Soil Consultants
Ground Investigation
Geotechnical Analysis
Contamination Assessment

SITE INVESTIGATION REPORT

PROPOSED REDEVELOPMENT:

KNELLER HALL, 65 KNELLER ROAD, TWICKENHAM, LONDON TW2 7DN

Client:	**RADNOR HOUSE SCHOOL LIMITED** **Pope's Villa, Cross Deep** **Twickenham, London** **TW1 4QG**
Consulting Engineers:	**AKSWARD LIMITED** **10 Bonhill Street,** **London EC2A 4PE**
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1.0 INTRODUCTION

Consideration is being given to the repurposing of the existing site into schooling facilities. The partially vacant site with multiple structures, including Kneller Hall (a Grade II listed building), was the previous site of the 'Army School of Music'.

At this stage, it is understood that the redevelopment is to comprise:

- A new two-storey sports centre with swimming pool,
- A new three-storey teaching block,
- Single-storey extensions to the band practice hall and Kneller Hall
- Demolition and rebuilding of a single-storey sports pavilion and
- Rejuvenation and turfing of sports pitches.

In connection with the proposed works, Soil Consultants Ltd (SCL) were commissioned by AKSWard on behalf of the client, Radnor House School Ltd, to carry out a ground investigation to include the following elements:

- Review of Phase 1 Desk Study/Preliminary Risk Report prepared by Jomas Engineering Environmental (Ref:P4134J2485/AB Dated 9th Feb 2022) and UXO assessment report carried out by MACC International Limited (Ref: 5609-05, Issue Version 1.2, Dated: 07/01/2020)
- Intrusive investigation to identify the ground sequence and groundwater conditions
- Geotechnical and geo-environmental sampling and laboratory testing
- Provision of advice on foundations, and ground floor slabs
- Provision of a Stage 1 Tier 2 generic quantitative risk assessment and refined Conceptual Site Model (CSM)

This report includes a review of findings and conclusions of the Desk Study research and Preliminary Risk Assessment. It then describes the intrusive investigation undertaken, gives a summary of the ground conditions encountered and discusses various foundation options. The Stage 1 Tier 2 generic environmental appraisal is then provided, including a revised CSM.

2.0 SITE DESCRIPTION

The site is located in Twickenham which is within the London Borough of Richmond upon Thames. The Kneller Hall site was formerly the Royal Military School of Music, comprising approximately 20 structures of mixed use, including accommodation, teaching/school buildings, Kneller Hall, band practice spaces, an outside band stand and sports pitches, as shown on the appended Site Plans.

Located by National Grid Reference TQ 147 742, the site covers an area of approximately 9.55ha with the main access off the northern section of Kneller Road. Site dimensions are approximately 315m, north to south, and approximately 400m, east to west. Bounded on all sides by a predominantly residential area, The Duke of Cambridge pub is located opposite the entrance to the southwest. Some tennis courts are located to the northeast and Twickenham (Rugby) Stadium is located approximately 250m to the east (separated from the site by some residential properties and a primary school).

The northern boundary comprised a mainly wooded and grassed area, with garages, and various instrument rehearsal rooms. The central western portion of site contains multiple structures of various ages and variable states of repair. Three buildings contain basement plant rooms namely; the Band Practice Hall, Kneller Hall and an accommodation structure in the central western area of site. The plant room associated with the accommodation structure extended beyond the footprint into the courtyard area (Photos 4, 6, 15, 16, 17 &18).

The buildings were generally of between single and three storey height and traditional brick construction as shown on the appended photographs. These buildings are mainly concentrated in the western third of the overall site. The eastern area of site generally comprised an open grassed area formerly used as sports pitches.

Many mature and semi-mature trees are present mainly concentrated around the boundaries, especially in the northern area. This northern area included mature trees of largely deciduous species including, but not limited to cherry, horse chestnut, oak, beech, maple, and sycamore, up to approximately 25m tall, but mostly between 10m and 16m in height. The southwest corner of site comprised mainly maple and lime species between approximately 8m and 12m tall. The central and western part of the site contained trees interspersed between the buildings and most notably, a mature avenue of mixed beech, sycamore, and London plane trees of about 15m height, which leads to the bandstand at the rear of Kneller Hall. Trees of mixed species also lined the southern boundary comprising mixed species including oak, beech, sycamore and holly of between 10m and 16m in height.

Topographical drawings of site were provided by the engineers which are included in Appendix A (Ref: Warner Surveys, Drawing numbers LT/220/0504/P/001a to LT/220/0504/P/001f, Dated: 22/01/2021). Spot levels on the drawing indicate the highest point of the site lies in the southwestern corner with ground levels sloping away to the northeast and south. The northwest corner is at an elevation of +12.49mOD, the northeast corner at +11.16mOD, southeast corner at +10.03mOD. Kneller Hall located in the central southern area is at about the highest point of the site at an elevation of about +14.55mOD.

The current site features are shown on the Site Plan and Site Photographs which are included in Appendix A.

3.0 STAGE 1 TIER 1 PRELIMINARY RISK ASSESSMENT (DESK STUDY)

A Desk Study/Preliminary Risk Assessment report for Kneller Hall was undertaken by Jomas Associates Ltd (Ref: P4134J2485/AB, dated 09.02.2022). Their report is included as Appendix B and should be read in conjunction with this report.

3.1 Summary

Earliest available historical maps (1865) indicates that the site contained two Grade II listed buildings surrounded by seven smaller buildings one of which was a school. There was a reservoir running along the northern boundary. A small building shown towards the southeast of the site with the remainder of the area landscaped. By 1894 the reservoir had extended further along the northern boundary, and some small buildings towards the west have been removed by this time. By 1934 there are four additional buildings towards the west of the area and by 1960-1961 there are thirteen buildings shown in the central area towards the west side. Some reconfiguration of the buildings occurred during this time, with three above ground tanks noted and the reservoir along the northern boundary being infilled. There is an additional building alongside garage structures towards the north of the site shown on maps dated 1972 to 1973. There is also an electricity substation noted on site at this time. By 1973-1974 there are fifteen buildings across the western half of the site, as well as the small buildings towards the southeast and does not change up to current time.

The surrounding area has largely been agricultural followed by residential use, with occasional industrial features in the wider area. Industrial uses of note include a smithy, sewage works, gravel pits, horticultural nurseries, cement works and an electricity substation.

Published geology indicates the site to be underlain by superficial deposits, overlying the London Clay Formation. The superficial deposits comprise the Taplow Gravel Formation outcropping in the southeastern area of site and the Kempton Park Gravel outcropping across the eastern half. Head deposits are shown along the north and west boundaries above the superficial deposits. Worked ground and artificial deposits are reported along the northern extremity of the site.

Hydrogeology: The superficial deposits on site comprise a Principal and Secondary 'Undifferentiated' Aquifer, while the underlying London Clay classifies as Unproductive. The site is not within a Source Protection Zone (SPZ) and there are no licensed abstraction points on site or within 1km. Groundwater flooding risk on site fall into High to Low risk categories, highest being in the northwest corner of site.

Hydrology: The nearest surface water feature refers to a historical non-evaporative cooling located 712m northeast, with six records within 2km. Surface water flooding has a highest risk on site as 1 in 30year return period of depth between 0.3m and 1.0m.

3.2 Preliminary Risk Assessment and preliminary Conceptual Site Model

The Jomas Associates Ltd identified on-site potential contamination sources, which comprised an electricity substation and above-ground tanks along with potentially infilled land (reservoir/pond on site and pond 50m off-site). Their Risk Matrix estimation assesses the site as Moderate/Low Risk, associated with the potential presence of a wide range of potential contaminants, including metals, inorganic and organic chemicals, pH, Asbestos, and Polychlorinated biphenyls (PCBs).

Also mentioned within the CSM, the site was rated none to moderate on geological hazards. The highest of these was a moderate rating for high shrink swell clays, which was classified as no further action required.

4.0 EXPLORATORY WORK AND LABORATORY TESTING

The ground investigation was carried out in May 2020 and is described below.

4.1 Constraints of investigation

The investigation was carried out in general accordance with the specification produced by AKSWard (Ref: L221004, dated 07/03/22). This determined the scope of the investigation and the approximate locations and depths of the exploratory points. At this time a number of buildings were present with no access available and thus exploratory work was limited to external areas. Part of the site was being used as a filming set at the time of the investigation works which caused further limitations.

The Preliminary Risk Assessment by Jomas Associates identified specific risk items in relation to potential contamination sources/types. These risks required additional investigation/testing over the original scope in order to target the potential contamination sources identified (principally a tank and electricity substation).

A preliminary UXO assessment had been carried out by MACC International Limited (Ref: 5609-05, Issue Version 1.2, Dated: 07/01/2020) (presented in Appendix C) and this identified the site to be a mixed low and medium-risk area. A specialist EOD engineer from Brimstone Site Investigation Ltd was therefore employed for the intrusive phase of the investigation undertaken within the medium-risk areas identified.

No anomalies were encountered during the investigation works, but similar EOD attendance will be required within the medium-risk areas, during the construction phase. A letter of site attendance from Brimstone is presented in Appendix C.

4.2 Cable percussive boreholes

Four deep boreholes were carried out using cable percussive drilling techniques. Sampling and in-situ Standard Penetration Testing (SPT) was carried out at appropriate intervals throughout the boreholes and monitoring pipes installed to facilitate monitoring of water and ground gas levels. SPTs were undertaken in both cohesive and granular soils the hammer Energy Ratio (E_r) for the equipment used was 61%; the relevant test certificate is appended.

A summary of the boreholes is as follows:

Loc ID	Ground level	Coordinates	BH depth	Installation details
BH01	+13.3mOD	514646E 174285N	25.00m	Dual monitoring pipe installation 19mm Piezometer: 25.0m below ground level, with gas tap 50mm Standpipe. Response zone: 1.50m to 6.00m, with gas tap
BH02	+12.145mOD	514578E 174346N	15.00m	Dual monitoring pipe installation 19mm Piezometer: 15.0m below ground level, with gas tap 50mm Standpipe. Response zone: 1.00m to 3.00m, with gas tap
BH03	+13.132mOD	514570E 174255N	24.00m	Dual monitoring pipe installation 19mm Piezometer: 24.0m below ground level, with gas tap 50mm Standpipe. Response zone: 3.00m to 9.00m, with gas tap
BH04	+19.2mOD	514698E 174240N	15.00m	Dual monitoring pipe installation 19mm Piezometer: 15.00m below ground level, with gas tap 50mm Standpipe. Response zone: 1.00m to 5.00m, with gas tap

4.3 Dynamic sampler boreholes & dynamic probe testing

Ten dynamic sampler (windowless) boreholes (WS1 to WS10) were completed using a small tracked drilling rig under the supervision of an experienced geo-environmental engineer. Representative samples were taken for geotechnical and environmental testing and PID headspace testing was carried out. Monitoring pipes were installed in WS3, WS6 and WS10. Dynamic probe testing was undertaken from the base of boreholes WS4, WS8 and WS10 where drilling terminated prior to the target depth of 5.00m bgl.

Sampling and in-situ testing were carried out at regular. SPTs were undertaken generally at 1m intervals and the hammer Energy Ratio (E_r) for the equipment used was 88%; the relevant test certificate is appended.

A summary of these boreholes is provided below:

Loc ID	Ground level	Coordinates	BH depth	Installation details
WS1	+12.56mOD	514562E 174318N	5.45m	Poor Recovery from 4.00m Water Strike: 1.90m
WS2	+12.50mOD	514617E 174367N	1.26m	Refused on Reinforced concrete. Redrill 0.75m to south.
WS2A	+12.50mOD	514617E 174367N	5.45m	Poor Recovery from 4.00m Water Strike: 2.00m
WS3	+12.25mOD	514667E 174345N	5.45m	Monitoring Installation: Response zone 0.50m bgl to 3.00m bgl Poor Recovery from 4.00m Water Strike: 4.00m
WS4	+13.08mOD	514710E 174283N	1.50m	Dynamic Probe follow-on Water Strike identified during probing: Approximately 2.60m
WS5	+12.15mOD	514708E 174360N	5.45m	Poor Recovery from 2.00m Water Strike: 1.90m
WS6	+11.06mOD	514859E 174314N	5.45m	Monitoring Installation: Response zone 0.50m bgl to 2.00m bgl Poor Recovery from 4.00m Water Strike: 2.00m
WS7	+11.49mOD	514831E 174243N	5.45m	No recovery from 3.00m Water Strike: 2.00m
WS8	+10.40mOD	514917E 174197N	2.45m	Dynamic Probe follow-on
WS9	+12.25mOD	514795E 174180N	5.45m	No Recovery from 3.00m Water Strike: 2.40m
WS10	+10.58mOD	514876E 174105N	3.45m	Monitoring Installation: Response zone 1.00m bgl to 2.20m bgl Dynamic Probe follow-on Water Strike: 2.00m

4.4 Hand excavated trial pits

Seven trial pits (TP1 to TP7) were excavated by hand to expose the configuration of the foundations to some of the existing structures. The locations were generally determined by AKSWard although TP4 was moved, for safety reasons, due to the proximity to an adjacent high-powered electricity relay station (Photo 21).

Two additional shallow pits (HP1 and HP2) were excavated in order to obtain shallow samples for contamination testing. HP1 was located adjacent to an electricity substation and HP2 in an area identified in the desk study as having historic tanks.

4.5 Soakage testing

Two trial pits (SK1 and SK2) were excavated using a tracked mini excavator for the purposes of undertaking infiltration testing. Within time/budgetary constraints, two tests were achieved in SK1 at 2.00m depth and one test in SK2 1.50m depth following the general procedure of BRE DG365.

4.6 In-Situ CBR testing

Six in-situ California Bearing Ratio (CBR) tests (CBR1 to CBR6) were undertaken using standard plunger type apparatus.

4.7 Groundwater and gas monitoring

Groundwater/gas monitoring was carried out on three occasions following completion of the site works on 26th May, 30th May and 6th June 2022. Water samples were recovered from the three dynamic sampler borehole installations and four cable percussive borehole installations on 26th May and 30th May respectively. The results of the groundwater and gas monitoring are presented in Appendix A.

4.8 Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

- Index properties tests (Atterberg Limits)
- Natural Moisture Contents
- Particle size distribution tests
- Unconsolidated, undrained triaxial tests

4.9 Chemical and contamination testing

Selected soil samples were delivered to a specialist laboratory (DETS Ltd) and the following testing was carried out:

- General soil suite - 8no samples
- Asbestos quantification - 1no sample
- TPH-CWG/BTEX - 3no samples
- VOC/SVOC - 2no samples
- PCB - 1no sample
- Waste Acceptance Criteria (WAC) - 6no samples
- Topsoil Suite - 4no samples
- General water suite - 3no samples
- Soluble sulphate/sulphur/pH analyses - 16no samples

The engineering borehole and trial pit logs, in-situ testing and the laboratory testing results are included in Appendix A. The location of the exploratory holes are shown on the appended Site Plan and a summary table giving survey data is also provided.

5.0 GROUND CONDITIONS

Published BGS information (1:50,000 and 1:10,000 scale maps) indicates that the northwest corner of the site is underlain by Head Deposits which, are directly underlain by River Terrace Deposits, which outcrop across the remainder of the site. The younger Taplow Gravel Member outcrops across the western part with the older Kempton Park Gravel Member to the east. These River Terrace Deposits are underlain by the London Clay Formation which attains an appreciable thickness in this area.

The geological map shows an area of worked ground in an east to west strip across the northern margin of the site which coincides with former pond shown on the historical maps. Whilst this pond may have been for ornamental purposes, the wider area has been subject to gravel extraction and indeed, this may have occurred across this northern area.

From our exploratory work, the upper zone of the London Clay attained a characteristic texture of soliflucted material produced as a consequence of freeze thaw during the glacial periods and there is some evidence of geological re-working of the soils at the interface between the River Terrace Deposits and the underlying London Clay. Shallow Head Deposits across the northern part of the site were not readily identifiable and may have been largely removed through the construction of the pond. It has been reported by the structural engineers that a culvert exists through the site which may carry water along the line of the former pond. An obstruction was met in borehole WS2 which appeared to be concrete but it is not known if this is the curler or not.

The sequence encountered by our investigation is summarised as follows:

Stratum	Depth to base	Level at base	Thickness
Made ground	Varies between 0.10m and 3.50m	Varies between +10.48mOD and +8.64mOD	Up to 3.50m
Alluvium (Pond Deposits) (only in WS2A & WS3; possibly WS1)	Varies between 1.70m and 2.00m	Varies between +16.53mOD and +10.24mOD	Between 0.20m and 1.25m
River Terrace Deposits (absent in BH02, WS3 and WS9)	Varies between 2.05m and 7.40m	Approximately +9.01mOD and +5.73mOD	Between 1.15m and 4.90m
Soliflucted Material (not encountered in all locations)	Varies between 4.50m and 9.60m	Varies between +6.99mOD and +3.53mOD	Between 0.60m and 4.70m
London Clay (not encountered in some of the shallower boreholes)	Base not proven, extended to maximum borehole depth at 25.00m	Below -11.70mOD	Not proven

Detailed descriptions are presented on the exploratory hole records and the ground sequence is represented on the geological cross sections; this information is appended.

5.1 Made ground /Topsoil

Where present at the exploratory holes, Topsoil attained a nominal thickness between about 0.1m and 0.4m.

Made ground was encountered in all exploratory locations (with the exception of WS4, WS7 and WS10) and extended to depths of between 0.60m and 3.50m. However, the made ground on average extended to between about 1.0m and 2.0m and was generally deeper in the northern part of the site, where the pond existed. It is also evident that made up ground is generally thicker across the western part of the site (in built areas) which could indicate that this area has been upfilled at some stage.

The soils were of variable composition comprising a mix of cohesive and granular soils. The clay soils were generally composed of soft to firm (locally firm to stiff) gravelly clay, with the granular soils composed of clayey gravel. These soils contained variable proportions of man-made materials such as brick, concrete, ash/clinker, coal, metal and wood.

Standard Penetration Test (SPT) 'N' values of between 2 and 30 were measured (mean 'N' value = 14) indicating variable but generally very loose/soft to medium dense conditions.

5.2 Alluvium

Alluvium was present in the northern area which coincides with the former pond identified in this area from the desk study.

The deposit comprises of peat, peaty/organic clay which were identified in boreholes WS2A and WS3. In WS1, a layer of slightly organic sand was identified between 1.10m and 1.80m depth which, may either be part of the Taplow Gravel or deposits associated with the pond.

One SPT was undertaken within the alluvium in WS3 at 1.00m and this gave an N value of 4, indicating low strength material.

A moisture content test in this material gave a value of 37% and a plasticity index of 35%.

5.3 River Terrace Deposits

The River Terrace Deposits, comprise the Taplow Gravel Member overlying the Kempton Park Gravel Member; the division between which could not be readily established. These were encountered beneath the made ground and where the full depth was proven they extended to depths of between 2.05m and 7.40m. Generally, the deposits were thicker and coarser on the western half of site, and thinner and finer grained to the east. It is also noted that they were absent in boreholes BH02, WS3 and WS9.

These soils had a variable composition between gravelly sand, sandy gravel and sand & gravel. Locally, the soils were slightly clayey (generally in the upper zone) but also contained varying proportions of silt.

SPT 'N' values of between 4 and 66 were measured within the deposits giving a range between loose and very dense conditions. However, the majority of results lie within the medium dense to dense range.

5.4 Soliflucted/Geologically Reworked Material

Geologically re-worked deposits were identified in multiple locations and included suspected soliflucted London Clay deposits. These soliflucted soils were generally described as orange brown/dark grey gravel sized lithorelicts in a matrix of silty clay. They were generally encountered in locations in the north and east of site where the River Terrace Deposits were thinnest or absent, from between 0.90m and 3.90m depth extending to between 4.50m and 5.45m. It should be noted that whilst soliflucted deposits were not readily identifiable at the deep borehole locations these soils could be present across this area if there is a significant change in the thickness of the granular deposits.

In some boreholes, there is a horizon of gravelly clay, which we consider to be geologically re-worked London Clay which occurs at its interface with the River Terrace Deposits. This zone varied in thickness, generally less that 0.5m, but attained a greater thickness of about 2m in some areas. It is noted, that in Borehole BH03, that there is a repeated sequence of clay and gravel at this interface and this may represent an ancient rotational failure along a former river channel, or variation in depositional/erosional environment.

Apart from the compositional differences, these deposits generally had a firm consistency and lower strength characteristics compared to unaffected London Clay. Standard Penetration Test (SPT) 'N' values of between 7 and 27 were measured through these deposits indicating variable conditions. Measured cohesion values were predominantly between 40kN/m^2 and 50kN/m^2 indicating low to medium strength material.

Laboratory testing on these soils generally gave natural moisture contents of around 30% with plasticity index values of about 40%. This shows the clay is of high to very high on the BS classification and High volume change potential on the NHBC classification.

5.5 London Clay Formation

The London Clay was identified at depths ranging between 0.90m and 7.40m and extended to the full depth investigated. Dynamic probes were undertaken in three locations (WS4, WS8 and WS10) and are presented as DP4, DP8 and DP10 and these exhibited a decrease in blow count from approximately 20 blows per 75mm penetration to approximately 3 blows per 75mm penetration. This reduction in blow count, which occurred at depths of between 2.6m and 4.2mis interpreted to reflect a change in lithology from the River Terrace Deposits into the underling London Clay.

The upper weathered/oxidised zone of this deposit attained a brown colouration, with the less weathered zone being characterised by dark grey fissured clay containing distinct silty/slightly sandy zones and partings of fine sand/silt and black pyritic. Rare to occasional pyrite nodules were also present along with claystone nodules at random depths. Notably, the clay became silty and sandy below about 18m to 20m to its base at 25.00m.

Laboratory testing on these soils generally gave natural moisture contents of around 30% with plasticity index values of about 40%. This shows the clay is of high to very high on the BS classification and High volume change potential on the NHBC classification.

Triaxial testing and SPTs indicate the London Clay to be of a medium strength becoming high strength. A strength / depth graph is presented in Appendix A

5.6 Groundwater

A summary of groundwater observations is presented in the table below.

BH/WS	Inflows: Depth (m) Level (mOD)	Pipe diameter and depth	Monitoring results Depth (m) Level (mOD) 26 May 2022	30 May 2022	06 June 2022
BH01	4.00m(+9.30)	50mm at 6.00m depth 19mm at 25.00m depth	3.20 (+10.10) 3.13 (+10.17)	3.21 (+10.09) 3.07 (+10.23)	3.23 (+10.07) 3.32 (+9.98)
BH02	None observed	50mm at 3.00m depth 19mm at 15.00m depth	1.37 (+10.77) 1.91 (+10.23)	1.34 (+10.80) 14.14 (-2.00)	1.37 (+10.77) 12.24 (-0.10)
BH03	None observed	50mm at 9.00m depth 19mm at 24.00m depth	2.39 (+10.74) 2.37 (+10.76)	2.34 (+10.79) 2.39 (+10.74)	2.39 (+10.74) 2.34 (+10.79)
BH04	None observed	50mm at 5.00m depth 19mm at 15.00m depth	3.78 (+10.54) 3.86 (+10.46)	3.80 (+10.52) 2.64 (+11.68)	3.82 (+10.50) 3.66 (+10.66)
WS3	4.00 (+8.25)	50mm at 5.00m depth	1.26 (+10.99)	1.23 (+11.02)	1.10 (+11.15)
WS6	2.00(+9.06)	50mm at 2.00m depth	1.23 (+9.83)	1.25 (+9.81)	1.31 (+9.75)
WS10	2.00(+8.58)	50mm at 3.00m depth	Dry	Dry	Dry

Groundwater levels can of course vary seasonally and with prevailing weather conditions. We recommend that additional monitoring is undertaken prior to design and construction to ascertain water levels in relation to the development/construction works. It is noted that some of the deep 19mm piezometers are reading shallow groundwater levels. It is recommended that these wells are developed to determine if the water tables are hydraulically continuous.

5.7 Environmental observations

No obvious olfactory or visual signs of soil or groundwater contamination were encountered in the boreholes. PID headspace testing (for VOC concentrations) was undertaken on samples of made ground and natural soils during the borehole exercise and during subsequent monitoring - no elevated levels were noted.

6.0 GEOTECHNICAL ASSESSMENT

The proposed works at this site include the following elements:

- Demolition of various structures on site to make way for new structures.
- Demolition and re-construction of two extensions to Kneller Hall and a single storey extension to the Band Practice Hall.
- Construction of an L' shaped three storey teaching block with anticipated column loads of between 1000kN and 2000kN; either reinforced concrete frame or steel frame construction.
- Construction of a two-storey steel framed sports centre and swimming pool.
- Demolition and re-construction of a single storey sports pavilion.
- Rejuvenation of the existing sports pitches.

The investigation has revealed that a variable ground sequence is present which will dictate the founding options for each of the structures. Towards the north of the site, significant made/disturbed ground is present where a pond formerly crossed from east to west. The thickness of the River Terrace Deposits is variable and generally overlies the London Clay Formation. As discussed in Section 5.0, from an examination of the samples, it is evident that the upper horizons of the London Clay have been 'geologically reworked' with the appearance of soliflucted material and which characteristically have a lower strength profile. The site has been developed over a relatively long period and thus obstructions may be present in the ground not identified during this investigation and this aspect should not be overlooked.

We have considered each of the buildings with regards to the specific ground conditions, structure and structural loads.

6.1 Kneller Hall single storey extension (Building 1)

The single storey extension to Kneller Hall is proposed adjoining the eastern flank of the northern arm (west wing). From the information provided, we understand that the main building (excluding the northern arm) incorporates a single level basement across the footprint. Whilst structural loads are unavailable, we anticipate this structure would generate relatively low loads.

BH04, which is closest to Kneller Hall has revealed about 2.0m of made ground resting on River Terrace Deposits which attain a thickness of about 2.90m at this locality. Whilst the borehole is approximately 1.3m lower than the rear of Kneller Hall, on the basis of this borehole we consider that traditional spread foundations could be utilised to support the structure.

Foundations would need to be cast just within the undisturbed competent River Terrace Deposits and we envisage a depth of about 2.0m would be appropriate; deepening would of course be required to bypass any deeper made or disturbed ground. Where foundations are in close proximity to the basement structure, it would be necessary to deepen foundations to the level of the existing basement foundations in order to avoid surcharge loading the basement wall. Foundations can be stepped up as distance from the retaining wall increases. It would however be prudent to undertake further boreholes along the line of the extension to establish the depth to the top of the gravel and their thickness.

For preliminary assessment of the feasibility and sizing of foundations placed within the natural gravel, we envisage that an allowable bearing resistance of 200kN/m^2 would be appropriate; this would be applicable to moderate sized strip or pad foundations, say up to 2.0m width. As required by EC7, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design the bearing resistance should be determined, using undrained and/or drained analysis as appropriate, to calculate the degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice.

6.2 Band Practice Hall single storey extension (Building 3)

The existing structure is showing evidence of significant structural distress and from the structural and foundation arrangements, it is self evident that strengthening and underpinning works have been carried out in the past. The boreholes (BH01 and BH03) indicate that made up ground could be present in this area to between 2.2m and 2.5m depth and indeed, the foundations to this structure appear to be founded on relatively weak soils which have settled significantly under the current structural loading arrangement. Whilst we have not undertaken back analysis of the foundations and founding stratum, it is probable that all foundations to this structure would require significant underpinning to control further movement.

Whilst traditional spread foundations could be adopted for this extension (and underpinning) a piled alternative could also be a viable option. A further complication would be the presence of a basement/ plant room which exists below the western half of the building, the full extent of which is unknown.

From BH01 and BH03, it is anticipated the natural granular River Terrace Deposits will be encountered at a depth of between about 2.20m and 2.50m bgl and attain a thickness of between about 3.9m and 4.9m. If traditional spread foundations are to be adopted, it would be prudent to undertake further boreholes along the line of the extension and existing building to confirm the depth to the top of the gravel and its thickness.

Foundations would need to be cast just within the undisturbed competent River Terrace Deposits and we envisage a depth of between about 2.30m and 2.60m bgl would be appropriate; deepening would of course be required to bypass any deeper made or disturbed ground. Where foundations are in close proximity to the existing basement structure, it would be necessary to deepen foundations to the level of the basement foundations in order to avoid surcharge loading the basement wall. Foundations can be stepped up as distance from the basement retaining wall increases. It would however be prudent to undertake further boreholes along the line of the extension to establish the depth to the top of the gravel and their thickness.

For preliminary assessment of the feasibility and sizing of foundations placed within the natural gravel, we envisage that an allowable bearing resistance of 175kN/m^2 would be appropriate; this would be applicable to moderate sized strip or pad foundations, say up to 2.0m width. As required by EC7, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design the bearing resistance should be determined, using undrained and/or drained analysis as appropriate, to calculate the degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice.

6.3 Teaching Block (Building 4)

From the information provided, we envisage that column loads for this building will be in the order of about 1,500kN to 2,000kN for reinforced concrete frame construction. Alternatively, column loads between about 1,000kN and 1,500kN could be expected for a steel frame construction.

Boreholes BH03 and WS1 are within/close to the footprint of this structure and these indicate that made up ground to between 1.10m and 2.50m depth could be expected, resting on natural granular River Terrace Deposits, which are at least 4.35m thick at this locality. Thus, traditional spread foundations could be adopted for this structure or alternatively, a piled foundation could be considered and this is discussed below.

For preliminary assessment of the feasibility and sizing of foundations placed within the natural gravel, we envisage that an allowable bearing resistance of 150kN/m^2 would be appropriate; this would be applicable to moderate sized strip or pad foundations, say up to 3.5m width. As required by EC7, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design the bearing resistance should be determined, using undrained and/or drained analysis as appropriate, to calculate the degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice.

It noted that should be noted that between 7.4m and 9.6m, an interbedded sequence of cohesive and granular deposits has been identified. This may be an inherent characteristic of geologically re-worked material (possibly attributable to an ancient slip due to solifluction processes) or natural geological processes. For the design and performance of traditional spread foundations placed at shallower depth, we do not consider this phenomenon would adversely affect foundation performance.

6.4 Sports Centre and Swimming Pool (Building 5)

The location of this structure spans the area formerly occupied by a pond and the boreholes closest to this building (BH01 and WS3) indicate highly variable ground conditions. The shallow ground sequence comprises both cohesive and granular deposits which would have differing performance if traditional spread foundations were adopted, suggesting the structure would be at risk from excessive differential settlement.

We consider that piled foundations would be required for this building and this is discussed below in Section 6.6

6.5 Sports Pavilion (Building 6)

Demolition of the existing structure and construction of a new single storey sports pavilion is proposed at this location. The potential loads of the proposed structure were undetermined at the time of investigation, although we envisage low to moderate structural loads for this type building. The existing structure is located approximately 10m from mature trees of mixed species but include those considered as high water demand. Borehole WS9 indicates that clay soils are likely to be present at this locality and it may be possible to adopt spread foundation for this structure if the species of trees present are at a suitable distance to not adversely affect foundation performance and this should be checked.

Spread foundations will need to bypass any made and/or disturbed ground (through removal of the existing structure) and be placed within the cohesive soils of the London Clay Formation (some of which may be soliflucted). It is noted that at this location soils having the appearance of soliflucted material is present but, we consider that these soils would provide a suitable bearing stratum, albeit of lower strength characteristics.

We recommend that within the zones of influence of existing trees suitable precautions are taken with respect to root action and that foundations within influential distance of the trees are designed fully in accordance with NHBC Standards (Chapter 4.2, Building near trees'). Based upon our investigation, a **high** volume change potential classification should be adopted to determine the safe foundation depths, subject to a minimum founding depth of 1.00m. For any trees that are not to be removed (or are planted), mature tree heights should be assumed. For the current situation, foundations depths of up to 2.50m are envisaged in proximity to the trees.

For preliminary assessment of the feasibility and sizing of foundations placed within the soliflucted London Clay, we envisage that an allowable bearing resistance of 75kN/m^2 would be appropriate; this would be applicable to moderate sized strip, say up to 2.0m width. This design pressure would account for the variability in the competency of the deposits and serve to limit settlements. As required by EC7, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design the bearing resistance should be determined, using undrained and/or drained analysis as appropriate, to calculate the degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice.

Alternatively, consideration could be given to piled foundations such as CFA type or other proprietary piles such as helical screw piles or mini driven piles. Piles and ground beams would of course need to be designed to accommodate potential desiccation effects.

6.6 Foundation excavations and inspection

The foundation excavations will encounter variable non-engineered made ground and provision for temporary lateral support should be made. The presence of groundwater in excavations could cause disturbance of the soils and possibly instability especially if perched water is present. Casting foundations in short runs may be required or alternatively, the use of trench sheet cut-off walls may be necessary. This aspect may of course be affected by seasonal variations in water level/weather, and thus when the design foundation depths are known, it would be advisable for the groundworks contractor to undertake advance trial excavations to assess requirements in this regard and water levels are continued to be monitored.

All excavations will need to be carefully inspected by an experienced foundation engineer. Local deepening must be carried out if unsuitable soils, such as made ground, soft clay or root-infested/desiccated clays, are encountered. In deepened excavations (>1.50m) where desiccated or root-infested clay is encountered, a void former should be placed on the inside of any foundations which have an external elevation, to accommodate any potential swelling of desiccated clay soils.

Subject to any preservation orders on the trees, it may be possible or prudent to remove trees which are within influential distance to the new structures to avoid potential desiccation issues in the future, especially where trees have not achieved their mature height and potential desiccation depths are limited.

6.7 Piled Foundations (based upon the ground conditions for the sports centre)

For the ground conditions encountered, with variable ground conditions and groundwater being present both within the superficial soils and at greater depths within the London Clay, we consider that CFA piles will present the optimum type. The following table of coefficients may be used for the preliminary determination of the pile resistance.

Shaft adhesion

Stratum (Based on BH01)	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit shaft adhesion 'q_s'
Made Ground	Above say 2.2m depth (about +11.10mOD)	N/A	Ignore
River Terrace Deposits	2.20m to 6.10m 6.5? depth (about +11.10mOD to +7.20mOD)	N/A	20kN/m^2
London Clay)	6.10m depth (about +7.20mOD)	Increases from 55kN/m^2 at a rate of 5kN/m^2/m	Increases linearly from 27.5kN/m^2 at a rate of 2.5kN/m^2/m (incorporates α = 0.50)

Notes:

a) Unit shaft adhesion 'q_s' = α x c_u (where α = 0.50 and c_u is the undrained cohesion from the strength profile)
b) The α value of 0.5 is based upon 102mm diameter triaxial tests and this should not be varied
c) The average shaft adhesion over the pile length should be limited to 110kN/m^2
d) The maximum value for unit shaft adhesion should be limited to 140kN/m^2
e) Based upon ground level at +13.30mOD (BH01). Clearly levels vary across the site and this should be taken into account in the final design by the specialists

End bearing

Stratum	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit base resistance 'q_b'
London Clay	Below 18m depth (Below about -4.70mOD)	Increases linearly from 115kN/m^2 at a rate of 5kN/m^2/m	Increases linearly from 1035kN/m^2 at a rate of 47.43N/m^2/m (incorporates Nc = 9)

Notes:

a) Unit base resistance 'q_b' = Nc x c_u (where Nc = 9 and c_u is the undrained cohesion from the strength profile)
b) Levels are based on a ground level of +13.30mOD - this is approximate and should be confirmed
c) Based upon ground level at +13.30mOD (BH01). Clearly levels vary across the site and this should be taken into account in the final design by the specialists

For guidance purposes, indicative pile resistances for CFA/bored piles are as follows, calculated using the above preliminary parameters and partial factors where relevant:

Pile diameter (mm)	Pile toe level (mOD)	Pile toe depth (m)	Compressive Resistance (kN) Combination 1	Combination 2
450	-4.70	18.00	715	430
	-6.70	20.00	845	510
	-8.70	22.00	985	600
	-10.70	24.00	1145	700
600	-4.70	18.00	1000	600
	-6.70	20.00	1180	710
	-8.70	22.00	1375	830
	-10.70	24.00	1595	960
750	-4.70	18.00	1320	785
	-6.70	20.00	1550	925
	-8.70	22.00	1800	1075
	-10.70	24.00	2080	1245
900	-4.70	18.00	1660	980
	-6.70	20.00	1945	1150
	-8.70	22.00	2250	13351545
	-10.70	24.00	2600	

Notes:

a) Concrete stress should be considered in the final design

b) Pile toe depth is relative to existing ground level (approximately +13.30mOD)

c) Pile resistances are given as a guide and do not constitute design recommendations

The design engineer must ensure that the correct comparisons are made between the properly factored Design Actions and Design Resistances. The above pile resistances have incorporated the required partial factors for ULS design but do not incorporate explicit checks on serviceability.

6.8 Sports Pitches (Area 8)

We understand that some regrading work is required for rejuvenation of these sports pitches and each will be grassed surfaced. Earthworks testing and classification was outside the scope of this report.

The boreholes undertaken across this area (WS6, WS7, WS8, WS9 & WS10) indicate that variable ground conditions exist below the current grass surfacing. Turf, topsoil and made ground is present up to 0.90m depth below which is either natural granular deposits or cohesive soils.

Following removal of the topsoil any re-grading work can then be undertaken. We envisage that the site won materials can be re-used where necessary but any clearly any unsuitable or deleterious materials should removed. The prepared formation level should be proof rolled and any loose or soft zones excavated and replaced with suitably compacted fill material. Any significant upfilling should be laid and compacted in appropriate layers. Topsoil may then be re-used (discussed in Section 7.5) and dressed accordingly.

Based on the laboratory test results and our visual inspection of the shallow ground conditions, we do not consider the shallow soils would be frost susceptible.

6.9 Swimming Pool excavation and retaining wall

The excavation for the proposed swimming pool is expected to encounter a significant thickness of variable made ground underlain by superficial deposits. Pool details were unavailable at the time of compilation of this report and we consider that a maximum excavation depth of about 2.5m would be required. Relatively high groundwater is present and an embedded retaining wall is likely to be the preferred option to permit the pool excavation and construction; sheet piles or a secant bored pile wall will probably be the optimum type. For a limited retained height, it may be possible to design the wall to be self-supporting or alternatively a robust arrangement of temporary internal bracings/props, including support elements near the top of the wall, could be used to maintain wall stability and assist in controlling any ground movements during construction.

Careful selection of the appropriate design parameters will be needed, incorporating allowances for factors such as the presence of groundwater and the possibility of soil softening. The following table of coefficients may be used for the preliminary design of the basement retaining wall:

Stratum	Bulk density (Mg/m^3)	Effective cohesion, c' (kN/m^2)	Effective friction angle, ϕ' (degrees)
Made ground	1.80	0	22
River Terrace Deposits (Sand and Gravel)	2.00	0	34
London Clay:			
<5m below pool level	2.00	0	21
>5m below pool level	2.00	5	21

Eurocode 7 stipulates that partial material factors must be applied to the best estimates of geotechnical soil properties during the design stage. The design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors. The determination of appropriate earth pressure coefficients and the pattern of earth pressure distribution should be carried out by the geotechnical designer; these will depend upon the type/geometry of the wall and the overall design approach. The piled walls may of course also be used to provide vertical load capacity subject to the necessary allowance being made for interaction effects. We recommend that a specialist contractor is consulted to confirm the most appropriate type of wall and to provide the final wall design.

6.10 Pool slab performance and soil heave

The basement excavation will involve the removal of approximately 2.5m of soil, resulting in unloading of about 50kN/m^2. This stress reduction will theoretically result in an element of heave in the London Clay although the presence of the 'stiff' gravel layer will tend to reduce the magnitude of movement. However, it should be noted that at the northern end of this building, the gravel is absent and thus there is potential for differential heave to occur. Other factors such as the length of the construction programme, the restraining effects of any axially loaded piles and the basement slab stiffness will also determine the amount of heave which will occur.

The potential long term effect of this heave in the London Clay as it recovers should be considered during slab design. The slab could be designed as a fully suspended structure, supported on the main foundations, and incorporating an effective void beneath to accommodate future heave movement. We have carried out a preliminary analysis based on worst case scenario of clay being present at formation level and this indicates that a total unrestrained heave of approximately 20mm could occur as a result of the unloading. Approximately 50% of this heave movement is likely to occur during a typical construction programme, leaving a maximum possible post-construction heave of about 10mm to be accommodated.

Alternatively, the slab could be ground bearing and designed to withstand potential heave forces/ movements. If it is (reasonably) assumed that the relationship between heave movement and pressure is linear, the maximum heave pressure for an infinitely stiff slab could therefore be about 25kN/m^2 for the fully constrained condition. However, this will not occur in reality and the heave pressure beneath a more flexible slab will clearly be less (due stress dissipation as the slab deflects); we anticipate that an 'average' stiffness slab would experience heave pressures of the order of 15kN/m^2, with <10mm upward heave movement. It should be noted that this estimate does not take account of the restraining effect of any bearing piles supporting the main structure or the embedded retaining wall piles – these could be significant and will reduce the overall heave movements and pressures. However, it is useful in that it allows general conclusions to be drawn regarding likely maximum under-slab pressures. The final design should of course ensure integrity of the pool base.

It will be necessary to consider uplift of the slab due to potential hydrostatic pressures and in this respect the guidelines incorporated in BS8102:2009 should be followed. The slab design will need to take account of potential seasonal fluctuations and/or accidental and flood conditions. We consider that that a design water level at 1m depth below current ground level would be suitable for preliminary purposes and this would result in a hydrostatic uplift pressure of about 15kN/m^2 on the pool slab; this design water level may need to be agreed with the local building control.

The above estimates assumes hydrostatic conditions with total stress used throughout and thus they include the water pressure in any soil uplift pressures/stresses. In the long-term condition, if the soil is permitted to heave (the slab deflects or there is a void former beneath the slab) then the water pressure will still remain. It is therefore important to note that the water pressure is not additional to the heave pressure and should be taken as the minimum uplift pressure for design. In this instance it is apparent that the water pressures may be more critical than potential soil heave pressures and would then be the minimum uplift pressure on the slab.

6.11 Floor slab construction

In areas external to basements/swimming pool, we consider that suspended floor slabs should be adopted due to the present of significant thicknesses of non-engineered made ground and / or potential desiccation effects.

6.12 Pavement construction

A range of CBR values of between 3.3% and 5.6%, were measured on site at a depth of about 0.50m. The CBR value adopted for design would depend on the test result for each area but a lower bound value of 3% is considered appropriate for preliminary design purposes.

Once the formation level is achieved the area should be proof rolled and any soft/loose zones replaced with suitably compacted fill material. It may be prudent to use a flexible paving solution in areas likely to be affected by future ground movement as a result of desiccation and seasonal variations in moisture content through growth of vegetation both on site and in adjacent properties.

The soils at formation level are assessed as being frost-susceptible and general guidelines suggest that in this situation pavements should be designed with a minimum construction thickness of 450mm.

6.13 Soakaways

Trial pit soakage testing was undertaken in two locations (SK1 and SK2), which resulted in infiltration rates of 2.48x10^{-5}m/s and 7.71x10^{-6}m/s in SK1 and 2.97x10^{-6}m/s in SK2; the results of the testing are presented in Appendix A.

Where the River Terrace Deposits are present, these may offer the opportunity to adopt traditional soakaways. The depth of the soakaways would be dictated by the level of the natural groundwater table and thus, continued monitoring is recommended. As the Superficial Aquifer is classified as both a Principal and secondary 'Undifferentiated' Aquifer, the use/construction of soakaways may need to be approved by the Environment Agency.

From the exploratory work, the shallow ground conditions are variable and the upper zone of the River Terrace Deposits can be slightly clayey in nature. Whilst the infiltration rates are relatively low, traditional soakaways may be feasible provided adequate storage is provided. The use of long trench style soakaways may offer a more efficient soakage potential utilising more permeable zones within the deposits. Once the location of the soakaways are finalised, we recommend that further targeted testing is undertaken at these locations.

Alternatively, storm water could be channelled off-site via existing facilities.

6.14 Foundation concrete

Shallow Foundations

In the shallow deposits up to about 4.0m depth, low concentrations of water-soluble sulphates (2:1 water/soil extract) were measured in selected soil and groundwater samples, with near neutral to slightly alkaline pH values. The results fall into Site Design Class DS-1 of Table C2 given in BRE Special Digest 1 (2005). We assess the site as having 'mobile' groundwater and this would result in an ACEC Site Class of AC-1.

Consideration should also be given to the potential oxidation of pyritic soils. Following the procedure recommended in the BRE digest, the amount of oxidisable sulphides in these shallow soils is generally seen to be <0.3% in the majority of samples. However, some samples show slightly elevated oxidisable sulphides giving the characteristic value of Total Potential Sulphate of 1.01%, which equates to Class DS-3 with a resultant classification of ACEC AC-3.

Piled Foundations

Any piled foundations on site are likely to be founded in the London Clay, therefore those sulphate values have also been considered separately from the results of the shallow samples.

Low concentrations of water-soluble sulphates (2:1 water/soil extract) were measured in selected soil samples, with slightly alkaline pH reactivity. The results fall into Site Design Class DS-1 of Table C2 given in BRE Special Digest 1 (2005). We assess the deeper clay as having 'static' groundwater and this would result in an ACEC Site Class of AC-1s.

Consideration should also be given to the potential oxidation of pyritic soils. Following the procedure recommended in the BRE digest, the amount of oxidisable sulphides is seen to be >0.3% in all of the samples, suggesting that pyrite is probably present; this substantiates observations made during sample description. The characteristic value of Total Potential Sulphate is 1.97%, which equates to Class DS-4 with a resultant classification of ACEC AC-3s. If it is deemed unlikely that piles will be exposed to disturbed ground which might be vulnerable to oxidation, this more onerous classification may not be required; this must be determined by the pile designer who should provide the final classification; however, the results from the shallow samples should also be taken into consideration.

7.0 STAGE 1 TIER 2 ENVIRONMENTAL ASSESSMENT

This appraisal is generally based on the Environment Agency's 'Land contamination: risk management', 2020, adopting current UK practice which uses the Source-Pathway-Receptor methodology to assess contamination risks. For a site to be designated as contaminated a plausible linkage between any identified sources and receptors must be identified, ie whether significant pollution linkages (SPLs) are present. In considering the potential for contamination to cause a significant effect, the extent and nature of the potential source are assessed and pathways/receptors identified; without an SPL there is theoretically no risk to the receptors from contamination. The assessed risks to the various potential receptors are summarised in the report produced by Jomas Engineering Environmental (Dated 9th Feb 2022) in their Conceptual Site Model which is presented in Appendix B.

7.1 Environmental setting and context

The Site is underlain by Head deposits and River Terrace Deposits, which have a Superficial Aquifer Designation of 'Secondary Aquifer – Undifferentiated' and 'Principal Aquifer' respectively. The underlying London Clay has a Bedrock Aquifer Designation of 'Unproductive'. The site does not lie within a Source Protection Zone. Environment Agency records indicate four abstraction points within 2Km of the site, but none are closer than 1Km.

The site has been assessed as being of **Low to Moderate Environmental Sensitivity.**

7.2 Contamination sources and testing

The Preliminary Risk Assessment by Jomas, presented in Appendix B identifies significant potential sources of contamination and the associated risks. We undertook soil and groundwater analysis of eight soil and three water samples for a range of contaminants which were considered to reflect the potential historical/current site usages and the potential sources. Specifically, PID head-space testing and analysis for total and speciated petroleum hydrocarbons, VOCs, SVOCs and BTEX were included to reflect the presence of the infilled pond, the electricity substation and the former above ground tank(s).

The soil test results have been assessed where relevant against the DEFRA Soil Guideline Values (SGV) and Category 4 Screening Levels (C4SLs), together with the LQM/CIEH Suitable 4 Use Level (S4UL) for Human Health Risk Assessment in which Generic Assessment Criteria (GACs) have been derived from the CLEA Model (2nd Edition, 2009). Any groundwater test results have primarily been assessed against the Water Supply (Water Quality) Regulations 2016, Environmental Quality Standards (EQS) and the WHO Guidelines for Drinking Water Quality WHO/SDE/WSH/0.5.08/123. The contamination testing was carried out specifically for the purpose of providing a general guidance evaluation for the proposed development. Reference should be made to the foreword to the appended contamination test results in order to fully understand the context in which this discussion should be viewed.

The redevelopment will include hard cover, landscaping and grassed sports fields as part of the re-development. We have used, where relevant, the trigger levels for **Public Open Space (Residential)** to assess the results of the contamination testing.

Using the relevant trigger levels, all of the results fell below the threshold values. However, one sample (WS1 at 0.5m) revealed the presence of Chrysotile Asbestos fibres which, when assessed for concentration gave a value of 0.004% which is considered to be 'Very Low'.

The results of the testing suggest that there is no widespread contamination present at the exploratory hole positions. It should be noted that there may of course be pockets of undetected contamination between exploratory points and in areas of infilled ground.

Although obvious Asbestos-Containing Materials (ACM) such as corrugated sheeting etc were not observed on site nor generally identified in the samples examined, we note that buildings (especially those constructed before 2000) are a potential source of ACM. Furthermore, any made ground, construction or demolition materials on site may also contain ACM. Certainly, one sample revealed the presence of asbestos albeit in very low concentrations. These matters should be addressed in the Pe-construction H&S plan prior to any demolition or earthworks.

The asbestos quantification result of Chrysotile asbestos fibres measured at a concentration of 0.004% which is considered to be 'Very Low' with reference to the Control of Asbestos Regulations. Dependent on what is considered 'reasonably practicable, the guidance advises that a) assuming that any clearly visible asbestos containing products are absent, b) that a suitable/sufficient investigation has been completed and c) that assessment of the site has been carried out, asbestos below such concentrations would not strictly fall under the Control of Asbestos Regulations. Whilst this may suggest that, under these conditions, the implementation of a health and safety regime or dust suppression measures would not necessarily be required, we recommend that the main contractor provides the assessment of appropriate risk mitigation measures to be taken during construction.

7.3 Ground gas/vapour monitoring

The PRA identified a potential gas risk from the pond infill across the northern part of the site. Gas monitoring was undertaken on three occasions following completion of the boreholes. Monitoring in the majority of the installations measured small concentrations of carbon dioxide, between about 0.4% and 1.7%, generally with negligible flow rates/positive borehole pressures. Within BH01 and WS3, carbon dioxide was measured at maximum concentrations of between 3.1% and 4.0% respectively albeit with very low flow rates/positive borehole pressures. Concentrations of methane were detected at these locations were between 0.3% and 3.0%. Oxygen levels in the boreholes was also relatively low. We consider that these are almost certainly due to the decomposition of organic soils within the infill within this area and likely associated with the former pond. Concentrations of carbon monoxide and hydrogen sulphide in these boreholes were generally low.

We therefore consider that it would be advisable to incorporate gas protection measures into the structures across the northern and western part of the development (namely the Sports Centre and the Teaching Block). On the basis of the monitoring carried out to date, we consider that Characteristic Situation 2 should be adopted (as described in CIRIA C665 "Assessing risks posed by hazardous ground gases to buildings", 2007) and appropriate protection measures designed. Further monitoring should be carried out and we would recommend that at least three additional visits are made. The risk level should be revised if necessary according to the additional monitoring.

Protection measures against radon gas are not deemed necessary in accordance with the desk study information.

7.4 Disposal of excavated soils

A rigorous hazard assessment of the results was not within the scope of our investigation, but our preliminary conclusion from the contamination and WAC testing is that the made ground will probably classify as 'non-hazardous industrial waste' with an 'inert' classification for natural soils. The localised presence of asbestos may, however, result in a more onerous classification and early consultations should be made with appropriate waste facilities or regulators to confirm the off-site disposal requirements.

7.5 Re-use of topsoil

Topsoil classification testing was undertaken on four samples from the eastern part of the site where regrading for the sports pitches is to be undertaken. The results generally fall within the range of acidic to low fertility soils. These soils may be re-used for surface dressing of the pitches, however some conditioning/soil improvement may be required to provide a more balanced pH and improved nutrient content.

7.6 Unexploded ordnance risks

A preliminary UXO assessment had been carried out by MACC International Limited (Ref: 5609-05, Issue Version 1.2, Dated: 07/01/2020) and this identified the site to be a mixed low and medium-risk area. A specialist EOD engineer from was therefore employed for the intrusive phase of the investigation undertaken within the medium-risk areas identified.

No anomalies were encountered during the investigation works, but similar EOD attendance will be required within the medium-risk areas, during the construction phase.

7.7 Refined Conceptual Site Model

Taking into account the above discussion, the assessed risks to potential receptors identified in the PRA are summarised in the refined Conceptual Site Model (CSM) below. This includes recommendations for appropriate mitigation measures to render any SPLs inactive and reduce the risks to receptors to acceptable levels:

Source	Pathway	Receptor	Assessed risk, justification and measures to mitigate the risk to acceptable levels
On site: contaminated soil/water	Ingestion & direct contact	End user	**Low:** - No contamination was measured in the soil/groundwater samples above the relevant action level so there will be no active SPL - The near-surface soils were free from visual/olfactory evidence of volatile compounds/vapours; this was corroborated by analysis (TPH, VOC, SVOC). The SPL to human health will be inactive - A careful watching brief should be kept during construction and if obvious or suspected contamination is encountered this should be dealt with prescriptively; this would also apply to the identification of asbestos
	Ingestion, contact & inhalation	Construction workers and third parties	**Low:** - The SPL to human health created by the presence of ACMs (eg WS1 made ground) will be active during construction. The risks to these receptors will be managed through health & safety procedures and CDM regulations - No SPL to human health has been identified. Any residual risks to these receptors will be managed through health & safety procedures and CDM regulations
	Leaching from contaminated soils and migration in groundwater	Aquifer and surface water	**Low:** - Analysis of groundwater indicates no elevated contamination levels which suggest that leaching is currently minimal
	Direct contact with soil/water	Building fabric and infrastructure	- The effects of soluble sulphates and alkali/acidic ground are discussed in Section 6.12 of this report - Detailed assessment of soil/groundwater contamination with respect to water supply pipes is outside the scope of this report. The UKWIR publication 'Guidance for the selection of water supply pipes to be used in brownfield sites', 2010 states that if suitable barrier pipe is specified "there is no need to carry out soil sampling and analysis and this may be the most cost-effective solution". The validity of this approach will clearly be dependent upon the scale of the development and the quantity of pipe needed

Source	Pathway	Receptor	Assessed risk, justification and measures to mitigate the risk to acceptable levels
Off site: contaminated soil/water	Lateral migration of contaminants in groundwater	End-user and buildings	↓ No contamination measured in soils which may be associated with off-site sources ↓ No contamination measured in groundwater samples
On-site and off-site: ground gas & vapour	Lateral migration through strata, service runs and cracks in buildings	End-user and buildings	**Moderate:** ↓ Concentrations of carbon dioxide and methane were measured within the boreholes on site. Monitoring indicates that CIRIA C665 CS2 applies and appropriate gas protection measures must be incorporated. This will remove the pathway and therefore the SPL from gas risk will then be inactive ↓ Radon protection measures are not deemed necessary

In conclusion, based upon the information reviewed and the results of the investigation, our assessment is that with appropriate mitigation measures, it should be possible to reduce the risks to acceptable levels. The required mitigation measures identified above include vigilance on site to identify any potential contamination exposed during construction, control of asbestos and gas protection measures.

The investigation has provided general coverage of the site and it is self-evident that there may be zones of contamination within the site which were not encountered. A careful watching brief should be kept during construction to ensure that any potentially contaminated soil encountered is disposed of in a safe and controlled manner. Site workers should observe normal hygiene precautions when handling soils and if material suspected of being contaminated is identified during construction, this should be set aside under protective cover and further tests undertaken to verify the nature and levels of contamination present. If contamination is present, a full site re-assessment may be required and a contingency should be in place in this regard.

8.0 ADDITIONAL INVESTIGATION

The following additional works are recommended to aid design:

- Shallow borehole adjacent to the proposed Kneller Hall extension to determine local level of competent natural ground.
- Shallow borehole adjacent to the proposed Band Practice Hall extension to determine local level of competent natural ground.
- Further exploratory locations on boundary of proposed structure if shallow foundations are preferred for the proposed sports hall and swimming pool structure.
- Shallow borehole adjacent to northern portion of proposed new sports pavilion in order to assess the risk of desiccation and potential for differential settlement.
- Additional gas monitoring to fully assess the requirement for gas protection measures.
- There is a reported presence of a culvert which crosses the site in an unknown location and direction. In order to establish if this will coincide with any of the proposed works on site, it is recommended that the location of this culvert is established

GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition, Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata between the exploratory points, below the maximum depth of the investigation or where site conditions have changed since the exploratory work; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

Comments made relating to groundwater or ground-gas are based upon observations made during our investigation unless otherwise stated. Groundwater and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as (but not limited to) areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report (anything above a 'low' risk rating), reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk (for example near-surface chalk strata) it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report. No liability will be accepted for changes to the ground and groundwater conditions which occur post investigation.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

We will identify tree and plant species if possible, but a suitably qualified arboriculturalist/botanist should be consulted to provide definitive identification.

Where reference to 'topsoil' is made, this should be construed as any turf (if present) plus any obvious organic-rich/humic layer of soil beneath, which may or may not contain roots/rootlets. Unless otherwise requested, we do not provide a detailed description, undertake sampling/testing for classification purposes or provide a specific classification. The thickness of the 'topsoil' identified on our exploratory hole records is indicative only and should not be used for detailed volume or site strip calculations.

STANDARD TERMS OF APPOINTMENT OF SOIL CONSULTANTS LTD FOR GEOTECHNICAL SERVICES

1 Unless previously withdrawn, our offer remains valid for a period of sixty days from date of offer. If an instruction is given after the sixty days we reserve the right to reasonably adjust any cost associated with the project to reflect any variance on the original offer. In placing an instruction to proceed with exploratory work, whether directly from the Client or Client's representative, the Client is deemed to have accepted our Terms of Appointment.

2 Our offer is on the basis that free, unhindered access and working conditions are available and that the investigation can be completed in one visit, if applicable. Delays beyond our control will incur additional charges. If additional works outside our offer are required to facilitate the investigation these will be advised and any costs will be passed on to the Client.

3 In our quotation we will provide an estimate of any mobilisation period following an instruction to proceed. This estimate will be accurate at the time of quotation, but it should be noted that the mobilisation period may vary at a later date due to factors such as sub-contractor availability and workload.

4 In commissioning this work, the Client has a responsibility for the health, safety and welfare of operatives invited to undertake work on their site. The Client shall indemnify us in respect of any failure to fulfil their obligations in connection with all relevant and current Health and Safety Regulations.

5 The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access, space and budgetary limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique, or where a non-compliant technique has been specified, we will adopt practical and appropriate techniques to obtain indicative soil parameters.

6 Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in BS EN1997-2. Any interpretation which is provided is for guidance only and must not be regarded as design or design recommendation.

7 Where excavation is required as part of the exploratory work, the Client shall provide drawings or plans showing accurate and complete locations of all underground services and structures. In performing our service, we shall take reasonable precautions to avoid damage to underground services or structures. We will not be responsible for any damage caused to underground services or structures and will not be liable for any claims for damage, expenses arising or losses unless the location of all underground services or structures are accurately shown on drawings and those plans have been provided to us in good time prior to commencement of the exploratory work. Risk to the Client can be further reduced by undertaking a scan of the site using a specialist underground scanning service which would be intended to identify traceable services at shallow depth.

8 With some sites, especially those in certain areas of London and other large towns and cities, there may be a risk of unexploded ordnance (UXO) being present. Unless otherwise stated our offer is on the basis that the Client or their representative provides a preliminary UXO risk assessment for the site. It should be noted that if the site is deemed to be in an area of risk then further measures will be required. These would normally comprise either a more detailed risk assessment and/or specialist site attendance by an EOD engineer. These measures can be commissioned either by the Client or Soil Consultants Ltd. If the Client requires, we would be pleased to obtain a preliminary risk assessment at cost+10%.

9 The Client will supply a site plan (to a rational scale), an indication of the scope and type of the proposed development and an indication of any relevant structural loading information.

10 Should the Client terminate the contract after instruction, we reserve the right to recover costs associated to work carried out between the time of instruction and the point of termination. Cancellation fees, and material costs shall be charged at cost plus 20% (+VAT). Engineer/technician time shall be charged at £95+VAT per hour and principal consultant/director time shall be charged at £125+VAT per hour.

11 The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during the investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

12 If and when instructed, an agreed number of contamination tests will be carried out to give an outline assessment of potential contaminants. In some circumstances it may be necessary to recommend further monitoring, contamination testing and assessment and the scope of this work would be agreed with the Client. Notwithstanding this additional scope, local regulatory authorities may have specific requirements which need to be addressed. Unless otherwise agreed or stated our reporting will constitute neither a Quantitative Risk Assessment nor a Remediation Statement or Strategy.

13 Our reports are counter-checked by one of our suitably qualified and experienced engineers/geologists.

14 Notwithstanding anything to the contrary contained in these terms, our liability under or in connection with these terms whether in contract or in tort, in negligence, for breach of statutory duty or otherwise (other than in respect of personal injury or death) shall not exceed the sum equivalent to ten times our contract fee or £100,000 whichever is less in the aggregate for geotechnical and environmental matters unless otherwise agreed.

15 Without prejudice to any other exclusion or limitation of liability, damages, loss, expense or costs our liability for any claim or claims under this agreement be further limited to such sum as it would be just and equitable for us to pay having regard to the extent of our responsibility for the loss or damage giving rise to such claim or claims ("the loss and damage") and on the assumptions that:

(a) All other consultants, contractors, sub-contractors, project managers or advisers engaged in connection with the Project have provided contractual undertakings to the Client on terms no less onerous than those set out in the original contracts in respect of the carrying out of their obligations in connection with the Project; and

(b) There are no exclusions of or limitations of liability nor joint insurance or co-insurance provisions between the Client and any other party referred to in this clause and any such other party who is responsible to any extent for the loss and damage is contractually liable to the Client for the loss and damage; and

(c) All such other consultants, contractors, sub-contractors, project managers or advisers have paid to the Client such proportion of the loss or damage which it would be just and equitable for them to pay having regard to the extent of their responsibility for the loss and damage.

16 Further and notwithstanding anything to the contrary contained in this agreement and without prejudice to any provision in this agreement whereby liability is excluded or limited to a lesser amount, our liability under or in connection with this agreement whether in contract or in tort, in negligence, for breach of statutory duty or otherwise for any claim shall not exceed the amount, if any, recoverable by us by way of indemnity against the claim in question under professional indemnity insurance taken out by us and in force at the time that the claims or (if earlier) circumstances that may give rise to the claim is or are reported to the insurers in question. The limitation shall not apply if no such amount is recoverable due to us having been in breach of our obligations or the terms of any insurance maintained in accordance therewith or having failed to report any such claim or circumstances to the Insurers in question timeously.

17 Whilst our investigation may include asbestos screening/quantification on selected samples, this must not be deemed to constitute a full asbestos survey or be taken as sufficient to definitively identify the presence or quantity of asbestos within or on the ground. We will not accept responsibility if asbestos is encountered during any subsequent construction or development works and in placing a contract with us the Client accepts this condition. Where the fabric of a building is to be disturbed, the Client shall provide an appropriate asbestos survey to us prior to exploratory work and make adequate provision to allow the implementation of sufficient and appropriate protective/remedial measures for the work to progress safely.

18 Where our report refers to 'topsoil', this should be construed as any turf (if present) plus any obvious organic rich/humic layer of soil beneath, which may or may not contain roots/rootlets. Unless otherwise requested, we do not provide a detailed description, undertake sampling/testing for classification purposes or provide a specific classification. The thickness of the 'topsoil' identified on our exploratory hole records is indicative only and should not be used for detailed volume or site strip calculations; if this type of classification is required, this should be identified to us at an early stage and the method of sampling, testing and classification agreed.

19 The Client agrees that they shall not bring any claim personally against any director/employee of Soil Consultants Ltd or consultant to us in respect of loss or damage suffered by the Client arising out of this contract.

20 Our appointment shall be under simple agreement and our liability under this contract or in tort shall be for a period of six years from date of appointment.

21 Our reports are non-assignable and are prepared for the benefit of the Client. No reliance can be assumed by others without written agreement from Soil Consultants Ltd. We will provide a letter of reliance at our discretion and this will be subject to payment of our fee, which will be 10% of contract value, subject to a minimum fee of £1,250 plus VAT. The terms of our letter of reliance are non-negotiable and the beneficiary should be aware that the information shall only apply to the scheme for which the report was originally produced and the original rights and benefits will apply.

22 A VAT invoice (at current rate) will be presented in respect of the work undertaken. Payment of our account is to be made within twenty-eight days of issue of our invoice unless otherwise agreed. On no account shall payment be on a 'pay-when-paid' basis. The information contained within our report remains the property of Soil Consultants Ltd and no reliance may be assumed by any party with an interest in the project until payment has been received in full. After one calendar month interest shall be chargeable at 10% above the Bank of England Rate and compensation claimed in accordance with 'Late Payments of Commercial Debts (Interest) Act 1998 and subsequent revisions. If the debt is referred to a debt collection agency then we have the right to recover associated fees under the terms of our contract.

APPENDIX A

Fieldwork, in-situ testing and monitoring

- Foreword
- Borehole records
- Dynamic sampler borehole records
- Dynamic probe records
- Standard Penetration Test results
- SPT hammer calibration certificates
- Trial pit records
- Trial pit soakage test results
- In-situ California Bearing Ration test results
- Exploratory location GPS coordinates
- Groundwater and gas monitoring results

Laboratory testing

- Index property testing
- Plasticity chart
- Unconsolidated undrained triaxial test results (QUT)
- Particle size distribution tests

Ground profiles

- Plot of SPT 'N' value and undrained cohesion versus depth
- Cross section through boreholes

Contamination and chemical testing

- Foreword
- General soil suite
- WAC test results
- General water suite
- Sulphate/pH suite

Plans, drawings & photographs

- Site photographs
- Warner Surveys, Drawing numbers LT/220/0504/P/001a to LT/220/0504/P/001f
- Old Utility Survey Plan
- Proposed development plan
- Site Plan(s)
- Location Plan

APPENDIX B

- JOMAS Associates Ltd Report Text (Ref: P4134J2485/AB, Dated 09.02.2022)
- JOMAS Associates Ltd Report Appendices (Ref: P4134J2485, Dated January 2022)

APPENDIX C

- MACC International Limited Preliminary UXO Report (Ref: 5609-05, Dated: 07.10.2020)
- Brimstone UXO Letter of Attendance

FOREWORD FOR CABLE PERCUSSIVE DRILLING - GUIDANCE NOTES

GENERAL

The borehole records are compiled from the driller's description of the strata encountered, an examination of the samples by our geotechnical engineer and the results of in-situ and laboratory tests. Based on these data, the report presents an opinion on the configuration of strata within the site. However, such reasonable assumptions are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

BORING METHODS

The cable percussion technique of boring allows the ground conditions to be reasonably well established. However, some disturbance of the ground is inevitable, particularly some "softening" of the upper zone of clay immediately beneath a granular soil. The presence of thin layers of different soils within a stratum may not always be detected.

GROUND WATER

The depth at which ground water was struck is entered on the borehole records. However, this observation may not indicate the true water level at that time. Due to the speed of boring and the relatively small diameter of the borehole, natural ground water may be present at a depth higher than the water strike. Moreover, ground water levels are subject to variations caused by changes in the local drainage conditions and by seasonal effects. When a moderate inflow of water does take place, boring is suspended for at least 10 minutes to enable a more accurate short-term water level to be achieved. An estimate of the rate of inflow is also given. This is a relative term and serves only as a guide to the probable flow of water into an excavation.

Further observations of the water level made during the progress of the borehole are shown including end of shift and overnight readings and the depth at which water was sealed off by the borehole casing, if applicable.

Whilst drilling through granular soils, it is usually necessary to introduce water into the borehole to permit their extraction. When additional water has been used a remark is made on the borehole record and the implications are discussed in the text.

SAMPLES

Undisturbed samples of predominantly cohesive soils are obtained using a 100mm diameter open-drive sampler. In granular soils, disturbed bulk samples are taken and placed in polythene bags. Small jar samples are taken at frequent intervals in all soils for subsequent visual examination. Where ground water is encountered in sufficient quantity, a sample of the ground water is also taken.

IN-SITU STANDARD PENETRATION TESTS (SPT)

This test is performed in accordance with the procedure given in BS EN ISO 22476-3:2005. The individual blow count record for each test is given on a separate table. The 'N' value is normally the number of blows to achieve a penetration of 0.3m following a seating distance of 0.15m and is quoted at the mid-depth of the test zone. However if a change of stratum occurs within the test zone then a revised 'N' value can be calculated to assess one layer in particular. In hard strata full penetration may not be obtained. The presence of groundwater and particularly Where groundwater can affect the test and the measured values may not represent the true in-situ density of the soil.

FOREWORD FOR DYNAMIC SAMPLER BOREHOLES (WINDOWLESS) - GUIDANCE NOTES

GENERAL

The borehole records are compiled from the driller's description of the strata encountered, an examination of the samples by our geotechnical engineer and the results of in-situ and laboratory tests. Based on these data, the report presents an opinion on the configuration of strata within the site. However, such reasonable assumptions are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

BORING METHODS

The dynamic sampler technique uses 1m long tubes containing a rigid plastic liner. These are driven into the ground by a falling hammer, then withdrawn and the liner removed. The borehole commences using a large diameter tube (usually 100mm) with each succeeding tube reducing usually by 10mm in diameter to assist the extraction of the tube from the ground. Thus, it is theoretically possible to obtain a total continuous sample of the soil for examination or testing. Casing can be utilised as required. The technique allows the ground conditions to be reasonably well established although disturbance of the ground is inevitable, particularly some "softening" of the upper zone of clay immediately beneath a granular soil. The presence of thin layers of different soils within a stratum may not always be detected.

GROUND WATER

The depth at which ground water was struck is entered on the borehole records. However, this observation may not indicate the true water level at that time. Due to the speed of boring and the relatively small diameter of the borehole, natural ground water may be present at a depth higher than the water strike. Moreover, ground water levels are subject to variations caused by changes in the local drainage conditions and by seasonal effects. When a moderate inflow of water does take place, boring is suspended for at least 10 minutes to enable a more accurate short-term water level to be achieved. An estimate of the rate of inflow is also given. This is a relative term and serves only as a guide to the probable flow of water into an excavation.

Further observations of the water level made during the progress of the borehole are shown including end of shift and overnight readings and the depth at which water was sealed off by the borehole casing, if applicable.

SAMPLES

Small disturbed samples can be recovered from the lining tubes for subsequent laboratory testing, including moisture content, index property tests and contamination analyses.

IN-SITU TESTING

Standard Penetration Test (SPT): this test is performed in accordance with the procedure given in BS EN ISO 22476-3:2005. The individual blow count record for each test is given on a separate table. The 'N' value is normally the number of blows to achieve a penetration of 0.3m following a seating distance of 0.15m and is quoted at the mid-depth of the test zone. However if a change of stratum occurs within the test zone then a revised 'N' value can be calculated to assess one layer in particular. In hard strata full penetration may not be obtained. The presence of groundwater and particularly Where groundwater can affect the test and the measured values may not represent the true in-situ density of the soil.

Hand Shear Vane: provides the shear strength of cohesive soils, values reported in kPa

Pocket Penetrometer: provides an estimate of the unconfined compression strength, values reported in kg/cm^2

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH01**
Client:	**Radnor House School Ltd**	Coordinates: 514646E, 174285N	Sheet 1 of 3
Engineer:	**AKS Ward Ltd**	Ground Level: +13.30mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 12/05/2022 BH/casing dia: 200/150mm	B	0.10					Grass over dark brown slightly gravelly clayey silty sandy TOPSOIL with frequent rootlets. Gravel is fine to medium subrounded to angular flint, asphalt and brick.	
	B	0.30		0.30	13.00		MADE GROUND: Soft greyish brown slightly sandy silty sandy clay with rare rootlets. Gravel is fine to coarse subrounded flint, brick and rare clinker.	
	ES	0.80						
Hand excavated inspection pit to 1.20m	U	1.20						1
	B	1.60		1.60	11.70		MADE GROUND: Soft to firm orange, greyish brown, grey red and orangish brown mottled slightly gravelly silty clay. Gravel is fine to medium subrounded to rounded fine to medium flint and rare clinker.	
	D	2.00						
	SPT/S	2.00	N=18					2
Water added from 2.20m to assist drilling	D	2.20		2.20	11.10		Medium dense to dense greyish brown clayey, very sandy, slightly cobbly GRAVEL. Gravel is fine to coarse angular to subrounded flint.	
	PID	2.20	0.0					
	PID	2.50	0.0					
	B	3.00					*Below 3.00m: Gravel becomes rounded to subangular flint.*	
	D	3.00						3
	SPT/C	3.00	N>50*					
	PID	3.00	0.0					
	PID	3.50	0.0					
Groundwater strike at about 4.00m; No rise	B	4.00						
	D	4.00						4
	SPT/C	4.00	N=29					
	PID	4.00	0.0					
	B	5.00		5.00	8.30		Medium dense greenish grey slightly silty gravelly SAND. Gravel is fine to medium subangular to subrounded flint.	
	D	5.00						5
	SPT/C	5.00	N=25					
	PID	5.00	0.0					
	D	6.00						6
	D	6.10		6.10	7.20		Firm becoming stiff, orange brown, slightly sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine flint.	
	D	6.50		6.50	6.80		Firm to stiff dark grey, fissured, silty CLAY with rare infilled burrows.	
	U	6.50						
	B	7.00						7
200mm casing to 7.50m								
	D	8.00						8
	SPT/S	8.00	N=15					
							At 8.45m: Rare partings of fine sand.	
	D	9.00						9
	U	9.50						
	D	10.00		10.00	3.30			10
							Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

b) 50mm ID standpipe to 6.00m; 19mm piezometer to 25.00m

Borehole No: **BH01**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH01**
Client:	**Radnor House School Ltd**	Coordinates: 514646E, 174285N	Sheet 2 of 3
Engineer:	**AKS Ward Ltd**	Ground Level: +13.30mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
150mm casing to 10.30m							Stiff becoming very stiff dark grey, fissured, silty CLAY with rare infilled burrows.	
							At 10.00m: Rare partings of black pyritic sand.	
	D	11.00						11
	SPT/S	11.00	N=17				*At 11.0m: Claystone*	
	D	12.00					*Below 12.00m: Becomes slightly sandy.*	12
	U	12.50						
	D	13.00						13
	D	14.00						
	SPT/S	14.00	N=24				*At 14.00m: Rare pyrite nodules.*	14
	D	15.00						15
	U	15.50						
	D	16.00						16
	D	17.00						
	SPT/S	17.00	N=23				*At 17.00m: Claystone.*	17
	D	18.00					*Below 18.00m: Becoming locally slightly sandy.*	18
	U	18.50						
	D	19.00						19
	D	20.00		20.00	-6.70			20
							Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

b) 50mm ID standpipe to 6.00m; 19mm piezometer to 25.00m

Borehole No: **BH01**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH01**
Client:	**Radnor House School Ltd**	Coordinates: 514646E, 174285N	Sheet 3 of 3
Engineer:	**AKS Ward Ltd**	Ground Level: +13.30mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
	SPT/S	20.00	N=26				Stiff becoming very stiff dark grey, fissured, silty CLAY with infilled burrows.	
							At 20.00m: Rare partings of black pyrite sand.	
	D	21.00					*At 21.00m: Contains frequent infilled burrows.*	21
	U	21.50						
	D	22.00					*At 22.00m: Slightly sandy.*	22
	D	23.00						23
	SPT/S	23.00	N=32					
	D	24.00					*At 24.00m: Rare pyrite nodules.*	24
	U	24.50						
BH complete: 12/05/2022 BH depth: 25.00m Groundwater level: BH dry	D	25.00		25.00	-11.70		End of hole at 25.00m	25
								26
								27
								28
								29
								30

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

b) 50mm ID standpipe to 6.00m; 19mm piezometer to 25.00m

Borehole No: **BH01**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH02**
Client:	**Radnor House School Ltd**	Coordinates: 514579E, 174347N	Sheet 1 of 2
Engineer:	**AKS Ward Ltd**	Ground Level: +12.14mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 09/05/2022 BH/casing dia: 200mm/150mm	B	0.10					Grass over dark brown silty, clayey, slightly gravelly sand TOPSOIL with frequent rootlets. Gravel is angular to subrounded, fine to coarse flint, concrete, brick, tile, glass and rare mortar fragments.	
	B	0.50		0.50	11.64		MADE GROUND: dark red brown silty, clayey, slightly gravelly, fine to coarse sand with occasional rootlets. Gravel is angular to subrounded, fine to coarse flint, brick, rare tile and glass fragments.	
	ES	0.80						
	D	1.10		1.10	11.04		MADE GROUND: Soft dark orange brown silty, very gravelly, very sandy clay. Gravel of angular, fine to coarse flint, brick and rare clinker and pyrite nodules.	
Hand excavated inspection pit to 1.20m	PID	1.10	0.0					
	B	1.20						
	SPT/C	1.20	N=11					
	ES	1.60						
	D	1.90						
	PID	1.90	0.0	2.00	10.14		MADE GROUND: Firm to stiff dark grey silty, slightly gravelly, slightly sandy clay with rare pyrite nodules. Gravel is subangular to rounded, fine and medium flint and brick fragments.	
	B	2.00						
	U	2.00						
200mm casing to 2.80m								
	D	3.00						
	U	3.00						
	B	3.50		3.50	8.64		Soft becoming firm then stiff dark brownish grey fissured, silty CLAY with rare infilled burrows.	
	D	3.50						
	PID	3.50	0.7					
	D	4.00						
	SPT/S	4.00	N=6					
	PID	4.00	0.0					
	D	5.00					*Below 5.00m: Becomes stiff slightly sandy clay with occasional partings of black pyritic sand.*	
	U	5.00						
	D	6.00						
	B	6.50					*Between 6.50m and 7.00m: Claystone.*	
	SPT/S	6.50	N>50*					
	D	7.00					*Between 7.00m and 8.00m: Contains frequent partings of black pyritic sand and a coarse pyrite nodule.*	
	D	8.00						
	U	8.00						
	D	9.00						
	SPT/S	9.50	N=20				*Between 9.50m and 9.95m: Contains partings of black pyritic sand and rare coarse shell fragment.*	
	D	10.00		10.00	2.14		Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

b) 50mm ID standpipe to 6.00m; 19mm piezometer to 25.00m

Borehole No: **BH02**

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH02**
Client:	**Radnor House School Ltd**	Coordinates: 514579E, 174347N	Sheet 2 of 2
Engineer:	**AKS Ward Ltd**	Ground Level: +12.14mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
							Stiff dark brownish grey, fissured, silty CLAY.	
	D	11.00						
	U	11.00						
	D	11.50						
	D	12.00					*At 12.00m: Contains partings of black pyritic sand.*	
	SPT/S	12.50	N=22					
	D	13.00						
	D	14.00					*At 14.00m: Claystone.*	
	U	14.00						
	D	14.50					*At 14.50m: Vein of pyrite. (1-2mm thick)*	
BH complete: 09/05/2022 BH depth: 15.00m Groundwater level: BH dry	D	15.00		15.00	-2.86		End of hole at 15.00m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

b) 50mm ID standpipe to 6.00m; 19mm piezometer to 25.00m

Borehole No: **BH02**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH03**
Client:	**Radnor House School Ltd**	Coordinates: 514571E, 174255N	Sheet 1 of 3
Engineer:	**AKS Ward Ltd**	Ground Level: +13.13mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 10/05/2022 BH/casing dia: 200/150mm	B	0.10					Grass over dark brown slightly gravelly sandy TOPSOIL with frequent roots. Gravel is fine to medium angular to subrounded flint, brick, concrete and rare asphalt.	
	B	0.65		0.65	12.48		MADE GROUND: Firm slightly gravelly silty very sandy clay with frequent roots. Gravel is fine to coarse angular to subrounded flint, brick, clinker and charcoal.	
Hand excavated inspection pit to 1.20m	B SPT/C ES	1.20 1.20 1.40	N=10	1.20	11.93		MADE GROUND: Soft light grey, orange, brown and red mottled slightly gravelly silty very sandy clay with occasional roots. Gravel is fine to coarse subangular to subrounded fine to coarse flint and occasional brick and clinker.	
	U PID D	2.00 2.00 2.20	0.0				*At 2.20m: Mixed orange sand and soft grey clay.*	
	D	2.50		2.50	10.63		Medium dense orange grey, cobbly SAND and GRAVEL. Gravel is subangular to rounded, fine to coarse flint.	
	B SPT/C PID	3.00 3.00 3.00	N=17 0.0					
Water added at 4.00m to assist drilling	B D SPT/C PID	4.00 4.00 4.00 4.00	N=17 4.9					
	B D SPT/C	5.00 5.00 5.00	N=19					
	B D SPT/C	6.00 6.00 6.00	N=19					
	D	7.00						
	D	7.40		7.40	5.73		Firm orange brown slightly sandy silty CLAY.	
	D U	7.90 8.00		7.90	5.23		Firm dark grey, silty CLAY.	
	D	8.70		8.70	4.43		Orange brown gravelly to very gravelly fine to coarse SAND. Gravel is subangular and subrounded, fine to coarse flint.	
	D	9.60		9.60	3.53		Stiff dark grey, fissured, silty CLAY with rare infilled burrows and rare partings of black pyritic sand.	
	B	10.00		10.00	3.13		Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

b) 50mm ID standpipe to 6.00m; 19mm piezometer to 24.00m

Borehole No: **BH03**

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH03**
Client:	**Radnor House School Ltd**	Coordinates: 514571E, 174255N	Sheet 2 of 3
Engineer:	**AKS Ward Ltd**	Ground Level: +13.13mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
	D	10.00					Stiff to very stiff dark grey, fissured, silty CLAY with rare infilled burrows.	
200mm casing to 10.50m								
	D	11.00						11
	SPT/S	11.00	N=20					
150mm casing to 11.70m								
	D	12.00						12
	U	12.50						
	D	13.00					*At 13.00m: Pyrite nodule.*	13
	B	14.00					*At 14.00m: Claystone.*	14
	D	14.00						
	SPT/S	14.00	N>50*					
	D	15.00						15
	U	15.50						
	D	16.00						16
	D	17.00					*At 17.00m: Pyrite nodule.*	17
	SPT/S	17.00	N=22					
	D	18.00						18
	U	18.50						
	D	19.00						19
	D	20.00		20.00	-6.87			20

Continued on next sheet

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd
b) 50mm ID standpipe to 6.00m; 19mm piezometer to 24.00m

Borehole No: **BH03**

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH03**
Client:	**Radnor House School Ltd**	Coordinates: 514571E, 174255N	Sheet 3 of 3
Engineer:	**AKS Ward Ltd**	Ground Level: +13.13mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
	SPT/S	20.00	N=24				Stiff dark grey, fissured, silty CLAY with rare and infilled burrows. Locally slightly sandy.	
	D	21.00					*At 21.00m: Pyrite nodule.*	
	U	21.50						
	D	22.00					*At 22.00m: With occasional partings of black pyritic sand.*	
	D	23.00						
	SPT/S	23.00	N=24					
Chiselling on claystone for 30min at 24.0m; BH terminated								
BH completed: 10/05/2022 BH depth: 24.00m Groundwater depth: BH dry	D	24.00		24.00	-10.87		End of hole at 24.00m	

21 22 23 24 25 26 27 28 29 30

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd
b) 50mm ID standpipe to 6.00m; 19mm piezometer to 24.00m

Borehole No: **BH03**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH04**
Client:	**Radnor House School Ltd**	Coordinates: 514698E, 174241N	Sheet 1 of 2
Engineer:	**AKS Ward Ltd**	Ground Level: +14.32mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 11/05/2022 BH/casing dia: 200/150mm	B	0.10					Grass over dark brown silty, clayey, slightly gravelly sandy TOPSOIL with occasional rootlets. Gravel is angular to subrounded, fine and medium flint, brick, coal, mortar and rare clinker.	
	B	0.70		0.70	13.62		MADE GROUND: Very soft orange brown silty, gravelly to very gravelly, very sandy clay with rare rootlets. Gravel is subangular to rounded, fine to coarse flint and brick.	
	ES	1.00						1
Hand excavated inspection pit to 1.20m	B	1.20		1.20	13.12		MADE GROUND: Medium dense orange brown silty, clayey, gravelly to very gravelly, slightly cobbly, fine to coarse sand. Gravel is subangular to rounded, fine to coarse flint with rare brick fragments.	
	SPT/C	1.20	N=17					
	B	2.00		2.00	12.32		Dense orange brown slightly silty gravelly to very gravelly, cobbley fine to coarse SAND. Gravel is subangular to rounded, fine and medium flint.	2
	D	2.00						
	SPT/C	2.00	N=47					
	PID	2.00	0.0					
	B	3.00						3
	D	3.00						
	SPT/C	3.00	N=42					
	PID	3.00	0.0				*Between 3.50m and 4.50m Slightly sandy, subrounded and rounded, flint gravel.*	
	B	4.00						4
	D	4.00						
	SPT/C	4.00	N>50*					
	PID	4.00	0.0					
	D	4.90		4.90	9.42			
200mm casing to 5.00m	PID	4.90	0.0				Soft orange brown silty, slightly sandy CLAY.	5
	SPT/C	5.00	N=14					
	B	5.20		5.20	9.12		Firm becoming stiff dark brownish grey, fissured silty CLAY with rare infilled burrows.	
	D	5.20						
								6
	U	6.50						
	D	7.00					*Below 7.00m: Becoming sandy.*	7
End of shift: 11/05/2022 BH depth: 8.00m Casing depth: 5.00m Groundwater depth: BH dry Start of shift: 12/05/2022 Groundwater depth: BH dry	D	8.00						8
	SPT/S	8.00	N=16					
	B	8.90					*Between 8.90m and 9.60m Claystone.*	9
	U	9.50						
				10.00	4.32		Continued on next sheet	10

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

b) 50mm ID standpipe to 6.00m; 19mm piezometer to 25.00m

Borehole No: **BH04**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**BH04**
Client:	**Radnor House School Ltd**	Coordinates: 514698E, 174241N	Sheet 2 of 2
Engineer:	**AKS Ward Ltd**	Ground Level: +14.32mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
							Stiff dark brownish grey, fissured silty CLAY with rare infilled burrows.	
	D	11.00						
	D	11.50						
	SPT/S	11.50	N=21					
	D	12.00						
	U	12.50						
	D	13.00					*At 13.00m Claystone.*	
	D	14.00						
	SPT/S	14.00	N=26					
BH completed: 12/05/2022 BH depth: 15.00m Groundwater depth: BH dry	D	15.00		15.00	-0.68		End of hole at 15.00m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks:
a) Ground level and coordinates surveyed by Point Zero Surveys Ltd
b) 50mm ID standpipe to 6.00m; 19mm piezometer to 25.00m

Borehole No: **BH04**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS1**
Client:	**Radnor House School Ltd**	Coordinates: 514562E, 174318N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +12.56mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 11/05/22				0.10	12.46		ASPHALT	
	D	0.20					MADE GROUND: Dark brown clayey, slightly gravelly fine to coarse sand. Gravel is angular to subrounded, fine and medium brick, concrete, flint and asphalt.	
	PID	0.20	0.2	0.27	12.29			
	D	0.40					MADE GROUND: Friable, blackish brown silty slightly gravelly, sandy clay with frequent rootlets and root fragments and slight organic/ hydrocarbon odour.	
	E	0.50						
	PID	0.50	1.2					
	D	0.70		0.65	11.91		MADE GROUND: Firm friable, grey and red brown mottled silty slightly gravelly to gravelly, very sandy clay with occasional rootlets. Gravel is subangular and subrounded, fine to medium flint.	
Inspection pit to: 0.80m	PID	0.70	0.2					
BH diameter reducing with depth								
	D	1.00						1
	SPT/C	1.00	N=8	1.10	11.46			
	PID	1.00	0.2				Loose, greenish grey, orange red mottled clayey silty, slightly gravelly, possibly slightly organic fine to coarse SAND. Gravel is angular and subangular, fine flint.	
	D	1.30						
	PID	1.30	0.1					
							At 1.60m: Contains pockets of decaying roots and peat.	
	D	1.70						
	PID	1.70	0.1	1.80	10.76			
Water strike: 1.90m							Medium dense orange silty, slightly gravelly fine and medium SAND. Gravel is subrounded to rounded fine to medium flint. Locally slightly clayey.	
	D	2.00						2
	SPT/S	2.00	N=15				*Between 2.00m and 2.40m: Contains pockets of orange brown very sandy clay.*	
	D	2.01						
	D	2.30						
	PID	2.30	0.0					
	D	2.80						
	SPT/C	3.00	N=16					3
	D	3.30						
	D	3.80						
	PID	3.80	0.1					
BH Collapse to 2.50m	SPT/C	4.00	N=25					4
4.00m to 5.00m approximately 70% recovery.								
	D	4.50						
	SPT/C	5.00	N=25					5
BH complete: 11/05/22 BH depth: 5.45m Water depth: 1.90m				5.45	7.11		End of hole at 5.45m	6

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS1**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS2**
Client:	**Radnor House School Ltd**	Coordinates: 514617E, 174368N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +18.23mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 10/05/22	D	0.20					MADE GROUND: Grass over firm brown, locally mottled silty, slightly sandy, slightly gravelly, clay with occasional rootlets. Gravel is angular to subrounded, fine and medium mixed flint, brick and rare clinker.	
BH diameter reducing with depth	D	0.50		0.60	17.63		MADE GROUND: Firm mottled orange brown, red brown and grey, silty, slightly sandy, slightly gravelly, clay with occasional to rare rootlets and roots. Gravel is angular to subrounded, fine to coarse, flint, brick and concrete fragments.	
	E	0.80						
BH Complete: 10/05/22	D	1.00						
BH Depth: 1.26m	SPT/C	1.00	N=30					
Water depth: Dry	PID	1.00	0.1					
Refusal on concrete at 1.26m.				1.26	16.97		CONCRETE	
Redrill 0.75m to south.				1.26	16.97		End of hole at 1.26m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS2**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS2A**
Client:	**Radnor House School Ltd**	Coordinates: 514617E, 174368N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +18.23mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 10/05/22				0.10	18.13		Grass over dark brown sandy, silty, clayey TOPSOIL with frequent rootlets.	
	D	0.30					MADE GROUND: Firm orange brown, silty, slightly sandy, slightly gravelly, clay, with occasional rootlets. Gravel is subangular to rounded flint with brick fragments.	
	PP	0.30	2.9					
	PID	0.30	0.3					
	D	0.50						
	PP	0.50	2.7					
	PID	0.50	0.0					
	D	0.70						
	PP	0.70	6.5					
	PID	0.70	0.4					
	D	0.90						
	PP	0.90	5.3					
	PID	0.90	0.0					
Inspection pit to: 1.20m	SPT/C	1.00	N=20					
BH diameter reducing with depth	PP	1.30	3.5					
	PID	1.30	0.4					
	D	1.40						
				1.50	16.73		Soft dark brown to black, very silty, sandy, gravelly PEAT with frequent fibrous plant remains.	
	E	1.60						
	PID	1.60	0.1					
				1.70	16.53		Medium dense orange grey slightly silty very sandy GRAVEL. Gravel is subangular and subrounded, fine to coarse, flint. Locally gravelly sand.	
Water strike: 2.00m	D	2.00						
	SPT/C	2.00	N=28					
							Between 2.20m and 3.00m: Locally very clayey.	
	D	2.30						
	D	2.70						
	PID	2.70	0.1					
	SPT/C	3.00	N=12					
	PID	3.40	0.1					
	D	3.50						
				3.90	14.33		Firm orange brown becoming grey laminated, silty, slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint.	
4.00m to 5.00m approximately 30% recovery.	D	4.00						
	SPT/S	4.00	N=7					
	PID	4.00	0.1					
	D	4.50						
	PID	4.50	0.1					
	D	5.00						
	SPT/S	5.00	N=12					
BH complete: 10/05/22 BH Depth: 5.45m Water depth: 2.00m				5.45	12.78		End of hole at 5.45m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS2A**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS3**
Client:	**Radnor House School Ltd**	Coordinates: 514667E, 174345N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +12.24mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 10/05/22				0.03	12.22		ASHPHALT	
				0.18	12.06		CONCRETE	
							MADE GROUND: orange, grey, red brick, with frequent coarse gravel sized fragments of brick, concrete and asphalt.	
				0.40	11.84		MADE GROUND: Soft to firm, dark green grey and black silty, sandy, gravelly, organic clay. Gravel is angular, fine to coarse brick fragments.	
BH diameter reducing with depth	D	0.50						
	PID	0.50	0.1	0.60	11.64			
	E	0.70						
	D	0.80		0.75	11.50		MADE GROUND: Black silty, gravelly, slightly organic, fine to coarse sand. Gravel is subrounded, fine and medium flint, coarse, clinker, coal, glass and metal fragments.	
	HV	0.80	32					
	D	1.00					POSSIBLE MADE GROUND: Soft dark grey green, silty sandy organic clay, with occasional roots and fine fragments of brick.	
	SPT/S	1.00	N=4					
	D	1.10						
	HV	1.10	34					
	E	1.50						
	HV	1.50	32				*Between 1.60m and 1.80m: Black pseudo-fibrous, silty peat.*	
	D	1.70						
	PID	1.80	0.1					
	D	2.00		2.00	10.24		Soft to firm, mottled orange brown and blue grey silty CLAY with occasional to frequent decaying rootlets. Composed of gravel sized lithorelicts in a silty clay matrix.	
	SPT/S	2.00	N=8					
	D	2.10						
	HV	2.10	59					
	D	2.30						
	HV	2.30	55					
				2.50	9.74		Firm dark grey silty CLAY with occasional decaying rootlets and occasional lithorelicts.	
	D	2.60						
	HV	2.60	50					
50mm ID monitoring pipe installed to 3.00m	HV	2.90	42					
3.00m to 4.00m approximately 60% recovery.	D	3.00						
	SPT/S	3.00	N=8					
	PID	3.00	0.1					
	D	3.30						
	HV	3.50	50					
	D	3.60					*At 3.60m: Claystone.*	
Water strike: 4.00m								
No Recovery: 4.00m to 5.00m.	D	4.00						
	SPT/S	4.00	N=8					
	PID	4.00	0.0					
	D	5.00						
	SPT/S	5.00	N=9					
	PID	5.00	0.0					
BH complete: 10/05/22 BH depth: 5.45m Water depth: 4.00m				5.45	6.80		End of hole at 5.45m	

Backfill / Installation: 1, 2, 3, 4, 5, 6

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd b) 50mm ID standpipe to 2.50m

Borehole No: **WS3**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS4**
Client:	**Radnor House School Ltd**	Coordinates: 514710E, 174283N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +13.08mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 12/05/22	D	0.10					Grass over light greyish brown TOPSOIL with frequent roots.	
	PID	0.10	0.1	0.20	12.88		Dense brown becoming light orange brown slightly clayey slightly gravelly, very silty SAND. Gravel is subrounded, medium to coarse flint. Frequent roots up to 8mm diameter to 0.80m.	
	D	0.50						
	PID	0.50	0.1					
	D	0.90						
	PID	0.90	0.1					
	SPT/C	1.00	N=43					
Inspection Pit to: 1.20m BH diameter reducing with depth				1.30	11.78		Light orange brown and dark brown mottled sandy GRAVEL. Gravel is subangular to rounded, fine and medium flint. Occasional black manganese staining.	
	D	1.40						
BH Complete: 12/05/22 BH Depth: 1.50m Water Depth: Dry BH Refused on SPT at 1.50m. Dynamic probe follow-on. Water encountered at 2.60m.	SPT/C	1.50	N=66	1.50	11.58		End of hole at 1.50m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS4**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**		Borehole No: **WS5**
Client:	**Radnor House School Ltd**	Coordinates: 514709E, 174360N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +12.15mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 10/05/22							Grass over friable grey brown, silty sandy, gravelly clayey TOPSOIL,. Gravel of angular to subrounded, fine to coarse flint with fragments of brick and concrete.	
	D	0.30						
	PID	0.30	0.1	0.40	11.75		MADE GROUND: Soft, black brown, gravelly sandy silty clay. Gravel is angular to subrounded fine to coarse, flint with fragments of brick and clinker. Occasional roots.	
Inspection pit to 0.70m BH diameter reducing with depth	D	0.70						
	SPT/C	1.00	N=2	1.00	11.15		MADE GROUND: Firm orange brown, silty clay.	1
				1.10	11.05		MADE GROUND: Black fine to coarse, silty, slightly gravelly fine to coarse sand. Possibly bituminous.	
	E	1.30						
	D	1.40						
	PID	1.40	0.1	1.50	10.65		MADE GROUND: dark grey brown, gravelly, silty, very sandy clay. Gravel is angular to subrounded flint with fragments of brick. Locally with a black sheen.	
	D	1.60						
				1.70	10.45		Loose grey, clayey silty sandy GRAVEL. Gravel is fine to coarse, angular to subrounded flint. [Possible made or disturbed ground]	
Water strike: 1.90m								
2.00m to 3.00m approximately 60% recovery.	D	2.00					*Below 2.00m: Contains pockets of dark grey clay.*	2
	SPT/C	2.00	N=6					
	D	2.50						
3.00m to 4.00m approximately 70% recovery.	SPT/C	3.00	N=8					3
	D	3.50						
	PID	3.50	0.0					
4.00m to 5.00m approximately 30% recovery.	SPT/C	4.00	N=9					4
	D	4.50						
	PID	4.50	0.0					
	D	5.00					*At 5.00m: Becoming medium dense and contains dark grey clay.*	5
	SPT/S	5.00	N=13					
	PID	5.00	0.0					
BH Complete: 10/05/22 BH Depth: 5.45m Water depth: 1.90m				5.45	6.70		End of hole at 5.45m	6

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS5**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS6**
Client:	**Radnor House School Ltd**	Coordinates: 514860E, 174314N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +11.06mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 11/05/22				0.10	10.96		Grass over friable grey brown, sandy, silty, slightly gravelly clayey TOPSOIL. Gravel is angular, fine flint with rare fragments of clinker and brick. Occasional to frequent rootlets.	
	D	0.20						
	PID	0.20	0.0					
BH diameter reducing with depth							POSSIBLE MADE GROUND: Topsoil/Subsoil type material composed of firm friable silty, very sandy clay, with occasional to frequent rootlets.	
	E	0.60						
	D	0.70						
	PID	0.70	0.1					
				0.90	10.16			
	D	1.00					Dense orange brown clayey, silty, slightly gravelly, fine to coarse SAND with occasional pockets of clay. Gravel is angular and subangular, fine and medium flint.	
	SPT/C	1.00	N=49					
	PID	1.00	0.0					
	D	1.50					*Below 1.50m: becoming clayey sand and gravel*	
	PID	1.50	0.0					
Water strike: 2.00m	D	2.00						
	SPT/C	2.00	N=13	2.05	9.01		Firm to stiff orange brown silty CLAY composed of gravel sized lithorelicts in a brown silty clay matrix.	
	PID	2.00	0.0					
	HV	2.20	48					
	D	2.30						
	PID	2.30	0.0					
	HV	2.40	46				*Below 2.40m: becoming grey and dark grey.*	
	HV	2.60	42					
	D	2.70						
	HV	2.80	54					
	SPT/S	3.00	N=27					
	D	3.60						
	HV	3.60	60					
	PID	3.70	0.0					
4.00m to 5.00m approximately 40% recovery.	D	4.00					*At 4.00m: Claystone.*	
	SPT/C	4.00	N=19					
	D	4.50						
	PID	4.50	0.0					
				4.75	6.31		Firm dark grey fissured silty CLAY with rare infilled burrows.	
	D	5.00						
	SPT/S	5.00	N=20					
	PID	5.00	0.0					
BH Completed: 11/05/22 BH Depth: 5.45m Water depth: 2.00m				5.45	5.61		End of hole at 5.45m	

Backfill / Installation: 1, 2, 3, 4, 5, 6

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd b) 50mm ID standpipe to 2.00m

Borehole No: **WS6**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS7**
Client:	**Radnor House School Ltd**	Coordinates: 514831E, 174244N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +11.49mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 11/05/22	D PID	0.10 0.10	0.0				Grass over dark brown silty clayey, slightly gravelly sandy TOPSOIL. Frequent rootlets.	
BH diameter reducing with depth				0.50	10.99		Soft friable, grey and red, mottled, silty, very sandy CLAY. Occasional to rare rootlets.	
	D PID	0.70 0.70	0.0					
	SPT/S D PID	1.00 1.10 1.10	N=4 0.0	1.00	10.49		Loose orange brown and grey mottled clayey, silty, slightly gravelly fine and medium SAND.	1
	PID	1.60	0.1					
Water strike: 2.00m	SPT/S PID	2.00 2.00	N=7 0.1					2
				2.20	9.29		Soft to firm becoming stiff orange brown silty CLAY composed of gravel sized lithorelicts in a silty clay matrix.	
	D	2.50						
	HV	2.65	40					
	HV	2.85	38					
No Recovery: 3.00m to 4.00m	D SPT/S PID	3.00 3.00 3.00	N=16 0.1					3
No Recovery: 4.00m to 5.00m	SPT/S	4.00	N=17					4
				4.50	6.99		Firm to stiff dark grey fissured silty CLAY.	
	SPT/S	5.00	N=19				End of hole at 5.00m	5
BH complete: 11/05/22 BH depth: 5.45m Water depth: 2.00m				5.45	6.04			6

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS7**

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS8**
Client:	**Radnor House School Ltd**	Coordinates: 514918E, 174198N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +10.40mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 12/05/22								
	D	0.20		0.30	10.10		Grass over light greyish brown silty sandy TOPSOIL. Frequent roots.	
	D	0.40		0.60	9.80		MADE GROUND: light grey clayey silty sand. Gravel is subangular to subrounded fine to coarse flint. Occasional fragments of clinker.	
	D	0.70					Dark brown and grey mottled sandy, slightly clayey silty very sandy GRAVEL. Gravel is fine to coarse, subangular to subrounded flint. Localised black manganese staining.	
	PID	0.70	0.1					
	SPT/C	1.00	N=48	1.00	9.40		Dense light orange brown slightly silty, slightly gravelly SAND. Gravel is subangular, fine flint.	
	D	1.10						
Inspection pit to: 1.20m BH diameter reducing with depth	PID	1.10	0.1	1.20	9.20		Dense brown and orange brown slightly silty, sandy GRAVEL. Gravel is angular to subrounded, fine to coarse flint.	
	D	1.50						
	PID	1.50	0.1					
	D	1.90						
BH Refused at 2.00m.	PID	1.90	0.1					
	SPT/C	2.00	N=58					
BH Complete: 12/05/22 BH depth: 2.45m Water depth: Dry Dynamic probe follow-on.				2.45	7.95		End of hole at 2.45m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS8**

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS9**
Client:	**Radnor House School Ltd**	Coordinates: 514796E, 174181N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +12.25mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 11/05/22							Grass over dark brown, clayey, silty, slightly gravelly, sandy TOPSOIL. Gravel is angular and subrounded, fine and medium flint with fragments of brick and coal. Frequent rootlets.	
	D	0.30						
	PID	0.30	0.0					
BH diameter reducing with depth	E	0.40		0.50	11.75		MADE GROUND: Friable, dark grey, silty, very sandy clay with occasional to rare rootlets. Rare to occasional fragments of clinker and brick.	
	D	0.70						
	PID	0.70	0.0					
				0.90	11.35		Soft to firm orange brown, mottled, grey and red, very silty, slightly sandy CLAY. Composed of gravel sized lithorelicts in a very silty sandy clay matrix.	
	D	1.00						1
	SPT/S	1.00	N=7					
	D	1.01						
	HV	1.30	42					
	D	1.50						
	HV	1.50	45					
	HV	1.70	45					
	D	2.00					*Between 2.00m and 2.40m: Fine sand layer.*	2
	SPT/C	2.00	N=8					
	PID	2.00	0.1					
	D	2.30						
Water strike: 2.40m				2.40	9.85		Soft to firm dark grey, silty CLAY. Composed of gravel sized lithorelicts in a silty clay matrix.	
	HV	2.80	32					
No Recovery: 3.00m to 4.00m	D	3.00						3
	SPT/S	3.00	N=10					
	PID	3.00	0.1					
	D	3.01						
No Recovery: 4.00m to 5.00m	D	4.00						4
	SPT/S	4.00	N=8					
	D	5.00						5
	SPT/S	5.00	N=16					
	PID	5.00	0.1					
BH Completed: 11/05/22 BH Depth: 5.45m Water depth: 2.40m				5.45	6.80		End of hole at 5.45m	6

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd

Borehole No: **WS9**

Soil Consultants

Site & Location:	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**	Borehole No:	**WS10**
Client:	**Radnor House School Ltd**	Coordinates: 514876E, 174105N	Sheet 1 of 1
Engineer:	**AKS Ward Ltd**	Ground Level: +10.58mOD	Report No: 10728/SG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH Commenced: 12/05/22	D	0.10		0.10	10.48		Grass over light greyish brown clayey silty TOPSOIL. Frequent roots.	
	E	0.30					Subsoil type material composed of brown, dark brown slightly gravelly clayey silty SAND /slightly gravelly silty sandy CLAY. Gravel is fine to coarse flint.	
Inspection pit to: 0.60m BH diameter reducing with depth				0.60	9.98		Dark brown and orange brown clayey, sandy GRAVEL. Gravel is angular to subrounded, fine to coarse flint.	
	D	0.80						
	SPT/C	1.00	N=36	1.00	9.58		Dense light brown and yellowish brown, slightly silty very sandy GRAVEL. Gravel is angular to subrounded, fine to medium flint.	
	D	1.10						
	PID	1.10	0.0					
							Between 1.80m and 2.60m: Silty sand.	
Water strike: 2.00m	D	2.00						
	SPT/S	2.00	N=30					
							Below 2.60m: Becoming slightly gravelly, very clayey sand.	
				2.80	7.78			
	D	2.90					Dense orange brown slightly silty slightly sandy GRAVEL. Gravel is subrounded to rounded, fine to coarse flint.	
BH Complete: 12/05/22 BH depth: 3.45m Water depth: 2.00m Dynamic probe follow-on.	SPT/C	3.00	N=55					
				3.45	7.13		End of hole at 3.45m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: a) Ground level and coordinates surveyed by Point Zero Surveys Ltd b) 50mm ID standpipe to 3.00m

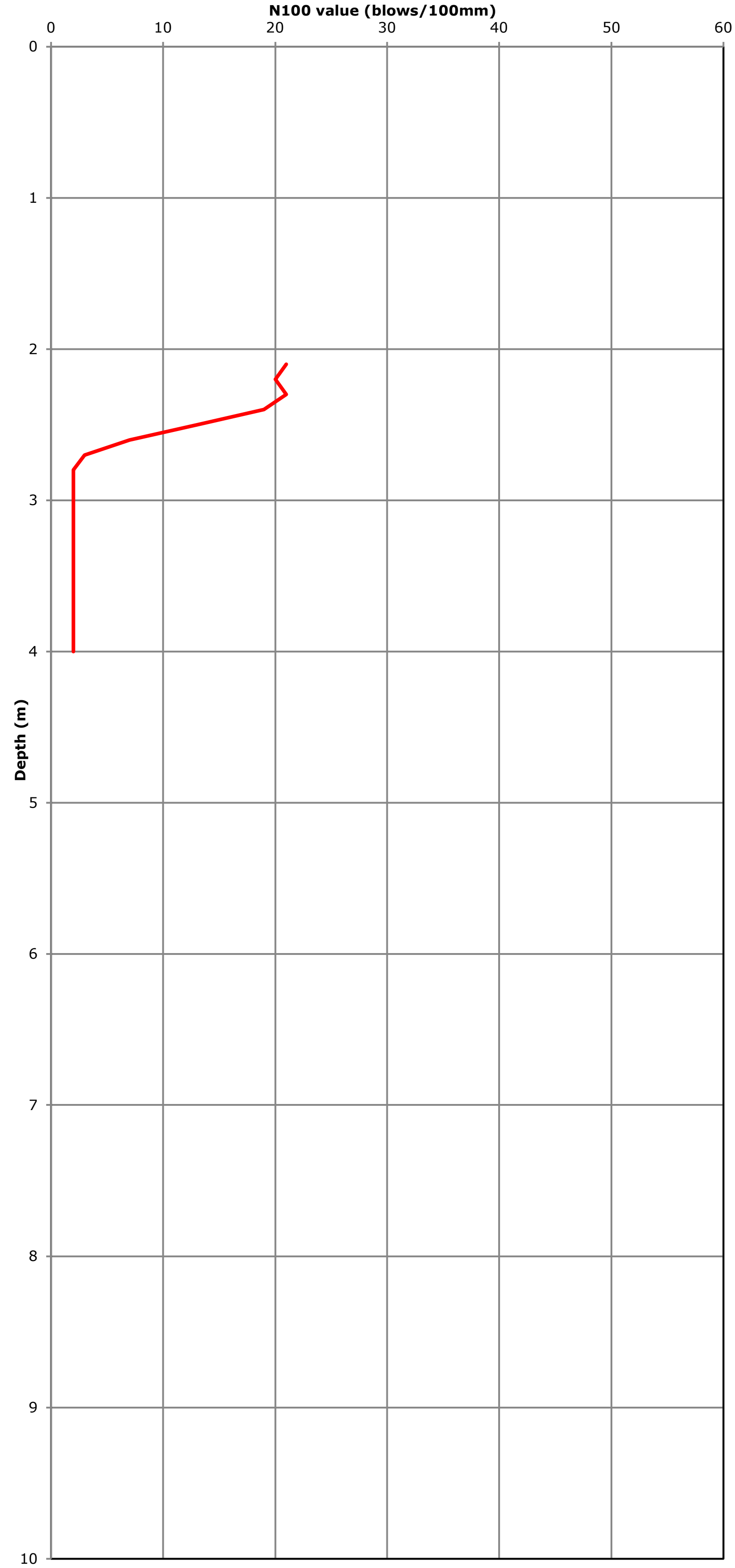
Borehole No: **WS10**

Soil Consultants

Site & Location	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**			DP No:	**WS4/DP4**
Client:	**Radnor House School Ltd**	Co-ords (E-N):	514710 174283	Sheet No:	1 of 1
Eng:	**AKS Ward Ltd**	Ground level (mOD):	+13.08	Report No:	10728/SG

Dynamic Probe Record

Depth (m)	DP blows/100mm				
0.50					
1.00					
1.50					
2.00	21	20	21	19	13
2.50	7	3	2	2	2
3.00	2	2	2	2	2
3.50	2	2	2	2	2
4.00					
4.50					
5.00					
5.50					
6.00					
6.50					
7.00					
7.50					
8.00					
8.50					
9.00					
9.50					
10.00					



Torque (Nm)

Probing by:	0				
Equipment:	DPSH-B	Hammer weight (kg)	63.5	Date:	12 May 22
Cone area (cm2):	20	Hammer drop (mm)	750	Rod dia (m	35

Remarks:

Soil Consultants

Site & Location	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**			DP No:	**WS8/DP8**
Client:	**Radnor House School Ltd**	Co-ords (E-N):	514918 174198	Sheet No:	1 of 1
Eng:	**AKS Ward Ltd**	Ground level (mOD):	+10.40	Report No:	10728/SG

Dynamic Probe Record

Depth (m)	DP blows/100mm					Torque (Nm)
0.50	16	17	21	25	20	
1.00	20	17	12	15	18	
1.50	17	17	17	14	8	
2.00	6	4	2	3	3	
2.50	3	3	2	3	3	
3.00						
3.50						
4.00						
4.50						
5.00						
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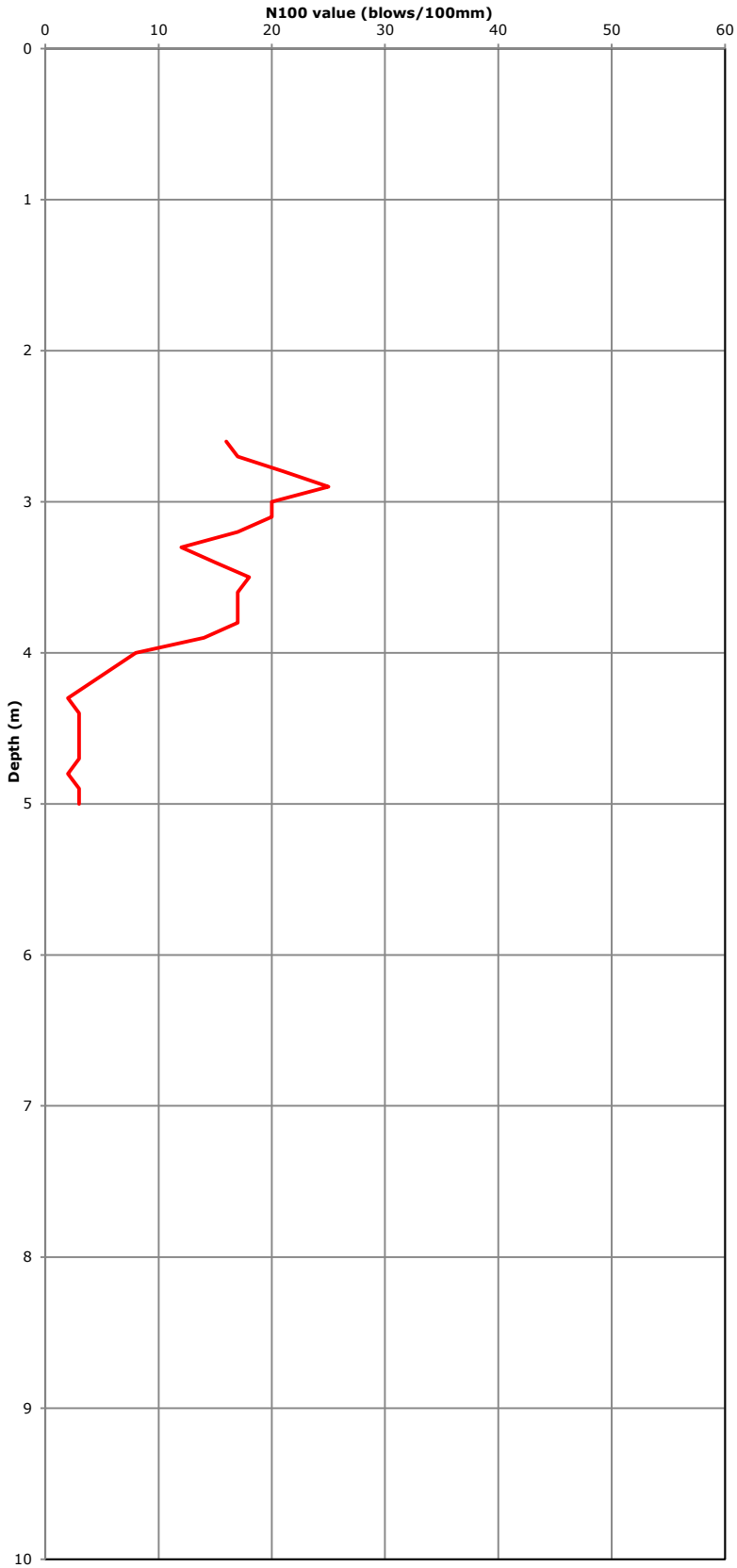
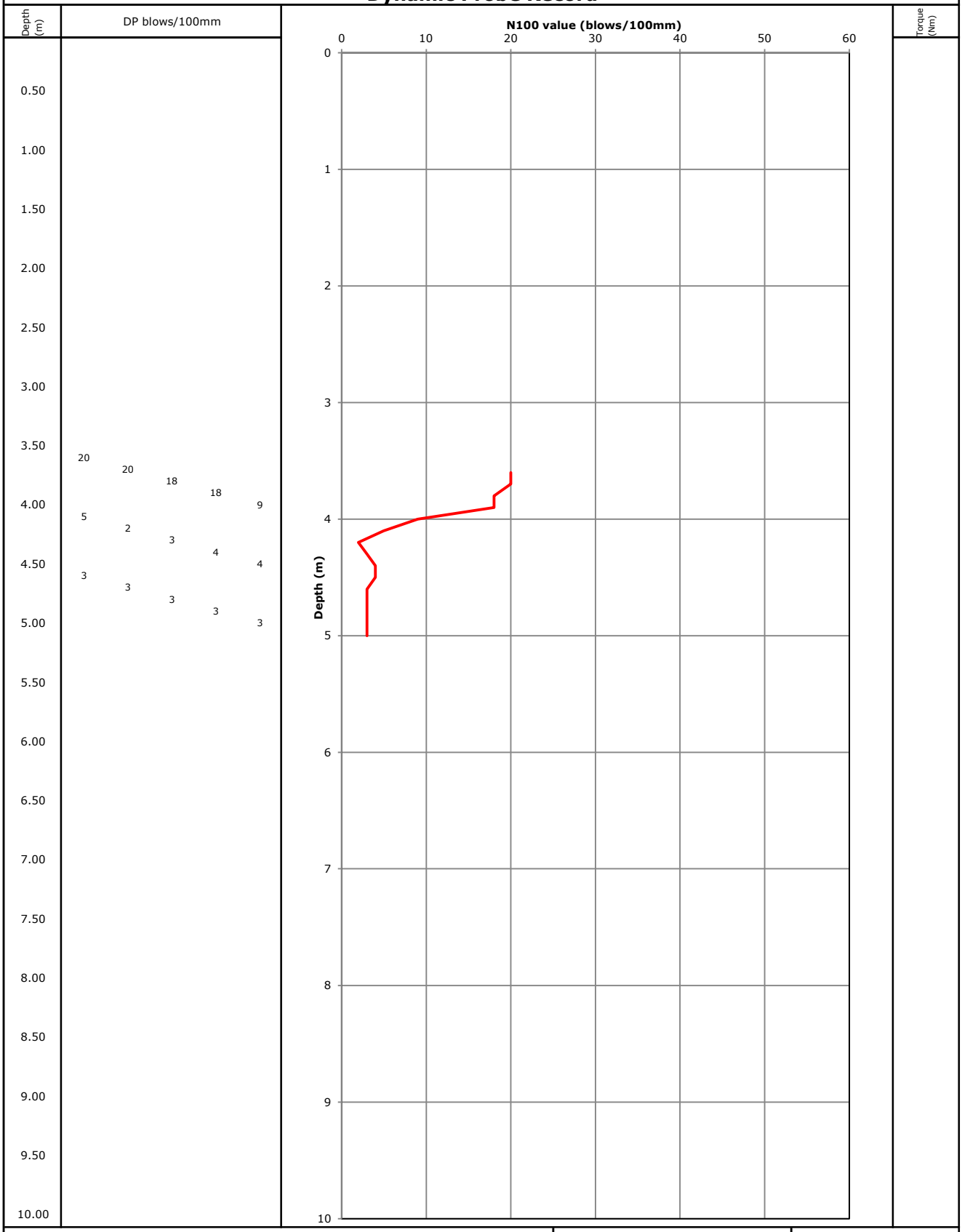


Probing by:	0			Remarks:	
Equipment:	DPSH-B	Hammer weight (kg)	63.5	Date:	12 May 22
Cone area (cm2):	20	Hammer drop (mm)	750	Rod dia (m	35

Soil Consultants

Site & Location	**Kneller Hall** **65 Kneller Road, Twickenham, London TW2 7DN**			DP No:	**WS10/DP10**
Client:	**Radnor House School Ltd**	Co-ords (E-N):	514876 174105	Sheet No:	1 of 1
Eng:	**AKS Ward Ltd**	Ground level (mOD):	+10.58	Report No:	10728/SG

Dynamic Probe Record



Probing by:	0			Remarks:	
Equipment:	DPSH-B	Hammer weight (kg)	63.5	Date:	12 May 22
Cone area (cm2):	20	Hammer drop (mm)	750	Rod dia (m	35

Soil Consultants

Site & Location	**Kneller Hall** **65 Kneller Road, Twickenham, London, TW2 7DN**	Report No:	**10728/SG**

STANDARD PENETRATION TEST SUMMARY

BH ID	Depth (m)	Test type	N value (Note b)	Blow-counts and penetration						Casing depth (m)	Water depth (m)	Remarks
				Seating blows		Test blows						
BH01	2.00	S	N=18	3	3	4	4	5	5	0.00	0.00	
BH01	3.00	C	N=17	1	2	4	4	4	5	2.00	0.00	
BH01	4.00	C	N=29	4	5	6	7	7	9	3.00	3.80	
BH01	5.00	C	N=25	4	5	5	6	6	8	4.80	4.10	
BH01	8.00	S	N=15	2	2	3	4	4	4	6.50	6.40	
BH01	11.00	S	N=17	2	3	3	4	5	5	10.30	0.00	
BH01	14.00	S	N=24	3	3	5	5	7	7	10.30	0.00	
BH01	17.00	S	N=23	3	4	4	5	7	7	10.30	0.00	
BH01	20.00	S	N=26	3	4	6	6	7	7	10.30	0.00	
BH01	23.00	S	N=32	4	4	7	8	8	9	10.30	0.00	
BH02	1.20	C	N=11	1	2	2	3	3	3	0.00	0.00	
BH02	4.00	S	N=6	1	1	1	1	2	2	2.80	0.00	
BH02	6.50	S	(50)	2	4	18	32/30mm			2.80	0.00	
BH02	9.50	S	N=20	2	2	4	5	5	6	2.80	0.00	
BH02	12.50	S	N=22	2	2	5	5	6	6	2.80	0.00	
BH03	1.20	C	N=10	1	2	2	2	3	3	0.00	0.00	
BH03	3.00	C	N=17	4	4	4	4	4	5	2.90	1.20	
BH03	4.00	C	N=17	4	4	4	4	4	5	4.00	3.40	
BH03	5.00	C	N=19	3	4	4	5	5	5	4.90	4.10	
BH03	6.00	C	N=19	3	3	4	5	5	5	6.00	4.00	
BH03	11.00	S	N=20	3	3	4	5	5	6	10.30	9.00	
BH03	14.00	S	(50)	25/25mm		50/10mm				10.30	9.00	
BH03	17.00	S	N=22	3	4	5	5	6	6	11.70	0.00	
BH03	20.00	S	N=24	3	4	5	6	6	7	11.70	0.00	
BH03	23.00	S	N=24	3	4	5	6	6	7	11.70	0.00	
BH04	1.20	C	N=17	1	3	4	4	4	5	0.00	0.00	
BH04	2.00	C	N=47	3	4	7	11	15	14	0.00	0.00	
BH04	3.00	C	N=42	2	5	6	9	12	15	2.80	1.10	
BH04	4.00	C	(49)	3	5	9	15	18	7/35mm	2.80	1.10	
BH04	5.00	C	N=14	2	2	3	4	4	3	5.00	3.30	
BH04	8.00	S	N=16	1	2	3	3	4	6	5.00	0.00	
BH04	11.50	S	N=21	2	3	4	5	6	6	5.00	0.00	
BH04	14.00	S	N=26	2	4	5	6	7	8	5.00	0.00	
WS1	1.00	C	N=8	1	2	2	2	2	2	0.00	Dry	
WS1	2.00	S	N=15	2	4	3	4	4	4	0.00	1.90	
WS1	3.00	C	N=16	3	4	4	4	4	4	0.00	1.90	
WS1	4.00	C	N=25	4	6	6	6	7	6	0.00	1.90	
WS1	5.00	C	N=25	5	6	6	6	6	7	0.00	1.90	
WS10	1.00	C	N=36	7	10	9	9	9	9	0.00	Dry	
WS10	2.00	S	N=30	5	7	8	7	7	8	0.00	2.00	
WS10	3.00	C	N=55	6	10	13	14	14	14	0.00	2.00	
WS2	1.00	C	N=30	8	8	8	8	7	7	0.00	Dry	
WS2A	1.00	C	N=20	2	2	5	5	5	5	0.00	Dry	

a) Standard Penetration Test : BS EN ISO 22476:2005 Part 3

b) Where full penetration was not achieved, the total test blow-counts are reported

c) Hammer Energy Ratio, Er = 61% for BH locations, Er = 88% for WS locations.

Site & Location	**Kneller Hall** **65 Kneller Road, Twickenham, London, TW2 7DN**	**10728/SG**

STANDARD PENETRATION TEST SUMMARY

BH ID	Depth (m)	Test type	N value (Note b)	Blow-counts and penetration						Casing depth (m)	Water depth (m)	Remarks
				Seating blows		Test blows						
WS2A	2.00	C	N=28	7	8	7	7	7	7	0.00	2.00	
WS2A	3.00	C	N=12	3	4	3	3	3	3	0.00	2.00	
WS2A	4.00	S	N=7	2	1	1	2	2	2	0.00	2.00	
WS2A	5.00	S	N=12	3	3	3	3	3	3	0.00	2.00	
WS3	1.00	S	N=4	1	1	1	1	1	1	0.00	Dry	
WS3	2.00	S	N=8	1	1	2	2	2	2	0.00	Dry	
WS3	3.00	S	N=8	1	1	2	2	2	2	0.00	Dry	
WS3	4.00	S	N=8	1	1	2	2	2	2	0.00	4.00	
WS3	5.00	S	N=9	2	2	2	2	2	3	0.00	4.00	
WS4	1.00	C	N=43	2	4	6	12	12	13	0.00	Dry	
WS4	1.50	C	N=66	12	13	17	16	16	17	0.00	Dry	
WS5	1.00	C	N=2	1	0	1	0	0	1	0.00	Dry	
WS5	2.00	C	N=6	1	2	1	2	1	2	0.00	1.90	
WS5	3.00	C	N=8	2	2	2	2	2	2	0.00	1.90	
WS5	4.00	C	N=9	1	2	2	3	2	2	0.00	1.90	
WS5	5.00	S	N=13	2	2	2	3	4	4	0.00	1.90	
WS6	1.00	C	N=49	4	6	12	12	12	13	0.00	Dry	
WS6	2.00	C	N=13	10	4	4	3	3	3	0.00	2.00	
WS6	3.00	S	N=27	3	3	3	3	10	11	0.00	2.00	
WS6	4.00	C	N=19	3	4	4	5	5	5	0.00	2.00	
WS6	5.00	S	N=20	4	5	5	5	5	5	0.00	2.00	
WS7	1.00	S	N=4	1	1	1	1	1	1	0.00	Dry	
WS7	2.00	S	N=7	2	2	1	2	2	2	0.00	2.00	
WS7	3.00	S	N=16	4	3	4	4	4	4	0.00	2.00	
WS7	4.00	S	N=17	4	4	4	4	4	5	0.00	2.00	
WS7	5.00	S	N=19	5	6	7	4	4	4	0.00	2.00	
WS8	1.00	C	N=48	4	6	8	12	14	14	0.00	Dry	
WS8	2.00	C	N=58	8	9	12	14	15	17	0.00	Dry	
WS9	1.00	S	N=7	1	1	2	2	1	2	0.00	Dry	
WS9	2.00	C	N=8	2	2	2	2	2	2	0.00	Dry	
WS9	3.00	S	N=10	2	2	3	2	2	3	0.00	2.40	
WS9	4.00	S	N=8	2	2	2	2	2	2	0.00	2.40	
WS9	5.00	S	N=16	3	4	4	4	4	4	0.00	2.40	

a) Standard Penetration Test : BS EN ISO 22476:2005 Part 3

b) Where full penetration was not achieved, the total test blow-counts are reported

c) Hammer Energy Ratio, Er = 61% for BH locations, Er = 88% for WS locations.

Soil Consultants

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING UK LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref:	AR3953
Test Date:	24/03/2022
Report Date:	24/03/2022
File Name:	AR3953.spt
Test Operator:	JL

Instrumented Rod Data

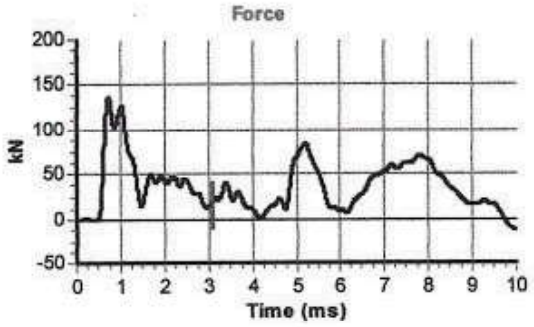
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	7080
Accelerometer No.2:	11609

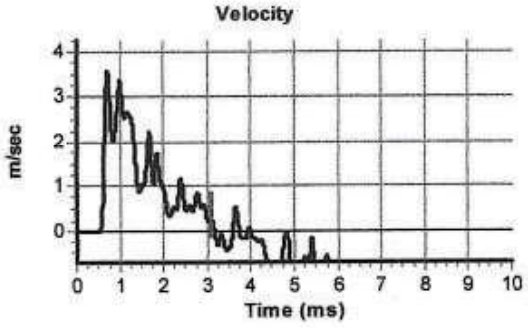
SPT Hammer Information

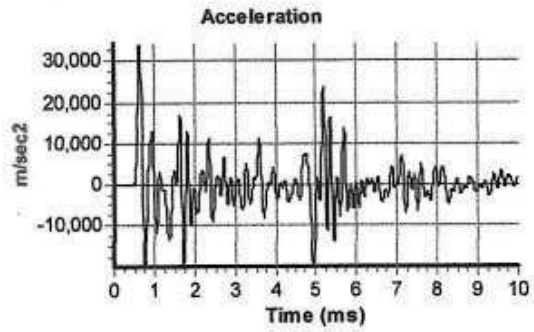
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

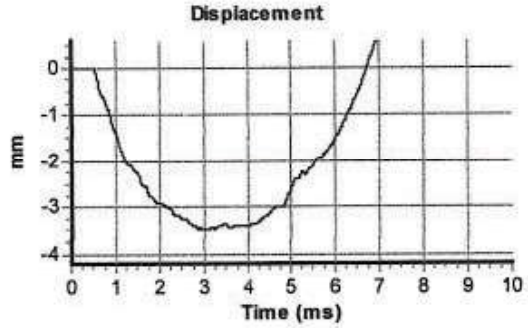
Comments / Location

Norseman Powerhouse Ltd/77655









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	289

Energy Ratio E_r (%): **61**

Signed: C.McCLUSKEY

Title: FITTER

The recommended calibration interval is 12 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Borehole Calibration & Testing Solutions Ltd

Unit 8
Orton Enterprise Centre
Orton Southgate
Peterborough
PE2 6XU

SPT Hammer Ref: KLS
Test Date: 10/01/2022
Report Date: 10/01/2022
File Name: KLS.spt
Test Operator: PC

Instrumented Rod Data

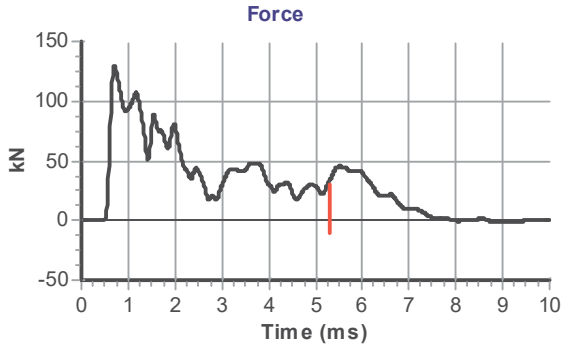
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.3
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 11853
Accelerometer No.2: 10332

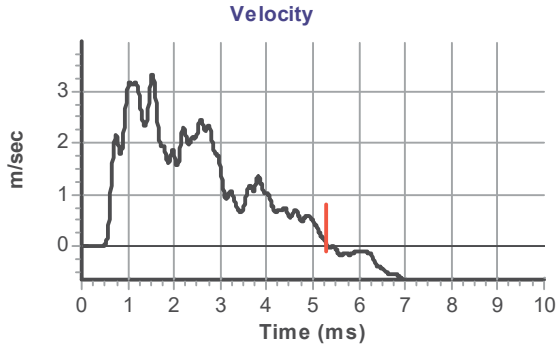
SPT Hammer Information

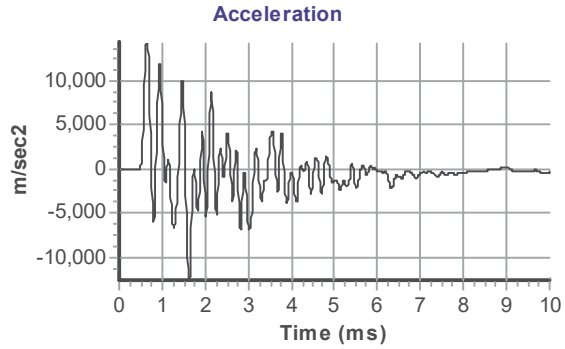
Hammer Mass m (kg): 63.0
Falling Height h (mm): 760
SPT String Length L (m): 15.0

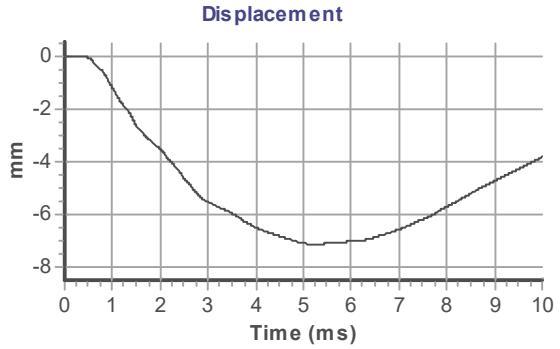
Comments / Location

Recommended calibration interval is 6 months, expiration 12 months









Calculations

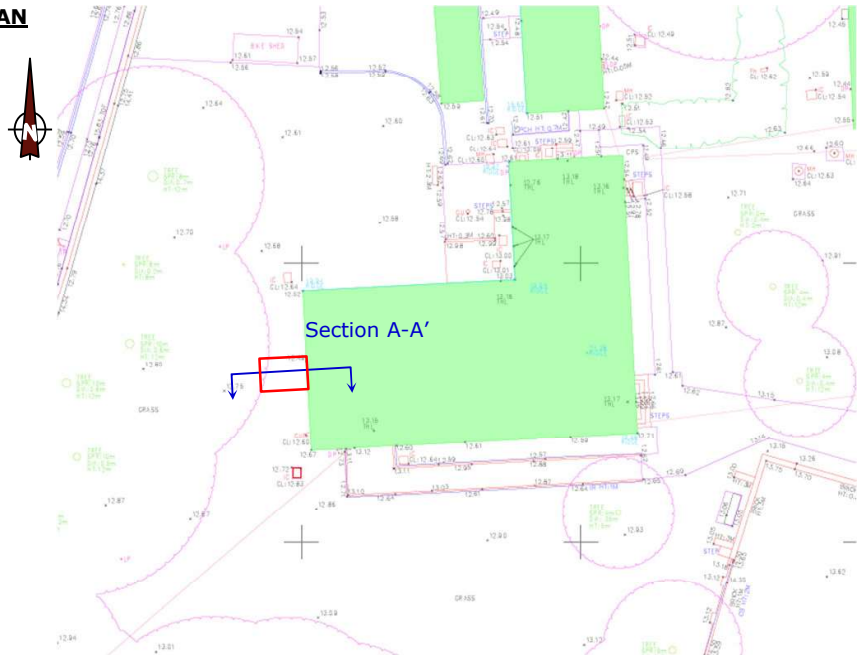
Area of Rod A (mm2): 944
Theoretical Energy E_{theor} (J): 419
Measured Energy E_{meas} (J): 477

Energy Ratio E_r (%): 88

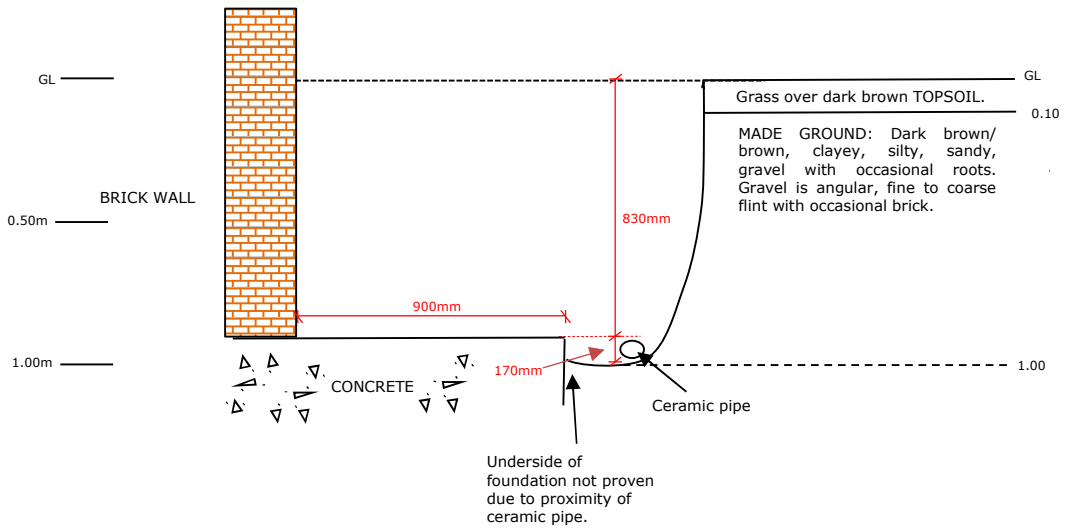
Signed: CR
Title: Operator

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP1 (1 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PLAN



SECTION A-A' (Looking South)



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	09/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavation	• Dry	
Stability:	Stable		
Remarks:	Base of foundation not identified due to presence of services		**Logged by**: JW

Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP1(2 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PHOTOGRAPHS

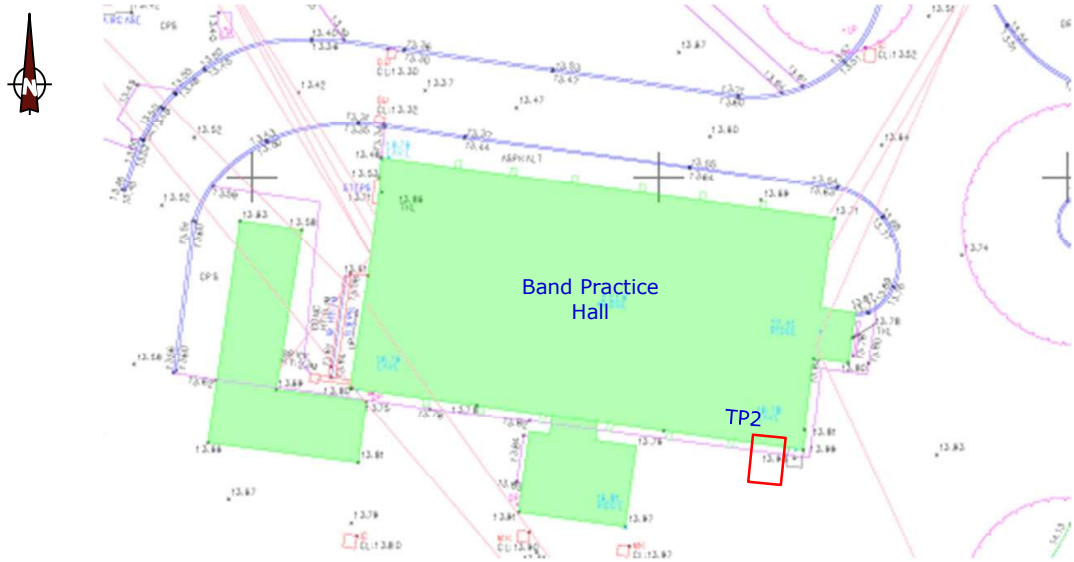
D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	09/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	
Stability:	Stable		
Remarks:	Base of foundation not identified due to presence of services		**Logged by**: JW

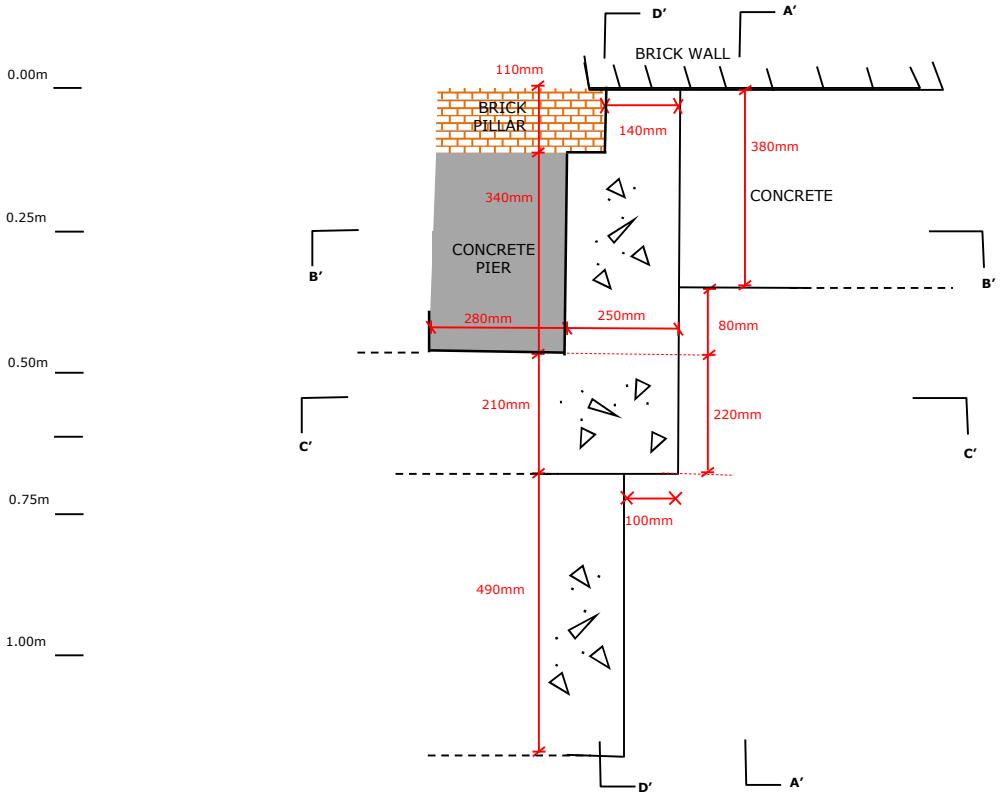
Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP2 (1 of 6)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PLAN



SECTION Plan view



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	13/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	E @ 0.3m D @ 0.4m D @ 0.6m D @ 0.9m
Stability:	Stable		
Remarks:	Additional supports and foundation added to structure over time.		**Logged by**: SG

Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP2 (2 of 6)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

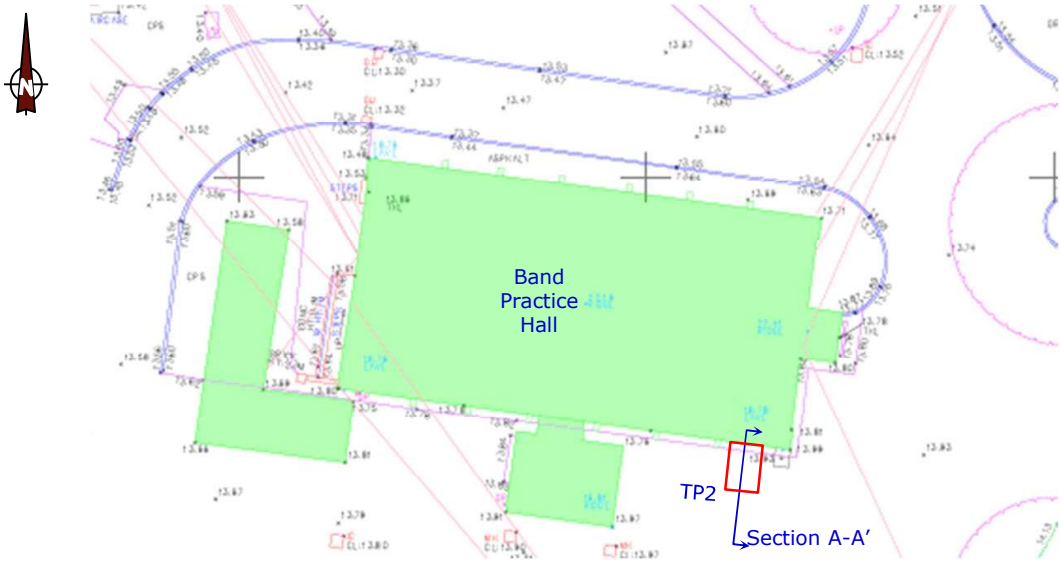
PHOTOGRAPHS

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

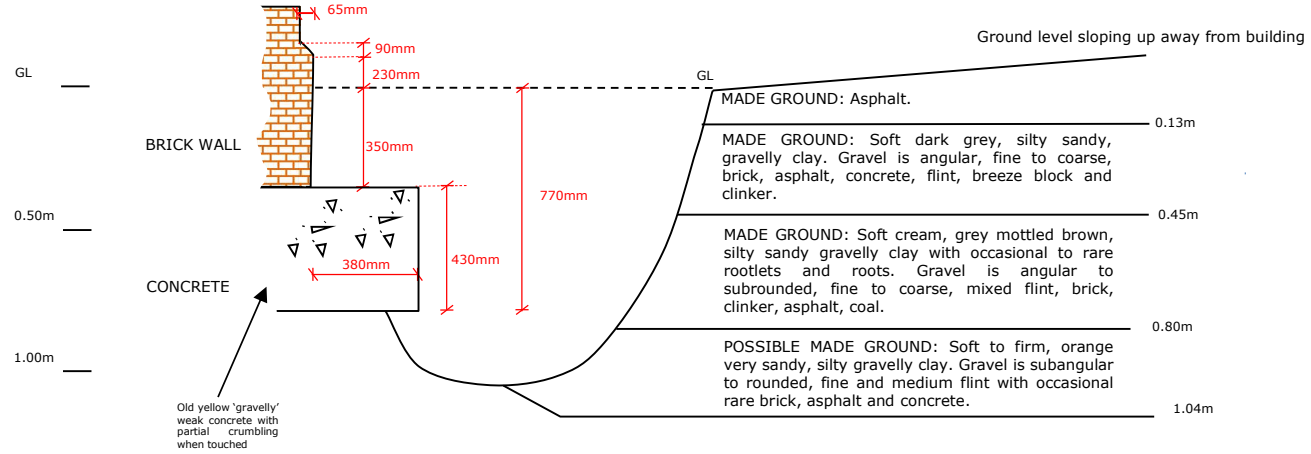
Date:	13/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	E @ 0.3m D @ 0.4m D @ 0.6m D @ 0.9m
Stability:	Stable		
Remarks:	Additional supports and foundation added to structure over time.		**Logged by**: SG

Site & Location	**Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN**	Trial Pit No: **TP2 (3 of 6)**
Client:	**Radnor House School Ltd**	Report No: **10728/SG**
Engineer:	**AKS Ward Ltd**	

PLAN



SECTION A-A' (Looking East)



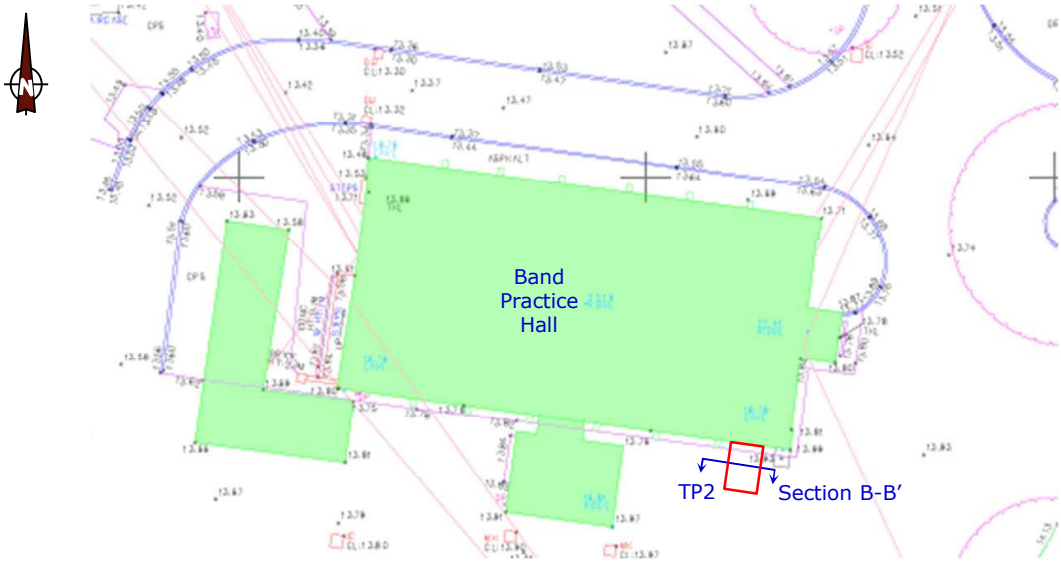
D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	13/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavation	• Dry	E @ 0.3m D @ 0.4m D @ 0.6m D @ 0.9m
Stability:	Stable		
Remarks:	Additional supports and foundation added to structure over time.		**Logged by**: SG

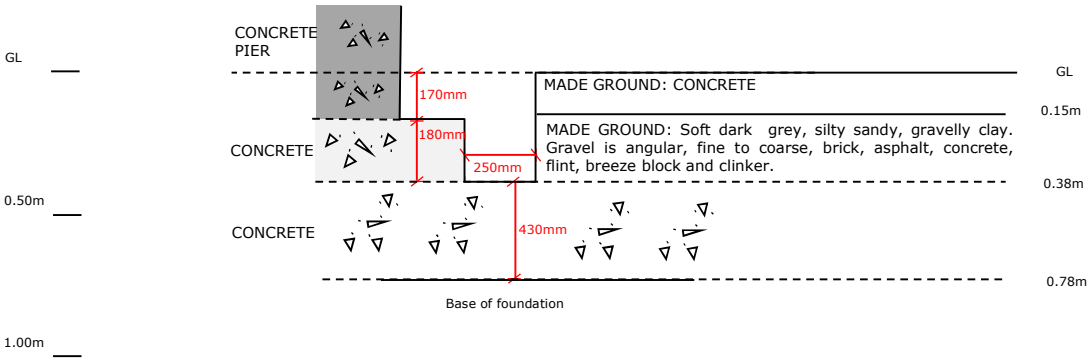
Soil Consultants

Site & Location	**Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN**	Trial Pit No: **TP2 (4 of 6)**
Client:	**Radnor House School Ltd**	Report No: **10728/SG**
Engineer:	**AKS Ward Ltd**	

PLAN



SECTION B-B' (Looking South)



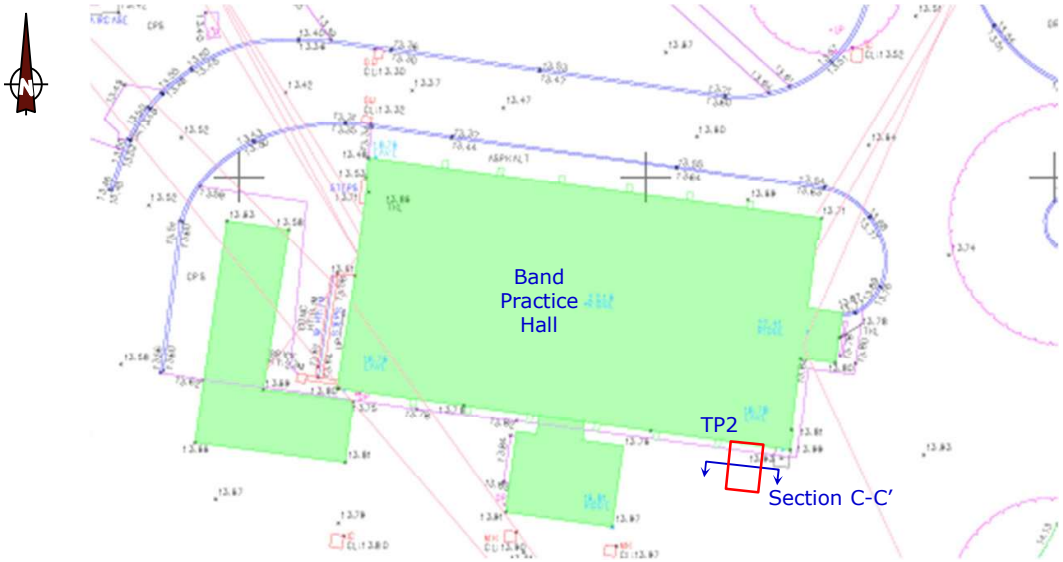
D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	13/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	E @ 0.3m D @ 0.4m D @ 0.6m D @ 0.9m
Stability:	Stable		
Remarks:	Additional supports and foundation added to structure over time.		**Logged by**: SG

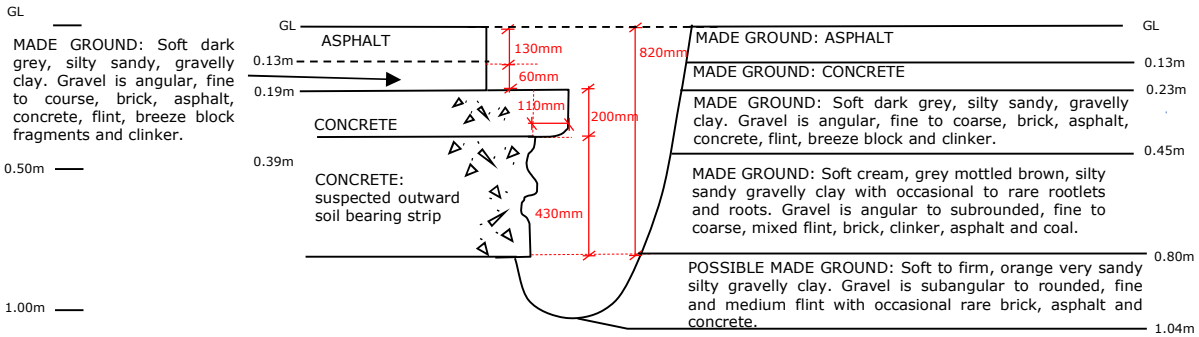
Soil Consultants

Site & Location	**Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN**	Trial Pit No: **TP2 (5 of 6)**
Client:	**Radnor House School Ltd**	Report No: **10728/SG**
Engineer:	**AKS Ward Ltd**	

PLAN



SECTION C-C' (Looking South)



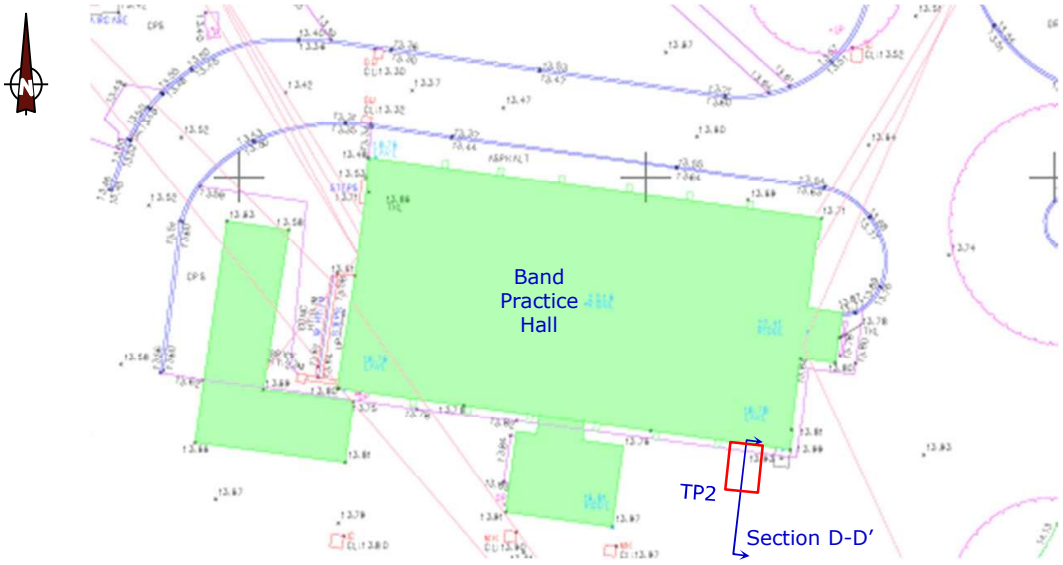
D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	13/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	E @ 0.3m D @ 0.4m D @ 0.6m D @ 0.9m
Stability:	Stable		
Remarks:	Additional supports and foundation added to structure over time.		**Logged by**: SG

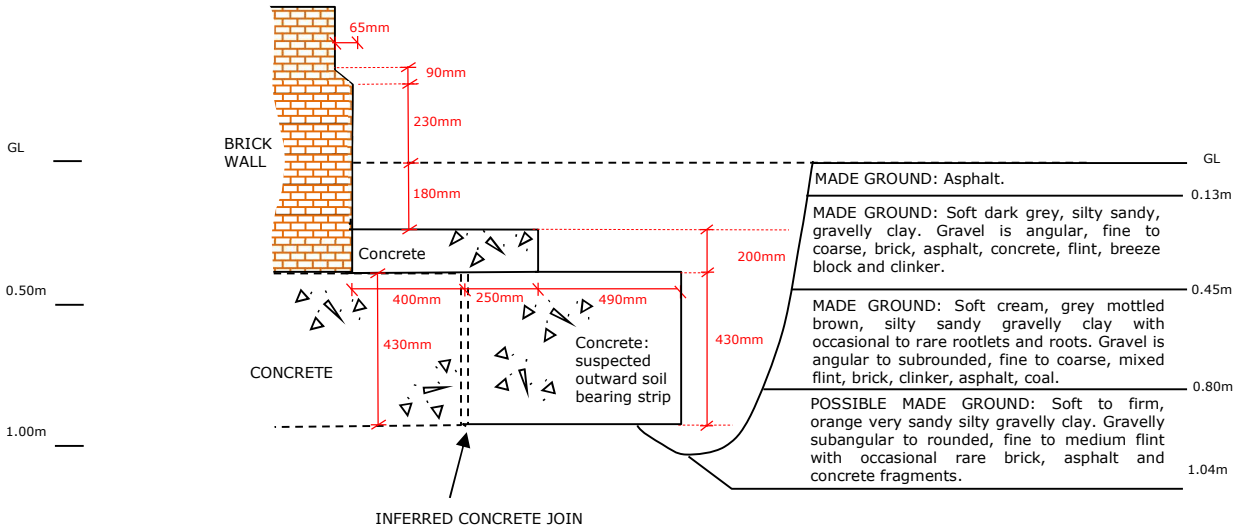
Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP2 (6 of 6)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PLAN



SECTION D-D' (Looking East)



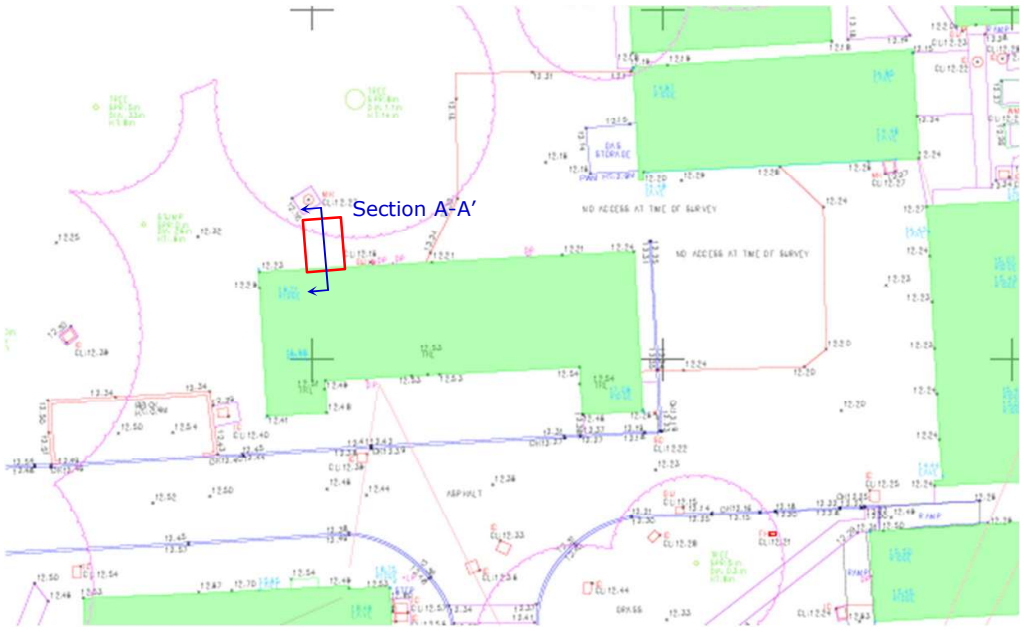
D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	09/05/21	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	E @ 0.3m D @ 0.4m D @ 0.6m D @ 0.9m
Stability:	Stable		
Remarks:	Additional supports and foundation added to structure over time.		**Logged by**: SG

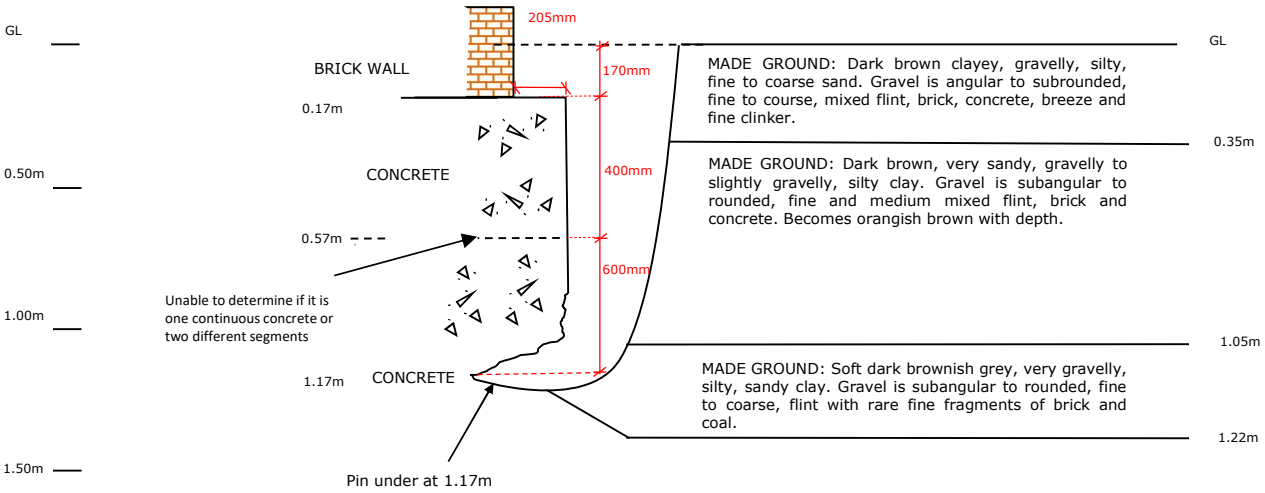
Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP3 (1 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PLAN



SECTION A-A' (Looking west)



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	09/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	Dry, becoming moist from 1.05m.	D @ 0.30m E @ 0.50m D @ 0.60m D @ 1.10m
Stability:	Stable		
Remarks:			**Logged by**: SG

Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP3 (2 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PHOTOGRAPHS

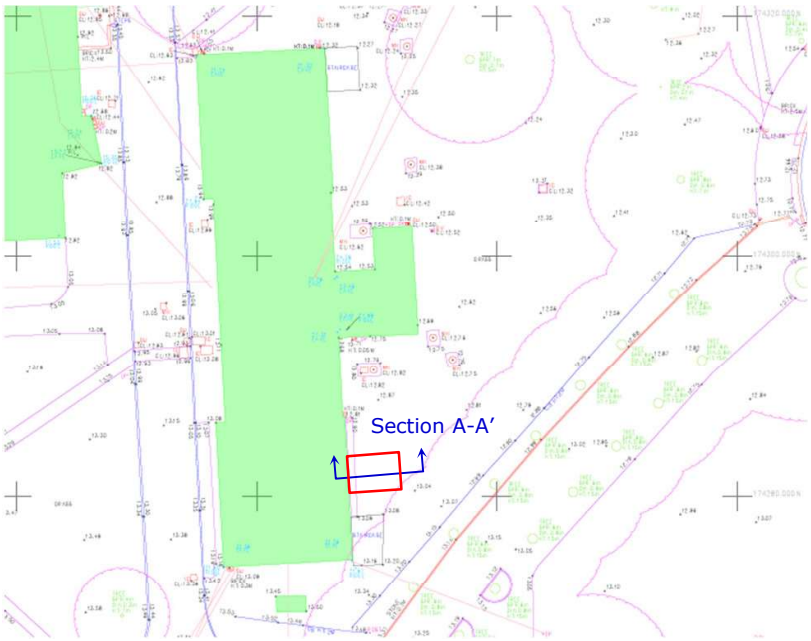
D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	09/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	Dry, becoming moist from 1.05m.	D @ 0.30m E @ 0.50m D @ 0.60m D @ 1.10m
Stability:	Stable		
Remarks:			**Logged by**: SG

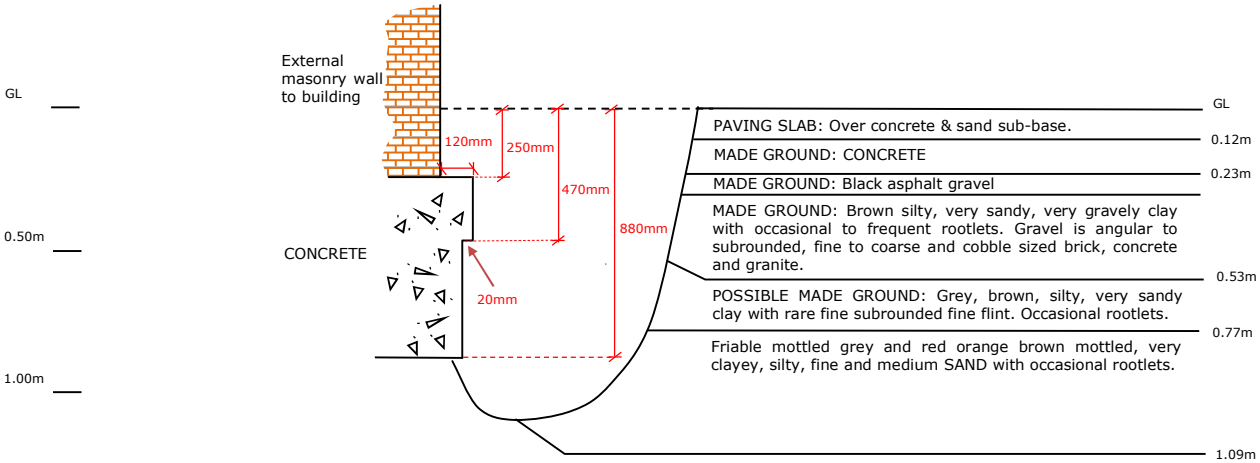
Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP4 (1 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PLAN



SECTION A-A' (Looking north)



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	09/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	D @ 0.40m E @ 0.60m D @ 0.70m D @ 1.00m
Stability:	Stable		
Remarks:			**Logged by**: SG

Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP4 (2 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

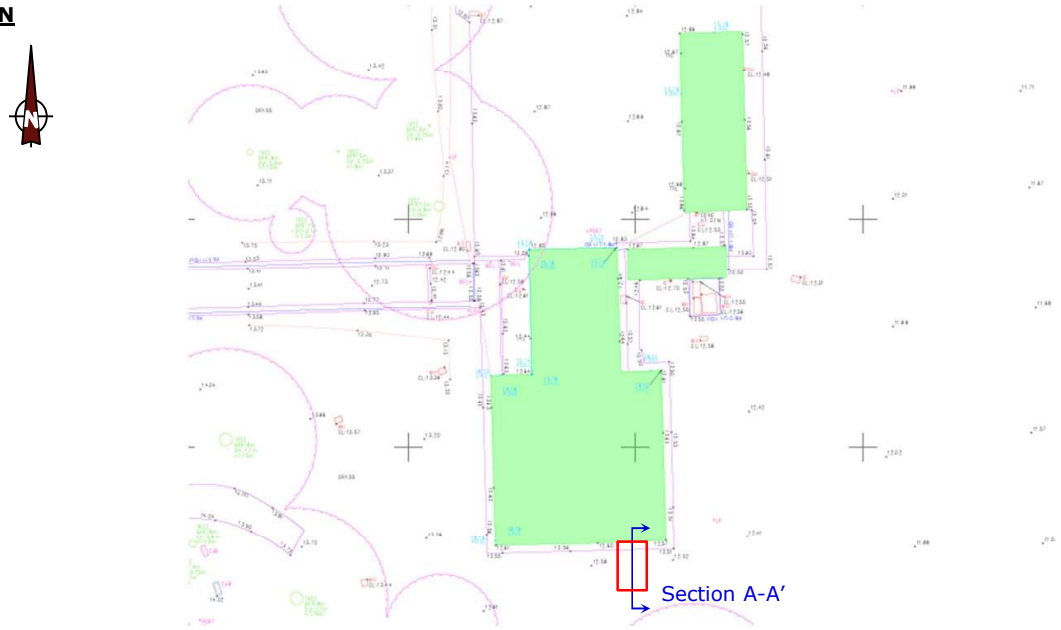
PHOTOGRAPHS

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

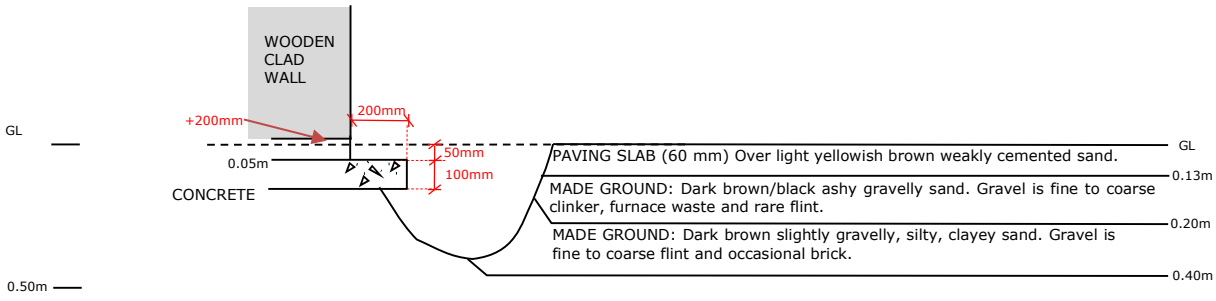
Date:	09/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	D @ 0.40m E @ 0.60m D @ 0.70m D @ 1.00m
Stability:	Stable		
Remarks:			**Logged by**: SG

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP5 (1 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PLAN



SECTION A-A'



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	12/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	D @ 0.15m D @ 0.30m
Stability:	Stable		
Remarks:			**Logged by**: JW

Soil Consultants

Site & Location	Kneller Hall, 65 Kneller Road, Twickenham, London TW2 7DN	Trial Pit No: TP5 (2 of 2)
Client:	Radnor House School Ltd	Report No: 10728/SG
Engineer:	AKS Ward Ltd	

PHOTOGRAPHS

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	12/05/22	**Groundwater details**	**Samples**
Equipment:	Hand excavated	• Dry	D @ 0.15m D @ 0.30m
Stability:	Stable		
Remarks:			**Logged by**: JW

Soil Consultants