# DESK STUDY & BASEMENT IMPACT ASSESSMENT REPORT

The Hall School
23 Crossfield Street
London NW3

Client: The Hall School

Engineer: Elliott Wood

J15302

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GEA Geotechnical & Environmental Associates

## Document Control

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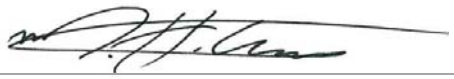
| **Report prepared by** |  | | |
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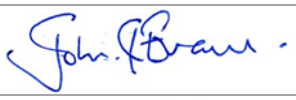
| |  | | |
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## CONTENTS

## Part 3: GROUND MOVEMENT ASSESSMENT

# 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 The Hall School, with respect to the demolition of the southern half of the school building and the subsequent construction of a new four-storey building with a double level basement. The purpose of the investigation has been to research the history of the site with respect to previous contaminative uses, to determine the ground conditions, to provide a preliminary assessment of the extent of any contamination and to provide information to assist with the design of the basement structure and suitable foundations. This report also includes a Basement Impact Assessment in order to comply with London Borough of Camden (LBC) Planning Guidance CPG4.

## SUMMARY OF SITE HISTORY

The earliest Ordnance Survey (OS) map studied, dated 1871, shows the site to be undeveloped in an area dominated by open fields, as the immediate surrounding area was also largely undeveloped. By 1896 the area had been developed, with Crossfield Street constructed and the site partially developed with a building positioned in the northwestern corner. According to online information, the school was founded in 1889 as Belsize School, but was later renamed The Hall at the turn of the 20$^{th}$ Century.Some time between 1920 and 1935, the building occupying the site was extended southwards, with two small outbuildings constructed across the southern half. The southern half of Crossfield Street was developed with the existing terraced houses between 1962 and 1973, whilst the site remained essentially unchanged until some time between 1991 and 1994, when the existing building across the southern half of the site, the Wreathen Hall, was constructed.

## GROUND CONDITIONS.

The investigation has encountered the expected ground conditions in that, below a generally moderate but locally significant thickness of made ground, the London Clay Formation was encountered. Made ground extended to depths of between 1.00 m and 3.80 m, although only extended to beyond 1.35 m in Borehole No 2. It was found to generally comprise brown and dark brown silty clay with gravel, decayed rootlets and fragments of brick and coal. In Borehole No 2, below a depth of 2.40 m, the made ground generally comprised crushed brick, which was loosely cemented in places, with gravel and concrete fragments. The London Clay initially comprised a weathered horizon of firm medium strength becoming stiff and high strength fissured locally thinly laminated brown clay with bluish grey veins, occasional pockets of orange-brown fine sand and grey silt and fine to coarse selenite crystals, which extended to the maximum depth investigated in the window sample boreholes and to a depth of 9.00 m in Borehole No 1. Below that depth, very stiff high strength to very high strength fissured locally very thinly laminated silty clay with fine selenite, occasional white shells, occasional pale grey veins and white foraminifera was encountered and proved to the maximum depth investigated, of 25.00 m. Claystones were encountered at 17.00 m and 23.70 m.

Seepage of groundwater was encountered in the made ground at depths of 2.40 m and 1.20 m in Borehole Nos 2 and 3 respectively and subsequent groundwater monitoring recorded variable water levels within the standpipes, which do not represent a continuous groundwater table, but rather perched water trapped within the standpipes. The results of the contamination testing have revealed elevated concentrations of arsenic, lead and total PAH including benzo(a)pyrene in the made ground.

## RECOMMENDATIONS AND BIA CONCLUSIONS

Excavations for the proposed basement structure will require temporary support to maintain stability and to prevent any excessive ground movements. Based on the groundwater observations to date, significant groundwater inflows are unlikely to be encountered within the basement excavation. The proposed use of a contiguous bored pile wall, coupled with localised underpinning. is considered to be a suitable solution for the construction and excavation of the proposed basement. Spread foundations excavated from basement level may be designed to apply a net allowable bearing pressure of 200 kN/m$^2$.

The ground movement analysis has indicated that the predicted damage to the neighbouring properties will be Category 0 ‘Negligible’ or Category 1 ‘Very Slight’ and is therefore within acceptable limits. The BIA has concluded that the proposed development will not have an impact on the local hydrogeological or hydrological setting.

# 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 (GEA) has been commissioned by The Hall School to carry out a ground investigation at The Hall School, 23 Crossfield Street, London NW3 4NU. This report also forms part of a Basement Impact Assessment (BIA), which has been carried out in accordance with guidelines from the London Borough of Camden in support of a planning application. Elliott Wood are the structural engineers.

### 1.1 Proposed Development

It is understood that it is proposed to demolish the existing southern section of the school building, known as the Wreathen Hall, and subsequently construct a new partly four-storey and partly two-storey building, which will include a double level basement. A section of the existing Wreathen Hall already includes a single level basement, which will be underpinned and incorporated into the new double level basement.

This report is specific to the proposed development and the advice herein should be reviewed once the development proposals have been finalised.

### 1.2 Purpose of Work

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

- to check the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to identify the configuration of existing foundations;
- to assess the possible impact of the proposed development on the local hydrogeology and surrounding structures;
- to provide advice with respect to the design of suitable foundations and retaining walls;
- 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

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- a review of readily available geological and topographical maps;

- a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database; and
- a walkover survey of the site carried out in conjunction with the fieldwork.

In the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- a single borehole advanced to a depth of 25.00 m by means of a dismantlable cable percussion drilling rig;
- standard penetration tests (SPTs), carried out at regular intervals in the borehole, to provide quantitative data on the strength of the soils;
- a series of three window sample boreholes advanced to a depth of 5.00 m;
- the installation of three groundwater monitoring standpipes, to depths of 5.00 m and 8.00 m, and two subsequent monitoring visits over a four-week period;
- five manually excavated trial pits to a maximum depth of 8.00 m;
- laboratory testing of selected soil samples for geotechnical purposes and the presence of contamination; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

### 1.3.1 Basement Impact Assessment

The work carried out also includes a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), all of which form part of the BIA procedure specified in the London Borough of Camden (LBC) Planning Guidance CPG4[1] and their Guidance for Subterranean Development[2] prepared by Arup (the "Arup report"). The aim of the work is to provide information on surface water, groundwater and land stability and in particular to assess whether the development will affect neighbouring properties or groundwater movements and whether any identified impacts can be appropriately mitigated by the design of the development.

### 1.3.2 Qualifications

The land stability element of the Basement Impact Assessment (BIA) has been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng), member of the Institution of Civil Engineers (MICE), and Fellow of the Geological Society of London (FGS) who has over 20 years' specialist experience in ground engineering. The subterranean (groundwater) flow assessment has been carried out by John Evans, MSc in Hydrogeology, Chartered Geologist (CGeol) and Fellow of the Geological Society of London (FGS). The surface water and flooding assessment has been carried out by Rupert Evans, a hydrologist with more than ten years consultancy experience in flood risk assessment, surface water drainage schemes and hydrology / hydraulic modelling. Rupert Evans is a Chartered Environmentalist, Chartered Water and Environmental Manager and a Member of CIWEM.

The assessments have been made in conjunction with Steve Branch, a BSc in Engineering

1 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*
2 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

Geology and Geotechnics, MSc in Geotechnical Engineering, a chartered geologist (CGeol) and Fellow of the Geological Society (FGS) with over 25 years' experience in geotechnical engineering and engineering geology.

All assessors meet the qualification requirements of the Council guidance.

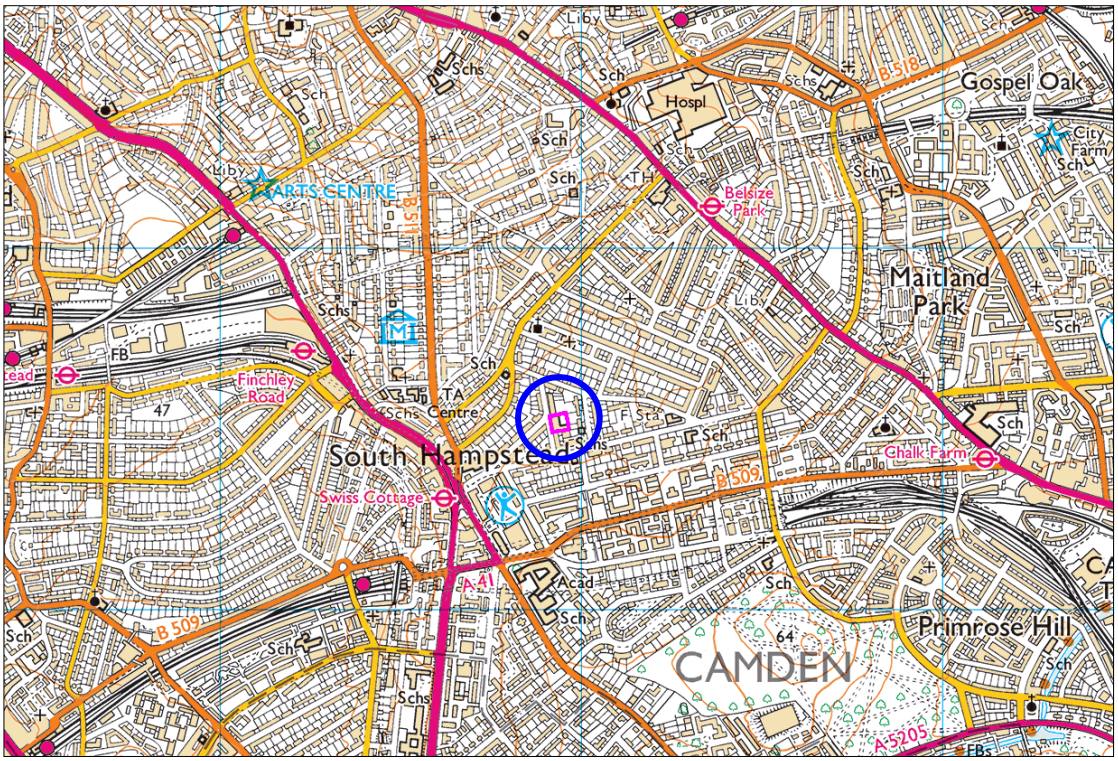
### 1.4 Limitations

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 groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

## 2.0 THE SITE

### 2.1 Site Description

The site is located in Belsize Park, northwest London, approximately 330 m to the northeast of Swiss Cottage London Underground station. It may be additionally located by National Grid Reference 526940,184520 and is shown on the map below.




The site covers a roughly square area of approximately 45 m north-south by 45 m east-west and fronts onto Crossfield Street to the west. It is bordered to the north by No 22 Crossfield Street, a three-storey house with a lower ground floor level and mansard roof, to the south by

No 24 Crossfield Street, a three-storey townhouse, and a number of single storey lock up garages. To the east the site is bounded by the rear gardens of properties fronting onto Strathray Gardens, some including single storey outbuildings.

The site is currently occupied by The Hall School, a partly four-storey and partly three-storey building, including a lower ground level, with a single storey section extending across the southeastern corner of the site, which includes a single level basement. The school building is essentially divided into two sections, the northern half of which is an original late 19th Century brick-built building, whilst the southern half of the building is a newer brick construction and includes the single level section with a single level basement that extends to 3.00 m below lower ground floor level. This section of the building is used a sports hall.

The school building occupies the majority of the site, whilst the remainder is occupied by a large Astroturf sports pitch and playground, with a concrete walkway along the southern and southeastern corner boundaries and paved and partially covered lightwells along the western boundary at lower ground floor level. The sports pitch at the rear of the site is also at lower ground floor level, which is at a level of approximately 1.50 m below street level.

Areas of soft landscaping are limited to planted beds along the western boundary, at the top of the lightwells, whilst an approximately 20 m to 25 m high London plane tree is positioned at the southern end of the Astroturf sports pitch and is understood to be the subject of a Tree Protection Order (TPO). London plane trees also line the pavement along Crossfield Street, with a number of mature deciduous trees also present outside of the site, along sections of the eastern boundary.

No potential sources of contamination were identified on the site or in the immediate surrounding area, which is predominantly residential. Topographically, the surrounding area slopes gently down to the south.

## 2.2 Site History

The site history has been researched by reference to online data and historical OS maps obtained from the Landmark database.

The earliest Ordnance Survey (OS) map studied, dated 1871, shows the site to be undeveloped in an area dominated by open fields as the immediate surrounding area was also largely undeveloped. A number of existing roads had been constructed to the north and south and were lined, as they are currently, with terraced and semi-detached properties. By 1896 the area had been developed, with Crossfield Street constructed and the site partially developed with a building positioned in the northwestern corner. Terraced properties had been constructed along Crossfield Street to the north, whilst the southern section of the street remained mostly undeveloped. According to online information[3], the school was founded in 1889 as Belsize School, but was later renamed The Hall at the turn of the 20th Century.

Some time between 1920 and 1935, the building occupying the site was extended southwards, with two small outbuildings constructed across the southern half of the site. The southern half of Crossfield Street was developed with the existing terraced houses between 1962 and 1973, whilst the site remained essentially unchanged until some time between 1991 and 1994, when the existing building across the southern half of the site, the Wreathen Hall, was constructed. The site has remained unchanged since that time to the present day, with the surrounding area remaining essentially unchanged since the 1960s and 1970s.

3 http://hallschool.co.uk/school-history/

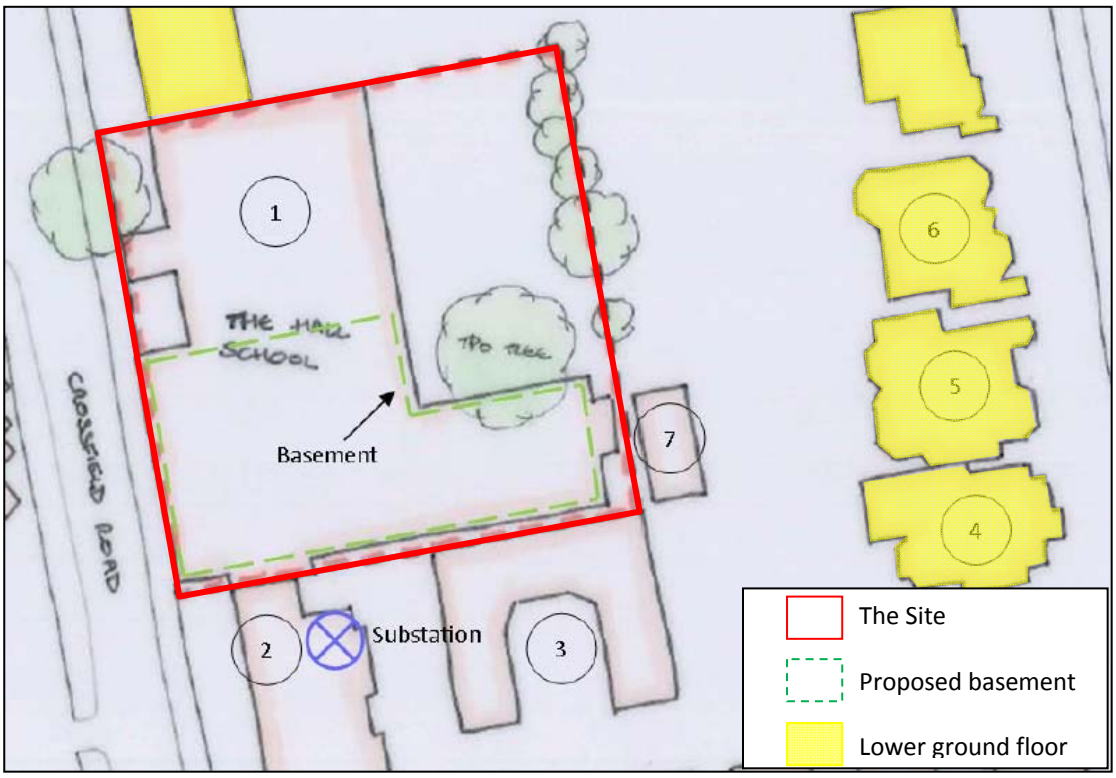
## 2.3 Other Information

A search of public registers and databases has been made by GEA via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The search has revealed that there are no existing or historical landfill sites, waste management, transfer or disposal sites within 500 m of the site. There have also not been any recorded pollution incidents to controlled waters within 500 m of the site and there are no recorded contaminated land registered sites within 500 m of the site. There are no Local Authority Pollution Prevention Controls (LAPPC) in place on sites within 100 m of the site and there are no discharge consents within 250 m of the site. A single water abstraction licence is in place within 250 m of the site, at a distance of 242 m southwest. The licence is for the abstraction of groundwater via a borehole, which extends into the chalk.

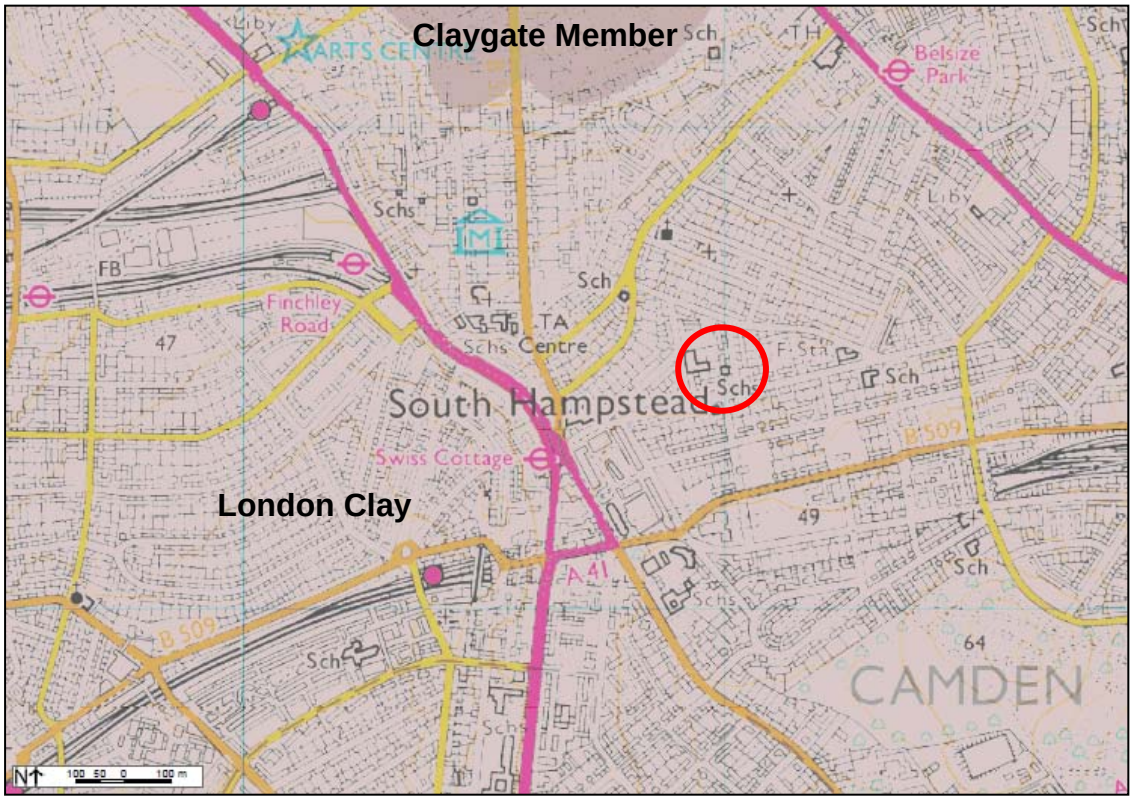
The search has indicated that the site is located in an area where less than 1% of homes are affected by radon emissions; as classified by the Health Protection Agency (HPA) and therefore no radon protective measures will be necessary.

Information on the properties surrounding the site has been gathered by Elliott Wood from the Local Authority planning portal and other sources, the results of which have been supplied to GEA. The results are summarised on the map below with the neighbouring properties to the north and to the east including lower ground floor levels similar to that on the site, whilst none of the surrounding properties currently include basements.



## 2.4 Geology

The British Geological Survey (BGS) map of the area (sheet 256) indicates that the site is underlain by the London Clay Formation, as shown by the digital geological map extract below.




The geology in this area is generally horizontally bedded such that the boundary between the geological formations roughly follows the ground surface contour lines. The boundary between the London Clay and the overlying Claygate Member is at a level of approximately 80 m OD, approximately 20 m above the level of the site, 550 m to the north.

## 2.5 Hydrology and Hydrogeology

The London Clay is classified as a Non-Aquifer and Unproductive Stratum, which refers to a soil or rock with low permeability that has a negligible effect on local water supply or river base flow, as defined by the Environment Agency (EA). The London Clay is not capable of supporting a continuous groundwater table, although isolated pockets of perched groundwater do occur within fissures and silt and sand partings. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x $10^{-10}$ m/s and 1 x $10^{-8}$ m/s, with an even lower vertical permeability.

The site is located within a Zone 2 (outer zone) Source Protection Zone (SPZs), although the site is not located in any other designated environmentally sensitive areas.

There are no natural surface water features within 1 km of the site, which is therefore not in an area at risk of flooding from rivers or sea and is not shown to be in an area at risk of surface water flooding, as defined by the EA.

Existing and historical spring lines are present at the interface between the essentially impermeable London Clay and the overlying Claygate Member, which predominantly comprises a sequence of silty sandy clay, clayey silt and clayey silty sand. These springs have been the source of a number of London's "lost" rivers, notably the Fleet, Westbourne and Tyburn. Two tributaries of the River Tyburn formerly flowed southwards approximately 150 m to the west and 150 m east of the site. The river continued in a southerly direction along through Swiss Cottage and St John's Wood into Regent's Park, where it issued into a large lake. From the lake it flowed south through the West End and the City of Westminster, before issuing into the Thames close to Vauxhall Bridge. Although the tributaries are no longer open watercourses, surface and near surface waters will still tend to flow towards the former river courses.

## 2.6 Preliminary Contamination 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.

### 2.6.1 Source

The desk study research has indicated that the site has only been occupied by the existing school buildings and is therefore not considered to have had a contaminative history and no potential sources of contamination were noted during the site walkover. In addition, the desk study has not indicated any off-site sources of contamination, including historical or existing landfill sites within 500 m of the site.

### 2.6.2 Receptor

The future users of the school will represent relatively high sensitivity receptors, although it should be noted that the site will in essence be occupied in its entirety by the buildings, including the proposed new basement, with only limited raised planted beds remaining. The site is underlain by a Non-Aquifer and Unproductive Stratum and therefore groundwater is not considered to be a sensitive receptor, whilst neighbouring sites are also considered to be of relatively low sensitivity. New 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 during the construction works.

### 2.6.3 Pathway

The existing building with the lower ground floor and the new proposed building with double level basement level will occupy the majority of the site, which along with the remaining Astroturf sport pitch and paved walkways, act as a permanent barrier between end users and the underlying soil. The existing planted beds along the western boundary will remain, which will provide a limited pathway between end users and the soil. The groundworks and construction period is considered to provide a pathway by which site workers and new buried services may come into contact with the shallow soils.

The underlying London Clay is classified as a Non-Aquifer and Unproductive Stratum. A continuous groundwater table will therefore not be present below the site and so there is not considered to be a pathway by which soluble contaminants may migrate onto and off of site. The London Clay also forms an aquiclude and will therefore form a barrier to contaminants migrating vertically down towards the Principal Chalk Aquifer. Overall there is considered to

be a low potential for a significant contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

### 2.6.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a VERY LOW risk of there being a significant contaminant linkage at this site, which would result in a requirement for major remediation work. Furthermore, as there is no evidence of filled ground within the vicinity of the site and no landfill sites, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site.

## 3.0 SCREENING

The LBC guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full BIA is required.

### 3.1 Screening Assessment

A number of screening tools are included in the Arup document and for the purposes of this report reference has been made to Appendices E1, E2 and E3 which include a series of questions within screening flowcharts for surface flow and flooding, subterranean (groundwater) flow and land stability. The flowchart questions and responses to these questions are tabulated below.

### 3.1.1 Subterranean (groundwater) Screening Assessment

| Question | Response for the Hall School |
|---|---|
| 1a. Is the site located directly above an aquifer? | No, the London Clay is classified as a non-aquifer and unproductive stratum |
| 1b. Will the proposed basement extend beneath the water table surface? | No. The London Clay does not support a continuous groundwater table due to the very low permeability. Localised perched groundwater inflows maybe encountered from within the made ground, however these would not be prolonged or of substantial volume. |
| 2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line? | No. |
| 3. Is the site within the catchment of the pond chains on Hampstead Heath? | No. This is confirmed by Figure 14 of the Arup report |
| 4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas? | No the proportions remain the same. |
| 5. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)? | No. |
| 6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line? | No. |

The above assessment has not identified any potential issues with regard to the hydrogeological setting of the site.

### 3.1.2 Stability Screening Assessment

| Question | Response for the Hall School |
|---|---|
| 1. Does the existing site include slopes, natural or manmade, greater than 7°? | No. The topographical maps and Figure 16 of the Arup report confirm that the site does not include slopes greater than 7°. |
| 2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°? | No. The development does not involve re-profiling the site. |
| 3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°? | No. The topographical maps and Figure 16 of the Arup report confirm that the site does not border land with slopes greater than 7°. |
| 4. Is the site within a wider hillside setting in which the general slope is greater than 7°? | No. The topographical maps and Figure 16 of the Arup report confirm that the site is not in area of such slope angles. |
| 5. Is the London Clay the shallowest strata at the site? | Yes, the geological map indicates that the site is directly underlain by the London Clay. |
| 6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained? | No. |
| 7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site? | No, although the London Clay is known to be affected by seasonal shrink and swell as a result of tree growth, there has not been any indication of previous movement taking place at the site. |
| 8. Is the site within 100 m of a watercourse or potential spring line? | No. |
| 9. Is the site within an area of previously worked ground? | No. |
| 10. Is the site within an aquifer? | No. |
| 11. Is the site within 50 m of Hampstead Heath ponds? | No. This is confirmed by Figure 14 of the Arup report |
| 12. Is the site within 5 m of a highway or pedestrian right of way? | *Yes. The site is within 5 m of the footway and road of Crossfield Street.* |
| 13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties? | *Yes. The double level basement will be excavated below the foundations of No 24 Crossfield Street to the south, the remaining school building to the north and a number of neighbouring outbuildings to the east and southeast.* |
| 14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines? | No. |

The above assessment has identified the following potential issues that need to be assessed:

The above assessment has identified the following potential issues that need to be assessed:

Q5 The London Clay is the shallowest stratum.
Q12 The site and proposed basement are within 5 m of Crossfield Street.
Q13 The founding depth of the proposed basement will be at a lower depth than a number of neighbouring foundations.

### 3.1.3 Surface Flow and Flooding Screening Assessment

| Question | Response for The Hall School |
|---|---|
| 1. Is the site within the catchment of the pond chains on Hampstead Heath? | No. Figure 14 of the Arup report confirms that the site is not located within this catchment area. |
| 2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route? | No. The proposed basement will remain below the existing basement footprint and below the footprint of the new building. |
| 3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas? | No. The proportions remain the same. |
| 4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses? | No. The proposed basement will remain below the existing basement footprint and below the footprint of the new building. |
| 5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses? | No. The proposals are very unlikely to result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses as the surface water drainage regime will be unchanged. |
| 6. Is the site in an area known to be at risk from surface water flooding such as South Hampstead, West Hampstead, Gospel Oak and Kings Cross, or is it at risk of flooding because the proposed basement is below the static water level of a nearby surface water feature? | No. The Camden Flood Risk Management Strategy dated 2013, together with Figures 3iii, 4e, 5a and 5b of the SFRA dated 2014, and Environment Agency online flood maps show that the site has a very low flooding risk from surface water, sewers, reservoirs (and other artificial sources), groundwater and fluvial/tidal watercourses.<br>In accordance with paragraph 5.11 of the CPG a positive pumped device will be installed across the lower ground floor in order to further protect the site from sewer flooding.<br>The site is not located within a Critical Drainage Area or a Local Flood Risk Zone, as identified in the Camden SWMP and Updated SFRA Figure 6/Rev 2. |

The above assessment has not identified any potential issues with regard to the hydrological setting of the site.

## 4.0 SCOPING AND SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

### 4.1 Potential Impacts

The following potential impacts have been identified by the BIA screening process.

| Potential Impact | Consequence |
|---|---|
| The site is underlain by the London Clay Formation | The London Clay is formed of highly shrinkable clay soils that are of high plasticity. This means that it can be affected by seasonal shrinking and swelling caused by tree growth and / or tree removal. Additionally, the unloading of the clay as a result of the basement excavation will give rise to a level of heave. Both scenarios can lead to movement and instability of nearby structures. |
| The development will increase the differential founding depth of adjacent foundations | Having differential founding depths can result in differential settlements, which could arise from seasonal shrink and swell, if underlain by clay soils, or as result of the increased |

| Potential Impact | Consequence |
|---|---|
| | foundations stiffness of underpinned foundations relative to those that remain unchanged. |
| The development is located within 5 m of the public highway | Should the design of retaining walls and foundations not take into account the presence of nearby infrastructure, it may lead to the structural damage of footway, highway and associated buried services. |

These potential impacts have been investigated through the site investigation, as detailed below.

## 4.2 Exploratory Work

In order to meet the objectives described in Section 1.2, a single borehole was drilled to a depth of 25.00 m using a dismantlable cable percussion drilling rig. Standard penetration tests (SPTs) were carried out at regular intervals in the boreholes and disturbed and undisturbed samples were recovered for subsequent laboratory examination and testing. The deep borehole was supplemented with a series of three window sampler boreholes advanced to a depth of 5.00 m, in order to provide further coverage of the area of the proposed lower ground floor extension and to confirm the shallow ground conditions.

Groundwater monitoring standpipes were installed in three of the boreholes, to depths of 5.00 m and 8.00 m, and have subsequently been monitored on two occasions over a one-month period. In addition to the boreholes, a series of five trial pits was manually excavated in order to determine the configuration of existing foundations.

The borehole and trial pit records and results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions.

## 4.3 Sampling Strategy

The deep borehole was positioned at the centre of the site, close to the proposed double level basement, whilst the window sample boreholes were located to provide additional coverage of the development. The positions of the trial pits were specified by Elliott Wood and positioned on site by GEA, along with the boreholes, in accessible locations, whilst avoiding known buried services.

A number of disturbed and undisturbed samples recovered from the boreholes were submitted to a geotechnical laboratory for a programme of testing that included moisture content and Atterberg limit tests, undrained triaxial compression tests and soluble sulphate and pH level analysis.

Four samples of made ground were subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. 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. The soil samples were selected on the basis of observations made on site, to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure and to provide advice in respect of re-use or for waste disposal classification.

The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs

accreditation and test methods are included in the Appendix together with the analytical results.

## 5.0 GROUND CONDITIONS

The investigation has encountered the expected ground conditions in that, below a generally moderate but locally significant thickness of made ground, the London Clay Formation was encountered and proved to the maximum depth investigated.

### 5.1 Made Ground

Made ground extended to depths of between 1.00 m and 3.80 m, although only extended to beyond 1.35 m in Borehole No 2. It was found to generally comprise brown and dark brown silty clay with gravel, decayed rootlets, brick and coal fragments. In Borehole No 2, below 2.40 m, the made ground generally comprised crushed brick, which was loosely cemented in places, with gravel and concrete fragments and may be indicative of a former structure in this location.

With the exception of notable fragments of extraneous material, no visual or olfactory evidence of significant contamination was observed within these soils. Four samples of made ground have been tested and the results discussed in 5.5.

### 5.2 London Clay Formation

The London Clay initially comprised a weathered horizon of firm medium strength becoming stiff and high strength fissured locally thinly laminated brown clay with bluish grey veins, occasional pockets of orange-brown fine sand and grey silt and fine to coarse selenite crystals, which extended to the maximum depth investigated in the window sample boreholes and to a depth of 9.00 m in Borehole No 1. Below that depth, very stiff high strength to very high strength fissured locally very thinly laminated silty clay with fine selenite, occasional white shells, occasional pale grey veins and white foraminifera was encountered and proved to the maximum depth investigated, of 25.00 m. Claystones were encountered at 17.00 m and 23.70 m.

These soils were found to be free from evidence of contamination and are of high shrinkability, with plasticity indices of between 43% and 54%. The results of quick undrained triaxial compression tests indicate the clay to increase in strength with depth from medium strength and an undrained shear strength of 64 kPa, to very high strength and an undrained shear strength of 173 kPa.

### 5.3 Groundwater

Seepage of groundwater was encountered in the made ground at depths of 2.40 m and 1.20 m in Borehole Nos 2 and 3 respectively. Groundwater monitoring has been carried out on two occasions over a one-month period and the results are shown in the table below.

| Date | Borehole No | Depth to water (m) |
|---|---|---|
| 6/11/2015 | 1 | DRY |
| | 2 | 2.73 |
| | 4 | 1.35 |

| Date | Borehole No | Depth to water (m) |
|---|---|---|
| 4/12/2015 | 1 | DRY |
| | 2 | 2.60 |
| | 4 | 1.32 |

The measured groundwater levels vary considerably and therefore the water levels recorded are not considered to represent a continuous groundwater level. It is evident that the water levels recorded in the standpipes are as a result of the perched groundwater inflows encountered from within the made ground during the drilling.

## 5.4 Soil Contamination

The table below sets out the values measured within four samples of made ground, which have been analysed; all concentrations are in mg/kg unless otherwise stated.

| Determinant | TP1 – 0.4 m (mg/kg) | TP4 – 0.5 m (mg/kg) | TP5 – 0.6 m (mg/kg) | BH3 – 0.9 m (mg/kg) |
|---|---|---|---|---|
| pH | 8.8 | 9.0 | 8.9 | 8.2 |
| Arsenic | 31 | 21 | **52** | 31 |
| Cadmium | 1.6 | 0.15 | 0.23 | 0.34 |
| Chromium | 51 | 35 | 35 | 40 |
| Copper | 50 | 53 | 71 | 77 |
| Mercury | 2.7 | 1.4 | 1.1 | 1.5 |
| Nickel | 32 | 14 | 19 | 22 |
| Lead | 220 | 280 | **470** | **580** |
| Selenium | 0.29 | 0.39 | <0.20 | 0.37 |
| Zinc | 1400 | 270 | 290 | 340 |
| Total Cyanide | <0.50 | <0.50 | <0.50 | <0.50 |
| Total Phenols | <0.30 | <0.30 | <0.30 | <0.30 |
| Sulphide | 3.2 | 6.1 | 5.9 | 2.8 |
| Total TPH | 100 | <10 | 47 | 110 |
| Naphthalene | 0.24 | <0.10 | 0.22 | 0.37 |
| Benzo(a)pyrene | **9.7** | 0.74 | **13** | **5.4** |
| Total PAH | **150** | 9.6 | **180** | **63** |
| Total organic carbon % | 1.0 | 3.6 | 2.7 | 2.9 |

### 5.4.1 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. To this end the table below indicates those contaminants of concern that have values in excess of a generic human health risk based guideline values which are either that of the CLEA[4] Soil Guideline Value where available, or is a Generic Screening Value calculated using the CLEA UK Version 1.06[5] software assuming a residential without plant uptake end use, or is based on the DEFRA Category 4 Screening values[6]. 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 a young female child aged 0 to six years old;
- that young children will not have prolonged exposure to the site;
- 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 two-storey small terraced house

It is considered that these assumptions are very conservative but acceptable for this generic assessment of this site. 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 results of the contamination testing have revealed a single elevated concentration of arsenic, elevated concentrations of lead in two samples and elevated concentrations of total PAH including benzo(a)pyrene within three of the samples tested. This assessment is based

[4] *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.
[5] Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009
[6] CL:AIRE (2013) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Final Project Report SP1010 and DEFRA (2014) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Policy Companion Document SP1010

upon the potential for risk to human health, which at this site is considered to be the critical risk receptor. The significance of the contamination results is considered further in Part 2 of the report.

## 5.5 Existing Foundations

The findings of the trial pits are summarised in the table below and sketches and photographs of each pit are included in the Appendix.

| Trial Pit No | Structure | Foundation detail | Bearing Stratum |
|---|---|---|---|
| **1** | Eastern elevation of 19th Century building | Concrete underpin<br>Top 170 mm<br>Base not proved at 1.80 m<br>No lateral projection | Unknown but likely to be London Clay |
| **2** | Eastern elevation to emergency exit stair to basement | Concrete strip<br>Top 400 mm<br>Base 0.75 m<br>Lateral projection 120 mm | MADE GROUND |
| **3** | Rear boundary wall Wreathen Hall (basement) | Potential concrete retaining wall<br>Top 360 mm<br>Base not proved<br>Lateral projection unknown | Unknown. Concrete extended across entire length and width of trial pit, extent of footing not established |
| **4** | Southern boundary wall | Concrete strip with two brick corbel steps<br>Top 600 mm<br>Base 0.95 m<br>Lateral projection 120 mm | MADE GROUND |
| **5** | Southern boundary wall | Brick footing<br>Top GL<br>Base 1.30 m<br>No lateral projection | MADE GROUND |
| | Southern elevation of Wreathen Hall | Concrete strip<br>Top 300 mm above ground level<br>Base 1.10 m<br>No lateral projection | MADE GROUND |

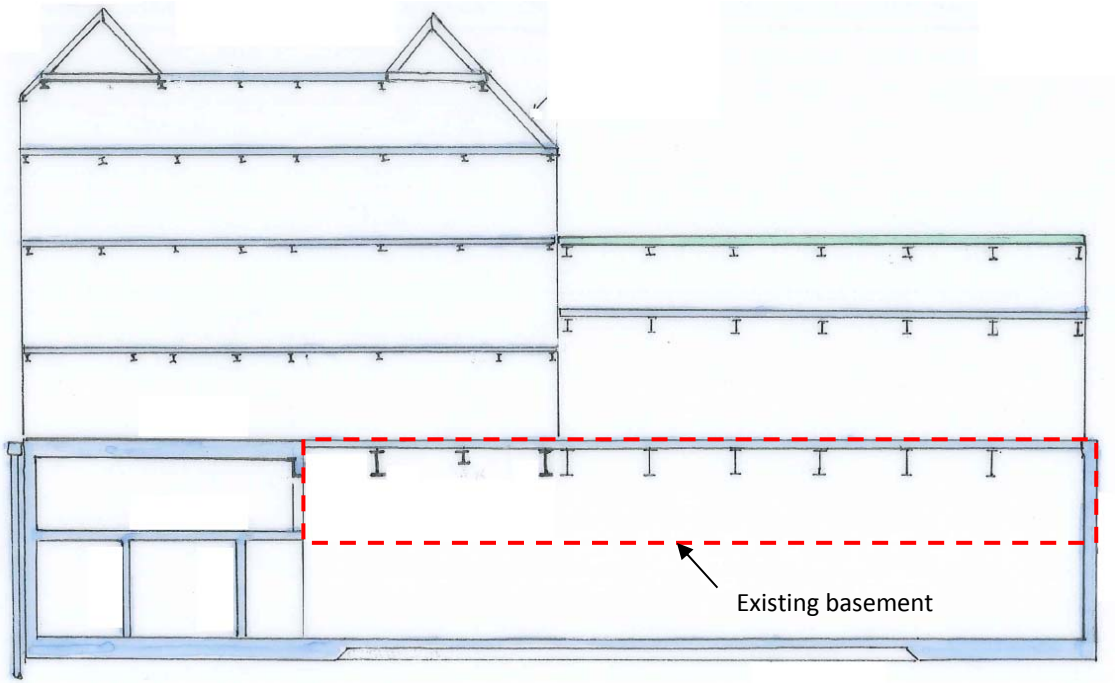
# Part 2: DESIGN BASIS REPORT

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 foundation options and contamination issues.

## 6.0 INTRODUCTION

The proposals include the demolition of the existing 1990s section of the school, known as the Wreathen Hall, and the subsequent construction of a new four-storey and two-storey building with a double level basement that will extend to a depth of 8.00 m below lower ground level.

Proposed new wall loads along the proposed retaining walls are understood to be in the order of between 500 kN/m and 650 kN/m. A section through the new building and basement is shown below.




## 7.0 GROUND MODEL

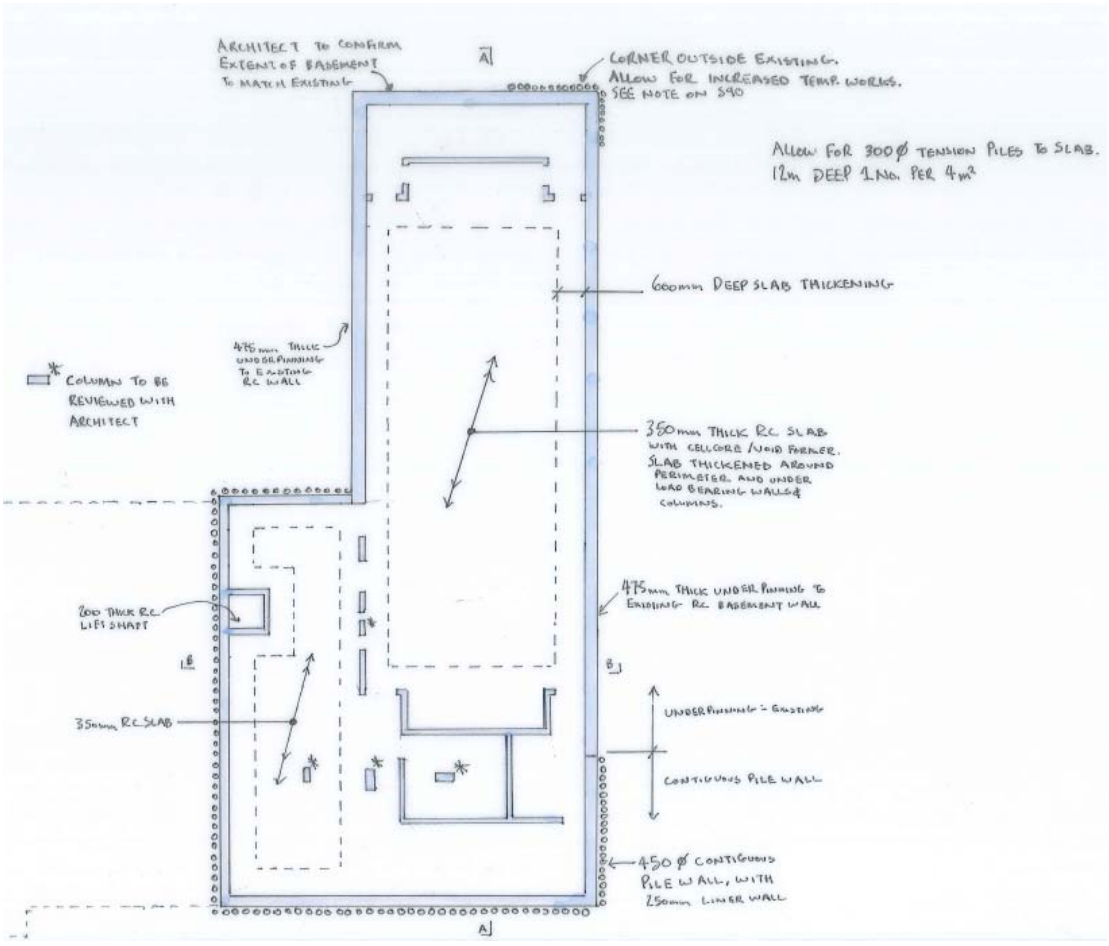
The desk study has indicated that the site has not had a contaminative history, having been occupied by the school for the entirety of the developed history. On the basis of the intrusive investigation, the ground conditions at this site can be characterised as follows:

- below a generally moderate and locally significant thickness of made ground, the London Clay Formation is present;
- made ground extends to depths of between 1.00 m and 3.80 m, although was only present beyond 1.35 m in a single location;

- the London Clay comprises a weathered horizon of firm to stiff fissured brown silty clay to a depth of 9.00 m;
- typical unweathered London Clay is present below 9.00 m to the maximum depth investigated, of 25.00 m;
- groundwater observations and monitoring have indicated seepages within the made ground but not a continuous groundwater table below the site; and
- the made ground contains elevated concentrations of arsenic, lead and total PAH including benzo(a)pyrene.

## 8.0 ADVICE AND RECOMMENDATIONS

It is understood that the new basement will extend to a depth of 8.00 m below lower ground floor level. It is proposed to form the basement retaining walls through a combination of underpinning of the existing basement walls and a contiguous bored pile wall below the remaining footprint of the new section of building that does not currently include a basement, as shown below.



## 8.1 Basement Construction

The formation level for the double level basement will be within the London Clay at a depth of 8.00 m below lower ground level. On the basis of the groundwater observations to date, perched groundwater inflows, as indicated by the monitoring to date, are likely to be encountered from within the made ground. However, such inflows are considered likely to be relatively slow and not prolonged, such that they should be adequately dealt with using conventional sump pumping methods.

There are a number of methods by which the sides of the excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by whether it is to be incorporated into the permanent works and have a load bearing function. The final choice will depend to a large extent on the need to protect nearby structures from movements, the required overall stiffness of the support system, and the need to control groundwater movement through the wall in the temporary condition. In this respect the stability of the neighbouring properties and the existing slope will be paramount.

The use of conventional underpinning to extend the existing single level basement walls is considered to be a suitable solution. As discussed above, perched groundwater may be encountered although these inflows should be adequately dealt with using sump pumping. It would however be prudent for the chosen contractor to have a contingency plan in place to deal with more significant inflows as a precautionary measure. The use of underpinning will require the soils being underpinned to stand unsupported and difficulties may be encountered with unsupported excavations in the made ground, particularly where groundwater is encountered. However, the trial pits excavated during the investigation did not encountered groundwater and did not indicate major instabilities in the made ground.

On the basis of the monitoring results to date, the use of a contiguous bored pile wall should be suitable for the remaining section of the basement, with localised grouting between piles to prevent any minor inflows. The noise and vibrations associated with the installation of sheet piles is likely to render their use as a temporary retaining wall unacceptable.

The ground movements associated with the excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity and the timing of the provision of support to the wall will have an important effect on movements. The stability of the existing foundations will need to be ensured at all times and the retaining walls will need to be designed to support the loads from these foundations unless they are underpinned. Careful workmanship will be required in the construction of the underpins and it is recommended that a suitable specialist contractor is consulted in this respect. Ground movements associated with the basement construction and excavation are however discussed further in Part 3 of this report.

### 8.1.1 Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls.

| Stratum | Bulk Density ($kg/m^3$) | Effective Cohesion ($c' – kN/m^2$) | Effective Friction Angle ($\Phi'$ – degrees) |
|---|---|---|---|
| Made ground | 1700 | Zero | 27 |
| London Clay | 2000 | Zero | 24 |

Significant groundwater inflows are unlikely to be encountered within the excavation, although monitoring of the standpipe should be continued in order to establish equilibrium levels. At this stage, it is recommended that for the design of the retaining walls, groundwater level should be assumed to be three-quarters of the retained height, unless the risk of groundwater and surface water collecting behind the retaining walls can be suitably mitigated through the use of a fully effective drainage system. The advice in BS8102:2009[7] should be followed in the design of the basement retaining walls and with regard to waterproofing requirements.

### 8.1.2 Heave

The proposed development will require excavation depths of approximately 4.00 m and 8.00 m, resulting in a net unloading of between around 80 kN/m$^2$ and 150 kN/m$^2$, which will lead to heave of the underlying London Clay. This will comprise immediate elastic movement, which will account for approximately 40% of the total movement and may be expected to be complete during the construction period, and long term movements, which will theoretically take many years to complete. These movements will, to some extent, be mitigated by the continued presence of the existing building, although consideration will need to be given to designing the basement slab to withstand heave pressures or consideration given to the use of tension piles. Further consideration is given to heave movements in Part 3 of this report.

## 8.2 Spread Foundations

New spread foundations excavated from below basement formation level may be designed to apply a net allowable bearing pressure of 200 kN/m$^2$, which incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

If, for any reason, spread foundations are not considered appropriate, piled foundations would provide a suitable alternative foundation solution.

## 8.3 Shallow Excavations

On the basis of the trial pit findings, it is considered likely that it will be feasible to form relatively shallow excavations that extend into the made ground without the requirement for lateral support, although localised instabilities may occur, particularly where deeper areas of made ground are present. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides will be required in order to comply with normal safety requirements.

Inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from perched water tables within the made ground, particularly within the vicinity of existing foundations, although such inflows should be suitably controlled by sump pumping. It should also be noted that concrete obstructions were encountered in a number of the trial pits and that similar obstructions, particularly associated with relic foundations, may be encountered in shallow excavations.

## 8.4 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate type. A conventional rotary augered pile may be appropriate, with temporary casing installed to maintain stability and prevent groundwater inflows, or alternatively the use

7 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

of bored piles installed using continuous flight auger (cfa) techniques, which would not require the provision of casing, would also be an appropriate choice of pile.

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

| Stratum | Depth (m) below lower ground floor | kN / $m^2$ |
|---|---|---|
| **Ultimate Skin Friction** | | |
| Made Ground and London Clay | Lower Ground Floor to 8.00 | Ignore (Basement excavation) |
| London Clay (clay - $\alpha$ = 0.5) | 8.00 to 25.00 | Increasing linearly from 50 to 95 |
| **Ultimate End Bearing** | | |
| London Clay | 20.00 to 25.00 | Increasing linearly from 1530 to 1710 |

In the absence of pile tests, guidance from the London District Surveyors Association (LDSA)[8] 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 it has been estimated that a 450 mm diameter pile extending to 20.00 m below lower ground floor level, 12 m below basement level, should provide a safe working load of approximately 525 kN. The same diameter pile extending to 25.00 m, approximately 17.00 m below basement level should provide a safe working load of approximately 770 kN.

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 an appropriate piling scheme and their attention should be drawn to the presence of claystones and potential groundwater inflows within the made ground and silt and sand partings within the London Clay.

## 8.5 Effect of Sulphates

Generally moderate concentrations of total sulphate have been measured in samples of the made ground and therefore indicate that buried concrete should be designed in accordance with Class DS-2 conditions of Table C2 of BRE Special Digest 1: SD1 Third Edition (2005). The measured pH conditions are mildly alkaline and therefore on the basis of static groundwater conditions being assumed for buried concrete an ACEC classification of AC-1s may be adopted. The guidelines contained in the above digest should be followed in the design of foundation concrete.

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

## 8.6 Basement Floor Slab

Following the excavation of the basement, it is likely that the floor slab for the proposed basement will need to be suspended over a void or layer of compressible material to accommodate the anticipated heave and any potential uplift forces from groundwater pressures unless the slab can be suitably reinforced to cope with these movements. This should be reviewed once the levels and loads have been finalised.

## 8.7 Site Specific Risk Assessment

The desk study has indicated that the site has not had a contaminative history, having been occupied by the existing school throughout its developed history. Therefore, no sources of contamination have been identified. The results of the contamination testing have however identified elevated concentrations of arsenic, lead and total PAH including benzo(a)pyrene within the made ground. No elevated concentrations of the other contaminants were identified.

The exact source of the contamination is unknown, however the made ground was noted as containing variable amounts of extraneous material, which is likely to be the source of the contamination. It is therefore not considered likely to be in a soluble form and does not pose a risk to groundwater or end users via hazardous vapours. The site is however almost entirely covered in hardstanding and buildings and therefore there is not a pathway by which end users of the school can come into contact with the contamination. Furthermore, the majority of the made ground is likely to be removed from around and within the area of the proposed new development and basement excavation, further reducing the risk to end users. Remedial measures are therefore not considered to be required, although consideration will need to be given to site workers as discussed below.

### 8.7.1 Site Workers

Site workers should be made aware of the potential 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[9] and CIRIA[10] and the requirements of the Local Authority Environmental Health Officer.

A watching brief should also be maintained during the groundwork, and if suspicious soils are encountered then a suitably qualified engineer should inspect the soils and further testing carried out if required.

## 8.8 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

9 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO

10 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association

the soil to be a hazardous waste or inert waste from a contaminated site. It should however be noted that the Environment Agency guidance WM3[11] 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[12] 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 £84.40 per tonne (about £150 per $m^3$) or at the lower rate of £2.65 per tonne (roughly £5 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 Environment Agency it is considered likely that the soils encountered during this ground investigation, as represented by the four chemical analyses carried out, would be generally classified as follows;

| Soil Type | Waste Classification (Waste Code) | WAC Testing Required Prior to Landfill Disposal? | Comments |
|---|---|---|---|
| Made ground | Non-hazardous (17 05 04) | No | - |
| London Clay | Inert (17 05 04) | Should not be required but confirm with receiving landfill | - |

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[13] 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.

## 9.0 BASEMENT IMPACT ASSESSMENT

The screening identified a number of potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

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

The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

| Potential Impact | Site Investigation Conclusions |
|---|---|
| The site is underlain by the London Clay Formation | The investigation has indicated that the site is underlain by the London Clay Formation. |
| The development will increase the differential founding depth of adjacent foundations | The proposed basement does not share any party walls with neighbouring structures, although differential founding depths will exist between the two parts of the building within the school site. |
| The development is located within 5 m of the public highway | The investigation has not indicated any specific problems, such as weak or unstable ground, voids or a high water table that would make working within 5 m of public infrastructure particularly problematic at this site. |

The results of the site investigation have therefore been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

*The site is underlain by the London Clay Formation*

The investigation has confirmed the presence of the London Clay Formation, which can give rise to a number of potential issues with regard to excavation and construction of a new basement structure. These include slope instability on existing and new slopes greater than 7º, heave of the clay soils associated with the unloading from the basement excavation and shrinking and swelling of the clay soils due to the removal of trees. However, at this site no such slope angles already exist or will be created by the development and there are no proposals to fell any trees, such that swelling of the clay soils due to their removal will not be an issue. In addition, although the depth of the proposed basement will give rise to unloading of the clay and therefore heave movements and pressures, these heave movements are unlikely to be significant as they will, to a certain extent, be restricted by the pressure applied by the loads of the proposed building. Furthermore, there is nothing abnormal about the proposed basement development and there are well-established engineering solutions to mitigate heave movements, including void formers below the slab and the use of tension piles if necessary. Therefore, it is not considered likely that the excavation of the proposed basement will have an impact on the existing building or on surrounding structures, provided that normal design and construction measures are taken to mitigate the impact.

The ground movements associated with the basement construction and excavation have been considered further and are discussed in Part 3 of this report.

*The site is located within 5 m of a public highway*

Whilst the proposed basement will be excavated within 5 m of the footway and highway of Crossfield Street, there is nothing unusual about the proposed basement that falls outside the scope of standard engineering practice and design. Provided that the design of the retaining walls takes into account any loading from the adjacent highway and the construction work is carried out in accordance with best practice, resulting ground movements should be within normal tolerable limits. This is considered further in Part 3 of this report.

*Differential founding depths*

The proposed basement does not share any party walls with neighbouring structures and so differential founding depths of neighbouring foundations will not be created. Differential founding depths will exist between the two parts of the building within the school site, although provided that the new foundations are suitably designed using standard engineering practice, there is no reason for the proposed basement to cause structural instability of adjacent foundations.

# Part 3: GROUND MOVEMENT ANALYSIS

This section of the report comprises an analysis of the ground movements arising from the proposed basement and foundation scheme discussed in Part 2 and the information obtained from the investigation, presented in Part 1 of the report.

## 10.0 INTRODUCTION

The sides of an excavation will move to some extent regardless of how they are supported. The movement will typically be both horizontal and vertical and will be influenced by the engineering properties of the ground, groundwater level and flow, the efficiency of the various support systems employed during underpinning and the efficiency or stiffness of any support structures used.

An analysis has been carried out of the likely movements arising from the proposed excavation and the results of this analysis have been used to predict the effect of these movements on surrounding structures.

### 10.1 Construction Sequence

The following sequence of operations has been provided by Elliott Wood and it has been used to enable analysis of the ground movements around the excavation both during and after construction.

In general, the sequence of works for excavation and construction will comprise the following stages.

1. Demolition of existing superstructure.
2. Installation of contiguous bored piled wall in area where no existing basement is present.
3. Install capping beams.
4. Temporary props installed at high level.
5. Excavate down and install mid-level props and lower-level props as excavation progresses.
6. Install basement slab and liner walls from lowest point up, removing props after curing process.
7. Underpin existing basement to lower level.
8. Prop at higher level
9. Excavate down and prop at lower level.
10. Cast basement slabs and liner walls from lowest level up

The underpins should be adequately laterally propped and sufficiently dowelled together, with the concrete cast and adequately cured prior to excavation of the basement and removal of the formwork and supports.

The detail of the support provided to adjacent walls is beyond the scope of this report at this stage and the structural engineer will be best placed to agree a methodology with the underpinning contractors once appointed.

# 11.0 GROUND MOVEMENTS

An assessment of ground movements within and surrounding the excavations has been undertaken using the X-Disp and P-Disp computer programs licensed from the OASYS suite of geotechnical modelling software from Arup. These programs are commonly used within the ground engineering industry and are considered to be appropriate tools for this analysis.

The X-Disp program has been used to predict ground movements likely to arise from the construction of the proposed lower ground floor extensions. This includes the settlement of the ground (vertical movement) and the lateral movement of soil behind the proposed retaining walls (horizontal movement).

The analysis of potential ground movements within the excavation, as a result of unloading of the underlying soils, has been carried out using the Oasys P-Disp Version 19.2 – Build 12 software package and is based on the assumption that the soils behave elastically, which provides a reasonable approximation of soil behaviour at small strains.

For the purpose of these analyses, the corners have been defined by x and y coordinates, with the x-direction parallel with the orientation east-west, whilst the y-direction is parallel with the orientation of north-south. Vertical movement is in the z-direction. Wall lengths of less than 10 m have been modelled as 1 m long structural elements, while greater than 10 m wall lengths have been modelled as 2 m elements to reflect the greater stiffness of the longer walls.

The full outputs of all the analyses can be provided on request and samples of the output movement contour plots are included within the appendix.

## 11.1 Ground Movements – Surrounding the Excavation

### 11.1.1 Model Used

For the X-Disp analysis, the soil movement relationships used for the embedded retaining walls are the default values within CIRIA report C580[14], which were derived from a number of historic case studies.

For the retaining walls that are to be formed of a contiguous bored pile wall, the analysis has adopted the values for ‘installation of a contiguous bored pile wall’, whilst ‘installation of a planar diaphragm wall’ has been adopted to represent the installation of the underpins. The ground movement curves for ‘excavations in front of a high stiffness wall in stiff clay’ have been adopted as being considered most appropriate for the proposed excavation.

The depths of the basement levels have been provided by Elliott Wood on cross-sectional drawings (ref 5-210 and 5-200, both dated June 2016). The embedment depth of the piles has been given as 10 m below basement level.

[14] Gaba, A, Simpson, B, Powrie, W and Beadman, D (2003) *Embedded retaining walls – guidance for economic design.* CIRIA Report C580.

The adjacent No 24 Crossfield Street does not include a basement, although it has been constructed at a level of approximately 1.00 m below ground level. It has been assumed that foundation level is 1.00 m below that level, approximately 0.5 m below the lower ground floor level of the site. The single storey structures to the south and east have also assumed to be founded at similar levels, whilst on the basis of the trial pits completed on site, the retained school building is assumed to be founded at 2.00 m below lower ground floor level.

### 11.1.2 Results

The results are presented to the degree of accuracy required to allow predicted variations in ground movements around the structure(s) to be illustrated, but may not reflect the anticipated accuracy of the predictions.

The predicted movements are based on the worst case of the individually analysed segments of 'hogging' and 'sagging' and these are summarised in the tables below. It should be noted that the combined effect of segments acting together typically improve the resultant movements and the values below are therefore deemed to be conservative. Furthermore, both excavations have been analysed within the same model, which has provided a global combined movement resulting from both excavations.

| Phase of Works | Maximum Movements due to Wall Deflection (mm) | |
|---|---|---|
| | Vertical Settlement | Horizontal Movement |
| Contiguous bored pile wall installation | 5-10 | 5-10 |
| Combined movements from contiguous wall installation and excavation | 14-20 | 24-30 |
| Underpinning | 5-9 | 4-6 |
| Combined movements from underpinning and excavation | 5-10 | 14-20 |

The analysis has indicated that the maximum vertical and horizontal settlements that will result from the retaining wall installation are less than 10.0 mm, while the movements arising from the combined wall installation and excavation are likely to range between 10mm to 20 mm vertical settlement and 14 mm to 30 mm horizontal movement.

The movements set out in the tables above are the maximum movements and the analysis has indicated that they occur immediately or just outside the line of the retaining walls. In reality, however, the combined movements from the wall installation and excavation phase would be expected to be less than those shown by the analysis, as they will be minimised due to control of the propping during temporary works coupled with a regime of movement monitoring. Additionally, due to the limitations of the software, it is not possible to model both forms of installation along the same line and therefore the contiguous bored pile wall movement curves have been adopted for sections that will be underpinned, in order to provide a worst case scenario. Interactions where an underpin wall and a contiguous bored wall intersect are also generally overly conservative as the software takes into account the movements from both walls, greatly increasing movements at these intersections.

## 11.2 Ground Movements within the Excavation (Heave)

Unloading of the underlying soils, particularly the clay soils of the underlying London Clay will take place as a result of the excavation of the proposed basement excavation and the

reduction in vertical stress will cause heave to take place. Undrained soil parameters have been used to estimate the potential short term movements, which include the "immediate" or elastic movements as a result of the basement excavation. Drained parameters have been used to provide an estimate of the total long-term movement.

The elastic analysis requires values of soil stiffness at various levels to calculate displacements. Values of stiffness for the soils at this site are readily available from published data and we have used a well-established method to provide our estimates. This relates values of $E_u$ and E', the undrained and drained stiffness respectively, to values of undrained cohesion (Cu), as described by Padfield and Sharrock[15] and Butler[16] and more recently by O'Brien and Sharp[17]. Relationships of $E_u = 500\ C_u$ and $E' = 300\ C_u$ for the cohesive soils have been used to obtain values of Young's modulus. These values may be slightly conservative but are considered to provide a sensible approach for this stage in the design. The Young's modulus of the granular soils has been calculated as 2000 x SPT N.

The excavation of an approximately 4 m thickness of soil will result in a net unloading of around 80 kN/m$^2$, whilst an 8 m thickness of soil will result in a net unloading of approximately 150 kN/m$^2$, assuming a unit weight of 18 kN/m$^3$ for the made ground and 20 kN/m$^3$ for the London Clay.

The soil parameters used in this analysis are tabulated below.

| Stratum | Depth Range (m) | Eu (MPa) | E'(MPa) |
|---|---|---|---|
| Made Ground | LG – 1.5 | 15 | 9 |
| London Clay | 1.5 – 8.0 | 37.5 | 22.5 |
| London Clay | 8.0 – 20.0 | 67.5 | 40.5 |
| London Clay | 20.0 – 40.0 | 115 | 69 |
| London Clay | 40.0 – 50.0 | 160 | 96 |

A rigid boundary for the analysis has been set at a depth of 50.0 m below the proposed excavation, within the London Clay. Below this depth the clay is considered to be essentially incompressible.

The potential heave movements are summarised in the table below

| Location | Heave Movement (mm) | |
|---|---|---|
| | Short-term Movement (Excavation Phase) | Total Movement |
| Centre of southeastern section | 15 to 18 | 25 to 27 |
| Southeastern corner | 5 to 8 | 3 to 5 |
| Centre of southern elevation | 10 to 12 | 8 to 12 |
| Southwestern section | 24 to 27 | 40 to 44 |
| Northwestern section | 24 to 27 | 40 to 44 |

[15] Padfield CJ and Sharrock MJ (1983) *Settlement of structures on clay soils*. CIRIA Special Publication 27

[16] Butler FG (1974) *Heavily overconsolidated clays: a state of the art review*. Proc Conf Settlement of Structures, Cambridge, 531-578, Pentech Press, Lond

[17] O'Brien AS and Sharp P (2001) *Settlement and heave of overconsolidated clays - a simplified non-linear method.* Part Two, Ground Engineering, Nov 2001, 48-53

| Location | Heave Movement (mm) | |
|---|---|---|
| | Short-term Movement (Excavation Phase) | Total Movement |
| Western elevation | 15 to 18 | 20 to 23 |

The P-Disp analysis indicates that the heave resulting from the basement excavation is likely to be in the order of between 8 mm and 20 mm at the centre of the southeastern portion of the basement, where only a single level excavation is taking place, whilst across the double level portion of the basement, between 18 mm and 27 mm of heave would be expected. These movements would be expected to be complete by the end of the excavation and construction period.

The design and loads have yet to be finalised at this stage, although indicative line loads have been provided by Elliott Wood for each elevation. These have therefore been taken into account in analysing the long term movements, with total heave movements of between 27 mm and 34 mm expected at the centre of the southeastern portion of the basement and between 23 mm and 44 mm expected across the western portion of the basement. These movements provide a worst-case scenario as there are likely to be greater loads across the proposed structure, which would either reduce long heave movements or recover some of the short term heave movements. Additionally, it is proposed to install 12 m long tension piles below the basement, which will in any case reduce heave movements.

If a compressible material is used beneath the slab, it will need to be designed to be able to resist the potential uplift forces generated by the ground movements. In this respect potential heave pressures are typically taken to equate to around 40% of the total unloading pressure.

## 12.0 DAMAGE ASSESSMENT

In addition to the above assessment of the likely movements that will result from the proposed development, the neighbouring buildings are considered to be sensitive structures, requiring Building Damage Assessments, on the basis of the classification given in Table 2.5 of C580[1]. The sensitive structures outlined above have been modelled as lines in the analysis and are the lines along which the damage assessment has been undertaken. A plan of the sensitive structures is provided overleaf.

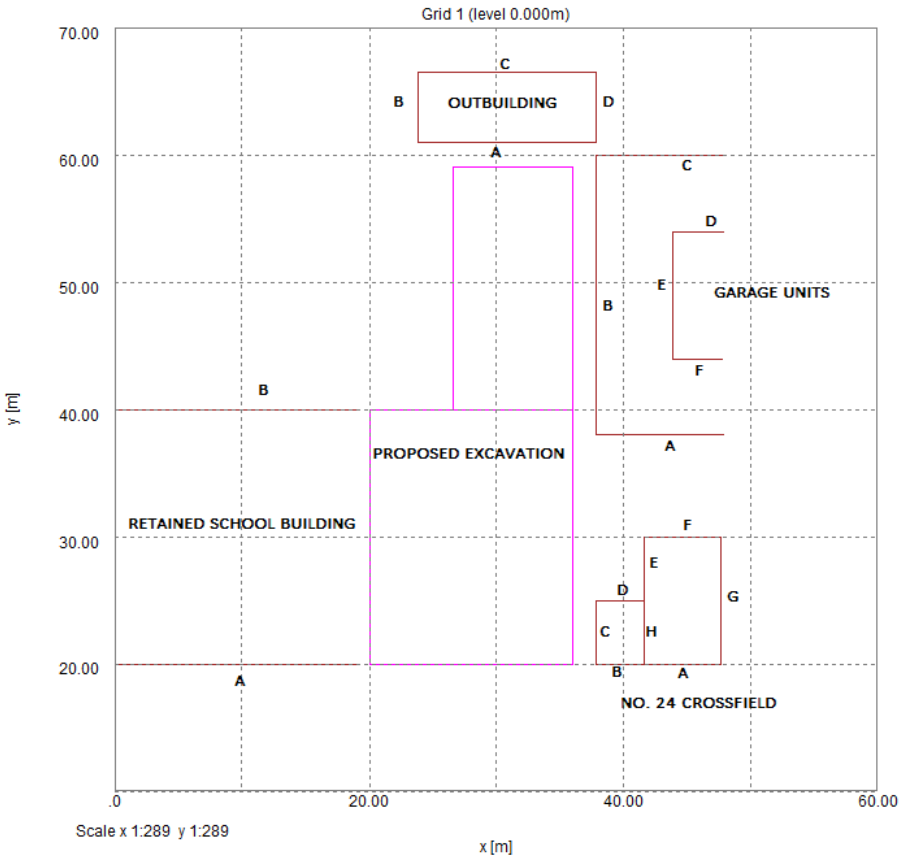
### 12.1 Retaining Wall Installation and Excavation Related Damage

The movements resulting from the wall installation phase and the combined retaining wall installation and basement excavation phases, have been estimated using the X-Disp modelling software to carry out an assessment of the likely damage to adjacent properties and the results are summarised for the combined wall installation and excavation in the table below.

| Sensitive Structure | Elevation | Category of Damage* |
|---|---|---|
| No 24 Crossfield Street | A | *Category 1- Very Slight* |
| | B | *Category 1- Very Slight* |
| | C | Category 0 – Negligible |
| | D | *Category 1- Very Slight* |
| | E | Category 0 – Negligible |

| Sensitive Structure | Elevation | Category of Damage* |
|---|---|---|
| | F | Category 0 – Negligible |
| | G | Category 0 – Negligible |
| | H | Category 0 – Negligible |
| Lockup Garage Units | A | *Category 1- Very Slight* |
| | B | *Category 2 - Slight* |
| | C | Category 0 - Negligible |
| | D | Category 0 - Negligible |
| | E | Category 0 - Negligible |
| | F | Category 0 - Negligible |
| Outbuilding at rear of No 5 Strathray | A | Category 0 - Negligible |
| | B | Category 0 - Negligible |
| | C | Category 0 - Negligible |
| | D | Category 0 - Negligible |

**From Table 2.5 of C580[1]: Classification of visible damage to walls.*




The analysis has predicted that the proposed installation of the bored pile wall, in addition to the excavation of the proposed basement, may generally result in building damage of sensitive structures of between Category 0 (negligible) and Category 1 (very slight), although a single elevation to the lockup garage block is indicated as Category 2 (slight). For those structures, some of the elevations will be subject to repointing and repair during and after the construction process.

### 12.2 Basement Heave Related Damage

The potential heave movements predicted by P-Disp have been used to carry out an assessment of the likely longer term damage to adjacent properties. The methodology contained within CIRIA 580 has been used with deflection ratios calculated from the line plots appended over their respective wall lengths and for the roughly 10 m to 15 m high neighbouring buildings. The calculated deflection ratios fall well below 1 in 400, which would be well within the 0.05 % strain that is within Burland Category 0 – negligible.

### 12.3 Comment

The Camden Planning Guidance for Basements and Lightwells (CPG4; July 2015) states that "The Council … will expect … mitigation measures where any risk of damage is identified of Burland category 1 'very slight' or higher. Following inclusion of mitigation measures into the proposed scheme the changes are to be re-evaluated and new net consequences determined."

The potential movements indicated by the ground movement analysis may be controlled to a wider extent during construction and particular consideration should be given to the sequence of wall construction, propping and excavation. The construction of the underpins has been modelled by adopting the profile of 'installation of a planar diaphragm wall'. In reality this is considered to be conservative due to the difference in size of a diaphragm wall and an underpin. In any case, where an existing wall is underpinned or re-used, the movements are likely to be lower than that of a diaphragm wall.

There is a wealth of experience with respect to the construction of underpinned retaining walls that suggests that ground movements should remain typically within the range of 2 mm to 5 mm following completion of the works, provided that they are installed by a reputable and experienced contractor in accordance with the guidelines published by the Association of Specialist Underpinning Contractors[18], which indicates that the predicted movements represent a conservative assessment of the likely movements.

### 12.4 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis should be checked by monitoring of the adjacent properties and structures. The structures to be monitored during the construction stages should include the neighbouring structures. Condition surveys of the above existing structures should be carried out before and after the proposed works.

The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

## 13.0 CONCLUSIONS

[18] Haslam S, O'Connor L (2013) *Guidelines on safe and efficient basement construction directly below or near to existing structures* ASUC

The analysis has concluded that the predicted damage to the neighbouring properties from the construction of the basement retaining walls and excavation would be generally 'Negligible to 'Very Slight', which the damage that would occur would generally fall within the acceptable limits, although repair will be required. A single elevation of the single storey lockup garage block is indicated as potentially experiencing Category 2 and Slight damage. However, given the single storey nature of this building, a certain amount of movement is likely to be tolerable, although as discussed previously, the conservative approach of the movement analysis is likely to be over-predicting movements and as such, that level of damage is unlikely to be realised. It is however recommended that movement monitoring is carried out on all structures prior to and during the proposed basement construction.

The separate phases of work, including excavation of the proposed basement level, will in practice be separated by a number of weeks during which time construction of permanent supports, basement slab and retaining wall curing will take place. This will provide an opportunity for the ground movements during and immediately after retaining wall construction to be measured and the data acquired can be fed back into the design and compared with the predicted values. Such a comparison will allow the ground model to be reviewed and the predicted wall movements to be reassessed prior to the main excavation taking place so that propping arrangements can be adjusted if required.

## 14.0 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.

# APPENDIX

Borehole Records

Trial Pit Records

Geotechnical Test Results

SPT & Cohesion/ Level Graph

Contamination test results

Generic Guideline Values

Envirocheck Summary

Historical Maps

Site Plan

**X-DISP ANALYSIS:**

**Wall Installation**
Contour Plots of Vertical Movements and Horizontal Movements

**Wall Installation and Basement Excavation combined**
Contour Plots of Combined Vertical Movements and Horizontal Movements

Tabular Output of Results

**P-DISP ANALYSIS:**

Short Term Movement Contour Plots

Total Movement Contour Plots

Displacement Graphs

**Building Damage Assessment:**

Tabular Output of Results

| GEA Geotechnical & Environmental Associates | Widbury Barn<br>Widbury Hill<br>Ware<br>SG12 7QE | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Borehole Number**<br>**BH1** |
|---|---|---|---|

| **Boring Method** | **Casing Diameter** | | **Ground Level (mOD)** | **Client** | **Job Number** |
|---|---|---|---|---|---|
| | Depth | Diameter | | | |
| Dismantlable Cable Percussion Rig | 2.00 | 150 | | The Hall School | J15302 |
| | **Location** | | **Dates** | **Engineer** | **Sheet** |
| | 526946.00E 184515.00N | | 28/10/2015 | Elliott Wood | Sheet 1 of 3 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (0.10) | Astro Turf surface over foam underlay and asphalt | | |
| 0.20 | D1 | | | | | (0.20) | Lean-mix concrete over stone chippings | | |
| 0.30 | D2 | | | | | (0.30) | Asphalt | | |
| 0.50 | B3 | | | | | | Made Ground (brownish grey silty clay with rootlets, gravel, brick, coal and concrete fragments) | | |
| 0.75 | D4 | | | | | (1.05) | | | |
| 1.20 - 1.65 | B5 | | | | | | | | |
| 1.20 - 1.65 | SPT (C)N=11 | 1.00 | | N=11 (1,2/2,2,3,4) | | 1.35 | Medium to firm fissured brown silty CLAY with pockets of orange-brown silt and fine sand and fine selenite, has blocky fissuring. | | |
| 1.75 | D6 | | | | | | | | |
| 2.00 - 2.45 | U7 | | | | | (1.65) | | | |
| 2.75 | D8 | | | | | | | | |
| 3.00 - 3.45 | D9 | | | | | 3.00 | | | |
| 3.00 - 3.45 | SPT (S)N=15 | 2.00 | | N=15 (1,2/3,3,4,5) | | | Stiff high strength locally fissured brown silty laminated CLAY with partings and pockets of orange-brown and grey silt and fine to coarse selenite crystals. | | |
| 3.75 | D10 | | | | | | | | |
| 4.00 - 4.45 | U11 | | | | | | | | |
| 4.75 | D12 | | | | | | | | |
| 5.00 - 5.45 | D13 | | | | | | | | |
| 5.00 - 5.45 | SPT (S)N=16 | 2.00 | | N=16 (1,2/3,3,4,6) | | | | | |
| 6.00 | D14 | | | | | | | | |
| 6.50 - 6.95 | U15 | | | | | (6.50) | | | |
| 7.50 | D16 | | | | | | | | |
| 8.00 - 8.45 | D17 | | | | | | | | |
| 8.00 - 8.45 | SPT (S)N=19 | 2.00 | | N=19 (4,3/4,5,5,5) | | | | | |
| 9.00 | D18 | | | | | | *abundant partings of orange-brown silty sand.* | | |
| 9.50 - 9.95 | U19 | | | | | 9.50 | Very stiff high strength to very high strength dark grey silty CLAY, locally very laminated with fine selenite, occasional white shells, occasional pale grey veins and white | | |

Continued on Next Page

**Remarks**

4 hrs spent moving rig and all equipment to borehole location.
Services inspection pit excavated from GL to 1.2 m for 1 hr.
Chiselling on claystone between 17.0 m to 17.30 m for 30 mins.
5hrs spent removing rig and equipment off of site.
Groundwater monitoring standpipe installed in borehole to 8.00 m.

| **Scale (approx)** | **Logged By** |
|---|---|
| 1:50 | ML |

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

| Site | Borehole Number |
|---|---|
| The Hall School, 23 Crossfield Street, London NW3 4NU | BH1 |

| Boring Method | Casing Diameter | | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|---|
| | Depth | Diameter | | | |
| Dismantlable Cable Percussion Rig | 2.00 | 150 | | The Hall School | J15302 |
| | **Location** | | **Dates** | **Engineer** | **Sheet** |
| | 526946.00E 184515.00N | | 28/10/2015 | Elliott Wood | Sheet 2 of 3 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | foraminifera. | | |
| 10.50 | D20 | | | | | | | | |
| 11.00 - 11.45 | D21 | | | | | | | | |
| 11.00 - 11.45 | SPT (S)N=24 | 2.00 | | N=24 (3,4/5,6,6,7) | | | | | |
| 12.00 | D22 | | | | | | | | |
| 12.50 - 12.95 | U23 | | | | | | | | |
| 13.50 | D24 | | | | | | | | |
| 14.00 - 14.45 | D25 | | | | | | | | |
| 14.00 - 14.45 | SPT (S)N=27 | 2.00 | | N=27 (3,5/5,6,7,9) | | | | | |
| 15.00 | D26 | | | | | (15.50) | | | |
| 15.50 - 15.95 | U27 | | | | | | | | |
| 16.50 | D28 | | | | | | | | |
| 17.00 - 17.45 | D29 | | | | | | *claystone at 17.00 m* | | |
| 17.00 - 17.45 | SPT (S)N=33 | 2.00 | | N=33 (14,15/11,8,6,8) | | | | | |
| 18.00 | D30 | | | | | | | | |
| 18.50 - 18.95 | U31 | | | | | | | | |
| 19.50 | D32 | | | | | | | | |
| 20.00 - 20.45 | D33 | | | | | | | | |

Continued on Next Page

**Remarks**

4 hrs spent moving rig and all equipment to borehole location.
Services inspection pit excavated from GL to 1.2 m for 1 hr.
Chiselling on claystone between 17.0 m to 17.30 m for 30 mins.
5hrs spent removing rig and equipment off of site.
Groundwater monitoring standpipe installed in borehole to 8.00 m.

| Scale (approx) | Logged By |
|---|---|
| 1:50 | ML |

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

| Site | Borehole Number |
|---|---|
| The Hall School, 23 Crossfield Street, London NW3 4NU | BH1 |

| Boring Method | Casing Diameter | | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|---|
| | Depth | Diameter | | | |
| Dismantlable Cable Percussion Rig | 2.00 | 150 | | The Hall School | J15302 |
| | **Location** | | **Dates** | **Engineer** | **Sheet** |
| | 526946.00E 184515.00N | | 28/10/2015 | Elliott Wood | Sheet 3 of 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 | SPT (S)N=34 | 2.00 | | N=34 (5,6/7,8,8,11) | | | | | |
| 21.00 | D34 | | | | | | | | |
| 21.50 - 21.95 | U35 | | | | | | | | |
| 22.50 | D36 | | | | | | | | |
| 23.00 - 23.45 | D37 | | | | | | | | |
| 23.00 - 23.45 | SPT (S)N=35 | 2.00 | | N=35 (5,6/8,8,9,10) | | | | | |
| | | | | | | | *claystone at 23.70 m* | | |
| 24.00 | D38 | | | | | | | | |
| 24.55 - 25.00 | D40 | | | | | | | | |
| 24.55 - 25.00 | SPT (S)N=37 | 2.00 | | N=37 (7,6/7,8,9,13) | | | | | |
| 24.55 - 25.00 | U39 | | | | | 25.00 | Complete at 25.000m | | |

**Remarks**

4 hrs spent moving rig and all equipment to borehole location.
Services inspection pit excavated from GL to 1.2 m for 1 hr.
Chiselling on claystone between 17.0 m to 17.30 m for 30 mins.
5hrs spent removing rig and equipment off of site.
Groundwater monitoring standpipe installed in borehole to 8.00 m.

| Scale (approx) | Logged By |
|---|---|
| 1:50 | ML |

| | | | | | |
|---|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates<br>Widbury Barn<br>Widbury Hill<br>Ware<br>SG12 7QE | | | | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Borehole Number**<br>**BH2** |
| **Boring Method**<br>Drive-in Window Sampler | **Casing Diameter**<br>Depth / Diameter | | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location**<br>526939.00E 184539.00N | | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>Sheet 1 of 1 |

| 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 | | | |
| | | | | | | (0.20) | Made Ground (dark brown and black silty sandy gravel with ash) | | |
| | | | | | | 0.40 | | | |
| | | | | | | | Made Ground (brown silty clay with gravel and fine brick fragments) | | |
| | | | | | | (2.00) | | | |
| 2.00 | D1 | | | | | | | | |
| | | | | Seepage | | 2.40 | | | |
| | | | | | | (0.40) | Made Ground (crushed brick and gravel) | | |
| | | | | | | 2.80 | | | |
| | | | | | | | Made Ground (greyish brown loosely cemented gravel and brick) | | |
| | | | | | | (1.00) | | | |
| | | | | | | 3.80 | | | |
| 4.00 | D2 | | | | | | Firm fissured locally very thinly laminated silty CLAY with partings of bluish grey silt occasional pockets of dark orange-brown fine sand, coarse selenite and fine white shells | | |
| 4.50 | D3 | | | | | (1.50) | | | |
| 5.00 | D4 | | | | | | | | |
| | | | | | | 5.30 | | | |
| | | | | | | | Complete at 5.300m | | |

**Remarks**

Borehole advanced through the base of TRial Pit 1 at a depth of 1.80 m.
Groundwater monitoring standpipe installed in borehole to 5.00 m.

| **Scale (approx)** | **Logged By** |
|---|---|
| 1:50 | ML |

| | | | | |
|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates<br>Widbury Barn<br>Widbury Hill<br>Ware<br>SG12 7QE | | | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Borehole Number**<br>**BH3** |
| **Boring Method**<br>Drive-in Window Sampler | **Casing Diameter**<br>Depth / Diameter | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location**<br>526964.00E 184508.00N | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>Sheet 1 of 1 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (0.15)<br>0.15 | Concrete with 6 mm reinforcement | | |
| | | | | | | | Made Ground (dark brown silty clay with gravel, decayed roots, brick and coal fragments) | | |
| | | | | | | (1.05) | | | |
| 0.90 | D1 | | | Seepage | | | | | |
| | | | | | | 1.20<br>(0.20) | Made Ground (brown silty clay with gravel) | | |
| | | | | | | 1.40 | Soft rapidly becoming firm fissured brown CLAY with bluish grey veins, occasional small pockets of orange-brown fine sand and fine selenite | | |
| 1.60 | D2 | | | | | | | | |
| 2.60 | D3 | | | | | | | | |
| 3.60 | D4 | | | | | (4.60) | | | |
| 4.60 | D5 | | | | | | *coarse selenite and pockets of pale grey silt below 4.50 m* | | |
| 5.60 | D6 | | | | | | | | |
| | | | | | | 6.00 | Complete at 6.000m | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| Borehole advanced through the base of Trial Pit No 2 at a depth of 0.70 m. | 1:50 | ML |

| | | | | |
|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates<br>Widbury Barn<br>Widbury Hill<br>Ware<br>SG12 7QE | | | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Borehole Number**<br>**BH4** |
| **Boring Method**<br>Drive-in Window Sampler | **Casing Diameter**<br>Depth / Diameter | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location**<br>526920.00E 184520.00N | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>Sheet 1 of 1 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (0.20)<br>0.20 | Concrete | | |
| | | | | | | (0.80) | Made Ground (brown silty clay with gravel and brick fragments) | | |
| | | | | | | 1.00 | Firm fissured locally very thinly laminated silty CLAY with partings of bluish grey silt occasional pockets of dark orange-brown fine sand, coarse selenite and fine white shells | | |
| | | | | | | (4.00) | | | |
| | | | | | | 5.00 | Complete at 5.000m | | |

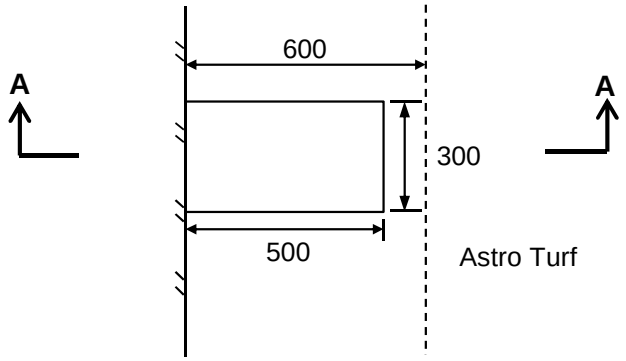
**Remarks**

Groundwater monitoring standpipe installed in borehole to a depth of 5.00 m.

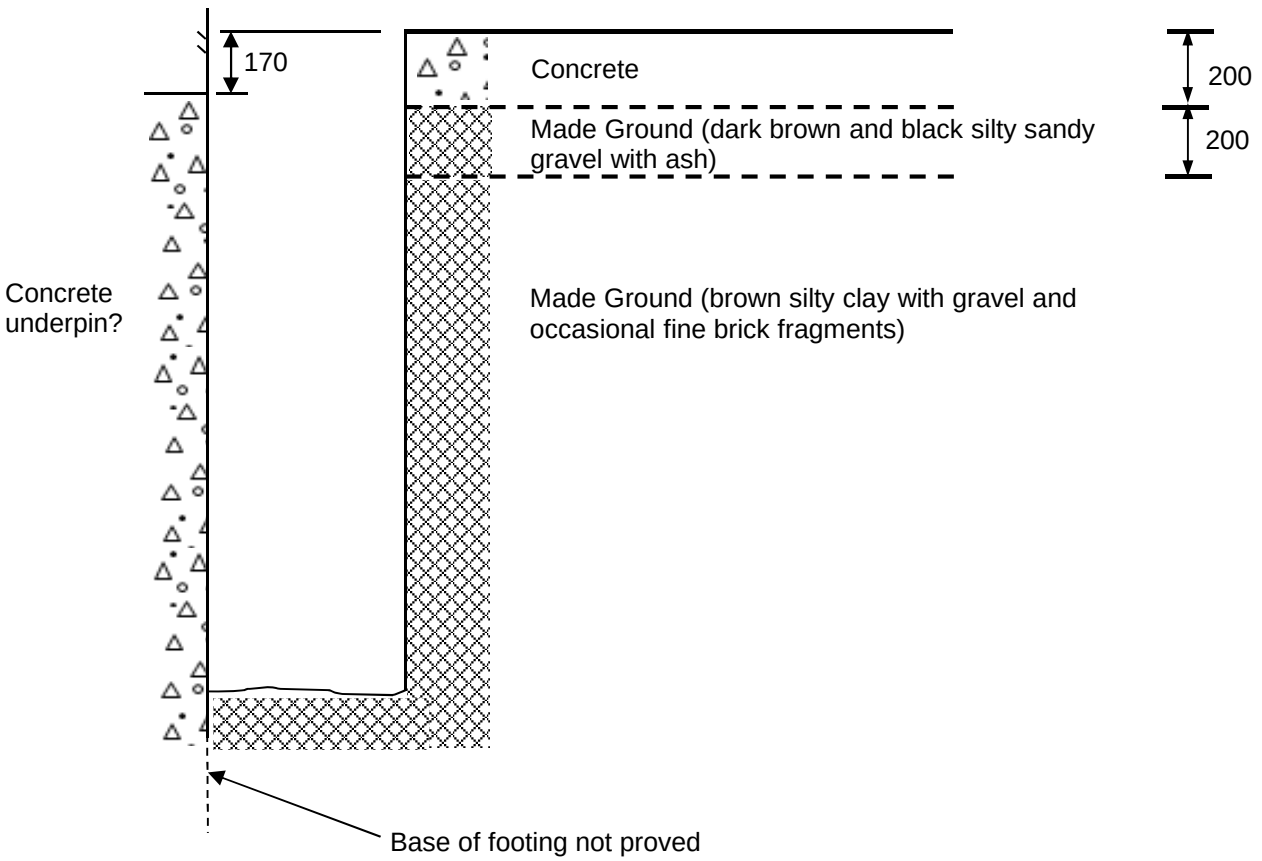
| **Scale (approx)** | **Logged By** |
|---|---|
| 1:50 | ML |

| | | | | |
|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates<br>Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | | | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>**1** |
| **Excavation Method**<br>Manual | **Dimensions**<br>500 x 300 x 1800 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>1 / 2 |

## Plan: -




## Section A - A: -




| | | |
|---|---|---|
| Remarks: | | Scale: |
| All dimensions in millimetres | Base of footing not proved. | 1:20 |
| Sides of trial pit remained stable during excavation | Borehole No 2 advanced through base of trial pit. | Logged by: |
| Groundwater: not encountered | Sample: 0.4 m | ML |

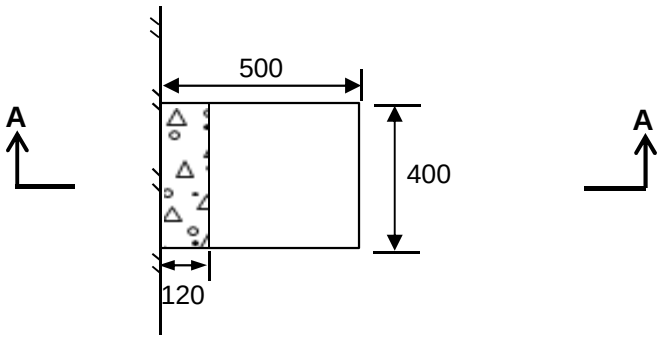
| | | | | |
|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates<br>Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | | | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>**1** |
| **Excavation Method**<br>Manual | **Dimensions**<br>500 x 300 x 1800 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>2 / 2 |

| | | |
|---|---|---|
| Remarks: | | Scale: |
| All dimensions in millimetres | Base of footing not proved. | 1:20 |
| Sides of trial pit remained stable during excavation | Borehole No 2 advanced through base of trial pit. | Logged by: |
| Groundwater: not encountered | Sample: 0.4 m | ML |

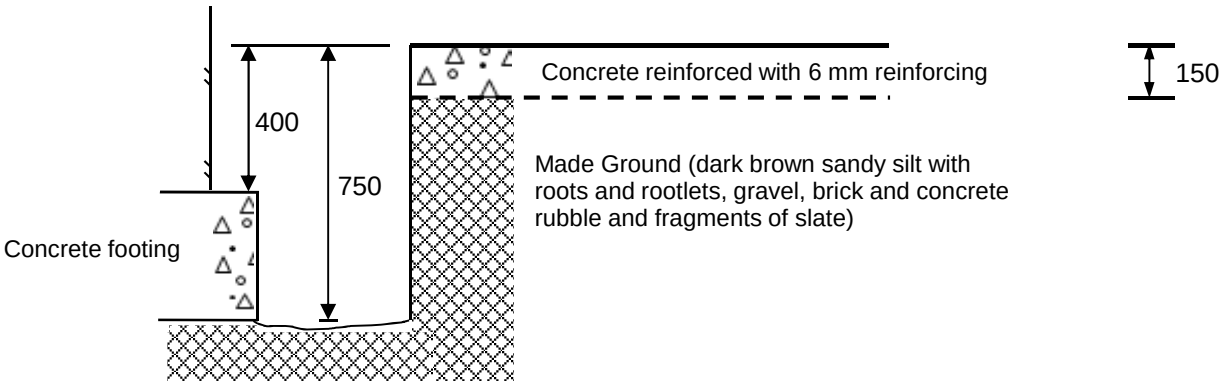
| GEA Geotechnical & Environmental Associates | Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>**2** |
|---|---|---|---|

| **Excavation Method**<br>**Manual** | **Dimensions**<br>500 x 400 x 750 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
|---|---|---|---|---|
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>1 / 1 |

## Plan: -



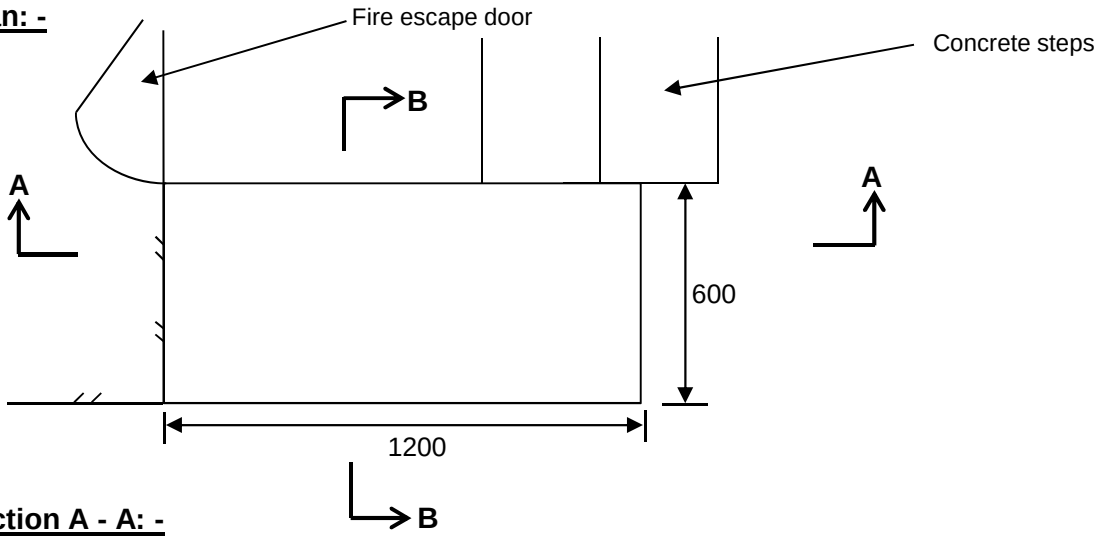

## Section A - A: -



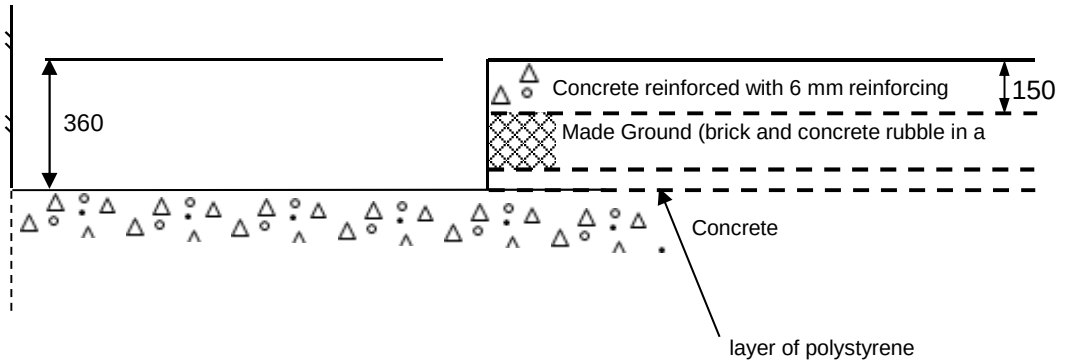

| Remarks: | | Scale: |
|---|---|---|
| All dimensions in millimetres | Borehole No 3 advanced through base of trial pit. | 1:20 |
| Sides of trial pit remained stable during excavation | | Logged by: |
| Groundwater: not encountered | | ML |

| | | | | |
|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates<br>Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | | | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>3 |
| **Excavation Method**<br>Manual | **Dimensions**<br>1200 x 600 x 360 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>1 / 2 |

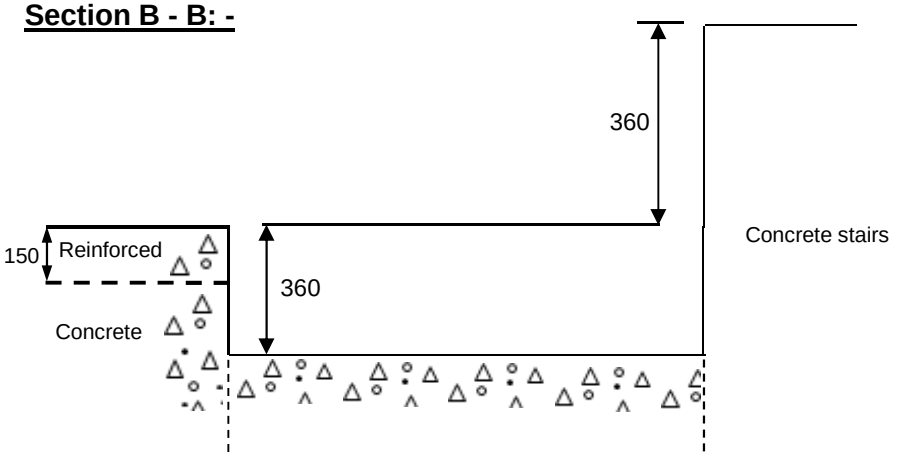
**Plan: -**




**Section A - A: -**




**Section B - B: -**




| | |
|---|---|
| Remarks:<br>All dimensions in millimetres<br>Sides of trial pit remained stable during excavation<br>Groundwater: not encountered | Scale:<br>1:20<br>Logged by:<br>ML |

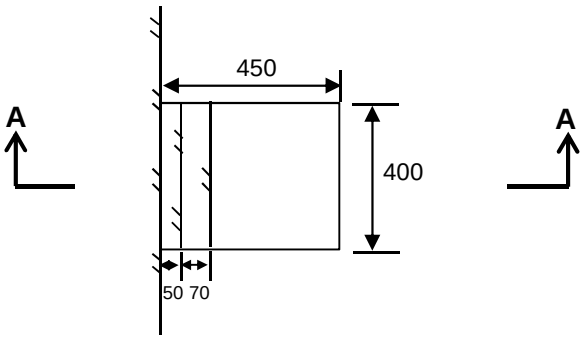
| | | | | |
|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates<br>Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | | | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>**3** |
| **Excavation Method**<br>**Manual** | **Dimensions**<br>1200 x 600 x 360 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>2 / 2 |

| | |
|---|---|
| Remarks:<br>All dimensions in millimetres<br>Sides of trial pit remained stable during excavation<br>Groundwater: not encountered | Scale:<br>1:20<br>Logged by:<br>ML |

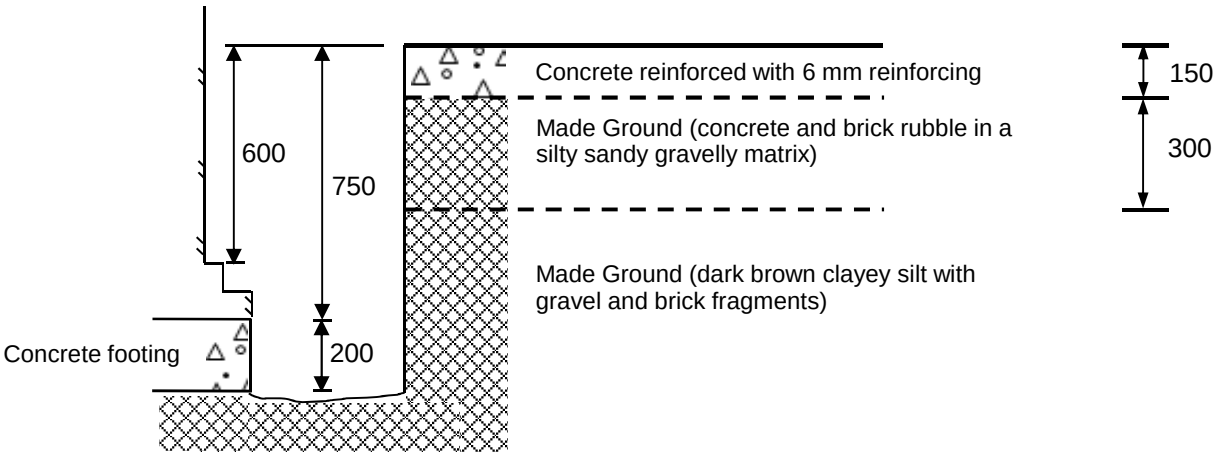
| GEA Geotechnical & Environmental Associates | Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>4 |
|---|---|---|---|

| **Excavation Method**<br>Manual | **Dimensions**<br>450 x 400 x 950 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
|---|---|---|---|---|
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>1 / 2 |

## Plan: -




## Section A - A: -




| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Groundwater: not encountered | ML |

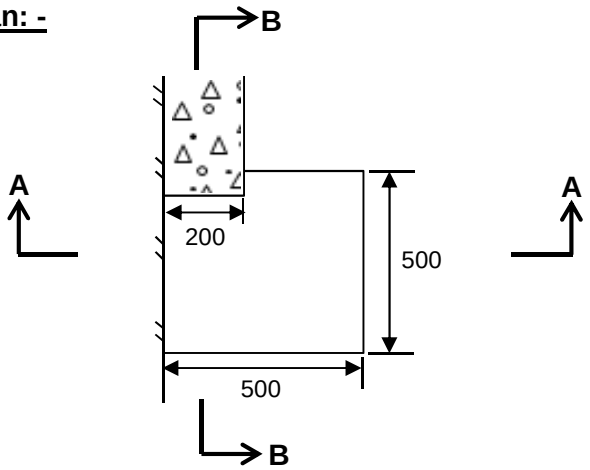
| GEA Geotechnical & Environmental Associates | Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>**4** |
|---|---|---|---|
| **Excavation Method**<br>**Manual** | **Dimensions**<br>450 x 400 x 950 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>2 / 2 |

| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Groundwater: not encountered | ML |

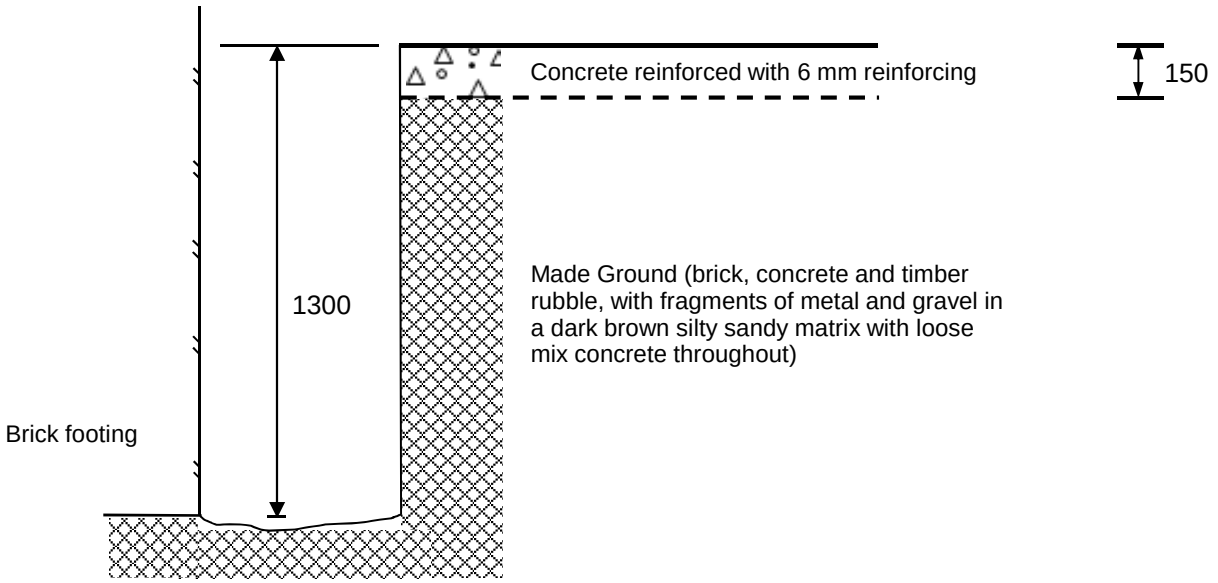
| GEA Geotechnical & Environmental Associates | Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>5 |
|---|---|---|---|

| **Excavation Method**<br>Manual | **Dimensions**<br>1300 x 500 x 500 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
|---|---|---|---|---|
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>1 / 3 |

**Plan: -**



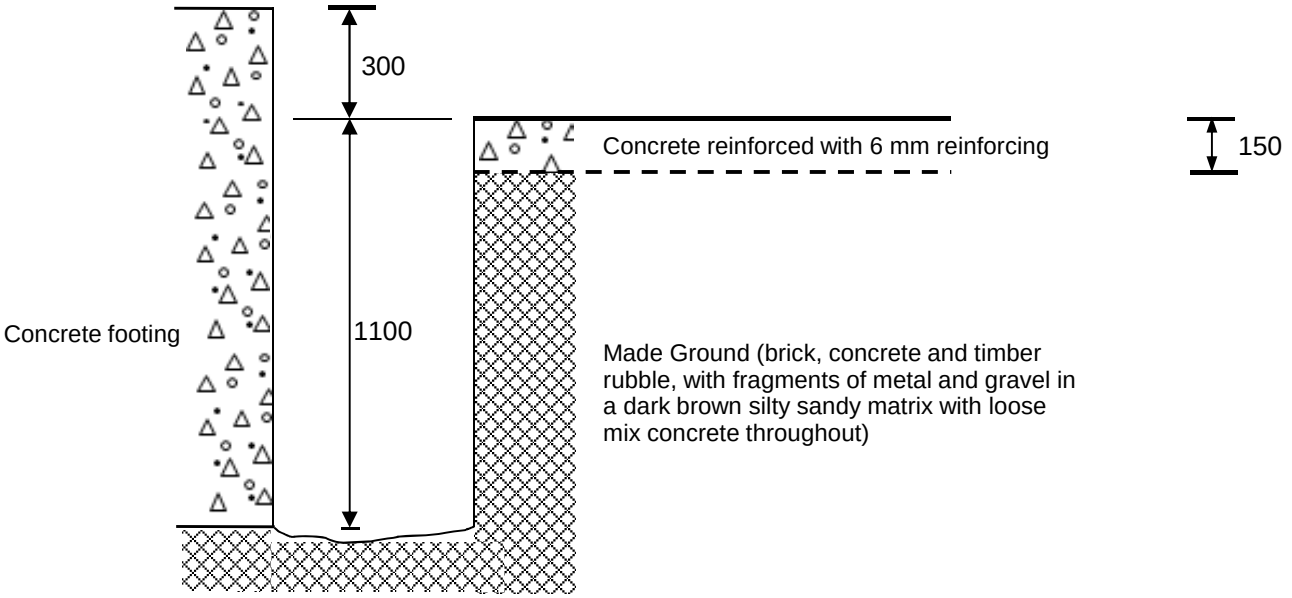

**Section A - A: -**




| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Groundwater: not encountered | ML |

| GEA Geotechnical & Environmental Associates | Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>**5** |
|---|---|---|---|
| **Excavation Method**<br>**Manual** | **Dimensions**<br>1300 x 500 x 500 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>2 / 3 |

## Section B - B: -




| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Groundwater: not encountered | ML |

| GEA Geotechnical & Environmental Associates | Widbury Barn<br>Widbury Hill<br>Ware<br>Herts SG12 7QE | **Site**<br>The Hall School, 23 Crossfield Street, London NW3 4NU | **Trial Pit Number**<br>**5** |
|---|---|---|---|
| **Excavation Method**<br>**Manual** | **Dimensions**<br>1300 x 500 x 500 | **Ground Level (mOD)** | **Client**<br>The Hall School | **Job Number**<br>J15302 |
| | **Location** | **Dates**<br>30/10/2015 | **Engineer**<br>Elliott Wood | **Sheet**<br>3 / 3 |

| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Groundwater: not encountered | ML |

# Summary of Test Results

| Job No. | Project Name | Programme | |
|---|---|---|---|
| 19833 | The Hall School | Samples received | 06/11/2015 |
| | | Schedule received | 10/11/2015 |
| Project No. | Client | Project started | 10/11/2015 |
| J15302 | GEA | Testing Started | 24/11/2015 |

| Hole No. | Sample | | | | Soil Description | NMC | Passing 425µm | LL | PL | PI | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | % | % | % | % | % | |
| BH1 | | 1.75 | | D | Brown slightly gravelly silty CLAY (gravel is fine and sub-angular) | 32 | 90 | 78 | 27 | 51 | |
| BH1 | | 2.75 | | D | Brown and occasional pale grey slightly gravelly silty CLAY (gravel is fine and sub-angular) | 30 | 99 | 78 | 28 | 50 | |
| BH1 | | 3.00 | | D | Brown and occasional blue grey slightly gravelly silty CLAY (gravel is fine and sub-angular) | 32 | | | | | |
| BH1 | | 3.75 | | D | Brown and occasional blue grey and orange silty CLAY with patchy decomposing selenite crystals | 37 | 100 | 72 | 29 | 43 | |
| BH1 | | 4.75 | | D | Brown and occasional blue grey and orange silty CLAY | 34 | | | | | |
| BH1 | | 5.00 | | D | Brown and occasional blue grey and orange silty CLAY with patchy decomposing selenite crystals | 31 | 100 | 72 | 29 | 43 | |
| BH1 | | 8.00 | | D | Grey and occasional brown silty CLAY | 31 | 100 | 78 | 28 | 50 | |
| BH2 | | 4.00 | | D | Brown and occasional grey silty CLAY with traces of selenite crystals | 28 | 100 | 72 | 26 | 46 | |
| BH3 | | 1.60 | | D | Brown and occasional blue grey silty CLAY with rare fine gravel | 34 | 99 | 80 | 26 | 54 | |
| BH3 | | 2.60 | | D | Brown and occasional blue grey silty CLAY | 28 | | | | | |
| BH3 | | 3.60 | | D | Brown and occasional blue grey silty CLAY with traces of selenite crystals and rare fine gravel | 31 | 99 | 70 | 24 | 46 | |
| BH3 | | 4.60 | | D | Brown and blue grey silty CLAY | 32 | | | | | |

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

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

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

**Checked and Approved**
**Initials** J.P
**Date:** 27/11/2015

UKAS TESTING 2519

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

# Summary of Test Results

| Job No. | Project Name | Programme | |
|---|---|---|---|
| 19833 | The Hall School | Samples received | 06/11/2015 |
| | | Schedule received | 10/11/2015 |
| Project No. | Client | Project started | 10/11/2015 |
| J15302 | GEA | Testing Started | 24/11/2015 |

| Hole No. | Sample | | | | Soil Description | NMC | Passing 425µm | LL | PL | PI | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | % | % | % | % | % | |
| BH3 | | 5.60 | | D | Brown and occasional blue grey silty CLAY | 29 | 100 | 78 | 26 | 52 | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
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**Test Methods: BS1377: Part 2: 1990:**
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

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

**Tel: 01923 711 288**
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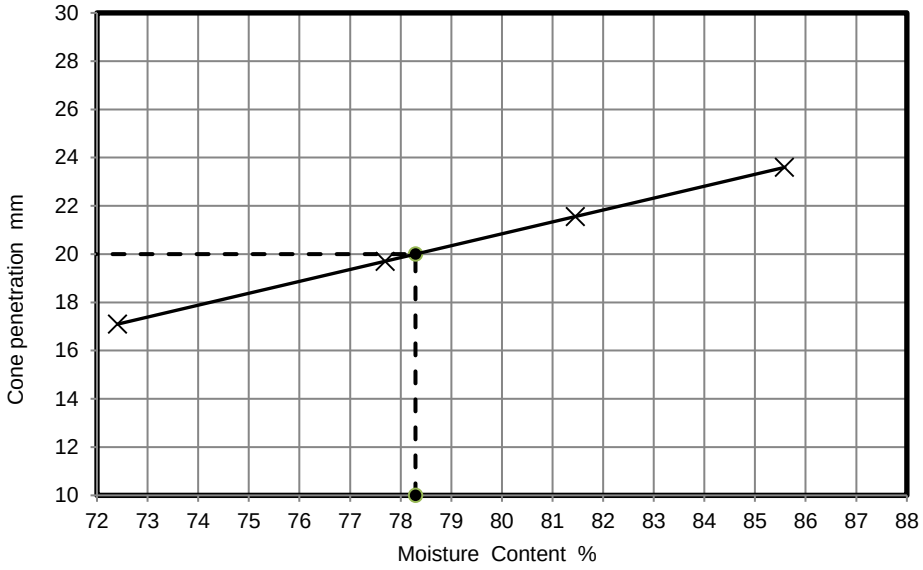
**Checked and Approved**

**Initials** **J.P**

**Date:** 27/11/2015

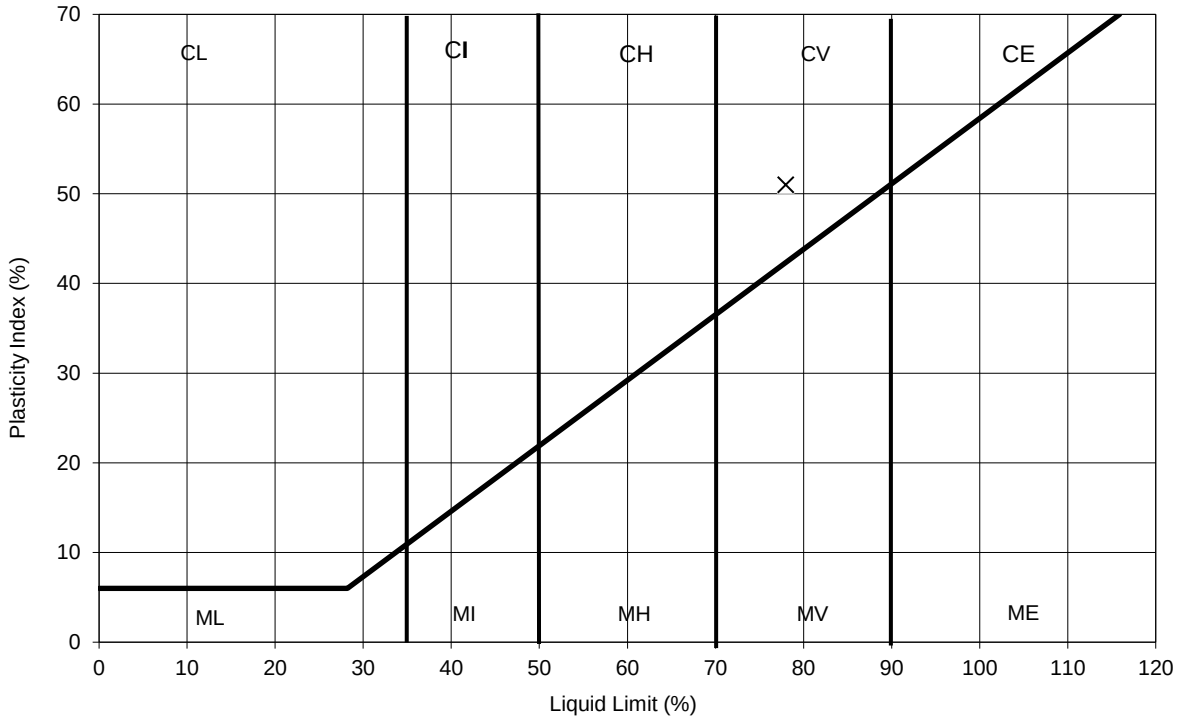
| | | | | | |
|---|---|---|---|---|---|
| | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 1.75 |
| Soil Description | Brown slightly gravelly silty CLAY (gravel is fine and sub-angular) | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 24/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **32** | **%** |
| **% PASSING 425µm SIEVE** | **90** | **%** |
| **LIQUID LIMIT** | **78** | **%** |
| **PLASTIC LIMIT** | **27** | **%** |
| **PLASTICITY INDEX** | **51** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying


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

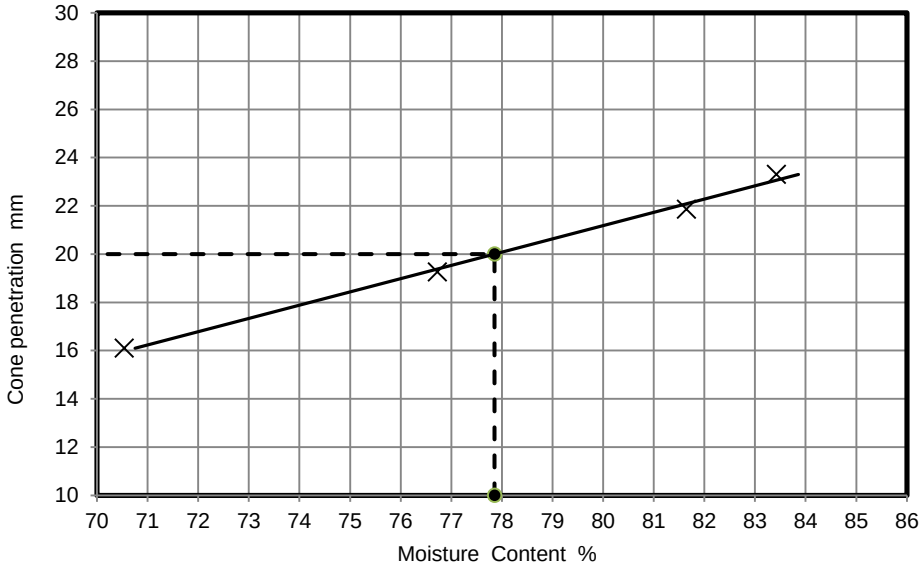

**Checked and Approved**

Initials: J.P
Date: 27/11/2015

UKAS TESTING 2519

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

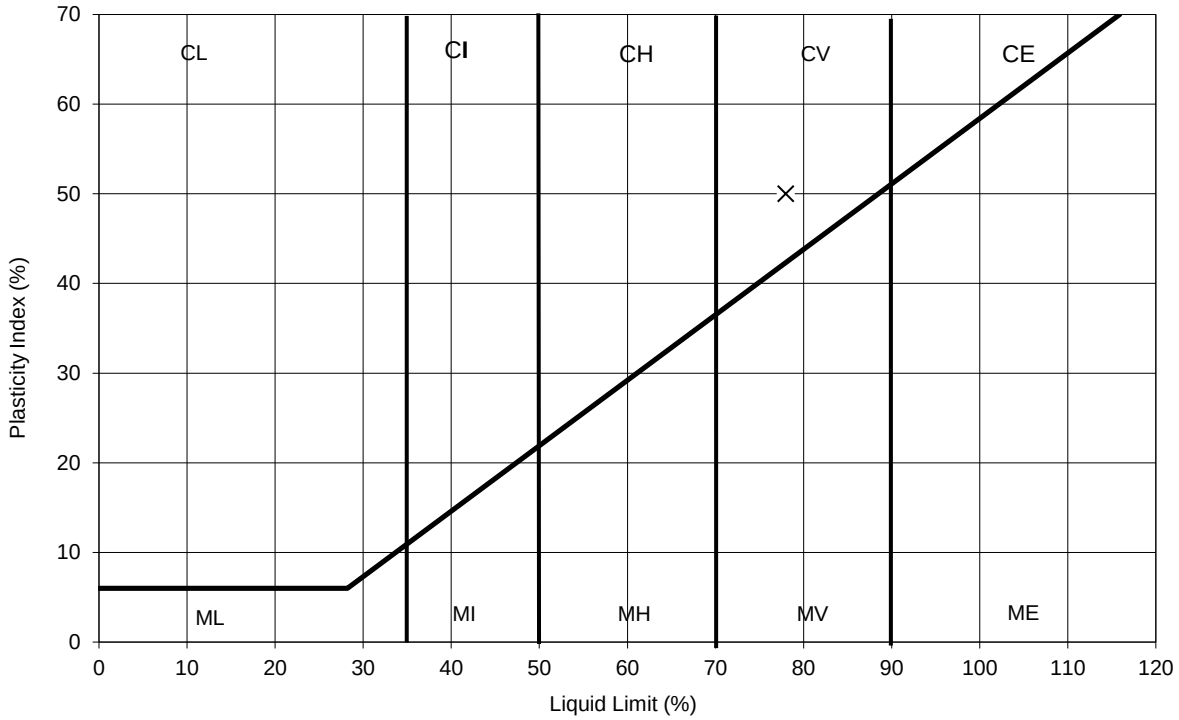
| | | | | | |
|---|---|---|---|---|---|
| K4 SOILS | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 2.75 |
| Soil Description | Brown and occasional pale grey slightly gravelly silty CLAY (gravel is fine and sub-angular) | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 24/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **30** | **%** |
| **% PASSING 425µm SIEVE** | **99** | **%** |
| **LIQUID LIMIT** | **78** | **%** |
| **PLASTIC LIMIT** | **28** | **%** |
| **PLASTICITY INDEX** | **50** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

**Checked and Approved**

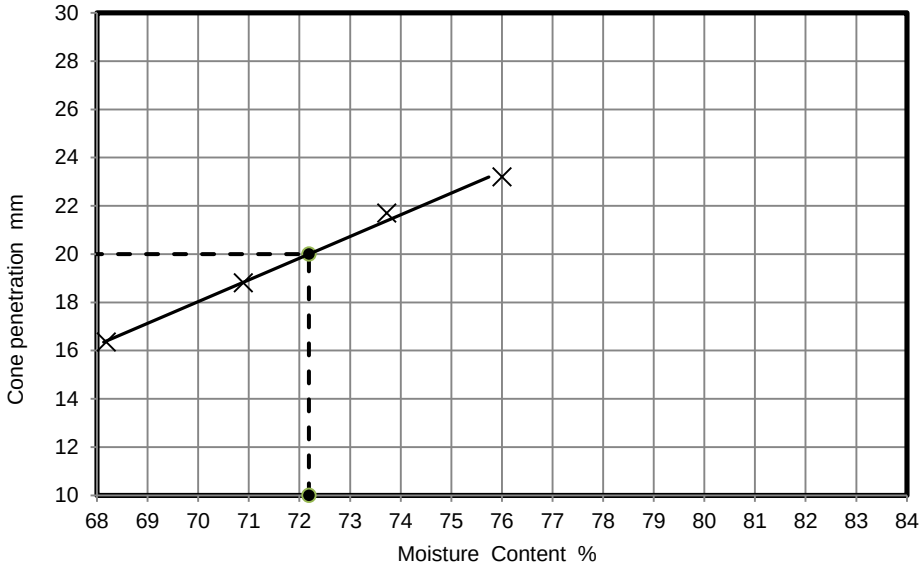
Initials: J.P
Date: 27/11/2015

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

UKAS TESTING 2519

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

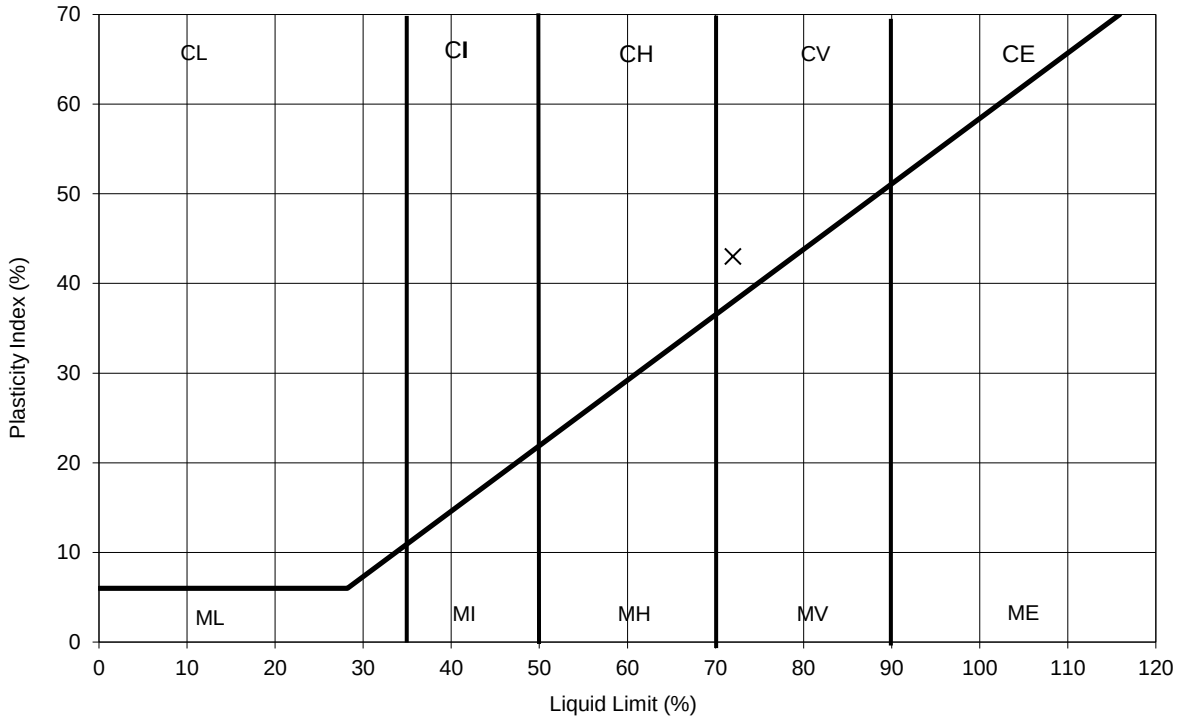
| | | | | | |
|---|---|---|---|---|---|
| K4 SOILS | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 3.75 |
| Soil Description | Brown and occasional blue grey and orange silty CLAY with patchy decomposing selenite crystals | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 24/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **37** | **%** |
| **% PASSING 425µm SIEVE** | **100** | **%** |
| **LIQUID LIMIT** | **72** | **%** |
| **PLASTIC LIMIT** | **29** | **%** |
| **PLASTICITY INDEX** | **43** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

**Checked and Approved**

Initials: J.P
Date: 27/11/2015

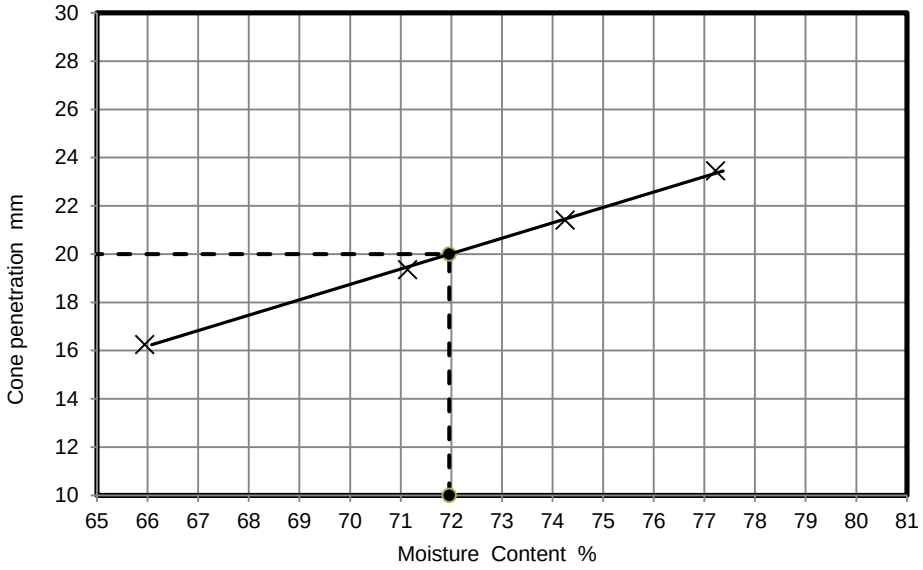
Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288 Email: James@k4soils.com

UKAS TESTING 2519

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

# LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

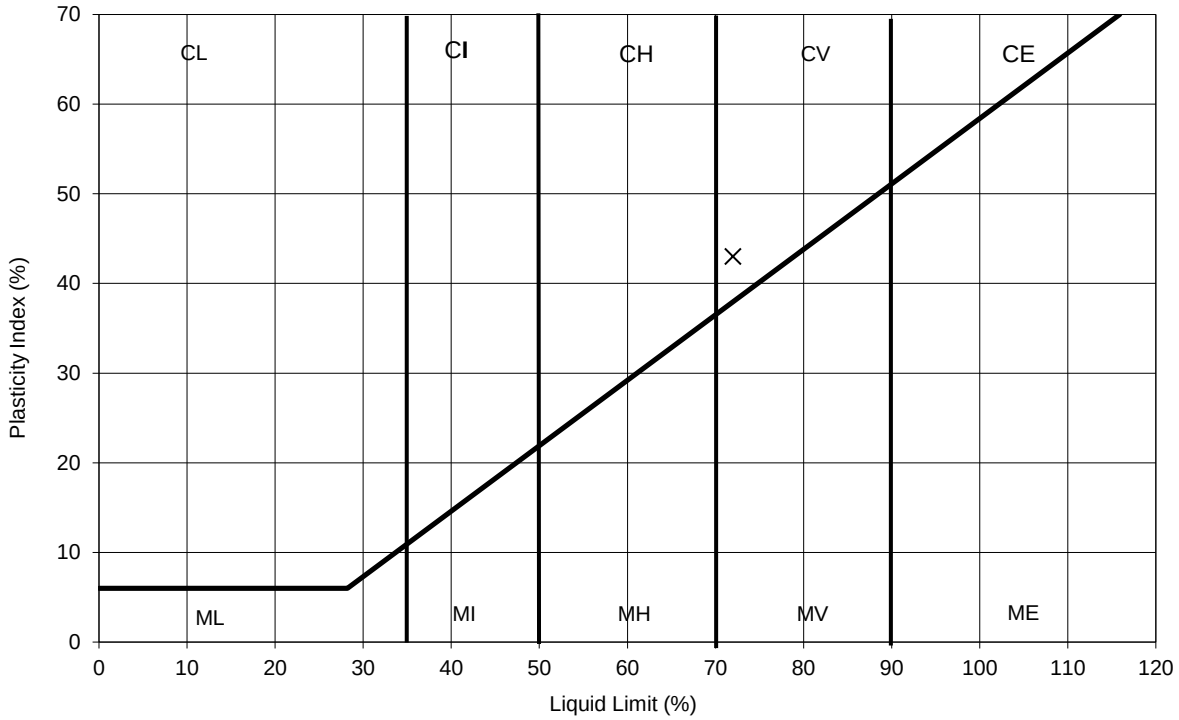
| | | | | | |
|---|---|---|---|---|---|
| | | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 5.00 |
| Soil Description | Brown and occasional blue grey and orange silty CLAY with patchy decomposing selenite crystals | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 24/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **31** | **%** |
| **% PASSING 425µm SIEVE** | **100** | **%** |
| **LIQUID LIMIT** | **72** | **%** |
| **PLASTIC LIMIT** | **29** | **%** |
| **PLASTICITY INDEX** | **43** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

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BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

**Checked and Approved**

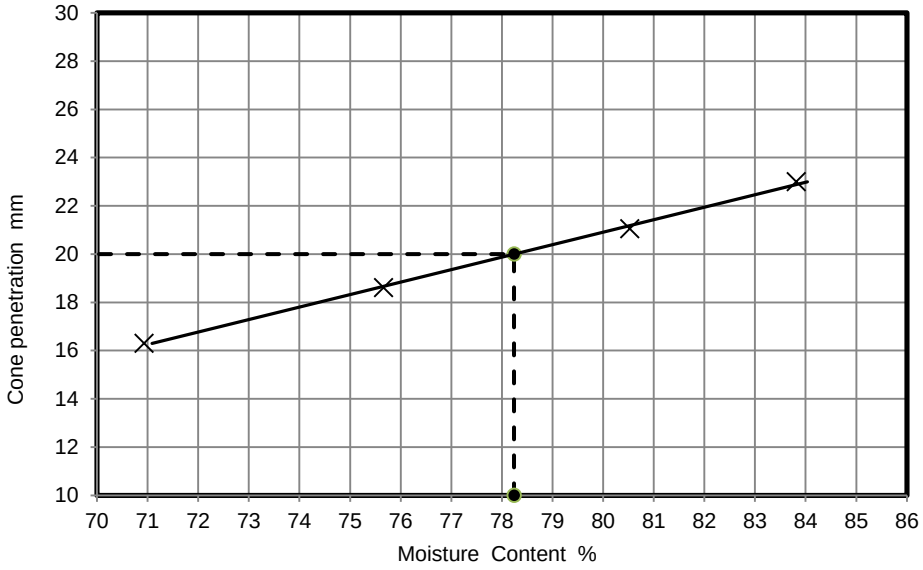
Initials: J.P
Date: 27/11/2015


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


2519

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

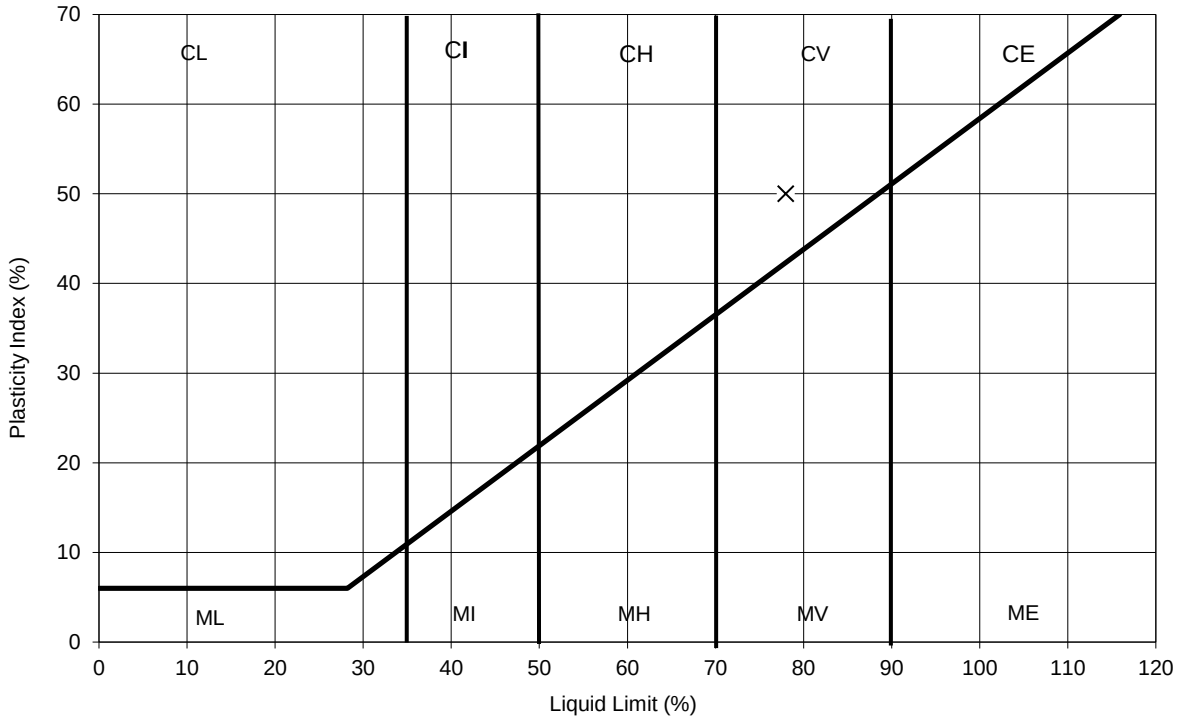
| | | | | | |
|---|---|---|---|---|---|
| | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 8.00 |
| Soil Description | Grey and occasional brown silty CLAY | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 24/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **31** | **%** |
| **% PASSING 425µm SIEVE** | **100** | **%** |
| **LIQUID LIMIT** | **78** | **%** |
| **PLASTIC LIMIT** | **28** | **%** |
| **PLASTICITY INDEX** | **50** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
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Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288 Email: James@k4soils.com

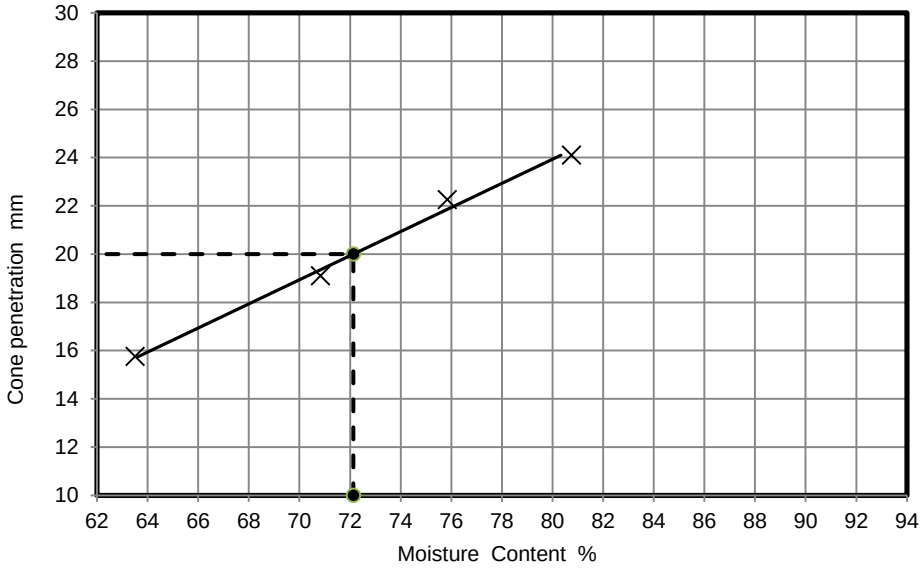

**Checked and Approved**

Initials: J.P
Date: 27/11/2015

2519

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

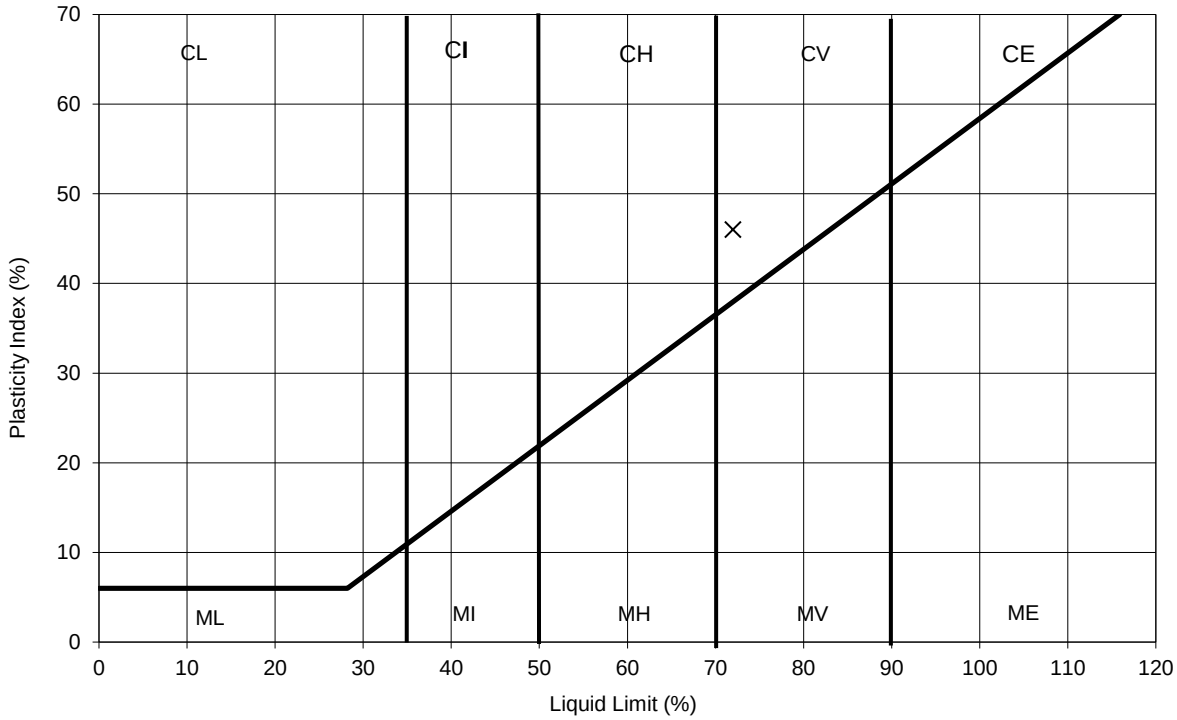
| | | | | | |
|---|---|---|---|---|---|
| K4 SOILS | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH2 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 4.00 |
| Soil Description | Brown and occasional grey silty CLAY with traces of selenite crystals | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 17/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **28** | **%** |
| **% PASSING 425µm SIEVE** | **100** | **%** |
| **LIQUID LIMIT** | **72** | **%** |
| **PLASTIC LIMIT** | **26** | **%** |
| **PLASTICITY INDEX** | **46** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

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Date: 27/11/2015

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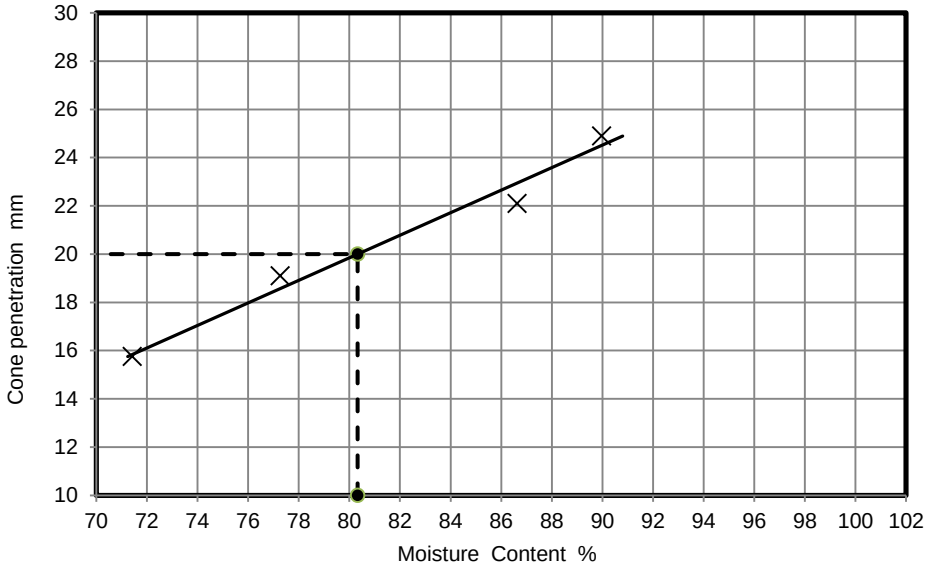
UKAS TESTING 2519

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

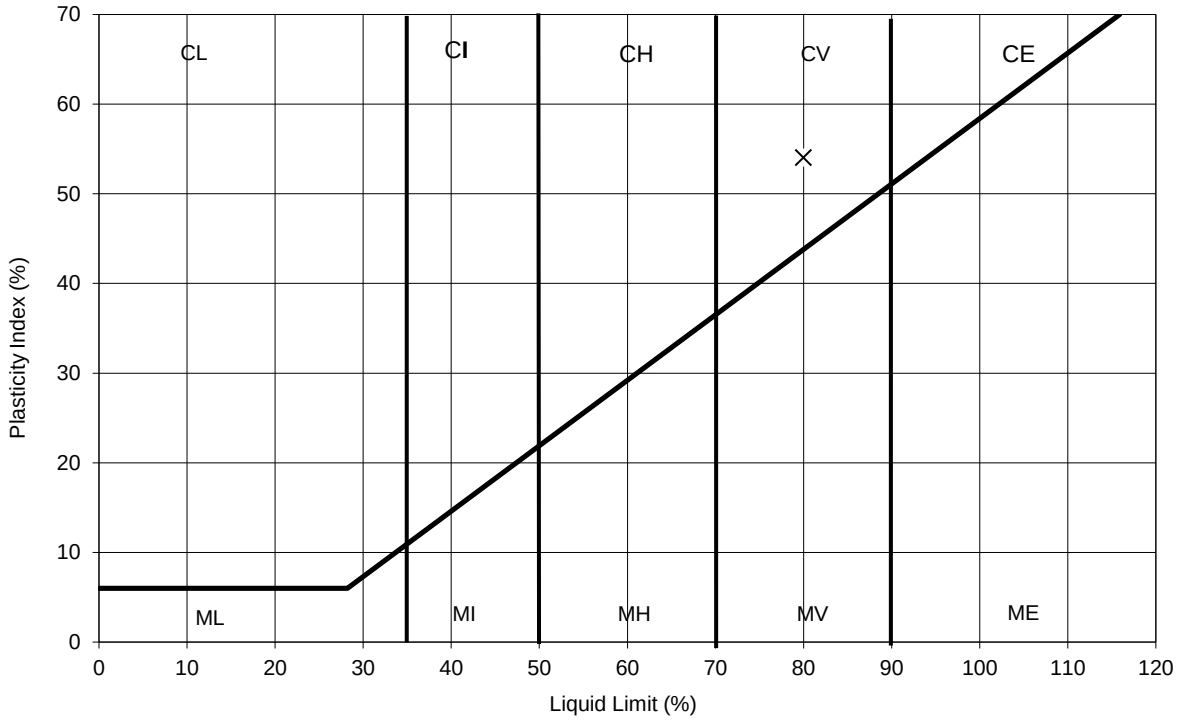
| | | | | | |
|---|---|---|---|---|---|
| K4 SOILS | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH3 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 1.60 |
| Soil Description | Brown and occasional blue grey silty CLAY with rare fine gravel | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 17/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **34** | **%** |
| **% PASSING 425µm SIEVE** | **99** | **%** |
| **LIQUID LIMIT** | **80** | **%** |
| **PLASTIC LIMIT** | **26** | **%** |
| **PLASTICITY INDEX** | **54** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
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**Checked and Approved**

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Date: 27/11/2015

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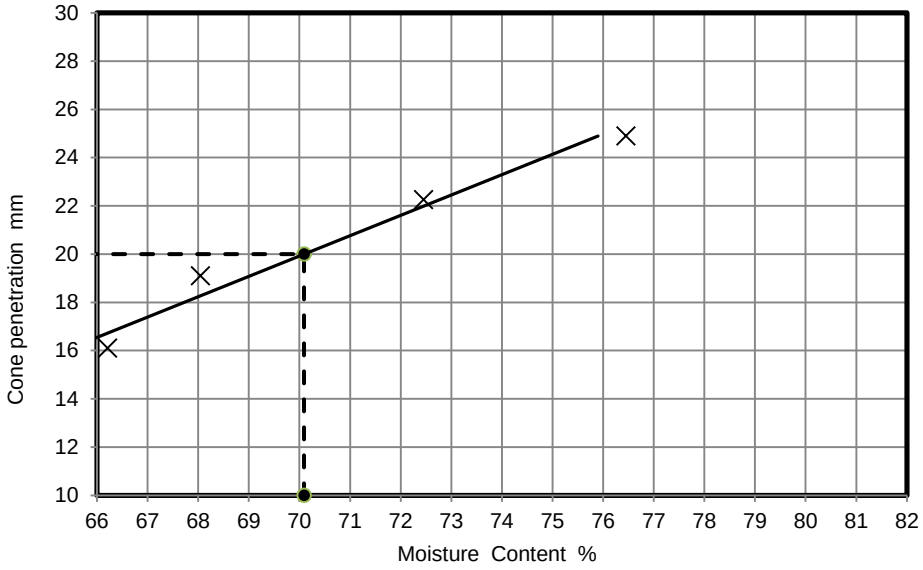
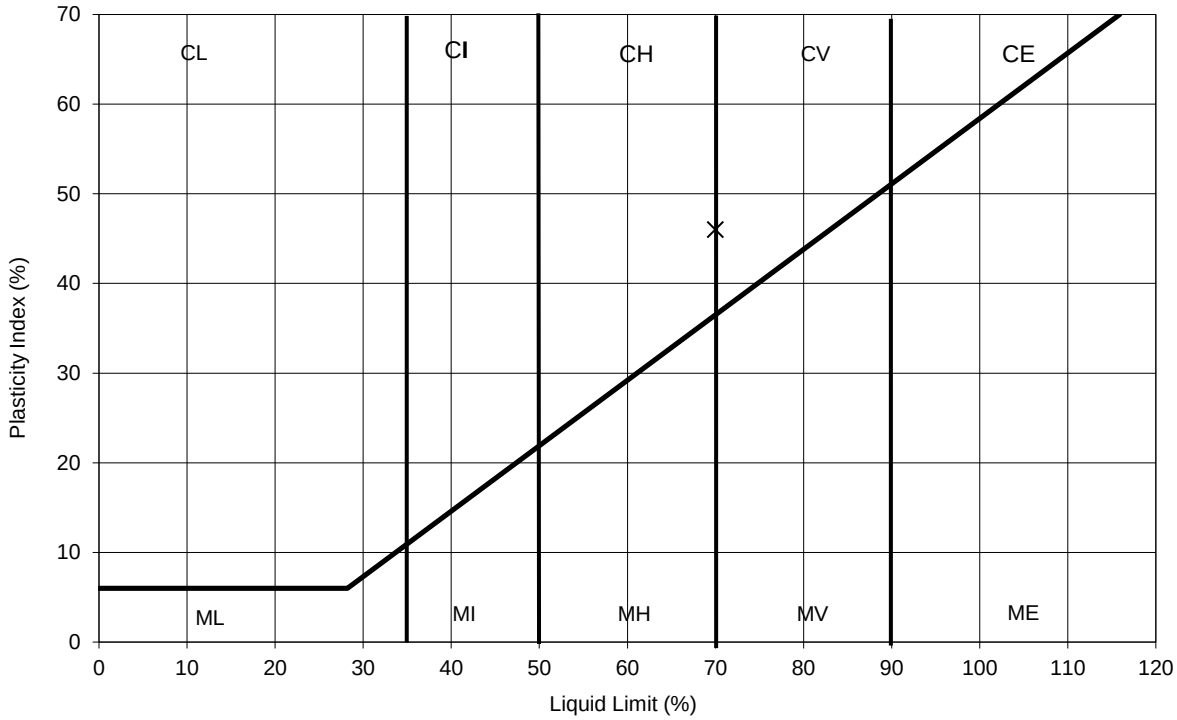
| | | | | | |
|---|---|---|---|---|---|
| K4 SOILS | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH3 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 3.60 |
| Soil Description | Brown and occasional blue grey silty CLAY with traces of selenite crystals and rare fine gravel | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 17/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **31** | **%** |
| **% PASSING 425µm SIEVE** | **99** | **%** |
| **LIQUID LIMIT** | **70** | **%** |
| **PLASTIC LIMIT** | **24** | **%** |
| **PLASTICITY INDEX** | **46** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

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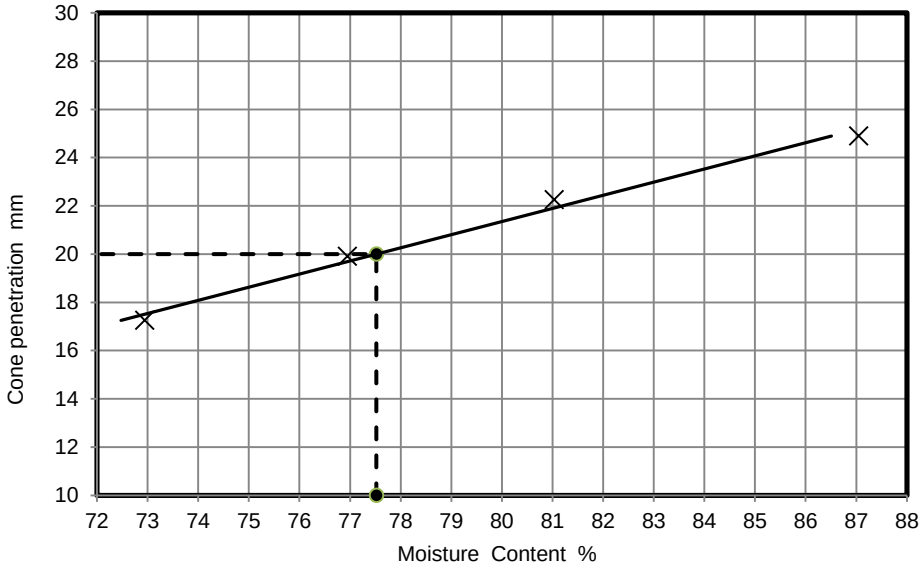
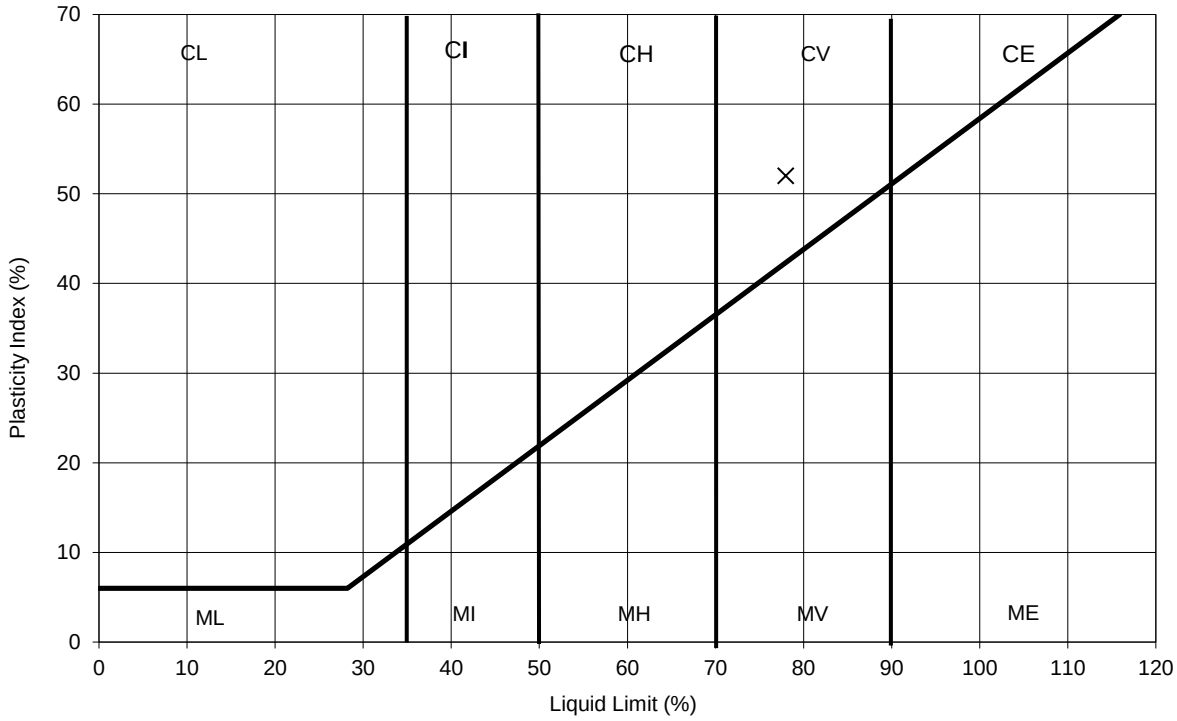
| | | | | | |
|---|---|---|---|---|---|
| K4 SOILS | **LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX** | | | Job No. | 19833 |
| | | | | Borehole/Pit No. | BH3 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth m | 5.60 |
| Soil Description | Brown and occasional blue grey silty CLAY | | | Sample Type | D |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| | | | | Project Started | 10/11/2015 |
| | | | | Date Tested | 17/11/2015 |




| | | |
|---|---|---|
| **NATURAL MOISTURE CONTENT** | **29** | **%** |
| **% PASSING 425µm SIEVE** | **100** | **%** |
| **LIQUID LIMIT** | **78** | **%** |
| **PLASTIC LIMIT** | **26** | **%** |
| **PLASTICITY INDEX** | **52** | **%** |

**Remarks**

**PLASTICITY INDEX**




**TEST METHOD**

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UKAS TESTING 2519

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

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

| Job No. | Project Name | Programme | |
|---|---|---|---|
| 19833 | The Hall School | Samples received | 06/11/2015 |
| | | Schedule received | 10/11/2015 |
| Project No. | Client | Project started | 10/11/2015 |
| J15302 | GEA | Testing Started | 24/11/2015 |

| Hole No. | Sample | | | | Soil description | Dry Mass passing 2mm | SO3 Content | SO4 Content | pH | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | % | g/l | g/l | | |
| BH1 | | 3.00 | | D | Brown and occasional blue grey slightly gravelly silty CLAY (gravel is fine and sub-angular) | 100 | 0.51 | 0.62 | 7.62 | |
| BH1 | | 9.00 | | D | Dark grey silty CLAY with scattered traces of selenite crystals | 100 | 0.69 | 0.82 | 7.66 | |
| BH1 | | 15.00 | | D | Dark grey silty CLAY | 100 | 0.56 | 0.67 | 7.63 | |
| BH1 | | 23.00 | | D | Dark grey silty CLAY | 100 | 0.71 | 0.86 | 7.72 | |
| BH2 | | 2.00 | | D | Brown and grey slightly gravelly silty CLAY (gravel is fm and sub-angular) | 95 | 0.13 | 0.16 | 7.80 | |
| BH3 | | 1.60 | | D | Brown and occasional blue grey silty CLAY with rare fine gravel | 99 | 0.31 | 0.37 | 7.84 | |
| BH3 | | 4.60 | | D | Brown and blue grey silty CLAY | 100 | 0.65 | 0.78 | 7.80 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |


**Test Report by K4 SOILS LABORATORY**
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**Tel: 01923 711 288**
**Email: James@k4soils.com**


**Checked and Approved**

**Initials J.P**

**Date: 27/11/2015**

# Unconsolidated Undrained Triaxial Compression tests without measurement of pore pressure
## Summary of Results

**Tests carried out in accordance with BS1377:Part 7 : 1990 clause 8 or 9 as appropriate to test**

| Job No. | Project Name | Programme | |
|---|---|---|---|
| 19833 | The Hall School | Samples received | 06/11/2015 |
| | | Schedule received | 10/11/2015 |
| Project No. | Client | Project started | 10/11/2015 |
| J15302 | GEA | Testing Started | 24/11/2015 |

| Hole No. | Sample Ref | Sample Top | Sample Base | Sample Type | Soil Description | Test Type | Density bulk Mg/m3 | Density dry Mg/m3 | w % | Length mm | Diameter mm | σ3 kPa | At failure: Axial strain % | At failure: σ1 - σ3 kPa | At failure: cu kPa | At failure: Mode | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH1 | | 2.00 | | U | Medium strength brown slightly sandy silty CLAY | UU | 2.03 | 1.60 | 27 | 198 | 102 | 40 | 13 | 127 | 64 | C | |
| BH1 | | 4.00 | | U | High strength brown silty CLAY with occasional selenite crystals | UU | 1.99 | 1.53 | 30 | 198 | 102 | 80 | 13 | 170 | 85 | C | |
| BH1 | | 6.50 | | U | High strength brown silty CLAY with occasional selenite crystals | UU | 1.97 | 1.51 | 30 | 198 | 102 | 130 | 5.6 | 215 | 108 | B | |
| BH1 | | 9.50 | | U | High strength dark grey silty CLAY | UU | 1.98 | 1.54 | 28 | 198 | 102 | 190 | 3.0 | 222 | 111 | B | |
| BH1 | | 12.50 | | U | High strength dark grey silty CLAY | UU | 2.06 | 1.63 | 26 | 198 | 102 | 250 | 5.6 | 298 | 149 | B | |
| BH1 | | 15.50 | | U | High strength dark grey silty CLAY | UU | 2.00 | 1.57 | 27 | 198 | 102 | 310 | 2.5 | 195 | 98 | B | |
| BH1 | | 18.50 | | U | Very high strength dark grey silty CLAY | UU | 1.97 | 1.55 | 27 | 198 | 102 | 370 | 7.1 | 347 | 173 | B | |
| BH1 | | 21.50 | | U | High strength dark grey silty CLAY | UU | 2.03 | 1.61 | 26 | 198 | 102 | 430 | 2.5 | 233 | 116 | B | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

| Legend | | | | |
|---|---|---|---|---|
| | UU - single stage test (single and multiple specimens) | σ3 | Cell pressure | Mode of failure ; B - Brittle |
| | UUM - Multistage test on a single specimen | σ1 - σ3 | Maximum corrected deviator stress | P - Plastic |
| | suffix R - remoulded or recompacted | cu | Undrained shear strength, ½ (σ1 - σ3) | C - Compound |


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


**Checked and Approved**
Initials: J.P
Date: 27/11/2015

2519

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

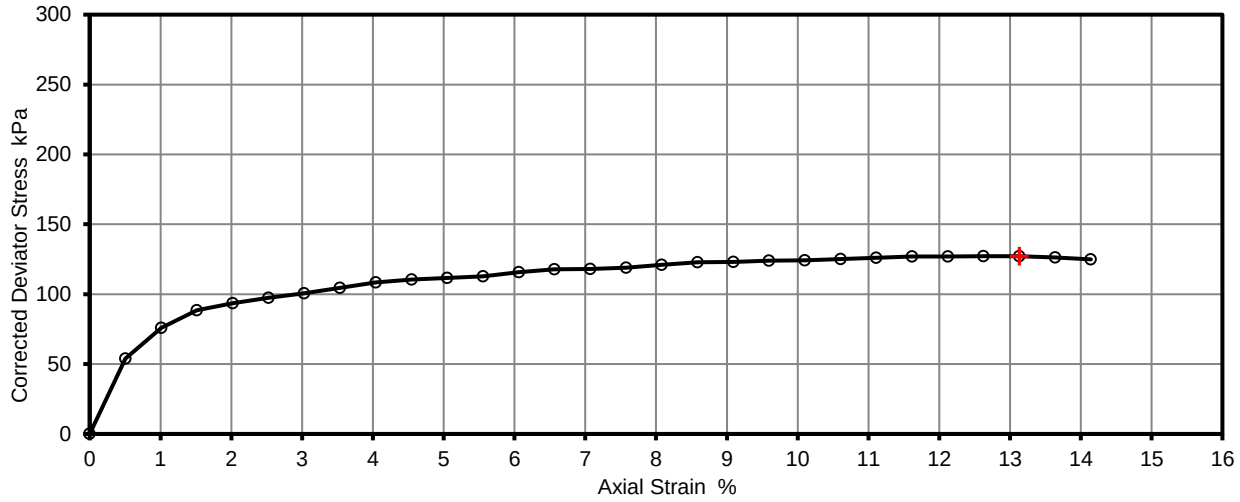
| | | | | | |
|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth | 2.00 m |
| Soil Description | Medium strength brown slightly sandy silty CLAY | | | Sample Type | U |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 |

**Remarks**

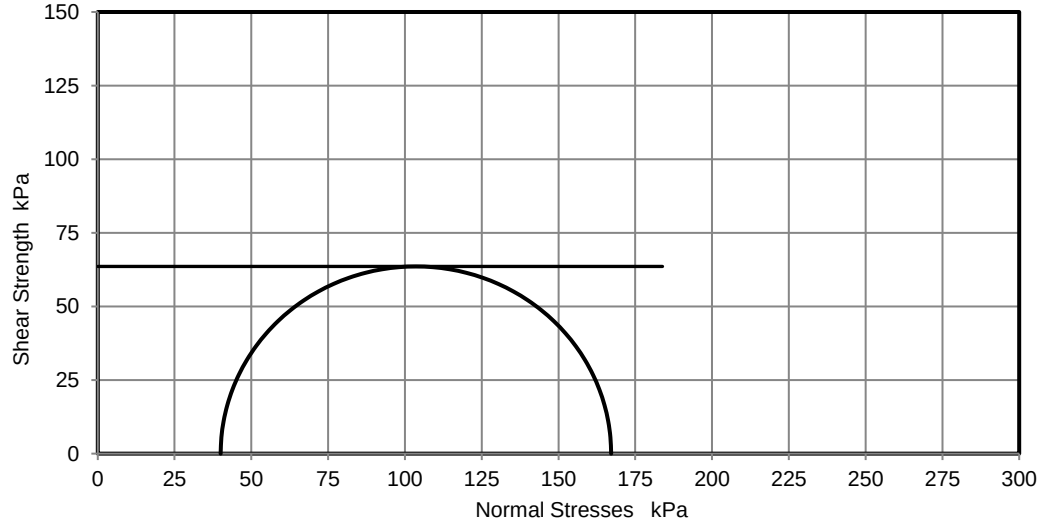
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 2.03 | Mg/m3 |
| Moisture Content | 27 | % |
| Dry Density | 1.60 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 40 | kPa |
| Axial Strain | 13.1 | % |
| Deviator Stress, ( σ1 - σ3 )f | 127 | kPa |
| Undrained Shear Strength, cu | 64 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Compound | |

**Deviator Stress v Axial Strain**




**Mohr Circles**




Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.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UKAS TESTING 2519

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

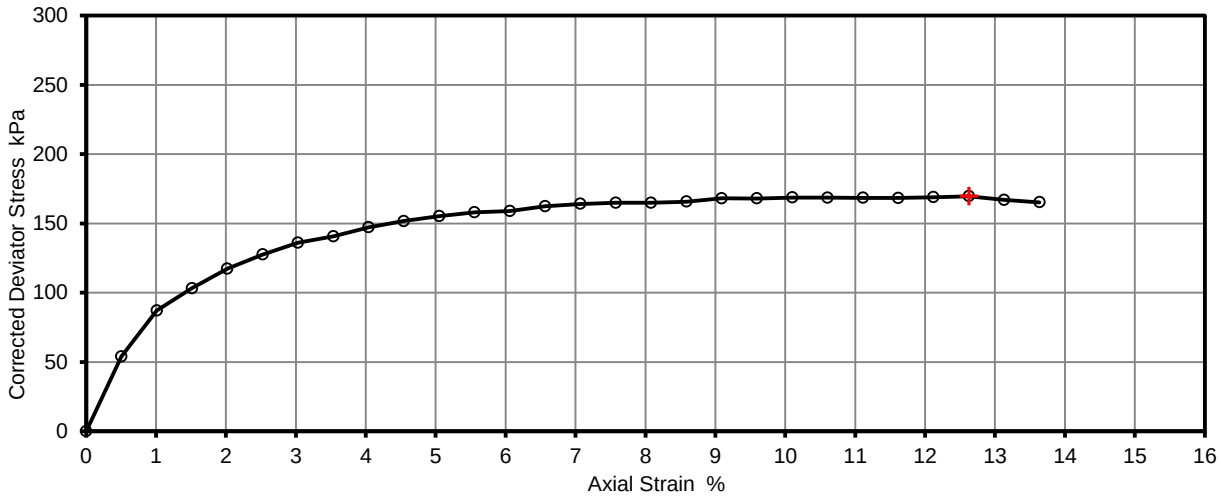
| | | | | | |
|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth | 4.00 m |
| Soil Description | High strength brown silty CLAY with occasional selenite crystals | | | Sample Type | U |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 |

**Remarks**

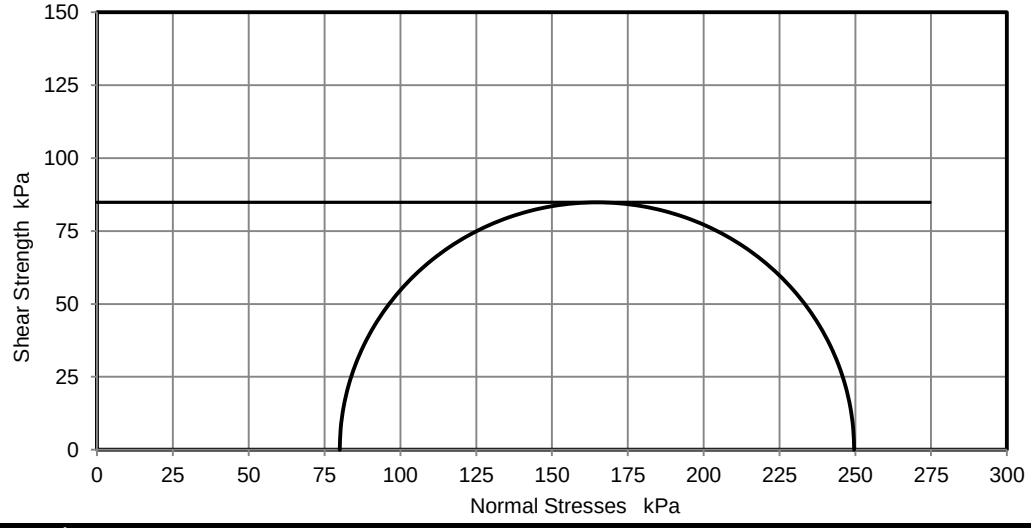
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 1.99 | Mg/m3 |
| Moisture Content | 30 | % |
| Dry Density | 1.53 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 80 | kPa |
| Axial Strain | 12.6 | % |
| Deviator Stress, ( σ1 - σ3 )f | 170 | kPa |
| Undrained Shear Strength, cu | 85 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Compound | |

**Deviator Stress v Axial Strain**




**Mohr Circles**




Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.


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


UKAS TESTING 2519

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

**Checked and Approved**
Initials: J.P
Date 27/11/2015

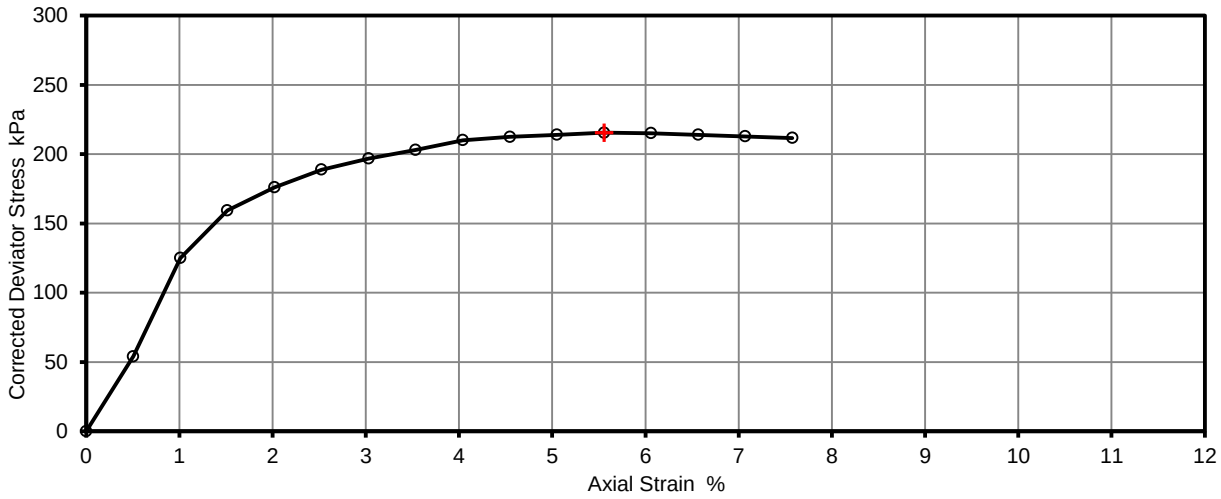
| | | | | | | |
|---|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 | |
| | | | | Borehole/Pit No. | BH1 | |
| Site Name | The Hall School | | | Sample No. | | |
| Project No. | J15302 | Client | GEA | Depth | 6.50 | m |
| Soil Description | High strength brown silty CLAY with occasional selenite crystals | | | Sample Type | U | |
| | | | | Samples received | 06/11/2015 | |
| | | | | Schedules received | 10/11/2015 | |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 | |

**Remarks**

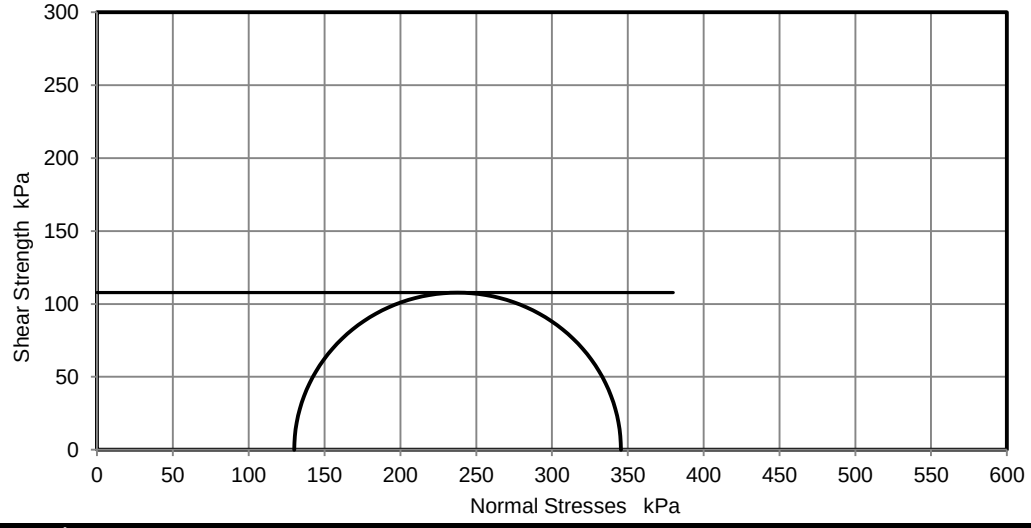
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 1.97 | Mg/m3 |
| Moisture Content | 30 | % |
| Dry Density | 1.51 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 130 | kPa |
| Axial Strain | 5.6 | % |
| Deviator Stress, ( σ1 - σ3 )f | 215 | kPa |
| Undrained Shear Strength, cu | 108 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Brittle | |

**Deviator Stress v Axial Strain**




**Mohr Circles**

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Date 27/11/2015

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

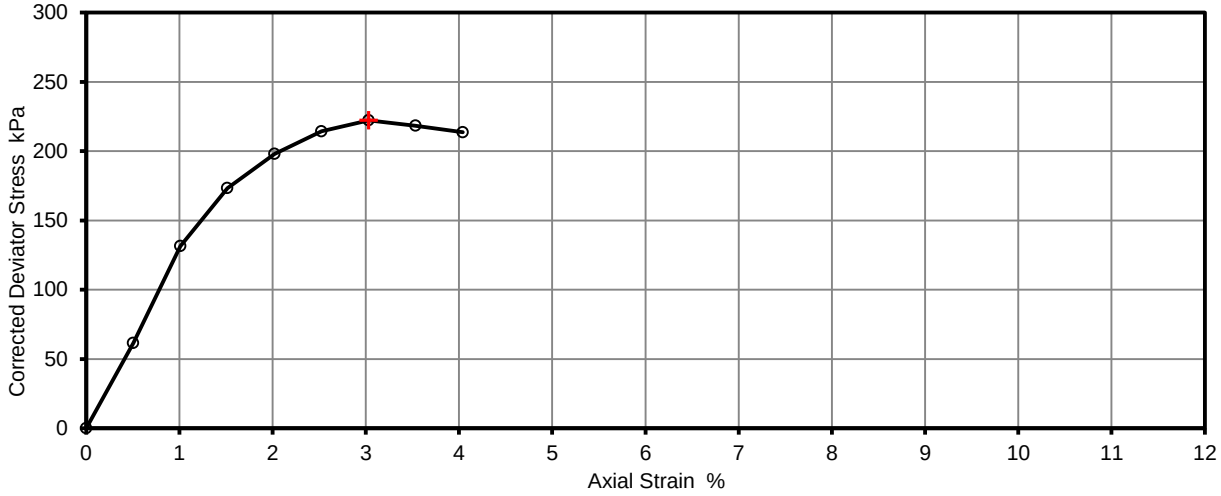
| | | | | | | |
|---|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 | |
| | | | | Borehole/Pit No. | BH1 | |
| Site Name | The Hall School | | | Sample No. | | |
| Project No. | J15302 | Client | GEA | Depth | 9.50 | m |
| Soil Description | High strength dark grey silty CLAY | | | Sample Type | U | |
| | | | | Samples received | 06/11/2015 | |
| | | | | Schedules received | 10/11/2015 | |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 | |

**Remarks**

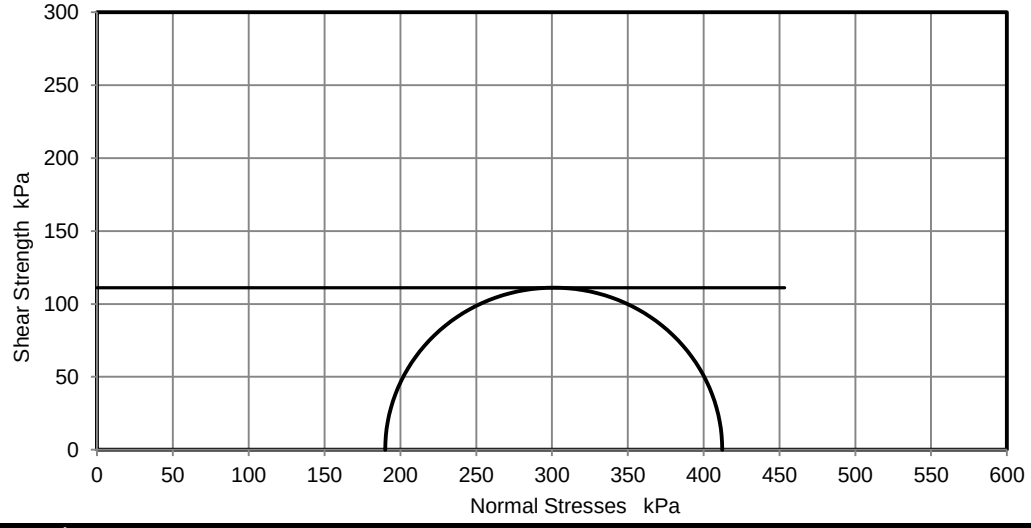
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 1.98 | Mg/m3 |
| Moisture Content | 28 | % |
| Dry Density | 1.54 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 190 | kPa |
| Axial Strain | 3.0 | % |
| Deviator Stress, ( σ1 - σ3 )f | 222 | kPa |
| Undrained Shear Strength, cu | 111 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Brittle | |

**Deviator Stress v Axial Strain**




**Mohr Circles**

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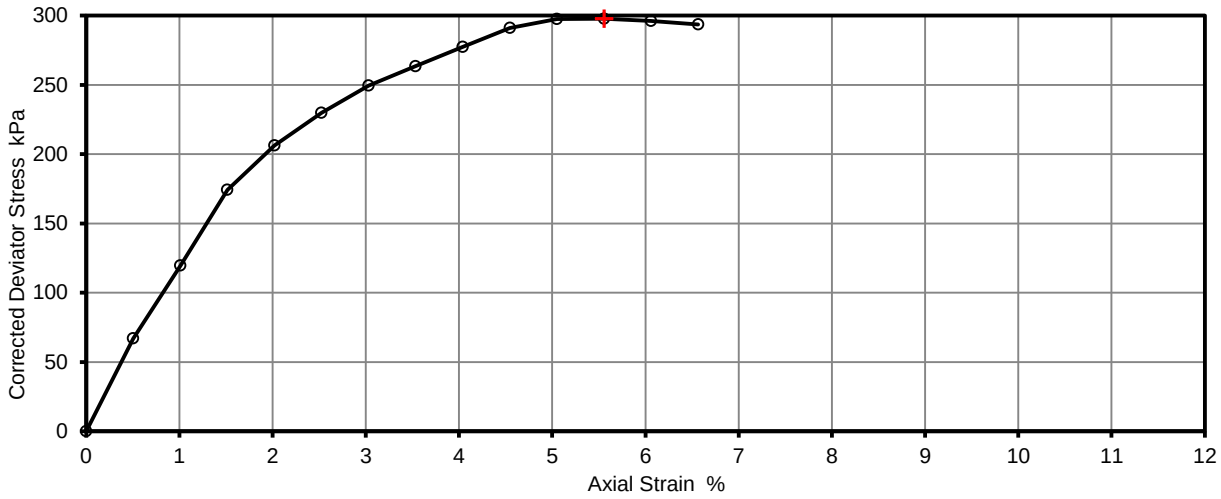
| | | | | | |
|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth | 12.50 m |
| Soil Description | High strength dark grey silty CLAY | | | Sample Type | U |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 |

**Remarks**

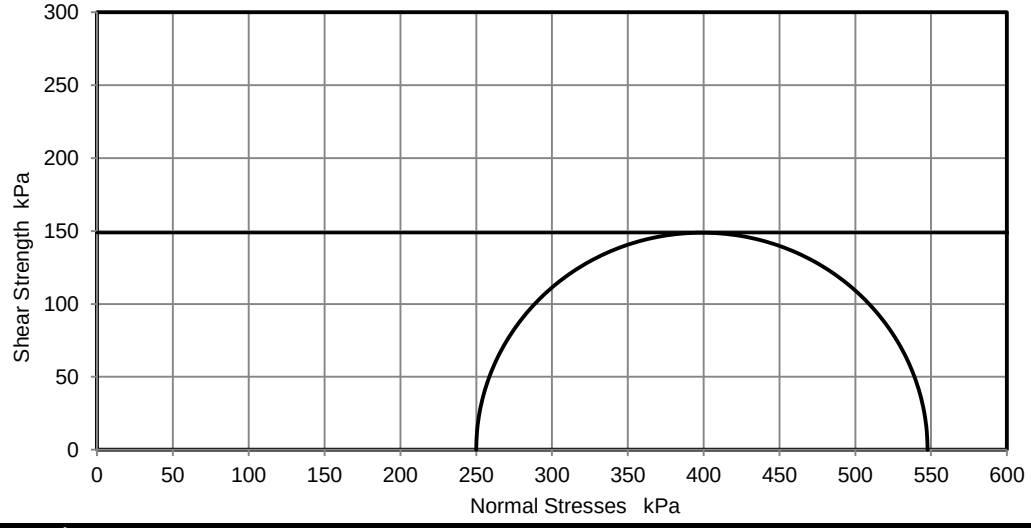
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 2.06 | Mg/m3 |
| Moisture Content | 26 | % |
| Dry Density | 1.63 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 250 | kPa |
| Axial Strain | 5.6 | % |
| Deviator Stress, ( σ1 - σ3 )f | 298 | kPa |
| Undrained Shear Strength, cu | 149 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Brittle | |

**Deviator Stress v Axial Strain**




**Mohr Circles**

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**Checked and Approved**
Initials: J.P
Date 27/11/2015

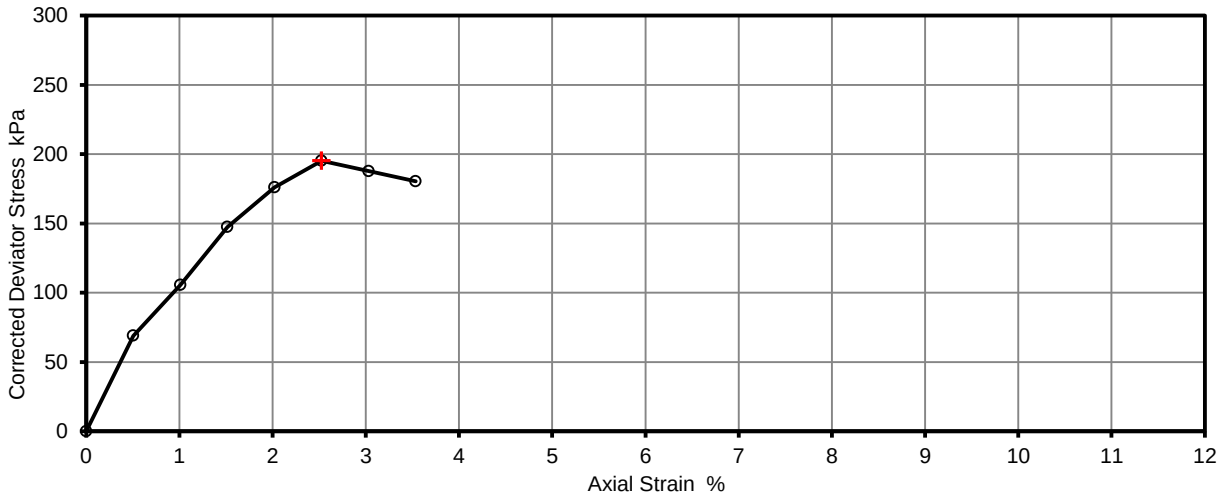
| | | | | | |
|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | The Hall School | | | Sample No. | |
| Project No. | J15302 | Client | GEA | Depth | 15.50 m |
| Soil Description | High strength dark grey silty CLAY | | | Sample Type | U |
| | | | | Samples received | 06/11/2015 |
| | | | | Schedules received | 10/11/2015 |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 |

**Remarks**

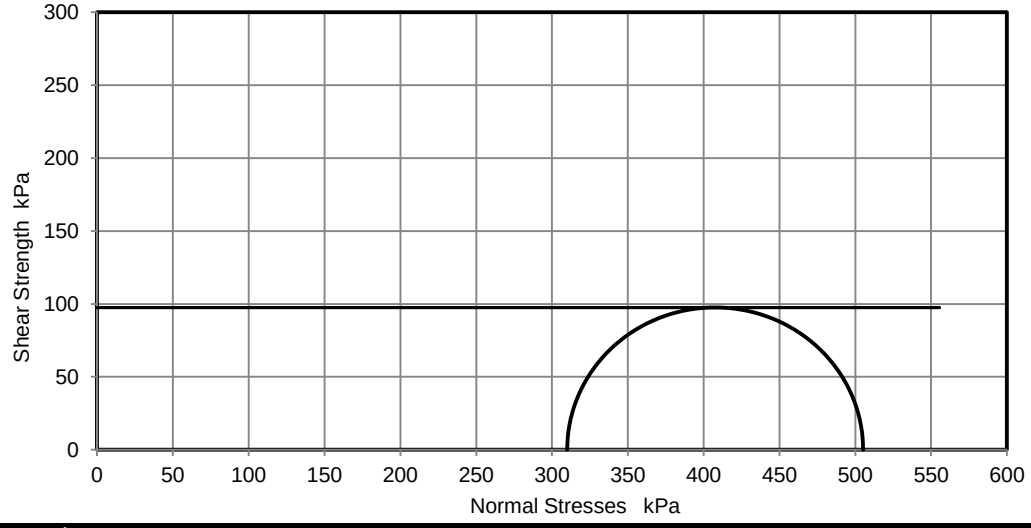
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 2.00 | Mg/m3 |
| Moisture Content | 27 | % |
| Dry Density | 1.57 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 310 | kPa |
| Axial Strain | 2.5 | % |
| Deviator Stress, ( σ1 - σ3 )f | 195 | kPa |
| Undrained Shear Strength, cu | 98 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Brittle | |

**Deviator Stress v Axial Strain**




**Mohr Circles**

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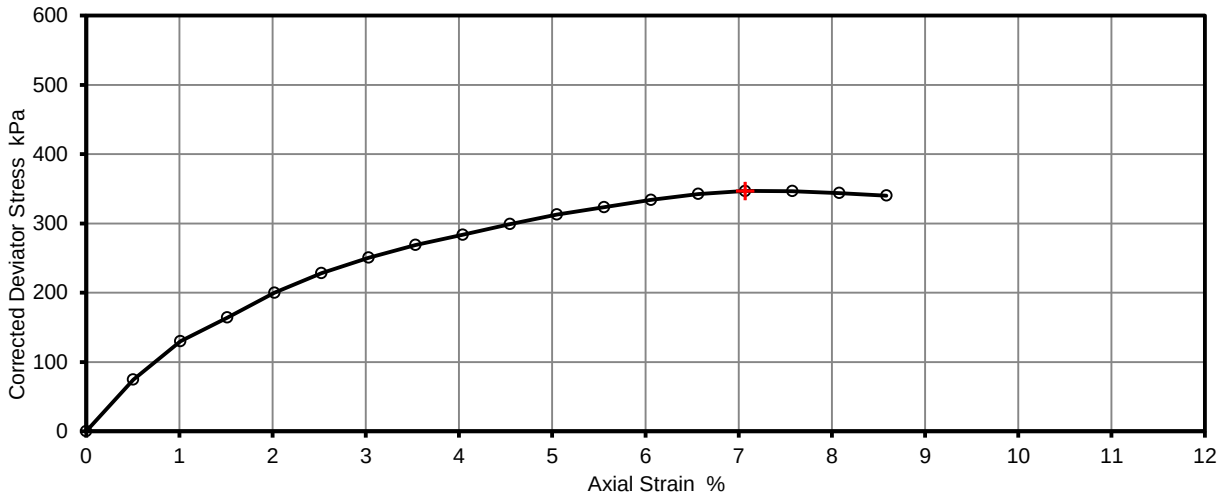
| | | | | | | |
|---|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 | |
| | | | | Borehole/Pit No. | BH1 | |
| Site Name | The Hall School | | | Sample No. | | |
| Project No. | J15302 | Client | GEA | Depth | 18.50 | m |
| Soil Description | Very high strength dark grey silty CLAY | | | Sample Type | U | |
| | | | | Samples received | 06/11/2015 | |
| | | | | Schedules received | 10/11/2015 | |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 | |

**Remarks**

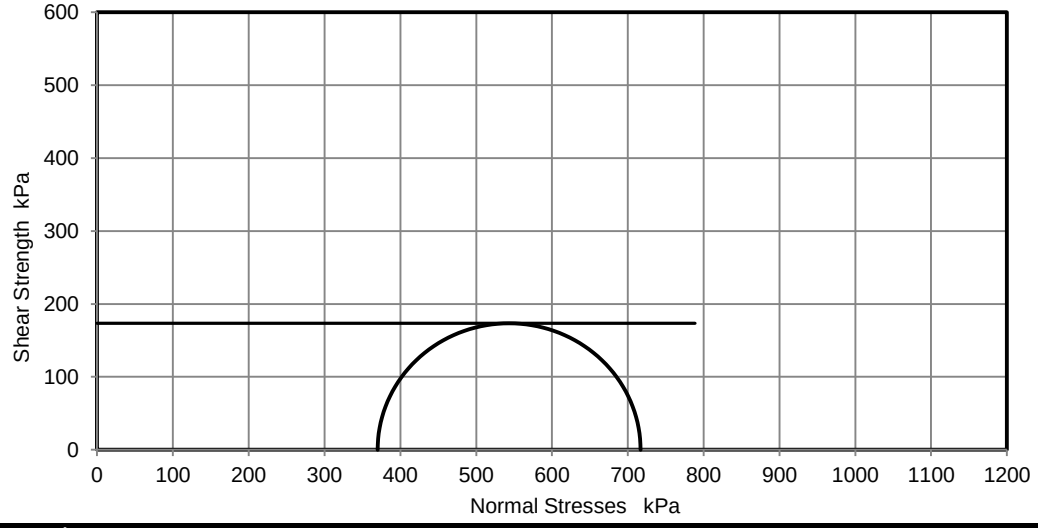
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 1.97 | Mg/m3 |
| Moisture Content | 27 | % |
| Dry Density | 1.55 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 370 | kPa |
| Axial Strain | 7.1 | % |
| Deviator Stress, ( σ1 - σ3 )f | 347 | kPa |
| Undrained Shear Strength, cu | 173 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Brittle | |

**Deviator Stress v Axial Strain**




**Mohr Circles**

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**Checked and Approved**
Initials: J.P
Date 27/11/2015

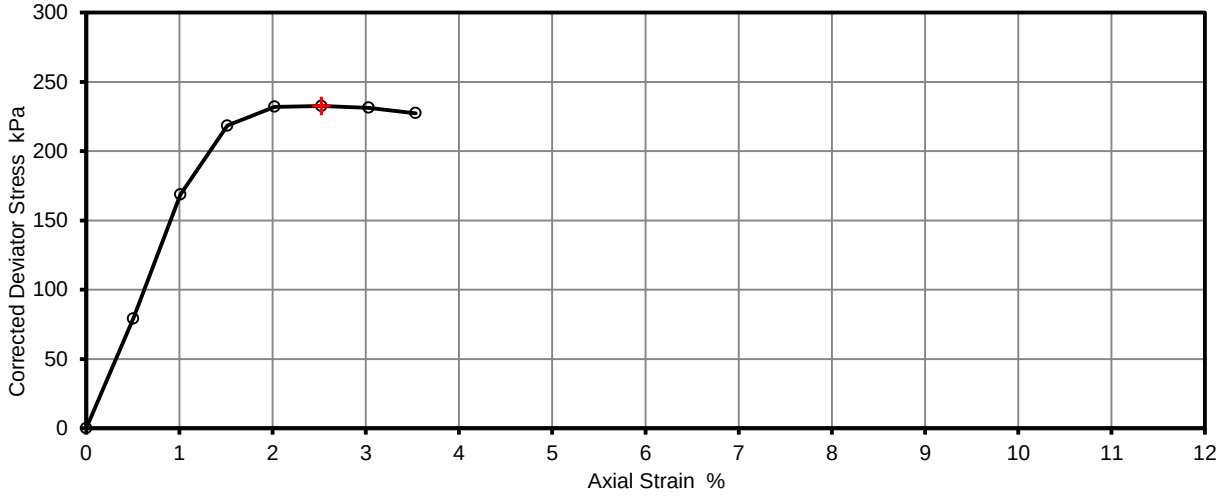
| | | | | | | |
|---|---|---|---|---|---|---|
| | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 19833 | |
| | | | | Borehole/Pit No. | BH1 | |
| Site Name | The Hall School | | | Sample No. | | |
| Project No. | J15302 | Client | GEA | Depth | 21.50 | m |
| Soil Description | High strength dark grey silty CLAY | | | Sample Type | U | |
| | | | | Samples received | 06/11/2015 | |
| | | | | Schedules received | 10/11/2015 | |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 24/11/2015 | |

**Remarks**

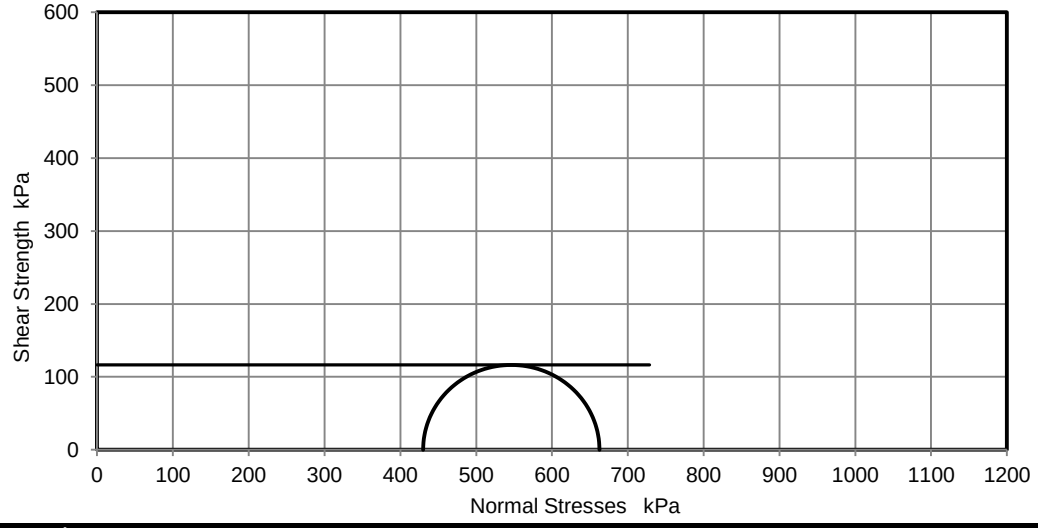
Position within sample

| | | |
|---|---|---|
| Test Number | 1 | |
| Length | 198.0 | mm |
| Diameter | 102.0 | mm |
| Bulk Density | 2.03 | Mg/m3 |
| Moisture Content | 26 | % |
| Dry Density | 1.61 | Mg/m3 |
| Rate of Strain | 2.0 | %/min |
| Cell Pressure | 430 | kPa |
| Axial Strain | 2.5 | % |
| Deviator Stress, ( σ1 - σ3 )f | 233 | kPa |
| Undrained Shear Strength, cu | 116 | kPa ½( σ1 - σ3 )f |
| Mode of Failure | Brittle | |

**Deviator Stress v Axial Strain**




**Mohr Circles**

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Initials: J.P
Date 27/11/2015

Geotechnical & Environmental Associates

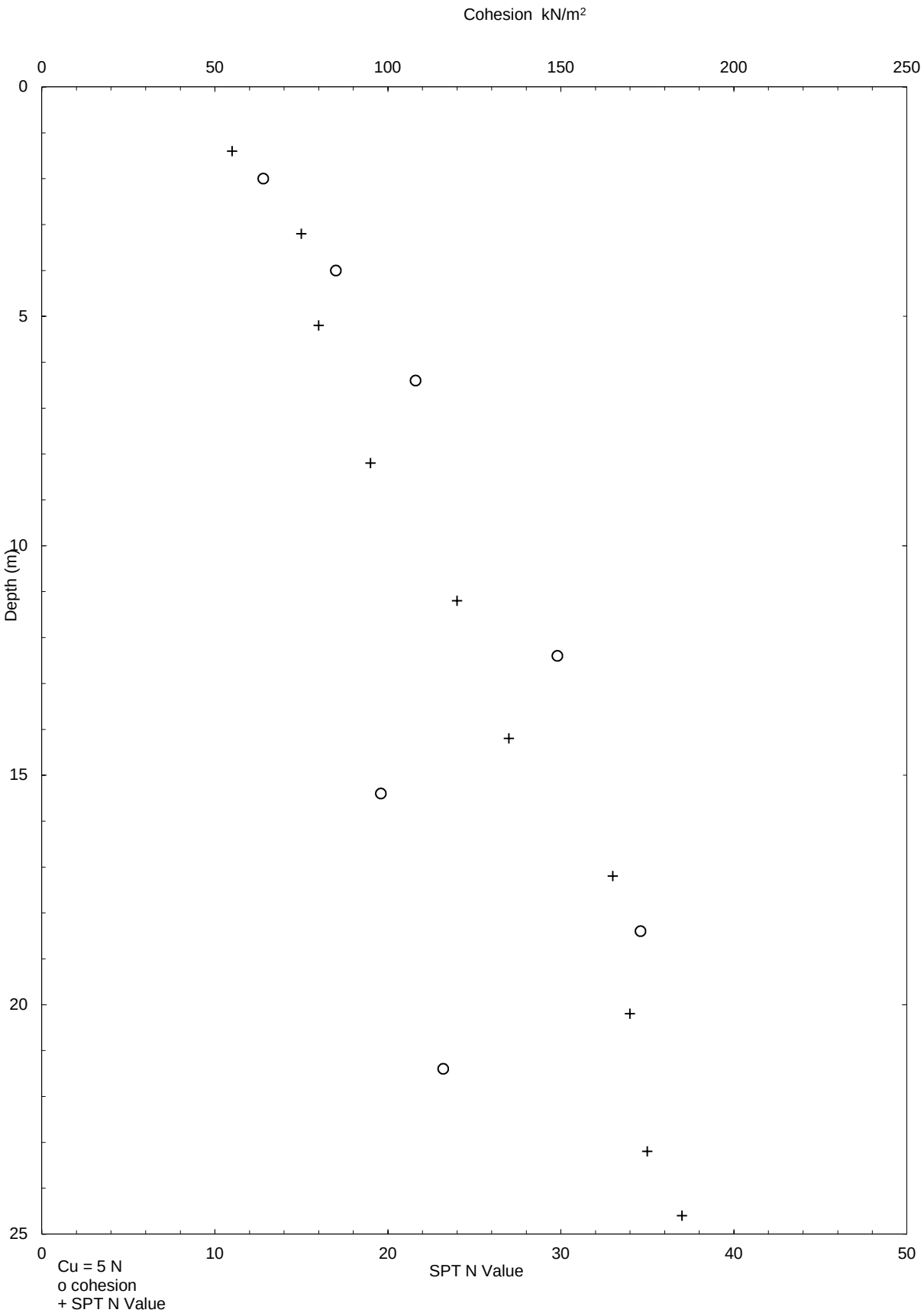
Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

# SPT & Cohesion / Depth Graph

| | |
|---|---|
| **Site** | The Hall School, 23 Crossfield Street, London NW3 4NU |
| **Client** | The Hall School |
| **Engineer** | Elliott Wood |

**Job Number** J16302

**Sheet** 1 / 1



Chemtest
The right chemistry to deliver results

# Results - Soil

## Project: J15302 The Hall School, Crossfield Street

| Client: GEA | | Chemtest Job No.: | | | 15-26088 | 15-26088 | 15-26088 | 15-26088 |
|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | Chemtest Sample ID.: | | | 215606 | 215607 | 215608 | 215609 |
| Order No.: | | Client Sample Ref.: | | | | | | |
| | | Client Sample ID.: | | | TP1 | TP4 | TP5 | BH3 |
| | | Sample Type: | | | SOIL | SOIL | SOIL | SOIL |
| | | Top Depth (m): | | | 0.4 | 0.5 | 0.6 | 0.9 |
| | | Bottom Depth (m): | | | | | | |
| | | Date Sampled: | | | 31-Oct-2015 | 31-Oct-2015 | 31-Oct-2015 | 31-Oct-2015 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | |
| Moisture | N | 2030 | % | 0.020 | 15 | 26 | 20 | 21 |
| Stones | N | 2030 | % | 0.020 | < 0.020 | < 0.020 | < 0.020 | < 0.020 |
| Soil Colour | N | 2040 | | N/A | Brown | Brown | Brown | Brown |
| Other Material | N | 2040 | | N/A | Stones | NONE | Stones | Stones |
| Soil Texture | N | 2040 | | N/A | Clay | Clay | Clay | Clay |
| pH | M | 2010 | | N/A | 8.8 | 9.0 | 8.9 | 8.2 |
| Sulphate (2:1 Water Soluble) as SO4 | M | 2120 | g/l | 0.010 | 0.025 | 0.063 | 0.032 | 0.037 |
| Chloride (Extractable) | M | 2220 | g/l | 0.010 | < 0.010 | 0.014 | < 0.010 | < 0.010 |
| Cyanide (Total) | M | 2300 | mg/kg | 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 |
| Sulphide (Easily Liberatable) | M | 2325 | mg/kg | 0.50 | 3.2 | 6.1 | 5.9 | 2.8 |
| Sulphate (Total) | M | 2430 | mg/kg | 100 | 640 | 1100 | 1000 | 1300 |
| Arsenic | M | 2450 | mg/kg | 1.0 | 31 | 21 | 52 | 31 |
| Cadmium | M | 2450 | mg/kg | 0.10 | 1.6 | 0.15 | 0.23 | 0.34 |
| Chromium | M | 2450 | mg/kg | 1.0 | 51 | 35 | 35 | 40 |
| Copper | M | 2450 | mg/kg | 0.50 | 50 | 53 | 71 | 77 |
| Mercury | M | 2450 | mg/kg | 0.10 | 2.7 | 1.4 | 1.1 | 1.5 |
| Nickel | M | 2450 | mg/kg | 0.50 | 32 | 14 | 19 | 22 |
| Lead | M | 2450 | mg/kg | 0.50 | 220 | 280 | 470 | 580 |
| Selenium | M | 2450 | mg/kg | 0.20 | 0.29 | 0.39 | < 0.20 | 0.37 |
| Zinc | M | 2450 | mg/kg | 0.50 | 1400 | 270 | 290 | 340 |
| Total Organic Carbon | M | 2625 | % | 0.20 | 1.0 | 3.6 | 2.7 | 2.9 |
| TPH >C5-C6 | N | 2670 | mg/kg | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C6-C7 | N | 2670 | mg/kg | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C7-C8 | N | 2670 | mg/kg | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C8-C10 | N | 2670 | mg/kg | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C10-C12 | N | 2670 | mg/kg | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C12-C16 | N | 2670 | mg/kg | 1.0 | 8.6 | < 1.0 | 4.1 | 4.6 |
| TPH >C16-C21 | N | 2670 | mg/kg | 1.0 | 53 | < 1.0 | 13 | 24 |
| TPH >C21-C35 | N | 2670 | mg/kg | 1.0 | 38 | < 1.0 | 30 | 82 |
| Total TPH >C5-C35 | N | 2670 | mg/kg | 10 | 100 | < 10 | 47 | 110 |
| Naphthalene | M | 2700 | mg/kg | 0.10 | 0.24 | < 0.10 | 0.22 | 0.37 |
| Acenaphthylene | M | 2700 | mg/kg | 0.10 | 0.73 | < 0.10 | 0.64 | 0.20 |
| Acenaphthene | M | 2700 | mg/kg | 0.10 | 1.5 | < 0.10 | 2.5 | 0.23 |
| Fluorene | M | 2700 | mg/kg | 0.10 | 1.8 | < 0.10 | 2.5 | 0.26 |
| Phenanthrene | M | 2700 | mg/kg | 0.10 | 23 | 1.1 | 22 | 4.1 |
| Anthracene | M | 2700 | mg/kg | 0.10 | 5.3 | 0.26 | 6.5 | 0.96 |
| Fluoranthene | M | 2700 | mg/kg | 0.10 | 29 | 1.8 | 33 | 11 |

Chemtest
The right chemistry to deliver results

# Results - Soil

## Project: J15302 The Hall School, Crossfield Street

| Client: GEA | | | Chemtest Job No.: | | 15-26088 | 15-26088 | 15-26088 | 15-26088 |
|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | Chemtest Sample ID.: | | 215606 | 215607 | 215608 | 215609 |
| Order No.: | | | Client Sample Ref.: | | | | | |
| | | | Client Sample ID.: | | TP1 | TP4 | TP5 | BH3 |
| | | | Sample Type: | | SOIL | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 0.4 | 0.5 | 0.6 | 0.9 |
| | | | Bottom Depth (m): | | | | | |
| | | | Date Sampled: | | 31-Oct-2015 | 31-Oct-2015 | 31-Oct-2015 | 31-Oct-2015 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | |
| Pyrene | M | 2700 | mg/kg | 0.10 | 27 | 2.3 | 32 | 11 |
| Benzo[a]anthracene | M | 2700 | mg/kg | 0.10 | 12 | 0.70 | 15 | 5.3 |
| Chrysene | M | 2700 | mg/kg | 0.10 | 12 | 0.98 | 14 | 6.0 |
| Benzo[b]fluoranthene | M | 2700 | mg/kg | 0.10 | 13 | 0.98 | 17 | 7.0 |
| Benzo[k]fluoranthene | M | 2700 | mg/kg | 0.10 | 5.3 | 0.71 | 6.9 | 3.1 |
| Benzo[a]pyrene | M | 2700 | mg/kg | 0.10 | 9.7 | 0.74 | 13 | 5.4 |
| Indeno(1,2,3-c,d)Pyrene | M | 2700 | mg/kg | 0.10 | 6.2 | < 0.10 | 8.5 | 3.5 |
| Dibenz(a,h)Anthracene | M | 2700 | mg/kg | 0.10 | 1.8 | < 0.10 | 2.6 | 1.2 |
| Benzo[g,h,i]perylene | M | 2700 | mg/kg | 0.10 | 5.6 | < 0.10 | 8.3 | 3.4 |
| Total Of 16 PAH's | M | 2700 | mg/kg | 2.0 | 150 | 9.6 | 180 | 63 |
| Total Phenols | M | 2920 | mg/kg | 0.30 | < 0.30 | < 0.30 | < 0.30 | < 0.30 |

## Report Information

### Key

| | |
|---|---|
| U | UKAS accredited |
| M | MCERTS and UKAS accredited |
| N | Unaccredited |
| S | This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis |
| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVCOs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

### Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

### Sample Retention and Disposal

All soil samples will be retained for a period of 60 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

GEA Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

# Generic Risk-Based Soil Screening Values

| | |
|---|---|
| **Site** | The Hall School, 23 Crossfield Street, London NW3 4NU |
| **Client** | The Hall School |
| **Engineer** | Elliott Wood |

**Job Number** J15302

**Sheet** 1 / 2

**Proposed End Use** Residential without plant uptake

**Soil pH** 8

**Soil Organic Matter content %** 2.5

| Contaminant | Screening Value mg/kg | Data Source |
|---|---|---|
| ***Metals*** | | |
| Arsenic | 40 | C4SL |
| Cadmium | 149 | C4SL |
| Chromium (III) | 3000 | LQM/CIEH |
| Chromium (VI) | 21 | C4SL |
| Copper | 2,330 | LQM/CIEH |
| Lead | 310 | C4SL |
| Elemental Mercury | 1.02 | SGV |
| Inorganic Mercury | 235 | SGV |
| Nickel | 99 | LQM/CIEH |
| Selenium | 595 | SGV |
| Zinc | 3,750 | LQM/CIEH |
| ***Hydrocarbons*** | | |
| Benzene | 1.4 | C4SL |
| Toluene | 320 | SGV |
| Ethyl Benzene | 180 | SGV |
| Xylene | 120 | SGV |
| Aliphatic C5-C6 | 55 | LQM/CIEH |
| Aliphatic C6-C8 | 160 | LQM/CIEH |
| Aliphatic C8-C10 | 46 | LQM/CIEH |
| Aliphatic C10-C12 | 230 | LQM/CIEH |
| Aliphatic C12-C16 | 1700 | LQM/CIEH |
| Aliphatic C16-C35 | 64,000 | LQM/CIEH |
| Aromatic C6-C7 | See Benzene | LQM/CIEH |
| Aromatic C7-C8 | See Toluene | LQM/CIEH |
| Aromatic C8-C10 | 65 | LQM/CIEH |
| Aromatic C10-C12 | 160 | LQM/CIEH |
| Aromatic C12-C16 | 310 | LQM/CIEH |
| Aromatic C16-C21 | 480 | LQM/CIEH |
| Aromatic C21-C35 | 1100 | LQM/CIEH |
| PRO ($C_5$ –$C_{10}$) | 647 | Calc |
| DRO ($C_{12}$ –$C_{28}$) | 66,490 | Calc |
| Lube Oil ($C_{28}$ –$C_{44}$) | 65,100 | Calc |
| **TPH** | **1000** | Trigger for speciated testing |

| Contaminant | Screening Value mg/kg | Data Source |
|---|---|---|
| ***Anions*** | | |
| Soluble Sulphate | 500 mg/l | Structures |
| Sulphide | 50 | Structures |
| Chloride | 400 | Structures |
| ***Others*** | | |
| Organic Carbon (%) | 6 | Methanogenic potential |
| Total Cyanide | 140 | WRAS |
| Total Mono Phenols | 420 | SGV |
| ***PAH*** | | |
| Naphthalene | 5.60 | C4SL exp & LQM/CIEH |
| Acenaphthylene | 3,020 | LQM/CIEH |
| Acenaphthene | 3,090 | LQM/CIEH |
| Fluorene | 2,480 | LQM/CIEH |
| Phenanthrene | 928 | LQM/CIEH |
| Anthracene | 22,200 | LQM/CIEH |
| Fluoranthene | 993 | LQM/CIEH |
| Pyrene | 2,380 | LQM/CIEH |
| Benzo(a) Anthracene | 7.8 | C4SL exp & LQM/CIEH |
| Chrysene | 15 | C4SL exp & LQM/CIEH |
| Benzo(b) Fluoranthene | 11.0 | C4SL exp & LQM/CIEH |
| Benzo(k) Fluoranthene | 15.6 | C4SL exp & LQM/CIEH |
| Benzo(a) pyrene | 4.70 | C4SL |
| Indeno(1 2 3 cd) Pyrene | 6.6 | C4SL exp & LQM/CIEH |
| Dibenzo(a h) Anthracene | 1.38 | C4SL exp & LQM/CIEH |
| Benzo (g h i) Perylene | 72 | C4SL exp & LQM/CIEH |
| **Screening value for PAH** | **67.1** | B(a)P / 0.15 |
| ***Chlorinated Solvents*** | | |
| 1,1,1 trichloroethane (TCA) | 29.8 | LQM/CIEH |
| tetrachloroethane (PCA) | 8.05 | LQM/CIEH |
| tetrachloroethene (PCE) | 3.39 | LQM/CIEH |
| trichloroethene (TCE) | 0.346 | LQM/CIEH |
| 1,2-dichloroethane (DCA) | 0.00931 | LQM/CIEH |
| vinyl chloride (Chloroethene) | 0.00248 | LQM/CIEH |
| tetrachloromethane (Carbon tetra | 0.0793 | LQM/CIEH |
| trichloromethane (Chloroform) | 3.91 | LQM/CIEH |

*Notes*

Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which pose 'LOW' risk to human health. Concentrations measured in excess of these valuesindicate a potential risk which require further, site specific risk assessment.

SGV - Soil Guideline Value, derived from the CLEA model and published by Environment Agency 2009

LQM/CIEH - Generic Assessment Criteria for Human Health Risk Assessment 2nd edition (2009)derived using CLEA 1.04 model 2009

C4SL - Defra Category 4 Screening value based on Low Level of Toxicological Risk

C4SL exp & LQM/CIEH calculated using C4SL revisions to exposure assessment but LQM/CIEH health croiteria values

Calc - sum of nearest available carbon range specified including BTEX for PRO fraction

B(a)P / 0.15 - GEA experince indicates that Benzo(a) pyrene (one of the most common and most carcenogenic of the PAHs) rarely exceeds 15% of the total PAH concentration, hence this Total PAH threshold is regarded as being conservative

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

# Generic Risk-Based Soil Screening Values

| | |
|---|---|
| **Site** | The Hall School, 23 Crossfield Street, London NW3 4NU |
| **Client** | The Hall School |
| **Engineer** | Elliott Wood |

**Job Number** J15302

**Sheet** 2 / 2

Proposed End Use **Residential without plant uptake**

**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 a young female aged 0 to 6 years old;
- ❑ that the exposure duration will be six years;
- ❑ that the building type equates to a terraced house.
- ❑ 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;

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 the generic screening value 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.

# Envirocheck® Report:

# Datasheet

## Order Details:

**Order Number:**
74136046_1_1

**Customer Reference:**
J15302

**National Grid Reference:**
526940, 184520

**Slice:**
A

**Site Area (Ha):**
0.22

**Search Buffer (m):**
1000

## Site Details:

The Hall School Charitable Trust
23 Crossfield Road
LONDON
NW3 4NU

## Client Details:

Mr S Branch
GEA Ltd
Widbury Barn
Widbury Hill
Ware
Herts
SG12 7QE

## Prepared For:

The Hall School

# Contents



**Introduction**

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

In the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.



**Report Version v50.0**

| Data Type | Page Number | On Site | 0 to 250m | 251 to 500m | 501 to 1000m (*up to 2000m) |
|---|---|---|---|---|---|
| **Agency & Hydrological** | | | | | |
| Contaminated Land Register Entries and Notices | | | | | |
| Discharge Consents | | | | | |
| Enforcement and Prohibition Notices | | | | | |
| Integrated Pollution Controls | | | | | |
| Integrated Pollution Prevention And Control | | | | | |
| Local Authority Integrated Pollution Prevention And Control | | | | | |
| Local Authority Pollution Prevention and Controls | pg 1 | | 1 | 4 | 13 |
| Local Authority Pollution Prevention and Control Enforcements | | | | | |
| Nearest Surface Water Feature | pg 3 | | Yes | | |
| Pollution Incidents to Controlled Waters | | | | | |
| Prosecutions Relating to Authorised Processes | | | | | |
| Prosecutions Relating to Controlled Waters | | | | | |
| Registered Radioactive Substances | pg 3 | | | | 36 |
| River Quality | | | | | |
| River Quality Biology Sampling Points | | | | | |
| River Quality Chemistry Sampling Points | | | | | |
| Substantiated Pollution Incident Register | | | | | |
| Water Abstractions | pg 10 | | 1 | 3 | (*16) |
| Water Industry Act Referrals | | | | | |
| Groundwater Vulnerability | pg 14 | Yes | n/a | n/a | n/a |
| Bedrock Aquifer Designations | pg 15 | Yes | n/a | n/a | n/a |
| Superficial Aquifer Designations | | | n/a | n/a | n/a |
| Source Protection Zones | pg 15 | 1 | | | 1 |
| Extreme Flooding from Rivers or Sea without Defences | | | | n/a | n/a |
| Flooding from Rivers or Sea without Defences | | | | n/a | n/a |
| Areas Benefiting from Flood Defences | | | | n/a | n/a |
| Flood Water Storage Areas | | | | n/a | n/a |
| Flood Defences | | | | n/a | n/a |
| Detailed River Network Lines | pg 15 | | Yes | | n/a |
| Detailed River Network Offline Drainage | | | | | n/a |

GEA Geotechnical & Environmental Associates

# Summary

| Data Type | Page Number | On Site | 0 to 250m | 251 to 500m | 501 to 1000m (*up to 2000m) |
|---|---|---|---|---|---|
| **Waste** | | | | | |
| BGS Recorded Landfill Sites | | | | | |
| Historical Landfill Sites | pg 16 | | | | 1 |
| Integrated Pollution Control Registered Waste Sites | | | | | |
| Licensed Waste Management Facilities (Landfill Boundaries) | | | | | |
| Licensed Waste Management Facilities (Locations) | | | | | |
| Local Authority Recorded Landfill Sites | | | | | |
| Registered Landfill Sites | | | | | |
| Registered Waste Transfer Sites | pg 16 | | | | 2 |
| Registered Waste Treatment or Disposal Sites | | | | | |
| **Hazardous Substances** | | | | | |
| Control of Major Accident Hazards Sites (COMAH) | | | | | |
| Explosive Sites | | | | | |
| Notification of Installations Handling Hazardous Substances (NIHHS) | | | | | |
| Planning Hazardous Substance Consents | | | | | |
| Planning Hazardous Substance Enforcements | | | | | |
| **Geological** | | | | | |
| BGS 1:625,000 Solid Geology | pg 17 | Yes | n/a | n/a | n/a |
| BGS Estimated Soil Chemistry | pg 17 | Yes | Yes | Yes | Yes |
| BGS Recorded Mineral Sites | | | | | |
| BGS Urban Soil Chemistry | pg 18 | | | Yes | Yes |
| BGS Urban Soil Chemistry Averages | pg 21 | Yes | | | |
| Brine Compensation Area | | | n/a | n/a | n/a |
| Coal Mining Affected Areas | | | n/a | n/a | n/a |
| Mining Instability | | | n/a | n/a | n/a |
| Man-Made Mining Cavities | | | | | |
| Natural Cavities | | | | | |
| Non Coal Mining Areas of Great Britain | | | | n/a | n/a |
| Potential for Collapsible Ground Stability Hazards | pg 21 | Yes | | n/a | n/a |
| Potential for Compressible Ground Stability Hazards | | | | n/a | n/a |
| Potential for Ground Dissolution Stability Hazards | | | | n/a | n/a |
| Potential for Landslide Ground Stability Hazards | pg 22 | Yes | | n/a | n/a |
| Potential for Running Sand Ground Stability Hazards | | | | n/a | n/a |
| Potential for Shrinking or Swelling Clay Ground Stability Hazards | pg 22 | Yes | | n/a | n/a |
| Radon Potential - Radon Affected Areas | | | n/a | n/a | n/a |
| Radon Potential - Radon Protection Measures | | | n/a | n/a | n/a |

# Summary

| Data Type | Page Number | On Site | 0 to 250m | 251 to 500m | 501 to 1000m (*up to 2000m) |
|---|---|---|---|---|---|
| **Industrial Land Use** | | | | | |
| Contemporary Trade Directory Entries | pg 23 | | 3 | 54 | n/a |
| Fuel Station Entries | pg 27 | | | 1 | 3 |
| **Sensitive Land Use** | | | | | |
| Areas of Adopted Green Belt | | | | | |
| Areas of Unadopted Green Belt | | | | | |
| Areas of Outstanding Natural Beauty | | | | | |
| Environmentally Sensitive Areas | | | | | |
| Forest Parks | | | | | |
| Local Nature Reserves | pg 29 | | | | 1 |
| Marine Nature Reserves | | | | | |
| National Nature Reserves | | | | | |
| National Parks | | | | | |
| Nitrate Sensitive Areas | | | | | |
| Nitrate Vulnerable Zones | | | | | |
| Ramsar Sites | | | | | |
| Sites of Special Scientific Interest | | | | | |
| Special Areas of Conservation | | | | | |
| Special Protection Areas | | | | | |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 1 | **Local Authority Pollution Prevention and Controls**<br>Name: Kings Dry Cleaners<br>Location: 25 Winchester Road, London, E4<br>Authority: London Borough of Waltham Forest, Environmental Health Department<br>Permit Reference: DC05<br>Dated: 6th July 2007<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Manually positioned to the address or location | A13SW (SW) | 210 | 3 | 526812 184310 |
| 2 | **Local Authority Pollution Prevention and Controls**<br>Name: Swiss Cottage Dry Cleaners<br>Location: 121 Finchley Road, London, Nw3 6hy<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: PPC/DC10<br>Dated: 12th January 2007<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Located by supplier to within 10m | A13SW (SW) | 367 | 4 | 526626 184270 |
| 3 | **Local Authority Pollution Prevention and Controls**<br>Name: B P Harmony<br>Location: 104a Finchley Road, London, NW3 5EY<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: Not Given<br>Dated: 1st July 1999<br>Process Type: Local Authority Air Pollution Control<br>Description: PG1/14 Petrol filling station<br>**Status: Authorised**<br>Positional Accuracy: Automatically positioned to the address | A12NE (W) | 440 | 4 | 526471 184554 |
| 3 | **Local Authority Pollution Prevention and Controls**<br>Name: Bp Harmony<br>Location: 104a Finchley Road, LONDON, NW3 5EY<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: PPC18<br>Dated: 1st July 1999<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG1/14 Petrol filling station<br>**Status: Permitted**<br>Positional Accuracy: Automatically positioned to the address | A12NE (W) | 440 | 4 | 526471 184554 |
| 4 | **Local Authority Pollution Prevention and Controls**<br>Name: Pyramid Cleaners<br>Location: 52 Besize Lane, London, Nw3 5ar<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: PPC/DC8<br>Dated: 1st January 2007<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Located by supplier to within 10m | A18SW (N) | 448 | 4 | 526872 184985 |
| 5 | **Local Authority Pollution Prevention and Controls**<br>Name: Chequers Textile Care Ltd<br>Location: 48 Englands Lane, London, Nw3 4ue<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: PPC/DC47<br>Dated: 5th December 2006<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Located by supplier to within 10m | A14NW (E) | 539 | 4 | 527498 184580 |
| 6 | **Local Authority Pollution Prevention and Controls**<br>Name: Swan Dry Cleaners<br>Location: 163 Haverstock Hill, London, Nw3 4qt<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: PPC/DC42<br>Dated: 24th January 2007<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Located by supplier to within 10m | A19SW (NE) | 639 | 4 | 527371 185032 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 11 | **Local Authority Pollution Prevention and Controls**<br>Name: Janet'S Hand Laundry Ltd<br>Location: 281a Finchley Road, London, Nw3 6nd<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: PPC/DC14<br>Dated: 12th January 2007<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Located by supplier to within 10m | A17SW (NW) | 839 | 4 | 526167 184924 |
| 12 | **Local Authority Pollution Prevention and Controls**<br>Name: The Dry Cleaners Of Hampstead<br>Location: 80 Haverstock Hill, London, Nw3 2be<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: PPC/DC41<br>Dated: 25th June 2007<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Located by supplier to within 10m | A14NE (E) | 929 | 4 | 527875 184684 |
| 13 | **Local Authority Pollution Prevention and Controls**<br>Name: The Royal Free Hospital<br>Location: Pond Street, LONDON, NW3 2QG<br>Authority: London Borough of Camden, Pollution Projects Team<br>Permit Reference: Not Given<br>Dated: 24th July 1992<br>Process Type: Local Authority Air Pollution Control<br>Description: PG5/1Clinical waste incineration processes under 1 tonne an hour<br>**Status: Authorisation revokedRevoked**<br>Positional Accuracy: Manually positioned to the address or location | A19NW (N) | 929 | 4 | 527296 185410 |
| 14 | **Local Authority Pollution Prevention and Controls**<br>Name: Ivy Dry Cleaner<br>Location: 4 Queens Terrace, London, Nw8 6dx<br>Authority: Westminster City Council, Environmental Health Department<br>Permit Reference: 06/40583/EE1EP<br>Dated: 14th September 2007<br>Process Type: Local Authority Pollution Prevention and Control<br>Description: PG6/46 Dry cleaning<br>**Status: Permitted**<br>Positional Accuracy: Manually positioned to the address or location | A8SW (S) | 984 | 5 | 526672 183539 |
| | **Nearest Surface Water Feature** | A13SW (SW) | 243 | - | 526760 184307 |
| 15 | **Registered Radioactive Substances**<br>Name: Royal Free Hampstead NHS Trust<br>Location: Royal Free Hospital, Pond Street, Hampstead, LONDON, Greater London, NW3 2QG<br>Authority: Environment Agency, Thames Region<br>Permit Reference: AV8011<br>Dated: 25th October 1996<br>Process Type: Authorisation under S13 RSA for the disposal of Radioactive waste (was RSA60 S7)<br>Description: Substantial variation to authorisation under RSA<br>**Status: Authorisation superseded by a substantial or non substantial variationSuperseded**<br>Positional Accuracy: Automatically positioned to the address | A19NW (N) | 918 | 6 | 527292 185400 |
| 15 | **Registered Radioactive Substances**<br>Name: Royal Free And University College Medical School Of University College London<br>Location: Royal Free Hospital, Pond Street, London, NW3 2QG<br>Authority: Environment Agency, Thames Region<br>Permit Reference: Bz9758<br>Dated: 5th January 2006<br>Process Type: Authorisation under S13 RSA for the disposal of Radioactive waste (was RSA60 S7)<br>Description: Minor variation to authorisation under RSA<br>**Status: Application has been authorised and any conditions apply to the operatorAuthorised**<br>Positional Accuracy: Manually positioned to the address or location | A19NW (N) | 920 | 6 | 527299 185399 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 16 | **Water Abstractions**<br>Operator: London Borough Of Camden<br>Licence Number: 28/39/39/0219<br>Permit Version: 1<br>Location: Swiss Cottage Open Space- Borehole<br>Authority: Environment Agency, Thames Region<br>Abstraction: Municipal Grounds: Spray Irrigation - Direct<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): Not Supplied<br>Yearly Rate (m3): Not Supplied<br>Details: Swiss Cottage Open Space, Winchester Road, London.<br>Authorised Start: 01 January<br>Authorised End: 31 December<br>Permit Start Date: 1st April 2008<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 10m | A13SW (SW) | 242 | 6 | 526800 184280 |
| 17 | **Water Abstractions**<br>Operator: London Borough Of Camden<br>Licence Number: Th/039/0039/087<br>Permit Version: 1<br>Location: Swiss Cottage Open Space- Borehole<br>Authority: Environment Agency, Thames Region<br>Abstraction: Municipal Grounds: Spray Irrigation - Direct<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): Not Supplied<br>Yearly Rate (m3): Not Supplied<br>Details: Swiss Cottage Open Space, Winchester Road, London<br>Authorised Start: 01 April<br>Authorised End: 31 March<br>Permit Start Date: 5th December 2013<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 10m | A13SW (SW) | 286 | 6 | 526750 184261 |
| 17 | **Water Abstractions**<br>Operator: London Borough Of Camden<br>Licence Number: Th/039/0039/087<br>Permit Version: 1<br>Location: Swiss Cottage Open Space- Borehole<br>Authority: Environment Agency, Thames Region<br>Abstraction: Municipal Grounds: General Washing/Process Washing<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): Not Supplied<br>Yearly Rate (m3): Not Supplied<br>Details: Swiss Cottage Open Space, Winchester Road, London<br>Authorised Start: 01 April<br>Authorised End: 31 March<br>Permit Start Date: 5th December 2013<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 10m | A13SW (SW) | 286 | 6 | 526750 184261 |
| 17 | **Water Abstractions**<br>Operator: London Borough Of Camden<br>Licence Number: Th/039/0039/087<br>Permit Version: 1<br>Location: Swiss Cottage Open Space- Borehole<br>Authority: Environment Agency, Thames Region<br>Abstraction: Municipal Grounds: Lake And Pond Throughflow<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): Not Supplied<br>Yearly Rate (m3): Not Supplied<br>Details: Swiss Cottage Open Space, Winchester Road, London<br>Authorised Start: 01 April<br>Authorised End: 31 March<br>Permit Start Date: 5th December 2013<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 10m | A13SW (SW) | 286 | 6 | 526750 184261 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| | **Water Abstractions**<br>Operator: London Borough Of Camden<br>Licence Number: 28/39/39/0091<br>Permit Version: 100<br>Location: Two Bores At Kentish Town Sports Centre, Prince Of Wales St<br>Authority: Environment Agency, Thames Region<br>Abstraction: Industrial; Commercial And Public Services: Laundry Use<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): Not Supplied<br>Yearly Rate (m3): Not Supplied<br>Details: St. Pancras Public Baths, Prince Of Wales Road, London Nw1<br>Authorised Start: 01 January<br>Authorised End: 31 December<br>Permit Start Date: 13th June 1966<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 10m | (E) | 1846 | 6 | 528800<br>184700 |
| | **Water Abstractions**<br>Operator: London Borough Of Camden<br>Licence Number: 28/39/39/0091<br>Permit Version: 100<br>Location: Two Bores At Kentish Town Sports Centre, Prince Of Wales St<br>Authority: Environment Agency, Thames Region<br>Abstraction: Other Industrial/Commercial/Public Services: Process Water<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): Not Supplied<br>Yearly Rate (m3): Not Supplied<br>Details: St. Pancras Public Baths, Prince Of Wales Road, London Nw1<br>Authorised Start: 01 January<br>Authorised End: 31 December<br>Permit Start Date: 13th June 1966<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 10m | (E) | 1846 | 6 | 528800<br>184700 |
| | **Water Abstractions**<br>Operator: Abbey Lodge Rtm Company Limited<br>Licence Number: 28/39/39/0115<br>Permit Version: 101<br>Location: Abbey Lodge, Park Road, London Nw8-Two Boreholes<br>Authority: Environment Agency, Thames Region<br>Abstraction: Household Water Supply: Drinking; Cooking; Sanitary; Washing; (Small Garden)<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): Not Supplied<br>Yearly Rate (m3): Not Supplied<br>Details: Abbey Lodge, Park Road, London Nw8<br>Authorised Start: 01 January<br>Authorised End: 31 December<br>Permit Start Date: 1st June 2006<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 10m | (S) | 1934 | 6 | 527420<br>182620 |
| | **Water Abstractions**<br>Operator: Wood Management Trustees Ltd<br>Licence Number: 28/39/39/0115<br>Permit Version: 100<br>Location: Two Boreholes At Abbey Lodge, Park Road, London Nw8<br>Authority: Environment Agency, Thames Region<br>Abstraction: Household Water Supply: Drinking; Cooking; Sanitary; Washing; (Small Garden)<br>Abstraction Type: Water may be abstracted from a single point<br>Source: Groundwater<br>Daily Rate (m3): 100<br>Yearly Rate (m3): 28640<br>Details: Abbey Lodge, Park Road, London Nw8<br>Authorised Start: 01 January<br>Authorised End: 31 December<br>Permit Start Date: 28th November 1991<br>Permit End Date: Not Supplied<br>Positional Accuracy: Located by supplier to within 100m | (S) | 1934 | 6 | 527420<br>182620 |
| | **Groundwater Vulnerability**<br>Soil Classification: Not classified<br>Map Sheet: Sheet 39 West London<br>Scale: 1:100,000 | A13SE<br>(E) | 0 | 6 | 526938<br>184518 |
| | **Drift Deposits**<br>None | | | | |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| | **Bedrock Aquifer Designations**<br>Aquifer Designation: Unproductive Strata | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Superficial Aquifer Designations**<br>No Data Available | | | | |
| 18 | **Source Protection Zones**<br>Name: Barrow Hill<br>Source: Environment Agency, Head Office<br>Reference: Th405<br>Type: Zone II (Outer Protection Zone): Either 25% of the source area or a 400 day travel time whichever is greater. | A13SE (E) | 0 | 6 | 526938 184518 |
| 19 | **Source Protection Zones**<br>Name: Barrow Hill<br>Source: Environment Agency, Head Office<br>Reference: Th405<br>Type: Zone I (Inner Protection Zone): Travel time of 50 days or less to the groundwater source. | A9NW (SE) | 752 | 6 | 527439 183917 |
| | **Extreme Flooding from Rivers or Sea without Defences**<br>None | | | | |
| | **Flooding from Rivers or Sea without Defences**<br>None | | | | |
| | **Areas Benefiting from Flood Defences**<br>None | | | | |
| | **Flood Water Storage Areas**<br>None | | | | |
| | **Flood Defences**<br>None | | | | |
| 20 | **Detailed River Network Lines**<br>River Type: Extended Culvert (greater than 50m)<br>River Name: St Agnes's Well<br>Hydrographic Area: D006<br>River Flow Type: Primary Flow Path<br>River Surface Level: Below Surface<br>Drain Feature: Not a Drain<br>Flood Risk Management Status: Other Rivers<br>Water Course Name: Not Supplied<br>Water Course Reference: Not Supplied | A13SE (E) | 222 | 6 | 527187 184509 |
| | **Detailed River Network Offline Drainage**<br>None | | | | |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 21 | **Historical Landfill Sites**<br>Licence Holder: Not Supplied<br>Location: London NW6<br>Name: Canfield Place<br>Operator Location: Not Supplied<br>Boundary Accuracy: As Supplied<br>Provider Reference: EAHLD12043<br>First Input Date: Not Supplied<br>Last Input Date: Not Supplied<br>Specified Waste Type: Not Supplied<br>EA Waste Ref: 0<br>Regis Ref: Not Supplied<br>WRC Ref: Not Supplied<br>BGS Ref: Not Supplied<br>Other Ref: DON009 | A12NW (W) | 875 | 6 | 526074 184790 |
| | **Local Authority Landfill Coverage**<br>Name: London Borough of Camden - Has no landfill data to supply | | 0 | 9 | 526938 184518 |
| | **Local Authority Landfill Coverage**<br>Name: Westminster City Council - Has supplied landfill data | | 651 | 5 | 526738 183866 |
| 22 | **Registered Waste Transfer Sites**<br>Licence Holder: P B Donoghue<br>Licence Reference: DL140<br>Site Location: BR Goods Yard at 269 Finchley Road, CAMDEN, London, NW3<br>Operator Location: As Site Address<br>Authority: Environment Agency - Thames Region, North East Area<br>Site Category: Transfer<br>Max Input Rate: Medium (Equal to or greater than 25,000 and less than 75,000 tonnes per year)<br>Waste Source Restrictions: No known restriction on source of waste<br>Licence Status: Licence lapsed/cancelled/defunct/not applicable/surrenderedCancelled<br>Dated: 1st February 1992<br>Preceded By Licence: DL140<br>Superseded By Licence: Not Given<br>Positional Accuracy: Manually positioned to the address or location<br>Boundary Quality: Not Supplied<br>Authorised Waste: Lwra Cat. A = Inert Wastes; Lwra Cat. Bi Gen.Non-Putresc; Max.Waste Permitted By Licence-Stated<br>Prohibited Waste: Clinical - As In Coll/Disp.Regs Of '88; Liquid/Slurry/Sludge Wastes; Poisonous, Noxious, Polluting Wastes; Special Wastes; Waste N.O.S. | A12NW (W) | 752 | 6 | 526200 184780 |
| 22 | **Registered Waste Transfer Sites**<br>Licence Holder: P B Donoghue<br>Licence Reference: DL140<br>Site Location: BR Goods Yard, 269 Finchley Road, CAMDEN, London, NW3<br>Operator Location: As Site Address<br>Authority: Environment Agency - Thames Region, North East Area<br>Site Category: Transfer<br>Max Input Rate: Medium (Equal to or greater than 25,000 and less than 75,000 tonnes per year)<br>Waste Source Restrictions: No known restriction on source of waste<br>Licence Status: Record supersededSuperseded<br>Dated: 1st August 1983<br>Preceded By Licence: Not Given<br>Superseded By Licence: DL140<br>Positional Accuracy: Manually positioned to the address or location<br>Boundary Quality: Not Supplied<br>Authorised Waste: Commercial Waste; Construction Ind. Wastes; Max.Waste Permitted By Licence(Stated)<br>Prohibited Waste: Clinical Waste -Clause 2 & 4 Hsc 1982; Notifiable Wastes; Putrescible Waste; Special Wastes | A12NW (W) | 752 | 6 | 526200 184780 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| | **BGS 1:625,000 Solid Geology**<br>Description: Thames Group | A13SE (E) | 0 | 2 | 526938 184518 |
| | **BGS Estimated Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Soil Sample Type: London<br>Arsenic Concentration: no data<br>Cadmium Concentration: no data<br>Chromium Concentration: no data<br>Lead Concentration: no data<br>Nickel Concentration: no data | A13SE (E) | 0 | 2 | 526938 184518 |
| | **BGS Estimated Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Soil Sample Type: London<br>Arsenic Concentration: no data<br>Cadmium Concentration: no data<br>Chromium Concentration: no data<br>Lead Concentration: no data<br>Nickel Concentration: no data | A13SE (E) | 36 | 2 | 527000 184518 |
| | **BGS Estimated Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Soil Sample Type: London<br>Arsenic Concentration: no data<br>Cadmium Concentration: no data<br>Chromium Concentration: no data<br>Lead Concentration: no data<br>Nickel Concentration: no data | A18SE (N) | 455 | 2 | 526938 185000 |
| | **BGS Estimated Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Soil Sample Type: London<br>Arsenic Concentration: no data<br>Cadmium Concentration: no data<br>Chromium Concentration: no data<br>Lead Concentration: no data<br>Nickel Concentration: no data | A18SE (N) | 457 | 2 | 527000 185000 |
| | **BGS Estimated Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Soil Sample Type: London<br>Arsenic Concentration: no data<br>Cadmium Concentration: no data<br>Chromium Concentration: no data<br>Lead Concentration: no data<br>Nickel Concentration: no data | A8NE (S) | 491 | 2 | 526938 184000 |
| | **BGS Estimated Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Soil Sample Type: London<br>Arsenic Concentration: no data<br>Cadmium Concentration: no data<br>Chromium Concentration: no data<br>Lead Concentration: no data<br>Nickel Concentration: no data | A8NE (S) | 498 | 2 | 527000 184000 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| | **BGS Measured Urban Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Grid: 526218, 183841<br>Soil Sample Type: Topsoil<br>Sample Area: London<br>Arsenic Measured Concentration: 19.00 mg/kg<br>Cadmium Measured Concentration: 0.70 mg/kg<br>Chromium Measured Concentration: 91.00 mg/kg<br>Lead Measured Concentration: 938.00 mg/kg<br>Nickel Measured Concentration: 30.00 mg/kg | A7SW (SW) | 956 | 2 | 526218 183841 |
| | **BGS Measured Urban Soil Chemistry**<br>Source: British Geological Survey, National Geoscience Information Service<br>Grid: 527669, 185211<br>Soil Sample Type: Topsoil<br>Sample Area: London<br>Arsenic Measured Concentration: 18.00 mg/kg<br>Cadmium Measured Concentration: 0.60 mg/kg<br>Chromium Measured Concentration: 100.00 mg/kg<br>Lead Measured Concentration: 937.00 mg/kg<br>Nickel Measured Concentration: 26.00 mg/kg | A19NE (NE) | 975 | 2 | 527669 185211 |
| | **BGS Urban Soil Chemistry Averages**<br>Source: British Geological Survey, National Geoscience Information Service<br>Sample Area: London<br>Count Id: 7189<br>Arsenic Minimum Concentration: 1.00 mg/kg<br>Arsenic Average Concentration: 17.00 mg/kg<br>Arsenic Maximum Concentration: 161.00 mg/kg<br>Cadmium Minimum Concentration: 0.30 mg/kg<br>Cadmium Average Concentration: 0.90 mg/kg<br>Cadmium Maximum Concentration: 165.20 mg/kg<br>Chromium Minimum Concentration: 13.00 mg/kg<br>Chromium Average Concentration: 79.00 mg/kg<br>Chromium Maximum Concentration: 2094.00 mg/kg<br>Lead Minimum Concentration: 11.00 mg/kg<br>Lead Average Concentration: 280.00 mg/kg<br>Lead Maximum Concentration: 10000.00 mg/kg<br>Nickel Minimum Concentration: 2.00 mg/kg<br>Nickel Average Concentration: 28.00 mg/kg<br>Nickel Maximum Concentration: 506.00 mg/kg | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Coal Mining Affected Areas**<br>In an area that might not be affected by coal mining | | | | |
| | **Non Coal Mining Areas of Great Britain**<br>No Hazard | | | | |
| | **Potential for Collapsible Ground Stability Hazards**<br>Hazard Potential: Very Low<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Potential for Compressible Ground Stability Hazards**<br>Hazard Potential: No Hazard<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| | **Potential for Ground Dissolution Stability Hazards**<br>Hazard Potential: No Hazard<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Potential for Landslide Ground Stability Hazards**<br>Hazard Potential: Very Low<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Potential for Running Sand Ground Stability Hazards**<br>Hazard Potential: No Hazard<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Potential for Shrinking or Swelling Clay Ground Stability Hazards**<br>Hazard Potential: Moderate<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Radon Potential - Radon Protection Measures**<br>Protection Measure: No radon protective measures are necessary in the construction of new dwellings or extensions<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |
| | **Radon Potential - Radon Affected Areas**<br>Affected Area: The property is in a lower probability radon area, as less than 1% of homes are above the action level<br>Source: British Geological Survey, National Geoscience Information Service | A13SE (E) | 0 | 2 | 526938 184518 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 23 | **Contemporary Trade Directory Entries**<br>Name: Cedo Ltd<br>Location: 32, Eton Avenue, London, NW3 3HL<br>Classification: Plastic Products - Manufacturers<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A13SE (E) | 170 | - | 527135 184498 |
| 24 | **Contemporary Trade Directory Entries**<br>Name: Drennan & Co<br>Location: 64, Belsize Park, London, NW3 4EH<br>Classification: Door & Gate Operating Equipment<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A13NW (W) | 195 | - | 526723 184584 |
| 25 | **Contemporary Trade Directory Entries**<br>Name: Soap Opera The<br>Location: 8, Winchester Road, London, NW3 3NT<br>Classification: Laundries & Launderettes<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A13SW (S) | 235 | - | 526882 184260 |
| 26 | **Contemporary Trade Directory Entries**<br>Name: Clean 4 You<br>Location: 55, Belsize Park, London, NW3 4EE<br>Classification: Cleaning Services - Domestic<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A13NW (W) | 264 | - | 526650 184571 |
| 27 | **Contemporary Trade Directory Entries**<br>Name: Gootc Ltd<br>Location: 26, Northways Parade, London, NW3 5DN<br>Classification: Dry Cleaners<br>**Status: Active**<br>Positional Accuracy: Automatically positioned to the address | A13SW (W) | 296 | - | 526630 184429 |
| 27 | **Contemporary Trade Directory Entries**<br>Name: Trans-World Trading Ltd<br>Location: 24, Northways Parade, London, NW3 5DN<br>Classification: Photographic Equipment & Supplies - Wholesale<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A13SW (W) | 296 | - | 526630 184429 |
| 27 | **Contemporary Trade Directory Entries**<br>Name: Smart Choice Dry Cleaners<br>Location: 23, Northways Parade, LONDON, NW3 5DN<br>Classification: Dry Cleaners<br>**Status: Active**<br>Positional Accuracy: Automatically positioned to the address | A13SW (W) | 296 | - | 526630 184429 |
| 28 | **Contemporary Trade Directory Entries**<br>Name: Chalcot House Services Ltd<br>Location: Flat 4, 47, Belsize Park Gardens, London, NW3 4JL<br>Classification: Cleaning Services - Domestic<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A13NE (NE) | 302 | - | 527182 184746 |
| 28 | **Contemporary Trade Directory Entries**<br>Name: Chalcot House Services<br>Location: Flat 1, 51, Belsize Park Gardens, London, NW3 4JL<br>Classification: Commercial Cleaning Services<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A13NE (NE) | 311 | - | 527202 184737 |
| 29 | **Contemporary Trade Directory Entries**<br>Name: Volvo Cars<br>Location: 1, Northways Parade, London, NW3 5EN<br>Classification: Car Dealers<br>**Status: Active**<br>Positional Accuracy: Automatically positioned to the address | A12SE (W) | 321 | - | 526596 184482 |
| 29 | **Contemporary Trade Directory Entries**<br>Name: Kwik-Fit<br>Location: 1, Northways Parade, London, NW3 5EN<br>Classification: Tyre Dealers<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A12SE (W) | 321 | - | 526596 184482 |
| 29 | **Contemporary Trade Directory Entries**<br>Name: Speedway<br>Location: 1, Northways Parade, London, NW3 5EN<br>Classification: Garage Services<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A12SE (W) | 321 | - | 526596 184482 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 39 | **Contemporary Trade Directory Entries**<br>Name: Haywood Motors<br>Location: A, 23, Lambolle Place, London, NW3 4PG<br>Classification: Garage Services<br>**Status: Active**<br>Positional Accuracy: Automatically positioned to the address | A14NW (E) | 421 | - | 527361 184663 |
| 39 | **Contemporary Trade Directory Entries**<br>Name: Belsize Motors<br>Location: A, 23, Lambolle Place, London, NW3 4PG<br>Classification: Garage Services<br>**Status: Active**<br>Positional Accuracy: Automatically positioned to the address | A14NW (E) | 421 | - | 527361 184663 |
| 39 | **Contemporary Trade Directory Entries**<br>Name: J A Harnett<br>Location: 4, Lancaster Stables, Lambolle Place, London, NW3 4PH<br>Classification: Antiques - Repairing & Restoring<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A14NW (E) | 438 | - | 527379 184661 |
| 40 | **Contemporary Trade Directory Entries**<br>Name: Hot Chiu<br>Location: Garden Flat, 26, Fitzjohns Avenue, London, NW3 5NB<br>Classification: Food Products - Manufacturers<br>**Status: Active**<br>Positional Accuracy: Automatically positioned to the address | A13NW (NW) | 429 | - | 526607 184839 |
| 41 | **Contemporary Trade Directory Entries**<br>Name: Pyramid<br>Location: 52, Belsize Lane, London, NW3 5AR<br>Classification: Dry Cleaners<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A18SW (N) | 447 | - | 526874 184984 |
| 42 | **Contemporary Trade Directory Entries**<br>Name: Kara Services<br>Location: 38, Fellows Road, London, NW3 3LH<br>Classification: Cleaning Services - Domestic<br>**Status: Active**<br>Positional Accuracy: Automatically positioned to the address | A14SW (E) | 454 | - | 527417 184459 |
| 43 | **Contemporary Trade Directory Entries**<br>Name: Gayle Mcvay<br>Location: 52, Belsize Park Gardens, London, NW3 4ND<br>Classification: Hats & Caps - Manufacturers<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A14NW (NE) | 460 | - | 527379 184728 |
| 44 | **Contemporary Trade Directory Entries**<br>Name: 47 Jours Design<br>Location: 19, Glenloch Road, London, NW3 4DJ<br>Classification: Soft Furnishings - Manufacturers<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A18SE (NE) | 461 | - | 527191 184943 |
| 45 | **Contemporary Trade Directory Entries**<br>Name: Agfa-Digital Photosnap Ltd<br>Location: 171, Finchley Road, London, NW3 6LB<br>Classification: Photographic Processors<br>**Status: Inactive**<br>Positional Accuracy: Automatically positioned to the address | A12NE (W) | 493 | - | 526419 184522 |
| 46 | **Fuel Station Entries**<br>Name: Hampstead Connect<br>Location: 104a, Finchley Road, London, NW3 5EY<br>Brand: BP<br>Premises Type: Petrol Station<br>**Status: Open**<br>Positional Accuracy: Automatically positioned to the address | A12NE (W) | 440 | - | 526471 184554 |
| 47 | **Fuel Station Entries**<br>Name: Belsize Park Service Station<br>Location: Belzier Park Service Station, 215, Haverstock Hill, London, NW3 4QE<br>Brand: BP<br>Premises Type: Petrol Station<br>**Status: Open**<br>Positional Accuracy: Automatically positioned to the address | A18NE (N) | 720 | - | 527187 185227 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 48 | **Fuel Station Entries**<br>Name: Boundary Road Service Station<br>Location: 150 Loudon Road, St Johns Wood, LONDON, NW8 0DH<br>Brand: Total<br>Premises Type: Not Applicable<br>**Status: Obsolete**<br>Positional Accuracy: Automatically positioned to the address | A7NE (SW) | 726 | - | 526423 183961 |
| 49 | **Fuel Station Entries**<br>Name: Loudon Road Service Station<br>Location: 21a, Loudon Road, St Johns Wood, London, Greater London, NW8 0NB<br>Brand: Unbranded<br>Premises Type: Not Applicable<br>**Status: Obsolete**<br>Positional Accuracy: Manually positioned to the address or location | A7SE (SW) | 993 | - | 526375 183661 |

| Map ID | Details | Quadrant Reference (Compass Direction) | Estimated Distance From Site | Contact | NGR |
|---|---|---|---|---|---|
| 50 | **Local Nature Reserves**<br>Name: Belsize Wood<br>Multiple Area: N<br>Area (m2): 2722.99<br>Source: Natural England<br>Designation Date: 28th March 2012 | A19NW (NE) | 855 | 7 | 527490 185214 |

# Data Suppliers

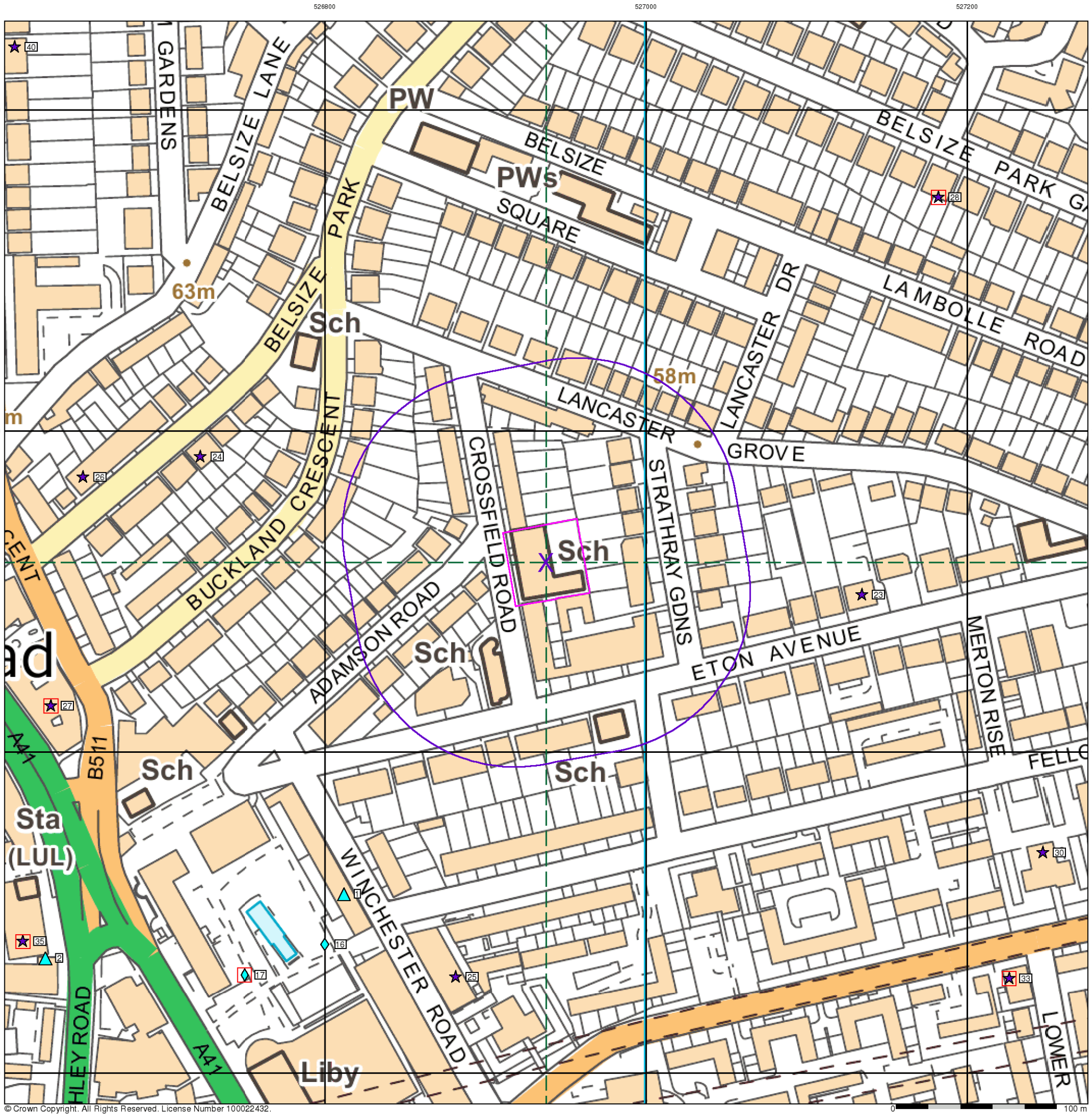
A selection of organisations who provide data within this report

| Data Supplier | Data Supplier Logo |
|---|---|
| Ordnance Survey | |
| Environment Agency | |
| Scottish Environment Protection Agency | |
| The Coal Authority | |
| British Geological Survey | |
| Centre for Ecology and Hydrology | |
| Natural Resources Wales | |
| Scottish Natural Heritage | |
| Natural England | |
| Public Health England | |
| Ove Arup | |
| Peter Brett Associates | |

# Useful Contacts

| Contact | Name and Address | Contact Details |
|---|---|---|
| 2 | **British Geological Survey - Enquiry Service**<br>British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG | Telephone: 0115 936 3143<br>Fax: 0115 936 3276<br>Email: enquiries@bgs.ac.uk<br>Website: www.bgs.ac.uk |
| 3 | **London Borough of Waltham Forest - Environmental Health Department**<br>154 Blackhorse Road, Walthamstow, London, E17 6NW | Telephone: 020 8496 3000<br>Fax: 0181 524 8960<br>Website: www.lbwf.gov.uk |
| 4 | **London Borough of Camden - Pollution Projects Team**<br>Seventh Floor, Town Hall Extension, Argyle Street, London, WC1H 8EQ | Telephone: 020 7278 4444<br>Fax: 020 7860 5713<br>Website: www.camden.gov.uk |
| 5 | **Westminster City Council - Environmental Health Department**<br>Council House, Marylebone Road, London, NW1 5PT | Telephone: 020 7641 1317<br>Fax: 020 7641 1142<br>Website: www.westminster.gov.uk |
| 6 | **Environment Agency - National Customer Contact Centre (NCCC)**<br>PO Box 544, Templeborough, Rotherham, S60 1BY | Telephone: 08708 506 506<br>Email: enquiries@environment-agency.gov.uk |
| 7 | **Natural England**<br>Suite D, Unex House, Bourges Boulevard, Peterborough, Cambridgeshire, PE1 1NG | Telephone: 0845 600 3078<br>Email: enquiries@naturalengland.org.uk<br>Website: www.naturalengland.org.uk |
| 8 | **Environment Agency - Head Office**<br>Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol, Avon, BS32 4UD | Telephone: 01454 624400<br>Fax: 01454 624409 |
| 9 | **London Borough of Camden**<br>Town Hall, Judd Street, London, WC1H 9JE | Telephone: 020 7974 4444<br>Fax: 020 7974 6866<br>Email: info@camden.gov.uk<br>Website: www.camden.gov.uk |
| - | **Public Health England - Radon Survey, Centre for Radiation, Chemical and Environmental Hazards**<br>Chilton, Didcot, Oxfordshire, OX11 0RQ | Telephone: 01235 822622<br>Fax: 01235 833891<br>Email: radon@phe.gov.uk<br>Website: www.ukradon.org |
| - | **Landmark Information Group Limited**<br>Imperium, Imperial Way, Reading, Berkshire, RG2 0TD | Telephone: 0844 844 9952<br>Fax: 0844 844 9951<br>Email: customerservices@landmarkinfo.co.uk<br>Website: www.landmarkinfo.co.uk |

Please note that the Environment Agency / Natural Resources Wales / SEPA have a charging policy in place for enquiries.




GEA Geotechnical & Environmental Associates

## General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location

## Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

## Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

## Geological

- BGS Recorded Mineral Site

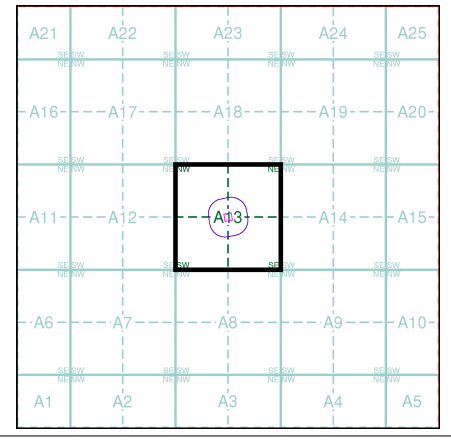
## Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

## Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry

## Site Sensitivity Map - Segment A13




## Order Details

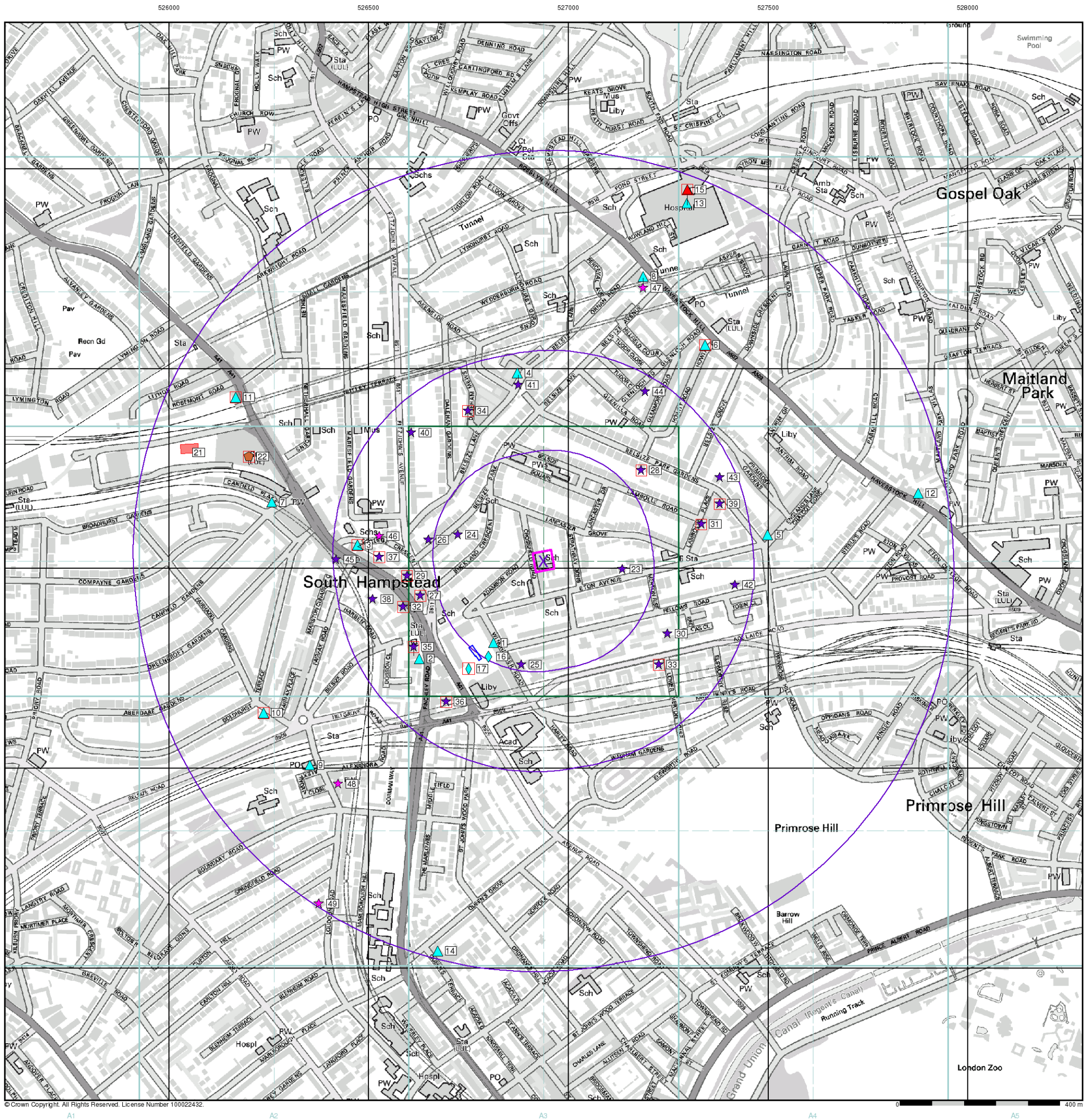
| | |
|---|---|
| Order Number: | 74136046_1_1 |
| Customer Ref: | J15302 |
| National Grid Reference: | 526940, 184520 |
| Slice: | A |
| Site Area (Ha): | 0.22 |

## Site Details

The Hall School Charitable Trust, 23 Crossfield Road, LONDON, NW3 4NU

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk






A1 A2 A3 A4 A5

GEA Geotechnical & Environmental Associates

## General

Specified Site
Specified Buffer(s)
Bearing Reference Point
Map ID
Several of Type at Location

## Agency and Hydrological

Contaminated Land Register Entry or Notice (Location)
Contaminated Land Register Entry or Notice
Discharge Consent
Enforcement or Prohibition Notice
Integrated Pollution Control
Integrated Pollution Prevention Control
Local Authority Integrated Pollution Prevention and Control
Local Authority Pollution Prevention and Control
Local Authority Pollution Prevention and Control Enforcement
Pollution Incident to Controlled Waters
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Registered Radioactive Substance
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River Quality Sampling Point
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Water Abstraction
Water Industry Act Referral

## Geological

BGS Recorded Mineral Site

## Industrial Land Use

Contemporary Trade Directory Entry
Fuel Station Entry

## Waste

BGS Recorded Landfill Site (Location)
BGS Recorded Landfill Site
EA Historic Landfill (Buffered Point)
EA Historic Landfill (Polygon)
Integrated Pollution Control Registered Waste Site
Licensed Waste Management Facility (Landfill Boundary)
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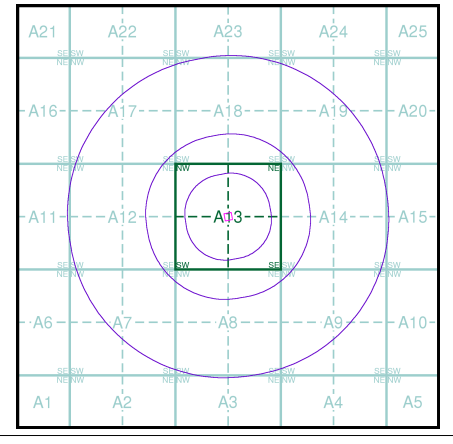
Registered Waste Transfer Site (Location)
Registered Waste Transfer Site
Registered Waste Treatment or Disposal Site (Location)
Registered Waste Treatment or Disposal Site

## Hazardous Substances

COMAH Site
Explosive Site
NIHHS Site
Planning Hazardous Substance Consent
Planning Hazardous Substance Enforcement

## Site Sensitivity Map - Slice A

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| National Grid Reference: | 526940, 184520 |
| Slice: | A |
| Site Area (Ha): | 0.22 |
| Search Buffer (m): | 1000 |

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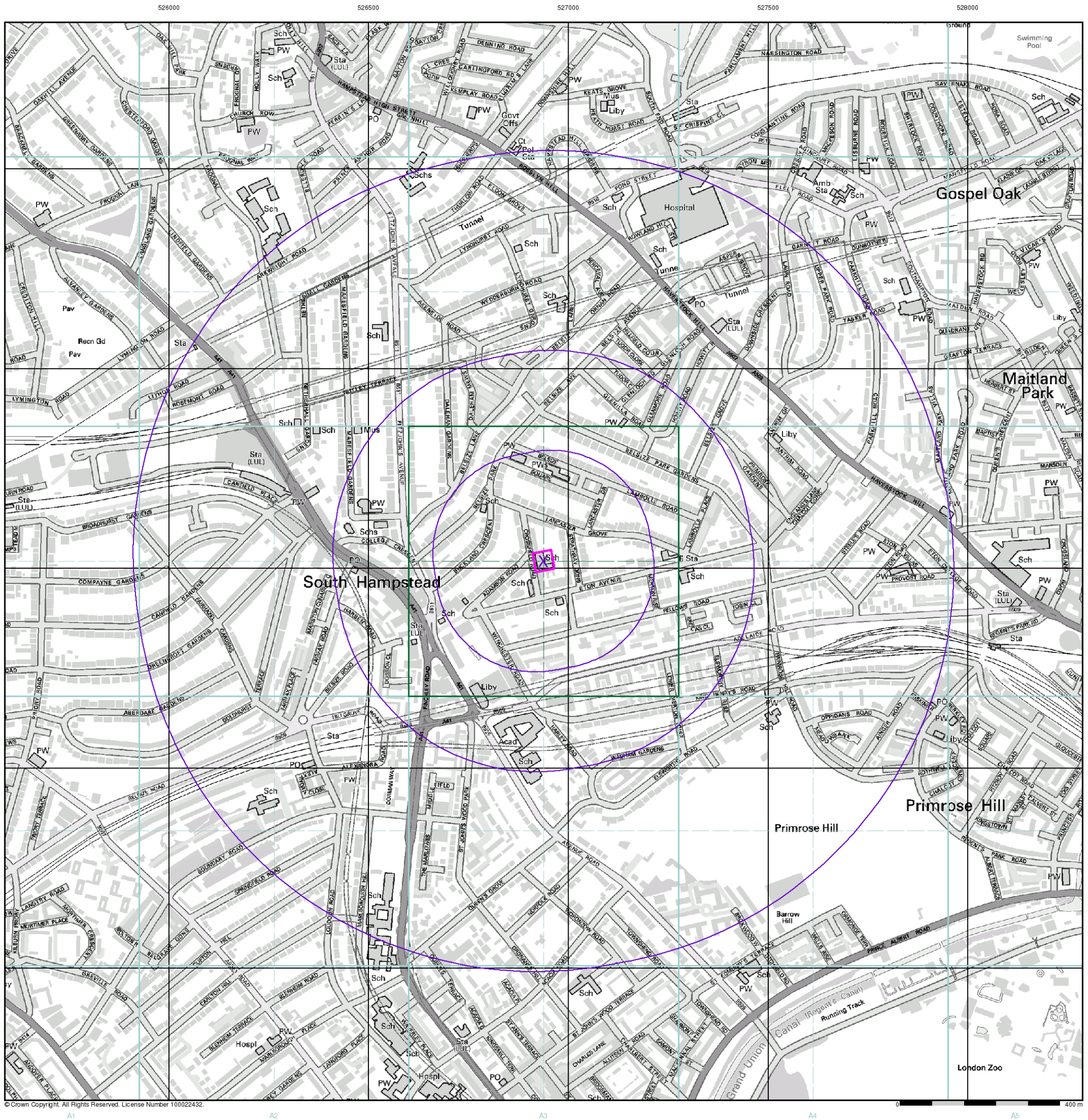





GEA Geotechnical & Environmental Associates

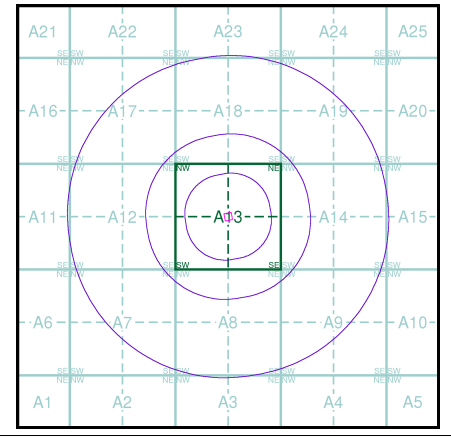
## General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

## Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

## Flood Map - Slice A

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