APPENDIX D Part 1: Geotechnical and Geoenvironmental Site Investigation Report Part 1 of 2

PEGASUS LIFE LIMITED

FITZJOHN'S AVENUE,
HAMPSTEAD, NW3 6PA

REPORT ON PHASE 2 GROUND INVESTIGATION

Contract: 52247A

Date: November 2014

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REPORT ON PHASE 2 GROUND INVESTIGATION

carried out at

FITZJOHN'S AVENUE,

HAMPSTEAD, NW3 6PA

Prepared for

PEGASUS LIFE LIMITED
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EXECUTIVE SUMMARY

On the instructions of Gleeds Management Services Limited, on behalf of Pegasus Life Limited, an investigation was undertaken to determine ground conditions to enable foundation and road/hard standing design to be carried out, together with a contamination risk assessment and a review of gas emissions.

The site, where it is proposed to develop a five and seven storey structure with part lower ground level (basement), for accommodation purposes, is situated at the junction of Fitzjohn's Avenue and Prince Arthur Road, approximately 200m to the south of Hampstead Tube Station, and may be located by Grid Reference TQ 264 855.

Published geological and hydrogeological records indicate the site to be situated above a Secondary A aquifer relating to the granular Bagshot Formation with the Claygate Member outcropping directly to the southwest. No superficial deposits are anticipated though Made Ground formed during the development of the existing and previous structures is anticipated to a moderate depth.

Site works were undertaken between the 13 and 29 August 2014 and comprised five boreholes to depths of between 11m and 20m below ground level (bgl), with one further borehole location aborted due to the presence of services. Three hand-dug trial pits were also carried out to reveal the foundations to the adjacent boundary wall.

The exploratory locations encountered the anticipated geological sequence being solid deposits of the Bagshot Formation, generally comprising interbedded firm occasionally stiff to very stiff sandy occasionally slightly gravelly clay and medium dense, occasionally loose or dense, clayey occasionally slightly gravelly fine sand. The Bagshot Formation, where proven, extended to a depth of between 8.50m and 14.90m bgl and was underlain by the Claygate Member of the London Clay Formation to the full depth of the investigation. This generally comprised unweathered stiff fissured dark grey occasionally sandy silty clay with partings of sand and clusters and speckling of iron pyrite.

The natural strata were overlain by Made Ground or Possible Made Ground (borehole 2) which extended to a depth of between 0.25m and 1.80m bgl and was unproven in trial pit 1 at 0.70m bgl.

On the basis of these observations together with results of in-situ and laboratory tests consideration could be given to the adoption of shallow spread foundations to support the proposed structure. Such foundations, at the proposed elevations for the new structure of 103.29m, 100.84m and 98.7m AOD, assuming the Bagshot Formation at shallow depth to be essentially a clay soil, may be designed to an allowable bearing pressure of 80kPa, 110kPa and 125kPa respectively, which would provide an adequate factor of safety against shear failure. Settlements, assuming a 1m wide pad, are likely to be less than 20mm. However, it may be considered that for foundations over a certain size and depth it may be more economical to adopt piles.

For the purposes of this contamination risk assessment, the results of the soil analyses have been compared to the Assessment Criteria (AC) derived in-house using the CLEA Software Version 1.06, CLEA SGVs published in Environment Agency Science Reports SCR050021 and SC050021/SR3, where available, and Generic Assessment Criteria (GAC), determined by LQM and CIEH, in accordance with current legislation and guidance.

Elevated levels of lead, benzo(a)pyrene and TPH were encountered within the soils at two locations while leachate analysis indicated elevated levels of lead, copper and TPH when compared to the relevant assessment criteria.

Recommendations have been made which include removal of contaminated soil and placing clean materials in order to prevent any potential risk to human health while it is also recommended that groundwater sampling and testing be undertaken in order to assess the risk to controlled waters.

Elevated levels of carbon dioxide have been recorded during the monitoring phase. As the results are also variable, it is recommended that further monitoring is undertaken.

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1.0 INTRODUCTION

1.1 It is understood that it is proposed to develop the site for accommodation purposes, comprising a five and seven storey structure that is joined at ground level and lower ground level (basement), which will house forty-two apartments.

1.2 On the instructions of Gleeds Management Services Limited, on behalf of Pegasus Life Limited, an investigation was undertaken to determine ground conditions to enable foundation and road/hard standing design to be carried out, together with a contamination risk assessment and a review of gas emissions.

1.3 This report should be read in conjunction with the Preliminary Investigation, which was reported under reference 52247 in August 2013.

1.4 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.

1.5 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.

1.6 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.

1.7 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 the junction of Fitzjohn's Avenue and Prince Arthur Road in Hampstead, North London and approximately 200m to the south of Hampstead Tube Station. The site can be located by Grid Reference TQ 264 855.

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 is not underlain by superficial deposits.

2.2.3 The solid geology is represented by the Bagshot Formation consisting of pale yellow-brown to pale grey or white, locally orange or crimson, fine to coarse grained sand that is frequently micaceous and locally clayey, with sparse glauconite and sparse seams of gravel. The Bagshot Formation is, in turn, underlain by the Claygate Member of the London Clay Formation comprising clay, silt and fine grained sand.

3.0 SUMMARY DESK STUDY FINDINGS

3.1 A Preliminary Investigation in the form of a desk study and site reconnaissance was carried out in August 2014 in order to assess the potential hazards on and adjacent to the site and prepare a risk assessment for further consideration.

3.2 Potential hazards relating to the underlying geology which may impact on the proposed development included Made Ground formed during the development of the existing and previous structures, which may be present to a moderate depth and likely be compressible and of low strength, and potentially high concentration of sulphates and sulphides associated with the Claygate Member, which may result in concrete attack.

3.3 A walkover survey was carried out on the 7 August 2014, at which time the site was at two levels. To the northeast, the ground level was at the same level as the surrounding area at about 105.80m AOD. To the southwest, ground level had been reduced to approximately 102.00m AOD, which was between 1.00m and 2.00 below the original ground level, to produce a level platform. Two structures occupied the majority of the site and were connected at first floor level. The building to the northeast was brick clad and between five and six storeys high with the building to the southwest, again brick clad, between three and four storeys high. Both buildings were in use as a residential hostel operated by the Hyelm Group.

3.4 A review of available historical maps indicated the site to have been undeveloped until the 1860s/1870s when Mount Farm was first shown. The site was redeveloped in the 1890s as a single Victorian dwelling with a large garden and remained substantially unchanged until the early 1970s when a new structure was constructed in the garden area of the site. The Victorian house was replaced around the late 1990s/early 2000s.

3.5 The research identified Made Ground, formed during previous development of the site, as a potential source of contamination which may form part of a pollutant linkage and would require further investigation.

4.0 SITE WORK

4.1 The site work was carried out between 13 and 29 August 2014. The locations of exploratory holes were identified by the client.

4.2 Three boreholes, designated 2, 5 and 6, were sunk by light cable percussion method, three boreholes, designated 1, 3 and 4, were undertaken by window sampler technique and three trial pits, designated 1 to 3, were dug by hand at the positions shown on the site plan, Appendix 1, Figure A1.1. The depths of boreholes and trial pits, descriptions of strata encountered and comments on groundwater conditions are given in the borehole and trial pit records, Appendix 2, Figures A2.1 to A2.8.

4.3 Borehole 6 was attempted but, due to the presence of services and difficulties in excavating an inspection pit prior to boring, was abandoned.

4.4 Representative disturbed and undisturbed samples were taken at the depths shown on the borehole and trial pit records and despatched to the laboratory. Standard (split-barrel and cone) penetration tests, ref. 10.6, 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.

4.5 Samples for environmental purposes were collected in amber glass jars and kept in a cool box.

4.6 Monitoring installations protected by a stopcock cover were installed in boreholes 4 and 5, as detailed in the borehole records and tabulated below.

Borehole No	Depth To Base (m)	Response Zone (m bgl)	Nominal Pipe Diameter (mm)	Gas Valve/Lockable Cover
BH4	12.00	1.00 to 12.00	50	Yes
BH5	20.00	1.00 to 20.00	50	Yes

4.7 The ground levels at the borehole and trial pit locations, reported on the records, were interpolated from spot levels on a survey drawing provided by the Client.

4.8 Gas monitoring visits were undertaken on the 13 and 21 October and 4 November 2014 and the results provided in Appendix 2, Figure A2.13.

5.0 LABORATORY TESTS

5.1 Geotechnical Testing

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

5.1.2 12 No. Water Content Tests

5.1.3 8 No. Plasticity Index Tests

5.1.4 11 No. Particle Size Distributions (by Wet Sieving)

5.1.5 6 No. pH Values

5.1.6 6 No. Sulphate Contents (Water Soluble)

5.1.7 7 No. Special Digest 1 Test Suites

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

5.2 Chemical Testing

5.2.1 The suite of chemical analyses has been based upon the findings of the preliminary investigation, along with any on-site observations, to investigate the potential sources of contamination identified in the conceptual model. The chemical analyses were carried out on selected samples of the Made Ground. Leachate analysis was also conducted on selected samples of the Made Ground. The nature of the analyses is detailed below:

5.2.2 **Metals Suite** - arsenic, boron (water soluble), cadmium, chromium (hexavalent), chromium (total), copper, lead, mercury, nickel, selenium and zinc.

5.2.3 **Organic Suite -** petroleum hydrocarbons – TPH CWG speciated analysis, polycyclic aromatic hydrocarbons (PAH) – USEPA 16 suite and phenols, BTEX compounds and MTBE.

5.2.4 **Inorganics Suite** – cyanide (free) and sulphate (water soluble).

5.2.5 **Others** - pH, organic matter content and asbestos.

5.2.6 The results of these tests are shown in Appendix 4, Figure A4.1 and Figure A4.2.

6.0 GROUND CONDITIONS ENCOUNTERED

6.1 Sequence

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

6.1.2 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.

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

Strata Encountered	Depth Encountered (m bgl)		Strata Thickness (m)
	From	To	
Made Ground/Possible Made Ground	0.00	0.25 to 1.80	0.25 to 1.80
Bagshot Formation	0.25 to 1.80	8.50 to 14.90	6.80 to 14.65
Claygate Member (London Clay Formation)	8.50 to 14.90	>20.00	>11.50

6.2 Made Ground/Possible Made Ground

6.2.1 This was encountered at each of the exploratory location and extended to a depth of between 0.25m below ground level (bgl) in borehole 5 and 1.80m bgl in borehole 1.

6.2.2 Boreholes 1 and 4, undertaken in areas of soft landscaping encountered a surface layer of topsoil 0.80m and 0.40m thick.

6.2.3 Whilst boreholes 2, 3 and 5, undertaken through existing hard standings, encountered a 0.10m thick layer of asphalt over reinforced concrete to 0.40m and 0.30m bgl in boreholes 2 and 3 respectively, and block paving over sandy granite sub-base to 0.15m bgl in borehole 5. Borehole 6 was terminated in an undermined thickness of concrete.

6.2.4 The natural strata directly underlay the hard standing in borehole 5, and possible Made Ground comprising soft sandy gravelly clay with sand pockets underlay the hard standing in borehole 2 to a depth of 1.70m bgl.

6.2.5 The Made Ground continued in boreholes 1, 3 and 4, below the hard standing or topsoil, generally as brown slightly gravelly to gravelly occasionally slightly clayey silty sand with varying proportions of clinker, glass, asphalt and brick fragments, and rootlets in boreholes 1 and 4, to a depth of 1.45m bgl in borehole 1 and to the full depth of the stratum in boreholes 3 and 4.

6.2.6 A further layer of Made Ground was encountered in borehole 1 between 1.45m ad 1.80m comprising firm brown silty sandy clay with rootlets and rare brick and clinker fragments.

6.2.7 Trial pits 2 and 3 encountered Made Ground to a depth of 0.60m bgl and unproven at 0.70m bgl in trial pit 1.

6.3 Bagshot Formation

6.3.1 This underlay the Made Ground/Possible Made Ground to a depth proven in boreholes 1, 2 and 5 of between 8.50m and 14.90m bgl generally increasing in depth broadly from the north to the south.

6.3.2 The stratum generally comprised interbedded firm to stiff occasionally stiff to very stiff orange brown silty sandy to very sandy occasionally slightly gravelly clay and medium dense slightly clayey to clayey silty occasionally slightly gravelly fine sand. Gravels were well rounded flint.

6.3.3 Boreholes 3 and 4, and trial pits 2 and 3 were terminated in this stratum and thus the full thickness was unproven.

6.4 Claygate Member

6.4.1 Deposits consistent with the Claygate Member of the London Clay Formation underlay the Bagshot Formation in the remaining locations to the full depth of the investigation at 20m bgl.

6.4.2 This stratum generally comprised unweathered stiff fissured dark grey occasionally sandy silty clay with partings of sand and clusters and speckling of iron pyrite.

6.4.3 A bed of claystone was noted between 15.50m and 15.80m bgl.

6.5 Groundwater

6.5.1 Several groundwater strikes were recorded throughout the soil profile.

6.5.2 These observations suggest groundwater, associated with the Bagshot Formation, is present at levels of between 93.2m and 95.5mAOD, and associated with the Claygate Member at levels of between 83.7m and 90.0m AOD rising in a twenty minute period to levels of between 87.1m and 90.8. The latter likely to be under sub-artesian pressure.

7.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS IN RELATION TO THE PROPOSED DEVELOPMENT

7.1 Structural Details

7.1.1 It is understood that the proposed development is to consist of a five and seven storey structure that is joined at ground level and lower ground level (basement), to form forty-two apartments.

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

7.1.3 Details of the foundations to the adjacent boundary wall to the site are provided in the trial pit logs given in Appendix 2, Figures A2.6 to A2.8 and trial pit photographs Figures A2.9 to A2.11.

7.2 Assessment of Soil Condition

7.3 General

7.3.1 It was not possible to retrieve undisturbed samples from the strata encountered due to the frequency of groundwater strikes, the interbedded nature of the strata and the proportion of fine sand.

7.3.2 A plot of SPT 'N' value, as measured and uncorrected, with elevation is provided in Appendix 5, Figure A5.1.

7.4 Made Ground

7.4.1 Made Ground or possible Made Ground was encountered to a depth of between 0.25m and 1.80m bgl and was principally comprised of silty sand and occasionally sandy clay.

7.4.2 SPTs were undertaken which recorded 'N' values of between 5 and 16 suggesting the material to be generally loose to medium dense.

7.5 Bagshot Formation

7.5.1 These generally comprised interbedded sandy clay and clayey sand with perched groundwater and extended to depths where proven of between 8.50m and 14.90m bgl.

7.5.2 Laboratory testing for the clay beds recorded natural moisture contents of between 11% and 25%, with an average of 19% and plasticity indices of between 18% and 33%, with an average of 27%. The plastic index test results are presented on the plasticity classification chart, Appendix 3, Figure A3.3.

7.5.3 These results indicate the clay beds in the stratum are of low to intermediate plasticity and of low to medium volume change potential as defined by the National House Building Council, ref. 10.9 and other published data, refs 10.10 and 10.11.

7.5.4 Therefore based on the average plasticity index of 27% it is considered that for design purposes medium volume change potential should be adopted. Changes in moisture content could result in moderate changes in volume, seasonal changes being exacerbated by the presence of trees.

7.5.5 Participle size distributions undertaken on bulk samples from a range of depths indicated a gravel content of between 0% and 10%, with one value of 45% and an average of 7%, a sand content of between 29% and 83%, with an average of 58%, a silt content of between 8% and 44%, with an average of 20% and a clay content of between 4% and 27%, with an average of 15%. The sand was predominantly fine grained.

7.5.6 SPTs were undertaken and where full penetration was achieved, recorded 'N' values of between 7 and 29, with one value of 50 and an average of 17 suggesting the stratum is generally medium dense, occasionally loose towards the top of the stratum.

7.5.7 Using empirical correlations and assuming the stratum to be a clay soil an average 'N' value of 17 might suggest an m_v value of 0.13 m^2/MN for this stratum with a conservative value for the top of the stratum in the order of 0.32m^2/MN.

7.6 Suggested Soil Characteristic Values

7.6.1 Summary of the geotechnical parameters derived from the laboratory and in-situ testing:

	Minimum	Maximum	Characteristic
Moisture Content (%)	11	25	19
Plasticity Index (%)	18	33	27
SPT 'N' value	7	29 (50)	17
Derived Compressibility, m_v (m^2/MN)	0.08	0.32	0.13
Gravel Content (%)	0	10	7
Sand Content (%)	29	83	58
Silt Content (%)	8	44	20
Clay Content (%)	4	27	15

7.7 Claygate Member

7.7.1 This was proven to underlay the Bagshot Formation to the full depth of the investigation at 20m bgl and generally comprised unweathered stiff fissured dark grey occasionally sandy silty clay with partings of sand and clusters and speckling of iron pyrite, with possible sub-artesian groundwater.

7.7.2 Laboratory testing undertaken on one sample of the clay recorded a natural moisture content of 25% with a plasticity index of 37%. The plastic index test result is presented on the plasticity classification chart, Appendix 3, Figure A3.3.

7.7.3 This result indicates the stratum to be of high plasticity and of medium volume change potential as defined by the National House Building Council, ref. 10.9 and other published data, refs 10.10 and 10.11.

7.7.4 A participle size distribution indicated a gravel content of 0%, a sand content of 56%, a silt content of 28% and a clay content of 16%.

7.7.5 SPTs were undertaken and where full penetration was achieved, recorded 'N' values of between 20 and 41, with an average of 34 which when using empirical correlations suggests the stratum is generally stiff to very stiff and of high to very high strength.

7.8 Foundation Design

7.8.1 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 shallow spread foundations to support the proposed structure.

7.8.2 Therefore, at the proposed formation elevations for the new structure of 103.29m, 100.84m and 98.7m AOD such foundations, assuming the Bagshot Formation at shallow depth is essentially a clay soil, may be designed to an allowable bearing pressure of 80kPa, 110kPa and 125kPa respectively, which would provide an adequate factor of safety against shear failure. Settlements, assuming a 1m wide pad, are likely to be less than 20mm, however, these should be checked when the final structural loading is known.

7.8.3 In addition conventional shallow spread footings should be taken through any Made Ground/Possible Made Ground and placed in the underlying natural strata, be at a minimum depth of 0.90m bgl and where within the zone of influence of recently removed, existing or proposed trees, foundations should be taken through the Made Ground and placed at depths recommended by the NHBC for soils of medium volume change potential. Compressible material should be placed on the inside faces of foundations as specified by the NHBC.

7.8.4 However, it may be considered that for foundations over a certain size and depth it may be more economical to adopt piles. Guidelines for the design of piles are given in Appendix 5, which may be used with the plot of 'N' value with depth included in Figure A5.1.

7.8.5 Within the zone of influence of trees the piles should be sleeved to depths equivalent to those specified by the NHBC for a foundation at the same location. Compressible material should be placed below and on the inside faces of pile caps and beams, as specified by the NHBC.

7.8.6 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.

7.8.7 However, as a guide, a basic assessment of the likely carrying capacity of bored piles can be determined using the guidelines given in Appendix 5 and included in the table below.

Length of Pile (m)	**Safe Working Load (kN)**		
	350mm Diameter	**400mm Diameter**	**450mm Diameter**
10	140	160	185
15	250	295	340
20	405	475	545

7.8.8 The assessment is based on traditional methods using an overall factor of safety of 3, it assumes the Bagshot Formation is a granular material, assumes an adhesion factor of 0.45 for the stiff clay in the Claygate Member and that the top 2m is Made Ground (from the highest elevation of 103.29m AOD) and thus is ignored.

7.8.9 It should be noted that groundwater was present, which could affect the installation of the piles and that casing will be required.

7.9 Retaining Wall Design

7.10 Estimation of ϕ' for Retaining Wall Design

7.10.1 New retaining walls for the proposed structure, which are understood to extend to a depth of some 7.7m bgl, are likely to be require to support predominantly the interbedded Bagshot Formation, which for the purpose of this report is considered to be a clay soil.

7.10.2 To determine the long term clay strength, effective stress analyses may be carried out, either fully drained or undrained with pore water pressure measurements. However, such tests must be carried out slowly to ensure equalisation of pore pressures and are therefore time consuming. It was not possible to retrieve suitable samples of the Bagshot Formation for such analysis due to the interbedded nature of the stratum and the high percentage of fine sand.

7.10.3 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 Bagshot Formation of 24° could be adopted.

7.10.4 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 that would affect the undrained shear strength. Sand beds were encountered within the Bagshot Formation for the depth of the proposed basement and though perched water was not observed.

7.11 Ground/Basement Floor Slabs

7.11.1 On the basis of observations on site together with the results of laboratory tests, it is recommended that outside the zone of influence of trees, consideration is given to constructing the ground/basement floor slabs on formation prepared in the Bagshot Formation. Any soft or deleterious material should be removed and replaced with properly compacted granular fill.

7.11.2 Within the zone of influence of trees, the ground floor slabs should be suspended over a void, in accordance with NHBC guidelines.

7.12 Excavations

7.12.1 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 would 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. 10.14.

7.12.2 Groundwater should not be expected in shallow excavations for foundations or services. However, it is possible that perched groundwater could be present in the Made Ground overlying the clay beds of the Bagshot Formation. It is considered that this could be dealt with by the use of a small pump.

7.12.3 Groundwater could be expected in excavations taken to depths in excess of 8m bgl.

7.13 Road and Hard Standing Design

7.13.1 The structural design of a road or hard standing is based on the strength of the subgrade, which is assessed on the California Bearing Ratio, CBR, scale from which the subgrade surface modulus can be estimated. Experience has indicated that the measurement of the in-situ CBR value tends to give unreliable results because of the influence of the moisture content of the materials. In practice, the correlation given by the Highways Agency, ref. 10.15, is usually more appropriate than direct determination of the CBR.

7.13.2 The process of design given in the guidance notes requires an estimate of CBR and subgrade stiffness modulus to be made at the design stage and in-situ measurement prior to construction.

7.13.3 On the basis of laboratory classification tests it is recommended that for formation prepared in the Bagshot Formation, with a characteristic plastic index value of 27%, a subgrade CBR value of 4% be adopted for design purposes. The assessment assumes there to be a low water table, good construction conditions and a thin pavement construction. Any areas of soft or deleterious material in the Made Ground should be excavated and replaced with a properly compacted granular fill.

7.13.4 For routine cases, all material within 450mm of the road surface should be non frost-susceptible, ref. 10.16.

7.14 Chemical Attack on Buried Concrete

7.14.1 The site has been classified in accordance with BRE Special Digest 1, ref. 10.17, as Made Ground, and as natural ground without the presence of pyrite being the Bagshot Formation and as natural ground that contains pyrite being the Claygate Member. Laboratory testing was undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1, ref. 10.17, be adopted.

7.14.2 The results of chemical tests in the Made Ground indicate a sulphate concentration in the soil of between 24mg/l and 1300mg/l as a 2:1 water/soil extract, with pH values in the range of 7.2 to 11.1.

7.14.3 The results of chemical tests in the Bagshot Formation indicate a sulphate concentration in the soil of between 27mg/l and 63mg/l as a 2:1 water/soil extract, with pH values in the range of 6.1 to 8.5.

7.14.4 The results of chemical tests in the Claygate Member, indicate a sulphate concentration in the soil of between 180mg/l and 350mg/l as a 2:1 water/soil extract, a total sulphate concentration of between 0.11% and 0.12% and total sulphur of between 0.48% and 0.60%, with pH values in the range of 7.2 to 7.6.

7.14.5 It is recommended that for conventional shallow foundations the groundwater should be regarded as mobile.

7.14.6 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	pH	WS (mg/l)	AS (%)	TPS (%)	OS (%)	Groundwater Condition	DS	AC
Made Ground	7.2	1300	N/a	N/a	N/a	Mobile	2	2
Bagshot Formation	6.1	63	N/a	N/a	N/a	Mobile	1	1
Claygate Member (unweathered)	7.2	350	0.12	1.80	1.68	Static	1/4	1s/3s

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

7.14.8 On the basis of the laboratory test results it is considered that a Design Sulphate Class for concrete located in the non-pyritic soils may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate, however where concrete is to come into contact with the Made Ground consideration should be given to DS and ACEC 2.

7.14.9 Where concrete is to be exposed to disturbed ground in which pyrite is available to be oxidised to sulphate, in this instance the Claygate Member below a depth of about 8.5m bgl, consideration should be given to a Design Sulphate Class of DS-4 with an ACEC class of AC-3s. However, it is considered that oxidisation is unlikely to occur below this depth following the installation of piles. Therefore, it is recommended that should piles be adopted a Design Sulphate Class of DS-1 and ACEC class of AC-1, as indicated by the water soluble sulphate would be appropriate.

8.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

8.1 Contaminated Land

8.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref. 10.18, which was introduced by the Environment Act 1995, ref. 10.19, as;

8.1.2 'Land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.'

8.2 Risk Assessment

8.2.1 The definition of contaminated land is based on the principles of risk assessment. Risk is defined as a combination of:

- The probability, or frequency of exposure to a substance with the potential to cause harm, and:
- The seriousness of the consequence.

8.3 Pollutant Linkage

8.3.1 The basis of an environmental risk assessment involves identifying a 'source' of contamination, a 'pathway' along which the contamination may migrate and a 'receptor' at risk from the contamination.

8.3.2 Current legislation defines the various elements of the pollution linkage as:

- A contaminant is a substance, which is in or under the ground and which has the potential to cause harm or to cause pollution of controlled waters.
- A pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected.
- A receptor is either a living organism, an ecological system, a piece of land or property, or controlled water.

8.3.3 A pollutant linkage indicates that all three elements have been identified. The site can only be defined as 'Contaminated Land' if a pollutant linkage exists and the contamination meets the criteria in Section 8.1 above.

8.3.4 The guidance proposes a four-stage approach for the assessment of contamination and the associated risks. The four stages are listed below:

- Hazard Identification
- Hazard Assessment
- Risk Assessment
- Risk Evaluation

8.3.5 The hazard identification and hazard assessment have been based upon the Preliminary Investigation and formed the conceptual site model, detailed in our report, reference 52247, dated August 2014.

8.3.6 The risk assessment and evaluation stages are presented in this phase 2 interpretive report, after an intrusive ground investigation has taken place.

8.4 Risk Assessment – Human Health

8.4.1 It is understood that it is proposed to develop the site for accommodation purposes, comprising a five and seven storey structure that is joined at ground level and lower ground level (basement), which will house forty-two apartments. The risk assessment has therefore been based on guidelines for a residential end use.

8.4.2 The results of the soil analyses have been compared to CLEA SGVs published in Environment Agency Science Reports SC050021/SR3, ref. 10.20, and SC050021, ref. 10.21, where available, and Generic Assessment Criteria (GAC), determined by LQM and CIEH, ref. 10.22, as well as Assessment Criteria (AC) derived in-house using the CLEA Software Version 1.06, ref. 10.23. The CLEA AC have been derived by Ian Farmer Associates in accordance with current legislation and guidance, as detailed in Appendix 6.

8.4.3 The guidance values used within this contamination assessment have been tabulated and are detailed within Appendix 6. The results have been tabulated, and compared against the relevant assessment criteria, and a summary table presented in Appendix 6, Figure A6.1

8.4.4 The results of chemical analyses have been processed in accordance with recommendations set out in the CIEH and CL:AIRE document 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref. 10.24. Where the concentrations determined on site are at or below the respective assessment criteria, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated.

8.4.5 Those contaminants with observed concentrations above the Guidance Level are detailed below:

Location	Depth (m)	Contaminant	Concentration (mg/kg)	Guidance Level (mg/kg)
BH1	0.30	Lead	1500	450
		Benzo(a)pyrene	1.3	0.83
BH3	1.00	TPH Aromatic C_{16}-C_{21}	440	250
		TPH Aromatic C_{21}-C_{35}	2900	890

8.4.6 Where the concentration of any contaminant is above the Guidance Level, further statistical analysis of the results has been conducted in accordance with the CIEH and CL:AIRE guidance, the results of which are presented in the summary table and on 'output sheets' in Appendix 6, Figure A6.1.

8.4.7 Before determining which statistical test can be applied to the data set, it is first necessary to determine the normality of the data distribution by carrying out the Shapiro-Wilk normality test, ref. 10.25. Where the data distribution is shown to be normal, the Upper Confidence Limit (UCL) test can be applied to the results and where data deviates from normality, an alternative method is selected.

8.4.8 The Shapiro-Wilk normality test indicates that the data for the results is normally distributed.

8.4.9 The relevant methods were applied to the contaminants of concern, the results of which gives the estimated upper bound of the 95th UCL of the samples. This test indicates whether any high concentrations represent a significant possibility of harm to human health.

8.4.10 The calculations from the UCL tests are provided in Appendix 6, Figure A6.1, and the results are tabulated below:

Contaminant	Value of UCL (mg/kg)	Guidance Value (mg/kg)	Comments
Lead	521	450	Outlier test required
Benzo(a)pyrene	0.50	0.83	Risk within acceptable limits for proposed use
TPH Aromatic C_{16}-C_{21}	126	250	Risk within acceptable limits for proposed use
TPH Aromatic C_{21}-C_{35}	825	890	Risk within acceptable limits for proposed use

8.4.11 To assess the significance of the contaminant concentrations that exceed the Guidance Level, the outlier test has been undertaken. This test determines whether the highest recorded contaminant concentrations are from the same population or represent a 'hotspot'.

8.4.12 The calculation from the outlier test for lead is provided in Appendix 6, Figure A6.1. This indicates that the result for lead is not an outlier and therefore represents a background concentration within the strata sampled. However, if this result is removed, the 95th percentile result no longer continues to exceed the Guidance Value.

8.5 Risk Assessment - Controlled Waters

8.5.1 The site is located above a Secondary A aquifer and there are no surface watercourses within 1km of the site.

8.5.2 An initial assessment of the risk to controlled waters has been carried out on the basis of the results of leachate analysis undertaken on samples from the Made Ground. The leachate results have been screened against the Water Supply (Water Quality) Regulations 2000, ref. 10.29.

8.5.3 It should be noted that there is no TPH guideline parameter within the Water Supply Regulations 2000. As such, the guidance value of 10µg/l within the Water Supply Regulations 1989, ref. 10.30, has been adopted as a conservative approach.

8.5.4 The leachate analysis indicates exceedances for lead, copper and TPH when compared against the Water Supply Regulations. However, if the leachate analysis is compared to freshwater EQS, ref. 10.31, then only TPH exceeds the relevant guidance level.

8.5.5 It is recommended that the Environment Agency be consulted with regard to the significance of these results, particularly in light of the fact that there is no current guideline TPH parameter within the Water Supply Regulations 2000.

8.5.6 Given the ground conditions encountered at the site and the results of this contamination assessment, it is considered likely that further assessment of the risks to controlled waters will be required.

8.6 Gas Generation

8.6.1 Gas monitoring visits were undertaken during October and November, generally during periods of low or falling atmospheric pressure. The results of the gas monitoring are included within Appendix 2, Figure A2.13.

8.6.2 Methane concentrations of less than 0.1% by volume were recorded during the various monitoring phases together with carbon dioxide concentrations of between <0.1% and 10.3%. Variable oxygen concentrations were recorded ranging from near atmospheric to depleted (12.9%).

8.6.3 Flow rates were recorded over a three minute period during the various return monitoring visits. The maximum of the three minute average flows was recorded at less than 0.1l/hr (limit of detection).

8.6.4 In accordance with the methodology published in CIRIA Document C665, ref. 10.47, the maximum recorded values were taken to calculate a Gas Screening Value for the site. The GSV calculated for carbon dioxide is 0.01l/hr. The GSV calculated for methane is 0.0001l/hr. Although this value indicates the site to be Characteristic Situation 1 (Appendix 7, Table A7.2), the high levels of carbon dioxide recorded on each visit would indicate that Characteristic Situation 2 would be more applicable. For Situation A, being any development other than low rise residential with suspended floor slab and ventilated void, gas protective measures are given in Appendix 7, sections A7.7 and A7.10.

8.6.5 These comments are based on three sets of readings over a period of 4 weeks, which does not follow the recommended guidelines given in Appendix 7, Table A7.1. These values were elevated and varied over the period of monitoring and therefore, it is recommended that a continued programme of monitoring be carried out to comply more closely with these guidelines before final design is undertaken.

8.6.6 Radon - The BRE guidance on Radon producing areas within the UK, (BR211:2007), indicates that the site lies within an area where radon protective measures are not required.

8.6.7 It is recommended that the Local Authority/NHBC are consulted regarding these gas protection measures for their approval prior to commencing construction.

8.7 Protection Of Services

8.7.1 Due to the increasing number of developments being undertaken on potentially contaminated land, the Water Supply Industry has identified the need to protect newly laid water supply pipes. They are likely to impose constraints on the nature of water supply pipes that are to be laid in contaminated land. Current guidance on the selection of materials for water pipes is provided by the UK Water Industry Research Limited, ref. 10.32, though some water supply companies may continue to refer to the previous guidance provided by Water Regulations Advisory Scheme, ref. 10.33, and should be consulted for confirmation.

8.8 Risk Evaluation

8.8.1 The conceptual model formed within the Preliminary Investigation has been updated to reflect the findings of the contamination risk assessment and the revised conceptual model, detailing the relevant pollutant linkages, is tabulated below:

Source	Potential Pathways	Receptor Group
Made Ground (lead, PAH, TPH)	• Ingestion of contaminated soil by direct contact • Ingestion of contaminants through vegetables • Entry of contaminants by skin or eye contact with contaminated soils or dust • Inhalation of contaminated dust	Humans • Site occupants[1] • Site users[1] • Construction workers[2] • Maintenance workers[1] • Neighbouring site users[2]
Made Ground (copper, lead. TPH)	• Infiltration • Migration • Surface run-off	Water Environment • Groundwater
Made Ground (Ground gas)	• Inhalation or migration of toxic / explosives gases / vapours	Humans • Site occupants[1] • Site users[1] • Construction workers[2] • Maintenance workers[1]
[1] – Assumes no remediation is undertaken [2] – Pathway exists only during the construction period		

8.9 Summary of Risk Evaluation

8.9.1 The above assessment identifies that the 'source – pathway – receptor' linkage potentially occurs with lead impacting upon the identified receptors. Therefore, it would be necessary to manage the risk at this location by either eliminating one of the links or by minimising the potential effects.

8.9.2 The elevated level of lead was from BH1 at a depth of 0.30m. The borehole was sunk within the garden area in the northwest corner of the site.

8.10 Waste

8.10.1 An initial assessment of the likely waste classification for any material to be disposed of has been conducted on the basis of the chemical test results obtained as part of the contamination risk assessment.

8.10.2 This assessment has been conducted using the HazWasteOnline[tm] tool, ref. 10.34, the summary output sheet from which is included within Appendix 4, Figure A4.3, with a full copy of the output included on the accompanying CD.

8.10.3 This initial assessment indicates that the following sample could be classified as hazardous waste:

Location	Depth (m)	Classification Result	Contaminant	Hazardous Property
BH1	0.30	Hazardous	Lead	H7: Carcinogenic H14: Ecotoxic
			Cyanide	H12: Release of toxic gases

8.10.4 It should be noted that this sample also identified the presence of asbestos fibres (amosite) which is also likely to classify the material as hazardous waste.

8.10.5 Individual tips might require further analysis prior to the disposal of any material from the site. Any such requirements should be clarified with the tip prior to any further analysis being undertaken.

9.0 MANAGEMENT OF CONTAMINATION

9.1 Remediation and Verification

9.1.1 The risk management framework set out in the Model Procedures for the Management of Land Contamination, CLR 11, ref. 10.35, is applicable to the redevelopment of sites that may be affected by contamination.

9.1.2 The risk management process set out in the Model Procedures has three main components:

- Risk assessment
- Options appraisal
- Implementation

9.1.3 This initial risk assessment has identified the presence of elevated lead, benzo(a)pyrene and total petroleum hydrocarbons concentrations within the Made Ground in the garden area and central forecourt of the site, plus elevated levels of lead, copper and TPH within the leachate results. Relevant pollutant linkages have been identified, as demonstrated in the updated conceptual model.

9.1.4 The remediation strategy will need to review methods of reducing or controlling the identified unacceptable risks. This could be done by removing or treating the sources of contamination, removing or modifying the pathways or removing or modifying the behaviour of the receptors, to ensure there is no significant risk of significant harm to either human health or controlled waters from the identified contamination, in relation to the proposed end use.

9.1.5 An important part of the risk management process is identifying and informing all stakeholders with an interest in the outcome of the risk management project. To this end, if the regulators have not yet been contacted with regard to the redevelopment of this site, it is recommended that they be supplied with a copy of both the Preliminary Investigation report and this Phase 2 Ground Investigation report in order to enable liaison to be undertaken with them.

9.1.6 Following liaison with the relevant regulatory bodies, a remediation strategy could be formulated, which should incorporate an options appraisal and summarise in detail the chosen remedial approach, along with the verification proposals. The remediation strategy should then be approved by the relevant regulatory authorities prior to implementation.

9.1.7 Where remediation is required, a verification report will need to be formulated following implementation of the remediation strategy, which should provide a complete record of all remedial activities conducted on site and include all the data obtained to support the remedial objectives and demonstrate that the remediation has been effective. Any unexpected conditions encountered during the remedial works should also be detailed within the verification report.

9.1.8 The elevated TPH identified in BH3 is likely to be removed as part of the construction as a basement is to be constructed.

9.1.9 This would only leave the elevated benzo(a)pyrene and lead identified in BH1 which will be within a garden area and would require some form of remediation. In gardens, landscaped areas or areas likely to be used for the growing of vegetables/fruit for consumption, a capping layer of 'inert' material could be provided to break the pathway between the identified contamination and end users of the site. The required thickness of the capping layer could be determined using guidance provided by the BRE, ref. 10.36.

9.1.10 In order to minimise the impact on future maintenance workers, where services are to be placed at a depth that puts them at or below the level of the source of contamination, it would be prudent to line the trenches and surround the services with clean inert material.

9.1.11 With respect to groundwater, the removal of the source during basement construction would go some way to reducing the potential risk to groundwater. However, it would be prudent to undertake groundwater sampling on at least two occasions in order to ascertain the impact on the groundwater from the elevated contaminants in the soil.

9.1.12 Elevated levels of carbon dioxide have been recorded during the monitoring period. However, the results are variable and it is recommended that further monitoring is undertaken to confirm these results.

9.2 Management of Unidentified Sources of Contamination

9.2.1 There is the possibility that sources of contamination may be present on the site, which were not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, these should be dealt with accordingly. A number of options are available for handling this material, which include:

- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal.

- Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.

- Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

9.3 Consultation

9.3.1 During the development of a site, consultation may be required for a number of reasons with a number of regulatory Authorities. The following provides an indication as to the most likely Authorities with which consultation may be required.

- **Local Authority.** There may be a planning condition regarding contamination and consultation will be required with a designated Contaminated Land Officer within the Environmental Health Department. The Local Authority is generally concerned with human health risks. Some Authorities now require 'Completion Certificates' to be signed off following remediation works.

- **Environment Agency.** Where a site is situated above an aquifer, within a groundwater protection zone or has been designated as a special site, the Environment Agency is likely to be involved to ensure that controlled waters are protected.

- **National House Building Council, NHBC.** Section 4.1 of the NHBC Standards requires land management to be addressed. For a new housing development to be approved by the NHBC, any remediation will require a validation report.

9.3.2 Based on the results of any consultation, there may be specific remediation requirements imposed by one or more of the Authorities.

9.4 Risk Management During Site Works

9.4.1 During ground works, some simple measures may have to be put in place to mitigate the risk of any known or previously unidentified contamination affecting the site workers and the environs. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure.

- Where appropriate, the provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of the contamination.

- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first.

- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.

9.4.2 Where contaminated materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

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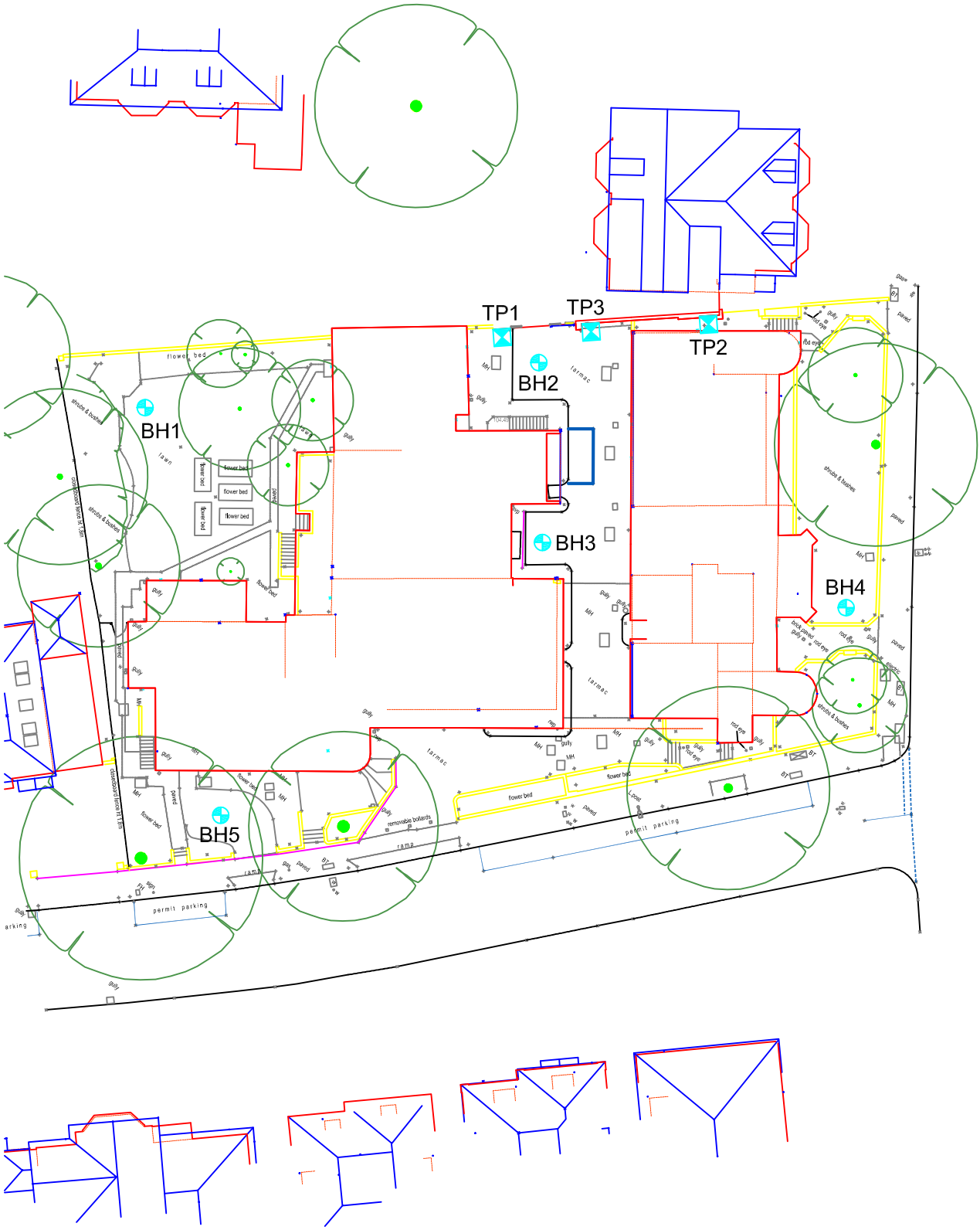
APPENDIX 1

DRAWINGS

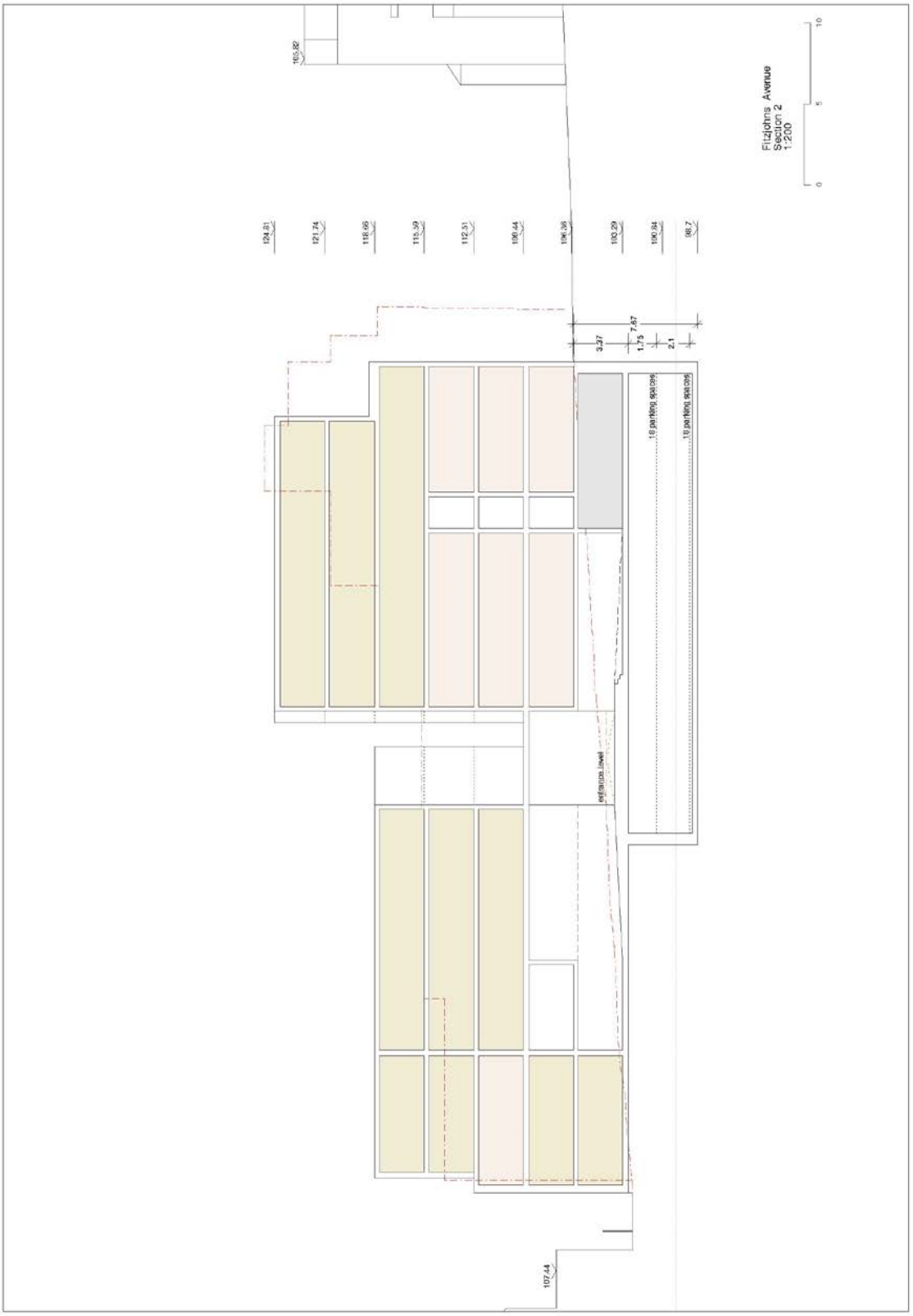


Scale :	N.T.S.
Drawn By :	P.L.E.
Job No:	52247
Fig:	A1.1

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

SITE PLAN

Arthur West House, Fitzjohn's Avenue, Hampstead NW3 6PA.



IAN FARMER ASSOCIATES Geotechnical & Environmental Specialists	**PROPOSED BUILDING ELEVATIONS**	Job no. 52247A
	Fitzjohn's Avenue, Hampstead, NW3 6PA	Fig. A1.2

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, 10.4 and BS 5930, ref. 10.3.

A2.1.2 Trial Pits

Shallow trial pits are generally dug by mechanical excavator, however, in difficult access locations or adjacent to structures, such pits may be hand dug. Pits are best used where the ground will stand unsupported and generally, the maximum depth of machine dug pits is 4m to 5m. Where personnel are required to enter pits, it is essential that side support is provided. Entry by personnel into unsupported pits deeper than 1.2m is not allowed for health and safety reasons.

Trial pits allow the in-situ condition of the ground to be examined both laterally and vertically and also allow discontinuities to be recorded. The field record should give the orientation of the pit with details of which face was logged, assessment of stability of sides of pit and groundwater as well as the strata encountered. Photographs of the pit should also be taken.

In-situ testing, such as hand penetrometer, hand vane, Macintosh probe, or similar, can be undertaken in the sides or base of pits while both disturbed and undisturbed samples recovered.

It is generally advisable to backfill the pits as soon as possible, open pits should not be left unattended.

A2.1.3 Light Cable Percussion Boring

For routine soil exploration to depths in excess of 3m, the light cable percussion rig is generally employed for boring through soils and weak rocks, refs 10.3, 10.4 and 10.5. It consists of a powered winch and tripod frame, with running wheels that are permanently attached so that the rig may be towed behind a suitable vehicle. The rig is towed into position and set up using its own winching system.

The locations of services are checked to make sure the borehole is not situated unacceptably near any services. Regardless of the proximity of services, a CAT scan is undertaken at the borehole location and a trial hole dug to 1.20m by hand.

Boreholes are advanced in soil by the percussive action of the cable tool. The force of the cylindrical tool as it is dropped a short distance cuts a plug of cohesive soil that is removed by the tool.

In non-cohesive soils, the borehole is advanced by a ‘shell’, otherwise known as a ‘bailer’ or ‘sand pump’, which incorporates a clack valve. Material is transferred into the shell and retained by the clack valve. The water level in a borehole is maintained above that in the surrounding granular soil to allow for temporary reductions in the head of water as the shell is withdrawn from the borehole. Water should flow from the borehole into the surrounding soil at all times to prevent ‘piping’ and loosening the soil at the base of the hole. The casing is always advanced with the borehole in granular soil so that material is drawn from the base rather than the borehole sides.

Obstructions to boring are overcome by fitting a serrated chiselling ring to the base of the percussion tool. For large obstructions, a heavy chisel with a hardened cutting edge may have to be used.

Disturbed samples are taken in polythene bags, jars or tubs that are sealed against air or water loss.

Undisturbed samples are generally taken in cohesive materials at changes in strata and at one metre intervals to 5 metres then at 1.5 metre intervals to the full depths of the borehole. The general purpose open-tube sampler is suitable for firm to stiff clays, but is often used to retrieve disturbed samples of weak rocks, soft or hard clay and also clayey sand or silts. This has been adopted for routine use, and usually consists of a 100mm internal diameter tube (U100), which is capable of taking soil samples up to 450mm in length. The undisturbed samples are sealed at each end using micro-crystalline wax to prevent drying.

Standard penetration tests are generally carried out in non-cohesive soils but also in stiff clays and soft rocks at frequencies similar to that of undisturbed sampling.

A2.1.4 Percussive Window Sampling Rig

The percussive sampler consists of a track mounted window sampler, ref. 10.38, 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. 10.4, BS 1377, Part 9, 1990 ref. 10.6 and ISO 22476 ref. 10.5.

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

A2.3 SAMPLES

A2.3.1 General

Samples have been recovered and stored in accordance with the guidelines given in ISO 22475-1:2006, ref. 10.38 and BS 5930, ref. 10.3.

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. 10.38, and BS 5930, ref. 10.3, 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. 10.4. 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. 10.4. 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.

UT	represents undisturbed 100mm diameter samples taken in thin walled sample tubes, the number of blows to obtain the sample also recorded.
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
▽	represents water strike
▼	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. 10.39, supplemented by section 6 of BS 5930, ref. 10.3 have been used in the soil descriptions contained within this report.

IAN FARMER ASSOCIATES

Site	Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Percussive Window Sampler		102.20	Pegasus Life Ltd	52247a
	Location TQ263854	**Dates** 13/08/2014	**Engineer** Gleeds Management Services Ltd	**Sheet** 1/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	E1				(0.80)	TOPSPOIL. Dark brown slightly gravelly sandy silt with occasional roots, rootlets, brick, concrete, clinker and glass fragments. Gravel is flint.		
				101.40	0.80			
0.90	E2				(0.65)	MADE GROUND. Brown slightly clayey, slightly gravelly silty fine to medium sand with occasional rootlets, organic remains, rare clinker and glass fragments. Becoming claying with depth. Gravel is flint.		
1.20-1.65 1.20	SPT(C) N=8 D3		1,1/2,2,2,2	100.75	1.45			
					(0.35)	MADE GROUND. Firm brown silty fine sandy clay with occasional organic remains, rootlets and rare traces of brick and clinker. Occasional fine to medium flint gravel.		
				100.40	1.80	1.60m to 2.00m; No recovery.		
2.00-2.45 2.00	SPT(C) N=7 D4		1,1/1,1,2,3			Firm brown mottled orange-brown slightly gravelly silty sandy CLAY. Sand is fine. Gravel is fine to coarse well-rounded flint.		
2.50	D5							
3.00-3.45 3.10	SPT(C) N=8 D6		1,1/1,2,2,3		(3.00)			
3.50	D7					3.40m to 4.40m; Soft to firm.		
4.00-4.45 4.00	SPT(C) N=16 D8		2,2/4,4,4,4					
4.50	D9							
				97.40	4.80			
4.90 5.00-5.45	D10 SPT(C) N=18		2,2/3,5,5,5			Firm orange-brown mottled light brown silty sandy CLAY interbedded with slightly clayey, and occasionally clayey, fine SAND.Rare well-rounded flint gravel		
5.30	D11					5.10m to 5.60m; Firm to stiff.		
5.80	D12					5.6m to 6.30m; Medium dense, slightly clayey fine SAND.		
6.00-6.45	SPT(C) N=17		4,5/5,5,4,3					
6.30	D13					Below 6.30m; Occasionally interlaminated orange-brown and brown with lenses of fine sand.		
6.80	D14							
7.00-7.45	SPT(C) N=10		2,2/2,2,3,3 Seepage(1) at 7.10m.					▽1
7.50	D15				(5.50)			
8.00-8.45	SPT(C) N=13		2,3/4,3,3,3 Water strike(2) at 8.20m.					▽2
8.50	D16					8.50m to 9.00m; Firm to stiff.		
9.00-9.45 9.10	SPT N=16 D17		2,3/3,4,4,5			9.00m to 10.00m; 10% recovery.		
10.00-10.45	SPT N=31		3,3/7,7,8,9					

Remarks
Slight seepage at 7.10m.
Groundwater struck at 8.20m.
Difficult drilling below 9.00m due to ingress of groundwater and sand.

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.1

IAN FARMER ASSOCIATES

Site	Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Percussive Window Sampler		102.20	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ263854	13/08/2014	Gleeds Management Services Ltd	2/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00 10.10	D18 D19					... as previous 10.00m to 11.00m; 10% recovery.		
				91.90	10.30	Stiff dark grey silty CLAY with frequent specks and clusters of iron pyrite crystals.		
					(0.70)			
				91.20	11.00	Complete at 11.00m		

Remarks
Borehole terminated at 11.00m

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.1

IAN FARMER ASSOCIATES

Site	Borehole Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH2

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	200mm cased to 12.00m 150mm cased to 18.00m	102.10	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 264 855	26/08/2014- 29/08/2014	Gleeds Management Services Ltd	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
					102.00	0.10	ASPHALT
						(0.30)	
					101.70	0.40	Reinforced CONCRETE.
0.50	D1						Possible MADE GROUND. Soft brownish grey sandy gravelly clay with occasional pockets of orange-brown fine to medium sand. Gravel is fine to coarse subangular to rounded flint.
						(1.30)	
1.20-1.65	SPT(C) N=5	1.00	DRY	1,0/2,1,1,1			
1.50	B1						
1.70	D2				100.40	1.70	Loose becoming medium dense orange-brown slightly clayey silty fine SAND.
2.00-2.45	SPT N=7	2.00	DRY	1,1/1,2,2,2			
2.00	D3						
3.00-3.45	SPT N=8	3.00	DRY	2,1/2,2,2,2			
3.00	B2						
3.00	D4						
4.00-4.45	SPT N=9	4.00	DRY	2,2/2,3,2,2			
4.00	D5						4.00m to 6.00m; Occasional coarse gravel-sized lumps of bluish grey sandy clay.
5.00-5.45	SPT N=10	5.00	DRY	2,2/3,2,3,2		(6.80)	
5.00	B3						
5.00	D6						
6.00	D7						
6.50-6.95	SPT N=12	6.00	DRY	2,3/3,2,3,4			
6.50	D8						
7.00	B4						
7.50	D9						
8.00-8.45	SPT N=13	8.00	DRY	3,4/3,4,3,3			
8.00	D10						
8.50	D11			Water strike(1) at 8.50m, rose to 8.10m in 20 mins.	93.60	8.50	Stiff, fissured dark grey silty sandy CLAY with occasional specks of iron pyrite and partings of orange-brown silty sand.
8.50-8.95	SPT N=20	8.00	DRY	4,5/5,3,5,7			
9.00	B5						
9.00	D12						
10.00-10.45	SPT N=27	10.00	DRY	6,5/8,5,7,7			

Legend

Water

Instr

▼1

▽1

Remarks
Chiselling from 0.00m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.2

IAN FARMER ASSOCIATES

Site	Borehole Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH2

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	200mm cased to 12.00m 150mm cased to 18.00m	102.10	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 264 855	26/08/2014- 29/08/2014	Gleeds Management Services Ltd	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
10.00	D13						... as previous
10.50	D14						10.00m to 12.50m; Firm to stiff with occasional bands of dark greenish grey and orange-brown.
11.50-11.95 11.50	SPT N=30 D15	11.00	DRY	4,4/4,7,11,8			
				Water strike(2) at 12.10m, rose to 11.30m in 20 mins.			
12.50	D16						At 12.50m; Recovered as soft to firm with frequent pockets of orange-brown sandy clay.
13.00-13.45 13.00 13.00	SPT N=28 B6 D17	13.00	12.00	5,4/6,6,7,9			
14.00-14.45 14.00	SPT N=33 D18	14.00	11.00	4,4/7,8,8,10		(11.50)	From 14.00m; Firm and grey with greenish and reddish brown banding, and partings of light grey fine sand and silt.
15.00	D19						
15.50-15.95 15.50	SPT N=38 D20	15.00	12.00	6,6/8,9,11,10			
16.00	D21						From 16.00m; No banding.
17.00-17.45 17.00	SPT N=40 D22	17.00	13.00	5,5/11,10,8,11			
18.00	D23						
18.50-18.95	SPT N=37	18.00	13.00	6,6/7,12,10,8			
19.00-19.45 19.00	SPT N=35 D24			8,7/8,9,10,8			
					82.10	20.00	

Legend: Water ▼2 ▽2; Instr

Remarks

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.2

IAN FARMER ASSOCIATES

Site	Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Percussive Window Sampler		102.20	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ264855	14/08/2014	Gleeds Management Services Ltd	1/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				102.10	0.10	ASPHALT		
					(0.20)			
				101.90	0.30	Reinfored CONCRETE.		
0.50	E1					MADE GROUND. Yellowish brown fine to coarse gravelly sand with frequent concrete and brick fragments/ cobbles, and occasional clinker, glass and asphalt fragments and flints.		
0.70	D1				(1.00)			
1.00	E2							
1.20-1.65	SPT(C) N=6		0,0/1,1,2,2	100.90	1.30	Firm brown mottled orange-brown silty sandy CLAY. Occasionally very sandy.		
1.40	D2							
1.90	D3							
2.00-2.45	SPT(C) N=12		2,2/3,3,3,3		(1.60)			
2.50	D4					From 2.65m; Firm to stiff.		
				99.30	2.90	Medium dense brown slightly clayey fine SAND.		
3.00-3.45	SPT(C) N=21		5,5/5,6,5,5					
3.00	D5				(1.30)			
3.70	D6							
4.00-4.45	SPT(C) N=22		1,2/4,6,6,6					
				98.00	4.20	Firm orange-brown mottled light brown silty sandy CLAY interbedded with clayey or slightly clayey fine SAND.Rare well-rounded flint gravel.		
4.30	D7					4.50m to 5.60m; Silty clayay fine SAND.		
5.00-5.45	SPT(C) N=24		4,5/6,6,6,6					
5.00	D8							
5.80	D9							
6.00-6.45	SPT(C) N=18		3,3/4,4,4,6			6.10m to 7.10m; Slightly clayey silty fine SAND.		
6.50	D10							
7.00-7.45	SPT(C) N=14		2,2/3,4,3,4					
7.20	D11							
					(6.80)			
			Water strike(1) at 7.70m.			7.70m to 7.90m; Slightly clayey fine SAND.		▽1
8.00-8.45	SPT(C) N=12		2,2/3,2,3,4			8.00m to 9.00m; 75% recovery.		
8.20	D12							
8.80	D13							
9.00-9.45	SPT(C) N=7		2,2/1,2,2,2			9.00m to 10.00m; No Recovery.		
10.00-10.45	SPT(C) N=19		4,4/4,5,5,5					

Remarks
Slight seepage at 3.70m.
Groundwater struck at 7.70m.
Difficult drilling below 8.00m due to ingress of groundwater and sand.

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.3

IAN FARMER ASSOCIATES

Site	Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Percussive Window Sampler		102.20	Pegasus Life Ltd	52247a
	Location TQ264855	**Dates** 14/08/2014	**Engineer** Gleeds Management Services Ltd	**Sheet** 2/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						... as previous 10.00m to 11.00m; No Recovery.		
11.00-11.45	SPT(C) N=19		3,4/4,4,5,6	91.20	11.00	Complete at 11.45m		

Remarks
Borehole terminated at 11.00m.

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.3

IAN FARMER ASSOCIATES

Site	Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH4

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Percussive Window Sampler		106.10	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ264855	15/08/2014	Gleeds Management Services Ltd	1/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.40)	TOPSOIL. Dark brownslightly gravelly clayey silty fine to medium sand with occasional roots, rootlets, brick, concrete and clinker fragments.			
0.30	E1			105.70	0.40				
0.80	E2				(0.70)	MADE GROUND. Brown slightly gravelly silty fine sand with occasional rootlets, brick fragments and rare clinker fragments.			
				105.00	1.10				
1.20-1.65	SPT(C) N=16		1,3/4,4,4,4		(0.50)	MADE GROUND. Dense brown mottled orange-brown silty clayey fine sand with occasional brick and clinker fragments. Rare flint pebbles.			
1.20	D3			104.50	1.60				
1.80	D4					Stiff to very stiff, becoming firm with depth, brown mottled orang-brown silty sandy CLAY with frequent decomposing rootlets.			
2.00-2.45	SPT(C) N=26		6,6/5,6,7,8			From 2.00m; Orange-brown mottled grey. Occasionally very sandy with occasional decomposing rootlets.			
2.30	D5								
2.90	D6								
3.00-3.45	SPT(C) N=19		5,5/5,5,4,5		(3.20)				
3.30	D7								
3.80	D8					From 3.70m; Becoming firm with occasional bands of fine sand.			
4.00-4.45	SPT(C) N=16		3,4/3,4,4,5						
4.20	D9								
4.60	D10								
4.80	D11			101.30	4.80				
5.00-5.45	SPT(C) N=18		2,3/4,4,5,5			Medium dense brown slightly silty clayey fine SAND. 5.00m to 5.65m; Very clayey.			
5.20	D12				(1.20)				
5.70	D13								
6.00-6.45	SPT(C) N=15		2,3/3,2,5,5	100.10	6.00	Firm to stiff orange-brown mottled light brown silty sandy CLAY interbedded with slightly clayey, and occasionally clayey, fine SAND.Rare well-rounded flint gravel			
6.20	D14					6.60m to 7.45m; Brown slightly clayey fine SAND.			
6.70	D15								
7.00-7.45	SPT(C) N=19		3,5/6,5,4,4						
7.50	D16					7.45m to 7.80m; Firm very sandy CLAY.			
						7.80m to 8.40m; Brown fine SAND.			
8.00-8.45	SPT(C) N=23		5,6/6,6,5,6						
8.20	D17					8.40m to 9.00m; Firm very sandy CLAY.			
8.60	D18								
9.00-9.45	SPT(C) N=50		8,8/9,11,14,16		(6.00)	9.00m to 9.85m; Brown slightly clayey fine SAND.			
9.50	D19								
10.00-10.45	SPT(C) N=22		2,3/3,4,6,9			9.85m; to 10.60m; Firm orange-brown and			

Remarks
35mm slotted standipipe installed to 11.50m.
Groundwater struck at 10.60m.

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.4

IAN FARMER ASSOCIATES

Site	Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH4

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Percussive Window Sampler		106.10	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ264855	15/08/2014	Gleeds Management Services Ltd	2/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
10.00	D20					grey silty sandy CLAY. ... as previous			
10.50	D21		Water strike(1) at 10.60m.			10.60m to 12.00m; Orange-brown slightly clayey, becoming clayey, fine SAND.		∇_1	
10.70	D22								
11.00-11.45	SPT(C) N=18		4,4/4,4,4,4,6						
11.30	D23		Water strike(2) at 11.30m.					∇_2	
11.80	D24								
				94.10	12.00	Complete at 12.00m			

Remarks

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.4

IAN FARMER ASSOCIATES

Site	Borehole Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH5

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.00m	103.20	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 264 854	20/08/2014-21/08/2014	Gleeds Management Services Ltd	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
					103.05	(0.15) 0.15	Block paving over sand sub base.
					102.95	0.25	MADE GROUND. Dark reddish brown silty sandy medium to coarse subangular granite gravel (Type 1 granular sub base).
0.50	D1					(0.55)	
0.50	E1				102.40	0.80	Brown slightly gravelly silty fine SAND with occasional roots and rootlets.
1.00	D2						Medium dense orange and greyish brown slightly clayey silty fine SAND.
1.00	E2						
1.50-1.95	SPT N=19	1.00	DRY	6/4,5,5,5		(1.70)	
1.50	D3						
2.00-2.45	SPT N=18	2.00	DRY	9/5,4,5,4			
2.00	D4						
					100.70	2.50	Firm orange and yellowish brown mottled grey very sandy silty CLAY with occasional bands and pockets of clayey to very clayer fine SAND.
2.90	D5						
3.00-3.45	SPT N=16	3.00	DRY	6/4,4,4,4			
3.00	D6						
3.50	D7						
4.00-4.45	SPT N=18	4.00	DRY	6/5,5,4,4			
4.00	D8					(3.70)	
4.50	D9						
5.00-5.45	SPT N=12	5.00	DRY	6/3,3,3,3			
5.00	D10						
6.00	D11						
					97.00	6.20	Medium dense brown clayey silty fine SAND.
6.50-6.95	SPT N=18	6.00	DRY	7/4,3,5,6			
6.50	D12						
8.00-8.45	SPT N=21	8.00	DRY	9/5,6,5,5			
8.00	D14						
9.00	D15						
				Moderate(1) at 9.30m, rose to 9.10m in 20 mins.			
9.50-9.95	SPT N=22	9.00	DRY	11/5,6,6,5			

Water: ▼1 ▽1

Remarks
Chiselling from 0.00m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.5

IAN FARMER ASSOCIATES

Site	Borehole Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	BH5

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.00m	103.20	Pegasus Life Ltd	52247a
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 264 854	20/08/2014-21/08/2014	Gleeds Management Services Ltd	2/2

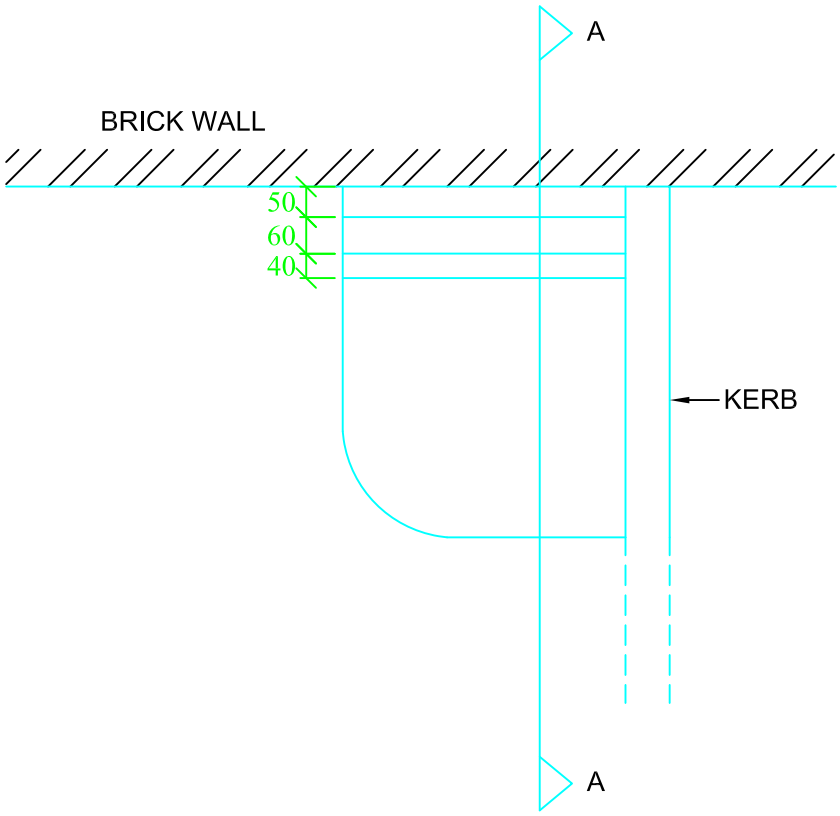
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
10.00	D16						... as previous At 10.00m; Very wet.		▼2	
						(8.70)				
11.00	D17			Moderate(2) at 11.00m, rose to 10.00m in 20 mins.					▽2	
11.00-11.45	SPT N=29	11.00	10.00	10/7,8,6,8						
12.00-12.45 12.00	SPT N=24 D18	12.00	DRY	13/5,7,5,7			From 12.00m; Wet and very clayey with occasional pockets of grey clay.			
13.00-13.45 13.00 13.00	SPT N=26 D19 D20	13.00	DRY	12/7,7,8,4						
14.00-14.45	SPT N=16	14.00	DRY	8/3,5,5,3						
					88.30	14.90	Stiff dark grey silty sandy CLAY.			
15.00	D21					(0.60)				
15.50-15.95	SPT N=50	15.00	DRY	20/25,25	87.70	15.50	CLAYSTONE			
						(0.30)				
					87.40	15.80	Stiff, becoming firm and occasionally fissured, dark grey silty sandy CLAY with occasional specks of iron pyrite.		▼4 ▼3	
16.00	D22									
17.00 17.00	D23 D24			Moderate(3) at 17.00m, rose to 16.10m in 20 mins.			At 17.00m; Soft to Firm, and dark bluish grey.		▽3	
17.00-17.45	SPT N=41	17.00	16.00	15/10,8,11,12						
						(4.20)				
18.00	D25						At 18.00m; Firm, brownish grey and slightly sandy.			
19.00-19.45 19.00	SPT N=37 D26	19.00	16.00	15/9,9,11,8			At 19.00m; Firm bluish grey with brown mottling and sandy.			
				Moderate(4) at 19.50m, rose to 16.00m in 20 mins.					▽4	
					83.20	20.00				

Remarks
Chiselling from 15.50m to 15.80m for 1 hour.

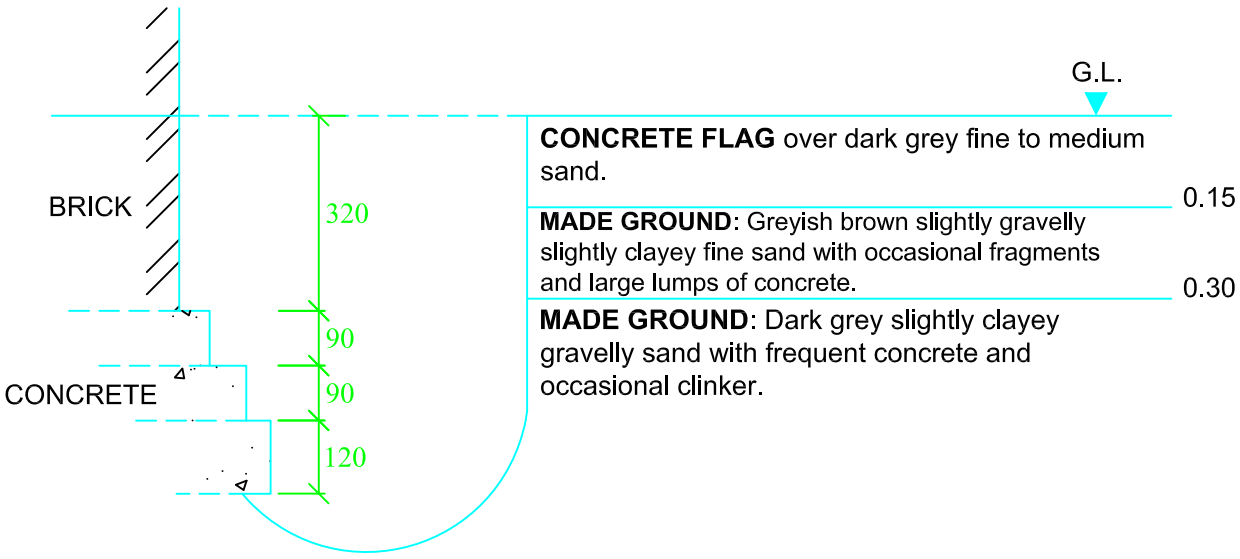
Scale (approx)	Logged By
1:50	BP/DAA

Figure No. A2.5

PLAN



SECTION A-A



END OF TRIAL PIT 0.70m

All dimensions in millimetres.
Depths of strata changes in metres.
Groundwater not encountered during excavation.
Date of Sitework 22/08/14.

Scale :	N.T.S.
Drawn By :	P.L.E.

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

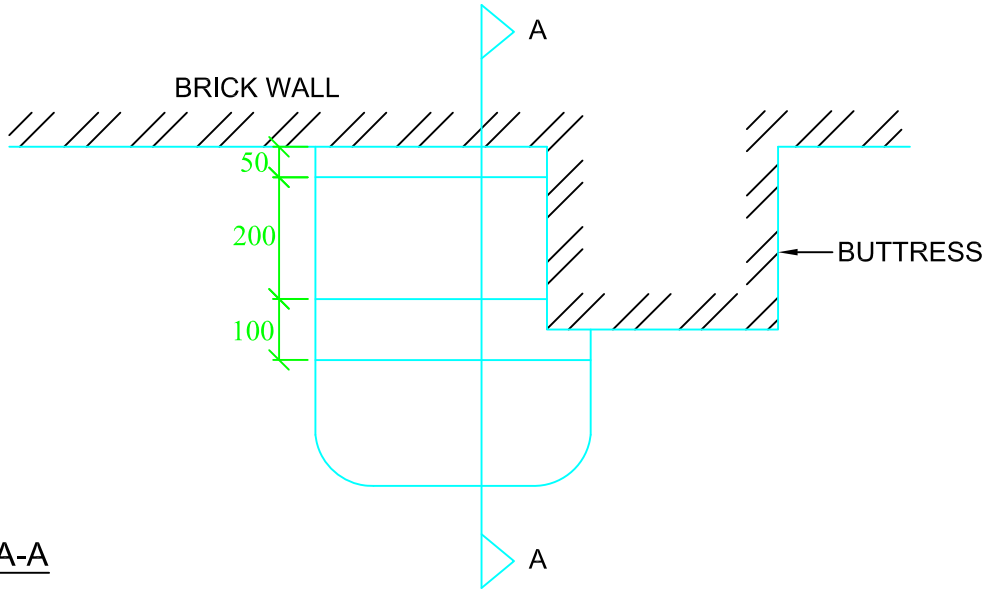
TRIAL PIT RECORD No 1

Arthur West House, Fitzjohn's Avenue, Hampstead NW3 6PA.

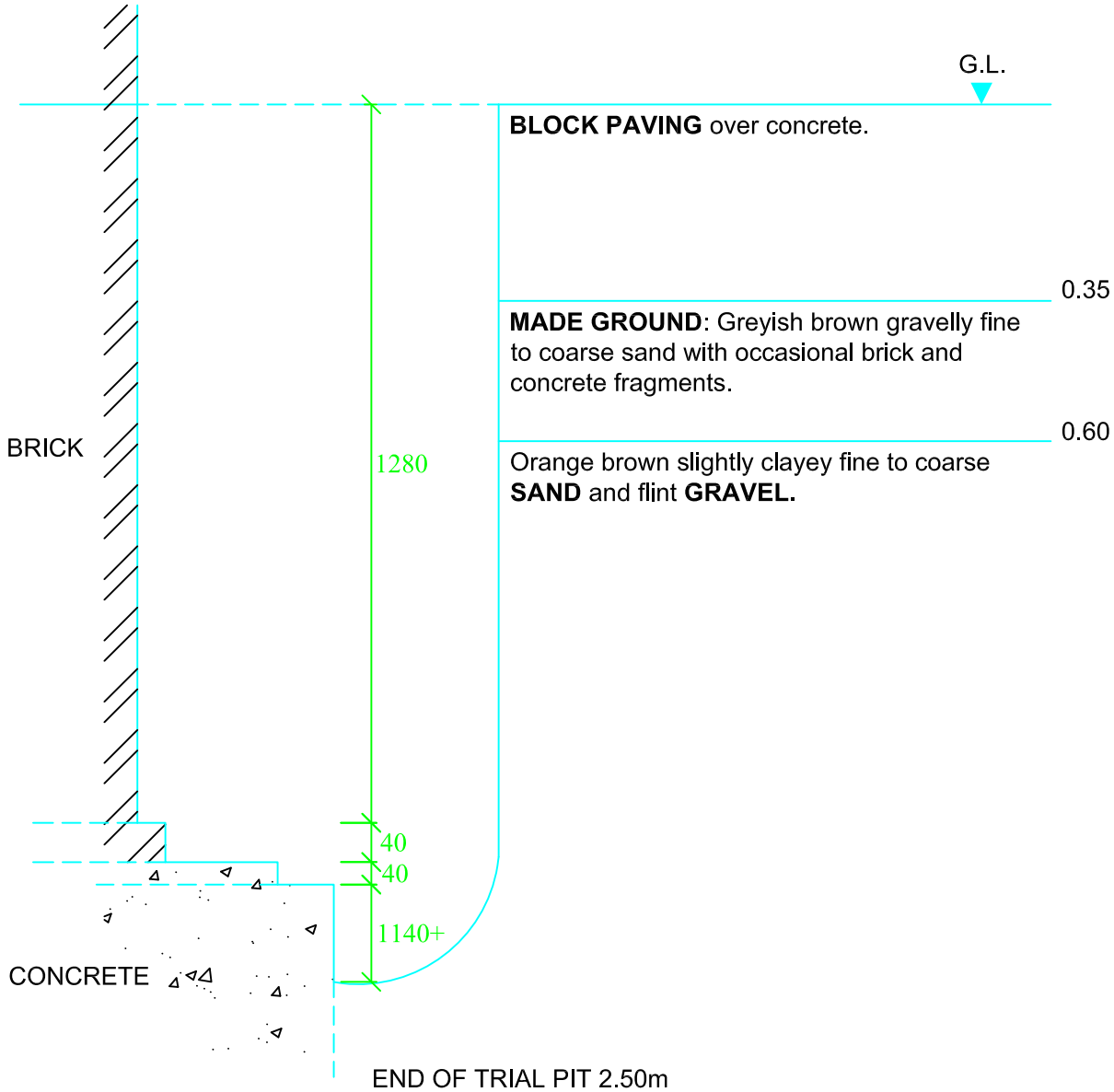
Job No: 52247

Fig: A2.6

PLAN



SECTION A-A



All dimensions in millimetres.
Depths of strata changes in metres.
Groundwater not encountered during excavation.
Date of Sitework 22/08/14.

Scale :	N.T.S.
Drawn By :	P.L.E.

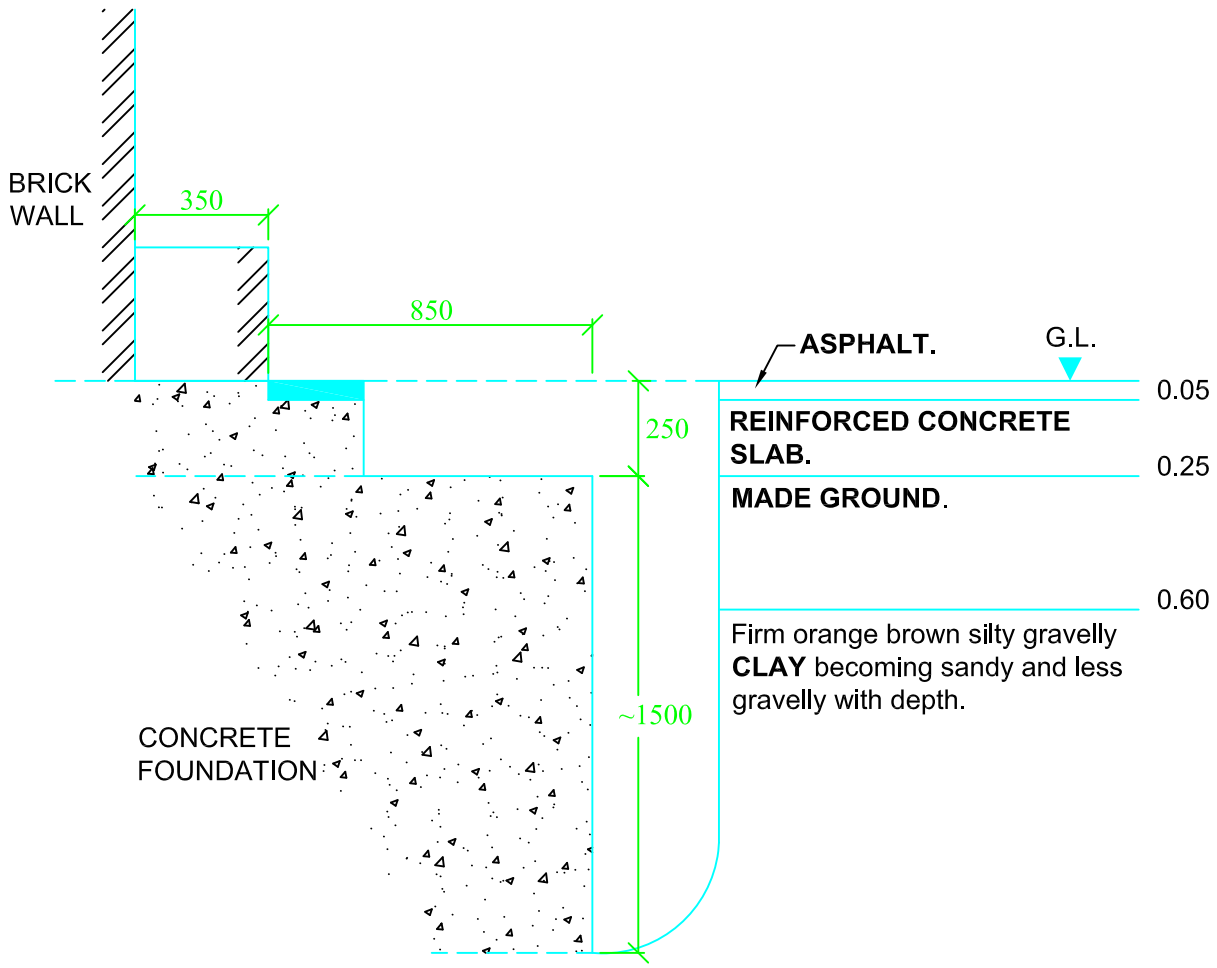
IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

TRIAL PIT RECORD No 2

Arthur West House, Fitzjohn's Avenue, Hampstead NW3 6PA.

Job No: 52247

Fig: A2.7



END OF TRIAL PIT 1.50m

All dimensions in millimetres.
Depths of strata changes in metres.
Groundwater not encountered during excavation.
Date of Sitework 22/08/14.

Scale :	N.T.S.
Drawn By :	P.L.E.
Job No:	52247
Fig:	A2.8

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

TRIAL PIT RECORD No 3

Arthur West House, Fitzjohn's Avenue, Hampstead NW3 6PA.

Trial pit 1

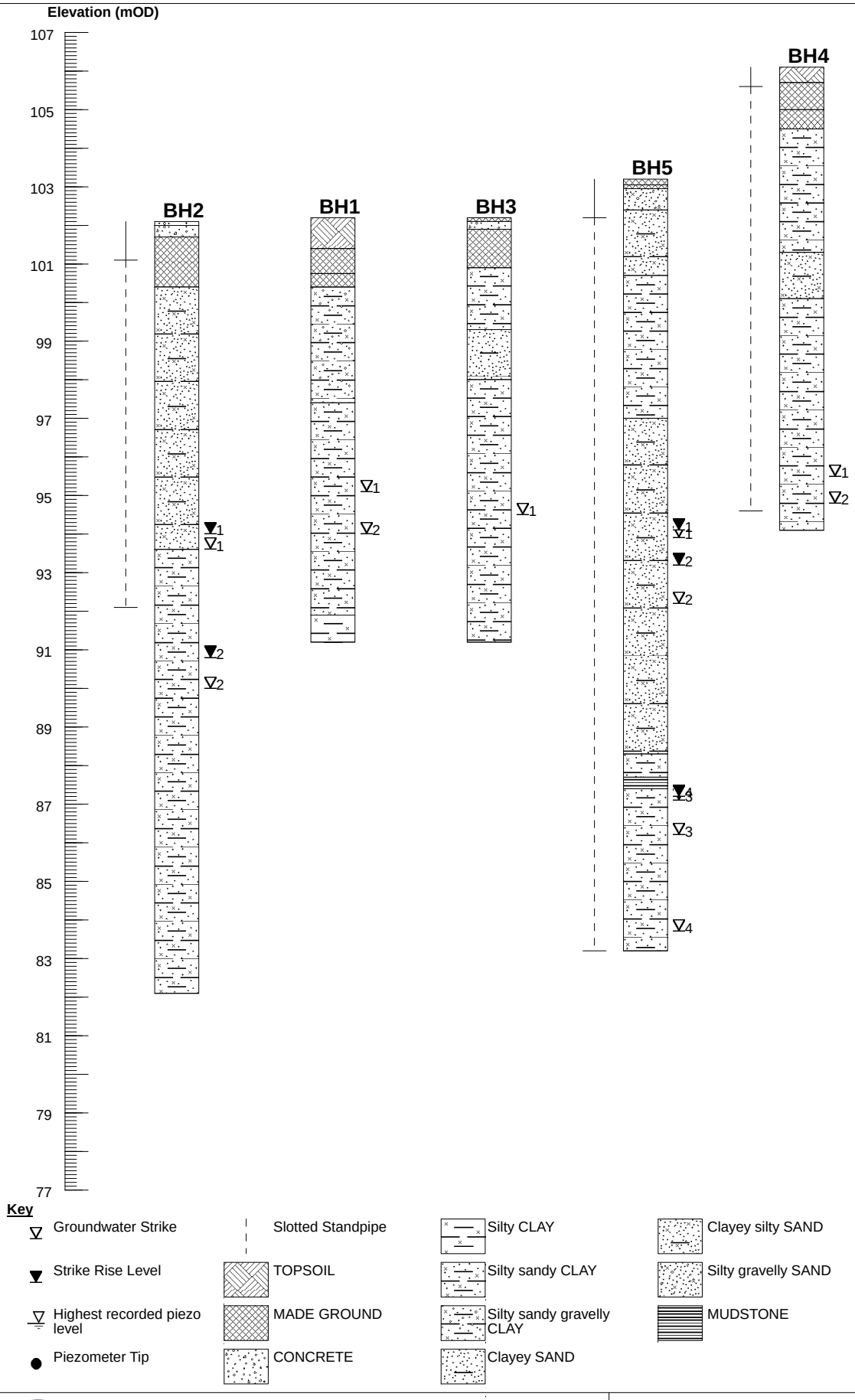
IAN FARMER ASSOCIATES Geotechnical & Environmental Specialists	**TRIAL PIT PHOTOGRAPHS**	Job no. 52247A
	Fitzjohn's Avenue, Hampstead, NW3 6PA	Fig. A2.9

Trial pit 2

IAN FARMER ASSOCIATES Geotechnical & Environmental Specialists	**TRIAL PIT PHOTOGRAPHS**	Job no. 52247A
	Fitzjohn's Avenue, Hampstead, NW3 6PA	Fig. A2.10

Trial pit 3

IAN FARMER ASSOCIATES Geotechnical & Environmental Specialists	**TRIAL PIT PHOTOGRAPHS**	Job no. 52247A
	Fitzjohn's Avenue, Hampstead, NW3 6PA	Fig. A2.11



IAN FARMER ASSOCIATES

Nominal Section

Site	Date Drawn	Date Checked	Sheet	Job Number
Arthur West House, 79 Fitzjohn's Avenue, Hampstead NW3 6PA	19/09/2014		1/1	52247a
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
Pegasus Life Ltd			1:150[V]	A2.12

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Background Readings:	Date of Visit	13/10/2014				
	CH_4%v/v	CO_2%v/v	O_2%v/v	H_2Sppm	COppm	VOC ppm
	0.0	0.0	21.0	0	0	NR
	Weather Conditions		Wet			
	Ground Conditions (dry/wet etc.)		Wet			
	Atmospheric Pressure (mb)		989			

RESULTS OF GAS AND GROUNDWATER MONITORING

Arthur West House, Fiztjohn's Avenue, Hampstead

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	
BH2	11:45	989	0.0	0.0	0.0	8.0	8.0	13.4	13.4	0	0	0	0	NR	NR	6.86	10.16	N
BH4	11:50	989	0.0	0.0	0.0	0.0	0.0	20.7	20.7	0	0	0	0	NR	NR	10.38	11.30	N
BH5	11:35	989	0.0	0.0	0.0	10.3	10.3	12.9	12.9	0	0	0	0	NR	NR	8.84	15.08	N

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

Readings Taken By:	**BP**	Checked By:	**WGG**

Job No: 52247A

Figure No: A2.13

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Background Readings:	Date of Visit	21/10/2014				
	CH_4%v/v	CO_2%v/v	O_2%v/v	H_2Sppm	COppm	VOC ppm
	0.0	0.0	20.9	0	0	NR
	Weather Conditions		Sunny			
	Ground Conditions (dry/wet etc.)		Wet			
	Atmospheric Pressure (mb)		1000			

Arthur West House, Fiztjohn's Avenue, Hampstead

RESULTS OF GAS AND GROUNDWATER MONITORING

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	
BH2	15:15	1000	0.0	0.0	0.0	8.6	8.6	13.4	13.4	0	0	0	0	NR	NR	6.80	10.13	N
BH4	15:20	1000	0.0	0.0	0.0	2.4	2.4	19.4	19.4	0	0	0	0	NR	NR	10.40	11.26	N
BH5	15:30	1000	0.0	0.0	0.0	0.0	0.0	20.8	20.8	0	0	0	0	NR	NR	8.82	14.99	N

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

Readings Taken By: **LH** Checked By: **WGG**

Job No: 52247A

Figure No: A2.13 cont'd

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Background Readings:	Date of Visit	04/11/2014				
	CH_4%v/v	CO_2%v/v	O_2%v/v	H_2Sppm	COppm	VOC ppm
	0.0	0.0	20.8	0	0	NR
	Weather Conditions		Sunny			
	Ground Conditions (dry/wet etc.)		Dry			
	Atmospheric Pressure (mb)		986			

Arthur West House, Fiztjohn's Avenue, Hampstead

RESULTS OF GAS AND GROUNDWATER MONITORING

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	
BH2	8:31	986	0.0	0.0	0.0	6.4	6.4	15.2	15.2	0	0	0	0	NR	NR	6.80	10.13	N
BH4	8:50	986	0.0	0.0	0.0	4.0	4.0	17.8	17.8	0	0	0	0	NR	NR	10.39	11.26	N
BH5	8:15	986	0.0	0.0	0.0	0.3	0.3	20.6	20.6	0	0	0	0	NR	NR	8.83	15.00	N

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

Readings Taken By: **AH** Checked By: **WGG**

Job No: 52247A

Figure No: A2.13 cont'd