Written Scheme of Investigation

22 KINGS MEWS LONDON WC1

For Queensgate Property Ltd

Tom Swannick MSc PCIfA

L-P:ARCHÆOLOGY

Written Scheme of Investigation

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Client:	Queensgate Property Ltd
Local Authority:	London Borough of Camden
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L-P:ARCHÆOLOGY

A trading name of L – P : Heritage LLP

The Truman Brewery | 91 Brick Lane | London, E1 6QL | +44 [0]20 7 770 6045 | london@lparchaeology.com

www.lparchaeology.com

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1. Introduction

1.1. This Written Scheme of Investigation (WSI) for excavation has been prepared by Tom Swannick of L - P : Archaeology on behalf of Queensgate Property Ltd.

1.2. The WSI considers a site known at 22 Kings Mews, London, WC1 (hereafter "the site"). The site is centred on National Grid Reference 530930, 182017 (**FIGURE 1 & FIGURE 2**).

1.3. The Local Planning Authority is the London Borough of Camden (LBC).

1.4. The site fronts onto Kings Mews to the west and is bounded by adjacent properties. To the north lies number 21 and to the south lies number 24 Kings Mews. To the east lies the rear of numbers 47 and 49 Gray's Inn Road.

1.5. The site is proposed for redevelopment including the demolition of existing structures and the construction of a three storey residential dwelling with new basement.

1.6. The site falls within an Archaeological Priority Area as defined by the Local Planning Authority. This is Archaeological Priority Area 2, "London Suburbs". The border of the area runs down the centre of Kings Mews with sites on the east side falling within the area, presumably as they represent plots that approximately front onto Gray's Inn Road. The site does not contain any scheduled monuments or listed building.

1.7. The proposed scheme will consist of several distinct elements of archaeological work, which are set out in detail below.

1.8. A site code for these works will be allocated by the Museum of London. This code must be allocated before any fieldwork commences.

2. Site Background

2.1. PLANNING

2.1.1. The site has been granted planning permission subject to condition, 2017/3015/P (APPENDIX 1), and this WSI has been prepared at the earliest opportunity.

2.1.2. In March 2012 the Department for Communities and Local Government issued the National Planning Policy Framework (NPPF) (DCLG 2012). Section 12 of this document sets out planning policies on the conservation of the historic environment.

2.1.3. In April 2014 the DCLG published the National Planning Practice Guidance (NPPG) notes which sets out how the government's planning policies are expected to be applied (DCLG 2014).

2.1.4. In addition, the following legislation is considered by this assessment:

- Ancient Monuments and Archaeological Areas Act 1979.
- Town and Country Planning Act 1990.

2.1.5. LBC must consider The Mayor of London's London Plan 2011 (consolidated with alterations in 2013, 2015 and 2016). Policies 7.8 and 7.9 are concerned with archaeology and heritage ((GREATER LONDON AUTHORITY 2016).

2.1.6. LBC take archaeological advice from Greater London Archaeological Advisory Service (GLAAS).

2.1.7. The London Borough of Camden must consider policies related to their Local Plan (Adopted 2017) (LONDON BOROUGH OF CAMDEN 2017).

2.1.8. The LDF development policy relating to archaeology is policy D2. This sets out LBC's approach to archaeology.

POLICY D2

The Council will protect remains of archaeological importance by ensuring acceptable measures are taken proportionate to the significance of the

heritage asset to preserve them and their setting, including physical preservation, where appropriate.

2.1.9. A Desk Based Assessment has been produced for this site (HUNT & MADIGAN 2012).

2.1.10. In response to the planning condition, this WSI has been prepared at the earliest opportunity and aims to lay out the archaeological methodology in order to adequately discharge the condition.

2.2. GEOLOGY

2.2.1. The British Geological Survey GeoIndex shows the site to be located on River Terrace Gravels over London Clay. This data is at relatively low resolution and offers only a rough indication of the site geology (BRITISH GEOLOGICAL SURVEY 2017).

2.2.2. A ground investigation report has been conducted at 22 Kings Mews in advance of the proposal (ALLVEY 2016) (APPENDIX 2). Two boreholes were undertaken on the site.

2.2.3. The borehole data from this report indicates that the "made ground" extends from 3.50m BGL to 4.70m BGL, which overlies alluvium that extends to 5.70m BGL, which in turn overlies Hackney Gravel at 7.60m BGL and London clay at 8.45m BGL.

2.2.4. The difference of c.1.2m in "made ground" deposits are likely indicative that the depth of these deposits will change over the course of the whole site area.

2.2.5. "Made ground" should be considered to be potentially of archaeological interest because it is representative of known human interaction. However, it is noted that the borehole data is split into two parts of made ground, with the upper first metre noted as being disturbed and containing concrete and cement. This is likely disturbance from the construction of the extant building.

2.2.6. The presence of alluvium overlying the Hackney Gravel member may be indicative of the site having previously flooded, due to it proximity to a water

course. This may possibly have been a tributary to the nearby Fleet River, or the flooding may have been from Fleet itself.

2.3. TOPOGRAPHY

2.3.1. The site lies to the north west of the historic core of Roman and Medieval London, north of the River Thames. The site lies a short distance to the west of the former course of the River Fleet.

2.3.2. The site lies on fairly flat ground at around 20m OD. In the wider area, the levels slope gently down from the south (21m OD at Theobald's Road) to the north (19m OD in Gray's Inn Road) and from the west to the east towards the valley of the Fleet. The former course of the Fleet is largely obscured by later build up of deposits. To the east of the Fleet, the land rises up steeply towards Islington.

2.3.3. To the north of the site, a small tributary stream of the River Fleet runs west to east. This tributary forms a later parish boundary and was a feature visible in the landscape until the 18th century.

3. Archaeological and Historical Background

3.1. An Archaeological Desk Based Assessment was prepared in support of the planning application (HUNT & MADIGAN 2012). This included a search of the Greater London Historic Environment Record (GLHER) for entries within 1km of the site. A brief summary of the archaeological background follows, with GLHER entries referenced using the Monument ID or site code (MLO12345, MNO12).

3.2. PREHISTORIC

3.2.1. The Prehistoric periods are difficult to interpret for the study site due to the low density of evidence as well as the low level of reliability of this evidence itself, most finds being isolated and inaccurately located. No Prehistoric remains are accurately located within the search area.

3.2.2. Should Prehistoric activity have occurred in the study area, it seems likely that this would have been located a short distance to the east on the higher ground overlooking the Fleet.

3.2.3. The potential for remains dating to any of the later Prehistoric period should be considered to be low to none.

3.3. ROMAN

3.3.1. The Roman city of London, *Londinium*, was established in the mid first century shortly after the Claudian invasion of Britain in AD 43. The study site is peripheral to this settlement, lying 1km to the north west of the nearest corner of the city walls at Newgate.

3.3.2. The conjectured route of two Roman roads run through the study area. The northernmost road is designated as road 20 by Margary and the southern as road 4a (MARGARY 1967).

3.3.3. Road 20 is ofter referred to as the "Old Street Bypass" as it would have provided an option for traffic between Colchester or The North to bypass London if heading on towards Silchester. This road ran from Old Ford (a crossing point of the River Lea) along Roman Road and Old Street to the study

area, where Margary suggests that it may have passed along Portpool Lane and on towards Red Lion Square where it met up with the Silchester Road. Margary is of the opinion that this is a Prehistoric (pre-London) route that became adopted into the Roman network (MARGARY 1967: 21). This route passes 150m to the south of the study site.

3.3.4. Road 4a is the main route from London to Silchester and lead out from Newgate along Holborn towards Edgware Road (MARGARY 1967). This passes some distance (500m) to the south of the study site and does not seem likely to influence the archaeological potential of the site.

3.3.5. A small number of findspots dated to the Roman period occur within the 500m study area. These are largely related to Roman funerary activity and broadly speaking these are clustered in the Holborn area.

3.3.6. There is some background potential for Roman archaeology within the study area, this includes the roads described above as well as the funerary activity seen along High Holborn. However, the location of the study site itself, over 500m from High Holborn, would suggest that overall the potential for Roman remains to be found on the study site remains low. Any such finds should they be found would most likely be isolated findspots or cremations.

3.4.MEDIEVAL

3.4.1. After the Roman period, *Londinium* was largely deserted and settlement shifted west. Excavation shows that Saxon London existed in the 7th Century at Aldwych and along the Strand (MALCOLM & BOWSHER 2003: 1). This meant the study area would have been peripheral to the main settlement at this time, lying around 1km north of the Strand. The site would have lain in the agricultural hinterland of this settlement.

3.4.2. Following the Norman Conquest in 1066, settlement activity in the study area gradually increased. To the east of the River Fleet lay Clerkenwell and to the south, the settlement area around St Andrews Church and along Holborn.

3.4.3. The site seems highly likely to have lain within the Medieval Manor of

Portpoole in the parish of St Andrew Holborn. This manor is not mentioned in the Domesday survey and so it can be inferred that it was an early Norman creation. This manor appears to have originally occupied the land north of High Holborn west of the River Fleet. The west east tributary of the Fleet later came to represent a parish boundary, but it can be assumed that the original manor extended north of this stream. The western limit is less certain.

3.4.4. During the Medieval period, the site lay within the lands of the Manor of Portpoole, north of the original location of the manor house. It seems most likely that the site itself lay in the fields of the manor throughout this period. The potential for significant archaeology on the study site is low.

3.5. POST MEDIEVAL

3.5.1. There is a rich source of documentary evidence for the study area from the 16th century onwards, this is complemented by a number of archaeological excavations.

3.5.2. The Agas map shows a raised bank of earth running along the west side of Gray's Inn Road. This map cannot, in the main, be treated as a highly accurate survey, even less so on the periphery of London. Nevertheless, should this be an accurate representation of an earth bank, this would be an interesting feature, possibly related to either a land boundary or to the maintenance of Gray's Inn Road itself.

3.5.3. Writing in around 1598, John Stow described the Inns of Court both within and without the Liberties of the City, indicating that Gray's Inn was well established in its function as an Inn of Court at this time (STOW 2005: 83). The only archaeological intervention within Gray's Inn (GYN06) did not encounter any archaeological deposits.

3.5.4. Stow also states that William Lamb a "gentleman and clothworker" built a conduit for fresh water in 1577 (STOW 2005: 113). Stow reports that various streams were brought to a head and then the water was taken by a lead conduit more than 2000 yards to Holborn Bridge (STOW 2005: 325). The route of the

conduit is not clear.

3.5.5. The 1720 map of the Parish of St. Andrew Holborn attributed to John Strype shows the first development on the west side of Gray's Inn Road north of Theobald's Road. It is difficult to tell if the development extends onto the study site, due to questions over the accuracy of the survey, however, it appears that the development was a series of houses along Gray's Inn Road with mews buildings at their rear. This is a fairly good indication that King's Mews itself dates to the period 1680 – 1720. The exact date and nature of this development is not clear from the map evidence alone. It is possible that the place name "King's Mews" relates to the former name of Theobald's Road, namely "the King's Way".

3.5.6. Rocque's Survey of London dated to 1746 (publication dates vary slightly) shows the ongoing development of the study area, but provides no further detail on the nature of the development on the study site itself.

3.5.7. Confirmation that the development on the east side of King's Mews was stables and garages comes in the form of a surveyors affidavit dated October 1776 confirming that the stables and coach houses erected on the east side of the street conformed to the requirements of the Building Act.

3.5.8. The excavated evidence from the study area complements this documentary material well. A large number of archaeological interventions have recorded Post Medieval activity. One group of such interventions, along the course of the Fleet, give quite a consistent picture of the 17th and 18th century infilling of the River Valley. This infilling would have taken the form of gradual encroachment onto the River and a silting up of the channel.

3.5.9. It seems highly likely that the extensive made ground deposits on the study site date to the 17th or 18th century, in line with other sites in the study area. There is high potential to encounter dumps of this age on the study site, although the significance of such remains is very low. There is medium potential to encounter remains of the initial development of the site dating to the late 17th century or early 18th century on the site.

4. Aims

4.1. The over-arching aim of the archaeological work is to mitigate the impact of the proposed development on the archaeological resource by preserving surviving archaeological remains by record.

4.2. The excavation work will result in the creation of as thorough and accurate a record of the archaeological deposits encountered as is reasonably possible, and understand the site and its significance as fully as possible in order to place the site within the wider landscape.

4.3. The specific aim of the excavation is:

- To identify the nature, extent and dating of the archaeologic deposits on site.
- To identify and date any palaeochannels or tributaries relating to the River Fleet.

5. Excavation Methodology

5.1. The proposed mitigation measures are comprised of three distinct elements of work being undertaken in four discrete areas. The extent of the works and methods to be employed in each element of the work are described below.

5.2. The main elements of work can be summarised as follows:

- Underpinning
- Piling
- Ground reduction for basement

5.3. The site occupies approximately 91m^2. Allowing for working room, the underpinning within the perimeter of the site boundary is proposed to be offset by at least 1metre (**FIGURE 3**). Thus the total size of required excavation for the underpinning trench will total c.24m^2, or 27% of the total site area.

5.4. The piling design has yet to be finalised, however, using the most structurally conservative scheme of approximately 8 piles (**FIGURE 4**), with a diameter of 600mm, this would impact a total of c.4.8m^2, or 5% of the total site area.

5.5. This would leave approximately c.59m^2, or 68% of the total site area that would be subject to an open area excavation (**FIGURE 5**).

5.6. At the present time there is not a detailed schedule or programme of works to indicate when these works will take place, however the sequence is likely to be as above.

5.7. Once this programme has been agreed and before site works commence, a supplement to this WSI will be submitted to the Historic England advisor and to the Local Planning Authority containing further more detail information about the exact design of the works to be employed on site.

5.8. UNDERPINNING

5.8.1. Where existing party walls are located, these areas will be underpinned in advance of the main development.

5.8.2. The frontage of the site, facing Kings Mews, will likely be underpinned in order to retain the road.

5.8.3. The current underpinning design is to excavate a trench offset c.1metre within the perimeter of the site. There is no set depth for the underpinning trench at this stage, and the depths will be dependant on the existing walls and geology.

5.8.4. The underpinning trench should extend circa 1meter into the study site measured from the party wall or frontage.

5.8.5. It is proposed that an archaeological watching brief is maintained during these works.

5.8.6. Should significant remains be encountered, then the archaeological team would take over the responsibility for the excavation itself. Under these circumstances, excavation will proceed within the underpin pit in accordance with the methodology for excavation set out below.

5.8.7. If important remains extend a short distance outside the limit of excavation of the pit, then excavation may be locally extended to preserve the integrity of the stratigraphic sequence. Should deposits extend a long way beyond the limits of excavation, the presumption is to leave these deposits in the ground so that they may be excavated under more controlled conditions.

5.8.8. Should significant deposits be encountered during underpinning, the impact of the piling strategy on these deposits should be assessed and inform piling design and placement.

5.9.PILING

5.9.1. The exact pile design and number of piles are yet to be finalised, however, at the time of writing, a total of 8 piles are proposed. The current proposal is to pile from the current ground level and trim the piles down simultaneously with the overall ground reduction.

5.9.2. There is currently no information as to whether piling probing will be required, however plant and other equipment will need to move across the site

during this phase.

5.9.3. The groundworks contractor shall be responsible for ensuring that no plant or other equipment moves across the site in a way that causes damage to underlying deposits. This may require the installation of temporary piling mats and/or temporary road structures. The archaeologist monitoring the works is to ensure that no underlying remains are disturbed and to ensure that the appropriate measures are put in place to prevent any such damage.

5.9.4. Should pile probing take place, the archaeological team will ensure that the probing is targetted and an absolute minimum of disturbance to archaeological deposits is achieved.

5.9.5. It will not be possible for the archaeologist to enter any probing trench and therefore any recording will be done from a safe position outside the trench.

5.9.6. Should significant deposits be encountered during probing, the impact of the piling strategy on these deposits should be assessed and inform piling design and placement.

5.9.7. Should no probing be required, piling will be monitored to ensure that pile placement is accurate and that a dialogue between L - P : Archaeology and groundcrew is maintained, in order to inform on any change of design.

5.10. OPEN AREA EXCAVATION

5.10.1. Modern made ground, concrete and remnants of any piling mat will be removed carefully under watching brief conditions down to the top of the archaeological deposits.

5.10.2. Overburden and modern deposits will be removed under a strict archaeological supervision according to the watching brief methodology set out below.

5.10.3. The entire area will then be subject to a rigorous "top-clean" to remove modern remains. This process may involve the removal of large or deep deposits. This process may require the breaking out of modern concrete

remains by machine or by hand.

5.10.4. It is vital that the field officer (senior archaeologist on site) makes the correct informed decision to remove all modern remains at the first instance as it will be difficult to re-enter the trench with a machine after the initial stripping.

5.10.5. A further key objective is to ensure that no underlying archaeological deposits are damaged during this removal process.

5.10.6. Once the overburden has been cleared, a site grid will be established across the area and excavation will progress according to the standard excavation methodology established below.

5.10.7. Given the volume in cubic metres and expected homogeneity of the archaeological make up layers on the site, once recorded in plan, machine excavation will likely be used to remove large homogenous deposits identified during the hand excavation.

5.10.8. Once the next deposit horizon has been reached, hand excavation of the site will recommence.

5.10.9. This process will then be repeated all the way down to the natural geology or the site formation level whichever is the higher.

5.10.10. In addition to the hand excavation according to the standard excavation methodology set out below, further sampling in the form of bulk samples or monoliths on the expected alluvial deposits may be considered appropriate following consultation with the Historic England Regional Science Advisor.

5.11. GENERAL WATCHING BRIEF METHODS

5.11.1. During the Watching Brief elements of the project the following methods will be employed.

5.11.2. An archaeological watching brief will cover ALL breaking and mechanical removal of modern material. One archaeologist must be present for every machine being used. The removal of modern material will be to the level identified by the archaeologist.

5.11.3. During the removal of overburden, care will be taken to reduce levels using appropriately sized plant and a toothless bucket. Removal of overburden is to be undertaken only under the supervision of a member of the project team.

5.11.4. Once archaeological levels have been reached these will be cleaned and excavated by hand according to the general excavation techniques set out below.

5.12. GENERAL EXCAVATION METHODS

5.12.1. Any modern overburden will be removed by machine under the supervision of an archaeologist. Recent make-up deposits and bulk deposits may be removed by machine after identification with hand cleaning. Appropriate plant will normally be a 360 degree tracked excavator with a toothless bucket. A breaker may be required to remove hardstanding or other obstacles.

5.12.2. Examination and cleaning of all archaeological deposits will be by hand using appropriate hand tools.

5.12.3. All features are to be recorded stratigraphically.

5.12.4. All archaeological deposits will be examined and recorded in accordance with the recording system set out below (SECTION 7).

5.12.5. Hand excavation by context is required for all archaeological deposits. For example these may include:

- Ditch or linear feature termini and inter-sections.
- Clusters of cuts and re-cut features.
- Post holes.
- Any structural evidence.
- Areas of organic potential.
- Burials and Human Remains.

5.12.6. Each significant archaeological horizon, will be hand excavated to meet the

research requirements of the excavation:

- Pits and postholes will normally be fully excavated.
- Linear features will be sectioned as appropriate.
- Excavated material will be examined in order to retrieve artefacts to assist in the analysis of the spatial distribution of artefacts.

5.12.7. Should archaeological deposits be encountered that are worthy of preservation *in situ,* excavation will cease. A site meeting will be held to assess the significance of the deposits and to decide on a strategy for sampling them to provide sufficient data for a useful assessment or subsequent mitigation strategy.

5.12.8. Large homogenous deposits may be removed by machine following appropriate hand cleaning and identification. This hand cleaning should take the form of examination in plan and in section, using hand excavated sondages if required. Use of machine to remove such bulk deposits is to be at the discretion of the field officer. Due care is to be taken to ensure that plant does not track over sensitive archaeological remains and where necessary appropriate protection must be laid down over the archaeological remains to prevent damage.

5.12.9. All works will be carried out in accordance with the relevant Standard and Guidance as set out by the Chartered Institute for Archaeologists (2014A). The project team will also abide by the GLAAS guidance (HISTORIC ENGLAND 2015).

6. Finds

6.1. GENERAL STRATEGY

6.1.1. United Kingdom Institute for Conservation guidelines for the preparation of excavation archives for long-term storage (WALKER 1990) will be followed. Arrangements for the curation of the site archive will be agreed with the Museum of London.

6.1.2. Pursuant to these agreements the archive will be presented to the Museum of London within 12 months of the completion of the fieldwork (unless alternative arrangements have been agreed in writing with the Local Planning Authority or Historic England). In addition, written confirmation from the client will be provided for the transfer of ownership.

6.2. COLLECTION POLICY

6.2.1. All identified finds, artefacts, industrial and faunal remains will be collected and retained in accordance with the finds retrieval policies of the Museum of London as specified in the Archaeological Site Manual (SPENCE 1994). No finds will be discarded without the prior approval of the curatorial departments of the Museum of London.

6.2.2. Unstratified finds will be collected and retained in accordance with the guidelines (MUSEUM OF LONDON 2009).

6.2.3. Material dating to the 19th century shall be retained and included with the finds assemblage.

6.2.4. The finds assemblage will be retained for deposition with the site archive in the Museum of London Archaeological Archive and Research Centre.

6.2.5. The potential presence of bulk materials from the bowling green deposits and possible demolition deposits means that a structured sampling approach may be required. It is important that this policy be determined in accordance with the properly qualified specialist. Due care should be taken to ensure that any such strategy takes into account the future research potential of the material.

Should such a strategy be required, the nature of this strategy will be agreed in writing as an addendum to this WSI with the Historic England advisor to the Local Planning Authority.

6.3. CONSERVATION

6.3.1. All members of the excavation team will be aware of the latest practice in dealing with finds on site. A copy of *First Aid for Finds* (LEIGH 1998) will be available in the site office alongside the recording manuals.

6.3.2. Should specialist on site conservation be required, this will be supplied by MoLA.

6.3.3. Packaging of all organic finds and metalwork will follow the UKIC/Rescue guidelines: *First Aid for Finds* (LEIGH 1998). Any necessary, conservation and treatment of metalwork will be arranged in conjunction with specialist conservators.

6.3.4. All finds and samples will be treated in a proper manner and to the standards of the Museum of London. They will be exposed, lifted, cleaned, conserved, marked, bagged and boxed in accordance with the guidelines set out in the United Kingdom Institute for Conservation *Conservation Guideline No. 2 (UNITED KINGDOM INSTITUTE FOR CONSERVATION 1983)*. Appropriate guidance set out in *Standards in the Museum Care of Archaeological Collections (MUSEUMS AND GALLERIES COMMISSION 1992)* will also be followed as well as the current CIfA guidelines (CHARTERED INSTITUTE FOR ARCHAEOLOGISTS 2014B).

6.4. FINDS PROCESSING

6.4.1. Materials will be removed from site and processed at L - P : Archaeology's finds processing facility.

6.4.2. All finds will be cleaned, processed, conserved, marked, bagged, boxed and recorded in accordance with the *General Standards for the preparation of archaeological archives deposited with the Museum of London* (MUSEUM OF LONDON 2009). This will ensure that they are ready for rapid deposition at the

Museum of London.

6.5. SPECIALIST ANALYSIS

6.5.1. On completion of the fieldwork, the site archive will be made ready for assessment by the relevant specialists.

6.5.2. The assessment reports on the significance and value for further research of the assemblages will be made at this time. The assessment is intended to consider the potential for further analysis of the archive in light of the research aims set out in this document.

7. Environmental Strategy

7.1. INTRODUCTION

7.1.1. Site specific borehole information has identified alluvial deposits with a potential for survival of environmental remains.

7.1.2. The sampling strategy set out here seeks to directly answer the research questions posed in SECTION 4 of this WSI.

7.2. PALAEO-ENVIRONMENTAL AND PALAEO-ECONOMIC SAMPLING STRATEGY

7.2.1. Aims of sampling are principally to recover palaeo-economic data relating specifically to the low level of activity and debris on site, to aid in characterising the area and interpreting the activities performed on, and around, the excavated location.

7.2.2. Function, Activities and Economy:

- define and characterise the function and activity associated the few features
- define the changing economic use of this land
- define the lived-in environment of the area

7.3. PRINCIPLES

7.3.1. Sampling will be predominately of bulk samples from dated or dateable contexts/features. Sample size of 30 litres is preferred, but each sample must be context specific and as such in some cases sample size will be smaller than that nominally anticipated.

7.3.2. A series of bulk samples (for charred plant and charcoal remains) will be taken from a range of feature types in each phase/period, but concentrating on features outlined above.

7.3.3. A select series of bulk samples from waterlogged deposits will be taken from key contexts. These will be generally 10 litres, but up to 30 litres (or greater)

to recover artefacts.

7.3.4. Geoarchaeological description may be undertaken through appropriate exposures of the ditch deposits or palaeochannels if deemed to be of value in addressing the research aims.

7.3.5. Sample types:

- Bulk sample 30 litres size for charred plant and charcoal remains, mineralised plant macrofossils and molluscs
- Bulk sample 10 to 30 litres for waterlogged plant remains and insects
- Bulk samples for cremated bone and charred plant and charcoal remains
- Bulk samples 30 to 50 litres for small mammal bones
- Specialist samples of 5 litres in continuous vertical sequence through ditch fills for molluscs, plant macrofossils and ostracods
- Monolith/kubiena samples

7.4. SITE SPECIFIC SAMPLING STRATEGY

BULK SAMPLES FOR CHARRED PLANT REMAINS (CPR), MINERALISED PLANT MACROFOSSILS AND MOLLUSCS

7.4.1. Bulk disturbed samples will be removed from a series of dated and dateable contexts, and primarily from contexts or features with good evidence of archaeological artefacts/activity. The sampling programme will ensure that a range of feature types are sampled from each of the main phased periods. Sampling will concentrate in particular on pits and single-event deposits.

7.4.2. In the unlikely event of cremation burials, and cremation-related deposits being present they will be fully sampled primarily for the recovery of small human bone fragments, but a selection will be isolated for flotation and the recovery of charred plant and charcoal remains, to aid in the interpretation of pyre technology and funerary practices.

BULK SAMPLES FOR INSECTS AND WATERLOGGED PLANT REMAINS

7.4.3. A picture of the local and natural surrounding environment may be provided by the preservation of insects and waterlogged plant remains in deeper, and waterlogged, features. All major, and a selection of other minor, deposits will be spot sampled. Where deposit sequences are present which encompass any significant span, then a series of samples will be taken through the deposit.

ANIMAL BONES AND SHELL

7.4.4. Sampling for recovery of fragmented large animal bone, fish bone and shells of edible marine molluscs will follow L - P : Archaeology standard practice.

SMALL MAMMAL BONES

7.4.5. Bulk samples for small mammal bones (pit fall victims) will be taken from a few pits to aid in the interpretation of the local natural and lived in environment.

GENERAL

7.4.6. A range of bulk samples for the recovery of charred plant remains, charcoal and industrial activity should be removed from a selection of:

- well-dated contexts
- clearly dumped and disposed debris (e.g. in pits)
- working areas

7.4.7. Sample size should follow recommendations by Historic England guidelines on environmental archaeology (CAMPBELL ET AL. 2011), and the standard applied by L - P : Archaeology as advised by the L - P : Environmental Consultant, taking into account any comments from the environmental consultant, Historic England Regional Science Advisor and the Historic England advisor to the Local Planning Authority.

7.4.8. Bulk samples from deeper features should be taken to assess, and sample for, the presence of waterlogged material (see feature-specific comments).

7.4.9. Consideration should be given to monolith sampling of well-dated, relatively long time sequences, if they occur, to provide an environmental and economic context (pollen and diatoms) for the site and also to aid in the interpretation of any feature-specific deposition or formation process (geoarchaeology).

OTHER FEATURE/CONTEXT -SPECIFIC COMMENTS

7.4.10. Dump deposits will be subject to systematic sampling. The exact number and location of samples is to be defined during fieldwork by the L - P : Environmental specialist in agreement with the Historic England Regional Science Advisor and the Historic England advisor to the Local Planning Authority.

7.4.11. Bulk samples (CPR) should be taken to evaluate and characterise the nature of this deposit.

7.4.12. A simplified feature by feature sampling guide is given below which can be displayed in the site office as a more immediate prompt and *aide memoir*.

7.5. FEATURE-TYPE SAMPLING REQUIREMENTS

7.5.1. In order to make the site specific sampling strategy easily implementable on-site, a pragmatic summary guide to sampling is set out in the table below.

7.5.2. This table should be copied and put up in a handy location on site such as the wall of the site accommodation.

Feature	Reason and Aim	Sample
Pits	especially from well-dated or artefact bearing contexts	bulk sample (CPR)
Well dated Post Medieval pits	especially from single event dumps or accumulations and artefact-rich contexts	selection of key features and contexts – bulk sampling (CPR)

Waterlogged deposits	as pits – but in deep sequences a series of samples could be advantageous	waterlogged samples (insects and plant remains)
Postholes	only if a) well-dated by artefacts or association, b) charcoal-rich for post timber	bulk sample (CPR)
Hearths	charcoal to feature function and examine woodland resources and management	bulk samples (CPR)
Burials	Defined deposits only	
Vessels	selection of vessel fills, especially those associated with funerary practices	bulk sample (CPR)
Cremation burials	to examine pyre technology and recover cremated bone	bulk sample (CPR and cremated bone)
Cremation-related deposits	Bulk sample to help define if these are cremation-related deposits	bulk sample (CPR)
Boundary ditches etc	Occasional sample, but especially from clearly dumped and artefact-rich deposits	bulk sample (CPR) vertical sequence of specialist samples
Quarry pits	None – unless there are clearly dumped and artefact rich-deposits	bulk sample (CPR)
Palaeochannels	interpret this material and potentially characterise by geoarchaeological description	bulk sample (CPR) kubiena sample

8. Human Remains

8.1. Human remains are unlikely to be encountered on the site, if they are then the following methodology will be employed:

8.2. CONSENTS

8.2.1. If human remains are encountered, in the first instance the Police must be informed at the earliest possible opportunity. Where the remains are clearly archaeological, care should be taken to explain the nature of the archaeological works carefully to the Police to prevent alarm or misunderstanding.

8.2.2. A license to excavate the remains must then be sought from the Ministry of Justice.

8.3. SITE SPECIFIC EXCAVATION METHODS

8.3.1. At all stages of archaeological work, human remains encountered will be treated with care and respect. All human remains, articulated or otherwise, will be retained. Burials will be excavated and recorded according to the standards laid out in McKinley and Roberts (MCKINLEY & ROBERTS 1993) and the Museum of London Archaeological Site Manual (SPENCE 1994). No remains will be left exposed overnight.

8.3.2. Remains will be retained on site in secure storage prior to transfer to the processing facilities.

8.3.3. Digital record photographs will be taken of all inhumation and cremation burials and significant deposits of disarticulated bone as part of the recording process. Publication quality photographs will be taken of all graves containing burial artefacts, and any burials considered of particular osteological or archaeological interest. Individual orthorectified digital photos will also be taken for each burial. These will be georeferenced to the National Grid and may be used in the digitisation of skeletons or as is in the site GIS.

8.3.4. Infant and neonatal burials and, where appropriate hands and feet, will be block-lifted to ensure full recovery. Where foetal remains are found in situ,

they will be given a unique context number but will be retained with the remains of the mother throughout the post-excavation process.

8.3.5. The 100% sampling of the basal fills of any and all graves which do not appear to contain human remains ('empty' graves) will be carried out to check for the presence of teeth and bone fragments. This sampling strategy will be subject to review by the project osteologist during excavation.

8.3.6. The skeleton will be lifted and placed in archive quality perforated plastic bags each containing two tyvek labels with site code, context number and details. Arms, legs, hands, feet, torso and skull will be placed in separate bags with the limbs, hands and feet separated into right and left sides. These will be placed in a large clear plastic bag to ensure that the integrity of each burial is retained.

8.3.7. Cremated bone will be excavated according to Brickley and McKinley (BRICKLEY & MCKINLEY 2004): all suspected cremation deposits will be 100% sampled, cinerary vessels containing burnt bone will be lifted (after seeking advice from the project conservators where appropriate) and excavated under laboratory conditions by the an osteologist.

8.4.PROCESSING

8.4.1. Treatment of all remains and samples will be to professional standards, those of the receiving body and in accordance with United Kingdom Institute for Conservation guidelines (UNITED KINGDOM INSTITUTE FOR CONSERVATION 1983).

8.4.2. Specialist processing staff will wash all human remains. The block lifted remains of neonates and infants will be processed using a floatation tank or bucket sieve with a 1 mm mesh to ensure complete recovery. All other inhumed remains will be washed over a 1 mm mesh. Once dry, inhumations will be bagged and boxed according to the requirements of the receiving body. The arms, legs, hands, feet, torso and skull will be placed in separate bags each containing two tyvek labels. The limbs, hands and feet will be separated into right and left sides. The remains will be placed in a clearly labelled box lined with jiffy foam. Human bone will not be marked.

8.4.3. Samples containing cremated human bone and samples from basal grave fills will be wet-sieved over a 1 mm mesh, dried and sorted. Cremated bone will be in an un-perforated bag and boxed together with the associated residue.

8.5. ASSESSMENT

8.5.1. Assessment of all stratified deposits of human remains will be carried out by a suitably qualified osteologist according to English Heritage Centre for Archaeology Guidelines 2002 (MAYS ET AL. 2002) and MoLA standards (POWERS UNPUBLISHED). Assessment data for inhumations and cremated remains will be recorded in an Excel format. Assessment of inhumations will use a coding system compatible with that used at analysis. A summary catalogue of disarticulated bone will be produced.

8.6. ANALYSIS

8.6.1. Analysis of inhumed remains will be carried out to recognised standards (BRICKLEY & MCKINLEY 2004) and the method statement of the Museum of London.

8.6.2. Inhumations will be recorded to the Museum of London Oracle database. Enabling comparison with all other sites analysed in the past four years at the Museum of London.

8.6.3. The analysis of cremated bone will be carried out according to (MCKINLEY & ROBERTS 1993) and (BRICKLEY & MCKINLEY 2004). Cremated remains will be recorded in a standardised Excel format.

8.6.4. All treatment of vulnerable or fragile bones required for photography or display, will be carried out by the L - P : Archaeology osteologist.

9. Recording System

9.1. The site code will be allocated by the Museum of London. This code will be used to label (using appropriate materials not adhesive labels) all sheets, plans and other drawings; all context and recording sheets; all photographs (but not negatives); all other elements of the documentary archive.

9.2. The recording system used will follow the Museum of London Archaeological Site Manual (SPENCE 1994).

9.3. STRATEGY

9.3.1. Our strategy for the archive conforms with our overall philosophy for the project. The maximum amount of record checking and interpretation should take place in the field and be transferred there and then into the archive.

9.3.2. In addition to the paper archive, an ARK database will be used to help this process (ARK DEVELOPERS 2016). The use of a database for context information as well as a linked GIS for spatial information is intended to provide a powerful tool for the ongoing interpretation and publication of the site.

9.3.3. The integrity of the site archive will be maintained during the course of the project and will be deposited for long term curation with the Museum of London. See SECTION 12 for further details on the archive.

9.4. THE WRITTEN RECORD

9.4.1. The written archive will consist of recording pro-forma recording sheets that are based on the Museum of London "single context" system and conform to the standards for archive deposition so as to ensure maximum cross archive compatibility.

9.4.2. Register sheets will be employed to act as master indices of all types of documentary resources. In particular a context register will be maintained at all times that acts as a master list of the contexts that have been issued.

9.4.3. Sample registers, finds recording sheets, access catalogues, and photo registers

will also be used.

9.4.4. Context sheets will contain individual descriptions of all archaeological strata and features excavated or exposed.

9.4.5. Context sheets will include all relevant stratigraphic relationships and a separate matrix diagram will also be employed.

9.4.6. The matrix for each trench will be fully checked during the course of the excavation. The field officer will be ultimately responsible for ensuring the integrity and completion of the matrix. The matrix will also form an integral part of the digital archive.

9.4.7. The back of all sheets will be printed with a grid for sketches and notes. Such notes and marginalia are considered an essential part of the record.

9.4.8. Documentary material including the paper archive, photographic negatives and prints will be stored in boxes to the standard required for submission into the Museum of London.

9.4.9. If there is any doubt over recording techniques and terminology, the Museum of London Archaeological Site Manual will be used as a guide (SPENCE 1994). Copies of the manual will be available on site in the site office.

9.5. THE DRAWN RECORD

9.5.1. A site location plan will be added into the site GIS based on the OS Mastermap data. This will be made available on paper and digitally in the site office. This base data will be used to show the investigation area and development site in relation to the surrounding locality and street pattern.

9.5.2. This base data will be supplemented by GIS shapefiles, which will show the location of the areas investigated in relation to the investigation area and OS grid. The locations of any OS bench marks used and site TBM will also be indicated. Again, this data will be available in digital form and as paper copies in the site office throughout the project.

9.5.3. The extent of any visible archaeological deposits will be recorded in plan by

the excavator of the context using 6H pencil on the provided permatrace drawing sheets at 1:20.

9.5.4. The drawing sheet should be completed in accordance with the Museum of London manual. Drawing conventions and line types are set out in detail in the manual. Drawings must also include: context number, grid square, matrix information and levels information.

9.5.5. Significant or complex deposits can be drawn at a higher scale such as 1:10 provided that the drawing is clearly marked as such.

9.5.6. Sections containing significant deposits, may be drawn. This should be at an appropriate scale, usually 1:10 or 1:20. All sections will be related to the Ordnance Datum using spot heights and registers of sections and plans will be kept.

9.5.7. Sketch plans and other drawings should be made on the back of context sheets, which have a grid printed to assist drawing. Such sketches provide valuable additional information and should be annotated in as much detail as possible.

9.6. THE PHOTOGRAPHIC RECORD

PRIMARY RECORD

9.6.1. Primary archive photographs will be taken by a nominated photographer(s) using a Fuji XT1 digital SLR. 35mm negative film such as Ilford FP4+ or medium format (120 roll film) may also be used where appropriate.

9.6.2. The photographic record will be sufficiently thorough and detailed to illustrate all significant phases, structures, important stratigraphic and structural relationships, and individual items of interest, including artefacts. If in doubt, most completely excavated contexts should be photographed.

9.6.3. All site photographs will include a photographic scale of appropriate size. Where appropriate a board giving context number, north arrow and date should be employed.

9.6.4. Digital files will be downloaded on a daily basis and backups sent to a secure

offsite location such as the L - P : Archaeology London office server. The camera will then be set to charge and all settings returned to their defaults.

9.6.5. Any films will be processed immediately on their completion. Processing and archival storage of all prints negatives and transparencies will be to Museum of London standards at the time of processing. No photographic materials will be kept in temporary storage media at any time.

9.6.6. Photographic negatives will be stored in archival quality polypropylene sleeves with strip divisions, three ring holes, centres 107mm apart and dimensions no greater than, 255mm (from the punched side to the opposite edge) by 300mm. The sleeve should have a white writing strip.

WORKING SHOTS

9.6.7. Working shots should illustrate both the general nature of the archaeological operation and also all of the key features photographed for the primary record.

9.6.8. Working shot photographs will be taken both by the nominated photographer and all other members of the team. These shots will be made using the Fuji XT1 digital SLR. Negative film and colour transparency film may also be employed where appropriate.

METADATA AND REGISTERS

9.6.9. Metadata will be created for each photograph. This may be recorded in the form of a paper photographic register using the L - P : Archaeology pro-forma sheet, or be entered directly onto the ARK database.

9.6.10. All images and their accompanying metadata will be uploaded to the project's ARK database.

9.7. SURVEY

9.7.1. A 5m x 5m site grid will be defined before fieldwork commences within the GIS system. This grid will then be tied in to the Ordnance Survey national grid and laid out using a Total Station or DGPS system by the team's surveyor.

9.7.2. Grid points will be marked using appropriate markers. Within trenches this will usually be in the form of steel pins. In public areas this may be by use of spray paint and survey markers. Grid point markers will be checked and relayed as necessary during the course of the project.

9.7.3. Basic site surveying and scale drawing will be undertaken by the excavation team using 30m tapes laid out between the 5m grid markers.

9.7.4. A level will be present on site at all times and all members of the site team will take levels for entry on the pro-forma plan sheets, context sheets and drawn sections.

9.8. GEOGRAPHICAL INFORMATION SYSTEM (GIS) AND DATABASE

9.8.1. The entire drawn archive will be scanned, georeferenced to the National Grid, digitised using ARKPlan, and maintained within a GIS. All other related non-spatial data (context, photographic, and finds archives) will be linked to it from an ARK system.

9.8.2. All plans will be scanned, georeferenced, and digitised using ARKPlan on a daily basis to allow for easy and rapid production of printed plans for the archaeologists in the field.

9.8.3. The context records will be entered into an ARK digital database on a regular basis.

10. Post Excavation Assessment Report

10.1.A formal report on the results of the archaeological works will be prepared on completion of the fieldwork. The report will conform to MORPHE (ENGLISH HERITAGE 2009):

- A non-technical summary (abstract).
- Introductory statements and site background.
- The aims and methods adopted in the course of the evaluation.
- A description of the nature, extent, date, condition and significance of all archaeological deposits recorded during the works, with specialist opinions and parallels from other sites if required.
- Illustrative material including maps, plans, sections, drawings and photographs as necessary.
- A catalogue of finds, including any specialist reports.
- A discussion and summary of the results, including a statement of significance.
- An index of the contents and location of the archive.
- Sources consulted.
- A copy of the OASIS record sheet.

10.2. Following approval, two bound copies of the report will be sent to the client. Subject to any contractual requirements on confidentiality, copies of the report will be submitted to Historic England within six months of completion of the report.

10.3. On completion of the assessment report, an Updated Project Design (UPD) will be produced. This will set out the revised research aims for the final analysis stage of the project. This will also included a revised publication proposal and detailed synopsis of the publication.

10.4.L - P : Archaeology shall retain full copyright of any report under the Copyright, Designs and Patents Act 1988 with all rights reserved; excepting that it hereby

provides an exclusive licence to the client in all matters directly relating to the project as described in this document. Any document produced to meet planning requirements can be copied for planning purposes by the Local Planning Authority. Any information deposited in the Sites and Monuments Record or Historic Environment Record can be freely copied without reference to the originator for research or planning purposes.

11. Publication, Outputs & Community Involvement

11.1. FINAL ANALYSIS AND PUBLICATION

11.1.1. On completion of the Post Excavation Report and Updated Project Design (see SECTION 11), a final stage of analysis will be undertaken. The scope of this analysis work will be set out in the UPD.

11.1.2. The results of the excavation will be published in an appropriate academic journal (such as LAMAS) or in an appropriate alternative format such as a monograph series. The UPD will contain a detailed publication proposal including a publication synopsis including approximate word limits, figure counts and overall size.

11.2. OTHER OUTPUTS

11.2.1. The project will publish the site archive in a digital form through the use of an ARK online database.

11.2.2. Detailed inquiries from members of the public regarding the construction works, or potentially sensitive information, will be directed to the project manager.

12. Archive

12.1. The site code will be used to mark all plans, drawings, context and recording sheets, photographs and other site material during excavation.

12.2. The site archive will be so organised as to be compatible with current requirements of the Museum of London. Individual descriptions of all archaeological strata and features excavated or exposed will be entered onto *pro-forma* recording sheets. Relevant context, sample and photograph registers and environmental sample sheets will also be used.

12.3. The landowner will sign a Deed of Transfer transferring title of the entire archive including finds and documentary materials to the Museum of London for long term curation and public access.

12.4. The integrity of the site archive will be maintained. All finds and records will be curated (subject to the Deed of Transfer) by the Museum of London and be available for public consultation. Appropriate guidance set out in the MGC "Standards in the Museum Care of Archaeological Collections" (MUSEUMS AND GALLERIES COMMISSION 1992), and the "Selection, Retention and Disposal of Archaeological Collections" (SOCIETY OF MUSEUM ARCHAEOLOGISTS 1993) will be followed in all circumstances.

12.5. United Kingdom Institute for Conservation guidelines for the preparation of excavation archives for long-term storage (WALKER 1990) will be followed. With consent of the landowner, arrangements for the curation of the site archive will be agreed with the appropriate museum.

12.6. Pursuant to these agreements the archive will be presented to the appropriate museum within six months of the completion of the fieldwork (unless alternative arrangements have been agreed in writing with the Local Planning Authority or English Heritage). In addition, written confirmation from the client will be provided for the transfer of ownership.

12.7. The project will be registered and regularly updated as part of the OASIS project.

12.8. The Museum of London shall be granted licence for the use of the archive for

13. Access and Site Monitoring

13.1. The Historic England advisor to the Local Planning Authority should be given notice of at least one working week prior to the commencement date of site works.

13.2. Reasonable access to the site will be arranged for the Local Planning Authority and GLAAS Advisors who will wish to make weekly site inspections to ensure that the archaeological investigations are progressing satisfactorily. A regular day and time for the meetings will be established once site works are under way.

13.3. In conjunction with the weekly site visits, a weekly progress report will be produced by the Project Manager. This will briefly detail progress on site as well as relevant findings and any other logistical matters affecting the programme.

14. Safety

14.1. Before any site work commences, a full Risk Assessment Document will be produced setting out the site specific health and safety policies that will be enforced in order to reduce to an absolute minimum any risks to health and safety.

14.2. As L - P : Archaeology are not the Principal Contractor on this site, the archaeological team will follow all guidelines and requirements as set out by the Principal Contractor. The Principal Contractor will provide barriers, hoardings and warning notices will be installed as appropriate.

14.3. All relevant health and safety law and regulations will be followed by the archaeological team. Appropriate PPE including safety helmets, boots and visibility jackets will be used by all personnel as necessary.

15. Staffing and Timetable

15.1. The project manager is Guy Hunt of L - P : Archaeology. The project manager will be responsible for the overall coherency of the team and for the management of the archaeological evaluation.

15.2. The field team will be lead by and appropriately qualified and experienced archaeologist, who will act as a field officer. The field officer will coordinate the fieldwork and field team. The field officer is responsible for the coherency of the fieldwork and the coordination of the site records and integrity of the documentary archive.

15.3. The field officer will supervise an excavation team composed of supervisors and excavators who will have appropriate experience of excavation in complex urban stratigraphy. Supervisors must have experience of excavating Post Medieval structural remains.

15.4. Finds and environmental material will be analysed by appropriately qualified specialists who have experience in the analysis of material from London.

15.5. The team will include a team member responsible for digitisation of the site records and the maintenance and survey of the site grid.

15.6. Matthew Law will act as the senior archaeo-environmental consultant and will be on hand to advise on the on-going sampling of the site.

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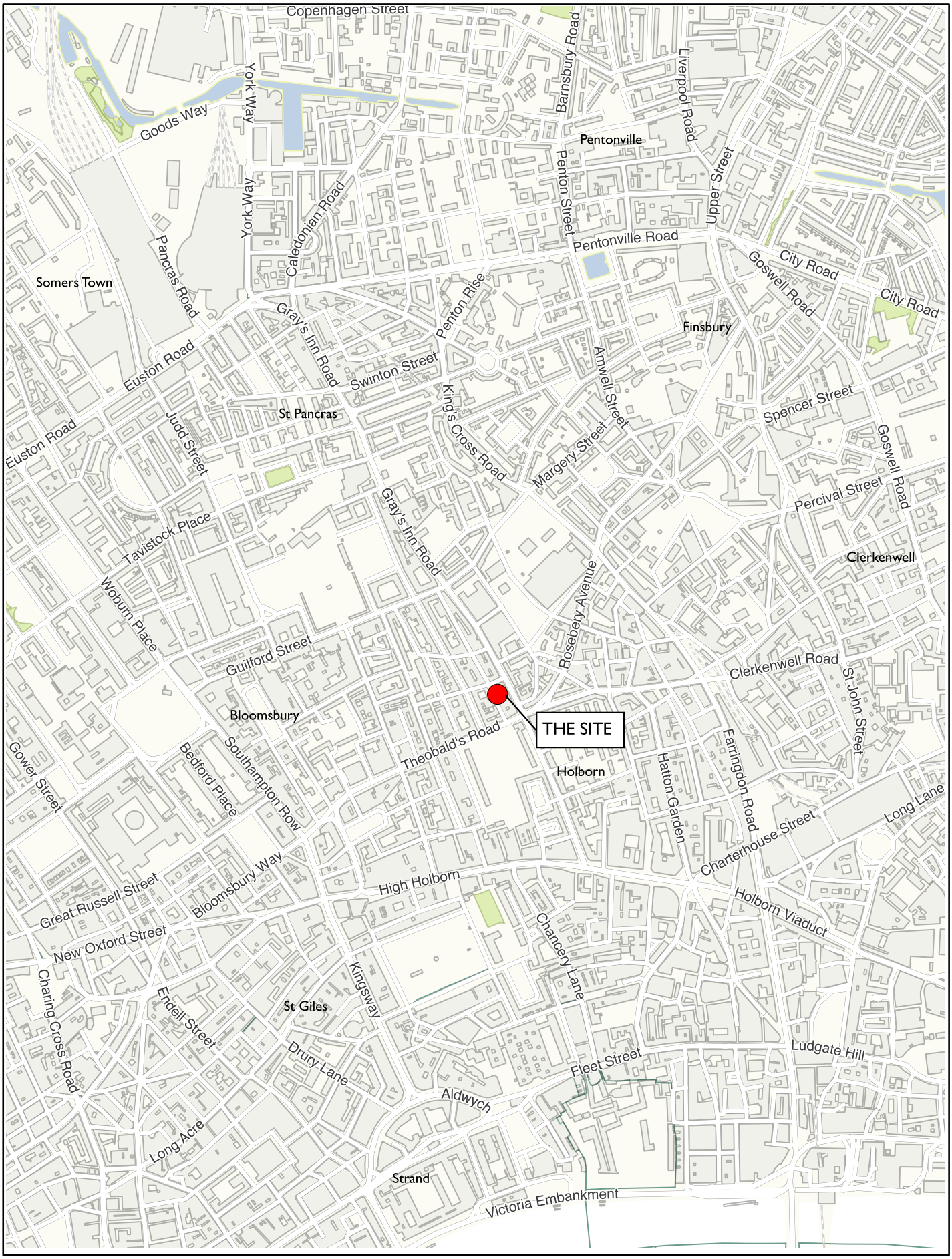
FIGURES

FIGURE1 // Site Location - General



0 500 m

N

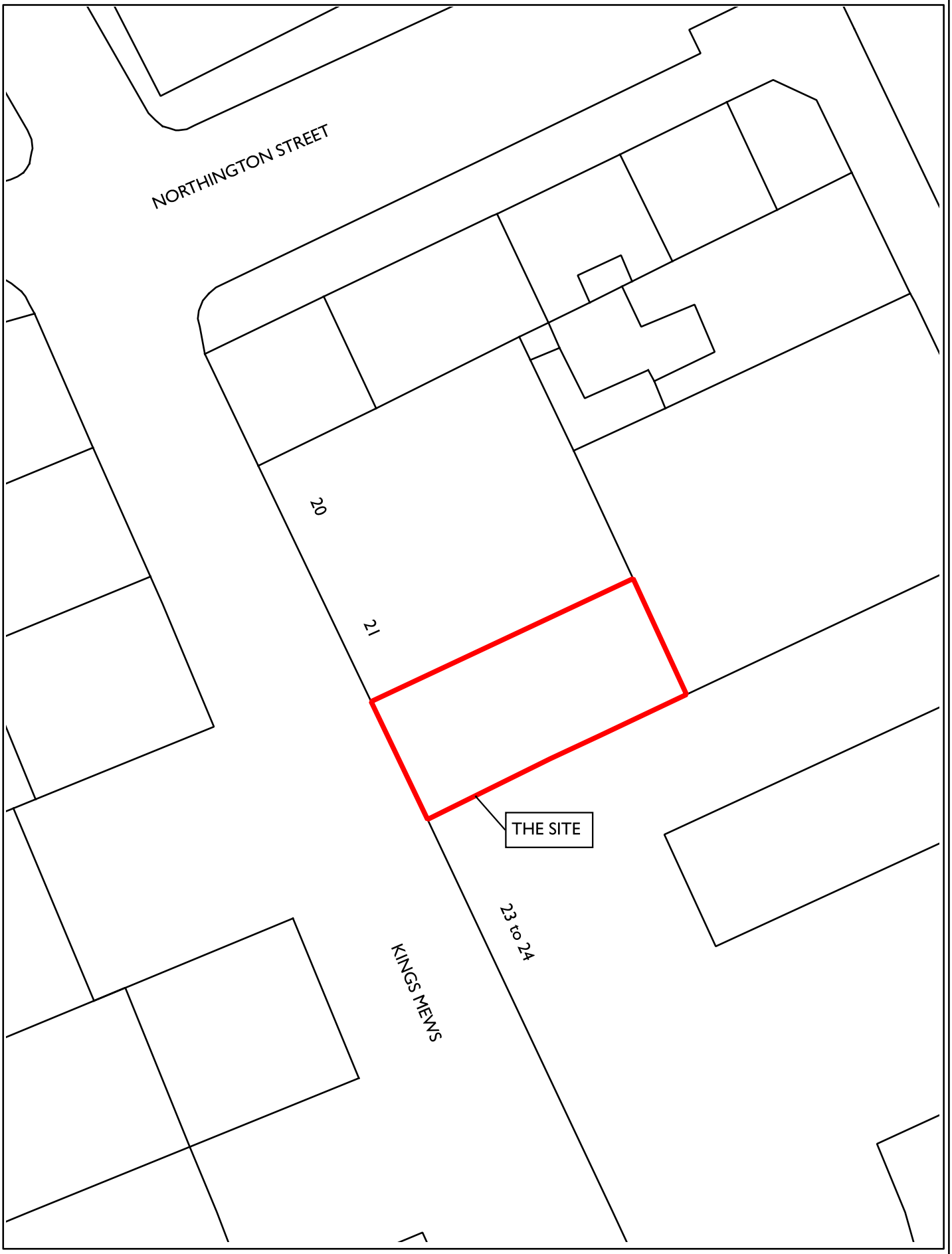
PROJECT // 1429L - Kings Mews

DESCRIPTION // Site Location

DOC REF: LP1429L-WSI-v1

L-P:ARCHÆOLOGY

FIGURE 2 // Site Location - Detail



0 10 m

N

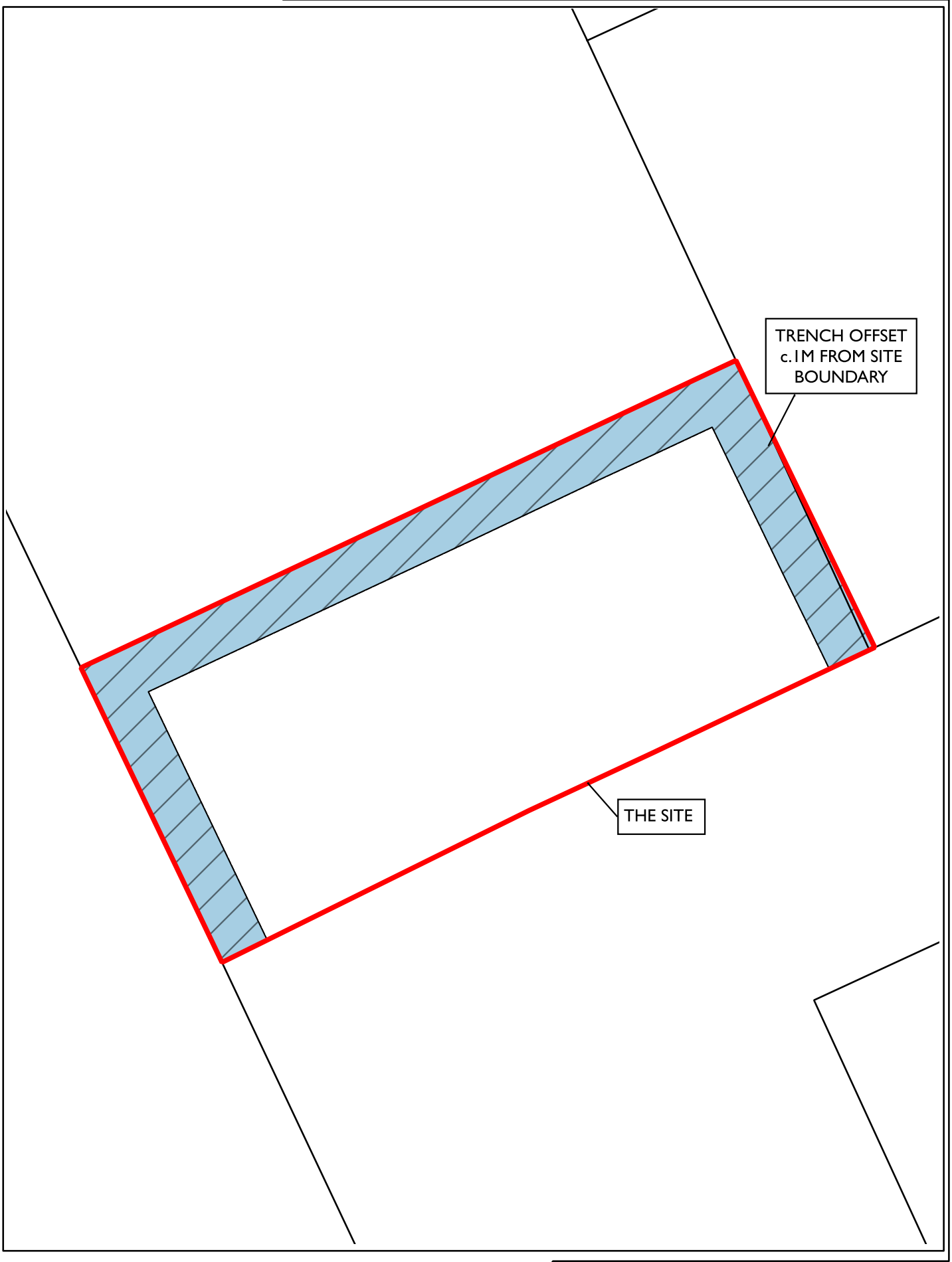
PROJECT // 1429L - Kings Mews

DESCRIPTION // Site Location - Detail

DOC REF: LP1429L-WSI-v1

L-P:ARCHÆOLOGY

FIGURE 3 // Underpinning Trench



0 5 m

N

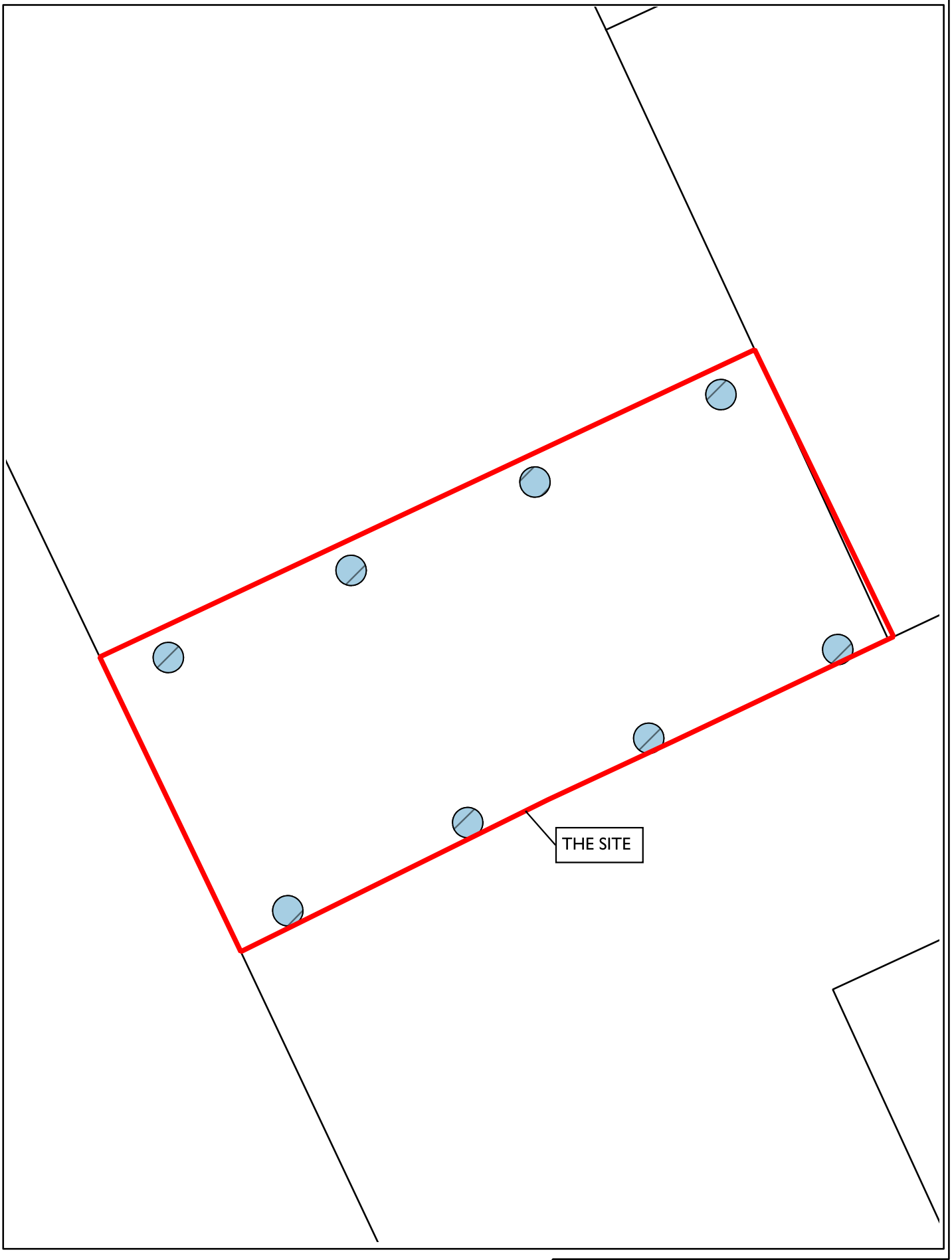
PROJECT // 1429L - Kings Mews

DESCRIPTION // Underpinning Trench

DOC REF: LP1429L-WSI-v1

L-P:ARCHÆOLOGY

FIGURE 4 // Indicative Pile Locations



0 5 m

N

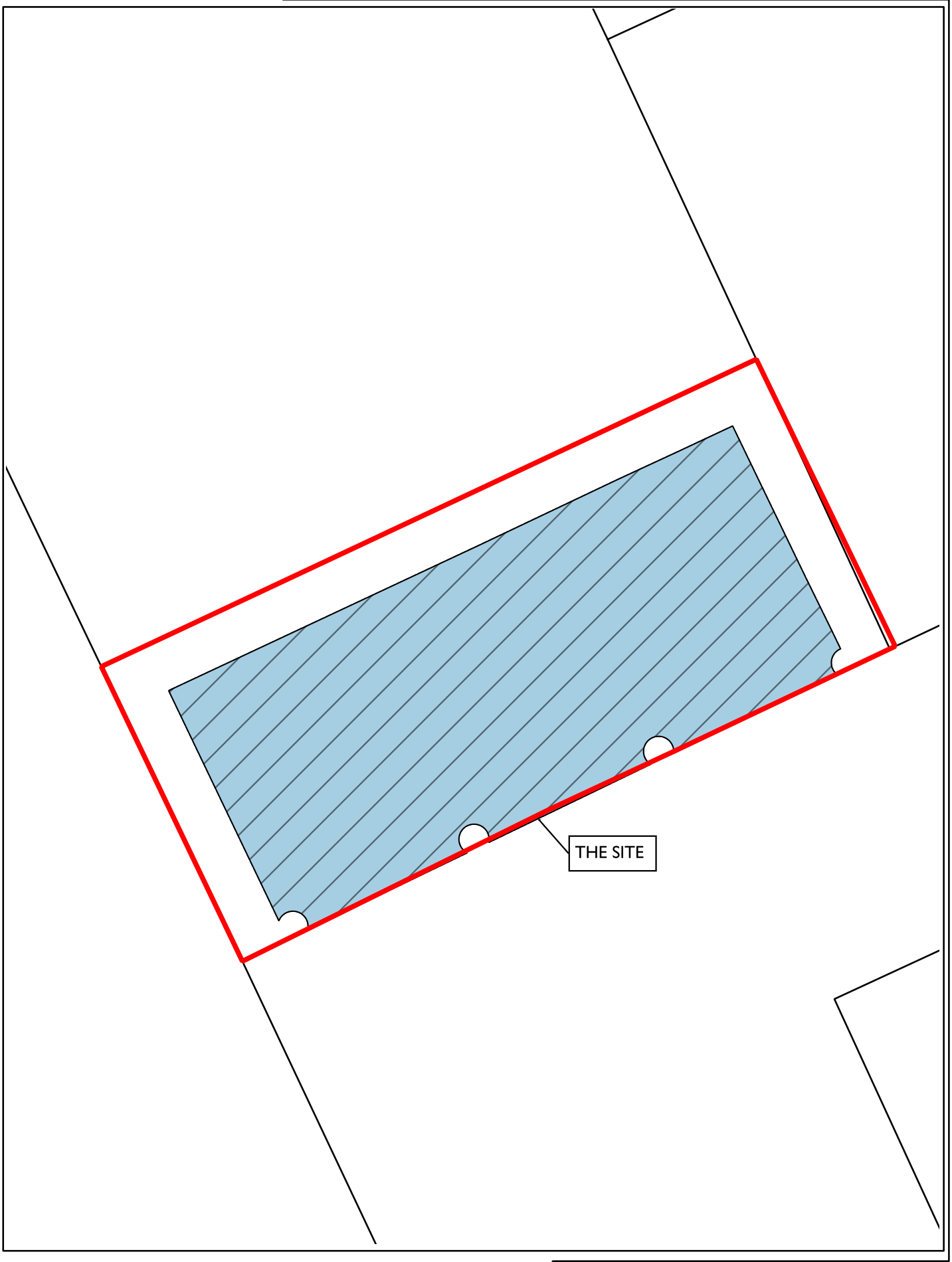
PROJECT // 1429L - Kings Mews

DESCRIPTION // Indicative Pile Locations

DOC REF: LP1429L-WSI-v1

L-P:ARCHÆOLOGY

FIGURE 5 // Open Excavation Area



0 5 m

N

PROJECT // 1429L - Kings Mews

DESCRIPTION // Open Excavation Area

DOC REF: LP1429L-WSI-v1

L-P:ARCHÆOLOGY

PLANNING CONDITION

APPENDIX 1

Regeneration and Planning
Development Management
London Borough of Camden
Town Hall
Judd Street
London
WC1H 9JE

Tel 020 7974 4444

planning@camden.gov.uk
www.camden.gov.uk/planning

Mr Matt Hartley
Buchanan Hartley Architects Limited
13 Grosvenor Gardens
London
SW1W 0BD

Application Ref: **2016/6816/P**
Please ask for: **Rob Tulloch**
Telephone: 020 7974 **2516**

20 June 2017

Dear Sir/Madam

DECISION

Town and Country Planning Act 1990 (as amended)

Full Planning Permission Granted Prior approval subject to Section 106 Legal agreement

Address:
22 King's Mews
London
WC1N 2JB

Proposal:
Erection of a 3 storey dwellinghouse and basement following partial demolition of the existing office/storage building (Class B1/B8).
Drawing Nos: Site Location Plan L(EX)100; (--)101 Rev C; 107 Rev C; 121; 122; 123; 124; 125; 134; 137; Basement Impact Assessment by Croft Structural Engineers Rev 1 dated 7th December 2016; Basement Impact Assessment by Croft Structural Engineers Rev 2 dated 17th March 2017; Hydrology, Land Stability and Ground Movement assessment by Maund Ge0-consulting dated 11th November 2016; Basement Impact Assessment Screening and Scoping Report by Campbell Reith dated October 2014; Sustainability Statement by AJ Energy Consultants dated June 2017; Energy Strategy by AJ Energy Consultants dated June 2017

The Council has considered your application and decided to grant permission subject to the following condition(s):

Condition(s) and Reason(s):

1 The development hereby permitted must be begun not later than the end of three years from the date of this permission.

Reason: In order to comply with the provisions of Section 91 of the Town and Country Planning Act 1990 (as amended).

2 All new external work shall be carried out in materials that resemble, as closely as possible, in colour and texture those of the existing building, unless otherwise specified in the approved application.

Reason: To safeguard the appearance of the premises and the character of the immediate area in accordance with the requirements of policy CS14 of the London Borough of Camden Local Development Framework Core Strategy and policy DP24 and DP25 iof the London Borough of Camden Local Development Framework Development Policies, and policies D1 and D2 of the Local Plan Submission Draft 2016.

3 The development hereby permitted shall be carried out in accordance with the following approved plans: Site Location Plan L(EX)100; (--)101 Rev C; 107 Rev C; 121; 122; 123; 124; 125; 134; 137; Basement Impact Assessment by Croft Structural Engineers Rev 1 dated 7th December 2016; Basement Impact Assessment by Croft Structural Engineers Rev 2 dated 17th March 2017; Hydrology, Land Stability and Ground Movement assessment by Maund Ge0-consulting dated 11th November 2016; Basement Impact Assessment Screening and Scoping Report by Campbell Reith dated October 2014; Sustainability Statement by AJ Energy Consultants dated June 2017; Energy Strategy by AJ Energy Consultants dated June 2017.

Reason: For the avoidance of doubt and in the interest of proper planning.

4 The proposed development shall not be occupied until the whole of the cycle parking provision shown on the approved drawings is provided. The whole of the cycle parking provision shall be permanently retained and maintained thereafter.

Reason: To ensure the development provides adequate cycle parking facilities in accordance with the requirements of policy CS11 of the London Borough of Camden Local Development Framework Core Strategy and policy DP17 of the London Borough of Camden Local Development Framework Development Policies and policy T1 of Camden Local Plan Submission Draft 2016.

5 Prior to the first occupation of the building a plan showing details of the green roof including species, planting density, substrate and a section at scale 1:20 showing that adequate depth is available in terms of the construction and long term viability of the green roof, and a programme for a scheme of maintenance shall be submitted to and approved in writing by the local planning authority. The green roof shall be fully provided in accordance with the approved details prior to first occupation and thereafter retained and maintained in accordance with the approved scheme of maintenance.

Reason: To ensure that the green roof is suitably designed and maintained in accordance with the requirements of policies CS13, CS14, CS15 and CS16 of the London Borough of Camden Local Development Framework Core Strategy and policies DP22, DP23, DP24 and DP32 of the London Borough of Camden Local Development Framework Development Policies and policies CC1 and CC2 of the Camden Local Plan Submission Draft 2016.

6 Prior to first occupation of the building, detailed plans showing the location and extent of photovoltaic cells to be installed on the building shall have been submitted to and approved by the Local Planning Authority in writing. The cells shall be installed in full accordance with the details approved by the Local Planning Authority and permanently retained and maintained thereafter.

Reason: To ensure the development provides adequate on-site renewable energy facilities in accordance with the requirements of policy CS13 of the London Borough of Camden Local Development Framework Core Strategy and policy DP22 of the London Borough of Camden Local Development Framework Development Policies and policies CC1 and CC2 of the Camden Local Plan Submission Draft 2016.

7 Detailed drawings, or samples of materials as appropriate, in respect of the following, shall be submitted to and approved in writing by the local planning authority before the relevant part of the work is begun:
a) Details including sections at 1:10 of all windows (including jambs, head and cill), louvres, external doors and balustrading.
b) Manufacturer's specification details of all facing materials (to be submitted to the Local Planning Authority) and samples of those materials (to be provided on site).
The relevant part of the works shall be carried out in accordance with the details thus approved and all approved samples shall be retained on site during the course of the works.

Reason: To safeguard the appearance of the premises and the character of the immediate area in accordance with the requirements of policy CS14 of the London Borough of Camden Local Development Framework Core Strategy and policies DP24 and DP25 of the London Borough of Camden Local Development Framework Development Policies and policies D1 and D2 of the Camden Local Plan Submission Draft 2016.

8 The dwelling hereby approved shall be designed and constructed in accordance with Building Regulations Part M4 (2), evidence demonstrating compliance should be submitted to and approved by the Local Planning Authority prior to occupation.

Reason: To ensure that the internal layout of the building provides flexibility for the accessibility of future occupiers and their changing needs over time, in accordance with the requirements of policy CS6 of the London Borough of Camden Local Development Framework Core Strategy and policy DP6 of the London Borough of Camden Local Development Framework Development Policies and policy H6 of the Camden Local Plan Submission Draft 2016.

9 The development hereby approved shall not commence until such time as a

suitably qualified chartered engineer with membership of the appropriate professional body has been appointed to inspect, approve and monitor the critical elements of both permanent and temporary basement construction works throughout their duration to ensure compliance with the design which has been checked and approved by a building control body. Details of the appointment and the appointee's responsibilities shall be submitted to and approved in writing by the local planning authority prior to the commencement of development. Any subsequent change or reappointment shall be confirmed forthwith for the duration of the construction works.

Reason: To safeguard the appearance and structural stability of neighbouring buildings and the character of the immediate area in accordance with the requirements of policy CS14 of the London Borough of Camden Local Development Framework Core Strategy and policy DP27 of the London Borough of Camden Local Development Framework Development Policies, and policy A5 of the Camden Local Plan Submission Draft 2016.

10 Notwithstanding the provisions of Article 3 of the Town and Country Planning (General Permitted Development) Order 2015 or any Order revoking and re-enacting that Order, no development within Part 1 (Classes A-H) [and Part 2 (Classes A-C)] of Schedule 2 of that Order shall be carried out without the grant of planning permission having first been obtained from the local planning authority.

Reason: To safeguard the visual amenities of the area and to prevent over development of the site by controlling proposed extensions and alterations in order to ensure compliance with the requirements of policies CS14 and CS5 of the London Borough of Camden Local Development Framework Core Strategy and policies DP24 and DP26 of the London Borough of Camden Local Development Framework Development Policies and policies A1, D1 and D2 of the Camden Local Plan Submission Draft 2016.

11 All windows to the rear elevation identified on drawing number L(--) 107 Rev C as being automatically openable shall only be open for smoke extraction purposes and shall remain shut at all other times.

Reason: In order to prevent unreasonable overlooking of neighbouring premises in accordance with the requirements of policy CS5 of the London Borough of Camden Local Development Framework Core Strategy and policy DP26 of the London Borough of Camden Local Development Framework Development Policies, and policy A1 of the Camden Local Plan Submission Draft 2016.

12 Prior to the commencement of development a programme of archaeological investigation, in accordance with a Written Scheme of Investigation, including the details of the suitably qualified investigating body to carry out such archaeological works as required shall be submitted to and approved in writing by the local planning authority. The development shall not take place until the site investigation and post investigation assessment has been completed in accordance with the programme set out in the approved Written Scheme of Investigation, and the provision made for analysis, publication and dissemination of the results and archive deposition has been secured.

Reason: Important archaeological remains may exist on this site. Accordingly the Council wishes to secure the provision of archaeological investigation and the subsequent recording of the remains prior to development in accordance with the requirements of policy CS14 of the London Borough of Camden Local Development Framework Core Strategy and policy DP25 of the London Borough of Camden Local Development Framework Development Policies, and policy D2 of the Camden Local Plan Submission Draft 2016.

13 Before any works hereby authorised begin, details of how the stability of the retained front elevation of the building will be maintained and protected shall be submitted to and approved by the Council. Such details shall include both temporary and permanent measures to strengthen any wall or vertical surface, to support any floor, roof or horizontal surface and to provide protection for the building against the weather during progress of the works. The development shall not be carried out other than in accordance with the approved details. For the avoidance of doubt, the fabric of the front facade of the building shall be retained as part of the development hereby permitted.

Reason: To safeguard the appearance of the premises and the character of the immediate area in accordance with the requirements of policy CS14 of the London Borough of Camden Local Development Framework Core Strategy and policies DP24 and DP25 of the London Borough of Camden Local Development Framework Development Policies, and policies D1 and D2 of the Local Plan 2017.

14 All windows to the rear elevation identified as being installed with louvres shall be installed as such and permanently retained as such thereafter.

Reason: In order to prevent unreasonable overlooking of neighbouring premises in accordance with the requirements of policy CS5 of the London Borough of Camden Local Development Framework Core Strategy and policy DP26 of the London Borough of Camden Local Development Framework Development Policies, and policy A1 of the Camden Local Plan Submission Draft 2016.

15 A sample panel of the facing brickwork demonstrating the proposed colour, texture, face-bond and pointing shall be provided on site and approved in writing by the local planning authority before the relevant parts of the works are commenced and the development shall be carried out in accordance with the approval given. The approved panel shall be retained on site until the work has been completed.

Reason: To safeguard the appearance of the premises and the character of the immediate area in accordance with the requirements of policy CS14 of the London Borough of Camden Local Development Framework Core Strategy and policy DP24 and DP25 of the London Borough of Camden Local Development Framework Development Policies and policies D1 and D2 of the Camden Local Plan Submission Draft 2016.

16 The development hereby approved shall be carried out in strict accordance with the submitted Basement Impact Assessments hereby approved and the

recommendation in the independent review by LBH Wembley unless otherwise agreed with the Council.

Reason: To safeguard the appearance and structural stability of neighbouring buildings and the character of the immediate area in accordance with the requirements of policy CS14 of the London Borough of Camden Local Development Framework Core Strategy and policy DP27 of the London Borough of Camden Local Development Framework Development Policies and policy A5 of the Local Plan Submission Draft 2016..

Informative(s):

1 Your proposals may be subject to control under the Building Regulations and/or the London Buildings Acts which cover aspects including fire and emergency escape, access and facilities for people with disabilities and sound insulation between dwellings. You are advised to consult the Council's Building Control Service, Camden Town Hall, Argyle Street WC1H 8EQ, (tel: 020-7974 6941).

2 Noise from demolition and construction works is subject to control under the Control of Pollution Act 1974. You must carry out any building works that can be heard at the boundary of the site only between 08.00 and 18.00 hours Monday to Friday and 08.00 to 13.00 on Saturday and not at all on Sundays and Public Holidays. You are advised to consult the Council's Compliance and Enforcement team [Regulatory Services], Camden Town Hall, Argyle Street, WC1H 8EQ (Tel. No. 020 7974 4444 or on the website http://www.camden.gov.uk/ccm/content/contacts/council-contacts/environment/contact-the-environmental-health-team.en or seek prior approval under Section 61 of the Act if you anticipate any difficulty in carrying out construction other than within the hours stated above.

3 You are reminded that this decision only grants permission for permanent residential accommodation (Class C3). Any alternative use of the residential units for temporary accommodation, i.e. for periods of less than 90 days for tourist or short term lets etc, would constitute a material change of use and would require a further grant of planning permission.

4 Your attention is drawn to the fact that there is a separate legal agreement with the Council which relates to the development for which this permission is granted. Information/drawings relating to the discharge of matters covered by the Heads of Terms of the legal agreement should be marked for the attention of the Planning Obligations Officer, Sites Team, Camden Town Hall, Argyle Street, WC1H 8EQ.

5 You are reminded that filled refuse sacks shall not be deposited on the public footpath, or forecourt area until within half an hour of usual collection times. For further information please contact the Council's Environment Services (Rubbish Collection) on 020 7974 6914/5. or on the website http://www.camden.gov.uk/ccm/content/contacts/council-contacts/environment/contact-street-environment-services.en.

6 Your proposals may be subject to control under the Party Wall etc Act 1996 which covers party wall matters, boundary walls and excavations near neighbouring buildings. You are advised to consult a suitably qualified and experienced Building Engineer.

7 You are advised that this proposal will be liable for the Mayor of London's Community Infrastructure Levy (CIL) and the Camden CIL as the additional floorspace exceeds 100sqm GIA or one unit of residential accommodation. Based on the information given on the plans, the Mayor's CIL Charging Schedule and the Camden Charging Schedule, the charge is likely to be £12,400 (248sqm x £50)for the Mayor's CIL and £124,000 (248sqm x £500) for the Camden CIL.

This amount is an estimate based on the information submitted in your planning application. The liable amount may be revised on the receipt of the CIL Additional Information Requirement Form or other changes in circumstances. Both CIL's will be collected by Camden after the scheme has started and could be subject to surcharges for failure to assume liability or submit a commencement notice PRIOR to commencement and/or for late payment. We will issue a formal liability notice once the liable party has been established. CIL payments will also be subject to indexation in line with the construction costs index.

8 The written scheme of investigation referred to in condition 12 will need to be prepared and implemented by a suitably qualified archaeological practice in accordance with English Heritage Greater London Archaeology guidelines. It must be approved by the planning authority before any on-site development related activity occurs.

In dealing with the application, the Council has sought to work with the applicant in a positive and proactive way in accordance with paragraphs 186 and 187 of the National Planning Policy Framework.

You can find advice about your rights of appeal at:

http://www.planningportal.gov.uk/planning/appeals/guidance/guidancecontent

Yours faithfully

David T. Joyce

David Joyce
Director of Regeneration and Planning

SI GROUND AND WATER REPORT

APPENDIX 11

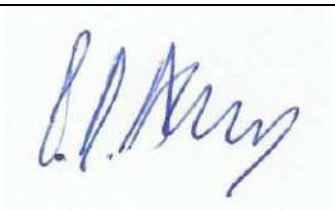
GROUND INVESTIGATION REPORT

for the site at

22 KINGS MEWS, CLERKENWELL, LONDON WC1N 2JB

on behalf of

ROSEBERY FINANCIAL C/O CROFT STRUCTURAL ENGINEERS

Report Reference: GWPR1789/GIR/OCTOBER 2016		Status: DRAFT
Issue:	Prepared By:	Verified By:
V1.01 October 2016		
	Philip Allvey BSc (Hons) M.Eng Geotechnical Engineer	Francis Williams M.Geol. (Hons) FGS CEnv AGS MSoBRA Director
File Reference: Ground and Water/Project Files/ GWPR1789 22 Kings Mews, Clerkenwell		

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1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by Rosebery Financial, c/o Croft Structural Engineers, on the 19th August 2016, to conduct a Ground Investigation at 22 Kings Mews, Clerkenwell, London WC1N 2JB. The scope of the investigation was detailed within the Ground and Water Limited fee proposal ref: GWQ2980, dated 19th August 2016.

1.2 Aims of the Investigation

The aim of the investigation was understood to be to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

The investigation was to be undertaken to provide parameters for the design of foundations by means of in-situ and laboratory geotechnical testing undertaken on soil samples recovered from trial holes.

A Desk Study and full scale contamination assessment were not part of the remit of this report. However, included within the fee proposal was an allowance to undertake chemical laboratory testing on soil samples recovered from the site to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public.

The techniques adopted for the investigation were chosen considering the anticipated ground conditions and development proposals on-site, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.

1.3 Conditions and Limitations

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

2.0 SITE SETTING

2.1 Site Location

The site comprised a 90m^2 rectangular shaped plot of land, orientated in a north-east to south-west direction, located on the north-east side of Kings Mews. The site was located ~25m south-east of Kings Mews junction with Northington Street. The site was located in Clerkenwell, central west London.

A site location plan can be seen in Figure 1 with a plan showing the site area presented in Figure 2. The approximate O.S. National Grid Reference for the centre of the site was TQ 30920 82021.

2.2 Site Description

The site comprised a two storey brick built mews type terraced property with double doors allowing access directly off Kings Mews. The site comprised an open plan disused building adjacent to an existing garage. Kings Mews was indicated to be at a topographic height of 21.10m AOD. It was noted that Kings Mews was noted to be ~3.12m lower than the rear terrace of 4 Gray's Court, on the north-eastern edge of the site.

An aerial view of the site is provided within Figure 3.

2.3 Proposed Development

At the time of reporting, October 2016, it was understood that the proposed development will comprise the partial demolition of the existing office/storage building and the construction of a three storey residential dwelling with basement. The proposed basement excavation will be formed at two levels, one at ~3.00 – 3.50m below ground level and a second at ~4.55m bgl. The proposed development is shown in Figure 4.

The basements levels will therefore be formed at ~6.00 – 6.50m and ~7.50 – 8.00m below the rear terrace of 4 Gray's Court.

2.4 Geology

The geology map of the British Geological Survey of Great Britain for the North London area (North London: Sheet No. 256) revealed the site was located on the Hackney Gravel Member overlying the bedrock deposits of the London Clay Formation. No areas of Worked Ground or Made Ground were noted within a 250m radius of the site.

Hackney Gravel Member

The rivers of the south-east of England, including the River Thames and its tributaries, have been subject to at least three changes of level since Pleistocene times. One result has been the formation of a complex series of River Terrace Deposits. The Lower River Terraces were numbered one to four, the lowest and most recent being number one. Geographical terms formerly used, such as Boyn Hill or Taplow Terrace, were generally abandoned due to problems of correlation. The most recent editions of the Geological sheet of the area has further subdivided the River Terrace Deposits, now relating them to depositional elevation. The Hackney Gravels are shown on the most recent geological sheet to be part of the Post-diversionary Thames River Deposits and are indicated to comprise gravel, sandy and clayey in parts and are found on higher ground than the existing flood plains.

London Clay Formation:
The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay Formation, and precautions against sulphate attack to concrete are sometimes required. The lowest part of the formation is a sandy bed with black rounded gravel and occasional layers of sandstone and is known as the Basement Bed. In the north London area the upper part of the London Clay Formation has been disturbed by glacial and/or periglacial action and may contain pockets of sand and gravel.

A BGS borehole ~80m north-west of the site revealed Made Ground and loam to 5.48m bgl and then loamy sand and gravels to 6.39m bgl.

2.5 Hydrogeology and Hydrology

A study of the aquifer maps on the Environment Agency website revealed the site to be located within a **Secondary A Aquifer** comprising the bedrock deposits of the Hackney Gravel Member, overlying **Unproductive Strata**, corresponding to the bedrock deposits of the London Clay Formation.

Superficial (Drift) deposits are permeable unconsolidated (loose) deposits, for example, sands and gravels. The bedrock is described as solid permeable formations e.g. sandstone, chalk and limestone.

Secondary aquifers include a wide range of drift and bedrock deposits with an equally wide range of water permeability and storage capacities. Secondary A Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

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

Examination of the Environment Agency records showed that the site was not located within a Groundwater Source Protection zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

No surface water features were noted within a 250m radius. The River Thames was noted ~1.7km south of the site.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at moderate depth (~4 - 6m below existing ground level (bgl)) and it was considered that the groundwater was flowing in alignment with topography in an overall southerly direction towards the River Thames.

Examination of the Environment Agency records showed that the site **was not situated** within an area at risk from flooding.

2.6 Radon

BRE 211 (2015) Map 4 of London, Sussex and West Kent revealed the site **was not** located within an area where mandatory protection measures against the ingress of Radon was likely to be required.

The site **was not** located within an area where a risk assessment was required.

3.0 FIELDWORK

3.1 Scope of Works

Fieldwork was undertaken on 22nd August 2016 and comprised the drilling of one hand held window sampler borehole (BH1) to a depth of 5.00m bgl and one Premier Windowless Sampler Borehole (BH2) to a depth of 8.54m bgl. Standard Penetration Testing (SPT) was undertaken within BH2 at 1.00m intervals. In addition a Super Heavy Dynamic Probe (DP2) was carried out through the base of BH2 to a depth of 11.00m bgl. The boreholes were drilled from a ground level similar to that of Kings Mews (~21.20m AOD).

A combined bio-gas and groundwater monitoring well was installed in BH1 and BH2 to 5.00m bgl. The construction of the wells installed can be seen tabulated below.

Combined Bio-gas and Groundwater Monitoring Well Construction				
Trial Hole	**Depth of Installation (mbgl)**	**Thickness of slotted piping with gravel filter pack (m)**	**Depth of plain piping with bentonite seal (m bgl)**	**Piping external diameter (mm)**
BH1	5.00	4.00	1.00m	19mm
BH2	5.00	4.00	1.00m	50mm

The approximate locations of the trial holes are given on Figure 5.

Prior to commencing the ground investigation, a walkover survey was carried out to identify the presence of underground services and drainage. Where underground services/drainage were suspected and/or positively identified, exploratory positions were relocated away from these areas.

As a further precautionary measure, the positions were hand excavated to 1.20m bgl and scanned with a Cable Avoidance Tool (CAT scanner) to minimise the risk to services.

Upon completion of the site works, the trial holes were backfilled and made good/reinstated in relation to the surrounding area.

3.2 Sampling Procedures

Small disturbed samples were recovered from the trial holes at the depths shown on the trial hole records. Soil samples were generally retrieved from each change of strata and/or at specific areas of concern. Samples were also taken at approximately 0.5m intervals during broad homogenous soil horizons.

A selection of samples were despatched for geotechnical testing purposes.

A programme of chemical laboratory testing, scheduled by Ground and Water Limited and carried out by QTS Environmental Limited, was undertaken on samples recovered from the boreholes to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public.

4.0 ENCOUNTERED GROUND CONDITIONS

4.1 Soil Conditions

All exploratory holes were logged by Philip Allvey of Ground and Water Limited generally in accordance with BS EN 14688 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.

The ground conditions encountered within the trial holes drilled on the site generally conformed to that anticipated from examination of the geology map. A capping of Made Ground was noted to overlie soils described as Alluvium, followed by the Hackney Gravel Member. The superficial deposits were underlain by the bedrock deposits of the London Clay Formation. Alluvium was only encountered in one of the boreholes (BH2).

The ground conditions encountered during the investigation are described in this section. For more complete information about the Made Ground, Alluvium, Hackney Gravel Member and London Clay Formation at particular points, reference must be made to the individual trial hole logs within Appendix B.

The trial hole location plan can be viewed in Figure 5.

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

Made Ground (BH1 and BH2)
Alluvium (BH2)
Hackney Gravel Member (BH1 and BH2)
London Clay Formation (BH1 and BH2)

Made Ground

Made Ground was noted beneath a 0.09 – 0.10m thick capping of concrete to a depth of 3.50 – 4.70m bgl in BH1 and BH2. These soils comprised a grey brown/dark brown/black clayey gravelly sand. The sand was fine to coarse gained and the gravel was occasional to abundant, fine to coarse, sub-angular to sub-rounded brick, flint, concrete, metal and cement (builders waste). A clay pocket was noted at 4.50m bgl.

Alluvium

Soils described as Alluvium were noted underlying the Made Ground in BH2 to a depth of 5.70m bgl. These soils comprised a brown/dark brown/grey brown clayey gravelly sand between 3.50-4.50m bgl and a gravelly sandy silty clay with black streaks between 4.50-5.70m bgl. The sand was fine to medium grained and the gravel was rare to occasional, fine to medium, sub-angular to sub-rounded flint. A slight organic smell was noted.

Hackney Gravel Member

Soils described as the Hackney Gravel Member were encountered underlying the Made Ground in BH1 and Alluvium in BH2 to a depth of 7.60m bgl in BH2, and for the remaining depth of BH1, a depth of 5.00m bgl. These soils comprised a grey sand and gravel. The sand was fine to coarse grained and the gravel was abundant, fine to medium, sub-angular to sub-rounded flint.

London Clay Formation
Soils described as the London Clay Formation were encountered underlying the Hackney Gravel Member in BH2, for the remaining depth of the borehole, a depth of 8.45m bgl. These soils comprised a grey brown silty clay.

For details of the composition of the Made Ground, Alluvium, Hackney Gravel Member and London Clay Formation at particular points, reference must be made to the individual trial hole logs within Appendix B.

4.2 Roots Encountered
No roots were roots were noted in BH1 or BH2.

It must be noted that the chance of determining actual depth of root penetration through a narrow diameter borehole is low. Roots may be found to greater depths at other locations on the site, particularly close to trees and/or trees that have been removed both within the site and its close environs.

4.3 Groundwater Conditions
Groundwater was not encountered during the intrusive investigation.

The results of the groundwater monitoring in the standpipes installed shall follow as an addendum to this report.

Exact groundwater levels may only be determined through long term measurements from monitoring wells installed on-site. It should be noted that changes in groundwater level do occur for a number of reasons including seasonal effects and variations in drainage.

The site investigation was conducted in August 2016, when groundwater levels are likely to be at their annual minimum (i.e. lowest). The long-term groundwater elevation may increase at some time in the future. Isolated pockets of groundwater may be perched within any Made Ground found at other locations around the site.

4.4 Obstructions
A Super Heavy Dynamic Probe (DP2) was carried out through the base of BH2 to a depth of 11.00m bgl where the stiffness of the soils prevented further progress.

No other sub-surface obstructions were noted during drilling of the boreholes.

5.0 INSITU AND LABORATORY GEOTECHNICAL TESTING

5.1 In-Situ Geotechnical Testing

5.1.1 Standard Penetration Tests (SPTs)

Standard Penetration Testing (SPT) was undertaken within BH2 at 1.00m intervals. The results of the SPT's have not been amended to take into account hammer efficiency, rod lengths and overburden pressure in accordance with Eurocode 7. In addition, a Super Heavy Dynamic Probe (SHDP) was carried out through the base of BH2 (DP2) to a depth of 11.00m bgl. The test results are presented on the borehole logs within Appendix B.

The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50 mm and an inside diameter of 35 mm, and a length of around 650mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5 kg falling through a distance of 760 mm. The sample tube is driven 150 mm into the ground and then the number of blows needed for the tube to penetrate each 150 mm up to a depth of 450 mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value".

Dynamic Probing involves the driving of a metal cone into the ground via a series of steel rods. These rods are driven from the surface by a hammer system that lifts and drops a 63.0kg hammer onto the top of the rods through a set height, thus ensuring a consistent energy input. The number of hammer blows that are required to drive the cone down by each 100mm increment are recorded. These blow counts then provide a comparative assessment from which correlations have been published, based on dynamic energy, which permits engineering parameters to be generated. *(The Dynamic Probe 'Super Heavy' (SHDP) Tests were conducted in accordance with BS 1377; 1990; Part 9, Clause 3.2).*

The cohesive soils of the Alluvium and London Clay Formation were classified based on the table below.

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

The granular soils of the Made Ground, Alluvium and Hackney Gravel Member were classified based on the table overleaf.

Correlation between equivalent 'SPT's derived from SHDP/ normalised SPT blow counts $(N_1)_{60}$ and granular classification.	
Classification	**Equivalent SPT Blow Counts (N1)**
Extremely Dense	>58
Very Dense	42 – 58
Dense	25 – 42
Medium	8 – 25
Loose	3 – 8
Very Loose	0 – 3

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

Interpretation of In-situ Geotechnical Testing Results					
Strata	**Equivalent 'SPT's derived from SHDP/ SPT "N" Blow Counts**	**Equivalent Undrained Shear Strength (kPa) Cohesive Soils**	**Soil Type**		**Trial Hole/s**
			Cohesive	**Granular**	
Made Ground	4 – 20	-	-	Loose - Medium	BH2 (GL – 3.50m bgl)
Alluvium (granular soils)	1	-	-	Very Loose	BH2 (3.50 – 4.50m bgl)
Alluvium (cohesive soils)	39	190	Very High	-	BH2 (4.50 – 5.70m bgl)
Hackney Gravel Member	14 – 35	-	-	Medium Dense – Dense	BH2 (5.70 – 7.60m bgl)
London Clay Formation	57	285	Very High	-	BH2 (7.60 – 8.45m bgl)
London Clay Formation *	64 – 115	320 - 575	Extremely High	-	DP2 (8.10 – 11.00m bgl)*

*Depth inferred and assumed to be the London Clay Formation, based on the results of the super heavy dynamic probe.

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

5.2 Laboratory Geotechnical Testing

A programme of geotechnical laboratory testing, scheduled by Ground and Water Limited and carried out by K4 Soils Laboratory and QTS Environmental Limited, was undertaken on samples recovered from the Made Ground, Alluvium, Hackney Gravel Member and London Clay Formation. The results of the tests are presented in Appendix C and D.

The test procedures used were generally in accordance with the methods described in BS1377:1990. Details of the specific tests used in each case are given below:

Standard Methodology for Laboratory Geotechnical Testing		
Test	**Standard**	**Number of Tests**
Atterberg Limit Tests	BS1377:1990:Part 2:Clauses 3.2, 4.3 & 5	3
Particle Size Distribution	BS1377:1990:Part 2:Clause 9	2
Water Soluble Sulphate & pH	BS1377:1990:Part 3:Clause 5	1
BRE Special Digest 1 (incl. pH, Electrical Conductivity, Total Sulphate, W/S Sulphate, Total Chlorine, W/S Chlorine, Total Sulphur, Ammonium as NH4, W/S Nitrate, W/S Magnesium)	BRE Special Digest 1 "Concrete in Aggressive Ground (BRE, 2005).	2

5.2.1 Atterberg Limit Tests

A précis of Atterberg Limit Tests undertaken on one sample of Alluvium and two samples of the London Clay Formation can be seen tabulated below.

Atterberg Limit Tests Results Summary							
Stratum	**Moisture Content (%)**	**Passing 425 μm sieve (%)**	**Modified PI (%)**	**Soil Class Range**	**Consistency Index (Ic)**	**Volume Change Potential Range**	
						NHBC	**BRE**
Alluvium	22	95	12	CL	Soft	Low	Low
London Clay Formation	31 – 33	95 – 100	50 – 58	CV	Stiff	High	High

NB: NP – Non-plastic
BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
Soil Classification based on British Soil Classification System.
Consistency Index (Ic) based on BS EN IS0 14688-2:2004.

5.2.2 Comparison of Soil's Moisture Content with Index Properties

5.2.2.1 Liquidity Index Analyses

The results of the Atterberg Limit tests undertaken on one sample of Alluvium and two samples of the London Clay Formation were analysed to determine the Liquidity Index of the samples. This gives an indication as to whether the samples recovered showed a moisture deficit and their degree of consolidation. The results are tabulated overleaf.

Liquidity Index Calculations Summary					
Strata/Trial Hole/Depth/Soil Description	**Moisture Content (%)**	**Plastic Limit (%)**	**Modified Plasticity Index (%)**	**Liquidity Index**	**Result**
Alluvium BH2/5.50m bgl (Brown and occasional dark grey slightly gravelly sandy silty CLAY. Gravel is fine to medium and sub-angular to angular).	22	15	12.4	0.57	Overconsolidated
London Clay Formation BH2/7.50m bgl (Brown and occasional grey slightly gravelly silty CLAY with occasional sand staining. Gravel is fine to medium and sub-angular to rounded).	31	27	50.4	0.08	Heavily overconsolidated
London Clay Formation BH2/8.00m bgl (Brown and occasional grey silty CLAY with occasional carbonaceous deposits).	33	28	58.0	0.09	Heavily overconsolidated

Liquidity Index testing revealed no evidence for potential moisture deficit within the overconsolidated sample of Alluvium or heavily overconsolidated samples of the London Clay Formation tested.

5.2.2.2 Liquid Limit

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

Moisture Content vs. Liquid Limit				
Strata/Trial Hole/Depth/Soil Description	**Moisture Content (MC) (%)**	**Liquid Limit (LL) (%)**	**40% Liquid Limit (LL)**	**Result**
Alluvium BH2/5.50m bgl (Brown and occasional dark grey slightly gravelly sandy silty CLAY. Gravel is fine to medium and sub-angular to angular).	22	28	11.2	MC > 0.4 x LL (No potential significant moisture deficit)
London Clay Formation BH2/7.50m bgl (Brown and occasional grey slightly gravelly silty CLAY with occasional sand staining. Gravel is fine to medium and sub-angular to rounded).	31	80	32.0	**MC < 0.4 x LL** **(Potential significant moisture deficit)**
London Clay Formation BH2/8.00m bgl (Brown and occasional grey silty CLAY with occasional carbonaceous deposits).	33	86	34.4	**MC < 0.4 x LL** **(Potential significant moisture deficit)**

The results in the table above indicated that a potential significant moisture deficit was present within the two samples of the London Clay Formation tested (BH2/7.50m and BH2/8.00m bgl). The moisture content values were below 40% of the liquid limit. The samples were described a slightly gravelly silty clay and a silty clay. No roots were noted in BH2. Consequently the apparent moisture deficit was likely to be related to the lithology of the soil (heavily overconsolidated and slightly gravelly) rather than the water demand of roots from nearby trees.

No potential significant moisture deficit was noted within the overconsolidated sample of the Alluvium tested.

5.2.3 Particle Size Distribution (PSD) Tests

The results of PSD testing undertaken on two samples of the Hackney Gravel Member in the trial holes are tabulated below.

PSD Test Results Summary			
Trial Hole/Depth/Soil Description	**Volume Change Potential Range**		**Passing 63µm sieve Range (%)**
	BRE	**NHBC**	
Hackney Gravel Member BH2/6.00m bgl (Greyish brown slightly clayey very gravelly SAND. Gravel is fine to coarse and sub-angular to rounded).	No	No	4.8
Hackney Gravel Member BH2/6.50 – 7.00m bgl (Greyish brown slightly clayey very gravelly SAND. Gravel is fine to coarse and sub-angular to rounded).	No	No	4.4

NB Volume Change Potential refers to BRE Digest 240 (based on Grading test results).

Volume Change Potential – BRE 240 states that a soil has a volume change potential when the clay fraction exceeds 15%. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve.

NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.

5.2.4 Sulphate and pH Tests

Sulphate and pH tests were undertaken on one sample from the London Clay Formation (BH2/8.00m bgl). The sulphate concentration was 0.93g/l with a pH of 7.79.

5.2.5 BRE Special Digest 1

In accordance with BRE Special Digest 1 'Concrete in Aggressive Ground' (BRE, 2005) one sample of Made Ground (BH2/2.50m bgl) and one sample of the Hackney Gravel Member (BH1/5.00m bgl) were scheduled for laboratory analysis to determine parameters for concrete specification. The results are given within Appendix D and a summary is tabulated below.

Summary of Results of BRE Special Digest Testing			
Determinand	**Unit**	**Minimum**	**Maximum**
pH	-	7.0	8.4
Ammonium as NH_4	mg/kg	17.9	19.9
Sulphur	%	0.02	0.08
Chloride (water soluble)	mg/kg	41	105
Magnesium (water soluble)	mg/l	0.8	3.1
Nitrate (water soluble)	mg/kg	100	1440
Sulphate (water soluble)	mg/l	114	248
Sulphate (total)	mg/kg	543	1481

5.3 Chemical Laboratory Testing – Human Health Risk Assessment

A programme of chemical laboratory testing, scheduled by Ground and Water Limited, and carried out by QTS Environmental Limited, was undertaken on one sample of Made Ground (BH2/0.50 – 0.80m bgl).

The methodology for sampling locations can be seen tabulated below.

Methodology for Sampling Locations		
Trial Holes	**Sampling Strategy**	**Anticipated Proposed End-use**
BH1 & BH2	Random sampling locations	Beneath proposed building.

The area investigated as part of the proposed redevelopment totals ~90m^2 (0.009ha) and with two sampling locations, given an unknown hotspot shape, the sampling density means that a hotspot with an area of approximately 67.5m^2 and a radius of approximately 4.64m would be encountered (CLR 4).

Soil sampling depths were chosen to reflect the receptors of concern, human health, and typically comprised a surface or near surface sample and then at approximately 0.50m depth increments thereafter, extending into the underlying natural soils. The receptors relevant to the sampling depths can be seen below:

Near surface samples	Direct ingestion, dermal contact and dust inhalation. Protection of end-users and maintenance workers e.g. Landscape Gardeners. Protection of shallow rooted plants.
>0.5m below ground level	Protection of deep rooted plants.

The depth of soil sampling can be seen within the trial hole logs presented in Appendix B.

The samples tested and the reasons for testing can be seen tabulated overleaf.

Methodology for Chemical Laboratory Testing		
Bore Holes	**Depth (m bgl)**	**Sampling Strategy**
BH2	0.50 – 0.80m	Random sampling strategy. Under proposed building.

The analysis suite is presented below and comprised:

- Semi Metals and Heavy Metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc (BH2/0.50 – 0.80m bgl);
- Asbestos Screen (BH2/0.50 – 0.80m bgl);
- Polycyclic Aromatic Hydrocarbons (PAHs) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene

(BH2/0.50 – 0.80m bgl);
- Fuel Oils – Speciated TPH including full aliphatic/aromatic split (BH2/0.50 – 0.80m bgl);
- BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene) and MTBE – used as marker compounds for Volatile Organic Compounds (VOCs) (BH2/0.50 – 0.80m bgl).

The chemical laboratory results are presented in Appendix D.

5.3.1 Soil Assessment Criteria

The derivation of Soil Assessment Criteria used within this report can be seen within Appendix E.

5.3.2 Determination of Representative Contamination Concentration

At the time of reporting, October 2016, it was understood that the proposed development will comprise the partial demolition of the existing office/storage building and the erection of a three storey residential dwelling. The proposed basement excavation will be formed at two levels, one at ~3.00 – 3.50m below ground level and a second at ~4.55m bgl. The proposed development is shown in Figure 4. The basements levels will therefore be formed at ~6.00 – 6.50m and ~7.50 – 8.00m below the rear terrace of 4 Gray's Court.The proposed development is shown in Figure 4.

Therefore, the results of the chemical laboratory testing were compared to the LQM/CIEH Suitable 4 Use Levels (S4UL) for a ***'Residential without homegrown produce'*** land-use scenarios, as this was considered the most appropriate land-use scenarios. The C4SL LLTC for Lead was compared to a ***'Residential without homegrown produce'*** land-use scenario.

Where no LQM/CIEH S4UL/C4SL LLTC was available for a particular determinant then preliminary reference was made to the laboratory detection limit of the determinant. If a positive concentration was noted then further risk assessment was undertaken.

For Cyanide, where no SGC/GAC or C4SL LLTC was available a Site Specific Assessment Criteria of 10mg/kg was adopted. This is based on ICRCL 59/83, TCL, ATRISK (SOIL) Screening Value and Dutch Intervention Value (ranging from 20 – 34mg/kg). Therefore, a SSAC of ~10mg/kg is considered conservative.

Where a contaminant of concern's LQM/CIEH S4UL/C4SL LLTC varies according to the Soil's Organic Matter (SOM), the SOM recorded for each soil sample was used to derive the appropriate SGV/GAC. The SOM of the sample analysed was 2.00. The results showing comparison of the representative contaminant concentrations are presented in the table overleaf.

Soil Guideline Values and General Acceptance Criteria Results	
Substance	**Sample Location Where available LQM/CIEH S4UL/, CSL4 LLTC or GAC were exceeded for relevant land-use scenario**
	"Residential without homegrown produce" Land-Use Scenario
Arsenic	None
Boron	None
Cadmium	None
Chromium (III)	None
Hexavalent Chromium (VI)	None
Copper	None
Lead	**393mg/kg (BH2/0.50 – 0.80m)**
Mercury (Elemental)	None
Nickel	None
Selenium	None
Vanadium	None
Zinc	None
Cyanide (Total)	None
Total Phenol	None
Naphthalene	None
Acenapthylene	None
Acenapthene	None
Fluorene	None
Phenanthrene	None
Anthracene	None
Fluoranthene	None
Pyrene	None
Benzo(a)anthracene	None
Chrysene	None
Benzo(b)fluoranthene	None
Benzo(k)fluoranthene	None
Benzo(a)pyrene	None
Indeno(1,2,3-cd)pyrene	None
Dibenz(a,h)anthracene	None
Benzo(ghi)perylene	None
TPH C5 – C6 (aliphatic)	None
TPH C6 – C8 (aliphatic)	None
TPH C8 - C10 (aliphatic)	None
TPH C10 - C12 (aliphatic)	None
TPH C12 - C16 (aliphatic)	None
TPH C16 - C21 (aliphatic)	None
TPH C21 - C34 (aliphatic)	None
TPH C5 – C7 (aromatic)	None
TPH C7 – C8 (aromatic)	None
TPH C8 – C10 (aromatic)	None
TPH C10 – C12 (aromatic)	None
TPH C12 – C16 (aromatic)	None
TPH C16 - C21 (aromatic)	None
TPH C21 - C35 (aromatic)	None
Benzene	None
Toluene	None
Ethylbenzene	None
Xylene (o, m & p)	None
MTBE	None
Asbestos Screen	None

Chemical laboratory testing revealed an elevated level of lead in BH2 at 0.50 – 0.80m bgl. A level of 393mg/kg was noted in excess of the LQM/CIEH S4ULs of 330mg/kg for a ***"Residential without homegrown produce"*** scenario.

Chemical laboratory testing of the Made Ground revealed no other elevated levels of determinants above the guideline levels for a '***Residential without homegrown produce'*** land-use scenarios.

In addition, the intrusive investigation did not reveal any visual or olfactory evidence to suggest any hydrocarbon-type contamination in the trial holes excavated on the site. The chemical laboratory results have verified that no elevated concentrations of aliphatic/aromatic hydrocarbons (C_5-C_{35}) or BTEX compounds are present in the soils underlying the site.

At the time of reporting, October 2016, it was understood that the proposed development will comprise the partial demolition of the existing office/storage building and the erection of a three storey residential dwelling with basement. The proposed basement excavation will be formed at two levels, one at ~3.00 – 3.50m below ground level and a second at ~4.55m bgl. The proposed development is shown in Figure 4. The basements levels will therefore be formed at ~6.00 – 6.50m and ~7.50 – 8.00m below the rear terrace of 4 Gray's Court.

No areas of soft landscaping are proposed as part of the development. BH2 was located under the footprint of the proposed structures and therefore basement excavations will remove any shallow Made Ground, therefore posing no risk to end users of the site. A further risk analysis should be carried out if any changes are made to the proposed development plan.

6.0 ENGINEERING CONSIDERATIONS

6.1 Soil Characteristics and Geotechnical Parameters

Based on the results of the intrusive investigation and geotechnical laboratory testing the following interpretations have been made with respect to engineering considerations.

- Made Ground was noted beneath a 0.09 – 0.10m thick capping of concrete to a depth of 3.50 – 4.70m bgl in BH1 and BH2.

  As a result of the inherent variability of Made Ground it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Topsoil or Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

  Made Ground may be found to deeper depth at other locations on the site, especially close to former structures/foundations and service runs.

- Soils described as Alluvium were noted underlying the Made Ground in BH2, to a depth of 5.70m bgl. These soils comprised a very loose brown/dark brown/grey brown clayey gravelly sand between 3.50-4.50m bgl and a gravelly sandy silty clay of very high undrained shear strength (190kPa) with black streaks between 4.50-5.70m bgl.

  The sand was fine to medium grained and the gravel was rare to occasional, fine to medium, sub-angular to sub-rounded flint. A slight organic smell was noted.

  Geotechnical testing revealed the soils of the cohesive Alluvium to **have a low volume change potential** in accordance with both BRE240 and NHBC Standards Chapter 4.2. The granular soils of the Alluvium were assumed to have a volume change potential in accordance with BRE240 and no volume change potential in accordance with NHBC Standards Chapter 4.2.

  Consistency Index calculations indicated the cohesive soils of the Alluvium to be soft. Geotechnical analysis showed no potential moisture deficit was noted within the overconsolidated soils of Alluvium tested.

  Alluvium is the most recent river or estuarine deposit and generally comprises silty clay usually with an appreciable organic content. Lenses of sand and gravel are also commonly found, as are pockets of peat.

  The BSI Code of Practice for Foundations, BS8004: 1986, Clause 2.2.2.3.4 Peat and organic soils, includes the caveat that *'all these soils are highly compressible, and even lightly loaded foundations will be subject to considerable settlements over a long period if placed on them. For this reason these soils are not suitable for carrying the loads for important structures'.*

  Therefore, the Alluvium was not considered a suitable founding strata.

- Soils described as the Hackney Gravel Member were encountered underlying the Made Ground in BH1 and Alluvium in BH2 to a depth of 7.60m bgl in BH2 and for the remaining depth of BH1, a depth of 5.00m bgl. These soils comprised a medium dense to dense grey

sandy and gravel. The sand was fine to coarse grained and the gravel was abundant, fine to medium, sub-angular to sub-rounded flint.

The soils of the Hackney Gravel Member were shown to have **no volume change potential** in accordance with both BRE240 and NHBC Standards Chapter 4.2.

Given their depth, the granular soils of the Hackney Gravel Member are considered likely to be a suitable bearing stratum for piled foundations for the proposed development. The settlements induced on loading are likely to be low to moderate.

- Soils described as the London Clay Formation were encountered underlying the Hackney Gravel Member in BH2 for the remaining depth of the borehole, a depth of 8.45m bgl. These soils comprised a grey brown silty clay of very high to extremely high undrained shear strength (285 - 575kPa).

  The soils of the London Clay Formation were shown to have **a high volume change potential** in accordance with both BRE240 and NHBC Standards Chapter 4.2. Geotechnical analyses indicated these soils to be stiff, heavily overconsolidated and with a potential lithology controlled moisture deficit.

  The soils of the London Clay Formation are heavily overconsolidated cohesive soils and given their depth are likely to be a suitable bearing stratum for piled foundations. The settlements induced on loading are likely to be moderate to high.

- No groundwater was noted during the intrusive investigation. The results of the groundwater monitoring in the standpipes installed shall follow as an addendum to this report.

- No roots were noted in BH1 or BH2.

6.2 Basement Foundations

At the time of reporting, October 2016, it was understood that the proposed development will comprise the partial demolition of the existing office/storage building and the construction of a three storey residential dwelling with basement. The proposed basement excavation will be formed at two levels, one at ~3.00 – 3.50m below ground level and a second at ~4.55m bgl. The proposed development is shown in Figure 4.

The basements levels will therefore be formed at ~6.00 – 6.50m and ~7.50 – 8.00m below the rear terrace of 4 Gray's Court.

The proposed development fell within Geotechnical Design Category 2 in accordance with Eurocode 7. The anticipated foundation loads were unknown to Ground and Water Limited at the time of the preparation of this report, but are thought to range between 75 – 150kN/m^2 based on experience.

The cohesive soils described as Alluvium were shown to have a **low volume change potential** in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2. The granular soils of the Alluvium were assumed to have a volume change potential in accordance with BRE240 and no volume change potential in accordance with NHBC Standards Chapter 4.2.

The soils described as the Hackney Gravel Member were shown to have **no volume change potential** in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The soils of the London Clay Formation were shown to have a **high volume change potential** in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

Foundations must therefore **not** be placed within cohesive root penetrated and/or desiccated soils and the influence of the trees surrounding the site must be taken into account. It is recommended that foundations are taken at least 300mm into non-root penetrated strata/desiccated soils or granular soils of no volume change potential.

No roots were encountered during the intrusive investigation.

Given the depth of Made Ground and Alluvium noted during the investigation a minimum foundation depth of 4.70 – 5.70m bgl was recommended for the basement.

It was considered likely the proposed basement will be constructed with load bearing concrete retaining walls with semi-ground bearing concrete floors. The following bearing capacities could be adopted for 5.00m long by 1.00m wide retaining wall strip footings or 1.5m by 1.5m pads at a depth of 4.70 – 5.70m bgl on the granular soils of the Hackney Gravel Formation. The bearing capacities and settlements were determined based on BH2/DP2.

Limit State: Bearing Capacities Calculated (Based on BH2/DP2)		
Depth (m BGL)	**Foundation System**	**Limit Bearing Capacity (kN/m^2)**
5.70	5.00m by 1.00m Strip	1228.50
	1.50m by 1.50m Pad	1479.92
	13.5m by 6.5m Mat	402.10

Serviceability State: Settlement Parameters Calculated (Based on BH2/DP2)			
Depth (m BGL)	**Foundation System**	**Limit Bearing Capacity (kN/m^2)**	**Settlement (mm)**
5.70	5.00m by 1.00m Strip	250	<12
	1.50m by 1.50m Pad	250	~10
	13.5m by 6.5m Mat	150	<15

A conservative allowance for the consolidation of plastic fines in the granular Hackney Gravel Formation has been included in this assessment.

The granular soils of the Hackney Gravel Formation were noted at a shallower depth (4.70m bgl) in BH1. The bearing capacities highlighted for strip and pad footings are applicable at 4.70m bgl. It was recommended that the allowable bearing capacity for a mat foundation is reduced to 100kN/m^2 if founded at 4.70m bgl.

A bearing capacity of less than 75N/m^2 at 4.70m bgl and 90N/m^2 at 5.70m bgl may result in heave of the underlying soils. Based on a 13.5m by 6.5m ground bearing basement mat with a self weight of 10kN/m^2, the immediate heave on removal of overburden pressure at 4.70m bgl would be ~8mm. ~6mm of heave would be expected at a founding depth of 4.70m bgl. This does not take into

account the potential for long term heave within the London Clay Formation at depth.

General Recommendations for Spread Foundations:

- Excavations must be kept dry and either concreted or blinded as soon after excavation as possible. If water were allowed to accumulate on the formation for even a short time not only would an increase in heave occur resulting from the soil increasing in volume by taking up water, but also the shear strength and hence the bearing capacity would also be reduced.

- Roots may be found to greater depths at other locations on the site, particularly close to trees and/or trees that have been removed both within the site and its close environs.

- Inspection of foundation excavations, prior to concreting, must be made by a competent and suitably qualified person to check for any soft spots and to check for the presence of roots.

- Any groundwater or surface water ingress must be prevented from entering foundation trenches. Excavations must be kept dry and either concreted or blinded as soon after excavation as possible. If water were allowed to accumulate on the formation for even a short time not only would an increase in heave occur resulting from the soil increasing in volume by taking up water, but also the shear strength and hence the bearing capacity would also be reduced and this could result in increased settlements.

- Foundation excavations must be carefully bottomed out and any loose soil or soft spots removed prior to the foundation concrete or blinding being placed. Failure to ensure that foundation excavations are suitably bottomed out could result in additional settlements.

- Foundations must not be cast over foundations of former structures and/or other hard spots.

- Isolated Pad Foundations must be at least 1.5 times the width of the widest pad apart to keep to the anticipated settlements.

- Final designs for the foundations should be carried out by a suitably qualified Engineer based on the findings of this investigation and with reference to the anticipated loadings, serviceability requirements for the structure and the developments proximity to former, present and proposed trees.

No groundwater was encountered during drilling of the boreholes. The results of the groundwater monitoring in the standpipes installed shall follow as an addendum to this report.

Based on the data obtained during the investigation to date it was considered unlikely that construction will take place at or below the groundwater table. Groundwater is anticipated to be encountered within the Hackney Gravel Member, at a level above its boundary with the impermeable London Clay Formation, encountered from 7.60m bgl. Drilling may have obscured the groundwater strike during construction.

However, given the significant thickness of Made Ground and Alluvium significant perched water, within these deposits, may be encountered. The advice of a reputable dewatering contractor,

familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the design of the excavation for the lower ground floor basement.

It was recommended that the wells installed are dipped prior to commencement of construction to confirm the anticipated groundwater level.

It must be mentioned that it was assumed that excavations will be kept dry and either concreted or blinded as soon after excavation as possible. If water were allowed to accumulate on the formation for even a short time not only would an increase in heave occur resulting from the soil increasing in volume by taking up water, but also the shear strength and hence the bearing capacity would also be reduced.

If the construction works take place during the winter months, when the groundwater level is expected to be at its higher elevation, perched water could accumulate thus dewatering could be required to facilitate the construction and prevent the base of the excavation blowing before the slab was cast. The advice of a reputable dewatering contractor, familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the design of the excavation for the basement.

The basement must be suitably tanked to prevent ingress of any groundwater, if applicable, and also surface water run-off. The basement must also be designed to take into account pressure exerted by the presence of groundwater in and around the basement, if applicable.

6.3 Piled Foundations

The construction of a piled foundation is a specialist job, and the advice of a reputable contractor, familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the foundation design, as the actual pile working load will depend on the particular type of pile and method of installation adopted. It is recommended the piles are taken through the Made Ground, Alluvium and Hackney Gravel Member into the soils of the London Clay Formation.

The foundation would comprise a piled foundation with reinforced ground beams. For the cumulative pile capacity calculations, shaft friction over the desiccated levels should be ignored and piles should not be terminated within desiccated soils where moisture recovery following tree removal could occur.

Indicative limit loads and settlements for a bored pile have been given within the table below and have been based on the SPT profile for BH2 and DP2.

An allowance for negative skin friction to occur within the top 5.70m of the soil has been included within the calculations where it could pass through any Made Ground/Alluvium and root penetrated soils and soils showing a possible moisture deficit. An adhesion factor of 0.45m has been applied to all cohesive units.

The bearing values may be limited by the maximum permissible stress allowable on a concrete pile. To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

EC2 – Eurocode 7 (Factor of Safety of ~2):

Bored Pile – Limit Loads and Settlement Parameters (Based on BH/DP2/Eurocode 7)						
Depth (m bgl)	Diameter (m)	Limit States (kN)			Settlement (Poulos Davis (1968))	
		Tip	Lateral	Total	Load (kN)	Total (Elastic + Rigid) (cm)
10	0.30	109.85	395.59	488.65	450	0.3022
	0.45	247.16	593.38	802.78	800	0.5032
	0.60	439.40	791.18	1163.43	1000	0.4717

Classic Theory (Factor of Safety of 3):

Bored Pile – Limit Loads and Settlement Parameters (Based on BH/DP2/ Classic Theory)						
Depth (m bgl)	Diameter (m)	Limit States (kN)			Settlement (Poulos Davis (1968))	
		Tip	Lateral	Total	Load (kN)	Total (Elastic + Rigid) (cm)
10	0.30	100.84	309.35	393.41	350	0.2350
	0.45	226.90	464.03	653.15	600	0.1660
	0.60	403.37	618.70	954.92	900	0.4245

The bearing values given in the table above are applicable to single piles. Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of approximately 0.8 and a calculation made to check the factor of safety against block failure.

The piles will need to be designed in accordance with the volume change potential of the soils encountered, depth of desiccation, root penetration, etc. Temporary casing may be required where the upper portion of the pile passes through the Made Ground, particularly where perched water is encountered, to prevent necking of the concrete.

Groundwater was not encountered during the intrusive investigation. The results of the groundwater monitoring in the standpipes installed shall follow as an addendum to this report.

6.4 Piled Basements

Basement rafts founded on piles have an effect of stiffening the raft and reducing or eliminating reconsolidation of ground heave, thereby reducing differential settlements or tilting.

Where piles are terminated on a yielding stratum such as stiff clay, settlement of the piles as the working load is built up are likely to result in some of the load being carried by the underside of the slab raft or by the pile caps. The soil beneath these relatively shallow structures is likely to then compress, causing the load to transfer back to the piles. The process is continuous with some proportion of the load being carried by the piles and some by the capping structure. Therefore while the piles must be designed to carry the fall of the super structure loading, the slab raft which transfers the load to the piles should have sufficient strength to withstand loading on the underside equivalent to the net load of the superstructure or to some proportionate of the net load which is assessed from a consideration of the likely yielding of the piles, the compressibility of the shallow soil layers and the effects of basement excavation and pile installation.

For piles constructed wholly in compressible clays, in the course of excavation for the basement, heave takes place, with further upwards movement caused by displacement due to pile driving, or if

bored piles are used, there may be a small reduction in the amount of heave due to inward movement of the clay around the pile boreholes.

After completion of the piling, we suspect the swelled soils would be trimmed off to the specified level of the underside of the basement. After concreting the basement slab, it was considered that there would be some tendency for pressure to increase due to long term swelling of the soil, but this is likely to be counteracted to some extent if driven piles are used by the soil displaced by the driving settling away from the slab as it reconsolidates around the piles. However, as the load of the basement increases with superstructure loading, the piles themselves are likely to settle due to consolidation of the soil in the region of the piles. It was considered that the soil surrounding the upper part of the piles would follow the downward movement of the underlying soil and thus there is likely to be no appreciable tendency for the full structural loading to come onto the basement slab.

After completion of the building, long-term settlement due to consolidation of the soil beneath the piles would most likely continue, but at all times the overlying soils would be considered to move downwards and are unlikely to develop appreciable pressure on the basement slab.

Thus, it can be stated that the maximum load which is likely to come from the underside of the slab would most likely be that due to the soil swelling in the early days after pile driving together with water pressure if the basement is below groundwater level. If; however, the working loads on the piles were to exceed their ultimate carrying capacity, they would move downwards relative to the surrounding soil. The slab would then carry the full load of the building, until consolidation of the soil throws the load back on the piles with progressive movement continuing until equilibrium is reached.

The net downward movement resulting from the algebraic sum of heave, reconsolidation, and further consolidation will be lower for the piled basement than for an unpiled basement. This is illustrated in the Figure A below.

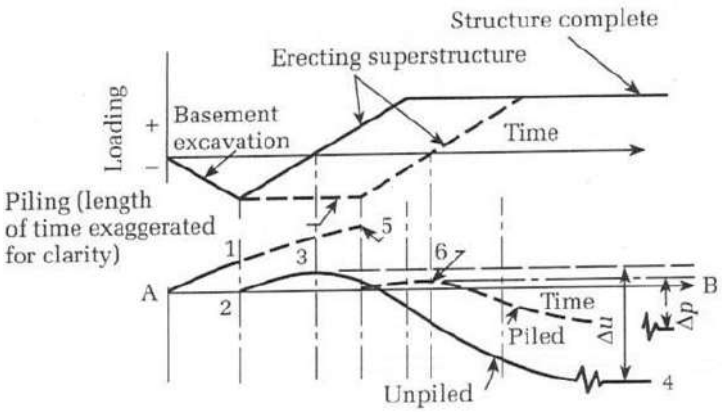


Figure A: Comparison of settlement/heave associated with piled and unpiled basements

In the case of the piled basement, the excavation will generally remain open and unconcreted for a longer period until all piles have been installed. After completion of piling (Point 5) the soil is trimmed off to the specified level and the floor slab is constructed. There will be some continuing upward movement of the basement level as the soil around and beneath the piles continue to swell, but if the piles are long in relation to the width of the building such movement will be very small. When the superstructure loading reaches the original overburden pressure (Point 6) reconsolidation

will take place. The net downward movement (Δp) will be less, since the swelling is less and the consolidation due to net additional super-structure loading will also be less since the piles have been terminated in soil of lower compressibility.

If however, the piles are relatively short, it was considered that there would be no appreciable reduction in net settlement as compared to an unpiled basement. The piles would then be wholly within the zone of swelling which may be greater because the excavation would remain open for a longer period. **To be effective in reducing net settlements, piles should be terminated below the zone of swelling.**

Therefore, based on the above, piles which are terminated below the zone of swelling and anchored against uplift by shaft friction or enlarged bases are considered to have considerable tension, and measures should be taken to prevent its occurrence. Reinforcement of the pile shafts in addition to sleeving the piles within the swelling zone could be considered. Uplift on the underside of the basement slab and the consequent transfer of the uplift forces to the piles can be prevented by providing a layer of weak compressible material below the slab.

Piles tend to be installed in groups under each column with the column load transferred to the pile group by the pile cap. These caps may also need some protection by installation of compressible layers below the pile cap. The underside of ground beams, running between pile caps, should also be fitted with these compressible materials in accordance with NHBC requirements for compressible materials on the sides of the pile caps and ground beams (inside edges).

A further risk with piled basements constructed by top-down methods in heaving clay is upward convexity occurring in the ground floor and upper immediate basement slabs where these are connected to the steel columns at an early stage in construction. In some circumstances tension can develop at the junction between the columns and the tops of the piles, and care is necessary to ensure that the holding-down bolts to the column base plates are sufficiently long and not overstressed.

6.5 Basement Excavations & Stability

Shallow excavations in the Made Ground/Alluvium are likely to be marginally stable at best. Long, deep excavations, through all of these strata are likely to become unstable, especially where groundwater strikes are noted.

The excavation of the basement must not affect the integrity of the adjacent structures beyond the boundaries. The excavation must be supported by suitably designed retaining walls. It is considered unlikely that battering the sides of the excavation, casting the retaining walls and then backfilling to the rear of the walls would be suitable given the close proximity of the party walls.

The retaining walls for the basement will need to be constructed based on an appropriate angle of shear resistance (Φ') for the ground conditions encountered.

Based on the ground conditions encountered within BH/DP2 the following parameters could be used in the design of retaining walls. These have been designed based the results of geotechnical classification tests and reference to literature.

Retaining Wall/Basement Design Parameters					
Strata	**Unit Volume Weight (kN/m^3)**	**Cohesion Intercept (c') (kPa)**	**Angle of Shearing Resistance (Ø)**	**Ka**	**Kp**
Made Ground	~15	0	~15	0.59	1.70
Alluvium	17 – 18	0	20	0.49	2.04
Hackney Gravel Member	~20	0	~34	0.28	3.54
London Clay Formation	20 - 24	0 - 12	24 - 28	0.42 – 0.36	2.37 - 2.77

Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported before excavations are entered by personnel.

No groundwater was encountered during drilling of the boreholes. The results of the groundwater monitoring in the standpipes installed shall follow as an addendum to this report.

Based on the data obtained during the investigation to date it was considered unlikely that construction will take place at or below the groundwater table. Groundwater is anticipated to be encountered within the Hackney Gravel Member, at a level above its boundary with the impermeable London Clay Formation, encountered from 7.60m bgl. Drilling may have obscured the groundwater strike during construction.

It was recommended that the wells installed are dipped prior to commencement of construction to confirm the anticipated groundwater level.

6.6 Hydrogeological Effects

The proposed development is located on a **Secondary A Aquifer** comprising the superficial drift deposits of the Hackney Gravel Member. The underlying London Clay Formation was described as **Unproductive Strata**.

The ground conditions encountered generally comprised a capping of Made Ground over the Alluvium, the Hackney Gravel Member and then the cohesive London Clay Formation. Based on a visual appraisal of the soils encountered the permeability of the Alluvium was likely to be variable and the Hackney Gravel Member was likely to be medium to high. Soils of the London Clay Formation are impermeable to groundwater.

No groundwater was encountered during drilling of the boreholes. The results of the groundwater monitoring in the standpipes installed shall follow as an addendum to this report.

Based on the data obtained during the investigation to date it was considered unlikely that construction will take place at or below the groundwater table. Groundwater is anticipated to be encountered within the Hackney Gravel Member, at a level above its boundary with the impermeable London Clay Formation, encountered from 7.60m bgl. Drilling may have obscured the groundwater strike during construction.

Perched water may be encountered within the Made Ground, Alluvium or the Hackney Gravel Member, especially after period of prolonged rainfall.

In relation to the basement, once constructed, the soils of the Hackney Gravel Member are likely to provide a porous medium through which water can migrate. However additional drainage should be considered as the cohesive deposits will act as a barrier for groundwater migration.

6.7 Sub-Surface Concrete

Sulphate concentrations measured in 2:1 water/soil extracts taken from the Made Ground, Hackney Gravel Member and London Clay Formation, from both the geotechnical and chemical laboratory testing, fell into Classes DS-2 of the BRE Special Digest 1, 2005, *'Concrete in Aggressive Ground'.*

Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of AC-2 for foundations within the Made Ground, Hackney Gravel Member and London Clay Formation. For the classification given, the "mobile" and "natural" case was adopted given the geology, and the history of the site.

The sulphate concentration in the samples ranged from 114 - 930mg/l with a pH range of 7.0 – 8.4. The total sulphate were noted to range between 0.05 – 0.15%.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1, 2005, *'Concrete in Aggressive Ground'* taking into account the pH of the soils.

It is prudent to note that pyrite nodules may be present within the London Clay Formation. Pyrite can oxidise to gypsum and this normally only occurs in the upper weathered layer, but excavation allows faster oxidation and water soluble sulphate values can rapidly increase during construction. Therefore rising sulphate values should be taken into account should ferruginous staining/pyrite nodules be encountered within the London Clay Formation.

6.8 Surface Water Disposal

Infiltration tests were beyond the scope of the investigation.

Soakaways constructed within the Hackney Gravel Member may prove satisfactory for surface water disposal, however infiltration rates may be restricted by their thickness and presence of clay fines. Soakaway tests to BRE365 may be required to confirm this.

The soils of the Hackney Gravel Member are a Secondary A Aquifer and consultation with the Environment Agency must be sought regarding any use that may have an impact on groundwater resources.

The principles of sustainable urban drainage system (SUDS) should be applied to reduce the risk of flooding from surface water ponding and collection associated with the construction of the basement.

6.9 Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation. For example, there may have been underground storage tanks (UST's) not identified during the Desk Study and/or Ground Investigation for which there is no historical or

contemporary evidence.

Such occurrences may be discovered during the demolition and construction phases for the redevelopment of the site.

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied. Should a new source of contamination be suspected or identified then the Local Authority will need to be informed.

6.10 Waste Classification

Foundation excavations on-site are likely to produce waste which will require classification and then recycling or removal from site.

Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal all waste must be classified as;

- Inert;
- Non-hazardous, or;
- Hazardous.

The Environment Agency's Hazardous Waste Technical Guidance (WM2) document outlines the methodology for classifying wastes.

Once classified the waste can be removed to the appropriately licensed facilities, with some waste requiring pre-treatments prior to disposal.

Based on a risk phrase analysis of the chemical laboratory test results, in accordance with EC Hazardous Waste Directive, undertaken by Ground and Water Limited, the Made Ground encountered onsite was **NON-HAZARDOUS.** The results of the assessment are given within Appendix F.

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM2, therefore producing an initial classification in accordance with the guidance, landfill operators have their own assessment tools and can often come to different conclusions. As a result, some landfill operators could refuse to take apparently suitable waste. It is recommended that the receiving landfill views the results of this assessment and the chemical laboratory results to determine their own classification.

6.11 Imported Material

Any soil which is to be imported onto the site must undergo chemical analysis to prove that it is suitable for the purpose for which it is intended.

The Topsoil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be stockpiled and tested prior to placing to ensure that the human receptor cannot come into contact with compounds that could be detrimental to human health. The compounds that are to be tested for are those given in the LQM CIEH Generic Assessment Criteria,

which can be viewed in Appendix E of this report.

6.12 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust were generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

N

NOT TO SCALE

APPROXIMATE SITE BOUNDARY

Project: 22 Kings Mews, Clerkenwell, London WC1N 2JB		**Figure 1**
Client: Rosebery Financial	**Date:** October 2016	ground&water
Site Location Plan	**Ref:** GWPR1789	

N

NOT TO SCALE

APPROXIMATE SITE BOUNDARY

Project: 22 Kings Mews, Clerkenwell, London WC1N 2JB	**Figure 2**
Client: Rosebery Financial	**Date:** October 2016
Site Development Area	**Ref:** GWPR1789

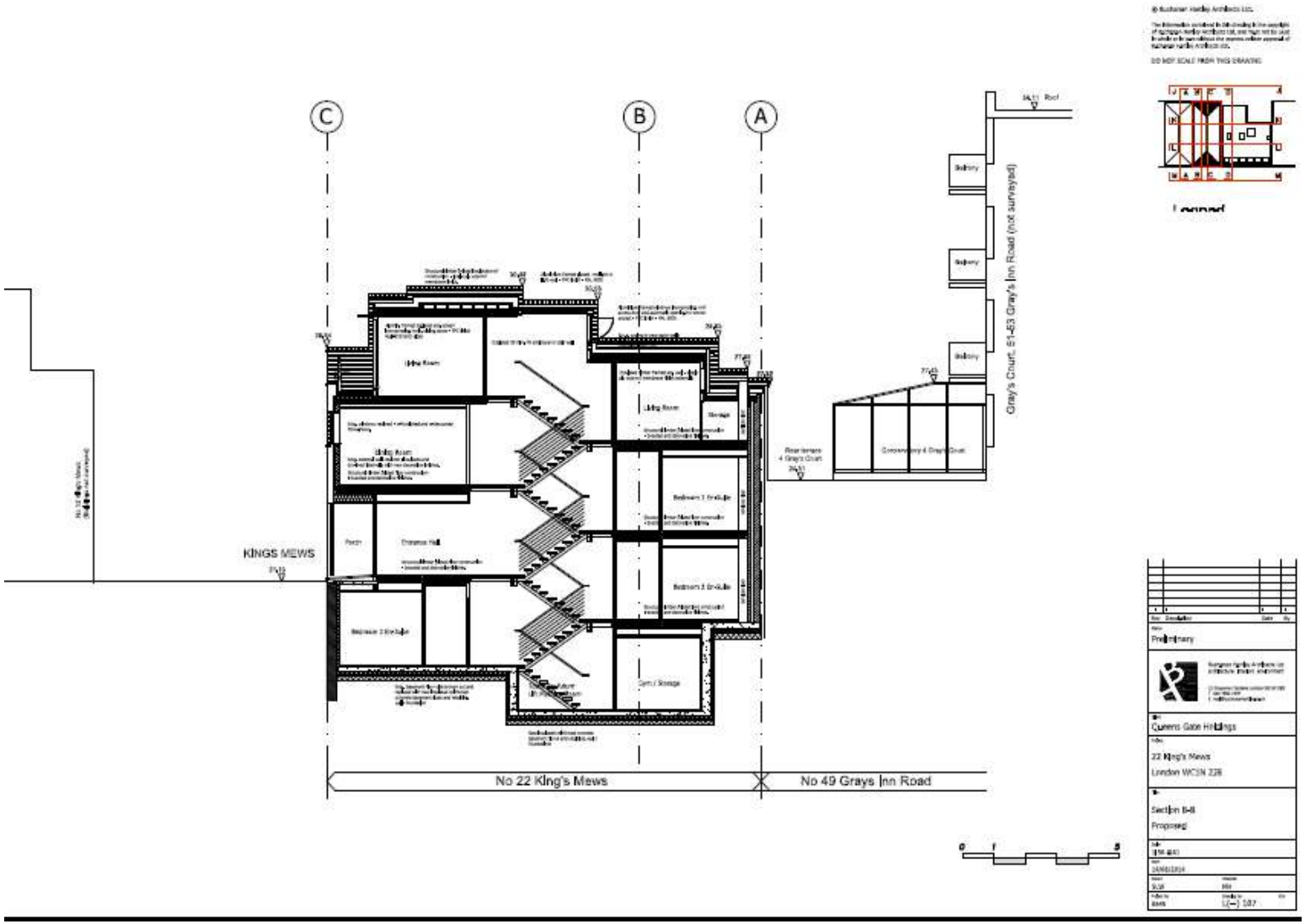
ground&water

N

NOT TO SCALE

APPROXIMATE SITE BOUNDARY

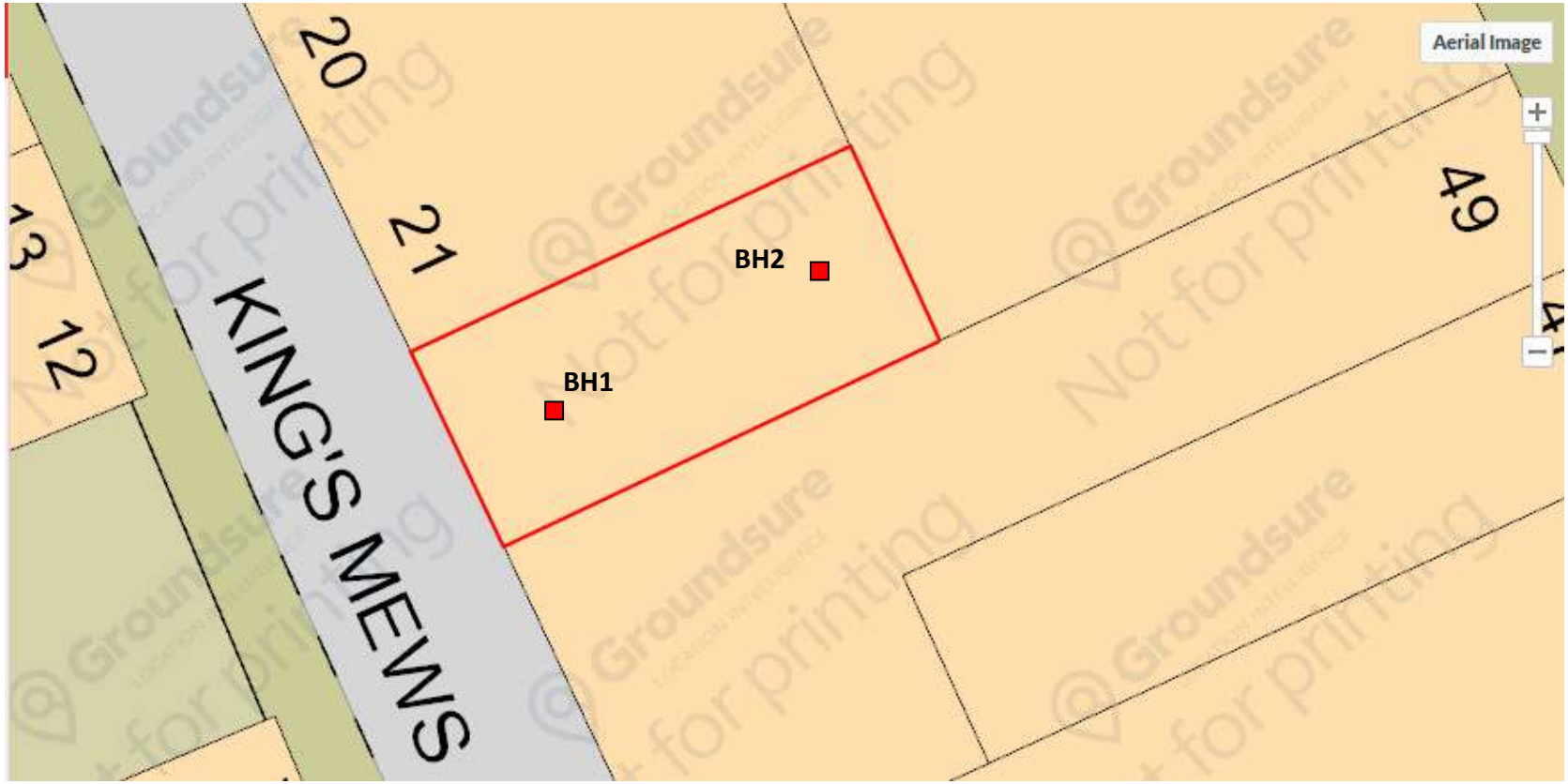
Project: 22 Kings Mews, Clerkenwell, London WC1N 2JB		**Figure 3**
Client: Rosebery Financial	**Date:** October 2016	ground&water
Aerial View of the Site	**Ref:** GWPR1789	



APPROXIMATE SITE BOUNDARY

Project: 22 Kings Mews, Clerkenwell, London WC1N 2JB	**Figure 4**
Client: Rosebery Financial	**Date:** October 2016
Proposed Development - Section View	**Ref:** GWPR1789

ground&water



■ **Borehole locations (BH1 and BH2)**

NOT TO SCALE

Project: **22 Kings Mews, Clerkenwell, London WC1N 2JB**		**Figure 5**
Client: **Rosebery Financial**	**Date:** **October 2016**	ground&water
Trial Hole Location Plan	**Ref:** **GWPR1789**	

APPENDIX A
Conditions and Limitations

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

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

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

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

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

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

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

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

The conclusions and recommendations relate to 22 Kings Mews, Clerkenwell, London WC1N 2JB.

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

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

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

APPENDIX B
Fieldwork Logs

Ground and Water Ltd

Borehole No
BH1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
22 Kings Mews	GWPR1789		WLS
Location: Clerkenwell, London WC1N 2JB		Level: -	Scale 1:50
Client: Rosebery Financial		Dates: 23/08/2016	Logged By PA

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.09			CONCRETE
		0.30	D					MADE GROUND: Grey/brown gravelly sand. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to coarse, sub-angular to sub-rounded brick and cement (builders waste).
		0.50	D					
		0.80	D					
		1.00	D					
		1.50	D					
		2.00	D					
		2.50	D					
					2.70			MADE GROUND: Black slightly clayey gravelly sand. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-angular to sub-rounded flint, brick, cement, metal and wood fragments. Clay pocket noted at 4.50m bgl.
		3.00	D					
		3.50	D					
		4.00	D					
		4.50	D					
					4.70			HACKNEY GRAVEL MEMBER/LYNCH HILL GRAVEL MEMBER: Grey brown SAND and GRAVEL. Sand is fine to coarse grained. Gravel is abundant, fine to medium, sub-angular to sub-rounded flint.
		5.00	D		5.00			End of Borehole at 5.00 m
			Type	Results				

Remarks: No groundwater encountered.
No roots noted.

AGS

Ground and Water Ltd

Borehole No
BH2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
22 Kings Mews	GWPR1789		WLS
Location: Clerkenwell, London WC1N 2JB		Level: -	Scale 1:50
Client: Rosebery Financial		Dates: 23/08/2016	Logged By PA

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.10			CONCRETE
		0.30	D					MADE GROUND: Grey to dark brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to medium, sub-angular to sub-rounded brick, flint, concrete and cement.
		0.50	D					
		0.80	D					
		1.00	SPT	N=4	1.00			
		1.00	D	(1,1/ 1,1,1,1)				MADE GROUND: Dark brown slightly clayey gravelly sand. Sand is fine to medium grained. Gravel is rare to occasional, fine to medium, sub-angular to sub-rounded flint, brick and cement.
		1.50	D					
		2.00	SPT	N=4				
		2.00	D	(1,1/ 1,1,1,1)				
		2.50	D					
		3.00	SPT	N=20				
		3.00	D	(2,5/ 5,5,5,5)				
		3.50	D		3.50			ALLUVIUM: Brown clayey gravelly SAND. Sand is fine to coarse grained. Gravel is occasional, fine to medium, sub-angular to sub-rounded flint.
		4.00	SPT	N=1				
		4.00	D	(1,0/ 0,0,0,1)				
		4.50	D		4.50			ALLUVIUM: Grey brown/dark brown with black streaks gravelly sandy silty CLAY. Gravel is rare to occasional, fine, sub-angular flint. (Slightly organic smell noted).
		5.00	SPT	N=39				
		5.00	D	(11,13/ 15,12,7,5)				
		5.50	D					
		6.00	SPT	N=14	5.70			HACKNEY GRAVEL MEMBER/LYNCH HILL GRAVEL MEMBER: Brown/light brown SAND and GRAVEL. Sand is fine to coarse grained. Gravel is abundant, fine to medium, sub-angular to sub-rounded flint.
		6.00	D	(3,3/ 4,3,3,4)				
		6.50	D					
		7.00	SPT	N=35				
		7.00	D	(7,6/ 8,8,9,10)				
		7.50	D					
		8.00	SPT	N=57	7.60			LONDON CLAY FORMATION: Grey brown silty CLAY.
		8.00	D	(13,13/ 13,14,14,16)				
					8.45			End of Borehole at 8.45 m
			Type	Results				

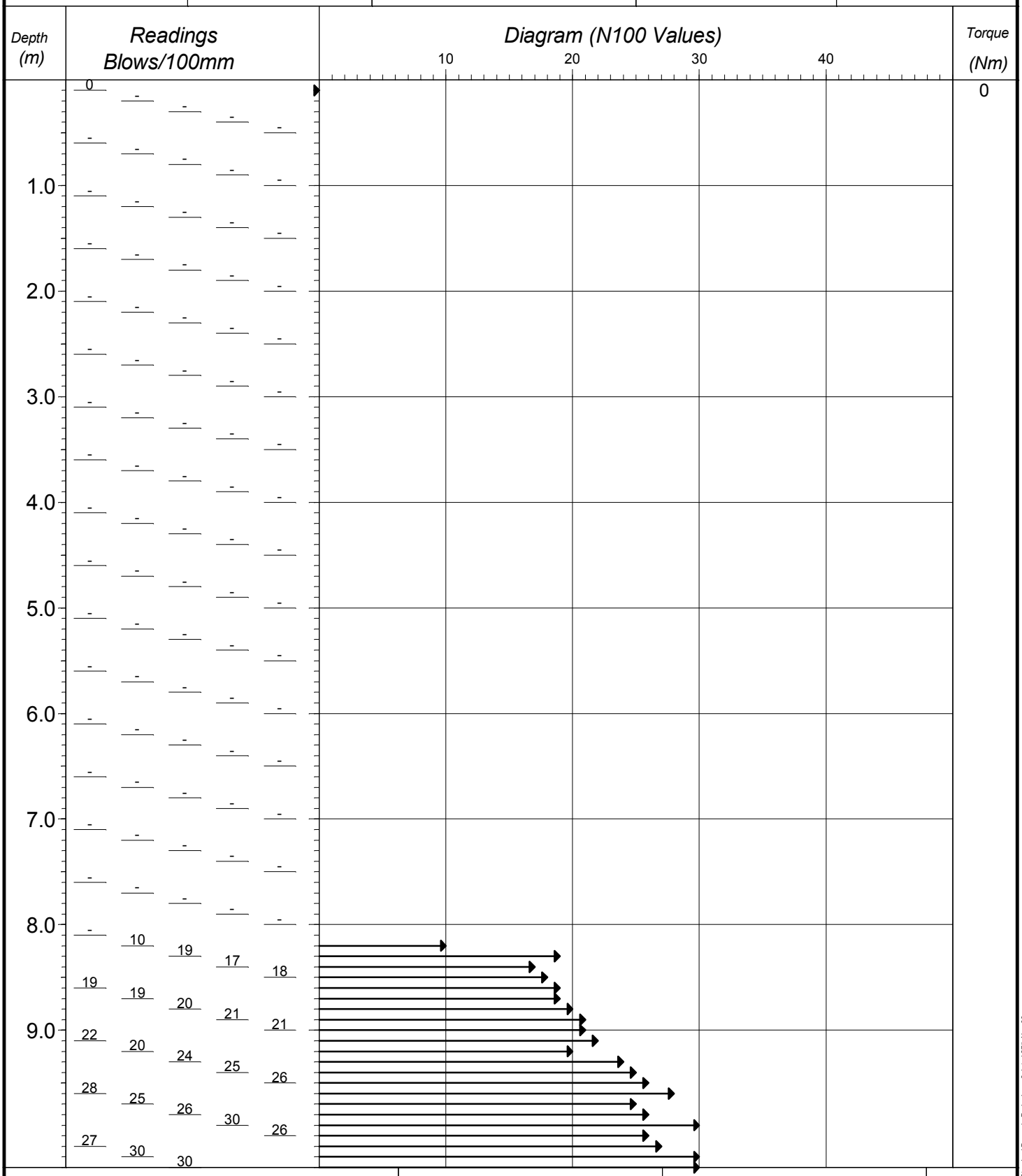
Remarks: No groundwater encountered.
No roots noted.

AGS

DYNAMIC PROBING

Probe No **DP2**	
Client **Rosebery Financial**	Sheet 1 of 2
Site **22 Kings Mews**	*Project No* **GWPR1789**

E -	*N* -	*Level* -	*Date* **23/08/2016**	*Logged by* **Norris**



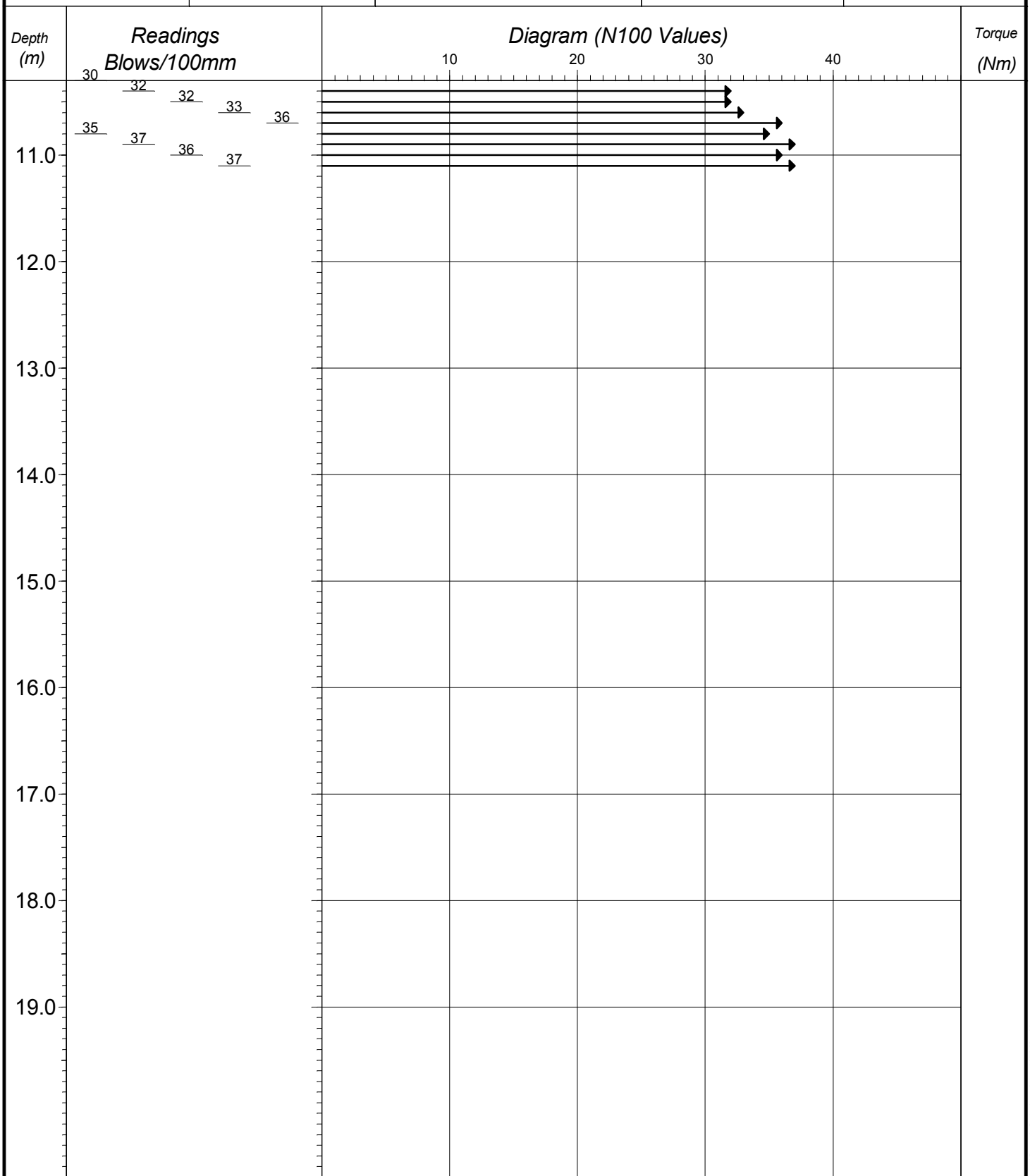
Ground and Water Ltd

Fall Height	**750**	*Cone Base Diameter*	**50**
Hammer Wt	**63.00**	*Final Depth*	**11.00**
Probe Type	**DPSH**	*Log Scale*	1:50

AGS

DYNAMIC PROBING

Probe No **DP2**				
Client **Rosebery Financial**			Sheet 2 of 2	
Site **22 Kings Mews**			*Project No* **GWPR1789**	
E -	*N* -	*Level* -	*Date* **23/08/2016**	*Logged by* **Norris**



Ground and Water Ltd	*Fall Height* **750**	*Cone Base Diameter* **50**	AGS
	Hammer Wt **63.00**	*Final Depth* **11.00**	
	Probe Type **DPSH**	*Log Scale* 1:50	

APPENDIX C
Geotechnical Laboratory Test Results

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

Job No.	Project Name	Programme	
21554	22 Kings Mews	Samples received	08/09/2016
		Schedule received	05/09/2016
Project No.	Client	Project started	08/09/2016
GWPR1789	Ground and Water Ltd	Testing Started	20/09/2016

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top	Base	Type		%	%	%	%	%	
BH2	-	5.50	-	D	Brown and occasional dark grey slightly gravelly sandy silty CLAY (gravel is fm and sub-angular to angular)	22	95	28	15	13	
BH2	-	7.50	-	D	Brown and occasional grey slightly gravelly silty CLAY with occasional sand staining (gravel is fm and sub-angular to rounded)	31	95	80	27	53	
BH2	-	8.00	-	D	Brown and occasional grey silty CLAY with occasional carbonaceous deposits	33	100	86	28	58	

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

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

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

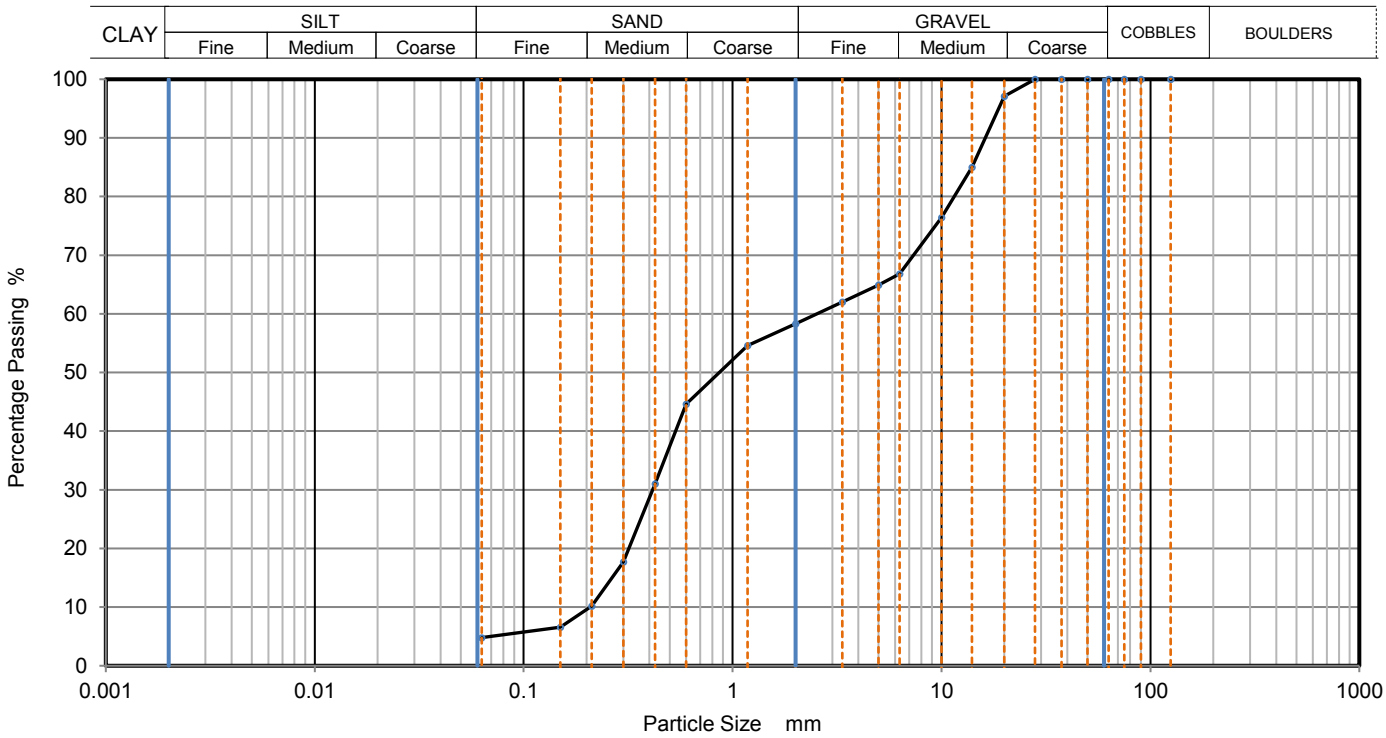
Checked and Approved

Initials **J.P**

Date: 22/09/2016

PARTICLE SIZE DISTRIBUTION

				Job Ref	21554
				Borehole/Pit No.	BH2
Site Name	22 Kings Mews			Sample No.	-
Project No.	GWPR1789	Client	Ground and Water Ltd	Depth	6.00 m
Soil Description	Greyish brown slightly clayey very gravelly SAND (gravel is fmc and sub-angular to rounded)			Sample Type	D
				Samples received	08/09/2016
				Schedules received	05/09/2016
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	08/09/2016
				Date tested	22/09/2016



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	97		
14	85		
10	76		
6.3	67		
5	65		
3.35	62		
2	58		
1.18	55		
0.6	45		
0.425	31		
0.3	18		
0.212	10		
0.15	7		
0.063	5		

Dry Mass of sample, g: 596

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	41.7
Sand	53.5
Fines <0.063mm	4.8

Grading Analysis		
D100	mm	
D60	mm	2.53
D30	mm	0.414
D10	mm	0.208
Uniformity Coefficient		12
Curvature Coefficient		0.33

Remarks

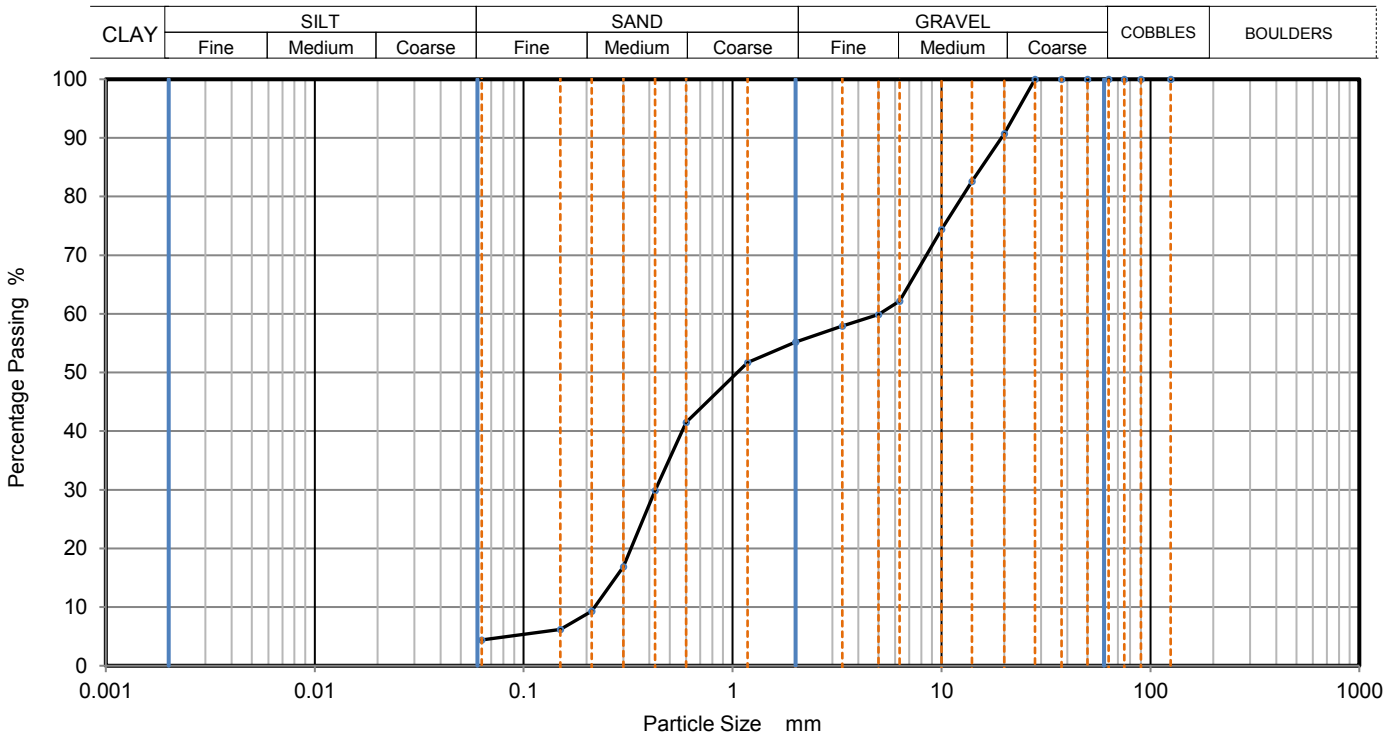
Preparation and testing in accordance with BS1377 unless noted below

K4 Soils Laboratory
Unit 8, Olds Close, Watford, Herts, WD18 9RU
Email: james@k4soils.com
Tel: 01923 711288

Checked and Approved
Initials: J.P
Date: 22/09/2016

PARTICLE SIZE DISTRIBUTION

Job Ref	21554				
Borehole/Pit No.	BH2				
Site Name	22 Kings Mews			Sample No.	-
Project No.	GWPR1789	Client	Ground and Water Ltd	Depth	6.50-7.00 m
Soil Description	Greyish brown slightly clayey very gravelly SAND (gravel is fmc and sub-angular to rounded)			Sample Type	D
				Samples received	08/09/2016
				Schedules received	05/09/2016
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	08/09/2016
				Date tested	22/09/2016



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	91		
14	83		
10	74		
6.3	62		
5	60		
3.35	58		
2	55		
1.18	52		
0.6	42		
0.425	30		
0.3	17		
0.212	9		
0.15	6		
0.063	4		

Dry Mass of sample, g	996

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	44.8
Sand	50.8
Fines <0.063mm	4.4

Grading Analysis		
D100	mm	
D60	mm	5.04
D30	mm	0.426
D10	mm	0.219
Uniformity Coefficient		23
Curvature Coefficient		0.16

Remarks

Preparation and testing in accordance with BS1377 unless noted below

K4 Soils Laboratory
Unit 8, Olds Close, Watford, Herts, WD18 9RU
Email: james@k4soils.com
Tel: 01923 711288

Checked and Approved
Initials: J.P
Date: 22/09/2016

Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results

Tested in accordance with BS1377 : Part 3 : 1990, clause 5.3 and clause 9

Job No.	Project Name	Programme	
21554	22 Kings Mews	Samples received	08/09/2016
		Schedule received	05/09/2016
Project No.	Client	Project started	08/09/2016
GWPR1789	Ground and Water Ltd	Testing Started	19/09/2016

Hole No.	Sample				Soil description	Dry Mass passing 2mm	SO3 Content	SO4 Content	pH	Remarks
	Ref	Top	Base	Type		%	g/l	g/l		
BH2	-	8.00	-	D	Brown and occasional grey silty CLAY with occasional carbonaceous deposits	100	0.77	0.93	7.79	

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

Checked and Approved

Initials J.P

Date: 22/09/2016

APPENDIX D
Chemical Laboratory Test Results

Phil Allvey
Ground & Water Ltd
2 The Long Barn
Norton Farm
Selborne Road
Alton
Hampshire
GU34 3NB

QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 16-48844

Site Reference:	22 Kings Mews
Project / Job Ref:	GWPR1789
Order No:	None Supplied
Sample Receipt Date:	07/09/2016
Sample Scheduled Date:	07/09/2016
Report Issue Number:	1
Reporting Date:	13/09/2016

Authorised by:

Russell Jarvis
Associate Director of Client Services

Authorised by:

Ela Mysiara
Inorganics & ICP Section Head

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

Soil Analysis Certificate						
QTS Environmental Report No: 16-48844	**Date Sampled**	23/08/16	23/08/16	23/08/16		
Ground & Water Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: 22 Kings Mews	**TP / BH No**	BH2	BH2	BH1		
Project / Job Ref: GWPR1789	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	**Depth (m)**	0.50 - 0.80	2.50	5.00		
Reporting Date: 13/09/2016	**QTSE Sample No**	226204	226205	226206		

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025	Not Detected				
pH	pH Units	N/a	MCERTS	7.0	7.7	8.4		
Total Cyanide	mg/kg	< 2	NONE	< 2				
Total Sulphate as SO_4	mg/kg	< 200	NONE		1481	543		
Total Sulphate as SO_4	%	< 0.02	NONE		0.15	0.05		
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	141	248	114		
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.14	0.25	0.11		
Total Sulphur	%	< 0.02	NONE		0.08	0.02		
Organic Matter	%	< 0.1	MCERTS	2				
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	1.2				
Ammonium as NH_4	mg/kg	< 0.5	NONE		17.9	19.9		
Ammonium as NH_4	mg/l	< 0.05	NONE		1.79	1.99		
W/S Chloride (2:1)	mg/kg	< 1	MCERTS		105	41		
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS		52.4	20.7		
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	MCERTS		1440	100		
Water Soluble Nitrate (2:1) as NO_3	mg/l	< 1.5	MCERTS		719	50		
Arsenic (As)	mg/kg	< 2	MCERTS	11				
W/S Boron	mg/kg	< 1	NONE	1.3				
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2				
Chromium (Cr)	mg/kg	< 2	MCERTS	13				
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2				
Copper (Cu)	mg/kg	< 4	MCERTS	45				
Lead (Pb)	mg/kg	< 3	MCERTS	393				
W/S Magnesium	mg/l	< 0.1	NONE		3.1	0.8		
Mercury (Hg)	mg/kg	< 1	NONE	< 1				
Nickel (Ni)	mg/kg	< 3	MCERTS	11				
Selenium (Se)	mg/kg	< 3	NONE	< 3				
Vanadium (V)	mg/kg	< 2	NONE	27				
Zinc (Zn)	mg/kg	< 3	MCERTS	43				
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Rosie Head

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).

Subcontracted analysis $^{(S)}$

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

Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 16-48844	**Date Sampled**	23/08/16				
Ground & Water Ltd	**Time Sampled**	None Supplied				
Site Reference: 22 Kings Mews	**TP / BH No**	BH2				
Project / Job Ref: GWPR1789	**Additional Refs**	None Supplied				
Order No: None Supplied	**Depth (m)**	0.50 - 0.80				
Reporting Date: 13/09/2016	**QTSE Sample No**	226204				

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1				
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1				
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1				
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1				
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1				
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1				
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1				
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1				
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1				
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1				
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1				
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{o}C

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Rose Lane
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Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 16-48844	**Date Sampled**	23/08/16				
Ground & Water Ltd	**Time Sampled**	None Supplied				
Site Reference: 22 Kings Mews	**TP / BH No**	BH2				
Project / Job Ref: GWPR1789	**Additional Refs**	None Supplied				
Order No: None Supplied	**Depth (m)**	0.50 - 0.80				
Reporting Date: 13/09/2016	**QTSE Sample No**	226204				

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01				
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05				
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2				
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2				
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3				
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3				
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10				
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21				
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01				
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05				
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2				
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2				
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2				
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3				
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10				
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21				
Total >C5 - C35	mg/kg	< 42	NONE	< 42				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

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

4480

Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 16-48844	**Date Sampled**	23/08/16				
Ground & Water Ltd	**Time Sampled**	None Supplied				
Site Reference: 22 Kings Mews	**TP / BH No**	BH2				
Project / Job Ref: GWPR1789	**Additional Refs**	None Supplied				
Order No: None Supplied	**Depth (m)**	0.50 - 0.80				
Reporting Date: 13/09/2016	**QTSE Sample No**	226204				

Determinand	**Unit**	**RL**	**Accreditation**					
Benzene	ug/kg	< 2	**MCERTS**	< 2				
Toluene	ug/kg	< 5	**MCERTS**	< 5				
Ethylbenzene	ug/kg	< 2	**MCERTS**	< 2				
p & m-xylene	ug/kg	< 2	**MCERTS**	< 2				
o-xylene	ug/kg	< 2	**MCERTS**	< 2				
MTBE	ug/kg	< 5	**MCERTS**	< 5				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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

Soil Analysis Certificate - Sample Descriptions
QTS Environmental Report No: 16-48844
Ground & Water Ltd
Site Reference: 22 Kings Mews
Project / Job Ref: GWPR1789
Order No: None Supplied
Reporting Date: 13/09/2016

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 226204	BH2	None Supplied	0.50 - 0.80	7.4	Brown clay with stones and brick
$ 226205	BH2	None Supplied	2.50	19.3	Brown clay with concrete
$ 226206	BH1	None Supplied	5.00	8.8	Brown sandy clay with concrete

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

$ samples exceeded recommended holding times

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Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 16-48844
Ground & Water Ltd
Site Reference: 22 Kings Mews
Project / Job Ref: GWPR1789
Order No: None Supplied
Reporting Date: 13/09/2016

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

D Dried
AR As Received

APPENDIX E
Soil Assessment Criteria

Appendix E
Soil Guideline Values and Genera Assessment Criteria

E1 Assessment Criteria

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'.

E1.1 Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment Model (CLEA).

The CLEA Guidance comprises the following documents:

1) EA Science Report SC050021/SR2: *Human health toxicological assessment of contaminants in soil.*
2) EA Science Report SC050021/SR3: *Updated technical background to the CLEA model.*
3) EA CLEA Bulletin (2009).
4) CLEA software version 1.06 (2009)
5) Toxicological reports and SGV technical notes.

The CLEA guidance and tools:

- *do not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures.*
- *do not cover risks to the environment, such as groundwater, ecosystems or buildings.*
- *do not provide a definitive test for telling when human health risks are significant.*
- *are not a legal requirement in assessing land contamination risks. They are not part of the legal regime for Part 2A of the Environmental Protection Act 1990.*

The CLEA guidance derives soil concentrations of contaminants above which (in the opinion of the EA) there may be a concern that warrants further investigation. It does not provide a definitive test for establishing that the risk is significant.

E1.2 Land-use Scenarios

The CLEA model uses a range of standard land-use scenarios to develop conceptual exposure models as follows:

1 Residential (with home grown produce) (RwHP)

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil and indoor dust ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours.
- Building type is a two-storey small terraced house.

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur. (Residential without homegrown produce (RwoHP)).

2) Allotments

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours.
- There is no building.

3) Commercial/Industrial

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

- Critical receptor is a working female adult (aged 16 to 65 years old).
- Exposure duration is a working lifetime of 49 years.
- Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours.
- Building type is a three-storey office (pre 1970).

E1.4 LQM/CIEH SUITABLE 4 USE LEVELS (S4UL)

For derivation of these S4UL reference must be made to:

Nathanial, P., McCaffrey, C., Gillet, A., Ogden, R., Nathanial, J.,. *The LQM/CIEH S4UL's for Human Health Risk Assessment*. **Land Quality Press**. 2015

The LQM/CIEH S4UL for a given land use is the concentration of the contaminant in soil at which the predicted daily exposure, as calculated by the CLEA software, equals the Health Criteria Value.

The final output for each contaminant represents a synthesis of new toxicological (and fate and transport) reviews published since the preparation of the 2nd edition LQM/CIEH GAC's (Nathanial et al., 2009).

In the derivation of LQM/CIEH S4UL's the principles of 'minimal' or 'tolerable' risk enshrined in SR2, which has not been withdrawn, has been maintained.

S4UL's have been derived for the basic CLEA land-uses, as described above, and for two new land uses:

- Public Open Spaces near Residential Housing (POSresi)
- Public Park (POSpark).

Public Open Spaces near Residential Housing (POSresi)
Includes the predominantly grassed areas adjacent to high density housing, the central green area on many 1930's – 1970's housing estates, and smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soils with planting. It is assumed that the close proximity to the place of residence will allow tracking back of soil to occur.

Public Park (POSpark)
An area of open space, usually owned and maintained by the local authority, provided for recreational uses including family visists and picnics, children's play area, informal sporting activities (not a dedicated sports pitch), and dog walking. It is assumed that tracking back of soils into places of residence will be negligible.

E1.5 Category 4 **Screening Levels (C4SLs)**
In the case of Lead, no SGV or GAC has been published to date. This is likely to be due to the toxicity review that is currently being undertaken by the Environment Agency. In the absence of updated toxicity information the SGV derived using CLEA 1.06 methodology and related toxicity will be used.

The overall objective of the C4SLs research project was to assist the provision of technical guidance in support of Defra's revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A) (Defra, 2012a). Specifically, the project aimed to deliver:

• A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
• A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised SG presented a new four category system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a

significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high. More specific guidance on what type of land should be considered as Category 4 (Human Health) is provided in Paragraphs 4.21 and 4.22 of the revised SG, as follows:

"4.21 The local authority should consider that the following types of land should be placed into Category 4: Human Health:
(a) Land where no relevant contaminant linkage has been established.
(b) Land where there are only normal levels of contaminants in soil, as explained in Section 3 of this Guidance.
(c) Land that has been excluded from the need for further inspection and assessment because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of this Guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of this Guidance.
(d) Land where estimated levels of exposure to contaminants in soil are likely to form only a small proportion of what a receptor might be exposed to anyway through other sources of environmental exposure (e.g. in relation to average estimated national levels of exposure to substances commonly found in the environment, to which receptors are likely to be exposed in the normal course of their lives).

4.22 The local authority may consider that land other than the types described in paragraph 4.21 should be placed into Category 4: Human Health if following a detailed quantitative risk assessment it is satisfied that the level of risk posed is sufficiently low."

The C4SLs are intended as "relevant technical tools" (in relation to Paragraph 4.21(c)) to help local authorities and others when deciding to stop further assessment of a site, on the grounds that it falls within Category 4 (Human Health).

The Impact Assessment (IA), which accompanied the revised SG (Defra, 2012b) provides further information on the nature and potential role of the C4SLs. Paragraph 47(h) of the IA states that:

"The new statutory guidance will bring about a situation where the current SGVs/GACs are replaced with more pragmatic (but still strongly precautionary) Category 4 screening levels (C4SLs) which will provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land."

A key distinction between the Soil Guideline Values (SGVs) and the C4SLs is the level of risk that they describe. As described by the Environment Agency (2009a):
"SGVs are guidelines on the level of long-term human exposure to individual chemicals in soil that, unless stated otherwise, are tolerable or pose a minimal risk to human health."

The implication of Paragraph 47(h) of the IA is that minimal risk is well within Category 4 and that the C4SLs should describe a higher level of risk which, whilst not minimal, can still be considered low enough to allow a judgement to be made

that land containing substances at, or below, the C4SLs would typically fall within Category 4. This reflects Paragraph 4.20 of the revised SG, which states:

"4.20 The local authority should not assume that land poses a significant possibility of significant harm if it considers that there is no risk or that the level of risk posed is low. For the purposes of this Guidance, such land is referred to as a "Category 4: Human Health" case. The authority may decide that the land is a Category 4: Human Health case as soon as it considers it has evidence to this effect, and this may happen at any stage during risk assessment including the early stages."

C4SLs, therefore, should not be viewed as "SPOSH levels" and they should not be used as a legal trigger for the determination of land under Part 2A.

The generic screening values referred to before usually take the form of risk-based Soil Guideline Values (SGVs) or other Generic Assessment Criteria (GACs) that are most typically derived using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) model, as described in the Environment Agency's SR2, SR3 and SR7 reports (EA, 2009b & c; EA, 2008). It is anticipated that C4SLs will be used in a similar manner; as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the SGVs.

The suggested approach to the development of C4SLs consists of the retention and use of the CLEA framework, modified according to considerations of the underlying science within the context of Defra's policy objectives relating to the revised SG. Within this context, it is suggested that the development of C4SLs may be achieved in one of three ways, namely:

- By modifying the toxicological parameters used within CLEA (while maintaining current exposure parameters);
- By modifying the exposure parameters embedded within CLEA (while maintaining current toxicological "minimal risk" interpretations); and
- By modifying both toxicological and exposure parameters.

There is also a suggested check on "other considerations" (e.g., background levels, epidemiological data, sources of uncertainty) within the approach, applicable to all three options.

It is suggested that a new term is defined for the toxicological guidance values associated with the derivation of C4SLs – a Low Level of Toxicological Concern (LLTC). A LLTC should represent an intake of low concern that remains suitably protective of health, and definitely does not approach an intake level that could be defined as SPOSH.

E1.6 CL:AIRE Generic Assessment Criteria (GAC)

For derivation of the CL:AIRE Generic Assessment Criteria (GAC) reference should be made to the following report:

CL:AIRE, *The Soil Generic Assessment Criteria for Human Health Risk Assessment.* **Contaminated Land: Applications in the Real Environment**. 2009.

Within this report CL:AIRE provided Generic Assessment Criteria (GAC's) in accordance with the CLEA software and the principles outlined above for a further 35 contaminants sometime encountered on land affected by contamination.

E1.7 Detailed Quantitative Risk Assessments (DQRA)
Where the adoption of an S4UL/GAC/C4SL is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses then a DQRA may be undertaking to develop site specific values for relevant soil contaminants.

⇒ Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.

⇒ Developing more accurate parameters using site data.

E1.8 Phytotoxicity
CLEA guidance only addresses human health toxicity; assessment of plant toxicity (phytotoxicity) is based on threshold trigger values obtained from the following source:

- ICRCL 70/90: *Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing*.

E1.8 Statistical Tests
DEFRA R&D Publication CLR 7 (DOE 1994) addressed the statistical treatment of test results and their comparison to Soil Guideline Values.

Consideration must be given to the appropriate area of land to be considered termed the critical averaging area.

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot.

It may be appropriate to compare the upper 95th percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

The DEFRA discussion paper Assessing risks from land contamination – a proportionate approach ('the way forward') (CLAN06/2006) aimed to increase understanding of the role that statistics can play in quantifying the uncertainty attached to the estimates of the mean concentration of contaminants in soil. In direct response CLAIRE/CIEH published a joint report, *Guidance in comparing soil contamination data with a critical concentration* (CLAIRE/CIEH 2008). A software implementation of the statistical techniques given in the report was published by ESI International (2008).

Treatment of Hot-Spots
⇒ A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.

⇒ Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.

E2 Ground and Water Limited Soil Assessment Criteria

The Soil Assessment Criteria used in the preparation of this report are tabulated in the following pages:

C4SL Low Level of Toxicological Concern

C4SL Low Level of Toxicological Concern						
Contaminant	**RwHP (mg/kg)**	**RwoHP (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**	**POSresi (mg/kg)**	**POSpark (mg/kg)**
Lead	<210	<330	<84	<6000	<760	<1400

Phytotoxicity Recommendations

ICRCL 70/90 ***Restoration of metalliferous mining areas***

Phytotoxicity (Harmful to Plants) Threshold Trigger Values	
Copper	250mg/kg
Zinc	1000mg/kg
Notes: Many cultivars and specifically grasses have a high tolerance and there will be no ill-effect at the threshold trigger values given for neutral or near neutral pH. Site observation of plant vitality may give additional guidance.	

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LQM CIEH Suitable 4 Use Levels (S4UL's)

LQM/CIEH Suitable 4 Use Levels – Metals and Semi-metals						
Contaminant	**RwHP (mg/kg)**	**RwoHP (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**	**POSresi (mg/kg)**	**POSpark (mg/kg)**
Metals:						
Arsenic	37	40	43	640	79	170
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11000	45	240000	21000	46000
Cadmium	11	85	1.9	190	120	532
Chromium (III)	910	910	18000	8600	1500	33000
Chromium (VI)	6	6	1.8	33	7.7	20
Copper	2400	7100	520	68000	12000	44000
Elemental Mercury	1.2	1.2	21	58	16	30
Inorganic Mercury	40	56	19	1100	120	240
Methylmercury	11	15	6	320	40	68
Nickel	180	180	230	980	230	3400
Selenium	250	430	88	12000	1100	1800
Vanadium	410	1200	91	9000	2000	5000
Zinc	3700	40000	620	730000	81000	170000

LQM/CIEH Suitable 4 Use Levels – BTEX Compounds							
Contaminant	**Soil Organic Matter**	**RwHP (mg/kg)**	**RwoHP (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**	**POSresi (mg/kg)**	**POSpark (mg/kg)**
Benzene	**1.0% SOM**	0.087	0.38	0.017	27	72	90
	2.5% SOM	0.170	0.70	0.034	47	72	100
	6.0% SOM	0.370	1.40	0.075	90	73	110
Toluene	**1.0% SOM**	130	880	22	56000	56000	87000
	2.5% SOM	290	1900	51	110000	56000	95000
	6.0% SOM	660	3900	120	180000	56000	100000
Ethylbenzene	**1.0% SOM**	47	83	16	5700	24000	17000
	2.5% SOM	110	190	39	13000	24000	22000
	6.0% SOM	260	440	91	27000	25000	27000
o-Xylene	**1.0% SOM**	60	88	**28**	6600	**41000**	**17000**
	2.5% SOM	140	210	**67**	15000	**42000**	24000
	6.0% SOM	330	480	**160**	33000	**43000**	33000
m-Xylene	**1.0% SOM**	59	82	31	6200	**41000**	17000
	2.5% SOM	140	190	74	**14000**	**42000**	24000
	6.0% SOM	320	450	170	31000	**43000**	33000
p-Xylene	**1.0% SOM**	**56**	**79**	29	**5900**	**41000**	**17000**
	2.5% SOM	**130**	**180**	69	**14000**	**42000**	**23000**
	6.0% SOM	**310**	**430**	**160**	**30000**	**43000**	**31000**
The most health protective value in each scenario for Xylene is highlighted in bold.							

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LQM/CIEH Suitable 4 Use Levels For TPH

Aliphatic		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
EC 5-6	1.0% SOM	42	42	730	3,200 (304) [sol]	570,000 (304) [sol]	95,000 (304) [sol]
	2.5% SOM	78	78	1,700	5,900 (558) [sol]	590,000	130,000 (558) [sol]
	6.0% SOM	160	160	3,900	12,000 (1150) [sol]	600,000 [l]	180,000 (1150) [sol]
EC >6-8	1.0% SOM	100	100	2,300	7,800 (144) [sol]	600,000	150,000 (144) [sol]
	2.5% SOM	230	230	5,600	17,000 (322) [sol]	610,000	220,000 (322) [sol]
	6.0% SOM	530	530	13,000	40,000 (736) [sol]	620,000	320,000 (736) [sol]
EC >8-10	1.0% SOM	27	27	320	2,000 (78) [sol]	13,000	14,000 (78) [sol]
	2.5% SOM	65	65	770	4,800 (118) [vap]	13,000	18,000 (118) [vap]
	6.0% SOM	150	150	1,700	11,000 (451) [vap]	13,000	21,000 (451) [vap]
EC >10-12	1.0% SOM	130 (48) [vap]	130 (48) [vap]	2,200	9,700 (48) [sol]	13,000	21,000 (48) [sol]
	2.5% SOM	330 (118) [vap]	330 (118) [vap]	4,400	23,000 (118) [vap]	13,000	23,000 (118) [vap]
	6.0% SOM	760 (283) [vap]	770 (283) [vap]	7,300	47,000 (283) [vap]	13,000	24,000 (283) [vap]
EC >12-16	1.0% SOM	1,100 (24) [sol]	1,100 (24) [sol]	11,000	59,000 (24) [sol]	13,000	25,000 (24) [sol]
	2.5% SOM	2,400 (59) [sol]	2,400 (59) [sol]	13,000	82,000 (59) [sol]	13,000	25,000 (59) [sol]
	6.0% SOM	4,300 (142) [sol]	4,400 (142) [sol]	13,000	90,000 (142) [sol]	13,000	26,000 (142) [sol]
EC >16-35	1.0% SOM	65,000 (8.48) [sol]	65,000 (8.48) [sol]	260,000	1,600,000	250,000	450,000
	2.5% SOM	92,000 (21) [sol]	92,000 (21) [sol]	270,000	1,700,000	250,000	480,000
	6.0% SOM	110,000	110,000	270,000	1,800,000	250,000	490,000
EC >35-44	1.0% SOM	65,000 (8.48) [sol]	65,000 (8.48) [sol]	260,000	1,600,000	250,000	450,000
	2.5% SOM	92,000 (21) [sol]	92,000 (21) [sol]	270,000	1,700,000	250,000	480,000
	6.0% SOM	110,000	110,000	270,000	1,800,000	250,000	490,000

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LQM/CIEH Suitable 4 Use Levels For TPH

Aromatic		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
EC 5-7 (Benzene)	1.0% SOM	70	370	13	26,000 (1220) [sol]	56,000	76,000 (1220 [sol]
	2.5% SOM	140	690	27	46,000 (2260) [sol]	56,000	84,000 (2260) [sol]
	6.0% SOM	300	1,400	57	86,000 (4710) [sol]	56,000	92,000 (4710) [sol]
EC >7-8 (Toluene)	1.0% SOM	130	860	22	56,000 (869) [vap]	56,000	87,000 (869) [sol]
	2.5% SOM	290	1,800	51	110,000 (1920) [sol]	56,000	95,000 (1920) [sol]
	6.0% SOM	660	3,900	120	180,000 (4360) [vap]	56,000	100,000 (4360) [vap]
EC >8-10	1.0% SOM	34	47	8.6	3,500 (613) [vap]	5,000	7,200 (613) [vap]
	2.5% SOM	83	110	21	8,100 (1500) [vap]	5,000	8,500 (1500) [vap]
	6.0% SOM	190	270	51	17,000 (3850) [vap]	5,000	9,300 (3580) [vap]
EC >10-12	1.0% SOM	74	250	13	16,000 (364) [sol]	5,000	9,200 (364) [sol]
	2.5% SOM	180	590	31	28,000 (899) [sol]	5,000	9,700 (889) [sol]
	6.0% SOM	380	1,200	74	34,000 (2150) [sol]	5,000	10,000
EC >12-16	1.0% SOM	140	1,800	23	36,000 (169) [sol]	5,100	10,000
	2.5% SOM	330	2,300 (419) [sol]	57	37,000	5,100	10,000
	6.0% SOM	660	2,500	130	38,000	5,000	10,000
EC >16-21	1.0% SOM	260	1,900	46	28,000	3,800	7,600
	2.5% SOM	540	1,900	110	28,000	3,800	7,700
	6.0% SOM	930	1,900	260	28,000	3,800	7,800
EC >21-35	1.0% SOM	1,100	1,900	370	28,000	3,800	7,800
	2.5% SOM	1,500	1,900	820	28,000	3,800	7,800
	6.0% SOM	1,700	1,900	1,600	28,000	3,800	7,900
EC >35-44	1.0% SOM	1,100	1,900	370	28,000	3,800	7,800
	2.5% SOM	1,500	1,900	820	28,000	3,800	7,800
	6.0% SOM	1,700	1,900	1,600	28,000	3,800	7,900
EC >44-70	1.0% SOM	1,600	1,900	1,200	28,000	3,800	7,800
	2.5% SOM	1,800	1,900	2,100	28,000	3,800	7,800
	6.0% SOM	1,900	1,900	3,000	28,000	3,800	7,900

SOM = Soil Organic Matter Content (%)

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LQM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAH's)

Determinants		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Acenapthene	1.0% SOM	210	3,000 (57.0) [sol]	34	84,000(57.0) [sol]	15,000	29,000
	2.5% SOM	510	4,700(141) [sol]	85	97,000(141) [sol]	15,000	30,000
	6.0% SOM	1100	6,000(336) [sol]	200	100,000	15,000	30,000
Acenapthylene	1.0% SOM	170	2,900(86.1) [sol]	28	83,000(86.1) [sol]	15,000	29,000
	2.5% SOM	420	4,600(212) [sol]	69	97,000(212) [sol]	15,000	30,000
	6.0% SOM	920	6,000(506) [sol]	160	100,000	15,000	30,000
Anthracene	1.0% SOM	2,400	31,000(1.17) [vap]	380	520,000	74,000	150,000
	2.5% SOM	5,400	35,000	950	540,000	74,000	150,000
	6.0% SOM	11,000	37,000	2,200	540,000	74,000	150,000
Benzo(a)anthracene	1.0% SOM	7.20	11	2.90	170	29	49
	2.5% SOM	11	14	6.50	170	29	56
	6.0% SOM	13	15	13	180	29	62
Benzo(a)pyrene	1.0% SOM	2.20	3.20	0.97	35	5.70	11
	2.5% SOM	2.70	3.20	2.00	35	5.70	12
	6.0% SOM	3.00	3.20	3.50	36	5.70	13
Benzo(b)flouranthene	1.0% SOM	2.60	3.90	0.99	44	7.10	13
	2.5% SOM	3.30	4.00	2.10	44	7.20	15
	6.0% SOM	3.70	4.00	3.90	45	7.20	16
Benzo(ghi)perylene	1.0% SOM	320	360	290	3,900	640	1,400
	2.5% SOM	340	360	470	4,000	640	1,500
	6.0% SOM	350	360	640	4,000	640	1,600
Benzo(k)flouranthene	1.0% SOM	77	110	37	1,200	190	370
	2.5% SOM	93	110	75	1,200	190	410
	6.0% SOM	100	110	130	1,200	190	440
Chrysene	1.0% SOM	15	30	4.10	350	57	93
	2.5% SOM	22	31	9.40	350	57	110
	6.0% SOM	27	32	19	350	57	120
Dibenzo(ah)anthracene	1.0% SOM	0.24	0.31	0.14	3.50	0.57	1.10
	2.5% SOM	0.28	0.32	0.27	3.60	0.57	1.30
	6.0% SOM	0.30	0.32	0.43	3.60	0.58	1.40

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LQM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAH's)

Determinants		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Flouranthene	1.0% SOM	280	1,500	52	2,3000	3,100	6,300
	2.5% SOM	560	1,600	130	2,3000	3,100	6,300
	6.0% SOM	890	1,600	290	2,3000	3,100	6,300
Flourene	1.0% SOM	170	2,800 (30.9) ^{sol}	27	63,000(30.9) ^{sol}	9,900	20,000
	2.5% SOM	400	3,800(76.5) ^{sol}	67	68,000	9,900	20,000
	6.0% SOM	860	4,500(183) ^{sol}	160	71,000	9,900	20,000
Indeno(123-cd)pyrene	1.0% SOM	27	45	9.50	500	82	150
	2.5% SOM	36	46	21	510	82	170
	6.0% SOM	41	46	39	510	82	180
Napthalene	1.0% SOM	2.30	2.6	4.10	190 † (76.4) ^{sol}	4,900 †	1,200 † (76.4) ^{sol}
	2.5% SOM	5.60	5.6	10	460 † (183) ^{sol}	4,900 †	1,900 † (183) ^{sol}
	6.0% SOM	13	13	24	1,100 † (432) ^{sol}	4,900 †	3,000
Phenanthrene	1.0% SOM	95	1,300(183) ^{sol}	18	22,000	3,100	6,200
	2.5% SOM	220	1,500	38	22,000	3,100	6,200
	6.0% SOM	440	1,500	90	23,000	3,100	6,300
Pyrene	1.0% SOM	620	3,700	110	54,000	7,400	15,000
	2.5% SOM	1200	3,800	270	54,000	7,400	15,000
	6.0% SOM	2000	3,800	620	54,000	7,400	15,000
Coal Tar (Benzo(a)pyrene used as marker compound	1.0% SOM	0.79	1.2	0.32	15	2.20	4.40
	2.5% SOM	0.98	1.2	0.67	15	2.20	4.70
	6.0% SOM	1.10	1.2	1.20	15	2.20	4.80

^{vap} – GAC presented exceeds the vapour saturation limit, which is presented in brackets.
^{sol} – GAC presented exceeds the soil saturation limit, which is presented in brackets.

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LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Chloroalkanes & alkenes						
1,2 Dichloroethane						
1.0% SOM	0.0071	0.0092	0.0046	0.67	29	21
2.5% SOM	0.011	0.013	0.0083	0.97	29	24
6.0% SOM	0.019	0.023	0.016	1.70	29	28
1,1,2,2 Tetrachloroethane						
1.0% SOM	1.60	3.90	0.41	270	1,400	1,800
2.5% SOM	3.40	8.00	0.89	550	1,400	2,100
6.0% SOM	7.50	17	2.00	1,100	1,400	2,300
1,1,1,2 Tetrachloroethane						
1.0% SOM	1.20	1.50	0.79	110	1,400	1,500
2.5% SOM	2.80	3.50	1.90	250	1,400	1,800
6.0% SOM	6.40	8.20	4.40	560	1,400	2,100
Tetrachloroethene						
1.0% SOM	0.18	0.18	0.65	19	1,400	810 ^{sol}(424)
2.5% SOM	0.39	0.40	1.50	42	1,400	1,100 ^{sol}(951)
6.0% SOM	0.90	0.92	3.60	95	1,400	1,500
1,1,1 Trichloroethane						
1.0% SOM	8.80	9.00	48	660	140,000	57,000 ^{vap}(1425)
2.5% SOM	18	18	110	1,300	140,000	76,000 ^{vap}(2915)
6.0% SOM	39	40	240	3,000	140,000	100,000 ^{vap}(6392)
Tetrachloromethene						
1.0% SOM	0.026	0.026	0.45	2.90	890	190
2.5% SOM	0.056	0.056	1.00	6.30	920	270
6.0% SOM	0.130	0.130	2.40	14	950	400
Trichloroethene						
1.0% SOM	0.016	0.017	0.041	1.20	120	70
2.5% SOM	0.034	0.036	0.091	2.60	120	91
6.0% SOM	0.075	0.080	0.210	5.70	120	120
Trichloromethane						
1.0% SOM	0.91	1.20	0.42	99	2,500	2,600
2.5% SOM	1.70	2.10	0.83	170	2,500	2,800
6.0% SOM	3.40	4.20	1.70	350	2,500	3,100
Vinyl Chloride						
1.0% SOM	0.00064	0.00077	0.00055	0.059	3.50	4.80
2.5% SOM	0.00087	0.00100	0.00100	0.077	3.50	5.00
6.0% SOM	0.00014	0.00150	0.00180	0.120	3.50	5.40

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LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Explosives						
2,4,6 Trinitrotoluene						
1.0% SOM	1.60	65	0.24	1,000	130	260
2.5% SOM	3.70	66	0.58	1,000	130	270
6.0% SOM	8.10	66	1.40	1,000	130	270
RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)						
1.0% SOM	120	13,000	17	210,000	26,000	49,000(18.7)^{sol}
2.5% SOM	250	13,000	38	210,000	26,000	51,000
6.0% SOM	540	13,000	85	210,000	27,000	53,000
HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)						
1.0% SOM	5.70	67,00	0.86	110,000	13,000	23,000(0.35)^{vap}
2.5% SOM	13	67,00	1.90	110,000	13,000	23,000(0.39)^{vap}
6.0% SOM	26	67,00	3.90	110,000	13,000	24,000(0.48)^{vap}
Atrazine						
1.0% SOM	3.30	610	0.50	9,300	1,200	2,300
2.5% SOM	7.60	620	1.20	9,400	1,200	2,400
6.0% SOM	17.40	620	2.70	9,400	1,200	2,400
Pesticides						
Aldrin						
1.0% SOM	5.70	7.30	3.20	170	18	30
2.5% SOM	6.60	7.40	6.10	170	18	31
6.0% SOM	7.10	7.50	9.60	170	18	31
Dieldrin						
1.0% SOM	0.97	7.00	0.17	170	18	30
2.5% SOM	2.00	7.30	0.41	170	18	30
6.0% SOM	3.50	7.40	0.96	170	18	31
Dichlorvos						
1.0% SOM	0.032	6.40	0.0049	140	16	26
2.5% SOM	0.066	6.50	0.0100	140	16	26
6.0% SOM	0.140	6.60	0.0220	140	16	27
Alpha - Endosulfan						
1.0% SOM	7.40	160(0.003)^{vap}	1.20	5,600(0.003)^{vap}	1,200	2,400
2.5% SOM	18	280(0.007)^{vap}	2.90	7,400(0.007)^{vap}	1,200	2,400
6.0% SOM	41	410(0.016)^{vap}	6.80	8,400(0.016)^{vap}	1,200	2,400

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LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Pesticides						
Beta - Endosulfan						
1.0% SOM	7.00	190(0.00007)[vap]	1.10	6,300(0.00007)[vap]	1,200	2,400
2.5% SOM	17	320(0.0002)[vap]	2.70	7,800(0.0002)[vap]	1,200	2,400
6.0% SOM	39	440(0.0004)[vap]	6.40	8700	1,200	2,500
Alpha - Hexachlorocyclohexanes						
1.0% SOM	0.23	6.90	0.035	170	24	47
2.5% SOM	0.55	9.20	0.087	180	24	48
6.0% SOM	1.20	11	0.210	180	24	48
Beta - Hexachlorocyclohexanes						
1.0% SOM	0.085	3.70	0.013	65	8.10	15
2.5% SOM	0.200	3.80	0.032	65	8.10	15
6.0% SOM	0.460	3.80	0.077	65	8.10	16
Gamma - Hexachlorocyclohexanes						
1.0% SOM	0.06	2.90	0.0092	67	8.2	14
2.5% SOM	0.14	3.30	0.0230	69	8.2	15
6.0% SOM	0.33	3.50	0.0540	70	8.2	15
Chlorobenzenes						
Chlorobenzene						
1.0% SOM	0.46	0.46	5.90	56	11,000	1,300(675)[sol]
2.5% SOM	1.00	1.00	14	130	13,000	2,000(1520)[sol]
6.0% SOM	2.40	2.40	32	290	14,000	2,900
1,2-Dichlorobenzene						
1.0% SOM	23	24	94	2,000 (571)[sol]	90,000	24,000(571)[sol]
2.5% SOM	55	57	230	4,800 (1370)[sol]	95,000	36,000(1370)[sol]
6.0% SOM	130	130	540	11,000 (3240)[sol]	98,000	51,000(3240)[sol]
1,3-Dichlorobenzene						
1.0% SOM	0.40	0.44	0.25	30	300	390
2.5% SOM	1.00	1.10	0.60	73	300	440
6.0% SOM	2.30	2.50	1.50	170	300	470
1,4-Dichlorobenzene						
1.0% SOM	61	61	15	4,400 (224)[vap]	17,000[g]	36,000 (224)[vap]
2.5% SOM	150	150	37	10,000 (540)[vap]	17,000[g]	36,000 (540)[vap]
6.0% SOM	350	350	88[g]	25,000 (1280)[vap]	17,000[g]	36,000 (1280)[vap]
1,2,3,-Trichlorobenzene						
1.0% SOM	1.50	1.50	4.70	102	1,800	770(134[vap]
2.5% SOM	3.60	3.70	12	250	1,800	1,100(330)[vap]
6.0% SOM	8.60	8.80	28	590	1,800	1,600(789)[vap]

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LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds						
Contaminant	**RwHP (mg/kg)**	**RwoHP (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**	**POSresi (mg/kg)**	**POSpark (mg/kg)**
Chlorobenzenes						
1,2,3,- Trichlorobenzene						
1.0% SOM	1.50	1.50	4.70	102	1,800	770(134)[vap]
2.5% SOM	3.60	3.70	12	250	1,800	1,100(330[lvap]
6.0% SOM	8.60	8.80	28	590	1,800	1,600(789)[vap]
1,2,4,- Trichlorobenzene						
1.0% SOM	2.60	2.60	55	220	15,000	1,700(318)[vap]
2.5% SOM	6.40	6.40	140	530	17,000	2,600(786)[vap]
6.0% SOM	15	15	320	1,300	19,000	4,000(1880)[vap]
1,3,5,- Trichlorobenzene						
1.0% SOM	0.33	0.33	4.70	23	1,700	380(36.7)[vap]
2.5% SOM	0.81	0.81	12	55	1,700	590(90.8)[vap]
6.0% SOM	1.90	1.90	140	130	1,800	860(217)[vap]
1,2,3,4,- Tetrachlorobenzene						
1.0% SOM	15	24	4.40	1,700(122[lvap]	830	1,500(122)[vap]
2.5% SOM	36	56	11	3,080(304)[vap]	830	1,600
6.0% SOM	78	120	26	4,400(728)[vap]	830	1,600
1,2,3,5,- Tetrachlobenzene						
1.0% SOM	0.66	0.75	0.38	49(39.4)[vap]	78	110(39)[vap]
2.5% SOM	1.60	1.90	0.90	120(98.1)[vap]	79	120
6.0% SOM	3.70	4.30	2.20	240(235)[vap]	79	130
1,2,4, 5,- Tetrachlobenzene						
1.0% SOM	0.33	0.73	0.06	42(19.7)[sol]	13	25
2.5% SOM	0.77	1.70	0.16	72(49.1)[sol]	13	26
6.0% SOM	1.60	3.50	0.37	96	13	26
Pentachlrobenzene						
1.0% SOM	5.80	19	1.20	640(43.0)[sol]	100	190
2.5% SOM	12	30	3.10	770(107)[sol]	100	190
6.0% SOM	22	38	7.00	830	100	190
Hexachlorobenzene						
1.0% SOM	1.80(0.20)[vap]	4.10 (0.20)[vap]	0.47	110(0.20)[vap]	16	30
2.5% SOM	3.30(0.50)[vap]	5.70 (0.50)[vap]	1.10	120	16	30
6.0% SOM	4.90	6.70 (1.2)[vap]	2.50	120	16	30

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LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds						
Contaminant	**RwHP (mg/kg)**	**RwoHP (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**	**POSresi (mg/kg)**	**POSpark (mg/kg)**
Phenols & Chlorophenols						
Phenols						
1.0% SOM	280	750	66	760[dir](31,000)	760[dir](11,000)	760[dir](8,600)
2.5% SOM	550	1,300	140	1,500[dir](35,000)	1,500[dir](11,000)	1,500[dir](9,700)
6.0% SOM	1100	2,300	280	3,200[dir](37,000)	3,200[dir](11,000)	3,200[dir](11,000)
Chlorophenols (4 Congeners)						
1.0% SOM	0.87	94	0.13	3,500	620	1,100
2.5% SOM	2.00	150	0.30	4,000	620	1,100
6.0% SOM	4.50	210	0.70	4,300	620	1,100
Pentachlorophenols						
1.0% SOM	0.22	27(16.4)[vap]	0.03	400	60	110
2.5% SOM	0.52	29	0.08	400	60	120
6.0% SOM	1.20	31	0.19	400	60	120
Others						
Carbon Disulphide						
1.0% SOM	0.14	0.14	4.80	11	11,000	1,300
2.5% SOM	0.29	0.29	10	22	11,000	1,900
6.0% SOM	0.62	0.62	23	47	12,000	2,700
Hexachloro-1,3-Butadiene						
1.0% SOM	0.29	0.32	0.25	31	25	48
2.5% SOM	0.70	0.78	0.61	68	25	50
6.0% SOM	1.60	1.80	1.40	120	25	51

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CL:AIRE Soil Generic Assessment Criteria				
Contaminant	**Residential (mg/kg)**	**Residential without plant uptake (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**
Metals:				
Antimony	ND	550	ND	7500
Barium	ND	1300	ND	22000
Molybdenum	ND	670	ND	17000

ND – Not Derived.
NA – Not Applicable

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	**Residential (mg/kg)**	**Residential without plant uptake (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**
1,1,2 Trichloroethane				
1.0% SOM	0.60	0.88	0.28	94
2.5% SOM	1.20	1.8	0.61	190
6.0% SOM	2.70	3.9	1.40	400
1,1-Dichloroethane				
1.0% SOM	2.40	2.50	9.20	280
2.5% SOM	3.90	4.10	17	450
6.0% SOM	7.40	7.70	35	850
1,1-Dichloroethene				
1.0% SOM	0.23	0.23	2.80	26
2.5% SOM	0.40	0.41	5.60	46
6.0% SOM	0.82	0.82	12	92
1,2,4-Trimethylbenzene				
1.0% SOM	0.35	0.41	0.38	42
2.5% SOM	0.85	0.99	0.93	99
6.0% SOM	2.00	2.30	2.20	220
1,2-Dichloropropane				
1.0% SOM	0.024	0.024	0.62	3.3
2.5% SOM	0.042	0.042	1.20	5.9
6.0% SOM	0.084	0.085	2.60	12
2,4-Dimethylphenol				
1.0% SOM	19	210	3.10	16000*
2.5% SOM	43	410	7.20	24000*
6.0% SOM	97	730	17	30000*
2,4-Dinitrotoluene				
1.0% SOM	1.50	170*	0.22	3700*
2.5% SOM	3.20	170	0.49	3700*
6.0% SOM	7.20	170	1.10	3800*
2,6-Dinitrotoluene				
1.0% SOM	0.78	78	0.12	1900*
2.5% SOM	1.70	84	0.27	1900*
6.0% SOM	3.90	87	0.61	1900*
2-Chloronapthalene				
1.0% SOM	3.70	3.80	40	390*
2.5% SOM	9.20	9.30	98	960*
6.0% SOM	22	22	230	2200*

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	**Residential (mg/kg)**	**Residential without plant uptake (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**
Biphenyl				
1.0% SOM	66*	220*	14	18000*
2.5% SOM	160	500*	35	33000*
6.0% SOM	360	980*	83	48000*
Bis (2-ethylhexyl) phthalate				
1.0% SOM	280*	2700*	47*	85000*
2.5% SOM	610*	2800*	120*	86000*
6.0% SOM	1100*	2800*	280*	86000*
Bromobenzene				
1.0% SOM	0.87	0.91	3.2	97
2.5% SOM	2.0	2.1	7.6	220
6.0% SOM	4.7	4.9	18	520
Bromodichloromethane				
1.0% SOM	0.016	0.019	0.016	2.1
2.5% SOM	0.030	0.034	0.032	3.7
6.0% SOM	0.061	0.070	0.068	7.6
Bromoform				
1.0% SOM	2.8	5.2	0.95	760
2.5% SOM	5.9	11	2.1	1500
6.0% SOM	13	23	4.6	3100
Butyl benzyl phthalate				
1.0% SOM	1400*	42000*	220*	940000*
2.5% SOM	3300*	44000*	550*	940000*
6.0% SOM	7200*	44000*	1300*	950000*
Chloroethane				
1.0% SOM	8.3	8.4	110	960
2.5% SOM	11	11	200	1300
6.0% SOM	18	18	380	2100
Chloromethane				
1.0% SOM	0.0083	0.0085	0.066	1.0
2.5% SOM	0.0098	0.0099	0.13	1.2
6.0% SOM	0.013	0.013	0.23	1.6
***Cis* 1,2 Dichloroethene**				
1.0% SOM	0.11	0.12	0.26	14
2.5% SOM	0.19	0.20	0.50	24
6.0% SOM	0.37	0.39	1.0	47

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	**Residential (mg/kg)**	**Residential without plant uptake (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**
Dichloromethane				
1.0% SOM	0.58	2.10	0.10	270
2.5% SOM	0.98	2.80	0.19	360
6.0% SOM	1.70	4.50	0.34	560
Diethyl Phthalate				
1.0% SOM	120*	1800*	19*	150000*
2.5% SOM	260*	3500*	41*	220000*
6.0% SOM	570*	6300*	94*	290000*
Di-*n*-butyl phthalate				
1.0% SOM	13*	450*	2.00	15000*
2.5% SOM	31*	450*	5.00	15000*
6.0% SOM	67*	450*	12	15000*
Di-*n*-octyl phthalate				
1.0% SOM	2300*	3400*	940*	89000*
2.5% SOM	2800*	3400*	2100*	89000*
6.0% SOM	3100*	3400*	3900*	89000*
Hexachloroethane				
1.0% SOM	0.20	0.22	0.27	22*
2.5% SOM	0.48	0.54	0.67	53*
6.0% SOM	1.10	1.30	1.60	120*
Isopropylbenzene				
1.0% SOM	11	12	32	1400*
2.5% SOM	27	28	79	3300*
6.0% SOM	64	67	190	7700*
Methyl *tert*-butyl ether				
1.0% SOM	49	73	23	7900
2.5% SOM	84	120	44	13000
6.0% SOM	160	220	90	24000
Propylbenzene				
1.0% SOM	34	40	34	4100*
2.5% SOM	82	97	83	9700*
6.0% SOM	190	230	200	21000*
Styrene				
1.0% SOM	8.10	35	1.60	3300*
2.5% SOM	19	78	3.70	6500*
6.0% SOM	43	170	8.70	11000*

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	**Residential (mg/kg)**	**Residential without plant uptake (mg/kg)**	**Allotment (mg/kg)**	**Commercial (mg/kg)**
Total Cresols (2-, 3-, and 4-methylphenol)				
1.0% SOM	80	3700	12	160000
2.5% SOM	180	5400	27	180000*
6.0% SOM	400	6900	63	180000*
***Trans* 1,2 Dichloroethene**				
1.0% SOM	0.19	0.19	0.93	22
2.5% SOM	0.34	0.35	1.90	40
6.0% SOM	0.70	0.71	0.24	81
Tributyl tin oxide				
1.0% SOM	0.25	1.40	0.042	130*
2.5% SOM	0.59	3.10	0.100	180*
6.0% SOM	1.30	5.70	0.240	200*

Notes: *Soil concentration above soil saturation limit

APPENDIX F
Waste Hazard Assessment

Waste Classification Report

TYEYL-SSHQC-HLGWM

Job name

GWPR1789 22 Kings Mews, Clerkenwell, London WC1N 2JB

Waste Stream

Ground and Water V2 PA

Comments

Project

GWPR1789 22 Kings Mews, Clerkenwell, London WC1N 2JB

Site

22 Kings Mews, Clerkenwell, London WC1N 2JB

Classified by

Name:
Allvey, Phillip
Date:
23/09/2016 16:22 UTC
Telephone:
07740110219

Company:
Ground and Water Limited
2 The Long Barn, Norton Farm
Selborne Road
Alton
GU34 3NB

Report

Created by: Allvey, Phillip
Created date: 23/09/2016 16:22 UTC

Job summary

#	Sample Name	Depth [m]	Classification Result	Hazardous properties	Page
1	BH2 0.50 - 0.80		Non Hazardous		2

Classification of sample: BH2 0.50 - 0.80

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:
BH2 0.50 - 0.80
Sample Depth:
0 m
Moisture content: **0%**
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands (Moisture content: 0%, no correction)

pH: (Whole conc. entered as: 7 pH, converted to conc.:7 pH or 7 pH)
salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex: (Cation conc. entered: <2 mg/kg, converted to compound conc.:<3.768 mg/kg or <0.000377%) IGNORED Because: "<LOD"
arsenic trioxide: (Cation conc. entered: 11 mg/kg, converted to compound conc.:14.524 mg/kg or 0.00145%)
boron tribromide/trichloride/trifluoride (combined): (Cation conc. entered: 1.3 mg/kg, converted to compound conc.:17.459 mg/kg or 0.00175%)
cadmium sulfide: (Cation conc. entered: <0.2 mg/kg, converted to compound conc.:<0.257 mg/kg or <0.0000257%, Note 1 conc.: <0.00002%) IGNORED Because: "<LOD"
Chromium (III) Sulphate: (Whole conc. entered as: 13 mg/kg or 0.0013%)
chromium(VI) oxide: (Cation conc. entered: <2 mg/kg, converted to compound conc.:<3.846 mg/kg or <0.000385%) IGNORED Because: "<LOD"
copper (I) oxide: (Cation conc. entered: 45 mg/kg, converted to compound conc.:50.665 mg/kg or 0.00507%)
lead chromate: (Cation conc. entered: 393 mg/kg, converted to compound conc.:613.007 mg/kg or 0.0613%, Note 1 conc.: 0.0393%)
mercury dichloride: (Cation conc. entered: <1 mg/kg, converted to compound conc.:<1.353 mg/kg or <0.000135%) IGNORED Because: "<LOD"
nickel dihydroxide: (Cation conc. entered: 11 mg/kg, converted to compound conc.:17.374 mg/kg or 0.00174%)
selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex: (Cation conc. entered: <3 mg/kg, converted to compound conc.:<7.661 mg/kg or <0.000766%) IGNORED Because: "<LOD"
divanadium pentaoxide; vanadium pentoxide: (Cation conc. entered: 27 mg/kg, converted to compound conc.:48.2 mg/kg or 0.00482%)
zinc chromate: (Cation conc. entered: 43 mg/kg, converted to compound conc.:119.288 mg/kg or 0.0119%)
phenol: (Whole conc. entered as: <2 mg/kg or <0.0002%) IGNORED Because: "<LOD"
naphthalene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
acenaphthylene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
acenaphthene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
fluorene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
phenanthrene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
anthracene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
fluoranthene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
pyrene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
benzo[a]anthracene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
chrysene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
benzo[b]fluoranthene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"

benzo[k]fluoranthene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
benzo[a]pyrene; benzo[def]chrysene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
indeno[123-cd]pyrene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
dibenz[a,h]anthracene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
benzo[ghi]perylene: (Whole conc. entered as: <0.1 mg/kg or <0.00001%) IGNORED Because: "<LOD"
benzene: (Whole conc. entered as: <2 mg/kg or <0.0002%) IGNORED Because: "<LOD"
toluene: (Whole conc. entered as: <5 mg/kg or <0.0005%) IGNORED Because: "<LOD"
ethylbenzene: (Whole conc. entered as: <2 mg/kg or <0.0002%) IGNORED Because: "<LOD"
xylene: (Whole conc. entered as: <2 mg/kg or <0.0002%) IGNORED Because: "<LOD"
o-xylene; [1] p-xylene; [2] m-xylene; [3] xylene [4]: (Whole conc. entered as: <2 mg/kg or <0.0002%) IGNORED Because: "<LOD"
diesel petroleum group: (Whole conc. entered as: <21 mg/kg or <0.0021%) IGNORED Because: "<LOD"
TPH (C6 to C40) petroleum group: (Whole conc. entered as: <42 mg/kg or <0.0042%) IGNORED Because: "<LOD"

Legend

- This determinand has one or more of its Hazard Statements and Risk Phrases defined and maintained by the Classifier

Notes utilised in assessment

C14: Step 5
"identify whether any individual ecotoxic substance is present at or above a cut-off value ..." , used on:

Test: "HP 14 on R50, R50/53, R51/53, R52/53, R52, R53" for determinand: "arsenic trioxide"
Test: "HP 14 on R50, R50/53, R51/53, R52/53, R52, R53" for determinand: "copper (I) oxide"
Test: "HP 14 on R50, R50/53, R51/53, R52/53, R52, R53" for determinand: "lead chromate"
Test: "HP 14 on R50, R50/53, R51/53, R52/53, R52, R53" for determinand: "nickel dihydroxide"
Test: "HP 14 on R50, R50/53, R51/53, R52/53, R52, R53" for determinand: "zinc chromate"
Test: "HP 14 on R50, R50/53, R51/53, R52/53, R52, R53" for determinand: "divanadium pentaoxide; vanadium pentoxide"

Note 1 , used on:

Test: "HP 5 on STOT SE 2; H371, STOT RE 2; H373" for determinand: "lead chromate"
Test: "HP 7 on Carc. 1A; H350, Carc. 1B; H350, Carc. 1A; H350i, Carc. 1B; H350i" for determinand: "lead chromate"
Test: "HP 10 on Repr. 1A; H360, Repr. 1A; H360D, Repr. 1A; H360Df, Repr. 1A; H360F, Repr. 1A; H360Fd, Repr. 1A; H360FD, Repr. 1B; H360, Repr. 1B; H360D, Repr. 1B; H360Df, Repr. 1B; H360F, Repr. 1B; H360Fd, Repr. 1B; H360FD " for determinand: "lead chromate"
Test: "HP 14 on R50, R50/53, R51/53, R52/53, R52, R53" for determinand: "lead chromate"

Determinand notes

Note 1 , used on:

determinand: "lead chromate"

Note A , used on:

determinand: "zinc chromate"

Appendix A: Classifier defined and non CLP determinands

pH (CAS Number: PH)

Comments: Appendix C4
Data source: WM3 1st Edition 2015
Data source date: 25/05/2015
Risk Phrases: None.
Hazard Statements: None.

salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex

CLP index number: 006-007-00-5
Data source: Commission Regulation (EC) No 790/2009 - 1st Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP1)
Additional Risk Phrases: None.
Additional Hazard Statements: EUH032>= 0.2%
Reason:
14/12/2015 - EUH032>= 0.2% hazard statement sourced from: WM3, Table C12.2

boron tribromide/trichloride/trifluoride (combined) (CAS Number: 10294-33-4, 10294-34-5, 7637-07-2)

Conversion factor: 13.43
Comments: Combines the hazard statements and the average of the conversion factors for boron tribromide, boron trichloride and boron trifluoride
Data source: N/A
Data source date: 06/08/2015
Risk Phrases: R14, T+; R26/28, C; R34, C; R35
Hazard Statements: EUH014, Acute Tox. 2; H330, Acute Tox. 2; H300, Skin Corr. 1A; H314, Skin Corr. 1B; H314

Chromium (III) Sulphate (CAS Number: 10101-53-8)

Comments:
Data source: 10101-53-8
Data source date: 24/06/2015
Risk Phrases: None.
Hazard Statements: None.

acenaphthylene (CAS Number: 208-96-8)

Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17/07/2015
Risk Phrases: R22, R26, R27, R36, R37, R38
Hazard Statements: Acute Tox. 4; H302, Acute Tox. 1; H330, Acute Tox. 1; H310, Eye Irrit. 2; H319, STOT SE 3; H335, Skin Irrit. 2; H315

acenaphthene (CAS Number: 83-32-9)

Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17/07/2015
Risk Phrases: R36, R37, R38, N; R50/53, N; R51/53
Hazard Statements: Eye Irrit. 2; H319, STOT SE 3; H335, Skin Irrit. 2; H315, Aquatic Acute 1; H400, Aquatic Chronic 1; H410, Aquatic Chronic 2; H411

fluorene (CAS Number: 86-73-7)

Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06/08/2015
Risk Phrases: N; R50/53
Hazard Statements: Aquatic Acute 1; H400, Aquatic Chronic 1; H410

phenanthrene (CAS Number: 85-01-8)

Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06/08/2015
Risk Phrases: R22, R36, R37, R38, R40, R43, N; R50/53
Hazard Statements: Acute Tox. 4; H302, Eye Irrit. 2; H319, STOT SE 3; H335, Carc. 2; H351, Skin Sens. 1; H317, Aquatic Acute 1; H400, Aquatic Chronic 1; H410, Skin Irrit. 2; H315

anthracene (CAS Number: 120-12-7)

Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17/07/2015
Risk Phrases: R36, R37, R38, R43, N; R50/53
Hazard Statements: Eye Irrit. 2; H319, STOT SE 3; H335, Skin Irrit. 2; H315, Skin Sens. 1; H317, Aquatic Acute 1; H400, Aquatic Chronic 1; H410

fluoranthene (CAS Number: 206-44-0)

Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21/08/2015
Risk Phrases: Xn; R22, N; R50/53
Hazard Statements: Acute Tox. 4; H302, Aquatic Acute 1; H400, Aquatic Chronic 1; H410

pyrene (CAS Number: 129-00-0)

Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21/08/2015
Risk Phrases: Xi; R36/37/38, N; R50/53
Hazard Statements: Skin Irrit. 2; H315, Eye Irrit. 2; H319, STOT SE 3; H335, Aquatic Acute 1; H400, Aquatic Chronic 1; H410

indeno[123-cd]pyrene (CAS Number: 193-39-5)

Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06/08/2015
Risk Phrases: R40
Hazard Statements: Carc. 2; H351

benzo[ghi]perylene (CAS Number: 191-24-2)

Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 23/07/2015
Risk Phrases: N; R50/53
Hazard Statements: Aquatic Acute 1; H400, Aquatic Chronic 1; H410

ethylbenzene (CAS Number: 100-41-4)

CLP index number: 601-023-00-4
Data source: Commission Regulation (EU) No 605/2014 – 6th Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP6)
Additional Risk Phrases: None.
Additional Hazard Statements: Carc. 2; H351
Reason:
03/06/2015 - Carc. 2; H351 hazard statement sourced from: IARC Group 2B (77) 2000

diesel petroleum group (CAS Number: 68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9)

Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25/05/2015
Risk Phrases: R40, R51/53, R65, R66
Hazard Statements: Flam. Liq. 3; H226, Skin Irrit. 2; H315, Acute Tox. 4; H332, Carc. 2; H351, Asp. Tox. 1; H304, STOT RE 2; H373, Aquatic Chronic 2; H411

TPH (C6 to C40) petroleum group (CAS Number: TPH)

Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25/05/2015
Risk Phrases: R10, R45, R46, R51/53, R63, R65
Hazard Statements: Flam. Liq. 3; H226, Asp. Tox. 1; H304, STOT RE 2; H373, Muta. 1B; H340, Carc. 1B; H350, Repr. 2; H361d, Aquatic Chronic 2; H411

Appendix B: Notes

C14: Step 5

from section: WM3: C14 in the document: "WM3 - Waste Classification"

"identify whether any individual ecotoxic substance is present at or above a cut-off value ..."

Note 1

from section: 1.1.3.2, Annex VI in the document: "CLP Regulations"

"The concentration stated or, in the absence of such concentrations, the generic concentrations of this Regulation (Table 3.1) or the generic concentrations of Directive 1999/45/EC (Table 3.2), are the percentages by weight of the metallic element calculated with reference to the total weight of the mixture."

Note A

from section: 1.1.3.1, Annex VI in the document: "CLP Regulations"

"Without prejudice to Article 17(2), the name of the substance must appear on the label in the form of one of the designations given in Part 3. In Part 3, use is sometimes made of a general description such as '... compounds' or '... salts'. In this case, the supplier is required to state on the label the correct name, due account being taken of section 1.1.1.4."

Appendix C: Version

Classification utilises the following:

- CLP Regulations - Regulation 1272/2008/EC of 16 December 2008
- 1st ATP - Regulation 790/2009/EC of 10 August 2009
- 2nd ATP - Regulation 286/2011/EC of 10 March 2011
- 3rd ATP - Regulation 618/2012/EU of 10 July 2012
- 4th ATP - Regulation 487/2013/EU of 8 May 2013
- Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013
- 5th ATP - Regulation 944/2013/EU of 2 October 2013
- 6th ATP - Regulation 605/2014/EU of 5 June 2014
- WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014
- Revised List of Wastes 2014 - Decision 2014/955/EU of 18 December 2014
- WM3 - Waste Classification - May 2015
- 7th ATP - Regulation 2015/1221/EU of 24 July 2015
- 8th ATP - Regulation (EU) 2016/918 of 19 May 2016
- POPs Regulation 2004 - Regulation 850/2004/EC of 29 April 2004
- 1st ATP to POPs Regulation - Regulation 756/2010/EU of 24 August 2010
- 2nd ATP to POPs Regulation - Regulation 757/2010/EU of 24 August 2010

HazWasteOnline Engine: WM3 1st Edition, May 2015
HazWasteOnline Engine Version: 2016.266.3109.6166 (22 Sep 2016)
HazWasteOnline Database: 2016.266.3109.6166 (22 Sep 2016)