

Greensilk Properties Limited.

BRIDGEWATER HOUSE, MANCHESTER

Phase 2 Geo-Environmental Assessment



Greensilk Properties Limited.

Bridgewater House, Manchester

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EXECUTIVE SUMMARY

Purpose of Report	The purpose of the report is to present a Phase II report for an intrusive investigation and an interpretative ground investigation report to support the discharge of Planning Condition 7 of planning permission, reference 134694/FO/2022. The supplementary investigation by ADS Ltd was completed on 13 December 2023.
Proposed Development	The proposed Site development is understood to be restoration and conversion of the Grade II listed Bridgewater House and redevelopment of car park area to create a ground plus three storey apartment building overall providing 53 residential units, including landscaping to courtyard, bike storage and associated works.
The Site	Bridgewater House, Manchester is located 1km northeast of Manchester city centre located a National Grid Reference SJ 83205 97342.
Site History	Historical mapping indicates that since 1851 the Site has been occupied by the existing Bridgewater House in the northern area of the site. The southern area of Site was occupied by existing unknown buildings between 1851 and 1977. The south of Site is now occupied by the existing car park. No other significant developments have occurred at the site up to the present day.
Ground Conditions	Site investigations proved the presence of Made Ground to depths between 1.20m and 3.10m bgl comprising a thin layer of sandy Gravel over sandy gravelly Clay both with brick and concrete and occasional timber. Underlying the Made Ground is Glaciofluvial Sheet Deposits comprising of sandy clay overlying bedrock of sandstones of the Chester Pebble Beds Formation.
Contamination Assessment	<p>Samples of Made Ground have been subject to a wide suite of contaminants testing and the results screened against GACs for the standard exposure scenario of 'residential use without home grown produce'.</p> <p>Thresholds for three PAH compounds are noted. No asbestos was detected in the samples screened.</p>
Ground Gas Assessment	Ground conditions and Ground Gas monitoring indicates a Characteristic Situation 1 (CS1). No special precautions are required for the proposed development.
Geotechnical Risk	<p>Buried Obstructions – although obstructions encountered were limited to a limestone paving slab in BH03, the historical records of small buildings present on site may result in relict foundations or infill voids.</p> <p>Variable Made Ground – Made Ground has been described as variable in its constituents and there may be reworked soft clays at the base.</p>
Conclusions	<p>Based on the proposed development including building and hardstanding cover, no specific remediation measures are recommended. Best practices should be adopted and followed for construction works and should include:</p> <ul style="list-style-type: none"> Tree pits and any soft standing should comprise of imported clean soils suitable for plant growth. New water pipes should be laid in clean granular imported fill material in line with best practice. A water pipeline risk assessment will likely be needed if potable water pipes are to be laid within existing Made Ground materials, to determine the most appropriate pipeline material. Ground Gas protection is required in line with Characterisation CS2. Should unexpected contamination be encountered during construction, works will cease and the local planning authority will be advised.

1 INTRODUCTION

1.1 TERMS OF REFERENCE

ADS Consult (ADS), a subsidiary of ADS Structural UK Limited, was instructed by Greensilk Properties Limited (the client) to provide a Phase 1 Preliminary Risk Assessment for the Site referred to as Bridgewater House, Manchester ('the Site').

A Site Location Plan and Site Boundary is presented as Figure A.1 and A.2 (Appendix A).

1.2 SCOPE AND OBJECTIVES

The objectives of this report are to:

- Establish the geological and hydrogeological conditions using existing available/published information.
- Summarise available information and identify site specific geotechnical and environmental hazards which may place a constraint upon the proposed site use.
- Produce an updated Conceptual Site Model identifying potential pollution linkages between sources of contamination, pathways and receptors.

The report presents the following information:

- Details of the ground investigation undertaken by ADS and the ground conditions encountered.
- Details and results of the geotechnical testing and contamination analysis.
- Recommendations for mitigating constraints to the proposed development where appropriate and providing preliminary parameters for foundation design.

Where applicable, the fieldwork was undertaken in accordance with BS5930:2015+A1:2020 Code of Practice for Ground Investigations and BS10175:2011+A2:2017 Investigation of Potentially Contaminated Sites.

1.3 PROPOSED DEVELOPMENT

The Site is located within the at Bridgewater House, Great Jackson Street, Manchester, M15 4AX (Figure A.1, Appendix A).

The permitted development is for the restoration and conversion of the Grade II listed Bridgewater House and redevelopment of car park area to create a ground plus three storey apartment building overall providing 53 residential units, including landscaping to courtyard, bike storage and associated works.

The development plan for the Site is included as Figure A.3 (Appendix A).

1.4 REFERENCES

Previous relevant reports for the site are summarised as:

- Phase 1 Preliminary Geo-environmental and Geotechnical Risk Assessment, by Ensaf Consultants. Dated June 2022. Reference: G79223, Revision 0 Version 1. Final

1.5 LIMITATIONS

This report is addressed to and may be relied up on by:

Greensilk Properties Limited

26 Chorley New Road

Bolton

BL1 4A

This document has been prepared for the sole use and reliance of the above-named party. This report shall not be relied upon or transferred to any other parties within the express written authorisation of ADS.

ADS neither owes nor accepts any duty to any third party and shall not be liable for any loss, damage or expense of whatsoever nature which is caused by their reliance on the information contained in this report.

The findings and opinions in this report are based upon information derived from a variety of information sources. ADS has endeavoured to assess all information provided and believe these information sources to be reliable.

This document is not a standalone document and should be read in conjunction with other Works Information and Contract Data.

2 ENVIRONMENTAL REVIEW

2.1 THE SITE

The Site is located at National Grid Reference SJ 83205 97342 and has a postcode M15 4AX. The Site is rectangular in shape and occupies an area of approximately 0.21 hectares (ha) and is approximately 33m Above Ordnance Datum (mAOD).

The Site is currently surrounded by commercial buildings under construction in the south and west of the Site. The A56 is situated to the north of Site with commercial properties further north. To the east of the Site is a construction car park.

The Site location is shown on Figure A.1 and a Site Development Plan is presented as Figure A.3.

2.2 SITE HISTORY

The Site is currently occupied by closed derelict buildings and a tarmacadam covered car park. Historical mapping indicates that since 1851 the Site has been occupied by the existing Bridgewater House in the northern area of the site. The southern area of Site was occupied by existing unknown buildings between 1851 and 1977. The south of Site is now occupied by the existing car park. No other significant developments have occurred at the site up to the present day.

2.3 GROUND CONDITIONS

Published geological mapping (BGS, 2004) indicates the Site to be underlain by superficial Glaciofluvial Sheet Deposits (Devensian – Sands and Gravels) and bedrock comprising sandstone of the Chester Formation (formerly the Chester Pebble Beds Formation).

The superficial drift deposits are a Secondary A aquifer and the underlying sandstone is a Principal Aquifer.

No faults are shown on the Site. A fault is present approximately 250m of the Site.

The Site is noted as within a coal mining area as defined by the coal mining authority, however the Site is not within a high-risk development zone and there are no records of mine entries, shallow workings, or coal seam outcroppings noted within 250m of the Site. A Coal Mining Risk Report was not commissioned in the Phase I assessment of the Site.

The Phase 1 indicates that there are no natural cavities, mining cavities, brit pits, underground workings, brine areas, gypsum, Tin mining or clay mining noted within 500 m of the Site.

The site is situated within an area where less than 1% of properties are above the Radon Action Level and therefore no radon protection measures are required for developments.

2.4 UXO

The Phase 1 assessment identified that the publicly available regional unexploded bomb risk maps indicate the site is in a moderate UXO risk area. An Unexploded Ordnance (UXO) risk desk study report was not undertaken.

2.5 PRELIMINARY CONCEPTUAL SITE MODEL

The Preliminary Conceptual Site Model derived as part of the Phase 1 desk study is re-presented below:

Table 2-1 – Preliminary Site Conceptual Model (extract from Phase 1 Assessment)

Source	Contaminant	Potential Migration Pathway	Potential Receptors	Likelihood of Occurrence	Severity	Overall Risk Rating	Active/Inactive
On-Site							
Unknown thickness of Made Ground Historical Depot	Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Se Zn) Polycyclic Aromatic	Direct contact, ingestion, and inhalation of contaminants on-site.	Human Health	Highly Likely	Minor	Moderate	Potentially Active - requires further investigation. Given the proposed residential with gardens development, a Phase II intrusive investigation of the underlying ground conditions will be required to perform a generic quantitative risk assessment and provide an updated conceptual site model.
		Uptake of toxins/ phytotoxins by plants.	Flora and Fauna	Likely	Minor	Low / Moderate	
	Hydrocarbons (PAHs) Total Petroleum Hydrocarbons (TPH)	Vertical migration of mobile contaminants off-site into underlying aquifers.	Controlled Waters (Principal Aquifers)	Likely	Minor	Low / Moderate	Potentially Active - requires further investigation. Given the proposed residential with gardens development, a Phase II intrusive investigation of the underlying ground conditions will be required to perform a generic quantitative risk assessment and provide an updated conceptual site model.
	Asbestos Fibres in Soil	Inhalation of contaminants on-site.	Human Health	Likely	Minor	Low / Moderate	Potentially Active - requires further investigation. Given the proposed residential with gardens development, a Phase II intrusive investigation of the underlying ground conditions will be required to perform a generic quantitative risk assessment and provide an updated conceptual site model.
	Ground Gas Production (CH ₄ & CO ₂)	Migration and inhalation of contaminants (leading to asphyxiation).	Human Health	Unlikely	Severe	Low / Moderate	Potentially Active - requires further investigation. Given the proposed residential with gardens development, a Phase II intrusive investigation of the underlying ground conditions will be required to perform a generic quantitative risk assessment and provide an updated conceptual site model.
		Accumulation of gases forming an explosive or anoxic atmosphere.	Building and Services	Unlikely	Severe	Low / Moderate	

Off-Site							
Current Electrical substation	PCB's	Vertical migration of mobile contaminants on-site through underlying aquifers	Human Health	Unlikely	Minor	Low	Inactive - Given the distance from the site of the source and the low mobility of PCB's it is unlikely to be a significant risk to the receptors on-site from the off-site source.
			Controlled Waters (Principal Aquifers)	Unlikely	Minor	Very Low	
Current mooring and unloading activities Historical depots, quays and warehouses; Historical automotive works	Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Se Zn) Polycyclic Aromatic Hydrocarbons (PAHs) Total Petroleum Hydrocarbons (TPH)	Vertical migration of mobile contaminants on-site through underlying aquifers	Human Health	Likely	Minor	Low / Moderate	Potentially Active - requires further investigation. Given the proposed residential with gardens development, a Phase II intrusive investigation of the underlying ground conditions will be required to perform a generic quantitative risk assessment and provide an updated conceptual site model.
			Flora and Fauna	Unlikely	Minor	Low / Moderate	
			Controlled Waters (Principal Aquifers)	Likely	Minor	Low	
	Ground Gases Production (CH4 & CO2)	Migration and inhalation of contaminants (leading to asphyxiation).	Human Health	Unlikely	Severe	Low / Moderate	Potentially Active - requires further investigation. Given the proposed residential with gardens development, a Phase II intrusive investigation of the underlying ground conditions will be required to perform a generic quantitative risk assessment and provide an updated conceptual site model.
		Accumulation of gases forming an explosive or anoxic atmosphere.	Building and Services	Unlikely	Severe	Low / Moderate	

2.6 PRELIMINARY GEOTECHNICAL CONSIDERATIONS

Preliminary geotechnical data presented within the Phase 1 data search identifies the following ground conditions shown in Table 2-2 below:

Table 2-2 – Summary of Desk Study Geotechnical Information

Hazard Type	Hazard Potential	Description
Shrink-Swell Clay	Negligible	Ground conditions predominantly non-plastic.
Landslides	Very Low	Slope instability hazards are unlikely to occur but consideration to potential problems of adjacent areas impacting on the Site should be considered. .
Soluble Rocks	Negligible	Soluble rocks are either not thought to be present within the ground, or not prone to dissolution
Compressible Ground	Negligible	Unlikely conditions to be present
Collapsible Deposits	Very Low	Unlikely conditions to be present
Running Sand	Very Low	Unlikely conditions to be present

In view of the history of the Site, the recorded ground conditions, current site conditions and proposed development layout, the following preliminary geotechnical considerations were identified in Table 2-3 below:

Table 2-3 – Summary of Desk Study Geotechnical Hazards

Hazard	Risk on-Site
Ground Stability	Negligible to low hazard potential.
Geotechnical Hazards (Mining)	Low risk: no special precautions required to be made in relation to the proposed development.
Existing Buildings / Obstructions	Existing public house to the north of Site is a grade II listed building and must not be damaged during works or refurbishment. Obstructions from buried foundations or infilled basements in the area of the previous depot and historical buildings in the southern area of Site.
Foundations	Foundation designs may require further investigation to determine ground strength characteristics.
Groundwater	Groundwater conditions unknown; however shallow groundwaters could impact the development and foundation design.
Slopes	Slope stability is considered a negligible risk for the proposed development as there are no significant changes in topography noted on the Site.
Retaining Structures	Retaining structures are not relevant to the proposed development. However, an existing brick wall was noted along the eastern boundary of the Site.
Ground Aggressivity	Ground aggressivity is not considered relevant to the proposed development.

3 ADS GROUND INVESTIGATION

3.1 APPROACH

The intrusive investigation was undertaken in general accordance with Eurocode 7, the Code of Practice for Ground Investigation BS 5930 (2015+A1:2020) and the Code of Practice for the Investigation of Potentially Contaminated Sites BS 10175 (2011+A2:2017).

The objectives of the investigation are to characterise the ground conditions, the hazard sources, pathways and receptors and to reduce uncertainties associated with the proposed redevelopment.

3.2 DESIGN OF INVESTIGATION

Investigation locations were selected to provide coverage of the proposed development area. The Phase 1 report did not identify any specific areas of the site to be targeted due to historical features so the investigation for contamination has been designed on a non-targeted approach with locations typically consistent with 25m spacing deemed appropriate for a residential development comprising apartments.

3.3 HEALTH & SAFETY

All work carried out on site was in accordance with GeoCon Site Investigations Ltd (GeoCon) and ADS Health & Safety policy.

3.4 FIELDWORK

Site work was carried out between 13 and 15 December 2023. The investigation comprised of:

- 3 No. cable percussion boreholes (BH01, BH02 and BH03) to bedrock
- 2 No. rotary cored boreholes (BH01 and BH03 only) extended into bedrock to allow the detailed description and sampling of bedrock.
- 3 No. dual purpose installations in Made Ground to monitor groundwater levels and ground gas concentrations.

The investigation locations are presented in Figure A.4 (Appendix A).

All locations were scanned using Ground Penetration Radar for the potential presence of services prior to works and during the works a UXO specialist was present to monitor the ground ahead of drilling to avoid the potential to disturb UXO.

Upon completion of the siteworks, the standpipes were monitored on six occasions for groundwater and gas levels. The gas levels monitored were oxygen, carbon dioxide, methane, carbon monoxide and hydrogen sulphide. The flow rate of each borehole was also monitored. The results are presented in Appendix E.

3.5 GROUND CONDITIONS

Detailed logs of the strata encountered, together with records of the samples taken and standpipe installations are provided in Appendix B.

3.5.1 GEOLOGY

The strata encountered in the investigation were generally consistent with the anticipated geology identified in the Preliminary Environmental Risk Assessment.

A summary of the geological strata encountered is shown in Table 3-1 below.

Table 3-1 – Summary of Ground Encountered

Soil Type	Thickness range mbgl	Typical description
Hardstanding	0.10 – 0.15	General patchwork of tarmac and concrete hardstanding in moderate to poor condition
Made Ground	1.10 – 2.95	Dark grey sandy gravel with rare brick, concrete fragments. Gravel is subangular to sub-rounded, fine to medium limestone
Clay (possible Made Ground) – BH03	1.30	A layer of grey, mottled, sandy-gravelly clay layer in BH03 only. Located beneath a limestone paving slab it likely represents fill of reworked Made Ground.
Sandy-Gravelly Clay	1.9 – 4.50	Stiff dark brown sandy gravelly clay. Gravel is subrounded, fine mudstone.
Sandstone	Not proven	Extremely weak and highly weathered reddish-brown sandstone

Made Ground is present up to 3.10m bgl.

Glaciofluvial deposits are present beneath the majority of the site (between 2.8m bgl and 7.0m bgl). The description is variable but is typically stiff dark brown sandy gravelly clay, generally siltier in shallower formation.

The underlying solid geology is indicated to comprise of sandstone encountered between 5.00m and 7.00m bgl and described as upper weathered reddish-brown sandstone zone, weak in strength (proved to a depth of >13.0m bgl).

3.5.2 UNDERGROUND STRUCTURES AND OBSTRUCTIONS

With the exception of the surface hardstanding's, a buried limestone foundation slab obstruction was recorded in BH03 at depth of 1.2 m bgl. No other obstructions were encountered.

3.5.3 VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

No visual or olfactory evidence of contamination was noted during the site works.

3.6 LABORATORY TESTING

A summary of chemical laboratory analysis is outlined below.

3.6.1 GEO-ENVIRONMENTAL LABORATORY TESTING - SOIL

5 No. samples of Made Ground were submitted to a UKAS/MCERTS accredited laboratory and analysed for a broad suite of determinands listed below.

- Asbestos (screen)
- pH

- Metals (arsenic, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium and zinc).
- Speciated polyaromatic hydrocarbons (PAH).
- Speciated total petroleum hydrocarbons (TPH CWG) including benzene, toluene, ethylbenzene and xylenes (BTEX) and methyl tert-butyl ether (MTBE).

The results are presented in Appendix C.

3.6.2 GEOTECHNICAL LABORATORY TESTING

Representative soil samples were scheduled for:

- Natural moisture content and plasticity index.
- pH value and water-soluble sulphate (SD1 Suite).
- Undrained Shear Strength Triaxial Tests and Hand Shear Vane Testing
- Uniaxial compressive strength tests.
- Point load tests.
- One dimensional Consolidation Tests.

The results are summarised below and presented in Appendix D.

3.7 GROUND GAS MONITORING

Dual use gas and groundwater monitoring installations were constructed within all three of the boreholes at the site during ground investigation. Each well has been constructed using 50mm diameter HDPE pipe. All of the borehole installations have a 6mm pea gravel surround to the slotted pipe with a bentonite seal above and a gas tap. The covers are cemented flush with ground level and are round lockable stopcock covers.

ADS employed Geocon Investigations to undertake the gas monitoring. Geocon used a GFM 436 Gas Analyser. Prior to its use a calibration check can be performed against gas readings in air. It is recommended that this check is undertaken once on each day the analyser is used.

The results of the ground gas monitoring are discussed in Section 7 below.

4 GEOTECHNICAL TESTING RESULTS

4.1 IN SITU TESTING

Standard Penetration Tests (SPT's) were undertaken at regular intervals within the boreholes to provide 'N' values for empirical assessment of strength and density parameters. Detailed results of the SPT tests and blow counts are included on the borehole logs included in Appendix B and a summary is presented in Table 4-1 below.

Table 4-1 – Standard Penetration Test Results Summary

Stratum / Geological Origin	Range of SPT 'N' Values	Number of Tests	Comments
Made Ground	1-7	4 	SPT testing confirms the made ground to be loose low density
Glaciofluvial Sheet Deposits	1-38	8	SPT testing suggests that the Glaciofluvial Sheet Deposits are locally soft in places
Chester Pebble Beds (Sandstone) Formation	33-50	6	High SPT values suggest the sandstone is hard and dense.

4.2 LABORATORY RESULTS

4.2.1 NATURAL MOISTURE CONTENT AND PLASTICITY INDEX

Samples of cohesive material from the Made Ground and the Glaciofluvial Sheet Deposits were taken for moisture content and plasticity index determinations. The modified plasticity index can be used as an indicator of volume change potential of the soil and is calculated as the plasticity index of the soil multiplied by the fraction of particles less than 425µm.

The moisture content of the Made Ground ranged from 18% to 20% and the moisture content of the Glaciofluvial Sheet Deposits ranged from 14% to 28% with an average of 23%. Atterburg Limit Determination of the Glaciofluvial Sheet Deposits indicate the material to be clay of intermediate plasticity, with liquid limits ranging between 41% and 44%, plastic limits ranging between 20% and 21% and plasticity indices ranging between 21% and 23%.

Calculation of the Modified Plasticity Index, in accordance with NHBC standards, indicates these soils have a low volume change potential. The Consistency Index (Ic) values for the samples tested ranged from 0.61 to 0.86.

Table 4-2 – Volume Change Potential in the Superficial Sheet Deposits

Stratum	Range of Plasticity Indices % (Modified)	Volume Change Potential
Superficial Sheet Deposits	18-19	Low

4.2.2 PH VALUE AND WATER-SOLUBLE SULPHATE (SD1 SUITE)

The Aggressive Chemical Environment for Concrete classifications for the soil types identified at the site have been determined in accordance with BRE Special Digest 1:2005 (SD1). SD1 requires that sites are first identified as being in one of four categories based on natural ground / 'Brownfield' conditions and pyrite content. The site has been categorised as: Brownfield – Non-pyrite.

The highest water-soluble sulphate value and characteristic pH value for each soil type analysed are summarised in Table 4-3 below:

Table 4-3 – Summary of SD1 Suite Analysis

Stratum / Geological Origin	Characteristic Water-Soluble Sulphate Value (mg/l SO ₄)	Characteristic pH Value
Made Ground	22	7.4
Made Ground	64	3.3
CLAY (Glaciofluvial Sheet Deposit)	38	8.1

As the characteristic value of sulphate is less than 3000mg/l and the characteristic pH is greater than 5.5, the concentrations of magnesium, nitrate and chloride are not considered significant in determining the design sulphate class.

4.2.3 UNDRAINED TRIAXIAL TESTING

Shear strength of the natural superficial strata is determined by quick undrained triaxial tests on single 100mm diameter specimens at a series of confining pressures.

One sample failed due to collapse upon extrusion and was unable to undergo testing, however three tests were successful. The results at 80kPa cell pressure are summarised in the table below and are presented in full within Appendix D. The sample that was unable to be scheduled for undrained triaxial testing was instead tested using a hand shear vane, returning a peak shear strength of 23kPa.

Table 4-4 – Triaxial Testing Results Summary

Location ID & Depth (m bgl)	Stratum	Undrained Shear Strength from Triaxial (kPa)
Sample 14, BH01, 4.00	Glaciofluvial Sheet Deposit	23
Sample 9, BH03, 3.00-3.45	Glaciofluvial Sheet Deposit	65
Sample 14, BH03, 5.00-5.45	Glaciofluvial Sheet Deposit	57

4.2.4 UNIAXIAL COMPRESSIVE STRENGTH TESTING

To evaluate the stability of rock against loading, uniaxial compressive strength tests were carried out in line with ISRM suggested methods (1974 – 2006). Four sandstone samples were taken at depths between 8 and 11mbgl. The unconfined compressive strength of the samples ranged 13.4 to 18.3MPa, suggesting a characterisation of very weak can be applied using the classifications detailed by Attewell & Farmer (1976).

The results are summarised below in Table 4-5 and are presented in full in Appendix D.

Table 4-5 – Uniaxial Testing Results Summary

Location ID & Depth (m bgl)	Stratum	Unconfined Compressive Strength (MPa)
BH01, 8.00-9.00	Sandstone	13.4
BH01, 12.00-13.00	Sandstone	13.5
BH03, 8.00-9.00	Sandstone	15
BH03, 10.00-11.00	Sandstone	18.3

4.2.5 POINT LOAD TESTING

Point Load Testing was carried out on eight samples of the Sandstone to allow for classification of the strength of the sandstone. The Point Load Testing was carried out in line with ISRM Suggested Methods for Rock Characterisation (2007). The corrected Point Load Strength (IS50) ranged from 0.06MPa to 0.37MPa.

4.2.6 ONE DIMENSIONAL CONSOLIDATION TESTING

The results of 2No. one dimensional consolidation tests carried out on samples of the Glaciofluvial Sheet Deposits indicated coefficients of volume compressibility of between 0.115m²/MN and 0.709m²/MN, indicative of a medium to high compressibility 'clay' as detailed in Tomlinson (7th edition, 2001). Laboratory testing certificates are presented in full in Appendix D.

4.3 EXCAVATIONS, TRENCH SHORING & DEWATERING

Shallow excavations within the top 3.0m of the site should be readily achievable using standard excavation plant. Temporary excavations in the Made Ground are unlikely to remain stable and some form of temporary support or battering back to a safe angle is likely to be required to where an excavation is to be left open for any length of time. All trenches should be excavated in accordance with CIRIA Report 97 'Trenching Practice'.

No groundwater was encountered through the ground investigations on site. However, the potential for perched groundwater within the Made Ground cannot be discounted. Should perched groundwater ingress be encountered during foundation excavations or earthworks, close side support (temporary shoring) and appropriate dewatering measures, such as provision of sump and pump type water control systems may be required.

5 GEOTECHNICAL ASSESSMENT

5.1 GENERAL

This assessment has been prepared on the understanding that the site is to be developed into a ground floor plus three storey apartment building and on an interpretation of the parameters determined from the field work and laboratory analysis described in this site investigation.

If development proposals change, it may be necessary to revise the conclusions and recommendations made in this report and ADS should be contacted to provide further advice.

5.2 CHARACTERISTIC VALUES AND DESIGN BEARING RESISTANCE

Based upon the site investigation data and a review of the derived values summarised in Section 4, characteristic values can be assigned to each stratum. EC7 defines the characteristic value of a soil or rock as a cautious estimate of the value affecting the occurrence of the limit state. The characteristic values to be used in design are highlighted in Table 5-1.

- Strength/Density have been derived from uncorrected SPT N data and laboratory UCS testing.
- Equivalent approximate undrained shear strengths (c_u) have been derived from the uncorrected SPT N data, adopting f_1 values (Stroud, 1974) as appropriate to the recorded plasticity.
- Angle of shearing resistance (ϕ') for the glaciofluvial sheet deposits has been derived from correlations with the Plasticity Index as adapted from Gibson in Carter & Bentley (2016).
- Angle of shearing resistance (ϕ') for coarse soils has been derived from in-situ uncorrected SPT N values (Peck, 1967), reproduced in Tomlinson (2001).

Table 5-1 – Range of characteristic values for geotechnical design

Stratum / Geological Origin	Strength / Density	Descriptor Range of Derived Values	Undrained Strength (c_u - kPa)	Bulk Density (kN/m^3)	Angle of Shearing Resistance (ϕ' - deg)
Made Ground (Cohesive)	Very loose - loose	SPT N values of 1-7	4-30	18-19	25-30 – Granular 28 – 31 (Cohesive)
Glaciofluvial Sheet Deposits (Cohesive)	Firm-Stiff (Locally soft)	SPT N values of 1-38	95 – 135 (Firm to Stiff) 4 – 30 (Locally soft)	19-20	28-29
Chester Pebble Beds (Sandstone) Formation	Very Weak	SPT N values of 33-50	150-225	20-22	36-41

5.3 FOUNDATIONS

The appropriate foundation solution for the site will depend on the structural loading, load distribution and limiting criteria for settlement of the buildings. At the time of writing the report, ADS have not been provided with details on the loading criteria for the proposed apartment complex.

The below represents a geotechnical assessment of possible foundation solutions and infrastructure design; it does not constitute a detailed design report for the proposed development and the merits of the available options should be discussed/reviewed by the foundation/structural engineers.

5.3.1 STRIP, PAD AND TRENCH FILL FOUNDATIONS

The Made Ground in its current condition is considered unsuitable as bearing strata using conventional shallow spread foundations due to the potential for excessive total and differential settlements and the potential low bearing capacity characteristics. As such, any foundations should be extended in depth through the full thickness of the Made Ground to transfer loads to the underlying competent soils of the Glaciofluvial Sheet Deposits and Sandstone.

In BH01 and BH03 a layer of softer Glaciofluvial Deposits was encountered at 2.80-3.80mbgl and 1.2-2.5mbgl respectively. Any soft spots such as these should be over-excavated until competent ground is reached. The underlying stiff Glaciofluvial Deposits are considered to have a characteristic undrained shear strength of at least 90kN/m², as derived from the SPT 'N' values.

Trench fill foundations may be required in place of shallow strip and pad foundations due to the thickness of the Made Ground, dependant on the cut/fill requirements of the site.

5.3.2 PILED FOUNDATIONS

Continuous Flight Augur piling is suitable for the ground conditions and provides minimal levels of vibration and produces low noise emissions which would be beneficial considering the proximity of residential and commercial buildings to the proposed site. However, the need to dispose of arisings may be prohibitive.

Rigid inclusions would be suitable for the ground conditions but would require the advice of a piling specialist as the stiff clays of the Glaciofluvial Sheet Deposits may be difficult to penetrate using the displacement augur.

Vibro piling is not considered appropriate due to the loose nature of the Made Ground and the proximity of residential and commercial buildings to the proposed development.

5.4 FLOOR SLABS

If a piled solution is adopted for the structure, this technique should be extended beneath the floor slab and a suitably reinforced floor slab designed.

A ground bearing slab is not considered to be suitable due to the presence of loose Made Ground. Whilst the Made Ground could be removed and replaced either with a suitably engineered granular layer or re-engineered Made Ground, it is considered that the cost of disposing of the arisings and the compact nature of the site may be prohibitive.

The above advice is provided for guidance only at this stage.

5.5 DESIGN CLASS FOR CONCRETE

An assessment of the chemical testing of the Made Ground and Glaciofluvial Sheet Deposits was carried out in accordance with BRE Special Digest 1 (2005). The results of the chemical testing indicate that a Design Sulphate Classification of DS-1 may be adopted along with an ACEC class of AC-1. Mobile groundwater conditions have been assumed.

5.6 GEOTECHNICAL RISKS

Following the Ground Investigation, the main residual geotechnical are as follows:

- Buried Obstructions – although obstructions encountered were limited to a limestone paving slab in BH03, the historical records of small buildings present on site may result in relict foundations or infill voids.
- Variable Made Ground – Made Ground has been described as variable in its constituents and there may be reworked soft clays at the base.

6 ENVIRONMENTAL ASSESSMENT

6.1 INTRODUCTION

The approach to the human health risk assessment reported here follows the principles given in the Land Contamination Risk Management (LCRM) Guidance, i.e. application of the following assessment hierarchy:

- Tier 1 risk screening by establishment of potential pollutant linkages, i.e. the preliminary conceptual site model (PCSM), or
- Tier 2 generic quantitative assessment using generic assessment criteria (GACs) that represent 'acceptably low' risk, or
- Tier 3 quantitative risk assessment using site specific assessment criteria (SSACs) that represent 'unacceptable risk', or where generic assessment criteria are not available, or they are not applicable to the CSM.

The results of laboratory analysis have been screened against GACs including the Defra Category 4 Screening Levels (C4SL) and LQM and CIEH S4ULs for Human Health Risk Assessment and are provided in Appendix G.

The standard exposure scenario of 'residential use without home grown produce' has been used to identify potential exposure pathways for human health receptors for the site. Organic contamination (PAH, TPH and BTEX) have been screened against the GAC for an assumed worst case 1% Soil Organic Matter (SOM).

6.2 SOIL ANALYSIS RESULTS

A comparison of the soil concentrations to the selected GAC (screen results presented in Appendix G) has identified GAC exceedances as detailed in the table below.

Table 6-1 – Human health soil GAC exceedances

Analyte	GAC (mg/kg)	Locations exceeding	Depths exceeding	Concentrations exceeding (mg/kg)	Strata Exceeding
Benzo(a)pyrene	3.2	BH01	2.00m	7.6	Made Ground
Benzo(b)fluoranthene	3.9	BH01	2.00m	9.1	Made Ground
Dibenz(a,h)anthracene	0.31	BH01	2.00m	0.86	Made Ground

The GAC exceedances suggest that if Made Ground remained accessible near the surface of the redevelopment, there would be theoretical risks to residential site users associated with Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenz(a,h)anthracene concentrations within the Made Ground.

Five samples were screened for asbestos and no asbestos was detected.

6.3 PRELIMINARY REMEDIATION ASSESSMENT

The concentrations of potential contaminants recorded at the site are indicated to be above GAC for three PAH substances and the nature of Made Ground is that it can be variable in content. As a result, the following preliminary recommendations for development are presented:

- **Watching Brief:** During earthworks, should any obvious evidence of unexpected contamination be encountered it should be reported to a geo-environmental engineer so that an inspection can be undertaken, and appropriate sampling and assessment work be carried out.
- **Construction Workers:** Appropriate health and safety precautions should be adopted during any excavation works to avoid exposure to potentially contaminated soils and dust.
- **Asbestos fibres** have not been detected in the samples tested. However, there is potential for asbestos to be present within all Made Ground materials, especially those containing demolition materials, and therefore appropriate mitigation should be considered during redevelopment to prevent exposure of site workers and neighbours to asbestos fibres in soils. This could include, but not be limited to the following:
 - Measures to prevent site operatives and neighbouring site users being exposed to airborne fibres during the redevelopment.
 - Measures to prevent exposure of future site users within the future development to affected soils (e.g. use imported soils for potential landscaped areas).
- **Import of Soils:** The proposed development will be covered by hard surfacing with no green space except for some tree planting. The contamination detected is suitable to remain under hardstanding. Soil will need to be imported for tree pits. Any topsoil/subsoil imported will need to be compliant with BS:3882:2015 and meet the requirements of the British Standards/Landscape Architect. The chemical suitability of any imported soils for use as cover in soft landscaped areas will need to be demonstrated.
- **Water Pipe Specification:** It is recommended that potable water pipes are laid in clean imported granular material in line with best practice. A water pipeline risk assessment will likely be required to justify the choice of pipeline material.

7 GROUND GAS ASSESSMENT

To date, five ground gas monitoring visits have been completed between 21 December 2023 and 15 February 2024. The results are presented in Appendix E.

A summary of the monitored results is presented in Table 7.1.

Table 7-1 – Gas Monitoring Results Summary (Steady State)

Location	Oxygen (% vol)		Carbon Dioxide (% vol)		Methane (% vol)		Flow (l/hr)	Groundwater mbgl	Top of Screen
	Min	Max	Min	Max	Min	Max	Max	Range	mbgl
BH01	19.3	20.5	0.0	0.9	0.0	0.0	1.8	1.08 – 1.80	1.00
BH02	17.4	20.5	0.0	1.8	0.0	0.0	7.8	1.21 – Dry	1.00
BH03	11.7	18.7	1.3	3.9	0.0	0.0	0.1	1.24 – Dry	1.00

In summary, the observations from the monitoring are:

- Methane has not been recorded.
- Carbon dioxide was recorded at a maximum concentration of 3.9% v/v within monitoring well BH03
- The maximum recorded peak ground gas flow rate was 7.8/hr, recorded in monitoring well BH02, screened within the Made Ground. It should be noted that this was recorded within a partially flooded installation, however, has been used within the GSV calculation to allow a conservative assessment.
- The lowest recorded oxygen concentration (16.6% v/v), associated with elevated carbon dioxide Atmospheric pressure ranged from 981mb to 1015mb

It is understood that the proposed development will include the construction of a new residential building three-storeys high and likely to have concrete floor slabs and internal room partitions. Screening of ground gas monitoring results based on calculating 'borehole hazardous gas flow rates' (Qhg), the subsequent selection of a characteristic 'gas screening value' (GSV) to compare against 'characteristic gas situation' (CS) as stated in BS 8485:2015 +A1:2019 and CIRIA C66520 has been undertaken.

The method uses both gas concentrations and borehole flow rates to calculate the Qhg for CH₄ and CO₂, for each monitoring location and visit. Qhg is calculated by:

$$\text{Borehole flow rate (l/h)} \times (\text{gas concentration (CH}_4 \text{ or CO}_2 \text{ \% v/v)} / 100)$$

Upon the calculation of Qhg, a GSV can then be selected and is normally the maximum Qhg (precluding reasons such as, but not limited to, Site setting, proposed development, ground gas generation potential and as temporally or spatially limited data which may have an effect on monitored ground gas results).

The GSV can then be compared against Table 2 of BS 8485:2015 + A1:2019 to define a 'Characteristic Situation' (CS) for the Site. A CS defines a hazard potential from ground gas and assigns a minimum gas protection score dependent on the type of development as defined in Table 3 of BS8485:2015 + A1:2019. Gas protection scores dependent on the development type and defined CS is presented in Table 4 of BS8485:2015 + A1:2019. Tables 5 to 7 of BS8485:2015 + A1:2019 present protection measures which should be used to achieve the required gas protection score.

Based the calculated Qhg, the GSV is considered to be 0.304l/hr (CS2 – low hazard potential).

The following lines of evidence indicate that the hazard potential for the development from ground gas will be very low and that a CS1 classification is more appropriate:

- Calculation of GSV's for each borehole and monitoring event separately indicates CS1 on all occasions.
- The maximum flow was observed in BH2 only and limited to one occasion. The subsequent 4 visits show no flow detected. The period from the first reading to the second indicates that groundwater has risen in the borehole and may have created an artificial 'pumping' effect due to compression of the air in the installation and release on monitoring. The recorded carbon dioxide concentration was very low at 0.3% and the calculated GSV for that occasion is 0.023l/hr ie <0.07l/hr.
- Results show consistently <1% methane concentration and <5% carbon dioxide concentration in line with very low hazard potential.
- Made Ground is described as clayey sandy gravel/gravelly sandy clay with brick and concrete ie no significant observed organic content.
- The site is located in a low risk area for radon.
- The site is not located over historical coal mining.

On the basis of the above it is recommended that the site is classified as Very Low Hazard Potential ie a CS1 classification and no special precautions are required to protect the proposed development from ground gas.

8 REVISED CONCEPTUAL SITE MODEL

From the site investigation the conceptual site model has been updated:

Table 8-1 – Updated Site Conceptual Model

Source	Contaminant	Potential Migration Pathway	Potential Receptors	Likelihood of Occurrence	Severity	Overall Risk Rating	Reason/Mitigation
On-Site							
Made Ground	Polycyclic Aromatic Hydrocarbons (PAHs)	Direct contact, ingestion, and inhalation of contaminants on-site.	Human Health	Likely	Minor	Low	<ul style="list-style-type: none"> Buildings and hardcover will prevent end-users from having contact with soil.
		Uptake of toxins/ phytotoxins by plants.	Flora and Fauna	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> Tree pits to be lined with imported soils.
		Vertical migration of mobile contaminants off-site into underlying aquifers.	Controlled Waters (Principal Aquifers)	Likely	Minor	Low	<ul style="list-style-type: none"> No mobile contaminants detected. Superficial deposits proven to be present and provide a low permeability layer to prevent downward migration.
	Asbestos Fibres in Soil	Inhalation of contaminants on-site.	Human Health	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> No asbestos detected in samples. Buildings and hardcover will prevent end-users from having contact with soil.
	Ground Gas Production (CH ₄ & CO ₂)	Migration and inhalation of contaminants (leading to asphyxiation).	Human Health	Low	Mild	Low	<ul style="list-style-type: none"> Ground conditions and ground gas results indicate a CS1 classification for ground gas risk to the development.
		Accumulation of gases forming an explosive or anoxic atmosphere.	Building and Services	Low	Mild	Low	

9 CONCLUSIONS

Ground Conditions

Site Investigation undertaken in 2023 recorded the ground conditions typically comprise of Made Ground to depths between 0.15 and 1.8m bgl. Made Ground is underlain by a firm to stiff gravelly clay, occasional soft spots are present at the top of the clay. The Clay lies directly over sandstone bedrock proven at between 5.00m and 7.00m bgl.

Visual and olfactory evidence of contamination was not recorded.

Geotechnical Risks

- Buried Obstructions – although obstructions encountered were limited to a limestone paving slab in BH03, the historical records of small buildings present on site may result in relict foundations or infill voids.
- Variable Made Ground – Made Ground has been described as variable in its constituents and there may be reworked soft clays at the base.

Contaminated Land Risks

The Preliminary CSM for the Site has been revised and the following risk identified:

- Made Ground materials is expected to be covered by hardstanding and buildings so precautions are required to protect the site's end users.
- Tree pits and any soft standing should comprise of imported clean soils suitable for plant growth.
- New water pipes should be laid in clean granular imported fill material in line with best practice. A water pipeline risk assessment will likely be needed if potable water pipes are to be laid within existing Made Ground materials, to determine the most appropriate pipeline material.
- Ground Gas protection is not required.

Contaminated Land Remediation and Verification

No specific active remediation measures are recommended. Best practices should be adopted and followed for construction works.

Should unexpected contamination be encountered during construction, works will cease and the local planning authority will be advised.

Appendix A

FIGURES





Key



Site Location



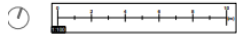
ADS Consult
107 Mere Grange Business Park
Leaside
St Helens
WA9 5GG
Tel: +44 (0) 203 823 2800

Figure A.1
Site Location Plan

Project:
Bridgewater House, Manchester

Client:
Greensilk Property Ltd.

- Existing with Bridgewater House
- Proposed with Bridgewater House
- Outline of apartments (S10.1)
- New landscaping



Scale: 1:500

PLANNING ISSUE

Site: 100m x 100m (approximate) and 100m x 100m (approximate) and 100m x 100m (approximate)



Project: Bridgewater House
 Date: 10/10/2023
 Drawn: [Name]
 Checked: [Name]
 Scale: 1:500

Key

— Site Boundary



ADS Consult
 107 Mere Grange Business Park
 Leaside
 St Helens
 WA9 5GG
 Tel: +44 (0) 203 823 2800

Figure A.2 Site Development Plan

Project:

Bridgewater House, Manchester

Client:

Greensilk Property Ltd.



Key



Cable Percussion
hole with rotary core



Cable Percussion hole



ADS Consult
107 Mere Grange Business Park,
Leaside, St Helens,
WA9 5GG

Tel: +44 (0) 151 541 4000

Figure 2
Exploratory Hole Location Plan

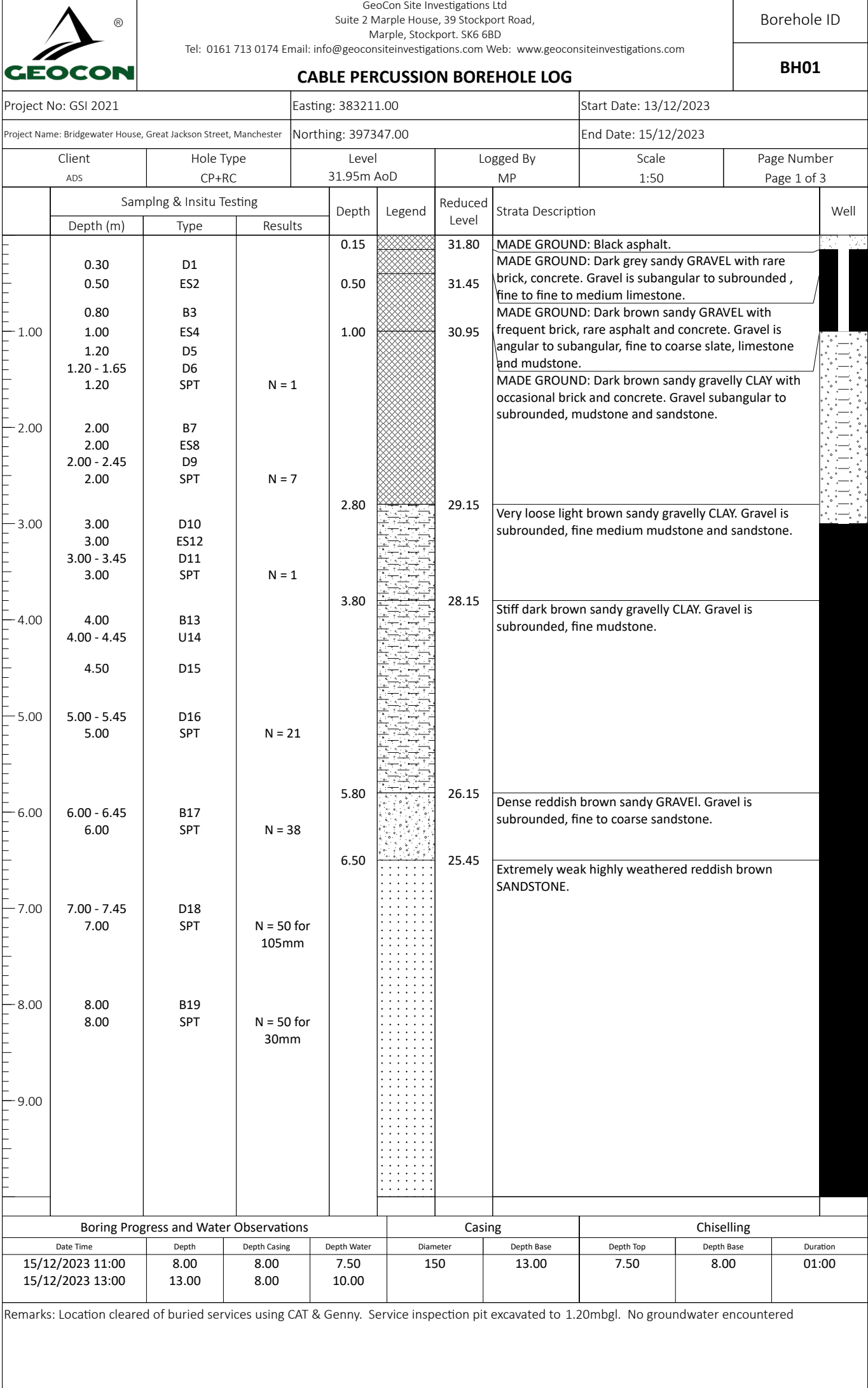
Project:
Bridgewater House, Manchester

Client:
Greensilk Property Ltd.

Appendix B

EXPLORATORY HOLE LOGS





		GeoCon Site Investigations Ltd Suite 2 Marple House, 39 Stockport Road, Marple, Stockport. SK6 6BD Tel: 0161 713 0174 Email: info@geoconsiteinvestigations.com Web: www.geoconsiteinvestigations.com						BOREHOLE ID																																										
		ROTARY CORED BOREHOLE LOG						BH01																																										
GSI 2021				Easting: 383211.00			Start Date: 13/12/2023																																											
Bridgewater House, Great Jackson Street, Manchester				Northing: 397347.00			End Date: 15/12/2023																																											
Client ADS		Hole Type CP+RC		Level 31.95m AoD		Logged By MP		Scale 1:50		Page Number Page 2 of 3																																								
	Coring Data			Depth	Reduced Level	Legend	Strata Description	Weathering & Discontinuities	Well																																									
	TCR % SCR % ROD %	IF min average max	SPT																																															
1.00																																																		
2.00																																																		
3.00																																																		
4.00																																																		
5.00																																																		
6.00																																																		
7.00																																																		
8.00	100 70 35	10						Weathering: Moderately disintegrated. Discontinuities: 0 to 10 degrees very close to close spaced planar rough with fine sand infilling.																																										
9.00	100 89 79	5						Weathering: Slightly disintegrated.																																										
<table border="1"> <tr> <th colspan="4">Boring Progress and Water Observations</th> <th colspan="2">Casing Diameter by Depth</th> <th colspan="4">Flush Details</th> </tr> <tr> <th>Date Time</th> <th>Depth</th> <th>Depth Casing</th> <th>Depth Water</th> <th>Diameter</th> <th>Depth Base</th> <th>Depth Top</th> <th>Depth Base</th> <th>Flush Type</th> <th>Flush Return (%)</th> </tr> <tr> <td>15/12/2023 11:00</td> <td>8.00</td> <td>8.00</td> <td>7.50</td> <td>150</td> <td>13.00</td> <td>8.00</td> <td>13.00</td> <td>Air Mist</td> <td>100</td> </tr> <tr> <td>15/12/2023 13:00</td> <td>13.00</td> <td>8.00</td> <td>10.00</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>											Boring Progress and Water Observations				Casing Diameter by Depth		Flush Details				Date Time	Depth	Depth Casing	Depth Water	Diameter	Depth Base	Depth Top	Depth Base	Flush Type	Flush Return (%)	15/12/2023 11:00	8.00	8.00	7.50	150	13.00	8.00	13.00	Air Mist	100	15/12/2023 13:00	13.00	8.00	10.00						
Boring Progress and Water Observations				Casing Diameter by Depth		Flush Details																																												
Date Time	Depth	Depth Casing	Depth Water	Diameter	Depth Base	Depth Top	Depth Base	Flush Type	Flush Return (%)																																									
15/12/2023 11:00	8.00	8.00	7.50	150	13.00	8.00	13.00	Air Mist	100																																									
15/12/2023 13:00	13.00	8.00	10.00																																															
Remarks: Location cleared of buried services using CAT & Genny. Service inspection pit excavated to 1.20mbgl. No groundwater encountered																																																		



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BOREHOLE ID
BH01

ROTARY CORED BOREHOLE LOG

GSI 2021
Bridgewater House, Great Jackson Street,
Manchester

Easting: 383211.00
Northing: 397347.00

Start Date: 13/12/2023
End Date: 15/12/2023

Client
ADS

Hole Type
CP+RC

Level
31.95m AoD

Logged By
MP

Scale
1:50

Page Number
Page 3 of 3

	Coring Data			Depth	Reduced Level	Legend	Strata Description	Weathering & Discontinuities	Well
	TCR % SCR % ROD %	IF min average max	SPT						
11.00	100 89 77	7		13.00	18.95		Extremely weak highly weathered reddish brown SANDSTONE.		
	90 73 55	8							
12.00	100 100 97	5							
13.00									
14.00									
15.00									
16.00									
17.00									
18.00									
19.00									

Boring Progress and Water Observations

Date Time	Depth	Depth Casing	Depth Water
15/12/2023 11:00	8.00	8.00	7.50
15/12/2023 13:00	13.00	8.00	10.00

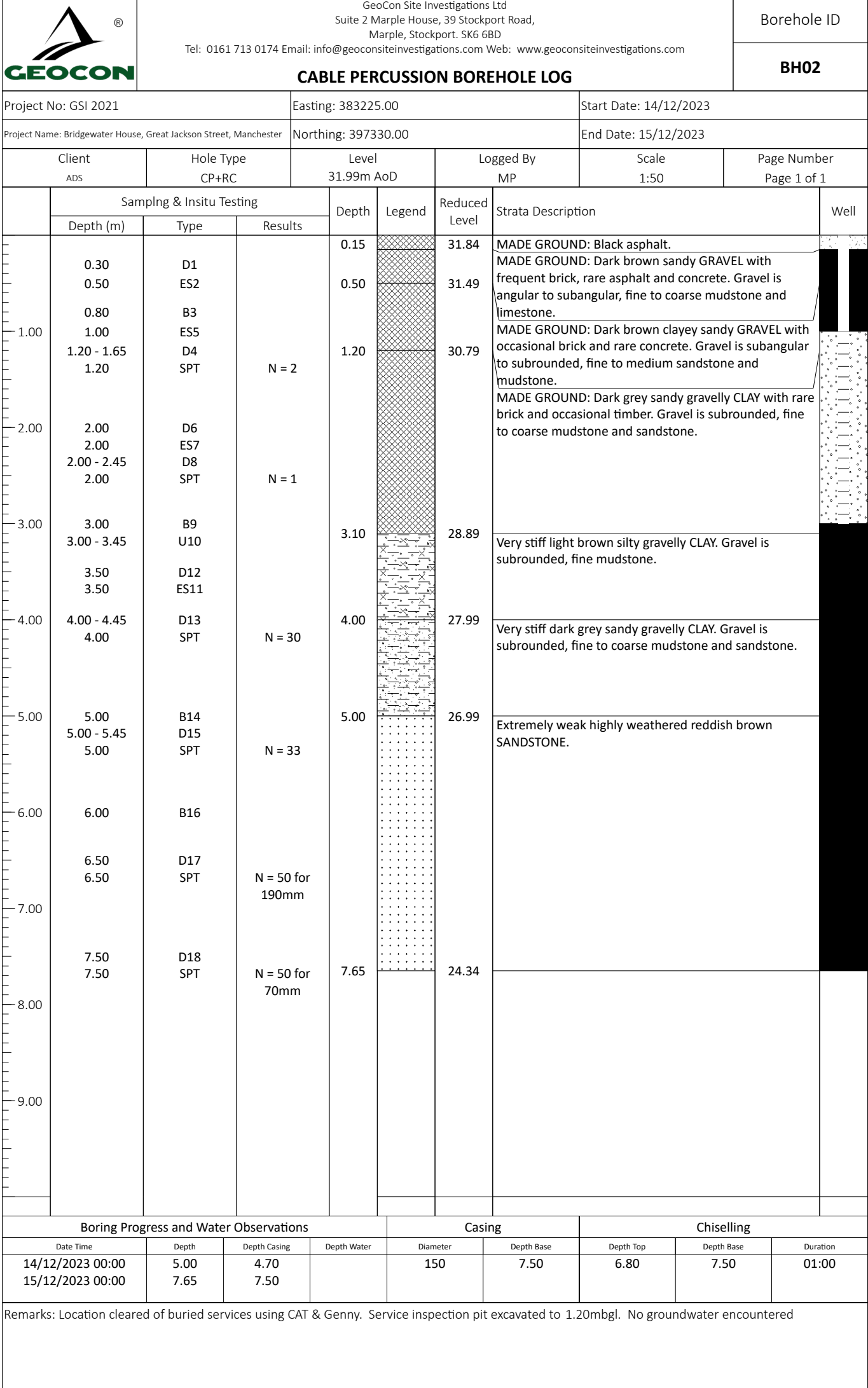
Casing Diameter by Depth

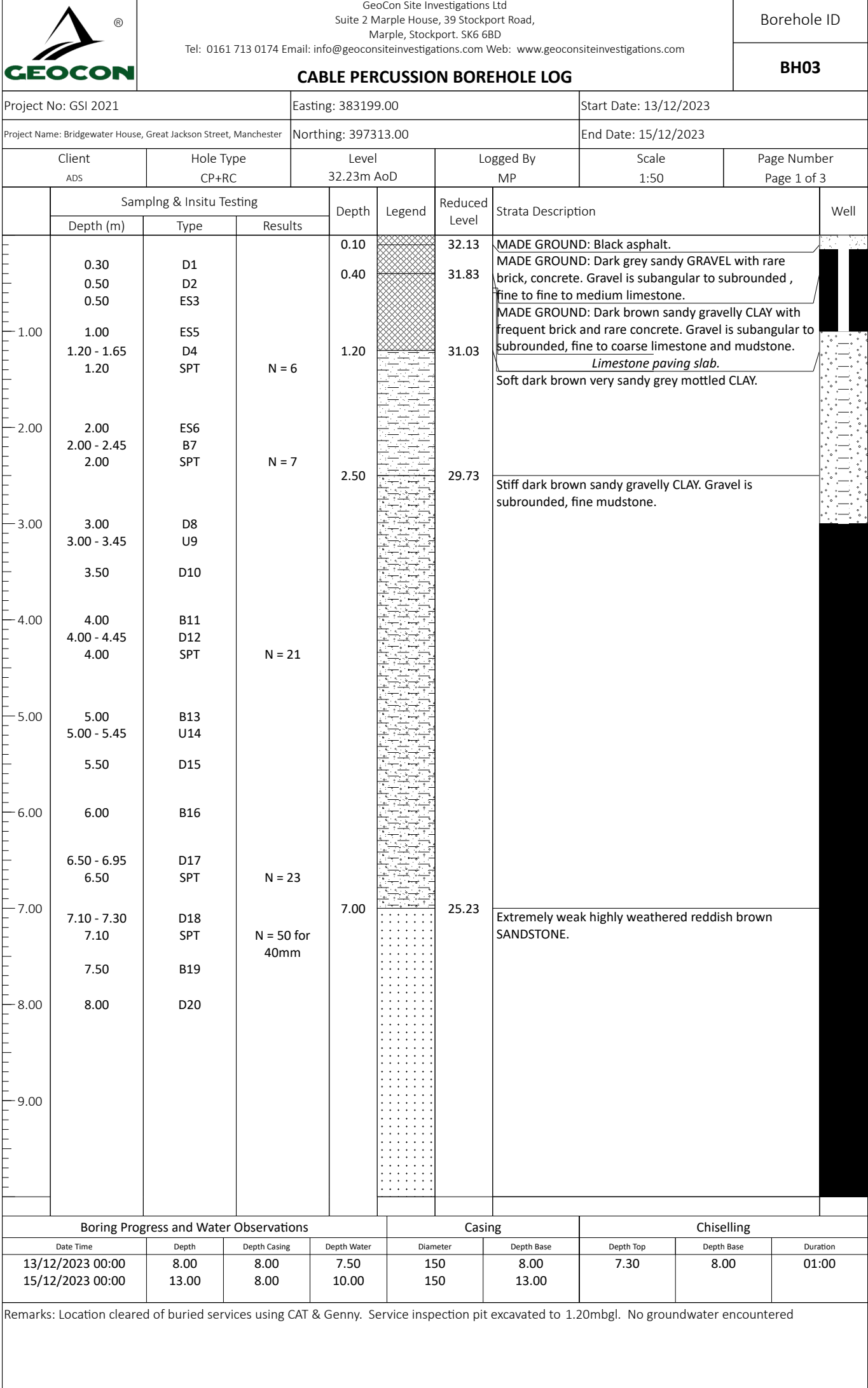
Diameter	Depth Base
150	13.00

Flush Details

Depth Top	Depth Base	Flush Type	Flush Return (%)
8.00	13.00	Air Mist	100

Remarks: Location cleared of buried services using CAT & Genny. Service inspection pit excavated to 1.20mbgl. No groundwater encountered





		GeoCon Site Investigations Ltd Suite 2 Marple House, 39 Stockport Road, Marple, Stockport. SK6 6BD Tel: 0161 713 0174 Email: info@geoconsiteinvestigations.com Web: www.geoconsiteinvestigations.com						BOREHOLE ID		
		ROTARY CORED BOREHOLE LOG						BH03		
GSI 2021				Easting: 383199.00			Start Date: 13/12/2023			
Bridgewater House, Great Jackson Street, Manchester				Northing: 397313.00			End Date: 15/12/2023			
Client ADS		Hole Type CP+RC		Level 32.23m AoD		Logged By MP		Scale 1:50		Page Number Page 2 of 3
	Coring Data			Depth	Reduced Level	Legend	Strata Description	Weathering & Discontinuities	Well	
	TCR % SCR % ROD %	IF min average max	SPT							
1.00										
2.00										
3.00										
4.00										
5.00										
6.00										
7.00										
8.00	85 68 48	5						Weathering: Slightly disintegrated. Discontinuities: 0 to 10 degrees very close to close spaced planar rough with fine sand infilling.		
9.00	100 65 23	13						Weathering: Moderately disintegrated.		
Boring Progress and Water Observations				Casing Diameter by Depth			Flush Details			
Date Time	Depth	Depth Casing	Depth Water	Diameter	Depth Base	Depth Top	Depth Base	Flush Type	Flush Return (%)	
13/12/2023 00:00	8.00	8.00	7.50	150	8.00	8.00	13.00	Air Mist	100	
15/12/2023 00:00	13.00	8.00	10.00	150	13.00					
Remarks: Location cleared of buried services using CAT & Genny. Service inspection pit excavated to 1.20mbgl. No groundwater encountered										



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BOREHOLE ID
BH03

ROTARY CORED BOREHOLE LOG

GSI 2021

Bridgewater House, Great Jackson Street, Manchester

Easting: 383199.00

Northing: 397313.00

Start Date: 13/12/2023

End Date: 15/12/2023

Client

ADS

Hole Type

CP+RC

Level

32.23m AoD

Logged By

MP

Scale

1:50

Page Number

Page 3 of 3

	Coring Data			Depth	Reduced Level	Legend	Strata Description	Weathering & Discontinuities	Well
	TCR % SCR % ROD %	IF min average max	SPT						
<div> <div>90</div> <div>68</div> <div>47</div> </div>	<div>7</div>		13.00	19.23	<div> <div>.....</div> </div>	<div>Extremely weak highly weathered reddish brown SANDSTONE.</div>	<div>Weathering: Slightly disintegrated.</div> <div>Weathering: Moderately disintegrated.</div>		
<div> <div>11.00</div> <div>95</div> <div>77</div> <div>62</div> </div>	<div>6</div>								
<div> <div>12.00</div> <div>100</div> <div>72</div> <div>43</div> </div>	<div>13</div>								
<div> <div>13.00</div> </div>									
<div> <div>14.00</div> </div>									
<div> <div>15.00</div> </div>									
<div> <div>16.00</div> </div>									
<div> <div>17.00</div> </div>									
<div> <div>18.00</div> </div>									
<div> <div>19.00</div> </div>									

Boring Progress and Water Observations

Date Time

13/12/2023 00:00

15/12/2023 00:00

Depth

8.00

13.00

Depth Casing

8.00

8.00

Depth Water

7.50

10.00

Casing Diameter by Depth

Diameter

150

150

Depth Base

8.00

13.00

Flush Details

Depth Top

8.00

Depth Base

13.00

Flush Type

Air Mist

Flush Return (%)

100

Remarks: Location cleared of buried services using CAT & Genny. Service inspection pit excavated to 1.20mbgl. No groundwater encountered



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Tel: 0844 504 3901,
Fax: 0844 504 3902,
Email: info@geoconsiteinvestigations.com
Web: www.geoconsiteinvestigations.com

PROJECT ID
GSI 2021 Bridgewater House, Great Jackson
Street, Manchester

TITLE
Rock Core Photograph
BH01 Box 1: 8.00– 11.00mbgl

DRAWING NUMBER
GSI 2021/01

DATE
December 2023

SCALE
N.T.S

DRAWN BY
MP



GeoCon Site Investigations Ltd
Suite 2 Marple House,
39 Stockport Road,
Marple,
Stockport,
SK6 6BD.
Tel: 0844 504 3901,
Fax: 0844 504 3902,
Email: info@geoconsiteinvestigations.com
Web: www.geoconsiteinvestigations.com

PROJECT ID
GSI 2021 Bridgewater House, Great Jackson
Street, Manchester

TITLE
Rock Core Photograph
BH01 Box 2: 11.00– 13.00mbgl

DRAWING NUMBER
GSI 2021/02

DATE
December 2023

SCALE
N.T.S

DRAWN BY
MP



GeoCon Site Investigations Ltd
Suite 2 Marple House,
39 Stockport Road,
Marple,
Stockport,
SK6 6BD.
Tel: 0844 504 3901,
Fax: 0844 504 3902,
Email: info@geoconsiteinvestigations.com
Web: www.geoconsiteinvestigations.com

PROJECT ID
GSI 2021 Bridgewater House, Great Jackson
Street, Manchester

TITLE
Rock Core Photograph
BH03 Box 1: 8.00– 11.00mbgl

DRAWING NUMBER
GSI 2021/03

DATE
December 2023

SCALE
N.T.S

DRAWN BY
MP



GeoCon Site Investigations Ltd
Suite 2 Marple House,
39 Stockport Road,
Marple,
Stockport,
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Tel: 0844 504 3901,
Fax: 0844 504 3902,
Email: info@geoconsiteinvestigations.com
Web: www.geoconsiteinvestigations.com

PROJECT ID
GSI 2021 Bridgewater House, Great Jackson
Street, Manchester

TITLE
Rock Core Photograph
BH03 Box 2: 1100– 13.00mbgl

DRAWING NUMBER
GSI 2021/04

DATE
December 2023

SCALE
N.T.S

DRAWN BY
MP

Appendix C

CHEMICAL TEST RESULTS



Andy Moore
ADS Structural
107 Mere Grange Business
Leaside
St Helens
Cheshire
WA9 5GG

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

e: andy.moore@adsconsult.uk

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 23-76212

Project / Site name:	Bridgewater House, Manchester	Samples received on:	15/12/2023
Your job number:		Samples instructed on/ Analysis started on:	21/12/2023
Your order number:		Analysis completed by:	04/01/2024
Report Issue Number:	1	Report issued on:	04/01/2024
Samples Analysed:	5 soil samples		

Signed: *A. Czerwińska*

Agnieszka Czerwińska
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-76212

Project / Site name: Bridgewater House, Manchester

Lab Sample Number				2918309	2918310	2918311	2918312	2918313
Sample Reference				BH01	BH01	BH02	BH02	BH03
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.00	0.50	1.00	2.00	0.50
Date Sampled				15/12/2023	15/12/2023	14/12/2023	14/12/2023	13/12/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	-	49	-	< 0.1
Moisture Content	%	0.01	NONE	19	-	8.1	-	20
Total mass of sample received	kg	0.001	NONE	0.8	-	0.8	-	0.8

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	EWS	EWS	EWS	EWS	EWS

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.6	-	7.9	-	7.6
----------------	----------	-----	--------	-----	---	-----	---	-----

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.16	-	< 0.05	-	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.12	-	< 0.05	-	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	1.9	-	0.09	-	< 0.05
Fluorene	mg/kg	0.05	MCERTS	1.4	-	0.08	-	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	12	-	0.72	-	< 0.05
Anthracene	mg/kg	0.05	MCERTS	4.2	-	0.16	-	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	20	-	1.7	-	< 0.05
Pyrene	mg/kg	0.05	MCERTS	17	-	1.7	-	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	8.2	-	0.75	-	< 0.05
Chrysene	mg/kg	0.05	MCERTS	8.1	-	0.72	-	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	9.1	-	0.86	-	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	3.1	-	0.34	-	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	7.6	-	0.73	-	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	3.3	-	0.33	-	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.86	-	0.12	-	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	3.6	-	0.46	-	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	99.9	-	8.73	-	< 0.80
-----------------------------	-------	-----	-----------	------	---	------	---	--------

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	17	-	11	-	10
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	-	< 0.2	-	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	-	< 1.8	-	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	18	-	14	-	19
Copper (aqua regia extractable)	mg/kg	1	MCERTS	57	-	33	-	38
Lead (aqua regia extractable)	mg/kg	1	MCERTS	180	-	82	-	57
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.4	-	< 0.3	-	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	25	-	20	-	25
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	150	-	66	-	85

Analytical Report Number: 23-76212

Project / Site name: Bridgewater House, Manchester

Lab Sample Number				2918309	2918310	2918311	2918312	2918313
Sample Reference				BH01	BH01	BH02	BH02	BH03
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.00	0.50	1.00	2.00	0.50
Date Sampled				15/12/2023	15/12/2023	14/12/2023	14/12/2023	13/12/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	-	< 5.0	-	< 5.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.02	NONE	< 0.020	-	< 0.020	-	< 0.020
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.02	NONE	< 0.020	-	< 0.020	-	< 0.020
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.05	NONE	< 0.050	-	< 0.050	-	< 0.050
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-	3.4
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-	13
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	9.8	-	68	-	86
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	NONE	13	-	70	-	100

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.01	NONE	< 0.010	-	< 0.010	-	< 0.010
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.01	NONE	< 0.010	-	< 0.010	-	< 0.010
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.05	NONE	< 0.050	-	< 0.050	-	< 0.050
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	1.1	-	< 1.0	-	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	14	-	2.4	-	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	72	-	16	-	< 10
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	56	-	130	-	< 10
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	NONE	140	-	150	-	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected



Analytical Report Number : 23-76212
Project / Site name: Bridgewater House, Manchester

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2918309	BH01	None Supplied	2	Brown clay and sand with gravel.
2918311	BH02	None Supplied	1	Brown clay and loam with gravel and stones.
2918313	BH03	None Supplied	0.5	Brown clay and sand with gravel and brick.

Analytical Report Number : 23-76212

Project / Site name: Bridgewater House, Manchester

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards. Refer to CoA for analyte specific accreditation.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260. Refer to CoA for analyte specific accreditation	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID. Refer to CoA for band specific accreditation.	In-house method with silica gel split/clean up.	L088/76-PL	D	MCERTS

Analytical Report Number : 23-76212

Project / Site name: Bridgewater House, Manchester

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Appendix D

GEOTECHNICAL TEST RESULTS





LABORATORY REPORT



Contract Number: PSL24/0064

Report Date: 18 January 2024

Client's Reference:

Client Name: ADS Consult
107 Mere Grange Business Park
Leaside
St Helens
WA9 5GG

For the attention of: Andy Moore

Contract Title: Bridgewater House, Manchester

Date Received: 3/1/2024
Date Commenced: 3/1/2024
Date Completed: 16/1/2024

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Managing Director)

R Berriman
(Associate Director)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

S Eyre
(Senior Technician)


T Watkins
(Senior Technician)

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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Bridgewater House, Manchester

Contract No:

PSL24/0064

Client Ref:

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m ³ Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH01	7	B	2.00	-	20							
BH01	14	U	4.00	-	25							
BH01	15	D	4.50	-	24			44	21	23	82	Intermediate Plasticity CI
BH02	10	U	3.00	3.45	26							
BH03	4	D	1.20	1.65	21							
BH03	9	U	3.00	3.45	18							
BH03	7	B	2.00	2.45	28			41	20	21	85	Intermediate Plasticity CI
BH03	14	U	5.00	5.45	14							

SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.



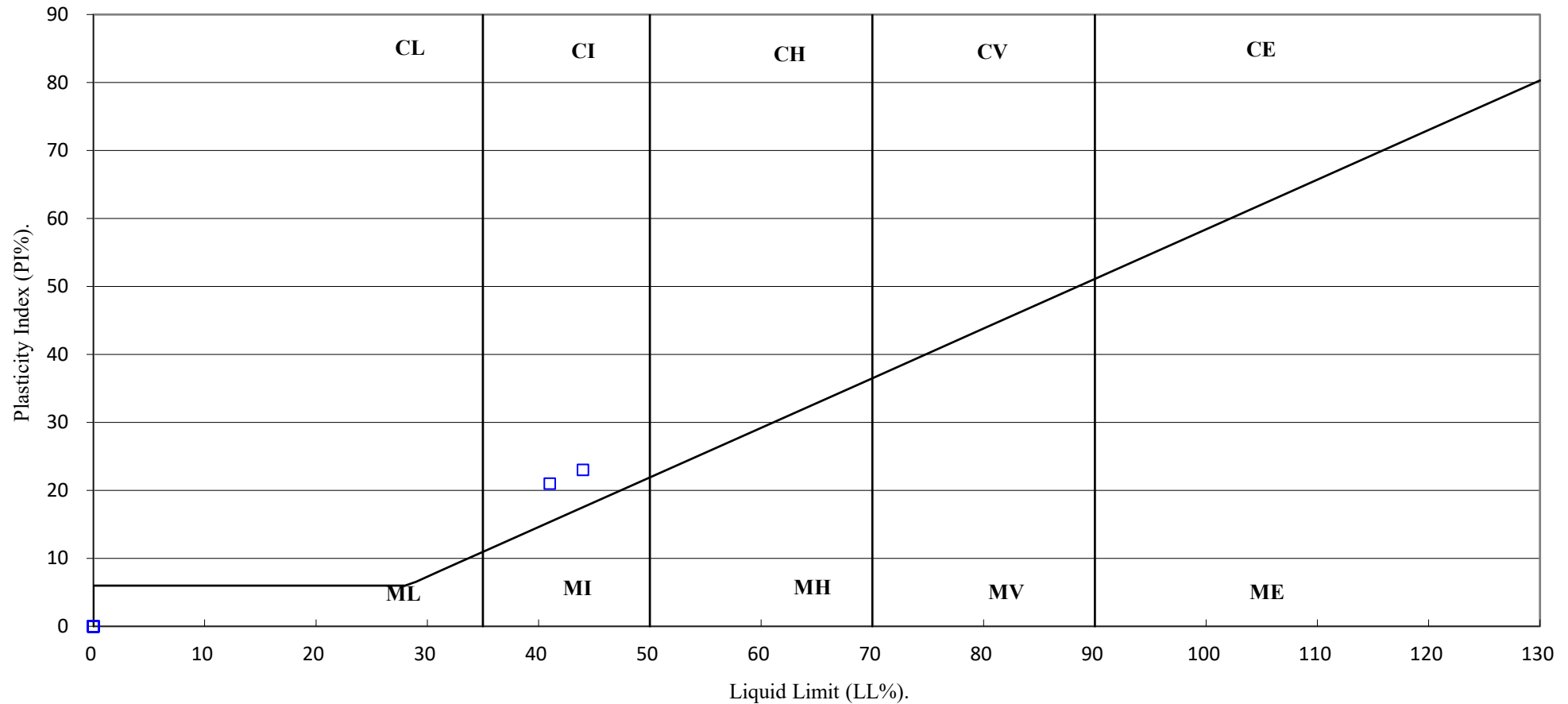
Bridgewater House, Manchester

Contract No:

PSL24/0064

Client Ref:

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



Bridgewater House, Manchester

Contract No:

PSL24/0064

Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 9

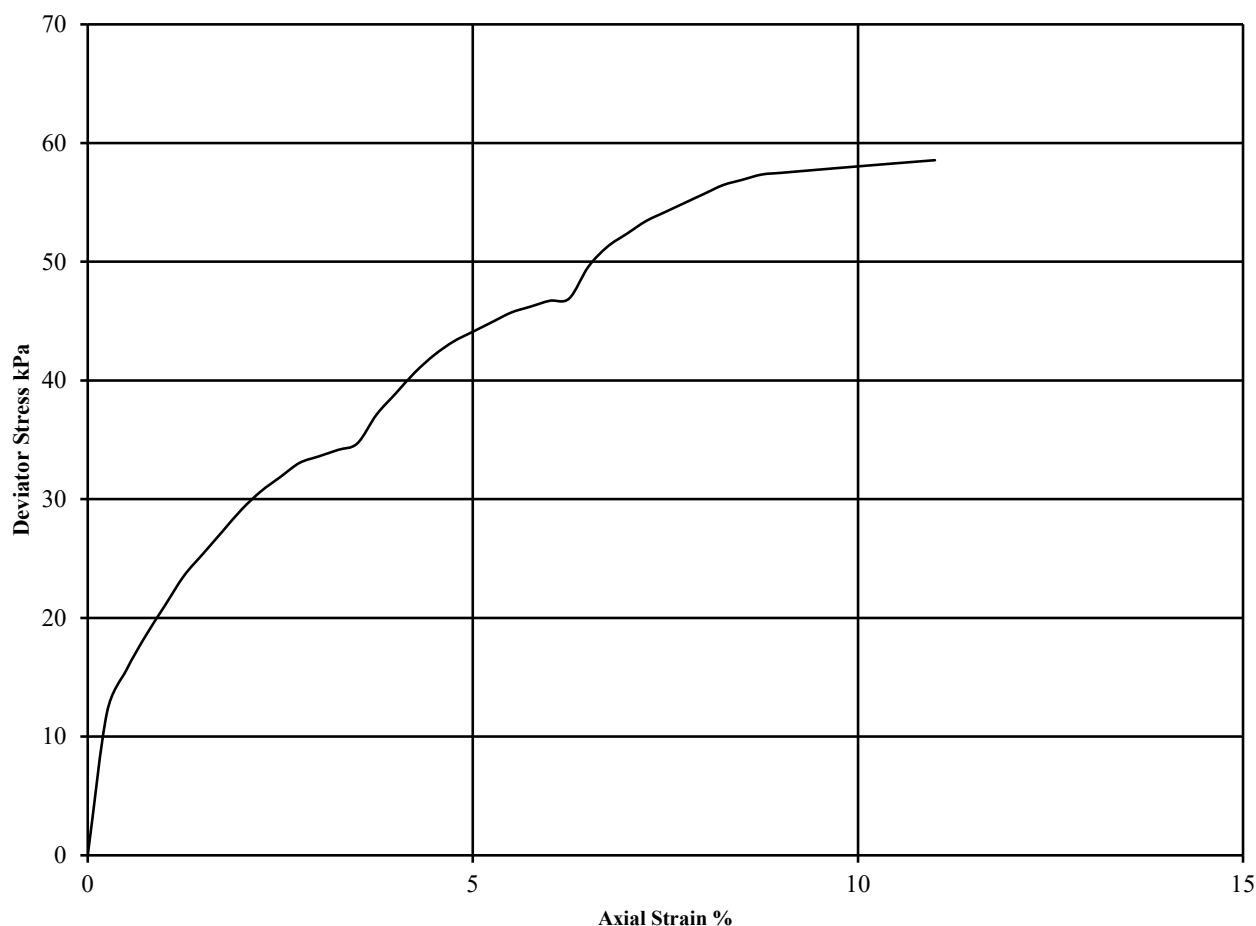
Hole Number: BH01

Top Depth (m): 4.00

Sample Number: 14

Base Depth (m):

Sample Type U



Diameter (mm):		102	Height (mm):		204	Test:	UU Multistage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick Membrane Correction applied (kPa) 0.37 0.36 0.35 See summary of soil descriptions
1	25	1.98	1.59	40	35	17	3.5		
				80	47	23	6.3		
				160	59	29	11.0	Intermediate	



Bridgewater House, Manchester

Contract No:

PSL24/0064

Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

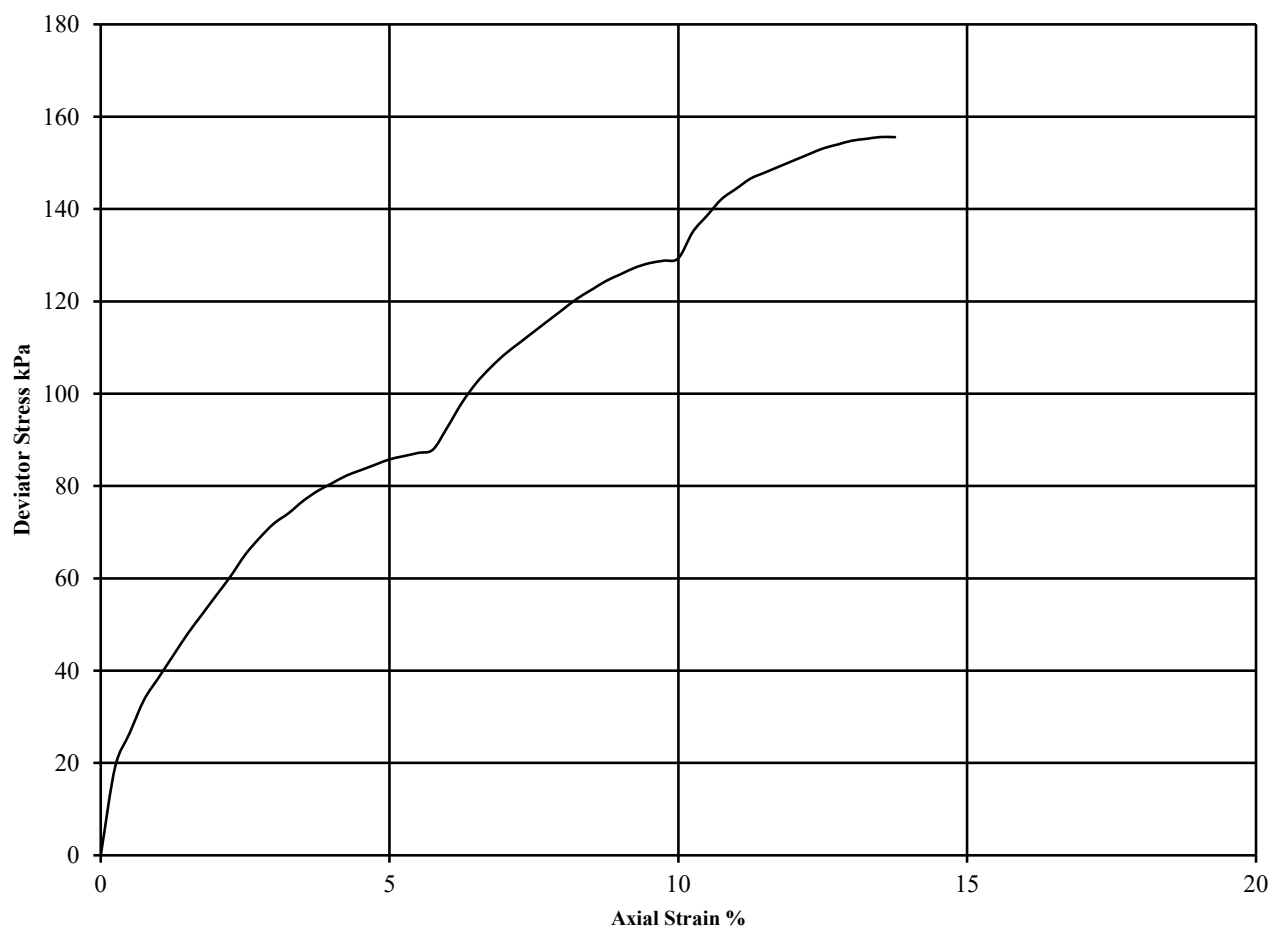
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 9

Hole Number: BH03 Top Depth (m): 3.00

Sample Number: 9 Base Depth (m): 3.45

Sample Type U



Diameter (mm):		102	Height (mm):		204	Test:	UU Multistage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick Membrane Correction applied (kPa) 0.36 0.35 0.35 See summary of soil descriptions
1	28	1.93	1.51	30	88	44	5.8		
				60	129	65	10.0		
				120	156	78	13.5	Plastic	



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

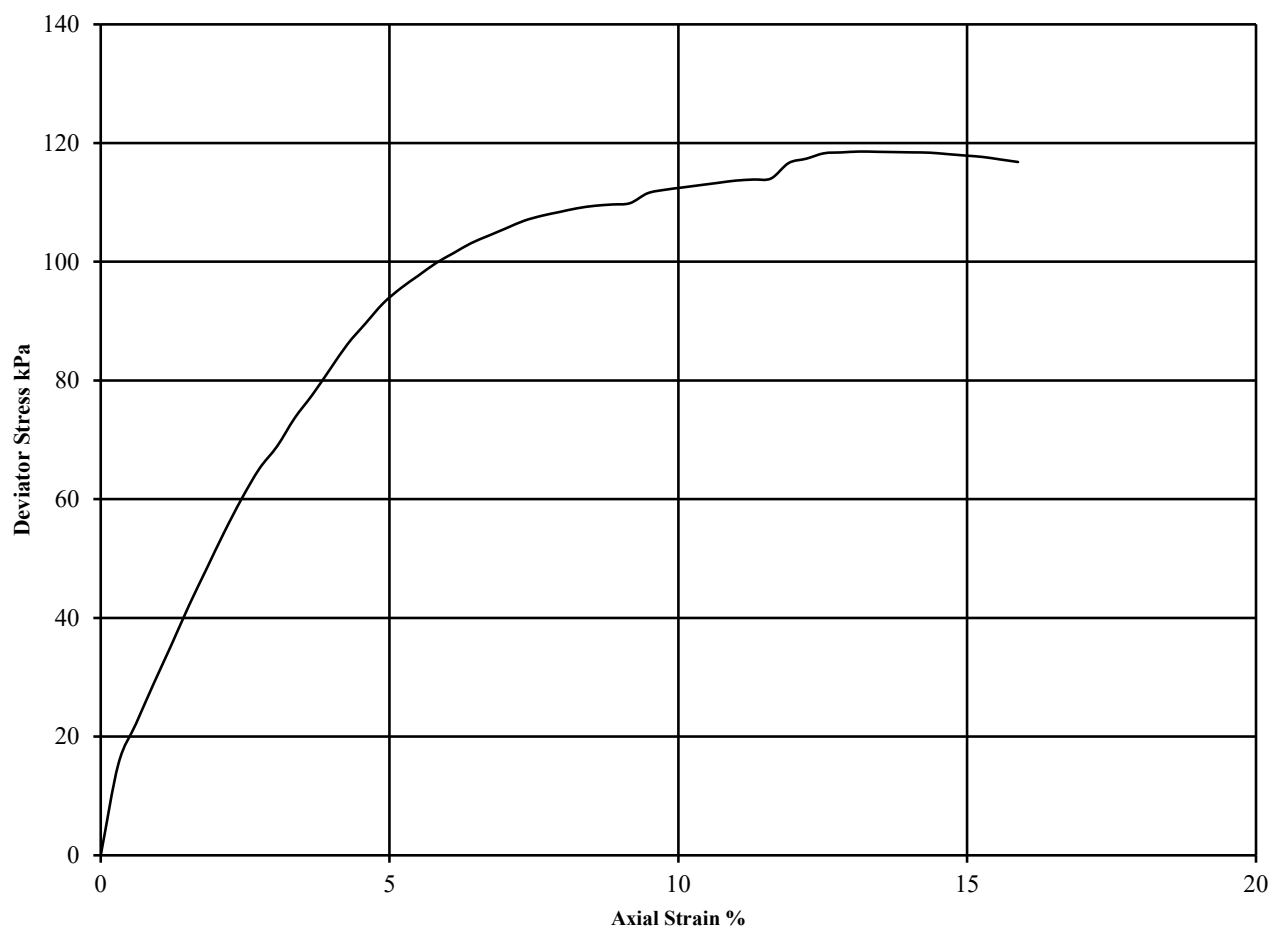
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 9

Hole Number: BH03 Top Depth (m): 5.00

Sample Number: 14 Base Depth (m): 5.45

Sample Type U



Diameter (mm):		102	Height (mm):		167	Test:	UU Multistage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick Membrane Correction applied (kPa) 0.36 0.35 0.35 See summary of soil descriptions
1	14	2.20	1.93	50	110	55	9.2		
				100	114	57	11.6		
				200	119	59	13.1	Intermediate	



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: BH01

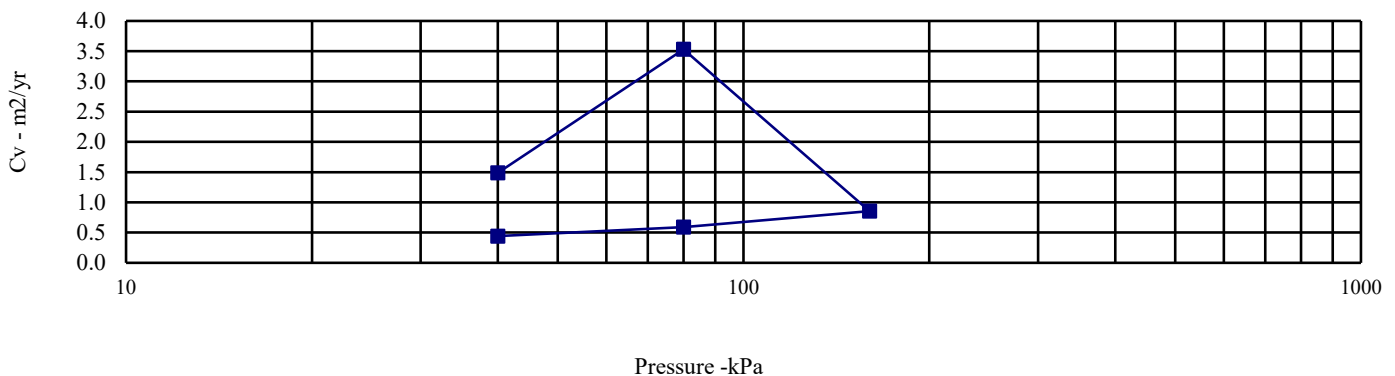
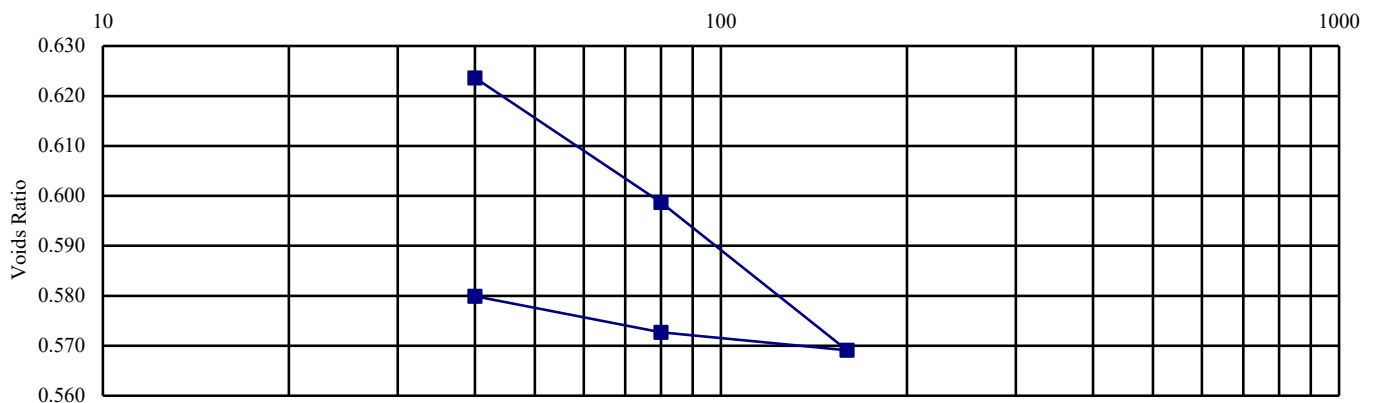
Top Depth (m): 4.00

Sample Number: 14

Base Depth (m) :

Sample Type: U

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	25	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	1.99	0	40	0.709	0.442	Method used to	
Dry Density (Mg/m3):	1.59	40	80	0.384	0.591	determine CV:	T90
Voids Ratio:	0.671	80	160	0.231	0.856	Nominal temperature	
Degree of saturation:	100.7	160	80	0.029	3.530	during test 'C':	20
Height (mm):	20.04	80	40	0.115	1.490	Remarks:	
Diameter (mm)	75.02					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: BH03

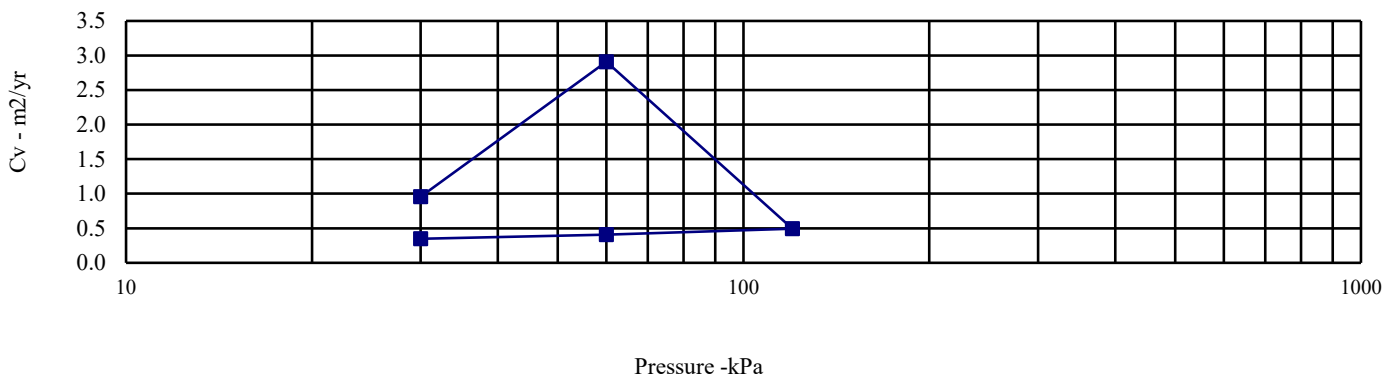
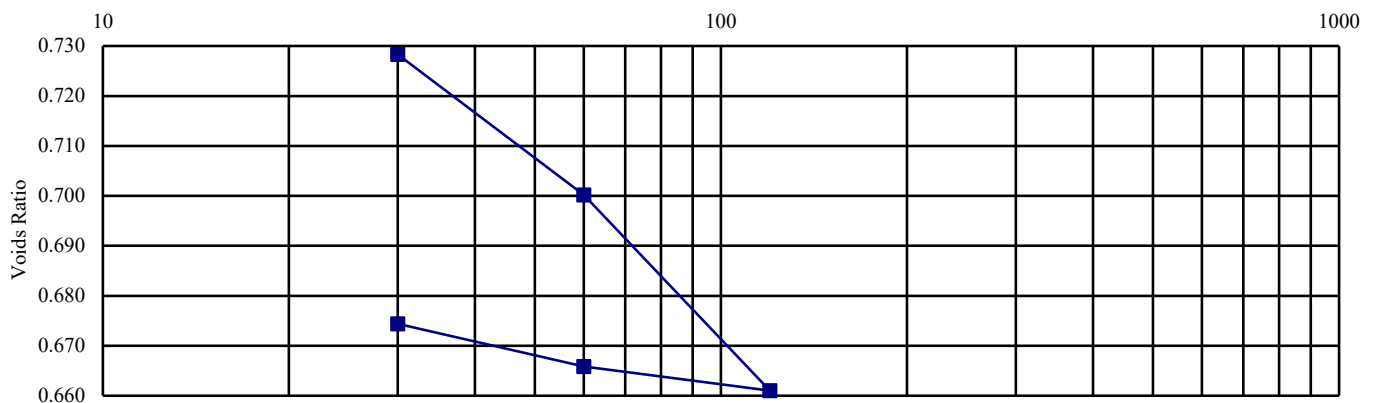
Top Depth (m): 3.00

Sample Number: 9

Base Depth (m) : 3.45

Sample Type: U

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	28	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	1.92	0	30	0.670	0.348	Method used to	
Dry Density (Mg/m3):	1.50	30	60	0.543	0.408	determine CV:	T90
Voids Ratio:	0.764	60	120	0.384	0.496	Nominal temperature	
Degree of saturation:	95.8	120	60	0.049	2.910	during test 'C':	20
Height (mm):	20	60	30	0.171	0.956	Remarks:	
Diameter (mm)	75.01					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:

UNIAXIAL COMPRESSIVE STRENGTH

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: BH01 **Top Depth (m):** 8.00
Sample Number: - **Base Depth (m):** 9.00
Sample Type: - **Sample Date:** 15/12/2023
Storage Condition: - **Date of Receipt** -
Sample Description: -

Specimen Details/Conditions	
Diameter - mm:	85.09
Height - mm:	220.10
Water Content - %:	8.7
Sample Mass - g:	2734.5
Bulk Density - Mg/m ³ :	2.18
Dry Density - Mg/m ³ :	2.01
Height Ratio: * Sample complies with H:D ratio	2.6
Degree of Saturation - %:	57
Assumed Specific Gravity for Degree of Saturation:	2.90

Test Result	
Load Frame/Machine:	CM1/Controls
Date of test:	16/01/2024
Test Duration - mins:	00:17
Orientation:	Unknown
Stress Rate - MPa/s:	0.79
Strain at Failure - kN:	76.40
Unconfined Compressive Strength - Mpa:	13.4
Mode of Failure:	Vertical Shear

Remarks: -



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:
-

UNIAXIAL COMPRESSIVE STRENGTH

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: BH01 **Top Depth (m):** 12.00
Sample Number: - **Base Depth (m):** 13.00
Sample Type: - **Sample Date:** 15/12/2023
Storage Condition: - **Date of Receipt** -
Sample Description: -

Specimen Details/Conditions	
Diameter - mm:	85.01
Height - mm:	220.11
Water Content - %:	10.9
Sample Mass - g:	2764.4
Bulk Density - Mg/m ³ :	2.21
Dry Density - Mg/m ³ :	2.00
Height Ratio: * Sample complies with H:D ratio	2.6
Degree of Saturation - %:	70
Assumed Specific Gravity for Degree of Saturation:	2.90

Test Result	
Load Frame/Machine:	CM1/Controls
Date of test:	16/01/2024
Test Duration - mins:	00:17
Orientation:	Unknown
Stress Rate - MPa/s:	0.79
Strain at Failure - kN:	76.40
Unconfined Compressive Strength - Mpa:	13.5
Mode of Failure:	Vertical Shear

Remarks: -



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:
-

UNIAXIAL COMPRESSIVE STRENGTH

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: BH03 **Top Depth (m):** 8.00
Sample Number: - **Base Depth (m):** 9.00
Sample Type: - **Sample Date:** 15/12/2023
Storage Condition: - **Date of Receipt** -
Sample Description: -

Specimen Details/Conditions	
Diameter - mm:	85.06
Height - mm:	200.14
Water Content - %:	11.6
Sample Mass - g:	2403.4
Bulk Density - Mg/m ³ :	2.11
Dry Density - Mg/m ³ :	1.89
Height Ratio: * Sample does not comply with H:D ratio	2.4
Degree of Saturation - %:	63
Assumed Specific Gravity for Degree of Saturation:	2.90

Test Result	
Load Frame/Machine:	CM1/Controls
Date of test:	16/01/2024
Test Duration - mins:	00:17
Orientation:	Unknown
Stress Rate - MPa/s:	0.88
Strain at Failure - kN:	85.10
Unconfined Compressive Strength - Mpa:	15
Mode of Failure:	Vertical Shear

Remarks: -



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:
-

UNIAXIAL COMPRESSIVE STRENGTH

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: BH03 **Top Depth (m):** 10.00
Sample Number: - **Base Depth (m):** 11.00
Sample Type: - **Sample Date:** 15/12/2023
Storage Condition: - **Date of Receipt** -
Sample Description: -

Specimen Details/Conditions	
Diameter - mm:	85.12
Height - mm:	212.12
Water Content - %:	9.8
Sample Mass - g:	2740.9
Bulk Density - Mg/m ³ :	2.27
Dry Density - Mg/m ³ :	2.07
Height Ratio: * Sample does not comply with H:D ratio	2.5
Degree of Saturation - %:	70
Assumed Specific Gravity for Degree of Saturation:	2.90

Test Result	
Load Frame/Machine:	CM1/Controls
Date of test:	16/01/2024
Test Duration - mins:	00:17
Orientation:	Unknown
Stress Rate - MPa/s:	1.08
Strain at Failure - kN:	103.90
Unconfined Compressive Strength - Mpa:	18.3
Mode of Failure:	Vertical Shear

Remarks: -



Bridgewater House, Manchester

Contract No:
PSL24/0064
Client Ref:
-

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

[illegible]

***Note** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular



Bridgewater House, Manchester

Contract No:

PSL24/0064

Client Ref:

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

[illegible]

***Note** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random



Bridgewater House, Manchester

Contract No:

PSL24/0064

Client Ref:

SUMMARY OF LABORATORY HAND VANES

(BS1377 : PART 7 : 1990)

[illegible]

* This test is out of our UKAS scope



Bridgewater House, Manchester

Contract No:

PSL24/0064

Client Ref:



4161



7 - 11 Harding Street
Leicester
LE1 4DH

Professional Soils Laboratory
5/7 Hexthorpe Road
Hexthorpe
Doncaster
DN4 0AR

Analytical Test Report: L24/00250/PSL - 24-40653

Your Project Reference:	PSL2/0064 Bridgewater House, Manchester		
Your Order Number:	PSL24/0064	Samples Received / Instructed:	11/01/2024 / 11/01/2024
Report Issue Number:	1	Sample Tested:	11/01 to 17/01/2024
Samples Analysed:	3 soil samples	Report issued:	17/01/2024

Signed

Peter Swanston
Technical Manager
CTS Group

Notes:

General

Please refer to Methodologies page for details pertaining to the analytical methods undertaken.

Samples will be retained for 14 days after issue of this report unless otherwise requested.

Moisture Content was determined in accordance with CTS method statement MS - CL - Sample Prep, oven dried at <30°C.

Moisture Content is reported as a percentage of the dry mass of soil, this calculation is in accordance with BS1377, Part 2, 1990, Clause 3.2

Where specification limits are included these are for guidance only. Where a measured value has been highlighted this is not implying acceptance or failure and certainty of measurement values have not been taken into account.

Uncertainty of measurement values are available on request.

Samples were supplied by customer, results apply to the samples as received.

Deviating Samples

On receipt samples are compared against our sample holding and handling protocols, where any deviations have been noted these are reported on our deviating sample page (if present)

Accreditation Key

UKAS = UKAS Accreditation, MCERTS = MCERTS Accreditation, u = Unaccredited

MCERTS Accreditation only covers the SAND, CLAY and LOAM matrices

Date of Issue: 30.10.2023

Issued by: J. Gane

Issue No: 4

Rev No: 5



4161



7 - 11 Harding Street
Leicester
LE1 4DH

L24/00250/PSL - 24-40653

Project Reference - PSL2/0064 Bridgewater House,
Manchester

Analytical Test Results - Chemical Analysis

Lab Reference			335371	335372	335373
Client Sample ID			-	-	-
Client Sample Location			BH01	BH01	BH03
Client Sample Type			B	D	D
Client Sample Number			7	15	4
Depth - Top (m)			2.00	4.50	1.20
Depth - Bottom (m)			2.00	4.50	1.65
Date of Sampling			14/12/2023	14/12/2023	13/12/2023
Time of Sampling			-	-	-
Sample Matrix			Clay	Clay	Clay
Determinant	Units	Accreditation			
Water soluble sulphate (as SO ₄)	(mg/l)	u	22	38	64
Acid Soluble Sulphate	(%)	u	0.04	0.03	0.04
Total Sulphur	(%)	UKAS	0.04	0.07	0.03
pH Value	pH Units	MCERTS	7.4	8.1	7.5
Water Soluble Chloride	(mg/l)	u	3.4	8.7	3.3
Water Soluble Nitrate (As NO ₃)	(mg/l)	u	1.1	< 1.0	< 1.0
Water Soluble Magnesium	(mg/l)	u	3.3	7.7	6.0
Water Soluble Ammonium Ion	(mg/l)	u	1.3	5.0	1.3



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Leicester
LE1 4DH

L24/00250/PSL - 24-40653

Project Reference - PSL2/0064 Bridgewater House, Manchester

Sample Descriptions

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Description	Moisture Content (%)	Stone Content (%)	Passing 2mm test sieve (%)
335371	-	BH01	B	7	Brown slightly gravelly silty sandy clay	-	-	56
335372	-	BH01	D	15	Brown slightly gravelly silty clay	-	-	59
335373	-	BH03	D	4	Light brown sandy clay	-	-	94



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L24/00250/PSL - 24-40653

Project Reference - PSL2/0064 Bridgewater House, Manchester

Sample Comments

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Comments
335371	-	BH01	B	7	
335372	-	BH01	D	15	
335373	-	BH03	D	4	



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7 - 11 Harding Street
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L24/00250/PSL - 24-40653

Project Reference - PSL2/0064 Bridgewater House, Manchester

Analysis Methodologies

Test Code	Test Name / Reference	Sample condition for analysis	Sample Preparation	Test Details
ANIONSS	MS - CL - Anions by Aquakem (2:1Extract)	Oven dried	Passing 2mm test sieve	Determination of Anions (inc Sulphate, chloride etc.) in soils by Aquakem. Analysis is based on a 2:1 water to soil extraction ratio
PHS	MS - CL - pH in Soils	As received	Passing 10mm test sieve	Determination of pH in soils using a pH probe (using a 1:3 soil to water extraction)
ASSO4S	MS - CL - Acid Soluble Sulphate	Oven Dried	Passing 2mm test sieve	Determination of total sulphate in soils by acid extraction followed by ICP analysis
SAMPLEPREP	MS - CL - Sample Preparation	-	-	Preparation of samples (including determination of moisture content) to allow for subsequent analysis
1377TS-ELT	BS1377 Total Sulphur Content by HTC	Oven dried	BS1377 : Part 1 : 2016	Total Sulphur Content testing of Soil in accordance with BS 1377 : Part 3 : 2018 + A1 : 2021 Clause 7.10 (using Eltra CS-800 Analyser)
1377MGICP	BS1377 WS Magnesium (ICP)	Oven dried	Passing 2mm test sieve	Water Soluble Magnesium testing of Soil in accordance with BS 1377 : Part 3 : 2018 + A1 : 2021 Clause 10.



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L24/00250/PSL - 24-40653

Project Reference - PSL2/0064 Bridgewater House, Manchester

Sample Deviations

Deviations are listed below against each sample and associated test method, where deviation(s) are noted it means data may not be representative of the sample at the time of sampling and it is possible that results provided may be compromised.

Observations on receipt

A - No date of sampling provided

C - Received in inappropriate container

H - Contains headspace

T - Temperature on receipt exceeds storage temperature

R - Sample(s) received with less than 96 hours for testing to commence/complete, any result formally classed as deviating will be marked with an X against the applicable test (i.e. RX)

Observations whilst in laboratory

X - Exceeds sampling to extraction or analysis timescales

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Test	Deviations
335371	-	BH01	B	7	BS1377 Total Sulphur Content by HTC	RX
335371	-	BH01	B	7	MS - CL - Anions by Aquakem (2:1Extract)	RX
335371	-	BH01	B	7	MS - CL - pH in Soils	RX
335372	-	BH01	D	15	BS1377 Total Sulphur Content by HTC	RX
335372	-	BH01	D	15	MS - CL - Anions by Aquakem (2:1Extract)	RX
335372	-	BH01	D	15	MS - CL - pH in Soils	RX
335373	-	BH03	D	4	BS1377 Total Sulphur Content by HTC	RX
335373	-	BH03	D	4	MS - CL - Anions by Aquakem (2:1Extract)	RX
335373	-	BH03	D	4	MS - CL - pH in Soils	RX

Test Amendment Notice

Date:	11.01.24
PSL Contract Reference:	0064
Contract Title:	BRIDGEWATER HOUSE MANC
Engineer/Client Details:	ANDY MOORE
Sample Details:	BH02 @ 3-3.45
Testing required:	Q.U.T

Details of Unsuitability

The above sample cannot be performed due to the following reasons:

- 1 The Sample has not been received
- 2 There is insufficient material for the required testing:
 Sample Mass received (g)
 Sample Mass required (g)
- 3 The sample has been previously tested
- 4 The sample has been misplaced in the laboratory
- 5 The sample is unsuitable for testing because collapsed
 upon extraction

Please advise action required:

- 1 Perform the testing on the following sample:
- 2 Combine samples has follows for testing:
- 3 Perform the following alternative testing:
- 4 Perform a non standard test:
- 5 Take no further action
- 6 Undertake the following instructions:

Signed

(Project Engineer)

Date



Appendix E

GAS MONITORING DATA SHEETS





Gas Monitoring Results Sheet

GeoCon Site Investigations Ltd

Suite 2 Marple House,
39 Stockport Road,
Marple,
Stockport.
SK6 6BD

Tel: 0161 713 0174

email: info@geoconsiteinvestigations.com

Online: www.geoconsiteinvestigations.com

Site: Bridgewater House, Great Jackson Street, Manchester
Project Number: GSI 2021
National Grid Reference: XXXX
Instrument: GFM 436 & Dip meter

Monitoring Point Reference	Date	Atmospheric pressure (mb)	Flow Range (l/hr)		Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Methane Gas Screening Value (GSV) (l/hr)	Carbon Dioxide Gas Screening Value (GSV) (l/hr)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Standing Water Level (mbgl)	Well Depth (mbgl)
			Peak	Steady	Peak	Steady	Peak	Steady	Low	Steady						
BH01	21 December 2023	998	0.0	0.0	0.0	0.0	0.2	0.2	20.1	20.1	0.0000	0.0000	0.0	0.0	1.52	1.91
	03 January 2024	982	1.8	1.8	0.0	0.0	0.2	0.2	20.3	20.3	0.0000	0.0036	0.0	0.0	1.08	1.91
	18 January 2024	1002	-6.4	-6.4	0.0	0.0	0.5	0.5	19.3	19.3	0.0000	-0.0320	0.0	0.0	1.77	1.91
	30 January 2024	1022	0.0	0.0	0.0	0.0	0.9	0.9	19.5	19.5	0.0000	0.0000	0.0	0.0	1.80	1.91
	15 February 2024	998	0.0	0.0	0.0	0.0	0.0	0.0	20.5	20.5	0.0000	0.0000	0.0	0.0	1.52	1.89
	27 February 2024	1015	-0.1	-0.4	0.0	0.0	0.0	0.0	19.8	19.8	0.0000	0.0000	0.0	0.0	Dry	1.87
BH02	21 December 2023	998	-1.2	-1.2	0.0	0.0	0.1	0.1	20.5	20.5	0.0000	-0.0012	0.0	0.0	1.79	3.00
	03 January 2024	981	7.8	7.8	0.0	0.0	0.3	0.3	18.9	18.9	0.0000	0.0234	0.0	0.0	1.21	3.00
	18 January 2024	1001	0.0	0.0	0.0	0.0	1.8	1.8	17.4	17.4	0.0000	0.0000	0.0	0.0	2.17	3.00
	30 January 2024	1022	0.0	0.0	0.0	0.0	0.8	0.8	18.5	18.5	0.0000	0.0000	0.0	0.0	1.68	3.00
	15 February 2024	998	0.0	0.0	0.0	0.0	0.0	0.0	18.9	18.9	0.0000	0.0000	0.0	0.0	1.43	3.00
	27 February 2024	1015	-0.1	-0.4	0.0	0.0	0.6	0.6	18.6	18.6	0.0000	-0.0024	0.0	0.0	Dry	3.00
BH03	21 December 2023	997	-2.4	-2.4	0.0	0.0	1.3	1.3	18.7	18.7	0.0000	-0.0312	0.0	10.0	1.56	3.00
	03 January 2024	980	26.0	0.0	0.0	0.0	2.6	2.6	16.6	16.6	0.0000	0.0000	0.0	0.0	1.24	3.00
	18 January 2024	N/A	NR	NR	NR	NR	NR	NR	-	-	-	-	-	-	-	-
	30 January 2024	1022	0.1	0.1	0.0	0.0	3.6	3.6	11.7	11.7	0.0000	0.0036	0.0	0.0	1.52	3.00
	15 February 2024	998	0.0	0.0	0.0	0.0	3.3	3.3	12.4	12.4	0.0000	0.0000	0.0	0.0	1.40	3.00
	27 February 2024	1015	-0.3	-0.6	0.0	0.0	3.9	3.9	11.9	11.9	0.0000	-0.0234	0.0	0.0	Dry	3.00
Maximum			26.0	7.8	0.0	0.0	3.9	3.9	11.7	11.7	0.0000	0.0234	0.0	10.0		

Additional Information:

Date	Engineer	Weather	Air Temperature (°C)	Ground Conditions	Pressure Trend	Comments
21 December 2023	MP	Light rain, high winds	11.0	Damp	Rising	N/A
03 January 2024	MP	Light rain, high winds	7.0	Wet	Falling	N/A
18 January 2024	MP	Sunny	-4.0	Dry	Rising	Couldn't access BH03 due to groundwater freezing in the standpipe.
30 January 2024	AH	Clear	6.0	Damp	Rising	N/A
15 February 2024	AH	Light rain	15.0	Wet	Falling	N/A
27 February 2024	AS	Overcast	4.0	Dry	Steady	N/A

* All monitoring point locations are monitored for a minimum of 60 seconds, and both the peak reading and the steady / rest readings are recorded

* BD = Below the detection limit of the gas analyser (0.1units)

* NR = No reading taken

* NA = Not Applicable



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107 Mere Grange Business Park,
Leaside,
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adsstructural.com