The Hope Lease Ltd

The Hope Project, Camden

Geo-environmental site assessment

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd.

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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by Heyne Tillett Steel, on behalf of The Hope Lease Ltd (the ‘Client’), to carry out a geo-environmental assessment of the land at Koko, Camden, London, NW1 7JE. The site includes Koko, The Hope and Anchor Pub and the adjacent buildings enclosed by Camden High Street, Crowndale Road, Bayham Street and Bayham Place. It is understood the site is being considered for redevelopment as a private members club (sui generis), roof terraces and restaurant and bar venue, and is known as The Hope Project.

This report is subject to the RSK service constraints given in Appendix A.

1.1 Objective

The objective of the work is to evaluate client liabilities as part of the due diligence process, to support a planning application and provide preliminary foundation advice.

1.2 Scope

The scope of the investigation and layout of this report has been designed with consideration of CLR11 (Environment Agency, 2014) and BS 10175: 2013 (BSI, 2013) and guidance on land contamination reports issued by the Environment Agency (EA) (2010a).

The project was carried out to an agreed brief as set out in RSK’s proposal (ref. 371475 T03 (00) dated 9th May 2016. The scope of works for the assessment included:

- a preliminary risk assessment (PRA) to include a review of existing reports, geological, hydrogeological and hydrological information, a commercially available environmental database, and historical plans; correspondence with regulatory authorities; and a site walkover – this information is used to develop an initial conceptual site model to consider any potentially complete pollutant linkages
- a review of published geological data to assess ground stability
- an intrusive investigation consisting of one cable percussion borehole, two window sample boreholes and fourteen trial pits with laboratory analysis plus subsequent groundwater and gas monitoring
- development of a refined conceptual site model followed by generic quantitative risk assessment (GQRA) to assess complete pollutant linkages that may require the implementation of mitigation measures to facilitate redevelopment
- a detailed quantitative risk assessment (DQRA) to assess theoretical risks to human health and the environment

- identification of outline mitigation measures for complete pollutant linkages or recommendations for further work
- interpretation of ground conditions and geotechnical data to provide recommendations with respect to foundations and infrastructure design
- a factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary
- an assessment of the potential waste classification implications of soil arisings.

1.3 Existing reports

The following reports detailing previous works at the site were made available for review:

- Asbestos Register Review 2016 by ESP Consulting (ref KOKO-160321-MG-ASB-NE, dated 21st March 2016)

These reports have been referred to within this report as appropriate.

1.4 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows may vary from those reported due to seasonal, or other, effects.

Whilst asbestos containing materials were not identified during the fieldworks or supporting laboratory analysis, the history of the site indicates asbestos may well be present. Asbestos is often present in discrete areas. Thus, although not encountered during the site investigation, may be found during more extensive ground works.

Parts of the ground investigation was conducted within the existing lower ground floor and basement levels and access to several areas was restricted by the presence of various fixtures, plant and equipment.

2 THE SITE

2.1 Site location and description

The site is located in Camden, London, NW1 7JE, at National Grid reference 529242, 183411, as shown on Figure 1. The site is occupied by Koko nightclub, The Hope and Anchor Pub, and the adjacent buildings enclosed by Camden High Street, Crowndale Road, Bayham Street and Bayham Place.

The area around the site comprises predominantly mixed commercial and residential developments with Regents Park and the London Zoo approximately 645m to the west of the site, as detailed in Table 1.

Table 1: Site setting

To the north:	Bayham Place with terraced retail, commercial and residential properties beyond.
To the east:	Bayham Street with commercial and residential properties beyond.
To the south:	Crowndale Road with commercial and residential properties beyond
To the west:	Mornington Crescent LUL station, with the Northern line passing beneath Camden High Street into Eversholt Street. Retail, commercial and residential properties beyond. London Zoo and Regent's Park in the wider area.

The site covers approximately 0.16 hectares at an elevation of approximately 22.80m above Ordnance Datum (AOD) and comprises the following main attributes:

- Grade II listed Koko (nightclub) on the western half of the site which comprises 5 storeys with a roof terrace, lower ground floor levels and basement, the latter of which is used for storage.
- The Hope and Anchor Pub on the southeastern corner of the site on the corner of Bayham Street and Crowndale Road, and comprises 1-3 storeys with cellar. The pub closed down in 2013 and is currently unoccupied.
- The Bayham Street property on the northeastern corner of the site on the corner of Bayham Street and Bayham Place. The property is 2-3 storeys in height with mansard roof and comprises No 1 Bayham Street and No 65 Bayham Place. It is currently unoccupied.
- A small courtyard is present within the Hope and Anchor pub and abuts onto Koko.

2.2 Proposed development

The site in question is being considered for redevelopment as a new private members club (sui generis), roof terraces and entertainment venue. The full proposal description is:

"Demolition of 65 Bayham Place, 1 Bayham Street (retention of façade) and rebuilding to provide private members club (sui generis) with extension to the rear and basement; retention and refurbishment of the ground floor of the Hope & Anchor Public House (Use Class A4) with 1st/2nd floor internal demolition and replacement to provide restaurant and bar, minor reconfiguration to circulation space within KOKO. Use of the Flytower by the private members club with retention of original theatre equipment. Installation of fourth floor extension to provide amenity space with terrace restaurant and bar. The proposals also include for the conversion of the KOKO dome to a private bar and general refurbishment and restoration to the building, along with the installation of new plant".

The proposed redevelopment will involve the retention of Koko and the part of the facade to the middle buildings on the Bayham Street frontage, and redevelopment of the surrounding site to provide new complementary facilities, linking to the existing venue. The existing buildings at 1 Bayham Street and 65 Bayham Place (herein called the Bayham Street property) and the upper floors of the Hope and Anchor pub, will be demolished and replaced by a new building with four storeys above ground, housing the private members club and dining rooms. The facade to the Hope and Anchor pub will be retained. Development of the Grade II listed Koko club will include a number of new roof extensions, predominantly on the northern side of the building on Bayham Place.

A new core will be constructed to provide stability to the development, envisaged to be constructed from reinforced concrete frame supported on new piled foundations. Localised additional storeys built above the existing properties will change the load distribution onto the existing foundations. The existing buildings will also be refurbished with some internal walls removed. It is anticipated that the new basement will extend to approximately 17.50m AOD, with a lift pit extending 1.40m deeper, and be constructed in part by secant piled walls and part underpinning of existing foundations to the Hope and Anchor pub. Column loads will be supported on cantilevered pile caps, using a combination of compression and tension piles to transmit the loads.

The planned layout of the site is shown on Figure 3.

3 PRELIMINARY RISK ASSESSMENT (PRA)

3.1 Site walkover

The site was visited on 2nd April 2016 to undertake a site walkover. Photographs are provided in Appendix C. Potentially significant environmental and geotechnical issues arising from the survey are summarised below. At the time of the site walkover, the Bayham Street property and the Hope and Anchor pub were used as storage for a local charity shop and occupied by live in guardians on the upper floors to prevent squatters returning to the properties.

Potentially contaminative activities carried out on the site currently were identified in the form of a boiler room at lower ground floor level within Koko, a cellar hatch operated by hydraulics is located within Koko at lower ground level on the Bayham Place frontage and lowers down to basement level, a bin store within Koko at lower ground floor level where waste from club operations are temporarily stored, and storage of various cleaning and maintenance supplies across lower ground floor and basement levels within Koko.

It was also not possible to access all of the rooms within Koko and as such, it is unknown if any sources of contamination are contained within.

No potentially significant ground contamination or geotechnical issues were identified during the site reconnaissance survey of the Hope and Anchor pub and Bayham Street property.

An asbestos register report has been provided for the Koko nightclub, in which various sources of asbestos containing materials (ACMs) were identified, including the stage fire curtain, flash guards, panel infills, fuse boards, gaskets and insulation boards. The removal of a number of sources of asbestos was carried out in 2004/5, however it is assumed that all materials removed were done so safely by a competent contractor.

At the time of the site walkover, no asbestos register was available for The Hope and Anchor pub and Bayham Street property. However, since the walkover and the intrusive survey, a Refurbishment Survey was carried out by Eton Environmental Group (report ref J012312, dated 1st September 2017). Asbestos containing materials were identified in two locations: in the cement flue adjacent to the boiler in the basement (asbestos type chrysotile) and in a paper coating behind decorative tiles on the ground floor (asbestos type chrysotile). The report notes that a number of areas across the site were in accessible at the time of the survey and should be presumed to contain asbestos until proven otherwise. Therefore, the presence of potential ACM's within parts of these buildings' fabric cannot be ruled out.

Possible pathways for the migration of cleaning chemicals and hydraulic oils were identified, comprising potential spillages into sump chambers at basement level, however it is understood that the water is pumped off site and anticipated to be into the mains sewer. Whilst areas of the site were inaccessible during the site walkover to verify their use, it is anticipated that these areas are covered by hardstanding and no plausible pathways will exist for the migration of the contaminants. Similarly, the remainder of the site is covered by hardstanding such that no plausible pathways will exist for the migration of the contaminants.

The current chemical storage and handling procedures are of a high standard and, although potential sources of contamination exist on site in the form of small amounts of cleaning products, no plausible pathways for the migration of contamination currently exist.

The site reconnaissance survey revealed potential issues associated with high groundwater table beneath the Koko club. Anecdotal evidence suggests that the site has had a long history of problems associated with a high groundwater table such that a series of connected sump chambers have been installed to accommodate the groundwater, and is regularly pumped out of the final chamber.

In addition, a recently blocked sewer within the Hope and Anchor bounds caused the sewer to fail and water to seep through the walls of the party wall shared with Koko and flood the basement.

3.2 Ground conditions

3.2.1 Geology

Published records (British Geological Survey, 2006) for the area indicated the geology of the site to be characterised by the succession recorded in Table 2.

Several borehole records were downloaded from the British Geological Survey website to provide further information regarding ground conditions in the vicinity of the site. Copies of these are included in Appendix D.

Table 2: Geology at the site

Geological unit	Description	Estimated thickness (m)
Worked Ground	Not provided, but described as “areas where the ground has been cut away such as quarries and road cutting”.	Unknown
London Clay (weathered)	Firm to stiff fissured brown, occasionally mottled orange, silty CLAY, with occasional pockets of fine sand and gypsum.	6.70 to 10.60

Geological unit	Description	Estimated thickness (m)
London Clay (unweathered)	Stiff to very stiff fissured grey silty CLAY, with occasional partings of fine sand, occasional claystones and locally with pyrite.	20.40
Lambeth Group	Mottled CLAY, sandy green CLAY[1]	15.25
Thanet Sand	Grey SAND[1]	6.00
Chalk	CHALK and Flints[1]	72.54+
Source: BGS Borehole records and records from nearby RSK project (590m to the NE of the site).		
Notes: [1] Limited descriptions taken from historic borehole records		

A site investigation carried out by RSK approximately 590m to the northeast of the site, encountered weathered London Clay extending to depths of between 5.50m to 8.50m, over unweathered London Clay, which was proved to the maximum depth investigation of 25.00m. Groundwater was encountered as very slow seepages at depths of between 9.00m and 10.50m bgl associated with claystones within the London Clay, and perched water within the made ground.

The existing topography and history of development of the site suggests that, in addition to these natural strata, made ground should be expected beneath the site.

3.2.2 Radon

The environmental database report (GroundSure report, dated 3rd May 2016) indicates that the site is not located within an 'Affected Area' as defined by the Documents of the National Radiological Protection Board (Radon Atlas of England and Wales, NRPB-W26-2002) and therefore the risk of significant ingress of radon into structures on-site is considered low.

3.2.3 Mining and quarrying

Evidence has been sought to identify any mining and quarrying operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- an environmental database report (Appendix F)
- records held by local authority/EA
- old Ordnance Survey maps and plans (see Section 3.5)
- geological maps (see Section 3.2.1)

With reference to the above data there are no recorded mines or quarries within a 250m radius of the site.

3.2.4 Landfilling and land reclamation

Evidence has been sought to identify any landfilling or land reclamation operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include those noted in Section 3.2.3 above.

There are no records of landfill sites (former or current) within 250m of the site (i.e. within the planning consultation zone). Furthermore, there are no records of landfills within a 0.5km radius of the site.

The 1:50 000 geological map for the area (Sheet 256) published by the British Geological Survey (BGS) in 2006, indicates that the site is underlain by ‘worked ground”, defined by the BGS as ”areas where the ground has been cut away such as quarries and road cuttings”. There are a number of ‘worked ground’ areas around the site, noted to be predominantly east of Regents Park.

With reference to the historical data there have clearly been some phases of construction and demolition on the site and therefore the presence of made ground should be expected.

3.3 Hydrogeology

3.3.1 Aquifer characteristics

Based on the published geological map referred to above, the hydrogeology of the site is likely to be characterised by the presence of an aquitard comprising the London Clay Formation.

Confined by the London Clay Formation is a deep aquifer, comprising a sequence of deposits consisting of the lower part of the Lambeth Group and Thanet Sands (Basal Sands) and the White Chalk. These units are expected to be in hydraulic continuity.

Based on the BGS borehole records and nearby site investigations, shallow groundwater is not anticipated. BGS record TQ28SE10 recorded a groundwater level within the London Clay at 22.56m depth in 1901, and at 32.92m depth in 1910 within the Lambeth Group. Therefore, the anticipated depth to the groundwater table is in the order of 22.50m below ground level.

Seepages of groundwater were encountered within the London Clay on the other nearby BGS records, typically associated with claystone, however these seepages appeared to have dried out upon completion of the boreholes. The presence of seepages within the London Clay should therefore be anticipated.

The EA status report issued in 2015 ‘Management of the London Basin Chalk Aquifer’ indicates that the potentiometric surface of the groundwater in the deep aquifer in the site area in January 2015 was at approximately -36.00m AOD, i.e. approximately 58.80m below ground level.

It is also possible that localised perched water may also be present in the made ground.

3.3.2 Vulnerability of groundwater resources

The site has been classified by the EA website to overlie a:

- 'unproductive' strata (London Clay Formation): low permeability with negligible significance for water supply or river base flow.
- principal aquifer (Deep Aquifer - lower Lambeth Group/Thanet Sand/Chalk): layers of rock or drift deposit that have high intergranular and/or fracture permeability (usually providing a high level of water storage). They may support water supply and/or river base flow on a strategic scale

The soils beneath the site are classified as having no leaching potential.

3.3.3 Risk from rising groundwater levels

Rising groundwater levels can effect foundations and structures and may result in flooding if not properly controlled. In certain areas groundwater levels are rising owing to reduced groundwater abstraction by industry. London is at particular risk but the situations in Birmingham, Liverpool, Glasgow and Nottingham are also being monitored.

As defined within CIRIA Special Publication 69 (Simpson et al., 1989) the site lies within the critical areas in the London basin in which deep foundations and basements and exceptional structures are potentially at risk from the rising groundwater levels in the deep aquifer. The rise in groundwater levels started during the mid-1960s as a result of a significant reduction in groundwater abstraction from the Chalk aquifer. Prior to this, the Chalk aquifer had been increasingly exploited as a result of increasing industrialisation throughout the 19th century and early part of the 20th century.

The deep aquifer beneath the site comprises a sequence of Tertiary Deposits (consisting of the lower part of the Lambeth Group and Thanet Sands) and the Chalk. These units are expected to be in hydraulic continuity and therefore have been considered as a single aquifer unit.

Following the issue of CIRIA Special Publication 69 (Simpson et al., 1989), the Rising Groundwater Level Working Group (GARDIT) was formed in March 1998. This group publicly launched a strategy proposal for controlling rising groundwater beneath London. As a result of the implementation of the GARDIT strategy, groundwater levels are now considered to be stabilising across much of the London Basin and the GARDIT Strategy is considered to have been successful. There will be ongoing monitoring and control of groundwater levels in the London Basin using the abstraction licensing process.

Notwithstanding the above, in view of the recorded depth to groundwater in the deep aquifer beneath the site the risk of rising groundwater to the proposed development is considered low.

3.3.4 Licensed groundwater abstraction

The environmental database (GroundSure, dated 3rd May 2016) report indicates that there are 52 current licensed groundwater abstractions (15 of which are public water supply boreholes) within a 2km radius of the site. The nearest is located approximately 895m to the northeast of the site and is operated by Hanson Quarry Products Europe Ltd for 'general use relating to high loss' purposes. The nearest potable water supply is located approximately 1.35km north of the site at Kentish Town Sports Centre.

In terms of aquifer protection, the EA generally adopts a three-fold classification of source protection zones (SPZ) for public supply abstraction wells.

- zone 1 or 'inner protection zone' is located immediately adjacent to the groundwater source and is based on a 50-day travel time from any point below the water table to the source. It is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source
- zone 2 or 'outer protection zone' is defined by a 400-day travel time from a point below the water table to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.
- zone 3 or 'total catchment' is the area around the source within which all groundwater recharge is presumed to be discharged at the source.

Information available on the EA website indicates that the site does not lie within a currently designated groundwater Source Protection Zone.

3.4 Hydrology

3.4.1 Surface watercourses

There are no ponds, streams or drainage ditches on or adjacent to the site. The nearest identified surface watercourse to the site is the Regent's Canal located approximately 540m to the northeast of the site. The canal starts to the west of the site, goes around the top of Regents Park, around 600m to the north of the site, before heading southeast / east.

The EA classification of the water quality in the stretch of the Regent's Canal nearest to the site is grade E (poor) in 2009, however, previous to this was F (bad).

The Lost Rivers of London (Barton, 1992) show the course of the historical Fleet River, which flows southwards into the River Thames, to be located approximately 325m east of the site, near St Pancras Hospital. The river is now culverted.

There are no licensed discharge consents within 500m of the site.

A single contamination incident is recorded 344m northeast of the site and relates to an incident in 2002 involving fire-fighting run-off water. The incident was a category 3 (minor) water impact and a category 4 (no impact) land and air impact.

3.4.2 Surface water abstractions

Surface water abstractions identified, using the environmental database (GroundSure report), within a 2km radius of the site are detailed in Table 3.

Table 3: Surface water abstractions

Reference	Distance and orientation from site	Comment
28/39/39/0172 (x2 licences)	512m E	Thames Surface Water – non-tidal (historical), Make-Up or Top Up Water
28/39/39/0164	939m NW	Thames Surface Water – non-tidal (historical), Non-Evaporative Cooling
2 8/39/39/0173	946m NW	Thames Surface Water – non-tidal (historical), Non-Evaporative Cooling
28/39/39/0164	1041m E	Thames Surface Water – non-tidal (active), Non-Evaporative Cooling

3.4.3 Site drainage

Surface drainage from the site appears to be discharged into the mains drainage network. There are a series of 4no linked underground sump chambers beneath the Koko club, which run in a northwest-southeast direction and is pumped from the northernmost sump within the lower level basement. It is understood from the club maintenance team that this is to deal with a high (perched) groundwater level.

The BGS geological maps note worked ground beneath/close to the site. The high (perched) groundwater table beneath Koko may therefore be a residual effect from the perched water collecting within the disturbed/worked ground. A concealed preferential pathway for the migration of contamination in the sub-surface may therefore exist beneath the site.

3.4.4 Preliminary flood risk assessment

The indicative floodplain map for the area, published by the EA, shows that the site does not lie within the designated floodplain of the River Thames. The risk of flooding each year has been assessed by the EA as very low, i.e. 0.1% (1 in 1000) or less.

3.5 History of site and surrounding area

The history of the land-use and development of the site and surrounding area has been assessed based on the following sources:

- historical maps within the environmental database from 1870 to 2014
- internet search
- historical maps of London
- local archives
- company archives/interviews with site staff
- information from the local planning authority (where received)
- Preliminary UXO Risk Assessment (1st Line Defence report ref EP3439-00, dated 6th May 2016)

Copies of OS and County Series maps are included in the environmental database report in Appendix E. Reference to historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.

Planning records held by Camden Council pertaining to the site date from 1938 when permission was granted for the erection of alterations to an existing sign for The Camden Hippodrome, and in 1965 for The Hope and Anchor pub for the rebuilding of the ground floor extension. No significant further planning consents of note are held for either property and no planning history is available for the Bayham Street property.

The development history of the site and surrounding area from the above sources is detailed in Table 4 and summarised below.

The earliest Ordnance Survey map (1870 – 1873) shows the site to be developed with a number of terraced residential properties and The Hope and Anchor pub. The surrounding area was predominantly terraced residential properties with the existing major road system already in place. Tramlines running up and down Camden High Street and Hampstead Road immediately west of the site are shown on the 1896 maps with a number of small industries within the surrounding area. The tramlines are understood to have been removed by the late 1940s.

By 1900, the site was redeveloped into its existing configuration and The Camden Theatre (now Koko) was opened on Boxing Day. The site has essentially remained unchanged throughout its developed history, with the only real changes occurring to what is now the Koko nightclub. The latter has been used as cinema in its former years before the BBC took over the venue in 1940 when it was used for recording shows. The club was renamed the Camden Hippodrome in the early 1950's and has been predominantly a music venue since that time, with a number of name changes including The Camden Palace and, more recently, Koko, from 2005.

The surrounding area essentially remained unchanged up until the post war years, when a number of industries popped up and former ruins were redeveloped. Such instances include car parks, garages, metal works, printing works, unspecified works, and a tobacco factory located 90m southwest of the site. The early 1960s saw a boom in housing development and a number of blocks of terraced properties were knocked down and redeveloped into council estates to the northeast of the site.

The site and surrounding area have essentially remained unchanged since the 1970s.

Table 4: Summary of historical development

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
1870 - 1873	The Hope and Anchor pub situated on the corner of Crowndale Road and Bayham Street. The pub is separate from the other Bayham Street properties. The remainder of the site is terraced residential properties with private gardens.	The surrounding area is predominantly terraced residential properties with churches and schools. Major road system as existing today in place, including Crowndale Road, Eversholt Road, Camden High Street and Bayham Street. Bayham Place called Gloucester Street.
1876 – 1879	No change.	No significant change. The Western Railway present 285m to the SE.
1882 (small scale map only available)	No change.	No significant change
1894	No change.	No significant change
1896	The pub developed into existing configuration. No change to remainder of the site.	Tram tracks running along Camden High Street and Hampstead Road. Gloucester Street renamed Bayham Place. Pianoforte Manufactory 80m to NE. Cobden Works (furniture) 65m W.
1900	The site is redeveloped into its existing configuration. The Koko Club opened, then called The Camden [picture] Theatre.	-
1916	No change.	Station (electric railway) located at junction of Camden High Street, Hampstead Road and Eversholt Road, directly SW of the site outside Koko. Station is called Mornington Crescent and opened in 1907. Pianoforte factory moved to 185m NW

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
		of site. Tramline / railway tracks join Camden High Street tracks from along Crowndale Road.
1920 (small scale map only available)	No change.	No significant change.
1938 (small scale map only available)	No change.	No significant change.
1948 – 1951	No change.	Surrounding area bombed during the war creating many ruins, including an area 170m NW. Tramline understood to have closed down.
1951 – 1952	Koko Club called “Camden Hippodrome”.	Tobacco works on Mornington Crescent 90m SW. Large Post Office 20m S. Printing Works and Bakery 70m NW. Car park at site of former ruin, 170m NW. Car Body Works 205m N. Metal Works 120m NE. Tram station outside Koko renamed as Mornington Crescent Station.
1957	No change.	No significant change.
1961 - 1964	Koko Club called “Camden Theatre” and was used by the BBC.	Car park to the NW redeveloped into an apparent council estate comprising a large building. Works 30m N on Bayham Street. Works 115m NW. Tobacco factory redeveloped into a number of large buildings, including Greater London House. The block of terraced houses and the metal works bounded by Bayham Street, Bayham Place, Plender Street and Camden Street, immediately NE of site redeveloped into a large estate comprising a number of large buildings.
1966 – 1968	No change.	The block of houses 155m N of site and directly north of Plender Street being redeveloped.

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
1968 - 1972	No change.	Development north of Plender Street redeveloped into an apparent council estate comprising a number of large buildings. Electrical substation 190m NE.
1971 – 1973	No change.	No significant change.
1986 – 1991	Koko Club called “The Camden Palace”.	No significant change. Electrical substation 235m NW. Garage 220m N.
1989 – 1995	No change.	No significant change.
2002 (small scale map only available)	No change.	No significant change.
2005	Koko Club opened following a 6 month interior renovation.	-
2010 (small scale map only available)	No change.	No significant change.
2014 (small scale map only available)	No change.	No significant change.

3.5.1 Unexploded ordnance

With reference to the London Bomb Damage maps, the surrounding area was struck by a number of bombs during WWII. As such, a Preliminary UXO Risk Assessment was carried out by 1st Line Defence (Ref EP3439-00, dated May 2016), which is appended in Appendix F. The report concluded that there are no records of any strikes within the site boundary or on structures immediately adjacent to the site, and that the site was occupied by a theatre and a Public House during WWII, the former of which was not open to the public for commercial purposes during the Blitz, but due to its size and importance is still likely to have been utilised by the local community and is anticipated to have sustained a reasonable frequency of access. Additionally, it is highly likely that damage to the site and to adjacent structures would have been noted and investigated. The report considers that the risk of encountering UXO during the proposed works is minimal and that no further action is necessary.

3.6 Sensitive land uses

No national or internationally designated sensitive land uses such as sites of special scientific interest (SSSI) were identified within 500m of the site. A comprehensive evaluation of ecological receptors is outside the scope of this report.

3.7 Licences and permissions

The environmental database report holds the following records of relevance to the study:

- 6 historical records of potentially contaminative industrial land use within 250m of the site, and include the following activities; electricity railway station, London Transport Station and an unspecified station.
- 24 current records of potentially contaminative industrial land use within 250m of the site, and include the following activities; distribution and haulage, unspecified works or factories, vehicle hire and rental, photographic and optical equipment and electronic equipment.
- two petrol stations, 28m southwest and 436m south of the site, both obsolete/closed. No further information supplied regarding these.
- A National Grid high voltage underground electricity transmission cable 475m north of the site.
- Six Part A(2) and Part B Activities within 500m of the site. These relate to dry cleaners 85m northwest, 248m east and 484m southeast of the site.
- 17 records of Category 3 or 4 disposal of radioactive waste authorisations within 500m of the site. Seven of these licenses have been revoked. The closest record relates to the Royal Veterinary College 291m northeast of the site.
- 55 historical garage and motor vehicle repair sites within 500m of the site, the closest of which was 203m northwest of the site.
- 25 historical tanks were identified within 500m of the site, the closest of which was 283m southwest of the site in 1968.
- 77 historical electrical substation, electricity works, and generating stations records were identified within 500m of the site: the closest being an electrical substation 86m to the southeast.
- One record of a tunnel within 50m of the site, relating to the London Underground Northern Line 10m southwest of the site under Camden High Street, at an approximate depth of 16mbgl.

Information supplied by LUL with regards to their infrastructure adjacent to the site indicate the Mornington Crescent station is directly beneath Camden High Street on which Koko fronts. Two tunnels enter the station, one 10m southwest of the site and the other 55m southwest of the site. The two sets of tracks represent where the Northern Line splits into two branches: the Bank branch and the Charing Cross branch.

In addition to the above, railway tracks heading towards Euston Train Station are present approximately 265m west of the site.

3.8 Local authority environmental health department information

The environmental health department (EHD) of London Borough of Camden has been contacted to obtain any records of contamination in connection with the site. No response has been received at the time of writing.

3.9 Initial conceptual model

The information presented in Sections 2 and 3.1 to 3.8, has been used to compile an initial conceptual model. The identified potential sources of contamination, associated contaminants and receptors have been considered with plausible pathways that may link them. The resulting potential pollutant linkages are considered in Section 3.9.5. The risk classification has been estimated in accordance with information in Appendix G.

3.9.1 Summary of potential contaminant sources

Potential sources and contaminants of concern are summarised in Table 5.

Table 5: Potential sources and types of contamination

Potential sources	Contaminants of concern
On-site historical	
Terrace housing (pre-1870 to 1900)	Unknown fill material resulting from demolition of previous buildings (but potentially including heavy metals, ash, clinker, sulphates, polycyclic aromatic hydrocarbons (PAHs)).
On-site present day	
Nightclub building with boiler rooms, electrics, electrical rooms, floorings.	No sources of potential ground contamination identified. Asbestos containing materials have been recorded within the boiler and electrical rooms and various electrics, panels and flooring materials around the club.
Storage of chemicals on site	Small quantities of general cleaning and maintenance supplies
Made ground (i.e. fill material), including “worked ground” as	Unknown fill material (but potentially including heavy metals, ash, clinker, sulphates, polycyclic aromatic

Potential sources	Contaminants of concern
noted on BGS geological map.	hydrocarbons (PAHs), asbestos etc.)
Off-site	
Garages, 220m W (1980s – 1990s) and 205m N (1950s)	Hydrocarbons, petroleum spirit, ethylene glycol, methyl tertiary butyl ether (MTBE), oil and waste oil, chlorinated and non-chlorinated solvents.
Various current and historical industrial land uses including: tobacco factory, furniture works, printing works, vehicle hire and rental, distribution and haulage, photographic and optical equipment	Fuel oils, lubricating oils, heavy metals, polychlorinated biphenyls (PCBs), PAHs, solvents and other common industrial contaminants.
Adjacent and nearby former and current industrial activities, electrical substations.	Hydrocarbons (transformer oil) and polychlorinated biphenyls (PCBs), heavy metals, ash, clinker, sulphates and polycyclic aromatic hydrocarbons (PAHs).
"Worked ground" (as BGS geological map)	Ground gases, leachate
Railway, 10m south-west of site (early 1900s to present)	Fuel oils, lubricating oils, heavy metals, PAHs, PCBs, ethylene glycol, ash, sulphate, herbicides and asbestos
Gas sources and gas generation potential in line with BS8576	
"Worked ground" (as BGS geological map)	Carbon dioxide and methane
Other man made: spills/leaks, sewage sludge, made ground, etc.	Carbon dioxide, methane and trace gases

3.9.2 Sensitive receptors

Sensitive receptors at this site include:

- future site occupants
- adjacent site users
- potable water supply pipes

Please note that construction workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures including CDM regulations.

3.9.3 Summary of plausible pathways

The plausible pathways are summarised below:

- direct contact (soil, dust and vegetable ingestion, dermal contact, dust and fibre inhalation)

- ground gas and soil gas inhalation
- chemical attack of infrastructure (including water supply pipes) and buildings.

3.9.4 Data gaps and uncertainties

Historical mapping indicates the site was already developed prior to the earliest map available. As such, information pertaining to the site usage prior to this is unknown. At the time of writing, no response has been received at the time of writing has been received from the environmental health department (EHD) of the London Borough of Camden who has been contacted to obtain any records of contamination in connection with the site.

Additionally, it is not understood what period of ground construction the “worked ground” the BGS geological map notes to be beneath the site relates to.

3.9.5 Potentially complete pollutant linkages

The outline conceptual model is summarised in Table 6. The risk classification has been undertaken in accordance with CIRIA C552 (Rudland et al., 2001), a summary of which is included in Appendix D.

Table 6: Risk estimation for potentially complete pollutant linkages

Potential Contaminant	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
<u>On Site</u> Made Ground across site from historical and present day activities (heavy metals, PAH, sulphate, asbestos, etc.)	Human health (current and future site users) Water supply pipes Building structures	Ingestion of contaminated soil, dust, liquid Inhalation of contaminated dust and vapours/gases Contact with contaminated ground/liquid	Moderate	Medium	**Moderate/ Low Risk** The excavations required to form the existing basement levels on site are likely to have removed a substantial amount of any previous made ground. The proposed refurbishment works will likely maintain the full cover of the Koko and pub buildings and hardstanding, thereby breaking any potential pathways with future site users. Excavation for the new basement and foundations across the remainder of the site will require the removal of any existing made ground. New buried structures and services would be suitably designed to withstand chemical attack. The London Clay will likely retard lateral and vertical migration of contaminants.
<u>On Site</u> Ground gases from made ground / worked ground on site. (methane & carbon dioxide)	Human health (current and future site users)	Inhalation of contaminated vapours/gases	Low	Medium	**Moderate/Low Risk** Excavations to form the new basement and its foundations beneath the Bayham Street property will remove any potentially contaminated made ground, which will in any case be covered by the new building and surrounding hardstanding, thereby breaking any potential pathways with future site users. The Koko building has existed for over a century such that the risk of ground gas is minimal.

Potential Contaminant	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
On Site Possible leaks & spills from chemical storage on site. (unknown material)	Human health (current and future site users) Water supply pipes Third Party land	Inhalation of contaminated vapours/gases Contact with contaminated ground/liquid	Low	Minor	**Low Risk** Only very limited amounts of chemical storage on site for cleaning purposes etc. Spills from chemicals stored on site are likely to be retarded by the presence of hardstanding and good housekeeping will minimise the risk of spillage. However, spillages may enter the sump chambers in Koko at basement level however it is anticipated that pumped water from the sumps enters the mains sewer system. New buried structures and services would be suitably designed to withstand chemical attack. The London Clay will likely retard lateral and vertical migration of contaminants.
Off Site Possible leaks & spills from historical tobacco factory, furniture works, printing works, vehicle hire and rental, distribution and haulage, photographic and optical equipment. (oil, fuel oils, lubricants, asbestos, heavy metals, zinc, polychlorinated biphenyls (PCBs), PAHs, ethylene glycol, solvents) and other common industrial contaminants.	Human health (current and future site users) Water supply pipes Third Party Land	Inhalation of contaminated vapours/gases Contact with contaminated ground/liquid Surface runoff	Unlikely	Medium	**Low Risk** It is anticipated that the site perimeter has been covered by hardstanding throughout its developed history such that any contaminants entering the site via surface runoff are unlikely to have entered the soil beneath the site. The industrial uses are no longer present such that airborne pathways are no longer in existence. New buried structures and services would be suitably designed to withstand chemical attack. The London Clay will likely retard lateral and vertical migration of contaminants.

Potential Contaminant	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
Off Site Sources Railway Garage Electrical Substation	Third Party land Water supply pipes	Surface runoff	Unlikely	Medium	**Low Risk** The London Clay will likely retard lateral and vertical migration of contaminants. Whilst part of the site was covered by gardens in its early developed history, it is now covered by hardstanding in its entirety and any soft landscaping will have been removed and replaced by basements such that any contaminants entering the site via surface runoff are unlikely to have entered the soil beneath the site or will have been removed during previous development. The industrial uses are no longer present such that airborne pathways are no longer in existence. New buried structures and services would be suitably designed to withstand chemical attack.

The conceptual model does not identify any potentially complete contaminant linkages with a risk estimate of moderate or above which would drive investigation works, but it was deemed prudent to carry out some limited investigation to confirm the assumptions made in this desk based study.

4 SITE INVESTIGATION METHODOLOGY

RSK carried out intrusive investigation work on 27th June to 20th July 2016 and subsequent ground gas and groundwater monitoring in the following three month period, to confirm the potential pollutant linkages identified in the outline conceptual model and to inform geotechnical constraints.

4.1 Sampling strategy and methodology

The techniques adopted for the investigation have been chosen considering the anticipated ground conditions, existing land use and the proposed development.

Hand excavated trial pits were carried out at locations specified by Heyne Tillett Steel in order to expose existing foundations to the buildings. Within the Bayham property the pits were excavated from ground level, within the Hope and Anchor pub they were excavated within the cellar, and within Koko the trial pits were excavated at both lower ground floor and basement level. It was not possible to fully excavate a number of trial pits to determine the full depth and/or extent of the foundations due to a number of sewers encountered within and adjacent to the pits and the presence of localised groundwater, which restricted the trial pit size.

Due to access restrictions, the deep cable percussive borehole was drilled using a specialist modular “cut-down” rig within the Bayham Property at ground level. A 200mm diameter core was removed from the floor slab to facilitate the borehole.

Two shallow window sample boreholes were drilled within Koko at lower ground floor and basement level using a specialist “cut-down” window sampling rig as the site due to access restrictions. The boreholes were drilled to provide information on ground conditions beneath the foundations at a number of locations and facilitate installation of shallow gas and groundwater monitoring standpipes.

Falling and rising head tests were carried out in the borehole installations to estimate the hydraulic connectivity of the soils.

4.1.1 Health, safety and environment considerations

An asbestos register report has been provided for the Koko nightclub, in which various sources of asbestos containing materials (ACMs) were identified, including the stage fire curtain, flash guards, panel infills, fuse boards, gaskets and insulation boards. The removal of a number of sources of asbestos was carried out in 2004/5, however it is assumed that all materials removed were done so safely under a competent contractor.

No asbestos register was provided for The Hope and Anchor pub and Bayham Street property. Therefore, the presence of potential ACM's within parts of these buildings' fabric cannot be ruled out.

A drainage survey was not provided prior to start of the intrusive investigation but was started by another contractor in the week commencing 4th July 2016 whilst intrusive works were ongoing. A number of services, predominantly sewers, were encountered within the trial pits which restricted their size and depth limiting the information obtainable.

Additionally, shallow groundwater beneath Koko restricted the depth to which some of the trial pits could be advanced due to the risks associated with blind digging.

A number of investigation points were located within the cellar and basement of the buildings across the site where ventilation and lighting was limited. A dust filtration unit was used to filter dust particles arising from activities which created dust and task lighting was provided where required.

4.1.2 Investigation locations

The site work was carried out by RSK between the 27th June and 20th July 2016 and comprised the activities summarised in Table 7, along with a justification for each exploratory hole location. The investigation and the soil descriptions were carried out in general accordance with BS5930: 2015 - Code of Practice for Ground Investigations. The exploratory hole logs and other site work records are presented in Appendix H.

The locations of the intrusive investigations are shown in Figure 2. The rationale for these locations is given in Table 7.

Table 7: Exploratory hole and monitoring well location rationale

Investigation Type	Exploratory hole number	Response zone (m bgl)	Rationale
Boreholes – by cable percussion drilling	BH1	1.40m to 5.00m	To prove the geological succession beneath the site, obtain geotechnical data and determine the contamination status of the ground beneath the site and facilitate ground gas and groundwater monitoring
Boreholes – by window sample drilling	WS1	1.00m to 3.60m	To prove the geological succession beneath selected foundations, obtain geotechnical data and facilitate ground gas and groundwater monitoring.
	WS2	0.55m to 4.55m	
Trial Pits	TP1 to TP4	NA	To expose foundations to the Bayham Place property and to retrieve samples for chemical testing.
Trial Pits	TP5 to TP8	NA	To expose foundations to the Hope and Anchor pub and to retrieve samples for chemical testing.

Investigation Type	Exploratory hole number	Response zone (m bgl)	Rationale
Trial Pits	TP9 to TP12	NA	To expose foundations to the basement level in Koko and to retrieve samples for chemical testing.
Trial Pits	TP13 to TP14	NA	To expose foundations to the lower ground floor level in Koko and to retrieve samples for chemical testing.

The investigation and the soil descriptions were carried out in general accordance with 'BS 5930:2015 Code of Practice for Ground Investigations' (BSI, 2015). The exploratory hole records are presented in Appendix H.

The investigation points were located approximately by reference to physical features present on the site at the time of investigation and were agreed with Heyne Tillett Steel during a site walkover prior to the intrusive investigation. The ground levels at the borehole locations were interpolated from the levels shown on the site plan provided.

4.1.3 Soil sampling, in-situ testing and laboratory analysis

Soils collected for laboratory analysis were collected in a variety of containers appropriate to the anticipated testing suite required. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

Selected samples were placed in polythene bags for headspace screening with a photo-ionisation detector (PID) fitted with a 10.2eV bulb. Soils collected for laboratory analysis were collected in a variety of containers appropriate to the anticipated testing suite required. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

Ten samples were taken and are recorded together with their depths and the PID screening results on the exploratory hole records in Appendix H. The samples were transported to the laboratory in chilled cool boxes. Laboratory chain of custody forms can be provided if required. The rationale for soil sample chemical analysis is presented in Table 8.

Table 8: Scheduled analysis – soil

Exploratory hole no. and sample depth (m bgl)	Analyte	No. of samples	Rationale
BH1 (1.10) TP1 (0.20) TP2 (0.50)	Metals suite (As, Cd, tCr, Pb, Hg, Se, Cu, Ni, Zn)	10	Standard suite of testing undertaken on a selection of non-
	Speciated Total Petroleum Hydrocarbon with identification	8	

Exploratory hole no. and sample depth (m bgl)	Analyte	No. of samples	Rationale
TP4 (0.60) TP5 (0.50) TP6 (0.80) TP7 (0.35) TP9 (0.40) TP13a (0.30) TP14 (0.20)	Speciated Polycyclic Aromatic Hydrocarbons (PAHs)	10	targeted samples obtained from the made ground deposits
	Soil Organic Matter	8	
	Asbestos screen	10	
	VOC by GCMS	2	PID readings above 0.1ppm and strong sewage odour detected in TP13a.
TP1 (0.20) TP5 (0.50)	FULL 2 BATCH WASTE SUITE (WAC) (Full solid waste plus 2 batch leach test plus metals)	2	To determine the waste classification.

Standard penetration tests (SPTs) were carried out within the cohesive London Clay deposits at regular intervals of approximately 3m, alternated with UT100 samples at the same frequency, during the cable percussion on the borehole records presented in Appendix H and within the summary table included within Appendix H. Disturbed samples were taken from each stratum encountered for subsequent geotechnical analysis.

4.1.4 Groundwater monitoring and levelling

Depths to groundwater were recorded using an electronic dip meter on four occasions. The monitoring results are given in Section 5.2 and presented in Appendix I.

4.1.5 Ground gas monitoring

In line with the conceptual model which indicated soil gas sources with gas generation on site and in the surrounding area, response zones were installed to target the sources or pathways as detailed in Table 6.

Three monitoring rounds have been undertaken to provide data to support the conceptual model. Monitoring included periods of falling atmospheric pressures and after/during rainfall.

An infrared gas meter was used to measure gas flow, concentrations of carbon dioxide (CO_2), methane (CH_4) and oxygen (O_2) in percentage by volume, while hydrogen sulphide (H_2S) and carbon monoxide (CO) were recorded in parts per million. Initial and steady state concentrations were recorded. In addition, during the first monitoring round, all wells were screened with a PID to establish if there are any interferences and cross-sensitivity of other hydrocarbons with the infrared gas meter.

The atmospheric pressure before and during monitoring, together with the weather conditions, was recorded.

All monitoring results together with the temporal conditions are contained within Appendix I and discussed in Section 5.3.

4.1.6 In-situ hydraulic conductivity testing

Rising and falling head tests were undertaken during developing in BH1 to ascertain the hydraulic conductivity of the London Clay. The results of the in-situ hydraulic conductivity tests are found within Section 5.2.1.

5 GROUND CONDITIONS

The results of the intrusive investigation and subsequent laboratory analysis undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented in Appendix H.

5.1 Soil

The exploratory holes revealed that the site is underlain by a variable thickness of made ground over the London Clay Formation. This confirms the stratigraphical succession described within the initial conceptual model. For the purpose of discussion, the ground conditions are summarised in Table 9 and the strata discussed in subsequent subsections

Table 9: General succession of strata encountered

Strata	Exploratory holes encountered	Depth to top of stratum m bgl (m AOD)	Thickness (m)
Made ground	All positions	GL (17.60 to 22.80)	0.18 to 2.12
London Clay Formation	All except TP1, TP3, TP5, TP11, TP13b.	0.18 to 2.12 (17.05 to 21.80)	0.10 to 24.20
Lambeth Group	BH1	25.40	>4.60

5.1.1 Made ground

Beneath a nominal thickness of concrete screed and concrete slab, the made ground generally comprised fine soils with a significant portion of coarse material and ranged in thickness from 0.18m to 2.12m. The base of the made ground was not proven in trial pits TP1, TP3, TP5, TP11 and TP13b.

This stratum comprised dark brown / brown slightly sandy gravelly silty clay, locally with horizons of dark red brown silty very gravelly sand / sandy gravel with high cobble content, and with occasional brick, clinker, ash and slate, pottery, concrete and wood and occasional pockets of brown and grey mottled clay.

5.1.2 London Clay Formation

London Clay was encountered beneath the made ground at depths of 0.18m to 2.12m bgl (17.05m AOD to 21.80m AOD).

The London Clay typically comprised a weathered horizon of firm to stiff fissured brown mottled grey silty clay with occasional mica speckling and extended to a depth of 7.80m (14.95m AOD) in BH1. This in turn was underlain by stiff becoming very stiff fissured dark grey silty clay, locally slightly sandy, with occasional mica speckling, selenite, forams and pyritised wood, and with a glauconitic horizon near the base. The London Clay extended to a depth of 25.40m (-2.65m AOD).

Claystone bands were encountered in BH1 at depths of 11.80m (10.95m AOD) and 12.80m (9.95m AOD), and in WS1 at depths of 1.25m (18.15m AOD) and 3.60m (15.80m AOD).

No visual or olfactory evidence of contamination was encountered within the stratum.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 10 and laboratory test results can be found in Appendix J.

Table 10: Summary of in-situ and laboratory test results for London Clay

Soil parameters	Range	Reference
Liquid limit (%)	60 to 78	Appendix J
Plasticity limit (%)	24 to 33	Appendix J
Plasticity index (%)	36 to 49	Appendix J
Plasticity term	High to Very High	-
Moisture content (%)	21 to 35	Appendix J
Bulk Density (Mg/m^3)	1.96 to 2.05	Appendix J
SPT 'N' values	5 to 33 (250[1])	Appendix H & J Figure 5
SPT 'N_{60}' values	5 to 35	Appendix H & J Figure 5
Undrained shear strength inferred from SPT 'N_{60}' values (kN/m^2) (f_1 = 5)	25[2] to 175	Appendix J Figure 4
Undrained shear strength measured by triaxial testing (kN/m^2)	79 to 411	Appendix J Figure 4
Strength term	High to Extremely High	-
Notes: [1] SPT refusal – extrapolated value [2] Low undrained shear strength values inferred from SPT 'N_{60}' values in the weathered surface are uncharacteristically low.		

5.1.3 Lambeth Group

The Lambeth Group was proven in BH1 at a depth of 25.40m (-2.65m AOD) extending to the full depth of the investigation of 30.00m (-7.25m AOD), and typically comprised very stiff fissured yellowish brown, blue-grey and dark red mottled clay.

No visual or olfactory evidence of contamination was encountered within the stratum.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 11 and laboratory test results can be found in Appendix J.

Table 11: Summary of in-situ and laboratory test results for Lambeth Group

Soil parameters	Range	Reference
Liquid limit (%)	56	Appendix J
Plasticity limit (%)	25	Appendix J
Plasticity index (%)	32	Appendix J
Plasticity term	High	-
Moisture content (%)	19 to 26	Appendix J
Bulk Density (Mg/m^3)	2.04	Appendix J
SPT 'N' values	54 to 56[1]	Appendix H & J Figure 5
SPT 'N_{60}' values	57 to 59	Appendix H & J Figure 5
Undrained shear strength inferred from SPT 'N_{60}' values (kN/m^2)	285 to 295	Appendix J Figure 4
Undrained shear strength measured by triaxial testing (kN/m^2)	215	Appendix J Figure 4
Strength term	Very High	-
Notes: [1] SPT refusal – extrapolated value		

5.2 Groundwater

Groundwater was encountered during the investigation as detailed in Table 12.

Table 12: Groundwater results during investigation

BH/TP	Stratum	Strike (m bgl)	Rise (m)
BH1*	London Clay	24.50 (seepage)	-
WS1	London Clay	3.20 (seepage)**	2.10
Notes: * groundwater recorded at 4.58m upon completion of grouting borehole during standpipe installation. ** groundwater level upon completion of borehole, possibly associated with claystone band encountered at 3.60m.			

In addition to the above, groundwater was encountered within the trial pits following their excavation at depths of between 0.35m and 1.21m (21.59m AOD and 17.30m AOD).

The results of the subsequent groundwater monitoring and well surveying exercise are summarised in Table 13.

Table 13: Groundwater monitoring data

Monitoring well	Target Stratum	Response Zone	Depth to water m bgl (m AOD)			
			20.7.16	3.8.16*	8.9.16	3.11.16
BH1	London Clay	1.40 to 5.00	3.90 (18.85)	3.90 (18.85)	4.02 (18.73)	**
WS1	London Clay	1.00 to 3.60	-	0.88 (18.52)	0.95 (18.45)	1.00 (18.40)
WS2	London Clay	0.55 to 4.55	-	0.18 (17.47)	0.48 (17.17)	0.37 (17.28)
Notes: All boreholes developed during their first monitoring visit. * Basement partly flooded on day of visit. ** Borehole obstructed – no monitoring undertaken.						

It is considered that the groundwater within the trial pits reflect groundwater accumulated around foundations and perched within made ground. However, shallow groundwater within a number of trial pits within Koko's lower ground floor and basement levels at depths of between 0.35m and 1.00m (17.30m AOD and 18.35m AOD) potentially reflect a more persistent shallow perched groundwater table as noted in the anecdotal evidence provided from Koko.

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal variations. Ongoing monitoring would be required to establish both the full range of conditions and any trends in groundwater levels.

The findings reflect the perched groundwater table in the London Clay at an elevation of approximately 18.50m AOD, with localised perched groundwater around the foundations.

5.2.1 Results of hydraulic conductivity testing

A rising head test was carried out during development of the installation in BH1. The borehole was purged dry and after 5 hrs and 35 minutes the water level has risen by 0.18m. On consideration of the results, it was possible that a failure in the seal within the installation was allowing perched groundwater from within the made ground to enter the standpipe. As such, a falling head test was carried out during the next monitoring visit. The water level within the standpipe fell by 0.67m over a period of 3 hours and an in-situ permeability of 7.80×10^{-9} m/sec has been calculated.

In view of the rising and falling head tests carried out, the hydraulic conductivity of the shallow London Clay is considered to be extremely low.

5.2.2 Visual/olfactory evidence of soil and groundwater contamination

During the excavation of trial pit TP13a, groundwater seepage was encountered at a depth of 0.60m (18.80m AOD) and was noted to be of a black colouration. The trial pit was located within the bin store of Koko in which a strong stale beer, cleaning product and sewage odour was noted. Window sample WS1 was advance through TP13a and a groundwater and gas monitoring standpipe was installed.

During the monitoring visit on the 3rd August, groundwater was noted at a depth of 0.88m (18.52m AOD) in WS1. The water was found to be black and have a very strong sewage odour. A water sample was taken and was sent for analysis of a common range of contaminants.

5.3 Ground gas regime

The results of the ground gas monitoring and testing carried out are given in Appendix I. The minimum and maximum results are recorded in Table 14.

Table 14: Summary of ground gas monitoring results

Borehole	Response zone/strata	Probable source(s) of ground gas	Number of monitoring visits	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Flow rate (l/hr)	Water level (m gl)	Atmospheric pressure (mbar)
BH1	1.40 – 5.00	MG	3*	<0.1	<0.1	19.2 – 20.2	-0.1 to 0.1	3.90 – 4.02	1007 - 1009
WS1	1.00 – 3.60	MG	3	1.0 – 2.3**	8.2 – 9.2	15.8 – 20.0	-0.4 to 0.2***	0.88 – 1.00	1007 - 1018
WS2	0.55 – 4.55	MG	3	<0.1	<0.1 – 1.9	17.0 – 20.3	-1.0 to 0.1***	0.18 – 0.50	1007 - 1019

Notes: MG – Made Ground

Steady state gas concentrations and flows are presented in this table

* Borehole obstructed on third visit – no monitoring undertaken.

** Peak reading of 71.2 %

*** Initial release of pressure heard upon opening gas tap, with readings off scale, falling to steady state after approximately 2 to 10 minutes.

During the monitoring visit on the 3rd August, it was not possible to monitor the installations in WS1 and WS2 for gas due high water levels within the standpipe. It was noted that on this occasion, the basement of Koko had partly flooded, including the corridor adjacent to WS2, understood to be because of an internal blocked pipe within

Koko. It was not possible to monitor the installation in BH1 on the 3rd November due to an obstruction over the borehole.

During monitoring of the installation in WS1 on the 3rd November, a hydrogen sulphide type odour was noted. Elevated methane and hydrogen sulphide levels were recorded initially during monitoring (peak readings of 71.2% and >214ppm/greater than upper limit detectable by the gas monitor, respectively) before falling to steady state levels after 20 minutes or so.

5.4 Existing foundations

Fourteen foundation inspection pits (TP1 to TP14) were hand-dug to expose the foundation configuration of the existing buildings. Reference should be made to the trial pit records presented in Appendix H for details on the findings.

It was not possible to fully excavate a number of trial pits to determine the full depth and/or extent of the foundations due to a number of sewers encountered within and adjacent to the pits and the presence of localised groundwater, which restricted the trial pit size. In these instances, in order to determine the thickness of the concrete footings, small diameter Hilti-drill holes were drilled through the footings to confirm the depth to the underside of foundation.

5.5 Refinement of the initial conceptual site model

The exploratory holes confirm the stratigraphical succession described within the initial conceptual model in that the site is underlain by a variable thickness of made ground overlying the London Clay Formation, with Lambeth Group encountered at depth.

Locally, in TP13a/WS1, the groundwater encountered was found to be black and have a very strong sewage odour and during gas monitoring a hydrogen sulphide type odour was detected with corresponding elevated methane and hydrogen sulphide concentrations recorded. This borehole location is located in a room with two foul water sewers running under the slab into the room adjacent where a sewer manhole was located. It is possible that there is a leakage from the sewer. Groundwater encountered elsewhere across the site was not noted to contain any visual or olfactory contamination or elevated concentrations of methane or hydrogen sulphide, such that this appears to be localised to the sewer runs. Further, no potential pathway exists in respect to controlled waters as the London Clay will retard lateral and vertical migration of any potentially mobile contaminants.

The gas monitoring results appear to confirm that ground gas poses a low risk to the proposed development, with localised elevated readings recorded at TP13a/WS1.

5.5.1 Uncertainty

Anecdotal evidence indicates that the site has had a long history of problems associated with a high groundwater/perched water table. Groundwater was recorded in the standpipe installations at elevations of between 17.47m and 18.85m AOD, including during a period of basement flooding.

The source of the groundwater and the high water table is uncertain. Groundwater was not recorded at these elevations whilst drilling. It is possible that a leaking drain or water supply pipe may be the cause of a high perched groundwater table, particularly below Koko.

6 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (EA, 2014), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

6.1 Linkages for assessment

Section 5.4 presents the refined conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in Table 15.

Table 15: Linkages for generic quantitative risk assessment

Potentially relevant pollutant linkage	Assessment method
1. Direct contact with impacted soil by future residents	Human health GAC in Appendix M for a proposed commercial end use since proposed end use includes hotel and entertainment venue.
2. Inhalation exposure of future residents to asbestos fibres	Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development.
3. Contaminants permeating potable water supply pipes	Comparison of soil data to GAC in Appendix M for plastic water supply pipes using UKWIR (2010) guidance.
4. Concentrations of methane and carbon dioxide in ground gas entering and accumulating in: depressions and excavations that could affect workers enclosed spaces or small rooms in new buildings, which could affect future residents. In the case of methane this could create a potentially explosive atmosphere, while death by asphyxiation could result from carbon dioxide.	Gas screening values (GSV) have been calculated using maximum methane and carbon dioxide concentrations with maximum flow rates recorded at the site. The GSV have been compared with the revised Wilson and Card classification presented within CIRIA report C665 (Wilson et al., 2007) owing to the development comprising buildings with a ground floor slab. In addition, the gas regime is considered within the context of a conceptual model as required by both aforementioned guidance documents and BS8576

6.2 Methodology and results

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

Chemical analysis has been performed on ten selected samples of made ground. All soil samples scheduled for laboratory testing were also inspected visually on receipt at the laboratory for the presence of materials potential containing asbestos, e.g. fragments of asbestos-cement products.

The full chemical results are presented within Appendix K. The results have been assessed with respect to human health, asbestos and the performance of construction materials and controlled waters (aquifer beneath the site) in the following sections, with respect to commercial end use.

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

6.2.1 Direct contact with impacted soil by future residents

End users of the site are defined as those who are exposed to sources of contamination on a regular and predictable basis. In the case of developments for an educational end use, the critical receptor is considered to be a 0 to 6 year old female.

Due to the heterogeneous nature of the soil strata analysed, statistical analysis of the laboratory results are not considered appropriate. As such, the results of the laboratory analysis undertaken have been compared directly to the appropriate GAC for each contaminant, based upon an average Soil Organic Matter (SOM) of 6%.

The comparison has confirmed the absence of any contaminants within the underlying made ground or natural soil, which could pose a chronic health risk to future site users via direct contact or inhalation pathways. On this basis, there is a very low risk to the end users of the site.

6.2.2 Inhalation exposure of future residents to asbestos fibres

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of made ground.

6.2.3 Impact of organic contaminants on potable water supply pipes

For initial assessment purposes, the results of the investigation have been compared with the GAC presented in Appendix N for this linkage, which are reproduced from *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (UKWIR, 2010).

The results indicate that a relevant linkage is unlikely to exist associated with organic contaminants and therefore pollutant polyethylene (PE) and/or polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

6.2.4 Perched groundwater analysis

A single groundwater sample was recovered from WS1 and analysed for a range of common contaminants, the results of which are found in Appendix L.

Whilst no relevant pollutant linkage to controlled waters was identified in the revised conceptual model, potentially contaminated perched groundwater was encountered during the fieldwork at WS1. The analytical results have been screened against controlled water GAC, specifically UK drinking water standard and freshwater, as a "worst case scenario".

The analytical results are generally below the GAC's with the exception of a slightly elevated concentration of total petroleum hydrocarbons, specifically aliphatic bands C6-C8 (50μg/l) compared to the stringent 10ug/l threshold for drinking water. In addition, sulphate is slightly elevated against background levels. It is noted that the sample was located in the part of the site adjacent to the sewers in Koko, where the groundwater was noted to be black and have a strong sewage odour. No other contaminated groundwater was encountered elsewhere across the site. It is likely that the source of the contamination is from a leaking sewer and is a localised issue.

In any event, the site is underlain by a significant thickness of impermeable London Clay, which will attenuate any contaminants within groundwater, such a relevant linkage to the Principal Aquifer at depth is unlikely to exist. However, when there is an intention to discard groundwater, the chemical test results will indicate the appropriate disposal options and a discharge consent should be obtained.

6.2.5 Ground gas assessment

The results have been assessed in accordance with the guidance provided in BS8576, NHBC guidance and *CIRIA Report C665*. In the assessment of risks and selection of appropriate mitigation measures, both reports highlight the importance of the conceptual model.

6.2.5.1 *Summary of CSM*

The conceptual site model determined that there is a potential source for ground gases arising from made ground / worked ground, and there is a feasible migration pathway to the site via the made ground.

6.2.5.2 *General*

CIRIA C665 identifies two types of development, termed Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume).

In both situations, it is important to note that the GSV thresholds are guideline values and not absolute. The GSV thresholds may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of methane, should lead to consideration of the need to adopt a higher risk classification than the GSV threshold indicates.

The site is to be redeveloped with private members club and entertainment venue and therefore falls under Situation A.

Situation A relates to all development types except low-rise housing and, by combining the qualitative assessment of risk (see refined conceptual model in Section 5.4) with the gas monitoring results, provides a semi-quantitative estimate of risk for a site. The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flows for methane and carbon dioxide. Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

6.2.5.3 *Assessment of data*

The GSV calculations for each borehole are included in Appendix I. The gas monitoring data has identified a maximum steady state methane concentration of 2.3% and a maximum steady state concentration of carbon dioxide of 9.2%. A maximum gas flow rate of 0.2 l/hr has been recorded.

The maximum steady state concentrations were recorded within WS1 which was noted to be adjacent to a potentially failed foul sewer. In addition, water levels within the installation were found to be above the response zone and the water was analysed as having a slightly elevated concentration of total petroleum hydrocarbons, specifically aliphatic bands C6-C8 (50μg/l), and slightly elevated sulphate. A hydrogen sulphide type odour was detected during monitoring. Groundwater encountered elsewhere across the site was not noted to contain any visual or olfactory contamination or high concentrations of methane or hydrogen sulphide, such that this is potentially a localised issue associated with a potentially leaking sewer.

As such, the maximum concentrations recorded in WS1 have been omitted whilst characterising the site, and a maximum methane concentration of <0.1%, a maximum concentration of carbon dioxide of 1.9%, and a maximum gas flow rate of -1.0 l/hr has been used.

Based on the concentrations, Gas Screen Values (GSV's) may be calculated as follows:

- $CSV_{METHANE}$ = (<0.1/100)*-1.0 = <-0.001 l/hr; and
- $CSV_{CARBON\ DIOXIDE}$ = (1.9/100)*-1.0 = -0.019 l/hr.

Based on the GSVs the site has been characterised as Characteristic Situation 1 (CS1), such that no special precautions will be necessary.

The localised conditions around WS1 are noted to be in an area of site for which no excavation is anticipated, however, should any excavations be proposed in this area that should require man entry then air quality within the excavation should be monitored prior to accessing the excavation and regularly throughout the works .

6.3 Environmental assessment conclusions

The results of the GQRA indicate that relevant pollutant linkages are absent and therefore the site is suitable for the proposed end use.

The conceptual model and initial ground gas monitoring results conducted on site indicate that the site falls into a Characteristic Situation 1, for which no gas protection measures are required. Notwithstanding this, should any excavations be proposed in the area of WS1 it is recommended that air quality within the excavation is checked prior to entering and regularly throughout the works

It is possible that ground works could encounter different conditions from those revealed by the site investigation. It is therefore recommended that the ground works be monitored for previously undetected suspect materials and if found appropriate additional testing and advice is sought.

7 GEOTECHNICAL SITE ASSESSMENT

7.1 Engineering considerations

It is understood that the site is being considered for redevelopment as a new private members club, roof terraces and restaurant and bar venue. It is proposed to retain Koko, the lower floors of the Hope and Anchor pub and the facade to the middle buildings on the Bayham Street frontage, and demolish the structure behind the Bayham Street facade, the Bayham Street property and the upper floors of the Hope and Anchor pub. The private members club will comprise four storeys and construction of a new basement level beneath the southwest corner of the Bayham Street property, for use as stair and elevator access to the Koko basement. Development of the Grade II listed Koko club will include a number of new roof extensions, predominantly on the northern side of the building on Bayham Place.

A new core will be constructed to provide stability to the development, envisaged to be constructed from reinforced concrete frame supported on new foundations. Localised additional storeys built above the existing properties will change the load distribution onto the existing foundations. The existing buildings will also be refurbished with some internal walls removed. It is anticipated that the new basement will extend to approximately 17.50m AOD and be constructed in part by secant piled walls and part underpinning of existing foundations of the Hope and Anchor pub. Column loads will be supported on cantilevered pile caps, using a combination of compression and tension piles to transmit the loads.

Proposed loads (DL + LL - unfactored) have been provided by HTS and these are summarised below:

- Koko - column loads of 310 to 750kN, with compression pile loads ranging from 120 to 700kN.
- New Private Members Club (Bayment Street Property/Hope & Anchor pub) - column loads of 175 to 1000kN, with compression pile loads ranging from 150 to 1010kN.
- New basement – entire core load of 7100kN supported by 12 No. piles.

7.2 Geotechnical hazards

A summary of commonly occurring geotechnical hazards is given in Table 16 together with an assessment of whether the site may be affected by each of the stated hazards.

Table 16: Summary of main potential geotechnical hazards that may affect site

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Sudden lateral changes in ground conditions			✓	Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils	✓	London Clay present beneath the site of medium to high shrinkability, however is unlikely to affect the site.		Design to NHBC Standards Chapter 4 or similar
Highly compressible and low bearing capacity soils, (including peat and soft clay)			✓	Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions			✓	Likely to affect ground engineering and foundation design and construction
Running sand at and below water table			✓	Likely to affect ground engineering and foundation design and construction
Karstic dissolution features (including 'swallow holes' in Chalk terrain)			✓	May affect ground engineering and foundation design and construction – refer to Section 4.1.2
Evaporite dissolution features and/or subsidence			✓	May affect ground engineering and foundation design and construction
Ground subject to or at risk from landslides			✓	Likely to require special stabilisation measures
Ground subject to peri-glacial valley cambering with possible gulls			✓	Likely to affect ground engineering and foundation design and construction
Ground subject to or at risk from coastal or river erosion			✓	Likely to require special protection/stabilisation measures
High groundwater table (including waterlogged ground)	✓	Perched groundwater encountered locally at shallow depths in trial pits beneath Koko.		May affect temporary and permanent works

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Rising groundwater table due to diminishing abstraction in urban area			✓	May affect deep foundations, basements and tunnels
Underground mining			✓	Likely to require special stabilisation measures
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)	✓	Existing basements and buried sewers running through the site. LUL Northern Line and Mornington Crescent Tube Station present adjacent to western boundary of site.		Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	✓	Made Ground present across the site extending to depths of between 0.18m and >2.12m.		Likely to affect ground engineering and foundation design and construction
Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates)	✓	See Section 7.5		May affect ground engineering and foundation design and construction
Note: Seismicity is not included in the above table as this is not normally a design consideration in the UK.				

7.3 Foundations

7.3.1 General suitability

The investigation has proven the presence of a variable thickness of made ground extending to depths of between 0.18m to in excess of 2.12m (17.05 to 21.80m AOD), which is in turn underlain by the London Clay. The London Clay extended to a depth of 25.40m (-2.65m AOD) in BH1, where it is underlain by the Lambeth Group which was proved to the full depth investigated of 30.00m (-7.25m AOD).

Groundwater was encountered within the trial pits following their excavation at depths of between 0.35m and 1.21m (21.59m AOD and 17.30m AOD), whilst seepages in BH1 and WS1 within the London Clay were noted at 3.20m (16.20m AOD) and 24.50m (-1.75m AOD) associated with claystone bands. The findings of the groundwater monitoring reflect the perched groundwater table in the London Clay at an elevation of approximately 18.50m AOD, with localised perched groundwater around the foundations.

Considering the relatively high column loads proposed in Koko, combined with the need to limit any differential movement with the existing structure and obvious restrictions to constructing relatively large pad footings within the existing building confines, piled foundations will provide the most suitable solution to support the new column loads.

The foundation solution for the new building will largely be determined by the need to excavate a new basement and limit differential movements between the new and existing structures. In relation to the later, the excavation for the basement and subsequent new construction will be accompanied by a sequence of ground movements, including immediate elastic and longer-term swelling heave on unloading and elastic and longer term consolidation settlement on reloading. The amounts of each component of movement will depend upon a number of factors, not least the construction timetable and ultimate loadings. The ground movements will affect the ground outside of the immediate construction envelope and could potentially affect adjoining properties. A detailed assessment of the potential ground movements is to be undertaken once the formation level, method of construction and loadings have been finalised.

It is understood that the new basement excavation will be facilitated by the use of a secant piled wall in the southwest corner of the Bayham Street property, which it is proposed will be used lightly loaded on the eastern wall by two columns to support the super structure loads from above. A small number of walls to the Hope and Anchor pub will require underpinning to the new basement level to form the basement walls. The new basement core will be supported on a number of piles below slab level and the new superstructure will be supported by cantilevered pile caps. Alternatively, consideration could be given to a basement raft foundation.

7.3.2 Basement raft foundation

For preliminary design purposes a maximum net safe bearing pressure in the order of 150kN/m^2 (factor of safety of 3) is considered suitable, although it will be necessary to check that the associated settlements are acceptable to the proposed structure and surrounding buildings.

In order to prevent any existing foundations/sub-structures forming ‘hard’ spots beneath the raft foundation and leading to potentially damaging differential movement, it is recommended that these are broken out and remaining voids backfilled with compacted granular fill.

7.3.3 Underpinning of existing foundations

The recommendations for the design and construction of the new underpins in relation to the ground conditions are set out in Table 17.

Table 17: Design and construction of underpinning to existing foundations

<table>
<tr><th>Design/construction considerations</th><th colspan="4">Design/construction recommendations</th></tr>
<tr><td>Founding stratum</td><td colspan="4">London Clay - High strength clay</td></tr>
<tr><td>Depth</td><td colspan="4">The new basement floor level is set at an elevation of approximately 17.50m AOD, such that it will be consistent with the existing lower ground floor level of Koko, and it anticipated that new underpins are constructed some 0.50m to 1.00m below this level.</td></tr>
<tr><td rowspan="7">Net allowable bearing capacity</td><td colspan="4">Net safe bearing pressure kN/m^2</td></tr>
<tr><td></td><td colspan="3">Strip Footings</td></tr>
<tr><td>Width</td><td>0.50m</td><td>0.75m</td><td>1.00m</td></tr>
<tr><td>Depth</td><td colspan="3">Settlement limited to less than 25mm</td></tr>
<tr><td rowspan="3">0.50 - 1.00m+</td><td colspan="3">145</td></tr>
<tr><td colspan="3">Settlement limited to less than 10mm</td></tr>
<tr><td colspan="3">145</td></tr>
<tr><td>Basis of allowable bearing pressures</td><td colspan="4">Each net allowable bearing pressure includes an overall factor of safety of 3 against bearing capacity failure and the settlement limited to 25mm or 10mm, respectively.</td></tr>
<tr><td>Stability of excavations</td><td colspan="4">Excavation support systems will be required to facilitate the underpinning through the non-self supporting made ground.</td></tr>
<tr><td>Dewatering</td><td colspan="4">Perched groundwater was encountered at shallow depth within the made ground and London Clay therefore it is likely that there will be a requirement for some dewatering.

The cohesive nature of the soils encountered suggests that pumping from open sumps should be sufficient to keep the excavations reasonably dry.</td></tr>
<tr><td>Construction considerations</td><td colspan="4">The underpinning works should be carefully planned to ensure that sufficient support is maintained beneath the party walls at all times.

All foundation excavations should be inspected, and any made ground and soft, organic or otherwise unsuitable materials removed and replaced with mass concrete.

The London Clay is a relatively silt-rich soil, hence susceptible to softening once exposed. Therefore, the foundation concrete should be placed soon after excavation and water prevented from ponding in the base of the excavation.</td></tr>
</table>

7.3.4 Piled foundations

Recommendations for the design and construction of pile foundations in relation to the ground conditions are set out in Table 18.

Table 18: Design and construction of piled foundations

Design/construction considerations	Design/construction recommendations	
Pile type	The construction of mini bored/'SFA' piles is considered technically feasible within the confines of the Koko and conventional bored or 'CFA' piles for the new private members club.	
Possible constraints on choice of pile type	Given the close proximity of the existing structures it is considered that the vibration/noise associated with pile driving may not be acceptable.	
Temporary casing	Owing to the presence of perched groundwater within the London Clay, as well as water seepages associated with claystone bands within the London Clay, bored piles are likely to require temporary casing throughout their depth. Alternatively, the use of CFA/SFA injected bored piles usually overcomes this issue.	
Man-made obstructions	The presence of buried sub-structures or other obstructions within made ground may lead to some difficulty during piling. Where buried obstructions are encountered, it will be necessary to either relocate the pile(s) or make allowance for removing the obstruction.	
Hard strata	An allowance should be made for chiselling thin 'rock' bands (claystone) within the London Clay or Reading Formation.	
Pile design parameters for cohesive deposits	Undrained shear strength c_u (kN/m^2)	London Clay: Cu = 70 @21.55mAOD + 6.0.z kN/m^2 where z = depth into clay to -2.65mAOD. Lambeth Group: Cu = 215 kN/m^2
	Adhesion factor α	0.5
	End bearing factor N_q	9
General parameters	Limiting concrete stress (kN/m^2)	7.5N/mm^2
	Global margin of safety (Compression Piles)	2.6 – No load tests required 2.2 – Working tests only 2.0 – Preliminary pile test(s) and working tests
	Global margin of safety (Tension Piles)	3.0
	Limiting shaft friction (kN/m^2)	110
Special precautions relating to bored pile shafts and bases	Bored pile concrete should be cast as soon after completion of boring as possible and in any event the same day as boring. Prior to casting the base of the pile bore should be clean, otherwise a reduced safe working load will be required. Similarly,	

Design/construction considerations	Design/construction recommendations
	if the pile bore is left open the shaft walls may relax/soften, leading to a reduced safe working load.

The design procedure for piles varies considerably, depending on the proposed type of pile. However, for illustrative purposes Table 19 to Table 22 give likely working pile loads for traditional bored, cast-in-situ concrete piles of various diameters and lengths, based on the design parameters given in Table 18. The pile design may be refined using an EC7 partial factored approach for final design.

Table 19: Illustration of typical pile working loads for Bored/CFA cast-in-situ compression piles – Koko

Typical pile working loads (kN)				
Depth of pile below assumed Cut Off Level of 16.90mAOD	Pile diameter			
	300mm	350mm	400mm	450mm
Factor Safety 2.6				
10.00	266	318	372	428
12.00	328	391	456	523
14.00	394	469	546	625
16.00	465	552	641	733
18.00	530*	640	743	848
20.00	-	722*	849	969
22.00	-	-	942*	1085
Factor Safety 2.2				
10.00	314	376	439	506
12.00	388	462	539	618
14.00	466	554	645	738
16.00	530*	652	758	867
18.00	-	722*	878	1003
20.00	-	-	942*	1145
22.00	-	-	-	1193
Factor Safety 2.0				
10.00	346	413	483	566
12.00	426	508	592	680
14.00	513	609	709	812
16.00	530*	717	834	953

18.00	-	722*	942*	1103
20.00	-	-	-	1193*
22.00	-	-	-	-
Notes: *Pile material limiting stress is the limiting criteria				

Table 20: Illustration of typical pile working loads for Bored/CFA cast-in-situ tension piles – Koko

Typical pile working loads (kN)				
Depth of pile below assumed Cut Off Level of 16.90mAOD	Pile diameter			
	300mm	350mm	400mm	450mm
Factor Safety 3.0				
10.00	197	230	263	296
12.00	248	290	331	373
14.00	303	354	405	455
16.00	362	423	483	543
18.00	425	496	566	637
20.00	491	573	655	737
22.00	530*	652	745	838
Notes: *Pile material limiting stress is the limiting criteria				

Table 21: Illustration of typical pile working loads for Bored/CFA cast-in-situ compression piles – New Private Members Club

Typical pile working loads (kN)				
Depth of pile below assumed Cut Off Level of 21.60mAOD	Pile diameter			
	300mm	350mm	450mm	600mm
Factor Safety 2.6				
10.00	213	254	343	489
12.00	265	316	423	599
14.00	321	382	510	718
16.00	382	454	604	846
18.00	447	530	704	982
20.00	517	612	810	1127
22.00	530*	699	923	1280
24.00	-	722*	1043	1142

Typical pile working loads (kN)				
Depth of pile below assumed Cut Off Level of 21.60mAOD	Pile diameter			
	300mm	350mm	450mm	600mm
Factor Safety 2.2				
10.00	252	301	405	578
12.00	313	373	500	708
14.00	379	452	603	849
16.00	452	536	714	999
18.00	529	627	832	1160
20.00	530*	722*	957	1331
22.00	-	-	1091	1513
24.00	-	-	1193	1704
Factor Safety 2.0				
10.00	277	331	446	636
12.00	344	411	550	779
14.00	418	497	663	934
16.00	497	590	785	1099
18.00	530*	690	905	1276
20.00	-	722*	1053	1465
22.00	-	-	1192*	1664
24.00	-	-	-	1875
Notes: *Pile material limiting stress is the limiting criteria				

Table 22: Illustration of typical pile working loads for Bored/CFA cast-in-situ tension piles – New Private Members Club

Typical pile working loads (kN)				
Depth of pile below assumed Cut Off Level of 21.60mAOD	Pile diameter			
	300mm	350mm	400mm	450mm
Factor Safety 3.0				
10.00	157	183	235	314
12.00	200	233	299	399
14.00	246	287	369	492
16.00	296	346	444	592

18.00	350	408	525	700
20.00	408	476	612	816
22.00	469	547	704	938
24.00	530*	623	802	1069
Notes: *Pile material limiting stress is the limiting criteria				

It should be stressed that the above capacities do not take into consideration pile group effects which is more pronounced for a large number of closely spaced piles.

Notwithstanding the above, we would recommend that a specialist piling contractor should be contacted at an early stage for their advice on the most suitable pile type and capacity for the soils encountered at this site, particularly for the restricted access works within koko.

7.3.5 Foundation works risk assessment

It is anticipated that a foundation works risk assessment report will not be required for the development because concentrations of chemicals of potential concern (COPC) within made ground were typically below corresponding GAC. In addition, a considerable thickness of cohesive London Clay beneath the site is likely to significantly retard migration pathways.

7.3.6 Basement floor slabs

The formation level of the new basement is anticipated to lie wholly within the high strength clays of the London Clay Formation.

Consideration will need to be given to designing the basement slab to withstand both heave of the underlying clay soils resulting from unloading due to excavation and groundwater pressures. A detailed assessment of the potential magnitude of clay heave associated with the formation of new basement will be the subject of a separate report.

The heave pressures exerted by the underlying clay will depend on many issues not least the time delay from excavation to slab construction, but for preliminary purposes heave pressures in the range of 15 to 25kN/m^2 may be assumed for the 2.85m and 5.00m excavation depths below the pub and Bayham Street properties, respectively, to form the new basement. The 350mm thickness removal beneath the remainder of the Hope and Anchor pub is likely to give rise to a nominal heave pressure of 2 kN/m^2 or less. These pressures may, however, be avoided by providing a suitable thickness of compressible void former beneath the basement slab.

The results of monitoring programme have recorded a highest perched groundwater level of 3.90m or 18.85m AOD, i.e. close to the underside of the proposed basement slabs. Therefore, the design should consider the associated hydrostatic uplift pressures acting on the underside of the slabs and any potential future rise in groundwater levels or an abnormal event, such as a burst water main etc.

7.4 Retaining Wall Design Parameters

In order to facilitate the new basement construction it is proposed to construct a secant piled wall.

On the basis of the ground investigation information the following soil parameters in Table 23 may be adopted for retaining wall design purposes.

Table 23: Retaining wall design parameters

Soil type	Unit weight (kN/m^3)	Short Term Characteristics		Long Term Characteristics	
		C_U (kN/m^2)	ϕ (°)	c' (kN/m^3)	ϕ' (°)
Made Ground	18.0	-	-	-	28[1]
Weathered London Clay to ~15.00mAOD	20.0	70 +6.00.z	-	0	25[1]
London Clay	20.0	110 +6.00.z	-	5[1]	25[1]
Notes: (1) Based on published values and previous experience in the absence of drained testing					

Groundwater has been identified above the proposed basement levels and therefore it will be necessary to allow for hydrostatic pressures acting behind retaining structures.

The basement structure will need to incorporate suitable waterproofing measures and reference should be made to BS 8102:2009 'Code of practice for protection of below ground structures against water from the ground' for further guidance.

In order to prevent damage to adjacent structures, the design of the retaining wall and basement excavation must address the risk of excessive deformation of the wall and bracing, both in the temporary and permanent condition, to ensure that the horizontal and vertical soil movement around and below the excavation remain within acceptable levels. A detailed assessment of the potential ground movements associated with the project is the subject of a separate report.

7.5 Chemical attack on buried concrete

The results of chemical tests carried out on soil samples of the made ground indicate 2:1 water soil extract sulfate contents of up to 2640 mg/l with generally near neutral or alkaline pH values. Chemical analysis of a sample of the perched groundwater returned a soluble sulphate concentration of 2472mg/l with a pH of 6.54.

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance. The desk study and site walkover indicate that, for the purposes of this assessment of the aggressive chemical environment, the site should be considered as a brownfield development. A suite of chemical analyses appropriate to this site classification was carried out on soil samples.

These results indicate that, in accordance with BRE Special Digest 1: 2005 *Concrete in aggressive ground*, the Aggressive Chemical Environment for Concrete (ACEC) Classification is ***AC-3*** with a Design Sulfate Class for the site of ***DS-3***. This assumes nominally mobile groundwater conditions and that no significantly disturbed clay comes into contact with concrete foundations or structures.

If significantly disturbed clay is likely to come into contact with concrete foundations or structures it will be necessary to carry out additional tests on the soil to investigate its total potential sulfate content. This will facilitate a re-evaluation of the ACEC Classification and Design Sulfate Class for the material, to take into consideration potential oxidation of available sulphides (e.g. pyrite), as defined in Table C1 (natural ground sites) or C2 (brownfield sites) BRE Special Digest 1: 2005.

7.6 Soakways

It is considered that soakaways will not be appropriate for discharging surface run-off water at the site due to the characteristically poor infiltration characteristics of the London Clay and the issues with existing perched groundwater identified on site.

8 REUSE OF MATERIALS AND WASTE

8.1 Reuse of suitable materials

Under the Waste Framework Directive naturally occurring soils are not considered waste if re-used on the site of origin for the purposes of development.

In accordance with the definition provided in the Waste Framework Directive, materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Thus, soils that are not of clean and natural origin, i.e. made ground (whether contaminated or not) and other materials such as recycled aggregate, do not become waste until the aforementioned criteria are met.

The Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011) (CoP) was developed in consultation with the Environment Agency and development industry to enable the re-use of materials under certain scenarios and subject to demonstrating that specific criteria are met. The current re-use scenarios covered by the CoP comprise:

- Re-use on the site of origin (with or without treatment)
- Direct transfer of clean and natural soils between sites
- Use in the development of land other than the site of origin following treatment at an authorised Hub site (including a fixed Soil Treatment Facility).

The importation of made ground soils (irrespective of contamination status) or crushed demolition materials is not currently permitted under the CoP and requires either a standard rules environmental permit or a U1 waste exemption (see below).

In the context of excavated materials used on sites undergoing development, four factors are considered to be of particular relevance in determining if the material is a waste or when it ceases to be waste:

- the aim of the Waste Framework Directive is not undermined, i.e. if the use of the material will create an unacceptable risk of pollution of the environment or harm to human health it is likely to be waste
- the material is certain to be used
- the material is suitable for use both chemically and geotechnically
- only the required quantity of material will be used.

The CoP requires the preparation of a materials management plan (MMP) that confirms the above factors will be met. This plan needs to be reviewed by a 'Qualified Person' (QP) who will then issue a declaration form to the EA. As the project progresses, data must be collated and on completion a verification report produced that shows the MMP was followed and describes any changes.

The MMP establishes whether specific materials are classified as waste and how excavated materials will be treated and/or re-used in line with the CoP. The MMP is likely to form part of the site waste management plan.

The site has been developed previously and the investigation has confirmed the presence of made ground. Therefore, before any excavation works begin on-site, an MMP will need to be prepared, reviewed by a QP; and a Declaration lodged with the EA.

As noted above, under the Waste Framework Directive naturally occurring soils are not considered waste and therefore arisings of clean natural soils, e.g. from foundation and drainage excavations, may be re-used on the site. However, it is important that these soils should be stockpiled separately and not become cross-contaminated with made ground / contaminated soils or construction wastes.

If it is proposed to import clean and naturally occurring soils direct from another site, the receiving site's MMP would need to be updated in advance of importation.

8.2 Treatment to meet suitable-for-use criteria

Where materials do not meet the suitable for use criteria it may be possible to treat them under an environmental permit (mobile treatment licence) to enable them to be reused onsite.

To enable the treatment options to be determined, an options appraisal and a remediation strategy document will be necessary to support discussion of the issues with regulators and third parties.

8.3 Reuse of waste materials

If material is discarded as waste then its reuse on site may still be possible. Waste soils and recycled aggregate can be reused on site under a standard rules environmental permit or a U1 waste exemption from the Environmental Permitting (England and Wales) Regulations 2010 provided that they are suitable for the proposed use, i.e. not cause harm to human health or the environment. However, it should be noted that these have strict limits on the quantity of material that can be reused.

8.4 Wastes for landfill disposal

Wastes require pre-treatment prior to disposal at landfill. Pre-treatment must be a physical, thermal, chemical or biological process (including sorting) that changes the characteristics of the waste to reduce its volume, reduce its hazardous nature, facilitate its handling and enhance its recovery.

The latest, edition of the EA's 'Technical Guidance WM3' (2015) Guidance on the classification and assessment of waste, requires that within a mixed waste* the separately identifiable wastes are assessed separately. Mixing of different types of hazardous waste and hazardous waste with other waste substances is prohibited under the Waste Framework Directive. Wastes that have been mixed must be separated whenever possible.

It is best practice to provide your waste carrier (or the disposal site) with details of how the waste has been treated. Your waste carrier may provide a pre-treatment confirmation form or space on the waste transfer note to detail the pre-treatment.

The classification of waste soil is a two-stage process, the first being an assessment of whether the soil is considered hazardous or not following the guidance within Technical Guidance WM3. For off-site disposal to landfill the results of Waste Acceptance Criteria (WAC) testing must then be reviewed to establish if the soil is acceptable at the relevant class of landfill or requires pre-treatment to reduce specific hazardous properties.

8.4.1 Waste acceptance criteria

All inert, stable non-reactive hazardous and hazardous wastes have limit values (waste acceptance criteria) set out in legislation that must be met before that class of landfill can accept the waste. Currently, no WAC are in place for non-hazardous waste.

Soil and other materials that are found not to be hazardous may be classified as either non hazardous or inert. In order to determine whether they can be classed as inert the soil must be tested and found to be below the inert waste acceptance criteria.

8.4.2 Waste sampling plan

Technical Guidance WM3 sets out in Appendix D requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. At this stage RSK consider that the level of soil sampling is insufficient to robustly categorise the material.

RSK recommends that a Sampling Plan be prepared to support any waste classifications and hazardous waste assessments, prior to development.

8.4.3 Preliminary waste assessment

Given the level of data obtained, scale of the development and heterogeneity of the site soils the following assessment should be considered indicative and further assessment should be undertaken following the preparation of a Waste Sampling Plan.

Envirolab (an RSK company) has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool for potential off-site disposal of materials in the future. The results are presented in Table 24.

Table 24: Results of waste soils characterisation assessment (HASWASTE)

Sample ref/location	Waste classification
BH1 (ES1 @ 1.10m)	Not hazardous
TP1 (ES1 @ 0.70m)	Not hazardous
TP2 (ES1 @ 0.50m)	Not hazardous
TP4 (ES1 @ 0.60m)	Not hazardous
TP5 (ES2 @ 0.50m)	Not hazardous
TP6 (ES1 @ 0.80m)	Not hazardous
TP7 (ES1 @ 0.35m)	Not hazardous
TP9 (ES1 @ 0.40m)	Not hazardous
TP13a (ES1 @ 0.30m)	Not hazardous
TP14 (ES1 @ 0.20m)	Not hazardous

None of the samples were classified as hazardous waste. Therefore to determine whether waste might be classified as inert or non hazardous, WAC testing has been undertaken on samples of made ground recovered from TP1 and TP5, the results of which are presented in Appendix K.

The results obtained for TP1 are below the leaching limit values for inert waste and therefore the waste is considered suitable for disposal at an inert landfill or a site that has a valid exemption from the Environmental Permitting (England and Wales) Regulations 2010 registered with the EA.

The results obtained for TP5 pass the leaching limit values for inert waste, but the sample exceeds the solid waste threshold for total organic carbon (TOC). A higher TOC limit value may be permitted by the Environment Agency at an inert waste landfill, provided the DOC value of 500mg/kg is achieved at L/S 10 l/kg, which it is in this instance. This should be checked with the receiving landfill to confirm whether it would be accepted as inert waste and they may request additional testing to confirm the TOC concentrations within the waste soils.

8.4.4 Asbestos within waste soils

The latest, edition of Technical Guidance WM3, requires that within a mixed waste the separately identifiable wastes be assessed separately.

For instance where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately. Visible asbestos containing material should, where feasible, be separated from soils and classified as stable, non-reactive hazardous waste, which can then be disposed of within a stable non-reactive hazardous waste landfill or a special cell in a non-hazardous waste landfill.

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of made ground.

8.5 Landfill tax

Waste producers disposing of material to landfill are required to pay landfill tax by HM Revenue and Customs.

The tax is chargeable by weight (tonnage) and two rates apply, either standard or lower rate. The lower rate only applies to those less polluting wastes as set out in the Landfill Tax (Qualifying Material) Order 2011, which include naturally occurring rock and soil, concrete, some minerals, some furnace slags and ash, and some low-activity organic compounds. Evidence confirming that the waste qualifies for the lower rate will be required, and standard rate tax will apply for the whole waste load for any loads of mixed waste.

Currently (since April 2016), standard rate landfill tax is £84.40 per tonne and rising to £86.10 after the 1st April 2017.

The lower rate of landfill tax applicable to less polluting wastes (i.e. 'inert' wastes) is £2.65 per tonne, rising to £2.70 after 1st April 2017. Material disposed of at a soil treatment centre will not be subject to landfill tax.

Material disposed of at a soil treatment centre will not be subject to landfill tax.

8.6 Groundwater

When there is an intention to discard groundwater, chemical test results in Appendix L will indicate the appropriate disposal options. This could include disposal to treatment facility, via consent (issued by the water authority) to foul sewer or via consent (issued by the EA) to a watercourse or land.

8.7 Recommendations

RSK recommends that consideration as to how potentially waste soils will be dealt with as part of this development is given as early in the project planning process as possible. Such planning can lead to cost savings where potentially waste soils are viewed as a resource and retained on-site as part of the development. We also recommend, where off-site disposal is being considered, that appropriate facilities are identified and discussions initiated to confirm suitability of the facility to take the material. Potentially, these may include soil treatment facilities as well as landfills.

RSK can provide specialist advice to assist in this process, which can be complex and subject to regular regulatory change.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Environmental

The assessment of the potential pollutant linkages identified within the refined conceptual site model indicates that no specific remediation or pollution control measures are envisaged as being necessary as part the proposed redevelopment.

The conceptual model and results ground gas monitoring conducted on site indicate that the site falls into a Characteristic Situation 1, for which no gas protection measures are required. Notwithstanding this, should any excavations be proposed in the area of WS1 it is recommended that air quality within the excavation is checked prior to entering and regularly throughout the works.

It is possible that ground works could encounter different conditions from those revealed by the site investigation. It is therefore recommended that the ground works be monitored for previously undetected suspect materials and if found appropriate additional testing and advice is sought.

9.2 Reuse of materials and waste

None of the samples tested were classified as hazardous waste. Therefore to determine whether waste might be classified as inert or non hazardous, samples of made ground taken from TP1 (0.70m) and TP5 (0.50m) were submitted for WAC testing.

The results obtained for TP1 are below the leaching limit values for inert waste and therefore the waste is considered suitable for disposal at an inert landfill or a site that has a valid exemption from the Environmental Permitting (England and Wales) Regulations 2010 registered with the EA.

The results obtained for TP5 pass the leaching limit values for inert waste, but the sample exceeds the solid waste threshold for total organic carbon (TOC). A higher TOC limit value may be permitted by the Environment Agency at an inert waste landfill, provided the DOC value of 500mg/kg is achieved at L/S 10 l/kg, which it is in this instance. This should be checked with the receiving landfill to confirm whether it would be accepted as inert waste and they may request additional testing to confirm the TOC concentrations within the waste soils.

When there is an intention to discard groundwater, chemical test results in Appendix L will indicate the appropriate disposal options. Consent also should be obtained from the water authority to discharge to the foul sewer.

9.3 Geotechnical

Beneath the existing concrete ground and basement slabs, the exploratory holes revealed that the site is underlain by a variable thickness of made ground over the London Clay, with Lambeth Group at depth. The London Clay extends to a depth of 25.40m (-2.65m AOD) and is underlain by the Lambeth Group which was proved to the full depth investigated, of 30.00m (-7.25m AOD).

Groundwater was encountered within the trial pits following their excavation at depths of between 0.35m and 1.21m (21.59m AOD and 17.30m AOD), whilst seepages in BH1 and WS1 within the London Clay were noted at 3.20m (16.20m AOD) and 24.50m (-1.75m AOD) associated with claystone bands. The findings of the groundwater monitoring reflect the perched groundwater table in the London Clay at an elevation of approximately 18.50m AOD, with localised perched groundwater around the foundations.

Considering the relatively high column loads proposed in Koko, combined with the need to limit any differential movement with the existing structure and obvious restrictions to constructing relatively large pad footings within the existing building confines, piled foundations will provide the most suitable solution to support the new column loads.

In view of the potential ground movements associated with the basement excavation, piles are considered the most suitable foundation solution for the new private members club building. Alternatively, consideration could be given to a basement raft foundation.

Consideration will need to be given to designing the new basement slabs to withstand both heave of the underlying clay soils resulting from unloading due to excavation and groundwater pressures.

In order to prevent damage to adjacent structures, the design of the new retaining walls and basement excavation must address the risk of excessive deformation of the wall and bracing, both in the temporary and permanent conditions, to ensure that the horizontal and vertical soil movement around and below the excavation remain within acceptable levels.

The Aggressive Chemical Environment for Concrete (ACEC) Classification is AC-3 with a Design Sulphate Class for the site of DS-3.

The ground conditions encountered on site are not suitable for the adoption of soakaways.

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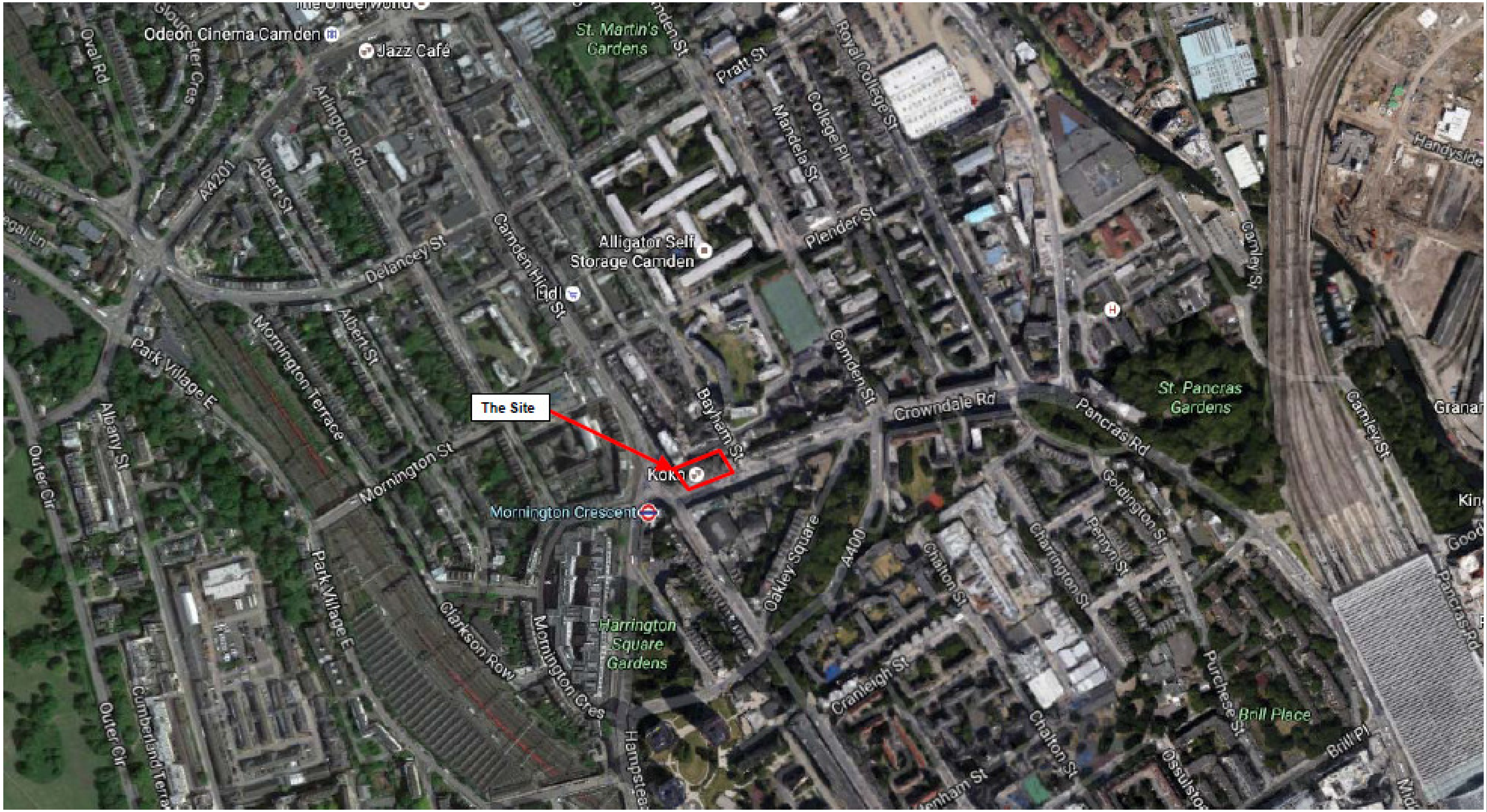
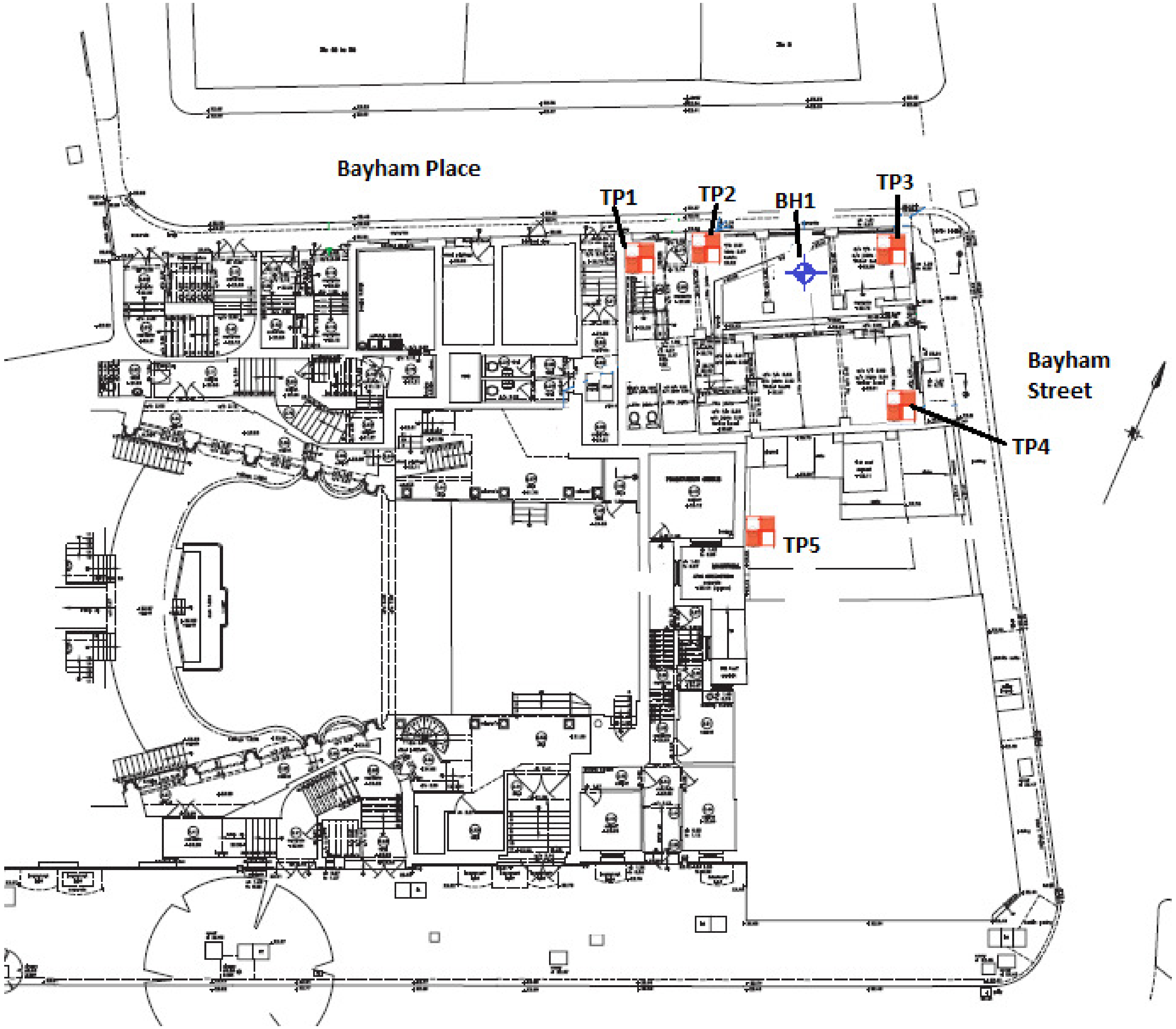
FIGURES

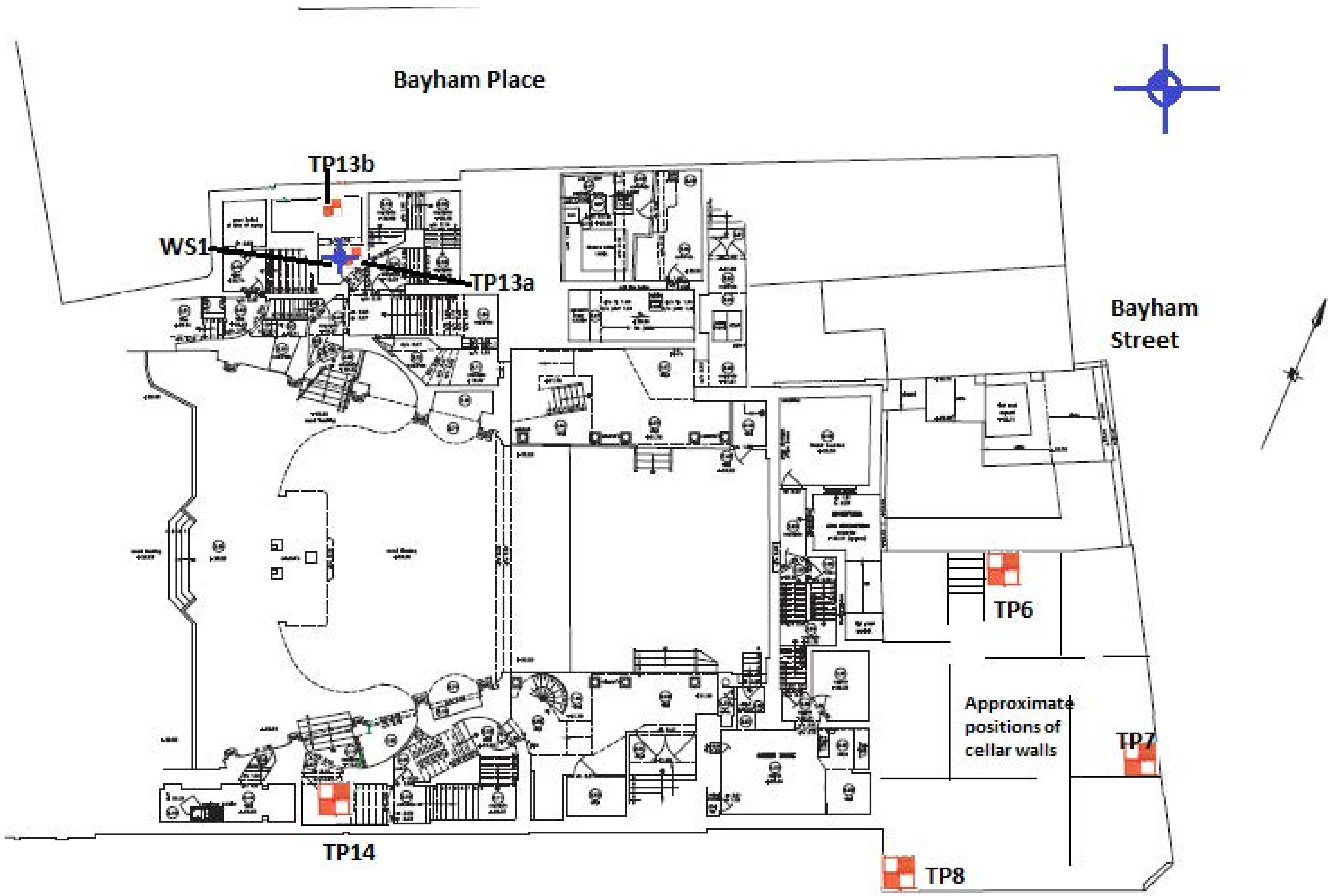


RSK	SITE LOCATION PLAN	**Client:**	The Hope Lease Limited	**Figure No:**	1
		Site:	The Hope Project, Camden, London	**Job No:**	371475
		Scale:	NTS	**Source:**	Google



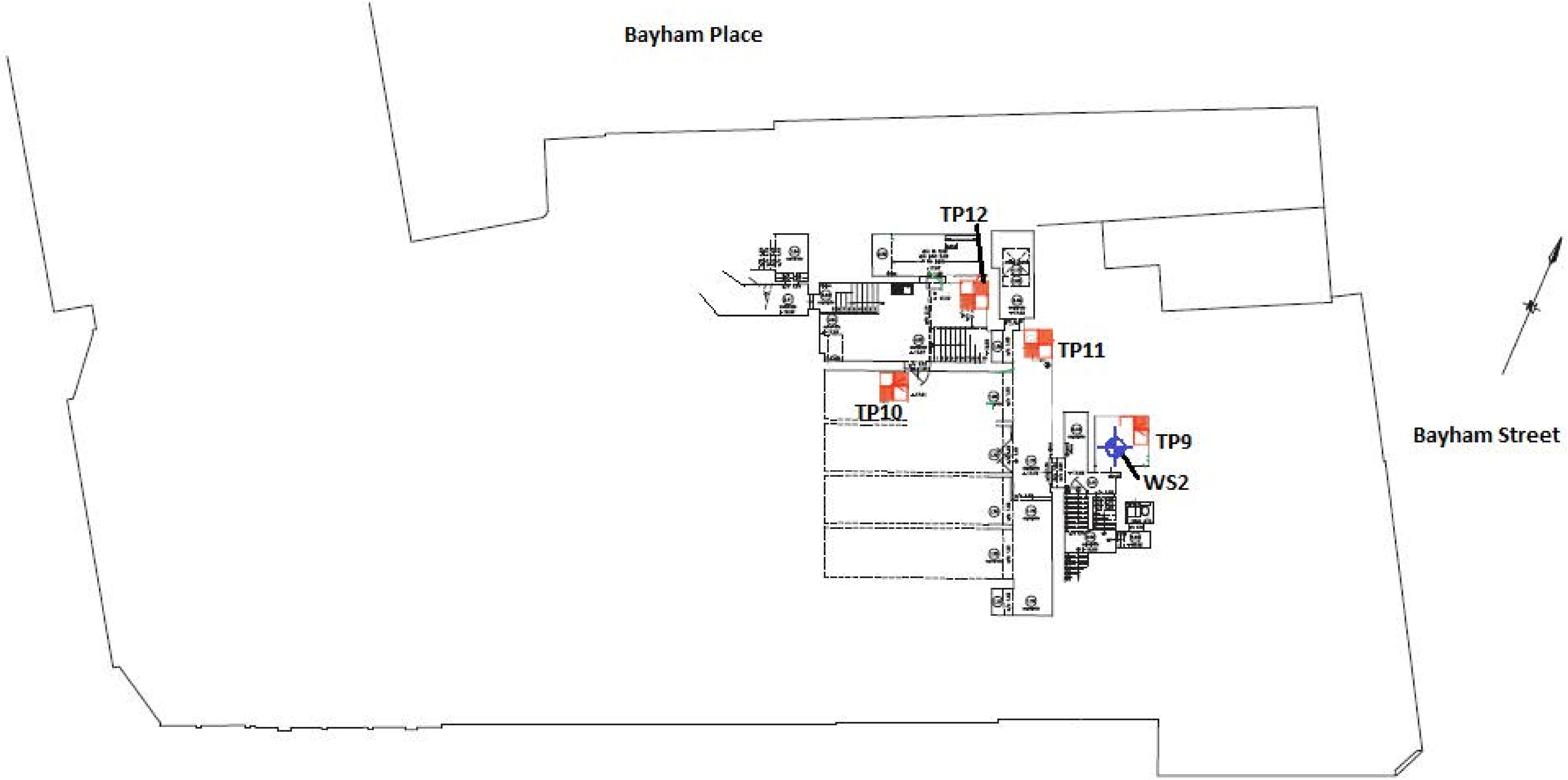
Ground floor level

RSK	EXPLORATORY HOLE LOCATION PLAN	**Client:** The Hope Lease Limited	**Figure No:**	2a
		Site: The Hope Project, Camden, London	**Job No:**	371475
		Scale: NTS	**Source:**	Heyne Tillett Steel, The Hope Project, Geotechnical Investigations, Sk04 A



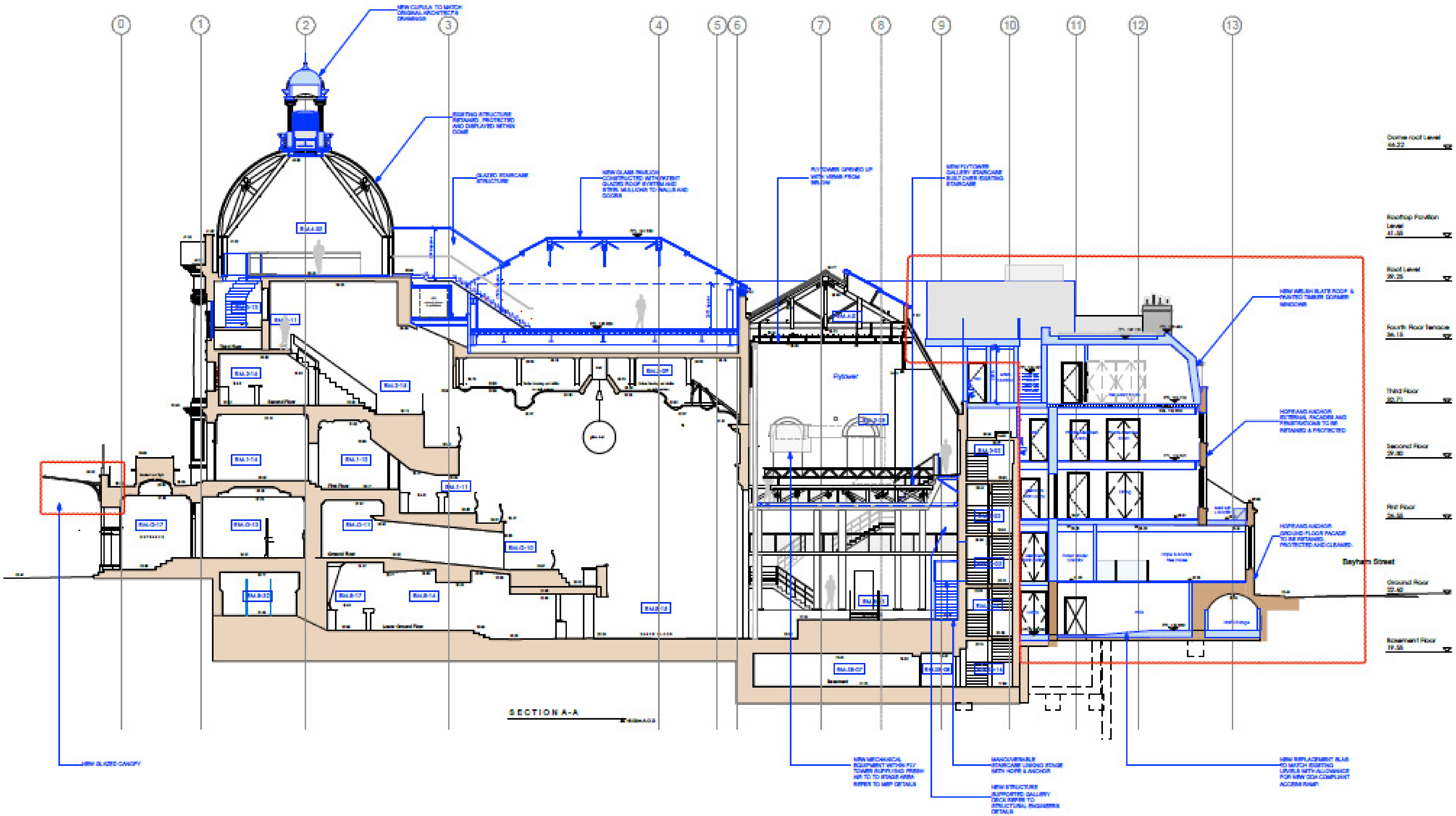
Lower ground floor level

RSK	EXPLORATORY HOLE LOCATION PLAN	**Client:** The Hope Lease Limited	**Figure No:** 2b
		Site: The Hope Project, Camden, London	**Job No:** 371475
		Scale: NTS	**Source:** Heyne Tillett Steel, The Hope Project, Geotechnical Investigations, Sk04 A



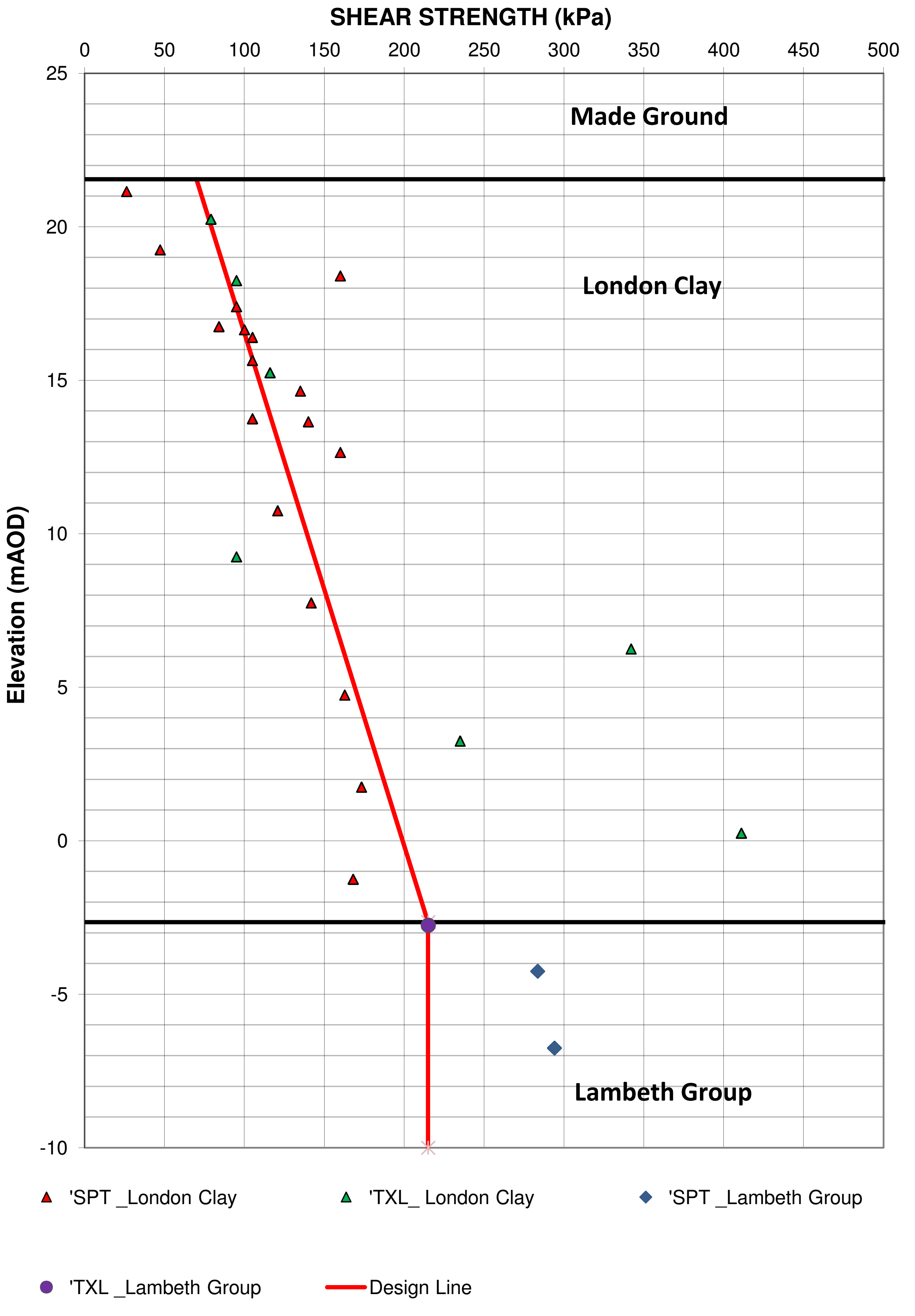
Koko Club Basement Level

EXPLORATORY HOLE LOCATION PLAN	**Client:** The Hope Lease Limited	**Figure No:**	2c
	Site: The Hope Project, Camden, London	**Job No:**	371475
	Scale: NTS	**Source:**	Heyne Tillett Steel, The Hope Project, Geotechnical Investigations, Sk04 A

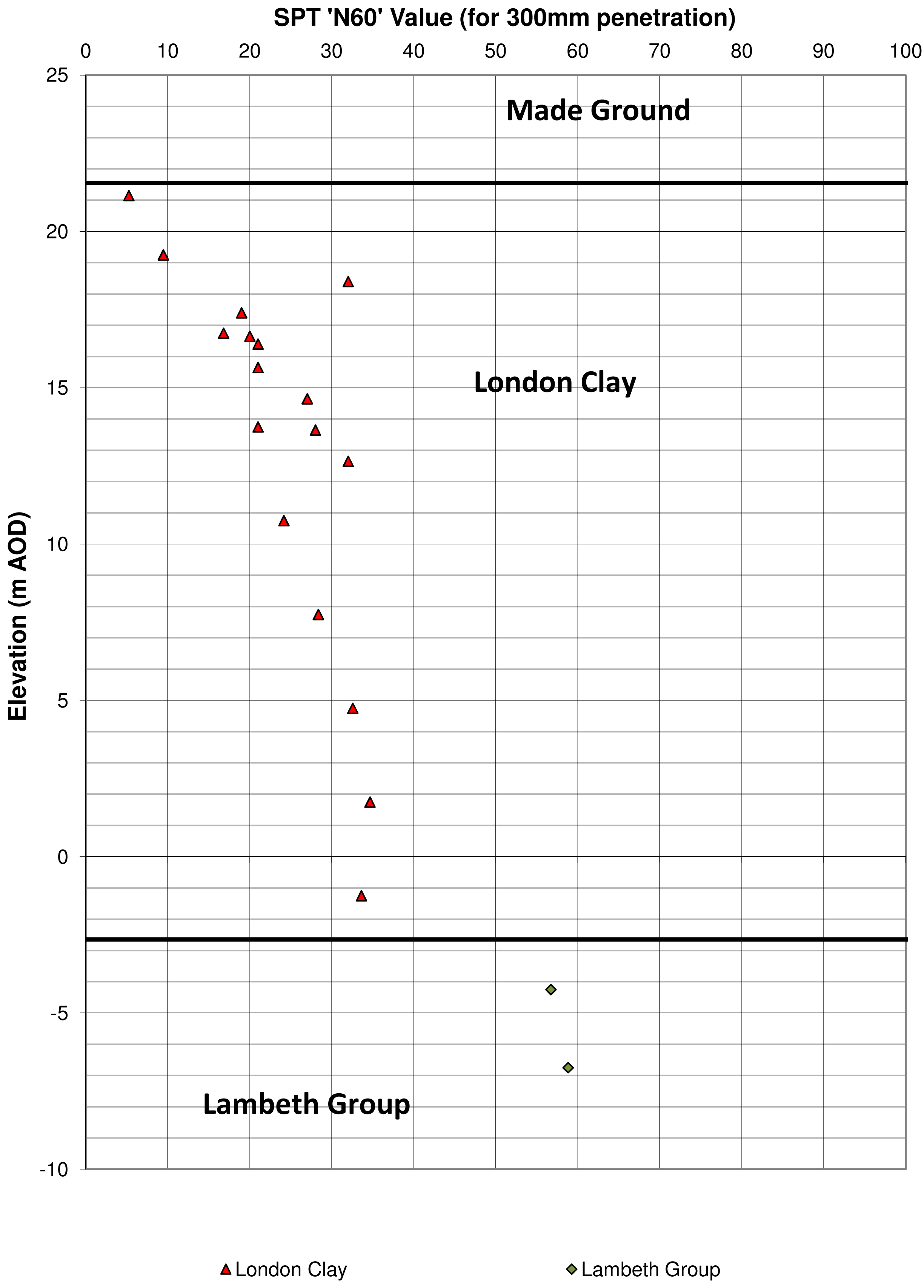


RSK	**PROPOSED DEVELOPMENT PLAN**	**Client:** The Hope Lease Limited	**Figure No:** 3
		Site: The Hope Project, Camden, London	**Job No:** 371475
		Scale: NTS	**Source:** Architect Drawing No. AHA/KKC/PR/300 (18.5.17)

RSK	SHEAR STRENGTH vs ELEVATION		
Site: The Hope Project	**Client:** The Hope Lease Ltd	**Job Number:**	371475
		Figure:	4



RSK	SPT 'N' VALUES vs ELEVATION		
Site: The Hope Project	**Client:** The Hope Lease Ltd	**Job Number:**	371475
		Figure:	5



APPENDIX A
SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for The Hope Lease Ltd (the "client") in accordance with the terms of a contract between RSK and the "client".. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B
SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA of the EPA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2010 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Planning Policy

Contaminated land is often dealt with through planning because of land redevelopment. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF).

The new framework has only limited guidance on contaminated land, as follows:

- *"planning policies and decisions should also ensure that:*

- *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*
- *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- *adequate site investigation information, prepared by a competent person, is presented".*

APPENDIX C
SITE PHOTOGRAPHS

PHOTOGRAPHIC LOG

Photo no.	Date:
1	1.7.16

Direction photo taken:

East

Description:

Koko frontage on Camden High Street

Photo No.	Date:
2	11.7.16

Direction photo taken:

Southwest

Description:

The Hope and Anchor Pub and Bayham Street properties

Photo No.	Date:
3	22.4.16

Direction Photo Taken:

East

Description:

Bayham Street property

Photo No.	Date:
4	22.4.16

Direction Photo Taken:

South

Description:

The Hope and Anchor Pub

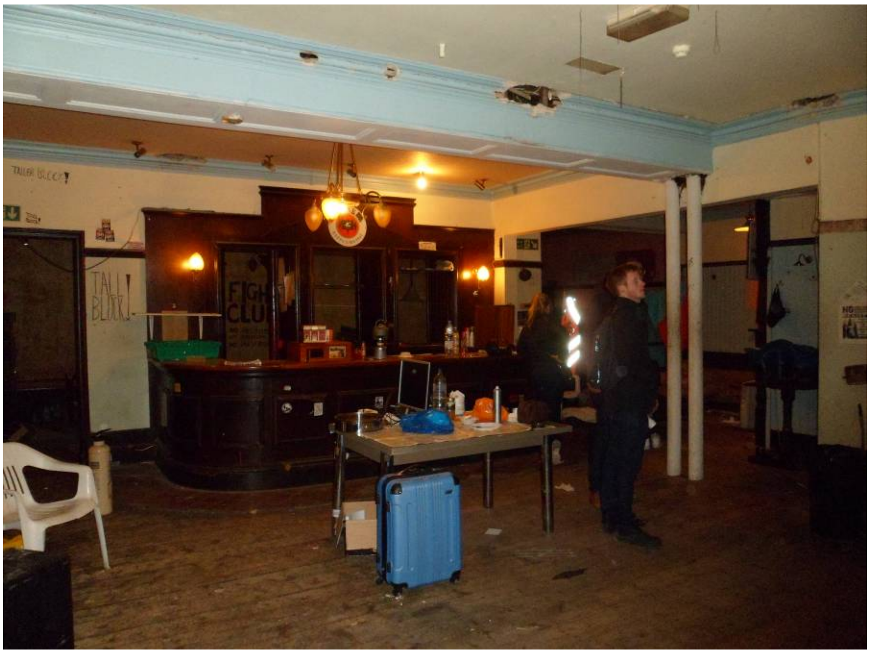


Photo No. 5	Date: 22.4.16	
Direction Photo Taken: South		
Description: The Hope and Anchor Pub		

Photo No. 6	Date: 22.4.16	
Direction Photo Taken: South		
Description: The Hope and Anchor Pub cellar		

Photo No. 7	Date: 22.4.16	
Direction Photo Taken: Southeast		
Description: The Hope and Anchor Pub cellar		

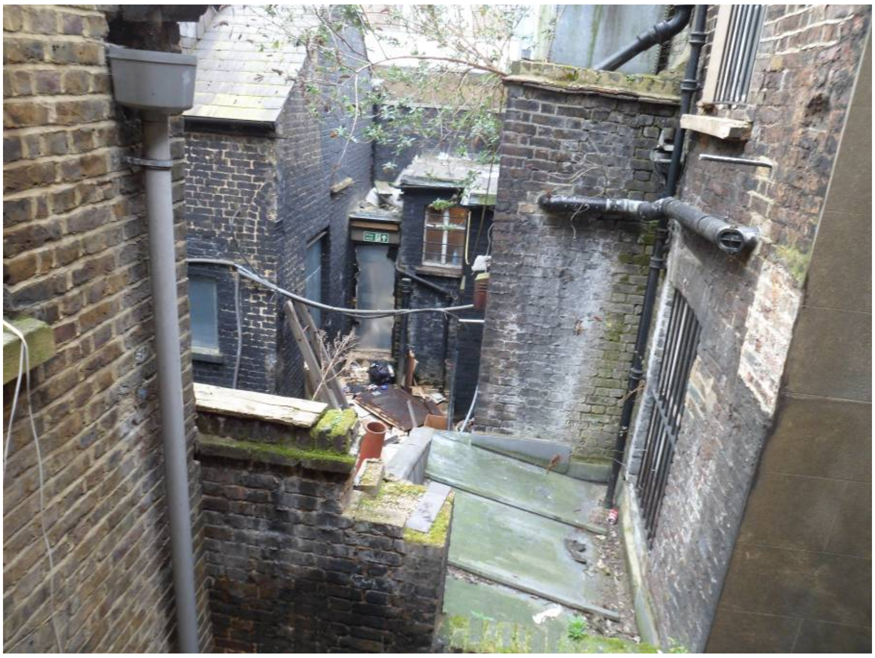
Photo No. 8	Date: 22.4.16	
Direction Photo Taken: East		
Description: The Hope and Anchor Pub courtyard, taken from inside Koko		

Photo No. 9	Date: 22.4.16	
Direction Photo Taken:		
Description: Sump chamber in Koko basement		

Photo No. 10	Date: 22.4.16	
Direction Photo Taken:		
Description: Old boiler in Koko boiler room at lower ground floor level		

Photo No. 11	Date: 11.7.16	
Direction Photo Taken:		
Description: ACM flash guard in Koko basement		

Photo No. 12	Date: 11.7.16	
Direction Photo Taken:		
Description: Storage in Koko basement		

Photo No. 13	Date: 11.7.16	
Direction Photo Taken:		
Description: Koko COSHH cupboard in basement		

Photo No. 14	Date: 11.7.16	
Direction Photo Taken:		
Description: Koko basement		

APPENDIX D
RISK ASSESSMENT METHODOLOGY

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: preliminary, generic quantitative and detailed quantitative. An outline conceptual model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (contaminant–pathway–receptor) and is used as the basis for the design of the site investigation. The outline conceptual model is updated as further information becomes available, for example as a result of the site investigation.

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- highly likely: the event appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution
- likely: it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term
- low likelihood: circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term
- unlikely: circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- severe: short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000)
- medium: chronic damage to human health ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem
- mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment
- minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the probability of an event occurring and its consequences have been classified, a risk category can be assigned according to the table below.

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

Definitions of these risk categories are as follows together with an assessment of the further work that may be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability; urgent investigation and remediation are likely to be required.
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required. Remedial works may be necessary in the short term and are likely over the long term.
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild.
- Very low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

APPENDIX E
BGS RECORDS