SITE INVESTIGATION & BASEMENT IMPACT ASSESSMENT REPORT

70 Elsworthy Road
London
NW3 3BP

Client: Latitude London

Engineer: Elliott Wood

J15143

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Geotechnical & Environmental Associates

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EXECUTIVE SUMMARY

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

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Elliott Wood, on behalf Latitude London, with respect to the proposed demolition of the existing main house and the subsequent construction of a new house with a single level basement and refurbishment of existing Mews house. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground conditions and hydrogeology, to assess the extent of any contamination and to provide information to assist with the design of suitable foundations and retaining walls. The report also includes information required to comply with the London Borough of Camden (LBC) Planning Guidance CPG4, relating to the requirement for a Basement Impact Assessment (BIA) including a ground movement assessment.

DESK STUDY FINDINGS

The earliest map studied, dated 1871, shows the site to be occupied by gardens associated with houses fronting onto Avenue Road. The next map, dated 1896, indicates the site to be vacant with the exception of outbuildings and glass houses on the eastern side. At some time between 1915 and 1935 the site and surrounding area were developed with the existing buildings and has since remained unchanged.

GROUND CONDITIONS

The investigation has generally encountered the expected ground conditions in that, beneath a moderate thickness of made ground, the London Clay Formation was encountered and proved to the maximum depth investigated. The made ground extended to depths of between 0.75 m and 1.20 m and below a surface of hardstanding / topsoil underlain by clayey sandy silt with occasional fragments of flint, brick, concrete, carbonaceous fragments and rootlets. In Borehole Nos 1 and 3 a geotextile hemp membrane was encountered at depths of 0.3 m and 0.2 m respectively. The underlying London Clay initially comprised soft to stiff light brown mottled orange-brown mottled grey clay. This initial horizon of the London Clay extended to a maximum depth of 5.0 m and was underlain by stiff brown clay to a depth of 12.0 m, where it was underlain by stiff dark grey slightly silty fissured clay to the full depth of investigation of 15.0 m.

Groundwater was encountered as seepages at 0.3 m depth in Borehole 3 and 3.7 m in Borehole No 1.

Chemical analysis has indicated no elevated concentrations of contaminants within the made ground.

RECOMMENDATIONS

Basement formation level should be within the London Clay and moderate width strip or pad foundations bearing on the firm clay below basement level may be designed to apply a net allowable bearing pressure of 100 kN/m^2. Alternatively, piled foundations may be adopted.

Groundwater monitoring has indicated water to be present at depths of 1.7 m (47.4 m OD) and 4.1 m (45.0 m OD) and groundwater is likely to be encountered during basement excavation. Additional monitoring should be carried out to assess the extent to which the basement will be affected by groundwater inflows, but at this stage it is expected that inflows will be controllable by sump pumping.

No special measures should be required with respect to soil contamination.

Part 1: INVESTIGATION REPORT

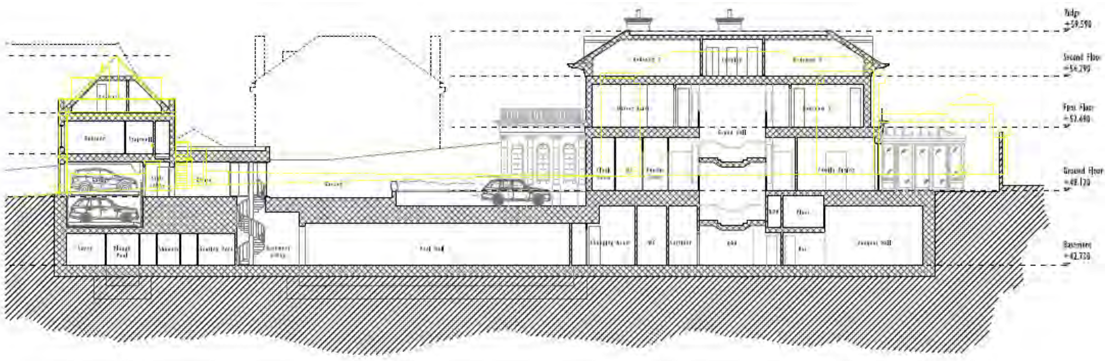
This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) have been commissioned by Elliott Wood on the behalf of Latitude London, to carry out a Desk Study and Site Investigation at 70 Elsworthy Road, London, NW3 3BP. This report also includes a Basement Impact Assessment (BIA), which has been carried out in in support of a planning application. A Ground Movement Analysis has also carried been carried out by GEA and is reported separately (J15143A Issue 2, dated 17 August 2015).

1.1 Proposed Development

Consideration is being given to the demolition of the existing building and construction of a new building with a single level basement. It is also proposed to refurbish the existing mews buildings in the south of the site and a section through the proposed development is shown below.



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 assess the possible impact of the proposed development on the local hydrogeology;
- to provide advice with respect to the design of suitable foundations and retaining walls and to provide a ground movement model;
- 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 hydrogeological maps;
- 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 cable percussion borehole, advanced to a depth of 15.0 m;
- two window sample boreholes, advanced to depths of 5.0 m and 8.0 m, by means of an open drive (terrier) drilling rig;
- standard penetration tests (SPTs), carried out at regular intervals in the cable percussion borehole, to provide additional quantitative data on the strength of the soils;
- the installation of three groundwater monitoring standpipes and a single monitoring visit;
- laboratory testing of selected soil samples for geotechnical purposes and for 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.

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

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[2] and their Guidance for Subterranean Development[3] prepared by Arup ("the Arup report"). The aim of the work is to provide information on surface water, land stability and groundwater 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 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004
2 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*
3 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

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 (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 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 and the number of locations where the ground was sampled. 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 approximately 500 m southeast of Swiss Cottage London Underground station and is bounded by Elsworthy Road to the south and by neighbouring residential buildings and their associated gardens to the north, east and west. It can also be located using National Grid Reference 526990, 183930.

The site is roughly rectangular in shape, measuring approximately 75m by 20 m. A large two-storey house occupies the north of the site and a driveway along the length of the western boundary provides access to a mews building in the south of the site. The mews building is a two storey structure that appears to be used for residential purposes.

A large garden / landscaped area is located between the main building and the mews building and consists of a large lawn area with perimeter flower beds. No large trees were present on site at the time of the field work. Mature trees are present close to the east and west of the site.

The site and immediate surrounding area are essentially level at an Ordnance Datum (OD) level of approximately 49.1 m OD with a slight gradient from north to south to 47.3 m OD according to drawing 1422-PL-041, which was provided by the consulting architect.

2.2 Site History

The earliest map studied, dated 1871, shows the site to be occupied by gardens associated with houses fronting onto Avenue Road. The next map, dated 1896, indicates the site to be vacant with the exception of outbuildings and glass houses on the eastern side. At some time between 1915 and 1935 the site and surrounding area were developed with the existing buildings and has since remained unchanged.

2.3 Other Information

A search of public registers and databases has been made via the Envirocheck database and a summary of the results of this search is included in the Appendix. More detailed information relating to the search can be provided on request.

No operational or historic landfills, waste transfer, treatment or disposal sites are recorded within 1 km of the site. There are no controlled processes operating within 250 m of the site.

A local authority pollution prevention and control is recorded 450 m to the north of the site. In addition there are a number of contemporary trade directory entries within 500 m of the site.

The site is located within an Environment Agency designated Source Protection Outer Zone 2 (SPZ) and is 300m from an Environment Agency designated Source Protection Inner Zone 1. It is not within an area indicated by the Environment Agency to be at risk from flooding.

The site is shown to be located in an area where soil lead content is between 300 mg/kg to 600 mg/kg, which is higher than the DEFRA Category 4 Screening values[4].

London Underground Ltd (LUL) has confirmed that the site is not located within 50 m of any London Underground services.

Three Network Rail tunnels run in an east-west orientation approximately 80 m (closest to site) to the north of the site and form the Primrose Hill Tunnel network. The lines run a service connecting London Euston (southeast of site) to the Willesden Junction (northwest of site).

Network rail have confirmed that the site lies outside its exclusion zone.

2.4 Geology

The Geological Survey map of the area (sheet 256) indicates that the site should be underlain by made ground over the London Clay Formation.

An investigation carried out previously by GEA, approximately 200 m to the east of the site revealed that beneath a variable thickness of made ground, the London Clay Formation was present and was proved to the maximum investigated depth of 15.00 m. The made ground extended to depths of 0.50 m and 2.00 m and generally comprised brown silty clayey sand or

4 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

sandy clay with gravel, brick, concrete and ash fragments. The underlying London Clay initially appeared to be reworked London Clay to depths of between 3.00 m and 3.60 m, comprising brown clay with fine brick fragments and occasional layers of grey mottled black clay with brick fragments. The London Clay that was then encountered was comprised firm, becoming stiff, fissured brown clay with bluish grey veins extending to depths of 10.40 m. Stiff grey fissured London Clay then extended to the full depth of the investigation (15 m).

2.5 Hydrology and Hydrogeology

The topographical maps show that the nearest surface water is the Grand Union Canal situated approximately 700 m to the southeast of the site, just north of Regents Park. The site is not within an area at risk from flooding as defined by the EA.

The London Clay is classified by the Environment Agency as unproductive strata, which refers to deposits that have low permeability and negligible significance for water supply or river base flow.

The London Clay is a very low permeability cohesive formation that cannot support active groundwater flow or, subsequently, a water table. The London Clay does contain groundwater but it is not able to transmit this as active flow. Standpipes within the London Clay do commonly fill with locally drained groundwater to shallow levels however these are not representative of a coherent water table and some standpipes can be dry or to take a very long time to fill.

Due to the predominantly cohesive nature of the soils, the groundwater flow rate is likely to be negligible. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1×10^{-10} m/s and 1×10^{-8} m/s, with an even lower vertical permeability.

The site is located within an Environment Agency designated Source Protection Outer Zone (SPZ), but this relates to a deep abstraction from the chalk and is therefore not relevant to the proposed development. The site is not within an area indicated by the Environment Agency to be at risk from flooding.

Groundwater was encountered during the aforementioned previous GEA investigation as seepages from within the London Clay at depths of 3.50 m and 12.60 m. Three standpipes were installed and groundwater was measured at depths of 1.32 m and 1.61 m within the Made Ground, these were assumed to be perched water tables.

Reference to the Lost Rivers of London[5] indicates that the site is located between two tributaries of the former River Tyburn.

2.6 Preliminary Risk Assessment

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

5 Nicholas Barton (2000) *London’s Lost Rivers.* Historical Publications Ltd

2.6.1 Source

The historical usage of the site that has been established by the desk study and the site walkover indicates that the site does not have a potentially contaminative history by virtue of it having been occupied by a residential property since 1935. There are thus no obvious likely sources of contamination on the site or in its immediate vicinity. No sources of soil gas have been identified.

2.6.2 Receptor

The use of the site for a residential end use may result in exposure to the soil and thus represents a relatively high sensitivity end-use. Buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into contact with any contaminants present in the soils during demolition and construction works. Being underlain by an unproductive aquifer, groundwater is unlikely to be considered as a particularly sensitive receptor.

2.6.3 Pathway

As the site is underlain by an unproductive aquifer, there is a low potential for contaminant exposure pathways to exist for contaminants to move onto and off the site with the direction of groundwater flow. End users could conceivably come into contact with soils within private garden areas, although such pathways are already in existence. Not withstanding the risk to site workers and buried services, 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 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 and as it is anticipated to be underlain by cohesive soils at shallow depth, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site; there should thus be no need to consider soil gas exclusion systems.

3.0 SCREENING

The London Borough of Camden guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full Basement Impact Assessment (BIA) 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 Appendix E which includes a series of questions within a screening flowchart for three categories; groundwater flow; land stability; and surface water flow. Responses to the questions are tabulated on the following pages.

3.1.1 Subterranean (groundwater) Screening Assessment

Question	Response for 70 Elsworthy Road
1a. Is the site located directly above an aquifer?	No. Geological records indicate that the site is underlain by the London Clay.
1b. Will the proposed basement extend beneath the water table surface?	Unlikely. The London Clay cannot support a water table however the basement could potentially extend beneath locally monitored water levels.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	Yes. A tributary of the River Tyburn is located 100 m to the west of the site.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No. The site is outside the catchment of Hampstead Heath ponds.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No – the proposed building footprint and external works do not substantially change the proportion of hard surfaced areas, assuming at least 1 m of 'clean' fill between basement roof and ground level
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. No change would be made to the current site drainage arrangements and London Clay is generally unsuitable for soakaways.
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. There are no local ponds or spring lines present within 100m of the site.

The screening exercise has not identified any potential issues which should be assessed.

Q2 A tributary of the River Tyburn is located 100 m to the west of the site.

3.1.2 Stability Screening Assessment

Question	Response for 70 Elsworthy Road
1. Does the existing site include slopes, natural or manmade, greater than 7°?	No. The site is predominantly flat and is not shown on the slope angle map (Fig 16) of the Arup report to be in an area where slopes of greater than 7° are present.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No. Details of the proposed development provided do not include the re-profiling of the site to create new slopes.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No. Topographical maps and Figures 16 and 17 of the Arup report confirm the neighbouring land does not include a slope greater than 7°.
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	No, not according to the slope angle map in the Arup report
5. Is the London Clay the shallowest strata at the site?	*Yes, The London Clay is prone to seasonal shrink-swell (subsidence and heave).*
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?	*Yes, according to the Phase II Arboricultural Impact Assessment Report (Ref 798), six trees will be removed as part of the development.*
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	*Yes, the London Clay is prone to seasonal shrink-swell and can cause structural damage. Desiccation was not noted during the fieldwork, but desiccation may be present within close proximity to existing trees elsewhere on site. The proposed basement will however extend to a general depth of about 5.2 m to 7.0 m, such that new foundations would be expected to bypass any desiccated soils present.*

Question	Response for 70 Elsworthy Road
8. Is the site within 100 m of a watercourse or potential spring line?	Yes. A tributary of the River Tyburn is located 100 m to the west of the site.
9. Is the site within an area of previously worked ground?	No. Geological maps and site investigation confirm the site is not underlain by worked ground.
10. Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required?	No. Geological maps and site investigation confirm the site is underlain by an 'unproductive aquifer' as defined by the Environmental Agency.
11. Is the site within 50 m of Hampstead Heath ponds?	No. Not according to figures 3, 5, 8 and 14 of the Arup report.
12. Is the site within 5 m of a highway or pedestrian right of way?	No. The site is within 5 m of Elsworthy Road, but the proposed basement is outside that distance.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes. The property is detached but the new proposed development will increase foundation depths to a possible maximum depth of 15.0 m (Approximately 35 m OD).
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No. Topographical maps and plans of infrastructure tunnels were reviewed, in addition to online infrastructure maps, showing exclusions zones. Written confirmation was also provided by Network Rail to confirm distance from Primrose Hill Tunnels.

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

Q5 The London Clay is prone to seasonal shrink-swell (subsidence and heave).

Q6 According to the Phase II Arboricultural Impact Assessment Report (Ref 798),six trees will be removed as part of the development

Q7 The London Clay is prone to seasonal shrink-swell and can cause structural damage.

Q8 A tributary of the River Tyburn is located 100 m to the west of the site.

Q13 The development will potentially increase the foundation depth relative to the neighbouring properties to approximately 15.0 m depth

3.1.3 Surface Flow and Flooding Screening Assessment

Question	Response for 70 Elsworthy Road
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 – any additional surface water gained from an increased hardstanding area will be attenuated to ensure they are not increased or altered. The basement will largely be beneath the footprint of the buildings and existing hardstanding area, therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report does not apply across these areas. However, as the basement and development will also extend into parts of the site which are currently permeable, the distance between the roof of the basement and ground surface will not always be 1m. It is considered that the use of SUDS attenuation will mitigate any impact by not meeting the 1m requirement.

3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No – the proposed building footprint and external works do not substantially change the proportion of hard surfaced areas, assuming at least 1 m of 'clean' fill between basement roof and ground level.
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 – it is proposed to allow for new attenuation to control how water is stored from additional hardstanding areas. The attenuation size will be based upon peak surface water flows and discharge rates into existing sewers will be agreed with Thames Water. The basement will largely be beneath the footprint of the buildings and existing hardstanding area, therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report does not apply across these areas. However, as the basement and development will also extend into parts of the site which are currently permeable, the distance between the roof of the basement and ground surface will not always be 1m. It is considered that the use of SUDS attenuation will mitigate any impact by not meeting the 1m requirement.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No - the proposed basement is very unlikely to result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses. It is proposed to allow for new attenuation to control how water is stored from additional hardstanding areas. The basement will largely be beneath the footprint of the buildings and existing hardstanding area, therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report does not apply across these areas. However, as the basement and development will also extend into parts of the site which are currently permeable, the distance between the roof of the basement and ground surface will not always be 1m. It is considered that the use of SUDS attenuation will mitigate any impact by not meeting the 1m requirement.
6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature?	Yes. Figures 5a of the Camden SFRA dated 2014 show that the site is located within an area that has had internal flooding to properties from sewers. Elsworthy Road is not identified on Figure 3ii of the SFRA to have flooded in 1975 or 2002. Figure 3ii of the SFRA and EA maps shows a very low surface water flooding risk to the site. The site is located within Flood Zone 1 and there is a low risk of flooding from reservoirs and other artificial sources. The basement is likely to be constructed within a perched water table, however, the mitigation measures outlined in this BIA such as tanking the basement will reduce the risk to acceptable levels. The site is located within the Critical Drainage Area number GROUP3-005 as identified in the Camden SWMP. Therefore, a flood risk assessment has been completed and is appended.

The above assessment has identified the following potential issue that need to be assessed.

Q6 The site is located within a Flood Zone 1 and there is a low risk of flooding from reservoirs and other artificial sources. Additionally, the site is located within Critical Drainage Area number GROUP3-005 as identified by the Camden SWMP.

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.

Potential Impact	Consequence
London Clay is the shallowest stratum at the site.	The London Clay is prone to seasonal shrink-swell (subsidence and heave).
Six trees will be removed as part of the proposed developments	The removal of trees will affect the quantity of water uptake within their zone of influence (NHBC Guidelines, Section 4.2) which could result in differential heave movements.
Seasonal shrink-swell can result in foundation movements.	If a new basement is not dug to below the depth likely to be affected by tree roots this could lead to damaging differential movement between the subject site and adjoining properties.
Founding depths relative to neighbours.	If not designed and constructed appropriately, the excavation of a basement may result in structural damage to neighbouring buildings and structures.
The site is located within 100 m of former watercourse.	This may affect flow to former watercourses.
The site is in an area identified to have surface water flood risk	A Flood Risk Assessment is appended.

These potential impacts have been investigated through the site investigation, as detailed in Section 9.0.

4.2 Exploratory Work

In order to meet the objectives described in Section 1.2 a single cable percussion borehole was drilled to a depth of 15 m and was supplemented by two opendrive sampler boreholes to depths of 5.0 m and 8.0 m.

Standard penetration tests (SPTs) were carried out at regular intervals in all boreholes and disturbed and undisturbed samples were recovered for subsequent laboratory examination, geotechnical testing and contamination analysis.

Groundwater monitoring standpipes were installed to depths of 5.0 m and 8.0 m and have been monitored on a single occasion.

The borehole records and results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum (OD) levels shown on the borehole records have been interpolated from spot heights shown on a site survey drawing (ref: 1422-PL-041, dated February 2015), which was provided by the consulting architect.

4.3 Sampling Strategy

The borehole locations were positioned on site by GEA to provide optimum coverage of the site with due regard to the proposed development, whilst avoiding the areas of known services. The scope of investigation was determined by GEA in consultation with the consulting engineers and the Client.

Thee 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 to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure or groundwater pathway 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.

A number of disturbed and undisturbed samples of natural soil were submitted to a geotechnical testing laboratory and were subject to a number of material property and strength tests, including four point Atterberg Limit, moisture content, particle size distribution tests (PSD) and quick undrained triaxials.

5.0 GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, beneath a variable and locally significant thickness of made ground, the London Clay was encountered, which proved to the full depth of the investigation.

5.1 Made Ground

The made ground generally comprised brown to dark brown silty sandy clay with brick, flint, rootlets and occasional decaying carbon was encountered to depths of between 0.75 m (48.4 m OD) to 1.2 m (46.5 m OD).

In Borehole Nos 1 and 3 a geotextile membrane was encountered at approximately 0.3 m depth. This is suspected to be part of the driveway construction and not a barrier for contaminative soils.

No visual or olfactory evidence of contamination was observed within these soils, although fragments of decaying carbon were noted within the made ground, which can commonly contain elevated concentrations of PAH, including benzo(a)pyrene and naphthalene. Samples of the made ground have been analysed for a range of contaminants and the results are summarised in Section 5.4.

5.2 London Clay

The London Clay initially comprised an upper layer of generally soft to firm becoming stiff brown mottled grey Clay to a maximum depth of 5.0 m (44.1 m OD). Below this depth stiff to very stiff blue grey fissured clay was encountered to a maximum of 15.0 m depth, where the investigation was completed.

In Borehole Nos 1 and No 3 claystones were encountered at 3.7 m depth (45.4 m OD) and 12.0 m depth (35.7 m OD), respectively.
Laboratory plasticity index test results indicate the clay to be of high volume change potential.

The results from the laboratory undrained triaxial compression tests and insitu SPT tests, which are plotted against depth on a graph in the appendix, indicate the clay to generally increase in strength with depth from medium strength to very high strength with undrained shear strength increasing from 50 kN/m^2 at a depth of 2.0 m, to 165 kN/m^2 at a depth of 15.0 m.

5.3 Groundwater

During drilling groundwater was encountered as seepages associated with the claystones in the London Clay at a depth of 3.7 m (45.4 m OD).

Groundwater was encountered as seepage in the made ground at 0.3 m depth (47.4 m OD) in Borehole No 3. This is suspected to be a perched water table resulting from surface run off from the brick driveway.

Results of subsequent monitoring visits are shown in the table below.

Borehole No	Standpipe depth (m)	Depth to groundwater (m) [Level m OD]	
		01/07/2015	18/11/2015
1	8.00	1.70 [47.40 m]	2.00 [49.1]
2	5.00	4.10 [45.00 m]	Inaccessible
3	5.00	Dry	2.40 [45.20]

5.4 Soil Contamination

The table below sets out the values measured within three samples of made ground; all concentrations are in mg/kg unless otherwise stated.

Determinant	BH1 0.1 m	BH2 1.2 m	BH3 0.3 m
pH	10.1	7.9	8.4
Arsenic	21	15	16
Cadmium	0.22	<0.1	<0.10
Chromium	27	41	54
Copper	28	32	21
Mercury	<0.10	0.6	0.19
Nickel	32	22	36
Lead	71	110	68
Selenium	<0.2	0.41	<0.2
Zinc	78	59	61
Total Cyanide	<0.5	<0.5	<0.5
Total Phenols	<0.3	<0.3	<0.3

Determinant	BH1 0.1 m	BH2 1.2 m	BH3 0.3 m
Sulphide	13	5.9	4.4
TPH	26	<10	<10
Total PAH	20	<2.0	4.2
Benzo(a)pyrene	2.1	<0.10	0.48
Naphthalene	0.2	<0.10	<0.1
Total organic carbon %	2.7	1.3	0.86

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[6] Soil Guideline Value where available, or is a Generic Screening Value calculated using the CLEA UK Version 1.06[7] software assuming a residential end use with plant uptake, or is based on the DEFRA Category 4 Screening values[8]. The key generic assumptions for this end use are as follows:

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

It is considered that these assumptions are 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;

6 *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.
7 Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009
8 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

- 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.

When comparing the results from the contamination testing to those in the Soil Guideline Values and Generic Guideline Values, the analyses have revealed no elevated concentrations in excess of the generic risk-based screening values.

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

Part 2: DESIGN BASIS REPORT

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

6.0 INTRODUCTION

It is understood that consideration is being given to the demolition of the existing building and the subsequent construction of a new two-storey with a single level basement and additional refurbishment to the existing mews building.

7.0 GROUND MODEL

The desk study has revealed that the site has not had a potentially contaminative history, having apparently been occupied by the existing residential property for the entirety of its developed history and on the basis of the fieldwork, the ground conditions at this site can be characterised as follows.

- Beneath a variable and locally significant thickness of made ground, the London Clay was encountered and proved to the maximum depth investigated;

- the made ground extends to depths of between 0.75 m (48.4 m OD) to 1.2 m (46.5 m OD);

- the underlying London Clay comprised an initial soft to firm soft to firm becoming stiff brown mottled grey Clay with occasional fragments of decaying wood/carbon to a maximum depth of 5.0 m (44.1 mOD). Below this depth stiff to very stiff blue grey clay was encountered to a maximum of 15.0 m depth, where the investigation was completed.

- In Borehole No 1 a claystone was encountered at 3.7 m depth (45.4 mOD) and in Borehole No 3 a claystone was encountered at 12.0 m depth (35.7 m OD).;

- during drilling groundwater was encountered as a seepage associated with the claystone in the London Clay at a depth of 3.7 m (45.4 m OD);

- a seepage of groundwater was also encountered from the made ground during drilling at a depth of 0.3 m (47.4 m OD) in Borehole No 3. This is suspected to be associated with a perched water table;

- groundwater monitoring has recorded groundwater at depths of 1.7 m (47.4 m OD) and 4.1 m (45.0 m OD) in Borehole Nos 1 and 2, with Borehole No 3 recorded as dry; and

- the contamination analyses have not indicated any elevated concentrations which could pose a risk to human health.

8.0 ADVICE AND RECOMMENDATIONS

Formation level for the proposed basement is likely to be within the London Clay. Significant groundwater inflows are not anticipated in the basement excavation and the consulting engineers are understood to favour the use of a bored pile wall to support the excavation.

It has been assumed that the basement excavation will bypass potentially desiccated clay soils that may be present elsewhere on site.

Excavations for the proposed basement structure will require temporary support to maintain stability of the excavation and surrounding structures at all times.

The existing foundations of the Mews building will need to be underpinned prior to construction of the proposed new basement or will need to be supported by new retaining walls.

It is understood that the use of piled foundations is proposed.

8.1 Basement Excavation

It is understood that the new basement will be excavated to a depth of approximately 5.2 m to 7.0 m below existing ground level, to a level of 47.2 m OD. Therefore formation level is likely to be within the firm to stiff clay of the London Clay. A section through the proposed development is shown below.

Groundwater monitoring has shown that groundwater may be encountered within the depth of the basement but it is not clear to what extent the groundwater measured represents perched water within the made ground or shallow groundwater within the London Clay. The monitoring also provides no indication of the rate at which groundwater may enter the excavation or the volume of water that may be encountered. Monitoring of the standpipes should be continued and ideally trial excavations should be carried out, to depths as close to the full basement depth as possible, to provide an indication of the likely ground water conditions. Additionally, simple rising head tests could be carried out within the standpipes to provide some indication of groundwater flow.

Any groundwater present within the weathered London Clay is likely to be as discrete pockets of water rather than in continuous layers from silt and sand partings. Each individual pocket may be of relatively low volume and individual inflows may cease once the pocket is emptied. On this basis inflows may not be significant and should be adequately dealt with through sump pumping. However, as the basement excavation will cover a much larger area than that covered by the investigation, it is possible that larger pockets or inter-connected layers of groundwater could be encountered. It would therefore be prudent for the chosen contractor to have a contingency plan in place to deal with more significant or prolonged inflows as a precautionary measure.

In any case, inflows could conceivably occur from perched water tables, particularly in the vicinity of existing foundations but should be adequately dealt with through sump pumping.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by the requirement to prevent ground water inflows and whether it is to be incorporated into the permanent works and have a load bearing function.

It may be appropriate to form the retaining walls by underpinning of the existing foundations, using a traditional 'hit and miss' approach, subject to further monitoring or trial excavations. Careful workmanship will be required to ensure that movement of the surrounding structures does not arise during underpinning of the existing foundations, but this method will have the benefit of minimising the plant required and maximising usable space in the new basement. The contractor should have a contingency in place to deal with any groundwater inflows.

If groundwater inflows cannot be suitably controlled or if sufficient space is not available to carry out trial pits, consideration may be given to the use of a bored pile retaining wall.

A bored pile wall would have the advantage of being incorporated into the permanent works and will be able to provide support for structural loads. On the basis of the monitoring to date, it should be possible to adopt a contiguous bored pile wall, with the use of localised grouting and / or pumping if necessary in order to deal with groundwater inflows. A contiguous bored piled wall would have the disadvantage of reducing usable space in the basement, and in this respect a secant wall may be preferable as it would overcome the requirement for any secondary groundwater protection in the permanent works and maximise the basement area.

The ground movements associated with the basement 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. In this respect the timing of the provision of support to the wall will have an important effect on movements.

Consideration will need to be given to a retention system that maintains the stability at all times of the existing building, neighboring properties and structures. The existing foundations will need to be underpinned prior to excavation of the basement or will need to be supported by new retaining walls.

8.1.1 Basement 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 (Φ' – degrees)
Made Ground	1800	Zero	25
London Clay	1900	Zero	24

Groundwater has been measured as seepage at depths of 3.7 m and 12.0 m, with further monitoring indicating groundwater to be present at depths of 1.7 m and 4.1 m. On this basis, groundwater might be anticipated to be encountered in the 5.2 to 7.0 m deep basement and further monitoring should be undertaken as detailed in Section 8.1.1. Reference should be made to BS8102:2009[9] with regard to requirements for waterproofing and design with respect to groundwater pressures.

8.1.2 Basement Heave

In the area beneath the demolition of the existing house and subsequent excavation of approximately 7.0 m of soil will result in an unloading of approximately to 160 kN/m^2. In the area beneath the existing garden the excavation of approximately 5.2 m to 7.0 m of soil will result in an unloading of approximately 130 kN/m^2. In the area beneath the mews building an excavation of approximately 5.2 m will result in an unloading of approximately 95 kN/m^2.

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

This unloading will result in heave of the underlying London Clay, which will comprise short term elastic movement and longer term swelling that will continue over a number of years. The effects of the longer term swelling movement will be mitigated to some extent by the load applied by the new foundations and the continued presence of the existing house but may need to be subject to analysis in due course.

8.2 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate. A conventional rotary augered pile may be appropriate but consideration will need to be given to the possible instability and water ingress in the made ground and within any silty or sandy zones within the London Clay. The use of bored piles installed using continuous flight auger (cfa) techniques may therefore be the most appropriate, especially as the use of a limited access rig may be required.

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

Stratum	Depth m	kN / m^2
Ultimate Skin Friction		
Basement Excavation	GL to 5.0	Ignore (Basement excavation)
London Clay (α = 0.5)	5.00 to 15.00	Increasing linearly from 35 to 80
Ultimate End Bearing		
London Clay	10.00 to 15.00	Increasing linearly from 1035 to 1485

In the absence of pile tests, guidance from the London District Surveyors Association (LDSA)[10] suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads. On the basis of the above coefficients and a factor of safety of 2.6 it has been estimated that a 450 mm diameter pile extending 10.0 m below basement level to a depth of 15 m below ground level, should provide a safe working load of about 400 kN.

The above example is 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 potential groundwater inflows within the made ground and silt and sand partings within the London Clay.

8.3 Shallow Excavations

On the basis of the borehole findings, it is considered that shallow excavations for foundations and services that extend through the made ground or clay should remain generally stable in the short term, although some instability may occur. However, should deeper excavations be considered or if excavations are to remain open for prolonged periods it is recommended that provision be made for battered side slopes or lateral support. Where

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

personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

The investigation has indicated that groundwater inflows might be encountered within made ground and from claystones within the London Clay. Some form of groundwater control is likely to be required and should be suitably controlled by sump pumping, although this should be confirmed by additional investigations, ideally in the form of trial excavations to the full depth of the proposed basement.

8.4 Basement Floor Slabs

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 utilise appropriate reinforcement and tension piles 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 are known.

8.5 Effect of Sulphates

Chemical analyses of selected soil samples have revealed generally low concentrations of soluble sulphate, corresponding to Class DS-4 and AC-3s of Table C1 of BRE Special Digest 1:2005. The guidelines contained in the above digest should be followed in the design of any new foundation concrete.

8.6 Site Specific Risk Assessment

The desk study research has indicated that the site has not had a potentially contaminative history, having been used for residential purposes since 1896.

The site is not considered to have had a historical contaminative use and the results of the contamination analysis do not indicate any elevated concentrations in excess of the generic risk-based screening values. On this basis, it is not considered that any remedial measures to protect sensitive receptors are necessary.

8.7 Waste Disposal

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE guidance[11], will need to be disposed of to a licensed tip. 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 going to landfill is subject to landfill tax at either the standard rate of £80 per tonne (about £145 per m^3) or at the lower rate of £2.50 per tonne (roughly £5 per m^3). However, the classification for tax purposes is not the same as that for disposal purposes. Currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring rocks and soils which are accurately described as such in terms of the 2011 Order[12] would qualify for the 'lower rate' of landfill tax.

11 CL:AIRE (2011) *The Definition of Waste: Development Industry Code of Practice* Version 2, March 2011
12 *Landfill Tax (Qualifying Material) Order 2011*

Based upon on the technical guidance provided by the Environment Agency[13] it is considered likely that the made ground from this site, as represented by the four chemical analyses carried out, would be classified as a NON-HAZARDOUS waste under the waste code 17 05 04 (soils and stones not containing dangerous substances) and would be taxable at the standard rate. It is likely that the natural soils, if separated out, could be classified as an INERT waste also under the waste code 17 05 04. This material would be taxable at the lower rate, if accurately described as naturally occurring sand and gravel in terms of the 2011 Order on the waste transfer note. As this site has not had a contaminative history there should be no requirement for WAC leaching analyses to confirm that this material is suitable for landfilling, although this would require confirmation from the receiving site.

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[14] 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 and its likely landfill taxable rate 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 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 to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

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

The site investigation indicates that the site is directly underlain by the London Clay, which is classified as by the Environment Agency as an unproductive strata.

13 Environment Agency (2013) *Hazardous Waste: Interpretation of the definition and classification of hazardous waste. Technical Guidance* WM2 Third Edition, August 2013

14 Regulatory Position Statement (2007) *Treating non-hazardous waste for landfill - Enforcing the new requirement* Environment Agency 23 Oct 2007

Potential Impact	Site Investigation Conclusions
London Clay is the shallowest stratum at the site	The London Clay is prone to seasonal shrink-swell (subsidence and heave).
Seasonal shrink-swell can result in foundation movements	The London Clay is prone to seasonal shrink-swell and can cause structural damage. Desiccation was not noted during the fieldwork, but desiccation may be present within close proximity to existing trees elsewhere on site. The proposed basement will extend to a general depth of about 5.2 to 7.0 m, such that new foundations would be expected to bypass any desiccated soils present.
Six trees will be removed as part of the proposed developments	The removal of trees will affect the quantity of water uptake within their zone of influence (NHBC Guidelines, Section 4.2) which could result in differential heave movements.
Founding depths relative to neighbours	The retention system will ensure the stability of the excavation and neighbouring properties at all times. Neighbouring properties are not in particularly close proximity and the new building will be detached.
The site is within 100 m of former watercourse	The site investigation did not establish the presence of alluvial deposits beneath the site which indicated any hydraulic continuity with saturated alluvial deposits associated with the Tyburn stream.
Surface Water Flooding	A flood risk assessment has been completed and indicates that there is a low risk of groundwater flooding across the site as long as precautionary measures, such as basement tanking and non-return valves are fitted where appropriate.

The results of the site investigation have 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 within 100 m of former watercourse

The River Tyburn has been culverted to form a drain and is, therefore, unlikely to have any impact on, or be influenced by, the surrounding groundwater level and is not, therefore, considered to present a risk to slope stability at this site, where the risk of an impact on slope stability from changes in groundwater flow is considered to be low due to the negligible permeability of the London Clay. The proposed basement development would not impact on the surrounding water environment.

On the basis of a conservative assumption that the surrounding properties have single or double level basements, it is likely that the cumulative effect of these basements on groundwater flow will be negligible, partly because the basements are far enough removed from the proposed development that any groundwater would be able to move around the site, but mainly because the low permeability of the London Clay means ground water flow is negligible in any case.

Seasonal Shrink-Swell and Tree Removal

The proposed basement will extend to a depth of about 5.2 to 7.0 m, such that new foundations will be expected to bypass any desiccated soils. Furthermore no desiccation was noted on site and so the removal of trees and potential change in water uptake should not have a significant effect on the proposed development However the tree identified as T19 in the Arboricultural Report is located within close proximity of a neighbouring structure with an unknown foundation depth and as such there is a risk that the removal of this tree may affect the neighbouring property.

Subject to inspection of foundation excavations in the normal way to ensure that there is not significant unexpectedly deep root growth, it is not considered that the occurrence of shrink-swell issues in the local area has any bearing on the proposed development.

The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties

At the time of writing this report no data was available on the surrounding properties with regards to basement levels and foundations. To this extent and to remain conservative it has been assumed that surrounding properties do not have basements and are founded on shallow foundations approximately 1.5m depth. Therefore the proposed basement will extend to a significant depth relative to the existing foundations of the neighbouring properties and will need to be designed to ensure the stability of the site and any potentially sensitive structures that are in close proximity to the site.

A ground movement assessment has been carried out and is reported separately (J15143A Issue 2, dated 17 August 2015).

9.1 BIA Conclusion

A Basement Impact Assessment has been carried out following the information and guidance published by the London Borough of Camden. Information from a Site Investigation has been used to assess potential impacts identified by the screening process.

It is concluded that the proposed development is unlikely to result in any specific land or slope stability issues. A Flood Risk Assessment has concluded that the site is at a low risk from flooding from groundwater and other sources at the site as long as precautionary measures, such as basement tanking and non-return valves, are applied where appropriate..

10.0 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.

An issue that requires careful consideration at this site is the extent to which groundwater will affect the basement excavation in the temporary condition and the level of the water table to be adopted in the permanent design. Recommendations have been made for continued monitoring of the standpipes to address these issues, but it is important that the contractor is able to deal with inflows of groundwater that may be locally more significant than anticipated.

It is recommended that heave movements are checked by further analysis once the loadings and final levels are known.

If during ground works any visual or olfactory evidence of contamination is identified it is recommended that further investigation be carried out and that the risk assessment is reviewed. These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

As only a limited number of samples have been tested, it would be prudent to carry out contamination testing on additional samples of made ground / topsoil recovered from the areas of the site that are to remain as soft landscaped gardens, in order to ensure the absence of any significant contamination.

APPENDIX

Borehole Records

Monitoring Records

Geotechnical Test Results

SPT and Cohesion / Depth Graph

Chemical Analyses (Soil)

Generic Risk Based Screening Values

Historical Mapping

Flood Risk Assessment Report

Site Plan

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
SG12 7QE

Site	Borehole Number
70 Elsworthy Road, London, NW3 3BP	BH1

Boring Method	Casing Diameter: Diameter	Casing Diameter: Depth Base	Ground Level (mOD)	Client	Job Number
Open drive sampler			49.10	Latitude London	J15143

Location	Dates	Engineer	Sheet
696249.00E 5713643.00N	01/06/2015	Elliott Wood	Sheet 1 of 1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
0.10	ES2					(0.30)	Made Ground (light brown silty sand with occasional gravel of brick and flint.
					48.80	0.30	
0.50	ES1					(0.30)	Made Ground (Hemp geotextile over tarmac over silty clay with occasional gravel of flint, brick, tarmac. Some rootlets)
					48.50	0.60	
						(0.15)	Made Ground (Concrete over light brown silty sand with gravel of brick, flint, concrete, tarmac and glass.
					48.35	0.75	Soft to firm light brown mottled grey CLAY with gravel sized fragments of decaying wood/carbon. Occasional pockets of selenite crystals. Very weak claystone encountered at 3.7 m depth. Became stiff mottled blue grey CLAY at 4.8 m depth
0.80 - 0.90	D3						
1.00 - 1.45	SPT (S)N=7	0.00		N=7 (2,1/1,2,2,2)			
1.50 - 1.60	D4						
2.00 - 2.45	SPT (S)N=12	0.00		N=12 (2,1/3,2,3,4)			
2.50 - 2.60	D5						
3.00 - 3.45	SPT (S)N=15	0.00		N=15 (2,1/3,3,4,5)			
3.20 - 3.30	D6						
				Seepage			
4.00 - 4.45	SPT (S)N=12	0.00		N=12 (2,2/2,3,3,4)			
						(7.25)	
4.80 - 4.90	D7						
5.00 - 5.45	SPT (S)N=11	0.00		N=11 (2,2/2,3,3,3)			
5.50 - 5.60	D8						
6.00 - 6.45	SPT (S)N=15	0.00		N=15 (2,2/3,3,4,5)			
6.90 - 7.00	D9						
7.00 - 7.45	SPT (S)N=19	0.00		N=19 (2,3/3,5,5,6)			
7.80 - 8.00	D10						
8.00 - 8.45	SPT (S)N=21	0.00		N=21 (2,3/4,5,6,6)	41.10	8.00	Complete at 8.00m

Remarks

Groundwater encountered as seepage at 3.70 m depth

Scale (approx)	Logged By
1:50	JD

GEA Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
SG12 7QE

Site
70 Elsworthy Road, London, NW3 3BP

Borehole Number
BH2

Boring Method	Casing Diameter: Diameter	Casing Diameter: Depth Base	Ground Level (mOD)	Client	Job Number
Open Drive Sampler			49.15	Latitude London	J15143

Location	Dates	Engineer	Sheet
696228.00E 5713673.00N	01/06/2015	Elliott Wood	Sheet 1 of 1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.50)	Made Ground (Topsoil over dark bluish grey clay with gravel sized fragments of brick, concrete and decaying carbon.		
0.30	ES2								
					48.65	0.50	Made Ground (soft brown clay with occasional fragments of brick and flint).		
0.60	ES1								
0.70	D3					(0.70)			
1.00 - 1.45	SPT (S)N=10	0.00		N=10 (1,1/2,3,2,3)					
					47.95	1.20	Soft to stiff light orange-brown mottled grey slightly silty CLAY with occasional gravel sized pockets of selenite. Pocket of fine to coarse brown sand with claystone gravel fragments at 3.5m depth Claystone fragment encountered at 4.4m depth		
1.50 - 1.60	D4								
2.50 - 2.70	D5								
3.00 - 3.45	SPT (S)N=16	0.00		N=16 (2,2/3,4,4,5)		(3.80)			
3.50 - 3.70	D6								
4.50 - 4.70	D7								
5.00 - 5.45	SPT (S)N=19	0.00		N=19 (2,2/4,4,5,6)	44.15	5.00	Complete at 5.00m		
5.45 - 5.90	SPT (S)N=36	0.00		N=36 (7,8/9,8,9,10)					
5.90 - 6.35	SPT (S)N=57	0.00		N=57 (11,13/13,14,15,15)					
6.35 - 6.80	SPT (S)N=69	0.00		N=69 (16,16/17,17,17,18)					
6.80 - 7.25	SPT (S)N=101	0.00		N=101 (20,20/28,25,24,24)					

Remarks

Groundwater not encountered

Scale (approx) 1:50

Logged By JD

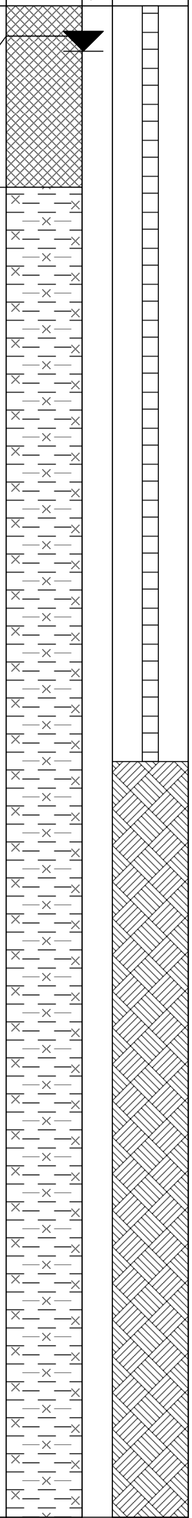
GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware SG12 7QE	**Site** 70 Elsworthy Road, London, NW3 3BP

Borehole Number: BH3

Boring Method	Casing Diameter (Diameter / Depth Base)	Ground Level (mOD)	Client	Job Number
Cable Percussion		47.70	Latitude London	J15143

Location	Dates	Engineer	Sheet
	18/06/2015	Elliott Wood	Sheet 1 of 2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
						(0.20)	Made Ground (Brick Driveway over sand binding over concrete).
0.25	D1				47.50	0.20	Made Ground (Geotextile membrane over soft to firm grey-green clay with fragments of brick, decaying carbon, rootlets).
				Seepage			
0.30	ES2						
0.50	D3					(1.00)	
1.20 - 1.65	U4				46.50	1.20	Firm to stiff brown slightly silty slightly sandy CLAY.
2.00 - 2.45	SPT (S)N=15	0.00	0.3	N=15 (1,2/3,4,4,4)			
2.00 - 2.45	SPTLS5						
2.75	D6						
3.00 - 3.45	U7						
3.75	D8						
4.00	SPTLS9						
4.00 - 4.45	SPT (S)N=16	0.00	0.3	N=16 (2,3/3,4,4,5)			
5.00 - 5.45	U10						
						(10.80)	
6.00 - 6.45	SPT (S)N=17	0.00	0.3	N=17 (1,2/3,4,5,5)			
6.00 - 6.45	SPTLS11						
8.00 - 8.45	U12						
9.00 - 9.45	SPT (S)N=19	0.00	0.3	N=19 (3,4/4,5,5,5)			
9.00 - 9.45	SPTLS13						



Continued on Next Page

Remarks

Groundwater encountered as seepage at 0.3 m depth
SPT refusal at 12. m depth on claystone band

Scale (approx) 1:50

Logged By JD

GEA Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
SG12 7QE

Site	Borehole Number
70 Elsworthy Road, London, NW3 3BP	BH3

Boring Method	Casing Diameter: Diameter	Casing Diameter: Depth Base	Ground Level (mOD)	Client	Job Number
Cable Percussion			47.70	Latitude London	J15143

Location	Dates	Engineer	Sheet
	18/06/2015	Elliott Wood	Sheet 2 of 2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
11.00 - 11.45	U14								
12.00 - 12.45	SPT (C)	0.00	0.3	N=0 (50,0/0,0,0,0)	35.70	12.00	Hard claystone over stiff dark blue-grey slightly silty slightly sandy fissured CLAY.		
12.00 - 12.45	SPTLS15								
13.00 - 13.45	U16								
						(3.00)			
14.00 - 14.45	D17								
14.00 - 14.45	SPT (S)N=30	0.00	0.3	N=30 (5,6/6,7,8,9)					
15.00 - 15.45	U18				32.70	15.00	Complete at 15.00m		
15.50 - 15.95	SPT (S)N=32	0.00	0.3	N=32 (4,5/7,8,8,9)					
15.50 - 15.95	SPTLS19								

Remarks

Groundwater encountered as seepage at 0.3 m depth
SPT refusal at 12. m depth on claystone band

Scale (approx)	Logged By
1:50	JD

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

Groundwater Monitoring

Site: 70 Elsworthy Road, London, NW3 3BP

Client: Latitiude London

Engineer: Elliott Wood

Job Number J15143

Sheet 1/1

Borehole No 1		Borehole No 2		Borehole No 3			
Date	Depth to Groundwater m	Date	Depth to Groundwater m	Date	Depth to Groundwater m		
01-Jul-15	1.70	01-Jul-15	4.10	01-Jul-15	Dry		

Remarks:

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression			Chemical Tests			Other tests and comments
Borehole / Trial Pit	Sample Ref	Depth (m)	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH1	D1	0.80-0.90	D	Mottled dark grey, brown and orange silty CLAY with rare fine to medium flint gravel and rootlets.	28	67	21	46	99									
BH1	D2	1.50-1.60	D	Mottled brown, orange and dark grey silty CLAY with rare fine sand.	28										8.1	4.6	420	
BH1	D3	2.50-2.60	D	Mottled brown, orange-brown rare grey silty CLAY with rare orange silt, gypsum and rootlets.	27	71	23	48	100									
BH1	D4	3.20-3.30	D	Mottled brown, orange-brown rare grey silty CLAY with rare gypsum.	28										8.0	5.6	710	
BH1	D5	4.80-4.90	D	Dark orange-brown silty CLAY with rare gypsum.	29	69	23	46	100									
BH1	D6	5.50-5.60	D	Dark orange-brown silty CLAY with rare gypsum and grey silt.	30													
BH1	D7	6.90-7.00	D	Brown silty CLAY with rare gypsum.	27													

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

Checked and Approved by

Operations Manager
29/06/2015

Project Number:

GEO / 22742

Project Name:

70 ELSWORTHY ROAD, LONDON, NW3 3BP
J15143

GEOLABS®

Summary of Natural Moisture Content

Job No.	Project Name	Programme	
19115	70 Elsworthy Road	Samples received	25/06/2015
		Schedule recieved	25/06/2015
Project No.	Client	Project started	30/06/2015
J15143	GEA	Reported	10/07/2015

Hole No.	Sample				Soil Description	NMC	Remarks
	Ref	Top	Base	Type		%	
BH3		0.50		D	Brown slightly gravelly CLAY (gravel is fmc and sub-angular)	25.0	
BH3		2.00		D	Brown slightly blue grey mottled CLAY	33.0	
BH3		4.00		D	Brown CLAY	27.0	

UKAS TESTING 2519

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2

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 **KP**

Date: 10/07/2015

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

MSF-5-R1(b) -Rev. 0

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	
19115	70 Elsworthy Road	Samples received	25/06/2015
		Schedule received	25/06/2015
Project No.	Client	Project started	30/06/2015
J15143	GEA	Testing Started	08/07/2015

Hole No.	Sample				Soil description	Dry Mass passing 2mm	SO3 Content	SO4 Content	pH	Remarks
	Ref	Top	Base	Type		%	g/l	g/l		
BH3		8.00		U	High strength fissured brown CLAY with selenite crystals	99	1.15	1.38	8.09	

UKAS TESTING
2519

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

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

Checked and Approved
Initials kp
Date: 10/07/2015

MSF-5-R29 (Rev. 0)

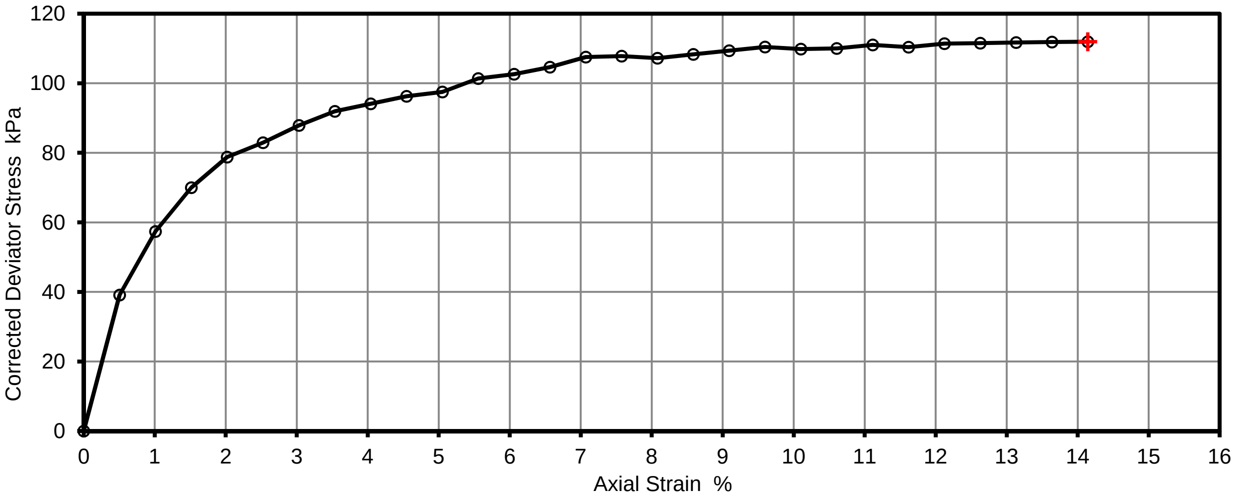
K4 SOILS	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**			Job Ref	19115
				Borehole/Pit No.	BH3
Site Name	70 Elsworthy Road			Sample No.	
Project No.	J15143	Client	GEA	Depth	1.20 m
Soil Description	Medium strength fissured brown and blue grey mottled CLAY			Sample Type	U
				Samples received	25/06/15
				Schedules received	25/06/15
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	06/07/15

Remarks

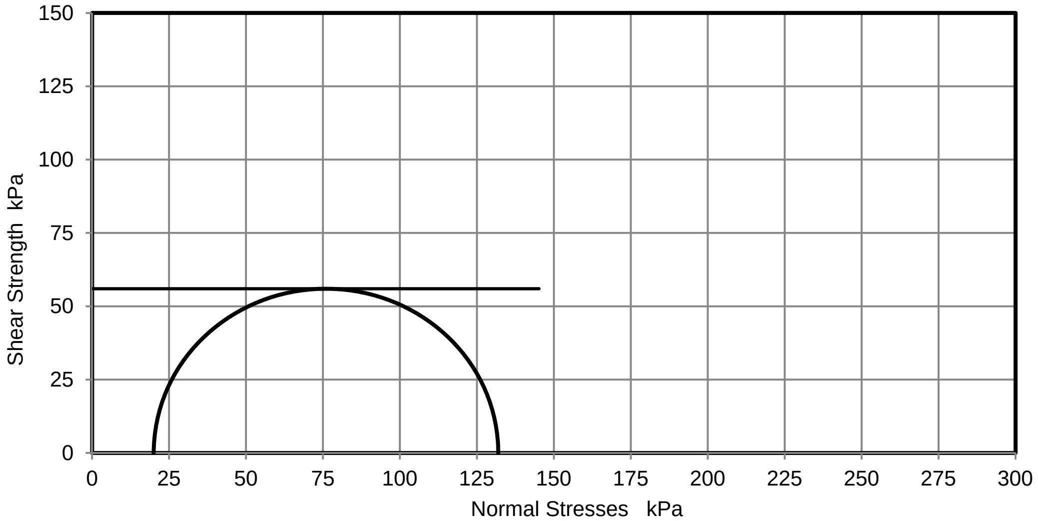
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	1.96	Mg/m3
Moisture Content	32.1	%
Dry Density	1.48	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	20	kPa
Axial Strain	14.1	%
Deviator Stress, (σ1 - σ3)f	112	kPa
Undrained Shear Strength, cu	56	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.

UKAS TESTING 2519

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

Checked and Approved
Initials: kp
Date 10/07/2015

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

MSF-5 R7 (Rev.0)

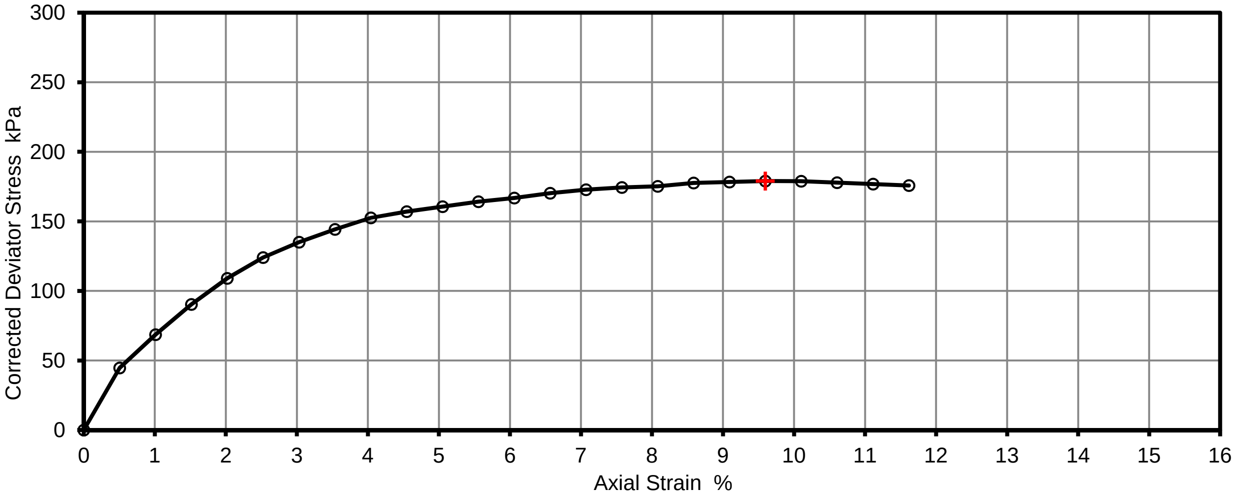
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	19115	
				Borehole/Pit No.	BH3	
Site Name	70 Elsworthy Road			Sample No.		
Project No.	J15143	Client	GEA	Depth	3.00	m
Soil Description	High strength slightly fissured brown slightly mottled blue grey CLAY with rare selenite crystals deposits			Sample Type	U	
				Samples received	25/06/15	
				Schedules received	25/06/15	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	07/07/15	

Remarks

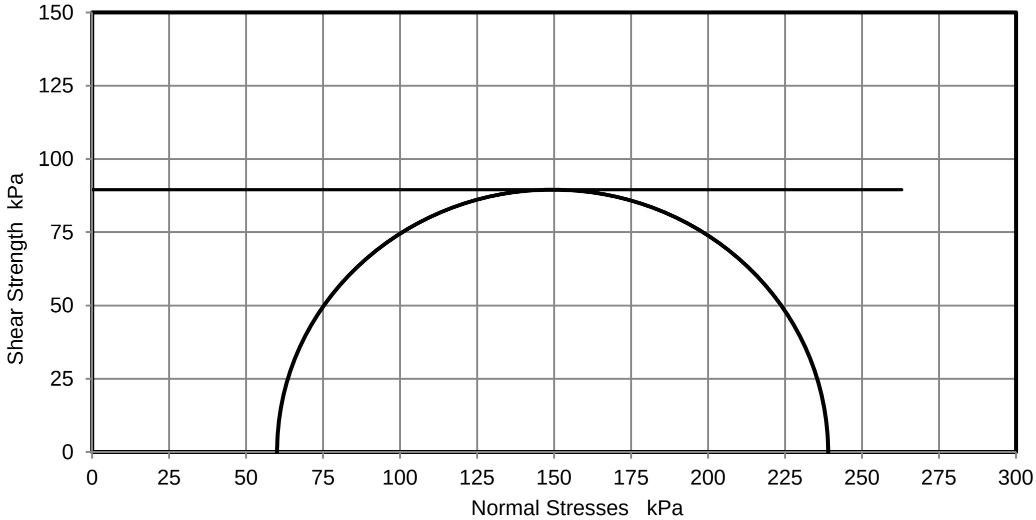
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	2.00	Mg/m3
Moisture Content	28.4	%
Dry Density	1.56	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	60	kPa
Axial Strain	9.6	%
Deviator Stress, (σ1 - σ3)f	179	kPa
Undrained Shear Strength, cu	90	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

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UKAS TESTING 2519

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Checked and Approved
Initials: kp
Date 10/07/2015

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

MSF-5 R7 (Rev.0)

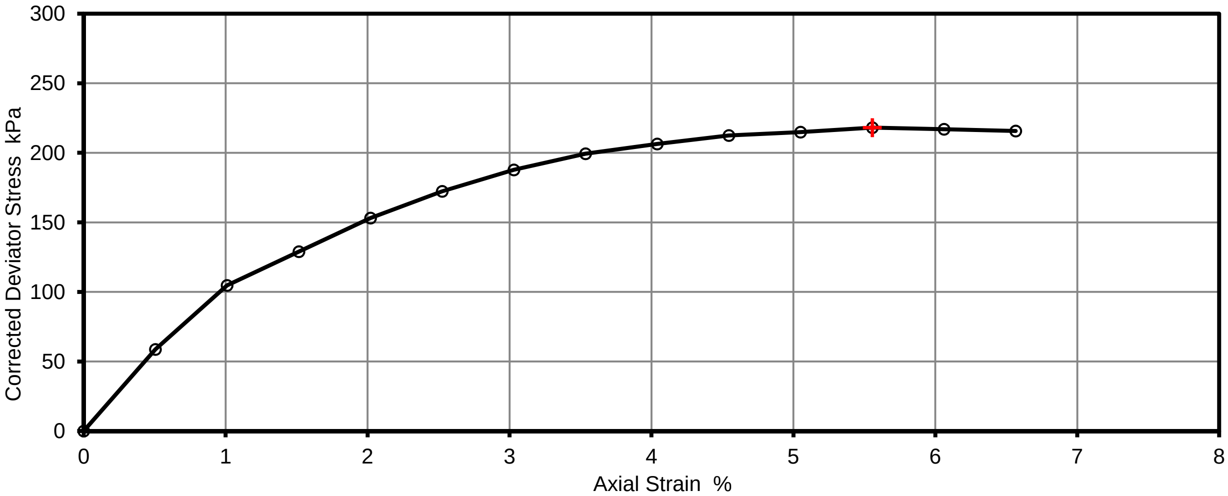
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	19115	
				Borehole/Pit No.	BH3	
Site Name	70 Elsworthy Road			Sample No.		
Project No.	J15143	Client	GEA	Depth	5.00	m
Soil Description	High strength fissured brown CLAY with occasional selenite crystals			Sample Type	U	
				Samples received	25/06/15	
				Schedules received	25/06/15	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	07/07/15	

Remarks

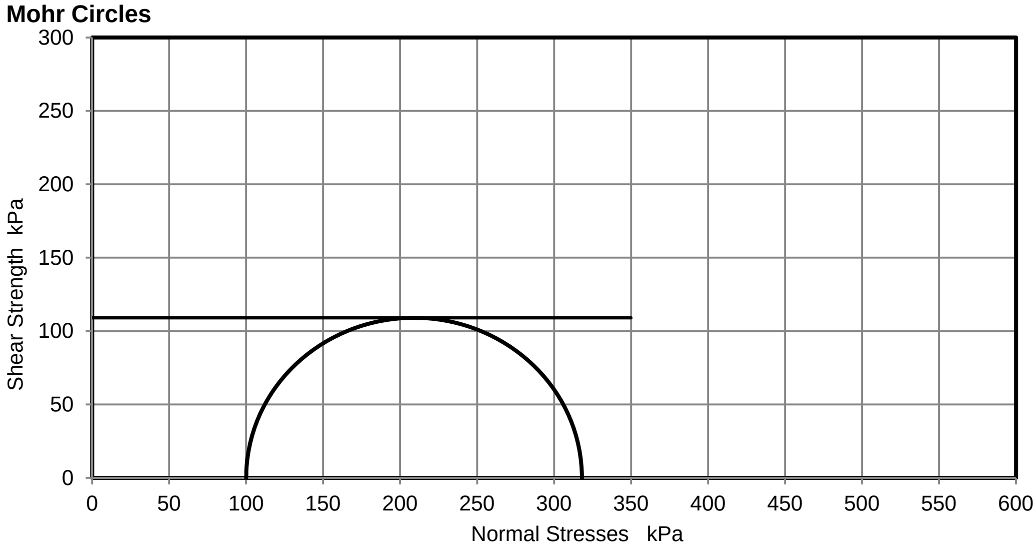
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	1.98	Mg/m3
Moisture Content	29.1	%
Dry Density	1.53	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	100	kPa
Axial Strain	5.6	%
Deviator Stress, (σ1 - σ3)f	218	kPa
Undrained Shear Strength, cu	109	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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Test Report by K4 SOILS LABORATORY
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Checked and Approved
Initials: kp
Date 10/07/2015

2519

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

MSF-5 R7 (Rev.0)

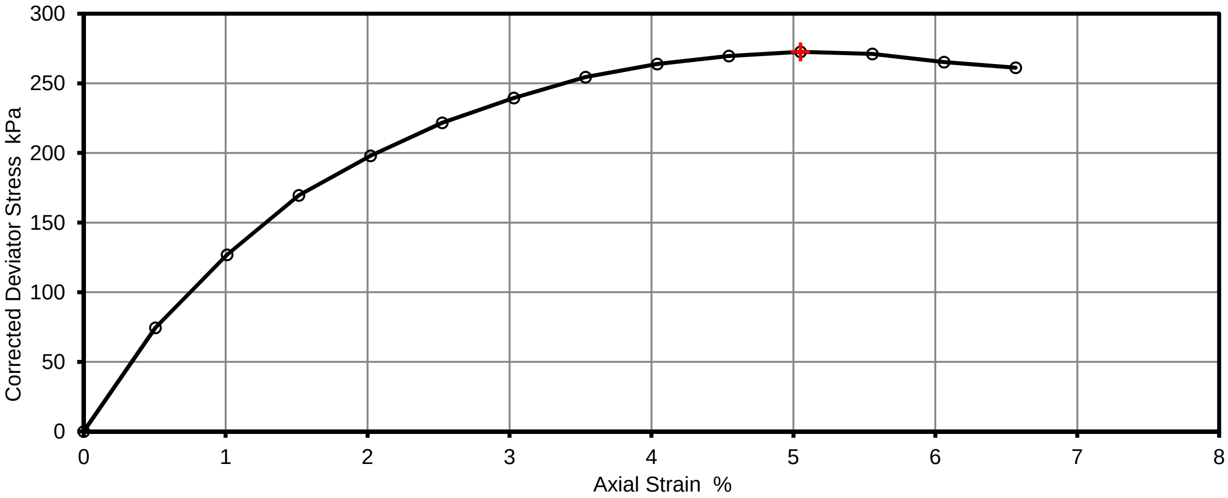
K4 SOILS	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**			Job Ref	19115
				Borehole/Pit No.	BH3
Site Name	70 Elsworthy Road			Sample No.	
Project No.	J15143	Client	GEA	Depth	8.00 m
Soil Description	High strength fissured brown CLAY with selenite crystals			Sample Type	U
				Samples received	25/06/15
				Schedules received	25/06/15
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	06/07/15

Remarks

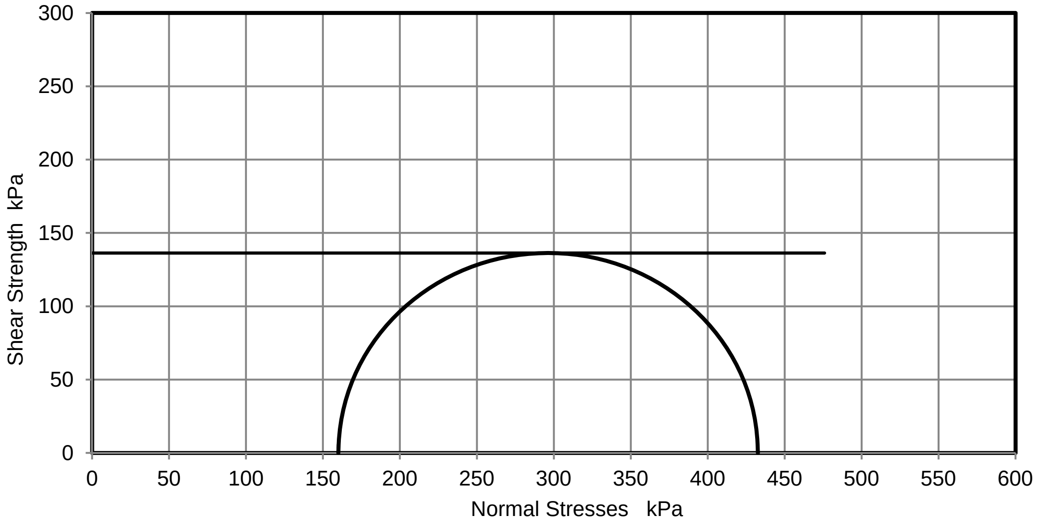
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	2.03	Mg/m3
Moisture Content	26.8	%
Dry Density	1.60	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	160	kPa
Axial Strain	5.1	%
Deviator Stress, (σ1 - σ3)f	273	kPa
Undrained Shear Strength, cu	136	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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Test Report by K4 SOILS LABORATORY
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UKAS TESTING 2519

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Checked and Approved
Initials: kp
Date 10/07/2015

MSF-5 R7 (Rev.0)

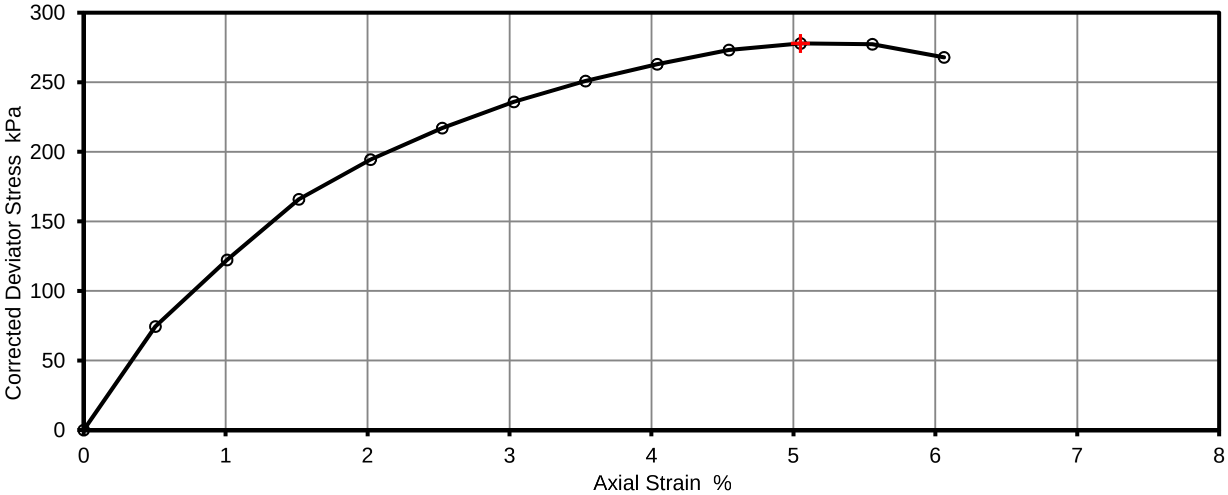
K4 SOILS	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**			Job Ref	19115	
				Borehole/Pit No.	BH3	
Site Name	70 Elsworthy Road			Sample No.		
Project No.	J15143	Client	GEA	Depth	11.00	m
Soil Description	High strength fissured brown CLAY with occasional selenite crystals			Sample Type	U	
				Samples received	25/06/15	
				Schedules received	25/06/15	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	06/07/15	

Remarks

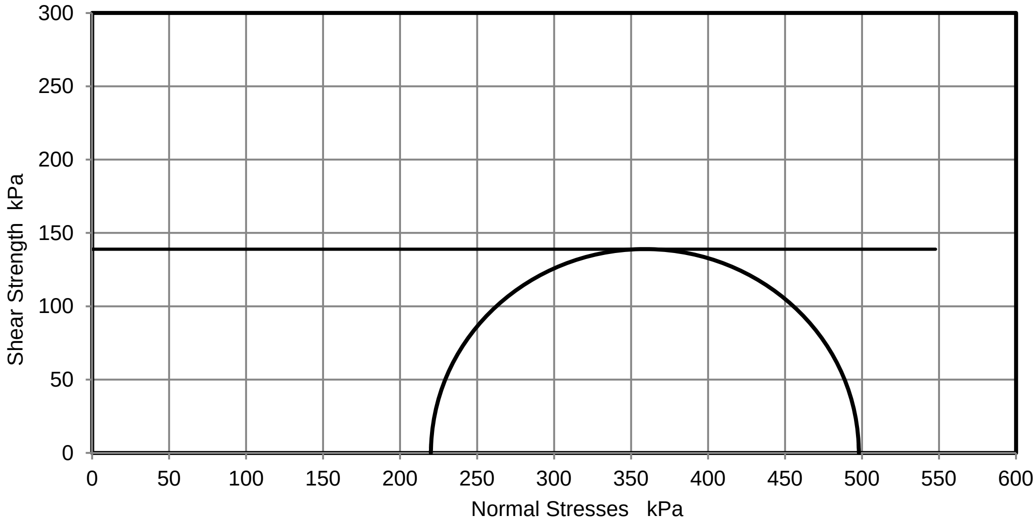
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	1.97	Mg/m3
Moisture Content	27.6	%
Dry Density	1.55	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	220	kPa
Axial Strain	5.1	%
Deviator Stress, (σ1 - σ3)f	278	kPa
Undrained Shear Strength, cu	139	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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UKAS TESTING 2519

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

Checked and Approved
Initials: kp
Date 10/07/2015

MSF-5 R7 (Rev.0)

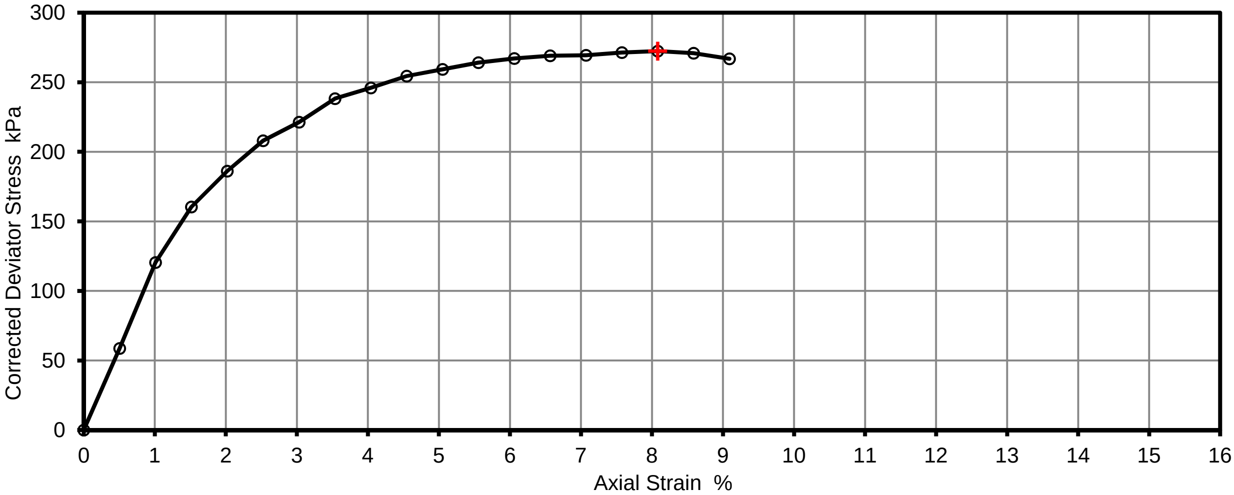
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	19115	
				Borehole/Pit No.	BH3	
Site Name	70 Elsworthy Road			Sample No.		
Project No.	J15143	Client	GEA	Depth	13.00	m
Soil Description	High slightly fissured dark grey CLAY			Sample Type	U	
				Samples received	25/06/15	
				Schedules received	25/06/15	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	07/07/15	

Remarks

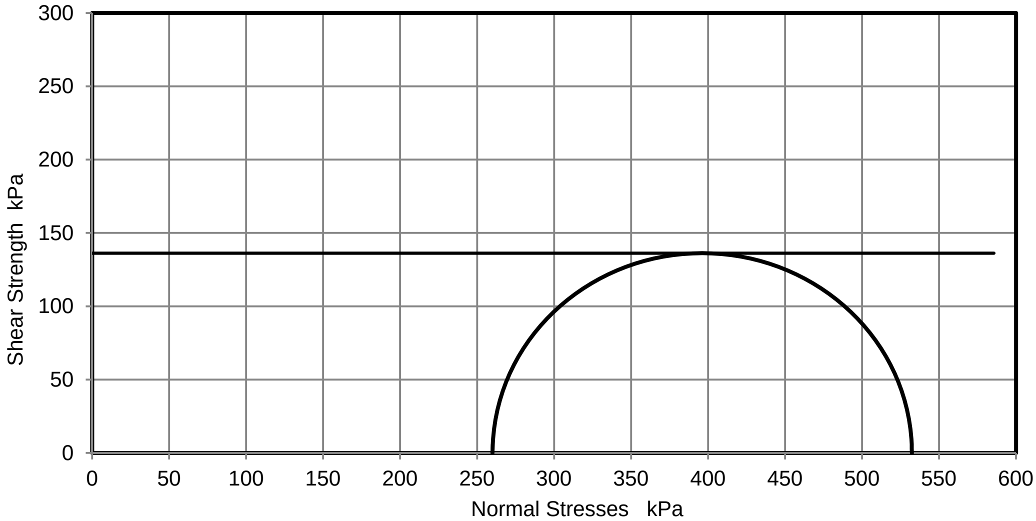
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	2.05	Mg/m3
Moisture Content	27.6	%
Dry Density	1.60	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	260	kPa
Axial Strain	8.1	%
Deviator Stress, (σ1 - σ3)f	272	kPa
Undrained Shear Strength, cu	136	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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Test Report by K4 SOILS LABORATORY
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UKAS TESTING 2519

Checked and Approved
Initials: kp
Date 10/07/2015

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

MSF-5 R7 (Rev.0)

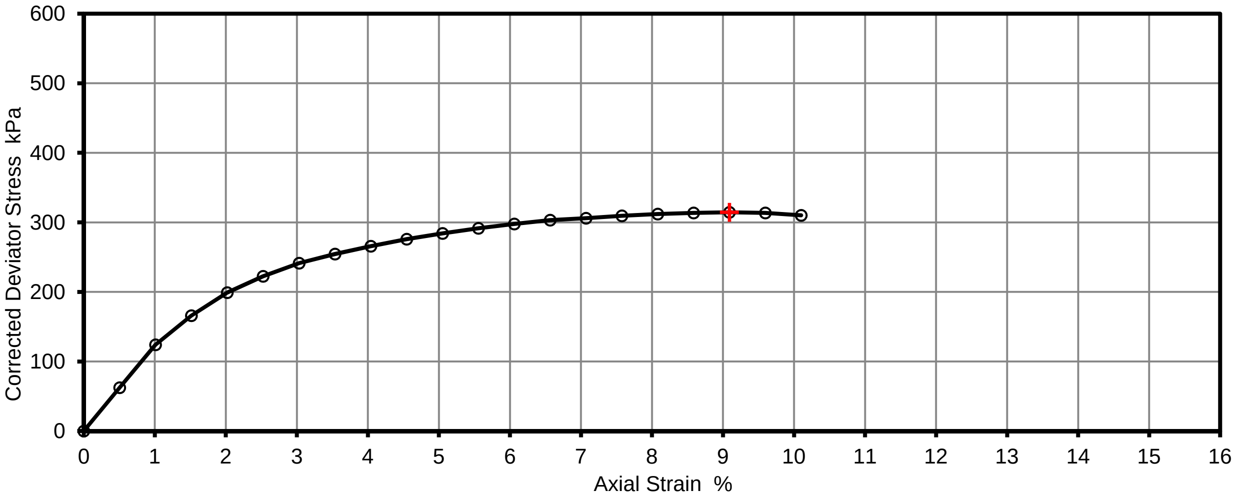
Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	19115	
			Borehole/Pit No.	BH3	
Site Name	70 Elsworthy Road		Sample No.		
Project No.	J15143	Client: GEA	Depth	15.00	m
Soil Description	Very high strength fissured dark grey CLAY		Sample Type	U	
			Samples received	25/06/15	
			Schedules received	25/06/15	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		Date of test	07/07/15	

Remarks

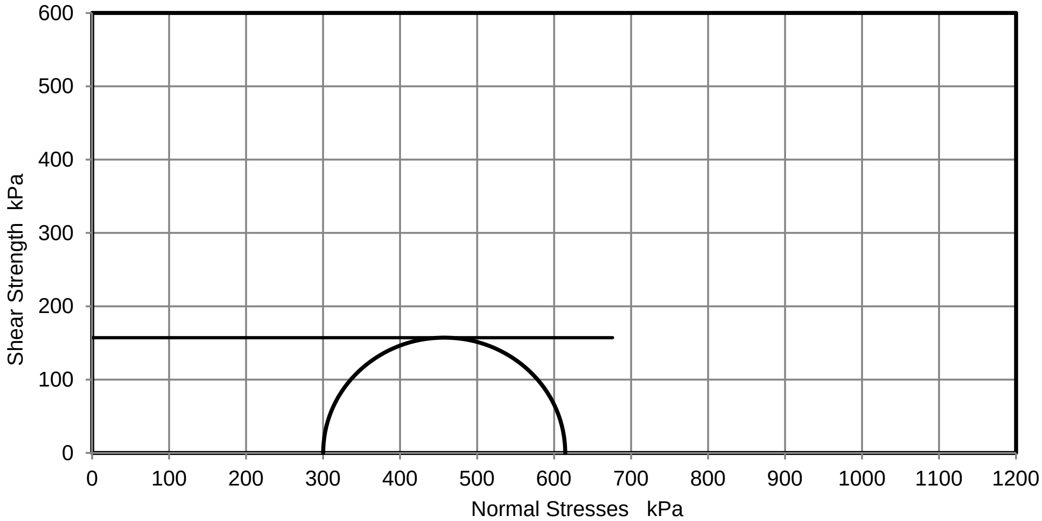
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	2.00	Mg/m3
Moisture Content	27.7	%
Dry Density	1.56	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	300	kPa
Axial Strain	9.1	%
Deviator Stress, (σ1 - σ3)f	314	kPa
Undrained Shear Strength, cu	157	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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Test Report by K4 SOILS LABORATORY
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Email: James@k4soils.com

Checked and Approved
Initials: kp
Date 10/07/2015

UKAS TESTING 2519

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

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	
19115	70 Elsworthy Road	Samples received	25/06/2015
		Schedule received	25/06/2015
Project No.	Client	Project started	30/06/2015
J15143	GEA	Testing Started	08/07/2015

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	Mode	Remarks
BH3		1.20		U	Medium strength fissured brown and blue grey mottled CLAY	UU	1.96	1.48	32	198	102	20	14.1	112	56	C	
BH3		3.00		U	High strength slightly fissured brown slightly mottled blue grey CLAY with rare selenite crystals deposits	UU	2	1.56	28	198	102	60	9.6	179	90	C	
BH3		5.00		U	High strength fissured brown CLAY with occasional selenite crystals	UUR	1.98	1.53	29	198	102	100	5.6	218	109	B	
BH3		8.00		U	High strength fissured brown CLAY with selenite crystals	UU	2.03	1.6	27	198	102	160	5.1	273	136	B	
BH3		11.00		U	High strength fissured brown CLAY with occasional selenite crystals	UU	1.97	1.55	28	198	102	220	5.1	278	139	B	
BH3		13.00		U	High slightly fissured dark grey CLAY	UU	2.05	1.6	28	198	102	260	8.1	272	136	B	
BH3		15.00		U	Very high strength fissured dark grey CLAY	UU	2	1.56	28	198	102	300	9.1	314	157	B	

Legend
UU - single stage test (single and multiple specimens)
UUM - Multistage test on a single specimen
suffix R - remoulded or recompacted

σ3 Cell pressure
σ1 - σ3 Maximum corrected deviator stress
cu Undrained shear strength, ½ (σ1 - σ3)

Mode of failure ; B - Brittle, P - Plastic, 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: kp
Date: 10/07/2015

UKAS TESTING 2519

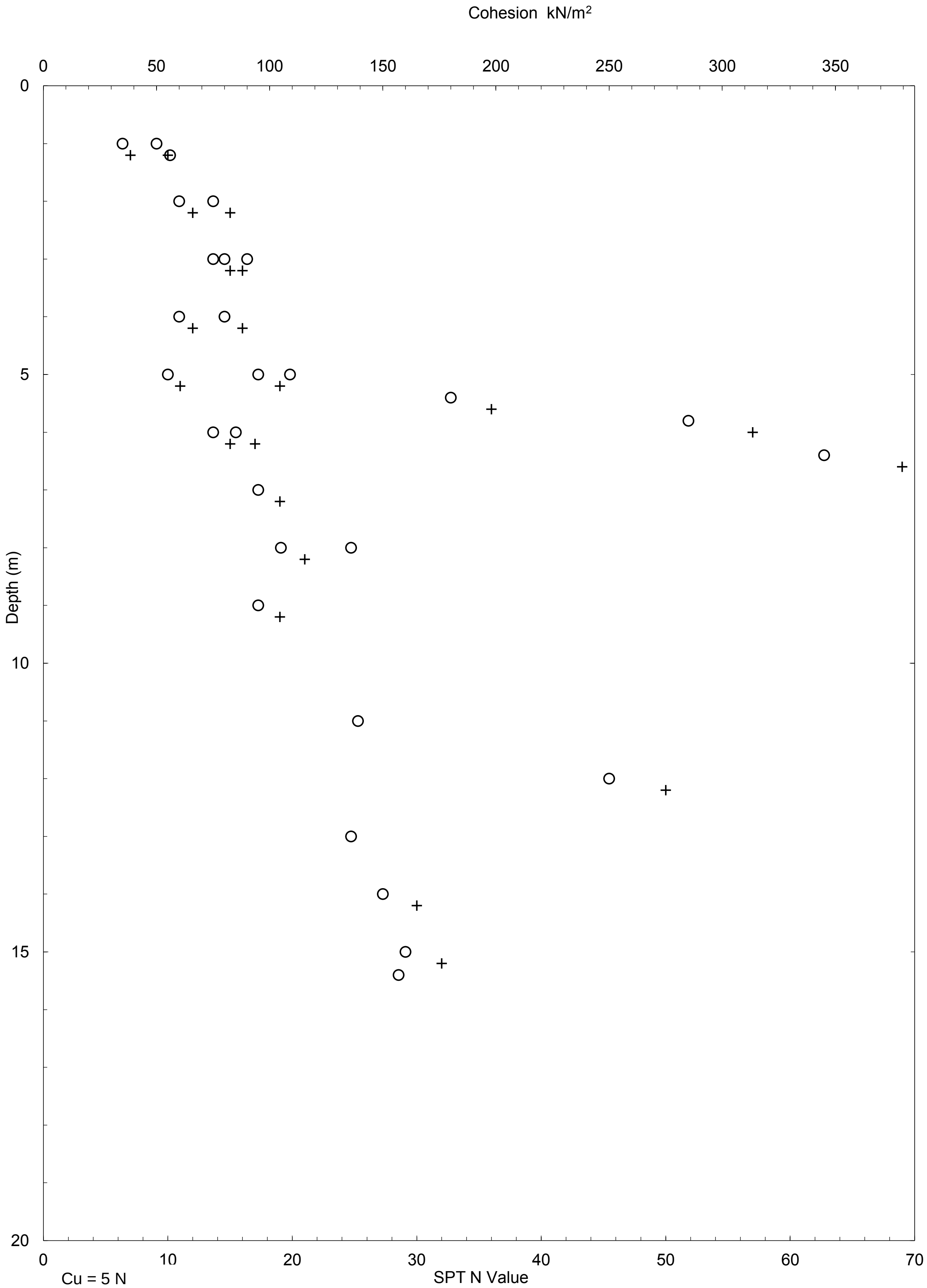
Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

SPT & Cohesion / Depth Graph

Site	70 Elsworthy Road, London, NW3 3BP	**Job Number**	J15143
Client	Elliott Wood	**Sheet**	1 / 1
Engineer			



Cu = 5 N
o cohesion
+ SPT N Value

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report Number:	15-13010 Issue-1		
Initial Date of Issue:	10-Jun-2015		
Client:	GEA		
Client Address:	Widbury Barn Widbury Hill Ware Hertfordshire SG12 7QE		
Contact(s):	Jack Deaney		
Project:	J15143 - 70 Elsworthy Road		
Quotation No.:		**Date Received:**	05-Jun-2015
Order No.:		**Date Instructed:**	08-Jun-2015
No. of Samples:	2	**Target Due Date:**	10-Jun-2015
Turnaround: (Wkdays)	5	**Results Due Date:**	12-Jun-2015
Date Approved:	10-Jun-2015		

Approved By:

Details: Keith Jones, Technical Manager

Chemtest
The right chemistry to deliver results

Results Summary - Soil

Project: J15143 - 70 Elsworthy Road

Client: GEA	**Chemtest Job No.:**				15-13010	15-13010
Quotation No.:	**Chemtest Sample ID.:**				149566	149568
Order No.:	Client Sample Ref.:				ES2	ES2
	Client Sample ID.:				BH1	BH2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.10	0.30
	Bottom Depth(m):					
	Date Sampled:				01-Jun-15	01-Jun-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Moisture	N	2030	%	0.02	6.1	18
Stones	N	2030	%	0.02	< 0.020	< 0.020
Soil Colour	N				brown	brown
Other Material	N				stones	stones
Soil Texture	N				sand	clay
pH	M	2010			10.1	7.9
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.01	0.040	0.051
Chloride (Extractable)	M	2220	g/l	0.01	< 0.010	< 0.010
Cyanide (Total)	M	2300	mg/kg	0.5	< 0.50	< 0.50
Sulphide (Easily Liberatable)	M	2325	mg/kg	0.5	13	5.9
Sulphate (Total)	M	2430	mg/kg	100	< 100	< 100
Arsenic	M	2450	mg/kg	1	21	15
Cadmium	M	2450	mg/kg	0.1	0.22	< 0.10
Chromium	M	2450	mg/kg	1	27	41
Copper	M	2450	mg/kg	0.5	28	32
Mercury	M	2450	mg/kg	0.1	< 0.10	0.60
Nickel	M	2450	mg/kg	0.5	32	22
Lead	M	2450	mg/kg	0.5	71	110
Selenium	M	2450	mg/kg	0.2	< 0.20	0.41
Zinc	M	2450	mg/kg	0.5	78	59
Total Organic Carbon	M	2625	%	0.2	2.7	1.3
TPH >C5-C6	N	2670	mg/kg	1	< 1.0	< 1.0
TPH >C6-C7	N	2670	mg/kg	1	< 1.0	< 1.0
TPH >C7-C8	N	2670	mg/kg	1	< 1.0	< 1.0
TPH >C8-C10	N	2670	mg/kg	1	< 1.0	< 1.0
TPH >C10-C12	N	2670	mg/kg	1	< 1.0	< 1.0
TPH >C12-C16	N	2670	mg/kg	1	1.9	< 1.0
TPH >C16-C21	N	2670	mg/kg	1	5.9	< 1.0
TPH >C21-C35	N	2670	mg/kg	1	19	< 1.0
Total TPH >C5-C35	N	2670	mg/kg	10	26	< 10
Naphthalene	M	2700	mg/kg	0.1	0.20	< 0.10
Acenaphthylene	M	2700	mg/kg	0.1	< 0.10	< 0.10
Acenaphthene	M	2700	mg/kg	0.1	0.17	< 0.10

Chemtest
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Results Summary - Soil

Project: J15143 - 70 Elsworthy Road

Client: GEA				**Chemtest Job No.:**	15-13010	15-13010
Quotation No.:				**Chemtest Sample ID.:**	149566	149568
Order No.:				Client Sample Ref.:	ES2	ES2
				Client Sample ID.:	BH1	BH2
				Sample Type:	SOIL	SOIL
				Top Depth (m):	0.10	0.30
				Bottom Depth(m):		
				Date Sampled:	01-Jun-15	01-Jun-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Fluorene	M	2700	mg/kg	0.1	0.19	< 0.10
Phenanthrene	M	2700	mg/kg	0.1	2.0	< 0.10
Anthracene	M	2700	mg/kg	0.1	0.62	< 0.10
Fluoranthene	M	2700	mg/kg	0.1	2.5	< 0.10
Pyrene	M	2700	mg/kg	0.1	2.3	< 0.10
Benzo[a]anthracene	M	2700	mg/kg	0.1	1.4	< 0.10
Chrysene	M	2700	mg/kg	0.1	1.8	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.1	2.3	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.1	0.96	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.1	2.1	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.1	1.8	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.1	0.40	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.1	1.7	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2	20	< 2.0
Total Phenols	M	2920	mg/kg	0.3	< 0.30	< 0.30

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The right chemistry to deliver results

Report Information

Key

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N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
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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

UKAS TESTING 2183

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

Chemtest
The right chemistry to deliver results

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report Number:	15-14269 Issue-1		
Initial Date of Issue:	24-Jun-2015		
Client:	GEA		
Client Address:	Widbury Barn Widbury Hill Ware Hertfordshire SG12 7QE		
Contact(s):	Jack Deaney		
Project:	J15143 - 70 Elsworthy Road, London, NW3 3BP		
Quotation No.:		**Date Received:**	22-Jun-2015
Order No.:		**Date Instructed:**	22-Jun-2015
No. of Samples:	1		
Turnaround: (Wkdays)	3	**Results Due Date:**	24-Jun-2015
Date Approved:	24-Jun-2015		

Approved By:

Details: Darrell Hall, Laboratory Director

Results Summary - Soil

Chemtest
The right chemistry to deliver results

Project: J15143 - 70 Elsworthy Road, London, NW3 3BP

Client: GEA				Chemtest Job No.:	15-14269
Quotation No.:				Chemtest Sample ID.:	155902
Order No.:				Client Sample Ref.:	BH3
				Client Sample ID.:	ES2
				Sample Type:	SOIL
				Top Depth (m):	0.3
				Bottom Depth(m):	
				Date Sampled:	18-Jun-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Moisture	N	2030	%	0.02	22
Stones	N	2030	%	0.02	< 0.020
Soil Colour	N				brown
Other Material	N				stones
Soil Texture	N				clay
pH	M	2010			8.4
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.01	0.13
Chloride (Extractable)	M	2220	g/l	0.01	0.017
Cyanide (Total)	M	2300	mg/kg	0.5	< 0.50
Sulphide (Easily Liberatable)	M	2325	mg/kg	0.5	4.4
Sulphate (Total)	M	2430	mg/kg	100	940
Arsenic	M	2450	mg/kg	1	16
Cadmium	M	2450	mg/kg	0.1	< 0.10
Chromium	M	2450	mg/kg	1	54
Copper	M	2450	mg/kg	0.5	21
Mercury	M	2450	mg/kg	0.1	0.19
Nickel	M	2450	mg/kg	0.5	36
Lead	M	2450	mg/kg	0.5	68
Selenium	M	2450	mg/kg	0.2	< 0.20
Zinc	M	2450	mg/kg	0.5	61
Total Organic Carbon	M	2625	%	0.2	0.86
TPH >C5-C6	N	2670	mg/kg	1	< 1.0
TPH >C6-C7	N	2670	mg/kg	1	< 1.0
TPH >C7-C8	N	2670	mg/kg	1	< 1.0
TPH >C8-C10	N	2670	mg/kg	1	< 1.0
TPH >C10-C12	N	2670	mg/kg	1	< 1.0
TPH >C12-C16	N	2670	mg/kg	1	< 1.0
TPH >C16-C21	N	2670	mg/kg	1	< 1.0
TPH >C21-C35	N	2670	mg/kg	1	< 1.0
Total TPH >C5-C35	N	2670	mg/kg	10	< 10
Naphthalene	M	2700	mg/kg	0.1	< 0.10
Acenaphthylene	M	2700	mg/kg	0.1	< 0.10
Acenaphthene	M	2700	mg/kg	0.1	< 0.10

Chemtest
The right chemistry to deliver results

Results Summary - Soil

Project: J15143 - 70 Elsworthy Road, London, NW3 3BP

Client: GEA	**Chemtest Job No.:**				15-14269
Quotation No.:	**Chemtest Sample ID.:**				155902
Order No.:	Client Sample Ref.:				BH3
	Client Sample ID.:				ES2
	Sample Type:				SOIL
	Top Depth (m):				0.3
	Bottom Depth(m):				
	Date Sampled:				18-Jun-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Fluorene	M	2700	mg/kg	0.1	< 0.10
Phenanthrene	M	2700	mg/kg	0.1	0.57
Anthracene	M	2700	mg/kg	0.1	0.14
Fluoranthene	M	2700	mg/kg	0.1	0.79
Pyrene	M	2700	mg/kg	0.1	0.50
Benzo[a]anthracene	M	2700	mg/kg	0.1	0.32
Chrysene	M	2700	mg/kg	0.1	0.83
Benzo[b]fluoranthene	M	2700	mg/kg	0.1	0.34
Benzo[k]fluoranthene	M	2700	mg/kg	0.1	0.25
Benzo[a]pyrene	M	2700	mg/kg	0.1	0.48
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.1	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.1	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.1	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2	4.2
Total Phenols	M	2920	mg/kg	0.3	< 0.30

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The right chemistry to deliver results

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customerservices@chemtest.co.uk

GEA Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
Herts SG12 7QE

Generic Risk-Based Soil Screening Values

Site	70 Elsworthy Road, London, NW3 3BP	**Job Number**	J15143
Client	Elliott Wood	**Sheet**	1 / 1
Agent			

Proposed End Use Residential with plant uptake

Soil pH 8

Soil Organic Matter content % 2.5

Contaminant	Screening Value mg/kg	Data Source
Metals		
Arsenic	37	C4SL
Cadmium	26	C4SL
Chromium (III)	3000	LQM/CIEH
Chromium (VI)	21	C4SL
Copper	2,330	LQM/CIEH
Lead	200	C4SL
Elemental Mercury	1	SGV
Inorganic Mercury	170	SGV
Nickel	130	LQM/CIEH
Selenium	350	SGV
Zinc	3,750	LQM/CIEH
Hydrocarbons		
Benzene	0.34	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})	646	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	0.5 g/l	Structures
Sulphide	50	Structures
Chloride	400	Structures
Others		
Organic Carbon (%)	6	Methanogenic potential
Total Cyanide	140	WRAS
Total Mono Phenols	290	SGV
PAH		
Naphthalene	5.30	Rev. LQM/CIEH
Acenaphthylene	400	LQM/CIEH
Acenaphthene	480	LQM/CIEH
Fluorene	380	LQM/CIEH
Phenanthrene	200	LQM/CIEH
Anthracene	4,900	LQM/CIEH
Fluoranthene	460	LQM/CIEH
Pyrene	1,000	LQM/CIEH
Benzo(a) Anthracene	6.7	Rev. LQM/CIEH
Chrysene	11	Rev. LQM/CIEH
Benzo(b) Fluoranthene	9.5	Rev. LQM/CIEH
Benzo(k) Fluoranthene	14.1	Rev. LQM/CIEH
Benzo(a) pyrene	4.40	C4SL
Indeno(1 2 3 cd) Pyrene	5.6	Rev. LQM/CIEH
Dibenzo(a h) Anthracene	1.27	Rev. LQM/CIEH
Benzo (g h i) Perylene	69	Rev. LQM/CIEH
Screening value for PAH	**62.9**	B(a)P / 0.15
Chlorinated Solvents		
1,1,1 trichloroethane (TCA)	12.9	LQM/CIEH
tetrachloroethane (PCA)	2.1	LQM/CIEH
tetrachloroethene (PCE)	2.1	LQM/CIEH
trichloroethene (TCE)	0.22	LQM/CIEH
1,2-dichloroethane (DCA)	0.008	LQM/CIEH
vinyl chloride (Chloroethene)	0.00064	LQM/CIEH
tetrachloromethane (Carbon tetra	0.039	LQM/CIEH
trichloromethane (Chloroform)	1.3	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

Rev LQM/CIEH calculated using C4SL revisions to exposure assessment but LQM/CIEH health criteria values

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

B(a)P / 0.15 - GEA experience 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

Historical Mapping Legends

Ordnance Survey County Series and Ordnance Survey Plan 1:2,500

Quarry, Gravel Pit, Sand Pit

Clay Pit, Shingle, Refuse Heap

Sloping Masonry, Flat Rock

Marsh, Reeds, Osiers

Rough Pasture, Furze, Wood

Mixed Wood, Brushwood, Orchard

Fir, Ford, Stepping Stones

Ferry, Waterfall, Lock

Trig. Station; 507 Altitude at Trig. Station

B.M.325·9 Bench Mark; 342 Surface Level

Arrow denotes flow of water; Antiquities (site of)

Cutting, Embankment

Railway crossing Road, Level Crossing, Road crossing Railway

Railway crossing River or Canal, Road over single stream, Road over River or Canal

County Boundary (Geographical)

County & Civil Parish Boundary

Administrative County & Civil Parish Boundary

Co. Boro. Bdy. — County Borough Boundary (England)

Co. Burgh Bdy. — County Burgh Boundary (Scotland)

B.P B.S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	Sl.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250

Inactive Quarry, Chalk Pit or Clay Pit; Active Quarry, Chalk Pit or Clay Pit

Rock, Boulders

Cliff; Slopes (Top)

Roofed Building, Glazed Roof Building

Sloping Masonry (Top), Archway

Non-Coniferous Tree (surveyed), Coniferous Tree (surveyed)

Non-Coniferous Trees (not surveyed), Coniferous Trees (not surveyed)

Orchard Tree, Scrub, Bracken

Coppice, Osier; Reeds; Marsh, Saltings

Rough Grassland, Heath, Culvert

Direction of water flow; B M Bench Mark; Antiquity (site of)

Cave Entrance, Triangulation Station, Electricity Pylon

E T L — Electricity Transmission Line

County Boundary (Geographical)

County & Civil Parish Boundary

Civil Parish Boundary

Admin. County or County Bor. Boundary

L B Bdy — London Borough Boundary

Symbol marking point where boundary mereing changes

BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250

Cliff; Slopes (Top)

Rock, Rock (scattered)

Boulders, Boulders (scattered)

Positioned Boulder, Scree

Non-Coniferous Tree (surveyed), Coniferous Tree (surveyed)

Non-Coniferous Trees (not surveyed), Coniferous Trees (not surveyed)

Orchard Tree, Scrub, Bracken

Coppice, Osier; Reeds; Marsh, Saltings

Rough Grassland, Heath, Culvert

Direction of water flow, Triangulation Station, Antiquity (site of)

E T L — Electricity Transmission Line; Electricity Pylon

BM 231.60m Bench Mark; Buildings with Building Seed

Roofed Building, Glazed Roof Building

Civil parish/community boundary

District boundary

County boundary

Boundary post/stone

Boundary mereing symbol (note: these always appear in opposed pairs or groups of three)

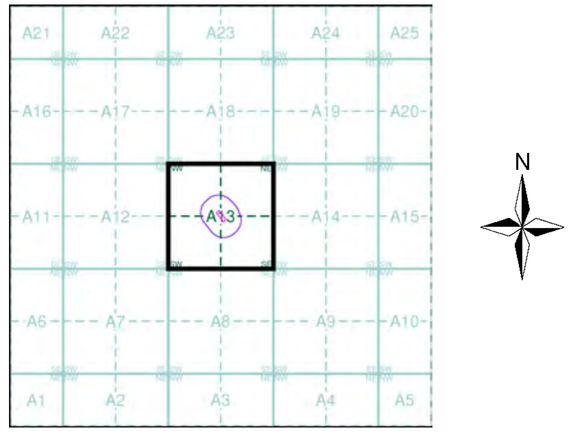
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, WrT	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

Geotechnical & Environmental Associates

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
London	1:2,500	1871	2
London	1:2,500	1896	3
London	1:2,500	1915	4
London	1:2,500	1935	5
Historical Aerial Photography	1:1,250	1946	6
Ordnance Survey Plan	1:1,250	1953 - 1954	7
Ordnance Survey Plan	1:2,500	1954 - 1955	8
Additional SIMs	1:2,500	1954	9
Ordnance Survey Plan	1:1,250	1960 - 1966	10
Ordnance Survey Plan	1:1,250	1967 - 1972	11
Ordnance Survey Plan	1:1,250	1973 - 1988	12
Supply of Unpublished Survey Information	1:1,250	1973 - 1974	13
Additional SIMs	1:1,250	1978 - 1979	14
Additional SIMs	1:1,250	1984 - 1985	15
Large-Scale National Grid Data	1:1,250	1991	16
Large-Scale National Grid Data	1:1,250	1992 - 1995	17

Historical Map - Segment A13



Order Details

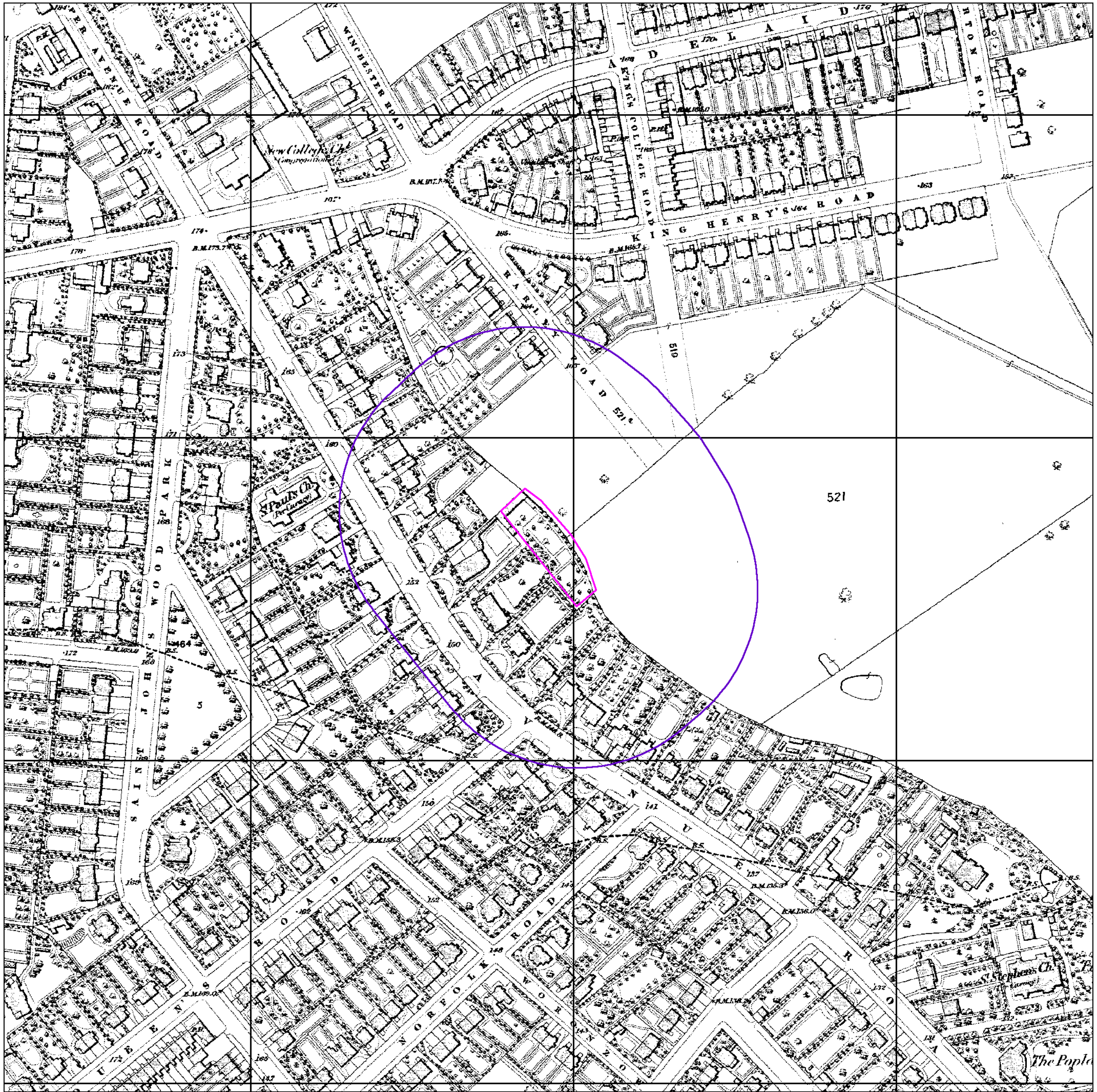
Order Number:	67330199_1_1
Customer Ref:	j15143
National Grid Reference:	526990, 183930
Slice:	A
Site Area (Ha):	0.18
Search Buffer (m):	100

Site Details

70 Elsworthy Road, LONDON, NW3 3BP

Landmark Information Group

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



0 100 m

Geotechnical & Environmental Associates

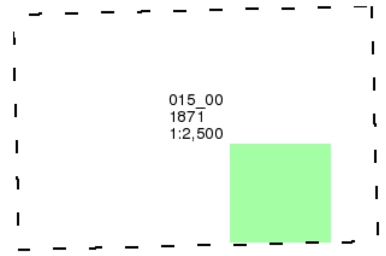
London

Published 1871

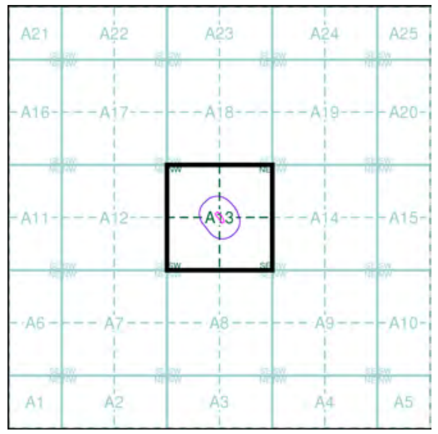
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



N

Order Details

Order Number: 67330199_1_1
Customer Ref: j15143
National Grid Reference: 526990, 183930
Slice: A
Site Area (Ha): 0.18
Search Buffer (m): 100

Site Details

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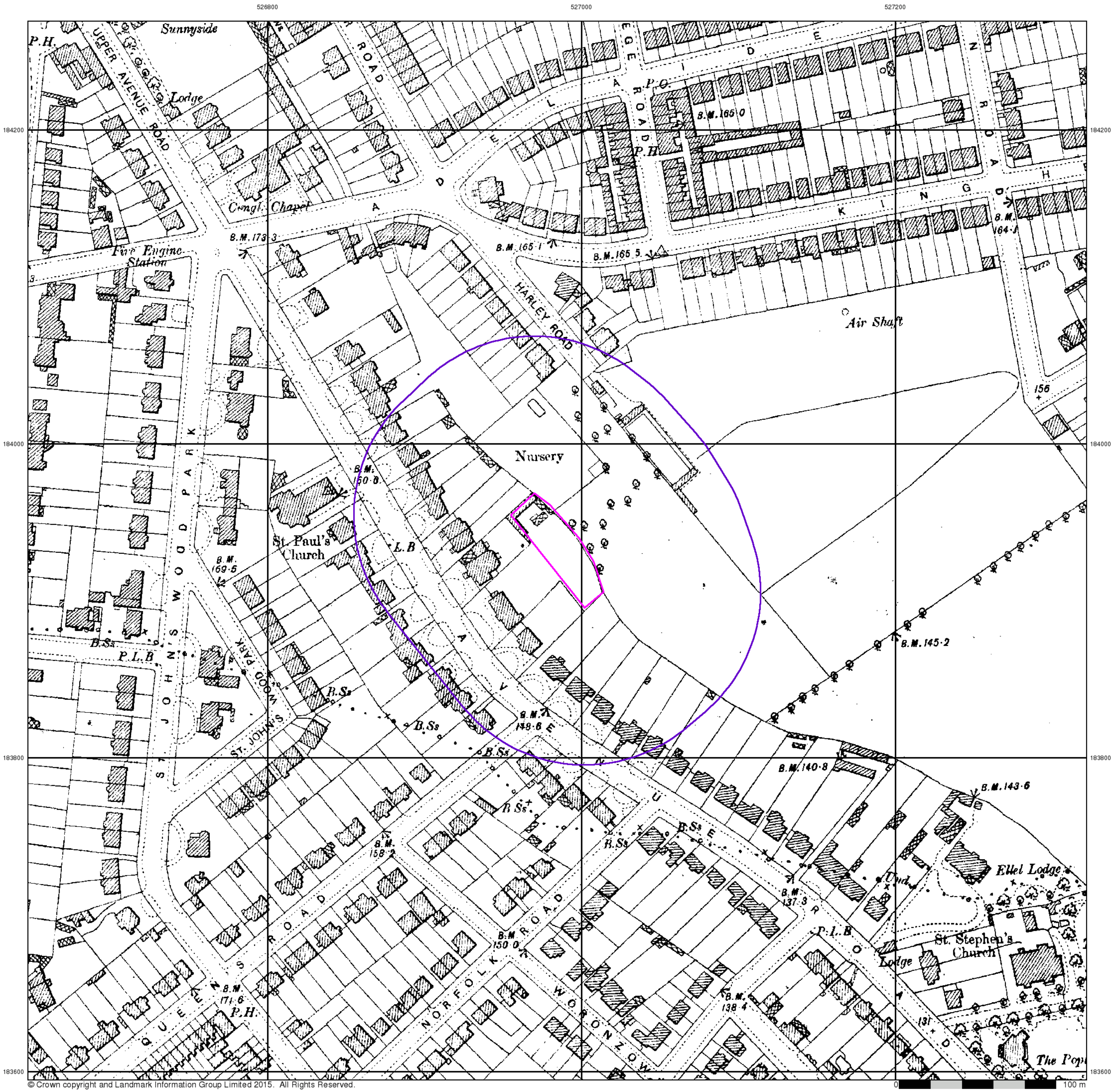

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GEA Geotechnical & Environmental Associates

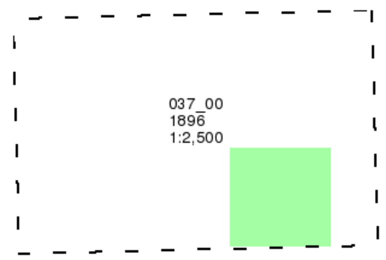
London

Published 1896

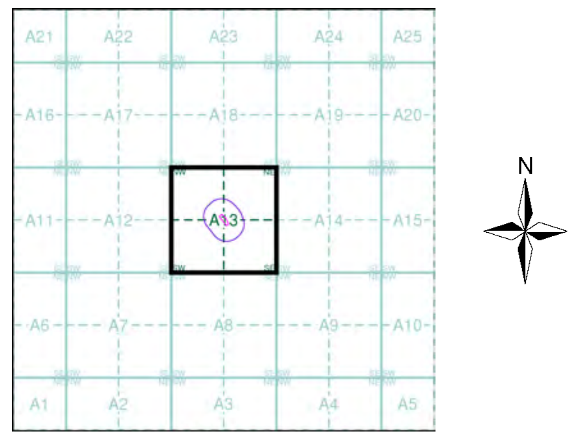
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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Geotechnical & Environmental Associates

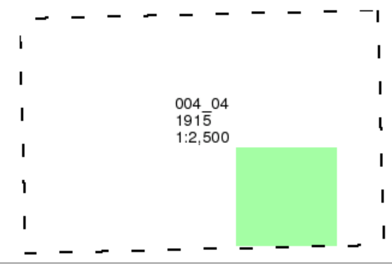
London

Published 1915

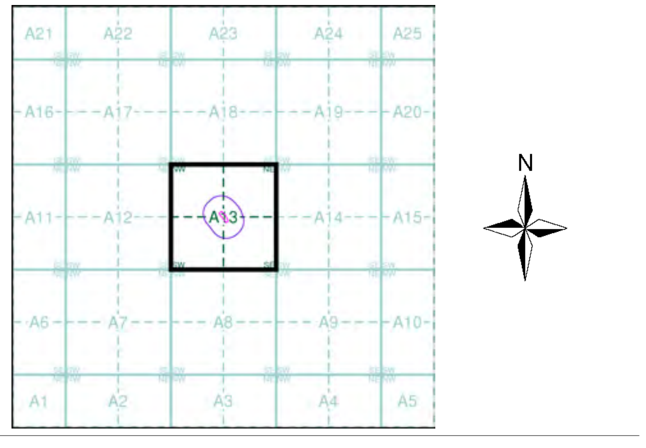
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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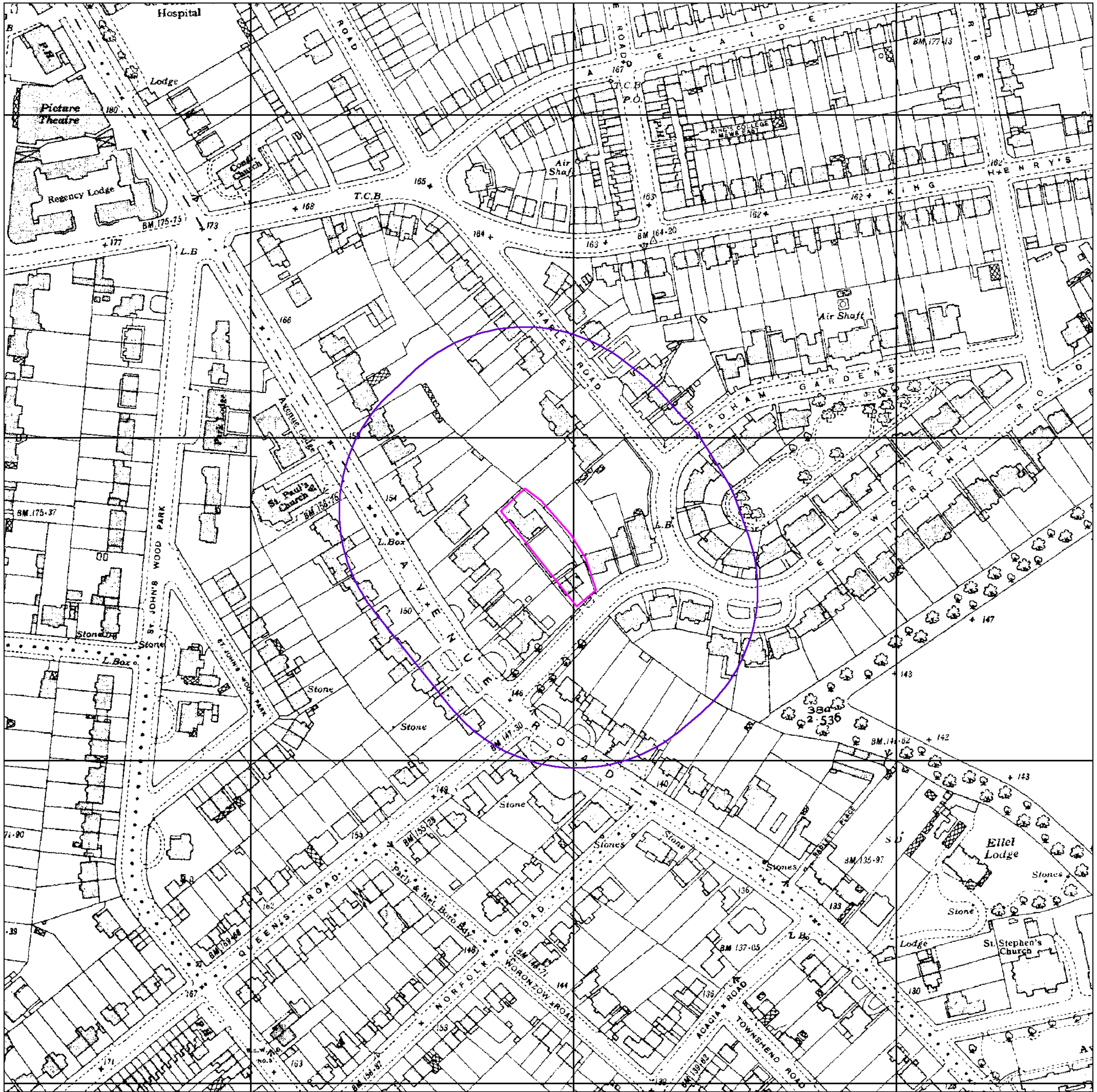


Geotechnical & Environmental Associates

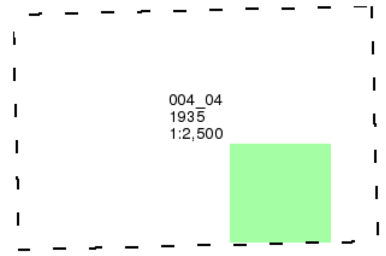
London

Published 1935

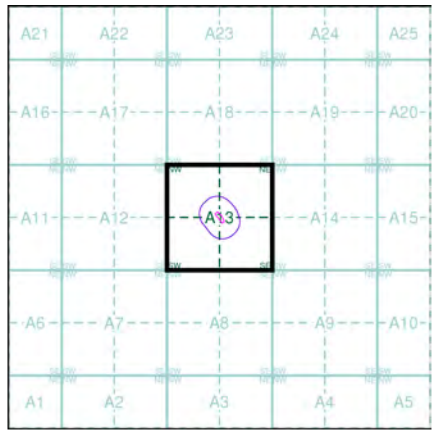
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



N

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0 100 m

Geotechnical & Environmental Associates

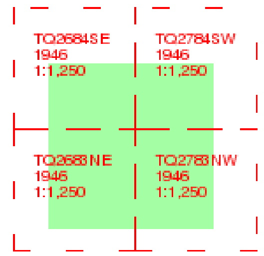
Historical Aerial Photography

Published 1946

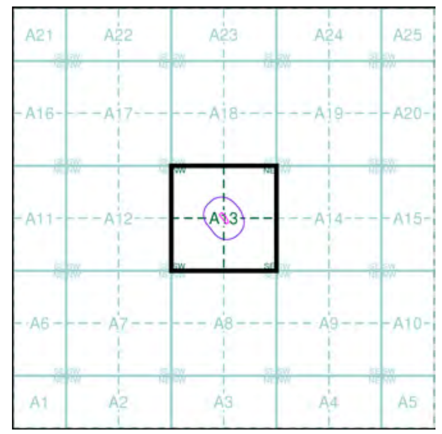
Source map scale - 1:1,250

The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 1950's meant that every photograph was re-checked for potentially unsafe information with security sites replaced by fake fields or clouds. The original editions were withdrawn and only later made available after a period of fifty years although due to the accuracy of the editing, without viewing both revisions it is not easy to spot the edits. Where available Landmark have included both revisions.

Map Name(s) and Date(s)



Historical Aerial Photography - Segment A13



N

Order Details

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Customer Ref: j15143
National Grid Reference: 526990, 183930
Slice: A
Site Area (Ha): 0.18
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Site Details

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Geotechnical & Environmental Associates

Ordnance Survey Plan

Published 1953 - 1954

Source map scale - 1:1,250

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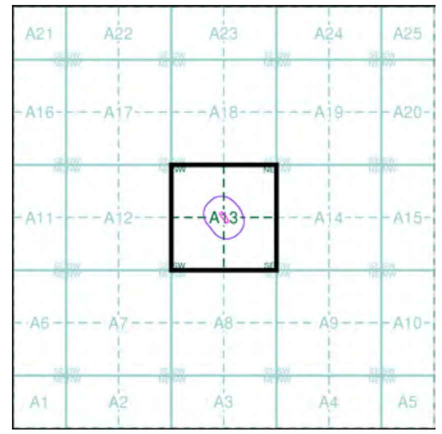
Map Name(s) and Date(s)

TQ2684SE 1954 1:1,250	TQ2784SW 1954 1:1,250
TQ2683NE 1954 1:1,250	TQ2783NW 1953 1:1,250

Historical Map - Segment A13



N

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0 100 m

GEA Geotechnical & Environmental Associates

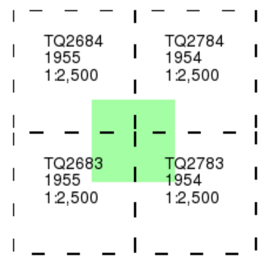
Ordnance Survey Plan

Published 1954 - 1955

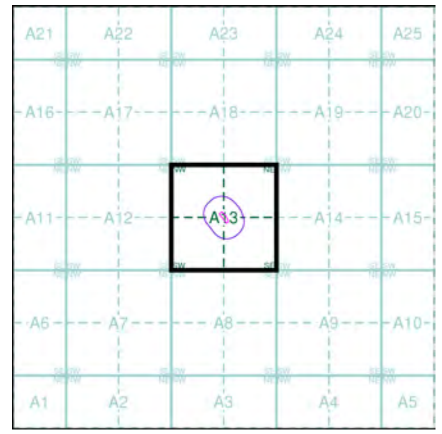
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



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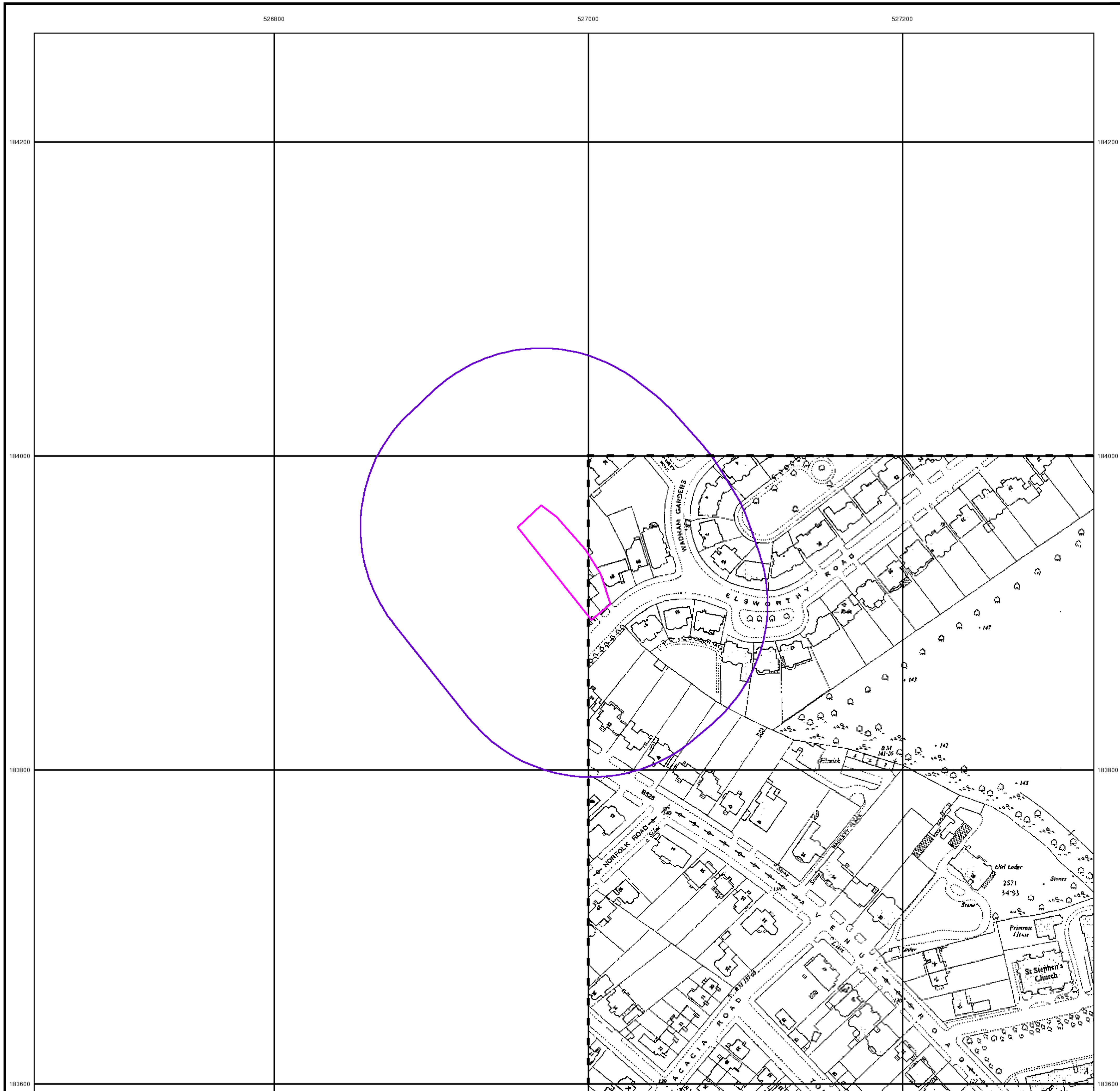


Geotechnical & Environmental Associates

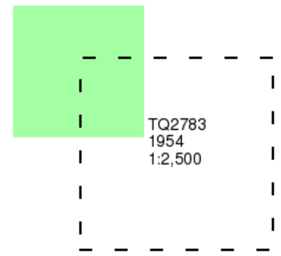
Additional SIMs

Published 1954

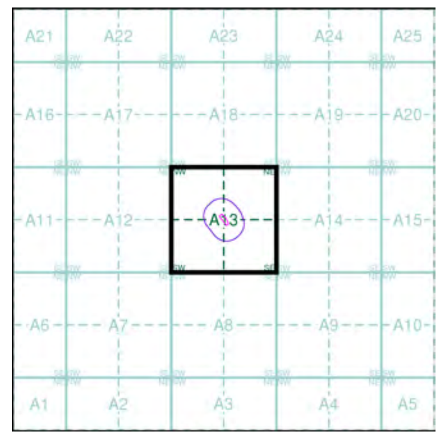
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



N

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