plot immediately to the south-west of the junction of Northington Street and John's Mews had been cleared of its former end of terrace house (No.15 Northington Street) and the unsupported end of the adjacent No.17 shored up.

The 1965, 1:2500 scale maps TQ 3081 and TQ 3082 (Figure R) show the site as before; the adjacent site to the north as a commercial (vehicle repair) garage; and various areas in the district to have been cleared or still occupied by ruins.

The 1974, 1:1250 scale maps TQ 3081 NE and TQ 3082 SE (Figure S) and the 1982 edition of TQ 3082 SE (Figure T) show the site unchanged. By theses dates, the cleared land to the north-west of the junction of John's Mews and Northington Street had been partly redeveloped with a primary school, whilst the land at the southern end of John's Mews had been redeveloped with a library and residential blocks. The eastern part of the council depot along the western side of John's Mews was marked as an assembly hall on the 1974 survey. Further residential development had taken place around the primary school site to the north-west by the time of the 1982 revision.

London Borough of Camden planning records of 1982 indicate that the basement and ground floors of the adjacent No.13 Northington Street were authorised for general industrial use, whilst the first floor was for residential use.

The 1990-91, 1:1250 scale maps TQ 3081 NE and TQ 3082 SE (Figure U) show the site and immediate area largely as before. The adjoining buildings to the immediate south (Nos.29 & 31 John's Mews and Nos.31 & 32 John Street) appear to have been reconfigured since the 1982 survey.

The 1995, 1:1250 scale map revisions (TQ 3081 NE and TQ 3082 SE) have the site and surrounding area unchanged (Figure V).

Planning records of 1995 record that No.27 John's Mews was permitted to add a roof extension for use as a single dwelling. In the same year, the adjacent No.13 Northington Street was granted permission for a change of use and the conversion of the basement and ground floor into two self-contained maisonettes.

The 2002 Raster Map at 1:10,000 scale (Figure W), shows the site and surrounding area as it was in the 1990s. Similarly, the 2010 and 2014 (not reproduced) National Grid maps at 1:10,000 scale have the site in little detail and apparently as before.

The 2015 aerial photograph presented on page 1 of Appendix 2 shows the site apparently as it was in the 1990s but locally in the shadow of the adjacent taller buildings.

The 2017 National Grid Map extract (Figure X) shows the site unchanged and as it was at the time of this investigation. The adjacent former rear garden to No.30 John Street was now shown to be almost entirely covered by a building.

Summary

In summary, the site was within an area of bowling greens/gardens during most of the Eighteenth Century, and was developed with a single mews building between 1755 and 1792. The dwelling and stable (later residents' garage) has remained largely unchanged apart from the addition of a roof extension at the end of the Twentieth Century.

The immediate surrounding area has been, and is, mixed residential/commercial with a number of offices, small scale factories, stores, and latterly a council depot. The adjacent building to the north was formerly a vehicle repair garage at ground level, whilst a basement car park was/is present to the immediate south. Planning records indicate that No.13 Northington Street included a basement in 1982, and subsequently, although this was not recorded on the 1960 Goad's Insurance map.

ENVIRONMENTAL DATABASE INFORMATION

Appendix 2 contains information from Environmental Databases for a radius of up to 2km from the site. The information covers various datasets and contributors include the Environment Agency, Local Authorities, British Geological Survey, Ordnance Survey and the Coal Authority. The results obtained are presented together with a detailed search on selected areas of enquiry, and have been described below for a radius of 250m from the site.

Historical Land Use

Details on historic industrial sites in the surrounding area are presented in Section 1 of the Environmental Searches Report in Appendix 1. In summary, there are no potentially contaminative uses identified on the site, and eighteen (18) identified within 250m. These are for a police station, a workhouse, an unspecified yard, and a hospital, 136m to 231m distant. There is one (1) record pertaining to a historical tank 189m east of the site in 1878. There are eleven (11) records relating to three historical energy features (electricity sub-stations) within 250m of the plot, 147m to 176m to the east, and 200m north-east.

There are no records of historical petrol and fuel sites within 250m of the site.

There is one (1) record of a historical garage and motor vehicle repair workshop on the site in 1960, although this actually refers to the adjacent site to the north (No.13 Northington Street), and eight (8) within 250m of the plot. The latter refer to garage workshops, 126m north and 220m north-east of the site.

There is a single (1) recorded area of potentially infilled land within 250m of the site. This relates to unspecified ground workings 145m south-east of the site.

Environmental Permits, Incidents & Registers

The following is a summary of the main points for environmental authorisations:

Statutory Authorisations

IPC & IPPC Regulations: There are no (0) recorded sites authorised by the Environment Agency under Part I of the Environmental Protection Act 1990, to carry out processes subject to Integrated Pollution Control (IPC) or Integrated Pollution Prevention and Control (IPPC) on, or within 250m of the site. There are no (0) recorded IPC Registered Waste Sites on, or within 250m of the site.

Keeping of Dangerous Substances: There is one (1) Environment Agency List 1 and no (0) List 2 Dangerous Substance Inventory Sites listed within 250m of the site. The former refers to the use of mercury and cadmium at a plating works some 171m east of the site.

Enforcement Notices and Authorised Processes: There are three (3) Part B activities recorded by the Environment Agency under Part I of the Environmental Protection Act 1990 within 250m of the site. These relate to two dry cleaners 156m north-east and 165m south-west of the site.

Keeping of Radioactive Substances: There are no (0) records held by the Environment Agency under the Radioactive Substances Act 1993, within 250m of the site.

Discharge Consents

Discharge Consents: There are no (0) recorded discharge consents recorded on or within 250m of the site.

Water Industry Act Referrals: There are no (0) recorded referrals under the Water Industry Act on or within 250m of the site.

Discharges to Water: There are no (0) licences recorded by the Environment Agency, to discharge to watercourses in accordance with the Water Resources Act 1991 positioned within 250m of the site.

Storage of Hazardous Substances

Storage of Hazardous Substances: There are no (0) recorded sites subject to hazardous substances consents granted by the relevant local authority under the Planning (Hazardous Substances) Act 1990 on, or within 250m of the site.

Control of Major Accidents: There are no (0) recorded sites regulated by the Health and Safety Executive under the Control of Major Accident Hazards (COMAH) regulations 1999, on, or within 250m of the site.

Notification of Installations Handling Hazardous Substances: There are no (0) site regulated by the HSE under the Notification of Installations Handling Hazardous Substances (NIHHS) regulations noted on or within 250m of the site.

Pollution Incidents

Pollution Incidents and Prosecutions: There are no (0) recorded pollution incidents recorded within 250m of the site.

Contaminated Land Register Entries & Notices: There are no (0) recorded entries or notices on the Contaminated Land Register listed on, or within 250m of the site.

Landfill & Waste Sites

The following is a summary of the main points for the Waste section:

Landfill Sites: There are no (0) recorded landfill sites licensed by the Environment Agency under Part II of the Environmental Protection Act 1990, within 250m of the site.

Registered Landfill or Local Authority Recorded Landfill Sites: There are no (0) recorded operational or non-operational landfills located on or within 250m of the site.

Registered Waste Transfer Site: There are no (0) recorded waste transfer sites on or within 250m of the site.

Waste Treatment, Transfer and Disposal: There are no (0) listings for waste treatment, transfer or disposal recorded within 250m of the site.

Potentially Contaminative Uses

Current Industrial Sites: There are no (0) recorded potentially contaminative uses listed for the site address and forty (40) within 250m of the site. The latter are for the offices of two consulting engineers, 23m to the south; shoemakers, milliners and jewellers, 34m to the south; several publishers, 35m to the north; a council depot 47m to the south-west; the offices of various companies on neighbouring streets; and two (2) electricity sub-stations located 200m to the east and north-east of the site.

Fuel Station Entries: There are no (0) recorded fuel filling stations recorded within 250m of the site.

National High Voltage Underground Electricity Transmission Cables: There are no (0) records for high voltage underground electricity transmission cables within 250m of the site.

National Grid High Pressure Gas Transmission Pipelines: There are no (0) recorded underground high pressure gas transmission pipelines within 250m of the site.

Geology & Hydrogeology – Pathways & Receptors

The following is a summary of the main points for the sensitivity section:

Artificial & Made Ground: The site, including a 50m buffer, is not recorded within an area of made or worked ground.

Drift Deposits & Solid Geology: The site, including a 50m buffer, is recorded as being covered by superficial deposits of the Lynch Hill Gravel and Hackney Gravel and underlain by the solid geology of the London Clay.

Groundwater Vulnerability: The site is designated by the EA as being covered by the Secondary (A) Aquifer of the Lynch Hill Gravel and underlain by the solid geology London Clay.

Water Abstractions: There are no (0) recorded water abstraction licences listed on, or within 2000m of the site.

Source Protection Zones: The site does not lie within a Source Protection Zone.

River Quality: There is no (0) Environment Agency information relating to river quality within 250m of the site.

River Network & Surface Water Features: There are no (0) river networks or surface water features within 250m of the site.

Flood Risk: The site does not lie within Zone 2 or Zone 3 flood plains. The site is not within a zone benefiting from flood defences. The site is also not within 250m of areas used for flood storage. The site has a very low risk of flooding from rivers and the sea. The site is in an area that has potential below surface for groundwater flooding.

Environmentally Sensitive Receptors

Environmentally Sensitive Areas: There are no (0) environmentally sensitive areas within 250m of the site.

Natural & Mining Hazards

Natural Subsidence Risk: According to the British Geological Survey there is: a 'Very Low' hazard potential for Landslides, Running Sand and Collapsible Rocks; and a 'Negligible' hazard potential for Shrinking or Swelling Clay, Soluble Rocks and Compressible Ground.

Coal Mining: The site is not within 75m of any areas affected by coal mining.

Non-Coal Mining: The site is not within 75m of any areas affected by non-coal mining.

Brine Affected Areas: The site is not within 75m of any areas affected by brine extraction.

Radon Affected Area: The site lies within an area where less than 1% of properties are above the action level for radon.

Radon Protection Measures: The site lies within an area where no radon protection measures are necessary for new dwellings or extensions in accordance with Building Research Establishment report BR211 (1999).

PRELIMINARY RISK ASSESSMENT

In order to assess the risks associated with the presence of ground contamination the linkages between the sources and potential receptors to contamination need to be established and evaluated. This is in accordance with the Environmental Protection Act 1990, which provides a statutory definition of Contaminated Land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that

- *Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- *Pollution of controlled waters is being, or is likely to be, caused*

There are three principal factors that are assessed whilst undertaking a qualitative risk assessment for any site. These are the presence of a contamination source, the existence of migration pathways and the presence of a sensitive target(s). It should be noted that it is necessary for each element of source, pathway and target to be present in order for exposure of a human or environmental receptor to occur.

UK Government guidance on the assessment of contaminated land, requires risk to human health and the environment to be reviewed using source – pathway – target relationships. If each of these elements is present, the linkage provides a potential risk to the identified targets. ***Contaminants or potential pollutants*** identified as ***sources*** in relation to the identified previous uses are listed below in Table 1.

Table 1: Identified Potential Contaminant Sources

Contaminant Source	***Comments***
Drainage/Buildings	Effluent from leaking drains would provide a contaminant source. The existing building may have asbestos containing material within it.
Soil Beneath Site	Contamination may be present within any made ground materials beneath the site.
Soil Gas	Potential soil gas generated from made ground or natural organic soils.
Ground Contamination Outside Site Boundary	Ground contamination migrating from adjoining sites, notably the adjacent former vehicle repair garage immediately to the north and the basement car park to the immediate south.

A ***Pathway*** is defined as one or more routes through which a receptor is being, or could be, exposed to, or affected by, a given contaminant.

Potential ***Target or Receptors*** fall within the categories of Human Health, Water Environment, Flora and Fauna, and Building Materials.

There are a number of possible pathways for the contaminants identified on the site to impact human and/or environmental receptors and these are summarised in Tables 2 and 3.

Table 2: Human Receptors and Pathways

Human Receptor-Mechanism	***Typical Exposure Pathway***
Human Inhalation	Breathing Dust and Fumes Breathing Gas emissions
Human Ingestion	Eating -contaminated soil, for example by small children -plants grown on contaminated soil Ingesting dust or soil on fruit or vegetables Drinking contaminated water
Human Contact	Direct skin contact with contamination Direct skin contact with contaminated liquids

Table 3: Water Receptors and Pathways

Receptor-Water Environment	***Typical Exposure Pathway***
Groundwater The site is covered by the Secondary (A) Aquifer of the Lynch Hill Gravel and underlain by the practically impervious London Clay.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and migrate to underlying groundwater. Contamination leads to restriction/prevention of use as a resource, for example, drinking water, and can have secondary impacts on other resources, which depend on it.
Surface Water/Watercourses There are no watercourses or surface water features recorded within 250m of the site.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and laterally migrate. Contamination leads to a restriction/prevention of use: -as drinking water resource -for amenity use Effects on aquatic life

Preliminary Conceptual Model

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research documented in the preceding sections of this report.

A generalised preliminary conceptual model relative to the construction phase and completed development is presented below in Table 4.

Table 4: Preliminary Conceptual Model Relative to Construction/Future Use of Site

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources			
		Drainage/ Buildings	**Soil Beneath Site**	**Soil Gas**	**Ground Contamination Outside Site Boundary**
Human Health – ground workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Likely	Low likelihood	Low likelihood	Low likelihood
Human Health – users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Unlikely	Low likelihood	Low likelihood	Low likelihood
Water Environment	Migration through ground into surface water or groundwater	Low likelihood	Low likelihood	Unlikely	Low likelihood
Flora	Vegetation on site growing on contaminated soil.	Low likelihood	Low likelihood	Unlikely	Low likelihood
Building Materials	Contact with contaminated soil	Low likelihood	Low likelihood	Unlikely	Low likelihood

Key to Table 4

Estimated Potential for Linkage with Contaminant Source	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.
N/A	Not Applicable

SITE WORK

A single borehole and three extended foundation inspection pits were undertaken under the supervision of a Geo-environmental Engineer at the positions depicted on the site plan at the rear of this report, as requested by the Engineer. Services information was obtained and referenced in relation to the exploratory hole positions prior to boring/excavation.

The investigation was undertaken following the protocols detailed in British Standards (BS) 'Code of Practice for Site Investigations' (BS5930:2015) and 'Methods of test for soils for engineering purposes' (BS1377:1990).

Borehole

The single borehole (BH 1) was undertaken by a restricted access, low headroom cable percussive rig on 23rd and 24th November 2017. The final borehole position was chosen following a scan using a cable avoidance tool (CAT). The concrete floor slab was cored using electrically powered diamond drilling equipment at 250mm diameter, and a starter pit was hand dug to 1.20m depth in order to confirm the absence of buried services.

The borehole was then advanced using weighted claycutter and shell tools, initially working within 150mm diameter casing. Water was added to enable drilling of coarse grained soils. Borehole BH 1 was completed at the intended depth of 20.00m below ground level.

Standard penetration tests were undertaken in the borehole within made ground and coarse grained soils in order to give an indication of the in-situ relative density/shear strength of the material. The test was made by driving a 50mm diameter solid cone (C) into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 750mm. The penetration resistance was usually determined as the number of blows required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole. Where the full penetration was not achieved the actual penetration and the number of blows were recorded. The results have been tabulated to the rear of the borehole record.

Undisturbed samples (U) nominally 100mm in diameter were taken in clay. The ends of the samples were capped and sealed to maintain them in as representative condition as possible during transit to the laboratory.

Representative disturbed samples of soil were taken from the boring tools at regular intervals throughout the depth of the boreholes and placed in polycarbonate pots/small plastic bags (D samples) and large plastic bags (B samples). A sample of water (W) was recovered from the borehole once sufficient water had accumulated for collection.

On completion of borehole BH 1 a 50mm diameter standpipe was installed to 7.00m below ground level, with a gravel response zone up to 1.00m below ground level. Above the response zone to this installation, the borehole was backfilled with bentonite, whilst the hole beneath the installation was infilled with clean arisings. A protective stopcock cover was concreted into the ground flush with the surface over the top of the installation.

The borehole record gives the descriptions and depths of the various strata encountered, results of the in-situ tests, details of all samples taken, installation details and the groundwater conditions observed during boring, on completion and subsequently in the standpipe. Excess spoil was removed from site and disposed of at a licenced facility.

Trial Pits

Three foundation inspection pits (TPs 1 to 3) were also undertaken on 23rd and 24th November 2017 using hand tools and a small breaker. Where necessary, the pits were extended using 75mm diameter hand auger tools. The exposed strata and foundations were logged and the soils sampled by the supervising Geo-environmental Engineer. The pits were completed at depths between 2.10m and 4.30m below ground level.

Disturbed samples of soil were taken at regular intervals throughout the pits and placed in polycarbonate pots and glass jars (D samples).

In clay, an immediate assessment of the apparent soil cohesion was made by the supervising Geo-environmental Engineer using a Pilcon hand shear vane (V). The average of three readings was recorded on the pit records in kPa.

A Mackintosh Probe was used to ascertain the in-situ relative density of coarse grained soils within the trial pits. The 25mm diameter solid cone point of the probe was screwed onto the rods and driven into the ground by repeated blows of a 4.5kg slide hammer with a fall of 0.3m. The blow counts for each 0.30m driven or, alternatively the depth driven for 100 blows were recorded.

The trial pit records give descriptions and depths of the various strata encountered, the details of all samples and the groundwater conditions observed during excavation. Sketch sections, plans and photographs of the exposed footings are presented on the pages following the record for each excavation.

The spoil was returned to the pits and placed in layers, which were recompacted, and the surface layers reinstated.

Gas and Groundwater Monitoring

Three return visits were made during December 2017 in order to monitor methane, carbon dioxide and oxygen gas levels in the borehole standpipe. Ambient pressures and flow rates were recorded together with the depth to groundwater. The water levels have been added to the borehole record, whilst the gas/groundwater results are presented following the exploratory hole records.

A sample of groundwater was recovered from the borehole standpipe during the first return monitoring visit, placed in amber glass and plastic bottles, and transported directly to the analysing laboratory.

LABORATORY TESTING

The samples were inspected in the laboratory and assessments of the soil characteristics have been taken into account during preparation of the exploratory hole records. The soil sample descriptions are in accordance with BS5930:2015.

The chemical testing schedule was devised by Ground Engineering Limited for a broad suite of potential contaminants, outlined by the Environment Agency (EA) and National House Building Council (NHBC) document R&D 66; 2008 'Guidance for the Safe Development of Housing on Land Affected by Contamination'.

The geotechnical tests were conducted to BS1377:1990 and other industry standards, and the results are presented following the exploratory hole records, whilst the results of the chemical tests are presented in Appendix 3.

Geotechnical Testing

The index properties of a selected soil sample were determined as a guide to soil classification and behaviour. The liquid limit was determined by the cone penetrometer method.

The particle size distribution of selected samples were obtained by sieve analysis. The results of these tests are given as particle size distribution curves at the end of this report.

Selected test specimens were prepared at full diameter from the undisturbed samples recovered from the borehole. An immediate undrained triaxial compression test was made on each sample at a single cell pressure approximately equivalent to the overburden pressure for that sample's depth. The results have been plotted against depth in Figure 1. The moisture content and bulk densities of these specimens were also determined.

An indication of the settlement characteristics of selected samples were obtained from tests in the consolidation apparatus or oedometer. Each test was performed on a 75mm diameter sample, about 19mm thick, contained in a steel ring. The sample was saturated and the swelling pressure balanced prior to applying a constant load with drainage at both ends. When primary compression was complete, the load was increased and this repeated for three increments of load. The sample was then unloaded in a single stage. The rate and total amount of consolidation were continually monitored using a computer controlled E.L.E. Datasystem 7 Unit. The results were plotted and analysed by the computer for each increment of load to obtain the coefficients of compressibility (m_v), and of consolidation (c_v), which govern the amount and rate of settlement, respectively.

Selected samples of soil and water were analysed to determine the concentration of soluble sulphates. The pH values were also determined using an electrometric method.

Chemical Testing

Six soil samples recovered from the exploratory holes were tested for total concentrations of arsenic, cadmium, chromium, lead, mercury, selenium, nickel and benzo[a]pyrene, together with speciated polyaromatic hydrocarbons (PAH), boron, copper and zinc, phenols, total and free cyanide, hexavalent chromium, sulphate, sulphide and pH. The organic content of these samples was also determined. Three soil samples were screened for total petroleum hydrocarbons (TPH) and three samples were also screened for asbestos containing material (ACM).

The water sample recovered from the borehole standpipe was tested for a similar suite of contaminants as detailed above for the soil samples, plus speciated TPH (TPH CWG).

A sample of made ground, from BH 1 at 2.00m to 2.50m depth, was scheduled for a Waste Acceptance Criteria (WAC) CEN Leachate Suite at 10l/kg.

GROUND CONDITIONS

The ground conditions encountered were generally as expected from the known history of the site and geological records with a significant thickness of made ground covering a localised remnant of Alluvium, and Lynch Hill Gravel. These superficial deposits were underlain by the solid geology of the London Clay at 5.20m depth, whilst the underlying strata of the Lambeth Group were met at 19.20m below ground level. The latter was found to at least 20.00m depth in the completed BH 1.

Made Ground

The concrete floor slab was 0.20m thick and was underlain initially by predominantly coarse grained made ground. The latter included layers of brick rubble in BH 1 and TP 3 to 0.85m and 0.50m depth, respectively. The coarse grained fill was generally a dark brown and brown, clayey sand and gravel with occasional brick and concrete cobbles. The gravel fraction consisted of brick, concrete, ash, flint, mortar, slate and fragments of bone, glass and pottery. Trial pits TP 2 and TP 3 were completed within this coarse grained fill at 2.10m and 2.40m depth, whilst its base was proved in TP1 at 2.20m and at 2.50m in BH 1.

Within the coarse grained fill in BH 1 between 1.20m and 2.00m depth, below 2.20m depth in TP 1, and below 2.50m depth in BH 1, a soft or firm, brown, dark grey brown and dark grey mottled, sandy and gravelly, silty clay fill with occasional brick cobbles was met. This made ground had a similar gravel content to the coarse grained fill and was proved to 3.70m and 3.75m below ground level in TP 1 and BH 1, respectively.

Alluvium

At 3.70m depth in TP 1, a firm, brown, orange brown and grey mottled, slightly sandy, silty clay with a faint organic odour, occasional fine and medium gravel size ferruginous concretions, and rare angular flint gravel was encountered. This remnant of Alluvium, or Pond

Deposit, was 0.50m thick and was proved to 4.20m depth in the south-eastern corner of this small site. This stratum was not encountered in BH 1.

Lynch Hill Gravel

The superficial Lynch Hill Gravel was met beneath the made ground (BH 1) and Alluvium (TP 1) at 3.75m and 4.20m below ground level, and was found to at least 4.30m depth where TP 1 was completed. In the borehole this stratum was a very dense, light brown, slightly silty, very sandy gravel, with a gravel fraction of angular to rounded flint, and occasional quartzite. The Lynch Hill Gravel was proved to 5.20m depth in BH 1, a recorded thickness of 1.45m, which was consistent with nearby well and borehole records.

London Clay

The solid geology of the London Clay was reached at 5.20m depth and was initially reworked to a firm, brown and orange brown mottled, slightly sandy, slightly gravelly clay with a gravel fraction of angular to rounded flint. This reworked horizon was 0.30m thick and was followed by a firm, closely fissured, grey brown clay with occasional silt partings. The London Clay became stiff, fissured and silty below 8.00m, and from 10.00m depth contained rare gravel size pyrite nodules. These 'Basement Beds' of the London Clay became slightly sandy below 17.00m depth, and were proved to 19.20m below ground level, a recorded thickness of 14.00m.

Lambeth Group

The underlying solid geology of the Lambeth Group was met at 19.20m and began with a 0.30m thick layer of very stiff, grey, shelly clay. Below 19.50m depth the borehole entered a very stiff, red brown and light blue grey mottled clay, and these typical 'mottled beds' of the Lambeth Group were found to at least 20.00m below ground level where the borehole was completed.

Groundwater

The two shallowest, 2.10m and 2.40m deep, trial pits (TP 2 and TP 3) were dry during excavation and on completion. The extended TP 1 met a water seepage within the Alluvium at 4.00m below ground level.

The addition of water to enable boring of the Lynch Hill Gravel from 3.75m to 5.00m depth in BH 1 will have masked any initial water ingress within this stratum, but water was recorded by the driller as being met at 5.00m and rose to 4.80m in the fifteen minutes before drilling resumed. This water was largely sealed out of the borehole once the casing entered the underlying London Clay, and the 20.00m deep borehole was 'damp' on completion.

The water levels recorded in the 7.00m deep standpipe during December 2017 recorded water levels between 3.46m and 3.60m below ground level.

Evidence of Contamination

The made ground contained fragments of brick, concrete, ash, mortar, pottery, bone and glass.

There was no olfactory or visual evidence of hydrocarbon contamination.

No visual evidence of asbestos containing material was detected within the exploratory holes.

Existing Foundations

The foundations to the rear/eastern elevation uncovered by trial pits TP 1 and TP 2 comprised corbelled brick on a concrete strip footing that was based at 1.60m (TP 2) and 2.00m (TP 1) depth. This footing projected 0.28m (TP 2) and 0.48m (TP 1) from the rear wall.

The foundation to the adjacent southern elevation was also exposed in TP 1 where concrete underpinning was found below 0.72m depth and was extended to 4.00m below ground level. The underpinning projected 0.06m from the face of the brickwork.

Trial pit TP 3 was dug against the northern elevation and found brickwork to at least 1.90m depth, indicating the presence of deep foundations or a basement immediately to the north of the site. Hand augered extensions at the base of this pit were abandoned on obstructions at 2.30m (adjacent the wall) and 2.40m (0.30m distant) depth, which may indicate the depth to the top of brick corbels on a concrete strip footing.

COMMENTS ON THE GROUND CONDITIONS IN RELATION TO FOUNDATION DESIGN AND CONSTRUCTION

The investigation found a significant thickness of made ground beneath the existing building, which is bounded to the north and south by existing basements. Foundations for the 3.50m deep basement will need to penetrate this made ground to reach the top of the underlying very dense Lynch Hill Gravel, which was met at 3.75m and 4.20m a minimum of 1.00m above the interface with the underlying firm becoming stiff solid geology London Clay. Indeed there may be a net reduction in pressure at the reduced basement floor level, although resultant base heave would not be expected.

Standpipe water levels were recorded at about 3.50m below the ground level, at about or just above the proposed basement floor level. This water level is considered to reflect the depth of 'perched' groundwater within the superficial Lynch Hill Gravel.

Foundation Depths

The exploratory holes encountered natural ground at about 3.70m depth within this site although it may locally be expected to lie at slightly greater depth associated with the neighbouring basement car park to the south.

The underlying thin remnant of Alluvium (or Pond Deposit) was found to have a plasticity index of 25% and so is of a medium volume change potential, whilst the Lynch Hill Gravel may be regarded as a non-shrinkable stratum. The top of the high volume change potential London Clay was recorded at 5.20m below street level and so will be well below the depth affected by tree root-induced desiccation.

Foundations will need to be taken down through the made ground and laterally non-persistent Alluvium and into the top of the very dense Lynch Hill Gravel, which was met at 3.75m and 4.20m below ground level within this small site. Depending on the basement excavation depth, this may therefore require the construction of foundations 0.70m below the 3.50m deep proposed basement floor level.

Bearing Capacity

The construction of a 3.50m deep basement on this site will remove most of the made ground. The foundations will need to be extended so that they reach the underlying very dense sand and gravel at 3.75m to 4.20m depth. With only 1.00m to 1.45m of sand and gravel remaining between the base of the made ground/Alluvium and the top of the London Clay, the superior bearing properties of the very dense Lynch Hill Gravel can only partly be utilised, during the design of strip or pad foundations for the proposed basement walls.

The results of the in-situ standard penetration tests indicate that an allowable bearing pressure of $300kN/m^2$ could have been applied on foundations cast just below basement level on the Lynch Hill Gravel, if this stratum was of a greater thickness than the 1.00m to 1.50m proved/inferred from this investigation. Due to the presence of the underlying firm London Clay below 5.20m depth, a reduced maximum safe bearing pressure of $200kN/m^2$ on the top of the Lynch Hill Gravel would be appropriate in order not to overstress the London Clay, which initially has a maximum safe bearing capacity of $115kN/m^2$, with a factor of safety of 3.0.

A bearing pressure of $200kN/m^2$ should be sufficient to support the likely foundation pressures for the new structure and for adjacent buildings underpinned to the same depth as the proposed basement.

Basement

The construction of a 3.50m deep basement will remove most of the made ground. Foundations for the basement walls just below the new basement floor level would be within the very dense Lynch Hill Gravel and could be designed using the previously detailed bearing parameters.

Alternatively a basement raft foundation could be considered for this structure, although this would need to be designed using the bearing properties of the underlying London Clay. A net safe bearing capacity of $100kN/m^2$, which incorporates a factor of safety of 3.0, could be used for the design of a 7.00m wide raft foundation at 3.50m below existing ground level.

It is estimated that theoretical base heave at the centre of a 9.00m long and 7.00m wide, 3.50m deep unconfined basement excavation would be in the order of 15mm, based on the proposed basement dimensions and the results of the oedometer tests in the London Clay. However, with between 1.00m and 1.50m of Lynch Hill Gravel remaining below the proposed underside of the 3.50m deep basement floor slab, little, if any, base heave would be expected following the removal of about $65kN/m^2$ of overburden pressure within the basement, as any heave would dissipate between inter-grain contacts within the Lynch Hill Gravel.

A likely basement raft loading is unknown but if it were the $65kN/m^2$ of removed overburden pressure no net heave/settlement would be expected. Raft loadings greater than $65kN/m^2$ could result in net settlement, whilst conversely loads lower than $65kN/m^2$ could result in net heave, although as detailed above this is considered unlikely. Net differential heave/settlement will need to be taken into account in the design of the basement floor. The advice of specialists should be sought in this regard.

Excavations/Groundwater

The excavation of the basement to approximately 3.50m below existing ground level will require the construction of close support to its sides, the control of groundwater, and the need to avoid undermining adjacent structures.

The use of mass concrete basement walls, constructed in alternate panels around the perimeter of the basement could provide support, a limited cut-off to 'perched' water and reduce the scale of any dewatering required within the basement excavation.

An alternative would be to use sheet, contiguous or secant piled walls around the perimeter of the basement, although this may well be problematical on this relatively small restricted access site. Piling to a sufficient depth to mobilise adequate passive pressure below the basement level should be feasible on this site.

The excavation of a 3.50m deep basement could then be undertaken within the mass concrete or piled walls, although it should be noted that mass concrete, contiguous and sheet pile lined excavations may not be water tight.

In order to construct the basement beneath this site it will be necessary to provide permanent support to the adjacent structures, which are based on deepened strip and underpinned foundations. This support can either be provided by underpinning these structures to the same depth as the proposed basement prior to basement construction or by constructing piled walls to the excavation that are adequately propped during construction by temporary support and permanently by the basement and ground floors, to prevent movement at the top of the retaining walls.

Such lateral movement would otherwise be accompanied by settlement of the ground behind the basement walls. CIRIA report C580 'Embedded Retaining Walls' (2003) indicates very small scale horizontal and vertical movements resulting from the construction of a secant piled wall embedded in sand and stiff clay, as does the use of high support stiffness (high propped walls and top down construction) to the basement excavation. Provided that such a very stiff bracing system is used to prevent deflection of the proposed and existing basement walls, and that the neighbouring structures arc of robust construction, the anticipated level of structural damage, if any, would fall within Category 0 'Negligible' as described in Table 2.5 of the aforementioned CIRIA document.

The advice of specialist groundworks contractors with experience of constructing such basements should be sought, particularly in respect of other potential methods of providing support to the sides of the basement excavation.

The basement excavation should be inspected on completion to ensure that the condition of the soil complies with that assumed in design. Should pockets of inferior material be present, they should be removed and replaced with well graded hardcore or lean mix concrete. The excavated surface should be protected from deterioration and a blinding layer of concrete used where foundations are not completed without delay.

Water was recorded in the borehole standpipe at about 3.50m depth within the base of the made ground. This is at or just above the proposed basement excavation level. Potential flotation due to this groundwater level will not therefore be a problem on this site.

As the groundwater level approximately coincides with the floor of the proposed basement, it will be necessary to waterproof the basement in order to prevent the ingress of groundwater into the completed structure. In addition, downward percolating surface water will need to be prevented from entering the basement.

Safety precautions should not be neglected especially where personnel are to enter excavations when close side support will be required in order to maintain excavation stability. All excavations should be undertaken in accordance with CIRIA Report 97 '*Trenching Practice*'.

Care should also be taken to ensure that the proposed retaining walls of the basement are not surcharged with plant and equipment or the stockpiling of materials and excavated soils outside of the basement excavation.

Piled Foundations

In the event that piled foundations are preferred due to practical or economic considerations related to the construction of the basement and underpinning foundations on this site, the ground conditions are considered suitable for bored or CFA, but not driven piles as the vibrations during installation of driven piles could damage the existing dwelling and adjacent structures. The advice of specialist piling contractors should be sought as to their preferred method of pile installation in these conditions on this restricted access site and their attention drawn to the very dense nature of the Lynch Hill Gravel, and the possible presence of concretionary limestone nodules within the London Clay beneath the site.

Preliminary working loads for a single bored pile may be estimated for design and cost purposes using pile bearing coefficients, which are based on the following assumptions.

1) The ultimate load on a pile would be the sum of the side friction/adhesion acting on the pile shaft together with the end bearing load.

2) The pile bearing properties within the depth of the proposed basement have been ignored.

3) The shaft friction of a pile within sand and gravel would be a function of the SPT 'N' values and the overburden pressure. The groundwater level was recorded at about 3.50m depth. End bearing within the 1.00m to 1.50m thick layer of very dense Lynch Hill Gravel should not be considered.

4) In the London Clay and Lambeth Group the shaft adhesion and end bearing would be a function of the lower bound average of the apparent cohesion values determined by triaxial compression strength tests (Figure 1).

5) A factor of safety of at least 2.0 would be used to assess pile working loads. If test loading of selected piles were not practical the factor of safety would be increased to at least 2.5.

Item	**Ultimate Pile Bearing Value kN/m^2**
Shaft adhesion/friction in ground to about 4m	Ignored
Average shaft adhesion in Lynch Hill Gravel	20
Average shaft adhesion in firm London Clay to 8m	25
Average shaft adhesion in stiff London Clay, 8m to 14m	45
Average shaft adhesion in stiff London Clay below 14m	60
End bearing in London Clay at 10m	810
End bearing in London Clay at 15m	1080

Using these coefficients it is estimated that a single, 300mm diameter bored pile installed to 10m below ground level would have an anticipated working load of 95kN, with a factor of safety of 2.5, whilst a 15m long pile of the same diameter would have an anticipated working load of 190kN, with the same factor of safety. Different pile lengths, or diameters, from those detailed above would give different available working loads, which could be tailored to suit the working loads required.

The design of piled foundations on this site will also need to take into account potential tensile stresses in the piles during basement construction where the net change in load is to be reduced.

A piling specialist should undertake the final design of piles.

Retaining Walls

The walls of the proposed basement will act as retaining walls and will need to be designed accordingly. For a permanent retaining wall analysis effective stress parameters would be appropriate, however, in the absence of effective stress testing on samples from this site, published parameters, previous experience and in-situ test results could be used as a conservative approach.

The design of retaining walls around the basement area may be based on the following stress parameters:

Soil Type	Bulk Density (Mg/m^3) γ_B	Effective Shear Strength (kPa) c'	Angle of Shearing Resistance (degrees) ϕ'
Made Ground/ Alluvium	1.80	0	28
Lynch Hill Gravel	2.10	0	41
London Clay	2.00	0-2	22

Buried Concrete

Sulphate analysis of the soil and water samples tested gave results in Design Sulphate Classes DS-1 and DS-2 of the BRE Special Digest 1, Table C2 (2005) presented in Appendix 4. The pH results were between 7.6 and 10.3 and so alkaline.

Using the sulphate and pH results an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2 would be considered appropriate for buried concrete beneath this site as detailed in the above cited BRE document.

Slope Stability

The ground within which the level plot is located slopes down gently to the north/north-east and falls from 23mOD at the southern end of John's Mews to about 22mOD at its junction with Northington Street, 80m distant. This is a slope angle of less than 1 degree and hence this slope is not marked on Figure 16 of the London Borough of Camden 'Guidance for subterranean development' (2010), which indicates slopes of greater than 7 degrees.

There is no evidence of historical slope instability, nor would it be expected based on the topography of the immediate surrounding area.

On this site it is considered unlikely that the proposed basement development will induce slope instability.

Other Issues

The basement development beneath this site would only be considered likely to affect the drainage system of the site itself. However, drainage and sewerage records for the surrounding buildings will need to be referenced, if available, or perhaps surveyed to confirm that the site does not share a communal drainage system that runs beneath the site.

The flow of surface water within the surrounding area, from west to east, should not be changed by the proposed basement on this small site.

As previously described, 'perched' groundwater was recorded within the basal part of the made ground beneath this site at 3.50m below ground level. The proposed 3.50m basement excavation depth therefore does not extend below the 'perched' groundwater level, although foundation excavations for the basement walls may well need to extend slightly below this level to reach the underlying Lynch Hill Gravel. Little or no displacement of groundwater will therefore take place by its exclusion from beneath the area of the proposed basement and footings, so little or no rise would be expected in the level at which groundwater currently stands adjacent to the site.

The orientation of the small proposed basement, when considered together with the adjacent existing basements to the immediate north and south of the site, would be across the likely direction of near surface groundwater flow from west to east on this gently sloping ground. As the proposed 3.50m deep basement does not extend below the recorded 'perched' groundwater level, the drainage path will not be increased.

COMMENTS ON THE CHEMICAL TEST RESULTS

The results of the laboratory chemical testing on the near surface soil samples tested have primarily been compared to soil screening values (SSVs) produced by Land Quality Management Limited (LQM) and the Chartered Institute for Environmental Health (CIEH) presented in their document 'The LQM/CIEH S4ULs for Human Health Risk Assessment: 2015 (Publication Number S4UL3608)'. The LQM/CIEH S4ULs are intended for use in assessing the potential risks posed to human health by contaminants in soil and are transparently-derived and cautious 'trigger values' above which further assessment of the risks or remedial action may be needed. The S4ULs (Suitable for Use Levels) have been derived, in accordance with UK legislation and Environment Agency policy, using a modified version of the Environment Agency CLEA 1.06 software.

Reference has also been given to ATRISKsoil soil screening values produced by Atkins Limited and provided under licence to Ground Engineering Limited. Atkins SSVs have been derived in line with the Environment Agency 2009 guidance using the CLEA 1.04 and 1.06 software. With the absence of a S4UL for cyanide the ATRISKsoil SSV has been used as the soil screening criteria within this report.

In 2014 the Department for Environment Food and Rural Affairs (DEFRA) published, in their document SP1010, Category 4 Screening Levels (C4SL) for several contaminants including lead. The C4SL represent screening levels below which the land could be considered suitable for a specified use and definitely not contaminated land in respect of those determinands. With the absence of S4UL for lead the C4SL has been used as the soil screening criteria within this report.

For each contaminant the adopted soil screening criteria have been calculated for the following land uses:

- Residential use with home grown produce
- Residential use without home grown produce
- Commercial and industrial usage

The intended purpose of the SSVs are as "intervention values" in the regulatory framework for assessment of human health risks in relation to land use. These values are not binding standards, but are intended to inform judgements about the need for action to ensure that a new use of land does not pose any unacceptable risks to the health of the intended users.

Table 5 compares the test results for the made ground with the SSVs in relation to the specified uses. The number of test results, which exceed these values, are also provided.

Table 5: Comparison of Chemical Test Results for Made Ground with Soil Screening Values (SSVs)

Determinand	Number of Samples	Min Value (mg/kg)	Max Value (mg/kg)	Number of Samples Exceeding SSV for:			Measured 95th Percentile (mg/kg)	Soil Screening Criteria SSV (1.0% SOM)			
				Residential with home grown produce	Residential without home grown produce	Commercial / Industrial		Assessment Method	Residential with home grown produce mg/kg	Residential without home grown produce mg/kg	Commercial/ Industrial mg/kg
Organic matter	6	1.6%	4.1%	-	-	-	-	-	-	-	-
Arsenic	6	16	24	0	0	0	22.98	S4UL	37	40	640
Cadmium	6	0.11	0.27	0	0	0	0.21	S4UL	11	85	190
Trivalent* Chromium	6	8.2	35	0	0	0	25.79	S4UL	910	910	8600
Hexavalent Chromium	6	<0.50	<0.50	0	0	0	<0.50	S4UL	6	6	33
Lead	6	140	720	5	5	0	644.19	C4SL	200	310	2330
Mercury	6	0.63	2.0	0	0	0	1.74	S4UL	11	15	320
Selenium	6	<0.20	0.94	0	0	0	0.78	S4UL	250	430	12,000
Nickel	6	9.7	41	0	0	0	28.90	S4UL	130	180	980
Phenols	6	<0.30	<0.30	0	0	0	<0.30	S4UL	120	440	440
Benzo[a]pyrene	6	<0.10	<0.10	0	0	0	<0.10	S4UL	0.79	1.2	15
Copper	6	30	66	0	0	0	58.41	S4UL	2400	7100	68,000
Zinc	6	52	100	0	0	0	86.45	S4UL	3700	40,000	730,000
Free Cyanide	6	<0.50	<0.50	0	0	0	<0.50	ATRISK	34	34	34

Notes

*The concentration of Trivalent Chromium is assumed to be equivalent to the Total Chromium concentration. This is because most naturally occurring chromium is in the trivalent (chromic) state.

S4UL and C4SL for metals were derived using 6% SOM. These values are not sensitive to SOM and would also be applicable for 1% SOM and 2.5% SOM.

LQM/CIEH S4ULs 'Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3608. All rights reserved'.

ATRISKsoil SSVs produced by Atkins Limited and provided under licence to Ground Engineering Limited.

Discussion of Results and Statistics

The results of the laboratory analysis indicate the made ground contains elevated concentrations of lead, which exceeded residential soil screening criteria. The highest recorded concentrations of lead did not exceed its screening value for a commercial/industrial end use. None of the other contaminants tested for exceeded their respective screening values for a residential or commercial/industrial land uses.

Statistical analysis, based on the mean value test, indicates that the US95 value for lead (644.19mg/kg) exceeded its SSV for a residential with home grown produce end use and a residential without home grown produce end use.

The maximum value test for the data indicates that the highest lead values obtained were not statistical outliers, and so are representative of the sample population.

The results indicate that the made ground beneath the site would be unsuitable for retention at the surface in a residential setting due to the presence of statistically elevated concentrations of lead within the made ground.

Visual evidence of ACM was not recorded during this investigation, during sample preparation in the laboratory, and during screening in the laboratory by a qualified chemist.

Visual and olfactory evidence of hydrocarbon impacted soils was not detected within the soils beneath this site during the investigation. The three TPH results and the TPH result within the WAC test ranged were all <10mg/kg. This confirms that the soils tested beneath this site have not been impacted by hydrocarbons.

GROUNDWATER TEST RESULTS

A sample of water recovered from the BH 1 standpipe was analysed in the laboratory for a suite of common inorganic and organic potential contaminants primarily for characterisation purposes, and speciated TPH. The primary assessment tool employed for the generic screening of samples for the protection of 'Controlled Waters' consists of the Statutory Instrument 2000 No.3184 'The Water Supply (Water Quality) Regulations 2000'. This amends the 1991 version, which provides a standard of 10μg/l for dissolved or emulsified hydrocarbons represented by TPH in the laboratory analysis. There is no amendment indicated in Statutory Instrument 2000 No.3184 and so in the absence of an amendment or update we refer to the 1991 standard, which is generally accepted.

The results are presented in Appendix 3 and fractions of test results that exceed these levels are summarised below in Table 6.

Table 6: Comparison of Chemical Test Results with Water Supply Regulations

Determinand	Value detected in sample	The Water Supply (Water Quality) Regulations Maximum Concentration/Value for Consumers Taps	Fraction of samples Exceeding Water Supply Regulation
Arsenic (total) μg/l	1.6	10 μg/l	**0/1**
Boron (Water Soluble) μg/l	350	1000 μg/l	**0/1**
Cadmium (total) μg/l	<0.080	5.0 μg/l	**0/1**
Chromium (total) μg/l	5.4	50 μg/l	**0/1**
Copper (total) μg/l	4.9	2000 μg/l	**0/1**
Cyanide (total) mg/l	<0.050	0.05 mg/l	**0/1**
Lead (total) μg/l	<1.0	10 μg/l	**0/1**
Mercury (total) μg/l	0.72	1.0 μg/l	**0/1**
Nickel (total) μg/l	9.1	20 μg/l	**0/1**
pH value	7.7	6.5 (minimum) 10.0 (maximum)	**0/1**
Phenols mg/l	<0.030	0.0005 mg/l	**-/1**
Selenium (total) μg/l	3.8	10 μg/l	**0/1**
Sulphate (soluble) mg/l	250	250 mg/l	**0/1**
Sulphide mg/l	<0.050	No limit	**0/1**
Zinc (total) μg/l	11	5000 μg/l	**0/1**
PAHs μg/l	<0.20	0.10 μg/l	**-/1**
Benzo[a}pyrene μg/l	<0.010	0.010 μg/l	**0/1**
TPH μg/l	<10	10 μg/l	**0/1**

With regard to the water quality recorded, none of the levels of the elements and compounds tested for exceeded standard drinking water thresholds within the sample of water recovered from the standpipe installed in BH 1, including TPH.

SOIL GAS MONITORING RESULTS

The three return visits to site in December 2017 recorded concentrations of landfill type gases (methane, carbon dioxide and oxygen) in the BH 1 standpipe. The results are presented to the rear of the exploratory hole records. The recorded concentrations of methane were all less than 0.1%. The carbon dioxide levels ranged between <0.1% and 0.3%. The recorded oxygen concentrations within the standpipes were comparable to atmospheric conditions. The in-situ measurement confirmed a negligible gas emission rate with a recorded flow rate of <0.1l/hr in all instances.

Assuming a positive flow rate of 0.1l/hr, the results give a Gas Screening Value (GSV) of 0.0003l/hr. This GSV falls within Characteristic Situation 1 as defined by BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

UPDATED CONCEPTUAL MODEL

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research and the intrusive ground investigation documented in the preceding sections of this report.

A generalised conceptual model, updated following the intrusive works, monitoring and testing, and targeted to provide coverage across the site, relative to the construction phase and completed development, is presented below in Table 7.

Table 7: Updated Conceptual Model Relative to Construction and Future Development

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources			
		Drainage/ Buildings	Soil Beneath Site	Soil Gas	Ground Contamination Outside Site Boundary
Human Health – ground workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Moderate	Moderate	Very Low	Very Low
Human Health – users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	N/A	Very Low	Very Low	Very Low
Water Environment	Migration through ground into surface water or groundwater	N/A	Very Low	Very Low	Very Low
Flora	Vegetation on site growing on contaminated soil.	N/A	Very Low	Very Low	Very Low
Building Materials	Contact with contaminated soil	N/A	Very Low	Very Low	Very Low

Key to Table 7

RISK	Definition
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or, there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) and remedial works may be necessary in the short term and likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.
N/A	Not Applicable because the proposed development will remove the source.

COMMENTS ON GROUND CONTAMINATION IN RELATION TO PROPOSED DEVELOPMENT

The proposed residential redevelopment will include the remodelling of the mews dwelling and the construction of a basement under its whole footprint. Anticipated exposure scenarios relating to the site and future redevelopment works including remedial options as applicable are discussed as follows.

This investigation may not have revealed the full extent of contamination on the site and appropriate professional advice should be sought if subsequent site works reveal materials that may appear to be contaminated.

Contaminated Soil

The exploratory holes found about 3.70m of made ground beneath the site. The made ground contained statistically elevated concentrations of lead, which exceeded soil screening values for residential end uses. None of the other contaminants tested for statistically exceeded their respective screening values for a residential or commercial/industrial land use.

Existing Drainage/Buildings

Redundant foul or surface water drain runs, should be removed from beneath the site and precautions should ensure that any remaining effluent is directly disposed off-site. The integrity of existing drainage should be checked, and where they are to be retained, any damaged sections should be replaced prior to development. The latter measures should remove any future risk to human health and to the water environment.

The existing building may have asbestos containing materials within it. Suitable precautions, in line with current best practice, should be put in place to protect workers from the effects of asbestos material, during the remodelling/construction phase.

Human Health - Construction Workers

The presence of lead contamination within the made ground soils beneath the site indicates that there is a moderate risk that a pathway could develop affecting groundworkers during the construction phase of development.

However, no special precautions would be required during the development of the site by workers who may come into contact with the soil during groundworks, providing standard precautions are adopted which should generally include the procedures given by the Health and Safety Executive (The Blue Book) HS(G)66.

For the protection of workers during groundworks the following is recommended:

a) Limit repeated or prolonged skin contact with soils by wearing gloves with sleeves rolled down.

b) Washing facilities should be made available to groundworkers, so as to minimise the potential for inadvertent ingestion of soil.

c) If any soils are revealed which are different to those encountered by this ground investigation, the advice of a specialist should be sought in view of classifying the material and ascertaining its risk to groundworkers.

d) Dust suppression measures such as 'damping down', could also be adopted to prevent the spread of soil contaminants.

Human Health - Users of Completed Development

The risk of the encountered ground contamination affecting the site users when present beneath buildings and permanent areas of hardstanding would be considered to be very low. This is because it would be highly unlikely that the general site users would normally be able to penetrate the basement walls and floors, which would be necessary for them to uncover any contaminated soils beneath the site, and after taking into account that the made ground beneath the site will be largely removed during basement excavation.

Effects on Services

Consideration should be given to upgrading service materials, particularly for water supply pipes, where they will be in contact with made ground containing elevated concentrations of lead, or ensure that the made ground is not used as a backfill around such water supply pipes. Further guidance on the selection of materials for use as water supply pipes should be sought from the local water supplier.

Soil Gas

According to database information, there are no active landfills within influencing distance of the site and although up to 3.70m of made ground and a localised Alluvium (or Pond Deposit) was encountered these soils were not found to include a significant amount of organic or putrescible material.

The gas monitoring has determined that a Characteristic Situation 1 would apply and that no special precautions are required to protect the proposed development from ingress of soil gases.

The site lies within an area where radon protection measures are not required for new dwellings in accordance with BR211.

Water Environment

Groundwater was found to lie within the base of the made ground at about 3.50m below ground level. The site and immediate surrounding area are devoid of water courses, surface water features and source protection zones.

The groundwater was tested the site was tested and found to have no elevated concentrations of contaminants when compared to drinking water standards. There was no evidence that the groundwater has been historically impacted by hydrocarbons associated with the vehicle repair garage and basement car park on the adjacent sites to the north and south, respectively. The results are considered to reflect the quality of the near surface groundwater beneath the site.

It is consequently considered unlikely that the proposed redevelopment, including the installation of foundations, would impact the quality of the water environment.

Off-Site Disposal of Soil Arisings

The results of chemical analysis are provided in Appendix 3 and can be used for the basic characterisation of the soil destined for landfill. The Environment Agency publication Hazardous Waste, Technical Guidance WM2 outlines the methodology for classifying wastes and should be referenced for guidance. The test results (total metals, hydrocarbons and cyanide) should be compared to the relevant thresholds to determine whether they fall into the primary categories of non-hazardous waste or hazardous waste and will help indicate the likely European Waste Catalogue (EWC) code, which is determined by the waste type. The results of Waste Acceptance Criteria (WAC) leachate testing should be used to check whether if categorised as non-hazardous waste it could be disposed of at an inert waste landfill; or if categorised as hazardous waste whether it could qualify as stable non-reactive hazardous waste for disposal in non-hazardous landfill.

Excavated material and excess spoil should always be classified prior to removal from site as required by 'Duty of Care' (Environmental Protection Act, 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal. Basic characterisation is the responsibility of the waste producer and compliance checking and on-site verification are generally the responsibility of the landfill operator. The landfill operator will need to liaise with the waste producer as the approach relies on the information from basic characterisation.

It is expected that clean arisings from excavations into the natural soils across this site would also fall into the inert category under the European Waste Catalogue description 'Soil and Stones', EWC code 17 05 04 with restrictions excluding topsoil and peat.

CONTAMINATION ASSESSMENT CONCLUSIONS

The proposed residential redevelopment will include the remodelling of the dwelling and the construction of a basement under the whole footprint of the mews house. The existing site is detailed on the site plan at the rear of this report. The proposed site layout will need to be provided by the Engineer in due course to satisfy planning conditions. As the basement will occupy the entire footprint of the site there will be no gardens or landscaping included within the proposed redevelopment.

Remediation Statement

Remediation of the soils beneath the site, in respect of the redevelopment, is not considered necessary, as the proposed basement floors and walls will prevent contact between any contaminated ground and the site end users.

GROUND ENGINEERING LIMITED

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B.Sc.(Hons.), M.Sc.,
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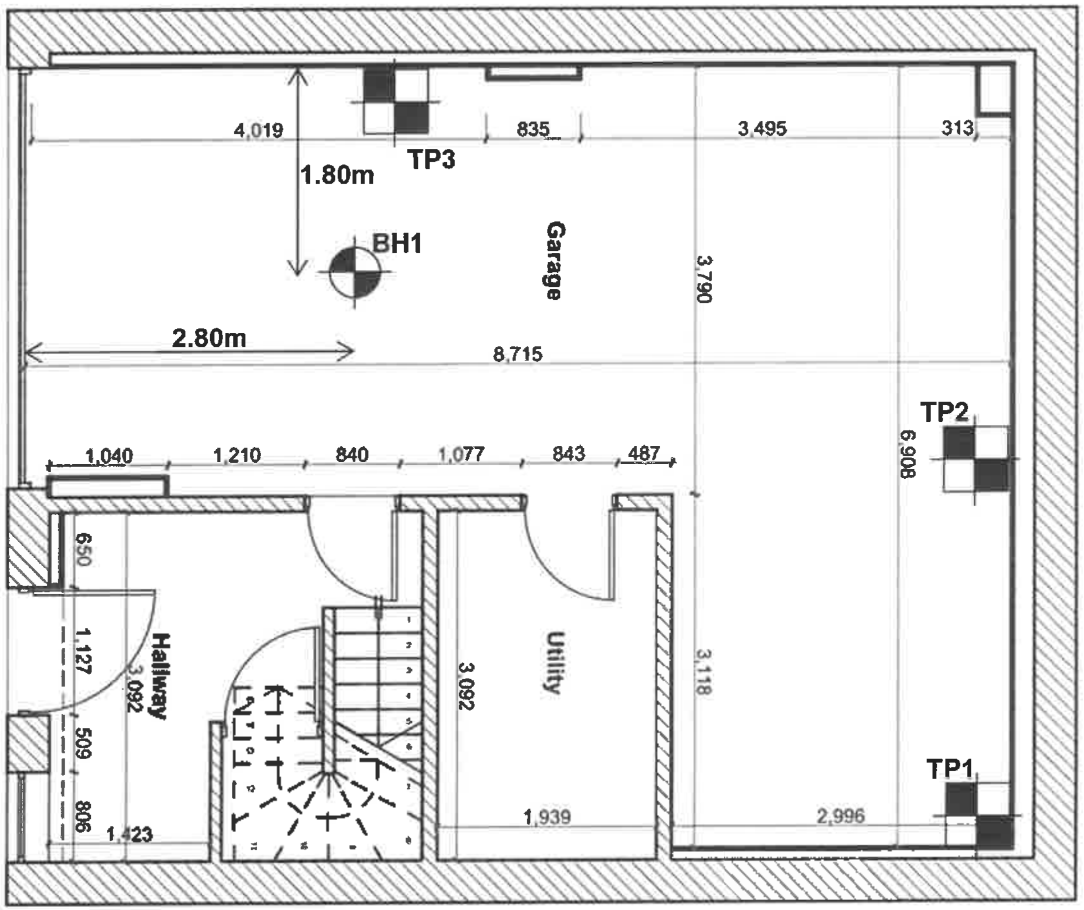
Senior Geotechnical Engineer

Site Plan
(Taken from Engineer's Drawing)

John's Mews



Not to Scale

Project : 27 John's Mews, London WC1

Client : Brendan O'Toole

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Peterborough Tel: 01733 566566

Project No.
C14337

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Site: 27 JOHN'S MEWS, LONDON WC1

BOREHOLE BH1

Date: 23/11/17 to 24/11/17

Hole Size: 150mm dia to 20.00m

Ground Level:

Depth m	Type	Blows	(Date) Casing	Description of Strata	Depth m	O.D. Level m
0.20-0.30	B1			MADE GROUND - CONCRETE floor slab.	0.20	
0.30-0.45	B2			MADE GROUND - Brown, slightly clayey SAND AND GRAVEL with occasional brick cobbles. Gravel of brick, concrete, slate and ash.	0.45	
0.85-1.20	B3			MADE GROUND - Red brown, sandy GRAVEL AND COBBLES of brick.	0.85	
				MADE GROUND - Brown, slightly clayey SAND AND GRAVEL with occasional brick cobbles. Gravel of brick, concrete, slate and ash.	1.20	
1.20-1.70	B4			MADE GROUND - Soft, brown and dark grey brown mottled, slightly gravelly, sandy, silty CLAY with occasional brick cobbles. Gravel of brick, concrete, mortar, ash and flint.		
1.35-1.65	C	N4				
2.00-2.50	B5				2.00	
2.15-2.45	C	N2	2.00	MADE GROUND - Very loose, brown, slightly clayey SAND AND GRAVEL with occasional brick cobbles. Gravel of brick, concrete, ash, mortar and slate.	2.50	
2.50-3.00	B6			MADE GROUND - Soft, brown and dark grey mottled, slightly gravelly, sandy, silty CLAY with occasional brick cobbles. Gravel of brick, concrete, flint, ash, mortar and slate. Becoming dark brown below 3.50m depth.		
3.10-3.50	B7					
3.25-3.55	C	N6	3.10			
3.50-3.75	B8					
3.75-4.00	B9				3.75	
4.00-4.50	B10			Very dense, light brown, slightly silty, very sandy GRAVEL. Gravel of angular to rounded flint and occasional quartzite.		
4.15-4.41	C	50*	4.00	(LYNCH HILL GRAVEL)		
4.80-5.30	B11					
4.95-5.25	C	N56	4.80		5.20	
5.30-5.80	B12			Firm, brown and orange brown mottled, slightly sandy, slightly gravelly CLAY. Gravel of angular to rounded flint. (REWORKED LONDON CLAY)	5.50	
5.30	W1			Firm, closely fissured, grey brown CLAY with occasional silt partings.		
5.80-6.00	U1	38	5.70			
6.00	D1					
6.70-7.15	U2	40	5.70	(LONDON CLAY)		
7.15	D2					
7.50-7.95	U3	40	6.00			
7.95	D3				8.00	
8.00	W2			Stiff, fissured, grey brown, silty CLAY with occasional silt partings.		
8.00	D4					
9.00-9.45	U4	50	6.00			
9.40	D5			(LONDON CLAY)		
10.00	D6				10.00	

Inst.: BENEATH INSTALLATION (below 7.00m)

REMARKS
1. Floor slab cored using diamond drilling equipment
2. Excavating a pit from 0.20m to 1.20m for 1 hour
3. Water added from 3.75m to 5.00m
4. Borehole cased to 6.00m depth
5. Gas monitoring standpipe installed to 7.00m depth

Project No 14337

Scale 1:50

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KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▽c Level on completion
c▽w Level casing withdrawn
▽s Standpipe Level

Groundwater Strikes

No	Depth m Struck	Rose to	Rate	Cased	Sealed
1	5.00	4.80	slow	5.00	5.60

Groundwater Observations

Date	Hole	Casing	Water
23/11/17	8.00	5.70	dry
24/11/17	8.00	5.70	6.50
24/11/17	20.00	6.00	damp
04/12/17	7.00		3.60
11/12/17	7.00		3.46

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Site: 27 JOHN'S MEWS, LONDON WC1

BOREHOLE BH1

Date: 23/11/17 to 24/11/17

Hole Size: 150mm dia to 20.00m

Ground Level:

Samples and in-situ Tests: Depth m	Type	Blows	(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
				BENEATH INSTALLATION	Stiff, closely fissured, grey brown, silty CLAY with occasional silt partings and rare gravel size pyrite nodules.		10.00	
10.50-10.95	U5	60	6.00	BENEATH INSTALLATION				
10.95	D7			BENEATH INSTALLATION				
11.50	D8			BENEATH INSTALLATION				
12.00-12.45	U6	50	6.00	BENEATH INSTALLATION				
12.45	D9			BENEATH INSTALLATION				
13.00	D10			BENEATH INSTALLATION				
13.50-13.95	U7	60	6.00	BENEATH INSTALLATION				
13.95	D11			BENEATH INSTALLATION				
14.50	D12			BENEATH INSTALLATION	(LONDON CLAY)			
15.00-15.45	U8	65	6.00	BENEATH INSTALLATION				
15.45	D13			BENEATH INSTALLATION				
16.00	D14			BENEATH INSTALLATION				
16.50-16.95	U9	70	6.00	BENEATH INSTALLATION				
16.95	D15			BENEATH INSTALLATION	Becoming slightly sandy below 17.00m depth.			
17.50	D16			BENEATH INSTALLATION				
18.00-18.45	U10	70	6.00	BENEATH INSTALLATION				
18.45	D17			BENEATH INSTALLATION				
19.20	D18			BENEATH INSTALLATION			19.20	
					Very stiff, grey, shelly CLAY. (LAMBETH GROUP)		19.50	
19.50-19.95	U11	80	6.00	BENEATH INSTALLATION	Very stiff, red brown and light blue grey mottled CLAY. (LAMBETH GROUP)			
20.00	D19			BENEATH INSTALLATION			20.00	

REMARKS

Borehole completed at 20.00m depth

Project No 14337

Scale 1:50

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KEY
D - Disturbed Sample
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U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/*- SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes

No	Struck	Rose to	Rate	Cased	Sealed

Groundwater Observations

Date	Hole	Casing	Water
19/12/17	7.00		3.56

Borehole Number	Depth (m)	Casing Depth (m)	Depth to Water (m)	Type of Test *	Seating Drive Blows/ Penetration (mm)	Test Drive: 300mm Blows for each successive 75 mm Penetration				N Value	Extra-polated Value
BH1	1.20 - 1.65			C	2/150	1	1	1	1	4	
	2.00 - 2.45	2.00		C	1/150	1	0	1	0	2	
	3.10 - 3.55	3.10		C	1/150	1	1	1	3	6	
	4.00 - 4.41	4.00	3.90	C	12/150	11	15	17	7/30		59
	4.80 - 5.25	4.80	4.80	C	22/150	15	22	10	9	56	

* C denotes test using a solid cone
S denotes test using a split barrel sampler

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Results of Standard/Cone Penetration Tests

14337
Table No

27 JOHN'S MEWS, LONDON WC1

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Site: 27 JOHN'S MEWS, LONDON WC1

TRIAL PIT TP1

Date: 23/11/17 to 24/11/17

Pit Size: 1.00m L x 0.60m W x 4.30m D.

Ground Level:

Depth m	Type	Result	(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
				MADE GROUND - CONCRETE floor slab.		0.20	
0.30	D1			MADE GROUND - Dark brown, clayey SAND AND GRAVEL with occasional brick cobbles. Gravel of brick, flint, mortar, concrete, pottery fragments and ash.			
0.60	D2						
0.80	D3						
1.10	D4						
1.50	D5						
1.80	D6						
2.10	D7					2.20	
2.40	V1	(51)		MADE GROUND - Firm, brown, slightly sandy, gravelly CLAY. Gravel of flint, brick, ash and mortar.			
2.50	D8						
2.80	D9						
2.90	V2	(59)					
3.00	D10						
3.30	D11						
3.40	V3	(65)					
3.50	D12						
3.60	D13					3.70	
3.80	D14			Firm, brown, orange brown and grey mottled, slightly sandy, silty CLAY with a faint organic odour, occasional fine and medium gravel size ferruginous concretions, and rare angular flint gravel. (ALLUVIUM)			
3.80	V4	(75)					
4.05	D15		1 ▽				
4.10	V5	(73)					
4.20	D16					4.20	
4.30	D17			Orange brown SAND AND GRAVEL. Gravel of angular to sub-angular flint. (LYNCH HILL GRAVEL)		4.30	
4.30-4.38	MP1	100		Pit completed at 4.30m depth			

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
R - Root Sample
W - Water Sample
ES - Environmental Sample
▽ Water Strike
▼ Water Rise
▼c Level on completion
MP - Mackintosh Probe
P( ) - Hand Penetrometer Cohesion ( ) kPa
V - Vane Shear Test Cohesion ( ) kPa

REMARKS
1. No live roots observed
2. Groundwater seepage at 4.00m depth
3. Pit sides stable

Project No 14337

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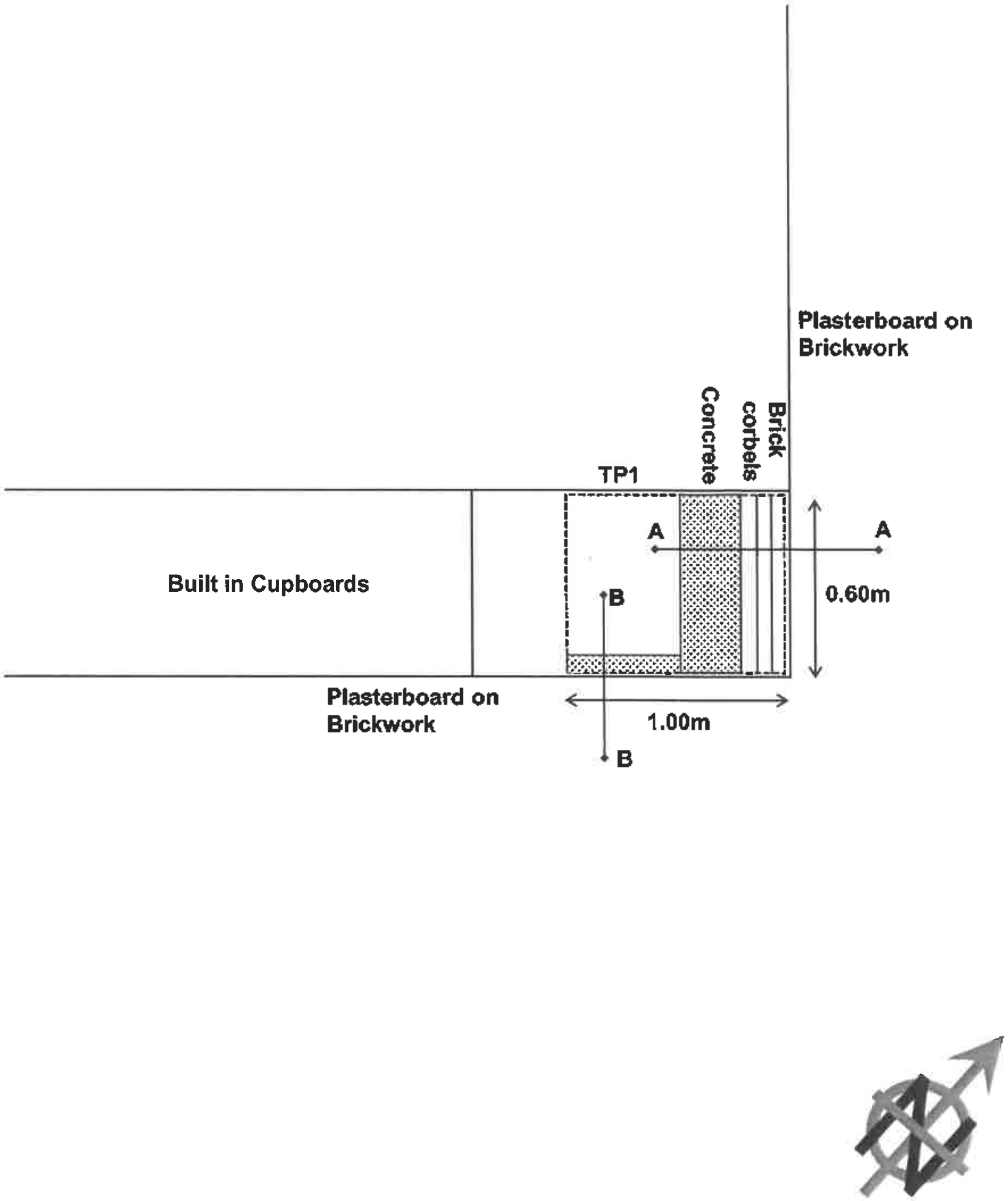
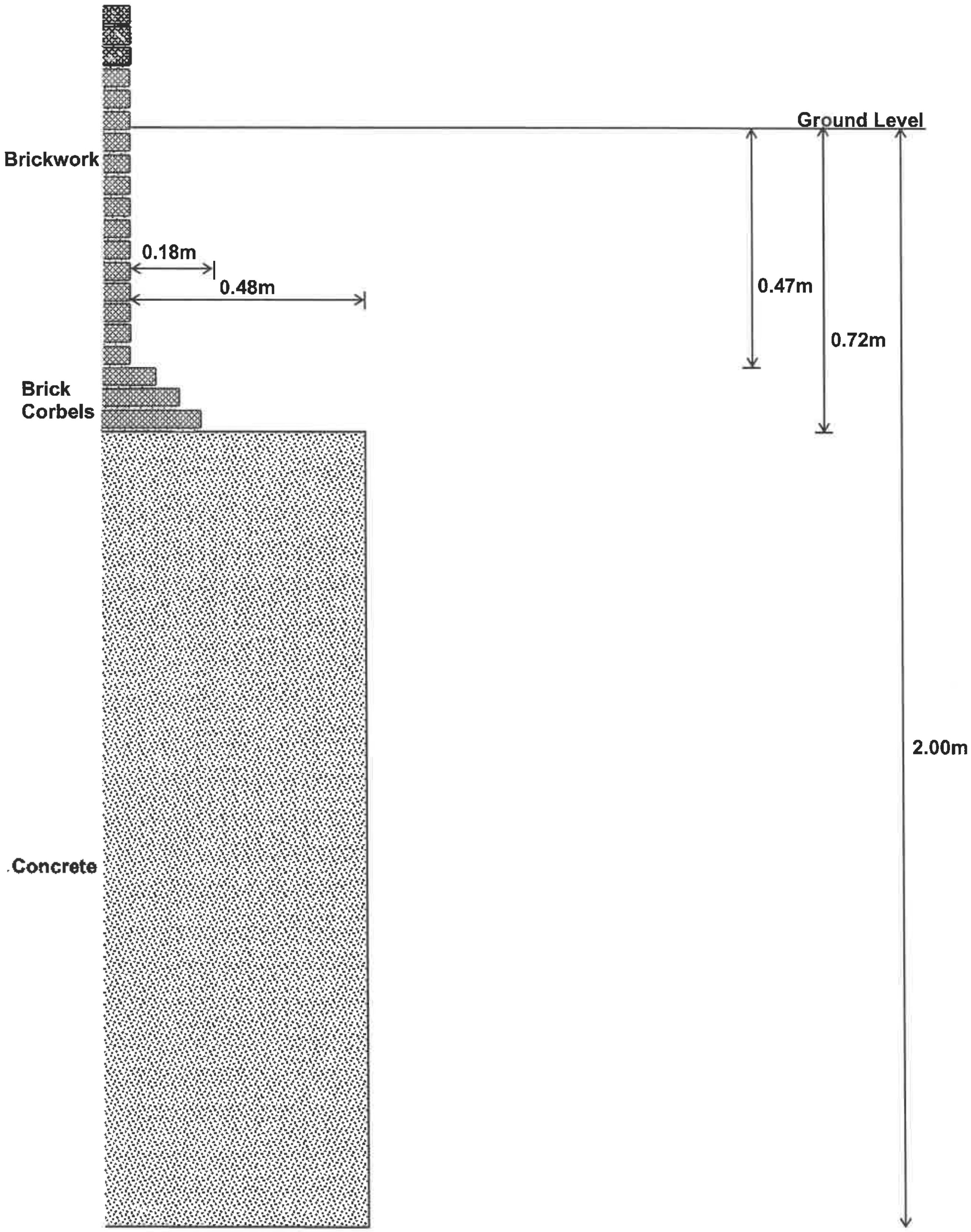
Trial Pit TP1
Plan View



Not To Scale

Project : 27 John's Mews, London WC1 **Client : Brendan O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No. C14337**

Trial Pit TP1
Cross Section A-A



Not To Scale

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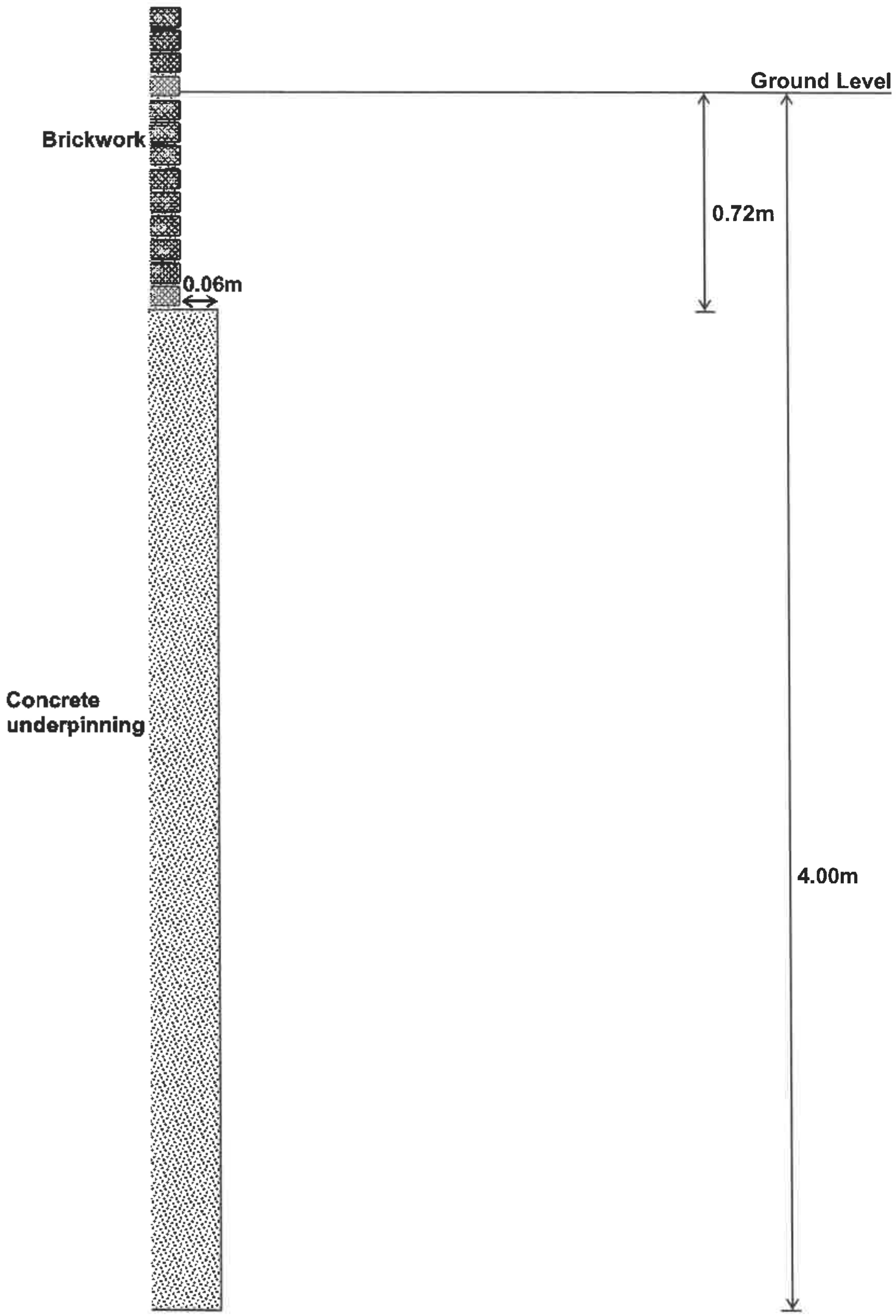
Trial Pit TP1
Cross Section B-B



Not To Scale

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Trial Pit TP1
Photographs

Project : 27 John's Mews, London WC1 **Client : Brendan O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

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www.groundengineering.co.uk

Site: 27 JOHN'S MEWS, LONDON WC1

TRIAL PIT TP2

Date: 23/11/17 to 24/11/17

Pit Size: 0.70m L x 0.40m W x 2.10m D.

Ground Level:

Samples and in-situ Tests Depth m	Type	Result	(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
				MADE GROUND - CONCRETE floor slab.		0.20	
0.30	D1			MADE GROUND - Dark brown and brown, clayey SAND AND GRAVEL with occasional brick and concrete cobbles. Gravel of brick, concrete, slate, pottery fragments and mortar.			
0.60	D2						
0.90	D3						
1.20	D4						
1.50	D5						
1.80	D6						
1.85-2.11	MP1	100					
2.10	D7					2.10	
				Pit completed at 2.10m depth			

KEY
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS
1. No live roots observed
2. Pit dry
3. Pit sides stable

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Scale	Page
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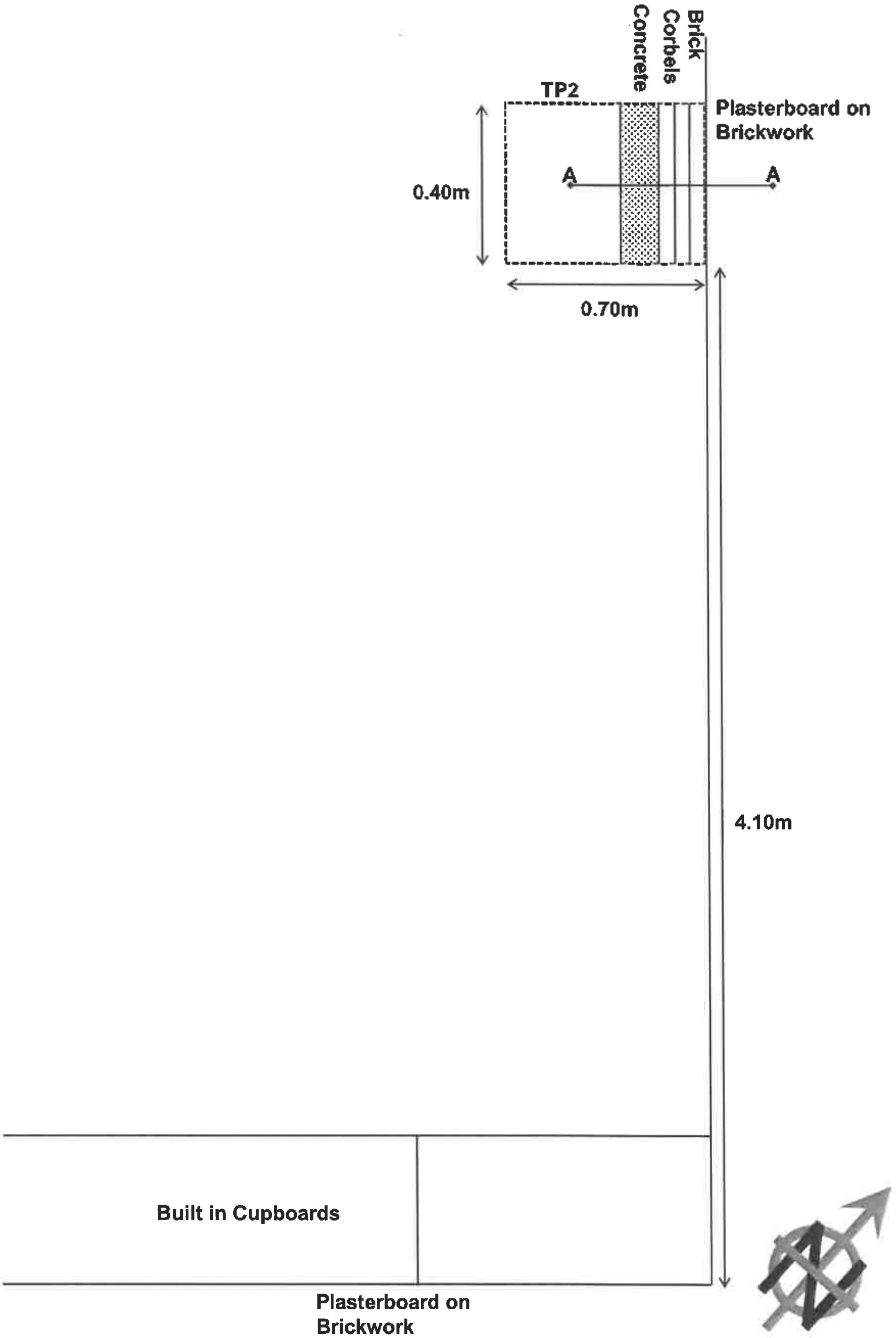
Trial Pit TP2
Plan View



Not To Scale

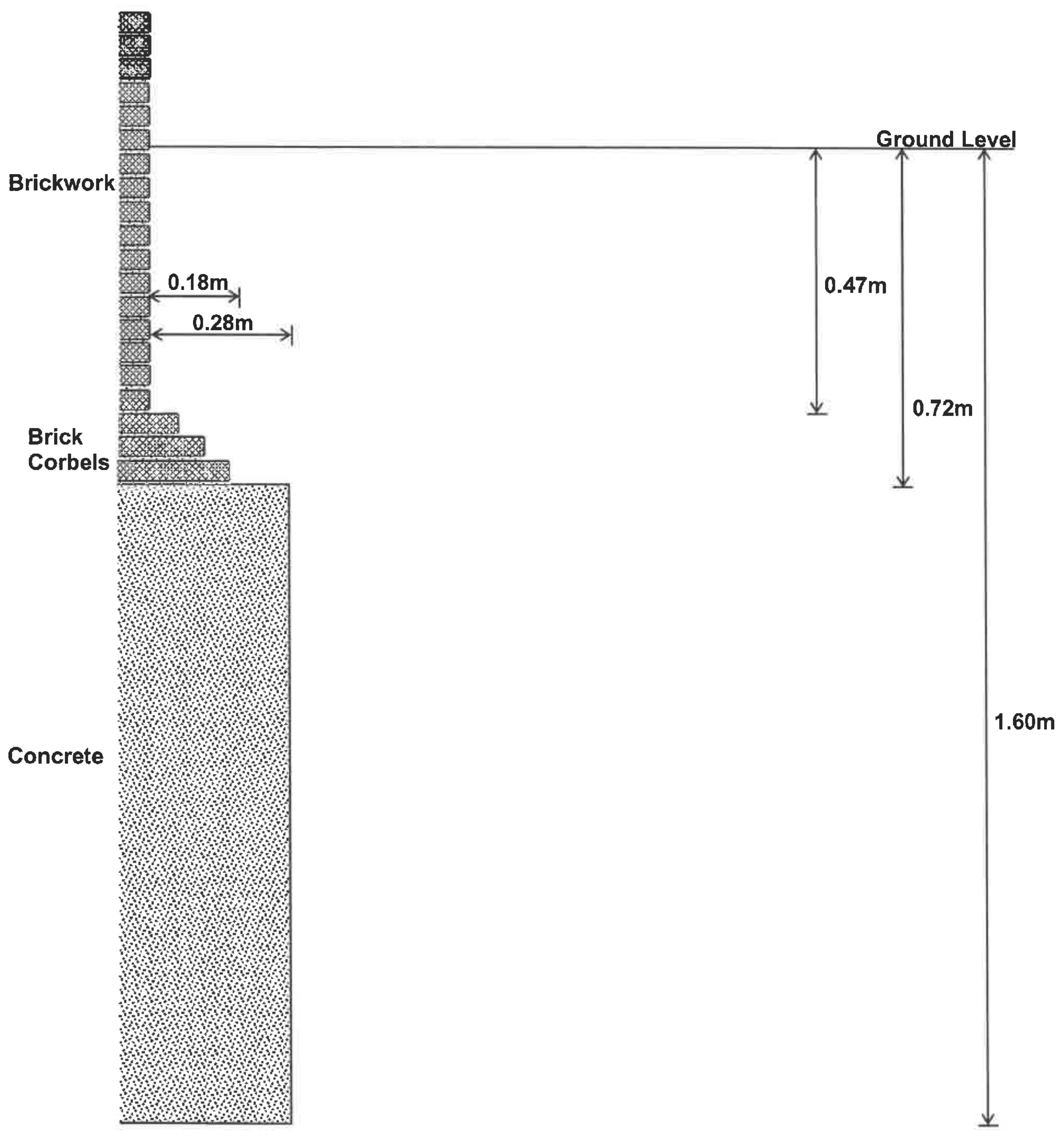
Project : 27 John's Mews, London WC1

Client : Brendan O'Toole

GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No. C14337

Trial Pit TP2
Cross Section A-A



Not To Scale

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Trial Pit TP2
Photograph

Project : 27 John's Mews, London WC1 Client : Brendan O'Toole	GROUND ENGINEERING LIMITED Peterborough Tel : 01733 566566	Project No. C14337

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Site: 27 JOHN'S MEWS, LONDON WC1		TRIAL PIT TP3
Date: 24/11/17	Pit Size: 0.65m L x 0.40m W x 2.40m D.	Ground Level:

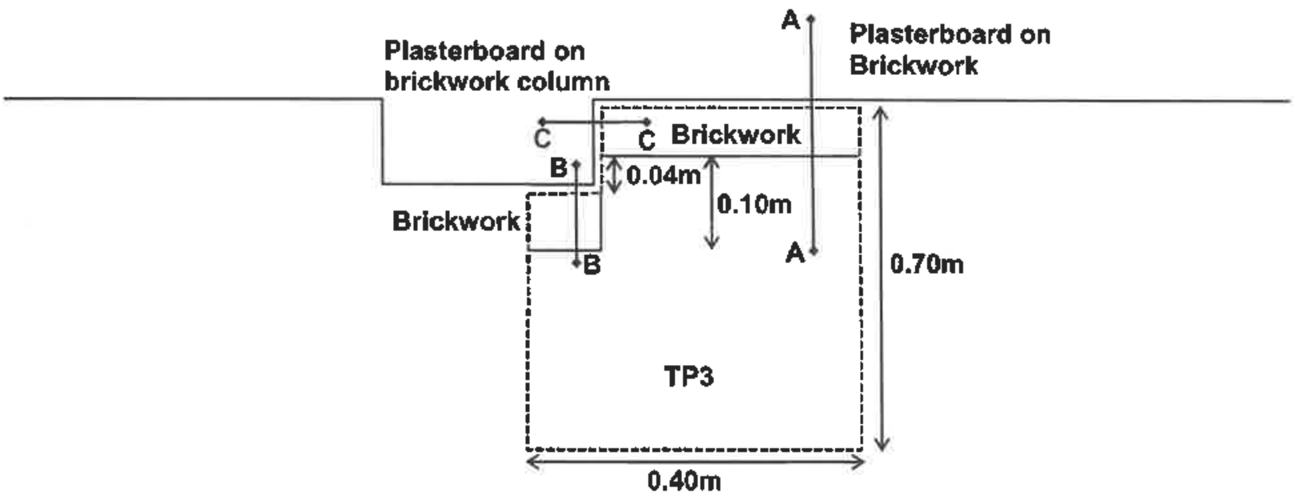
Samples and in-situ Tests: Depth m	Type	Result	(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
				MADE GROUND - CONCRETE floor slab.		0.20	
0.30	D1			MADE GROUND - Red brown, slightly sandy GRAVEL. Gravel of brick.		0.50	
0.60	D2			MADE GROUND - Brown, clayey SAND AND GRAVEL with occasional brick and concrete cobbles. Gravel of brick, concrete, ash, flint, bone fragments, glass, slate and pottery.			
0.90	D3						
1.20	D4						
1.50	D5						
1.80	D6						
2.10	D7						
2.40	D8					2.40	
				Pit completed at 2.40m depth			

KEY
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS
1. No live roots observed
2. Pit dry
3. Pit sides stable

Project No	
14337	
Scale	Page
1:25	1/1

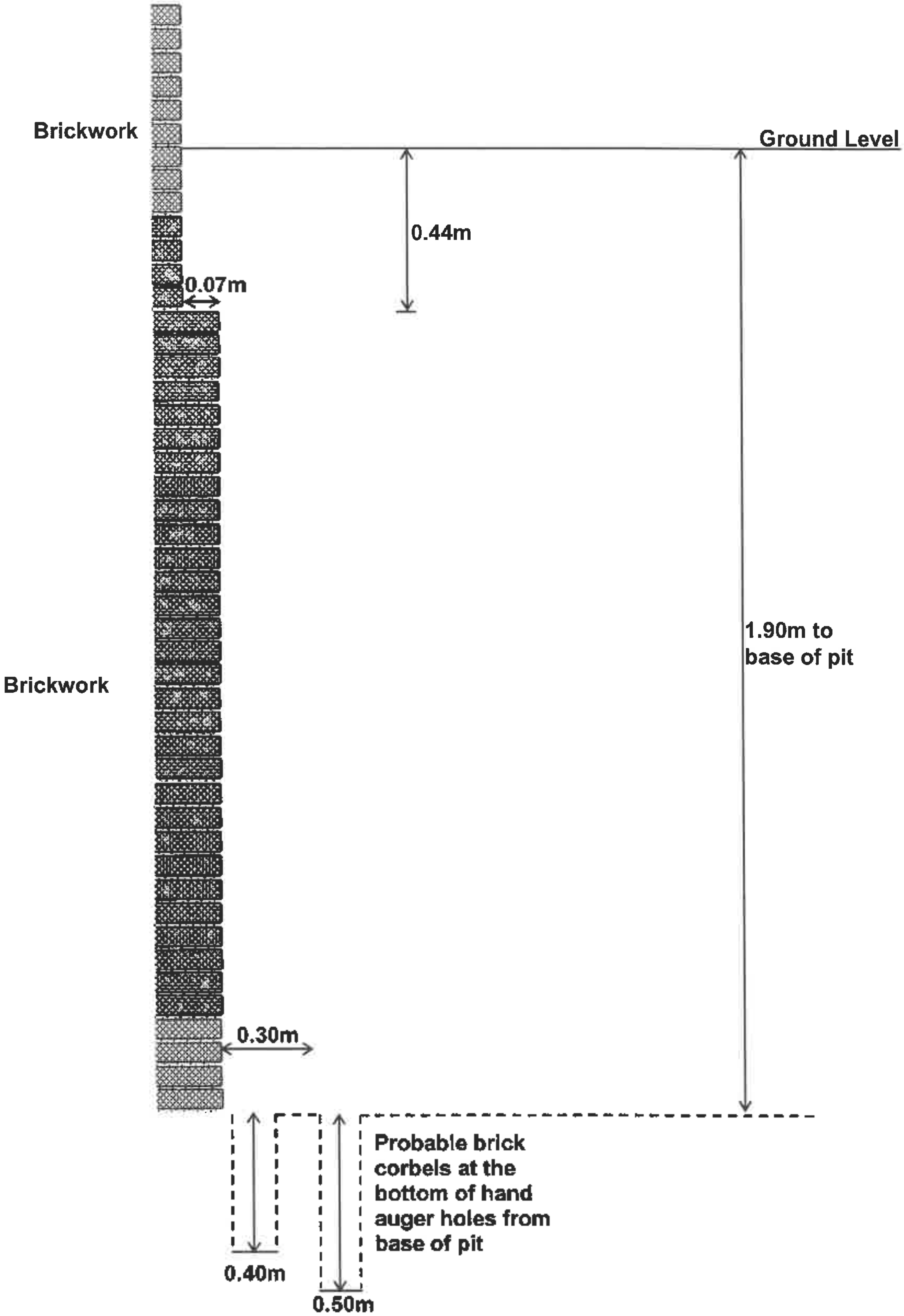
Trial Pit TP3
Plan View



Not To Scale

Project : 27 John's Mews, London WC1 **Client : Brendan O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No. C14337**

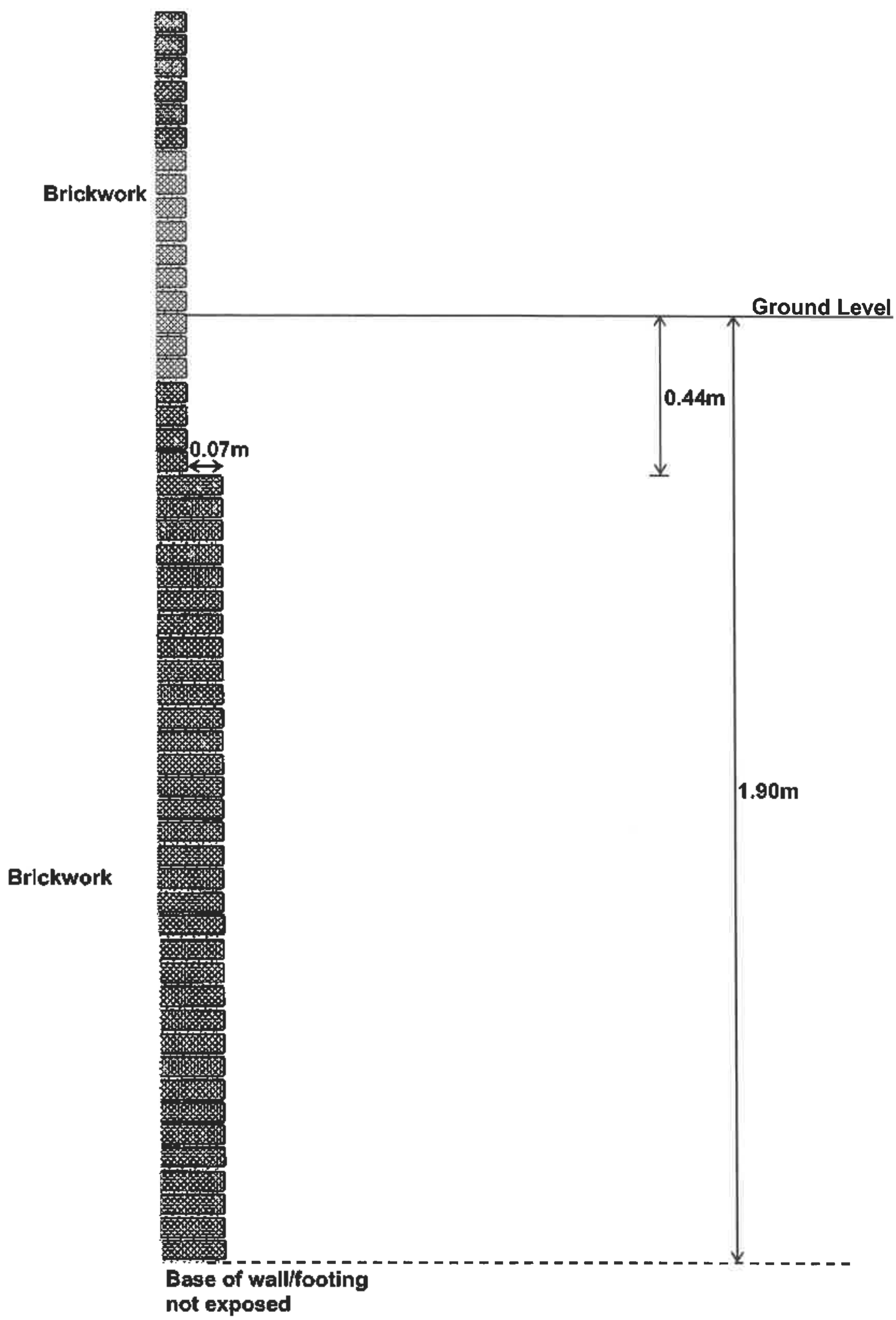
Trial Pit TP3
Cross Section A-A



Not To Scale

Project : 27 John's Mews, London WC1 **Client : Brendan O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

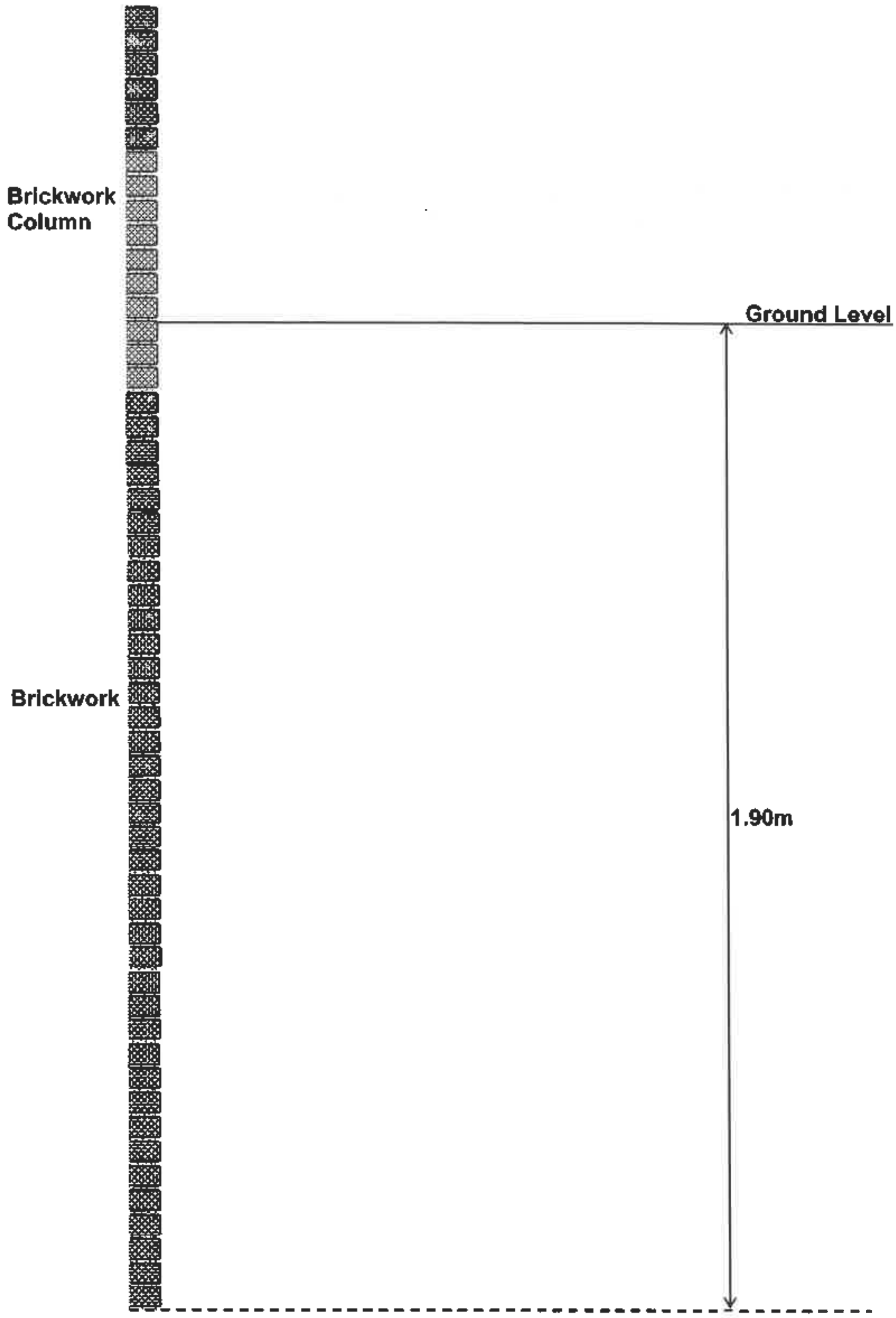
Trial Pit TP3
Cross Section B-B



Not To Scale

Project : 27 John's Mews, London WC1 **Client : Brendan O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Trial Pit TP3
Cross Section B-B



Not To Scale

Project : 27 John's Mews, London WC1 **Client : Brendan O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Trial Pit TP3
Photograph

Project : 27 John's Mews, London WC1 Client : Brendan O'Toole	GROUND ENGINEERING LIMITED Peterborough Tel : 01733 566566	Project No. C14337

Groundwater/Gas Monitoring Record **GROUND ENGINEERING LIMITED**

Site: **27 John's Mews, London WC1**

Report Ref: C14337

Date	Borehole	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Flow Rate (l/hr)	Atmosph. Pressure (mb)	Depth of Well (m)	Depth to Groundwater (m)	Comments
		Peak	Steady	Peak	Steady	Min.	Max.					
04/12/17	BH 1	<0.1	<0.1	<0.1	<0.1	20.4	20.4	<0.1	1033	7.00	3.60	
11/12/17	BH 1	<0.1	<0.1	0.2	0.2	20.2	20.2	<0.1	981	7.00	3.46	
19/12/17	BH 1	<0.1	<0.1	0.3	0.3	20.3	20.3	<0.1	1032	7.00	3.56	

Equipment: GasLog GFM 430, 50m tape dipmeter.

LABORATORY TEST RESULTS

CONTRACT 27 JOHN'S MEWS, LONDON WC1

Bore-hole	Sample	Depth m	Classification: Liquid Limit %	Classification: Plastic Limit %	Classification: Plasticity Index %	Classification: Moisture Content %	Density: Bulk Mg/m^3	Density: Dry Mg/m^3	Triaxial Compression: Type	Triaxial Compression: Principal Stress Difference kPa	Triaxial Compression: Cell Pressure kPa	Triaxial Compression: Shear Strength kPa	Triaxial Compression: Angle of Shear Resistance degrees	Sulphates (SO_4) Soil: Total % Dry Wt.	Sulphates (SO_4) Soil: Aqueous Extract mg/l	Sulphates (SO_4) Water: mg/l	Sulphates (SO_4): pH	Remarks
BH1	B4	1.20 - 1.70													1029		9.6	
	B6	2.50 - 3.00													198		8.5	
	B8	3.50 - 3.75													189		7.7	
	W1	5.30														58	7.6	
	U1	5.80 - 6.00				32	1.92	1.46	Q	105	120	52	0					
	U2	6.70 - 7.15				36	1.90	1.40	Q	94	140	47	0					
	U3	7.50 - 7.95				30	1.96	1.51	Q	114	160	57	0		437		8.2	
	U4	9.00 - 9.45				32	1.86	1.42	Q	143	190	71	0					
	U5	10.50 - 10.95				30	2.01	1.54	Q	270	220	135	0					
	U6	12.00 - 12.45				29	1.98	1.53	Q	186	250	93	0		383		8.4	
	U7	13.50 - 13.95				25	2.02	1.61	Q	257	280	128	0					

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

14337

GROUND ENGINEERING LIMITED
Tel: 01733-566566
www.groundengineering.co.uk

LABORATORY TEST RESULTS

CONTRACT 27 JOHN'S MEWS, LONDON WC1

Bore-hole	Sample	Depth m	Classification: Liquid Limit %	Classification: Plastic Limit %	Classification: Plasticity Index %	Classification: Moisture Content %	Density: Bulk Mg/m^3	Density: Dry Mg/m^3	Triaxial Compression: Type	Triaxial Compression: Principal Stress Difference kPa	Triaxial Compression: Cell Pressure kPa	Triaxial Compression: Shear Strength kPa	Triaxial Compression: Angle of Shear Resistance degrees	Sulphates (SO_4): Soil Total % Dry Wt.	Sulphates (SO_4): Soil Aqueous Extract mg/l	Sulphates (SO_4): Water mg/l	pH	Remarks
BH1	U8	15.00 - 15.45				25	2.04	1.63	Q	274	310	137	0					
	U9	16.50 - 16.95				21	2.04	1.68	Q	235	340	118	0					
	U10	18.00 - 18.45				25	2.05	1.65	Q	234	370	117	0					
	U11	19.50 - 19.95				23	2.03	1.65	Q	378	400	189	0					

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

14337

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L I M I T E D
Tel: 01733-566566
www.groundengineering.co.uk

LABORATORY TEST RESULTS

CONTRACT 27 JOHN'S MEWS, LONDON WC1

Trial-pit	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil Total % Dry Wt.	Soil Aqueous Extract mg/l	Water mg/l	pH	
TP1	D14	3.80	43	18	25													SOIL CLASSIFICATION = CI 0% retained on 425µm sieve

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

14337

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UKAS TESTING 8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

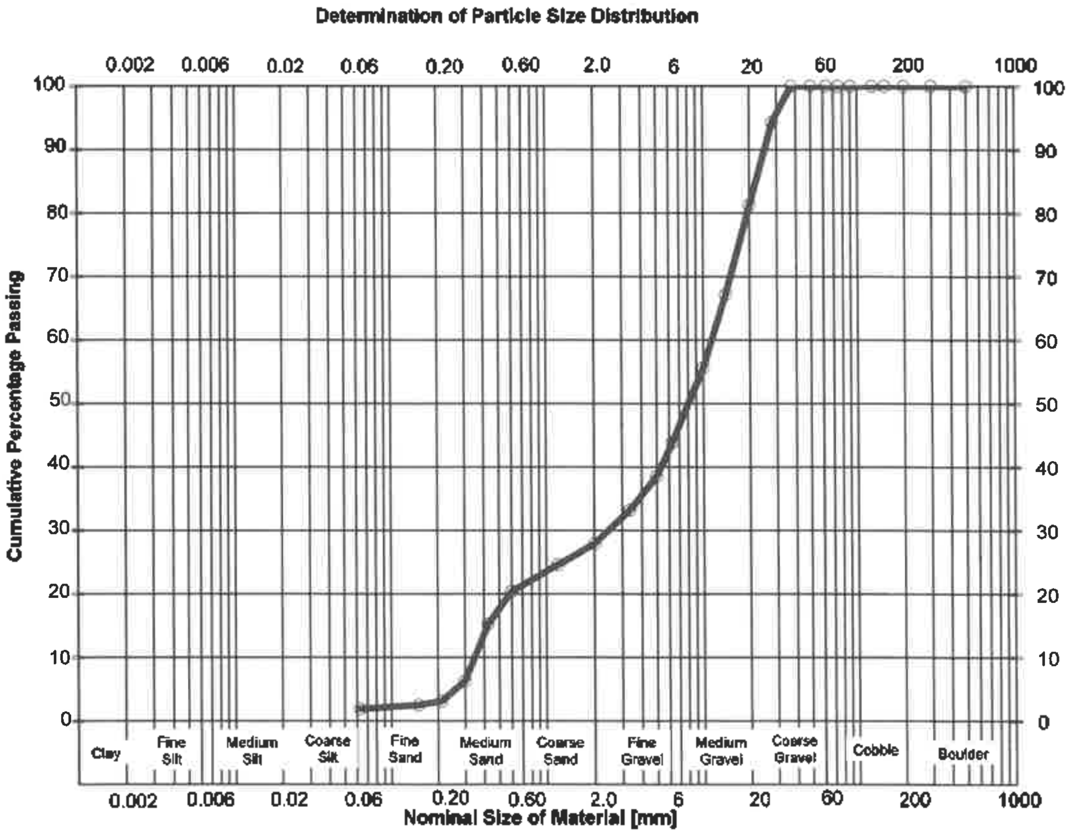
Tested in Accordance with BS 1377-2: 1990: Clause 9.2
Sieved Grading

Client:	Ground Engineering Ltd	Certificate Number:	PL6079-1/4/710-2
Client Address:	Newark Road	Client Reference:	C14337
	Peterborough	Lab Job Number:	PL6079-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	28.11.2017
Contact:	Steve Fleming	Date Tested:	07.12.2017
		Certificate of Sampling:	N/A
Site Name:	27 Johns Mews	Sampling Certificate No.:	N/A
Site Address:	London WC1	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL6079-1/4 **Pre-treatment for organic material:** N/A
Client Reference: B9

Sample Description: Brown sandy GRAVEL. Gravel consists of sub-angular to sub-rounded flint and quartzite

Material Specification: Not Required **Depth Top:** 3.75m
Location: BH1 **Depth Base:** 4.00m
Source: **Supplier:**



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	94
20	81
14	67
10	56
6.3	44
5.0	39
3.35	33
2.00	28
1.18	25
0.600	20
0.425	15
0.300	6
0.212	3
0.150	3
0.063	2
0.020	
0.006	
0.002	

Comments:

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 21.12.2017 Page 1 of 1
Form Number: GELab/C/709-2 Version 47

Registered in England & Wales
Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterborough PE1 5UA

8180

GROUND ENGINEERING

Newark Road Peterborough
t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

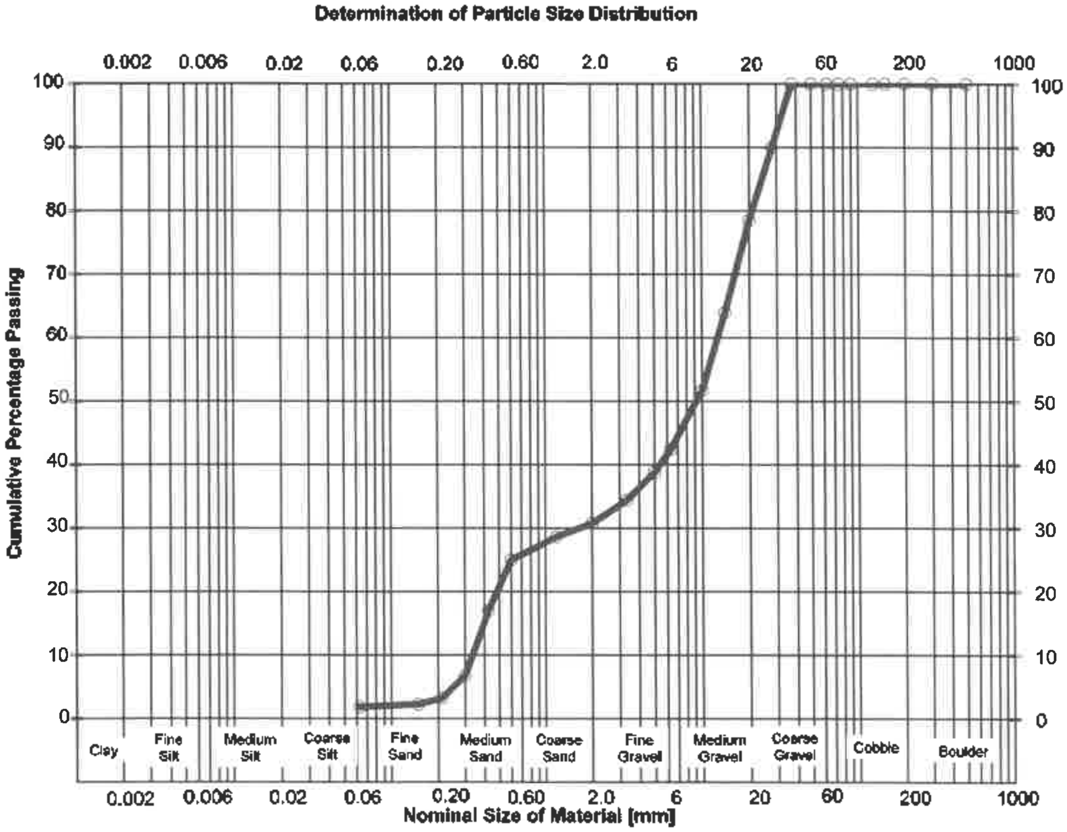
Tested in Accordance with BS 1377-2: 1990: Clause 9.2
Sieved Grading

Client:	Ground Engineering Ltd	Certificate Number:	PL6079-1/5/710-2
Client Address:	Newark Road	Client Reference:	C14337
	Peterborough	Lab Job Number:	PL6079-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	28.11.2017
Contact:	Steve Fleming	Date Tested:	07.12.2017
		Certificate of Sampling:	N/A
Site Name:	27 Johns Mews	Sampling Certificate No.:	N/A
Site Address:	London WC1	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL6079-1/5
Client Reference: B10
Pre-treatment for organic material: N/A

Sample Description: Brown sandy GRAVEL. Gravel consists of angular to sub-rounded flint

Material Specification: Not Required
Location: BH1
Source:
Depth Top: 4.00m
Depth Base: 4.50m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	90
20	78
14	64
10	52
6.3	42
5.0	39
3.35	34
2.00	31
1.18	29
0.600	25
0.425	17
0.300	7
0.212	3
0.150	2
0.063	2
0.020	
0.006	
0.002	

Comments:

Approved Signatory: M. Hartnup - Laboratory Manager

Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 21.12.2017 Page 1 of 1
Form Number: GELab/C/709-2 Version 47

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Reg Office: Ground Engineering Ltd
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t: 01733 566566 f: 01733 315280
e: admin@groundengineering.co.uk

TEST CERTIFICATE

Determination of Particle Size Distribution

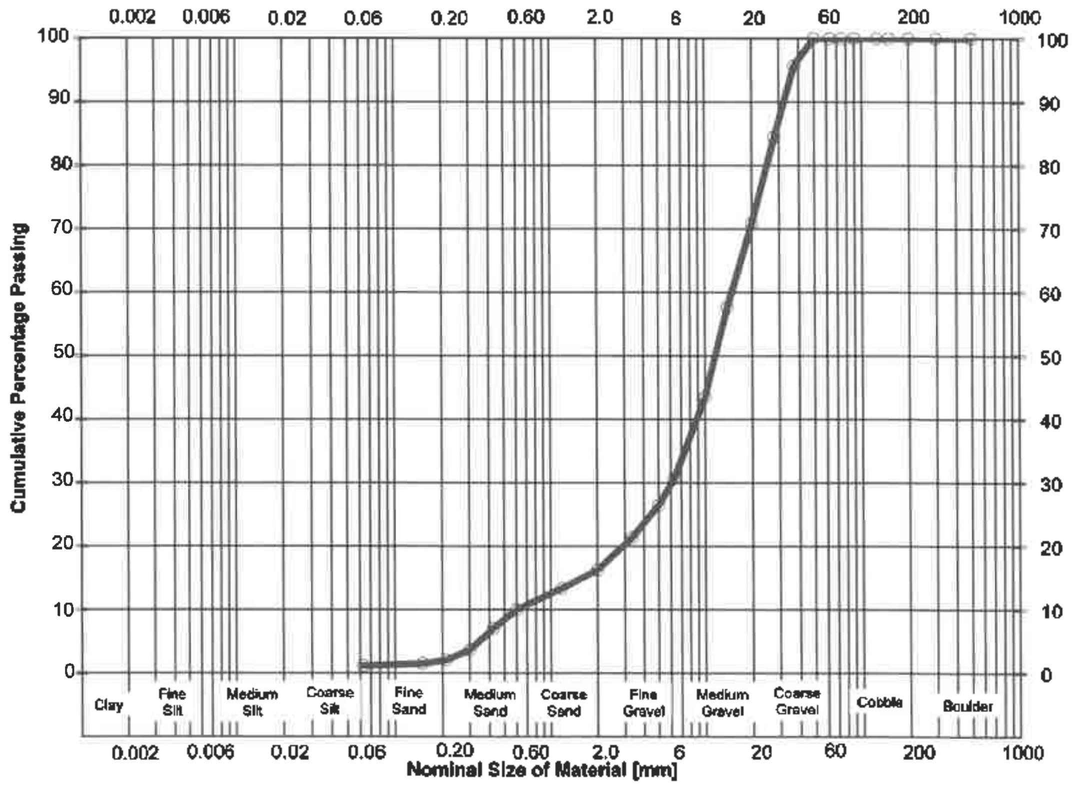
Tested in Accordance with BS 1377-2: 1990: Clause 9.2
Sieved Grading

Client:	Ground Engineering Ltd	Certificate Number:	PL6079-1/6/710-2
Client Address:	Newark Road	Client Reference:	C14337
	Peterborough	Lab Job Number:	PL6079-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	28.11.2017
Contact:	Steve Fleming	Date Tested:	07.12.2017
		Certificate of Sampling:	N/A
Site Name:	27 Johns Mews	Sampling Certificate No.:	N/A
Site Address:	London WC1	Sampled By:	Client

TEST RESULTS **Laboratory Reference:** PL6079-1/6 **Pre-treatment for organic material:** N/A
Client Reference: B11

Sample Description: Brown sandy GRAVEL. Gravel consists of angular to sub-rounded flint and quartzite

Material Specification: Not Required **Depth Top:** 4.80m
Location: BH1 **Depth Base:** 5.30m
Source: **Supplier:**



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	96
28	84
20	71
14	58
10	44
6.3	31
5.0	26
3.35	21
2.00	16
1.18	13
0.600	10
0.425	7
0.300	4
0.212	2
0.150	2
0.063	1
0.020	
0.006	
0.002	

Comments:

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 21.12.2017 Page 1 of 1
Form Number: GELab/C/709-2 Version 47

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e: admin@groundengineering.co.uk

TEST CERTIFICATE

One-Dimensional Consolidation Properties

(Tested in accordance with BS1377 : Part 5 1990)

Client:	Ground Engineering Ltd	Certificate Number:	PL6079-1-9/731
Client Address:	Newark Road	Client Reference Number:	C14337
	Peterborough	Date Sampled:	Unknown
	Cambridgeshire	Date Received:	28.11.2017
Postcode:	PE1 5UA	Date Tested:	11.12.2017
Contact:	Steve Fleming	Sampling Certificate No:	N/A
Site Name:	27 Johns Mews	Certificate of Sampling:	N/A
Site Address:	London WC1	Sampled By:	Client

Test Details

Location: BH1

Sample Ref: U2

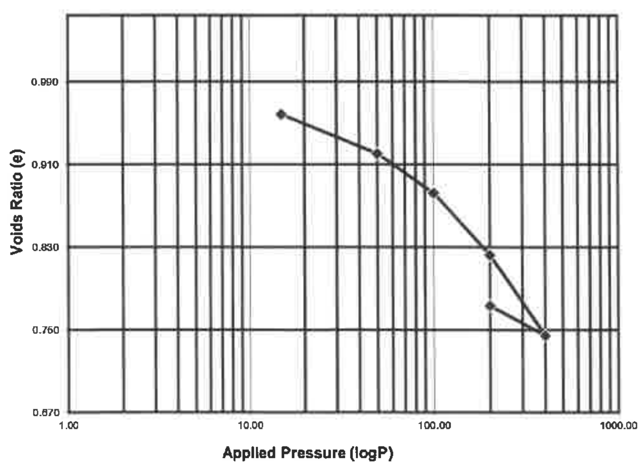
Sample Description: Firm brown orange brown grey silty CLAY

Particle Density (Mg/m^3):	2.71	Assumed
Mean Lab Temp. (°C):	22	
Variations from Standard:	None	
Lab Reference:	PL6079-1-9	
Depth:	6.70 m	

Specimen Details

	INITIAL	FINAL
Height (mm):	18.94	17.15
Bulk Density (Mg/m^3):	1.87	2.05
Moisture Content (%):	35	34
Dry Density (Mg/m^3):	1.38	1.53
Voids Ratio:	0.958	0.773
Degree of Saturation (%):	99.7	100.0
Diameter (mm):	74.96	N/A
Swelling Pressure (kPa):	15	N/A
Method of time fitting used:	Log Time	N/A

Voids Ratio against logarithm of Applied Pressure



Applied Pressure (kPa)	Coefficient of Compressibility m_v (m^2/MN)	Coefficient of Consolidation c_v (m^2/year)
15		
	0.55	1.02
50		
	0.40	0.48
100		
	0.32	0.45
200		
	0.21	0.45
400		
	0.08	---
200		

Comments:

Approved Signatory:	[x] M.Hartnup - Laboratory Manager [ ] L.Petch - Team Leader	Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 21/12/2017

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Reg Office: Ground Engineering Ltd
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GROUND ENGiNEERiNG

TEST CERTIFICATE

One-Dimensional Consolidation Properties

(Tested in accordance with BS1377 : Part 5 1990)

Newark Road Peterborough
t:01733 566566 f:01733 315280
e: admin@groundengineering.co.uk

Client:	Ground Engineering Ltd	Certificate Number:	PL6079-1-11/731
Client Address:	Newark Road	Client Reference Number:	C14337
	Peterborough	Date Sampled:	Unknown
	Cambridgeshire	Date Received:	28.11.2017
Postcode:	PE1 5UA	Date Tested:	11.12.2017
Contact:	Steve Fleming	Sampling Certificate No:	N/A
Site Name:	27 Johns Mews	Certificate of Sampling:	N/A
Site Address:	London WC1	Sampled By:	Client

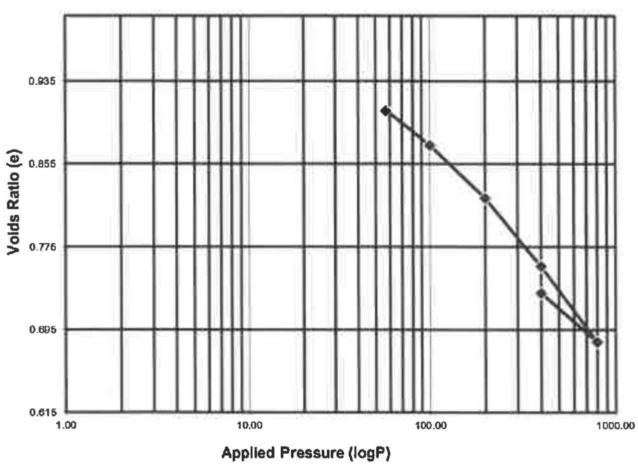
Test Details

Location:	BH1	
Sample Ref:	U4	
Sample Description:	Firm brown silty CLAY	
Particle Density (Mg/m^3):	2.71	Assumed
Mean Lab Temp. (^{o}C):	22	
Variations from Standard:	None	
Lab Reference:	PL6079-1-11	
Depth:	9.00 m	

Specimen Details

	INITIAL	FINAL
Height (mm):	18.59	16.86
Bulk Density (Mg/m^3):	1.90	2.07
Moisture Content (%):	34	32
Dry Density (Mg/m^3):	1.42	1.57
Voids Ratio:	0.907	0.730
Degree of Saturation (%):	100.0	100.0
Diameter (mm):	75.06	N/A
Swelling Pressure (kPa):	57	N/A
Method of time fitting used:	Log Time	N/A

Voids Ratio against logarithm of Applied Pressure



Applied Pressure (kPa)	Coefficient of Compressibility m_v (m^2/MN)	Coefficient of Consolidation c_v (m^2/year)
57		
100	0.42	1.49
200	0.27	0.72
400	0.18	0.56
800	0.10	1.53
400	0.07	---

Comments:

Approved Signatory: [x] M.Hartnup - Laboratory Manager
[ ] L.Petch - Team Leader

Signed:

for and on behalf of Ground Engineering Ltd

Date Reported: 21/12/2017

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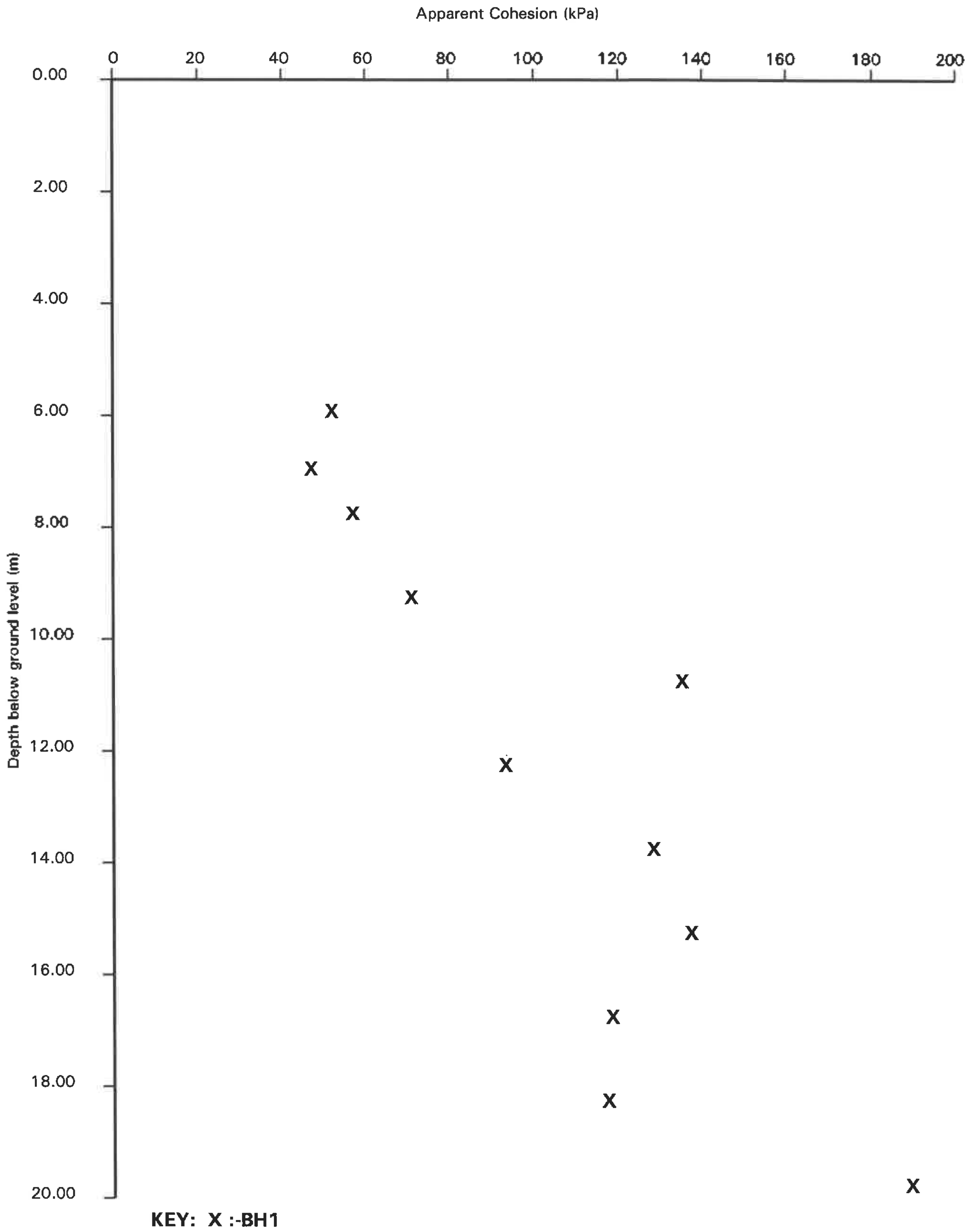


Apparent Cohesion (kPa) vs Depth below ground level (m).

SITE	27 JOHN'S MEWS, LONDON WC1		
CLIENT	BRENDAN O'TOOLE	Contract Number	14337
GROUND ENGiNEERiNG LIMITED Tel: 01733-566566 www.groundengineering.co.uk	Date 02/01/18	Figure	1

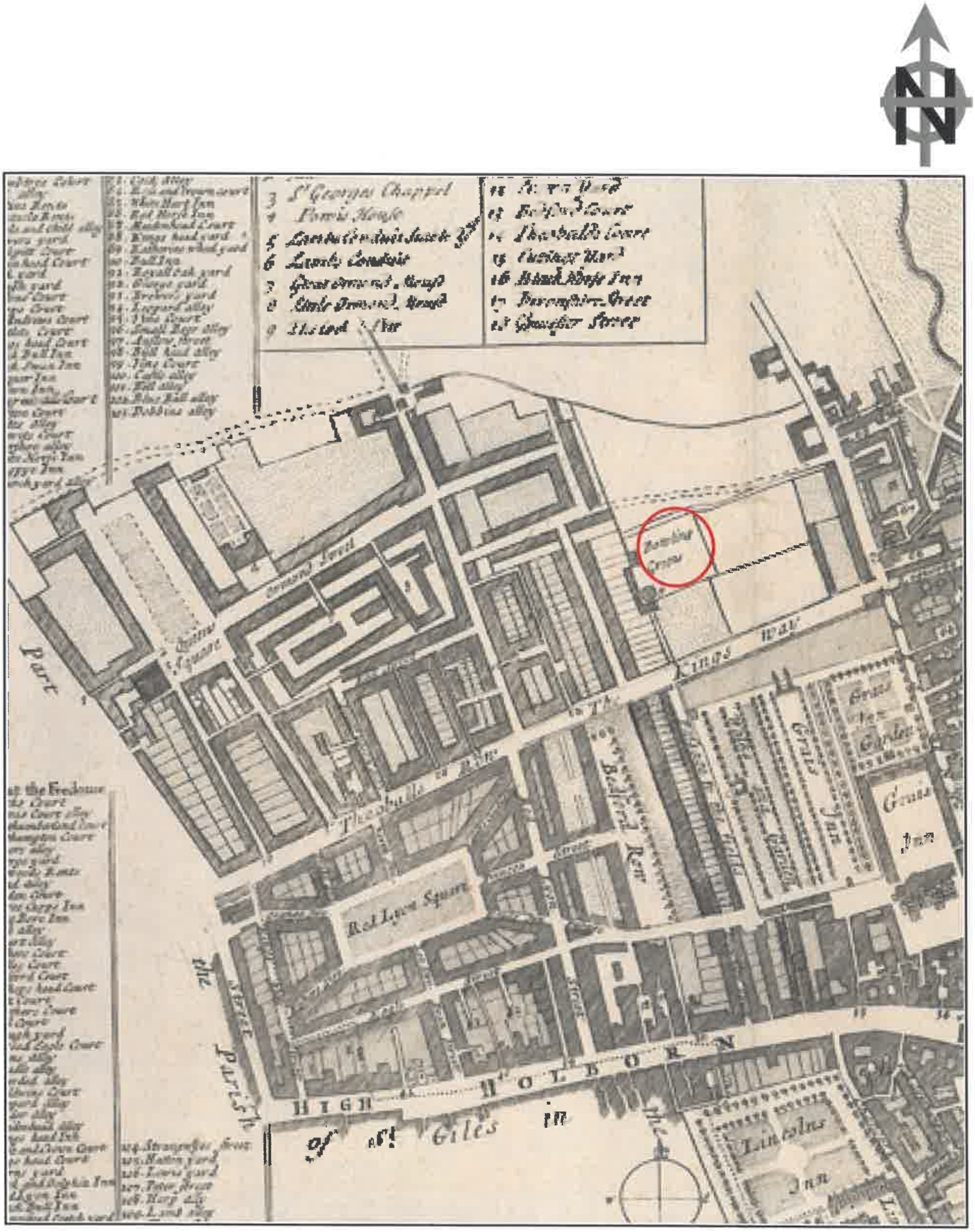
APPENDIX 1

HISTORICAL MAPS

Site History

Figure A

Reproduced from the **1720** Stow's 'Survey of the Cities of London & Westminster'
Not to scale



Project : 27 John's Mews, London WC1

Client : Brendon O'Toole

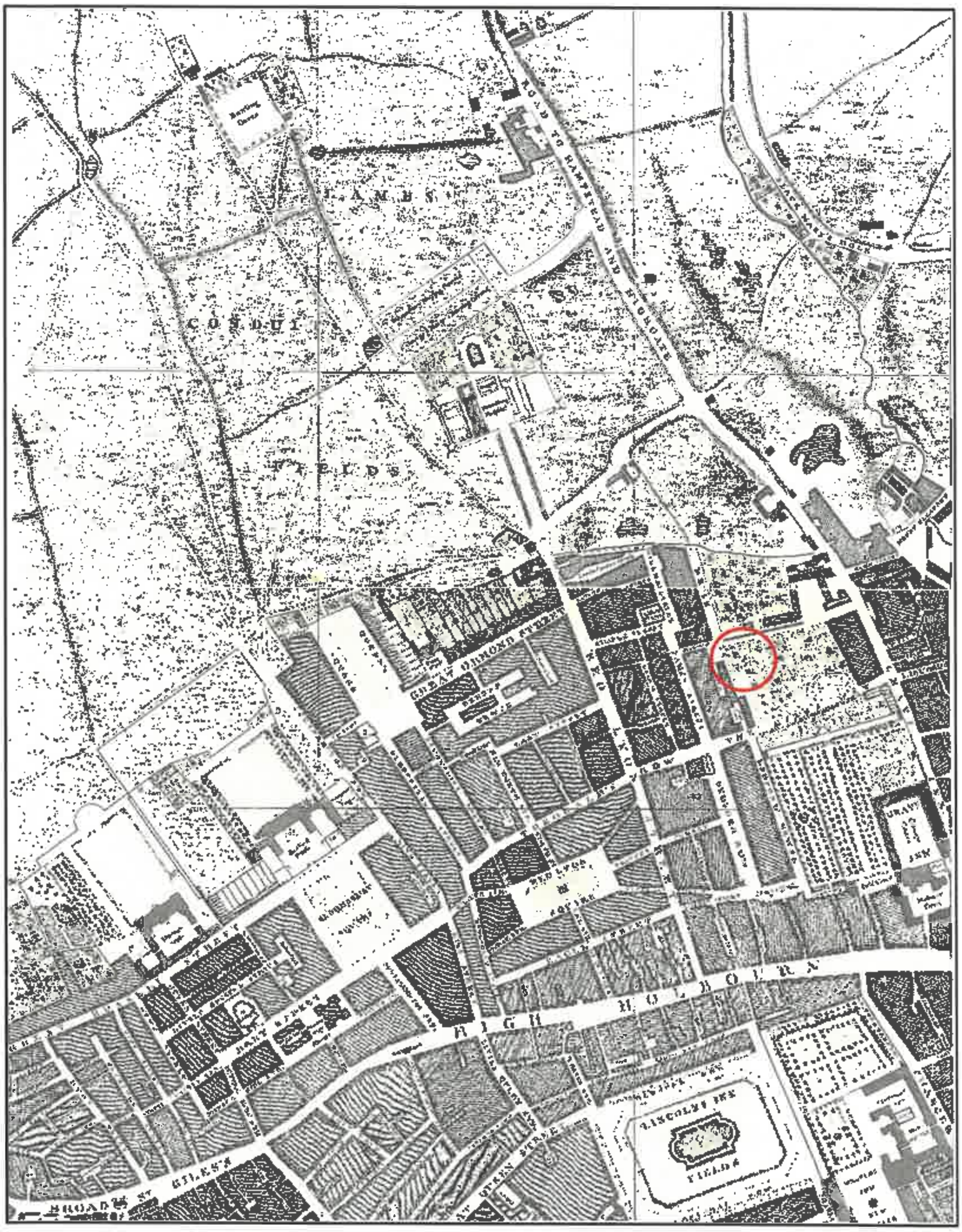
GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C14337

Site History

Figure B

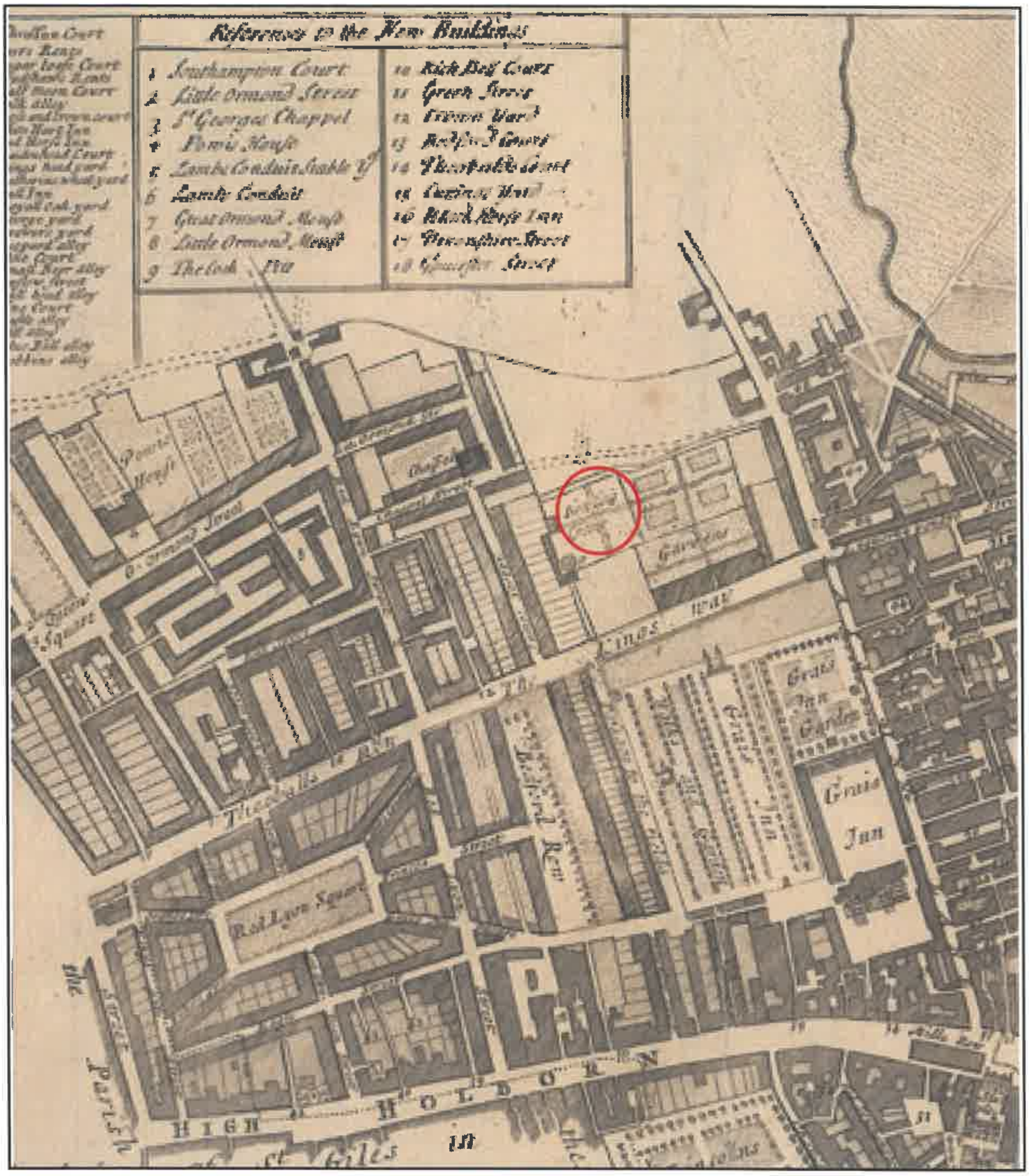
Reproduced from the **1747** John Rocque's **Plan of the Cities of London and Westminster and Borough of Southwark**
Not to scale



Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

# Site History	**Figure C**

Reproduced from the **1755** Stow's 'Survey of the Cities of London & Westminster'
Not to scale



Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

Figure D

Reproduced from the **1792** 1st Edition **Richard Horwood's Plan of London**
Not to scale

Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

Figure E

Reproduced from the **1813** 3rd Edition **Richard Horwood's Plan of London**
Not to scale

Project : 27 John's Mews, London WC1

Client : Brendon O'Toole

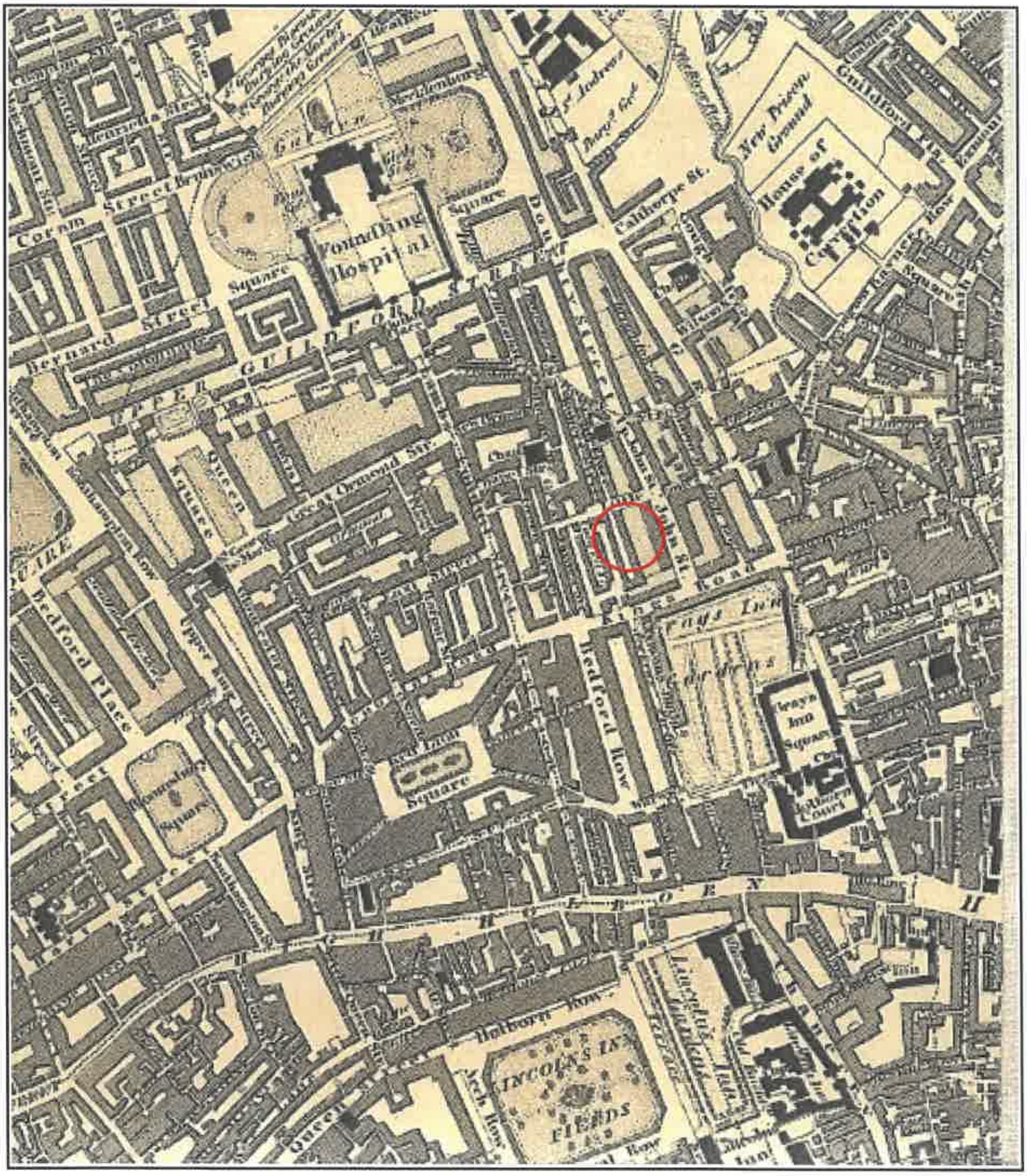
GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C14337

Site History

Figure F

Reproduced from the **1827** edition Greenwood's **Map of London**
Not to scale.



Project : 27 John's Mews, London WC1

Client : Brendon O'Toole

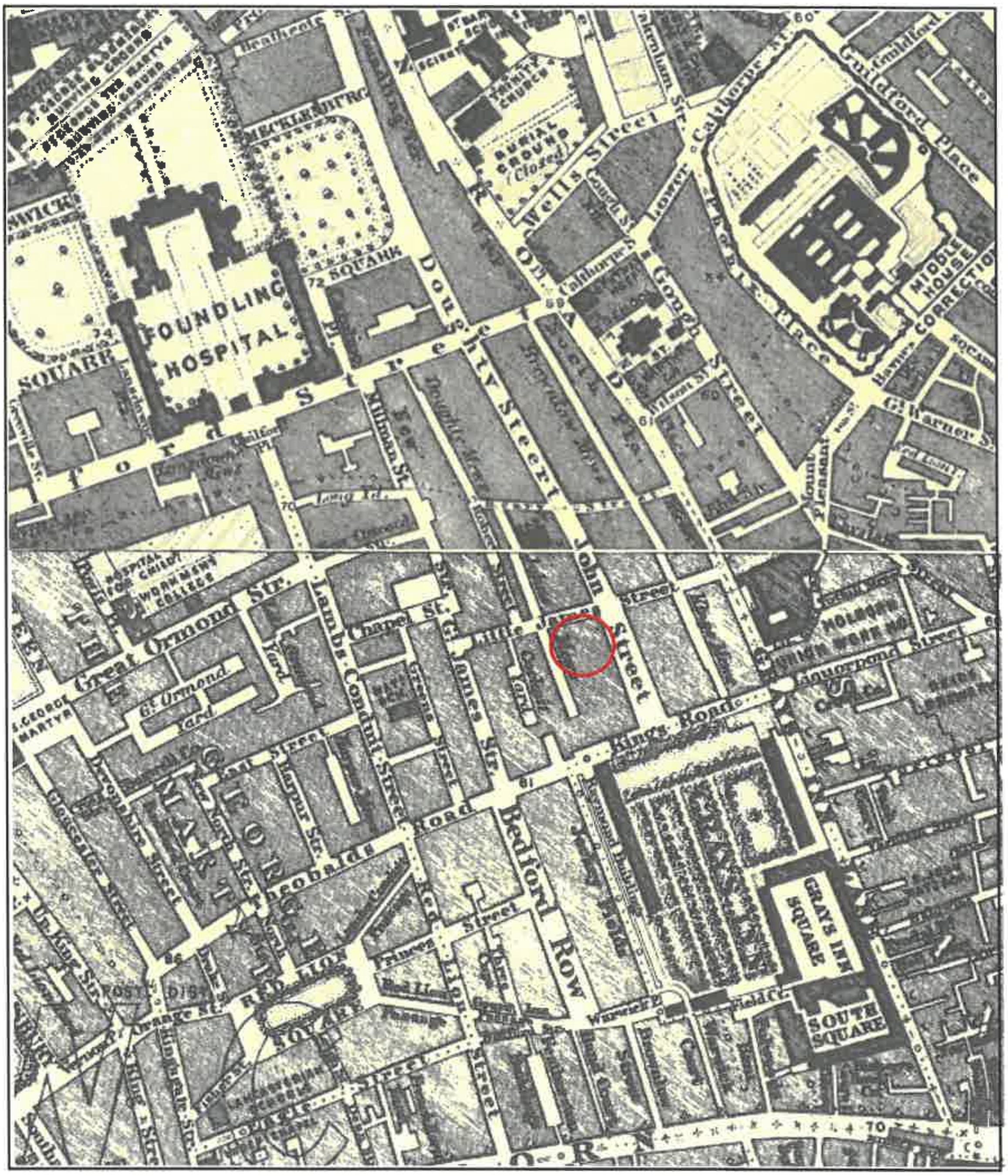
GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C14337

Site History

Figure G

Reproduced from the **1862** edition Stanford's **Library Map of London and its Suburbs, Not to scale.**



Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

Figure H

Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

Figure I

Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

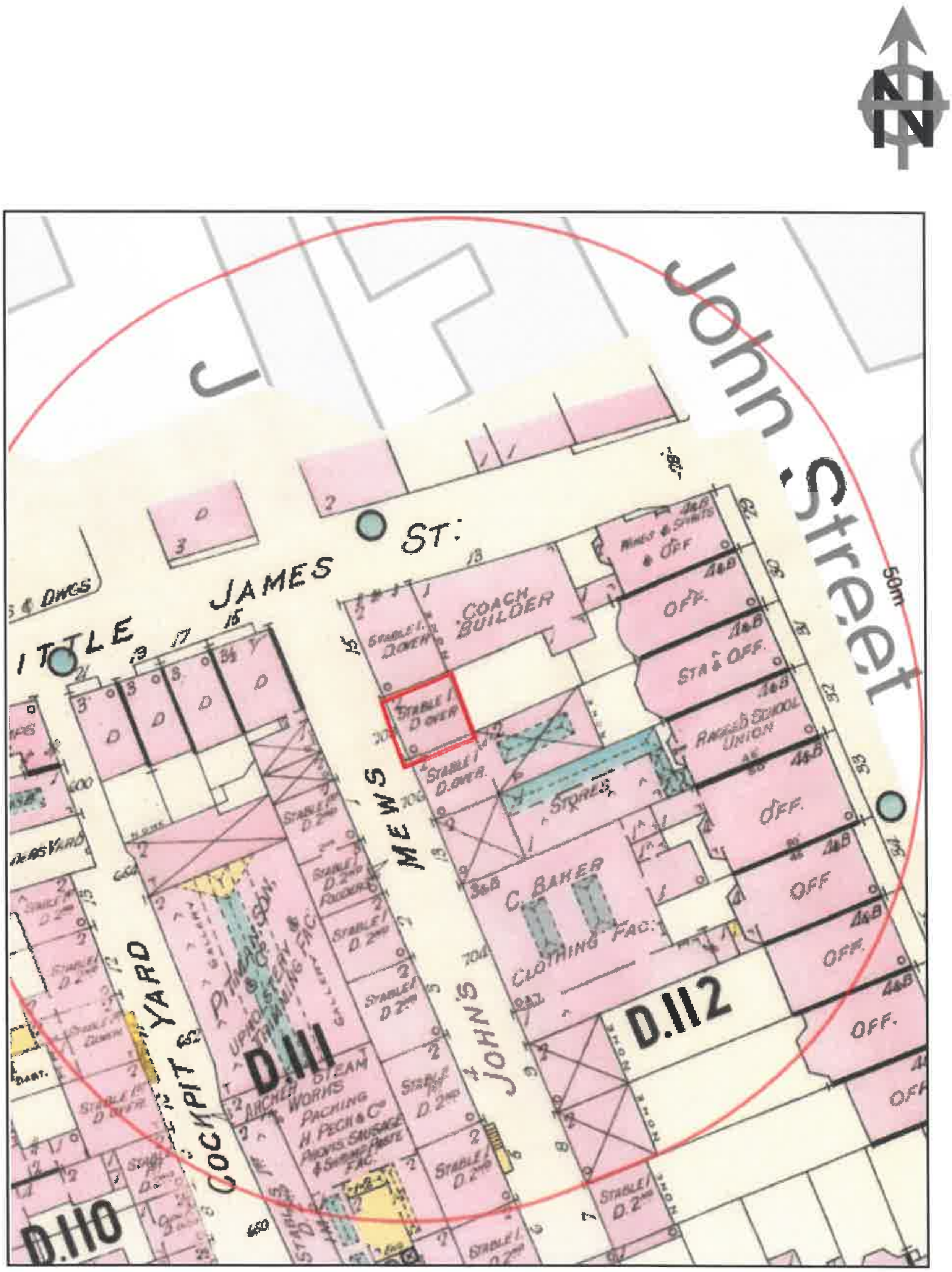
Figure J

Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

Figure K

Reproduced from the **1901 Goad's Insurance Map**
Not to scale



Project : 27 John's Mews, London WC1

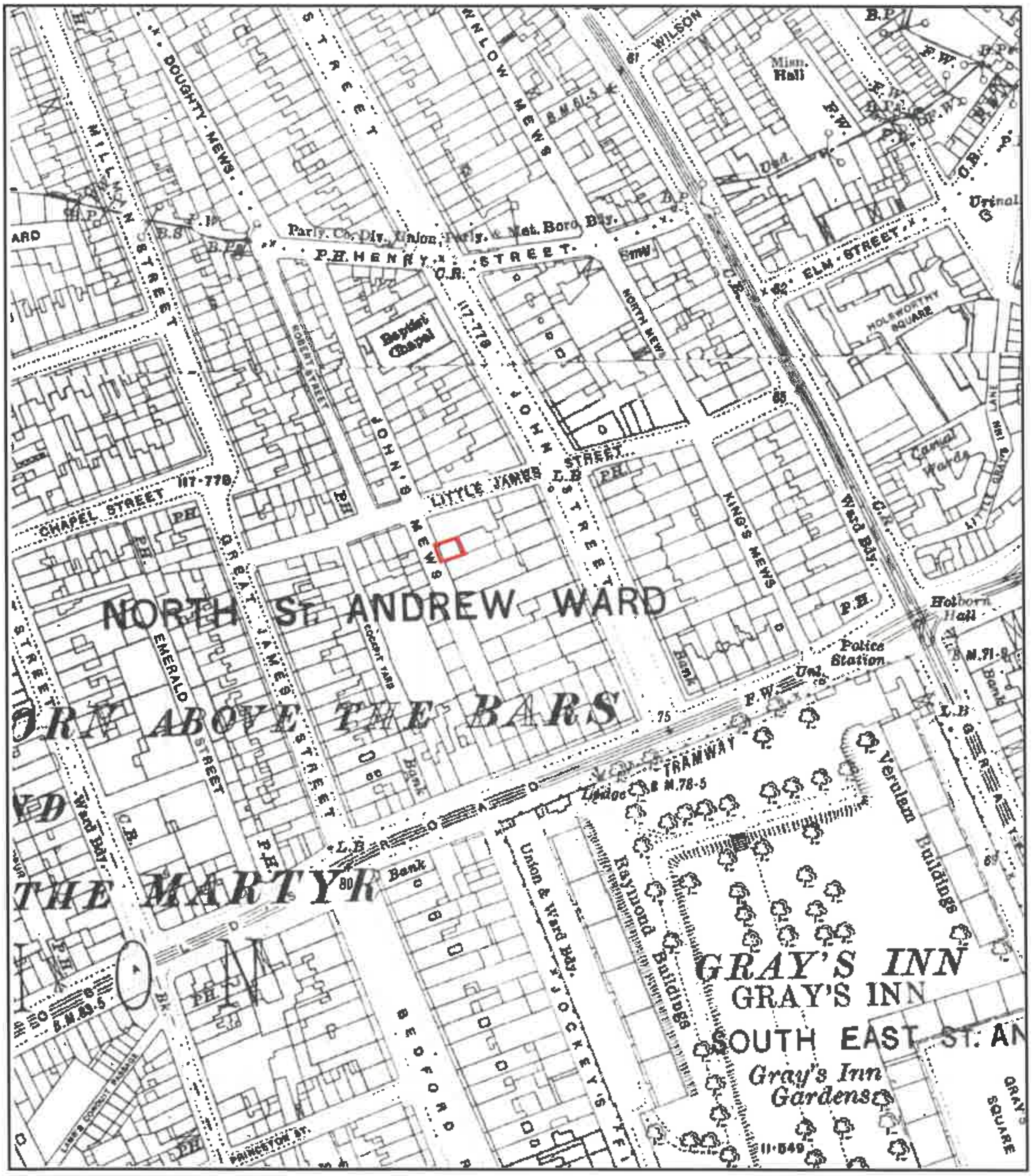
Client : Brendon O'Toole

GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C14337

Site History

Figure L



Project : 27 John's Mews, London WC1

Client : Brendon O'Toole

GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C14337

Site History

Figure M

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Project : 27 John's Mews, London WC1

Client : Brendon O'Toole

GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C14337

Site History

Figure N

Reproduced from the **1939-45 London County Council Bomb Damage Map, Not to scale.**

Colour Key References
(for guidance only)

Black
Total destruction

Purple
Damaged beyond repair

Dark Red
Seriously damaged; doubtful if repairable

Light Red
Seriously damaged, but repairable at cost

Orange
General blast damage – not structural

Yellow
Blast damage, minor in nature

Light Blue
Clearance areas

Light Green
Clearance areas

V1 flying bomb

V2 long range rocket

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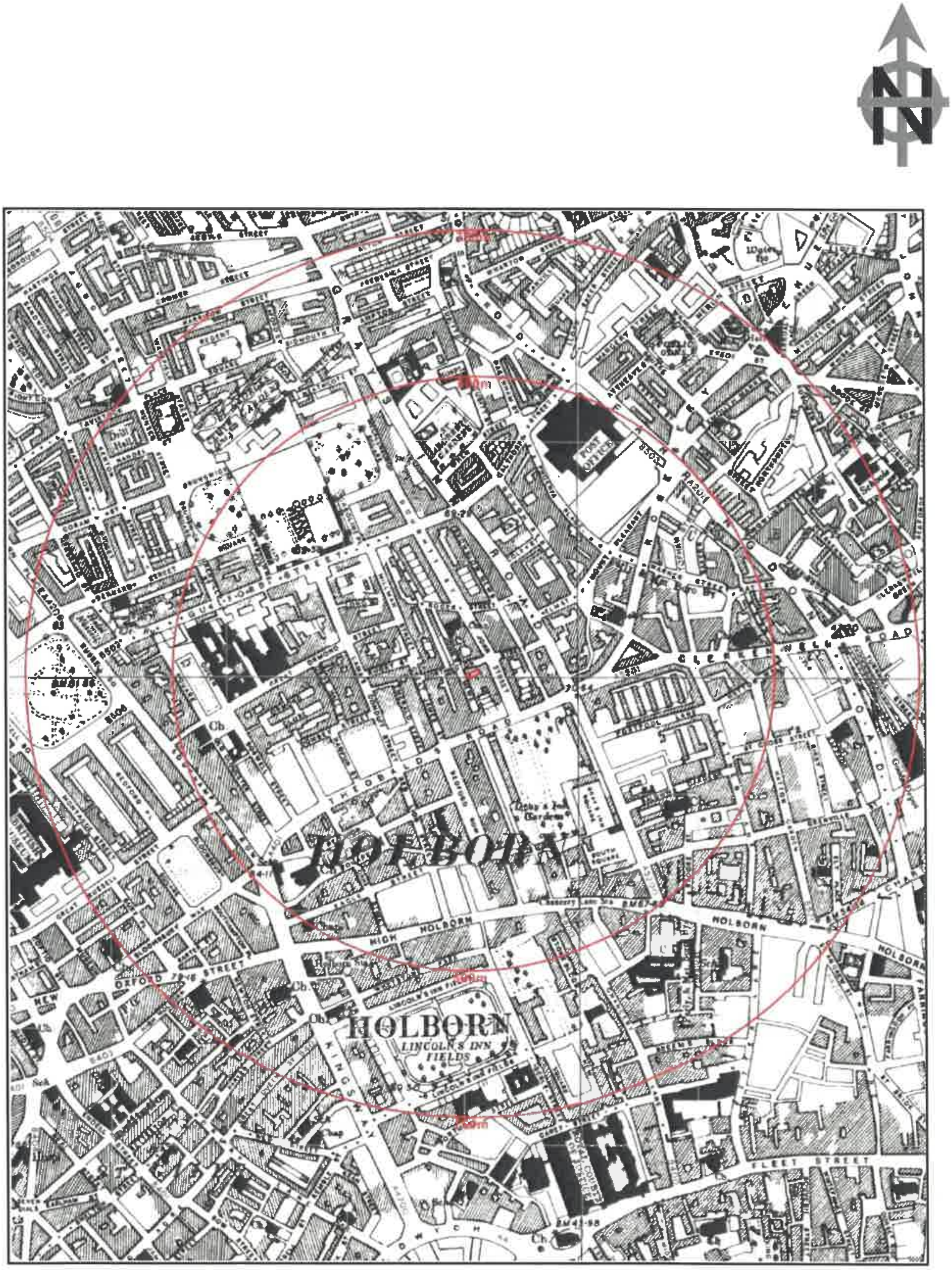
Site History

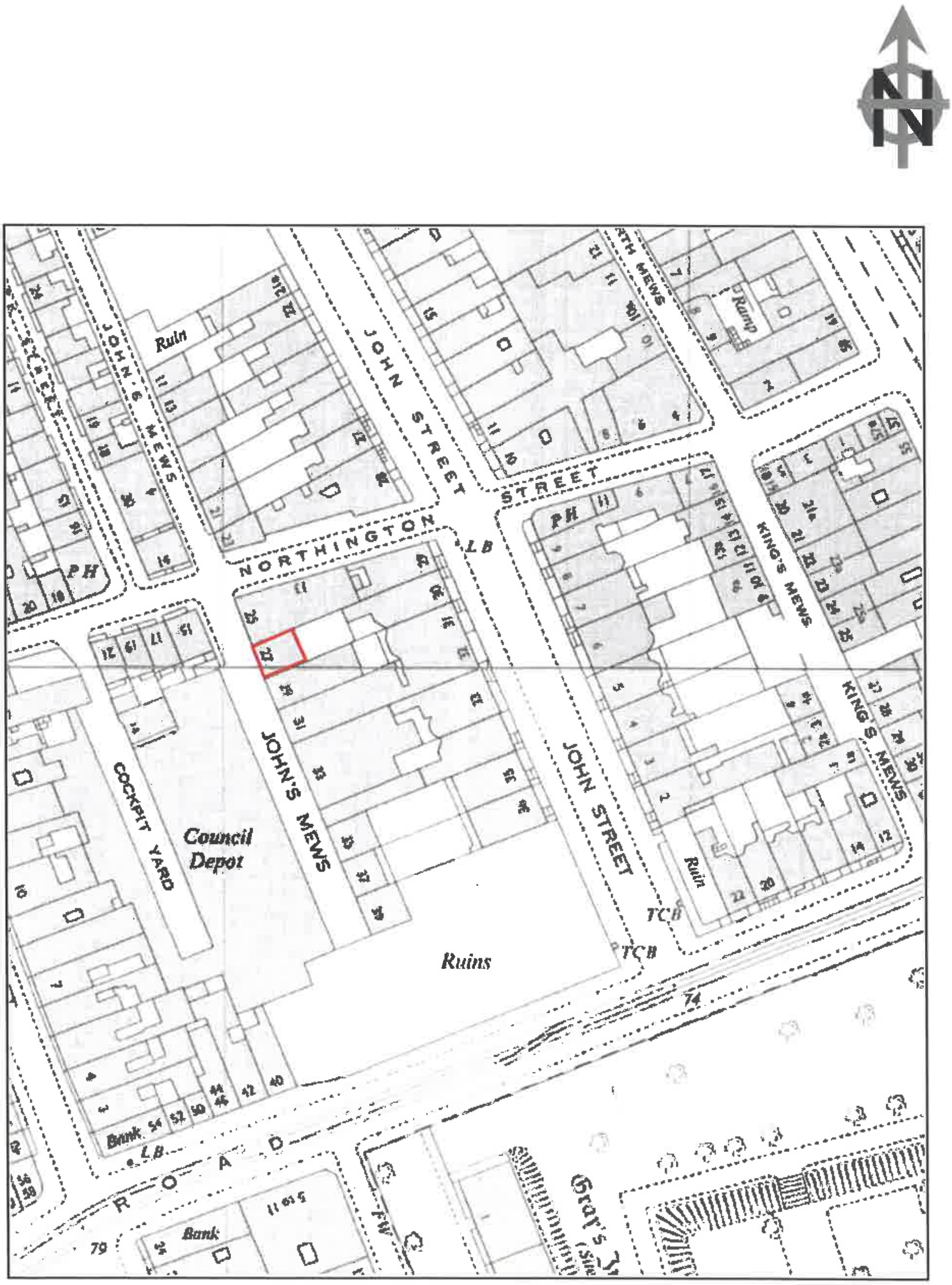
Figure O



Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

Figure P



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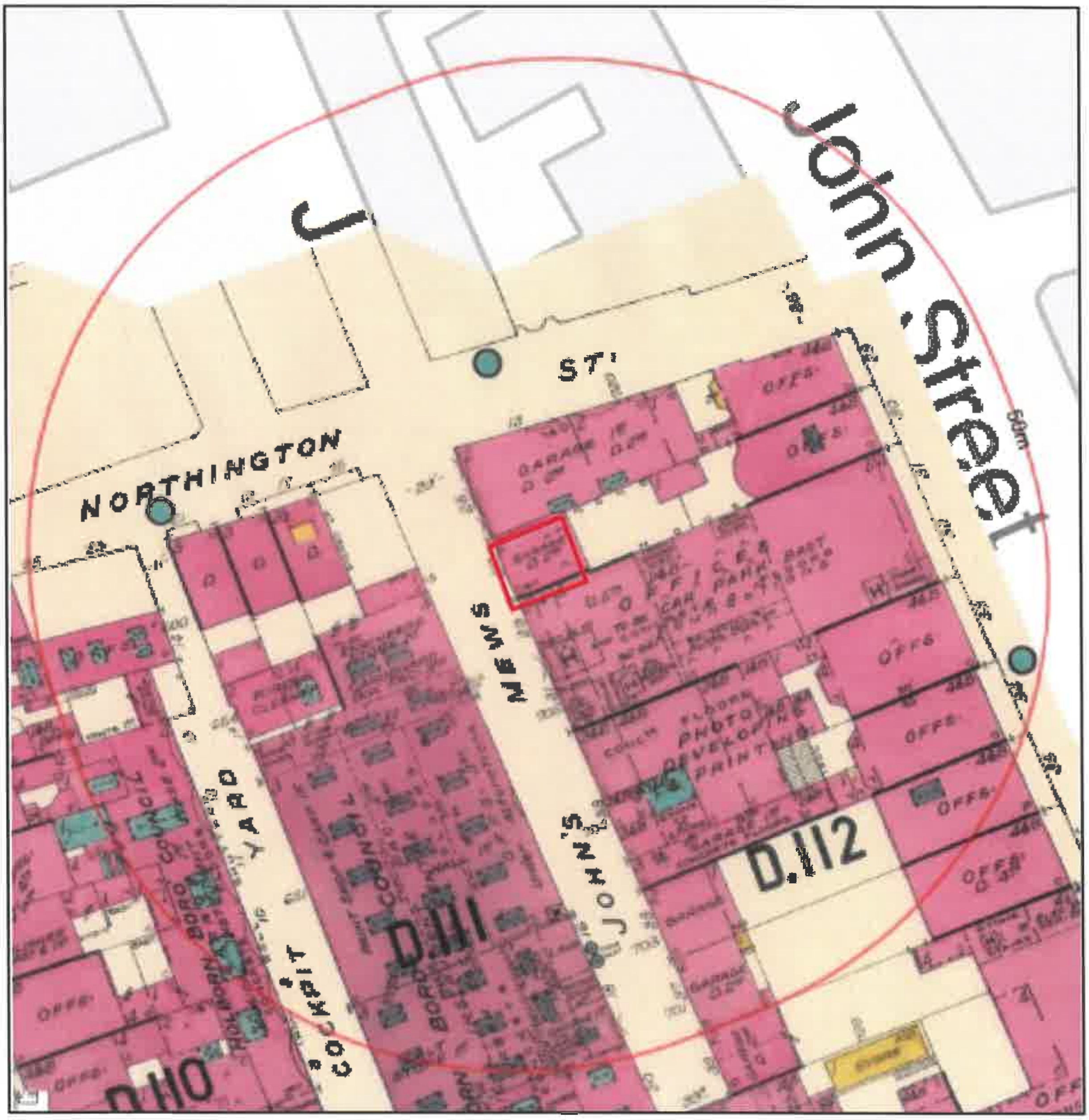
Site History

Figure Q

Reproduced from the **1960 Goad's Insurance Maps**
Not to scale



Project : 27 John's Mews, London WC1 **Client : Brendon O'Toole**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C14337**

Site History

Figure R

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