

Site Details:

Mallinson Sports Centre,
Highgate School, Bishopswood
Road, London, N6 4NY

Client Ref: 9916_JRCB
Report Ref: SCL-2713492
Grid Ref: 527935, 187749

Map Name: National Grid

Map date: 1991

Scale: 1:1,250

Printed at: 1:2,000



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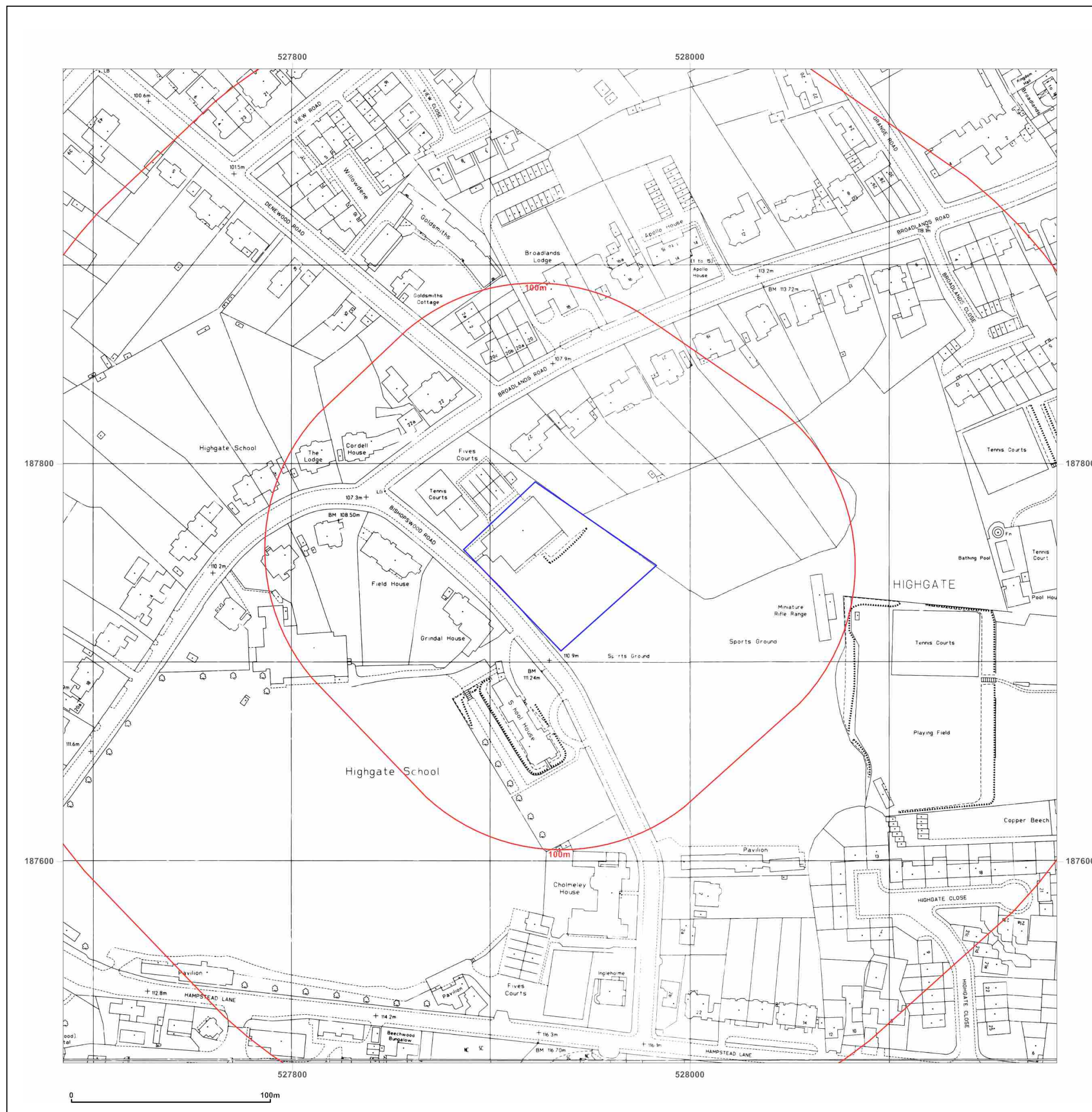


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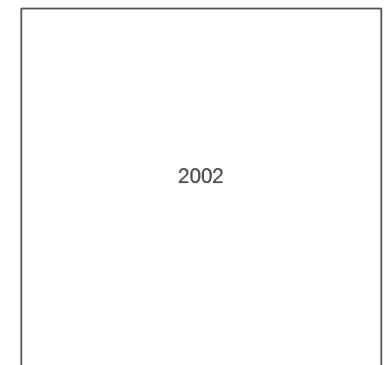
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Report Ref: SCL-2713492
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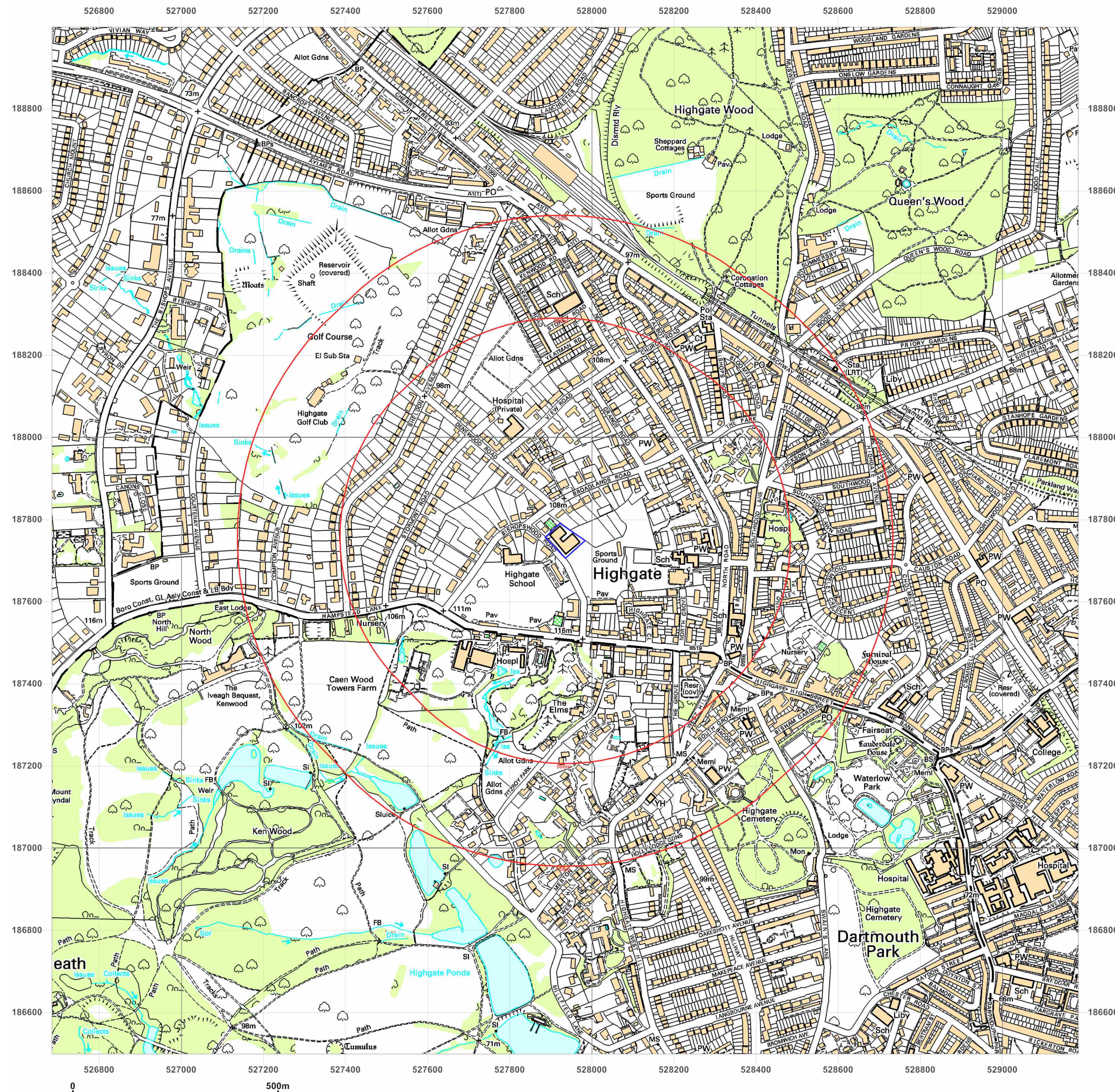


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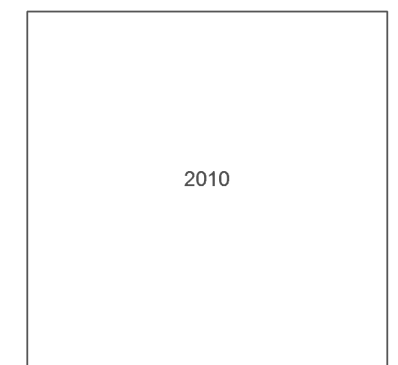
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Grid Ref: 527935, 187749

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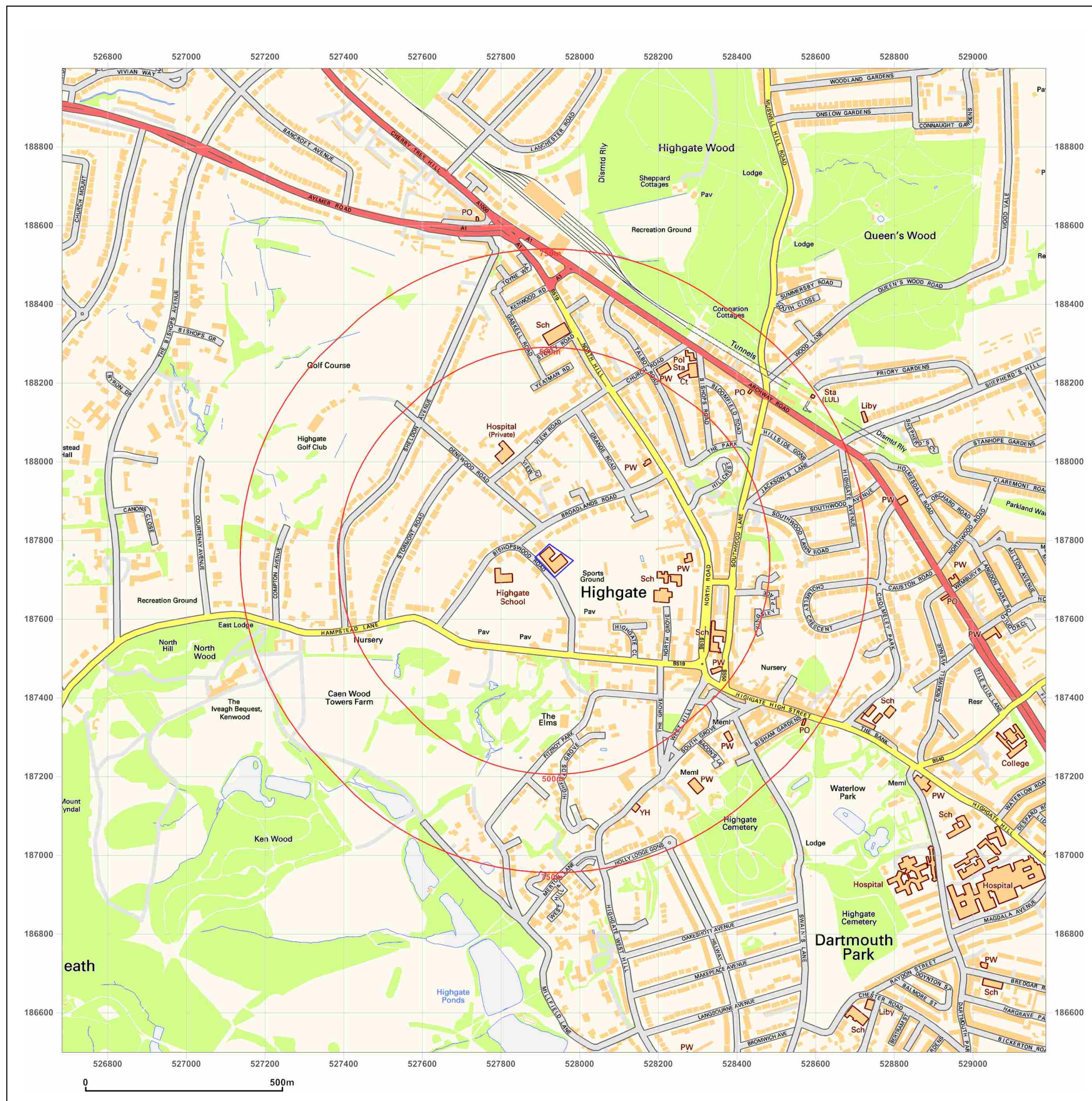


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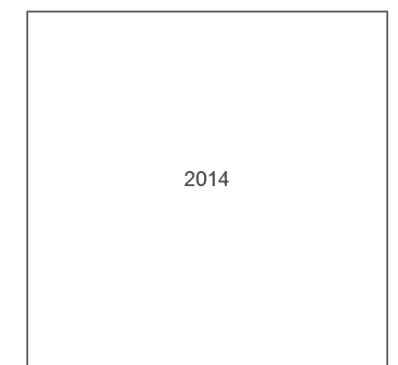
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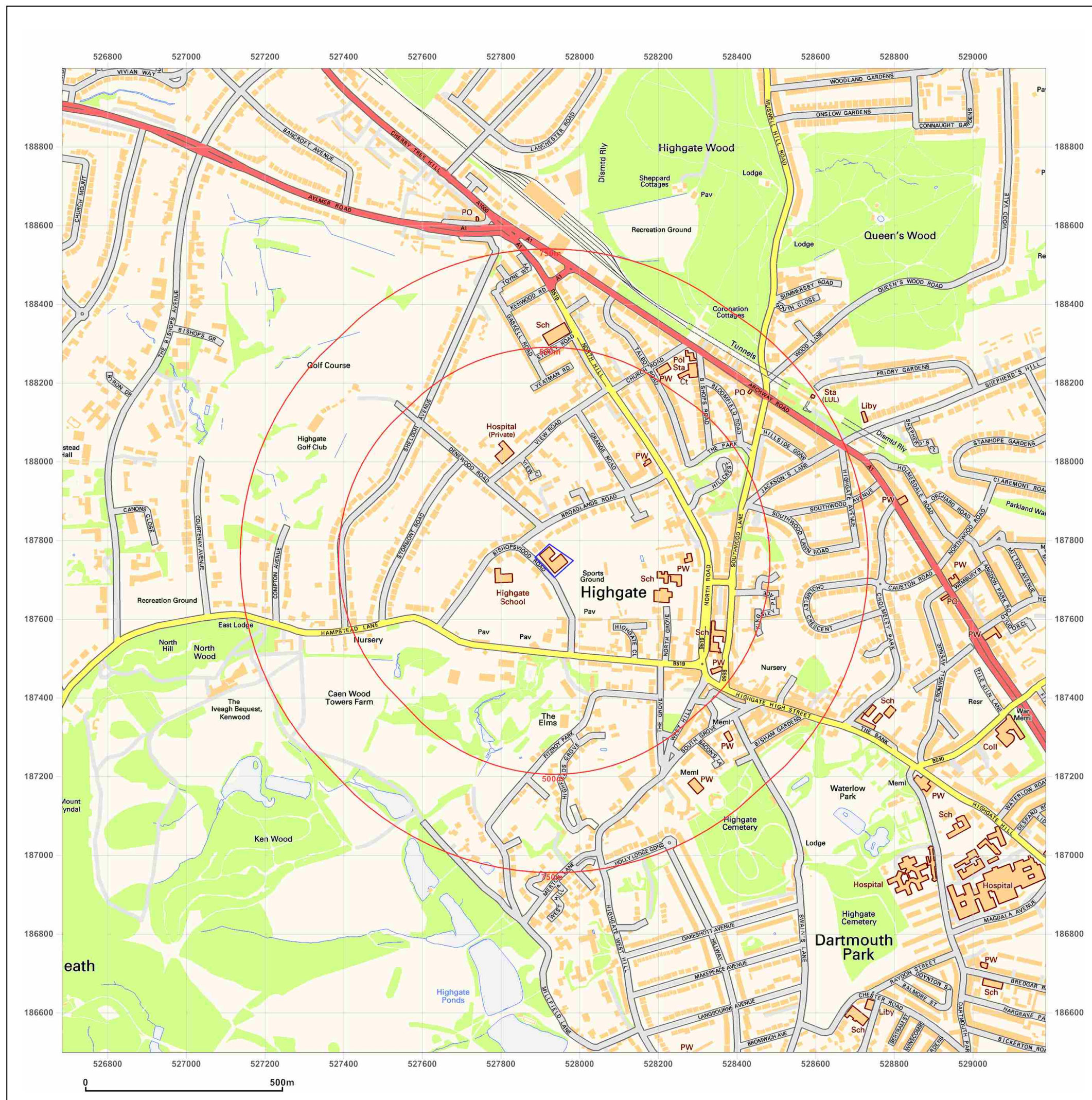


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REPORT ON SUPPLEMENTARY GROUND INVESTIGATION

**MALLINSON SPORTS CENTRE, HIGHGATE SCHOOL
BISHOPSWOOD ROAD, LONDON N6 4PH**



Client: **HIGHGATE SCHOOL**
North Road
London N6 4AY

Consulting Engineers: **PRINGUER-JAMES CONSULTING ENGINEERS LTD**
10 Beulah Road
Wimbledon SW19 3SB

SCL Report ref: **9916A / MR / JRCB**

Date: **6th February 2019**

SUPPLEMENTARY GROUND INVESTIGATION REPORT**MALLINSON SPORTS CENTRE, HIGHGATE SCHOOL
BISHOPSWOOD ROAD, LONDON N6 4PH****DOCUMENT ISSUE STATUS:**

Issue	Date	Description	Author	Checked / approved
Rev 0	06/02/2019	First issue	Matthew Rust BSc, FGS	John Bartley BSc, MSc, CGeol, FGS

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1.0 INTRODUCTION

Consideration is being given to the refurbishment and development of the existing Mallinson Sports Centre. Four main phases of work have been identified including the construction of an additional sports hall and new courts, together with the refurbishment of the existing swimming pool.

A site investigation was undertaken by Soil Consultants Ltd in 2016 in relation to scheme (SCL Ref: 9916/JRCB/OT, 22/02/16). The scope of the development works has since increased and we were commissioned by Pringuer-James Consulting Engineers (PJCE), on behalf of the client, Highgate School, to carry out a supplementary ground investigation to cover the increased development area, mainly to the north-west and south-east of the main buildings.

This report summarises the additional investigation, discusses the ground sequence in relation to the existing investigation and then provides advice on foundation and pavement design, updated as required.

No additional environmental testing/appraisal was requested.

2.0 SITE DESCRIPTION

A detailed description of the site is included in our 2016 report. The overall site has not undergone major change but construction work was being undertaken in the main swimming pool area and courtyard area which were inaccessible during this phase of investigation.

The supplementary investigation targeted the areas to the north-west and south-east of the existing buildings where the additional work is proposed. The north-western area was predominately occupied by 'Eton Five Courts' and an asphalt-surfaced playground. Numerous lime and sycamore trees were located around the boundary of this area; the tree details are noted on the Existing Site & Services Layout Plan, dated Jan 2016 Drawing No. 13849/JV/1 provided by PJCE (and reproduced in the Appendix).

The south-easterly area of the site mainly comprised open ground with the exploratory locations being positioned between the existing sports hall and the all-weather pitch. The ground in this area was locally boggy at the time of our investigation in December 2018.

A Site Plan showing the new site outline is included in the Appendix.

3.0 EXPLORATORY WORK

The supplementary ground investigation was carried out on 17th December 2018 and comprised the following elements:

3.1 Dynamic sampler boreholes

Four dynamic (windowless) sampler boreholes (WS1 to WS4) were completed using a tracked drilling rig under the supervision of an experienced geotechnical engineer from SCL. The boreholes were taken to depths of between 5.0m and 5.45m below ground level (bgl).

Both hand vane and standard penetration testing (SPT) was carried out at regular intervals and representative samples were taken for geotechnical testing. The hammer Energy Ratio (Er) for the SPT equipment used was 60%; the relevant test certificate is appended.

Monitoring pipes (35mm ID) were installed within all four boreholes to facilitate future groundwater and gas monitoring.

3.2 California Bearing Ratio testing

Three in-situ CBR tests were carried out using the TRL Dynamic Cone Penetrometer (DCP). Bulk samples were also retrieved at the same locations for laboratory remoulded CBR tests.

3.3 Geotechnical and chemical laboratory testing

The following geotechnical laboratory testing was completed:

-  Natural moisture content and index properties (Atterberg Limit) tests
-  CBR tests on remoulded samples
-  Soluble sulphate/sulphur/pH (by DETS Ltd)

The engineering borehole logs and the geotechnical laboratory testing results are included in the Appendix. The ground levels at the exploratory locations have been interpolated from the topographical survey drawing provide by PJCE (untitled).

4.0 GROUND CONDITIONS

The site investigation carried out in 2016 indicated that the site is underlain by a variable thickness of made ground overlying the Claygate Member, resting upon the London Clay Formation. This ground sequence was generally confirmed by the supplementary investigation and a summary of the sequence, taking into account both investigation phases, is outlined below:

4.1 Made ground

The made ground was present in all boreholes and extended to depths of between 0.30m and 1.10m bgl. It was variable in composition, comprising either dark grey/black gravel or soft/firm gravelly clay, with subsidiary amounts of ash, brick, concrete, glass and clinker fragments.

4.2 Claygate Member

The Claygate Member was present within all boreholes beneath the made ground layer, and extended to depths of between 3.60m and 3.90m bgl; this is equivalent to between approximately +101.95mOD and +106.10mOD. It generally comprised soft or firm brown/orange, pale grey and blue/grey clay with a variable silt and sand content and occasional gravelly pockets. Occasional pockets of clayey gravel were identified in all boreholes (except of WS1) suggesting that localised natural re-working has occurred. Hand vane tests and SPT N-values indicate a low to medium strength classification. Index property tests indicate a low to medium (locally high) plasticity clay/silt (BS scheme) and non-plastic to medium volume change potential (NHBC scheme).

4.3 London Clay Formation

The London Clay Formation was met at depths of between 3.60m and 3.90m bgl. Its interface with the Claygate Member exhibited a marked dip from about +105m/+106mOD in east of the site down to about +102mOD/+103mOD in the western area. The formation generally comprised dark grey/grey silty clay with a variable sand content; occasional silt/sand partings were also present. Hand vane tests, SPT N-values and triaxial tests indicate the clay to be locally low strength in the upper levels, becoming medium then high strength with depth. Index property tests indicate an intermediate to high plasticity clay (BS scheme) and medium volume change potential (NHBC scheme).

4.4 Groundwater

Groundwater inflows generally occurred at depths of between 2.20m and 3.60m bgl. There appears to be a general flow down to the west, with water levels at about +106m/+107mOD in the east, falling to about +104m/+105mOD in the central and western parts of the site following the topography.

Localised shallower inflows were observed in the 2016 trial pits at between 0.90m and 1.20m depth, and in the 2018 borehole, WS1, at about 0.30m depth; these observations indicate that shallow perched groundwater is present locally.

5.0 GEOTECHNICAL ASSESSMENT

The proposed scheme involves the phased refurbishment/development of the existing sports centre. A summary of the proposals in areas covered by the supplementary investigation is as follows:

-  In the western part of the site, the existing covered courts and squash courts are to be demolished, with the subsequent construction of a new sports hall. FFL of the new hall will be +103.45mOD, ie between approximately 2.5m to 3.5m below current ground level. We understand that a piled retaining wall is to be installed prior to excavation down to the proposed formation level. Piled foundations are, we understand, proposed to carry the structural loads
-  In the eastern, higher-lying part of the site, new covered courts are to be constructed. An FFL of +106.9mOD is proposed (ie the same as the existing sports hall), and this is between approximately 1.5m to 2.5m below existing ground level. Again, we understand that a piled retaining wall is planned to support the excavation, with the structural loads being supported by piles

A cross section through the site showing the proposed configuration is included in the Appendix.

The supplementary boreholes have indicated that the upper part of the ground sequence in the eastern and western parts of the site is not significantly different from the 2016 investigation. The following sections address the proposed 'basement' excavations and piled foundations. We have also included advice on the use of spread foundations at basement level.

5.1 Basement construction and retaining walls

Western zone (new sports hall): the proposed FFL is +103.45mOD and allowing for the basement slab construction the overall excavation level is likely to be about +103.00mOD, where we expect the Claygate Beds (locally naturally reworked) or the London Clay to be exposed. The existing ground level lies at between about +106mOD to +107mOD and therefore excavation depths of between 3m to 4m are envisaged. The groundwater in the two western boreholes (WS1 and WS2) was present at between +104.7mOD and +106.4mOD (with the latter probably being a localised near-surface pocket) and therefore the retaining wall will need to be water-tight to provide adequate groundwater control. Either a secant bored pile wall or steel sheet piled wall could be considered.

Eastern zone (new covered courts): the proposed FFL is +106.9mOD for these new courts, with probable overall excavation level to about +106.5mOD allowing for the slab. The ground surface in this area varies between +109.5mOD and +108.5mOD and excavation depths of between 2m to 3m will therefore be required. Groundwater was encountered in the boreholes at between +106.2mOD and +107.05mOD, and therefore the excavation is likely to extend slightly below the water table, at least locally. We recommend that continued monitoring of the borehole installations is carried out to confirm the groundwater level in this area as equilibrium levels could be significantly higher than those recorded at the end of the fieldwork. On the basis of the current information, it would be advisable to allow for a water-tight structure such as a secant bored pile wall or a sheet piled wall.

Careful selection of the appropriate design parameters will be needed, incorporating allowances for 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
Claygate Member	2.00	0	23
London Clay:			
<5m below basement level	2.00	0	21
>5m below basement 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.

Due consideration should be given by the designer to the potential presence of desiccated soils where the walls lie within a zone of tree root influence. If trees are removed or die, any desiccated clays could conceivably result in higher than active forces on the back of the wall and this will need to be addressed.

We recommend that a specialist contractor or engineer is consulted to confirm the most appropriate type of wall and to provide the final wall design.

5.2 Spread foundations at basement level

Western area (new sports hall)

The basement excavation is expected to either expose the London Clay or remain just above its interface with the Claygate Beds. We consider that any foundations should be placed within the London Clay at or below +102mOD. For a preliminary assessment of the feasibility/sizing of such foundations, we envisage that an allowable bearing resistance of 110kN/m² would be achievable; this would be applicable to moderate sized strip or pad foundations, say up to 2.5m 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, bearing resistances should be determined, using drained and/or undrained parameters as appropriate, to calculate the degree of utilisation of the foundation (limit state GEO).

Eastern area (new covered courts)

The basement excavation is expected to remain within the Claygate Beds, with the London Clay being between about 0.40m and 1.40m below the anticipated excavation level. Spread foundations could be placed within the Claygate Beds but with a limited allowable bearing resistance of, say, 70kN/m² to allow for the presence of soft/low strength zones. A higher allowable bearing resistance of 110kN/m² could be adopted for foundations in the more competent medium strength London Clay, although these will obviously need to be deeper. The EC7 design approach discussed above will again need to be followed.

Desiccation

A number of mature trees are present, particularly on the northern and western site boundaries. Whilst this is not a residential development, we recommend that the guidance contained within the NHBC Standards (Chapter 4.2 'Building near trees') is followed, with local deepening being carried out below any potential zones of desiccated clay. We recommend that a 'medium' volume change potential is used for all soils to assess minimum 'safe' founding depths.

Excavations

Foundation excavations will take place from basement level. The retaining structures around the periphery are expected to control any sustained groundwater inflows, but there may still be localised pockets encountered; we anticipate that these will be effectively controlled by localised pumping. The natural soils, particularly the Claygate Beds, are expected to be highly susceptible to water-softening/disturbance and any foundations will need to be cast immediately following excavation, or a blinding layer placed.

All foundations must be carefully inspected by an experienced professional person to ensure that suitable soils have been exposed, and local deepening should be carried out if very soft soils or root-infested/desiccated soils are encountered.

5.3 Piled foundations

Piled foundations will transfer the structural loads into the relatively competent London Clay. CFA piles are considered to be most appropriate for the ground and groundwater conditions present. The following parameters, as recommended in our previous 2016 report, may be used for a preliminary estimate of pile resistance:

Shaft adhesion

Stratum	Depth / level	Undrained cohesion (from strength profile)	Ultimate unit shaft adhesion 'q _s '
Made ground	Up to 1.10m thick	N/A	Ignore
Claygate Member and upper London Clay (note e)	Above +103mOD	30kPa	15kPa
London Clay	Below +103mOD to +89mOD	Increases linearly from 120kN/m ² at a rate of 5.7kPa/m	Increases linearly from 60kPa at a rate of 2.85kPa/m (incorporates $\alpha = 0.50$)

Notes:

- Unit shaft adhesion 'q_s' = $\alpha \times c_u$ (where $\alpha = 0.50$ and c_u is the undrained cohesion from the design line)
- The α value of 0.5 is based upon 102mm diameter triaxial tests and this should not be varied
- The average shaft adhesion over the pile length should be limited to 110kN/m²
- The maximum value for unit shaft adhesion should be limited to 140kN/m²
- The contribution of all potentially desiccated soils within the zone of tree influence should be ignored. Sufficient tensile reinforcement should be incorporated, as required, to resist swelling forces

End bearing

Stratum	Depth / level	Undrained cohesion (from strength profile)	Ultimate unit base resistance 'q _b '
London Clay	Below +95mOD to +89mOD	Increases linearly from 166kPa at a rate of 5.7kPa/m	Increases linearly from 1,494kPa at a rate of 51.3kPa/m (incorporates $N_c = 9$)

Notes:

- Unit base resistance in clay 'q_b' = $N_c \times c_u$ (where $N_c = 9$ and c_u is the equivalent undrained cohesion from the design line)

A piling specialist must be consulted at an early stage to advise on the most appropriate pile type and to ultimately provide the final pile design.

5.4 Floor slabs, soil heave and hydrostatic pressures

The excavations for the new sports hall and the covered/sunken courts will involve the permanent removal of soil which will theoretically result in an element of heave in the London Clay; factors such as the length of the construction programme, the restraining effects of any axially loaded piles and the basement slab stiffness would determine the amount of soil heave which could actually occur. In addition to this stress-related heave, there is also potentially an element of swell-related movement in peripheral areas where the slab is in the zone of any tree influence.

Suspended floor slab

This type of slab would incorporate a suitable void beneath to accommodate the soil heave/swell. The proposed excavations will result in an average unloading of about 60kN/m^2 and 40kN/m^2 in the areas of the new sports hall and covered/sunken courts, respectively. We have carried out a preliminary analysis and this indicates that total unrestrained heave of approximately 30mm and 15mm respectively could occur as a result of the unloading for the sports hall and courts. Approximately 50% of this heave movement is likely to occur during a typical construction programme, leaving maximum possible post-construction heave of about 15mm and 8mm respectively to be accommodated for stress-related soil heave. In any areas where the slab lies within the zones of tree influence, NHBC guidelines should be followed when determining the void thickness.

Ground-bearing slab

The slabs could be ground bearing and designed to withstand potential heave forces/movements. With respect to any stress-related ground heave, 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 30kN/m^2 (sports hall) and 20kN/m^2 (courts) 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 and 10kN/m^2 respectively, with $<10\text{mm}$ movement. The slab self-weight will cancel out a significant proportion of these heave forces and this approach is therefore expected to be suitable.

In any peripheral zones where the slabs may lie within zones of tree influence, we recommend that NHBC guidance is used to identify the extent of the associated wedge of theoretically desiccated soils, using a 'medium' volume change potential. If this wedge extends below the proposed slab, it is recommended that potentially affected soils are removed and replaced with compacted granular fill.

Proof-rolling should be carried out to identify any significant soft spots which should be replaced with compacted granular fill. Careful inspection of the exposed formation should be carried out and if any root-infested or obviously desiccated soils remain, these should again be removed and replaced with compacted granular fill.

As discussed in Section 5.2, the exposed soils are likely to be highly susceptible to water-softening and disturbance. The exposed formation must be protected from rain/run-off and blinded/foundations cast as soon as practical.

Hydrostatic pressure

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 hydrostatic uplift pressures of about 30kN/m^2 and 20kN/m^2 on the sports hall and covered court slabs respectively.

The above soil heave estimates assume 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.

5.5 Pavement construction

Following removal of topsoil, a CBR value of 2% is considered appropriate for the underlying shallow made ground and natural clay soils. The formation must be proof-rolled prior to pavement construction, and any soft/loose zones replaced with suitably compacted granular material. It would be prudent to use a flexible paving solution in areas likely to be affected by future ground movement as a result of possible desiccation and seasonal variations in moisture content.

5.6 Foundation concrete

The concrete classification has been assessed using the results from both phases of investigation. Low to moderate concentrations of soluble sulphates have been measured within slightly acidic to slightly alkaline pH values. The results fall into Site Design Classes DS-1 to DS-2 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-2.

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 just under 50% of the samples (including results from initial site investigation), suggesting that pyrite is probably present; this substantiates observations made during sample description. The characteristic value of Total Potential Sulphate is 2.9%, which equates to Class DS-4 with a resultant classification of ACEC AC-4. If it is deemed unlikely that the piles and basement raft/slab 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 foundation designer who should provide the final classification.



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 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.

Comments made relating to ground-water or ground-gas are based upon observations made during our investigation unless otherwise stated. Ground-water 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.

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.

(Rev_1_08_03_2013)

APPENDIX

Fieldwork, in-situ testing and monitoring

- ✚ Dynamic sampler borehole records
- ✚ Standard Penetration Test results
- ✚ SPT hammer energy rating certificate
- ✚ TRL DCP results (California Bearing Ratio)

Geotechnical laboratory testing

- ✚ Moisture content and index property testing
- ✚ Plasticity charts
- ✚ Determination of California Bearing Ratio (remoulded samples)

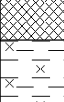
Chemical testing

Sulphate/sulphur/pH test results (DETS Ltd Report: 19-00061, 10/01/19)

Plans & drawings

- ✚ Existing site and service layout (Randall Surveys LLP; drawing no. 13849/JV/2; dated January 2016)
- ✚ Proposed plan
- ✚ Proposed section (Ed Toovey architects, Drawing No: 1182/GS/01, Aug 2018)
- ✚ Site Plan
- ✚ Location Plan

Site & Location: Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH							Borehole No: WS1		
Client: Highgate School					Coordinates: 527890E, 187800N		Sheet 1 of 1		
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +105.75mOD		Report No: 9916A/MR		
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation	
	Type	Depth (m)		Depth (m)	Level (m)				
BH commenced: 17/12/2018				0.20	105.55		Grass over TOPSOIL. Occasional live roots.		
BH diameter 90mm GL to 1m, reducing with depth	D	0.30		0.45	105.30		MADE GROUND: dark grey black ashy slightly silty sandy gravel. Gravel is fine to coarse, angular to subrounded clinker and brick. Occasional ash pockets.		
	D	0.50		0.60	105.15		MADE GROUND: firm brown mottled grey brown slightly silty slightly gravelly clay. Gravel is fine to medium angular to subrounded flint and brick. Rare ash pockets and rare live roots. Slight organic odour.		
Water seepage at about 1.00m	HV	0.50	50				Firm locally soft orange brown and blue grey silty sandy CLAY with rare flint gravel. Occasional partings and lenses of silt and sand. Rare pockets of clayey silt.		
	HV	0.65	60						
	D	0.70							
	D	0.85							
	HV	0.85	50						
	D	0.95							
	HV	0.95	55						
	D	1.00							
	SPT/S	1.00	N=8						
	D	1.30							
	HV	1.30	40						
	HV	1.50	40						
	D	1.60							
	HV	1.70	44						
	D	1.90		1.85	103.90			Orange brown mottled grey clayey silty GRAVEL / gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint. Firm locally soft orange brown and brown silty sandy CLAY. Occasional partings and lenses of silt and sand. Rare pockets of clayey silt.	
	HV	1.95	44	2.00	103.75				
	D	2.00							
	SPT/S	2.00	N=7						
D	2.30								
HV	2.50	35							
D	2.60								
HV	2.80	60							
D	2.95								
D	3.00								
SPT/S	3.00	N=8							
D	3.30								
HV	3.30	45							
D	3.60								
HV	3.60	50							
HV	3.80	50	3.80	101.95		Firm dark grey sandy silty to very silty CLAY with occasional silt and sand partings. <i>becoming slightly sandy below about 4.00m</i> <i>rare shells at about 4.60m</i>			
D	3.90								
D	4.00								
SPT/S	4.00	N=11							
D	4.60								
No recovery from 4.00m to 4.50m	D	4.80							
	HV	4.80	70						
	D	5.00							
	SPT/S	5.00	N=18						
	D	5.00							
BH complete: 17/12/2018 BH depth: 5.45m Water depth: dry 35mm ID monitoring pipe installed to 5.00m				5.45	100.30		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: Dynamic Sampler	
Remarks: Approximate coordinates and ground levels interpolated from Existing Site & Services Layout (Jan 2016, Dwg No. 13849/JV/1)								Borehole No: WS1	

Site & Location: Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH							Borehole No: WS2		
Client: Highgate School					Coordinates: 527878E, 187783N		Sheet 1 of 1		
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +106.70mOD		Report No: 9916A/MR		
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation	
	Type	Depth (m)		Depth (m)	Level (m)				
BH commenced: 17/12/2018	D	0.20		0.15	106.55		MADE GROUND: asphalt.		
Water inflow at about 0.30m to 1.00m (fast) BH diameter 90mm GL to 1m, reducing with depth	D	0.35		0.30	106.40		MADE GROUND dark grey mottled black ashly slightly silty gravel. Gravel is fine to coarse, angular to subrounded clinker and brick.		
	HV	0.35	38	0.40	106.30		MADE GROUND: soft locally very soft brown mottled green grey slightly sandy silty clay. Rare brick fragments. Slight organic odour.		
	D	0.50							
	HV	0.50	30	0.60	106.10		MADE GROUND: soft dark brown mottled grey brown slightly sandy silty clay / clayey silt. Rare brick, flint and clinker gravel. Rare ash. Slight organic odour.		
	D	0.65							
	HV	0.70	30					Soft becoming firm brown and blue grey mottled orange brown silty CLAY. Rare flint gravel.	
	D	0.85							
	HV	0.95	40						
	D	1.00							
	SPT/S	1.00	N=8						
No recovery from 2.00m to 2.30m	HV	1.25	50	1.30	105.40		Soft to firm orange brown mottled blue grey slightly sandy silty CLAY. Rare partings of silt and sand.		
	D	1.30							
	HV	1.45	40						
	HV	1.55	38						
	D	1.60							
	HV	1.75	40						
	D	1.90		1.85	104.85		<i>rare gravel below about 1.75m.</i>		
	D	2.00						Loose pale grey and orange brown clayey silty GRAVEL / gravelly CLAY. Gravel is fine to coarse angular to subrounded flint. Rare sand.	
	SPT/S	2.00	N=7						
				2.30	104.40			Soft locally firm brown mottled orange brown and blue grey silty sandy CLAY. Occasional partings of silt and sand.	
No recovery from 4.00m to 4.70m	D	2.50							
	HV	2.50	20						
	HV	2.70	35						
	D	2.75							
	D	2.95							
	HV	2.95	42						
	D	3.00							
	SPT/S	3.00	N=11						
	D	3.40							
	D	3.60							
HV	3.65	30							
No recovery from 4.00m to 4.70m	D	3.95		3.90	102.80		Firm becoming stiff dark grey silty sandy CLAY. Occasional silt and sand partings.		
	D	4.00							
	SPT/S	4.00	N=13						
	HV	4.00	58						
	D	4.80							
	SPT/S	5.00	N=17						
BH complete: 17/12/2018 BH depth: 5.45m Water depth: dry 35mm ID monitoring pipe installed to 5.00m				5.45	101.25		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: Dynamic Sampler	
Remarks: Approximate coordinates and ground levels interpolated from Existing Site & Services Layout (Jan 2016, Dwg No. 13849/JV/1)								Borehole No: WS2	

Site & Location: Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH						Borehole No: WS3		
Client: Highgate School				Coordinates: 527973E, 187731N		Sheet 1 of 1		
Engineer: Pringuer-James Consulting Engineers Ltd				Ground Level: +109.25mOD		Report No: 9916A/MR		
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 17/12/2018				0.20	109.05		Grass over TOPSOIL. Occasional live roots.	
BH diameter 90mm GL to 1m, reducing with depth	D	0.40					MADE GROUND: dark brown / dark grey slightly clayey, slightly silty gravel. Gravel is fine to coarse, angular to subrounded igneous rock and flint.	
	HV	0.60	20	0.60	108.65		MADE GROUND: soft becoming firm dark grey brown and brown grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse angular to subrounded flint, brick, igneous rock and clinker. Slight organic odour. <i>becoming dark green grey below about 0.85m.</i>	
	D	0.65						
	HV	0.80	45					
	D	0.90						
	D	1.00						
	SPT/S	1.00	N=8	1.10	108.15		Firm orange brown and blue grey slightly sandy silty CLAY with rare flint gravel. Occasional partings of silt and sand.	
	HV	1.20	55				<i>becoming sandy below about 1.40m.</i>	
	D	1.30						
	HV	1.40	65					
	D	1.60						
HV	1.70	65						
Water seepage at about 2.20m to 2.25m; sand lense	D	1.90		1.80	107.45		Orange brown and blue grey slightly silty gravelly CLAY / clayey GRAVEL. Gravel is fine to coarse, angular to rounded flint.	
	D	2.00		2.00	107.25		Soft to firm orange brown and blue grey silty to very silty sandy to very sandy CLAY. Occasional partings and pockets of clayey silt and sand.	2
	SPT/S	2.00	N=8					
	HV	2.20	35					
	D	2.30						
	D	2.60					<i>locally grades to very clayey sand below about 2.70m.</i>	
	D	2.90						
	HV	2.90	36					3
	D	3.00						
	SPT/S	3.00	N=12					
	D	3.60						
HV	3.60	40						
D	3.80		3.80	105.45		Firm dark grey silty sandy CLAY. Rare silt and sand partings.		
HV	3.90	40						
D	4.00							
SPT/S	4.00	N=12						
No recovery from 4.00m to 4.70m	D	4.80						
	HV	4.80	55					
	D	5.00						
	SPT/S	5.00	N=14					
BH complete: 17/12/2018 BH depth: 5.45m Water depth: 3.50m 35mm ID monitoring pipe installed to 5.00m				5.45	103.80		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: Dynamic Sampler
Remarks: Approximate coordinates and ground levels interpolated from Existing Site & Services Layout (Jan 2016, Dwg No. 13849/JV/1)								Borehole No: WS3

Site & Location: Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH							Borehole No: WS4	
Client: Highgate School					Coordinates: 527960E, 187718N		Sheet 1 of 1	
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +109.70mOD		Report No: 9916A/MR	
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 17/12/2018							Grass over TOPSOIL. Occasional live roots.	
BH diameter 90mm GL to 1m, reducing with depth	HV	0.25	30	0.20	109.50		MADE GROUND: soft dark brown / dark grey slightly gravelly silty clay. Gravel is fine to coarse angular to subrounded flint, brick, concrete, quartzite and glass. Locally slightly sandy.	
	D	0.30						
	D	0.50						
	HV	0.50	30					
	D	0.70						
	D	0.90		0.85	108.85		MADE GROUND: firm dark green grey silty to very silty clay with rare gravel-sized brick and clinker.	
	HV	0.90	60	1.00	108.70			
	SPT/S	1.00	N=8					
	HV	1.20	65				Firm orange brown and blue grey slightly sandy silty CLAY with rare flint gravel. Rare parting of silt and sand.	
	D	1.30						
	HV	1.50	45					
	D	1.60						
	HV	1.85	46				Loose to medium dense orange brown mottled dark orange brown very clayey GRAVEL / gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint.	
	D	1.90		2.00	107.70			
	SPT/S	2.00	N=10					
D	2.20		2.35	107.35		Soft locally firm orange brown mottled brown and blue grey sandy silty to very silty CLAY. Occasional partings of silt and sand.		
D	2.50							
HV	2.50	30						
Water inflow at about 3.00m to 3.50m (fast)	HV	2.70	35					
	D	2.80						
	HV	2.90	30					
	D	3.00						
	SPT/S	3.00	N=15					
	D	3.20						
	D	3.50						
	HV	3.60	45	3.60	106.10		Firm dark grey slightly sandy to sandy silty CLAY. Rare partings of silt and sand.	
	D	3.80						
	HV	3.80	42					
D	4.00							
SPT/S	4.00	N=14						
BH complete: 17/12/2018								
BH depth: 5.00m, no recovery between 4.45m to 5.00m								
Water depth: 3.50m								
35mm ID monitoring pipe installed to 4.00m								
				5.00	104.70		End of hole at 5.00m	
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: Dynamic Sampling
Remarks: Approximate coordinates and ground levels interpolated from Existing Site & Services Layout (Jan 2016, Dwg No. 13849/JV/1)								Borehole No: WS4

Site & Location	Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH	Report No:	9916A / MR
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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						
WS1	1.00	S	N=8	2	2	2	2	2	2		Dry	
WS1	2.00	S	N=7	2	2	1	2	2	2		Dry	
WS1	3.00	S	N=8	2	2	2	2	2	2		Dry	
WS1	4.00	S	N=11	3	4	3	2	3	3		Dry	
WS1	5.00	S	N=18	4	5	5	4	4	5		Dry	
WS2	1.00	S	N=8	2	2	2	2	2	2		Dry	
WS2	2.00	S	N=7	2	1	2	2	1	2		Dry	
WS2	3.00	S	N=11	2	3	2	3	3	3		Dry	
WS2	4.00	S	N=13	3	4	3	4	3	3		Dry	
WS2	5.00	S	N=17	4	4	4	4	5	4		Dry	
WS3	1.00	S	N=8	2	2	2	2	2	2		Dry	
WS3	2.00	S	N=8	2	2	2	2	2	2		Dry	
WS3	3.00	S	N=12	3	4	3	3	3	3		Dry	
WS3	4.00	S	N=12	3	3	3	3	3	3		Dry	
WS3	5.00	S	N=14	3	4	3	3	4	4		Dry	
WS4	1.00	S	N=8	2	2	2	2	2	2		Dry	
WS4	2.00	S	N=10	4	4	4	2	2	2		Dry	
WS4	3.00	S	N=15	3	4	4	3	4	4		Dry	
WS4	4.00	S	N=14	3	4	3	4	4	3		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, $E_r = 60\%$

Neil Burrows
Southern Testing Laboratories
Unit 11
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref: DART312
Test Date: 02/02/2018
Report Date: 02/02/2018
File Name: DART312.spt
Test Operator: NPB

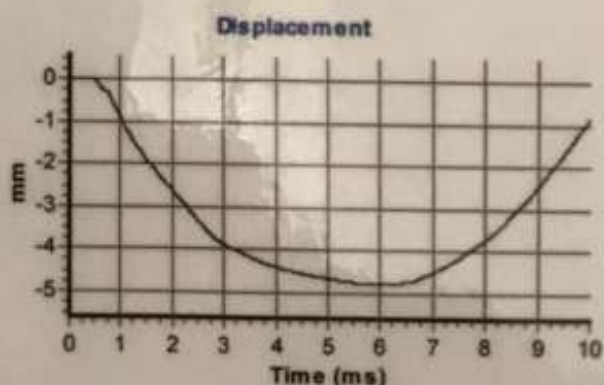
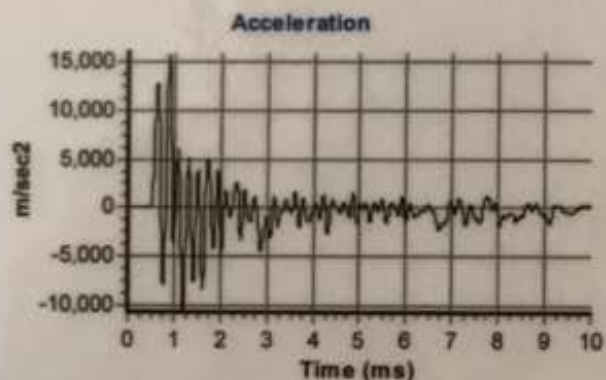
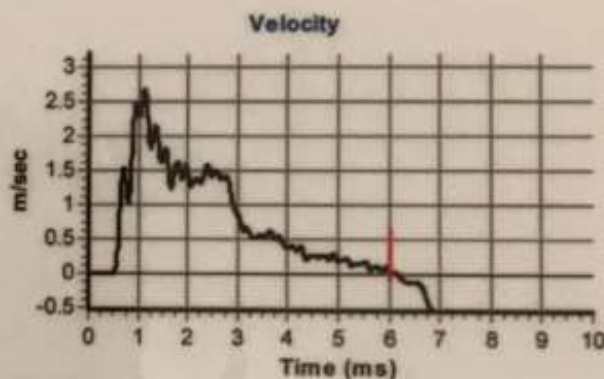
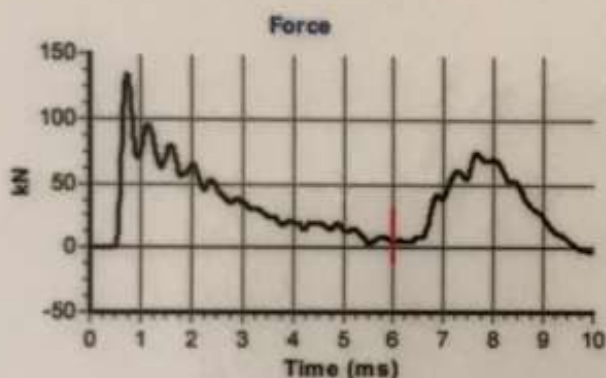
Instrumented Rod Data

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

SPT Hammer Information

Hammer Mass m (kg): 64.5
Falling Height h (mm): 750
SPT String Length L (m): 14.5

Comments / Location



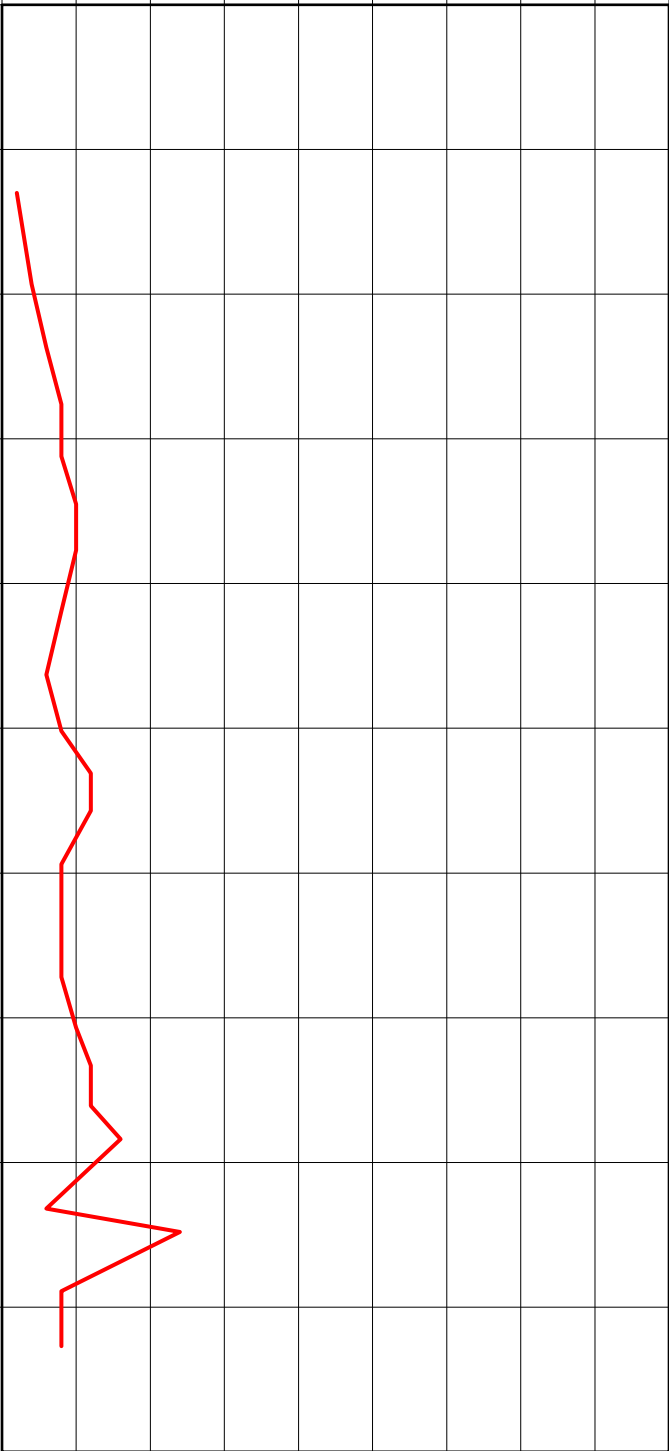
Calculations

Area of Rod A (mm^2): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 284

Energy Ratio E_r (%): **60**

Signed: N P Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

Site & Location	Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH			TRL Probe No:	TRL CBR1	
Client:	Highgate School			(Sheet 1 of 1)		
Project Managers:	Pringuer-James Consulting Engineers Ltd			Report No:	9916A / MR	
TRL Dynamic Cone Penetration test result						
Blow Count	Depth (mm)	mm per blow	CBR (%)	PLOT OF CBR VS DEPTH		
0	19	0		Estimated CBR (%) 0.05.010.015.020.025.030.035.040.045.0 0 100 200 300 400 500 600 700 800 900 1000 Depth below commencement level (mm) 		
1	130	111.0	1.0			
2	193	63.0	2.0			
3	237	44.0	3.0			
4	276	39.0	4.0			
5	312	36.0	4.0			
6	345	33.0	5.0			
7	377	32.0	5.0			
8	419	42.0	4.0			
9	463	44.0	3.0			
10	502	39.0	4.0			
11	531	29.0	6.0			
12	557	26.0	6.0			
13	594	37.0	4.0			
14	633	39.0	4.0			
15	672	39.0	4.0			
16	707	35.0	5.0			
17	733	26.0	6.0			
18	761	28.0	6.0			
19	784	23.0	8.0			
20	832	48.0	3.0			
21	848	16.0	12.0			
22	889	41.0	4.0			
23	927	38.0	4.0			
				Date of test:	17 / 12 / 18	
				Depth test commenced (mbgl):	0.019	

Site & Location	Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH			TRL Probe No:	TRL CBR2	
Client:	Highgate School			(Sheet 1 of 1)		
Project Managers:	Pringuer-James Consulting Engineers Ltd			Report No:	9916A / MR	
TRL Dynamic Cone Penetration test result						
Blow Count	Depth (mm)	mm per blow	CBR (%)	PLOT OF CBR VS DEPTH		
0	32	0		Estimated CBR (%) 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 0 100 200 300 400 500 600 700 800 900 1000 Depth below commencement level (mm)		
1	111	79.0	1.5			
2	168	57.0	2.5			
3	223	55.0	2.5			
4	271	48.0	3.0			
5	306	35.0	5.0			
6	343	37.0	4.0			
7	391	48.0	3.0			
8	453	62.0	2.0			
9	516	63.0	2.0			
10	554	38.0	4.0			
11	586	32.0	5.0			
12	627	41.0	4.0			
13	672	45.0	3.0			
14	718	46.0	3.0			
15	755	37.0	4.0			
16	798	43.0	3.0			
17	845	47.0	3.0			
18	891	46.0	3.0			
19	928	37.0	4.0			
Date of test:				17 / 12 / 18		
Depth test commenced (mbgl):				0.032		

Site & Location	Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH			TRL Probe No:	TRL CBR3		
Client:	Highgate School			(Sheet 1 of 1)			
Project Managers:	Pringuer-James Consulting Engineers Ltd			Report No:	9916A / MR		
TRL Dynamic Cone Penetration test result							
Blow Count	Depth (mm)	mm per blow	CBR (%)	PLOT OF CBR VS DEPTH			
0	34	0		Estimated CBR (%) Depth below commencement level (mm)			
1	117	83.0	1.5				
2	168	51.0	3.0				
3	221	53.0	2.5				
4	253	32.0	5.0				
5	279	26.0	6.0				
6	311	32.0	5.0				
7	340	29.0	6.0				
8	381	41.0	4.0				
9	426	45.0	3.0				
10	455	29.0	6.0				
11	489	34.0	5.0				
12	531	42.0	4.0				
13	567	36.0	4.0				
14	601	34.0	5.0				
15	634	33.0	5.0				
16	666	32.0	5.0				
17	697	31.0	5.0				
18	706	9.0	24.0				
19	715	9.0	24.0				
20	723	8.0	30.0				
21	730	7.0	35.0				
23	748	9.0	24.0				
25	768	10.0	24.0				
27	784	8.0	30.0				
29	796	6.0	40.0				
31	812	8.0	30.0				
33	826	7.0	35.0				
35	839	6.5	40.0				
37	853	7.0	35.0				
39	868	7.5	30.0				
41	887	9.5	24.0				
43	911	12.0	18.0				
44	926	15.0	14.0				
			Date of test:			17 / 12 / 18	
			Depth test commenced (mbgl):			0.034	

Site & Location	Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH	Report No:	9916A / MR
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SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	w _L (%)	w _p (%)	Pass 425 (%)	I _p (%)	Mod I _p (%)	I _L (%)	LOI (%)	Description
WS1	0.85	D	21								Orange brown and blue grey slightly sandy silty CLAY with rare flint gravel
WS1	0.95	D	25								Orange brown and blue grey slightly sandy silty CLAY with rare flint gravel.
WS1	1.00	D	21								Orange brown and blue grey silty sandy CLAY with rare flint gravel.
WS1	1.30	D	22								Orange brown and blue grey silty sandy CLAY with rare flint gravel.
WS1	1.60	D	22	34	17	>95	17		0.29		Orange brown and blue grey silty sandy CLAY with rare flint gravel.
WS1	1.90	D	19								Orange brown and blue grey silty sandy CLAY with rare flint gravel.
WS1	2.00	D	29								Orange brown and blue grey silty sandy CLAY with rare flint gravel.
WS1	2.30	D	31								Orange brown and blue grey silty sandy CLAY with rare flint gravel.
WS1	2.60	D	32								Orange brown and blue grey silty sandy CLAY with rare flint gravel.
WS1	2.95	D	26								Dark grey sandy silty to very silty CLAY.
WS1	3.00	D	27								Dark grey sandy silty to very silty CLAY.
WS1	3.30	D	29								Dark grey sandy silty to very silty CLAY.
WS1	3.60	D	28	52	22	>95	30		0.19		Dark grey sandy silty to very silty CLAY.
WS1	3.90	D	24								Dark grey sandy silty to very silty CLAY.
WS1	4.00	D	25								Dark grey sandy silty to very silty CLAY.
WS1	4.60	D	28								Dark grey sandy silty to very silty CLAY.
WS1	4.80	D	24								Dark grey sandy silty to very silty CLAY.
WS1	5.00	D	25								Dark grey sandy silty to very silty CLAY.
WS2	0.85	D	28								Brown and blue grey mottled orange brown silty CLAY.

Testing in accordance with BS EN ISO 17892 unless specified otherwise Date: 11 Jan 19

Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425µm: by estimation, by hand* or by sieving** (Classification Sheet 1 of 3)

Site & Location	Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH	Report No:	9916A / MR
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SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	w _L (%)	w _p (%)	Pass 425 (%)	I _p (%)	Mod I _p (%)	I _L (%)	LOI (%)	Description
WS2	1.00	D	25	47	19	>95	28		0.22		Brown and blue grey mottled orange brown silty CLAY.
WS2	1.30	D	27								Orange brown mottled blue grey slightly sandy silty CLAY.
WS2	1.60	D	25								Orange brown mottled blue grey slightly sandy silty CLAY.
WS2	1.90	D	10	41	20	25.7**	21	5	-0.50		Pale grey and orange brown clayey silty GRAVEL.
WS2	2.00	D	28								Pale grey and orange brown clayey silty GRAVEL.
WS2	2.50	D	27								Brown mottled orange brown and blue grey silty sandy CLAY.
WS2	2.75	D	263								Brown mottled orange brown and blue grey silty sandy CLAY.
WS2	2.95	D	28								Brown mottled orange brown and blue grey silty sandy CLAY.
WS2	3.00	D	27								Brown mottled orange brown and blue grey silty sandy CLAY.
WS2	3.40	D	29	49	21	>95	28		0.30		Brown mottled orange brown and blue grey silty sandy CLAY.
WS2	3.60	D	29								Brown mottled orange brown and blue grey silty sandy CLAY.
WS2	3.95	D	26								Dark grey silty sandy CLAY.
WS2	4.00	D	25								Dark grey silty sandy CLAY.
WS2	4.80	D	27								Dark grey silty sandy CLAY.
WS3	0.40	D	24								MADE GROUND: dark brown / dark grey slightly clayey, slightly silty gravel.
WS3	1.30	D	25	53	21	>95	32		0.12		Orange brown and blue grey slightly sandy silty CLAY with rare flint gravel.
WS3	1.60	D	22								Orange brown and blue grey slightly sandy silty CLAY with rare flint gravel.
WS3	1.90	D	21								Orange brown and blue grey slightly silty gravelly CLAY.
WS3	2.00	D	26								Orange brown and blue grey silty to very silty sandy to very sandy CLAY.

Testing in accordance with BS EN ISO 17892 unless specified otherwise Date: 11 Jan 19

Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425µm: by estimation, by hand* or by sieving** (Classification Sheet 2 of 3)

Site & Location	Mallinson Sports Centre, Highgate School, Bishopswood Road, London N6 4PH	Report No:	9916A / MR
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SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	w _L (%)	w _p (%)	Pass 425 (%)	I _p (%)	Mod I _p (%)	I _L (%)	LOI (%)	Description
WS3	2.30	D	26	39	20	100	19		0.32		Orange brown and blue grey silty to very silty sandy to very sandy CLAY.
WS3	2.60	D	37								Orange brown and blue grey silty to very silty sandy to very sandy CLAY.
WS3	2.90	D	28								Orange brown and blue grey silty to very silty sandy to very sandy CLAY.
WS3	3.00	D	35								Orange brown and blue grey silty to very silty sandy to very sandy CLAY.
WS3	3.60	D	30								Orange brown and blue grey silty to very silty sandy to very sandy CLAY.
WS3	3.80	D	27								Dark grey silty sandy CLAY.
WS3	4.00	D	25								Dark grey silty sandy CLAY.
WS3	4.80	D	26								Dark grey silty sandy CLAY.
WS3	5.00	D	25								Dark grey silty sandy CLAY.
WS4	1.30	D	22								Orange brown and blue grey slightly sandy silty CLAY with rare flint gravel.
WS4	1.60	D	23								Orange brown and blue grey slightly sandy silty CLAY with rare flint gravel.
WS4	1.90	D	21								Orange brown and blue grey slightly sandy silty CLAY with rare flint gravel.
WS4	2.00	D	9								Orange brown mottled dark orange brown very clayey GRAVEL.
WS4	2.20	D	11	30	13	35.5**	17	6	-0.10		Orange brown mottled dark orange brown very clayey GRAVEL.
WS4	2.50	D	24								Orange brown mottled brown and blue grey sandy silty to very silty CLAY.
WS4	2.80	D	27								Orange brown mottled brown and blue grey sandy silty to very silty CLAY.
WS4	3.00	D	26	40	24	100	16		0.15		Orange brown mottled brown and blue grey sandy silty to very silty CLAY.
WS4	3.20	D	33								Orange brown mottled brown and blue grey sandy silty to very silty CLAY.
WS4	3.50	D	22								Orange brown mottled brown and blue grey sandy silty to very silty CLAY.
WS4	3.80	D	26	49	21	100	28		0.18		Dark grey slightly sandy to sandy silty CLAY.
WS4	4.00	D	26								Dark grey slightly sandy to sandy silty CLAY.

Testing in accordance with BS EN ISO 17892 unless specified otherwise

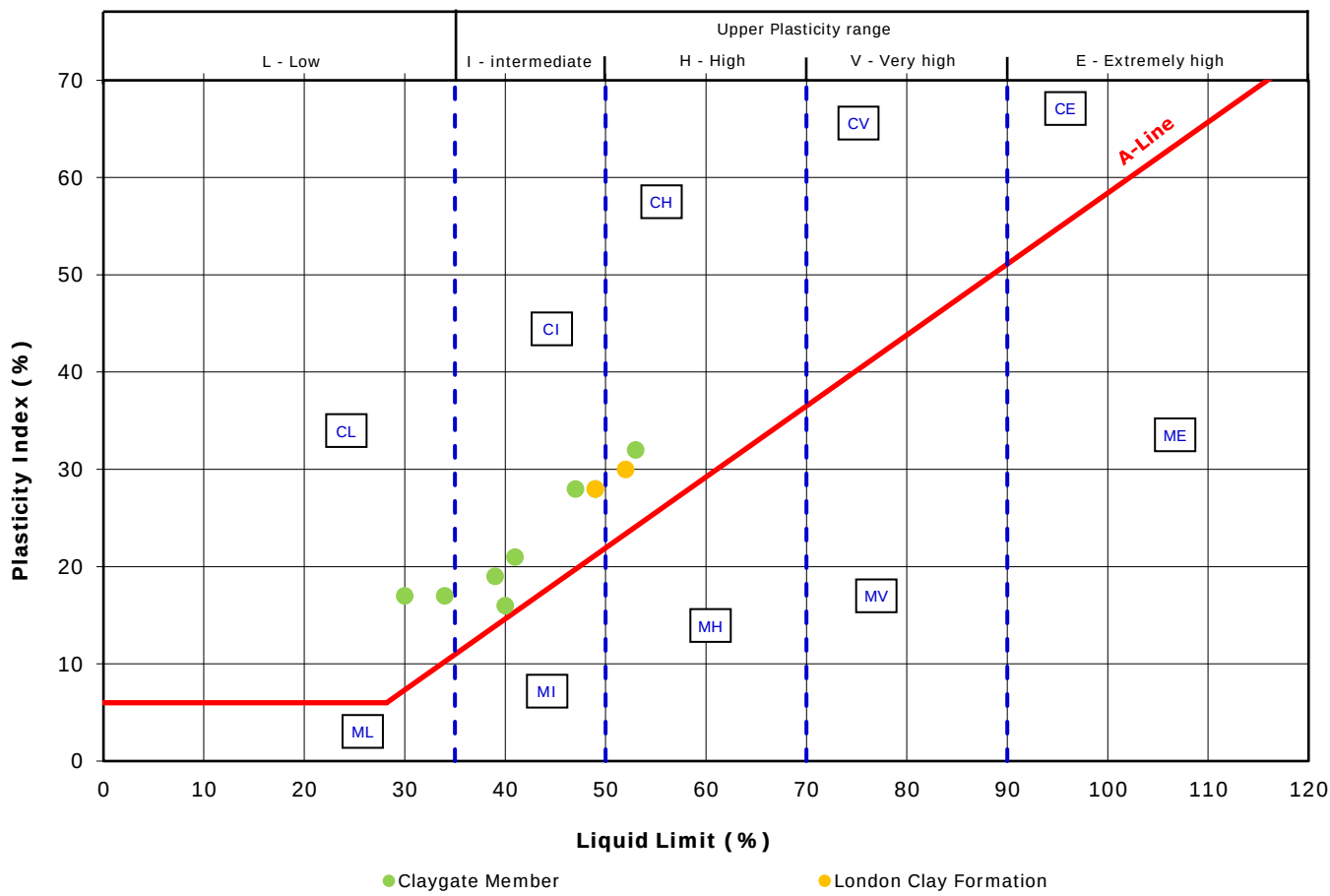
Date: 11 Jan 19

Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425µm: by estimation, by hand* or by sieving**

(Classification Sheet 3 of 3)

Plasticity Chart

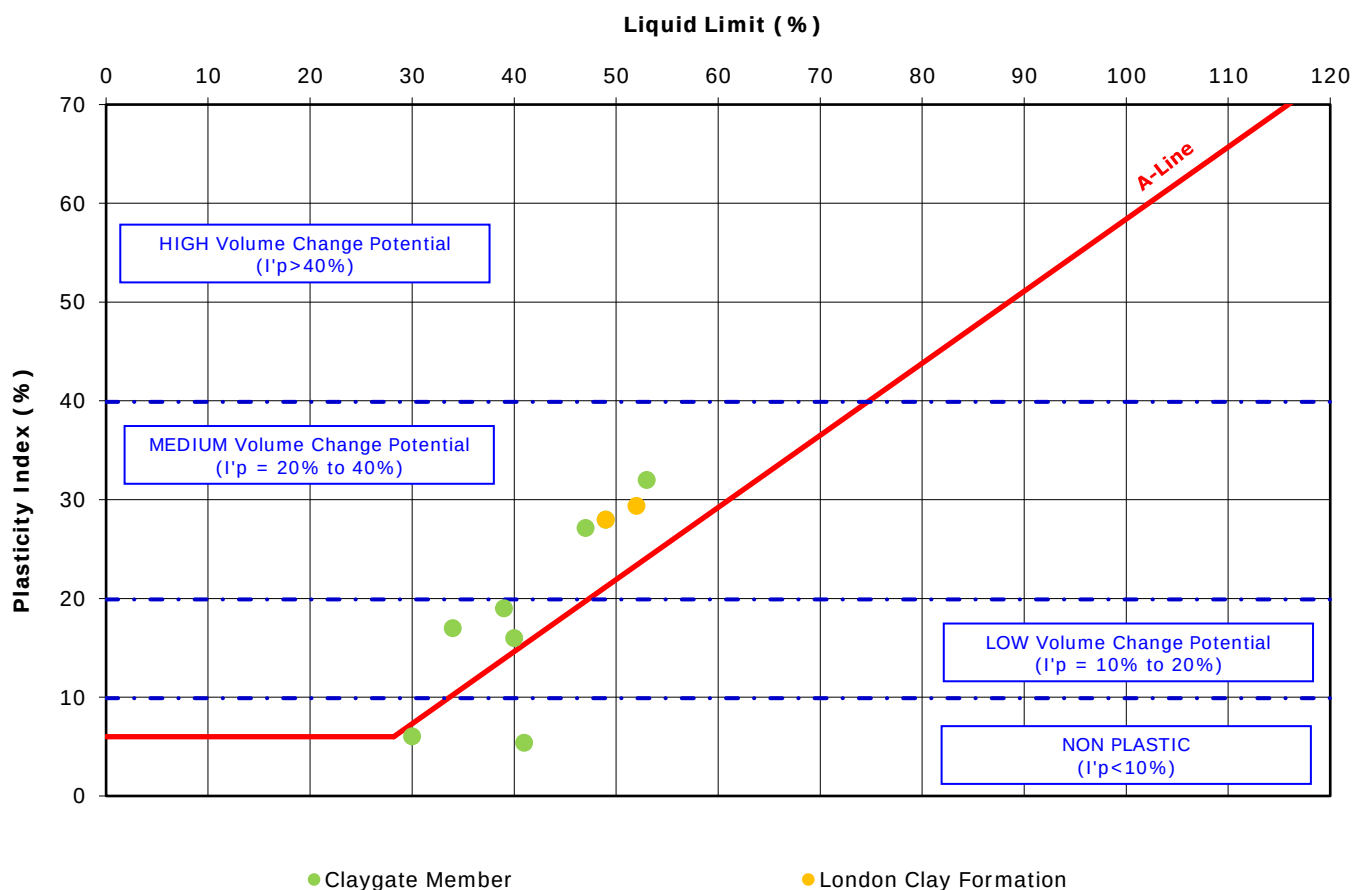


M - SILT [plots below the A-Line]

C - CLAY [plots above the A-Line]

Classification in accordance with BS5930:2015 "Code of practice for site investigations"

Plasticity Chart

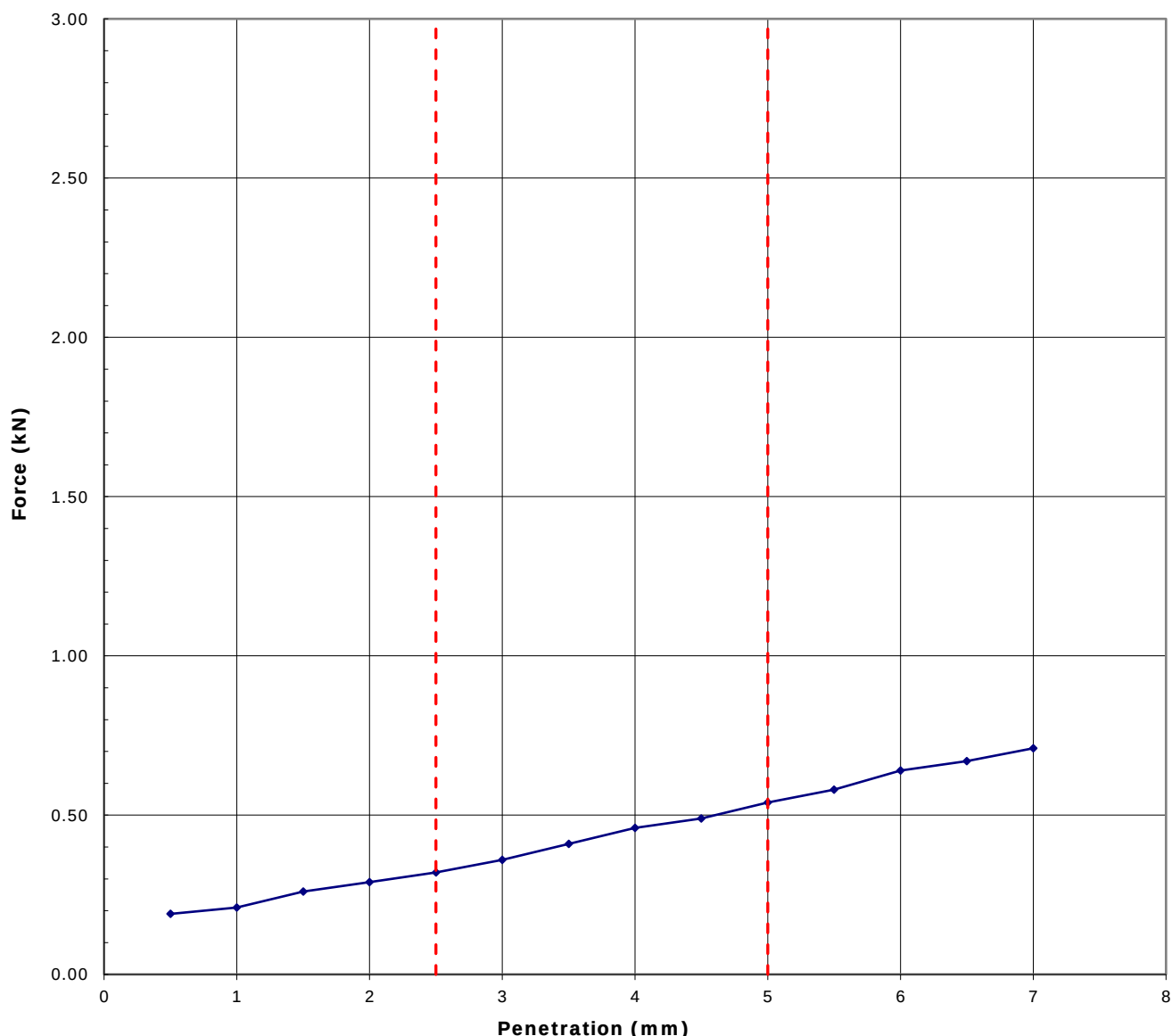


Modified Plasticity Index, I_p:

$$I_p = \frac{I_p \times (\% \text{ passing } 425\text{mm})}{100\%} \quad (\text{where } I_p = \text{Plasticity Index})$$

Classification in accordance with NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

Determination of California Bearing Ratio
(In accordance with: BS1377:1990, Part 4, Clause 7)



Location ID:	CBR1 (Top)	Stratum at test depth:	MADE GROUND: dark brown / black silty very clayey topsoil with occasional gravel. Gravel is fine to coarse subangular brick and masonry. Occasional live roots.
Depth:	0.50m		
Moisture content:	24.3%		
Bulk Density	1.943mg/m ³	Preparation: Method 5 - re-mould sample by dynamic compaction with 2.5kg hammer. Sample not soaked.	
Dry Density	1.573mg/m ³		

CBR results				
Penetration (mm)	Test force (kN)	Standard force (kN)	CBR (%)	Notes
2.5	0.32	13.2	2.4	
5.0	0.54	20.0	2.7	

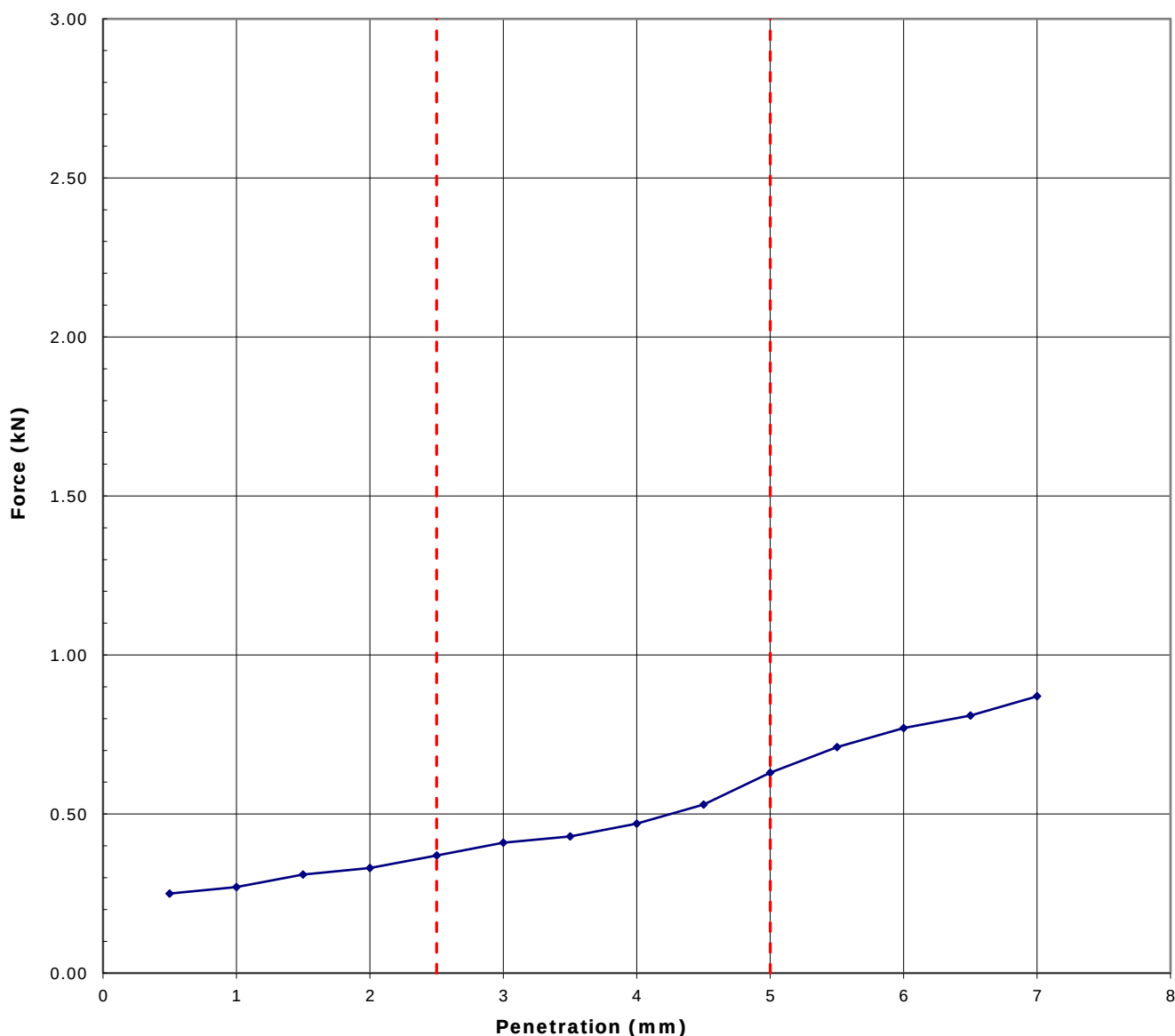
CBR value (%) 2.7

Surcharge: 10kPa

Test date: 04/01/2019

Certificate date: 10/01/2019

Determination of California Bearing Ratio
(In accordance with: BS1377:1990, Part 4, Clause 7)



Location ID:	CBR1 (Base)	Stratum at test depth:	MADE GROUND: dark brown / black silty very clayey topsoil with occasional gravel. Gravel is fine to coarse subangular brick, flint and masonry. Occasional live roots.
Depth:	0.50m		
Moisture content:	22.7%		
Bulk Density	1.943mg/m ³	Preparation: Method 5 - re-mould sample by dynamic compaction with 2.5kg hammer. Sample not soaked.	
Dry Density	1.573mg/m ³		

CBR results				
Penetration (mm)	Test force (kN)	Standard force (kN)	CBR (%)	Notes
2.5	0.37	13.2	2.8	
5.0	0.63	20.0	3.2	

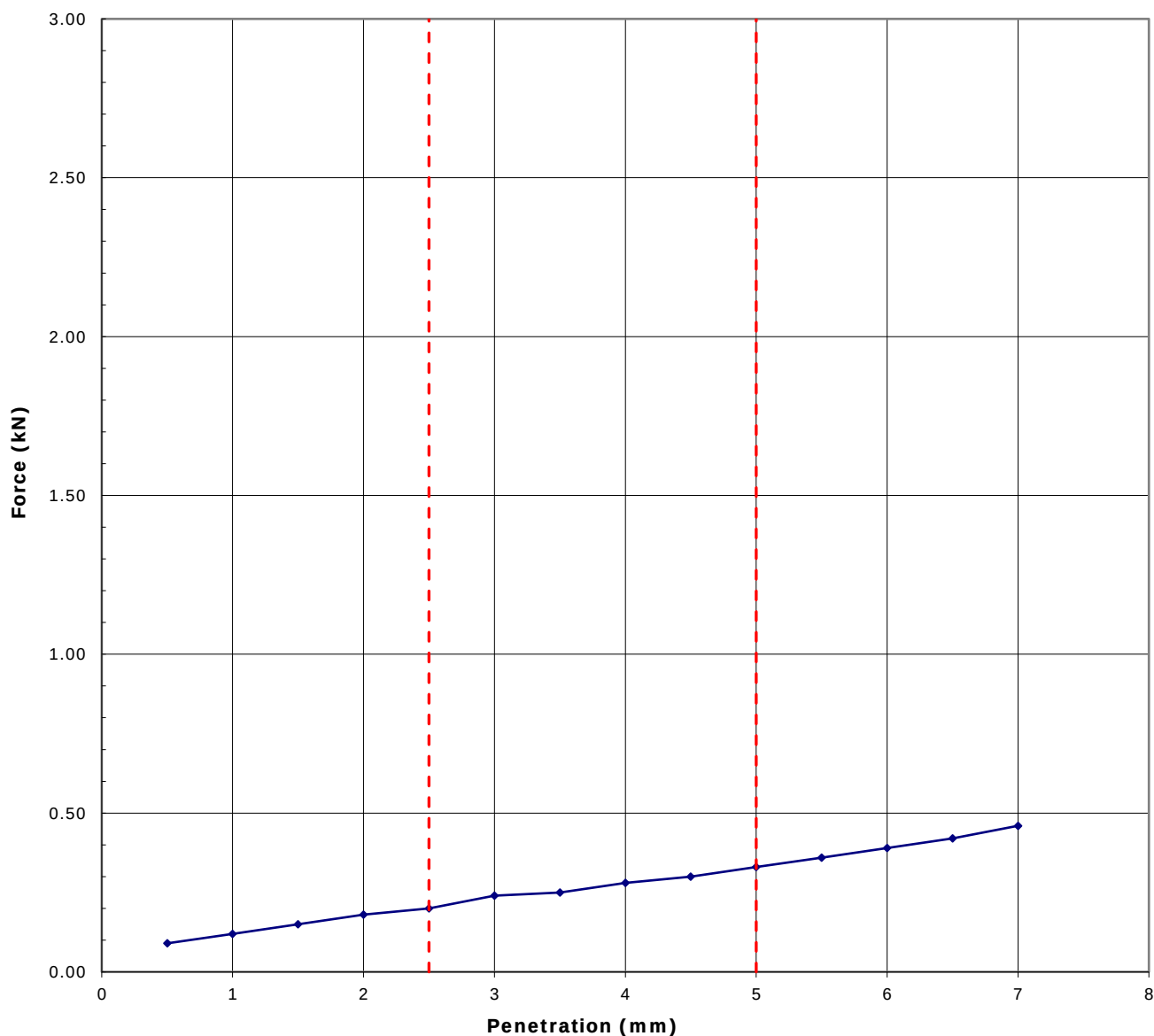
CBR value (%) 3.2

Surcharge: 10kPa

Test date: 04/01/2019

Certificate date: 10/01/2019

Determination of California Bearing Ratio
(In accordance with: BS1377:1990, Part 4, Clause 7)



Location ID:	CBR2 (Top)	Stratum at test depth: MADE GROUND: dark brown slightly sandy clayey silty topsoil with occasional gravel. Gravel is fine to coarse subangular brick and flint. Rare live roots.
Depth:	0.50m	
Moisture content:	28.4%	
Bulk Density	1.846mg/m ³	Preparation: Method 5 - re-mould sample by dynamic compaction with 2.5kg hammer. Sample not soaked.
Dry Density	1.442mg/m ³	

CBR results				
Penetration (mm)	Test force (kN)	Standard force (kN)	CBR (%)	Notes
2.5	0.20	13.2	1.5	
5.0	0.33	20.0	1.7	

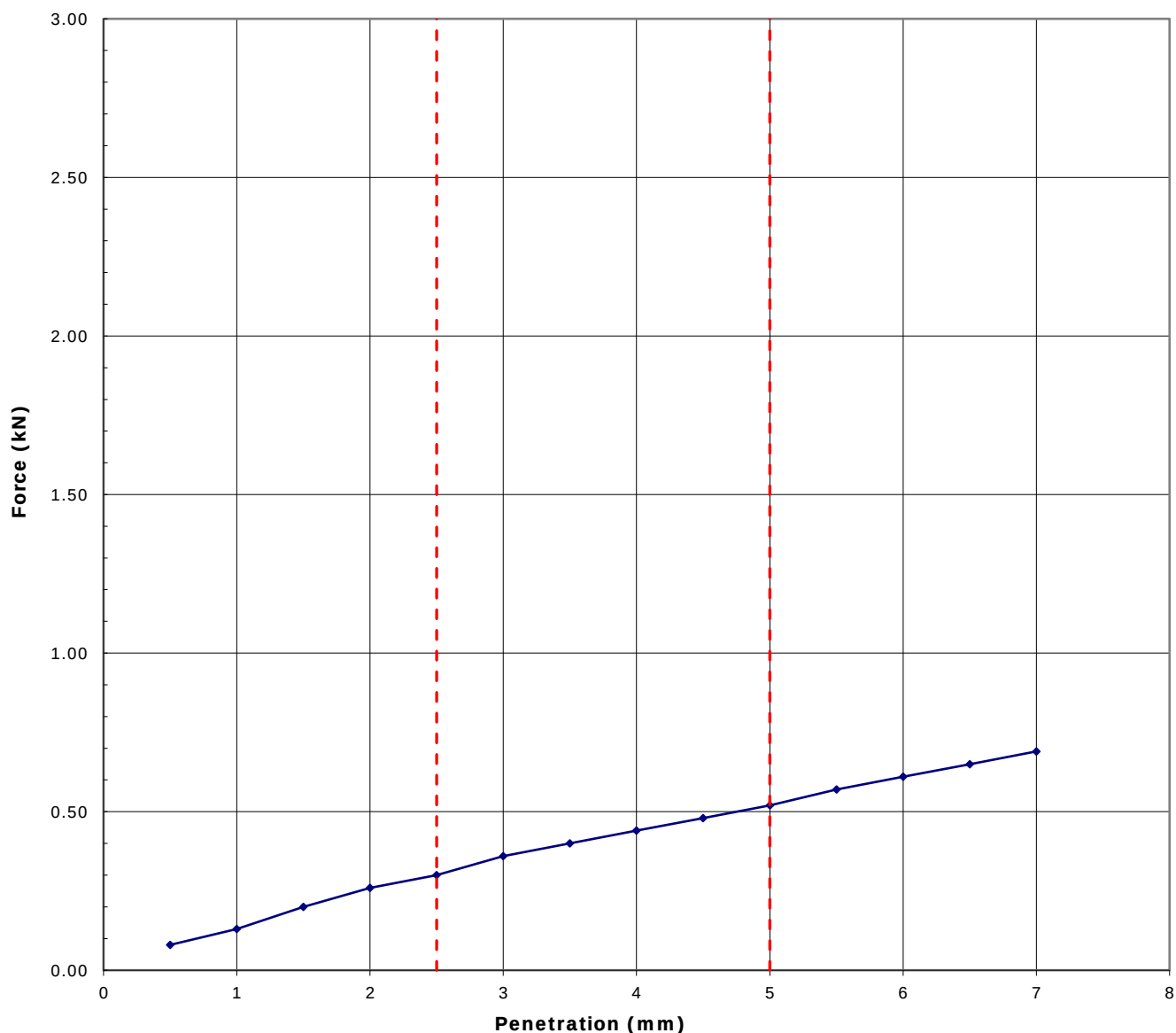
CBR value (%) 1.7

Surcharge: 10kPa

Test date: 04/01/2019

Certificate date: 10/01/2019

**Determination of California Bearing Ratio
(In accordance with: BS1377:1990, Part 4, Clause 7)**



Location ID:	CBR2 (Base)	Stratum at test depth:	MADE GROUND: dark brown slightly sandy clayey silty topsoil with occasional gravel. Gravel is fine to coarse subangular brick and flint. Rare live roots.
Depth:	0.50m		
Moisture content:	27.6%		
Bulk Density	1.846mg/m ³	Preparation:	Method 5 - re-mould sample by dynamic compaction with 2.5kg hammer. Sample not soaked.
Dry Density	1.442mg/m ³		

CBR results				
Penetration (mm)	Test force (kN)	Standard force (kN)	CBR (%)	Notes
2.5	0.30	13.2	2.3	
5.0	0.52	20.0	2.6	

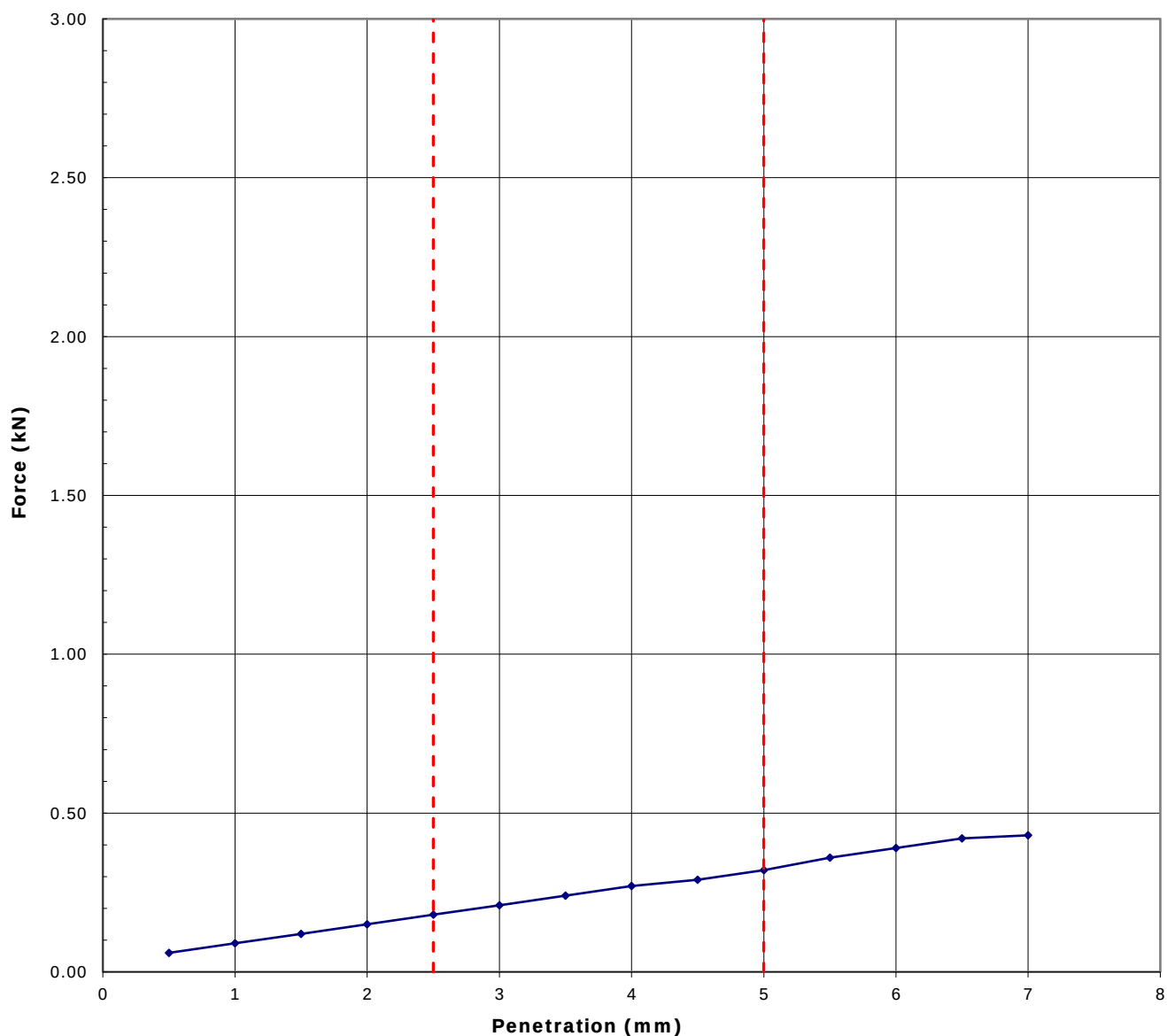
CBR value (%) 2.6

Surcharge: 10kPa

Test date: 04/01/2019

Certificate date: 10/01/2019

**Determination of California Bearing Ratio
(In accordance with: BS1377:1990, Part 4, Clause 7)**



Location ID:	CBR3 (Top)	Stratum at test depth: MADE GROUND: dark brown / black slightly clayey silty sandy topsoil with occasional gravel. Gravel is fine to coarse subangular brick and masonry. Occasional live roots.
Depth:	0.50m	
Moisture content:	28.8%	
Bulk Density	1.837mg/m ³	Preparation: Method 5 - re-mould sample by dynamic compaction with 2.5kg hammer. Sample not soaked.
Dry Density	1.425mg/m ³	

CBR results				
Penetration (mm)	Test force (kN)	Standard force (kN)	CBR (%)	Notes
2.5	0.18	13.2	1.4	
5.0	0.32	20.0	1.6	

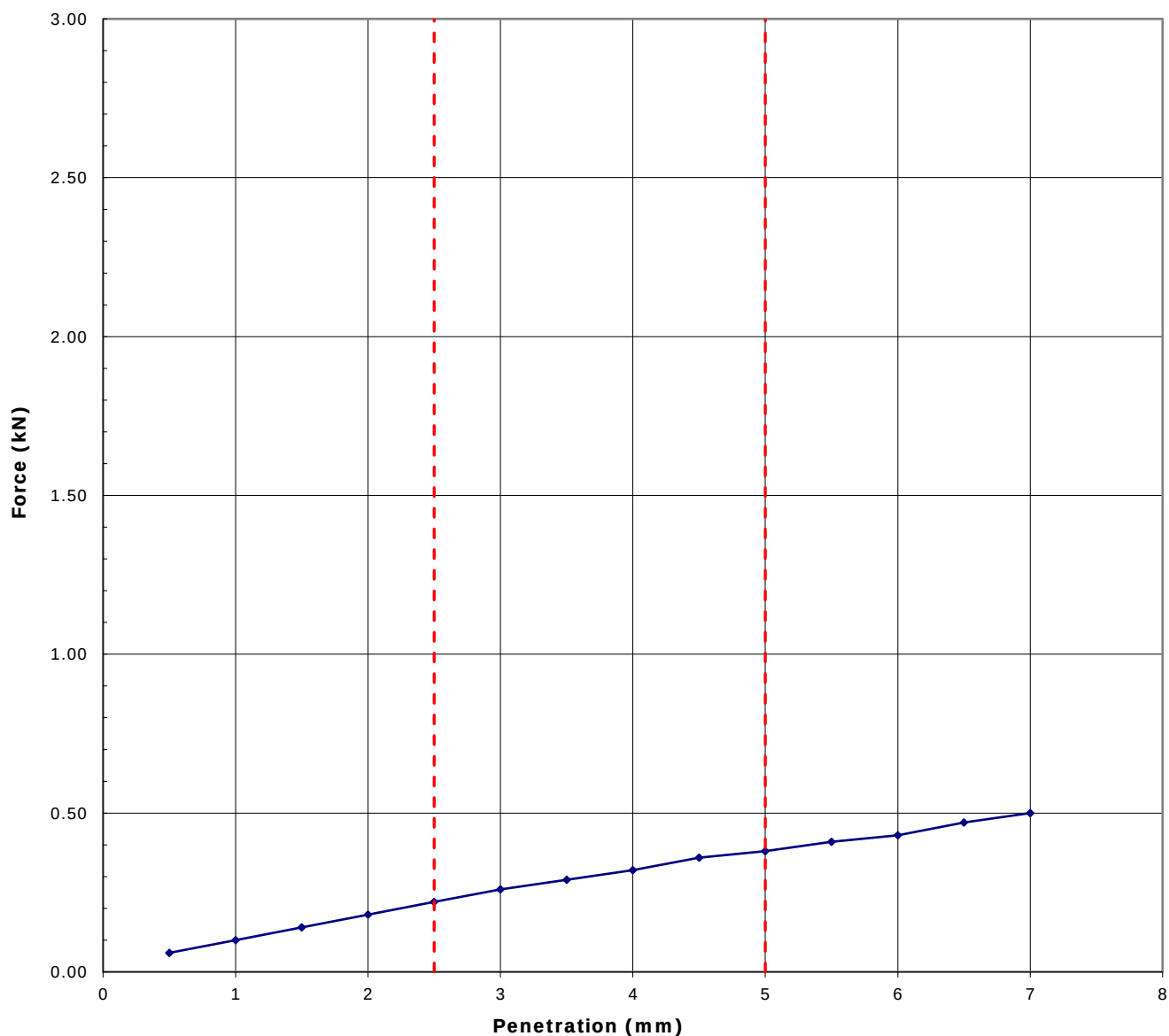
CBR value (%) 1.6

Surcharge: 10kPa

Test date: 04/01/2019

Certificate date: 10/01/2019

**Determination of California Bearing Ratio
(In accordance with: BS1377:1990, Part 4, Clause 7)**



Location ID:	CBR3 (Base)	Stratum at test depth:	MADE GROUND: dark brown / black slightly clayey silty sandy topsoil with occasional gravel. Gravel is fine to coarse subangular brick and masonry. Occasional live roots.
Depth:	0.50m		
Moisture content:	29.0%		
Bulk Density	1.837mg/m ³	Preparation: Method 5 - re-mould sample by dynamic compaction with 2.5kg hammer. Sample not soaked.	
Dry Density	1.425mg/m ³		

CBR results				
Penetration (mm)	Test force (kN)	Standard force (kN)	CBR (%)	Notes
2.5	0.22	13.2	1.7	
5.0	0.38	20.0	1.9	

CBR value (%) 1.9

Surcharge: 10kPa

Test date: 04/01/2019

Certificate date: 10/01/2019



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russell.jarvis@dets.co.uk

DETS Report No: 19-00061

Site Reference: Mallinson Sports Centre, Highgate School, London, N6 4PH

Project / Job Ref: 9916A/MR

Order No: 9916A/MR

Sample Receipt Date: 04/01/2019

Sample Scheduled Date: 04/01/2019

Report Issue Number: 1

Reporting Date: 10/01/2019

Authorised by:

Russell Jarvis
Associate Director of Client Services

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Soil Analysis Certificate						
DETS Report No: 19-00061	Date Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Mallinson Sports Centre, Highgate School, London, N6 4PH	TP / BH No	WS1	WS1	WS2	WS2	WS3
Project / Job Ref: 9916A/MR	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 9916A/MR	Depth (m)	0.85	2.00	1.60	2.95	1.30
Reporting Date: 10/01/2019	DETS Sample No	380544	380545	380546	380547	380548

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.0	7.4	7.4	7.1	7.4
Total Sulphate as SO ₄	mg/kg	< 200	NONE	< 200	1357	< 200	< 200	< 200
Total Sulphate as SO ₄	%	< 0.02	NONE	< 0.02	0.14	< 0.02	< 0.02	< 0.02
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	18	12	< 10	< 10	15
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.02	0.01	< 0.01	< 0.01	0.01
Total Sulphur	%	< 0.02	NONE	< 0.02	0.04	< 0.02	< 0.02	< 0.02

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Subcontracted analysis (S)



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Soil Analysis Certificate						
DETS Report No: 19-00061	Date Sampled	None Supplied	None Supplied	None Supplied		
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Mallinson Sports Centre, Highgate School, London, N6 4PH	TP / BH No	WS3	WS4	WS4		
Project / Job Ref: 9916A/MR	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: 9916A/MR	Depth (m)	4.80	2.50	3.80		
Reporting Date: 10/01/2019	DETS Sample No	380549	380550	380551		

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.2	6.5	8.3		
Total Sulphate as SO ₄	mg/kg	< 200	NONE	1213	1093	1176		
Total Sulphate as SO ₄	%	< 0.02	NONE	0.12	0.11	0.12		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	213	30	327		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.21	0.03	0.33		
Total Sulphur	%	< 0.02	NONE	0.73	0.04	0.78		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Subcontracted analysis (S)



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Soil Analysis Certificate - Sample Descriptions

DETS Report No: 19-00061

Soil Consultants Ltd

Site Reference: Mallinson Sports Centre, Highgate School, London, N6 4PH

Project / Job Ref: 9916A/MR

Order No: 9916A/MR

Reporting Date: 10/01/2019

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
^ 380544	WS1	None Supplied	0.85	12.8	Brown sandy clay with stones
^ 380545	WS1	None Supplied	2.00	18.2	Brown sandy clay
^ 380546	WS2	None Supplied	1.60	15.4	Brown sandy clay
^ 380547	WS2	None Supplied	2.95	16.3	Brown sandy clay
^ 380548	WS3	None Supplied	1.30	15.7	Brown sandy clay with stones
^ 380549	WS3	None Supplied	4.80	16.9	Grey sandy clay
^ 380550	WS4	None Supplied	2.50	15.7	Brown sandy clay
^ 380551	WS4	None Supplied	3.80	17.6	Grey sandy clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{I/S}

Unsuitable Sample ^{U/S}

^ no sampling date provided; unable to confirm if samples are within acceptable holding times



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 19-00061

Soil Consultants Ltd

Site Reference: Mallinson Sports Centre, Highgate School, London, N6 4PH

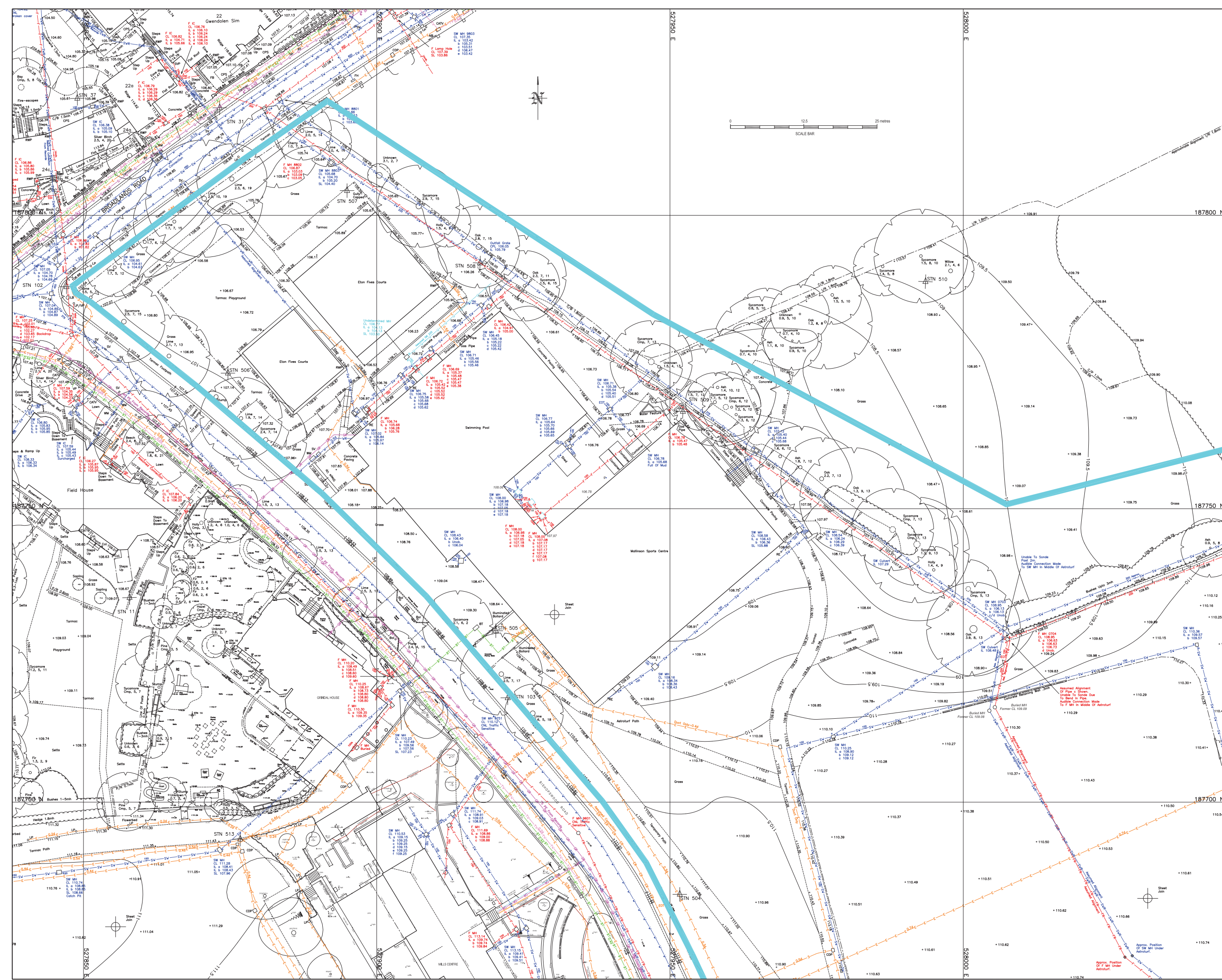
Project / Job Ref: 9916A/MR

Order No: 9916A/MR

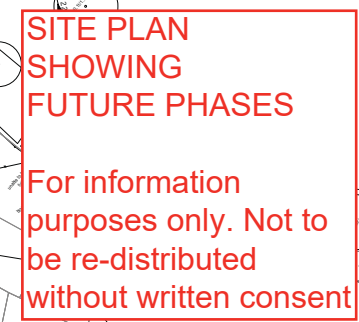
Reporting Date: 10/01/2019

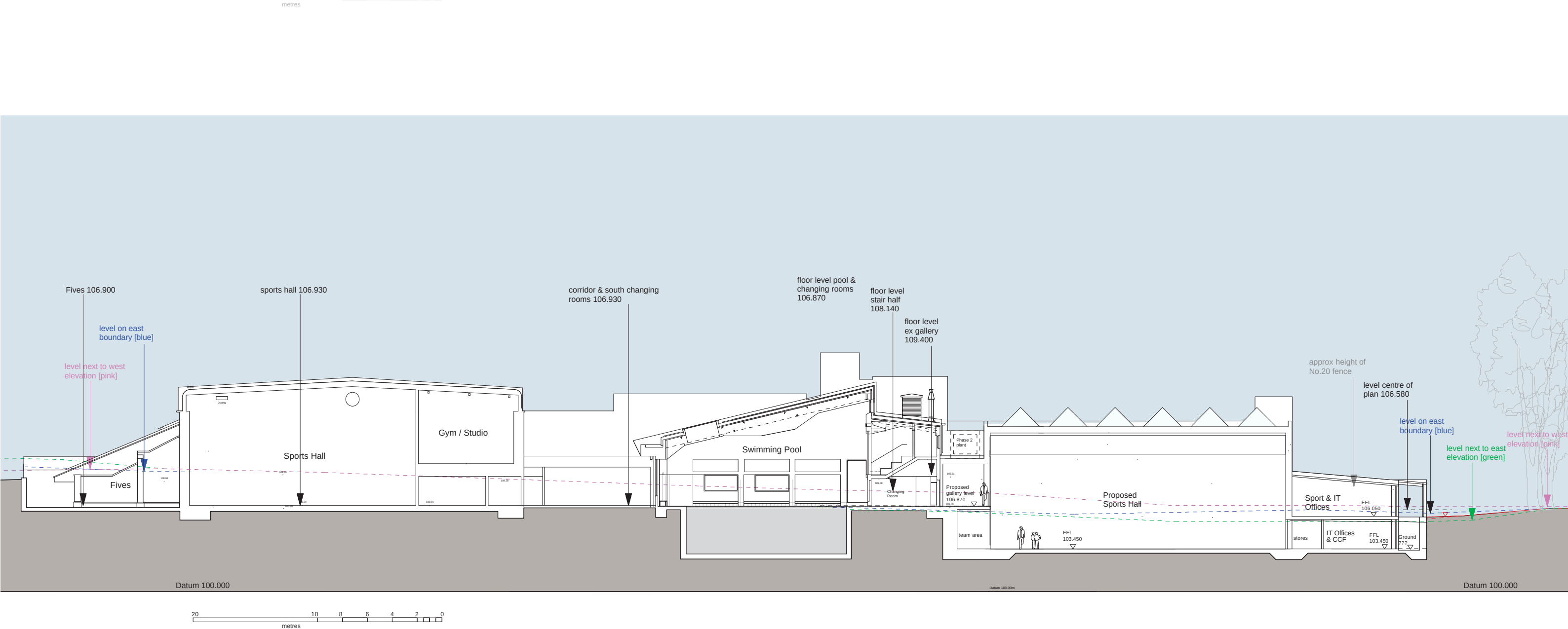
Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

[illegible]







MSC Development with North extension north-south section / part elevation
[combined section/elevation for design development only]

ed tooveyarchitects

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Revisions:

PRELIMINARY DRAFT ISSUE

- Always take site measurements
to verify dimensions
- Refer to M&E Engineers
drawings for all services

Highgate School MSC 4-Phase Future Development

Long Section: Phase 2 extension to north

August 2018

Drwg No. 1182 / GS / 01

Scale 1:300 @ A3

KEY

⊕ Dynamic sampler boreholes (WS1)

⊗ TRLs / CBRs (CBR1)

Site &
Location

**Mallinson Sports Centre, Highgate School,
Bishopswood Road, London N6 4PH**

Report No:
9916A / MR

Site Plan



0 20m
Scale = 1:500@A3