GROUND INVESTIGATION REPORT

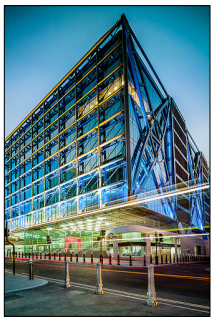
233-236 Nestles Avenue
Hayes & Harlington
London
UB3 4SH

Client: Buccleuch Property

J19090

June 2019



GEA

Document Control

Project title	233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	**Project ref**	J19090
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Issue No	Status	Amendment Details	Date	Approved for Issue
1	Final		13 June 2019	

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This report is intended as a Ground Investigation Report (GIR) as defined in BS EN1997-2, unless specifically noted otherwise. The report is not a Geotechnical Design Report (GDR) as defined in EN1997-2 and recommendations made within this report are for guidance only.

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EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Gardiner and Theobald on behalf of Buccleuch Property. The proposed development comprises demolition of the existing buildings and subsequent construction of four new apartment buildings varying in height from four storeys to eleven storeys. The purpose of the investigation has been to determine the ground conditions, to provide an indication of the presence of contamination and to provide information to assist with the design of suitable foundations.

SITE HISTORY

The earliest map studied, dated 1864, shows the site to have formed part of a large field at that time. A footpath crossed the southeastern corner of the site by 1914, at which time the area to the north of the site had been significantly developed. The Preliminary UXO Risk Assessment indicates that the site lay within the bounds of a National Filling Factory (NFF), which were created during WW1 in order to supply munitions for the military. By 1934, the site formed part of a sports ground. The 1938 map shows a building to have been constructed on the western portion of the site in a similar position to the existing museum. Post-War aerial photography, dated 1946, shows this building to have been cleared. By 1965, the existing site layout had been established, with the building housing the museum constructed in the west and the building in the east of the site labelled as an employment exchange. The on-site building to the south of the employment exchange was labelled as government offices by 1972. The site has essentially remained largely unchanged since that time.

GROUND CONDITIONS

Below a nominal to moderate thickness of made ground, Lynch Hill Gravel is present over London Clay, which was proved to the maximum depth of investigation of 30.00 m. Beneath the concrete surfacing the made ground generally comprised brown clayey sand with variable amounts of gravel, brick, concrete, ash, tile and pipe fragments, and extended to depths of between 0.3 m and 1.70 m. The Lynch Hill Gravel generally comprised dense and very dense yellowish brown and brown sandy gravel and gravelly sand to depths of between 4.75 m and 5.80 m. The density of the gravel generally decreased below a depth of 4.00 m and this decrease is most likely to be attributable to the presence of groundwater. The London Clay comprised an initial weathered layer of firm brown mottled orange-brown slightly sandy slightly silty clay, which extended to depths of between 5.20 m and 6.20 m. This was underlain by stiff becoming very stiff high becoming very high and locally extremely high strength fissured brownish grey silty clay, which extended to the full depth of investigation of 30.00 m. Claystones were encountered at depths of 15.40 m in Borehole No 3 and 14.00 m in Borehole No 4. Groundwater was encountered in Borehole Nos 1, 2 and 3, in the northern section of the site, at a depth of 4.50 m from within the Lynch Hill Gravel, which was noted as rising to a depth of 4.00 m. Groundwater was not encountered elsewhere. The chemical analyses have indicated four samples of the made ground to contain elevated concentrations of lead, while a single sample was found to contain an elevated concentration of TPH. Furthermore a single sample was found to contain an elevated concentration of sulphide. Asbestos was not detected in any of the 13 samples of made ground screened, but a single fragment of suspected asbestos containing cement board was tested and was found to contain chrysotile asbestos.

RECOMMENDATIONS

For the lower rise buildings the use of spread foundations bearing within the Lynch Hill Gravel may be appropriate and moderate width strip or pad foundations bearing on the dense gravel of the Lynch Hill Gravel may be designed to apply a net allowable bearing pressure of 300 kN/m^2. However, for the taller buildings it is likely that the loads will necessitate the use of piled foundations. In view of the ground conditions encountered beneath the site the most suitable method for the installation of piles is likely to be through continuous flight auger (CFA) methods.

A thickness of imported soil will be required in areas of proposed soft landscaping to protect end users and to ensure successful plant growth. Where the fragment of asbestos was encountered it would be prudent to inspect the soils once hardstanding has been removed to determine whether the fragment was an isolated occurrence. The soil in the area of the elevated TPH concentration should be removed from site and replaced with a suitable clean fill material.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

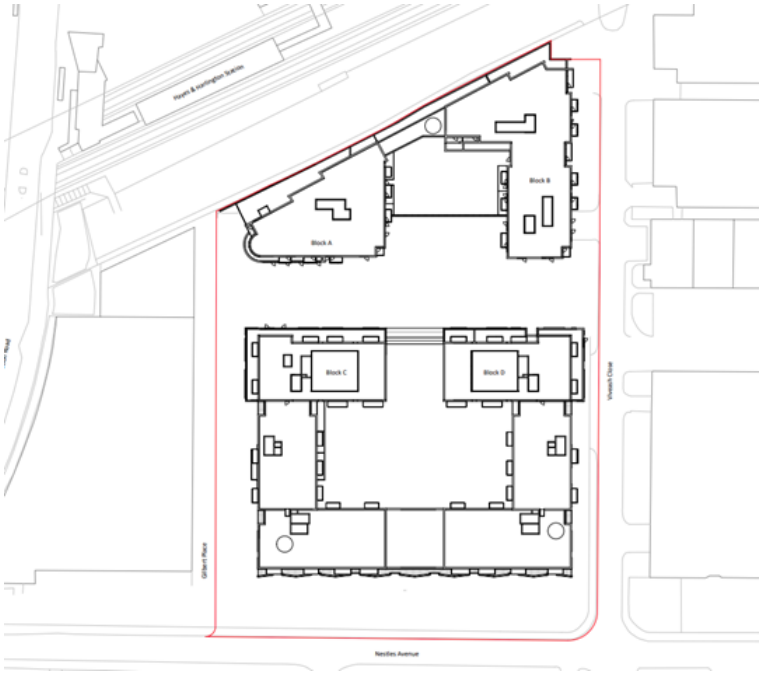
1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Gardiner & Theobald on the behalf of Buccleuch Property, to carry out a ground investigation at Nos 233–236 Nestles Avenue, Hayes & Harlington, London UB3 4SH.

The site has previously been the subject of a desk study report prepared by GEA (report reference J18167, dated 12th February 2018) and a summary of the findings of the report has been included for completeness.

1.1 Proposed Development

It is understood that it is proposed to demolish the existing buildings and subsequently construct four new apartment blocks, rising to between four storeys and eleven storeys, with commercial units at ground floor level. There are no basements included within the proposals. The buildings will be surrounded by areas of soft landscaping that will comprise managed communal space.



Proposed site plan

This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to assess the risk of encountering unexploded ordnance (UXO) beneath the site;
- the determine the ground conditions and their engineering properties;
- to provide advice with respect to the design of suitable foundations;
- to provide an indication of the degree of soil contamination present; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

A desk study has previously been completed for the site by GEA, and in the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- six boreholes advanced to a depth of 30.00 m using a cable percussion rig;
- a series of 14 boreholes advanced to a maximum depth of 2.45 m by means of an opendrive percussive sampling (Terrier) rig;
- standard penetration tests (SPTs) carried out at regular intervals within the boreholes to provide quantitative data on the strength of the soils;
- the installation of six gas and groundwater monitoring standpipes to a depth of 6.00 m and a single return monitoring visit;
- testing of selected soil samples for contamination and geotechnical purposes; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11[1] and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

The exploratory methods adopted in this investigation have been selected on the basis of the constraints of the site including but not limited to access and space limitations, together with any budgetary or timing constraints. Where it has not been possible to reasonably use an EC7 compliant investigation technique a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent where applicable and relevant published information.

1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004

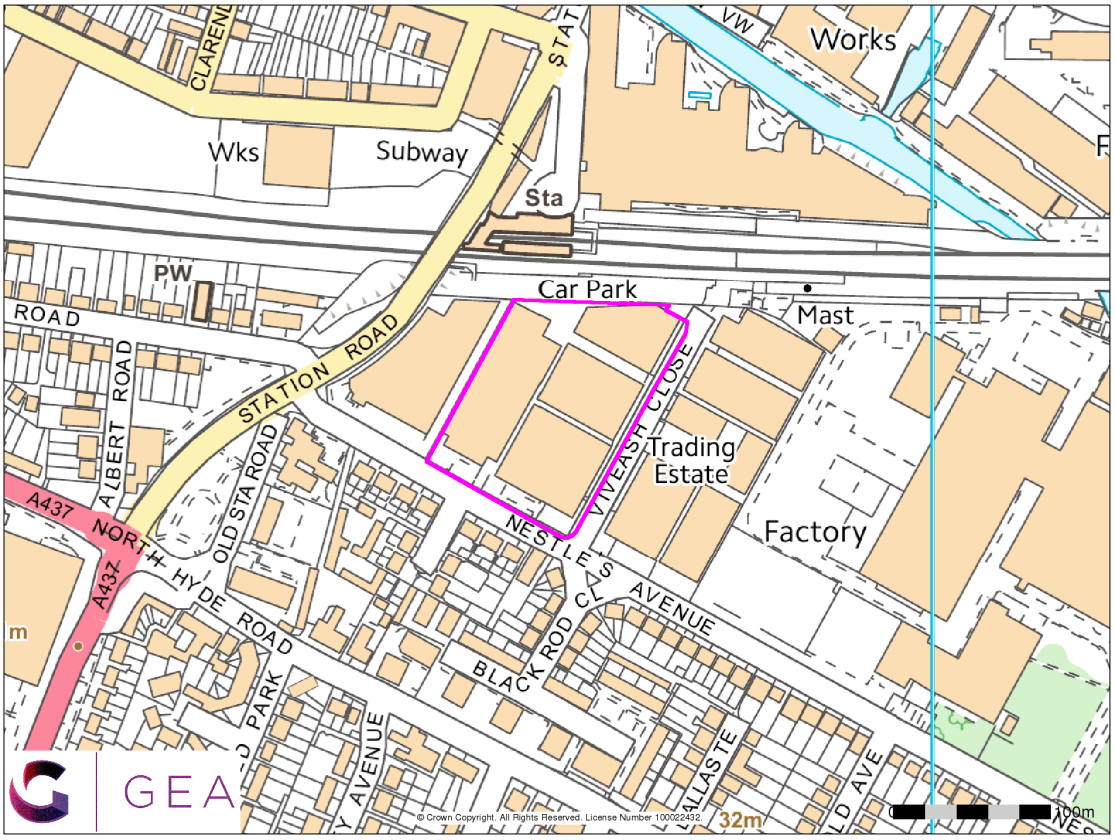
1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or ground water samples tested. No liability can be accepted for conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from third parties are given in good faith on the assumption that the information is accurate; no independent validation of third party information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located in the London Borough of Hillingdon, less than 20 m south of Hayes and Hillingdon railway station and approximately 3 km northwest of Heathrow Airport. The site is bounded by a car park for Hayes & Harlington railway station to the north, by Viveash Close to the east, Nestles Avenue to the south and an alleyway to the west separating the site from an Access Self Storage building next to Station Road further to the west. An electricity substation is present adjacent to the northeastern corner of the site. The site may be additionally located by National Grid Reference 509757 179312 and is shown on the map extract below.



The site is irregular in shape, measuring approximately 165 m northeast to southwest by 105 m northwest to southeast in maximum dimensions, and is within a generally mixed industrial and residential setting. It is occupied by four large industrial style buildings, three

of which in the eastern portion of the site are roughly square in shape and occupied by numerous workshops, whilst the fourth in the west forms a more rectangular shaped building occupied by the London Motor Museum.

A walkover of the site was carried out by a geotechnical engineer from GEA on 11th January 2017, although full access to all the buildings was not provided. A second walkover was carried out by an engineer from GEA on 29th April 2019, during the ground investigation.

The museum is a two-storey flat roofed building fronting onto Nestles Avenue to the south, with single storey extensions to the east and west. It was empty at the time of the investigation with no visible signs of contamination being noted. A car park is located at the front of the building and is in relatively good condition, with minor cracks, scars and service covers in the concrete surfacing. The majority of the site is roughly level although Nestles Avenue to the south is at a slightly higher elevation than the buildings fronting the road, with the hardstanding in this portion of the site sloping down slightly towards the buildings. The car park to the north of the site is approximately 1 m higher than the site; a brick retaining wall supports the northern elevation of the site.

No 233 to 236 Claremont House is a two-storey flat roof brick building located to the east of the museum and occupies the southernmost portion of the site. A tall single storey extension with an industrial style roof adjoins the building to the east, which is separated from the museum by an alleyway. At the time of the investigation the buildings were being used as storage areas and no potential sources of contamination were identified.

Panoramic view of the southern elevation of the site along Nestles Avenue, including the London Motor Museum occupying the western portion of the site. To the east of this is the extension to No 233 Claremont House and then the main building, which occupies the southern portion of the site. There is soft landscaping and hardstanding to the front of both buildings.

Access to No 236 Claremont House could not be provided but the consulting engineers have indicated this portion of the site to have been occupied by a motor repair workshop and storage, although it is currently vacant.

The eastern elevation of Claremont House extends along Viveash Close, beyond which are the two remaining buildings on the site that front onto Viveash Close to the west. These buildings in the north and east of the site are occupied by multiple businesses, all of which are involved with vehicle servicing, remodelling and maintenance and mostly form workshops with associated office space. The consulting engineers have indicated that No 2A Viveash Close was recently used as a design workshop and storage. The building was found to be vacant but the flooring in the workshop area of the building was clearly largely covered by a film of oil, although the floor slab was noted as being in a good condition with very few cracks. Access to the ground floor of No 1 Viveash Close was not available at the time of the

walkover or the ground investigation but is understood to have been vacant. The first floor was in use as office space by a firm of solicitors. An alleyway separates the two buildings, through which is an area of open space in the northern portion of the site. This is currently used to store vehicles and provides access to the garages occupying the northern portions of the buildings. During the walkover general waste was noted in the area.

Hoarding surrounds an area of hardstanding in the northeastern corner of the site, immediately adjacent to No 1 Viveash Close. The area generally comprised hardstanding with miscellaneous items presumably left by the previous occupiers of the building, including office furniture and tyres. Beyond this, the site is bordered by the railway car park to the north and the electricity substation to the northeast.

Panoramic view of the eastern elevation of the site along Viveash Close, including No 236 Claremont House on the corner.

Asbestos cement warning labels are present along the buildings in the alleyway between the two buildings fronting Viveash Close. It is likely that other asbestos containing materials are present throughout the structures and an asbestos survey will be required for the site.

Looking roughly west at the alleyway between the two buildings fronting Viveash Close, which are occupied by numerous garage businesses and workshops

Looking roughly northwest at the electricity substation outside the northeastern corner of the site, beyond which is the car park bordering the site to the north

The site is mostly covered by the footprints of the buildings and the hardstanding, the majority of which is formed of tarmac or concrete in a relatively poor condition with cracks and staining. The hardstanding to the front of No 236 Claremont House comprises chippings in a rubber mesh and could be forming a root protection zone. A small area covered by grass is present to the front of the museum and No 233 Claremont House. There are no other notable areas of soft landscaping present on the site. There are however large mature trees along Nestles Avenue to the south of the site.

2.2 Site History

The site history has been researched by reference to historical Ordnance Survey (OS) maps obtained from the Envirocheck database.

The earliest map studied, dated 1864, shows the site to have formed part of a large field. The existing railway line to the north had been established but not named and Hayes station was located approximately 35 m to the north of the site, on the other side of the tracks. The Grand Junction Canal is shown in its existing position running roughly northwest to southeast. A small extension of the canal ran under a bridge into the area to the north of the site. Brickfields occupied the surrounding area from approximately 100 m to the northwest and from 200 m to the northeast of the site and included associated infrastructure such as wells and clay mills to the northeast. The existing Nestles Avenue had been constructed but not labelled.

By 1895, the site was bounded to the south by a road extending south of the railway bridge and remained part of a field. A large rectangular carriage shed had been constructed on the other side of the railway line but before the extension of the canal, approximately 65 m to the north of the site. The brickfields and mills to the northeast and northwest are no longer labelled.

A footpath crossed the southeastern corner of the site by 1914, at which time the area to the north of the site had been significantly developed. The existing rows of properties along Station Road and the newly constructed Clayton Road and Blythe Road had been established from around 110 m north of the site, most likely housing the workers of the surrounding newly established works and factories. These included an engineering works, a marble, granite and slate works and a printing works from 310 m to the northwest of the site, on the other side of the canal. The extension of the canal had been demolished and the map indicates the ground to have been mounded, potentially formed of made ground or infilling material.

The Preliminary UXO Risk Assessment indicates that the site lay within the bounds of a National Filling Factory (NFF), which were created during WW1 in order to supply munitions for the military. The research suggests that the NFF at Hayes assembled numerous munitions including projectiles, fusing, exploders and detonators. It is not however clear from the evidence available the site's position within the NFF and the potential for the site to be contaminated with items of unexploded ordnance.

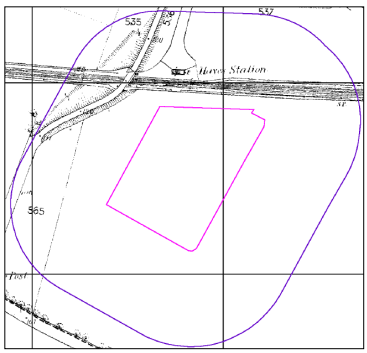
By 1934, the site formed part of a sports ground with the southern portion comprising open space and the northern portion covered by trees. A gated structure encroached onto the northeastern corner of the site and a rectangular building was present to the northwest. Further development had occurred in the surrounding area, including the construction of a canal engineering works around 130 m to the northwest of the site, on the other side of the railway. The carriage shed to the north had been demolished, leaving behind railway lines, and more branches had been added in the area previously occupied by mounds further to the north.

The larger scale mapping, dated 1938, shows a building to have been constructed on the western portion of the site in a similar position to the existing museum. Large industrial style buildings had also been constructed in the area to the east of the site, covering a section of the sports ground.

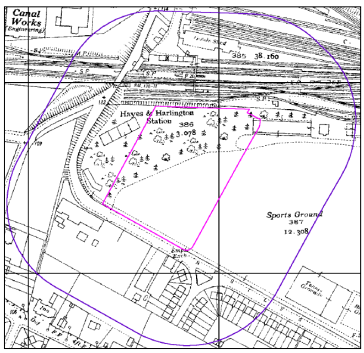
Post-War aerial photography, dated 1946, shows the western portion of the site to have been cleared, presumably where the building had been damaged by bombing. The UXO report has

not found any evidence to indicate any bombing incidents occurred directly on site, however there are records of bomb strikes to the northeast and northwest of the site. It is possible that the strikes to the northwest affected the site. The aerial photography shows that the existing rectangular shaped industrial buildings were constructed over the remainder of the site.

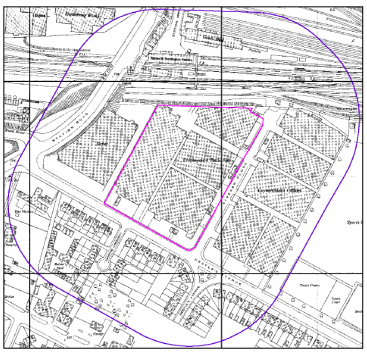
By 1965, the existing site layout had been established. The building housing the existing museum had been constructed in the west in the previously cleared area, fronting onto Nestles Avenue to the south. The building in the east of the site was labelled as an employment exchange. A depot had been constructed to the west and similar large industrial style buildings to the east, one of which was labelled as government offices. These developments had reduced the size of the sports ground. A garage was located 110 m to the south and a builders yard was within a residential area approximately 85 m to the southwest.



1864 historic map



1934 historic map



1965 historic map

The government offices to the east had been relocated into the building to the south of the employment exchange on the site by 1972. Tanks had been constructed around 60 m to the northeast of the site and a metal works had been constructed 80 m to the north, on the other side of the railway lines. An electricity transfer station had been constructed around 560 m to the southeast of the site by 1974 and it is likely that the electricity substation to the northeast of the site had been constructed around this time. The industrial buildings to the east of the employment exchange had been replaced by a collection of smaller units labelled 'Squirrels Trading Estate' by 1992.

The most recent map, dated 2017, shows the Network Rail car park to the north of the site. The tanks to the northeast and northwest are not labelled, but the mapping after 1972 is only at the larger scale and so it is possible that they were present after this time but not mapped in detail.

2.3 Other Information

The Envirocheck report has indicated that there is a historic landfill site 298 m to the east that accepted inert, commercial and household waste, although the last input date is listed as 1936. The age of the last input for this landfill is such that it is unlikely to affect the site and the next nearest historic landfill to the site is 770 m to the east. A licensed waste management facility and a registered waste transfer site are both located 516 m to the northeast of the site. Areas of infilled land (non-water) are listed from 120 m to the northwest, most likely associated with the brickfields in the historic mapping. Areas of infilled land over water are listed from 107 m to the north of the site and are likely to be associated with the infilling of the extension to the Grand Canal, which was present in historic mapping until 1914. These features are at such a distance that they are unlikely to have affected the site.

There are several pollution incidents to controlled waters within 200 m of the site. A single incident 145 m to the northeast in 1990 was classified as a Category 2 – significant incident, although it is unlikely to have affected the site due to the distance and date of the event. The remaining incidents are all greater than 100 m from the site and classified as Category 3 – minor incidents. A prosecution relating to controlled waters was issued in 1999 for the pollution of the Grand Union Canal with heavy fuel oil and diesel 352 m to the southeast of the site. This is unlikely to have migrated and affected the site as the canal is expected to be lined and therefore not in hydraulic connectivity with the surrounding ground.

Several BGS Recorded Mineral Sites are within 400 m of the site, located 124 m to the east, 283 m to the northwest, 309 m and 320 m to the northeast, all of which are listed as opencast operations at Botwell Brickfield. These sites correspond to the previously identified brick fields in the area surrounding the site in historic mapping and are all listed as having ceased activity.

Five Contemporary Trade Directory (CTD) entries are listed for the site, as detailed below;

CTD Entry name	Type of service	Location on site	Status
Sterling Performance Cars Limited	Car dealers	2a Viveash Close (NE)	Active
Lords Commercial Services	Garage	2 Viveash Close (NE)	Inactive
Cabmates	Car engine tuning and diagnostic services	233-236 Nestles Avenue	Active
Wrench Limited	Window tinting	1a Viveash Close	Active
T K O London	Car customisation and conversion specialists	1a Viveash Close	Inactive

The last two entries are also listed as Points of Interest for Commercial Services for vehicle repair, testing and services. A third Point of Interest for Commercial Services is positioned on site, named ‘Vanmatic Limited’, which is also listed for vehicle repair, testing and services.

The nearest fuel station entry is located 107 m to the southwest of the site, named South Hayes Express ESSO garage and is recorded as open. Hayes & Harlington railway station is located 46 m north of the site.

2.4 Detailed UXO Risk Assessment

A Preliminary UXO Risk Assessment was completed by 1st Line Defence (report ref EP5858-00, dated 11 January 2018) as part of the previously completed desk study report. The report concluded that further research in the form of a Detailed UXO Risk Assessment was required in order to determine the risk of encountering UXO beneath the site.

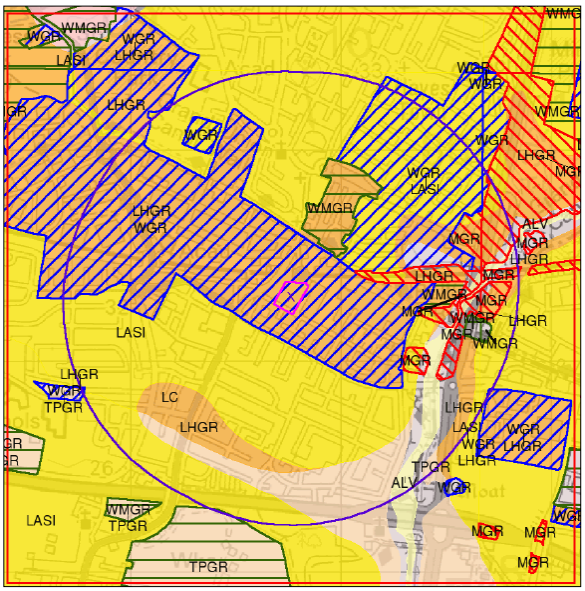
As a result, a detailed UXO Risk Assessment was commissioned by GEA and was completed by 1st Line Defence (report ref DA8572-00, dated 17th April 2019). A copy of the report has been included in the appendix. The risk assessment has been carried out in accordance with the guidelines provided by CIRIA, which state that the likelihood of encountering and detonating UXO below a site should be assessed along with establishing the consequences that may arise. The first phase comprises a preliminary risk assessment, which should be undertaken at an early stage of the development planning. If such an assessment identifies a high level of risk then a detailed risk assessment should be carried out by a UXO specialist, which will identify an appropriate course of action with regard to risk mitigation.

The report indicated that, during World War I, the site was located within the former bounds of a National Filling Factory (NFF), an explosive ordnance production facility. There is therefore the potential for contamination of the site with items of WWI explosive ordnance. During World War II, the site was located within the Urban District of Hayes and Harlington, which sustained a low to moderate density bombing campaign. Whilst no strikes are recorded for the site, records indicate bomb strikes to the north and northwest of the site, with photographic records indicating potential bomb damage to a building in the west of the site. The site is thought to have sustained a relatively good level of access during the war and post war aerial imagery suggests that the buildings on and around the site escaped serious bomb damage.

The site was cleared and redeveloped in the inter-war period with development continuing until after WWII. This redevelopment is expected to have included significant intrusive works into the ground and as a result and WW1 ordnance would probably have been found as part of the previous redevelopment. As a result, the risk of encountering UXO at the site is considered to be low. It is recommended that site-specific UXO awareness briefings are provided for all personnel conducting intrusive works, but on-site supervision of work will not be required.

2.5 Geology

The British Geological Survey (BGS) map of the area (Sheet 269), as reproduced by Envirocheck and shown on the extract below, indicates the site to be underlain by the Lynch Hill Gravel Member over the London Clay Formation. The Lynch Hill Gravel typically comprises sand and gravel, locally with lenses of clay, silt or peat. The London Clay Formation typically comprises homogenous, slightly calcareous silty clay to very silty clay, with some beds of clayey silt grading to silty fine-grained sand.



Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WMGR	Infilled Ground	Artificial Deposit	Cenozoic - Cenozoic
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Holocene - Holocene

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Flandrian
	LASI	Langley Silt Member	Clay and Silt	Devensian - Devensian
	LHGR	Lynch Hill Gravel Member	Sand and Gravel	Wolstonian - Wolstonian
	TPGR	Taplow Gravel Formation	Sand and Gravel	Wolstonian - Wolstonian
	BHT	Boyn Hill Gravel Member	Sand and Gravel	Wolstonian - Hoxnian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	LC	London Clay Formation	Clay, Silt and Sand	Eocene - Eocene
	LC	London Clay Formation	Clay and Silt	Eocene - Eocene

The site is also within an area of worked ground. It is possible that the worked ground is associated with the brickfields that were present in the surrounding area until around 1914. It is however unclear as to why the site has been included as being underlain by worked ground, as the historic maps after 1864 do not indicate the site to have been occupied by any activity that would result in worked ground.

The BGS do not hold archive records of boreholes drilled in proximity to the site. The nearest records are for a borehole advanced approximately 170 m to the east of the site, also within the area of worked ground, which is noted to have been re-drilled in 2004. The records indicate London Clay to be present from the surface and to extend to a depth of 58 m; the Lynch Hill Gravel was not encountered. Beneath this, soils of the Woolwich and Reading Beds, more recently classified as the Lambeth Group, were encountered to a depth of 77 m, over Thanet Sand to 78 m and then Upper Chalk to the full depth of investigation at 165 m.

A ground investigation has previously been carried out by GEA at a site located approximately 60 m to the east-southeast of the site. The investigation encountered a moderate thickness of made ground over Lynch Hill Gravel which was underlain by the London Clay. The made ground extended to a depth of 0.80 m. Very dense and dense sand and gravel of the Lynch Hill Gravel was then encountered and extended to a depth of 6.50 m, with a reduction in the density attributable to groundwater. The underlying London Clay comprised an initial weathered layer of firm brown and yellowish brown clay with rare fine gravel, which extended to a depth of 6.80 m, and was underlain by very stiff fissured brownish grey clay with mica and occasional partings of light brownish grey silt and fine sand, to the base of the borehole at 30.00 m. Claystones were encountered at depths of 15.70 m and 25.80 m.

2.6 Hydrology and Hydrogeology

The Environment Agency classifies the Lynch Hill Gravel beneath the site as a Principal Aquifer, referring to rock layers or drift deposits that have high intergranular and / or fracture permeability and therefore usually provide a high level of water storage, supporting water supply and / or river base flow on a strategic scale. Principal Aquifers were formerly classified as major aquifers. The London Clay Formation is classified as Unproductive Strata under the same scheme, which refers to rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Envirocheck records the nearest surface water feature to be 134 m to the northeast, the Grand Union Canal, although this is likely to be lined and therefore not in hydraulic connectivity with the surrounding soil. The nearest natural surface water feature is the River Crane approximately 750 m to the southeast of the site. Groundwater flow is therefore likely to be in a roughly south-easterly or easterly direction towards the river.

The majority of the site is covered by the existing buildings and hardstanding and therefore infiltration of rainwater into the ground beneath the site will be limited to the areas of soft landscaping. The majority of surface runoff is likely to drain into combined sewers in the main road.

There is the potential for groundwater flooding to occur at the surface in the north of the site and it is therefore recommended that a flood risk assessment be carried out by a specialist.

The aforementioned BGS archive record indicates a resting groundwater level of 8.59 m below ground level within the London Clay, which is likely to represent a seepage within a silty or sandy zone, although the details are limited.
As part of the GEA investigation referred to in the previous section, groundwater was monitored at depths of between 2.71 m and 2.87 m within a single borehole. In addition, during three ground gas monitoring visits, no elevated concentrations of ground gas were detected.

2.7 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2.7.1 Source

On site sources

The desk study findings indicate the site to have a potentially contaminative history as it has mostly been occupied by industrial buildings of unknown use from 1938. There are five contemporary trade directory entries for the site, three of which are currently active, and numerous vehicle servicing and maintenance workshops are known to be present in the northeast of the site. A vehicle museum recently occupied the building in the west of the site.

The existing use of the site by vehicle servicing garages with associated car parking areas indicates a number of potential sources of contamination. The walkover survey also identified drums of fuel or engine oil, asbestos containing materials and general waste. Hydrocarbon contamination is the most likely to be encountered due to localised spillages of fuel. The Department of the Environment (DoE) Industry Profile[2] indicates the following contaminants associated with vehicle workshops:

- metals and their compounds, including lead, copper and other metals from parts of the engine;
- acids/ alkalis;
- asbestos;
- organic compounds including non-halogenated solvents and halogenated solvents, polyaromatic hydrocarbons (PAHs) and other hydrocarbons, ethylene glycol and polymerised glycols and ethers from brake fluids, anti-freeze, cleaners and de-greasers etc.; and
- volatile organic compounds (VOCs) from paints.

If re-fuelling of vehicles occurs within the garages on site, reference to the relevant DoE Industry Profile[3] indicates that Methyl tert-butyl ether (MTBE), benzene, toluene, ethylbenzene and xylene (BTEX), total petroleum hydrocarbons (TPH) and naphthalene (a PAH) contamination may also be encountered, in addition to the above contaminants.

It is also possible that the buildings on site have been occupied by works and factories in the past. Contamination typically associated with factories and works includes heavy metals from paint, hydrocarbons from machine tools, solvents from paint and degreasers, asbestos used in fire protection, acids and alkalis and PAH from the incomplete combustion of waste wood.
The site is over an area of worked ground and therefore there is the potential for a source of soil gas production to be present beneath the site. This is not considered to be significant unless significant quantities of putrescible or organic material are encountered beneath the site during intrusive investigations.

[2] Department of the Environment Industry Profile (1996) *Road vehicle fuelling, service and repair garages*- transport and haulage centres. HMSO

[3] Department of the Environment Industry Profile (1996) *Road vehicle fuelling, service and repair - garages and filling station*s HMSO

The UXO Risk Assessment has indicated that an explosive ordnance production facility may have been present on site during World War I. The following contaminants are associated with explosives, propellants and pyrotechnics works, depending on the type of activities occurring within the factory[4];

- explosive materials;
- acidic effluent and explosive residues;
- mineral acids;
- non-chlorinated organic solvents / compounds and chlorinated organic cleaning solvents;
- general inorganic salts and inorganic compounds;
- calcium as lime;
- metals and metal salts, non-metals e.g. sulphur;
- asbestos and fuel oil; and
- PCBs (if electricity substations or transformers were present on the site).

Off-site sources
The site is located in an area with an industrial history. The historic map dated 1972 indicates tanks to have been constructed along the railway line approximately 80 m to the north of the site and alongside the buildings to the east, approximately 60 m to the northeast of the site; the contents and capacity of the tanks is unknown.

A metal works had been constructed beyond the railway line and goods shed by 1972, although it is not known whether this comprised an electroplating or other metal finishing works, iron and steel works, lead works or non-ferrous metal works. Along with the aforementioned contaminants, the following contaminants are associated with metal works with reference to the relevant Department of the Environment (DoE) Industry Profiles[5, 6, 7 & 8];

- mineral acids;
- oil;
- electroplating metals including copper, cadmium, chromium, lead, nickel, mercury, silver, tin and zinc;
- other metals and metalloids – beryllium, aluminium, magnesium, iron, manganese, molybdenum, vanadium;
- inorganic compounds including borates, nitrates, phosphates, fluoride, ammoniacal liquor and thiocyanate.

4 Department of the Environment Industry Profile (1995) *Chemical works: explosives, propellants and pyrotechnics manufacturing works*. HMSO
5 Department of the Environment Industry Profile (1995) *Metal manufacturing, refining and finishing works: electroplating and other metal finishing works*. HMSO
6 Department of the Environment Industry Profile (1995) *Metal manufacturing, refining and finishing works: iron and steel works*. HMSO
7 Department of the Environment Industry Profile (1995) *Metal manufacturing, refining and finishing works: lead works*. HMSO
8 Department of the Environment Industry Profile (1995) *Non-ferrous metal works (excluding lead works)*. HMSO

The desk study has identified a historic landfill 298 m to the north of the site and areas of infilled land within 150 m of the site, most likely associated with the former brick fields surrounding the site from 1864 until around 1935. Given the distance of the infilled land and date of the infilling of the historic landfill, these are unlikely to have impacted the site or result in the on-going production of significant quantities of landfill gas. However, whilst these are not considered to represent significant sources of gas, the migration of landfill or soil gas onto the site is still possible.

2.7.2 Receptor

The proposed redevelopment of the building for residential purposes will result in the end users representing relatively high sensitivity receptors. As the site is expected to be underlain by a Principal Aquifer, groundwater is also considered to represent a highly sensitive receptor. Adjacent sites are also therefore sensitive receptors.

Concrete and buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into contact with any contaminants present in the soils during construction works. Both are considered to be sensitive receptors.

2.7.3 Pathway

Within the site, end users will be isolated from direct contact with any contaminants that may be present within the made ground by the presence of the new building and the extent of the hardstanding, which will effectively form a barrier. However, in areas of soft landscaping, a pathway would exist whereby end users could come into contact with potentially contaminated soils through direct contact. As the areas of soft landscaping are to comprise managed areas, as opposed to communal or private gardens with the potential for produce to be grown, this is not considered to be significant.

A pathway is currently in existence in areas of soft landscaping and through cracks or gaps in the hardstanding.

As the site is expected to be underlain by the Lynch Hill Gravel, these granular soils would allow the migration of potentially contaminated groundwater or soil gas through the shallow soils to surrounding sites and vice versa.

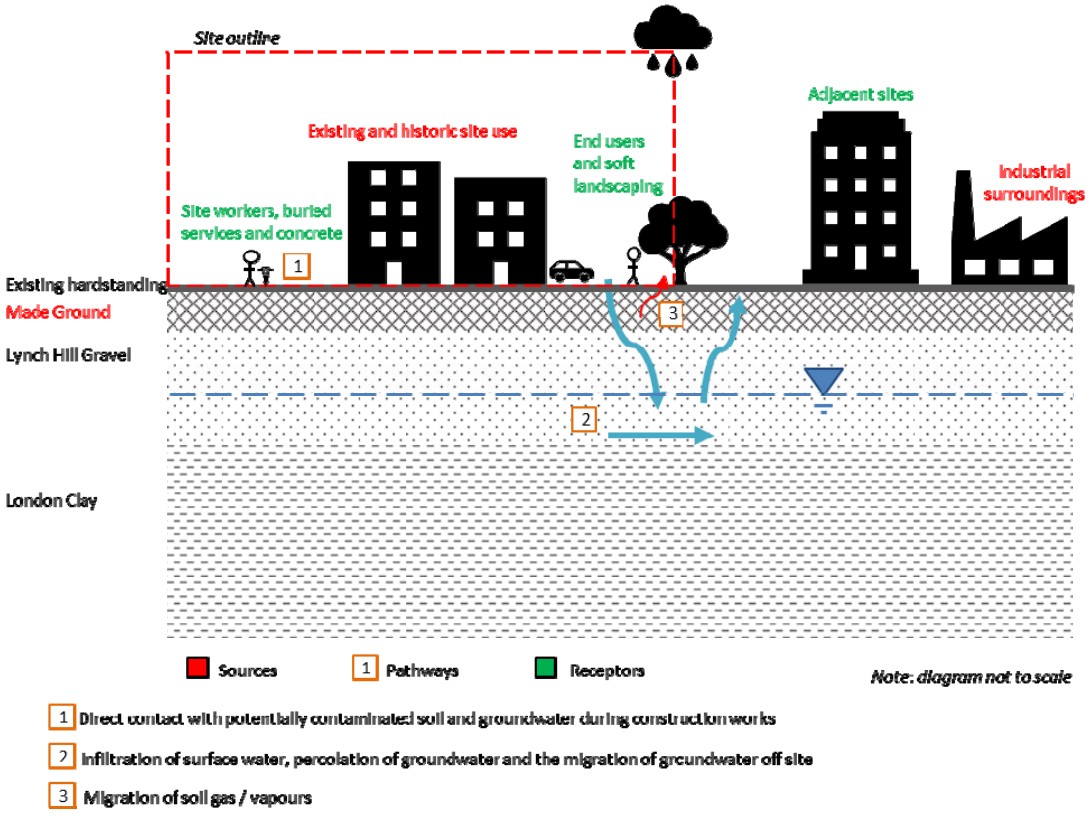
Buried services and concrete may be exposed to any contaminants present within the soil through direct contact and site workers will come into contact with the soils during construction works.

There is thus considered to be a moderate potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.7.4 Preliminary Risk Appraisal

In accordance with the guidelines provided by CIRIA[9], the following table and pictorial conceptual site model summarises possible pollution linkages for the site.

SOURCE	RECEPTOR	PATHWAY	PROBABILITY	CONSEQUENCE
Inorganic and organic contamination within near surface soils and groundwater resulting from existing and past activities on site, and the migration of contaminants associated with the railway and other works to the north	End users	Ingestion of contaminated soil or dust, through skin contact or inhalation	Low likelihood	Medium
		Vapours	Low likelihood	Mild
	Soft landscaped areas	Direct contact	Low likelihood	Moderate
	Groundwater (if Principal Aquifer is present)	Percolation and leaching of surface run-off	Likely	Medium
	Adjacent sites	Shallow perched water or drain runs	Likely	Medium
	Site workers	Ingestion of contaminated soil or dust, through skin contact or inhalation	Likely	Medium
	Buried services	Direct contact	Likely	Mild



9 Rudland, DJ, Lancefield, RM and Mayell, PN (2001) *Contaminated land risk assessment. A guide to good practice. CIRIA C552*

This method of risk evaluation involves classification of the magnitude of the potential consequence (severity) and probability (likelihood) of the risk. The method by which these factors are classified is detailed in the Appendix. On the basis of the consequence and probability the site can be attributed a level of risk, ranging from very low to very high and the procedure for making this assessment is shown in the Appendix, together with a description of each level of assessed risk and the actions that may be required to mitigate the risk.

On the basis of the above it is considered that there is a MODERATE RISK of there being a significant contamination linkage at this site which would result in requirement for remediation works.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, six cable percussion boreholes were advanced to a depth of 30.00 m and a series of 14 opendrive percussive sampler boreholes were advanced to a maximum depth of 2.45 m.

During boring, disturbed and undisturbed samples were obtained from the boreholes for subsequent laboratory examination and testing. Standard Penetration Tests (SPTs) were carried out at regular intervals to provide additional quantitative data on the strength of soils encountered.

Six monitoring standpipes have been installed into the cable percussion boreholes in order to carry out gas and groundwater and gas monitoring and to facilitate groundwater sampling. At this stage, it has not been possible to complete groundwater sampling or groundwater and gas monitoring visits due to a traveller incursion at the site. These will be carried out in due course, once access to the site has been regained.

A selection of the samples recovered from the boreholes was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA. The boreholes are appended, together with a site plan indicating the exploratory positions.

3.1 Sampling Strategy

The borehole locations were positioned on site by GEA in order to provide coverage if the site, whilst working within accessible locations and avoiding known and suspected buried services. The cable percussion boreholes were positioned in external areas due to the limited access available to the existing buildings. The opendrive percussive sampler boreholes were positioned in both internal and external positions to provide further coverage of the site.

Thirteen samples of the made ground have been tested for the presence of contamination. The analytical suite of testing was selected to identify contamination resulting from the former uses of the site and a range of typical industrial contaminants for the purposes of general coverage. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. All samples were also screened for the presence of asbestos.

A selection of the samples was also tested for the presence of semi-volatile organic compounds and volatile organic compounds (SVOCs and VOCs) and BTEX in order to identify the presence of solvents within the made ground, which may be present as a result of the vehicle repair works that largely occupied the site.

Selected samples were also tested for polychlorinated biphenyls (PCBs) in order to determine whether PCBs had migrated onto the site from the electricity substation to the northeast.

The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. A summary of the MCERTs accreditation and test methods are included with the attached results and further details are available upon request.

Samples of the natural soil were submitted to a laboratory for a programme of geotechnical testing, which included Atterberg limit testing, particle size distribution testing and soluble sulphate and pH analysis.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, beneath a nominal to moderate thickness of made ground, the Lynch Hill Gravel is present over the London Clay Formation, which extends to the maximum depth of investigation of 30.00 m.

4.1 Made Ground

Beneath the concrete surfacing the made ground generally comprised brown clayey sand with variable amounts of gravel, brick, concrete, ash, tile and pipe fragments, and extended to depths of between 0.3 m and 1.70 m.

Apart from the presence of fragments of extraneous material noted above, no visual or olfactory evidence of contamination was observed during the fieldwork. Thirteen samples of the made ground has however been analysed for a range of contaminants as a precautionary measure and the results are detailed within Section 4.6.

4.2 Lynch Hill Gravel

This stratum generally comprised dense and very dense yellowish brown and brown sandy gravel and gravelly sand extending to depths of between 4.75 m and 5.80 m. Refusal was reached in all opendrive sampler boreholes in the very dense granular soils at depths of between 1.00 m and 2.00 m.

The density of the gravel generally decreased below a depth of 4.00 m and this decrease is most likely to be attributable to the presence of groundwater.

4.3 London Clay

The London Clay comprised an initial weathered layer of firm brown mottled orange-brown slightly sandy slightly silty clay, which extended to depths of between 5.20 m and 6.20 m. Beneath this the stratum comprised stiff becoming very stiff fissured brownish grey silty clay occasional pale grey veins, shell fragments, selenite crystals and sandy layers, which extended to the full depth of investigation of 30.00 m. Claystones were encountered at depths of 15.40 m in Borehole No 3 and 14.00 m in Borehole No 4.

The results of plasticity index tests indicate the clay to be of high volume change potential, and the results of laboratory undrained triaxial compression tests indicate the clay to be of high becoming very high and locally extremely high strength.

4.4 Groundwater

Groundwater was encountered in Borehole Nos 1, 2 and 3, advanced in the northern section of the site, at a depth of 4.50 m from within the Lynch Hill Gravel, which was noted as rising to a depth of 4.00 m. Groundwater was not encountered elsewhere on the site due to the limited depth of the opendrive sampler boreholes and most likely due to the addition of water to aid drilling within the gravel which would have masked groundwater inflows. Combined gas and groundwater monitoring standpipes have been installed into Borehole Nos 1, 2, 3, 4, 5 and 6 and the installation details can be found on the appended borehole records.

Groundwater monitoring has not been possible to date as access to the site is not currently available. Two groundwater monitoring visits are proposed during which a sample of groundwater from each standpipe will be taken and these visits will be carried out once access to the site has been regained.

4.5 Gas Monitoring

At this stage it has not been possible to carry out any gas monitoring as access to the site is not currently available. Areas of infilled ground have been identified in the surrounding area and although these areas are considered to be located a sufficient distance from the site such that the risk from ground gas beneath the site is low, there is a risk that migrating soil gas could affect the site. As a result, it would be prudent to carry out an initial two visits once access to the site has been regained to ensure the site is not affected.

4.6 Soil Contamination

The table below sets out the values measured within the thirteen samples analysed; all concentrations are in mg/kg unless otherwise stated.

Determinant	Minimum concentration	Maximum concentration	Generic Risk-Based Screening Value	Number of samples above screening value
pH	7.5	11.0	-	-
Arsenic	13	30	40	0
Cadmium	<0.2	0.7	149	0
Chromium	18	36	3000	0
Lead	140	**1900**	310	4
Mercury	0.6	3.3	235	0
Selenium	<1.0	2.1	595	0
Copper	40	170	2330	0
Nickel	16	52	99	0
Zinc	76	320	3750	0
Total Cyanide	<1	<1	140	0
Total Phenols	<1.0	<1.0	310	0
Total PAH	5.97	32.1	66.4	0

Determinant	Minimum concentration	Maximum concentration	Generic Risk-Based Screening Value	Number of samples above screening value
Sulphide	<1.0	**68**	50	1
Benzo(a)pyrene	0.46	3.0	4.65	0
Naphthalene	<0.05	<0.05	2.33	0
TPH	13	**3100**	1000	1
Total Organic Carbon %	0.9	3.2	6	0

Note: Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report

Asbestos was not detected in any of the 13 samples of made ground, but a single fragment of suspected asbestos containing cement board was tested and was found to contain chrysotile asbestos. No elevated concentration of SVOCs or VOCs were detected and no measurable concentrations of PCBs or BTEX were detected by the contamination analysis.

4.6.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. Contaminants of concern are those that have a value in excess of a generic human health risk based guideline values, which is either the CLEA Soil Guideline Value where available, a Generic Screening Value calculated using the CLEA UK Version 1.06 software assuming a residential end use without plant uptake, or is based on the DEFRA Category 4 Screening values. The key generic assumptions for this end use are as follows:

- that groundwater will not be a critical risk receptor;
- that the critical receptor for human health will be young female children aged zero to six years old;
- that the exposure duration will be six years;
- that the critical exposure pathways will be direct soil and indoor dust ingestion, skin contact with soils and dust and inhalation of dust and vapours; and
- that the building type equates to a terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site as the majority of the development will be used for residential purposes and areas of soft landscaping will be limited to managed communal spaces. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However, where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;

- site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or

- soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

The chemical analyses have indicated four samples of the made ground to contain elevated concentrations of lead, while a single sample was found to contain an elevated concentration of TPH. Furthermore, a single sample was found to contain an elevated concentration of sulphide. Asbestos was not detected in any of the 13 samples of made ground, but a single fragment of suspected asbestos containing cement board was tested and was found to contain chrysotile asbestos.

The significance of these results is considered further in Part 2 of the report.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to the proposed development.

5.0 INTRODUCTION

It is understood that it is proposed to demolish the existing buildings and subsequently construct four new apartment blocks, rising to between four storeys and eleven storeys, with commercial units at ground floor level. There are no basements included within the proposals. The buildings will be surrounded by areas of soft landscaping that will comprise managed communal space. The proposed loads are not known but at this stage are anticipated to be moderate to high.

6.0 GROUND MODEL

The desk study has revealed that the site has had a potentially contaminative historical use as it has been occupied by an explosive ordnance production facility and numerous vehicle and maintenance workshops throughout its developed history. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- below a nominal to moderate thickness of made ground the Lynch Hill Gravel is present, and is underlain by the London Clay Formation;
- the made ground typically comprises brown clayey sand with variable amounts of gravel, brick, concrete, ash, tile and pipe fragments and extends to depths of between 0.30 m and 1.70 m;
- the Lynch Hill Gravel generally comprises dense and very dense yellow-brown and brown sandy gravel and gravelly sand and extends to depths of between 4.75 m and 5.80 m;
- the underlying London Clay comprises firm brown mottled orange-brown slightly sandy slightly silty clay, to depths of between 5.20 m and 6.20 m, underlain by stiff becoming very stiff high becoming very high and locally extremely high strength fissured brownish grey silty clay occasional pale grey veins, shell fragments, selenite crystals and sandy layers extending to the full depth of investigation, of 30.00 m. Claystones were encountered at depths of 15.40 m in Borehole No 3 and 14.00 m in Borehole No 4;
- groundwater is present within the Lynch Hill Gravel at depths of between 4.00 m and 4.50 m;
- a single sample of the made ground contains an elevated concentration of TPH and four samples of the made ground contain elevated concentrations of lead; and
- there are no other elevated concentrations of contaminants, including SVOCs, VOCs, BTEX and PCBs, and all samples have been found to be free from asbestos with the exception of a fragment of asbestos containing material which was found to contain chrysotile.

7.0 ADVICE AND RECOMMENDATIONS

For the lower rise buildings the use of shallow spread foundations bearing within the Lynch Hill Gravel may be appropriate. However, for the taller buildings it is likely that the loads will be such that the use of spread foundations will not be practical and piled foundations will be required.

7.1 Shallow Foundations

Moderate width strip or pad foundations bearing on the dense gravel of the Lynch Hill Gravel may be designed to apply a net allowable bearing pressure of 300 kN/m^2. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

Where the proposed loads are very high such that spread foundations are not possible piled foundations should be considered as an alternative.

7.2 Piled Foundations

For the ground conditions at this site a bored pile could be adopted. A conventional rotary augered pile could be utilised but consideration will need to be given to the possible instability and water ingress within the made ground and Lynch Hill Gravel. The use of bored piles installed using continuous flight auger (cfa) techniques may therefore be the most appropriate.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, based on the SPT and cohesion / depth graph in the appendix.

Stratum	Depths m	kN / m^2
Ultimate Skin Friction		
Made Ground	GL to 1.5	Ignored
Lynch Hill Gravel (above groundwater)	1.5 to 4.0	26
Lynch Hill Gravel (below groundwater)	4.0 to 5.5	42
London Clay	5.5 to 30.0	Increasing linearly from 45 to 128
Ultimate End Bearing		
London Clay	15.0 to 30.0	Increasing linearly from 1395 to 2295

In the absence of pile tests, guidance from the London District Surveyors Association (LDSA)[10] suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads. On the basis of the above coefficients, the following pile capacities have been estimated.

[10] LDSA (2009) *Foundations No 1 – Guidance notes for the design of straight shafted bored piles in London Clay*. LDSA

Pile diameter mm	Depth Below Ground Level m	Safe Working Load kN
450	15	430
	20	650
	25	900
600	15	605
	20	900
	25	1250

The above examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of a suitable piling scheme and their attention should be drawn to potential groundwater inflows and instability within the Lynch Hill Gravel and the presence of claystones within the London Clay.

7.3 Shallow Excavations

On the basis of the borehole findings it is considered that it will not be generally feasible to form relatively shallow excavations terminating within the Lynch Hill Gravel without the requirement for lateral support, and localised instabilities are particularly likely where groundwater is encountered.

Significant inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from perched water tables within the made ground. Such inflows should be suitably controlled by sump pumping.

7.4 Ground Floor Slab

Formation level for the new floor slabs will probably be within the made ground and, following a proof rolling exercise and the infilling of any soft spots with compacted granular fill it should be possible to adopt a lightly loaded floor slab. Alternatively a suspended floor slab could be adopted.

7.5 Design of New Areas of Hardstanding

In view of the presence of made ground across the site generally extending to a minimum depth of 0.50 m it is considered that any new hardstanding would be constructed within the made ground and as a result a California Bearing Ratio of less than 2 % is recommended. Testing could be carried out once the levels for the hardstanding have been confirmed, to confirm this view.

7.6 Disposal of Surface Water

In view of the presence of relatively high permeability granular deposits of the Lynch Hill Gravel beneath the site extending to depths of between 4.75 m and 5.80 m and groundwater being at a depth of about 4.00 m below ground level it should be feasible to utilise shallow soakaways for the disposal of surface water for this development. Soakaway testing in accordance with BRE 365 will be required at some stage to confirm the soakage rate of the soil which will inform the design of the soakaways.

7.7 Effect of Sulphates

Chemical analyses have revealed relatively low concentrations of soluble sulphate and near-neutral pH in accordance with Class DS-1 conditions of Table C2 of BRE Special Digest 1:SD Third Edition (2005). The measured pH values of the samples show that an ACEC class of AC-1 would be appropriate for the site. This assumes a mobile water condition at the site. The guidelines contained in the digest should be followed in the design of foundation concrete.

7.8 Contamination Risk Assessment

The desk study has revealed that the site has had a potentially contaminative historical use as it has been occupied by an explosive ordnance production facility and numerous vehicle and maintenance workshops throughout its developed history.

The chemical analyses have indicated that four samples of the made ground contain elevated concentrations of lead, while a single sample was found to contain an elevated concentration of TPH. Furthermore, a single sample was found to contain an elevated concentration of sulphide. Asbestos was not detected in any of the 13 samples of made ground, but a single fragment of suspected asbestos containing cement board was tested and was found to contain chrysotile asbestos. No elevated concentration of SVOCs or VOCs were detected and no measurable concentrations of PCBs or BTEX were detected by the contamination analysis.

The source of the lead contamination is unknown, although the previous known site uses are potential sources, but the made ground was noted as containing fragments of extraneous material and it is possible that fragments of such material, for example, coal or old paint fragments, could account for the elevated concentrations. As a result, the lead contamination is not likely to be in a soluble state and should not, therefore, pose a risk to adjacent sites, groundwater or buried services.

The elevated concentration of sulphide does not represent a risk to any potential receptors but could potentially affect plant growth on the site and it would be prudent to excavate out the existing made ground and import clean material for areas of soft landscaping around the area of Borehole No 20, if proposed.

A single fragment of suspected cement board containing asbestos was found within a services pit carried out for Borehole No 8. Testing of the material indicated the cement board to contain chrysotile asbestos. An additional sample from Borehole No 8, taken from a depth of 0.60 m was screened for the presence of asbestos and was found to be free from asbestos fibres, as were an additional 13 samples. As a result, this fragment is considered to be an isolated occurrence and not representative of the site as a whole. However, it is recommended that once the hardstanding has been removed from the area of Borehole No 8, the soils are inspected for fragments of asbestos containing material with any material being removed and tested. It may also be prudent to test a number of samples for the presence of asbestos fibres as a precaution.

Further analysis of the proportion of the aliphatic and aromatic compounds and the various carbon chain lengths within the elevated concentration of TPH has indicated the contamination to be 52% aliphatic and 48% aromatic with the contamination essentially comprising chain lengths 16 to 35. Carbon chains of this length are highly stable and are therefore unlikely to generate hazardous gases or provide a significant risk to groundwater and therefore adjacent sites.

The test result coupled with the history of the site indicate this concentration to probably represent a localised spillage or leakage of diesel or motor oil. Both chain lengths have been found to be present in concentrations above the respective generic screening values. No other samples were found to contain concentrations of TPH in excess of 110 mg/kg and as a result the elevated concentration is considered to be a individual outlying concentration, likely generated by a localised spillage or leakage of diesel or motor oil. It is recommended that the soil in the vicinity of Borehole No 20 is excavated and removed from site and is replaced by imported clean material to ensure that the concentration will not affect end users.

The contamination will pose a risk to site workers during the ground works and end users through a direct contact pathway. These risks are further assessed below.

7.8.1 End Users

End users will be isolated from contact with the made ground by the footprint of the proposed buildings, but protection measures will be required where end users may be exposed to the made ground in new areas of soft landscaping included in the design proposals. At this stage it is recommended that a cover thickness of imported subsoil and topsoil of up to 600 mm in thickness should be specified for any new areas of soft landscaping in accordance with recommendations from BRE[11]. It is likely to be possible to reduce the final thickness of cover required, but this will need to be determined once final levels have been established and the concentrations of potential contaminants within the imported material and in the soils at formation level are known. Imported soils should be certified as clean with appropriate documentation. The clean cover should include 150 mm thickness of certified topsoil at the surface in planted beds.

7.8.2 Site Workers

Apart from the physical hazards represented by the fill materials, elevated concentrations of lead have been measured in the made ground. Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE and CIRIA[12] and the requirements of the Local Authority Environmental Health Officer.

A watching brief should be maintained throughout the groundworks and if any evidence of contamination is encountered work should stop and the suspect material should be inspected by a geo-environmental engineer and may need to be sampled and tested to confirm the presence of contamination. In view of the results of the testing, further remedial works may be required.

7.9 Waste Disposal

Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste classification is a staged process and this investigation represents the preliminary sampling exercise of that process. Once the extent and location of the waste that is to be removed has been defined, further sampling and testing may be necessary. The results from this ground investigation should be used to help define the sampling plan for such further testing, which could include WAC leaching tests where the totals analysis indicates the soil to be a hazardous waste or inert waste from a contaminated site. It should

11 BRE (2004) *Cover systems for land regeneration. Thickness of cover systems for contaminated land.* BRE pub 465
12 CIRIA (1996) *A guide for safe working on contaminated sites* - Report 132, Construction Industry Research and Information Association

however be noted that the Environment Agency guidance WM3[13] states that landfill WAC analysis, specifically leaching test results, must not be used for waste classification purposes.

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE[14] guidance, will need to be disposed of to a licensed tip. Waste going to landfill is subject to landfill tax at either the standard rate of £91.35 per tonne (about £219 per m^3) or at the lower rate of £2.90 per tonne (roughly £6.95 per m^3). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring soil and stones, which are accurately described as such in terms of the 2011 Order, would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the EA it is considered likely that the soils encountered during this ground investigation, as represented by the chemical analyses carried out, would be generally classified as follows;

Soil Type	Waste Classification (Waste Code)	WAC Testing Required Prior to Landfill Disposal?	Current applicable rate of Landfill Tax
Made ground	Non-hazardous (17 05 04)	No	£91.35/tonne (Standard rate)
Made ground (containing TPH contamination)	Hazardous (17 05 03)	No	£91.35/tonne (Standard rate)
Lynch Hill Gravel & London Clay	Inert (17 05 05)	Should not be required but confirm with receiving landfill	£2.90 / tonne (Reduced rate for uncontaminated naturally occurring rocks and soils)

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[15] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be segregated onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

The above opinion with regard to the classification of the excavated soils is provided for guidance only and should be confirmed by the receiving landfill once the soils to be discarded have been identified.

The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material but may require further testing.

13 Environment Agency 2015. *Guidance on the classification and assessment of waste.* Technical Guidance WM3 First Edition
14 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2
15 Environment Agency 23 Oct 2007 *Regulatory Position Statement Treating non-hazardous waste for landfill - Enforcing the new requirement*

8.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work may be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

At this stage it has not been possible to monitor the standpipes for gas and groundwater and this will need to be carried out once the site has been secured to determine equilibrium groundwater levels and to establish any seasonal fluctuations and the requirement for gas protective measures. Groundwater samples will also need to be recovered from each standpipe and submitted for a suite of contamination testing to determine if the groundwater beneath the site has been contaminated by the previous uses of the site.

In accordance with the recommendations of the Detailed UXO Risk Assessment, a site-specific UXO awareness briefing will need to be given to all site workers conducting intrusive works.

The investigation has indicated a requirement for remedial measures to deal with the presence of contamination and there may be a requirement for a separate remediation proposals report to be prepared to comply with planning requirements. The remediation will need to be supervised and verified by a geoenvironmental engineer and a completion or validation report will also probably be required to support the planning application.

If during ground works any visual or olfactory evidence of contamination is identified it is recommended that further investigation be carried out and that the risk assessment is reviewed.

These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

APPENDIX

Borehole Records

SPT & Cohesion/Depth Graph

Geotechnical Test Results

Chemical Test Results

Generic Risk Based Screening Values

Detailed UXO Risk Assessment

Site Plan

GEA
Geotechnical & Environmental Associates
Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site	Borehole Number
233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 5.80 m		Buccleuch Property	J19090
	Location	**Dates**	**Agent**	**Sheet**
		29/04/2019-30/04/2019	Gardiner and Theobald	1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.20)	Concrete		
						0.20			
0.30	D1					0.30	Made Ground (brick and concrete fragments)		
0.50	B2						Made Ground (brown clayey sand with gravel and brick, ash and concrete fragments)		
						(1.40)			
1.20-1.65	SPT(C) N60=39	1.00	DRY	4,5/6,8,9,12					
1.20-1.65	B3								
						1.70			
1.75	D4						Dense yellowish brown sandy fine to coarse sub-angular to sub-rounded GRAVEL		
2.00-2.45	SPT(C) N60=97	2.00	DRY	7,10/15,22,25,25					
2.00-2.45	B5								
2.75	D6								
3.00-3.14	SPT(C) 37*/125	3.00	DRY	12,25/50		(2.80)			
3.00-3.45	50/12 B7								
3.75	D8								
4.00-4.45	SPT(C) N60=71	4.00	DRY	8,9/11,15,18,20				▼1	
4.00-4.45	B9								
				Fast Inflow(1) at 4.50m, rose to 4.00m in 20 mins, sealed at 5.80m.		4.50		▽1	
4.75	D10						Medium dense yellowish brown fine to coarse SAND with fine to coarse sub-angular to sub-rounded gravel		
5.00-5.45	SPT(C) N60=32	5.00	4.00	5,6/7,7,7,8		(1.20)			
5.00-5.45	B11								
						5.70			
							Firm brown mottled orange-brown sandy silty CLAY		
						(0.50)			
6.00	D12					6.20			
							Stiff becoming very stiff high becoming very high strength fissured grey slightly sandy becoming sandy silty CLAY with pale grey veins		
6.50-6.95	U13								
7.50	D14								
8.00-8.45	SPT N60=28	5.80	DRY	4,5/5,6,7,7					
8.00-8.45	D15								
						(5.30)			
9.00	D16								
9.50-9.95	U17								

Remarks
Groundwater monitoring standpipe installed to a depth of 6.00 m.

Scale (approx)	Logged By
1:50	AT

Figure No. J19090.BH1

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GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH1**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 5.80 m		Buccleuch Property	J19090
	Location	**Dates** 29/04/2019-30/04/2019	**Agent** Gardiner and Theobald	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50	D18								
11.00-11.45 11.00-11.45	SPT N60=29 D19	5.80	DRY	4,4/5,6,7,8					
						11.50	Very stiff very high strength fissured grey slightly sandy silty CLAY with pale grey veins and shell fragments		
12.00	D20								
12.50-12.95	U21								
13.50	D22								
14.00-14.45 14.00-14.45	SPT N60=31 D23	5.80	DRY	5,5/6,7,8,7					
15.00	D24								
15.50-15.95	U25								
						(8.50)			
16.50	D26								
17.00-17.45 17.00-17.45	SPT N60=41 D27	5.80	DRY	5,6/7,9,10,11					
18.00	D28								
18.50-18.95	U29								
19.50	D30								
20.00-20.45	SPT N60=44	5.80	DRY	5,6/8,10,11,10					

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
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GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH1**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 5.80 m		Buccleuch Property	J19090
	Location	**Dates** 29/04/2019-30/04/2019	**Agent** Gardiner and Theobald	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00-20.45	D31					20.00	Very stiff very high strength fissured grey sandy silty CLAY with shell fragments and selenite crystals		
21.00	D32								
21.50-21.95	U33					(3.00)			
22.50	D34								
23.00-23.45	SPT N60=51	5.80	DRY	5,7/10,11,13,12		23.00	Very stiff very high strength fissured grey silty CLAY with shell fragments and selenite crystals		
23.00-23.45	D35								
24.00	D36								
24.50-24.95	U37								
25.50	D38					(5.00)			
26.00-26.45	SPT N60=55	5.80	DRY	6,8/10,12,13,14					
26.00-26.45	D39								
27.00	D40								
27.50-27.95	U41								
28.50	D42					28.00	Very stiff very high strength fissured grey sandy silty CLAY with shell fragments and selenite crystals		
29.00	D43					(2.00)			
29.55-30.00	SPT N60=61	5.80	DRY	6,9/12,13,15,15					
29.55-30.00	D44					30.00			

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH1

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GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH2**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 5.50 m		Buccleuch Property	J19090
	Location	**Dates** 01/05/2019- 02/05/2019	**Agent** Gardiner and Theobald	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.20)	Concrete		
0.30	D1					0.20	Made Ground (brown clayey sand with gravel and brick fragments)		
0.50	B2					(0.80)			
						1.00	Dense yellowish brown very sandy fine to coarse sub-angular to sub-rounded GRAVEL		
1.20-1.65	SPT(C) N60=46	1.00	DRY	6,10/9,10,11,11					
1.20-1.65	B3								
1.75	D4								
2.00-2.38	SPT(C) 65/225	2.00	DRY	7,11/15,25,25					
2.00-2.45	B5								
						(3.50)			
2.75	D6								
3.00-3.15	SPT(C) 39*/125 50/25	3.00	DRY	14,25/50					
3.00-3.45	B7								
3.75	D8								
4.00-4.45	SPT(C) N60=64	4.00	DRY	7,9/10,12,15,20					▼1
4.00-4.45	B9								
				Fast Inflow(1) at 4.50m, rose to 4.00m in 20 mins, sealed at 5.50m.		4.50	Medium dense brown fine to coarse SAND and fine to coarse sub-angular to sub-rounded GRAVEL		▽1
4.75	D10					(0.90)			
5.00-5.45	SPT(C) N60=19	5.00	4.00	6,7/7,3,3,4					
5.00-5.45	B11								
						5.40	Firm brown mottled orange-brown silty CLAY		
						(0.60)			
6.00	D12					6.00	Stiff becoming very stiff high strength fissured grey silty CLAY with pale grey veins		
6.50-6.95	U13								
						(2.00)			
7.50	D14								
8.00-8.45	SPT N60=31	5.50	DRY	4,5/6,7,8,7		8.00	Very stiff high becoming very high strength fissured grey silty sandy CLAY with pale grey veins and selenite fragments		
8.00-8.45	D15								
9.00	D16								
9.50-9.95	U17								

Remarks
Groundwater monitoring standpipe installed to a depth of 6.00 m.
1 hour standing time waiting for obstructing vehicles to be moved.

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH2

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GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH2**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 5.50 m		Buccleuch Property	J19090
	Location	**Dates** 01/05/2019- 02/05/2019	**Agent** Gardiner and Theobald	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50	D18								
11.00-11.45 11.00-11.45	SPT N60=34 D19	5.50	DRY	4,6/7,7,8,8		(7.00)			
12.00	D20								
12.50-12.95	U21								
13.50	D22								
14.00-14.45 14.00-14.45	SPT N60=34 D23	5.50	DRY	5,6/7,8,8,7					
15.00	D24					15.00	Very stiff very high strength fissured grey silty CLAY with pale grey veins		
15.50-15.95	U25								
16.50	D26								
17.00-17.45 17.00-17.45	SPT N60=41 D27	5.50	DRY	6,7/8,9,10,10		(5.00)			
18.00	D28								
18.50-18.95	U29								
19.50	D30								
20.00-20.45	SPT N60=47	5.50	DRY	6,8/9,10,11,12					

Remarks	Scale (approx)	Logged By
	1:50	AT
	Figure No. J19090.BH2	

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GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH2**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 5.50 m		Buccleuch Property	J19090
	Location	**Dates** 01/05/2019- 02/05/2019	**Agent** Gardiner and Theobald	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00-20.45	D31					20.00	Very stiff very high strength fissured grey silty sandy CLAY with pale grey veins and shell fragments		
21.00	D32								
21.50-21.95	U33								
22.50	D34								
23.00-23.45 23.00-23.45	SPT N60=55 D35	5.50	DRY	5,8/11,12,12,14					
24.00	D36								
24.50-24.95	U37					(10.00)			
25.50	D38								
26.00-26.45 26.00-26.45	SPT N60=58 D39	5.50	DRY	6,9/11,12,14,15					
27.00	D40								
27.50-27.95	U41								
28.50	D42								
29.00	D43								
29.55-30.00 29.55-30.00	SPT N60=59 D44	5.50	DRY	6,10/11,13,14,15		30.00			

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH2

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GEA

Geotechnical & Environmental Associates

Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site	Borehole Number
233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	BH3

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 6.00 m		Buccleuch Property	J19090
	Location	**Dates** 19/04/2019-24/04/2019	**Agent** Gardiner and Theobald	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						0.10 (0.20)	Concrete		
0.30	D1					0.30	Made Ground (brick and concrete fragments)		
0.50	B2					(0.90)	Made Ground (brown clayey sand with gravel and brick fragments)		
						1.20			
1.20-1.65	SPT(C) N60=98	1.20	DRY	5,9/18,20,25,25			Dense yellowish brown sandy and fine to coarse sub-angular to sub-rounded GRAVEL		
1.20-1.65	B3								
1.75	D4								
2.00-2.14	SPT(C) 35*/125 50/12	2.00	DRY	15,20/50					
2.00-2.45	B5								
2.75	D6					(3.30)			
3.00-3.14	SPT(C) 47*/125 50/12	3.00	DRY	22,25/50					
3.00-3.45	B7								
3.75	D8								
4.00-4.45	SPT(C) N60=93	4.00	DRY	6,12/18,20,25,20					▼1
4.00-4.45	B9								▽1
				Fast Inflow(1) at 4.50m, rose to 4.00m in 20 mins, sealed at 6.00m.		4.50	Medium dense brown fine to coarse SAND with fine to coarse sub-angular to sub-rounded GRAVEL		
4.75	D10								
5.00-5.45	SPT(C) N60=29	5.00	DRY	4,5/6,6,7,7		(1.30)			
5.00-5.45	B11								
						5.80	Firm brown sandy silty CLAY		
6.00	D12					(0.40)			
						6.20	Stiff becoming very stiff high becoming very high strength fissured grey silty CLAY		
6.50-6.95	U13					(1.30)			
7.50	D14					7.50	Very stiff high becoming very high strength fissured grey silty sandy CLAY with shell fragments		
8.00-8.45	SPT N60=23	6.00	DRY	4,4/5,5,5,6					
8.00-8.45	D15								
9.00	D16								
9.50-9.95	U17					(4.50)			

Remarks
Groundwater monitoring standpipe installed to a depth of 6.00 m.

Scale (approx)	Logged By
1:50	AT

Figure No. J19090.BH3

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GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH3**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 6.00 m		Buccleuch Property	J19090
	Location	**Dates** 19/04/2019-24/04/2019	**Agent** Gardiner and Theobald	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50	D18								
11.00-11.45	SPT N60=27	6.00	DRY	4,5/5,6,6,7					
11.00-11.45	D19								
						12.00			
12.00	D20						Very stiff high strength fissured grey silty CLAY		
12.50-12.95	U21								
13.50	D22								
14.00-14.45	SPT N60=31	6.00	DRY	4,5/6,7,7,8					
14.00-14.45	D23								
15.00	D24								
15.50-15.64	SPT(C) 40*/125 50/12	6.00	DRY	15,25/50			Claystone encountered at 15.40 m		
15.50-15.95	D25								
						(8.00)			
16.50	D26								
17.00-17.45	SPT N60=35	6.00	DRY	5,6/7,7,8,9					
17.00-17.45	D27								
18.00	D28								
18.50-18.95	U29								
19.50	D30								
20.00-20.45	SPT N60=41	6.00	DRY	5,6/8,9,10,10					

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH3

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GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH3**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 6.00 m		Buccleuch Property	J19090
	Location	**Dates** 19/04/2019- 24/04/2019	**Agent** Gardiner and Theobald	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00-20.45	D31					20.00	Very stiff very high strength fissured grey sandy silty CLAY with shell fragments and pale grey veins		
21.00	D32								
21.50-21.95	U33					(3.00)			
22.50	D34								
23.00-23.45	SPT N60=49	6.00	DRY	6,7/9,11,12,12		23.00	Very stiff very high strength fissured grey silty CLAY with pale grey veins		
23.00-23.45	D35								
24.00	D36								
24.50-24.95	U37					(3.50)			
25.50	D38								
26.00-26.45	SPT N60=57	6.00	DRY	6,8/11,12,13,15					
26.00-26.45	D39								
27.00	D40					26.50	Very stiff fissured grey sandy silty CLAY		
27.50-27.95	U41					(1.00)			
28.50	D42					27.50	Very stiff very high strength fissured grey silty CLAY with pale grey veins		
29.00	D43					(2.50)			
29.55-30.00	SPT N60=57	6.00	DRY	6,9/11,12,15,13					
29.55-30.00	D44					30.00			

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No. J19090.BH3

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GEA

Geotechnical & Environmental Associates
Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site	Borehole Number
233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	BH4

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 6.00 m		Buccleuch Property	J19090
	Location	**Dates**	**Agent**	**Sheet**
		23/04/2019-24/04/2019	Gardiner and Theobald	1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.20) 0.20	Concrete		
0.30	D1					(0.30) 0.50	Made Ground (brown sand with gravel and brick fragments)		
0.50	D2					(0.20) 0.70	Made Ground (brown clay with gravel and brick fragments)		
						(0.50) 1.20	Made Ground (brown sandy clay with gravel and occasional brick fragments)		
1.20-1.65	SPT(C) N60=47	1.20	DRY	2,3/6,13,19,25		(0.50) 1.70	Dense brown clayey SAND with fine to coarse sub-angular to sub-rounded GRAVEL and pockets of orange-brown sandy clay		
1.20-1.65	B3								
1.75	D4						Dense yellowish brown sandy fine to coarse sub-angular to sub-rounded GRAVEL		
2.00-2.45	SPT(C) N60=63	2.00	DRY	3,5/7,18,25,34					
2.00-2.45	B5								
2.75	D6					(2.30)			
3.00-3.45	SPT(C) N60=42	3.00	DRY	2,4/6,11,18,21					
3.00-3.45	B7								
3.75	D8								
4.00-4.45	SPT(C) N60=23	4.00	DRY	4,7/7,8,7,8		4.00	Medium dense yellowish brown fine to coarse SAND and fine to coarse sub-angular to sub-rounded GRAVEL		
4.00-4.45	B9								
4.75	D10					(1.75)			
5.00-5.45	SPT(C) N60=18	5.00	4.50	3,5/4,7,7,6					
5.00-5.45	B11								
5.75	D12					5.75	Firm brown mottled orange-brown silty CLAY		
						(0.45) 6.20			
6.50-6.95	U13						Stiff becoming very stiff high strength fissured bluish grey silty CLAY with pale grey veins		
7.00	D14								
8.00-8.45	SPT N60=14	6.00	DRY	5,3/3,4,5,6					
8.00-8.45	D15								
						(4.80)			
9.00	D16								
9.50-9.95	U17								

Remarks
Groundwater not encountered.
Water added to assist drilling at depths of between 1.00 m and 5.00 m.
Groundwater monitoring standpipe installed to a depth of 6.00 m.
1.5 hours standing for UXO breifing.

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH4

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GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH4**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 6.00 m		Buccleuch Property	J19090
	Location	**Dates** 23/04/2019- 24/04/2019	**Agent** Gardiner and Theobald	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	D18								
11.00-11.45	SPT N60=20	6.00	DRY	3,4/5,6,7,8		11.00	Very stiff high becoming very high strength fissured grey silty CLAY with pale grey veins and shell fragments		
11.00-11.45	D19								
12.00	D20								
12.50-12.95	U21								
13.50	D22								
14.00-14.05	SPT 25*/25 50/25	6.00	DRY	25/50			Claystone encountered at a depth of 14.00 m		
14.00-14.45	D23								
15.00	D24					(8.00)			
15.50-15.95	U25								
16.50	D26								
17.00-17.45	SPT N60=26	6.00	DRY	5,7/8,7,10,9					
17.00-17.45	D27								
18.00	D28								
18.50-18.95	U29								
19.50	D30					19.00	Very stiff high strength fissured grey silty sandy CLAY with pale grey veins		
20.00-20.45	SPT N60=29	6.00	DRY	6,7/8,9,10,11					

Remarks	Scale (approx)	Logged By
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	Figure No.	J19090.BH4

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Geotechnical & Environmental Associates
Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site	Borehole Number
233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	BH4

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 6.00 m		Buccleuch Property	J19090
	Location	**Dates**	**Agent**	**Sheet**
		23/04/2019-24/04/2019	Gardiner and Theobald	3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00-20.45	D31								
21.00	D32								
21.50-21.95	U33					(5.50)			
22.50	D34								
23.00-23.45	SPT N60=38	6.00	DRY	6,8/10,12,13,15					
23.00-23.45	D35								
24.00	D36								
24.50-24.95	U37					24.50	Very stiff very high strength fissured grey silty sandy CLAY with pale grey veins and shell fragments		
25.50	D38								
26.00-26.45	SPT N60=37	6.00	DRY	6,8/10,11,12,16					
26.00-26.45	D39								
27.00	D40					(5.50)			
27.50-27.95	U41								
28.00	D42								
29.55-30.00	SPT N60=38	6.00	DRY	7,10/9,12,13,17					
29.55-30.00	D43					30.00			

Remarks

Scale (approx)	Logged By
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GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH5**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 10.00 m		Buccleuch Property	J19090
	Location	**Dates** 25/04/2019- 26/04/2019	**Agent** Gardiner and Theobald	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	Made Ground (dark brown clayey sand with gravel and occasional brick fragments)		
0.30	D1					0.30			
0.50	D2						Dense and very dense yellowish brown fine to coarse SAND with fine to coarse sub-angular to sub-rounded gravel		
						(1.70)			
1.20-1.65 1.20-1.65	SPT(C) N60=57 B3	1.20	DRY	2,4/8,16,22,30					
1.75	D4								
2.00-2.19 2.00-2.45	SPT(C) 22*/125 50/60 B5	2.00	DRY	12,10/50		2.00	Dense and very dense yellowish brown fine to coarse SAND and fine to coarse sub-angular to sub-rounded GRAVEL		
2.75	D6								
3.00-3.10 3.00-3.45	SPT(C) 25*/50 50/50 B7	3.00	DRY	25/50					
3.75	D8					(3.70)			
4.00-4.35 4.00-4.45	SPT(C) 57/200 B9	4.00	DRY	8,10/15,25,17					
4.75	D10								
5.00-5.45 5.00-5.45	SPT(C) N60=20 B11	5.00	DRY	7,5/7,7,6,6					
						5.70	Firm brown mottled orange-brown silty CLAY		
						(0.50)			
6.00	D12					6.20			
6.50-6.95	U13						Stiff becoming very stiff high strength fissured bluish grey silty slightly sandy CLAY		
7.00	D14					(1.80)			
8.00-8.45 8.00-8.45	SPT N60=17 D15	8.00	DRY	2,3/5,6,6,6		8.00	Very stiff high becoming very high strength fissured bluish grey silty CLAY with shell fragments and pale grey veins		
9.00	D16								
9.50-9.95	U17								

Remarks
Groundwater not encountered.
Water added to assist drilling between 1.00 m and 5.50 m.
Standpipe installed to a depth of 5.70 m.
3 hours standing time waiting for site access.

Scale (approx)	Logged By
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J19090.BH5

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GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH5**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 10.00 m		Buccleuch Property	J19090
	Location	**Dates** 25/04/2019- 26/04/2019	**Agent** Gardiner and Theobald	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	D18								
11.00-11.45	SPT N60=20	10.00	DRY	4,4/6,6,7,7					
11.00-11.45	D19								
12.00	D20								
12.50-12.95	U21					(9.00)			
13.50	D22								
14.00-14.45	SPT N60=26	10.00	DRY	5,6/7,8,9,10					
14.00-14.45	D23								
15.00	D24								
15.50-15.95	U25								
16.50	D26								
17.00-17.45	SPT N60=29	10.00	DRY	6,7/8,10,10,10		17.00	Very stiff very high strength fissured bluish grey silty sandy CLAY with shell fragments and pale grey veins		
17.00-17.45	D27								
18.00	D28								
18.50-18.95	U29					(3.00)			
19.50	D30								
20.00-20.45	SPT N60=36	10.00	DRY	5,8/8,11,14,15					

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH5

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GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH5**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 10.00 m		Buccleuch Property	J19090
	Location	**Dates** 25/04/2019- 26/04/2019	**Agent** Gardiner and Theobald	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						20.00			
20.00-20.45	D31						Very stiff very high strength fissured bluish grey silty CLAY with shell fragments and pale grey veins		
21.00	D32								
21.50-21.95	U33								
22.50	D34								
23.00-23.45 23.00-23.45	SPT N60=38 D35	10.00	DRY	5,8/10,13,13,15		(6.00)			
24.00	D36								
24.50-24.95	U37								
25.50	D38								
26.00-26.45 26.00-26.45	SPT N60=38 D39	10.00	DRY	5,8/10,12,13,15		26.00	Very stiff very high strength fissured bluish grey silty sandy CLAY with selenite crystals		
27.00	D40								
27.50-27.95	U41					(3.00)			
28.50	D42								
						29.00	Very stiff very high strength fissured bluish grey silty CLAY with pale grey veins		
29.55-30.00 29.55-30.00	SPT N60=44 D43	10.00	DRY	7,9/12,12,15,19		(1.00)			
						30.00			

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH5

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Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site	Borehole Number
233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	BH6

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 4.80 m		Buccleuch Property	J19090
	Location	**Dates** 30/04/2019-01/05/2019	**Agent** Gardiner and Theobald	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.20)	Concrete		
						0.20			
0.30	D1					(0.30)	Made Ground (brown clayey sand with gravel and brick fragments)		
0.50	D2					0.50			
						(0.70)	Made Ground (orange-brown sandy clay with gravel, cobbles and brick fragments)		
						1.20			
1.20-1.65	B3					(0.30)	Firm yellowish brown silty slightly sandy CLAY with fine to coarse sub-angular to sub-rounded gravel		
						1.50			
1.75	D4						Dense yellowish brown sandy fine to coarse sub-angular to sub-rounded GRAVEL		
2.00-2.45	SPT(C) N60=27	2.00	DRY	5,5/8,9,9,10					
2.00-2.45	B5								
2.75	D6								
3.00-3.45	SPT(C) N60=23	3.00	DRY	3,5/7,7,8,9		(3.25)			
3.00-3.45	B7								
3.75	D8								
4.00-4.45	SPT(C) N60=25	4.00	DRY	3,4/7,8,9,9					
4.00-4.45	B9								
						4.75			
4.75	D10						Firm brown silty CLAY		
5.00-5.45	SPT(C) N60=17	4.80	DRY	2,2/5,5,6,6		(0.45)			
5.00-5.45	D11					5.20			
							Stiff becoming very stiff high strength fissured grey silty CLAY with occasional shell fragments		
6.00	D12								
6.50-6.95	U13					(2.80)			
7.50	D14								
8.00-8.45	SPT N60=18	4.80	DRY	3,3/5,6,6,7		8.00			
8.00-8.45	D15						Very stiff very high strength fissured grey silty CLAY with occasional shell fragments		
9.00	D16								
9.50-9.95	U17								

Remarks
Groundwater not encountered.
Water added to assist drilling from 1.00 m to 4.50 m.
Groundwater monitoring standpipe installed to a depth of 5.80 m.

Scale (approx)	Logged By
1:50	AT

Figure No. J19090.BH6

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GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH6**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 4.80 m		Buccleuch Property	J19090
	Location	**Dates** 30/04/2019-01/05/2019	**Agent** Gardiner and Theobald	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50	D18								
11.00-11.45	SPT N60=19	4.80	DRY	3,4/5,6,7,7					
11.00-11.45	D19								
12.00	D20					(8.00)			
12.50-12.95	U21								
13.50	D22								
14.00-14.45	SPT N60=19	4.80	DRY	3,4/5,6,7,7					
14.00-14.45	D23								
15.00	D24								
15.50-15.95	U25								
						16.00	Very stiff very high strength fissured grey sandy silty CLAY with shell fragments and pale grey veins		
16.50	D26								
17.00-17.45	SPT N60=24	4.80	DRY	5,6/7,8,8,9					
17.00-17.45	D27								
18.00	D28								
18.50-18.95	U29								
19.50	D30								
20.00-20.45	SPT N60=26	4.80	DRY	5,7/7,7,9,11					

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH6

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GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site 233-236 Nestles Avenue, Hayes & Harlington, London UB3 4SH	Borehole Number **BH6**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to 4.80 m		Buccleuch Property	J19090
	Location	**Dates** 30/04/2019-01/05/2019	**Agent** Gardiner and Theobald	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00-20.45	D31								
21.00	D32								
21.50-21.95	U33								
22.50	D34								
23.00-23.45	SPT N60=27	4.80	DRY	6,7/8,8,10,10		(14.00)			
23.00-23.45	D35								
24.00	D36								
24.50-24.95	U37								
25.50	D38								
26.00-26.45	SPT N60=32	4.80	DRY	7,8/8,10,10,15					
26.00-26.45	D39								
27.00	D40								
27.50-27.95	U41								
28.50	D42								
29.55-30.00	SPT N60=40	4.80	DRY	8,10/12,12,15,14					
29.55-30.00	D43					30.00			

Remarks

Scale (approx)	Logged By
1:50	AT

Figure No.
J19090.BH6

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SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH1	2.00		B	Yellowish brown sandy GRAVEL															Particle Size Distribution
BH1	5.00		B	Yellowish brown very gravelly SAND															Particle Size Distribution
BH1	6.00		D	Brown mottled orangish brown fine sandy silty CLAY with rare fine to medium gravel.	27.2	72	24	48	98										
BH1	6.50		U	Very stiff fissured dark brown silty CLAY	26.9					2.00	1.58	Undisturbed	130	213	106				
BH1	9.00		D													8.7	0.31		
BH1	9.50		U	Very stiff fissured dark brown silty CLAY	25.5					1.99	1.59	Undisturbed	190	330	165				
BH1	12.50		U	Very stiff fissured dark brown silty CLAY	25.4					2.02	1.61	Undisturbed	250	366	183				
BH1	15.50		U	Very stiff fissured dark brown silty CLAY	24.9					2.04	1.63	Undisturbed	310	441	220				
BH1	18.50		U	Very stiff fissured dark brown silty CLAY with rare pyrite	26.4					2.03	1.61	Undisturbed	370	317	159				
BH1	21.50		U	Very stiff fissured dark brown silty CLAY	26.3					2.02	1.60	Undisturbed	430	539	269				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke - Senior Technician
23/05/2019

Project Number:

GEO / 29251

Project Name:

NESTLES AVENUE, LONDON
J19090

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SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH1	24.50		U	Very stiff fissured dark brown silty CLAY	26.7					2.01	1.58	Undisturbed	490	351	175				
BH1	28.50		D	Dark brown mottled light grey fine sandy silty CLAY with rare fine gravel.	23.5	69	26	43	99										
BH2	4.00		B	Yellowish brown very sandy flint GRAVEL															Particle Size Distribution
BH2	6.50		U	Very stiff fissured dark brown silty CLAY.	26.3					2.03	1.61	Undisturbed	130	179	90				
BH2	9.50		U	Very stiff fissured dark brown silty CLAY.	27.6					2.03	1.59	Undisturbed	190	231	115				
BH2	12.50		U	Very stiff fissured dark brown silty CLAY.	24.6					2.05	1.64	Undisturbed	250	320	160				
BH2	13.50		D	Dark brown fine sandy silty CLAY with rare fine gravel.	22.4	68	28	40	99										
BH2	15.50		U	Very stiff fissured dark brown silty CLAY.	24.6					2.05	1.64	Undisturbed	310	379	189				
BH2	18.00		D													8.3	0.14		
BH2	18.50		U	Very stiff fissured dark brown silty CLAY.	26.5					2.03	1.60	Undisturbed	370	442	221				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke - Senior Technician
23/05/2019

Project Number:

GEO / 29251

Project Name:

NESTLES AVENUE, LONDON
J19090

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SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH2	21.50		U	Very stiff fissured dark brown silty CLAY.	27.7					2.01	1.57	Undisturbed	430	382	191				
BH2	24.95		U	Very stiff fissured dark brown silty CLAY.	25.2					1.99	1.59	Undisturbed	490	450	225				
BH2	27.50		U	Very stiff fissured dark brown silty CLAY.	25.1					1.98	1.58	Undisturbed	550	325	162				
BH3	3.00		B	Yellowish brown sandy GRAVEL															Particle Size Distribution
BH3	5.00		B	Yellowish brown very gravelly SAND with rare lumps of brown clay. Gravel is flint.															Particle Size Distribution
BH3	6.00		D	Brown mottled grey fine sandy silty CLAY with rare fine to medium gravel.	19.7	72	25	47	98										
BH3	6.50		U	Very stiff fissured dark brown silty CLAY with rare siltstone	24.3					2.02	1.63	Undisturbed	130	247	124				
BH3	9.50		U	Very stiff fissured dark brown silty CLAY.	24.3					2.04	1.64	Undisturbed	190	399	199				
BH3	12.50		U	Very stiff fissured dark brown silty CLAY.	24.7					2.05	1.65	Undisturbed	250	291	146				
BH3	18.50		U	Very stiff fissured dark brown silty CLAY.	26.5					2.04	1.61	Undisturbed	370	378	189				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke - Senior Technician
23/05/2019

Project Number:

GEO / 29251

Project Name:

NESTLES AVENUE, LONDON
J19090

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SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH3	19.50		D	Dark brown fine sandy silty CLAY with rare fine to medium gravel.	21.2	76	25	51	99										
BH3	21.50		U	Very stiff fissured dark brown silty CLAY.	26.9					2.00	1.58	Undisturbed	430	346	173				
					16.0					2.03	1.75	Undisturbed	430	448	224				
BH3	24.50		U	Very stiff fissured dark brown silty CLAY.	26.1					1.98	1.57	Undisturbed	490	360	180				
BH3	25.50		D													8.8	0.18		
BH3	27.50		U	Very stiff fissured dark brown silty CLAY.	25.5					2.04	1.62	Undisturbed	550	260	130				
BH4	2.75		D													9.2	<0.010		
BH4	3.00		B	Yellowish brown sandy GRAVEL															Particle Size Distribution
BH4	5.00		B	Yellowish brown SAND and flint GRAVEL															Particle Size Distribution
BH4	6.50		U	Very stiff fissured dark brown silty CLAY.	26.5					2.00	1.58	Undisturbed	130	266	133				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke - Senior Technician
23/05/2019

Project Number:

GEO / 29251

Project Name:

NESTLES AVENUE, LONDON
J19090

GEOLABS®

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH4	9.00		D	Dark brown fine sandy silty CLAY with rare fine gravel.	25.3	67	23	44	99										
BH4	9.50		U	Very stiff fissured dark brown silty CLAY with rare siltstone.	21.4					2.03	1.67	Undisturbed	190	296	148				
BH4	12.50		U	Very stiff fissured dark brown silty CLAY with rare shell fragments.	24.9					2.04	1.63	Undisturbed	250	249	124				
BH4	15.50		U	Very stiff fissured dark brown silty CLAY with rare siltstone.	27.4					1.97	1.54	Undisturbed	310	307	154				
BH4	18.50		U	Very stiff fissured dark brown silty CLAY.	27.6					1.98	1.55	Undisturbed	370	258	129				
BH4	21.50		U	Very stiff fissured dark brown silty CLAY.	25.9					1.95	1.55	Undisturbed	430	190	95				
BH4	22.50		D	Dark brown fine sandy silty CLAY with rare fine gravel.	22.2	72	24	48	99										
BH4	24.50		U	Very stiff fissured dark brown silty CLAY.	18.5					2.05	1.73	Undisturbed	490	476	238				
BH4	27.50		U	Very stiff fissured dark brown silty CLAY.	23.7					2.02	1.64	Undisturbed	550	368	184				
BH4	28.00		D													8.9	0.11		

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

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Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH5	1.20		B													8.4	<0.010		
BH5	2.00		B	Yellowish brown SAND and GRAVEL															Particle Size Distribution
BH5	6.50		U	Very stiff fissured dark brown silty CLAY.	25.3					2.04	1.63	Undisturbed	130	291	145				
BH5	7.00		D	Dark brown fine sandy silty CLAY with rare fine gravel.	23.2	67	21	46	99							8.3	0.34		
BH5	9.50		U	Very stiff fissured dark brown silty CLAY.	24.1					2.04	1.65	Undisturbed	190	383	192				
BH5	12.50		U	Very stiff fissured dark brown silty CLAY.	25.4					2.03	1.62	Undisturbed	250	223	112				
BH5	15.50		U	Very stiff fissured dark brown silty CLAY.	26.8					2.00	1.58	Undisturbed	310	321	161				
BH5	16.50		D	Dark brown fine sandy silty CLAY with rare fine gravel.	27.1	75	27	48	99										
BH5	18.50		U	Very stiff fissured dark brown silty CLAY.	26.9					2.00	1.58	Undisturbed	370	442	221				
BH5	24.50		U	Very stiff fissured dark brown silty CLAY.	25.9					1.99	1.58	Undisturbed	490	339	169				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

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SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH5	27.50		U	Very stiff fissured dark brown silty CLAY.	24.3					2.06	1.66	Undisturbed	550	693	347				
BH6	1.20		B	Yellowish brown slightly gravelly slightly sandy silty CLAY.	11.3	45	18	27	41										
BH6	4.00		B	Yellowish brown sandy GRAVEL															Particle Size Distribution
BH6	6.50		U	Very stiff fissured dark brown silty CLAY.	25.0					2.02	1.62	Undisturbed	130	237	118				
BH6	9.50		U	Very stiff fissured dark brown silty CLAY.	24.6					2.05	1.64	Undisturbed	190	311	155				
BH6	12.00		D													8.6	0.11		
BH6	12.50		U	Very stiff fissured dark brown silty CLAY.	24.2					2.05	1.65	Undisturbed	250	394	197				
BH6	15.50		U	Very stiff fissured dark brown silty CLAY.	26.3					2.02	1.60	Undisturbed	310	190	95				
BH6	18.50		U	Very stiff fissured dark brown silty CLAY	26.1					2.00	1.58	Undisturbed	370	342	171				
BH6	21.50		U	Very stiff fissured dark brown silty CLAY with rare pyrite	28.0					2.00	1.56	Undisturbed	430	396	198				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

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SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH6	24.50		U	Very stiff fissured dark brown silty CLAY	26.1					2.01	1.59	Undisturbed	490	434	217				
BH6	27.50		U	Very stiff fissured dark brown silty CLAY	25.3					2.01	1.61	Undisturbed	550	516	258				
BH7	1.90		D													8.3	<0.010		
BH1	27.50		U	Very stiff fissured dark brown silty CLAY.	22.8														
BH10	1.50		D													8.4	<0.010		
BH13	1.00		D													8.4	<0.010		
BH13	1.60		D	Yellowish brown slightly clayey sandy GRAVEL															Particle Size Distribution
BH19	0.80		D	Brown clayey sandy GRAVEL															Particle Size Distribution
BH20	0.70		D	Brown clayey sandy GRAVEL															Particle Size Distribution

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

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23/05/2019

Project Number:

GEO / 29251

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NESTLES AVENUE, LONDON
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GEOLABS®

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

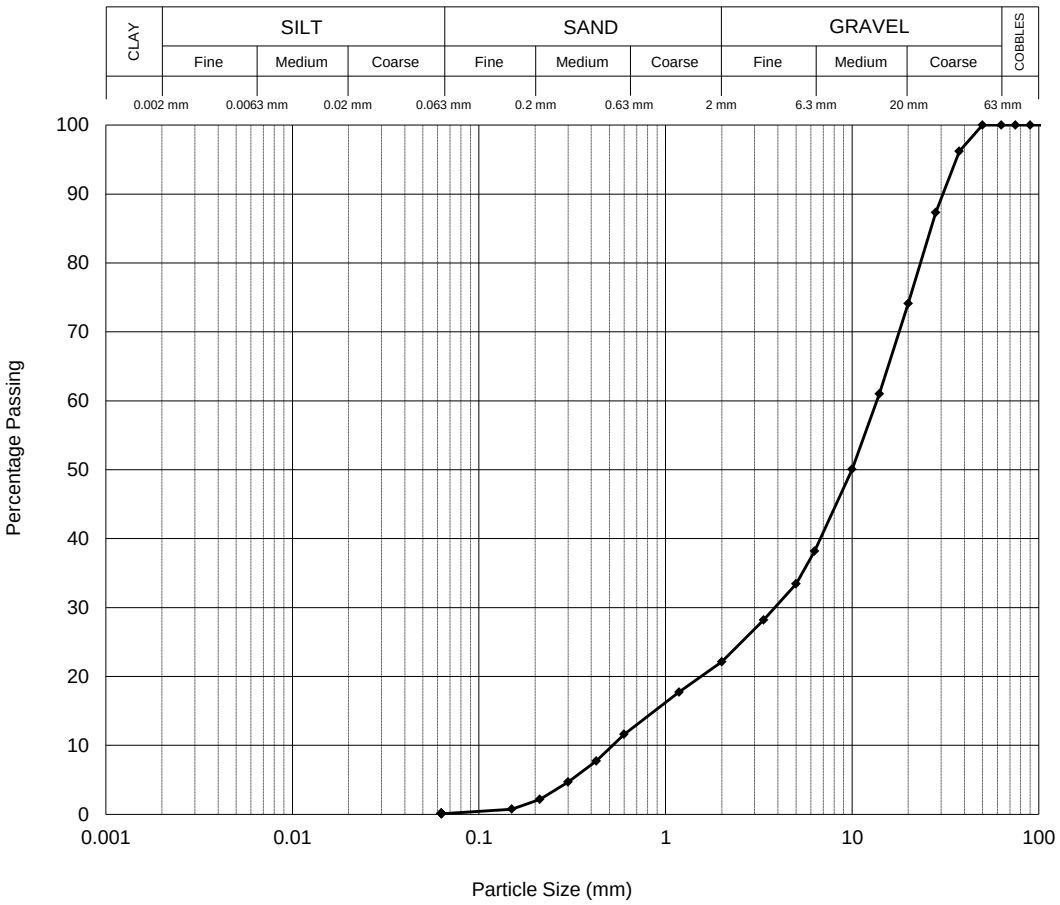
BH / TP No.	BH1
Depth (m)	2.00
Sample Type	B

Description

Yellowish brown sandy GRAVEL

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Dry Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	96
28.0 mm	87
20.0 mm	74
14.0 mm	61
10.0 mm	50
6.30 mm	38
5.00 mm	33
3.35 mm	28
2.00 mm	22
1.18 mm	18
600 µm	12
425 µm	8
300 µm	5
212 µm	2
150 µm	1
63 µm	0



Particle Proportions	
Cobbles	0
Gravel	78
Sand	22
Silt & Clay	0

Checked and Approved by

S Burke

S Burke - Senior Technician
23/05/2019

Project Number:

GEO / 29251

Project Name:

NESTLES AVENUE, LONDON
J19090

GEOLABS

UKAS TESTING 1982

Client : Geotechnical & Environmental Associates Limited, Widbury Barn, Widbury Hill, Ware, Hertfordshire, SG12 7QE (Ref 1558618827)

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

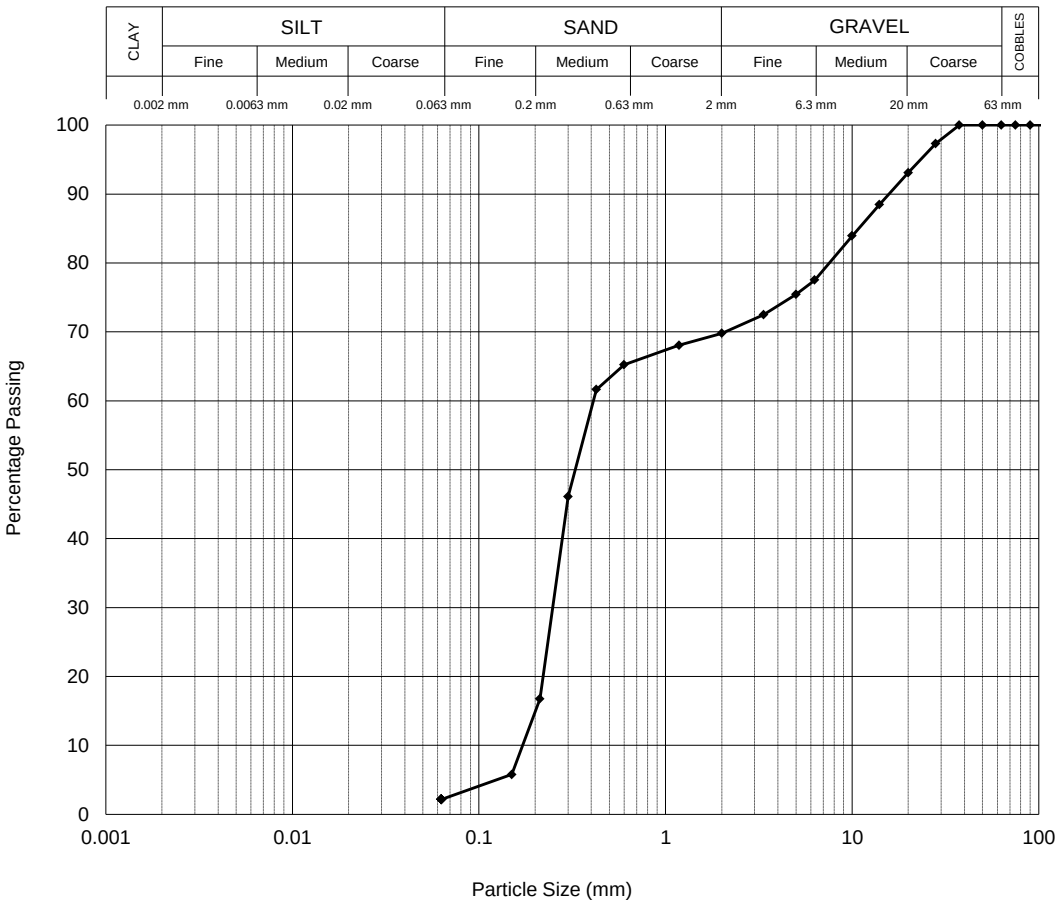
BH / TP No.	BH1
Depth (m)	5.00
Sample Type	B

Description

Yellowish brown very gravelly SAND

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Dry Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	97
20.0 mm	93
14.0 mm	88
10.0 mm	84
6.30 mm	78
5.00 mm	75
3.35 mm	73
2.00 mm	70
1.18 mm	68
600 µm	65
425 µm	62
300 µm	46
212 µm	17
150 µm	6
63 µm	2



Particle Proportions	
Cobbles	0
Gravel	30
Sand	68
Silt & Clay	2

Checked and Approved by

S Burke

S Burke - Senior Technician
23/05/2019

Project Number:

GEO / 29251

Project Name:

NESTLES AVENUE, LONDON
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GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

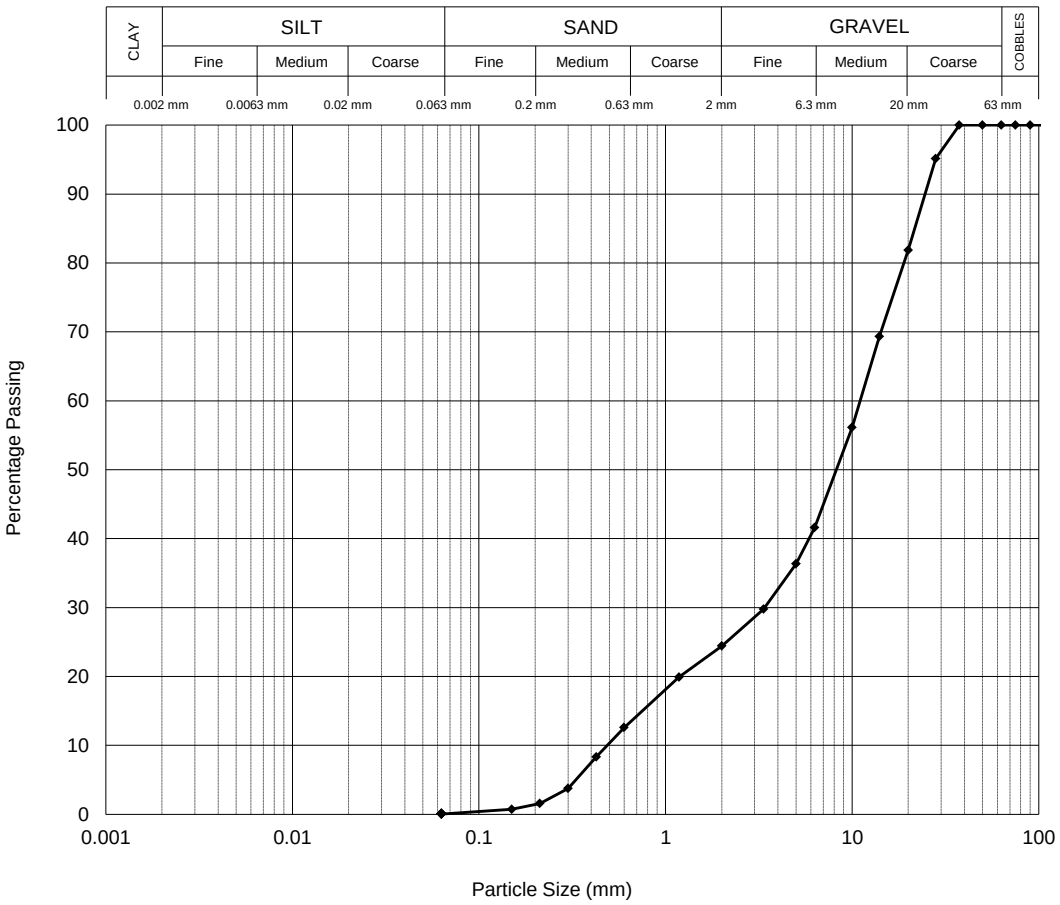
BH / TP No.	BH2
Depth (m)	4.00
Sample Type	B

Description

Yellowish brown very sandy flint GRAVEL

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Dry Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	95
20.0 mm	82
14.0 mm	69
10.0 mm	56
6.30 mm	42
5.00 mm	36
3.35 mm	30
2.00 mm	24
1.18 mm	20
600 µm	13
425 µm	8
300 µm	4
212 µm	2
150 µm	1
63 µm	0



Particle Proportions	
Cobbles	0
Gravel	76
Sand	24
Silt & Clay	0

Checked and Approved by

S Burke

S Burke - Senior Technician
23/05/2019

Project Number:

GEO / 29251

Project Name:

NESTLES AVENUE, LONDON
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GEOLABS

UKAS TESTING 1982