

GROUND INVESTIGATION REPORT

QUEENSMEAD SCHOOL

VICTORIA ROAD

SOUTH RUISLIP

Report Reference No. C15024

On behalf of:-

Morgan Sindall Construction and Infrastructure Ltd.

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April 2020

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MORGAN SINDALL CONSTRUCTION AND INFRASTRUCTURE LTD.

REPORT FOR A GROUND INVESTIGATION

AT

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INTRODUCTION

Morgan Sindall Construction and Infrastructure Ltd., the client, are involved in the construction of a replacement teaching block at Queensmead School, Victoria Road, South Ruislip. It is understood that the proposed works will include a new two-storey, flat-roofed teaching block, a plant room and a new temporary classroom. It is also understood that the temporary classroom will be used for approximately 18 months before removal and replacement with hardstanding.

Ground Engineering Limited was instructed by the client, to carry out a ground investigation to determine the nature and geotechnical properties of the underlying soils in relation to foundation design and construction of the development. In addition, a limited contamination assessment was to be included within the scope of this investigation.

LOCATION, TOPOGRAPHY AND GEOLOGY

Queensmead School is located on the northern side of Victoria Road, South Ruislip some 200m north-east of South Ruislip railway station, in the London Borough of Hillingdon. The proposed works are located at the south-eastern end of the school, close to the main school buildings, adjacent the northern side of a sports centre, and are centred at National Grid Reference TQ 1171 8549. A site location plan is presented at the rear of this report.

At the time of the investigation the site was occupied by several one and two-storey school buildings with peripheral parking and asphalt hardstanding, an asphalt playground to its north and a central grassed courtyard. A two-storey teaching block immediately west of the central courtyard is the building to be replaced. A large playing field was present at the north-western end of the school and several astro-turf pitches were located at the south-western corner. A new temporary classroom is to be installed close to the entrance to the playing field.

A Cherry tree was located within the central courtyard and a mature Poplar tree was present close to the entrance of the playing field.

The site stands at an approximate elevation of 35mOD on ground that falls gently to the south-east, toward a south-westward flowing stream, The Roxbourne, which is culverted some 100m south-east of the site.

The 2005 and 2006 geological maps for the area at 1:50,000 scale, Sheets 255 and 256, show the site to be directly underlain by the solid geology of the London Clay. The underlying Lambeth Group is shown cropping out 1km to the north-west of the site.

SITE WORK

The site work was undertaken between 19th and 25th March 2020 and comprised four cable percussive boreholes (BH 1 to BH 4). Borehole BH 2 was undertaken on Saturday 21st March due to access restrictions on this school site. The exploratory hole locations were undertaken at locations determined by the client and amended according to site conditions. The final positions are recorded on the exploratory hole location plan at the rear of this report.

The investigation was undertaken under the supervision of a Geo-environmental Engineer followed the protocols detailed in British Standards (BS) 'Code of Practice for Site Investigations' (BS5930:2015), 'Methods of test for soils for engineering purposes' (BS1377:1990) and 'Investigation of Potentially Contaminated Sites' (BS10175:2001).

Services information was provided prior to the start of the investigation and was referenced in relation to the exploratory hole positions prior to boring and a scan was undertaken using a cable avoidance tool (CAT).

The working areas were bounded by Heras fencing and barriers during the site work period. In addition, protective boards and plastic sheeting were deployed in order to minimise disturbance to the existing soft landscaping and surface layers.

The ground levels at the exploratory hole positions have been related to Ordnance Datum (OD) by interpolation using the spot heights marked on a topographic survey plan provided by the Client.

The exploratory hole records give the descriptions and depths of the various strata encountered, results of the in-situ tests, details of all samples taken, and the groundwater conditions observed during excavation/boring and on completion.

Cable Percussive Boreholes

Boreholes BH 1 to BH 4 were undertaken using a standard cable percussive boring rig between 19th and 25th March 2020. Prior to boring, a starter pit was dug to 1.20m below ground level using hand tools, and where necessary a small hydraulic breaker, in order to ensure

the absence of buried services. The boreholes were each undertaken within a compound formed by Heras fencing.

The boreholes were then advanced using weighted shell and claycutter tools, initially working within 200mm diameter casing, and then (BH 3) using 150mm diameter casing. The boreholes were completed at the intended depths of 15.00m (BH 1, BH 2 and BH 4) or 20.00m (BH 3) below ground level.

Representative small (D) and bulk (B) disturbed samples of soil were taken from the boring tools at regular intervals throughout the depth of the boreholes.

Undisturbed samples (U) nominally 100mm in diameter were taken in clay soils at regular intervals. The ends of the samples were capped and sealed to maintain them in as representative condition as possible during transit to the laboratory.

A standard penetration test (SPT) was undertaken within the Lambeth Group in BH 3, where the clay was too stiff to drive in the undisturbed sampler, in order to give an indication of its in-situ relative density/shear strength. The test was made by driving a 50mm diameter split spoon sampler (S) into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 760mm. The penetration resistance was determined as the number of blows (N) required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole. The result has been tabulated to the rear of the borehole BH 3 record.

On completion the boreholes were backfilled with arisings.

LABORATORY TESTING

The samples were inspected in the laboratory and assessments of the soil characteristics have been taken into account during preparation of the exploratory hole records. The soil descriptions have been made in accordance with BS5930:2015.

Chemical analysis of selected soil samples recovered from the exploratory holes was undertaken, by an independent laboratory, primarily for characterisation purposes. The chemical testing programme was devised by Ground Engineering Limited for a broad suite of potential contaminants, outlined by the Environment Agency (EA) and National House Building Council (NHBC) document R&D 66; 2008 'Guidance for the Safe Development of Housing on Land Affected by Contamination'.

The geotechnical tests were conducted to BS1377:1990 & 2016 and other industry standards, and the results are presented at the rear of this report, whilst the results of the chemical tests are presented in Appendix 1.

Geotechnical Testing

The moisture content and index properties of selected soil samples were determined as a guide to soil classification and behaviour. The liquid limit was determined by the cone penetrometer method.

Selected test specimens were prepared at full diameter from the undisturbed samples recovered from the cable percussive boreholes. Immediate undrained triaxial compression tests were made either at a cell pressure equivalent to the overburden pressure for that samples depth or using the multistage technique. The moisture content and bulk densities of these specimens were also determined. The triaxial test results have been plotted against depth in Figure 1.

Selected samples of soil were analysed to determine the concentration of soluble sulphates. The pH values were also determined using an electrometric method.

Chemical Testing

Selected soil samples from the exploratory holes were tested for total concentrations of arsenic, cadmium, chromium, lead, mercury, selenium, nickel and benzo[a]pyrene, together with speciated polyaromatic hydrocarbons (PAH), boron, copper and zinc, phenols, total and free cyanide, hexavalent chromium, sulphate, sulphide and pH. The organic content of the soil samples was also determined. The samples were also screened for total petroleum hydrocarbons (TPH).

Selected samples were also screened for asbestos containing material (ACM).

Samples of soil, from BH 2 and BH 4 at 0.50m depth, were scheduled for a Waste Acceptance Criteria (WAC) CEN Leachate Suite at 10l/kg.

GROUND CONDITIONS

The ground conditions encountered by the exploratory holes comprised a thin cover of topsoil and made ground over a Head Deposit (chillwash), which was underlain by the solid geology of the London Clay at 2.00m to 2.50m depth (31.95mOD to 32.25mOD), and followed by the Lambeth Group at 6.90m to 8.00m below ground level (26.10mOD to 27.85mOD). The 15.00m and 20.00m deep boreholes were completed within the Lambeth Group strata.

A soil profile is included at the rear of this report as Figure 2.

Topsoil/Made Ground

Where soft landscaping was present at the surface (BH 1 and BH 2), the site was surfaced by a 0.40m thick layer of stiff, friable, dark brown, sandy silt/clay topsoil.

Elsewhere, the site was surfaced by a 0.10m thick layer of asphalt. In BH 3 this was underlain by a red brown, silty sand and gravel fill, with occasional cobbles of brick, to 0.50m depth. This sub-base fill had a gravel fraction of granite and brick fragments. In BH 4 the asphalt at 0.10m depth was underlain by a 0.10m thick layer of reinforced concrete. Below this concrete was a black ash fill and a compacted sand and gravel fill to 0.50m depth.

The topsoil and made ground were found to depths of 0.40m and 0.50m below ground level on this site.

Head Deposits

The topsoil and made ground were underlain at 0.40m and 0.50m depth by a stiff, locally firm, brown, orange brown and grey mottled, locally slightly sandy, silty clay. This Head Deposit (chillwash) contained rare, thinly laminated, orange brown silt partings and medium gravel size calcareous concretions, and was found to between 2.00m and 2.50m below ground level (31.95mOD to 32.25mOD).

London Clay

The solid geology of the London Clay was met beneath the Head Deposits at between 2.00m and 2.50m depth (31.95mOD to 32.25mOD), and was initially weathered to a firm or stiff, closely fissured, brown and grey mottled clay with grey or orange brown stained fissures. At between 3.00m and 4.50m below ground level, the London Clay became a locally firm, becoming stiff and very stiff, grey, silty clay with rare, thinly laminated light grey silt partings, medium gravel size pyrite nodules, rounded, black flint gravel and gravel size, weak, light brown, calcareous siltstone nodules. Below 6.00m to 7.00m depth in BH 1 to BH 3, the London Clay became a firm or stiff, grey, slightly sandy, silty clay with rare fossil shell debris.

The London Clay was proved to between 6.90m and 8.00m depth on this site (26.65mOD to 27.75mOD) and was found to deepen slightly toward the east of the site.

Lambeth Group

The Lambeth Group, met beneath the London Clay at between 6.90m and 8.00m below ground level, generally comprised a very stiff, brown, orange brown, grey, purple and red brown mottled, locally sandy, silty clay with rare, medium gravel size, calcareous concretions. In BH 3 a 0.60m thick layer of brown, silty, fine sand was met at 17.50m depth, within the clay.

The Lambeth Group was found to at least the base of the boreholes at 15.00m or 20.00m below ground level.

Groundwater

Boreholes BH 1, BH 2 and BH 4 were dry during boring and upon completion. In BH 3 water was recorded overnight at 7.00m in the 8.00m deep hole, when the casing was at 5.00m depth, indicating a seepage in the London Clay between 5.00m and 7.00m below ground level.

In the same borehole, groundwater was subsequently met at 17.50m depth within a 0.60m thick layer of Lambeth Group sand. This water rapidly rose to 9.00m depth, was not sealed out by the casing, and was recorded at 15.00m below ground level on completion.

COMMENTS ON THE GROUND CONDITIONS IN RELATION TO FOUNDATION DESIGN AND CONSTRUCTION

It is proposed to demolish an existing two-storey building and construct a replacement teaching block, together with a new temporary classroom and plant room.

A thin layer of topsoil and made ground was found to cover the site, mantling firm and stiff Head Deposits, which were underlain by the stiff solid geology London Clay and very stiff Lambeth Group clay.

The Head Deposit and London Clay would be suitable strata into which mass concrete foundations could be installed for the proposed development, or alternatively piled foundation extended into the underlying London Clay and Lambeth Group strata could be considered.

Foundation Depths

The exploratory holes encountered topsoil and made ground to 0.40m and 0.50m depth. Foundations should be taken down through the topsoil and made ground and into the underlying naturally deposited soils.

The near surface Head Deposit clay, found to depths between 2.00m and 2.50m below ground level (31.95mOD to 32.25mOD), had modified plasticity indices of between 24% and 41%, and so is of a medium to high volume change potential. In open, naturally deposited ground, at least 30m from trees, the National House Building Council (NHBC) Standards Chapter 4.2 'Building near trees' (2020) recommends a minimum foundation depth of 1.00m in soils with a high volume change potential.

A Cherry tree is located 10m from the proposed footprint of the replacement teaching block, and a Poplar tree is located within 10m of the proposed temporary classroom. As the temporary classroom is understood to remain for only 18 months, any seasonal settlement/heave induced by the nearby Poplar tree is likely to be within tolerable limits. However, if a more permanent structure were required at this location, foundations should be constructed using the guidance below.

Reference to the previously cited NHBC standards indicates a 'worst case' minimum footing depth of 1.40m where a single, mature, moderate water demand Cherry tree is present 10.00m from foundations, in these high volume change potential soils. For a high water demand Poplar tree, within 13.00m of the proposed foundations, the standards indicate a 'worst case' footing depth of at least 2.50m. This could be progressively reduced to the minimum foundation depth of 1.00m in high volume change potential soils at 33.00m distance.

Foundations within the range of influence of trees, whether they are removed or retained, will have to be separated from the soil by a suitable void former. The required gap dimensions for footings in the high volume change potential clay soils are detailed in the previously cited NHBC document.

In summary, foundations for new buildings on this site could be based within the underlying, high volume change potential Head Deposit and London Clay. Foundations will need to be a minimum of 1.00m deep, but will locally need to be taken to a minimum of 1.40m depth, close to the Cherry tree, and to at least 2.50m below ground level at the western end of the site, close a mature Lombardy Poplar.

Bearing Capacity/Settlement

Based on the apparent cohesion results from the laboratory tests, the Head Deposit clay was of a firm, locally stiff consistency. Net safe bearing capacities, including a factor of safety of 3.0 against general shear failure are shown below in Table 1, and should be considered for foundations cast within the non-desiccated, Head Deposit clay across the site.

Table 1: Bearing Capacities for Strip and Pad Foundations

Foundation Depth (below existing ground level)	Bearing Capacity for a 0.60m wide strip foundation	Bearing Capacity for a 1.00m wide square pad foundation
1.00m	105kN/m ²	115kN/m ²
1.50m	120kN/m ²	135kN/m ²
2.00m	135kN/m ²	155kN/m ²
2.50m	135kN/m ²	160kN/m ²

Settlement for such loads should be within 25mm for load bearing brickwork for the proposed buildings.

Piled Foundations

The London Clay and Lambeth Group strata beneath the site would provide a suitable stratum into which bored or contiguous piles can be installed. The advice of a specialist piling contractor should be sought prior to design. The use of driven piles may be ruled out on this site on the basis of the potential for vibrations caused by the piling to be potentially damaging to neighbouring school buildings.

Within the range of influence of trees, such as close to the Lombardy Poplar at the western end of the site, piles would need to be sleeved to depths through the made ground, Head Deposits and root impacted clay soils.

For the purposes of preliminary pile design, the pile bearing coefficients given below, which are based on the following assumptions, may be used to assess working loads for a bored pile.

- 1) Ultimate shaft friction/adhesion should be ignored within the made ground.
- 2) The ultimate load on a pile would be the sum of the side friction/adhesion acting on the pile shaft together with the end bearing load.
- 3) In the clay strata the shaft adhesion and end bearing would be a function of the apparent shear strength obtained from the triaxial compression tests (Figure 1).
- 4) A factor of safety of at least 2.5 would be used to assess pile working loads, unless test loading of selected piles is undertaken, in which case it could be reduced to 2.0.
- 5) Where piles are installed in groups it will be necessary to position them at least 3.0 diameters apart, centre-to-centre, otherwise a reduction in individual working load will need to be taken into account.

Item	Ultimate Pile Bearing Value kN/m ²
Shaft friction/adhesion within the made ground and root impacted clay is ignored.	Nil
Average shaft adhesion in firm Head Deposits, to 2.5m	30
Average shaft adhesion in stiff London Clay, 2.5m to 8m	40
Average shaft adhesion in very stiff Lambeth Group, below 8m	100
End bearing in very stiff Lambeth Group, below 8m	1800

Using these coefficients it is estimated that single, 300mm and 450mm diameter bored piles installed to 10m depth would have anticipated working loads of 280kN and 390kN, respectively, with a factor of safety of 2.5. Bored piles extended to 15m depth would have available working loads of 460kN (300mm diameter) and 670kN (450mm diameter), at the same factor of safety of 2.5.

Different pile lengths, or diameters, from those detailed above would give different available working loads, which could be tailored to suit the working loads required.

A piling specialist should undertake final design of piles.

Excavations/Groundwater

The topsoil/made ground and underlying clay soils should be easily removed within foundation excavations for the proposed new buildings. Statutory safety precautions should not be neglected and excavations especially those where personnel are to enter, will need to be supported, or have battered sides where space permits. All excavations should be undertaken in accordance with CIRIA Report 97 *‘Trenching Practice’*

The boreholes were generally dry to 15.00m depth, except for a seepage between 5.00m and 7.00m below ground level in BH 3. A groundwater strike was also encountered at 17.50m depth, associated with a sand layer in the Lambeth Group, but should not be met by foundation excavations on this site. Some ‘perched’ groundwater may be encountered during wetter periods of the year, where water is trapped within the base of the made ground, Head

Deposits and above the practically impervious London Clay. Such inflows are likely to be seasonal and should easily be dealt with by pumping from sumps.

The base of foundation excavations should be inspected on completion to ensure that the condition of the soil complies with that assumed in design. Should pockets of inferior material or made ground be present, they should be removed and replaced with well graded, well compacted hardcore or lean mix concrete. The excavated surfaces should be protected from deterioration and a blinding layer of concrete used where foundations are not completed without delay. Care should be exercised to ensure that surface water is not allowed to collect in the base of excavations.

Floor Slabs

At the location of the replacement teaching block, a ground bearing floor slab may be adopted, following removal of any made ground, its replacement with well graded and compacted stone, careful inspection and preparation using a vibratory roller.

If a permanent structure were to be adopted at the western end of the site, within influencing distance of the Poplar tree, its floor slab should not be ground bearing and will need to be suspended upon the foundations in order to avoid possible differential movement between them.

These foundations should be separated from the underlying high volume change potential clay soils by a sub-floor gap, as indicated in Table 7 of the above cited NHBC Standards, in order to accommodate future heave, which may be continue even if the nearby tree were removed or dies.

Pavement Design

The likely pavement formation level within the site would be within Head Deposit clay on this site. The plasticity indices of the near-surface Head Deposit clay were between 24% and 45%.

Table 5.1 of Interim Advice Note (IAN) 73/06, Revision 1 (2009), indicates a design CBR value of 2.5% could be adopted for thin roads underlain by near surface clay with a plasticity index of 40%.

Provided that the sub-grade is compacted using a vibratory roller and any particularly soft pockets are removed and replaced, a conservative design CBR value of 2.5% could be adopted for hardstanding and road design on the clay soils at shallow depth on this site.

Buried Concrete

Sulphate analysis of the soil samples tested gave results in Design Sulphate Classes DS-1 and DS-2 of the BRE Special Digest 1, Table C2 (2005) presented in Appendix 2. The pH results of the soil were between 7.6 and 9.1 and so alkaline.

The London Clay is listed in this publication as being a stratum that may contain sulphides, such as pyrite, hence oxidation due to disturbance during the excavation of foundations may increase the total potential sulphate content. Visual evidence of pyrite was recorded within the London Clay. In the event that excavations into the London Clay are left exposed to the elements for a prolonged period, especially during winter months, there would be a potential for oxidation of any pyrite within the clay and, in the long term, possible thaumasite formation.

Using the characteristic soil sulphate result and pH results an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2 would be considered appropriate for buried concrete beneath this site as detailed in the above cited BRE document.

COMMENTS ON THE CHEMICAL TEST RESULTS OF SOIL

The results of the laboratory chemical testing on near surface soil samples have primarily been compared to soil screening values (SSVs) produced by Land Quality Management Limited (LQM) and the Chartered Institute for Environmental Health (CIEH) presented in their document 'The LQM/CIEH S4ULs for Human Health Risk Assessment: 2015 (Publication Number S4UL3608)'. The LQM/CIEH S4ULs are intended for use in assessing the potential risks posed to human health by contaminants in soil and are transparently-derived and cautious 'trigger values' above which further assessment of the risks or remedial action may be needed. The S4ULs (Suitable for Use Levels) have been derived, in accordance with UK legislation and Environment Agency policy, using a modified version of the Environment Agency CLEA 1.06 software.

Reference has also been given to ATRISKsoil soil screening values produced by Atkins Limited and provided under licence to Ground Engineering Limited. Atkins SSVs have been derived in line with the Environment Agency 2009 guidance using the CLEA 1.071 software. With the absence of a S4UL for cyanide the ATRISKsoil SSV has been used as the soil screening criteria within this report.

In 2014 the Department for Environment Food and Rural Affairs (DEFRA) published, in their document SP1010, Category 4 Screening Levels (C4SL) for several contaminants including lead. The C4SL represent screening levels below which the land could be considered suitable for a specified use and definitely not contaminated land in respect of those determinands. With the absence of S4UL for lead the C4SL has been used as the soil screening criteria within this report.

For each contaminant the adopted soil screening criteria have been calculated for the following land uses:

- Residential use with home grown produce
- Public open space away from residences
- Commercial and industrial usage

The intended purpose of the SSVs are as 'intervention values' in the regulatory framework for assessment of human health risks in relation to land use. These values are not

binding standards, but are intended to inform judgements about the need for action to ensure that a new use of land does not pose any unacceptable risks to the health of the intended users.

Table 2 compares the test results of the soil with the SSVs in relation to the specified uses. The number of test results, which exceed these values, are also provided.

Table 2: Comparison of Chemical Test Results of soil with SSVs

Determinand	Number of Samples	Min Value (mg/kg)	Max Value (mg/kg)	Number of Samples Exceeding SSV for:			Soil Screening Criteria SSV (1.0% SOM)			
				Residential with home grown produce	Public Open Space close to residences mg/kg	Commercial/ Industrial	Assessment Method	Residential with home grown produce mg/kg	Public Open Space close to residences mg/kg	Commercial/ Industrial mg/kg
Organic matter	4	<0.1%	0.7%	-	-	-	-	-	-	-
Arsenic	4	11	13	0	0	0	S4UL	37	79	640
Cadmium	4	<0.2	<0.2	0	0	0	S4UL	11	120	190
Trivalent Chromium	4	36	41	0	0	0	S4UL	910	1500	8600
Hexavalent Chromium	4	<4.0	<4.0	0	0	0	S4UL	6	7.7	33
Lead	4	12	66	0	0	0	C4SL	200	630	2330
Mercury	4	<0.3	<0.3	0	0	0	S4UL	11	40	320
Selenium	4	<1.0	<1.0	0	0	0	S4UL	250	1100	12,000
Nickel	4	23	34	0	0	0	S4UL	130	230	980
Phenols	4	<1.0	<1.0	0	0	0	S4UL	120	440	440
Benzo[a]pyrene	4	<0.05	<0.05	0	0	0	S4UL	0.79	2.2	15
Copper	4	19	30	0	0	0	S4UL	2400	12,000	68,000
Zinc	4	55	80	0	0	0	S4UL	3700	81,000	730,000
Free Cyanide	4	<1	<1	0	0	0	ATRISK	34	34	34
Notes S4UL and C4SL for metals were derived using 6% SOM. These values are not sensitive to SOM and would also be applicable for 1% SOM and 2.5% SOM. LQM/CIEH S4ULs ©Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3608. All rights reserved ATRISKsoil SSVs produced by Atkins Limited and provided under licence to Ground Engineering Limited.										

Discussion of Results

The results of the laboratory analysis (Table 2) on the soil samples tested indicate the absence of elevated concentrations contaminants, as none exceeded their respective screening values for a residential, public open space or commercial/industrial land use.

Due to the absence of elevated concentrations of contaminants, the soil on this site would be considered suitable for reuse at the surface in a public open space close to residences setting, which is considered to be representative of the use of the site as a school.

Fragments of asbestos containing material were not identified in the soils tested from this site.

Visual and olfactory evidence of hydrocarbon impacted soils was not detected within any of the boreholes on this site. The TPH results obtained from selected samples and the WAC tests were less than the laboratory detection limits in BH 2 and BH 4, and 45mg/kg and 52mg/kg in BH 1 and BH 3, respectively. These values are considered to reflect the presence of decayed organic material within the samples tested, rather than fuel contamination.

CONCEPTUAL MODEL

An assessment of the potential linkage between ground contamination sources, human and environmental receptors has been based on the intrusive ground investigation documented in the preceding section of this report.

A generalised conceptual model, updated following the intrusive works, monitoring and testing, and targeted to provide coverage across the site, relative to the construction phase and completed development, is presented below in Table 3.

Table 3: Conceptual Model Relative to Construction and Future Redevelopment

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources		
		Buildings/ Drainage	Soil Beneath Site	Ground Contamination Outside Site Boundary
Human Health i ground workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Moderate Likelihood	Low Likelihood	Low Likelihood
Human Health i users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	N/A	Low Likelihood	Low Likelihood
Water Environment	Migration through ground into surface water or groundwater	N/A	Very Low Likelihood	Low Likelihood
Flora	Vegetation on site growing on contaminated soil.	N/A	Very Low Likelihood	Low Likelihood
Building Materials	Contact with contaminated soil	N/A	Very Low Likelihood	Low Likelihood

Key to Table 3

Likelihood	Definition
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or, there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) and remedial works may be necessary in the short term and likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.
N/A	Not Applicable because the proposed development will remove the source.

COMMENTS ON GROUND CONTAMINATION IN RELATION TO PROPOSED DEVELOPMENT

It is proposed to demolish an existing two-storey building and replace it with a new two-storey teaching block, together with the construction of a new temporary classroom and plant room. No new areas of soft landscaping are anticipated within the development. Anticipated exposure scenarios relating to the site and future redevelopment works including remedial options as applicable are discussed as follows.

This investigation may not have revealed the full extent of contamination on the site and appropriate professional advice should be sought if subsequent site works reveal materials that may appear to be contaminated.

Contaminated Soil

The exploratory holes found up to 0.50m of topsoil/made ground beneath the site. No concentrations of contaminants tested for exceeded their respective SSVs for residential, public open space or commercial/industrial end uses.

Fragments of asbestos containing material were not identified in the soils tested from this site. No visual or olfactory evidence of hydrocarbons was detected, and the results of the TPH screening are not considered to reflect the presence of fuel contamination.

There is a low likelihood that the made ground soils would affect groundworkers and future end users of the site where the made ground is exposed, such as in gardens or landscaped areas.

Existing Drainage

Redundant foul or surface water drain runs, should be removed from beneath the site and precautions should ensure that any remaining effluent is directly disposed off-site. The integrity of existing drainage should be checked, and where they are to be retained, any damaged sections should be replaced prior to development. The latter measures should remove any future risk to human health and to the water environment.

Buildings

The existing teaching block may have asbestos containing materials within it. Suitable precautions, in line with current best practice, should be put in place to protect workers from the effects of asbestos material, during the redevelopment phase.

Human Health - Construction Workers

The absence of elevated levels of contamination, with regard to the SSVs for residential, public open space and commercial/industrial end uses, within the made ground soils beneath the site indicates that there is a low likelihood that a pathway could develop affecting groundworkers during the construction phase of development.

No special precautions would be required during the development of the site by workers who may come into contact with the soil during groundworks, providing that standard precautions are adopted which should generally include the procedures given by the Health and Safety Executive (The Blue Book) HS(G)66.

For the protection of workers during groundworks the following is recommended:

- a) Limit repeated or prolonged skin contact with soils by wearing gloves with sleeves rolled down.
- b) Washing facilities should be made available to groundworkers, as to minimise the potential for inadvertent ingestion of soil.
- c) If any soils are revealed which are different to those encountered by this ground investigation, the advice of a specialist should be sought in view of classifying the material and ascertaining its risk to groundworkers.

Human Health - Users of Completed Development

The results indicated that the made ground across the site would be considered suitable for retention or re-use at surface within the proposed school development (public open space close to residences). Soil remediation is therefore not considered to be necessary.

Effects on Services

Upgrading of service utility materials, particularly for water supply pipes, is unlikely to be required within the soils on this site. However, it would be advisable to ensure that the topsoil is not used as a backfill around water supply pipes and that they are laid within a clean bedding material. Further guidance on the selection of materials for use as water supply pipes should be sought from the local water supplier.

Water Environment

A groundwater seepage was recorded *perched* within the London Clay at between 5.00m and 7.00m depth. Groundwater was subsequently recorded *perched* within a sand layer of the Lambeth Group at 17.50m below ground level, beneath the practically impervious London Clay. No elevated concentrations of contaminants, with regard to the SSVs for residential with home grown produce, public open space close to residences and commercial/industrial end uses, were found in the made ground on the site. It is considered there is a very low risk that the proposed redevelopment, including the construction of foundations, would impact the quality of the water environment.

Off-Site Disposal of Soil Arisings

The results of chemical analysis are provided in Appendix 1 and can be used for the basic characterisation of the soil destined for landfill. The Environment Agency publication Hazardous Waste, Technical Guidance WM3 outlines the methodology for classifying wastes and should be referenced for guidance. The test results (total metals, hydrocarbons and cyanide) should be compared to the relevant thresholds to determine whether they fall into the primary categories of non-hazardous waste or hazardous waste and will help indicate the likely European Waste Catalogue (EWC) code, which is determined by the waste type. The results of Waste Acceptance Criteria (WAC) leachate testing should be used to check whether if categorised as non-hazardous waste it could be disposed of at an inert waste landfill; or if categorised as hazardous waste whether it could qualify as stable non-reactive hazardous waste for disposal in non-hazardous landfill.

Excavated material and excess spoil should always be classified prior to removal from site as required by 'Duty of Care' (Environmental Protection Act, 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal. Basic characterisation is the responsibility of the waste producer and compliance checking and on-site verification are generally the responsibility of the landfill operator. The landfill operator will need to liaise with the waste producer as the approach relies on the information from basic characterisation.

It is expected that clean arisings from foundation excavations into the natural soils across this site would also fall into the inert category under the European Waste Catalogue description 'Soil and Stones' EWC code 17 05 04 with restrictions excluding topsoil and peat.

CONTAMINATION ASSESSMENT CONCLUSIONS

The proposed redevelopment is for the construction of a replacement teaching block, new plant room and a temporary classroom. The existing site is detailed on the exploratory hole location plan at the rear of this report. The proposed development layout is also shown on a plan at the rear of this report, and will need to be confirmed by the Engineer/Architect in order to clearly identify areas of new gardens and soft landscaping, if envisaged.

Remediation Statement

Remediation of the soils beneath the site, in respect of the development, is not considered necessary due to the absence of elevated concentrations of contaminants. Indeed, the existing topsoil and near surface soils could be reused at the surface within the proposed redevelopment.

GROUND ENGINEERING LIMITED



A. J. MURDOCH

M.Geol., F.G.S.,

Project Geo-Environmental Engineer



S. J. FLEMING

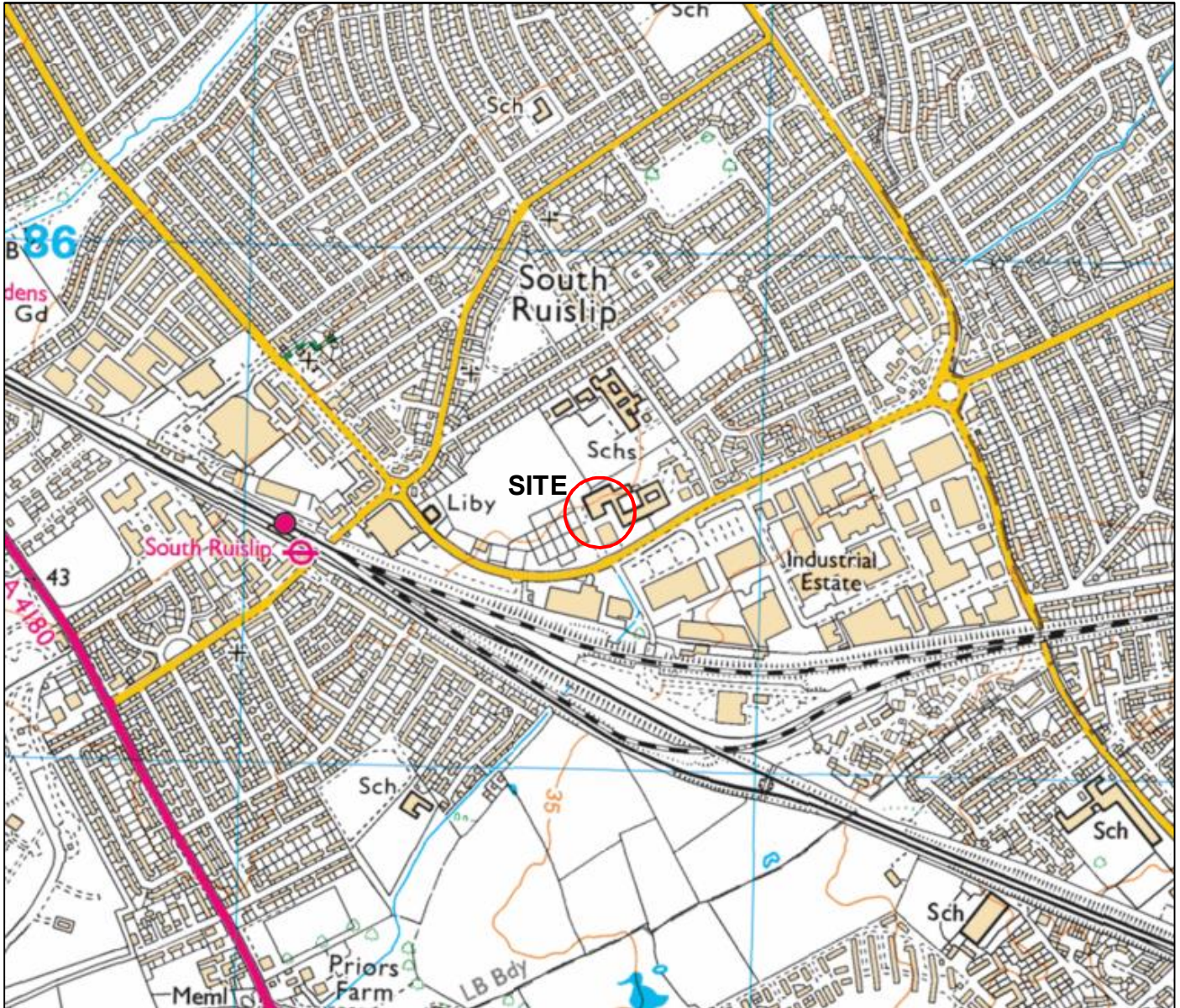
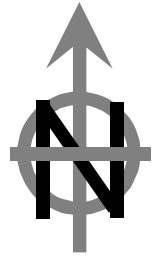
M.Sc., M.C.S.M.,

C.Geol., F.G.S.,

Director

Site Location Plan

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0m 500m 1000m

Project : Queensmead School, Victoria Road, South Ruislip

Client : Morgan Sindall C. & I. Ltd.

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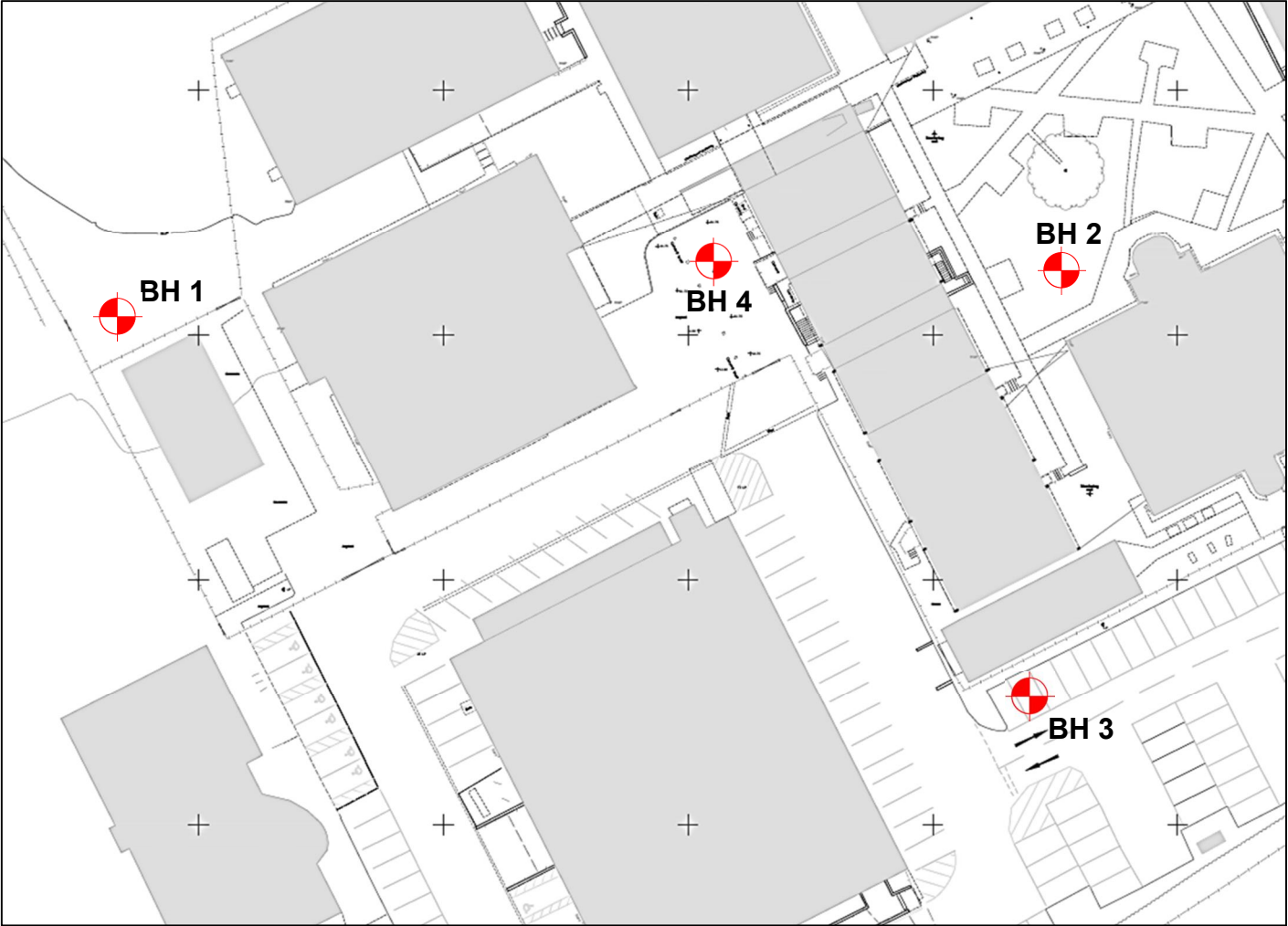
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Exploratory Hole Location Plan

Reproduced from a plan provided by the client.



0m 25m 50m

Key

Cable Percussive
Borehole



Project : Queensmead School, Victoria Road, South
Ruislip

Client : Morgan Sindall C. & I. Ltd.

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Cable Percussive Borehole



C15024

GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: QUEENSMEAD SCHOOL, SOUTH RUISLIP				BOREHOLE BH1 Ground Level: 35.25m. O.D.					
			Date: 23/03/20 to 24/03/20		Hole Size: 200mm dia to 15.00m							
Samples and in-situ Tests			(Date) Casing	Description of Strata	Legend	Depth m	O.D. Level m					
Depth m	Type	Blows										
0.50	B1			TOPSOIL - Stiff, friable, dark brown, sandy SILT/CLAY.		0.40	34.85					
1.20-1.65	U1	70		Firm, brown, orange brown and grey mottled, slightly sandy, silty CLAY with rare, thinly laminated, orange brown sand partings and medium gravel size calcareous concretions from 1.20m depth. (HEAD DEPOSIT)								
1.65 1.80 2.00-2.45	D1 B2 U2	75		Firm, becoming stiff, closely fissured, brown and grey mottled CLAY with orange brown stained fissures. (WEATHERED LONDON CLAY)		2.00	33.25					
2.45 2.50	D2 B3											
3.00-3.45	U3	75		Stiff, closely fissured, grey brown, silty CLAY with occasional thinly laminated, light grey silt partings, and rare fossil shell debris, medium gravel size pyrite nodules and rounded black flint pebbles.		3.00	32.25					
3.45 3.50	D3 B4											
4.00-4.45	U4	80										
4.45 4.50	D4 B5											
5.00-5.45	U5	85		(LONDON CLAY)								
5.45	D5											
6.00	B6			Stiff, grey brown, slightly sandy, silty CLAY with rare fossil shell debris.		6.00	29.25					
6.50-6.95	U6	90		(LONDON CLAY)								
6.95	D6											
7.50	B7			Very stiff, brown, orange brown, grey and purple mottled, silty CLAY.		7.50	27.75					
8.00-8.45	U7	85										
8.45	D7											
9.00	B8			(LAMBETH GROUP)								
9.50-9.95	U8	90										
9.95	D8					10.00	25.25					
REMARKS 1. Excavating a pit from 0.00m to 1.20m for 1 hour 2. Live roots observed to 1.65m depth 3. Borehole cased to 3.00m depth						Project No 15024						
						Scale 1:50	Page 1/2					
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample S/C - SPT Spoon/Cone ∇ - Water Strike ∇ - Water Rise N/* - SPT Blows for 0.3m or given penetration ES - Environmental Sample V - Vane Shear Test Cohesion () kPa Level on completion Level casing withdrawn Standpipe Level			Groundwater Strikes				Groundwater Observations					
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
									23/03/20	1.80	1.50	dry
							24/03/20	1.50	1.50	dry		
							24/03/20	3.00	3.00	dry		

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Date: 23/03/20
to 24/03/20

Ground Level: 35.25m. O.D.

REMARKS

Project No
15024

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KEY	N/* - SPT Blows for 0.3m or given penetration	Groundwater Strikes						Groundwater Observations			
		Depth m						Date	Depth m		
		No	Struck	Rose to	Rate	Cased	Sealed		Hole	Casing	Water
B - Bulk Sample	ES - Environmental Sample										
U - Undisturbed Sample	V - Vane Shear Test										
W - Water Sample	Cohesion () kPa										
S/C - SPT Spoon/Cone	▼c Level on completion										
▼ Water Strike	c▼w Level casing withdrawn										
▼ Water Rise	▼s Standpipe Level										

GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: QUEENSMEAD SCHOOL, SOUTH RUISLIP					BOREHOLE BH2				
			Date: 21/03/20		Hole Size: 200mm dia to 15.00m			Ground Level: 34.45m. O.D.				
Samples and in-situ Tests			(Date) Casing	Description of Strata	Legend	Depth m	O.D. Level m					
Depth m	Type	Blows										
0.50	B1			TOPSOIL - Stiff, friable, dark brown, sandy SILT/CLAY.		0.40	34.05					
1.20-1.65	U1	75		Firm, becoming stiff, brown, orange brown and grey mottled, slightly sandy, silty CLAY with rare medium gravel size calcareous concretions.								
1.65 1.70 2.00-2.45	D1 B2 U2	80		(HEAD DEPOSIT)								
2.45 2.50	D2 B3			Firm, closely fissured, brown and grey mottled CLAY with orange brown stained fissures.		2.50	31.95					
3.00-3.45	U3	85		(WEATHERED LONDON CLAY)								
3.45 3.50	D3 B4			Firm, becoming very stiff, closely fissured, grey, silty CLAY with rare, gravel size, weak, light brown, calcareous siltstone nodules, medium gravel size pyrite nodules and rounded, black flint gravel.		4.00	30.45					
4.00-4.45	U4	70		(LONDON CLAY)								
4.45 4.50	D4 B5											
5.00-5.45	U5	80										
5.45	D5											
6.00	B6											
6.50-6.95	U6	90										
6.95	D6			Firm, grey, slightly sandy, silty CLAY.		7.00	27.45					
7.50	B7			(LONDON CLAY)								
8.00-8.45	U7	90		Very stiff, light brown, red brown, orange brown and grey mottled, silty CLAY with rare, medium gravel size calcareous nodules.		7.80	26.65					
8.45	D7											
9.00	B8			(LAMBETH GROUP)								
9.50-9.95	U8	95										
9.95	D8					10.00	24.45					
REMARKS 1. Excavating a pit from 0.00m to 1.20m for 1 hour 2. Borehole cased to 3.00m depth						Project No 15024						
						Scale 1:50	Page 1/2					
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample S/C - SPT Spoon/Cone ▽w Water Strike ▽ Water Rise N/*- SPT Blows for 0.3m or given penetration ES - Environmental Sample V - Vane Shear Test Cohesion () kPa Level on completion Level casing withdrawn Standpipe Level			Groundwater Strikes				Groundwater Observations					
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
						21/03/20	15.00	3.00	dry			

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			Date: 21/03/20		Hole Size: 200mm dia to 15.00m				Ground Level: 34.45m. O.D.		
Samples and in-situ Tests			(Date) Casing	Description of Strata				Legend	Depth m	O.D. Level m	
Depth m	Type	Blows									
10.50	B9			Very stiff, brown, light brown, red brown and purple mottled, silty CLAY.				x x x x	10.00	24.45	
11.00-11.45	U9	100		(LAMBETH GROUP)				x x x x			
11.45	D9							x x x x			
12.00	B10			Very stiff, brown, light brown, red brown and grey mottled CLAY.				x x x x	12.00	22.45	
12.50-12.95	U10	95						x x x x			
12.95	D10							x x x x			
13.50	B11							x x x x			
14.00-14.45	U11	95		(LAMBETH GROUP)				x x x x			
14.45	D11							x x x x			
15.00	B12			Borehole completed at 15.00m depth				x x x x	15.00	19.45	
REMARKS											
									Project No 15024		
									Scale 1:50	Page 2/2	
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample S/C - SPT Spoon/Cone Water Strike Water Rise			N/* - SPT Blows for 0.3m or given penetration ES - Environmental Sample V - Vane Shear Test Cohesion () kPa Level on completion Level casing withdrawn Standpipe Level			Groundwater Strikes Depth m No Struck Rose to Rate Cased Sealed			Groundwater Observations Date Depth m Hole Casing Water		

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Date: 19/03/20
to 20/03/20

Ground Level: 34.10m. O.D.

REMARKS	1. Excavating a pit from 0.00m to 1.20m for 1 hour 2. Borehole cased to 5.00m (200mm) and 20.00m (150mm) depth
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Scale 1:50	Page 1/2
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KEY	N/* - SPT Blows for 0.3m or given penetration B - Bulk Sample ES - Environmental Sample U - Undisturbed Sample V - Vane Shear Test W - Water Sample Cohesion () kPa S/C - SPT Spoon/Cone ▽c Level on completion ▽ Water Strike c ▽w Level casing withdrawn ▽ Water Rise ▽s Standpipe Level	Groundwater Strikes						Groundwater Observations			
		Depth m						Date	Depth m		
		No	Struck	Rose to	Rate	Cased	Sealed		Hole	Casing	Water
		1	17.50	9.00		5.00	not	19/03/20	8.00	5.00	dry
								20/03/20	8.00	5.00	7.00
								20/03/20	20.00	5.00	15.00

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Date: 19/03/20
to 20/03/20

Ground Level: 34.10m. O.D.

REMARKS	Borehole completed at 20.00m depth	Project No 15024	
		Scale 1:50	Page 2/2

[illegible]

Borehole Number	Depth (m)	Casing Depth (m)	Depth to Water (m)	Type of Test *	Seating Drive Blows/ Penetration (mm)	Test Drive: 300mm Blows for each successive 75 mm Penetration				N Value	Extra- polated Value
BH3	12.50 - 12.95	5.00		S	10/150	7	7	9	9	32	

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* C denotes test using a solid cone
S denotes test using a split barrel sampler

Results of Standard/Cone Penetration Tests

15024

QUEENSMEAD SCHOOL, SOUTH RUISLIP

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Date: 24/03/20
to 25/03/20

Ground Level: 34.75m. O.D.

REMARKS	1. Excavating a pit from 0.00m to 1.20m for 1 hour 2. Borehole cased to 3.00m depth
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Scale 1:50	Page 1/2
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[illegible]

GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: QUEENSMEAD SCHOOL, SOUTH RUISLIP				BOREHOLE BH4		
			Date: 24/03/20 to 25/03/20		Hole Size: 200mm dia to 15.00m			Ground Level: 34.75m. O.D.	
Samples and in-situ Tests			(Date) Casing	Description of Strata	Legend	Depth m	O.D. Level m		
Depth m	Type	Blows							
10.50	B9			Very stiff, light grey and light brown mottled, silty CLAY.	x — x x — x — x — x x — x — x — x —	10.00	24.75		
11.00–11.45	U9	90		(LAMBETH GROUP)	x — x — x — x — x — x — x — x —	11.40	23.35		
11.45	D9			Very stiff, brown, orange brown, grey and purple mottled, silty CLAY.	x — x — x — x — x — x — x — x —				
12.00	B10			(LAMBETH GROUP)	x — x — x — x — x — x — x — x —				
12.50–12.95	U10	95			x — x — x — x — x — x — x — x —	13.20	21.55		
12.95	D10				x — x — x — x — x — x — x — x —				
13.50	B11			Very stiff, brown and light grey mottled, silty CLAY.	x — x — x — x — x — x — x — x —				
14.00–14.45	U11	90		(LAMBETH GROUP)	x — x — x — x — x — x — x — x —				
14.45	D11				x — x — x — x — x — x — x — x —				
15.00	B12			Borehole completed at 15.00m depth	x — x — x — x — x — x — x — x —	15.00	19.75		
REMARKS								Project No 15024	
								Scale 1:50	Page 2/2
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample S/C - SPT Spoon/Cone Water Strike Water Rise			N/* - SPT Blows for 0.3m or given penetration ES - Environmental Sample V - Vane Shear Test Cohesion () kPa Level on completion Level casing withdrawn Standpipe Level			Groundwater Strikes Depth m No Struck Rose to Rate Cased Sealed		Groundwater Observations Date Hole Casing Water	