TRAIN AND KEMP
ENGINEERING BUSINESS SOLUTIONS

BASEMENT IMPACT ASSESSMENT

for

3 DOWNSHIRE HILL

LONDON NW3

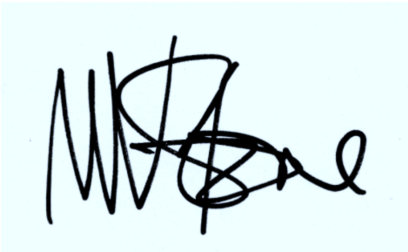
CONTENTS

Document Control

Revision	Date	Status
A	8/01/15	Final
B	15/04/15	Amended following GEA comments

This report has been prepared by Train and Kemp (Consulting Engineers) LLP using reasonable skill and care in accordance with the instructions of its client. No liability is extended to other parties.

The lead author is a Chartered Engineer. The Hydrology section has been endorsed by Deborah Ashton as a Chartered Geologist.



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. INTRODUCTION

This Basement Impact Assessment, BIA, has been prepared for the proposed single storey basement under No 3 Downshire Hill LondonNW3 6XE.

The BIA has been prepared in accordance with LB of Camden CPG4, Basements and Lightwells and the Camden Geological, Hydrogeological and Hydrological Study, CGHHS. Section 5, Flooding, also makes reference to Camden Flood Report, 2003, and Surface Water Management Plan, 2011.

CPG4 screening questions are presented in Appendix 1, survey photographs in Appendix 2, and the site investigation and scheme drawings in Appendices 4 and 5 respectively.

The BIA has been prepared by Marc Stone, a Chartered Engineer, and in accordance with CPG4, Section 3 on Groundwater Flow has been reviewed and endorsed by a Deborah Ashton, a Chartered Geologist, with her letter dated 07.01.15 in Appendix 7

1.1 BIA Stages

A Stage 1 Screening utilising the questions in CPG4 is presented in Appendix 1. Additional questions to the CPG4 screening are:

GW1B	Groundwater screen set -	relating to water issues rather than water table;
F6A	Surface Water Flooding -	relating to Surface Water Management Plan Local Flood Risk Zones

The screening has been used to define the Stage 2 Scope of the Assessment.

As part of the Stage 3 site investigations and study the following surveys were completed:

i. Site Investigation in 2014 Appendix 4

The Stage 4 Impact Assessment of the scheme is presented in Sections 3 to 6.

2. EXISTING SITE AND PROPOSED DEVELOPMENT

For the purposes of this assessment, Downshire Hill is taken to the South East of the property.

The floor levels are defined as:

New Basement	New basement extending from front to rear walls of house. The basement does not extend to boundary walls either side.
Lower Ground Floor:	Main entrance and level entrance from Downshire Hill
Ground Floor:	One storey above street level with kitchen and living accommodation No alterations
First Floor	No alterations
Second floor:	No Alterations

2.1 Description of property

The building is of modern construction set over 4 floors. The house is rectangular on plan and is constructed with loadbearing cavity walls and solid concrete floors. Internally there are isolated steel beams supporting floor and opening in walls.

The house shares a party wall with the property to the left when viewed from the road. The adjoining house is not the same age and No 3 has been built to enclose on the neighbouring flank wall. The house to the right of No 3 is separated by the width of two driveways

<u>London Underground Tunnels</u>

The Northern Line is located to the South of the property following the main Rosslyn Road

2.2 Topography and Levels

The site is on the slope down from Rosslyn Road in Hampstead village towards Belsize Park. Downshire Hill slopes down from Rosslyn Road towards Hampstead heath. The natural gradient is generally from northwest to southeast. The 1:25,000 OS Explorer Map shows the gradient in this area is 5m in 50m or 1 in

2.3 Proposed Scheme

The proposed scheme is to construct a new basement within the footprint of the existing house. The basement will extend under the existing parking area to the right of the house. The front and rear walls of the house will be underpinned but the new party wall to the left hand side will not require underpinning and the property to the right will not be affected by the basement works.

2.4 Basement and Foundations

<u>Basement</u>
The proposed basement will be constructed using reinforced concrete pins that will be design to resist the horizontal and vertical loads.

2.5 Trees

The existing trees within the rear and neighbouring gardens are to be maintained and the basement has been located beyond the root protection area of the closest tree.

3 GROUNDWATER FLOW

3.1 Stage 1 Screening

See Appendix 1 **GW**

3.2 Stage 2 Scoping

- The basement may extend into any perched water with the London Clay
- The construction of the basement will have to be carefully sequenced
- The site is adjacent to a Local Flood Risk Zone and on the boundary of a CDA area.

3.3 Stage 3 Study and Site Investigation

<u>Study</u>

In hydrogeological terms, London Clay is impermeable and water that is encountered has usually percolated down through the any fill material. The water is dependent on the prevailing weather conditions; under wet conditions this may present as a perched water table but under dry conditions this is usually just water issues that readily dissipate and do not form a continuous flow.

<u>Site Investigation</u>
The site investigation undertaken by Ian Farmer Associates confirmed the sub soil under the property to comprise of made ground to a depth of 1.2m below ground level. underlain by practically impermeable strata relating to the London Clay formation, to the full depth of the investigation at 8.45m bgl

Ground water was recorded during the site investigation at a depth of 4.1m and 4.5m bgl. The ground water was shown in borehole WS1 to be associated with a bed of material, some 1.0m in thickness, described as slightly sandy clay in which claystone fragments were recorded. Typically to the London Clay Formation claystone beds are not necessarily continuous but can be anticipated at roughly the same level across the site and often water bearing. Subsequent monitoring of the standpipe installations suggest the groundwater to have risen to depths of between 1.90m and 1.98m bgl suggesting the groundwater to be restricted by the overlying thickness of silty clay
Further groundwater seepage may be encountered within the Made Ground, perched above the London Clay Formation. The sources of groundwater in likely to be dependent on the prevailing weather condition, which

under wet conditions may be encountered as a perched water table but under dry conditions may not be present. As a source it is usually readily dissipated and does not form a continuous flow

Additional testing was carried out by Ian Farmer Associates comprising a falling head test in each borehole to estimate the rate of infiltration into the established head of water. The results of set out in Appendix 6

Construction

It is anticipated that the seepage of groundwater from the Made Ground will be encountered during the excavation of the basement particularly during periods of heavy rainfall, but this will be dealt with by using a small submersible pump.

Further, though unlikely due to the depth of the new basement, should the claystone bed noted in borehole WS1 daylight into the excavation, further groundwater ingress should be anticipated and may require a submersible pump of greater capacity.

3.4 Stage 4 Impact Assessment

Water Issues and Seepages

Whilst the site investigation established a water level close to or above the proposed basement slab level this is likely to be either seasonal perched water in the made ground or water running through a potential intermittent claystone bed within the London Clay Formation. Perched groundwater encountered is not considered to be of a magnitude that will impact adversely on the construction.

Groundwater Flow

The excavation for the proposed Basement will be within the London Clay and any minimal groundwater flowing across the site would have to flow laterally around the basement. Given:

- the clearance from the adjacent houses;
- and the intermittent nature of such groundwater flow,
- this will not have any impact on the adjoining properties.

The testing carried out by Ian Farmer Associates has established the infiltration rates of the subsoil as 6.45×10^{-6} of the subsoil.

Assuming the basement was excavated with all exposed faces allowing water to flow into the excavation, the total surface area available would be

Sides (7.8m + 12m) x 2 x 3.3m high = $130m^2$
Base (7.8m x 12m) = 93
$223m^2$

Therefore:

Rate of infiltration = K x Area
= $6.45 \times 10^{-6} \times 223m^2$
= $1.44 \times 10^{-3}\ m^3$ / sec

This gives a conservative water flow of 1.44 l/sec into the excavated basement assuming the retaining walls have not been constructed. If a safety factor of 3 is used for unknown ground conditions this would give a design flow rate of 4.3 l/sec

Standard submersible pumps that are used to clear ground water have a minimum capacity of 5 l/sec

- The ground has poor permeability and any ground water flows across the site will be minimal. If there is water seepage into the excavation during the works this can easily be removed using a small submersible pump as is used on most construction sites.

Increase in Impervious Area

The impervious area is not being increased by the new basement.

Water Features above excavation

There are no water features in close proximity to the property that are above the level of the house. There are ponds on the heath but they are a significantly lower level

4 GROUND STABILITY

4.1 Stage 1 Screening

See appendix 1

4.2 Stage 2 Scoping

- The excavation is close to neighbouring properties and the footpath to Downshire Hill

4.3 Stage 3 Study and Site Investigation

Land Stability
Both the site walkover and the records in the CGHHS show that there are no problems of land stability in the vicinity of the site.

The rear gardens to the adjoining properties were examined by peering over the fence and there were no signs of any slippage to the slope.

Site Investigation

Details of the soil profile established during the site investigation are given in Appendix 4. The investigation established that there is 1.2m of made ground, the London Clay is found at 1.2m and is a minimum of 7.5m thick.

4.4 Stage 4 Impact Assessment

Slope Gradients and Land Stability
The site has already been terraced and the site is generally level front to back and side to side. The new basement will be under the footprint of the property and will not impact on the stability of any of the slopes around Downshire Hill.

The basement retaining walls will be designed to resist and horizontal loads from the retained ground.

Trees
The existing trees are to be retained and the basement is beyond the root protection zone of any trees that have to be retained.

Aquifer
Groundwater flow is considered in 3.4.

Groundwater can also have a detrimental effect on ground stability with spring lines tending to cause local stability problems.

Whilst water was encountered in both the boreholes, it will not be a significant factor during construction as any water encountered within the London Clay being intermittent rather than continuous. The water would not affect the stability of the London Clay.

Surrounding properties and public footpath
Only the front and rear walls of the property will be underpinned. The basement does not extend to the side boundaries so underpinning of party and boundary walls will not be necessary. The basement walls will however be constructed using the traditional underpinning sequencing to avoid extensive temporary support.
The underpinning to the front elevation will take into account the imposed loads from the public footpath and highway beyond.

CIRIA REPORT C580

Ground movements associated with the retaining walls have been assessed in accordance with CIRIA Report C580. There are two types of ground movement; movement due to the installation of the retaining wall and movement due to excavation in front of the wall.

Movement due to the installation of the wall is taken to extend some 1.5 times the wall depth; with a 3.5m deep retaining wall this will be approximately 5.25m. From C580, table 2.2, the maximum vertical and horizontal movement can be taken as 0.05% and 0.1% respectively This will occur at the wall and will be of the order of 1.75mm and 3.5mm, reducing linearly to zero at 5.25m

Excavation in front of the wall will cause movements in towards the excavation. As conservative assumption we have taken an un-propped cantilever wall, the horizontal movement is taken as being 0.4% of the excavation depth and the vertical movement is taken as 0.35%. On a 3.5m excavation this would be 14mm horizontally and 12mm vertically at the wall reducing linearly to zero at 4 x the excavation depth [14m]. On short walls with corner braces, such as at Downshire Hill, the movement is usually 50% of the predicted and will be less than 6mm.

Total ground movements will be a combination of the wall installation and excavation movements.

Distance from Wall	Vertical			Horizontal		
	Install Wall	Excavation	Total	Install Wall	Excavation	Total
0m	1.75 mm	12 mm	13.75mm	3.5mm	14mm	17.5 mm
2.5	0.9 mm	10 mm	11 mm	1.75 mm	11.5 mm	13.25mm
5	0mm	7.7 mm	7.7 mm	0 mm	9 mm	9 mm
7.5	0mm	5.5mm	5.5mm	0mm	6.5 mm	6.5 mm

These total movements can be used to predict the likely strains to which adjacent buildings will be subjected. The critical building is No. 2 Downshire Hill which is located between the 2.5m and 7.5m contours. The differential movement across 2 Downshire Hill is 11 – 5.5 = 5.5mm vertically and 13.25 – 6.5= 6.75mm horizontally. Taking the building as being 5m wide this generates a deflection ratio of 0.11% and a horizontal stain of 0.135%.

This would place the potential crack as being Category 2, Slight, with cracks easily filled but redecoration probably being required.

The values calculated are conservative and it is generally accepted with the new excavation being 2.5m from the nearest party wall any ground moment from a single basement excavation will be negligible. If there were to movement it would be less than half of the value calculated and this would place the potential cracking as being Category 1 which is very slight.

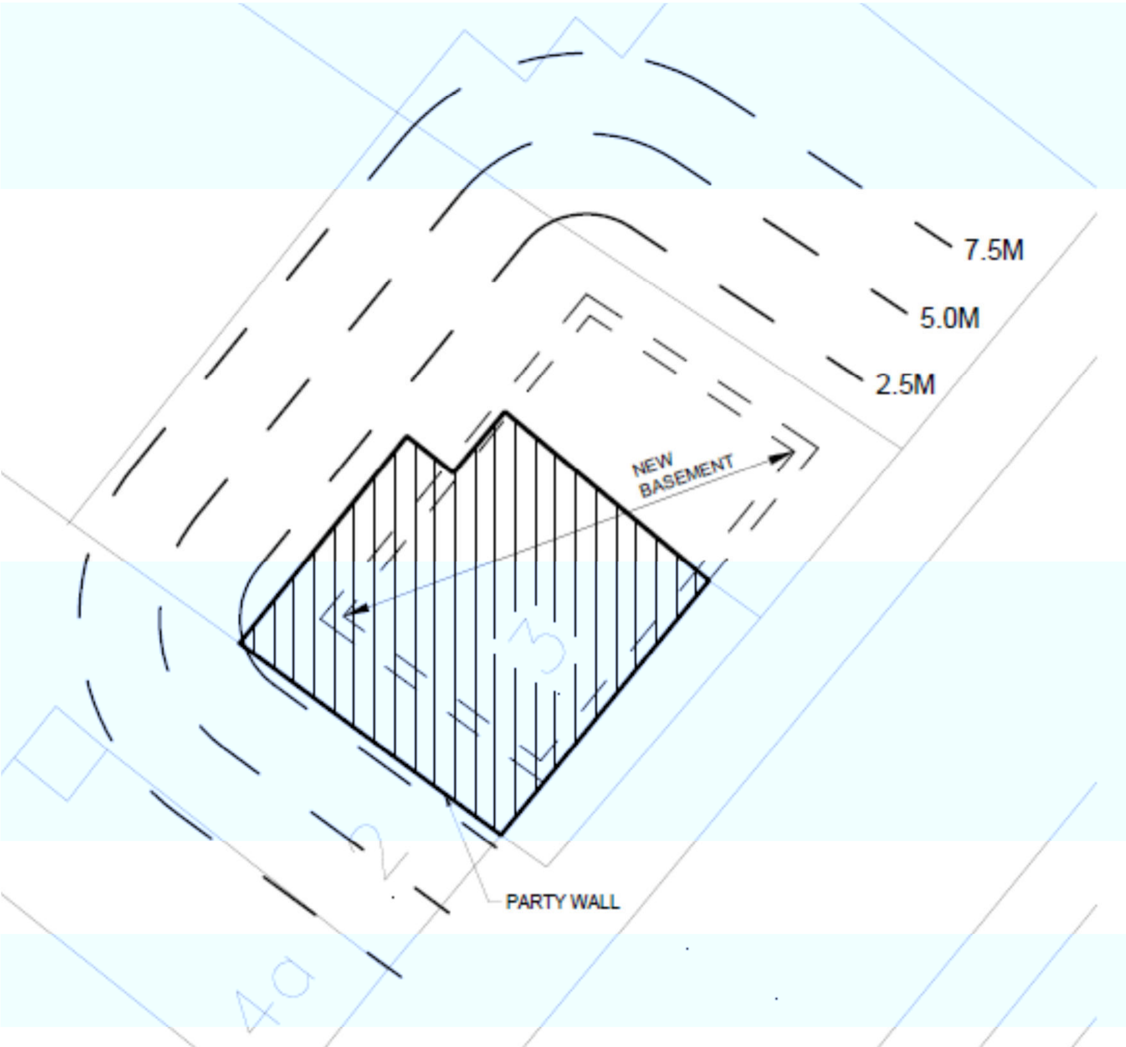
This would be covered with the Party Wall Award with No 3/2 Downshire Hill

Heave under new basement slab

With the removal of the overburden the anticipated heave within the centre of the basement will be approximately 11mm reducing to around 5mm at the edges and 3mm to the corners. The underpinning will be completed over a period of 8 to 10 weeks before the basement slab is cast. It is generally accepted that 50% of the heave in a clay soil occurs within 2 months of the overburden being removed therefore the maximum heave movement will be less than 5mm under the new basement slab. A compressible material will be used to absorb the residual heave forces when the slab is cast.

Heave under new underpinning

The line load from the masonry wall and concrete floors to the ground, first and second floor give a line load in the order of 74Kn/m run. The width of the new retaining wall with the reinforced toe will be around 1.2m. The removal of 3m of overburden will give an uplift of 54Kn/m^2 .This will produce and upward force of 65Kn/m which is less than the line load on the walls.



POTENTIAL GROUND MOVEMENTS DUE TO BASEMENT EXCAVATION		
CONTOUR	VERTICAL	HORIZONTAL
7.5 m	5.5 mm	6.5 mm
5.0 m	7.7 mm	9.0 mm
2.5 m	11.0 mm	13.25 mm

P1	FOR APPROVAL	AM	AM	18.03.1
Rev.	Description	By	Chkd.	Date

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Title: POTENTIAL GROUND MOVEMENTS DUE TO BASEMENT EXCAVATION

Drawing Status: APPROVAL

Date: MARCH 2015
Scale: 1:200
Drawn: AM
Chkd: AM
Drawing No. 12741_SK-01
Rev. P1

5 SURFACE FLOW AND FLOODING

5.1 Stage 1 Screening

See Appendix 1

5.2 Stage 2 Scoping

- The impervious area will remain unchanged
- Remote issue with site located to the side of a Local Flood Risk Zone.

5.3 Stage 3 Study and Site Investigation

Frognal LFRZ 3015
Draft Managing Surface Water 2011 defines a Local Flood Risk Zone, LFRZ 3015 to the North West of the site. The concern is surface water flooding and sewer capacity problems (partly resolved through the Sumatra Scheme) which causes water to collect behind the railway cutting to the south.

The LFRZ is in the valley formed by Frognal. There is not risk of surface water flooding to Downshire Hill

5.4 Stage 4 Impact Assessment

No increase in Impervious Area
This is discussed in 3.4

Frognal LFRZ 3015
Whilst Downshire Hill is adjacent to a LFRZ, it is more than 500m away and will not impact on the site and will not likely to suffer from surface water flooding.

6 ADDITIONAL IMPACT ASSESSMENTS

6.1 Sustainability, Amenity and Landscape

The majority of the basement is located under the footprint of the existing house. A section will be constructed beyond the boundary of the house under and area of existing impermeable paving. No trees are to be removed.

6.2 Lightwells

There will be one internal lightwell to the rear of the property.

6.3 Third Party Considerations and Impact on Neighbours

The rear gardens and adjacent drive ways to the surrounding properties acts as a buffer and there will be no significant impact on these.

6.4 Cumulative Impacts

The environmental setting is such that the impacts of the proposed scheme are minimal and as such there is no cumulative impact.

7 SUMMARY

The proposed Basement will be founded within the London Clay. The natural slope has been terraced with the construction of the original house. The excavation of the additional storey at the Basement will not increase the existing slope of the ground.

The proposed basement is being constructed remote from both boundary walls to either side of No3. The basement retaining walls will have to be constructed using underpinning techniques to avoid installing temporary works. The boundary walls will not be underpinned. Party Wall awards will have to be agreed with the neighbouring properties.

There are no significant groundwater issues and no problems of ground stability or surface water flooding. This means that there are no concerns with the environmental setting of the site.
The excavation of the Basement will use established techniques ensuring the stability of the neighbouring properties will be maintained. There is nothing in this BIA to suggest that the construction of the Basement, beneath the footprint of property that has had a detrimental impact on the site, neighbouring properties or natural environment.

Appendix 1: CPG4 Stage 1 Screening and Stage 2 Scoping

Basement Impact Assessment to CPG4
Stages 1 & 2: Screening and Scoping

Screen		Response	Amplification
Subterranean (groundwater) flow			
GW1. Is the site founded on an aquifer		No	CGHH Fig 4 show the site is founded on London Clay. CGHH Fig 8, Aquifer Designation Map, shows that London Clay is unproductive strata
GW1AWill the basement extend beneath the water table		No	The basement will not be below the watertable
GW1B Will the basement encounter water issues		Possibly	There may be local areas of perched water but these will be dealt with on site.
GW2. Is the site within 100m of a watercourse or a spring		No	CGHH Fig 12, Watercourses, a pond on the heath approximately 500mm from the property There are no springs in the area
GW3. Is the site within Hampstead Ponds catchment		No	CGHH Fig 14, shows the property is beyond any catchment areas
GW4. Will proportions of impermeable areas change		No	The basement is being extended but under and area of existing impermeable paving
GW5. Will more surface water discharge to ground		No	Existing surface water strategy will be maintained.
GW6. Is the lowest excavation lower than any nearby water feature.		No	The nearest water feature is too remote to be considered.
Ground stability			
Stability 1.	Are existing slopes > 1 in 8	No	CGHH Fig 16, Slope Angle May, shows that the slopes on this part of Hampstead are less than 7^{o} [1 in 8]. There are some steeper slopes to the closer to the heath.
Stability 2.	Will remodelled slopes be > 1 in 8	No	There will be no significant remodelling of the slopes
Stability 3.	Does neighbouring land slope > 1 in 8	No	CGHH Fig 10, Topographical Map shows that the 5m contours to this part of Hampstead are spaced at 50m giving a gradient of 1 in 10
Stability 4.	Is site on hillside with slope > 1 in 8	No	
Stability 5.	Is the site founded on London Clay	Yes	
Stability 6.	Will any trees be felled	No	
Stability 7.	Is there a history of seasonal movement	No	No signs of movement in the original house.
Stability 8.	Is the site within 100m of watercourse or spring	No	See answer to GW2.
Stability 9.	Is the site on worked ground	No	CGHH Fig 16 does not record any worked ground to this part of Hampstead
Stability 10A	Is the site on an aquifer	No	CGHH Fig 8 shows the site is founded on unproductive strata
Stability 10B	If so will excavation be below water table	No	
Stability 11.	Is the site within 50m of Hampstead Ponds	No	The site property is approximately 500m from the closest pond
Stability 12.	Is site within 5m of highway	Yes	The house is approximately 2m from Downshire Hill
Stability 13.	Will the basement increase differential depth of adjoining foundations	No	The basement is not being extended the full width of the property so the neighbouring properties do not have to be underpinned.
Stability 14.	Is the site over tunnels	No	The Northern Line tunnels are to the West of the site.
Surface Water and Flooding			

Screen		Response	Amplification
F1.	Is site within Hampstead Ponds Catchment	No	
F2.	Material changes in surface water flows	None	
F3.	Changes in impervious area	No	See answer to GW4
F4.	Changes in flow rate onto neighbouring land	No	
F5.	Changes in quality of water discharge	No	
F6.	Is site in area of risk from surface water flooding	No	CGHH Fig 15, Flood Map, does not show any history of flooding in the immediate area. Downshire Hill is on the boundary of CDA area Group 3_010
F6A	Is the site in a LFRZ?	No	The Draft Surface Water Management Plan, 2011, Fig 3.1 shows that LFRZ 3015, is to the North east of Downshire Hill

Stage 2 Scoping

The site is in an area of low risk and there are no further investigations or clarification required:

Possible areas that need further consideration and discussion are:

- The basement may extend into any perched water with the London Clay
- The construction of the basement will have to be carefully sequenced
- The site is adjacent to a Local Flood Risk Zone and on the boundary of a CDA area.

Appendix 2: Site Photographs

Front elevation of No 3

Flank wall of No 3 with existing hard impermeable paving

View showing rear garden and distance to No 4

View showing rear wall and junction with party wall of No 2

Appendix 3: Site Investigation

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3 DOWNSHIRE HILL,
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REPORT ON GROUND INVESTIGATION

Contract: 52180

Date: March 2014

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REPORT ON GROUND INVESTIGATION

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EXECUTIVE SUMMARY

On the instructions of Train and Kemp, an investigation was undertaken to determine ground conditions to enable foundation design to be carried out, together with a review of gas emissions.

The site, where it is proposed to construct a new basement, is situated at 3 Downshire Hill, approximately 370m to the west of Hampstead Heath Railway Station, and may be located by National Grid Reference TQ 268 856.

Geological mapping indicates the site to be underlain directly by solid geology comprising the London Clay Formation, briefly described as silty clay with the Claygate Beds indicated some 50m to the west of the site.

Site works were undertaken on the 13 February 2014 and comprised two boreholes carried out by window sampling apparatus taken to a depth of 8.45m below ground level. The exploratory locations encountered the anticipated geological stratum being the London Clay for the full depth of the investigation, weathered to a depth of some 6m, and overlain by a 1.00m to 1.20m thick layer of Made Ground.

Groundwater was recorded during the site works at a depth of 4.10m bgl in borehole WS1 and 4.50m bgl in borehole WS2 and during return monitoring visits at depths of between 1.90m and 1.98m bgl and 1.93m and 1.92m bgl respectively.

CONTENTS

1.0 INTRODUCTION

1.1 It is understood that the proposed development comprises a new retrofit basement occupying the majority of the existing building footprint.

1.2 On the instructions of Train and Kemp, an investigation was undertaken to determine ground conditions to enable foundation design to be carried out, together with a review of gas emissions.

1.3 It is recommended that a copy of this report be submitted to the relevant authorities to enable them to carry out their own site assessments and provide any comments.

1.4 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.

1.5 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.

1.6 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The site is situated at 3 Downshire Hill, approximately 370m to the west of Hampstead Heath Railway Station and may be located by National Grid Reference TQ 268 856.

2.1.2 A site plan is included in Appendix 1, Figure A1.1.

2.2 Geological Setting

2.2.1 Details of the geology underlying the site have been obtained from the British Geological Survey map, Sheet No. 256, 'North London', solid and drift edition, 1:50000 scale, published 2006.

2.2.2 The geological map indicates the site to be underlain directly by solid geology comprising the London Clay Formation, briefly described as silty clay.

2.2.3 The geological map indicated that deposits of the Claygate Beds are present some 50m to the west of the site. As such, it is possible that the Claygate Beds may be encountered overlying the London Clay Formation.

2.2.4 The geological map also indicates that the site is situated within an area of Head Propensity, suggesting that Quaternary Head deposits may overlay the solid geology. However, the presence of such deposits has not yet been confirmed by the British Geological Survey.

2.2.5 The site is within an urban area and, although not indicated as present on the site from the geological maps, the possibility that Made Ground exists on site cannot be discounted.

3.0 SITE WORK

3.1 The site work was carried out on the 13 February 2014 on the basis of the practices set out in BS 5930:1999, ref. 7.3, and ISO 1997:2007, ref 7.4.

3.2 Two boreholes, designated WS1 and WS2, were undertaken by drive-in window sampler technique at the positions shown on the site plan, Appendix 1, Figure A1.1. The depths of boreholes, descriptions of strata encountered and comments on groundwater conditions are given in the borehole records, Appendix 2, Figures A2.1 and A2.2.

3.3 Representative disturbed and undisturbed samples were taken at the depths shown on the borehole records and despatched to the laboratory. Standard (split-barrel and cone) penetration tests, refs. 7.6 and 7.5, were carried out in the boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records.

3.4 An approximate assessment of soil strengths was made by undertaking hand-held penetrometer tests in the ‘undisturbed’ soil in the window sampler, before removal from the sample tube. The results of these tests are included in the borehole records.

3.5 Monitoring installations protected by a stopcock cover were installed in both boreholes, as detailed in the borehole records, in order to monitor groundwater levels and to enable gas monitoring.

3.6 The ground levels at the borehole locations were not determined.

3.7 Groundwater and gas monitoring visits were undertaken on the 27 February and 13 March 2014, as detailed in Figure A2.3.

4.0 LABORATORY TESTS

4.1 Geotechnical Testing

4.1.1 Geotechnical soil analysis was undertaken of samples obtained during the investigation as follows:

4.1.2 5 No. Water Content Tests

4.1.3 5 No. Plasticity Index Tests

4.1.4 6 No. Quick Undrained Single-stage Triaxial Tests

4.1.5 2 No. pH Values

4.1.6 2 No. Sulphate Contents (Water Soluble)

4.1.7 3 No. Special Digest 1 Test Suites

4.1.8 The laboratory test reports are given in Appendix 3, Figures A3.1 and A3.2.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Sequence

5.1.1 The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from the geological map.

5.1.2 Interpolation of strata depths between locations should be undertaken with caution, particularly for depths of Made Ground where structures are still present at the time of the investigation.

5.1.3 Undrained shear strengths stated in the borehole logs are estimates based on manual tests or field tests.

5.1.4 The sequence and indicative thicknesses of strata are provided below:

Strata Encountered	Depth Encountered (m)		Strata Thickness (m)
	From	To	
Made Ground	0.00	1.00 to 1.20	1.00 to 1.20
London Clay Formation	1.00 to 1.20	>8.45	>7.45

5.2 Made Ground

5.2.1 Made Ground was encountered at both exploratory locations, extending from ground level to depths of 1.00m and 1.20m in boreholes WS1 and WS2 respectively.

5.2.2 The Made Ground comprised concrete paving slabs extending from ground level to a depth of 0.20m, underlain by dark brown sandy fine to medium angular to subrounded flint gravel with frequent ash, clinker, concrete and brick fragments.

5.2.3 The Made Ground in borehole WS1 became gravelly sandy clay from a depth of 0.70m below ground level.

5.3 London Clay Formation

5.3.1 Material interpreted as the London Clay Formation was encountered in both boreholes WS1 and WS2, underlying the Made Ground, and extending to the full depth of the investigation of 8.45m bgl.

5.3.2 The London Clay in borehole WS1 comprised weathered firm to stiff light orange brown silty clay with occasional selenite crystals from 1.00m to 3.60m bgl. In borehole WS2, a similar material was encountered from 1.20m to 4.00m bgl, comprising firm to stiff brown silty clay with selenite crystals and occasional rootlets.

5.3.3 From a depth of 3.60m bgl, firm to stiff brown silty clay with pockets of coarse sand sized selenite and claystone was encountered in borehole WS1 to a depth of 5.00m bgl. This was subsequently underlain by stiff fissured laminated dark brown silty clay with grey veins, calcareous nodules and selenite crystals to 8.45m bgl.

5.3.4 In borehole WS2 from a depth of 4.00m bgl, firm fissured laminated brown silty clay with occasional fine to medium gravel sized selenite crystals and rare decomposing rootlets was encountered to a depth of 6.15m bgl. This was subsequently underlain by unweathered stiff fissured laminated dark grey silty clay with selenite crystals to 8.45m bgl.

5.3.5 Claystone were encountered between 3.60m and 3.70m, and 4.50m and 4.60m bgl in borehole WS1 and was absent in borehole WS2.

5.4 Groundwater

5.4.1 Groundwater was encountered at a depth of 4.10m bgl in borehole WS1, and 4.50m bgl in borehole WS2. The rate of water inflow was not determined.

5.4.2 During two return visits to monitor the standpipes installed in the boreholes WS1 and WS2, groundwater was recorded at between 1.90m and 1.98m bgl and 1.93m and 1.92m bgl respectively.

6.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS IN RELATION TO THE PROPOSED DEVELOPMENT

6.1 Structural Details

6.1.1 It is understood that the proposed development is to consist of a new basement structure occupying the majority of the existing building footprint.

6.1.2 Precise structural details were not available at the time of preparation of this report.

6.2 Assessment of Soil Condition

6.3 General

6.3.1 Removing undisturbed samples of over-consolidated fissured clays from boreholes can result in disturbance of the material that is exacerbated during subsequent preparation for laboratory testing. This can result in misleadingly low shear strengths being obtained in the laboratory. See notes in Appendix 2, paragraph 2.3.1, regarding sample class and derived soil parameters.

6.3.2 In some cases, in-situ testing is more advantageous when compared with taking undisturbed samples followed by laboratory tests.

6.3.3 Work undertaken by Stroud, ref. 7.7, determined a relationship between SPT 'N' values and the undrained shear strengths of many over-consolidated clays. Further work by Stroud and Butler, ref. 7.8, in which data was analysed from sites covering a wide range of glacial deposits, confirmed there to be a correlation between the 'N' value and undrained shear strength.

6.3.4 The relationship was of the form:

- Cu = $F_1 \times N$
- m_v = $\dfrac{1}{F_2 \times N}$
- Where
- Cu = Undrained shear strength
- m_v = Coefficient of compressibility
- F_1 and F_2 = Factors

6.3.5 It was determined by Stroud that F_1 varied between 4kPa for material of high plasticity and 6kPa for material of low plasticity. Similarly F_2 varied between 400kPa and 600kPa. Clayton (1995) further showed, using part of Stroud's data, that F_1=11 when fissuring is removed by remoulding, ie in unfissured soils.

6.3.6 It is considered that for the London Clay Formation encountered on this site, a value of F_1 = 4.4kPa would be appropriate.

6.4 London Clay Formation

6.4.1 Laboratory testing for the London Clay Formation recorded natural moisture contents of between 25% and 35%, with an average of 31%, liquid limits of between 52% and 72%, with an average of 66%, plastic limits of between 23% and 27%, with an average of 26% and plasticity indices of between 29% and 45%, with an average of 40%. The plastic index test results are presented on the plasticity classification chart, Appendix 3, Figure A3.3.

6.4.2 These results indicate the London Clay Formation is of high to very high plasticity and of medium to high volume change potential as defined by the National House Building Council, ref 7.9, and other published data, refs 7.10 and 7.11.

6.4.3 It is considered that a characteristic plasticity index value of 40% could be adopted for this stratum and that for design purposes, high volume change potential should be adopted. Changes in moisture content will result in significant changes in volume, seasonal changes being exacerbated by the presence of trees.

6.4.4 Consistency index determinations were between 0.79 and 0.93, suggesting the stratum to be generally stiff.

6.4.5 Unconsolidated un-drained triaxial compression tests, undertaken on 'undisturbed' (Class B) samples suggest c_u values might be in the range of 41kPa and 159kPa, averaging 88kPa, whilst SPT 'N' values were between 9 and 27, with an average of 17, which when using the correlations and relationships indicated in paragraph 6.3 above suggests c_u values of between 40kPa and 119kPa, averaging 75kPa, also suggesting the stratum to be generally firm to stiff.

6.5 Suggested Soil Characteristic Values

6.5.1 Summary of the geotechnical parameters derived from the laboratory and in-situ testing for the London Clay Formation:

	Minimum	Maximum	Characteristic
Moisture Content (%)	25	35	31
Plasticity Index (%)	29	45	40
Consistency Index Values	0.79	0.93	0.86
SPT 'N' value	7	27	16
Consistency, c_u (kPa)	41	159	88
Derived Consistency, c_u (kPa) For f_l=4.4 kPa	40	119	75

6.6 Foundation Design

6.6.1 On the basis of observations made on site together with results of in-situ and laboratory tests, consideration could be given to the adoption of spread foundations to support the proposed retrofit basement, which is likely to be located at some 3.0m to 3.5m below ground level and will therefore be located in the weathered London Clay Formation.

6.6.2 At such a depth, though the London Clay has been established as being of high to very high plasticity and of high volume change potential, it is considered likely that the foundations would be below the depth of influence of existing and proposed trees.

6.6.3 The following table gives indicative allowable bearing pressures for concrete strips footings of an approximate breadth of 0.60m, installed at depths from 2.00m.

Depth	Allowable bearing capacity	Net allowable bearing capacity including stress reduction following removal of overburden
2.00m	130kPa	170kPa
3.00m	155kPa	215kPa
4.00m	180kPa	260kPa

6.6.4 Settlements are likely to be less than 10mm, however, these should be checked when the final structural loading is known

6.6.5 It may be considered that for foundations over a certain depth it may be more economical to adopt mini piles. Guidelines for the design of piles are given in Appendix 4, which may be used with the plot of shear strength with depth included in Figure A4.1.

6.6.6 The carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art techniques are often employed before they reach the public domain, perhaps several years down the line. Therefore, it is recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

6.7 Estimation of ϕ' for Retaining Wall Design

6.7.1 To determine the long term clay strength, effective stress analyses may be carried out, either fully drained or undrained with pore water pressure measurements. Samples retrieved from window sampler boreholes are not generally suitable for such tests due to sample quality.

6.7.2 Therefore, based on the sample descriptions and laboratory classification tests together with readily available published literature, it is considered reasonable for design purposes that an assumed angle of internal friction, ϕ' for the London Clay Formation of 22° could be adopted.

6.7.3 If the undrained strength of stiff clay is to be relied upon during temporary works construction, then care is necessary to ensure that there are no sand or silt partings containing free water which would affect the undrained shear strength. Free water was observed at a depth of some 4.0m to 4.5m below ground level during site works and groundwater was measured at a depth of some 2m bgl on return monitoring visits. Therefore, for temporary works below this depth consideration should be given to a reduced angle of internal friction of 15°.

6.8 Basement Floor Slabs

6.8.1 Basement floor slabs at an assumed depth of some 3m bgl may be prepared in the London Clay Formation. Any soft or deleterious material should be removed and replaced with properly compacted granular fill.

6.9 Excavations

6.9.1 On the basis of observations on site together with the results of in-situ and laboratory tests, it is considered that excavations to less than 1.20m may not stand unsupported in the short term. Side support for safety purposes should of course be provided to all excavations which appear unstable and those in excess of 1.20m deep, in accordance with Health and Safety Regulations, ref. 7.14.

6.9.2 Groundwater should be expected in shallow excavations for foundations or services taken to depths in excess of 2.00m bgl and perched groundwater could be present in the Made Ground overlying the London Clay Formation. It is considered that this could be dealt with by the use of a small pump.

6.10 Chemical Attack on Buried Concrete

6.10.1 The site has been classified in accordance with BRE Special Digest 1, ref. 7.15, as Made Ground and as natural ground that contains pyrite and laboratory testing undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1, ref. 7.15, be adopted.

6.10.2 The results of chemical tests in the Made Ground indicate a sulphate concentration in the soil of 480mg/l as a 2:1 water/soil extract, with a pH value of 8.6.

6.10.3 The results of chemical tests in the pyritic soils, the London Clay Formation, indicate a sulphate concentration in the soil of between 110mg/l and 2300mg/l as a 2:1 water/soil extract, a total sulphate concentration of between 0.04% and 0.72% and total sulphur of between 0.02% and 0.71%, with pH values in the range of 8.1 to 9.0.

6.10.4 It is recommended that for conventional shallow foundations the groundwater should be regarded as static, locally mobile in claystone beds.

6.10.5 Static groundwater is defined as ground which is permanently dry, or is relatively impermeable, that is with a coefficient of permeability of generally less than 10^{-7}m/s.

6.10.6 Characteristic values for each strata have been derived from laboratory results for pH, 2:1 water/soil extract (WS), total (acid) soluble sulphate (AS), equivalent Total Potential Sulphate (TPS) and Oxidisable Sulphate (OS), and are presented in the table below, together with Design Sulphate Class and the ACEC Class: -

Stratum	Depth (m)	pH	WS (mg/l)	AS (%)	TPS (%)	OS (%)	Groundwater Condition	DS	AC
Made Ground	1.00	8.60	480	N/A	N/A	N/A	Mobile	1	1
Weathered/ Leached London Clay	1.40	9	110	0.04	0.06	0.05	Static	1	1s
Weathered London Clay	4.40	8.2	2100	NT	NT	NT	Static	3	2s
Weathered London Clay	4.40	8.1	2300	0.72	0.81	0.09	Static	3	2s
Unweathered London Clay	6.45	8.5	910	0.29	2.13	1.84	Static	2/4	1s/3s

6.10.7 Values for OS greater than 0.30% indicate that pyrite is present and may be oxidised to sulphate where the ground is disturbed.

6.10.8 On the basis of the laboratory test results, it is considered that a Design Sulphate Class for concrete located in the Made Ground may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.

6.10.9 Where shallow foundations are taken into the pyritic soil, the London Clay Formation, it is considered that oxidation has taken place, OS <0.30%, and a Design Sulphate Class of DS-3 would be appropriate, with AC-2s.

6.10.10 Where concrete is to be exposed to disturbed ground in which pyrite is available to be oxidised to sulphate, in this instance the London Clay below a depth of about 6 metres, consideration should be given to a Design Sulphate Class of DS-4 with an ACEC class of AC-3s.

6.11 Gas Generation

6.11.1 Gas monitoring visits were undertaken on the 27 February and 13 March 2014, the results of which are included within Appendix 2, Figure A2.3.

6.11.2 The results of initial gas monitoring determined the presence of carbon dioxide at a concentration of up to 1.5%v/v with no detectable methane or air flow recorded.

6.11.3 On the basis of the limited gas monitoring carried out, with methane below 1%v/v and carbon dioxide below 5%v/v, no pollutant linkage has been determined and therefore, it is considered that no special precautions need be adopted within the proposed structures to prevent the ingress of toxic gases.

6.11.4 These comments are based on two sets of readings over a period of two weeks at atmospheric pressures of 1003mb and 1028mb, which does not follow the recommended guidelines given in Appendix 6, Table A6.1. A further monitoring visit is to be carried out to comply more closely with these guidelines.

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For and on behalf of Ian Farmer Associates (1998) Limited

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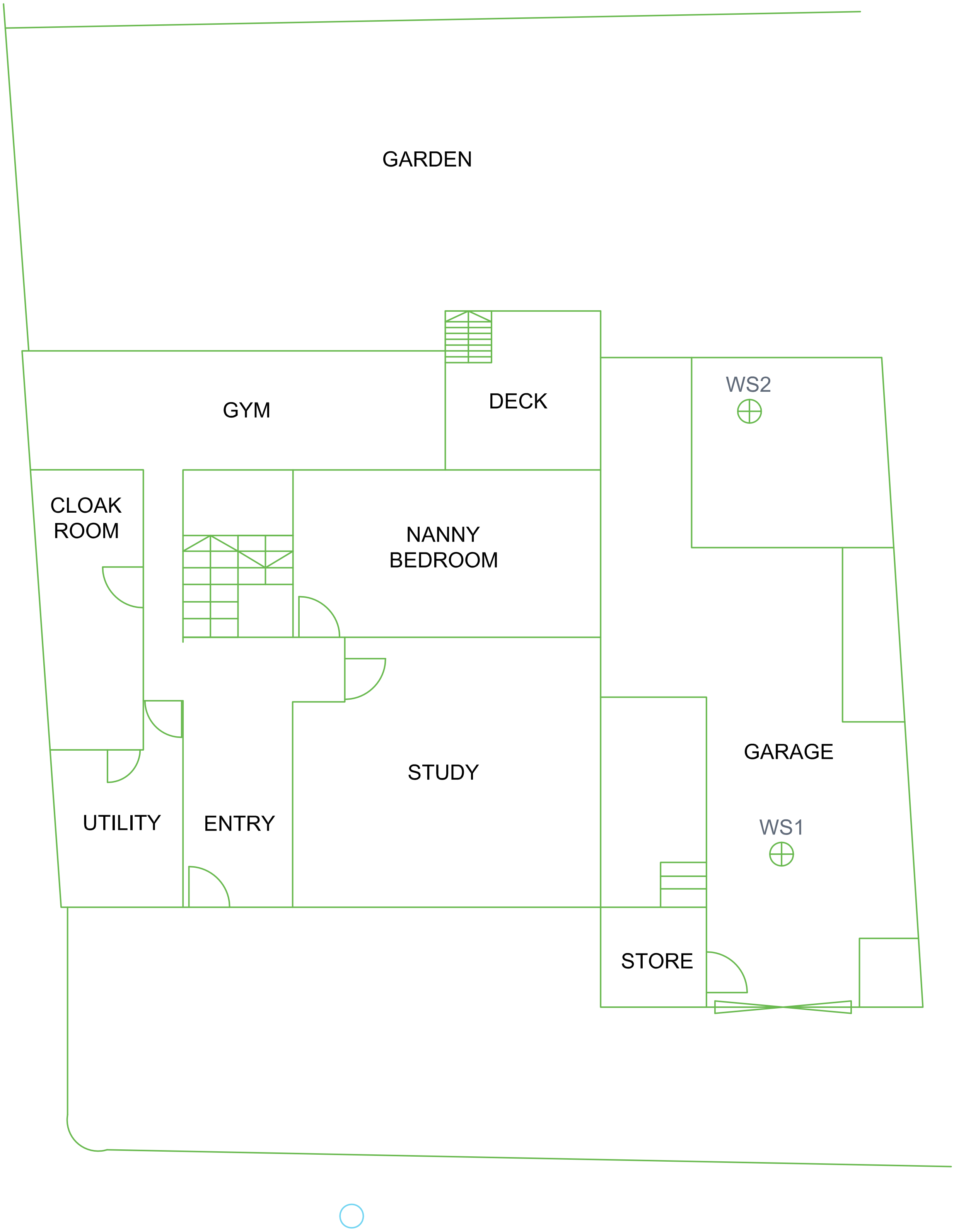
APPENDIX 1

DRAWINGS



		Scale : N.T.S.
		Drawn By : P.L.E.
IAN FARMER ASSOCIATES Geotechnical & Environmental Specialists	SITE PLAN	Job No: 52180
	3 Downshire Hill, London NW3 1NR.	Fig: A1.1

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 General

Site work is carried out in general accordance with the guidelines given in ISO 1997, 7.4 and BS 5930, ref 7.3.

A2.1.2 Percussive Window Sampling Rig

The percussive sampler consists of a track mounted window sampler, ref 7.16, with tube sizes varying in diameter from 98mm to 86mm. The sample tube is driven by a drop weight, which can also be used for dynamic probing and standard SPT tests. A cutting shoe is fitted to the bottom of each tube, whilst the sample is collected in a plastic sleeve.

The borehole is extended by using progressively smaller diameter tubes.

A2.2 IN-SITU TESTS

A2.2.1 Standard Penetration Test

The Standard Penetration Test is carried out in accordance with the proposals recommended by ISO 1997, ref 7.4 and BS 1377, Part 9, 1990 ref 7.6.

The standard penetration test, **SPT**, covers the determination of the resistance of soils to the penetration of a split barrel sampler. A 50mm diameter split barrel sampler is driven 450mm into the soil using a 63.5kg hammer with a 760mm drop. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows to achieve the standard penetration of 300mm is reported as the ‘N’ value.

The test is generally carried out in fine soils, however, it may also be carried out in coarse granular soils, weak rocks and glacial tills using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone replacing the split spoon sampler, **CPT.**

When attempting the standard penetration test in very dense material or weathered rocks it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner:

- Where the seating drive has been completed, the test drive is terminated if 50 blows are reached before the full penetration of 300mm is achieved. The penetration for 50 blows is recorded and an approximate N value obtained by linear extrapolation of the number of blows for the partial test drive.

- If the seating drive of 150mm is not achieved within the first 25 blows, the penetration after 25 blows is recorded and the test drive then commenced.

- For tests in soft rocks, the test drive should be terminated after 100 blows where the penetration of 300mm has not been achieved.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels as follows:

Term	SPT N-Value : Blows/300mm Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

A2.2.2 Pocket Penetrometer, PP

The pocket or dial penetrometer is intended to be used as a tool to provide a crude assessment of the presumed bearing value of a particular soil.

The presumed bearing value of a soil is given as $\frac{CuNc}{F}$ where

Cu = undrained shear strength

Nc = bearing capacity factor, generally taken as 6

F = factor of safety, generally taken as 3

Therefore, it may be seen that the penetrometer reading is approximately twice the undrained shear strength of the intact soil.

The penetrometer is 6.25mm diameter and therefore measures the intact shear strength of only a small portion of the soil. This makes the interpretation of the penetrometer difficult in terms of determining a safe bearing pressure due to the effects of fissuring on the behaviour of the soil en masse. However, it is ideal in assessing desiccation, as the strength of the intact clay between the fissures is an indicator of effective stress and therefore suction pressure in the soil.

A2.3 SAMPLES

A2.3.1 General

Samples have been recovered and stored in accordance with the guidelines given in ISO 22475-1:2006, ref 7.16 and BS 5930, ref 7.3.

The undisturbed samples recovered from the percussive sampler were of varying diameters depending upon the depth taken and the ground conditions encountered.

In accordance with EN ISO 22475, ref. 7.16, and BS 5930, ref. 7.3, the thick walled U100 sample is considered as a Class B sampling technique and will only produce Class 3 to 5 quality samples in accordance with EN 1997-2:2007, ref. 7.4. A similar assumption can be made from samples tested from the percussive window sample probing.

Laboratory strength and consolidation testing can only be carried out on Class 1 quality samples, which can be obtained from a Class A sampling technique, ref. 7.4. This is due to possible disturbance during sampling, giving a weaker strength in testing.

Therefore values for c_u and mv derived for use in this report can only be used as guidance and not used to determine the shear strength properties of the clay and is not used to give a descriptive strength in the borehole records.

U	represents undisturbed 100mm diameter sample, the number of blows to obtain the sample also recorded.
U fail	indicates undisturbed sample not recovered
J	represents sample recovered in an amber jar, generally for environmental analysis
HV	represents Hand Vane test with equivalent undrained shear strength in kPa.
PP	represents Pocket Penetrometer test with equivalent undrained shear strength in kPa.
CBR	represents California Bearing Ratio test
B	represents large bulk disturbed samples
D	represents small disturbed sample
W	represents water sample
$\underline{\triangledown}$	represents water strike
$\underline{\blacktriangledown}$	represents level to which water rose

A2.4 DESCRIPTION OF SOILS

A2.4.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, ref 7.17, supplemented by section 6 of BS 5930, ref. 7.3 have been used in the soil descriptions contained within this report.

IAN FARMER ASSOCIATES

Site 3 Downshire Hill, Hampstead, London NW3 1NR				**Number** WS1
Excavation Method Percussive Window Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Train and Kemp LLP	**Job Number** 52180
	Location TQ 268 856	**Dates** 13/02/2014	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records
1.00-1.45	SPT N=11		2,2/2,3,3,3
1.00-1.45	D1 .		
1.10-1.40	D2 PP 125kPa		
1.40-1.75	D3 PP 100kPa		
1.75-2.00	U1		
2.00-2.45	SPT N=9		1,1/2,2,3,2
2.00-2.30	D5		
2.00-2.45	D4		
2.30-2.60	D6 PP 88kPa		
2.60-3.00	D7 PP 100kPa		
3.00-3.45	SPT N=22		1,1/2,3,2,15
3.00-3.45	D8		
3.35-3.65	D9 PP 100kPa		
3.65-4.00	D10 PP 88kPa		
4.00-4.45	SPT N=11		2,2/2,3,3,3
4.00-4.40	D12 PP 38kPa		Water strike(1) at 4.10m.
4.00-4.45	D11		
4.40-4.75	D13 PP 88kPa		
4.75-5.00	U2		
5.00-5.45	SPT N=14		3,4/3,3,4,4
5.00-5.45	D14		
5.00-5.50	D15 PP 125kPa		
5.50-6.00	D16 PP 125kPa		
6.00-6.45	SPT N=18		3,3/4,4,5,5
6.00-6.45	D17		
6.15-6.45	D18 PP 100kPa		
6.45-6.75	D19 PP 175kPa		
6.75-7.00	U3		
7.00-7.45	SPT N=24		4,4/5,6,6,7
7.05-7.55	D20 PP 163kPa		
7.55-8.00	D21 PP 163 kPa		
8.00-8.45	SPT N=26		6,6/6,7,6,7

Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	(0.20) 0.20	CONCRETE paving slab.			
	(0.80) 1.00	MADE GROUND: Dark brown sandy fine to medium angular to subrounded flint gravel with frequent ash, clinker, brick and concrete fragments. Sand is fine to coarse. From 0.70m; Becoming gravelly sandy clay.			
	(2.60) 3.60	Firm to stiff light orange brown silty CLAY with occasional selenite crystals. From 2.10m; With rare rootlets, shell fragments and organic material.			
	(0.40) 4.00	Firm to stiff dark brown mottled grey slightly gravelly silty CLAY with occasional pockets of coarse sand sized selenite crystals and rare decomposing rootlets. Gravel is fine to medium angular to subangular claystone. From 3.60m to 3.70m; claystone.		∇1	
	(0.50) 4.50	Firm brown mottled grey slightly sandy silty CLAY with selenite crystals and occasional shell fragments. Sand is fine to coarse.			
	4.60 (0.40) 5.00	Firm brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is fine to medium angular to subangular claystone. From 4.50m to 4.60m; claystone.			
		Firm brown mottled grey slightly sandy silty CLAY with selenite crystals and occasional shell fragments. Sand is fine to coarse.			
	(3.45) 8.45	Stiff fissured laminated dark brown silty CLAY with grey veins, calcareous nodules and frequent selenite crystals. Fissures and laminations are extremely close. From 5.80m; With coarse gravel size selenite crystals.			
		Complete at 8.45m			

Remarks	**Scale (approx)** 1:50	**Logged By** AH
	Figure No. A2.1	

IAN FARMER ASSOCIATES

Site	Number
3 Downshire Hill, Hampstead, London NW3 1NR	WS2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Percussive Window Sampler			Train and Kemp LLP	52180
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 268 856	13/02/2014		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.20) 0.20	CONCRETE paving slab.			
					(0.65) 0.85	MADE GROUND: Dark brown sandy fine to medium subangular to subrounded flint gravel with clinker, brick and concrete fragments. Sand is fine to coarse.			
1.00-1.45 1.00-1.45 1.00-1.50	SPT N=7 D1 D2 PP 120kPa		1,1/1,2,2,2		(0.35) 1.20	MADE GROUND: Dark brown clayey gravelly fine to coarse sand with some fine to coarse gravel size brick, concrete and ceramic tile fragments.			
1.50-2.00	D3 PP 138kPa					Firm to stiff brown silty CLAY with selenite crystals and occasional rootlets.			
2.00-2.45 2.00-2.40 2.00-2.45 2.40-2.75	SPT N=10 D5 PP 88kPa D4 D6 PP 110kPa		1,2/2,2,3,3						
2.75-3.00	U1				(2.80)	From 2.50m; Slightly sandy with pockets of coarse sand.			
3.00-3.45 3.00-3.45 3.00-3.50	SPT N=10 D7 D8 PP 88kPa		2,2/2,2,3,3						
3.50-4.00	D9 PP 125kPa				4.00				
4.00-4.45 4.00-4.40 4.00-4.45 4.40-4.80	SPT N=11 D11 PP 125kPa D10 D12 PP 150kPa		2,2/2,3,3,3			Firm fissured laminated brown silty CLAY with rare decomposing rootlets, occasional small to medium gravel size selenite crystals. Fissures and laminations are extremely close.			
			Water strike(1) at 4.50m.					∇1	
4.80-5.00	U2								
5.00-5.45 5.00-5.45 5.00-5.50	SPT N=16 D13 D14 PP 150kPa		2,2/3,4,4,5		(2.15)				
5.50-6.00	D15 PP 188kPa					From 5.60m; Stiff with coarse gravel size selenite crystals.			
6.00-6.45 6.00-6.45 6.15-6.45	SPT N=20 D16 D17 PP 110kPa		4,4/5,5,5,5		6.15	Stiff fissured laminated dark grey silty CLAY with selenite crystals. Fissures and laminations are extremely close.			
6.45-6.75	D18 PP 160kPa								
6.75-7.00	U3								
7.00-7.45 7.00-7.45 7.00-7.50	SPT N=21 D19 D20 PP 138kPa		5,5/5,5,5,6		(2.30)				
7.50-8.00	D21 PP 138kPa								
8.00-8.45	SPT N=27		5,6/6,7,7,7		8.45				
						Complete at 8.45m			

Remarks	Scale (approx)	Logged By
	1:50	AH
	Figure No. A2.2	

RESULTS OF GAS AND GROUNDWATER MONITORING

3 Downshire Hill, Hampstead, London, NW3 1NR

Job No: 52180

Figure No: A2.3

Background Readings:	Date of Visit	27/02/2014				
	CH_4%v/v	CO_2%v/v	O_2%v/v	H_2Sppm	COppm	VOC ppm
	0.1	0.1	20.7	0	0	N/A
	Weather Conditions	Cloudy				
	Ground Conditions (dry/wet etc.)	Damp				
	Atmospheric Pressure (mb)	1003				

Hole No:	Time (hh:mm)	Atmos. Pressure (mb)	Gas Flow Rate (l/hr)	CH_4% v/v		CO_2% v/v		O_2% v/v		H_2S ppm		CO ppm		VOC ppm		Water Level	Depth of Well	Water Sample Y / N
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	mBGL	mBGL	
WS1	8:26	1003	0.0	0.1	0.1	0.0	0.0	19.5	19.5	0	0	0	0	N/R	N/R	1.90	7.09	N
WS2	8:21	1003	0.0	0.1	0.1	0.4	0.4	19.5	19.5	0	0	0	0	N/R	N/R	1.93	7.05	N

ND = Below detection limit of instrument. NR = Not Read.

Readings Taken By: **AH** Checked By: **DA**

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

RESULTS OF GAS AND GROUNDWATER MONITORING

3 Downshire Hill, Hampstead, London, NW3 1NR

Job No: 52180

Figure No: A2.3 cont

Background Readings:	Date of Visit	13/03/2014				
	CH_4%v/v	CO_2%v/v	O_2%v/v	H_2Sppm	COppm	VOC ppm
	0.1	0.0	20.5	0	0	N/A
	Weather Conditions	Sunny				
	Ground Conditions (dry/wet etc.)	Dry				
	Atmospheric Pressure (mb)	1028				

Hole No:	Time (hh:mm)	Atmos. Pressure (mb)	Gas Flow Rate (l/hr)	CH_4% v/v		CO_2% v/v		O_2% v/v		H_2S ppm		CO ppm		VOC ppm		Water Level	Depth of Well	Water Sample Y / N
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	mBGL	mBGL	
WS1	8:24	1028	0.0	0.1	0.1	0.1	0.1	18.6	18.6	0	0	0	0	N/R	N/R	1.98	7.03	N
WS2	8:29	1028	0.0	0.1	0.1	1.5	1.5	13.0	13.0	0	0	0	0	N/R	N/R	1.92	7.05	N

ND = Below detection limit of instrument. NR = Not Read.

Readings Taken By: **AH**

Checked By: **DA**

APPENDIX 3

LABORATORY TESTS

APPENDIX 3

GENERAL NOTES ON LABORATORY TESTS ON SOILS

A3.1 GENERAL

A3.1.1 Where applicable all tests are carried out in accordance with the relevant British Standard. The laboratory test procedures are reference in the laboratory report.

A3.1.2 Any discussion in this report is based on the values and results obtained from the appropriate tests. Due allowance should be made, when considering any result in isolation, of the possible inaccuracy of any such individual result. Details of the accuracy of results are included in this section, where applicable.

A3.2 SOIL CLASSIFICATION

A3.2.1 Classification of soils is usually undertaken by means of the Plasticity Classification Chart, sometimes called the A-Line Chart. This is graphical plot of PI against LL with the A-Line defined as PI = 0.73(LL - 20).

A3.2.2 This line is defined from experimental evidence and does not represent a well defined boundary between soil types, but forms a useful reference datum. When the values of LL and PI for inorganic clays are plotted on the chart they generally lie just above the A-Line in a narrow band parallel to it, while silts and organic clays plot below this line.

A3.2.3 Clays and silts are divided into five zones of plasticity:

Low Plasticity (L)	LL less than 35
Intermediate Plasticity (I)	LL between 35 and 50
High Plasticity (H)	LL between 50 and 70
Very High Plasticity (V)	LL between 70 and 90
Extremely High Plasticity (E)	LL greater than 90

A3.2.4 In general, clays of high plasticity are likely to have a lower permeability, are more compressible and consolidate over a longer period of time under load than clays of low plasticity. Clays of high plasticity are more difficult to compact as fill material.

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Tel. 0191 4828500 Fax. 0191 4828520 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

Ian Farmer Associates (1998) Ltd
Unit 1A,
Batford Mill,
Harpenden,
AL5 5BZ

F.A.O. Mrs D Ashton

TEST REPORT - 52180/1

Site :	3 Downshire Hill, Hampstead, London NW3 1NR
Job Number :	52180
Originating Client :	Train and Kemp LLP
Originating Reference :	52180
Date Sampled :	Not Given
Date Scheduled :	19/02/14
Date Testing Started :	28/02/14
Date Testing Finished :	06/03/14

Remarks :

- First Report for above Job Number
- Samples will be disposed of 28 days after the report is issued unless otherwise agreed
- This report may contain results from tests which are not included within the scope of the UKAS accreditation. Please see final sheet for details.

Authorised By: Nicholas O`Brien

Position : Assistant Laboratory Supervisor Date : 06/03/14

Ian Farmer Associates (1998) Limited. Registered in England and Wales No. 3661447
Registered Office: Unit 4 Faraday Close, Pattinson North Industrial Estate, Washington. NE38 8QJ
Offices in: Coventry (02476) 456565. Harpenden, Herts. (01582) 460018. Truro (01827) 261775
Warrington (01925) 855440. Newcastle upon Tyne (0191) 4828500. Motherwell (01698) 230231.

1464

Figure A3.1

IAN FARMER ASSOCIATES

Laboratory Test Report - 52180/1

Site : 3 Downshire Hill, Hampstead, London NW3 1NR

Client : Train and Kemp LLP

Job Number 52180

Page 2 / 9

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Moisture Content %	Sample Passing 425μm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Moisture Content %						
WS1	1.10	D2	Natural	25	99	25	52	23	29	0.07	CH	Brown sandy gravelly CLAY
WS1	3.65	D10	Natural	34	98	35	65	27	38	0.21	CH	Brown sandy gravelly CLAY
WS2	1.50	D3	Natural	31	100	31	71	26	45	0.11	CV	Brown silty CLAY
WS2	4.00	D11	Natural	32	98	32	69	27	42	0.12	CH	Brown sandy CLAY
WS2	6.15	D17	Natural	35	100	35	72	27	45	0.18	CV	Brown silty CLAY

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3.2 Determination of moisture content 4.3 Determination of the liquid limit 5.3 Determination of the plastic limit and plasticity index

Figure A3.1

IAN FARMER ASSOCIATES

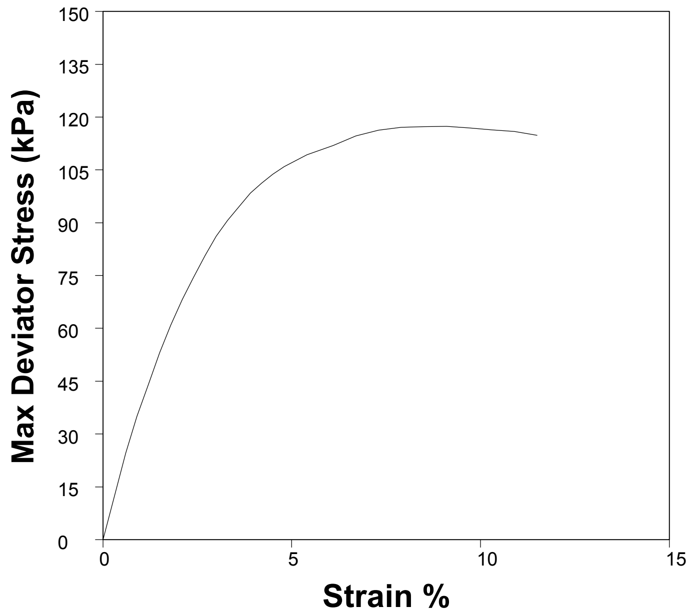
Laboratory Test Report - 52180/1

Site : 3 Downshire Hill, Hampstead, London NW3 1NR	**Job Number** 52180
Client : Train and Kemp LLP	**Page** 3 / 9

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
WS1	1.75	U1	Brown sandy silty CLAY

Initial Specimen		
Length of Sample (mm)		221
Depth from top of sample (mm)		25
Condition of Sample:		Undisturbed
Orientation:		Vertical
Test Type		Single Stage
Length of Specimen (mm)		165.1
Diameter of Specimen (mm)		81.3
Moisture Content (%)		30
Bulk Density (Mg/m³)		1.87
Dry Density (Mg/m³)		1.44
Membrane Thickness (mm)		0.44
Membrane Type		Latex
Rate of Strain (%/min)		1.95
Test Results	**Measured Cell Pressure (kPa)**	35
	Strain at Failure (%)	9.1
	Membrane Correction (kPa)	1.1
	Corrected Deviator Stress (kPa)	116
	Shear Stress (kPa)	**58**
	Mode of Failure (B/P/C)	**Compound**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

Figure A3.1

IAN FARMER ASSOCIATES

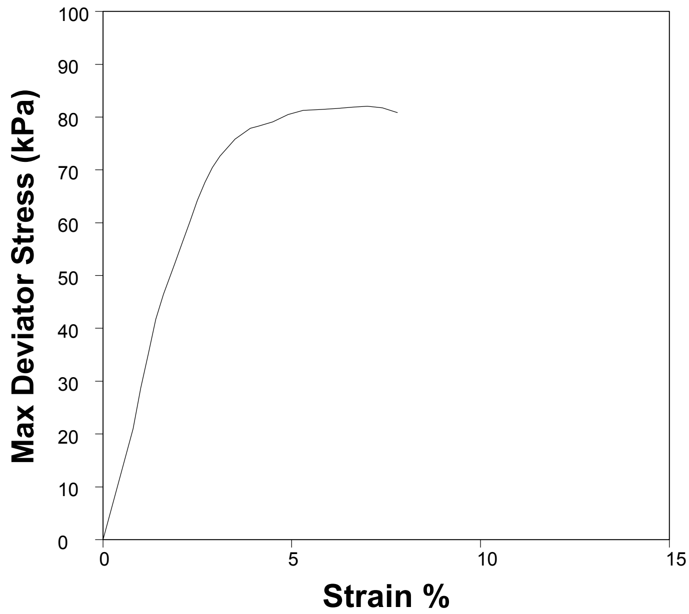
Laboratory Test Report - 52180/1

Site	: 3 Downshire Hill, Hampstead, London NW3 1NR	**Job Number** 52180
Client	: Train and Kemp LLP	**Page** 4 / 9

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
WS1	4.75	U2	Brown sandy gravelly CLAY

Initial Specimen		
Length of Sample (mm)		265
Depth from top of sample (mm)		0
Condition of Sample:		Undisturbed
Orientation:		Vertical
Test Type		Single Stage
Length of Specimen (mm)		121.6
Diameter of Specimen (mm)		60.1
Moisture Content (%)		35
Bulk Density (Mg/m³)		1.91
Dry Density (Mg/m³)		1.42
Membrane Thickness (mm)		0.37
Membrane Type		Latex
Rate of Strain (%/min)		1.98
Test Results	**Measured Cell Pressure (kPa)**	95
	Strain at Failure (%)	7
	Membrane Correction (kPa)	1.0
	Corrected Deviator Stress (kPa)	81
	Shear Stress (kPa)	**41**
	Mode of Failure (B/P/C)	**Compound**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

Figure A3.1

IAN FARMER ASSOCIATES

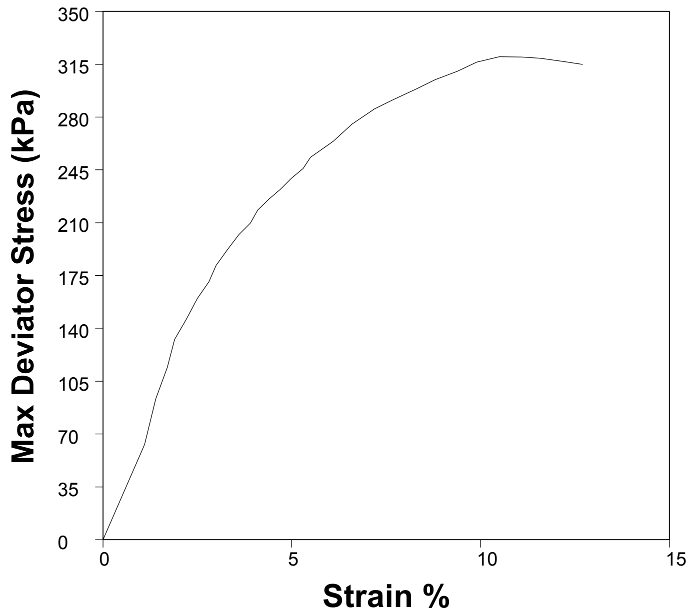
Laboratory Test Report - 52180/1

Site : 3 Downshire Hill, Hampstead, London NW3 1NR	**Job Number** 52180
Client : Train and Kemp LLP	**Page** 5 / 9

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
WS1	6.75	U3	Brown gravelly silty CLAY

Initial Specimen	**Length of Sample (mm)**	140
	Depth from top of sample (mm)	0
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		90.5
Diameter of Specimen (mm)		45.3
Moisture Content (%)		32
Bulk Density (Mg/m³)		2.19
Dry Density (Mg/m³)		1.66
Membrane Thickness (mm)		0.41
Membrane Type		Latex
Rate of Strain (%/min)		1.99
Test Results	**Measured Cell Pressure (kPa)**	135
	Strain at Failure (%)	10.5
	Membrane Correction (kPa)	2.1
	Corrected Deviator Stress (kPa)	318
	Shear Stress (kPa)	**159**
	Mode of Failure (B/P/C)	**Compound**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

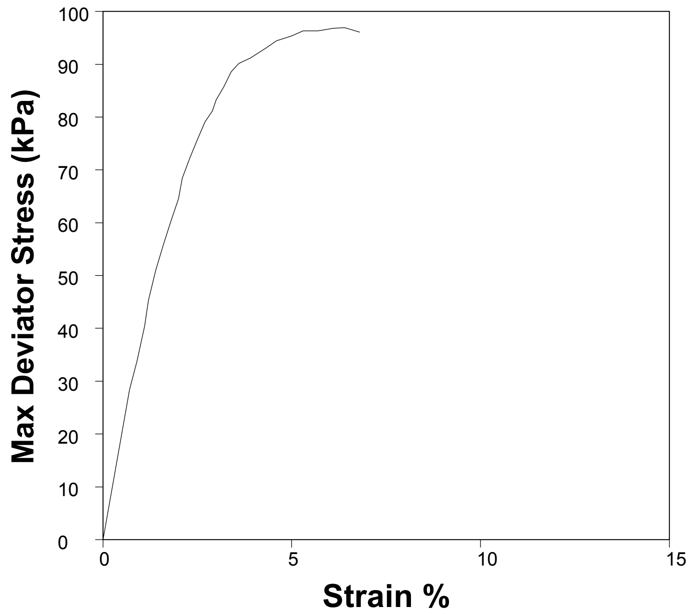
Figure A3.1

IAN FARMER ASSOCIATES	Laboratory Test Report - 52180/1

Site : 3 Downshire Hill, Hampstead, London NW3 1NR	**Job Number**	52180
Client : Train and Kemp LLP	**Page**	6 / 9

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
WS2	2.75	U1	Brown silty CLAY



Initial Specimen	**Length of Sample (mm)**	225
	Depth from top of sample (mm)	10
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		140.3
Diameter of Specimen (mm)		69.4
Moisture Content (%)		32
Bulk Density (Mg/m³)		1.92
Dry Density (Mg/m³)		1.45
Membrane Thickness (mm)		0.4
Membrane Type		Latex
Rate of Strain (%/min)		2.00
Test Results	**Measured Cell Pressure (kPa)**	55
	Strain at Failure (%)	6.4
	Membrane Correction (kPa)	0.9
	Corrected Deviator Stress (kPa)	96
	Shear Stress (kPa)	**48**
	Mode of Failure (B/P/C)	**Compound**

Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

Figure A3.1

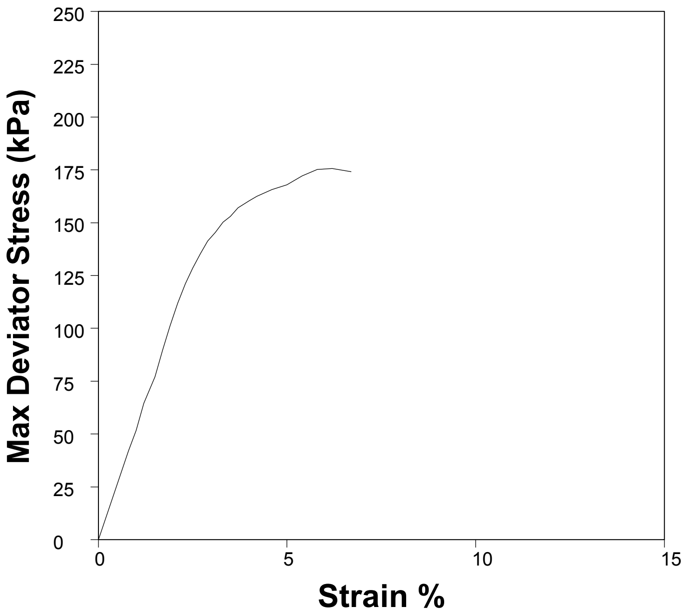
IAN FARMER ASSOCIATES	**Laboratory Test Report - 52180/1**

Site : 3 Downshire Hill, Hampstead, London NW3 1NR **Client** : Train and Kemp LLP	**Job Number** 52180 **Page** 7 / 9

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
WS2	4.80	U2	Brown silty sandy CLAY

Initial Specimen	**Length of Sample (mm)**	181
	Depth from top of sample (mm)	0
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		120.1
Diameter of Specimen (mm)		57.9
Moisture Content (%)		32
Bulk Density (Mg/m³)		1.96
Dry Density (Mg/m³)		1.48
Membrane Thickness (mm)		0.48
Membrane Type		Latex
Rate of Strain (%/min)		2.00
Test Results	**Measured Cell Pressure (kPa)**	96
	Strain at Failure (%)	6.2
	Membrane Correction (kPa)	1.2
	Corrected Deviator Stress (kPa)	175
	Shear Stress (kPa)	**87**
	Mode of Failure (B/P/C)	**Compound**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

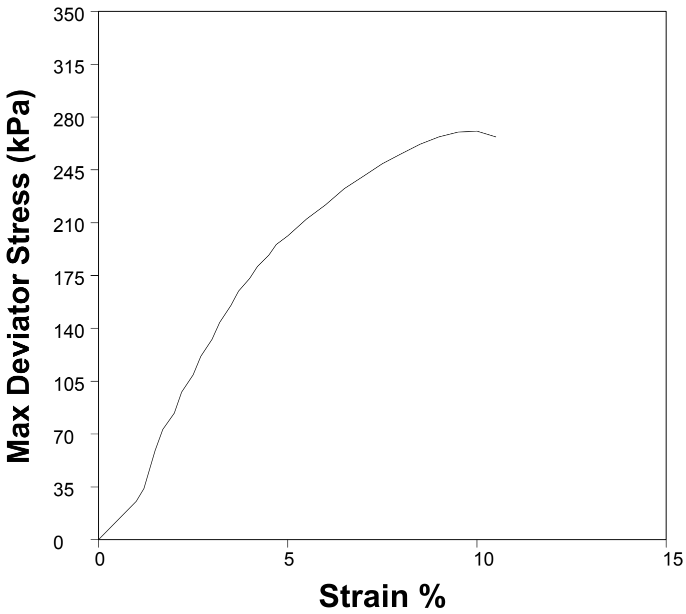
Figure A3.1

Site	: 3 Downshire Hill, Hampstead, London NW3 1NR	**Job Number**	52180
Client	: Train and Kemp LLP	**Page**	8 / 9

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
WS2	6.75	U3	Brown silty CLAY

Initial Specimen	**Length of Sample (mm)**	200
	Depth from top of sample (mm)	40
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		100.4
Diameter of Specimen (mm)		50.6
Moisture Content (%)		32
Bulk Density (Mg/m³)		1.84
Dry Density (Mg/m³)		1.40
Membrane Thickness (mm)		0.41
Membrane Type		Latex
Rate of Strain (%/min)		1.99
Test Results	**Measured Cell Pressure (kPa)**	135
	Strain at Failure (%)	10
	Membrane Correction (kPa)	1.8
	Corrected Deviator Stress (kPa)	269
	Shear Stress (kPa)	**134**
	Mode of Failure (B/P/C)	**Compound**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

Figure A3.1

Test Report : **52180/1**

Site : 3 Downshire Hill, Hampstead, London NW3 1NR
Job Number : 52180
Originating Client : Train and Kemp LLP

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

The following tests contained within this report are not UKAS Accredited.

Date of Issued : 06/03/14

Figure A3.1

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 14-99566

27-Feb-14

Client	Ian Farmer Associates 1A Batford Mill Lower Luton Road Harpenden Herts AL5 5BZ
Our Reference	14-99566
Client Reference	52180
Contract Title	3 Downshire Hill, London
Description	5 Soil samples.
Date Received	21-Feb-14
Date Started	21-Feb-14
Date Completed	27-Feb-14
Test Procedures	Identified by prefix DETSn (details on request).
Notes	Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING 2139

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • email: info@dets.co.uk • www.dets.co.uk

Figure A3.2

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 14-99566
Client Ref 52180
Contract Title 3 Downshire Hill, London

Sample ID	Depth	Lab No	Completed	Matrix Description
WS1	1.4	610927	27/02/2014	Light brown sandy CLAY
WS1	4.4	610928	27/02/2014	Light brown sandy gravelly CLAY
WS1	6.45	610929	27/02/2014	Dark brown sandy CLAY
WS2	1	610930	27/02/2014	Light brown sandy gravelly CLAY (made ground includes brick)
WS2	4.4	610931	27/02/2014	Dark brown sandy gravelly CLAY

Figure A3.2

Summary of Chemical Analysis
Soil Samples

Our Ref 14-99566
Client Ref 52180
Contract Title 3 Downshire Hill, London

Test	Method	LOD	Units					
			Lab No	610927	610928	610929	610930	610931
			Sample ID	WS1	WS1	WS1	WS2	WS2
			Depth	1.40	4.40	6.45	1.00	4.40
			Other ID					
			Sample Type	D	D	D	D	D
			Sampling Date	13/02/14	13/02/14	13/02/14	13/02/14	13/02/14
			Sampling Time	n/s	n/s	n/s	n/s	n/s
Inorganics								
pH	DETSC 2008#			9.0	8.2	8.5	8.6	8.1
Total Sulphate as SO4	DETSC 2321#	0.01	%	0.04		0.29		0.72
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	110	2100	910	480	2300
Total Sulphur as S	DETSC 2320	0.01	%	0.02		0.71		0.27

Key: # -MCERTS (accreditation only implied if report carries the MCERTS logo). n/s -not supplied.

Figure A3.2

Information in Support of the Analytical Results

Our Ref 14-99566
Client Ref 52180
Contract 3 Downshire Hill, London

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
610927	WS1 1.40 SOIL	13/02/14	PG		
610928	WS1 4.40 SOIL	13/02/14	PG		
610929	WS1 6.45 SOIL	13/02/14	PG		
610930	WS2 1.00 SOIL	13/02/14	PG		
610931	WS2 4.40 SOIL	13/02/14	PG		

Key: P-Plastic G-Bag

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time and/or inappropriate containers are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Figure A3.2

Appendix A - Details of Analysis

Method		Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002		Organic Matter	%	0.01	Air Dried	No	Yes	Yes
DETSC 2003		Loss on Ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2004		Total Sulphate	%	0.01	Air Dried	No	Yes	Yes
DETSC 2321		Total Sulphate	%	0.01	Air Dried	No	Yes	Yes
DETSC 2004		Water Soluble Sulphate	mg/l	10.00	Air Dried	No	Yes	Yes
DETSC 2076		Water Soluble Sulphate	mg/l	10.00	Air Dried	No	Yes	Yes
DETSC 2006		Chloride	mg/kg	0.01	Air Dried	No	Yes	Yes
DETSC 2008		pH	pH Units	0.10	Air Dried	No	Yes	Yes
DETSC 2301		Selenium	mg/kg	0.50	Air Dried	No	Yes	Yes
DETSC 2119		Ammonia	mg/kg	0.02	Air Dried	No	Yes	Yes
DETSC 2123		Boron (Water Soluble)	mg/kg	0.20	Air Dried	No	Yes	Yes
DETSC 2024		Sulphide	mg/kg	10.00	Air Dried	No	Yes	Yes
DETSC 2301		Antimony	mg/kg	1.00	Air Dried	No	No	No
DETSC 2301		Arsenic	mg/kg	0.20	Air Dried	No	Yes	Yes
DETSC 2301		Barium	mg/kg	1.50	Air Dried	No	Yes	Yes
DETSC 2301		Beryllium	mg/kg	0.20	Air Dried	No	Yes	Yes
DETSC 2301		Cadmium	mg/kg	0.10	Air Dried	No	Yes	Yes
DETSC 2301		Cobalt	mg/kg	0.70	Air Dried	No	Yes	Yes
DETSC 2301		Copper	mg/kg	0.20	Air Dried	No	Yes	Yes
DETSC 2301		Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC 2301		Iron	mg/kg	1.00	Air Dried	No	Yes	No
DETSC 2301		Lead	mg/kg	0.30	Air Dried	No	Yes	Yes
DETSC 2301		Manganese	mg/kg	20.00	Air Dried	No	Yes	Yes
DETSC 2325		Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 2301		Molybdenum	mg/kg	0.40	Air Dried	No	Yes	Yes
DETSC 2301		Nickel	mg/kg	0.20	Air Dried	No	Yes	Yes
DETSC 2301		Thallium	mg/kg	1.00	Air Dried	No	No	No
DETSC 2301		Vanadium	mg/kg	0.80	Air Dried	No	Yes	Yes
DETSC 2301		Zinc	mg/kg	1.00	Air Dried	No	Yes	Yes
DETSC 3049		Sulphur (Free)	mg/kg	0.50	As Received	No	Yes	Yes
DETSC 3301		PAH by GC-FID	mg/kg	0.10	As Received	No	Yes	No
DETSC 3311		TPH (C10 - C40)	mg/kg	20.00	As Received	No	Yes	Yes
DETSC 3401		PCB	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3321		Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3321		Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3321		Ethylbenzne	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3321		Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 2130		Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130		Easily Liberatable Cyanide	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130		Complex Cyanide	mg/kg	0.30	Air Dried	No	Yes	No
DETSC 2130		Total Cyanide	mg/kg	0.40	Air Dried	No	Yes	Yes
DETSC 2130		Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 3431		VOC	mg/kg	0.01	As Received	No	No	No
DETSC 3303	PAH by GCMS	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303		Anthracene	mg/kg	0.03	As Received	No	Yes	No
DETSC 3303		Chrysene	mg/kg	0.03	As Received	No	Yes	No
DETSC 3303		Fluorene	mg/kg	0.03	As Received	No	Yes	No

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Figure A3.2

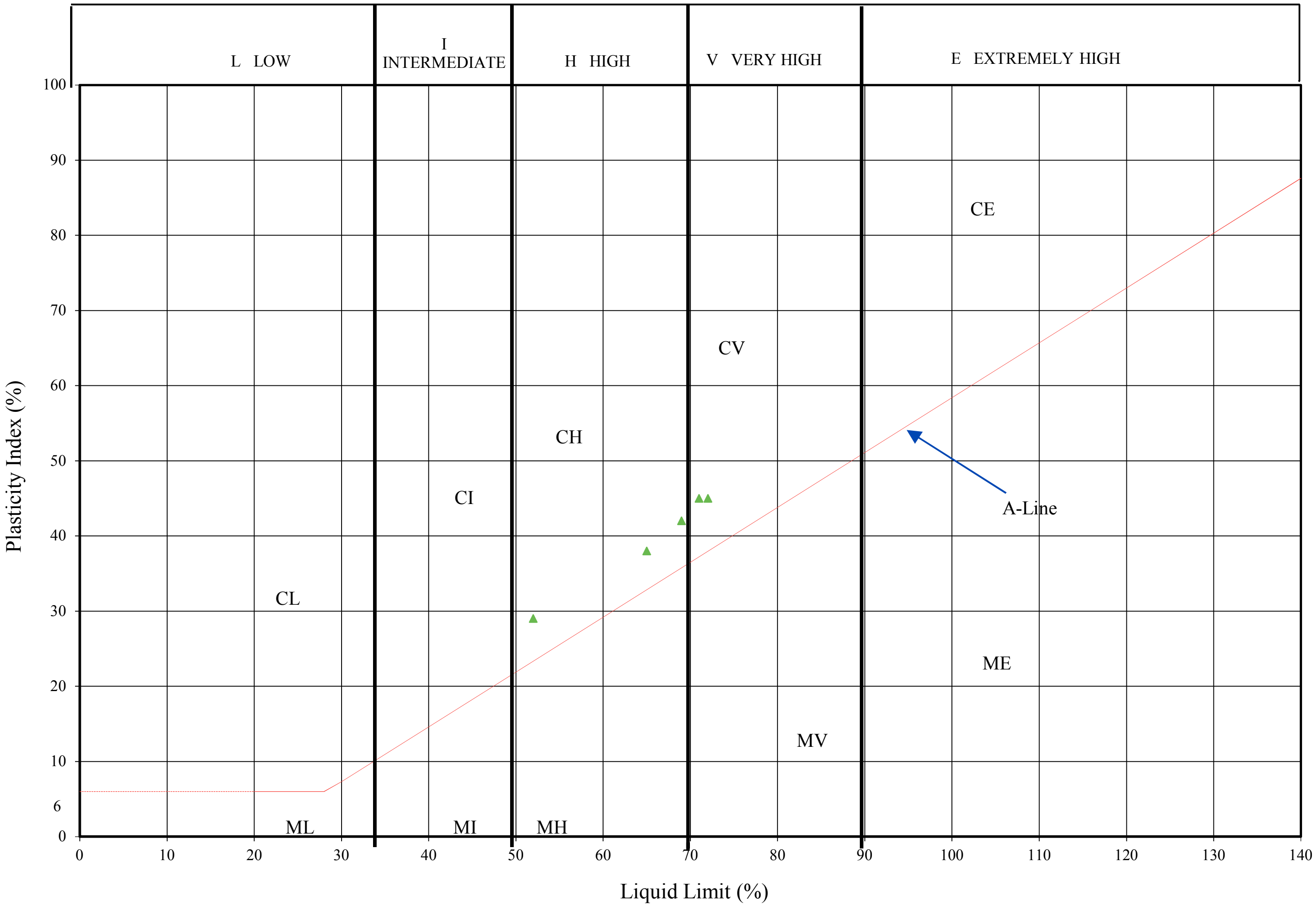
IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

PLASTICITY CLASSIFICATION CHART

3 Downshire Hill, Hampstead, London, NW3 1NR

Job no. 52180

Fig no. A3.3



SILTS generally plot below A Line
CLAYS generally plot above A Line

APPENDIX 4

DESIGN CONSIDERATIONS

APPENDIX 4

GUIDELINES FOR THE DESIGN OF PILES

FIRST APPROXIMATION OF WORKING LOAD

A4.1 GENERAL

The ultimate carrying capacity, Qu, of a particular pile is taken as the sum of the ultimate shaft friction resistance, Qs, and the ultimate end bearing resistance, Qb. This may be expressed as follows:-

$$Qu = Qs + Qb$$

$$= f.As + q.Ab$$

where	f	=	unit shaft resistance
	As	=	embedded surface area of pile
	q	=	unit end bearing resistance
	Ab	=	effective cross-sectional area of pile base

A4.2 COHESIVE SOILS

A4.2.1 Shaft Resistance

The ultimate shaft resistance, f, for piles in both compression or tension in cohesive soils is determined by applying a factor to the undrained shear strength, Cs, which exists in the soils along the embedded length of the pile, and is given by:-

$$f = \alpha.Cs$$

Where α is an adhesion factor, which for straight-shafted bored piles may be taken as 0.45 to 0.60.

Ultimate unit shaft friction should not exceed 100kPa.

A4.2.2 End Bearing

For piles terminating in cohesive soils, the ultimate unit end bearing resistance q, is given by:-

$$q = Nc.Cb$$

where Cb is the undrained shear strength at the base of the pile

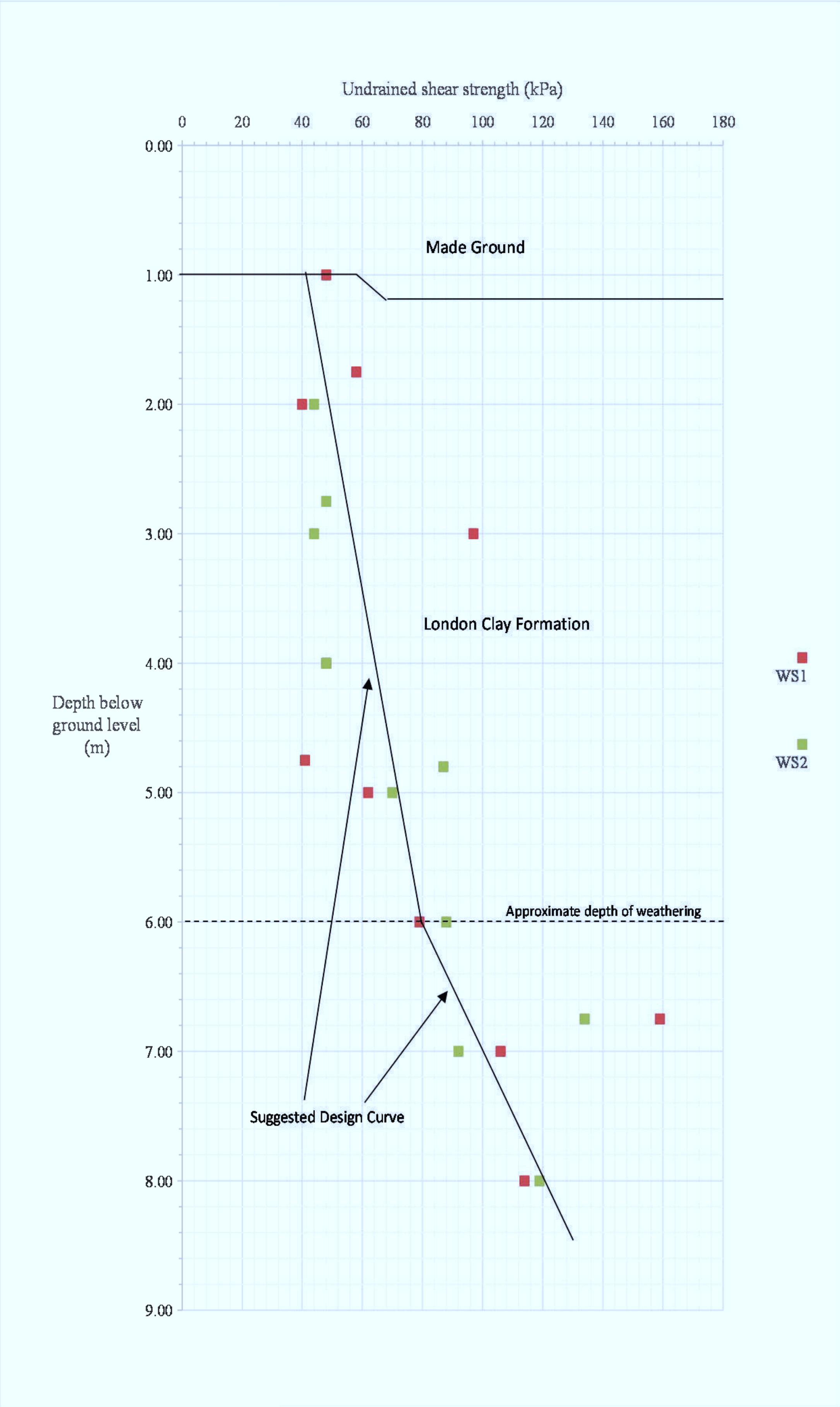
and Nc is a bearing capacity factor

The value of Nc for a cohesive material is variable, depending on the depth of the penetration of the pile into the bearing stratum. Generally, Nc could be taken to have a value of 9, except in the case of large diameter short piles where a lesser value should be used.

A4.3 FACTORS OF SAFETY

A4.3.1 Cohesive and Non-cohesive Soils

For cohesive and non-cohesive soils a factor of safety of 3 may be used to obtain the allowable or safe carrying capacity of piles from the ultimate carrying capacity.



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PLOT OF SHEAR STRENGTH WITH DEPTH	Job no.	52180
3 Downshire Hill, Hampstead, London NW3 1NR	Fig No	A4.1

APPENDIX 5

GAS GENERATION

APPENDIX 5

GENERAL NOTES ON GAS GENERATION

A5.1 GENERAL

A5.1.1 In the past, a series of guidance documents were published by CIRIA, ref. 7.16, providing advice on hazards associated with methane. This earlier guidance was consolidated in CIRIA Document C659 to provide a risk based approach to gas contaminated land. This was subsequently re-issued as CIRIA Document C665, ref 7.21. In 2007, British Standard, BS8485, ref 7.22, dealing with ground gas was published. It is recommended that guidance in C665 and BS8485 is adopted to provide a consistent approach in dealing with ground gas contamination, the principal details being as follows.

A5.1.2 This guidance is based on a similar approach to that for dealing with contaminated soil. The presence of hazardous gases could be deemed to be the 'source' in a 'pollutant linkage' that could lead to the conclusion that significant harm is or could be caused to people, buildings or the environment. In such circumstances the land could be deemed 'contaminated', ref. 7.18.

A5.1.3 Should a potential source of gas be identified in the conceptual model, a gas risk assessment should be carried out, sufficient to demonstrate to the local authority that the proposals mitigate any hazards associated with ground gas. The authority enforces compliance with Approved Document Part C of the Building Regulations, ref. 7.23.

A5.2 APPROACH

A5.2.1 A flow chart detailing the approach to assessing a site is given in CIRIA document C665, Figure 1.1. This may be summarised as follows.

- Carry out Phase 1 desk study, including initial conceptual model
- Assess site, potential presence of gas / potential unacceptable risk / identify further action, if necessary
- Monitor gas concentrations
- Assessment of Risk
- Recommendations / remediation
- Validation

A5.3 POLLUTANT LINKAGE ASSESSMENT

A5.3.1 A pollutant linkage assessment is presented in Appendix 3 of the Phase 1 Desk Study Report.

A5.3.2 Using the risk model in the desk study, the pollutant linkage can be identified and a preliminary estimate of risk undertaken. If there is no relevant pollutant linkage identified there is no risk. If there is a very low risk, it is likely that no further assessment is required. If further assessment is necessary, then gas monitoring is required.

A5.4 SITE MONITORING

A5.4.1 For sites with low generation potential, giving consistently low concentrations of soil gas under the worst-case conditions, a limited programme of monitoring would be appropriate. Where high or variable concentrations are anticipated or recorded, an extended programme of monitoring would be appropriate. The following guideline has been proposed, ref. 7.25.

Table A5.1

		Generation potential of source				
		Very low	**Low**	**Moderate**	**High**	**Very high**
Sensitivity of development	Low (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with gardens)	6/3*	9/6	12/6	24/12	24/24

Notes

1. First number is minimum number of readings and second number is minimum period in months, for example 4/1 – Four sets of readings over 1 month.

2. At least two sets of readings must be at low and falling atmospheric pressure (but not restricted to periods below <1000mb) known as worst case conditions (see Boyle and Witherington, 2006).

3. The frequency and period stated are considered to represent typical minimum requirements. Depending on specific circumstances fewer or additional readings may be required (e.g. any such variation subject to site specific justification). * The NHBC guidance is also recommending these periods/frequency of monitoring (Boyle and Witherington, 2006)

4. Historical data can be used as part of the data set.

5. Not all sites will require gas monitoring however, this would need to be confirmed with demonstrable evidence.

6. Placing high sensitivity end use on a high hazard site is not normally acceptable unless the source is removed or treated to reduce its gassing potential. Under such circumstances long-term monitoring may not be appropriate or required.

A5.4.2 Before taking any readings, zero the instrument, record atmospheric pressure and temperature.

A5.4.3 Gas flow should be recorded, giving the range of pressures, ensuring positive or negative flow is recorded.

A5.4.4 Record gas levels, recording peak and steady. Where steady state not obtained within 3 minutes, record change in concentration, where concentrations are decreasing, always record peak value. For very high concentrations, record for longer period of up to 10 minutes.

A5.5 ASSESSMENT OF RISK AND RECOMMENDATIONS

A5.5.1 The main method of characterising a site is the method described by Wilson and Card, ref. 7.26 and is termed Situation A. This can be used for all types of development except conventional low-rise housing with suspended ground floor and ventilated underfloor void.

A5.5.2 Low rise housing, Situation B, was developed by Boyle and Witherington, ref. 7.27 and was developed for the NHBC for classifying gassing sites for houses with suspended ground floor slab with ventilated void.

A5.5.3 Although the Code of Practice, ref 7.22, assesses the characteristic gas situation as CIRIA recommend for Situation A, see Table A5.2 below, their solution for gas protection systems is different, see section A5.10.

A5.6 SITUATION A - ASSESSMENT

A5.6.1 This system proposed by Wilson and Card, ref. 7.26 was originally developed in CIRIA Report 149, ref. 7.16.

A5.6.2 The method uses both gas concentrations and borehole flow rate for methane and carbon dioxide to define a Characteristic Situation for a site.

A5.6.3 Gas Screening Value (litre/hr) = borehole flow rate (litre/hr) x (gas concentration (%))/100. The GSV is determined for methane and carbon dioxide and the worst case adopted. The Characteristic Situation can then be determined from the table below. The GSV can be exceeded if the conceptual model indicates it is safe to do so, and other factors may lead to a change in the Characteristic Situation.

Table A5.2

Characteristic Situation	Risk Classification	Gas screening value (CH_4 or CO_2(1/hr)[1]	Additional factors	Typical source of generation
1	Very low risk	<0.07	Typically methane $\leq$1% and/or carbon dioxide $\leq$5%. Otherwise consider increase to Situation 2	Natural soils with low organic content “Typical” Made Ground
2	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to Characteristic Situation 3	Natural soil, high peat/organic content. “Typical” Made Ground
3	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
5	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	Very high risk	>70		Recent landfill site

1. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in Table A5.1
2. Source of gas and generation potential/performance must be identified.
3. If there is no detectable flow use the limit of detection of the instrument.

A5.7 SITUATION A – SOLUTION

A5.7.1 The Characteristic Situation can be used to define the scope of gas protective measures required.

A5.7.2 The CIRIA approach uses the characteristic situation to define the level of gas protection as follows:

Table A5.3

Characteristic situation	Residential building (Not low-rise traditional housing)		Office/commercial/industrial development	
	Number of levels of protection	Typical scope of protective measures	Number of levels of protection	Typical scope of protective measures
1	None	No special precautions	None	No special precautions
2	2	a) Reinforced concrete cast in situ floor slab (suspended non-suspended or raft) with at least 1200g DPM and underfloor venting b) Beam and block or pre-cast concrete and 2000g DPM / reinforced gas membrane and underfloor venting All joints and penetrations sealed	1 to 2	a) Reinforced concrete cast in-situ floor slab (suspended non-suspended or raft) with at least 1200g DPM b) Beam and block or pre cast concrete slab and minimum 2000g DPM/reinforced gas membrane c) Possibly underfloor venting or pressurisation in combination with a) and b) depending on use All joints and penetrations sealed
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space	1 to 2	All types of floor slab as above. All joints and penetrations sealed. Minimum 2000g/reinforced gas proof membrane and passively ventilated underfloor sub-space or positively pressurised underfloor sub-space
4	3	All types of floor slab as above.	2 to 3	All types of floor slab as above.

Characteristic situation	Residential building (Not low-rise traditional housing)		Office/commercial/industrial development	
		All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated underfloor subspace or positively pressurised underfloor sub-space, oversite capping or blinding and in ground venting layer		All joints and penetration sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility
5	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised underfloor sub-space, oversite capping and in ground venting wells or barriers	3 to 4	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility. In ground venting wells or barriers
6	5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design	4 to 5	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and actively ventilated or positively pressurised underfloor sub-space with monitoring facility, with monitoring. In ground venting wells and reduction of gas regime.

1. Typical scope of protective measures may be rationalised for specific developments on the basis of quantitative risk assessments.

2. Note the type of protection is given for illustration purposes only. Information on the detailing and construction of passive protection measures is given in BR414, ref. 7.24.

3. In all cases there should be minimum penetration of ground slabs by services and minimum number of confined spaces such as cupboards above the ground slab. Any confined spaces should be ventilated.

4. Foundation design must minimise differential settlement particularly between structural elements and ground-bearing slabs.

5. Commercial buildings with basement car parks, provided with ventilation in accordance with the Building Regulations, may not require gas protection for characteristic situations 3 and 4.

6. Floor slabs should provide an acceptable formation on which to lay the gas membrane. If a block and beam floor is used it should be well detailed so it has no voids in it that membranes have to span, and all holes for service penetrations should be filled. The minimum density of the blocks should be 600kg/m^3 and the top surface should have a 4:1 sand cement grout brushed into all joints before placing any membrane (this is also good practice to stabilise the floor and should be carried out regardless of the need for gas membrane).

7. The gas-resistant membrane can also act as the damp-proof membrane.

A5.8 SITUATION B -ASSESSMENT

A5.8.1 The NHBC has developed a characterisation system that is similar to Situation A but is specific to low-rise housing development with a clear ventilated underfloor void. The gas emission rates are compared to generic 'Traffic Lights'.

A5.8.2 The Traffic Lights include a Typical Maximum Concentration that is used for initial screening purposes. Where the Typical Maximum Concentration is exceeded the risk-based Gas Screening Value, GSV, should be adopted. The GSVs are determined for the 'model' low rise development and where they differ from this model, the GSV should be reassessed, ref. 7.21.

A5.8.3 The calculations should be made for both methane and carbon dioxide, and the worst case adopted. The GSV is only a guideline.

Table A5.4

Traffic light	Methane		Carbon dioxide	
	Typical maximum concentration[2] (% v/v)	Gas screening value (GSV)[3] (litres per hour)	Typical maximum concentration[2] (% v/v)	Gas screening value (GSV)[1,2] (litres per hour)
Green				
	1	**0.16**	5	**0.78**
Amber 1				
	5	**0.63**	10	**1.56**
Amber 2				
	20	**1.56**	30	**3.13**
Red				

1. Generic GSVs are based on guidance contained within latest revision of Department of the Environment and the Welsh Office (2004 edition) "The Building Regulations: Approved Document C" and used a sub-floor void of 150mm thickness.

2. The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgement will be required, based on a thorough understanding of the gas-regime identified at the site where monitoring in the worst temporal conditions has occurred.

3. The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

A5.9 SITUATION B – SOLUTION

A5.9.1 On the basis of this Traffic Light classification the following protection should be applied to low-rise housing.

Table A5.5

Traffic Light Classification	Protection measures required
Green	Negligible gas regime identified and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. A specialist contractor should always fit membranes. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

A5.10 CODE OF PRACTICE – SOLUTIONS

A5.10.1 The Characteristic Gas Situation is determine in a similar manner to that recommended by CIRIA, see Table A5.2 above.

A5.10.2 Having selected the Characteristic Gas Situation, the appropriate gas protection could be selected for the building. The tables below give a guide as to the relative performance of the various designs and systems.

A5.10.3 A guidance value for the required gas protection, in the range 0 to 7 should be obtained from Table A5.6 below. Then, a combination of ventilation and/or barrier system should be chosen from Table A5.7 to meet that requirement.

Table A5.6

Characteristic gas situation, CS	NHBC *traffic light*	Required gas protection			
		Non-managed property, e.g. private housing	**Public building A)**	**Commercial buildings**	**Industrial buildings B)**
1	*Green*	0	0	0	0
2	*Amber 1*	3	3	2	1 C)
3	*Amber 2*	4	3	2	2
4	*Red*	6 D)	5 D) 6 E)	4 5 7	3 4 6
NOTE: Traffic light indications are taken from NHBC Report no.: 10627-R01 (04) [3] and are mainly applicable to low-rise residential housing. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.					

A) Public buildings include, for example, managed apartments, schools and hospitals.
B) Industrial buildings are generally open and well ventilated. However, areas such as office pods might require a separate assessment and may be classified as commercial buildings and require a different scope of gas protection to the main building.
C) Maximum methane concentration 20% otherwise consider an increase to CS3.
D) Residential building on higher traffic light/CS sites is not recommended unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.
E) Consideration of issues such as ease of evacuation and how false alarms will be handled are needed when completing the design specification of any protection scheme.

A5.10.4 Having determined the appropriate guidance value from Table A5.6, an element or combination of elements from a), b), c) or d) in Table A5.7, should be chosen to achieve the required level of protection.

Table A5.7

PROTECTION ELEMENT/SYSTEM		**SCORE**	**COMMENTS**
a) Venting/dilution			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) A)	Very good performance	2.5	*Ventilation performance in accordance with Annex A, ref. 7.22*
	Good performance	1	*If passive ventilation is poor this is generally unacceptable and some form of active system will be required*

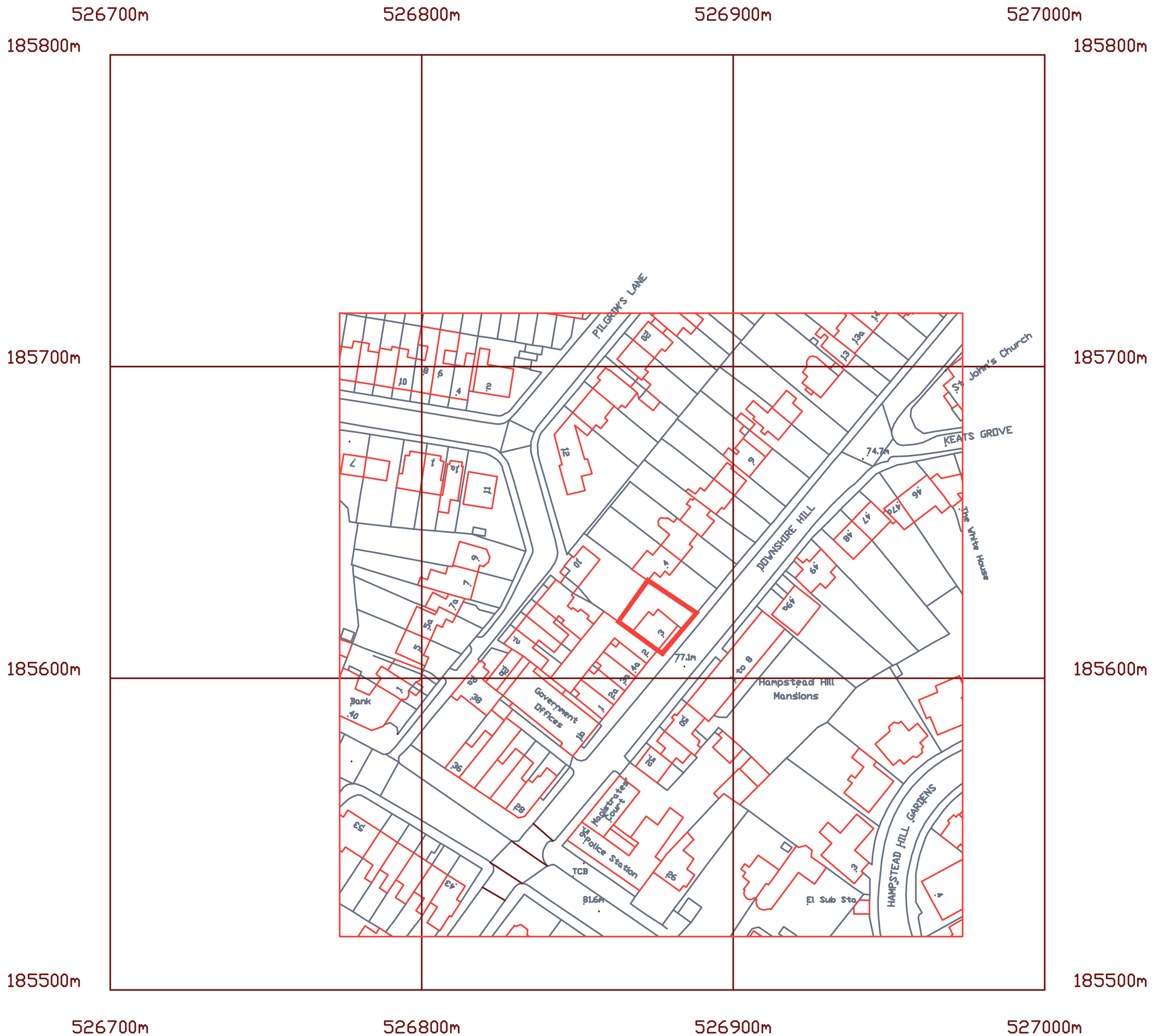
PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)A)		2.5	*There have to be robust management systems in place to ensure the continued maintenance of any ventilation system.* *Active ventilation can always be designed to meet good performance.* *Mechanically assisted systems come in two main forms: extraction and positive pressurization.*
Ventilated car park (basement or undercroft)		4	*Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F and IstructE guidance*
b) Barriers			
Floor slabs			
Block and beam floor slab		0	*It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum.* *Breached in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances*
Reinforced concrete ground bearing floor slab		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab		1.5	
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints		1.5	
Fully tanked basement		2	
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validationB), C)		0.5	*The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints*
Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA)B), C)		1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation		2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using hand held equipment		0.5	
Permanent monitoring and alarm systemA)	Installed in the underfloor venting/ dilution system	2	*Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe.*
	Installed in the building	1	

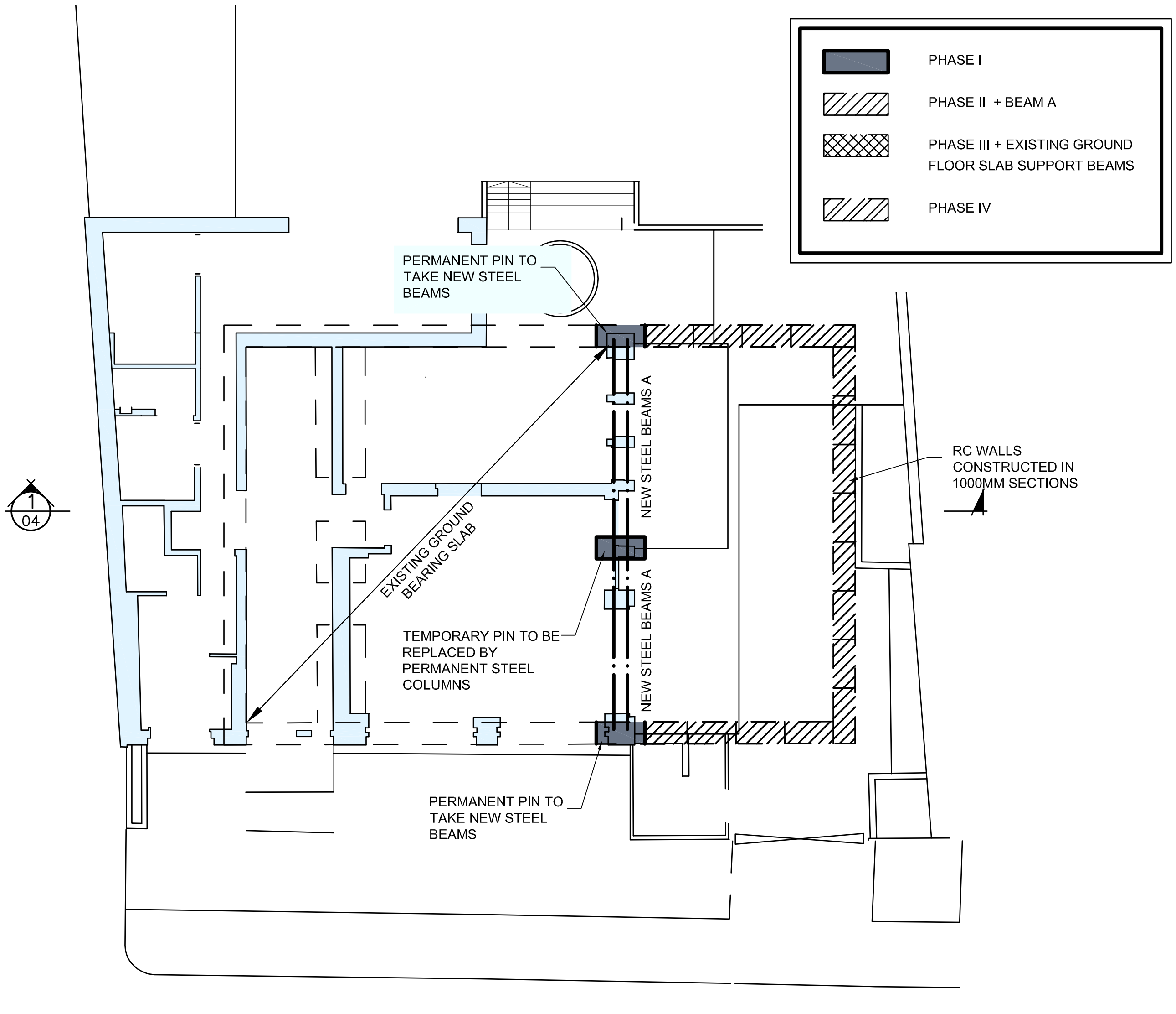
PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
e) Pathway intervention		
Pathway intervention	-	*This can consist of site protection measures for off-site or on-site sources (see Annex A, ref. 7.22)*
NOTE: In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection		

A) It is possible to test ventilation systems by installing monitoring probes for post installation validation.

B) If a 1200 g DPM material is to function as a gas barrier it should be installed according to BRE 414, ref. 7.24 being taped and sealed to all penetrations.

C) Polymeric Materials >1200g can be used to improve confidence in the barrier. Remember that their gas resistance is little more than the standard 1200g (proportional to thickness) but their physical properties mean that they are more robust and resistant to site damage.


526700m
526800m
526900m
527000m
185800m
185700m
185600m
185500m
PILGRIM'S LANE
DOWNSHIRE HILL
KEATS GROVE
St. John's Church
The White House
Hampstead Hill Mansions
Government Offices
Magistrates Court
Police Station
HAMPSTEAD HILL GARDENS
El Sub Sta
TCB
Bank
77.1m
74.7m
81.6m



GROUND FLOOR PLAN SHOWING BASEMENT OUTLINE UNDER
SHOWS PHASE I & II

GENERAL NOTES:

DIMENSIONS ARE NOT TO BE SCALED FROM THIS DRAWING

ALL DIMENSIONS ARE TO BE CHECKED ON SITE PRIOR TO COMMENCEMENT OF ANY WORKS, AND ANY DISCREPANCIES REPORTED IMMEDIATELY TO THE ENGINEER.

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DESIGN TEAM DETAILS AND SPECIFICATIONS.

SUGGESTED SEQUENCE OF WORKS:

1. INSTALL 3NO. PINS SHOWN AS PHASE I
2. NEW STEEL BEAM A TO BE INSTALLED TO SUPPORT FLANK WALL
3. RETAINING WALL/UNDERPIN SECTIONS SHOWN AS PHASE II TO BE CONSTRUCTED
4. WALLS SHOWN AS PHASE III TO BE UNDERPINNED IN 1M SECTIONS WORKING UNDER THE PROPERTY FROM THE RHS INCLUDING THE INSTALLATION OF TEMPORARY INTERNAL PINS AND STEEL BEAMS TO SUPPORT THE EXISTING GROUND FLOOR SLAB WALLS
5. SHOWN AS PHASE IV TO BE UNDERPINNED

ALL WORKS TO BE UNDERTAKEN EXTERNALLY

Rev.	Description	By	Chkd.	Date
P1	PRELIMINARY ISSUE	AM	MS	24.3.14

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Client: MR & MRS COPPEL

Project: 3 DOWNSHIRE HILL

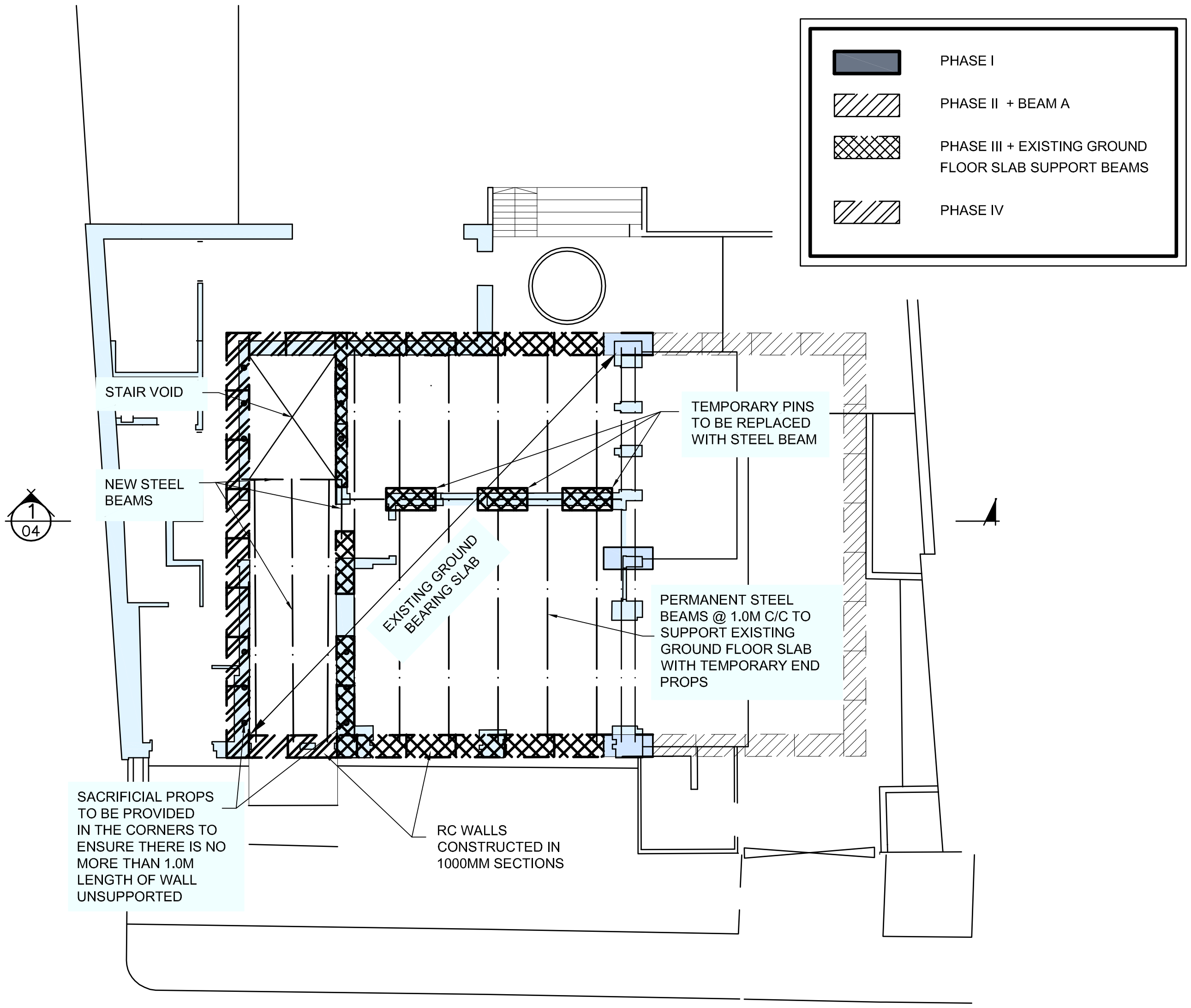
Title: SEQUENCING DRAWING 1 OF 2

Drawing Status: PRELIMINARY

Date: MARCH 2014
Scale: 1:100 @ A3
Drawn: AM
Chkd: MS

Drawing No. 12741_SK-01

Rev. P1



GROUND FLOOR PLAN SHOWING BASEMENT OUTLINE UNDER
SHOWS PHASE III & IV

GENERAL NOTES:

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5. SHOWN AS PHASE IV TO BE UNDERPINNED

ALL WORKS TO BE UNDERTAKEN EXTERNALLY

Rev.	Description	By	Chkd.	Date
P1	PRELIMINARY ISSUE	AM	MS	24.3.14

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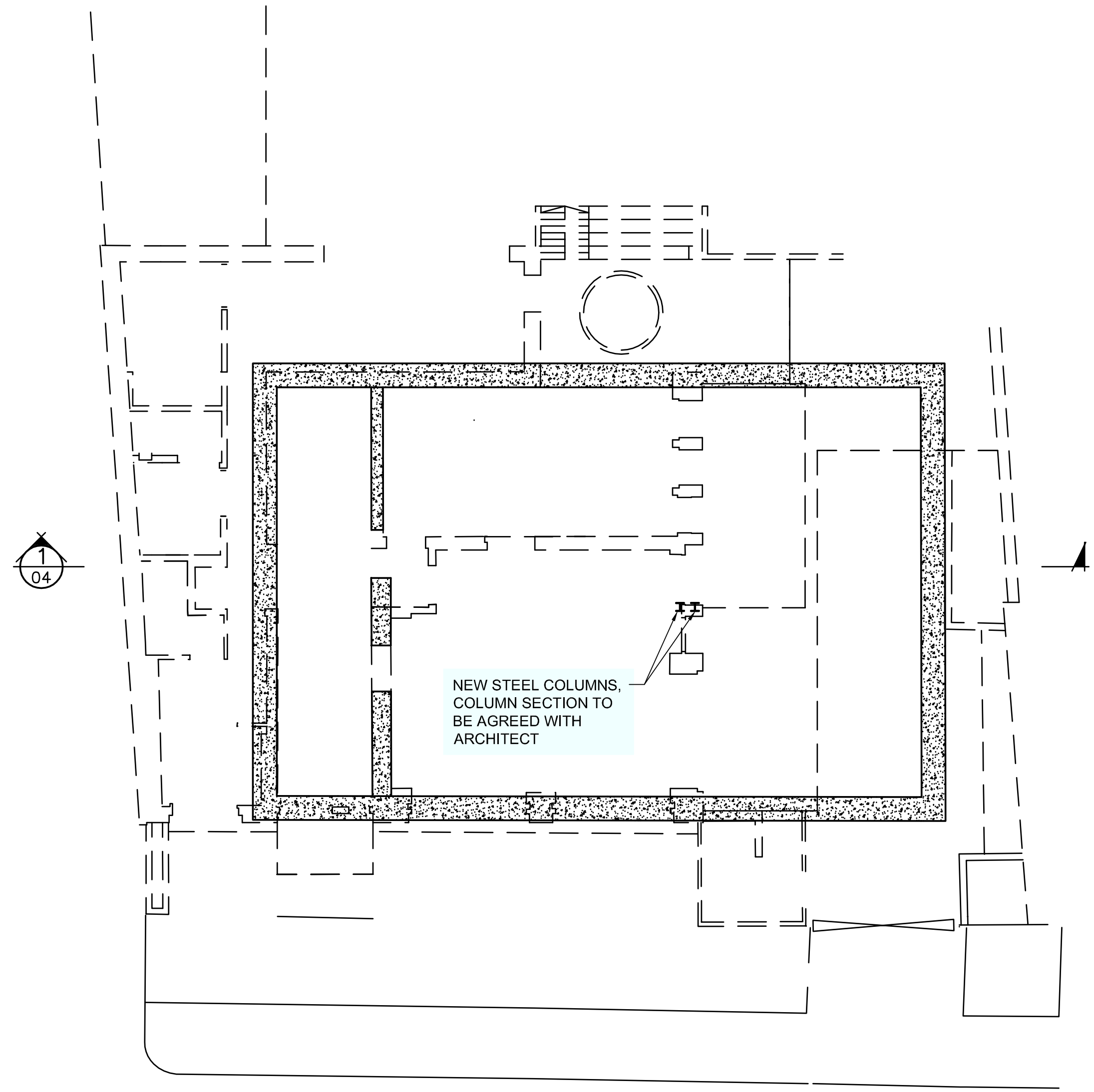
Client: MR & MRS COPPEL

Project: 3 DOWNSHIRE HILL

Title: SEQUENCING DRAWING 2 OF 2

Drawing Status: PRELIMINARY

Date:	MARCH 2014	Drawing No.	Rev.
Scale:	1:100 @ A3	12741_SK-02	P1
Drawn:	AM		
Chkd:	MS		



GENERAL NOTES:

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Rev.	Description	By	Chkd.	Date
P1	PRELIMINARY ISSUE	AM	MS	24.3.14

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Client: MR & MRS COPPEL

Project: 3 DOWNSHIRE HILL

Title: PROPOSED BASEMENT PLAN

Drawing Status: PRELIMINARY

Date:	MARCH 2014	Drawing No.	Rev.
Scale:	1:100 @ A3	12741_SK-03	P1
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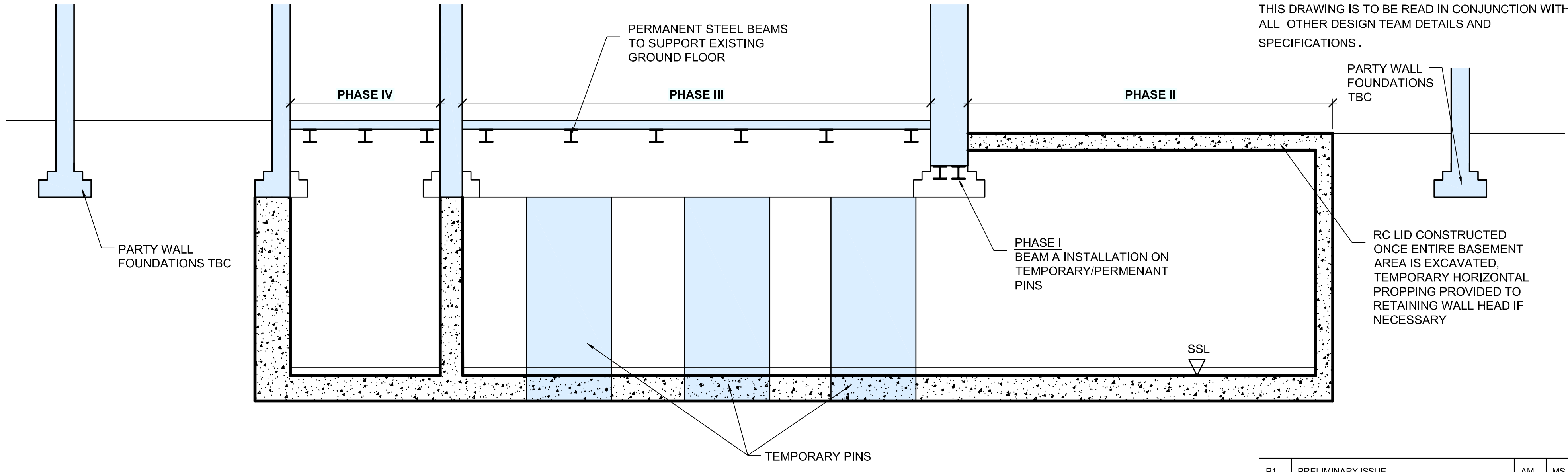
Chkd:	MS		



GENERAL NOTES:

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SUGGESTED SEQUENCE OF WORKS:

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5. SHOWN AS PHASE IV TO BE UNDERPINNED

ALL WORKS TO BE UNDERTAKEN EXTERNALLY

Rev.	Description	By	Chkd.	Date
P1	PRELIMINARY ISSUE	AM	MS	24.3.14

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Client: MR & MRS COPPEL

Project: 3 DOWNSHIRE HILL

Title: SECTION 1-1

Drawing Status: PRELIMINARY

Date:	MARCH 2014	Drawing No.	Rev.
Scale:	1:50 @ A3	12741_SK-04	P1
Drawn:	AM		
Chkd:	MS		

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

RESULTS OF GAS AND GROUNDWATER MONITORING

3 Downshire Hill, Hampstead, London, NW3 1NR

Job No: 52180A

Figure No: A1.1

Background Readings:	Date of Visit	02/10/2014				
	CH_4 % v/v	CO_2 % v/v	O_2 % v/v	H_2S ppm	CO ppm	VOC ppm
	0.0	0.0	20.8	0	0	0
	Weather Conditions	Cloudy				
	Ground Conditions (dry/wet etc.)	Dry				
	Atmospheric Pressure (mb)	1023				

Hole No:	Time (hh:mm)	Atmos. Pressure (mb)	Gas Flow Rate (l/hr)	CH_4 % v/v		CO_2 % v/v		O_2 % v/v		H_2S ppm		CO ppm		VOC ppm		Water Level	Depth of Well	Water Sample Y / N
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	mBGL	mBGL	
WS1	8:50	1023	0.0	0.0	0.0	2.7	2.7	18.5	18.5	0	0	0	0	0.1	0.1	2.03	7.06	N
WS2	9:05	1023	0.0	0.0	0.0	4.2	4.2	16.4	16.4	0	0	0	0	0.1	0.1	2.02	7.19	N

ND = Below detection limit of instrument. NR = Not Read.

Readings Taken By: AH

Checked By: DA

Background Readings:	Date of Visit	16/10/2014				
	CH_4 % v/v	CO_2 % v/v	O_2 % v/v	H_2S ppm	CO ppm	VOC ppm
	0.0	0.0	20.8	0	0	NR
	Weather Conditions		Overcast			
	Ground Conditions (dry/wet etc.)		Damp			
	Atmospheric Pressure (mb)		997			

Hole No:	Time (hh:mm)	Atmos. Pressure (mb)	Gas Flow Rate (l/hr)	CH_4 % v/v		CO_2 % v/v		O_2 % v/v		H_2S ppm		CO ppm		VOC ppm		Water Level	Depth of Well	Water Sample Y / N
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	mBGL	mBGL	
WS1	13:35	997	0.0	0.0	0.0	2.9	2.9	18.3	18.3	0	0	0	0	NR	NR	1.78	7.08	N
WS2	13:30	997	0.0	0.0	0.0	3.6	3.6	17.3	17.3	0	0	0	0	NR	NR	1.87	7.16	N

ND = Below detection limit of instrument. NR = Not Read.

Readings Taken By: BP

Checked By: DA

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

RESULTS OF GAS AND GROUNDWATER MONITORING

3 Downshire Hill, Hampstead, London, NW3 1NR

Job No: 52180A

Figure No: A1.1 cont

Falling Head Test Record Sheet

Contract Name:	3 Downshire Hill, London NW3 1NR
Contract No:	52180A
Date:	16/10/2014

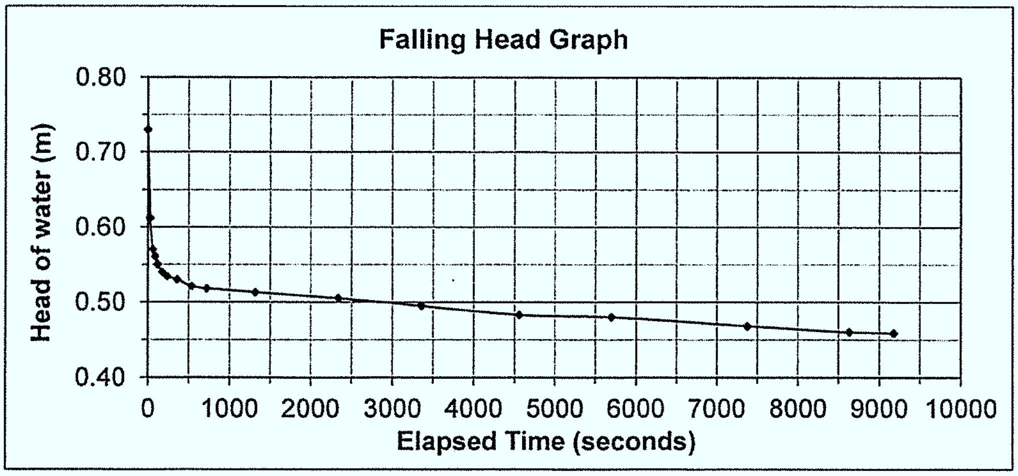
WS1 at 1.78m	**Diameter of Hole (m):**	0.08

Depth of Borehole (m)	Depth of Casing (m)	Depth to Base of Impermeable Stratum (m)	Response Zone (m)
1.78	N.A	1.00	0.78

Time	Depth to Water (m)	Fall in Water Level (m)	Head of Water (m)
0	1.050	0.00	0.73
30	1.168	0.12	0.61
60	1.210	0.16	0.57
90	1.219	0.17	0.56
120	1.230	0.18	0.55
180	1.240	0.19	0.54
240	1.246	0.20	0.53
360	1.250	0.20	0.53
540	1.259	0.21	0.52
720	1.262	0.21	0.52
1320	1.267	0.22	0.51
2340	1.275	0.23	0.51
3360	1.285	0.24	0.50
4560	1.297	0.25	0.48
5700	1.300	0.25	0.48
7380	1.312	0.26	0.47
8640	1.320	0.27	0.46
9180	1.321	0.27	0.46

Method of Analysis

Intake Factor (F) =	1.648445507		Intake Factor model (F) BS5930 fig 6d
Cross sectional area of response zone (A)=	0.005026548		
	100% to 0% level		75% to 25% level
$t_2(9180)-t_1(0)$	9180	$t_2(360)-t_1(20)$	340
H_1	0.73	H_1	0.66
H_2	0.46	H_2	0.53
k=	1.53399E-07	k=	1.96734E-06



A2.1

Falling Head Test Record Sheet

Contract Name:	3 Downshire Hill, London NW3 1NR
Contract No:	52180A
Date:	16/10/2014

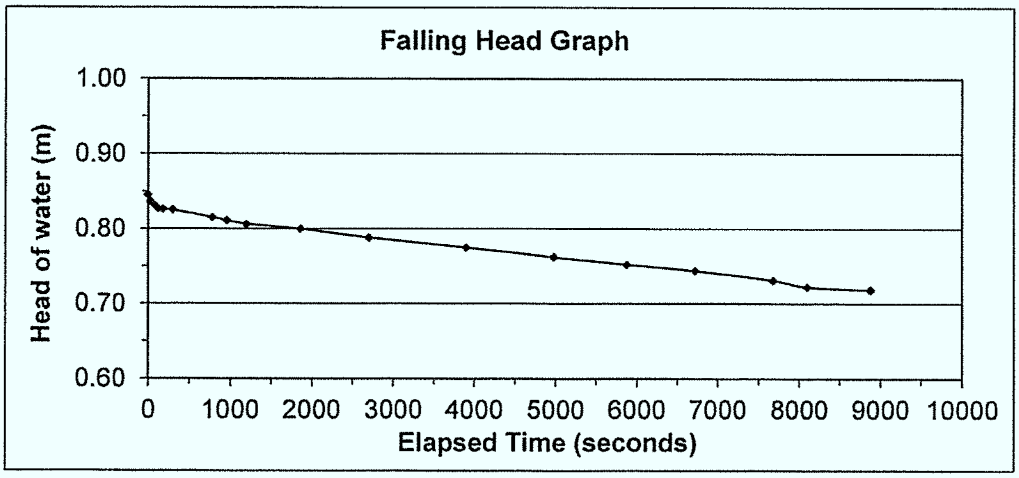
WS2 at 1.87m	Diameter of Hole (m):	0.08

Depth of Borehole (m)	Depth of Casing (m)	Depth to Base of Impermeable Stratum (m)	Response Zone (m)
1.87	N.A	1.00	0.87

Time	Depth to Water (m)	Fall in Water Level (m)	Head of Water (m)
0	1.025	0.00	0.85
30	1.034	0.01	0.84
60	1.037	0.01	0.83
90	1.040	0.02	0.83
120	1.043	0.02	0.83
180	1.044	0.02	0.83
300	1.045	0.02	0.83
780	1.055	0.03	0.82
960	1.059	0.03	0.81
1200	1.064	0.04	0.81
1860	1.070	0.05	0.80
2700	1.082	0.06	0.79
3900	1.095	0.07	0.78
4980	1.108	0.08	0.76
5880	1.118	0.09	0.75
6720	1.126	0.10	0.74
7680	1.139	0.11	0.73
8100	1.148	0.12	0.72
8880	1.152	0.13	0.72

Method of Analysis

Intake Factor (F) =	1.773804724		Intake Factor model (F) BS5930 fig 6d
Cross sectional area of response zone (A)=	0.005026548		
	100% to 0% level		75% to 25% level
$t_2(8880)-t_1(0)$	8880	$t_2(5880)-t_1(780)$	5100
H_1	0.85	H_1	0.82
H_2	0.72	H_2	0.75
k=	5.29688E-08	k=	4.95804E-08



A2.2

IAN FARMER ASSOCIATES

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Our Ref: DAA/da/52180/8110 7 January 2015

Train and Kemp LLP (Consulting Engineers) LLP
10 Kennington Park Place
London
SE11 4AS

F.A.O. Mr Marc Stone

Dear Sirs,

Re: 3 Downshire Hill, London SW3 1NR

Ian Farmer Associates (IFA) confirm that the comments provided in section 3 of the Train and Kemp Basement Impact Assessment, pertaining to the groundwater regime at 3 Downshire Hill, NW3 1NR are based upon information provided in IFA Ground Investigation Report, 52180 and can be relied upon for the purpose of constructing the proposed basement at the subject site.

Ian Farmer Associates cannot be held responsible for any of the information within the BIA Report not provided by themselves.

Yours faithfully,

DA Ashton

D A Ashton (Mrs)
Principal Geotechnical Engineer
BSc (Hons) MSc CGeol FGS
Fellow No 1012957

Enc Section 3 Text.

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