Southern Testing
Environmental & Geotechnical

Basement Impact Assessment & Site Investigation Report

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: 18 Grove Terrace, NW5 1PH

Client: Mr Jatin and Mrs Johanne Vara

Report Date: 28th October 2014

Project Reference: J11987

Southern Testing
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TABLE OF CONTENTS

FIGURES

A INTRODUCTION

1 Introduction

The object of this study was to produce an impact assessment for the proposed basement construction on this site in accordance with the requirements of the London Borough of Camden. Their requirements are set out within their Development Policy DP27 – Basements and Lightwells and the recent LB Camden guidance document entitled "Camden geological, hydrogeological and hydrological study – Guidance for subterranean development".

This report covers the initial desk study and screening process.

2 Scope

This report presents our desk study findings and our interpretation of these data.

The findings and opinions conveyed via this report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes are reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

This report was conducted and prepared for the sole internal use and reliance of Mr J Vara and the appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

B THE SITE

3 Site Location

The subject site comprises an existing terraced property, No 18 Grove Terrace, London, NW5 1PH which is located approximately 0.4km north east of Gospel Oak Station. The approximate National Grid Reference of the site is TQ 285 589.

The site/subject property at No 18 Grove Terrace, comprises a five storey (including lower ground floor and roof accommodation) terraced residential building. Grove Terrace is located on the north east side of Highgate Road.

Regionally ground levels generally comprise falls in a south-easterly direction from Parliament Hill/Hampstead Heath and Highgate which are located to the northwest and north of the site.

Within the vicinity of the site ground levels locally fall from Grove Terrace towards Highgate Road with more general local falls occurring in southerly direction at about 1-2° degrees.

Existing vegetation within the rear garden area (the area of proposed construction) consists of borders containing a variety of ornamental shrubs, various fruit trees (pear and apple) and a grape vine. Vegetation within the neighbouring gardens includes maple, cherry, yew, cyprus, silver birch and various ornamentals shrubs/trees.

A site location plan is presented as Figure 1.

4 Proposed Development

The proposed works include the construction of a basement for a dining room and roof garden extending out from the rear lower ground floor level of the subject property into the garden area together with an open lower terrace area. Figure 2 illustrates the proposed basement/lower terrace area.

C GROUND CONDITIONS

5 Published Geological Data

The British Geological Survey Map No 256 indicates that the site geology consists of London Clay.

The study site is marked on appended Figure 3 based upon the North Camden Geological Map taken from "Camden geological, hydrogeological and hydrological study – Guidance for subterranean development", which indicates the same mapped geology.

6 Previous Ground Investigation data

Very few publicly available records of ground investigation or historical boreholes are shown on the BGS website. The borehole information that is available does not disagree with the published information.

D HYDROLOGY & HYDROGEOLOGY

Data from the Environment Agency and other information relating to controlled waters is summarised below. The groundwater vulnerability assessment is based on the current data on the EA website.

Data		Remarks
Aquifer Designation	Superficial Deposits	No superficial Deposits present.
	Bedrock	The bedrock (London Clay) is mapped as an unproductive strata
Groundwater Vulnerability		Non Aquifer

Data	Remarks
Abstractions	On the basis of the information given on the EA website (October 2014) there are no water abstraction licenses in the area.
Source Protection Zones	The site is not located within a Source Protection Zone.
Surface Water Features	The nearest surface water features are the Hampstead Heath Pond Chain some 0.74km to the north west. The site lies outside of the catchment area to the ponds.
Marine/Fluvial Flood Risk	On the basis of the information given on the EA website (October 2014) the site is not located within an area at risk of flooding from fluvial sources.
Surface Water Flood Risk	The "Risk of Flooding from Surface Water" mapping on the Environment Agency website shows that Grove Terrace is located within an area of very low risk. Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%). The Highgate Road just to the west, which is at a slightly lower level to Grove Terrace, is situated within an area of low risk. Low means that each year, this area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).
Reservoir Flood Risk	On the basis of the information given on the EA website (October 2014) the site is located within an area of potential risk of flooding from Highgate Pond No 3. The estimated depth of flooding is below 0.3m

7 Shallow Groundwater

As the site is directly underlain by London Clay which is an unproductive strata, there are no shallow groundwater aquifers present. (see figure 8)

8 Surface Water Features

No culvert, rivers and or other water bodies are known within the immediate vicinity of the site. (see figure 5)

E UNDERGROUND STRUCTURES

9 Basements

From our walkover survey of the local area it appears that the neighbouring properties are of similar construction with lower ground floors like the subject property. The adjacent property (No 19) has a rear basement structure/extension with curved glass walls and a flat glass roof. The structure extends out from the lower ground floor of No 19 into the rear garden area. In plan the extension is oval shaped with curved glass walls which are approximately 1metre (at the closest point) from the shared garden wall to both properties. From a search of London Borough of Camden online planning applications, the basement to the adjacent property (No 19) was given approval in 2009.

From a further brief inspection of planning applications for basements within the immediate adjacent properties, the majority of basement applications for properties on Grove Terrace appear to be related to works to existing basements or front lightwell areas.

10 Transport & Other Infrastructure

No tunnels are known to be present within the immediate vicinity of the site. The nearest railway line (which runs on a viaduct) is approximately 280m to the south/south east of the site.

F BASEMENT IMPACT ON STRUCTURAL STABILITY

11 Structural Stability

DP27 "Maintain the structural stability of the building and neighbouring properties".

The proposed works include the construction of a basement extending out from the rear lower ground floor level of the subject property into the garden area for a dining room and roof garden together with an open lower terrace area.

The works will entail the excavation of a basement with a founding level of approximately 2.5m below the existing ground levels to the rear garden area of the property.

All works will be carried out in accordance with the Structural Engineers design. In terms of the method of basement construction it is envisaged that conventional underpinning methods will be adopted. Appropriate propping methods and working practices will be carried out to ensure that movements associated with the works are kept within acceptable limits.

The extent and nature of the propping/works will be evaluated during the detailed design phase of the works in order to allow discussions (should they be required) with the party wall surveyor to occur.

Throughout the construction phase the party walls on both sides of the building would be monitored for both movement and vibration to make sure these are within acceptable limits.

G SCREENING EXERCISE

DP27 "Avoid adversely affecting drainage and run-off or causing other damage to the water environment and Avoid cumulative impacts upon structural stability or the water environment in the local area" LB Camden's "guidance for subterranean development" requires that any development proposal which includes a subterranean basement should be screened in order to determine whether there is an requirement for a BIA to be carried out.

The proposed works include the construction of a basement area extending out from the rear of the subject property into the garden area together with an open lower terrace area. Therefore screening is required.

In this section, the questions in the screening flowcharts of Appendix E of the LB Camden guidance document are addressed in turn.

12 Surface Flow and Flooding

Question 1: Is the site within the catchment of the pond chains on Hampstead Heath?

No. The site is outside the catchment of the pond chains on Hampstead Heath (see Figure 4).

Question 2: As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?

No. The current proposal is to re-use the existing storm water connections to the Thames Water Sewer, provided that this is at a sufficient level to allow this to occur through gravity, otherwise the drainage will be pumped. Subject to a more detailed condition survey of these connections, it is not envisaged that any new connections will be required.

Question 3: Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?

The existing area of construction is mainly surfaced in jointed/permeable crazy paving. The proposed basement development includes a roof garden with an open lower courtyard area. Accordingly there could be an increase in hard surfaced area. However, any surface water that needs to be dealt with from the proposed roof garden and lower courtyard area will be directed to the existing storm water connections to the Thames Water sewer. Subject to a more detailed condition survey of these connections, it is not envisaged that any new connections will be required.

Question 4: Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?

No. The proposed basement will not alter surface water flows downstream as it will use existing connections to the sewer network.

Question 5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?

No. The quality of the surface water should be unaltered that is discharged to the sewer.

Question 6: Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?

No (See Figure 7). However Highgate Road just to the west, which is at a slightly lower level to Grove Terrace and also the Grove Terrace Mews, a lane leading off Grove Terrace to the north, are shown to have flooded in 1975.

13 Groundwater Flow

Question 1a: Is the site located directly above an aquifer?

No. The site is not located within an area designated as an aquifer. The site is underlain by London Clay designated as unproductive strata, see Figure 8.

Question 1b: Will the proposed basement extend beneath the water table surface?

Possibly. The presence of a perched groundwater table within more permeable made ground overlying the London Clay is considered possible at this stage. Subject to an intrusive investigation, allowances in construction and design could be required.

Question 2: Is the site within 100m of a watercourse, well (used/disused) or potential spring line?

No. (See figure 6). The nearest water course shown on the Camden Plan of Watercourses (Source Lost Rivers of London) shows the River Fleet approximately 100m to the east. According to the BGS Geology of Britain Viewer the nearest well (now abandoned) is shown 220m to the north west in the grounds to William Ellis School. We are not aware of any other active wells. Furthermore, given the geology of the area (London Clay) the potential presence of spring lines is negligible.

Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?

No. (See Figure 4). The Hampstead Heath Pond Chains are some 0.74km to the north west. The site lies outside of the catchment area to the ponds.

Question 4: Will the proposed basement development result in a change in the proportion of hard surfaced /paved areas?

The existing area of construction is mainly surfaced in jointed/permeable crazy paving. The proposed basement development includes a roof garden with an open lower courtyard area. Accordingly there could be an increase in hard surfaced area. The current proposal is to re-use the existing storm water connections to the Thames Water sewer. Subject to a more detailed condition survey of these connections, it is not envisaged that any new connections will be required.

Question 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. All surface water will be discharged to the sewer network through existing connections, replicating the existing arrangement.

Question 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 (not just the pond chains on Hampstead Heath) or spring line?

No. There are no known local water features or spring lines in the immediate vicinity of this site.

14 Slope Stability

Question 1: Does the existing site include slopes, natural or manmade, greater than 7 degrees? (approximately 1 in 8)

No. (see figure 9)

Question 2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degs? (approximately 1 in 8)

No. (see figure 9)

Question 3: Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degs? (approximately 1 in 8)

No. (see figure 9)

Question 4: Is the site within a wider hillside setting in which the general slope is greater than 7 degrees? (approximately 1 in 8)

No. Regionally ground levels generally comprise falls in a south-easterly direction from Parliament Hill/Hampstead Heath and Highgate which are located to the northwest and north of the site. Within the vicinity of the site ground levels locally fall from Grove Terrace towards Highgate Road with more general local falls occurring in southerly direction at about 1-2° degrees.

Question 5: Is the London Clay the shallowest strata at the site?

Yes. (See figure 3).

Question 6: Will any tree/s 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? (Note that consent is required from LB Camden to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).

With the possible exception of an immature fruit tree and some removal of ornamental shrubs no major trees are to be felled.

Question 7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?

No. We have no evidence indicating any possible shrink-swell subsidence in the local area. However the site is mapped as being underlain by London Clay which typically is classified as NHBC High Volume Change Potential. However, the site area includes a number of mainly fruit trees within the rear garden area and also a variety of trees in adjacent gardens which could give rise to shrink-swell subsidence.

Question 8: Is the site within 100m of a watercourse or a potential spring line?

No. (See Figure 6). The nearest water course shown on the Camden Plan of Watercourses (Source Lost Rivers of London) shows the River Fleet approximately 100m to the east. Given the geology of the area (London Clay) the potential presence of spring lines are negligible.

Question 9: Is the site within an area of previously worked ground?

No. The site is not within an area shown as having been worked. (See Figure 3).

Question 10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?

No. The site is not underlain by an aquifer. However it is common for perched groundwater to be present if made ground overlies the London Clay in which case some dewatering of the perched groundwater could be required. Minor seepage into the working area would be dealt with using sumps or other localised measures.

Question 11: Is the site within 50m of the Hampstead Heath ponds?

No. (See figure 4). The site is located approximately 0.74km south east of the Hampstead Heath Ponds.

Question 12: Is the site within 5m of a highway or pedestrian right of way?

No.

Question 13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?

The proposed finished floor levels of the basement structure will be similar to the lower ground floor levels of the subject 1.8-2.0m below the adjacent garden areas but would be slightly deeper than the lower slab level of the basement extension structure to No 19. The exact difference in level should be confirmed by the Structural Engineer/Architect at the detailed design stage.

Question 14: Is the site over (or within the exclusion zone of) any tunnels, e.g. 5lines?

No tunnels are known to be present within the immediate vicinity of the site. The nearest railway line (which runs on a viaduct) is approximately 280m to the south/south east of the site.

15 Conclusions from Screening

On the basis of this screening exercise, it is concluded that there are a number of items that will need to be investigated further and taken into the scoping stage of the process.

These are as follows:

- *A geotechnical investigation to confirm the ground conditions underlying the site.*
- *Desiccation of the underlying soils*
- *Groundwater monitoring.*
- *A series of trial pits to establish party wall foundations*

The reader is referred to the attached report which considers the above issues.

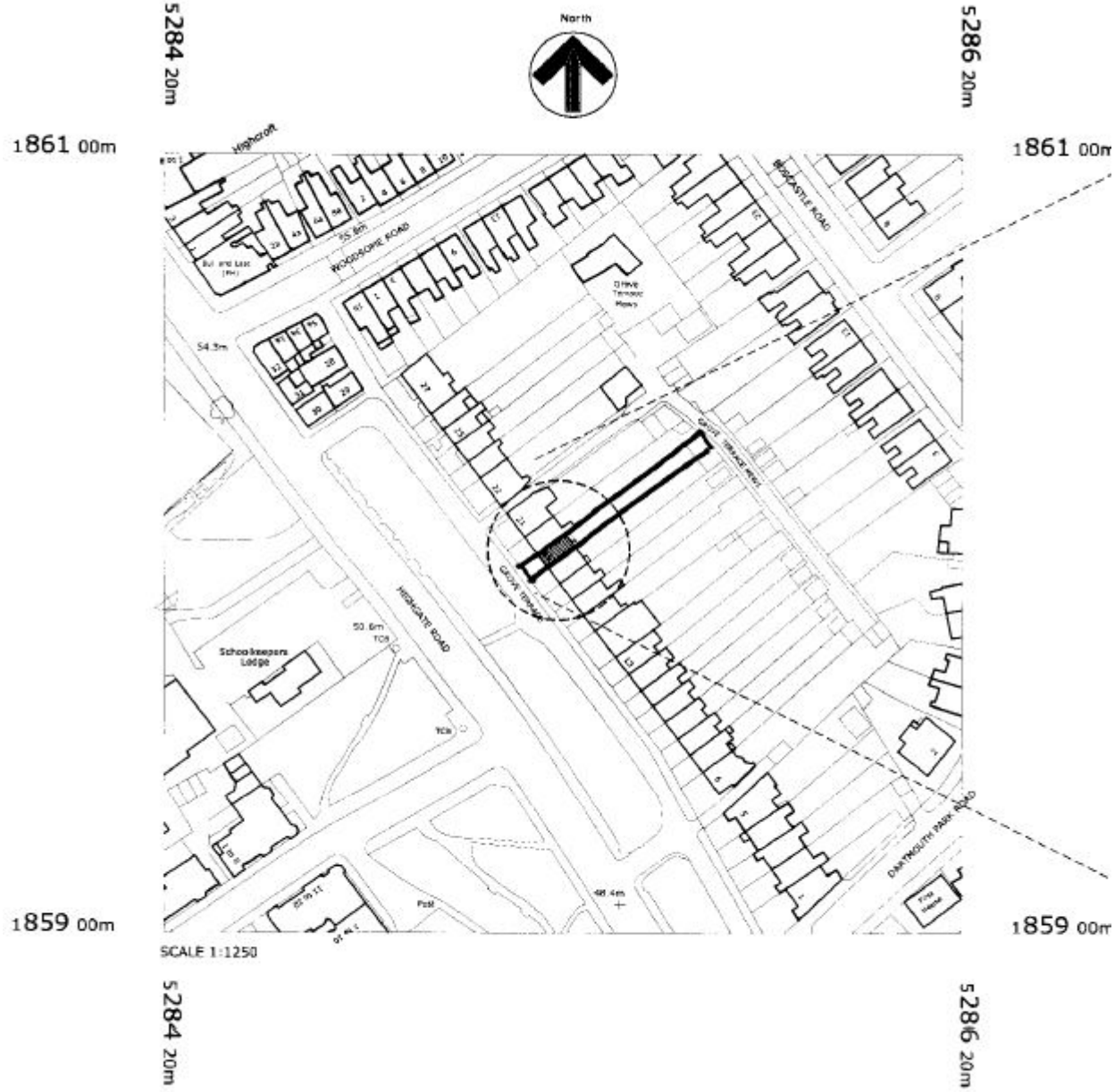
J N Race MSc CGeol
(Countersigned)

D Vooght MSc
(Signed)

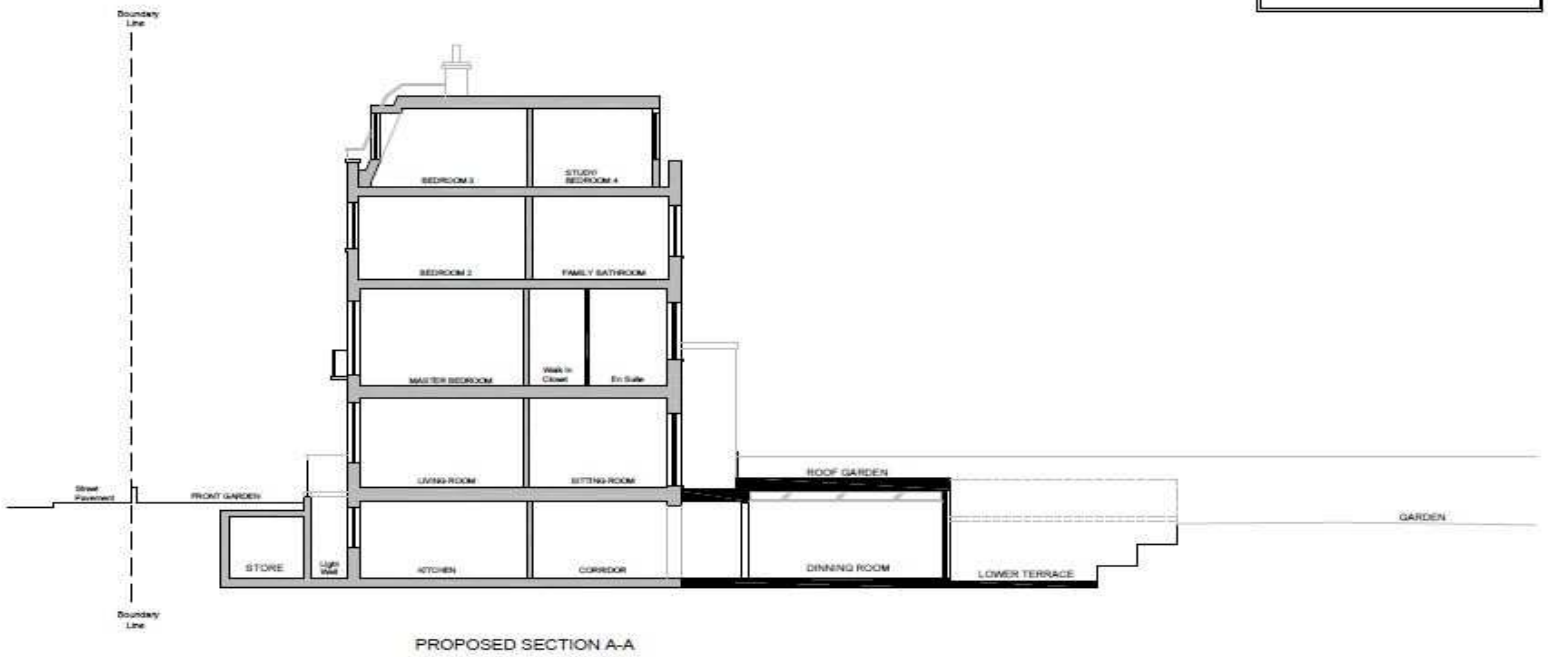
For and on behalf of Southern Testing Laboratories Limited

STL: J11987
27 October 2014

FIGURES



Site:	18 Grove Terrace, London, NW5	STL:J11987	Fig No: 1
Date:	24 October 2014	Site Location	



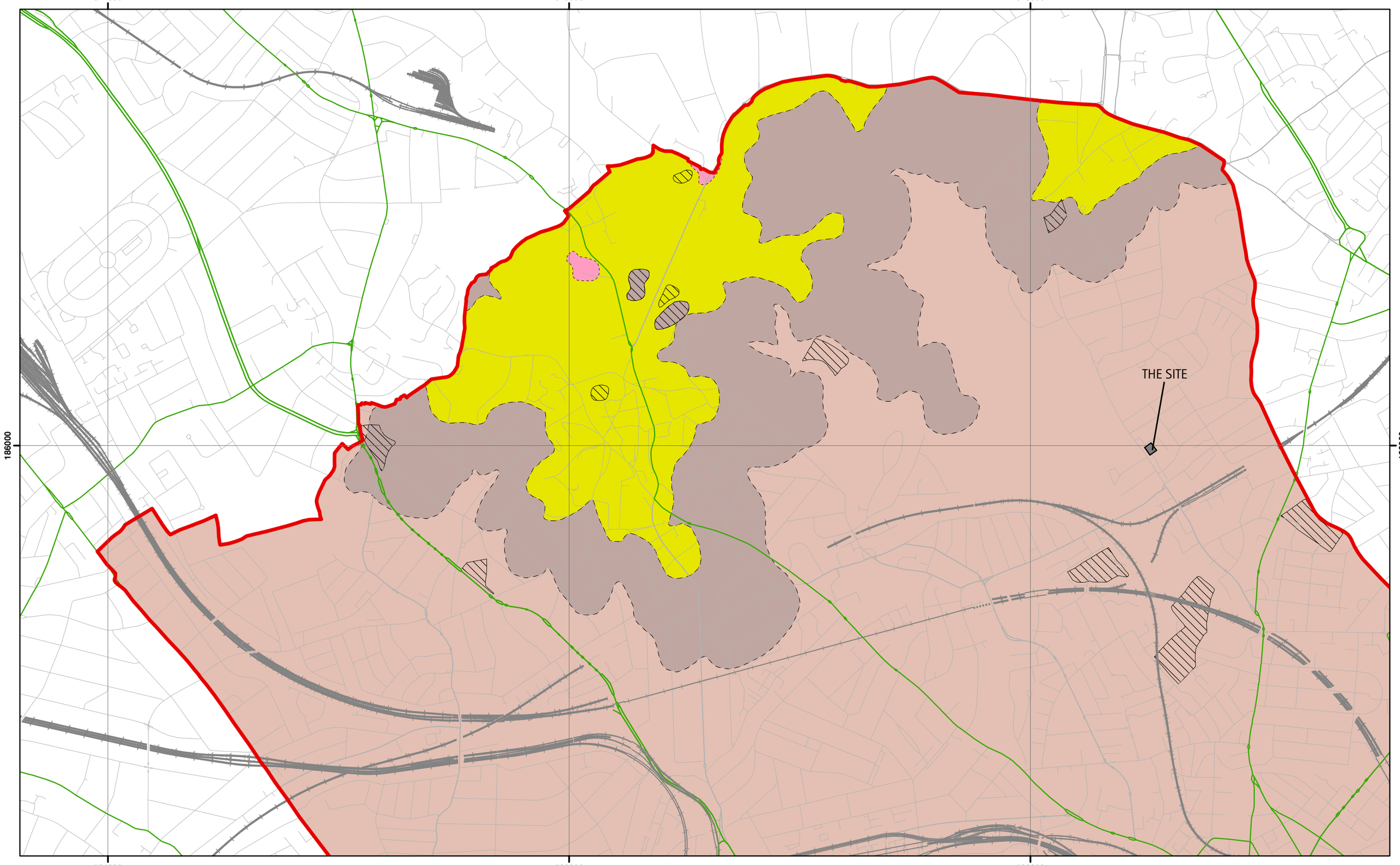
PROPOSED SECTION A-A

Site: 18 Grove Terrace, London NW5	STL: J11987	Fig No: 2
Date: 24 October 2014	Plan showing proposals	

Southern Testing

Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA
ST Consult: Twigden Barns, Brixworth Road, Creaton, Northampton NN6 8NN

ST Consult



Data Source: BGS Mapping - Scale 1:10,000

N

Scale at A3: 1:15,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.25 0.5 1 1.5
Kilometers

Legend

- London Borough of Camden
- Railway Lines
- A Roads

BGS 1:10K Artificial Ground

- MADE GROUND
- WORKED GROUND

BGS 1:10K Drift Geology

- ALLUVIUM
- HACKNEY GRAVEL FORMATION
- LANGLEY SILT FORMATION
- LYNCH HILL GRAVEL FORMATION
- STANMORE GRAVEL FORMATION

BGS 1:10K Solid Geology

- BAGSHOT FORMATION
- CLAYGATE MEMBER
- LAMBETH GROUP
- LONDON CLAY FORMATION

NB. Geological boundaries are largely indicative based on available geological mapping data

Camden Geological, Hydrogeological and Hydrological Study

North Camden Geological Map

Report: J11987 Site: 18 Grove Terrace, London NW5 Figure: 3

526000

528000

188000

186000

THE SITE

Catchments and Drainage after Haycock, 2010

N

Scale at A3: 1:10,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.125 0.25 0.5 0.75 1

Kilometers

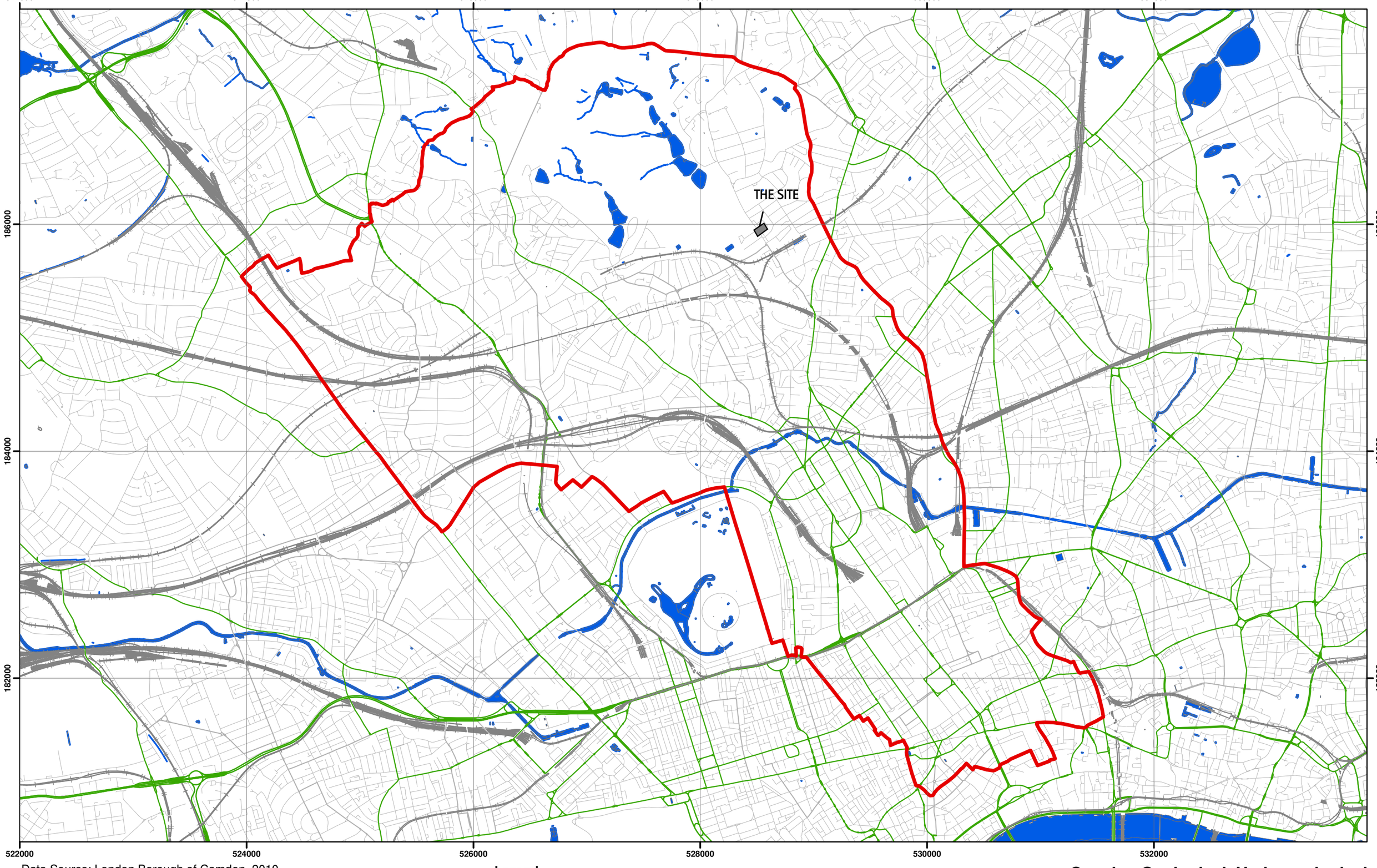
Legend

- London Borough of Camden
- Railway Lines
- A Roads
- Surface Water
- Highgate Chain Catchment
- Golders Hill Chain Catchment
- Hampstead Chain Catchment
- Hampstead Heath Extension Chain Catchment

Camden Geological, Hydrogeological and Hydrological Study

Hampstead Heath Surface Water Catchments and Drainage

Report: J11987 Site: 18 Grove Terrace, London NW5 Figure: 4



Data Source: London Borough of Camden, 2010

N

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

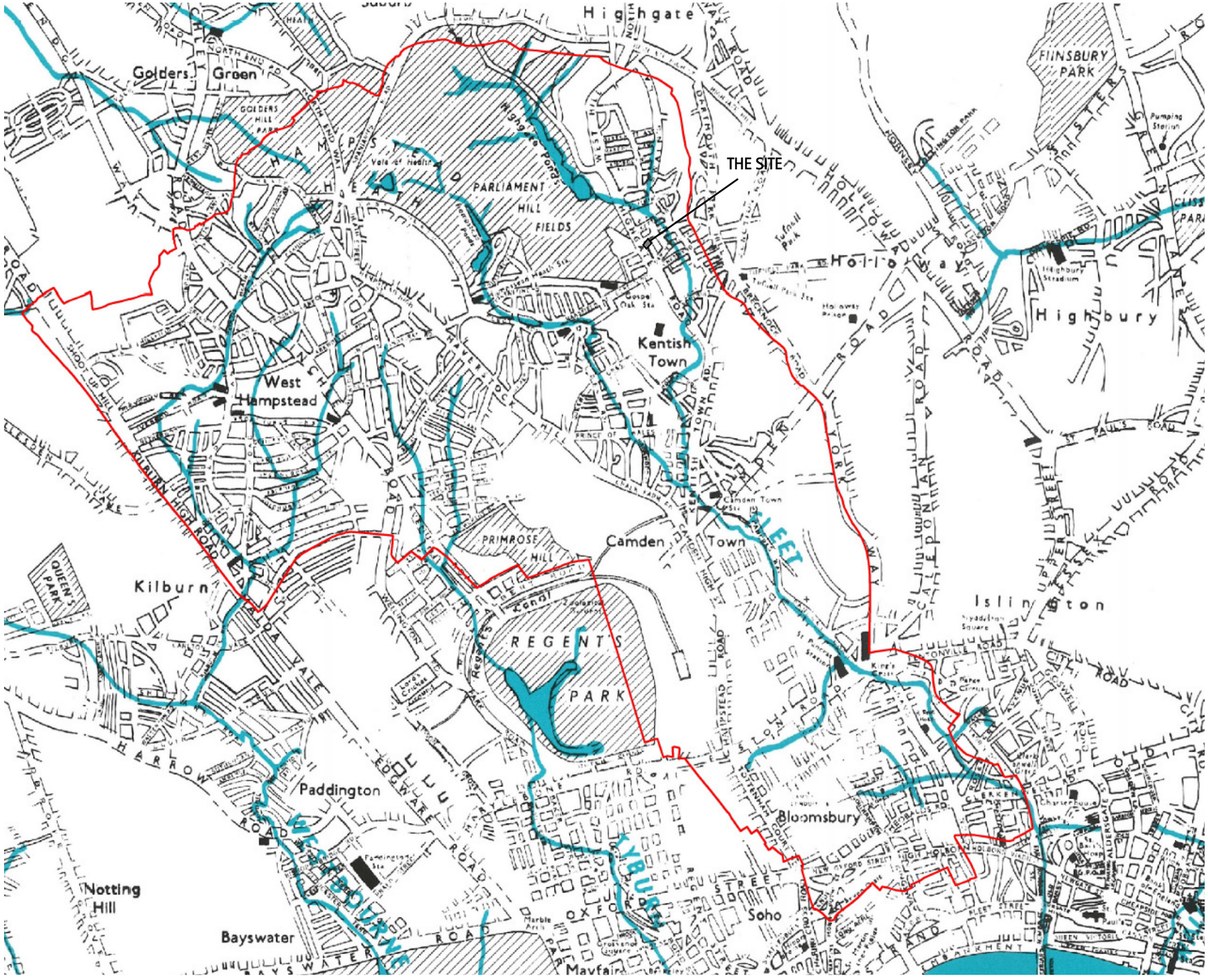
Legend

- London Borough of Camden
- Surface water
- Railway Lines
- A Roads

Camden Geological, Hydrogeological and Hydrological Study

Camden Surface Water Features

Report: J11987 Site: 18 Grove Terrace, NW5 Figure: 5



Camden Geological, Hydrogeological and Hydrological Study
Watercourses

Source – Barton, Lost Rivers of London

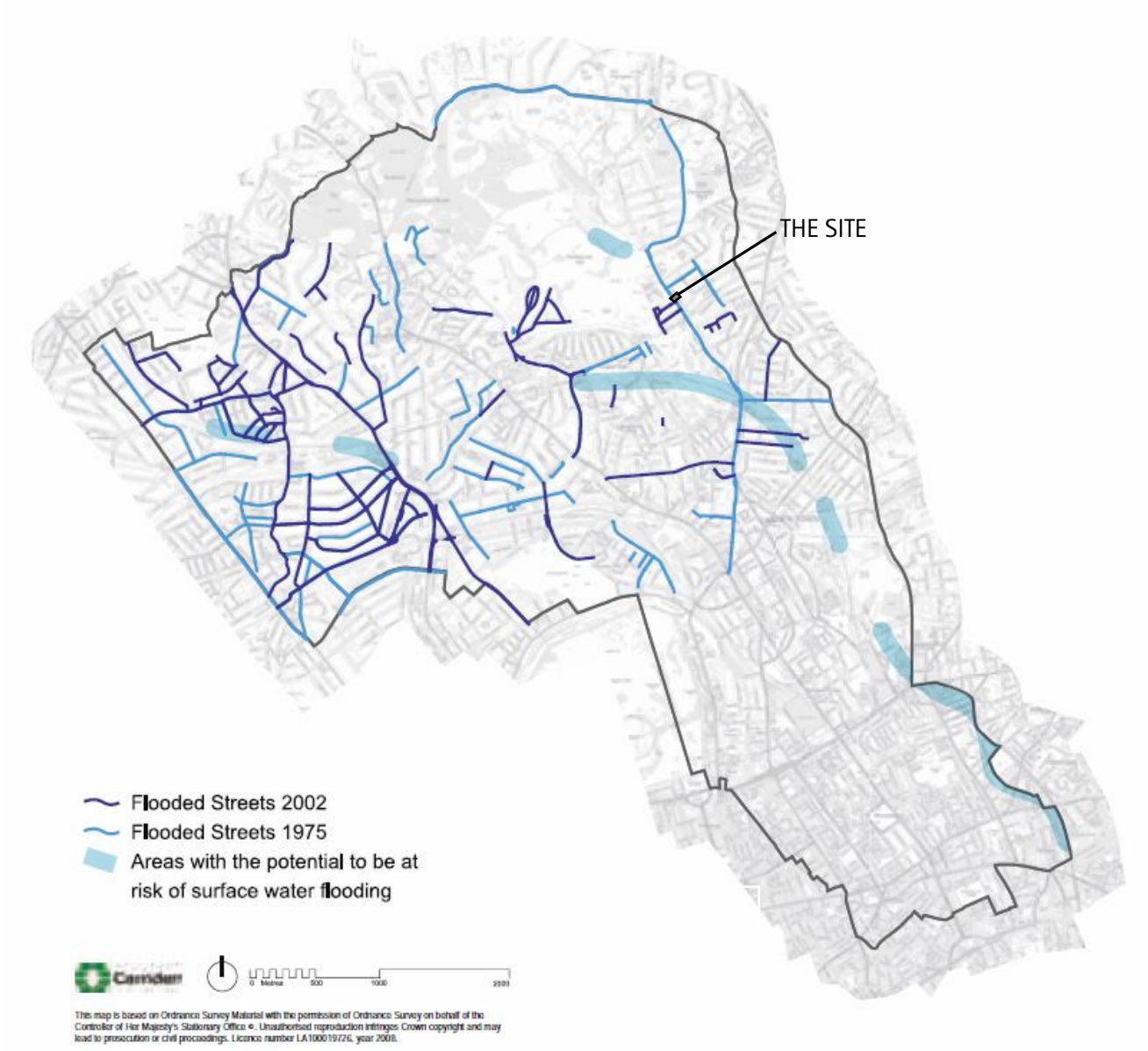


Figure 5 from Core Strategy, London Borough of Camden

Camden Geological, Hydrogeological and Hydrological Study
Flood Map

524000 526000 528000 530000 532000 534000

188000 186000 184000 182000

THE SITE

Environment Agency Aquifer Designation based on BGS Mapping

N

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

Legend

- Borough of Camden
- Railway Lines
- A Roads

Aquifer Designation

- Secondary A Aquifer
- Unproductive Strata

Source Protection Zone

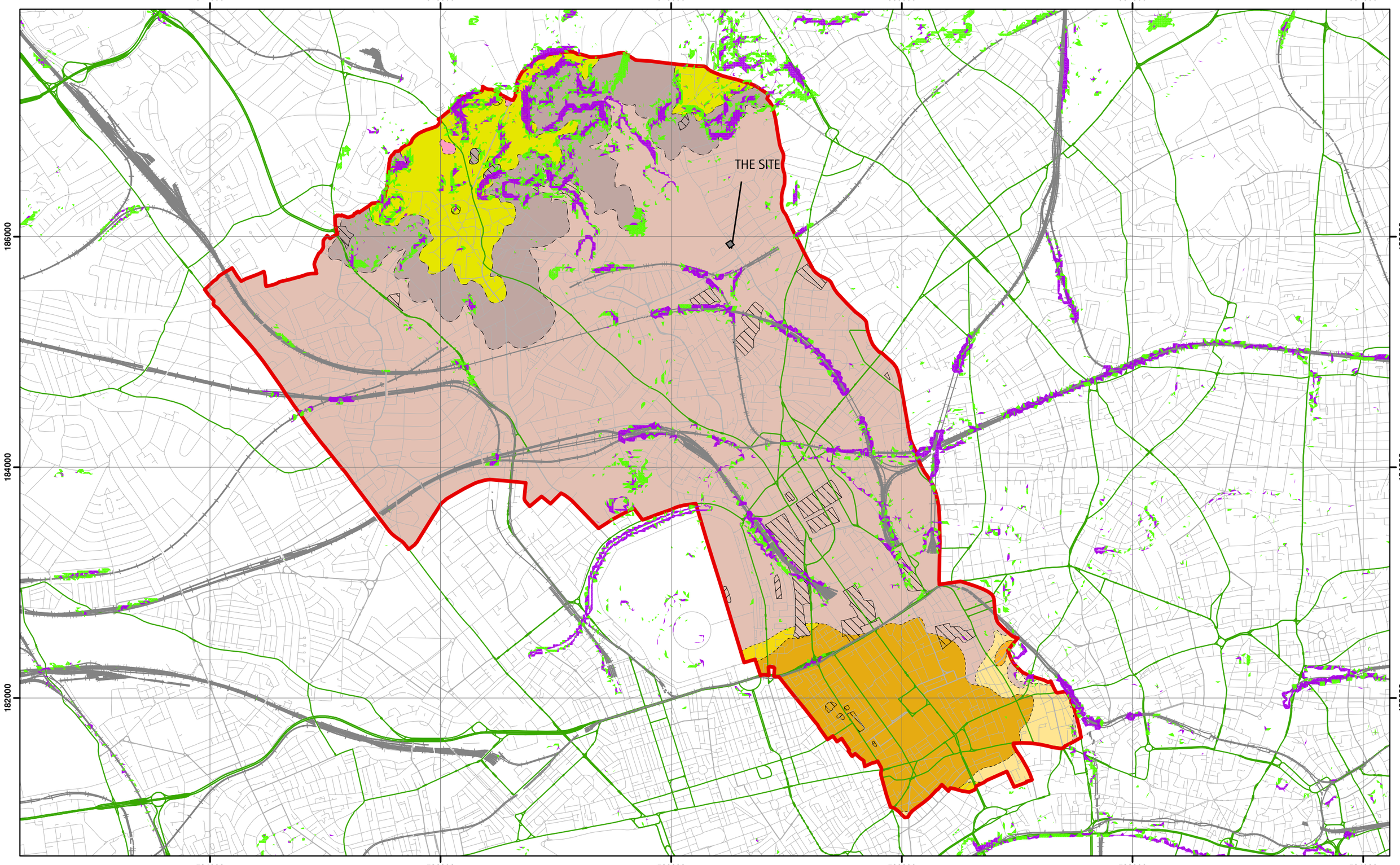
- Outer Source Protection Zone
- Inner Source Protection Zone

NB. Aquifer boundaries are indicative based on available geological mapping data

Camden Geological, Hydrogeological and Hydrological Study

Camden Aquifer Designation Map

Report: J11987 Site: 18 Grove Terrace, London NW5 Figure: 8



Slope Angles calculated from Digital Terrain Model Provided By Camden Bourough Council

N

Scale at A3: 1:30,000

1:10,000 BGS Mapping
Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

Legend

Slope
- 0° - 7°
- 7° - 10°
- > 10°

London Borough of Camden
Railway Lines
A Roads

BGS 1:10K Artificial Ground
- MADE GROUND
- WORKED GROUND

BGS 1:10K Drift Geology
- ALLUVIUM
- HACKNEY GRAVEL FORMATION
- LANGLEY SILT FORMATION
- LYNCH HILL GRAVEL FORMATION
- STANMORE GRAVEL FORMATION

BGS 1:10K Solid Geology
- BAGSHOT FORMATION
- CLAYGATE MEMBER
- LAMBETH GROUP
- LONDON CLAY FORMATION

NB. Geological boundaries are largely indicative based on available geological mapping

Camden Geological, Hydrogeological and Hydrological Study

Slope Angle Map

Report: J11987 Site: 18 Grove Terrace, London NW5 Figure: 9

Southern Testing
Environmental & Geotechnical

Site Investigation Report

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

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Client: Mr Jatin and Mrs Johanne Vara

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SUMMARY

The site comprises an existing terraced property, No 18 Grove Terrace, London, NW5 1PH, located approximately 0.4km to the north-east of Gospel Oak Station. The proposed works include the construction of a basement for a dining room and roof garden, extending out from the rear lower ground floor level of the subject property into the garden area, together with an open lower terrace area.

A desk study and formal contamination investigation were outside the requested scope of works.

Geological records indicate the site to be underlain by London Clay.

The soils encountered comprised made ground, overlying weathered London Clay.

To date, the highest standing water levels of 1.34 and 2.01m BGL, have been measured within the monitoring wells installed.

Precautions for BRE Class DS-2 sulphate are recommended for subsurface concrete with an ACEC classification of AC-1s.

NHBC High Volume Change Potential precautions will apply for the weathered London Clay soils.

The development includes a basement structure which we assume will be constructed using conventional underpinning methods. Parameters for retaining wall design are given.

The design of the new basement foundation system should take account the nature of the existing/adjacent foundations and their condition.

The results of the contamination testing, which were mainly carried out for waste classification purposes, are also included. Although a wider contamination investigation was outside the requested scope of works, soil analysis has indicated that the Made Ground and underlying natural soils tested were largely free from significant contamination, other than some minor lead impact of the Made Ground and, to a lesser extent, the natural soil. This is fairly typical in London. The results should be sent to the tip and the groundworks contractor and prospective tip, for their appraisal.

A discovery strategy should be put in place to deal with any significant contamination that comes to light during the development work. Such a discovery could alter the waste classification, site practices and mean that a remediation strategy is required.

J N Race MSc CGeol
(Countersigned)

D Vooght MSc
(Signed)

For and on behalf of Southern Testing Laboratories Limited

STL: J11987
27 October 2014

TABLE OF CONTENTS

A INTRODUCTION

1 Authority

Our authority for carrying out this work was given in an email dated 3rd September 2014 from Masoud Parvardin of Archetype Associates Limited acting, on behalf of the client Mr J Vara.

2 Location

The subject site comprises an existing terraced property, at No 18 Grove Terrace, London, NW5 1PH, located approximately 0.4km to the north-east of Gospel Oak Station. The approximate National Grid Reference of the site is TQ 285 589.

3 Proposed Construction

The proposed works include the construction of a basement extending out from the rear lower ground floor level of the subject property into the garden area, together with an open lower terrace area. It is envisaged that the works will be carried out using a form of conventional underpinning methods.

4 Object

The object of the investigation was to assess ground and groundwater conditions, foundation bearing and other soil parameters relevant to the proposed development.

A series of contamination tests were also carried out to assist with the waste classification of the soils to be removed from site as part of the basement excavation. This does not, however, constitute a detailed contamination investigation. A desk study was also outside the requested scope of works.

For the purposes of the contamination risk assessment, the proposed development land use is classified as **Residential with plant uptake, (CLEA model[1]/C4SL report[2]). The gas sensitivity of the site is rated as High (CIRIA C665[3]).**

5 Scope

This report presents our, exploratory hole logs and test results and our interpretation of these data.

A desk study and formal contamination investigation were outside the requested scope of works.

As with any site there may be differences in soil conditions between exploratory hole positions.

[1] Environment Agency Publication SC050021/SR3 'Updated technical background to the CLEA Model' (2009).
[2] SP1010 Development of Category 4 Screening Levels DEFRA (2014)
[3] CIRIA C665 (2006) Assessing risks posed by hazardous ground gases to buildings.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes is reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Mr J Vara and the appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

B THE SITE

6 Geology

The British Geological Survey Map at 1:50,000 indicates that the site geology consists of London Clay.

London Clay

London Clay is a well-known stiff (high strength) blue-grey, fissured clay, which weathers to a brown colour near the surface. It contains thin layers of nodular calcareous mudstone - "claystone" - from place to place, and crystals of water clear calcium sulphate (selenite) are common.

7 Hydrology and Hydrogeology

Data from the Environment Agency and other information relating to controlled waters is summarised below. The groundwater vulnerability assessment is based on the current data on the EA website.

Data		
Aquifer Designation	Superficial Deposits	There are no superficial deposits mapped.
	Bedrock	Unproductive Strata (London Clay) - deposits with low permeability that have negligible significance for water supply or river base flow.
Source Protection Zones		The site is not located within a Source Protection Zone.

Data	
Abstractions	On the basis of the information given on the EA website (October 2014) there are no licenses for water abstraction in the area.
Surface Water Features	The nearest surface water features are the Hampstead Heath Pond Chain some 0.74km to the north west. The site lies outside of the catchment area to the ponds.
Watercourses, well (used/disused) or potential spring lines	The nearest water course shown on the Camden Plan of Watercourses (Source Lost Rivers of London) shows the River Fleet approximately 100m to the east. According to the BGS Geology of Britain Viewer the nearest well (now abandoned) is shown 220m to the north west in the grounds to William Ellis School. We are not aware of any other active wells. Given the geology of the area (London Clay) the potential presence of spring lines are negligible.
Fluvial Flood Risk	On the basis of the information given on the EA website (October 2014) the site is not located within an area at risk of flooding from fluvial sources.
Surface Water Flood Risk	The "Risk of Flooding from Surface Water" mapping on the Environment Agency website shows that Grove Terrace is located within an area of very low risk. Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%). The Highgate Road just to the west, which is at a slightly lower level to Grove Terrace, is situated within an area of low risk. Low means that each year, this area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).
Reservoir Flood Risk	On the basis of the information given on the EA website (October 2014) the site is located within an area of potential risk of flooding from Highgate Pond No 3. The estimated depth of flooding is below 0.3m

8 Radon Risk

With reference to BRE guidance, no radon protection is required on this site.

9 Bomb Map

The published bomb map for the area, taken from the London County Council Bomb Damage Maps (1939-1945), shows that the site, along with the adjacent properties on Grove Terrace, did not suffer any bomb damage during WWII. The map does show, however, that No 4 Grove Terrace along with the adjacent No 5, which are located at the more southern end of Grove Terrace, did suffer some damage (refer Figure 2-Appendix D).

10 Site Location

The subject site comprises an existing terraced property, at No 18 Grove Terrace, London, NW5 1PH, located approximately 0.4km to the north-east of Gospel Oak Station.

11 General Description

The site/subject property at No 18 Grove Terrace, comprises a five storey (including lower ground floor and roof accommodation) terraced residential building. Grove Terrace is located on the north-east side of Highgate Road.

An inspection of historical maps freely available on the internet was carried out. The earliest map available, 1850-1851, does not show any of the existing properties on Grove Terrace, but does shows the basic road lines including Grove Terrace and Grove Terrace Mews; the latter runs along the rear boundaries of the properties on Grove Terrace. The next map dated 1873 shows the subject building, along with the other terraced properties on Grove Terrace. The later editions do not show any changes to the current properties on Grove Terrace.

The existing building is of masonry brick construction and comprises a detached 5-storey property (including a lower ground floor and roof accommodation). The properties, along with the rest of the buildings on Grove Terrace, have front lightwells. On its rear elevation the subject property has a small lightwell to the lower ground floor with a grill at ground level. From the rear of the house, a proportion of the garden is surfaced with crazy paving, whilst the remainder is grassed. Brick boundary walls separate the rear garden area from the adjacent gardens on its more northern and southern sides. A garage is situated at the end of the garden with access onto Grove Terrace Mews, an unmade lane that passes along the rear boundaries to the properties that front onto Grove Terrace and Boscastle Road to the north-east.

The adjacent detached properties all have lower ground floors and are of similar age and construction to that of the subject building. Of note, the adjacent property No19 Grove Terrace has a basement structure which extends out from rear of the property (at lower ground floor level) together with an upper glass roof/wall structure. In plan, the basement to No 19 curves away from the shared boundary wall to both properties.

Regionally ground levels generally comprise falls in a south-easterly direction from Parliament Hill/Hampstead Heath and Highgate, which are located to the north-west and north of the site. Within the vicinity of the site, ground levels locally fall from Grove Terrace towards Highgate Road with more general local falls occurring in a southerly direction, at about 1-2° degrees.

Existing vegetation within the rear garden area consists of borders containing a variety of ornamental shrubs, various fruit trees (pear and apple) and a grape vine. Vegetation within the neighbouring gardens includes maple, cherry, yew, cyprus, silver birch and various ornamentals shrubs/trees.

C SITE INVESTIGATION

11 Method

The strategy adopted for the intrusive investigation comprised the following:

- 2 No window sample holes were drilled to a depth of 6m.
- Groundwater monitoring wells were installed in both window sample boreholes for groundwater monitoring purposes.

- A series of 4 No test pits were hand excavated to establish foundation conditions to the boundary walls and rear porch to the building.

The exploratory borehole and trial pit locations are shown in Figure 1 in Appendix A.

The fieldwork was carried out on the 23rd September 2014, at which time the weather was dry.

12 Soils as Found

The soils encountered within the two window sample holes and hand-dug trial pits are described in detail in the attached exploratory hole logs (Appendix A).

A brief summary of the soils encountered is also given below.

Depth to Base (m BGL)	Soil Type	Description
1.24-2.0	MADE GROUND	Variable dark grey to brown silty sandy CLAY with occasional brick, ceramic, concrete fragments, ash, glass, and rootlets etc.
6.0+	WEATHERED LONDON CLAY	Firm to stiff, medium to high strength CLAY with occasional selenite crystals and silty patches.

A series of hand excavated pits were carried out to establish the rear porch foundations and the adjacent boundary walls. Cross sections showing our findings are given in Appendix A.

13 Groundwater Observations

A summary of the water level observations made during site works on the 23rd September 2014 is given below.

Test Location	Water Strikes/Observations
WS1	Dry on completion to 6.0mBGL
WS2	Dry on completion to 6.0mBGL
TP1	Dry to base of hole (1.4mBGL) on completion
TP2	Dry to base of hole (1.47mBGL) on completion

TP3	Dry to base of hole (1.1mBGL) on completion
TP4	Dry to base of hole (1.3mBGL) on completion

14 Groundwater Monitoring

Following the initial fieldworks the site was re-visited on two separate occasions, to monitor the wells installed. The results are presented in the table below.

Date of Reading	7/10/2014	22/10/2014
Location	Standing Water Level (mBGL)	
WS1	3.00	2.01
WS2	1.80	1.34

D FIELD TESTING AND SAMPLING

The following in-situ tests and sampling methods were employed. Descriptions are given in Appendix B.

- Disturbed Samples
- Hand Penetrometer Tests

E GEOTECHNICAL LABORATORY TESTS

The following tests were carried out on selected samples. Test method references and results are given in Appendix C.

- Moisture Content
- Atterberg Limit Tests
- Soluble Sulphate and pH

F DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

15 Soil Classification and Properties

Soil Type	Depth	Compressibility	VCP	Permeability	Frost Susceptible	CBR	Remarks
Made Ground	GL to 1.24/2.0m	N/A	N/A	Low but seepages from more permeable horizons are anticipated	Yes	N/A	Not suitable for foundations
Weathered London Clay	6.0m+	Medium	High	Very low/impermeable, but seepages from fissures can occur	No	Poor	

16 Swelling and Shrinkage

The results of the Atterberg Limit Tests on selected samples of the Weathered London Clay soils recorded plasticity indices in the range of 28% to 50%, which indicate that the clay soils are classified as NHBC Medium to High Volume Change Potential. On balance, we would recommend that NHBC High Volume Change Potential precautions are adopted.

It is noted that a number of fruit trees are present within the rear garden, with one of these being located approximately 2.0m from trial hole WS 2. Given this information, the presence of soil desiccation was investigated.

16.1.1 (Soil Desiccation)

Various methods are available in the appraisal of soil desiccation. We have listed below the methods used in our assessment:-

- Water content/Atterberg limit
- Shear Strength using hand penetrometer methods

16.1.2 Water Content/Atterberg Limit Test

Information from the Atterberg Limit test can sometimes be used to give an indication of desiccation that is present at the time of the investigation. It should be noted that they are only crude guides and therefore any conclusions drawn should be used in conjunction with other available data. The criterions used in our estimate of desiccation are as follows:

(i) The soils within the upper weathered zone will generally be at plastic limit + 2 to 4% where unaffected by trees.

(ii) The soils at depth below the very highly weathered zone are generally close to their plastic limit.

(iii) Where clays are desiccated by trees, they will be at significantly lower water contents than those given in (i) and (ii).

(iv) If soils are at a moisture content of less than 0.5 x liquid limit, they can be considered desiccated. Experience shows that rigid application of this criterion results in an overestimate of the depth of desiccation. As a consequence, this criterion has not been considered further.

(v) If soils are below a moisture content of 0.4 x liquid limit, then significant desiccation could be present and, depending on foundation loading, is likely to give rise to heave on removal of trees and structural damage.

Figure MC1 (Appendix C) shows a plot of moisture content versus depth for both test locations. Figure MC2 and MC3 (Appendix C) has been plotted with respect to the above criterion.

Referring to figure MC1, and within the upper 3.2m, the moisture contents in WS2 are typically lower than those recorded within WS1.

Below a depth of 3.2m, the moisture contents within WS1 are lower than those recorded within WS2. It is noted that WS1 is more remote from the adjacent vegetation than WS2 and therefore below 3.2m the results are somewhat contradictory. The moisture content profiles within both holes converge at a depth of 6.0m

Referring to Figures MC2 and MC3, and using the above desiccation criterion, in our opinion, there is no conclusive sign of significant desiccation within the upper 3.0m in either borehole. The tests indicate possible signs of desiccation within WS1 between 3.0-4.2m. As noted above, WS1 is located in an area which was more remote from the trees within the garden than WS2, and therefore, in this instance, the use of the criteria is not definitive proof of desiccation being present at depth in WS1.

16.1.3 Shear Strength

Pugh et al [4] used shear strength in their method of evaluating desiccation depths of London Clay, as they considered it offered a rapid, low cost technique.

The method basically consists of the use of simple hand penetrometer measurements of shear strength. By comparing the test results with that of a range of typical values for London Clay soils in a non-desiccated state, an assessment of soil desiccation can be made. The results of the hand penetrometer measurements are given in Figure HP1 (Appendix C).

[4] "A rapid and reliable on-site method of assessing desiccation in clay soils"
by R S Pugh, P G Parnell, and R D Parkes, Proc. Instn Civ. Engrs. Geotech. Engng. 1995, 113 pp. 25-30.

Referring to Figure HP1 there is no signs of soil desiccation indicated within test location WS1. Within WS2, again, there is no sign of desiccation within the upper 3m, although the possible presence of soil desiccation is indicated between 3.0-4.0m.

16.1.4 Summary on Desiccation

The above tests to determine desiccation are somewhat contradictory and not entirely consistent. Furthermore, given the tree types present (fruit trees of moderate water demand) we do not consider that the results of the tests are entirely conclusive and it is very unlikely that desiccation is present in either test hole below 3.0m.

Therefore, in terms of the proposed construction, we would recommend that the basement construction is designed using standard NHBC High Volume Change precautions.

17 Groundwater Levels

It should be noted that ground water levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Long term monitoring is required to assess the ground water regime and this was not possible during the course of this site investigation.

While siteworks were in progress, no groundwater entries were noted within the made ground or underlying Weathered London Clay.

To date, the highest groundwater levels measured within the monitoring wells installed have measured standing water levels of 1.34m BGL and 2.01m BGL. The presence of a standing water level reflects a perched groundwater table within the made ground.

On the basis of the measurements to date, groundwater ingress is not expected to be a significant problem in terms of dewatering issues etc during construction. Allowances for some dewatering, however, should be made from perched sources e.g. within the made ground, in the form of intermittent pumping from strategically placed collector sumps.

For the longer term condition, seepage entries from fissure flow within the clays and any perched water from within the overlying made ground should be allowed for in the design of the basement area e.g. provision of waterproofing measures, and also for hydrostatic uplift of the basement floor slab.

Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x 10^{-9} m/s and 1x 10^{-14} m/s, with an even lower vertical permeability. Accordingly, the groundwater flow rate is anticipated to be extremely low to negligible.

Any groundwater flows that take place will likely follow the local/regional topography which in this instance comprises local falls to the south of around 1-2°. Given the very slight falls in the local/regional topography, hence almost negligible hydraulic gradient, and the very low/impermeable nature of the underlying clay materials, there is negligible risk of the proposed basement walls causing a "damming effect" or mounding of water on the upstream faces.

On the basis of the observations/comments, it is concluded that the proposed development will not result in any specific issues relating to the hydrogeology of the site.

In terms of the potential cumulative effects on the groundwater environment in the local area, i.e. the effects on the adjacent basement to No 19 Grove Terrace, and should other future basements be granted beneath adjacent properties, the combination of the overall regional and local topographic falls of the area (hence negligible to low hydraulic gradients), and the very low/impermeable nature of the underlying London Clay, any resulting increases in groundwater levels within the area (locally or regionally) will be negligible.

18 Sulphates and Acidity

The measured pH of the two made ground samples analysed was 8.1, indicating slightly alkaline conditions. The measured pH of the natural Weathered London Clay soils analysed ranged between 7.1 and 8.3 and therefore they were neutral to slightly alkaline in reaction.

Within the made ground materials, soluble sulphate levels of 40 and 50mg/l were measured in the samples tested. Within the underlying natural Weathered London Clay soils analysed, soluble sulphate levels of between 50 and 941mg/l were measured. The characteristic value for the five tests carried out on the Weathered London Clay soils was 720mg/l.

On the basis of the above measurements, we would recommend that BRE Class DS-2 precautions are adopted for subsurface concrete, together with an ACEC Class of AC-1s.

19 Bearing Capacity

Where it is necessary to construct spread foundations or bases to retaining walls as part of the proposed works, all foundations should clearly penetrate any made ground and be formed on the underlying natural Medium to High Strength Clay materials. For foundations formed on these materials, an allowable bearing capacity of 125kPa may be adopted.

20 Heave

Due to stress relief following the removal of the existing soils to form the basement structure, both immediate (undrained) and long term (drained) heave displacements can be expected to occur in the underlying London Clay.

The immediate (undrained) heave displacements will more or less occur as excavation of the basement takes place and before the construction of basement elements e.g. slabs etc. Accordingly, only the long term (drained) heave displacements will need to be catered for in design, to overcome the problem of uplift pressures forming. This is normally overcome by installing appropriate void forming materials beneath the basement elements.

For the analysis of heave movements, the following stiffness parameters after Burland and Kalra (1986)[5] are suggested for the London Clay:

[5] Burland J.B. and Kalra J.C. (1986) Queen Elizabeth Conference Centre: geotechnical aspects, Proc. Inst. Civ. Engnrs, Part 1,80,1479-1503

Undrained Young's Modulus (E_u) = (10+5.2z) (MN/m^2)

Undrained Poisson Ratio (ν_u) =0.5

Drained Young's Modulus (E_d) = (7.5+3.9z) (MN/m^2)

Drained Poisson Ratio (ν_d) =0.2

Where z (m) is taken from the surface of the London Clay

Assuming a basement/excavation formation depth of about 2.5m beneath the existing ground levels, an analysis of heave displacements has been carried out using PDisp and the above parameters (Appendix E). For the purpose of the analysis we have assumed an unload pressure of 50kPa across the full area of the proposed basement structure and lower courtyard area.

Figure U1 relates to the immediate (undrained-end of construction stage) heave displacements and Figure V1 to the total long term (drained) heave displacements (which includes the end of construction displacements). The maximum undrained heave displacement, i.e. end of construction stage, occurs beneath the approximate central point of the proposed basement excavation area and is 7mm. The total long term drained heave movement (which includes the initial undrained heave movement) occurs at the same point and is 12mm.

We note that the proposed basement structure also includes a roof structure and therefore this could result in a reduction in net unloading assumed and hence heave displacements.

21 Basement Construction

Based on the findings of the boreholes and the soil types encountered, the following soil parameters are suggested for design of retaining walls:

Soil Type	Bulk density γ_b (kN/m^3)	Undrained Shear Strength (Temporary Condition)	Long Term Drained Condition	
			c' (kN/m^2)	φ^o
Made Ground	19	N/A	0	25
Weathered London Clay	20	Cu=50kPa@2m depth (surface of London Clay) increasing linearly with depth to 100kPa @6.0m depth	0	25

22 Excavations and Trenching

Statutory lateral earth support will be required in all excavations where men must work. Instability of the sides of any excavations carried out must be expected. Accordingly, measures should be taken at all times to ensure that excavations are adequately supported. Given the presence of the existing adjacent foundations (boundary walls and properties), close attention in design of temporary and permanent propping is required at all times, to prevent settlement or excessive lateral yielding of the excavation/foundations.

G LAND QUALITY

23 Analytical Framework

There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.

The CLEA model[6] provides a methodology for quantitative assessment of the long term risks posed to human health by exposure to contaminated soils. Toxicological data is used to calculate a Soil Guideline Value (SGV) for an individual contaminant, based on the proposed site use; these represent minimal risk concentrations and may be used as screening values.

In the absence of any published SGVs for certain substances, Southern Testing have derived or adopted Tier 1 screening values for initial assessment of the soil, based on available current UK guidance including the LQM/CIEH[7] and CL:AIRE[8] generic assessment criteria. In addition, in March 2014, DEFRA[9] published the results of a research programme to develop screening values to assist decision making under Part 2A of the Environmental Protection Act. Category 4 screening levels were published for 6 substances, with reference to human health risk only. This guidance includes revisions of the CLEA exposure parameters, presenting parameters for public open space land use scenarios, and also of the toxicological approach. The screening levels represent a low risk scenario, based on a 'Low Level of Toxicological Concern' rather than the 'Minimal Risk' of CLEA, and the analytical results of this investigation may be considered relative to these levels.

Site-specific assessments are undertaken wherever possible and/or applicable.

CLEA requires a statistical treatment of the test results to take into account the normal variations in concentration of potential contaminants in the soil and allow comparisons to be made with published guidance.

Whilst a formal contamination investigation was outside the requested scope of works (the intrusive investigation did not include a desk study or a conceptual model, for example), some

[6] Environment Agency Publication SC050021/SR3 'Updated technical background to the CLEA Model' (2009).
[7] The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment 2nd Edn. (2009).
[8] The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment (2009).
[9] SP1010 Development of Category 4 Screening Levels foe Assessment of Land Affected by Contamination. DEFRA, 2014.

basic contamination testing was undertaken to help assess the risk to site workers, as well as providing data to assist with the waste classification of any material taken off-site.

24 Site Investigation – Soil

24.1 Sampling Regime

The number of sample locations was to provide reasonable coverage of the area of the proposed works.

24.2 Testing

As there was no evidence of significant contamination noted during the site work, the following tests were undertaken to allow a general assessment of the contamination and waste classification.

Test Suite	Number of Samples	Soil Tested
STL Key Contaminant Suite and Asbestos Screen	2	Made Ground
STL Key Contaminant Suite	1	Natural Soils

The test results are presented in full in Appendix F. A summary and discussion of the significance of the results and identified contamination sources is given below.

24.3 Test Results and Identified contamination sources

24.3.1 General Contaminants

The results of the key contaminant tests have been analysed in accordance with the CLEA methodology. The samples have been grouped into two populations comprising made ground and natural soils although, as only two sample of the made ground and one sample of the natural London Clay soil was analysed, a statistical assessment was not possible. The test results are presented below, along with the screening values (to allow a basic assessment).

Soil Type: Made Ground

Contaminant	Unit	Measured Range (mg/kg)	Screening value
			Residential with Plant Uptake
Arsenic	mg/kg	15-22	32
Cadmium	mg/kg	0.1	10
Total Chromium	mg/kg	23-27	627
Lead	mg/kg	**450-540**	200
Mercury	mg/kg	1.1-3.7	7
Selenium	mg/kg	<3	350
Nickel	mg/kg	22	130
Copper	mg/kg	66-250	2300

Contaminant	Unit	Measured Range (mg/kg)	Screening value
			Residential with Plant Uptake
Zinc	mg/kg	110-150	3700
Phenol	mg/kg	<1	184-420
Benzo(a)pyrene	mg/kg	<0.1	0.8
Naphthalene	mg/kg	<0.1	1.5
Total Cyanide	mg/kg	<1	-

The made ground material analysed was generally free from significant contamination, with the exception of some fairly minor lead impact. In our experience, however, the lead concentrations reported are fairly typical of made ground material in London and is not considered significant in terms of the development proposals and the likely risk to the site workers (assuming basic health and safety measures are adopted) and the end users.

Soil Type: Natural Soils (Weathered London Clay)

Contaminant	Unit	Measured Range (mg/kg)	Screening value
			Residential with Plant Uptake
Arsenic	mg/kg	15	32
Cadmium	mg/kg	<0.1	10
Total Chromium	mg/kg	49	627
Lead	mg/kg	**210**	200
Mercury	mg/kg	<1	7
Selenium	mg/kg	<3	350
Nickel	mg/kg	58	130
Copper	mg/kg	97	2300
Zinc	mg/kg	130	3700
Phenol	mg/kg	<1	184-420
Benzo(a)pyrene	mg/kg	<0.1	0.8
Naphthalene	mg/kg	<0.1	1.5
Total Cyanide	mg/kg	<1	-

The contamination results for the natural soil analysed, with the exception of lead, were all less than their corresponding screening values. This concurs with the observations made on site and the results for the overlying fill material analysed. In most instances, the concentrations for corresponding contaminants were much lower in the natural soil analysed (even in the case of lead, for example), which suggests minimal leaching and a low risk to the aquifer.

Whilst no asbestos containing materials were detected in the samples of made ground and natural soil analysed, and none were observed in the exploratory holes, it should be noted that the exploratory hole was of small diameter/size, so the samples obtained may not reflect the full composition of the soils on the site. Therefore, there is always the potential for pockets of asbestos or for asbestos containing materials to be present, which have not been detected in the sampling.

It is also our experience that asbestos containing materials are quite often encountered in buried pockets and beneath slabs (sometimes adhering to the concrete). It is, therefore, advised that further examination is carried out, when suitable access is available.

All of the results should be forwarded to the tip for their appraisal and comments. Given that the made ground material is slightly impacted with lead, it would be prudent to separate the fill material from the natural arisings during construction. The tip might require that WAC testing is carried out.

Encountering more significant contamination, during the development works, could change the waste classification and the health and safety practices required on site.

25 Summary of Identified Contamination

Although a wider contamination investigation was outside the requested scope of works, soil analysis of two samples of the made ground and one sample of the natural Weathered London Clay has indicated that the Made Ground and underlying natural soils tested is largely free from significant contamination. Some minor impact with lead was reported in the Made Ground samples analysed, however, although less so in the natural soil sample tested. In our experience, this is typical of Made Ground in London and not considered significant in terms of the proposed development.

26 Recommendations

It is anticipated that the made ground soils and natural soils on site will be removed, as part of the basement construction in particular, and deposited at an appropriate waste management facility. No remediation is considered necessary at this stage.

The contamination results should be forwarded to this facility for confirmation of the waste classification, particularly whether the slight lead impact of the fill, will results in something other than an inert classification. The tip might require that WAC testing is carried out.

On the basis of these results, it appears that good general site practice, such as appropriate PPE and basic hygiene measures, will be sufficient to mitigate any minor risk to the ground workers. As with the waste management facility, these results should be provided to the ground workers for their appraisal.

A careful watch should be kept for any more significant contamination that comes to light during the construction works, as part of a discovery strategy. This will need inspection, sampling and analysis; depending on the results, this may alter the remediation strategy, the waste classification and, possibly, site practices.

H CONSIDERATIONS FOR IMPLEMENTATION AND VALIDATION OF REMEDIATION

27 General Guidance

It may be that specific local requirements apply to this site, of which we are not aware at this time.

In general terms, the workforce and general public should be protected from contact with contaminated material. There is a range of relevant documents published by the Health and Safety Executive, and organisations such as CIRIA, and the BRE.

Some soils will require removal from site and disposal to suitably licensed landfills. Different guidelines and charges will apply to different waste classification. As waste producers, the Developer holds responsibilities under the various governing regulations, the key elements of which are:-

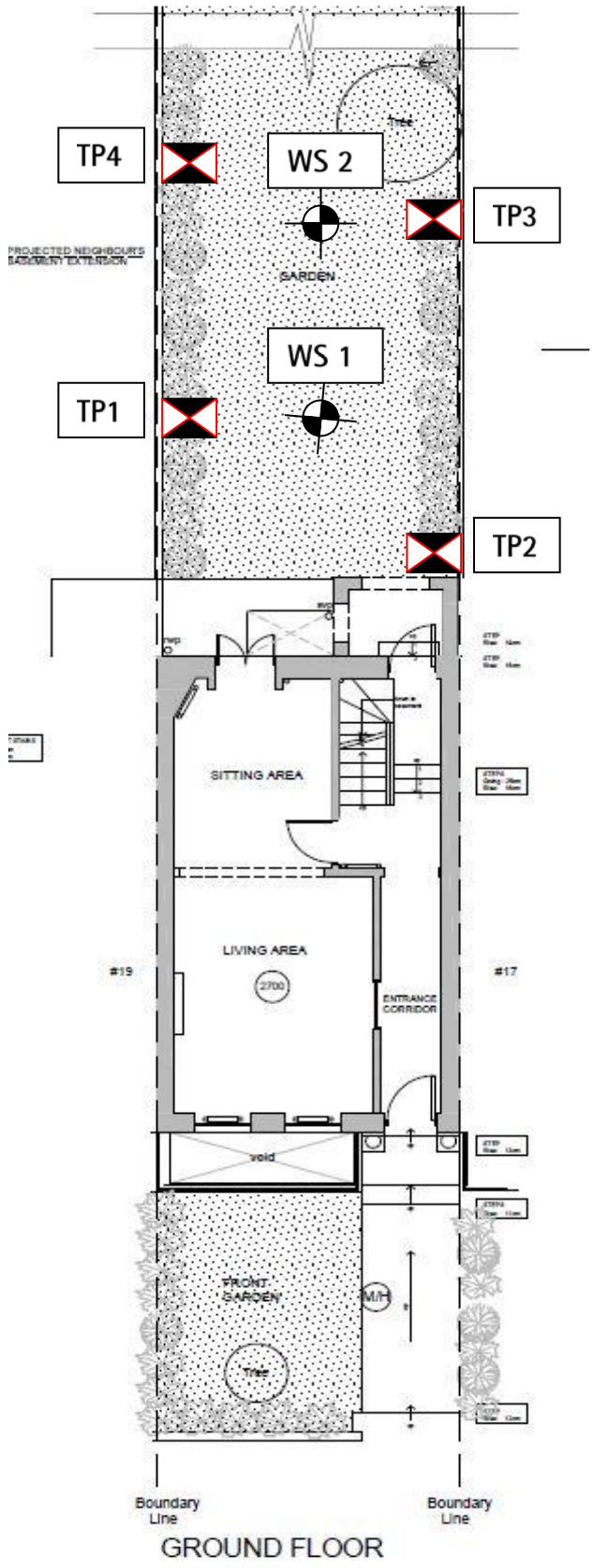
- Ensuring that waste is characterised in accordance with Technical Guidance WM2.
- Ensuring that waste is disposed of at a facility appropriately licensed to receive the waste as classified.
- Keeping accurate records of all waste classification, transfer and a disposal log including information such as:
    - Date, Waste Classification, Carrier's Registration Number, Transfer Note Number, Ultimate Destination.
- Submitting full copies of those records for inclusion in validation/closure reports.
- Maintaining those records for potential future regulatory inspection.

All hazardous and non-hazardous soils leaving site will need to be pre-treated.

Many water supply companies now require higher specification pipe on contaminated sites, even following remediation.

APPENDIX A

Site Plans and Exploratory Hole Logs and Photographs



NB:	Positions of Boreholes and/or Trial Pits are only indicative unless dimensioned		
Site:	18 Grove Terrace, London NW5	STL: J11987	Fig No: 1
Date:	06 October 2014	Trial Pit and Borehole Location Plan	

Southern Testing

Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA
ST Consult: Twigden Barns, Brixworth Road, Creaton, Northampton NN6 8NN

ST Consult

Southern Testing | ST Consult
Environmental & Geotechnical

Tel: 01342 333100

Project No.	Hole Type	Borehole No
J11987	WS	**WS1** Sheet 1 of 1

Project Name: 18 Grove Terrace (London NW5)

Dates: 23/09/2014

Location: London NW5

NGR: -

Client: Archetype Associates Limited

Level: -

Logged By: SM

Well	Water Strikes	Depth (m)	Type	Results	Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
						0.06		0.06	Crazy Paving
		0.50	ES			0.59		0.65	MADE GROUND composed of grey brown, slightly silty/sandy, CLAY, with frequent fine to coarse, sub-angular fragments of brick, ceramic, concrete and occasional medium to coarse, sub-rounded flint gravel.
		1.00	D			0.45		1.10	MADE GROUND composed of grey CLAY, with frequent fine brick fragments and occasional ash and concrete fragments.
		1.50		UCS = 90		0.90			MADE GROUND composed of grey brown, slightly silty, CLAY, with occasional medium to coarse, brick fragments.
		1.50	D						1.50m - 2.00m: Occasional fine to medium, sub-rounded flint gravel.
		1.75		UCS = 120					
		2.00		UCS = 80				2.00	Firm to stiff, medium to high strength, grey brown, CLAY, with occasional silty patches and selenite crystals.
		2.00	D						
		2.00	ES						
		2.25		UCS = 110					
		2.50		UCS = 160					
		2.50	D						
		2.75		UCS = 160					
		3.00		UCS = 190					
		3.00	D						
		3.25		UCS = 230					
		3.50		UCS = 180					
		3.50	D						
		3.75		UCS = 220					
		4.00		UCS = 320		4.00			
		4.00	D						
		4.25		UCS = 200					
		4.50		UCS = 250					
		4.50	D						
		4.75		UCS = 250					
		5.00		UCS = 270					
		5.00	D						
		5.25		UCS = 320					
		5.50		UCS = 280					
		5.50	D						
		5.75		UCS = 320					
		6.00		UCS = 380				6.00	End of Borehole at 6.00 m
		6.00	D						

	Type	Results

Borehole Details

Casing Depth (m bgl)	Hole Depth (m bgl)	Casing Diameter (mm)

Water Strikes

Date	Water (m)	Casing (m)	Time (mins)	Rose to (m)	Sealed (m)

General Remarks:

Hole dry on completion.

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Tel: 01342 333100

Project No.	Hole Type	Borehole No
J11987	WS	**WS2** Sheet 1 of 1

Project Name: 18 Grove Terrace (London NW5)

Dates: 23/09/2014

Location: London NW5

NGR: -

Client: Archetype Associates Limited

Level: -

Logged By: SM

Well	Water Strikes	Depth (m)	Type	Results	Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
						0.06		0.06	Crazy Paving (Concrete Slab)
		0.50	ES			0.56			MADE GROUND composed of grey brown to yellow, slightly clayey, silty, SAND, with frequent fragments of fine to medium brick and ash.
		0.70	D					0.62	
		1.00	D			0.78			MADE GROUND composed of grey brown, slightly sandy, CLAY, with frequent fine, sub-angular brick fragments and occasional rootlets.
		1.50		UCS = 150				1.40	
		1.50	D						Firm, medium to high strength, grey blue, silty, CLAY.
		1.60	ES						
		1.75		UCS = 170		0.70			
		2.00		UCS = 210					
		2.00	D					2.10	
		2.25		UCS = 200					Firm to stiff, medium to high strength, orangey brown, silty, CLAY, with occasional fine to medium, sub-rounded flint gravel, selenite crystals and sandy lenses/patches.
		2.50		UCS = 260					
		2.50	D						
		2.75		UCS = 310					
		3.00		UCS = 310					
		3.00	D						
		3.25		UCS = 400					
		3.50		UCS = 410					
		3.50	D						
		3.75		UCS = 380					
		4.00		UCS = 370		3.90			
		4.00	D						
		4.50		UCS = 120					
		4.50	D						
		4.75		UCS = 300					
		5.00		UCS = 260					
		5.00	D						
		5.25		UCS = 340					
		5.50		UCS = 320					
		5.50	D						
		5.75		UCS = 380					
		6.00		UCS = 300				6.00	
		6.00	D						End of Borehole at 6.00 m

	Type	Results

Borehole Details

Casing Depth (m bgl)	Hole Depth (m bgl)	Casing Diameter (mm)

Water Strikes

Date	Water (m)	Casing (m)	Time (mins)	Rose to (m)	Sealed (m)

General Remarks:

Hole dry on completion.

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Tel: 01342 333100

Project No.	Machine Type	Trialpit No
J11987	**Hand Dug**	**TP1** Sheet 1 of 1

Project Name: 18 Grove Terrace (London NW5)

NGR: -
Level: -

Date: 23/09/2014

Location: London NW5

Dimensions: 0.50m
Depth 1.40m
0.70m

Client: Archetype Associates Limited

Logged By AW

Samples & In Situ Testing			Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
Depth (m)	Type	Results					
				0.06		0.06	Crazy Paving.
				0.15			MADE GROUND composed of brown to black, silty, sandy, CLAY, with frequent fine to medium, angular brick fragments, occasional fine to medium glass, ceramic fragments, fine to medium ash and rootlets throughout (TOPSOIL).
						0.21	MADE GROUND composed of grey brown, slightly silty, CLAY, with frequent fine angular brick fragments and occasional cobbles of sub-angular bricks.
0.50	D						
				1.19			
1.00	D						
						1.40	Trial Pit Complete at 1.40 m

1

Remarks: Stable and dry on completion.

Pit Stability:

Groundwater:

PPT = Perth Penetration Test 'N' Value , UCS = Unconfined Compressive Strength (kN/m2) by Hand Penetrometer, HV= Hand Vane Result (kPa)

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Tel: 01342 333100

Project No.	Machine Type	Trialpit No
J11987	**Hand Dug**	**TP2** Sheet 1 of 1

Project Name: 18 Grove Terrace (London NW5)

NGR: -
Level: -

Date: 23/09/2014

Location: London NW5

Dimensions: 0.60m
Depth 1.47m
0.32m

Client: Archetype Associates Limited

Logged By AW

Samples & In Situ Testing			Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
Depth (m)	Type	Results					
				0.06		0.06	Crazing Paving.
0.30	ES			0.76			MADE GROUND composed of dark grey to brown, silty, sandy, CLAY, with occasional fine to medium, angular brick fragments, ceramic fragments, ash and rootlets throughout (TOPSOIL).
0.50	D						
1.00	D			0.42		0.82	MADE GROUND composed of grey brown, slightly silty, CLAY, with frequent fine angular brick fragments and occasional cobbles of sub-angular bricks.
1.40	ES			0.23		1.24	Soft to firm, low to medium strength, orange brown, slightly silty, CLAY.
1.47	D					1.47	Trial Pit Complete at 1.47 m

Remarks: Stable and dry on completion.

Pit Stability:

Groundwater:

PPT = Perth Penetration Test 'N' Value , UCS = Unconfined Compressive Strength (kN/m2) by Hand Penetrometer, HV= Hand Vane Result (kPa)

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Tel: 01342 333100

Project No.	Machine Type	Trialpit No
J11987	**Hand Dug**	**TP3** Sheet 1 of 1

Project Name: 18 Grove Terrace (London NW5)

NGR: -
Level: -

Date: 23/09/2014

Location: London NW5

Dimensions: 0.50m
Depth 1.10m
0.28m

Client: Archetype Associates Limited

Logged By AW

Samples & In Situ Testing			Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
Depth (m)	Type	Results					
				0.06		0.06	Crazy Paving.
							MADE GROUND composed of dark brown to black, silty, sandy, CLAY, with frequent fragments of fine to medium, sub-angular brick, ash and occasional ceramic and rootlets throughout.
0.20	D			0.30			
0.30	ES					0.36	
							MADE GROUND composed of brown/black, silty CLAY, with occasional fragments of medium to coarse, sub-angular to sub-rounded, brick, concrete, ceramic, and fine to coarse, sub-rounded, flint gravel.
0.50	D						
0.60	ES						
				0.64			
						1.00	1
							MADE GROUND composed of soft to firm, low to medium strength, grey brown, slightly silty, CLAY, with occasional fine sub-angular brick fragments.
1.05		UCS = 120		0.10			
1.05	D					1.10	
							Trial Pit Complete at 1.10 m

Remarks: Stable and dry on completion.

Pit Stability:

Groundwater:

PPT = Perth Penetration Test 'N' Value , UCS = Unconfined Compressive Strength (kN/m2) by Hand Penetrometer, HV= Hand Vane Result (kPa)

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Tel: 01342 333100

Project No.	Machine Type	Trialpit No
J11987	**Hand Dug**	**TP4** Sheet 1 of 1

Project Name: 18 Grove Terrace (London NW5)

NGR: -
Level: -

Date: 23/09/2014

Location: London NW5

Dimensions: 0.72m
Depth 1.30m
0.38m

Client: Archetype Associates Limited

Logged By AW

Samples & In Situ Testing			Level (m AOD)	Thickness	Legend	Depth (m)	Stratum Description
Depth (m)	Type	Results					
				0.65			MADE GROUND composed of black to brown, silty, sandy, CLAY, with frequent fragments of fine to medium, angular brick, occasional fine to medium, glass, ceramic and ash, rootlets throughout.
0.50	D						
						0.65	
0.70	ES						MADE GROUND composed of grey brown, slightly silty, CLAY, with frequent fine, angular brick fragments and occasional sub-angular brick cobbles.
				0.65			
1.00	D						
1.30	D					1.30	Trial Pit Complete at 1.30 m

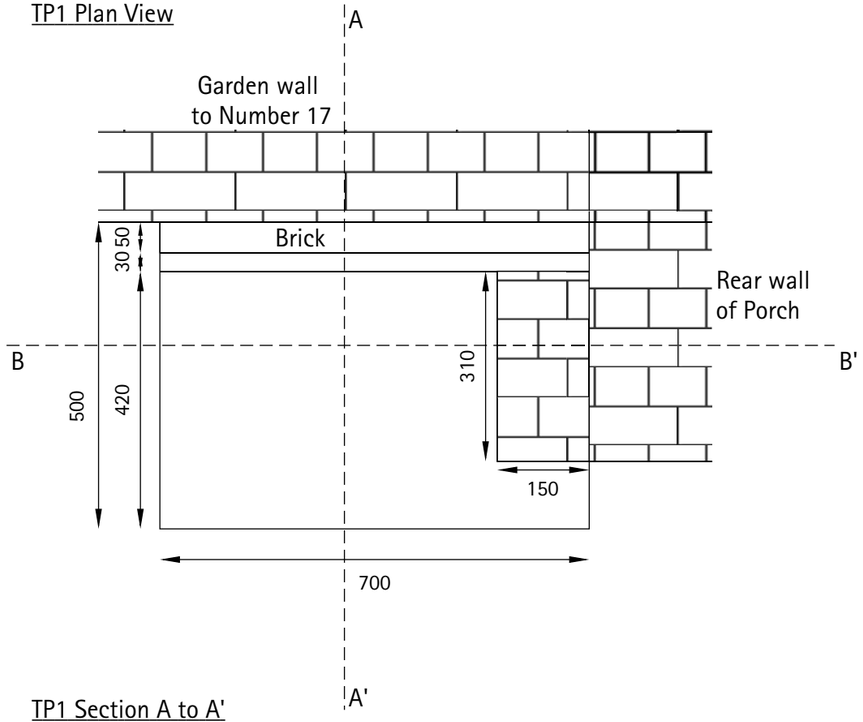
Remarks: Stable and dry on completion.

Pit Stability:

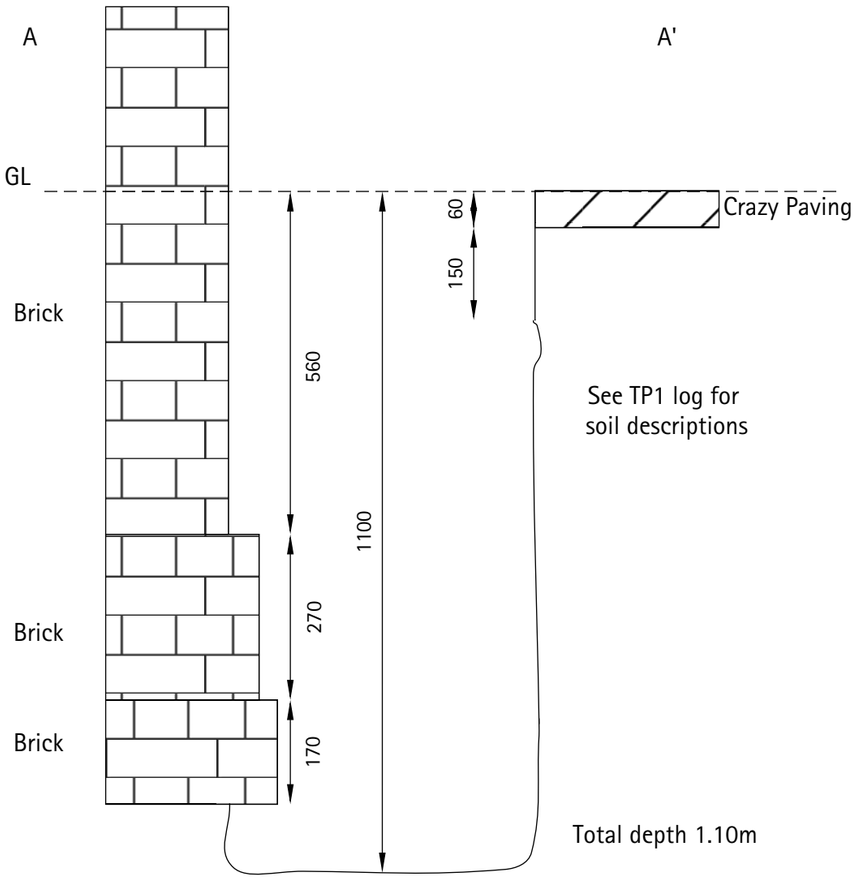
Groundwater:

PPT = Perth Penetration Test 'N' Value , UCS = Unconfined Compressive Strength (kN/m2) by Hand Penetrometer, HV= Hand Vane Result (kPa)

TP1 Plan View



TP1 Section A to A'



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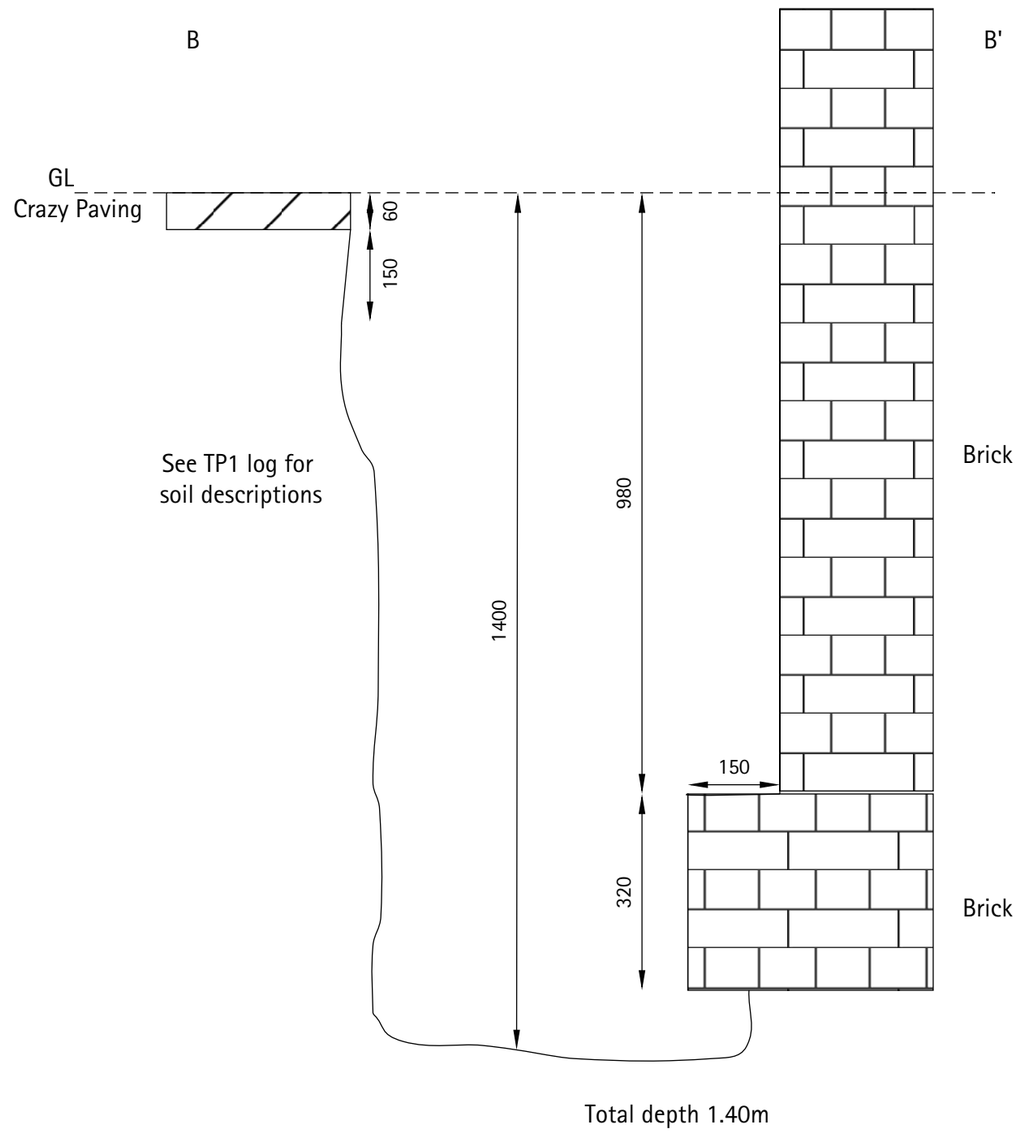

Notes

1. All dimensions in mm unless stated otherwise.

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Keeble House, Stuart Way, East Grinstead,
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Tel: 01342 333100 Fax: 01342 410321
www.southerntesting.co.uk

Client: Archetype Associates Limited

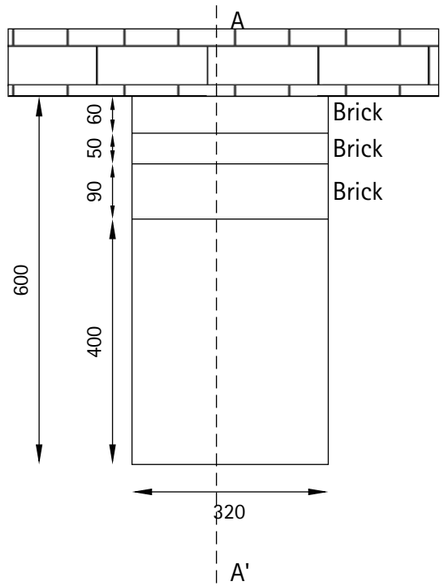
Job Title: 18 Grove Terrace (London NW5)

Description: Trial Pit Sections

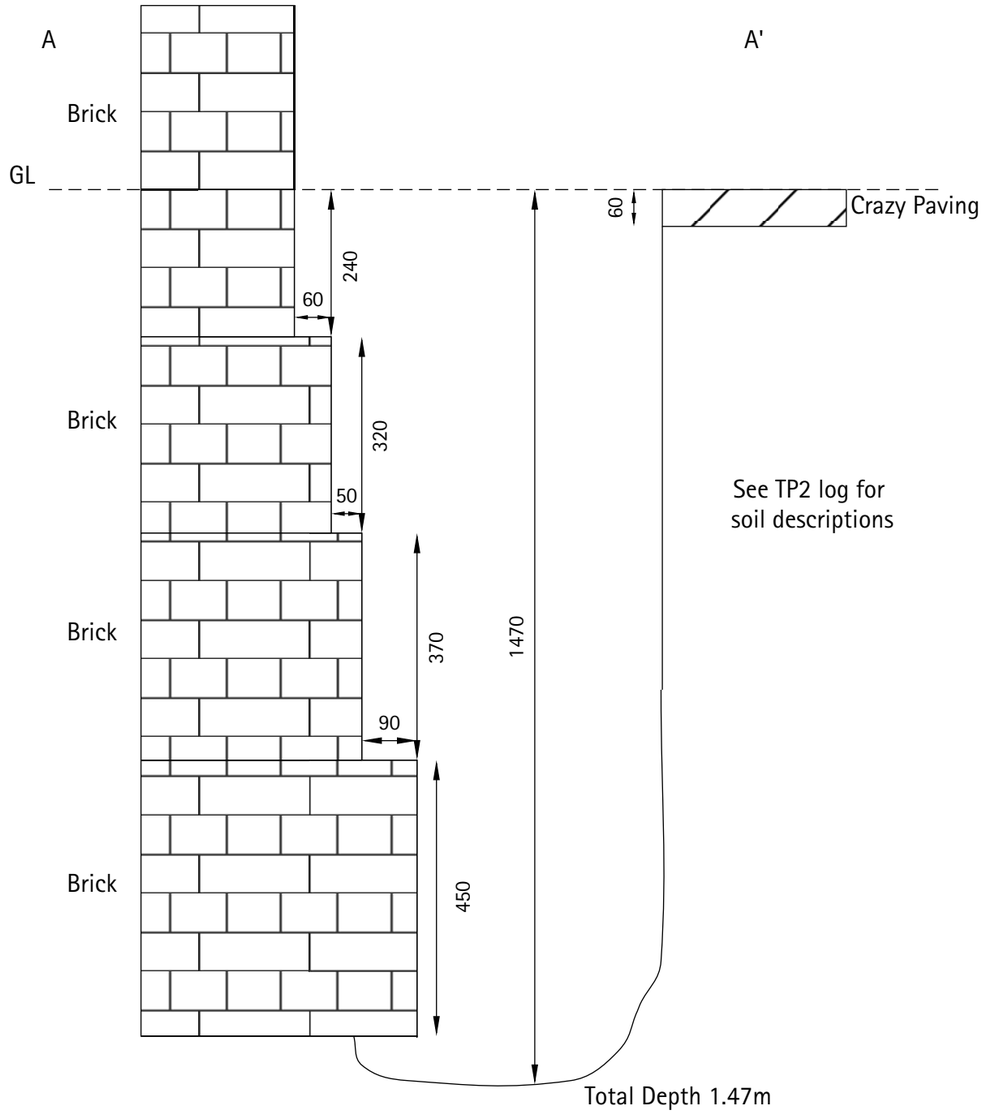
Drawing No: TPA

Scale: 1:100	Paper Size: A3
Drawn by: SM	Checked by: DV
Date: 23/09/2014	

TP2 Plan View



TP2 Section A to A'



Notes

1. All dimensions in mm unless stated otherwise.

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Client: Archetype Associates Limited

Job Title: 18 Grove Terrace (London NW5)

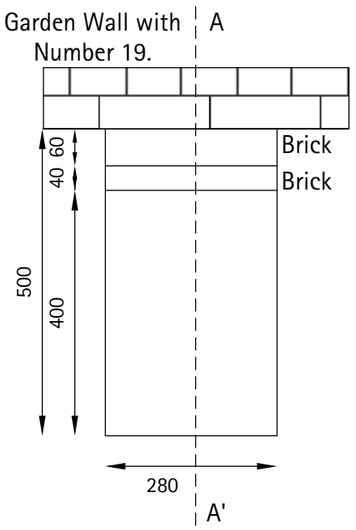
Description: Trial Pit Sections

Drawing No: TP2

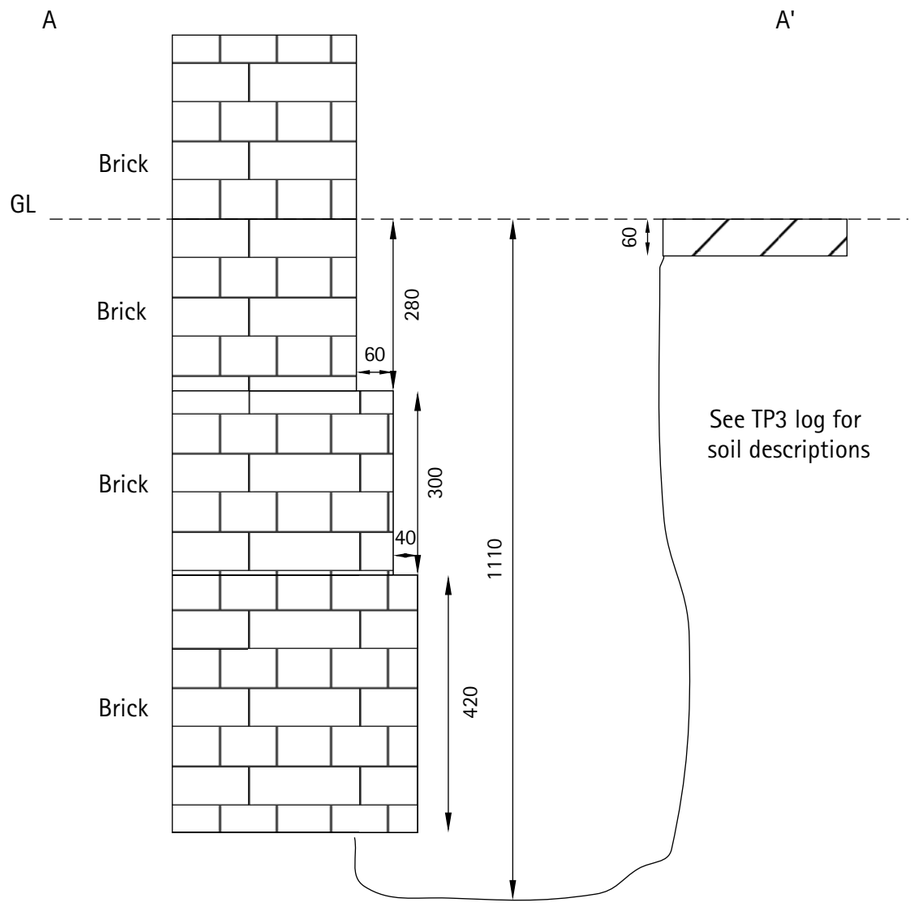
Scale: 1:100	Paper Size: A3
Drawn by: SM	Checked by: DV

Date: 23/09/2014

TP3 Plan View



TP3 Section A to A'



Total Depth 1.10m

Notes

1. All dimensions in mm unless stated otherwise.

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Tel: 01342 333100 Fax: 01342 410321
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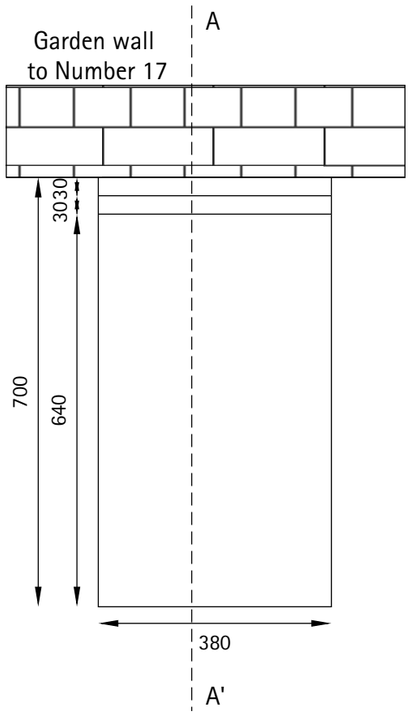
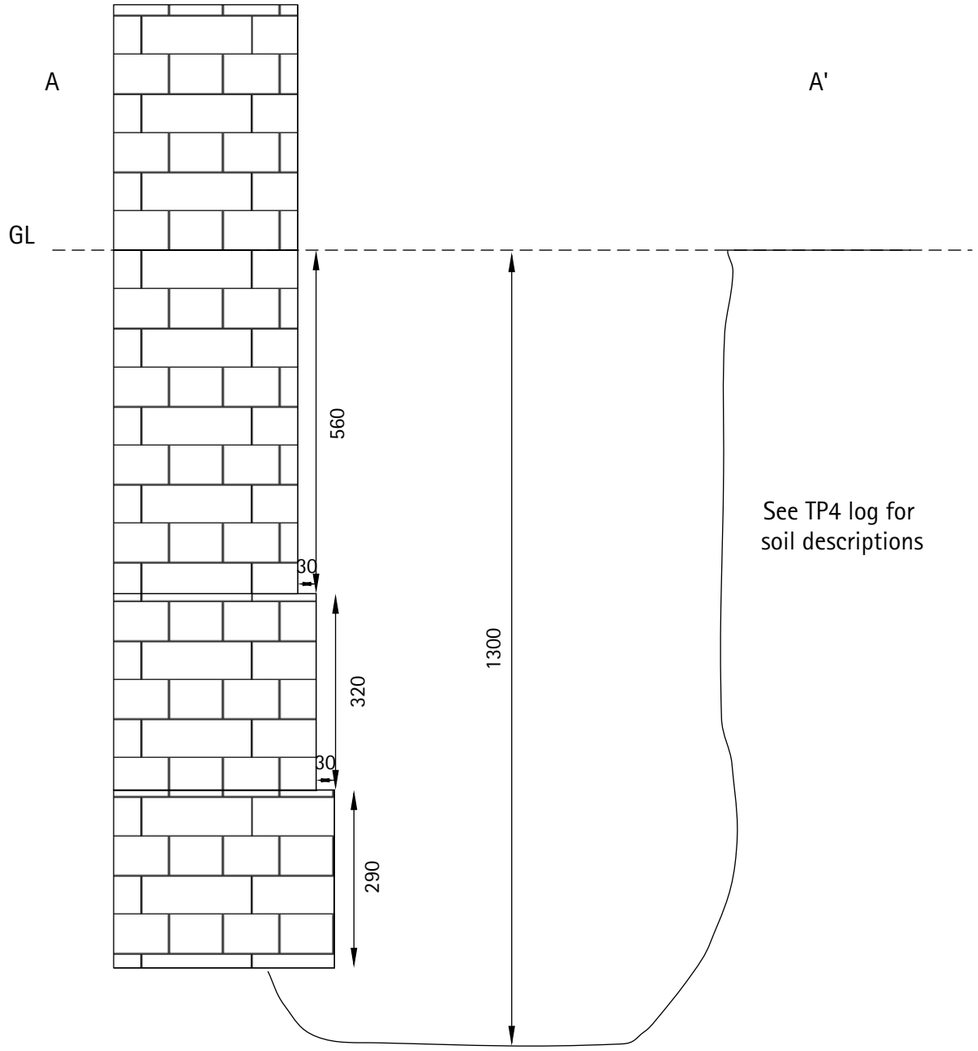
Client: Archetype Associates Limited	
Job Title: 18 Grove Terrace (London NW5)	
Description: Trial Pit Sections	
Drawing No: TP3	
Scale: 1:100	Paper Size: A3
Drawn by: SM	Checked by: DV
Date: 23/09/2014	

TP4 Plan View



TP4 Section A to A'



Total Depth 1.30m

Notes

1. All dimensions in mm unless stated otherwise.

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www.southerntesting.co.uk

Client: Archetype Associates Limited	
Job Title: 18 Grove Terrace (London NW5)	
Description: Trial Pit Sections	
Drawing No: TP4	
Scale: 1:100	Paper Size: A3
Drawn by: SM	Checked by: DV
Date: 23/09/2014	

TP1

TP2

TP3

TP4

APPENDIX B

Field Sampling and in-situ Test Methods & Results

Field Sampling and in-situ Test Methods

Disturbed Samples

Disturbed samples were taken from the trial holes intervals and stored in sealed glass jars and polythene bags, as appropriate.

Hand Penetrometer Test

The hand penetrometer consists of a spring loaded and calibrated plunger which is forced into the soil. A reading of unconfined compression strength (equal to twice cohesion) is given on a calibrated scale. In common with other hand methods of strength assessment (eg. the shear vane) it does not give an accurate indication of bearing capacity in stiff or fissured soils, because of the small test area. The figures are used for strength classification according to the table below

.

Hand Penetrometer Value (kPa)	Undrained Shear Strength cu (kPa)	Undrained Shear Strength of Clays
Less than 20	Less than 10	Extremely Low
20 to 40	10 to 20	Very Low
40 to 80	20 to 40	Low
80 to 150	40 to 75	Medium
150 to 300	75 to 150	High
300 to 600	150 to 300	Very High
More than 600	More than 300	Extremely High

APPENDIX C

Geotechnical Laboratory Test Methods & Results

Southern Testing | ST Consult

Atterberg and Moisture Content Summary

To BS1377-2:1990(2003) cl.3.2, 3.3, 4.2, 4.3

AGS

Project Name	18 Grove Terrace (London NW5)			Project Number	J11987
Client	Archetype Associates Limited	PE	DV	Date Issued	07-Oct-14

Location	Depth m	Sample Type	Visual Description	Comments	Natural MC %	Liquid Limit %	Plastic Limit %	Plasticity Index	Classi-fication	Passing 425 micron %
WS1	2.00	D	*Soft low strength light brown sandy CLAY with frequent fine sandstone gravel.*	*Sieve Prep*	*33*	*54*	*22*	*32*	*CH*	*88*
WS1	2.50	D			*27*					
WS1	3.00	D	*Stiff high strength light brown CLAY.*		*26*	*56*	*25*	*31*	*CH*	*100*
WS1	3.50	D			*23*					
WS1	4.00	D	*Stiff high strength light brown CLAY.*		*22*	*60*	*28*	*32*	*CH*	*100*
WS1	4.50	D			*29*					
WS1	5.00	D	*Stiff high strength light brown CLAY.*		*27*	*59*	*20*	*39*	*CH*	*100*
WS1	5.50	D			*29*					
WS1	6.00	D			*30*					
WS2	1.50	D	*Stiff high strength grey oxidised brown organic CLAY.*		*35*	*73*	*23*	*50*	*CVO*	*100*

Southern Testing | ST Consult

Atterberg and Moisture Content Summary

To BS1377-2:1990(2003) cl.3.2, 3.3, 4.2, 4.3

AGS

Project Name	*18 Grove Terrace (London NW5)*					Project Number		*J11987*	
Client	*Archetype Associates Limited*			PE	*DV*	Date Issued		*07-Oct-14*	

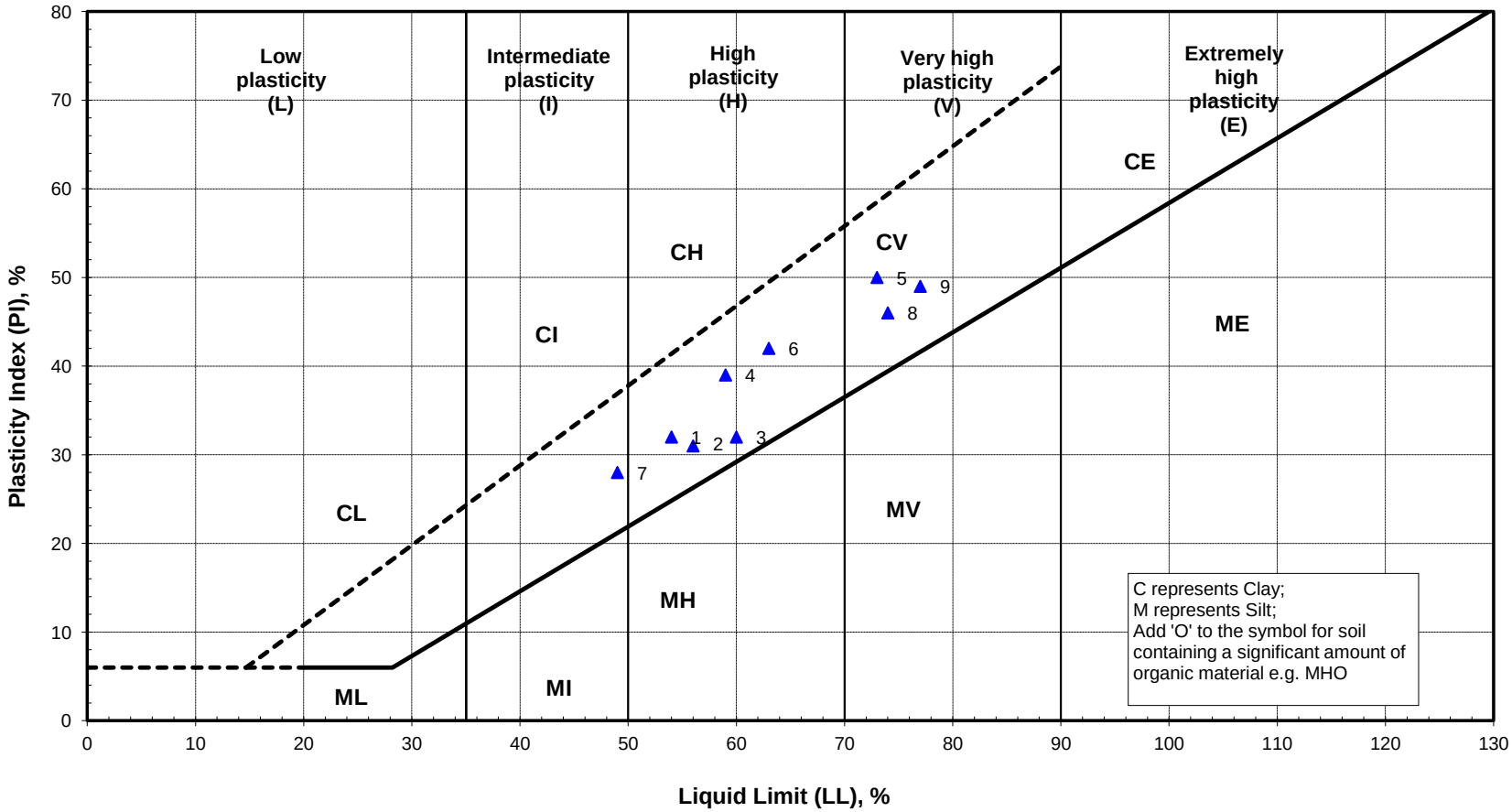
Location	Depth m	Sample Type	Visual Description	Comments	Natural MC %	Liquid Limit %	Plastic Limit %	Plasticity Index	Classi-fication	Passing 425 micron %
WS2	2.00	D	*Stiff high strength brown grey sandy CLAY with occasional sandstone gravel.*		*26*	*63*	*21*	*42*	*CH*	*98*
WS2	2.50	D			*25*					
WS2	3.00	D	*Stiff high strength light brown CLAY.*		*20*	*49*	*21*	*28*	*CI*	*100*
WS2	3.50	D			*26*					
WS2	4.00	D	*Stiff high strength light brown CLAY.*		*30*	*74*	*28*	*46*	*CV*	*100*
WS2	4.50	D			*38*					
WS2	5.00	D	*Stiff very high strength light brown CLAY.*		*31*	*77*	*28*	*49*	*CV*	*100*
WS2	5.50	D			*32*					
WS2	6.00	D			*30*					

Plasticity Chart for Atterberg Limit Tests

Project Name	*18 Grove Terrace (London NW5)*			**Project Number**	*J11987*
Client Name	*Archetype Associates Limited*	**PE**	*DV*	**Date Issued**	*07-Oct-14*

Key

No.	TH No.	Depth
1	WS1	2.00
2	WS1	3.00
3	WS1	4.00
4	WS1	5.00
5	WS2	1.50
6	WS2	2.00
7	WS2	3.00
8	WS2	4.00
9	WS2	5.00



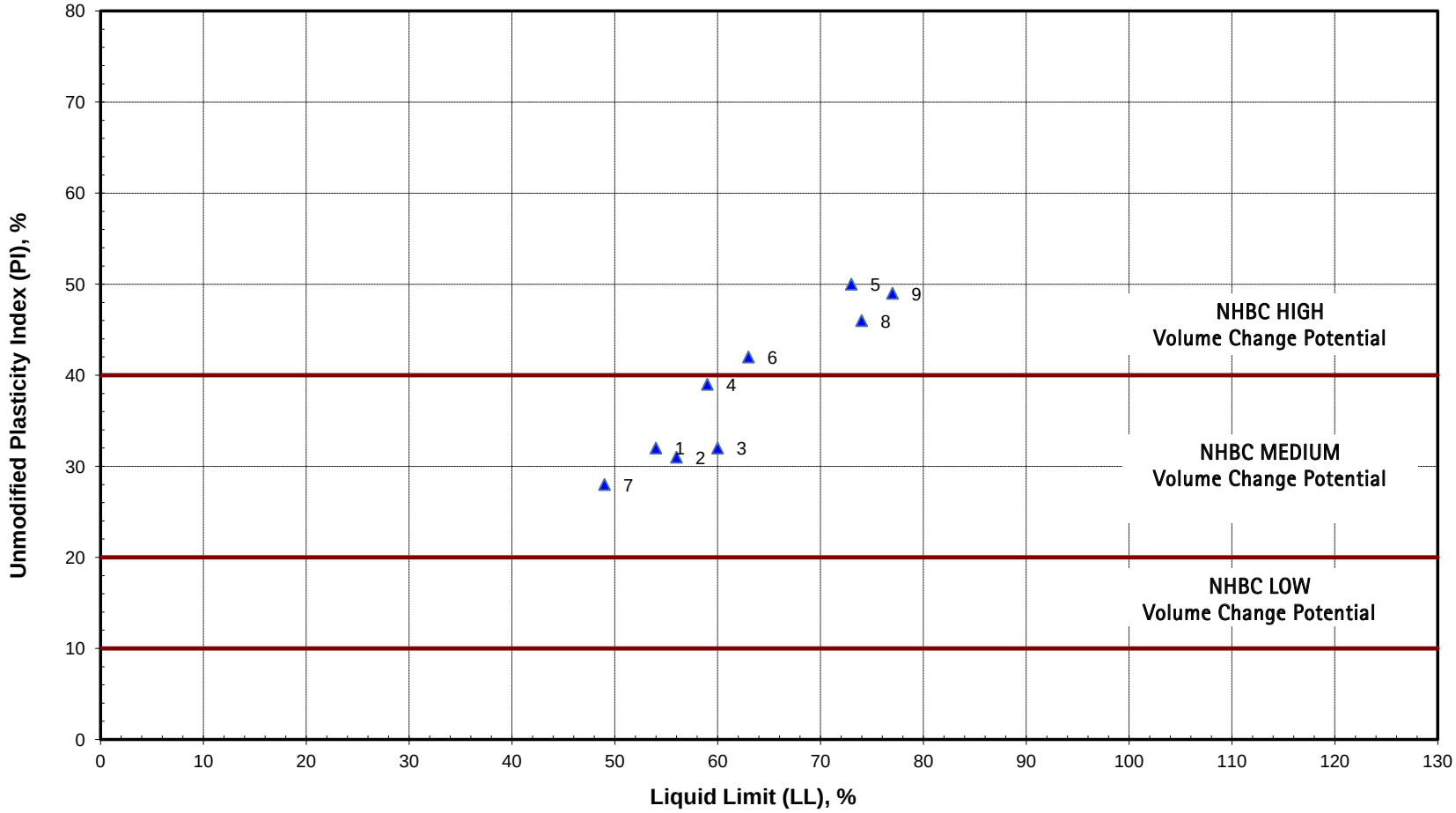
Liquid Limit		**Plastic Limit**		**Plasticity Index**	
Maximum Value	77	Maximum Value	28	Maximum Value	50
Minimum Value	49	Minimum Value	20	Minimum Value	28
Average Value	63	Average Value	24	Average Value	39

NHBC Classification for Volume Change Potential

Project Name	*18 Grove Terrace (London NW5)*			**Project Number**	*J11987*
Client Name	*Archetype Associates Limited*	**PE**	*DV*	**Date Issued**	*07-Oct-14*

Key

No.	TH No.	Depth
1	WS1	2.00
2	WS1	3.00
3	WS1	4.00
4	WS1	5.00
5	WS2	1.50
6	WS2	2.00
7	WS2	3.00
8	WS2	4.00
9	WS2	5.00



Liquid Limit		**Plastic Limit**		**Unmodified Plasticity Index**	
Maximum Value	77	Maximum Value	28	Maximum Value	50
Minimum Value	49	Minimum Value	20	Minimum Value	28
Average Value	63	Average Value	24	Average Value	39

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CHEMICAL & ELECTROCHEMICAL TESTING SUMMARY

To BS1377-3:1990(2003) cl 5.6 & 9.5

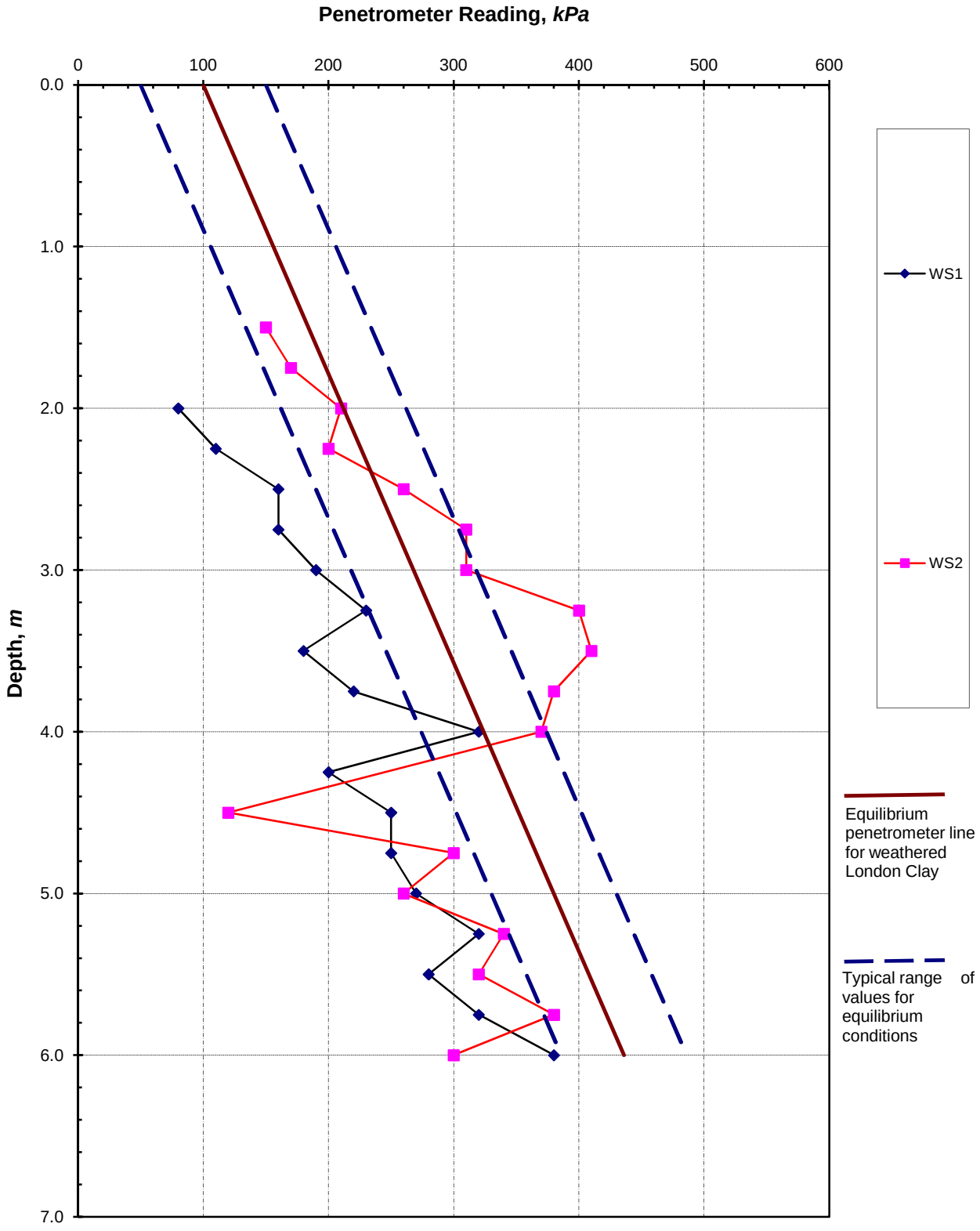
AGS

Project Name	18 Grove Terrace (London NW5)					Project Number	J11987
Client	Archetype Associates Limited			PE	*DV*	Date Issued	*07-Oct-14*

TH No.	Depth m	Sample Type	Visual Description	Comments	Passing 2mm %	pH Value	Soil Sulphate 2:1 Water Extract		Groundwater Sulphate	
							g/l SO_3	BRE mg/l SO_4	g/l SO_3	BRE mg/l SO_4
WS1	2.50	D	Stiff high strength light brown CLAY.		100.0	7.8	0.08	96		
WS1	3.50	D	Stiff high strength light brown CLAY.		100.0	7.6	0.78	941		
WS2	1.50	D	Stiff high strength grey oxidised brown organic CLAY.		100.0	8.1	0.21	250		
WS2	4.50	D	Firm high strength light brown CLAY.		100.0	7.1	0.42	499		

Pocket Penetrometer Reading *vs* Depth

Test Hole Nos: WS1 and WS2

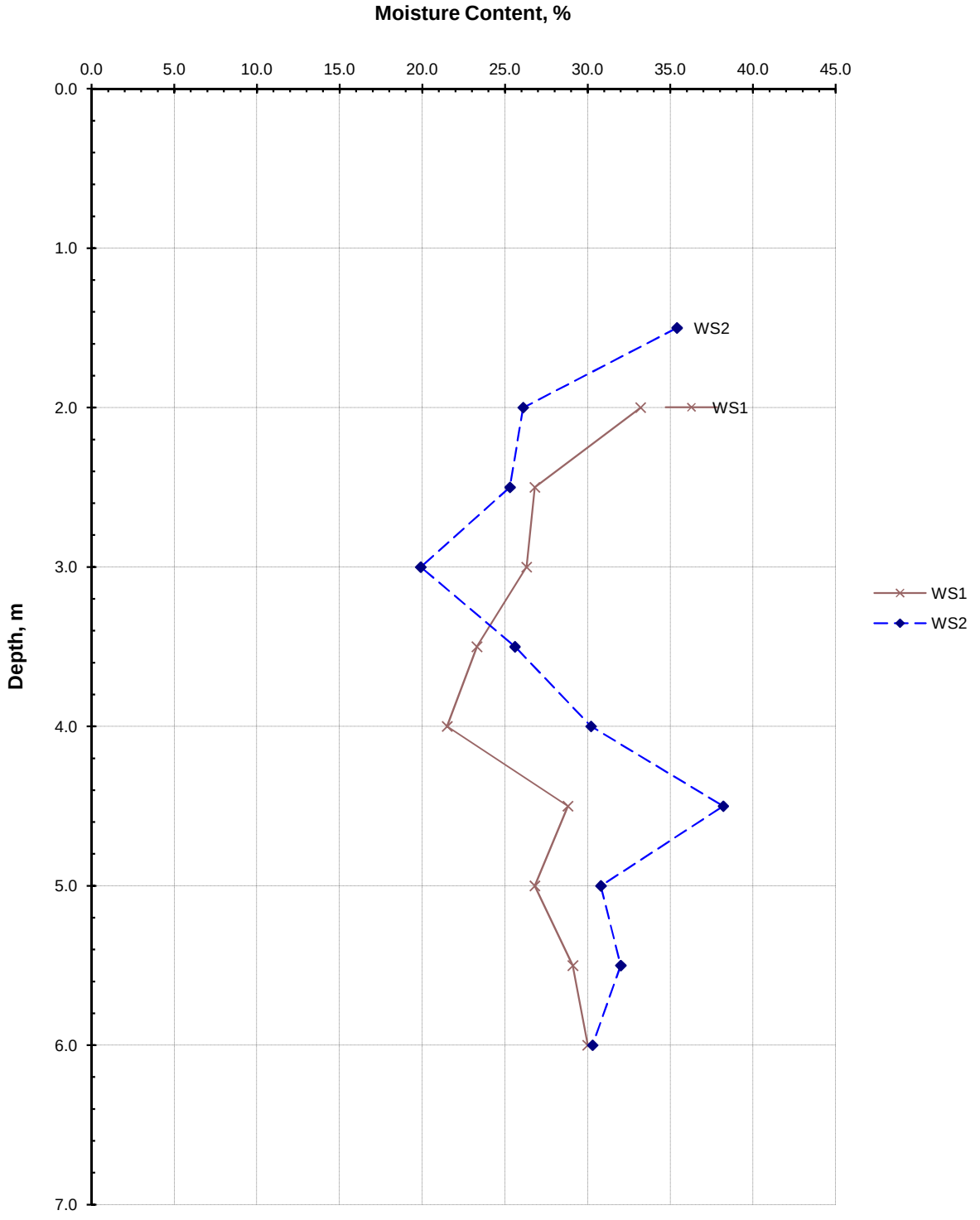


* *Reference made to "A rapid and reliable on-site method of assessing desiccation in clay soils", by R S Pugh, P G Parnell, and R D Parkes, Proc. Instn Civ. Engrs. Geotech. Engng. 1995, 113 pp. 25-30*

Client:	**Archetype Associates Limited**	**Job No:**	J11987		
Site:	**18 Grove Terrace, London NW5**	**Date:**	08/10/2014	**Fig.**	**HP1**

Moisture Content *vs* Depth

In Accordance with BS 1377 : Part 2 : 1990 : Clause 3

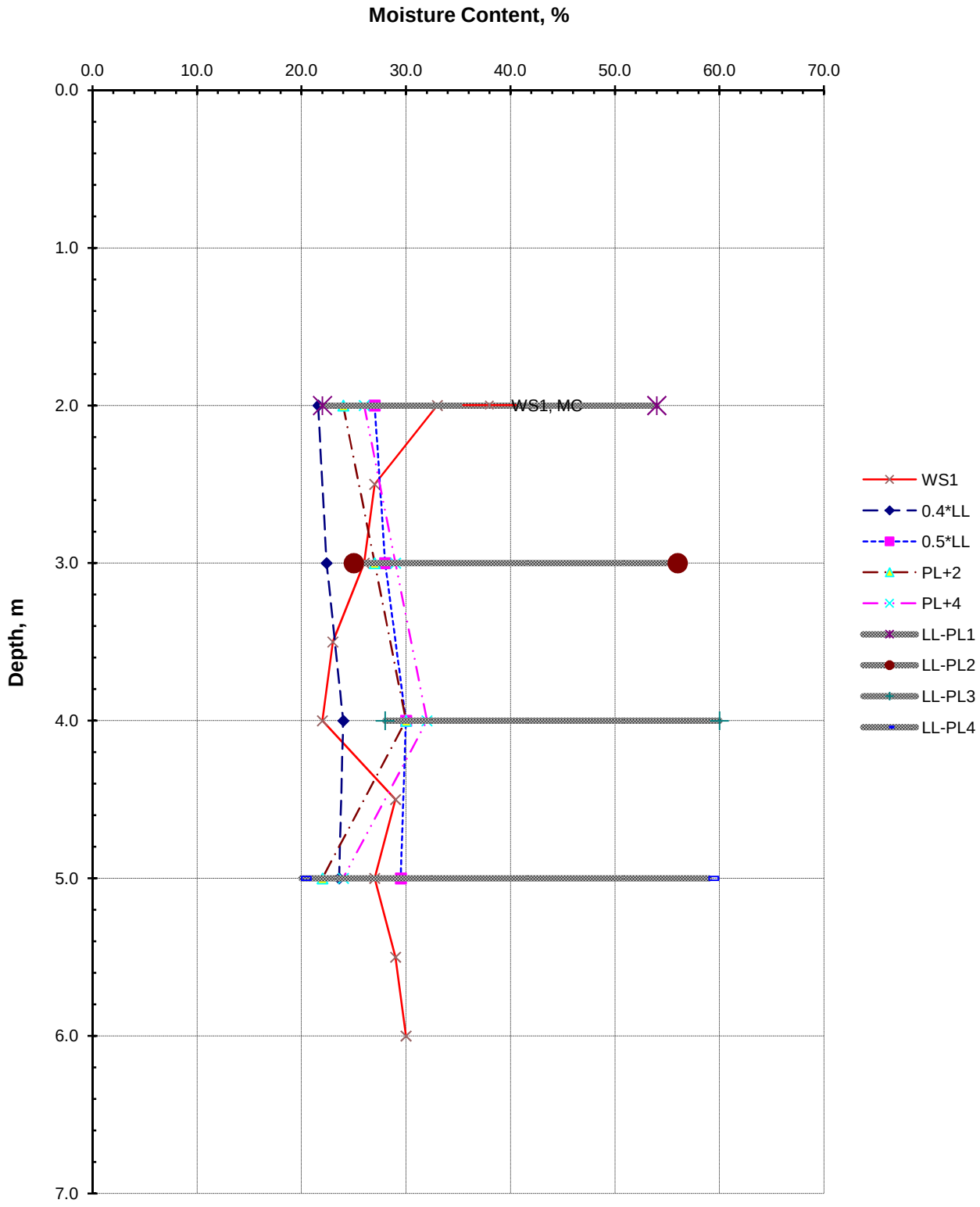


Note:

Client:	**Archetype Associates Limited**	**Site:**	**18 Grove Terrace, London NW5**		
Job No:	J11987	**Date:**	07/10/2014	**Figure:**	MC1

Moisture Content and Atterberg Limit Tests *vs* Depth

In Accordance with BS 1377 : Part 2 : 1990 : Clause 3

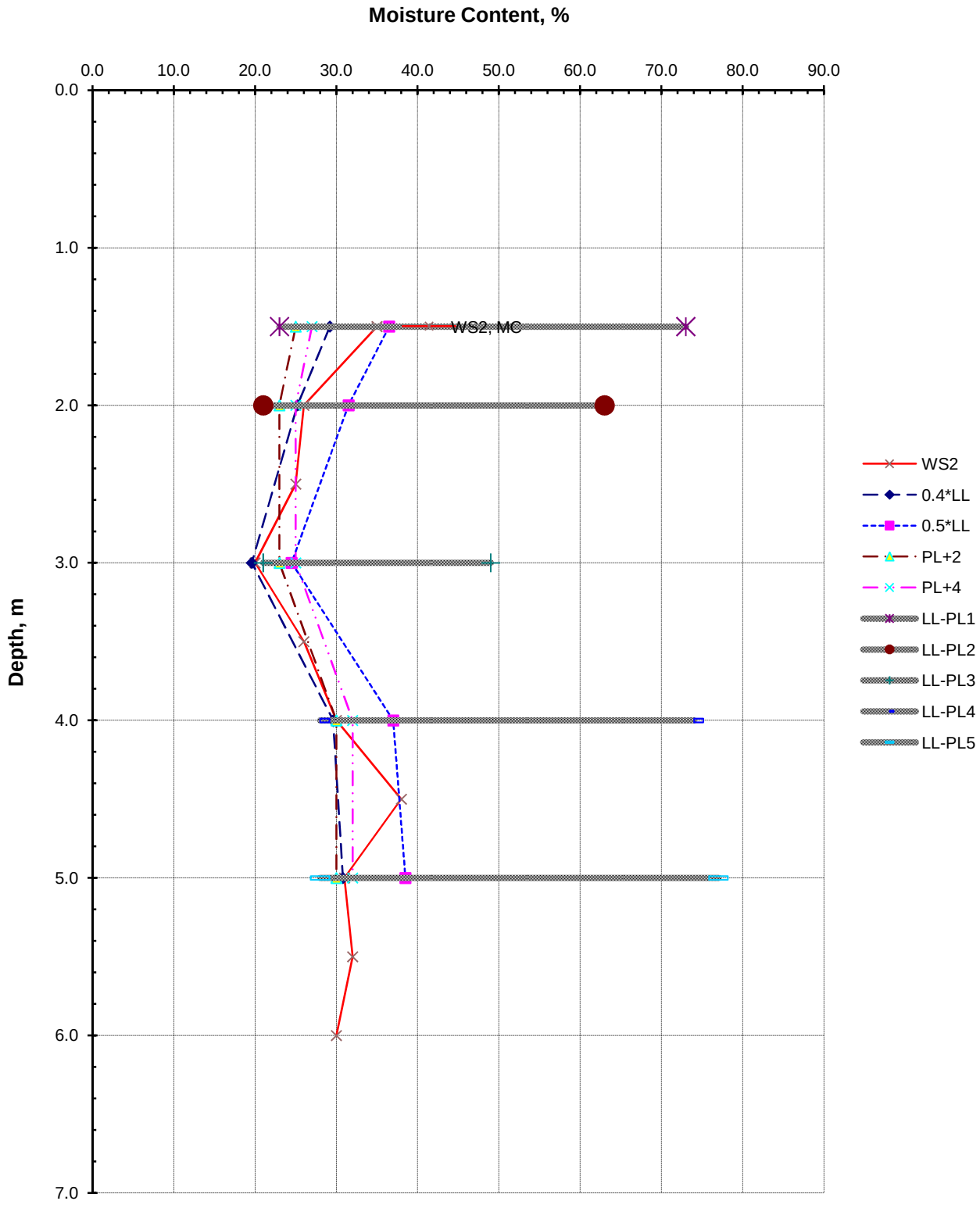


Note:

Client:	**Archetype Associates Limited**	**Site:**	**18 Grove Terrace, London NW5**		
Job No:	J11987	**Date:**	08/10/2014	**Figure:**	MC2

Moisture Content and Atterberg Limit Tests *vs* Depth

In Accordance with BS 1377 : Part 2 : 1990 : Clause 3



Note:

Client: Archetype Associates Limited		**Site:** 18 Grove Terrace, London NW5	
Job No: J11987	**Date:** 08/10/2014	**Figure:** MC3	

APPENDIX D

Bomb Map

Colour Key References
(for guidance only)

Black
Total destruction

Purple
Damaged beyond repair

Dark Red
Seriously damaged; doubtful if repairable

Light Red
Seriously damaged, but repairable at cost

Orange
General blast damage – not structural

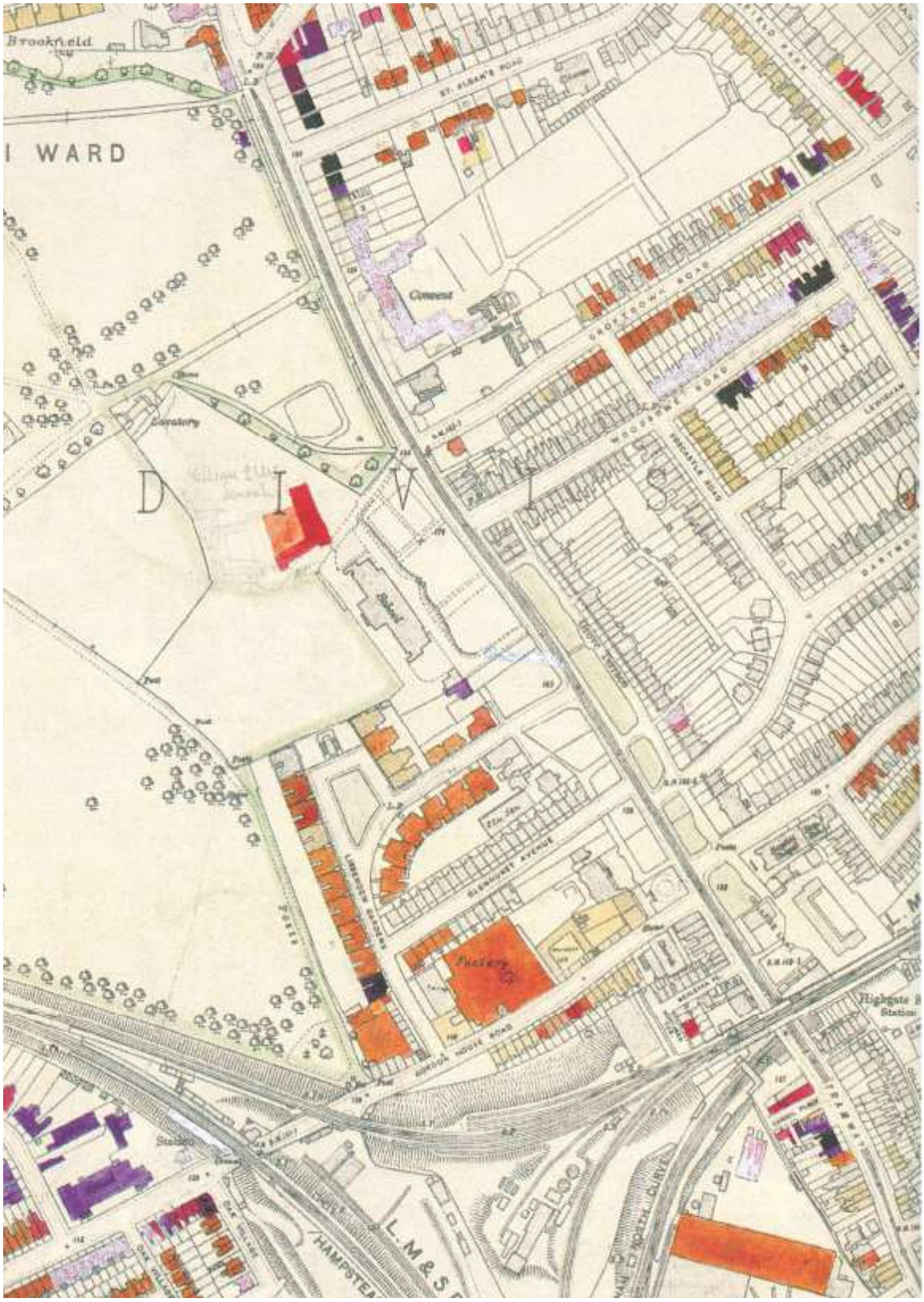
Yellow
Blast damage, minor in nature

Light Blue
Clearance areas

Light Green
Clearance areas

V1 flying bomb

V2 long range rocket



Site: 18 Grove Terrace, London NW5	STL: J11987	Fig No: 2
Date: 23 October 2014	Bomb Map	

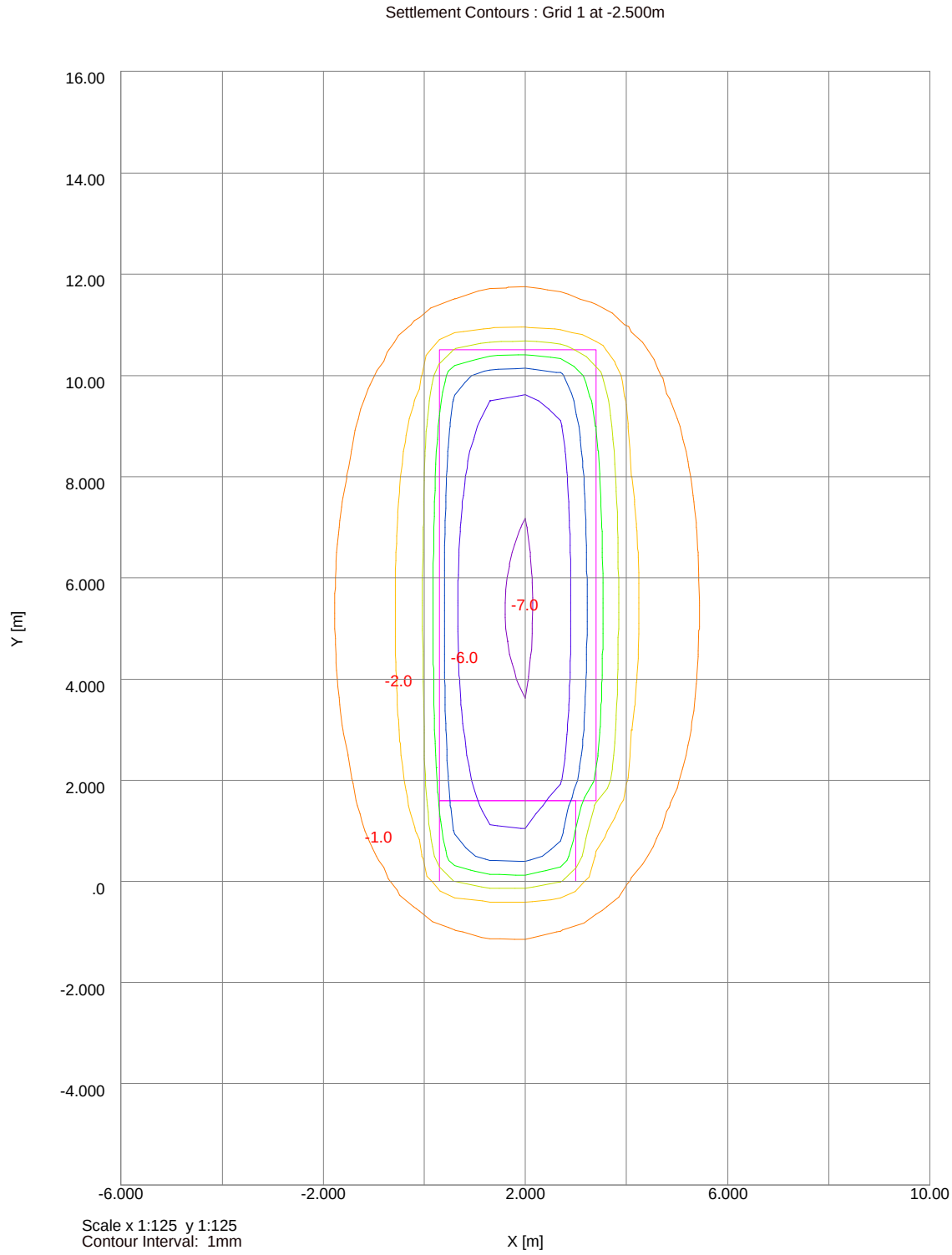
APPENDIX E

PDISP Output for heave displacements

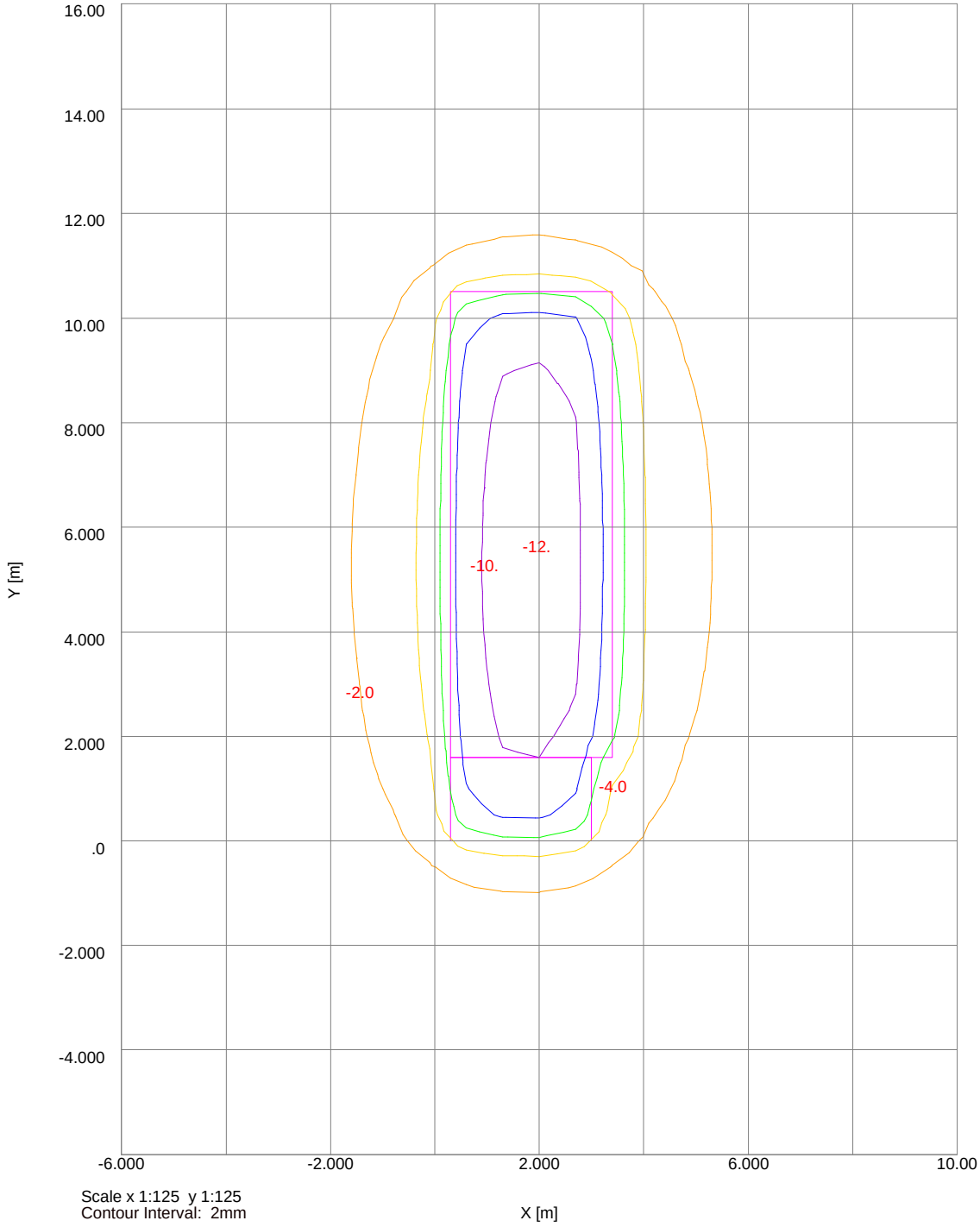
Oasys

18 Grove Terrace, NW5
Undrained Heave Displacements
Figure U1

Job No.	Sheet No.	Rev.
J11987		
Drg. Ref.		
Made by	Date 23-Oct-2014	Checked



Settlement Contours : Grid 1 at -2.500m



Scale x 1:125 y 1:125
Contour Interval: 2mm

APPENDIX E

Chemical Test Results

3 Crittall Drive
Springwood Industrial
Estate
Braintree
Essex
CM7 2RT
Tel : 01376 560120
Fax : 01376 552923

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 425408-1

Date of Report: 09-Oct-2014

Customer: Southern Testing Laboratories
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

Customer Contact: Mr David Vooght

Customer Job Reference: J11987
Customer Purchase Order: J11987_2
Customer Site Reference: 18 Grove Terrace (London NW5)
Date Job Received at SAL: 26-Sep-2014
Date Analysis Started: 30-Sep-2014
Date Analysis Completed: 09-Oct-2014

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with QP22

UKAS TESTING
1650

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

Report checked
and authorised by :
Miss Claire Brown
Customer Service Manager

Issued by :
Miss Claire Brown
Customer Service Manager

SAL Reference: 425408
Project Site: 18 Grove Terrace (London NW5)
Customer Reference: J11987

Soil Analysed as Soil
STL Key Contamintion Suite

				SAL Reference	**425408 001**	**425408 002**	**425408 003**
				Customer Sample Reference	**TP4 @ 0.70m**	**WS1 @ 0.50m**	**WS1 @ 2.00m**
				Date Sampled	**23-SEP-2014**	**23-SEP-2014**	**23-SEP-2014**
				Type	**Fill**	**Fill**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**			
Arsenic	T257	A40	2.0	mg/kg	**15**	**22**	**15**
Cadmium	T257	A40	0.1	mg/kg	**0.1**	**0.1**	<0.1
Chromium	T257	A40	0.5	mg/kg	**27**	**23**	**49**
Copper	T257	A40	2	mg/kg	**66**	**250**	**97**
Lead	T257	A40	2	mg/kg	**450**	**540**	**210**
Mercury	T245	A40	1.0	mg/kg	**1.1**	**3.7**	<1.0
Nickel	T257	A40	0.5	mg/kg	**22**	**22**	**58**
Selenium	T257	A40	3	mg/kg	<3	<3	<3
Zinc	T257	A40	2	mg/kg	**110**	**150**	**130**
Asbestos ID	T27	A40			Asbestos not detected	Asbestos not detected	-
Chromium VI	T6	A40	1	mg/kg	<1	<1	<1
Fraction Organic Carbon - F(oc)	T21	A40	1	%	<1	<1	<1
pH	T7	A40			**8.1**	**8.1**	**8.3**
Soil Organic Matter	T287	A40	0.1	%	**4.8**	**5.3**	**0.5**
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	**0.05**	**0.04**	**0.05**
Sulphide	T4	A40	10	mg/kg	<10	<10	<10
Cyanide(Total)	T4	AR	1	mg/kg	<1	<1	<1
Phenols(Mono)	T221	AR	1.0	mg/kg	<1.0	<1.0	<1.0
Moisture @ 105 C	T162	AR	0.1	%	**15**	**19**	**22**
Retained on 2mm	T2	A40	0.1	%	**13.0**	<0.1	<0.1

SAL Reference: 425408
Project Site: 18 Grove Terrace (London NW5)
Customer Reference: J11987

Soil Analysed as Soil
Total and Speciated USEPA16 PAH (SE) (MCERTS)

				SAL Reference	**425408 001**	**425408 002**	**425408 003**
				Customer Sample Reference	**TP4 @ 0.70m**	**WS1 @ 0.50m**	**WS1 @ 2.00m**
				Date Sampled	**23-SEP-2014**	**23-SEP-2014**	**23-SEP-2014**
				Type	**Fill**	**Fill**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**			
Naphthalene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Chrysene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
PAH(total)	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1

Index to symbols used in 425408-1

Value	Description
AR	As Received
A40	Assisted dried < 40C
W	Analysis was performed at another SAL laboratory
S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Sub contracted analysis performed by SAL Scotland & REC Asbestos Limited
Retained on 2mm is removed before analysis
Reported results on as received samples are corrected to a 105 degree centigrade dry weight basis
No loose asbestos fibres or asbestos containing materials were found

Method Index

Value	Description
T2	Grav
T221	Colorimetry (CE)
T21	OX/IR
T27	PLM
T162	Grav (1 Dec) (105 C)
T245	ICP/OES(Aqua Regia Extraction)
T4	Colorimetry
T7	Probe
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T287	Calc TOC/0.58
T6	ICP/OES
T16	GC/MS
T257	ICP/OES (SIM) (Aqua Regia Extraction)

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Arsenic	T257	A40	2.0	mg/kg	U	001-002
Arsenic	T257	A40	2	mg/kg	M	003
Cadmium	T257	A40	0.1	mg/kg	U	001-002
Cadmium	T257	A40	0.1	mg/kg	M	003
Chromium	T257	A40	0.5	mg/kg	U	001-002
Chromium	T257	A40	0.5	mg/kg	M	003
Copper	T257	A40	2	mg/kg	U	001-002
Copper	T257	A40	2	mg/kg	M	003
Lead	T257	A40	2	mg/kg	U	001-002
Lead	T257	A40	2	mg/kg	M	003
Mercury	T245	A40	1.0	mg/kg	U	001-003
Nickel	T257	A40	0.5	mg/kg	U	001-002
Nickel	T257	A40	0.5	mg/kg	M	003
Selenium	T257	A40	3	mg/kg	U	001-003
Zinc	T257	A40	2	mg/kg	U	001-002
Zinc	T257	A40	2	mg/kg	M	003
Asbestos ID	T27	A40			SU	001-002
Chromium VI	T6	A40	1	mg/kg	N	001-003
Fraction Organic Carbon - F(oc)	T21	A40	1	%	WN	001-003
pH	T7	A40			U	001-002
pH	T7	A40			M	003
Soil Organic Matter	T287	A40	0.1	%	WN	001-003
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	U	001-002
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	M	003
Sulphide	T4	A40	10	mg/kg	N	001-003
Cyanide(Total)	T4	AR	1	mg/kg	U	001-002
Cyanide(Total)	T4	AR	1	mg/kg	M	003
Phenols(Mono)	T221	AR	1.0	mg/kg	U	001-002
Phenols(Mono)	T221	AR	1.0	mg/kg	M	003
Moisture @ 105 C	T162	AR	0.1	%	N	001-003
Retained on 2mm	T2	A40	0.1	%	N	001-003
Naphthalene	T16	AR	0.1	mg/kg	U	001-003

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Acenaphthylene	T16	AR	0.1	mg/kg	U	001-003
Acenaphthene	T16	AR	0.1	mg/kg	U	001-002
Acenaphthene	T16	AR	0.1	mg/kg	M	003
Fluorene	T16	AR	0.1	mg/kg	U	001-002
Fluorene	T16	AR	0.1	mg/kg	M	003
Phenanthrene	T16	AR	0.1	mg/kg	U	001-003
Anthracene	T16	AR	0.1	mg/kg	U	001-002
Anthracene	T16	AR	0.1	mg/kg	M	003
Fluoranthene	T16	AR	0.1	mg/kg	N	001-003
Pyrene	T16	AR	0.1	mg/kg	N	001-003
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	U	001-002
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	M	003
Chrysene	T16	AR	0.1	mg/kg	U	001-002
Chrysene	T16	AR	0.1	mg/kg	M	003
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	U	001-002
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	M	003
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	U	001-002
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	M	003
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	U	001-002
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	M	003
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	U	001-002
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	M	003
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	U	001-002
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	M	003
PAH(total)	T16	AR	0.1	mg/kg	U	001-003