Renaker Build Ltd
Plot F, Great Jackson Street, Manchester
Geotechnical and Geo-environmental Interpretative Report (GIR)
Including Remediation & Verification Strategy
13 January 2022

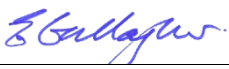


Results emerge
when local knowledge
intersects with
global expertise

Document Verification

Page 1 of 1

Job title	Plot F, Great Jackson Street		Job number 03558AA
Document title	Geotechnical and Geo-environmental Interpretative Report		File reference: 03558AA_R_002B_CT-GIR.docx
Document ref	03558AA_R_002B_CT - GIR.docx		

Issue	Date				
A	17/09/21	Filename	03558AA_R_002A_CT - GIR.docx		
		Description	First Issue – draft pending final factual report from GeoAssist		
			Prepared by	Checked by	Approved by
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		Signature			
B	13/01/22	Filename	03558AA_R_002B_CT - GIR.docx		
		Description	Final issue following receipt of final factual report and asbestos testing from GeoAssist. Inclusion of Deansgate SQ GI information. Remediation & Verification Strategy added in Section 11.		
			Prepared by	Checked by	Approved by
		Name	Craig Temporal	Ed Barrett	Eugene Gallagher
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		Filename			
		Description			
			Prepared by	Checked by	Approved by
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		Signature			

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Appendix A: GeoAssist Factual Report.

Appendix B: Geology Maps

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1 INTRODUCTION

1.1 General

Coffey Geotechnics Ltd (Coffey) has been appointed by Renaker Build Ltd (Renaker) to prepare a Geotechnical Interpretative Report (GIR) on the ground investigation undertaken by GeoAssist at the site at Great Jackson Street in April 2021. The final factual ground investigation report from GeoAssist is presented in Appendix A. This document presents the geotechnical and geo-environmental interpretation (the GIR) and includes the Remediation and Verification Strategy.

The results of the GIR feed into the Geotechnical Design Report (GDR), prepared by Coffey as a separate document. The GDR covers the following aspects of the project:

- Foundation design including bearing capacity and foundation settlement.
- Contiguous piled wall design.
- Bedrock excavatability.

1.2 The Site

The plots are located south of the Deansgate Square development, off Great Jackson Street, in the Castlefield area of Manchester. The entrance to the site is located at National Grid Reference 383398E, 397227N (SJ 833972).

A site layout plan is included as Figure 1.

The site consists of two distinct plots of land, Plot F1 to the west of Owen Street and Plot F2 to the east of Owen Street, south of the Deansgate Square development. The site is situated at an average elevation of +32.7mAOD and covers an area of 0.88 hectares. During the ground investigation works in April 2021 the site was being used for the following purposes:

- Plot F1: Former Peugeot garage used as construction site storage and site car parking.
- Plot F2: Used for construction site laydown and Deansgate Square construction site cabins.

Both plots are considered in this report; the overall site boundary (solid red line) and individual plot boundaries (coloured dashed lines) are shown on Figure 1.

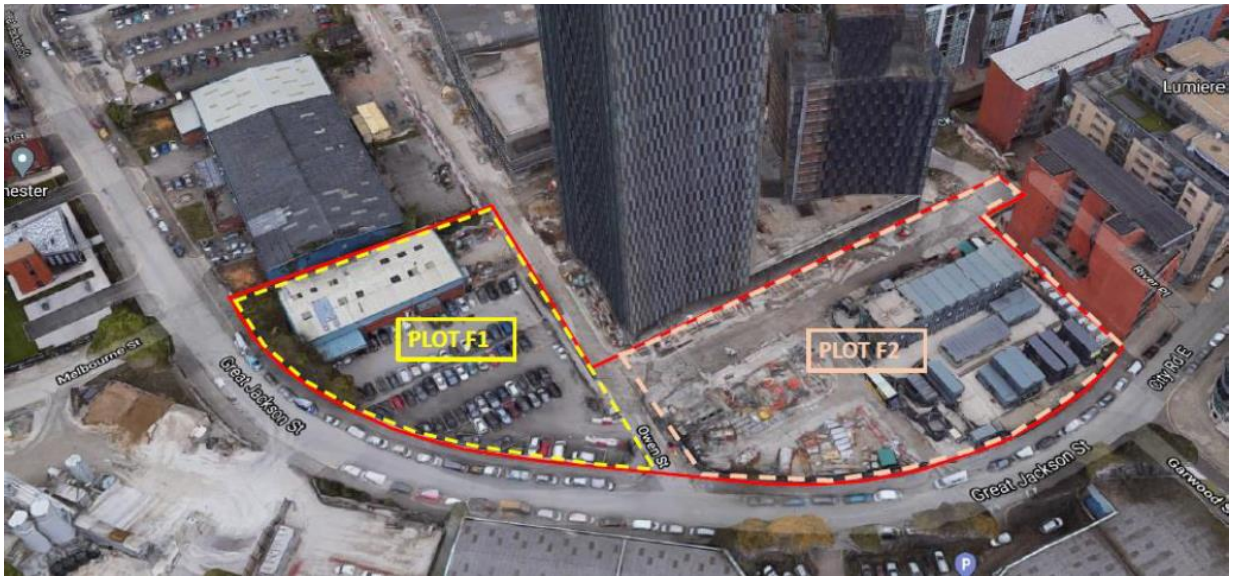


Figure 1: Site layout plan.

1.3 Proposed Development

The proposed development is for the demolition of the existing building on site and the construction of a high-quality residential scheme across two 51-storey towers (identified as Plot F1 and Plot F2), together with external areas both in the public realm and communal spaces dedicated to residents and internal spaces for residential amenity use including: a gym, private car parking within two (F2) and three (F1) tiered basements and extensive cycle parking facilities.

The updated layout drawings received by Coffey on 23 July 2021 indicate the following:

- Proposed finished ground levels for Plot F1 and Plot F2 to be 32.47mAOD and 33.11mAOD, respectively;
- Proposed basement levels for Plot F1 and Plot F2 to be 23.57mAOD and 26.61mAOD, respectively; and
- Proposed final elevation of the towers for Plot F1 and Plot F2 to be 186.07mAOD and 186.71mAOD, respectively.

2 DESK STUDY

Coffey has undertaken a Phase 1 Desk Study for the site which has been reported separately. A summary of the Phase 1 Desk Study is presented in the sections below. The full report should be referred to for further details (Ref 8).

2.1 Site History

Review of historical mapping shows that residential terrace housing was located on the site from at least 1848 until the mid-1900s, when demolition of these properties took place. The Knott Mill Ironworks and later an 'Automobile Engineering Works' were located directly adjacent the northern boundary of the site until 1990. The site was subsequently occupied by industrial buildings from 1992. In recent years part of the site has been used as a site compound during the construction of the nearby Deansgate Square towers.

2.2 Geology

2.2.1 Published Geology

An extract of the geological information from the Phase 1 Desk Study is presented in Appendix B. The information is an extract from the British Geological Survey (BGS) 1:10,000 map (sheet number SJ89NW) published in 1973. The information has been reviewed and is summarised below.

Review of the British Geological Survey (BGS) 1:10,000 map (sheet number SJ89NW) published in 1973 shows the site is underlain by superficial deposits from the Glaciofluvial Sheet Deposits, Devensian. These materials formed up to 2 million years ago in the Quaternary Period and are characterised as coarse-grained sand and gravels.

No made ground is identified specifically for the site on the BGS map. However, due to the location of the site in central Manchester and historical records showing evidence of past occupation on the site from residential buildings, made ground is anticipated.

The glaciofluvial deposits are indicated to be underlain by strata of the Chester Pebble Beds Formation (more recently renamed as Sherwood Sandstone). Bedrock can be characterised as sedimentary sandstone which formed approximately 247 to 250 million years ago in the Triassic Period.

No faults are shown to cross the site.

2.2.2 Previous Ground Investigation

GeoAssist conducted a ground investigation for the Deansgate Square project directly adjacent the northern boundary of the site, details of which can be found in the WSP (2018) Ground Investigation Report (Ref 3). Three of the exploratory boreholes (BH23 – 25) from this investigation lie within the boundary of the current site. Based on the information from these boreholes the lithologies presented in Table 1 can be expected.

Table 1: Expected lithologies beneath the site based upon desk study

Stratum	Depth to Base (mbgl)		Anticipated Thickness (m)	
	Min.	Max.	Min.	Max.
Made Ground	0.7	3.2	0.7	3.2
Glacial Till (Granular)	2.2	2.2	1.5	1.5
Glacial Till (Cohesive)	5.4	6.7	2.4	6.4
Weathered Sherwood Sandstone	7	8.7	1.1	2
Sherwood Sandstone	not known	not known	not known	not known

Groundwater monitoring from the adjacent Deansgate Square project indicates that groundwater is anticipated within the Sherwood Sandstone at a level between 24.7mAOD to 23.3mAOD (approximately 8.0 to 9.4mbgl).

2.3 Hydrogeology

The site is underlain by a highly productive principal aquifer up to 600m thickness and yielding 125litres/sec, inferred to be the Sherwood Sandstone stratum. The Environment Agency (EA) designate principal aquifers as:

> '*layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale'.*

The superficial drift deposits are designated as a Type A Secondary Aquifer, which is designated by the EA as:

> *'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.'*

2.4 Hydrology

The nearest surface water course is the River Medlock which is located within 100m to the north of the site and flows west before heading north towards and under Chester Road (A56). Beyond that lies the Bridgewater Canal and Castlefield Basin, approximately 300m north of the site.

The indicative floodplain map for the area presented in the Envirocheck report shows the site does not lie within an identified flood zone. The nearest flood zone is located approximately 100m north of the site on the northern bank of the River Medlock, between the river and Commercial Street. This is classed as flood zone 2 (extreme flooding from rivers or sea without defences).

On the EA/National Resource Wales (NRW) surface water map presented in the Envirocheck report, there is an area within the site classified as having a 'medium' risk of flooding based on a 100-year return period. This area lies approximately parallel with the eastern boundary of Plot F1 along Owen Street.

2.5 Radon

Public Health England (PHE) recommends that radon levels should be reduced in homes where the annual average radon concentration is at or above 200 becquerels per cubic metre (Bq/m^3).

Review of the BGS Indicative Atlas of Radon coverage indicates the site is in the lowest band of radon potential with less than 1% of homes above the 200 Bq/m^3 action level set out by PHE. Therefore, no radon protection is anticipated to be required for the proposed developments.

2.6 Unexploded Ordnance (UXO) Risk Assessment

A preliminary Unexploded Ordnance (UXO) risk assessment for the site has been undertaken online (zeticauxo.com) which indicates the whole Great Jackson Street site categorises as moderate risk, i.e. an area indicated as having a bombing density of 15 to 49 bombs per 1000 acre.

A 'pre-desk study risk assessment' for the site has been undertaken by Zetica which is based on a review of readily available records which documents potential sources of UXO in the vicinity of the site. The review identifies WWII as a potential source of UXO near the site. The output from Zetica's further review was as follows:

> *"It is recommended that a detailed desk study is commissioned to assess, and potentially zone, the Unexploded Ordnance (UXO) hazard level on the Site."*

On review, Coffey has re-examined the Manchester City Council City Architect's Department (Building Surveyor's Division) 1939-45 aerial bomb damage plans for the area (luna.manchester.ac.uk) as shown below in Figure 2. These show no bombs within the Plot F1 & F2 boundaries. One 'high explosive' (blue circle) is noted at the junction of the former Ferneley Street and Arthur Street to the north of Plot F1. No other incendiaries or other bombs are indicated within the Plot F1 and F2 boundaries.



Figure 2: Extract of 'Record location of aerial bombs'

Based on this additional site-specific desk study of contemporaneous records of bombing incidents and damage our assessment is that the UXO hazard level on the site is low.

3 GROUND INVESTIGATION

The intrusive ground investigation was undertaken by GeoAssist and based upon Coffey's Specification for Ground Investigation V4 (Ref: 03558AA_Spec_for Ground_Investigation_V4_GeoAssist). The factual report, including laboratory test results, is provided in Appendix A. An exploratory hole location plan is shown in Figure 3 below. The scope of works for the ground investigation is summarised in the sections below.

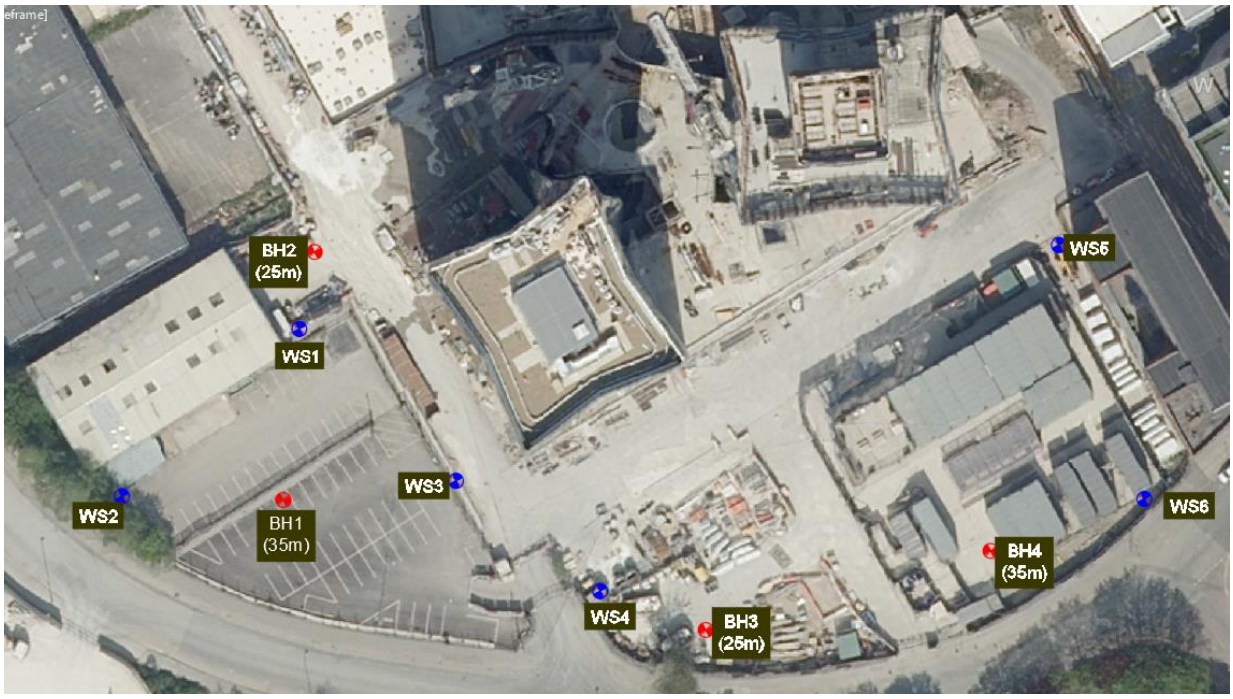


Figure 3: Exploratory hole location plan

3.1 Site Works

The ground investigation work was undertaken by GeoAssist in April 2021 in general accordance with BS5930:2015+A1:2020 and BS22476-5:2012. The investigation scope consisted of:

- 4 No. cable percussive boreholes (BH1 to BH4) with rotary follow on as follows:
    - BH1 and BH4 to 35m depth with High Pressure Dilatometer testing (HPD) and optical televiewer survey.
    - BH2 and BH3 to 25m depth.
- 6 No. windowless sample holes (WS1 to WS6) to 5 to 6m depth. (0.5m into weathered sandstone or to refusal).
- Standard Penetration Tests (SPTs) in the cable percussive boreholes at approximately 1m depth intervals within the superficial deposits.
- Groundwater and gas monitoring over a 3-month period.

- In-situ pressuremeter testing using HPD in stronger strata to give a direct measurement of stiffness.

3.1.1 Gas and Groundwater Monitoring

Ground gas monitoring was undertaken by GeoAssist in six visits over a three-month period between 24 May 2021 and 25 August 2021. Monitoring for the following gases was undertaken:

- Oxygen
- Carbon Dioxide
- Carbon Monoxide
- Methane
- Hydrogen Sulphide

Atmospheric pressure, lower explosive limit (LEL) and borehole gas flow rate measurements were also undertaken. The results of the monitoring are included in the GeoAssist factual report in Appendix A and discussed further in Section 7 of this report.

Table 2 shows the installation details for each of the exploratory holes.

Table 2: Exploratory hole installation details

Exploratory Hole ID	Response Zone Top (mbgl)	Response Zone Base (mbgl)	Response Zone Stratum
BH1	8.0	18.0	Sherwood Sandstone (Intact)
BH2	9.0	18.0	Sherwood Sandstone (Intact)
BH3	8.0	18.0	Sherwood Sandstone (Intact)
BH4	8.0	18.0	Sherwood Sandstone (Intact)
WS1	1.0	5.0	Made Ground and Glacial Till (Granular and Cohesive)
WS2	1.0	5.5	Glacial Till (Granular and Cohesive)
WS3	1.0	4.0	Glacial Till (Granular and Cohesive)
WS4	1.0	5.5	Made Ground and Glacial Till (Cohesive)
WS5	1.0	4.0	Made Ground and Glacial Till (Granular and Cohesive)
WS6	1.0	4.6	Made Ground and Glacial Till (Granular and Cohesive)

3.2 Laboratory Testing

3.2.1 Geotechnical Testing

Geotechnical laboratory testing was undertaken on recovered soil and rock samples in accordance with the relevant sections of BS 1377:1990. The scheduled testing comprised:

- 21 No. Natural moisture content

- 18 No. Atterberg Limits (Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI))
- 11 No. Particle size distribution (PSD) tests – Wet Sieve
- 7 No. Particle size distribution tests – Sedimentation
- 4 No. One-dimensional consolidation tests
- 8 No. Undrained Multistage Triaxial tests.
- 2 No. Consolidation Undrained Triaxial tests (only one test completed due to the quality of the samples).
- 24 No. Point Load tests.
- 17 No. Uniaxial Compression Tests
- 6 No. Uniaxial Compression Tests including measurement of Secant Modulus

Additionally, the BRE SD-1 (Full Suite) for the assessment of concrete in aggressive ground for a brownfield site where pyrite may be present was scheduled on 12 No. recovered soil samples and comprised:

- Water soluble sulphate
- Water soluble nitrate
- Chloride
- Magnesium
- pH.

Results from the geotechnical laboratory testing are included in the GeoAssist factual report in Appendix A and discussed further in Section 4 of this report.

3.2.2 Chemical Testing

Chemical laboratory testing was scheduled on 27 No. samples recovered from both the made ground and natural soils and 4 No samples from encountered groundwater for the following parameters:

- Asbestos screen and identification with quantification if found.
- Soil organic matter (SOM).
- MaxiSuite which comprises:
    - General inorganics (pH, cyanide, thiocyanate (as SCN), total sulphate (as SO4), sulphide, sulphur, phenols)
    - Polycyclic aromatic hydrocarbons (PAH) (naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthecene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(ghi)perylene)
    - Metals (arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium, zinc)

Results from the soil and groundwater chemical testing are included in the GeoAssist factual report in Appendix A and discussed further in Sections 5 and 6 of this report.

4 GROUND CONDITIONS

The ground conditions encountered during the 2021 GeoAssist ground investigation and anticipated to be encountered during the construction works are discussed in the following sections.

4.1 Material Descriptions.

4.1.1 Made Ground

Based on information outlined in the Desk Study (Ref 8), made ground below the site was anticipated to be encountered from ground level to between 0.7 and 3.2mbgl.

Made ground was identified in all exploratory locations from ground level to a maximum depth of 3.2mbgl. The made ground was encountered as both a clayey gravelly silty sand and sandy silty clay, with brick rubble, concrete, metal, and glass fragments.

BH4 identified asbestos cement fragments between 0.2 and 1.4mbgl.

A summary of the geotechnical test data available for the made ground is outlined in Table 3 below:

Table 3: Geotechnical Test Data - Made Ground

Test Parameter	Units	Number of tests	Value Range	Average
SPT	N-value	3	4 - 20	9
Shear Strength (Undrained Unconsolidated Triaxial)	kPa	2	75 - 94	84
Natural Moisture Content	%	3	16 - 39	24
Liquid Limit (LL)	%	1	43	-
Plastic Limit (PL)	%	1	22	-
Plasticity Index (Ip)	%	1	21	-
Modified Plasticity Index (Ip')	%	1	17.3	-
Bulk Density	MN/m^3	2	2.06 – 2.19	2.13

4.1.2 Glacial Till (Granular)

From the Desk Study (Ref 8), Glacial Till (Granular) was anticipated to be encountered to a depth of 2.2mbgl, with a layer thickness of 1.5m.

Glacial Till recovered as granular material was encountered in a number of locations including BH1, BH4, WS2, WS3, WS5 and WS6 at depths between 0.25 and 3.5mbgl with an average layer thickness of 0.75m. The material is generally described as brown/grey silty sandy gravel or brown clayey silty gravelly sand.

A summary of the geotechnical test data available for the Glacial Till (Granular) is outlined in Table 4 below:

Table 4: Geotechnical Test Data - Glacial Till (Granular)

Test Parameter	Units	Number of tests	Value Range	Average
SPT N	N-value	2	6 - 14	10

4.1.3 Glacial Till (Cohesive)

From the Desk Study (Ref 8), Glacial Till (Cohesive) was anticipated to be encountered to a depth of 6.7mbgl, with a layer thickness of between 2.4 and 6.4m.

Glacial Till recovered as cohesive material was encountered in all exploratory locations at depths between 0.7 and 6.0mbgl, with an average layer thickness of 2.75m. The material is generally described as stiff to very stiff brown gravelly sandy silty clay. A number of sand partings up to 0.2m thick were encountered within the layer in WS3 – WS5.

A summary of the geotechnical test data available for the Glacial Till (Cohesive) is outlined in Table 5 below:

Table 5: Geotechnical Test Data - Glacial Till (Cohesive)

Test Parameter	Units	Number of tests	Value Range	Average
SPT	N-value	6	8 - 63	30
Shear Strength (Undrained Unconsolidated Triaxial)	kPa	5	53 - 146	95
Natural Moisture Content	%	17	8.6 – 25	15
Liquid Limit (LL)	%	17	24 - 52	34
Plastic Limit (PL)	%	17	11 - 21	15
Plasticity Index (Ip)	%	17	12 - 31	18
Modified Plasticity Index (Ip')	%	17	11 - 31	17
Bulk Density	MN/m^3	9	1.98 – 2.22	2.10
Coeff. of volume compressibility (mv)	m^2/MN	4	0.37 – 0.44 (10 – 50kPa)* 0.19 – 0.29 (50 – 100kPa)* 0.09 – 0.16 (200 – 400kPa)*+	0.40 0.24 0.12
Coeff. of consolidation (cv)	m^2/yr	4	1.4 – 5.8 (10 – 50kPa)* 1.8 – 5.0 (50 – 100kPa)* 2.7 – 6.1 (200 – 400kPa)*+	3.4 3.5 4.8

* Test pressure ranges shown in brackets.

+ After unloading/reloading cycle.

4.1.4 Sherwood Sandstone (Weathered)

From the Desk Study (Ref 8), Sherwood Sandstone (Weathered) was anticipated to be encountered to a depth of 8.7mbgl, with a layer thickness of between 1.1 and 2.0m.

Sherwood Sandstone recovered as sand (completely weathered) was encountered in all four exploratory locations which reached rockhead (BH1 to BH4). The layer was encountered at depths between 4.7 – 7.0mbgl, with an average layer thickness of 0.85m. The material is generally described as very dense orange/brown silty sand with sandstone fragments and rounded gravel.

A summary of the geotechnical test data available for the Sherwood Sandstone (Weathered) is outlined in Table 6 below:

Table 6: Geotechnical test Data - Sherwood Sandstone (Weathered)

Test Parameter	Units	Number of tests	Value Range	Average
SPT	N-Value	4	89 – 237*	149

*pro rata value from penetration at refusal.

4.1.5 Sherwood Sandstone (Intact)

From the Desk Study (Ref 8), Sherwood Sandstone (Intact) was anticipated to be encountered at a depth of between 7.0 and 8.7mbgl. The thickness of the unit was not proven.

Intact Sherwood Sandstone was encountered between 5.9 and 7.0mbgl. The material is generally described as weak orange/brown slightly weathered inferior cemented silty fine to medium grained sandstone with faint thinly sub-horizontal bedding.

Photographs of the Sherwood Sandstone rock core are presented in the GeoAssist factual report in Appendix A. Total Core Recovery (TCR) in the Sherwood Sandstone ranged from 0 to 100% and was typically over 93%. Rock Quality Designation (RQD) ranged from 10 to 83% and was typically between 40 and 64%. Based on the borehole logs, the fracture spacing (I_f) ranged from non-intact to 300mm (medium spacing) and was typically 30 to 80mm (very close to close spacing).

The optical televiewer survey logs for BH1 and BH4 are presented in the GeoAssist factual report in Appendix A. The logs indicate fracture spacing ranged from 40 to 1860mm and was typically 160 to 500mm (close to medium spacing). This is significantly greater than the values recorded on the borehole logs. The joints dipped typically 8 to 19 degrees in the southwest direction (i.e. azimuths typically in the range of 195 to 255 degrees).

A summary of the geotechnical test data available for the Sherwood Sandstone (Intact) is outlined in Table 7 below.

Table 7: Geotechnical Test Data - Sherwood Sandstone (Intact)

Test Parameter	Units	Number of tests	Value Range	Average
SPT N	N-Value	5	166 – 300*	233
Uniaxial Compression Strength (UCS)	MPa	23	9.4 – 19.9	14.8
Point Load Index (IS_{50})	MPa	48	0.41 – 1.67	0.97

Test Parameter	Units	Number of tests	Value Range	Average
Bulk Density	Mg/m^3	23	2.14 – 2.28	2.20
Moisture Content	%	23	6.5 – 14.9	12.4
Secant Modulus	GPa	6	1.02 – 1.66	1.47

*Pro rata value from penetration at refusal.

In addition to the tests outlined in Table 7 above, nine high pressure dilatometer (HPD) tests were carried out within the Sherwood Sandstone. The full test report for the HPD tests in BH1 and BH4 is provided in the GeoAssist factual report in Appendix A. HPD testing undertaken during the 2018 GeoAssist ground investigation that lie within the Plot F site boundary (Section 2.2.2) has also been considered. This comprised 22 tests from three boreholes (BH23 – 25). The results from these tests have been used to derive a stiffness profile for the Sherwood Sandstone, which is presented on Figure 11 with further discussion in Section 4.2.

4.2 Derivation of Material Parameters

Figures 5 to 11 show data from in-situ and laboratory tests with elevation for: SPT N-values, Atterberg Limits, undrained shear strength, rock UCS and drained and undrained Young's modulus, respectively. Where appropriate these plots show proposed design lines.

The following correlations have been used to determine undrained and drained ground parameters. Typical material properties based on interpretations are given in Sections 4.2.1 to 4.2.4.

- Undrained shear strength (s_u) has been determined using the following correlation between plasticity index (Ip) and SPT N-value according to Stroud and Butler (1975). This correlation is valid for glacial tills and over-consolidated clays.

  $$s_u = f_1 \times \text{SPT N-value}$$

  where f_1 is a factor depending on the plasticity index of the soil.

- The critical state friction angle (ϕ'_{cv}) of clayey soils has been assessed using the following correlation with plasticity index as indicated in BS8004:2015:

  $$\phi'_{cv} = 42° - 12.5\log(Ip\%)$$

- Apparent cohesion (c') is generally assumed to be 0kPa, unless stated otherwise.

- Friction angle for granular materials has been derived using the between SPT N and angle of shearing resistance after Peck *et al* as reproduced from Tomlinson (Ref 17) below.

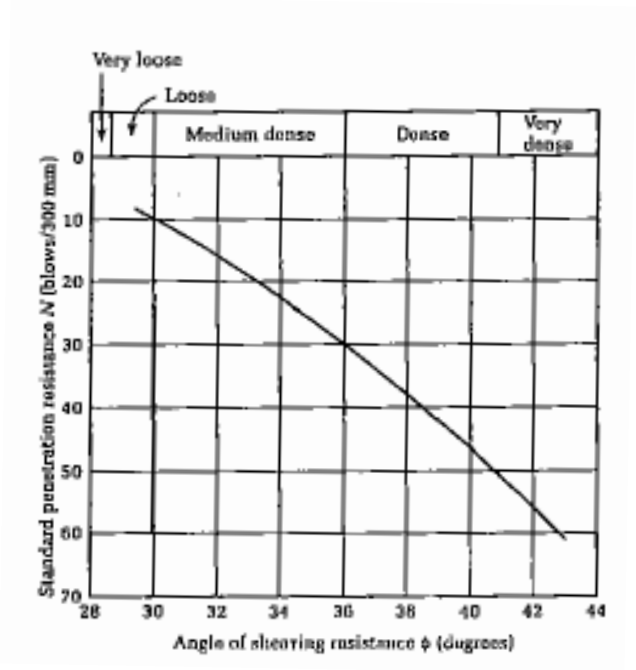


Figure 4: Relationship between SPT N and angle of shearing resistance (after Peck *et al*)

- Assessment of the strength parameters (effective friction angle ϕ' and apparent cohesion c') for the intact Sherwood Sandstone has been carried out using Rocsciences RSData software which uses the Hoek-Brown failure criterion (Ref 19).
- Figure 8 shows drained Young's Modulus (E') of soils with depth. E' has been assessed based on the Jamiolkowski *et al.* relationship (1979):

  $E_u/s_u = \lambda$

  $E' = E_u*(1+v)/(1+v_u)$

  where E_u is the undrained Young's Modulus, λ is a factor depending on the Ip and over consolidation ratio (OCR). v and v_u are the Poisson's ratio in drained and undrained conditions, respectively.
- Rock mass loading stiffness $E_{LOADING}$ was calculated using results of the high-pressure dilatometer testing and the following correlation:

  $E_{LOADING} = 2\ G_i\ (1 + v)$

  Where G_i is the initial shear modulus measured during the HPD test and v is the Poisson ratio which is assumed to be 0.3 for rocks as recommended in Tomlinson (Ref 17).
- For the unloading stiffness $E_{UNLOADING}$ the following correlation is used:

  $E_{UNLOADING} = 2\ G_{ur}\ (1 + v)$

  Where G_{ur} is the unloading shear modulus measured during the HPD test. The average of the measured G_{ur} from all unloading loops during the test is used. The stiffness profile for both loading and unloading is presented in Figure 11.

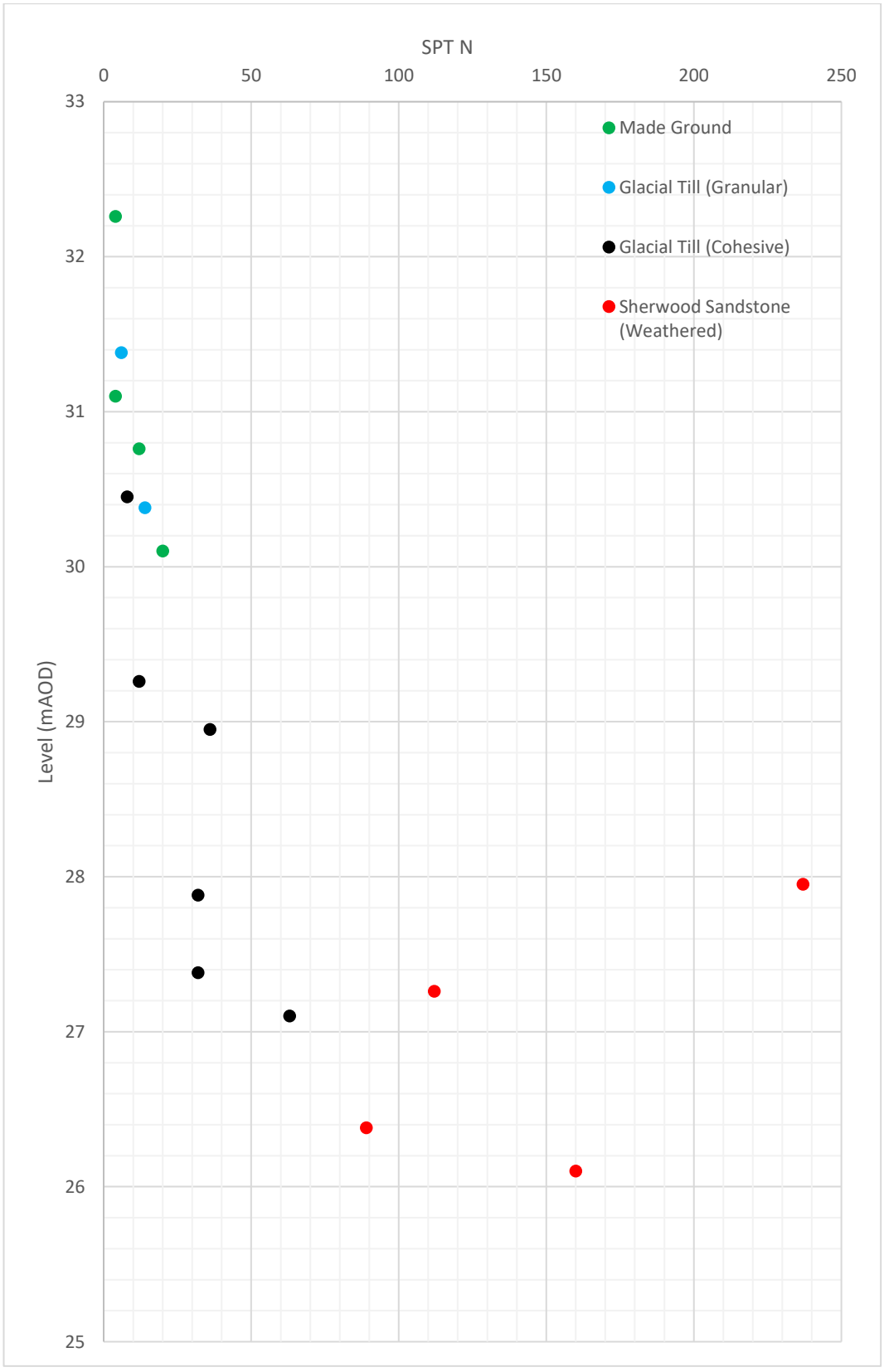


Figure 5: SPT N with Elevation

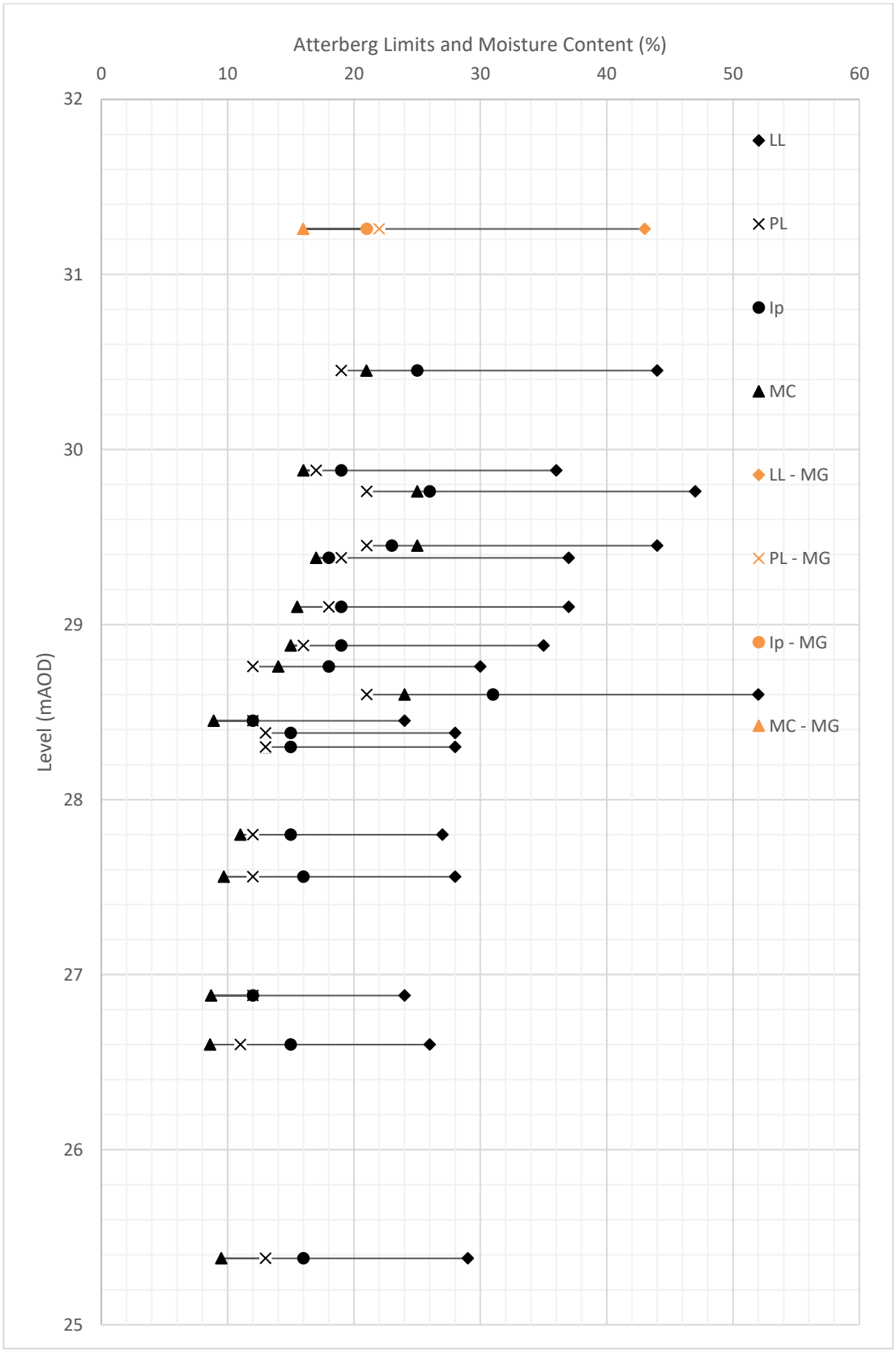


Figure 6: Atterberg Limits and Moisture Content with Elevation

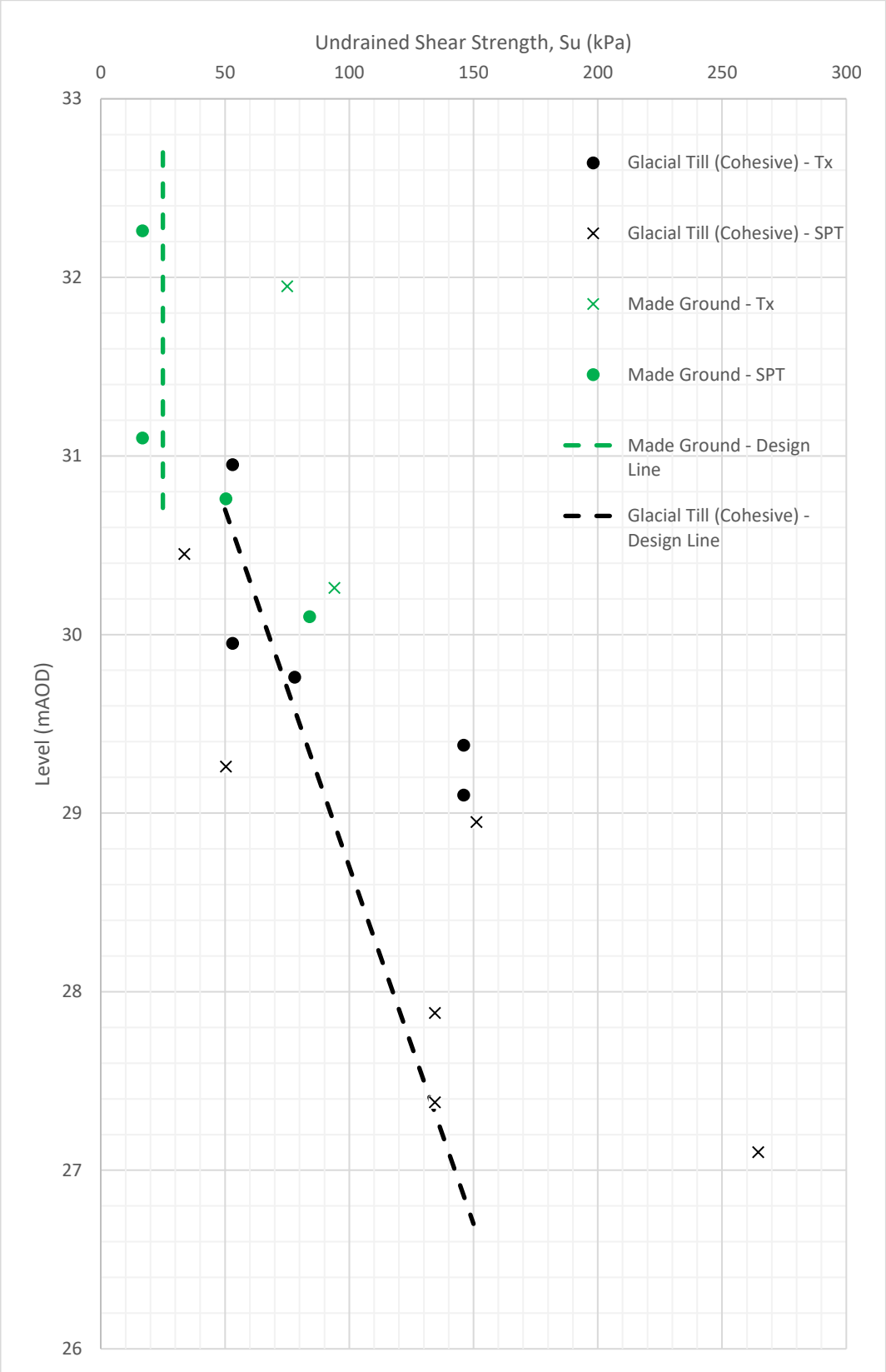


Figure 7: Undrained Shear Strength with Elevation

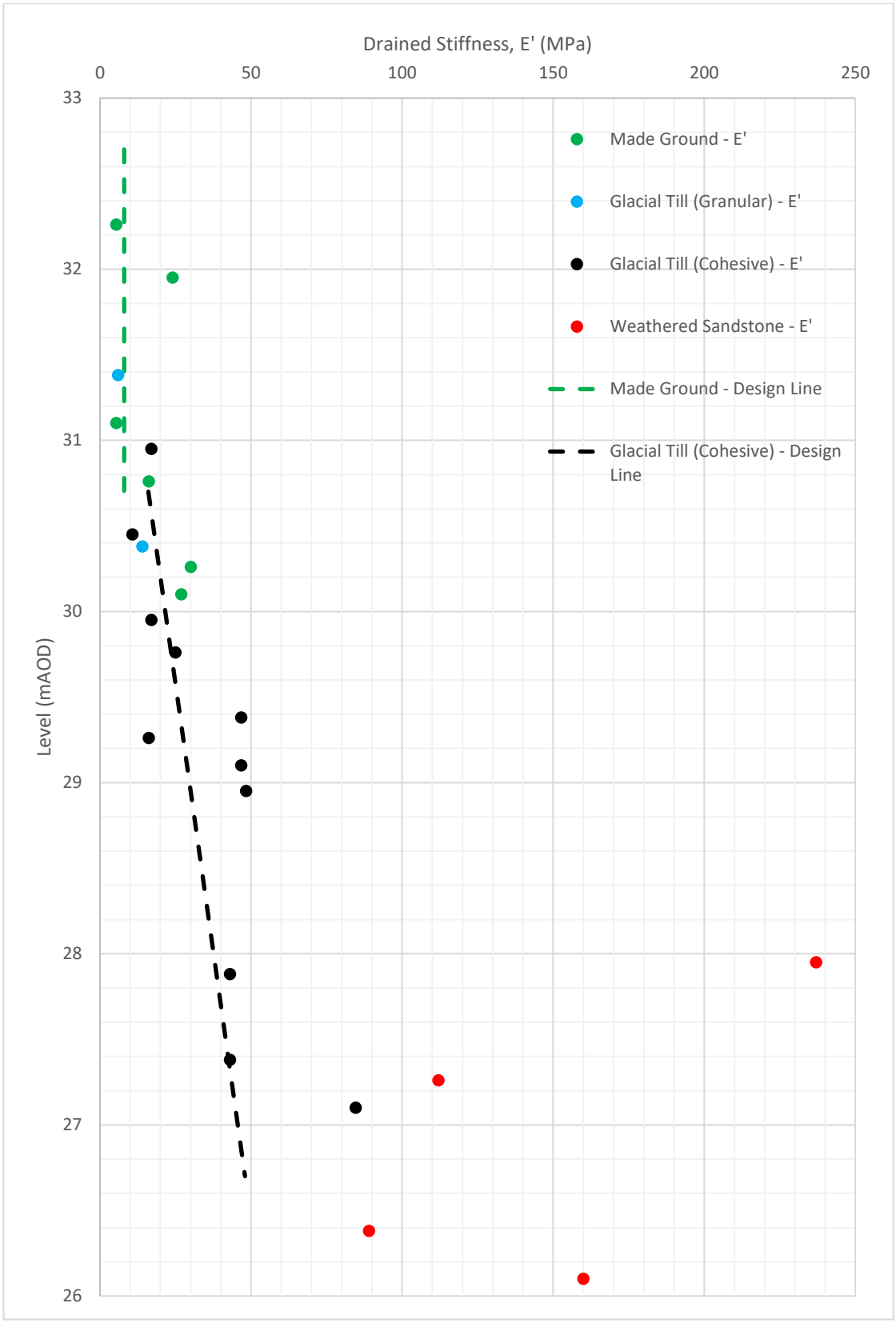


Figure 8: Soil Stiffness (Drained) with Elevation

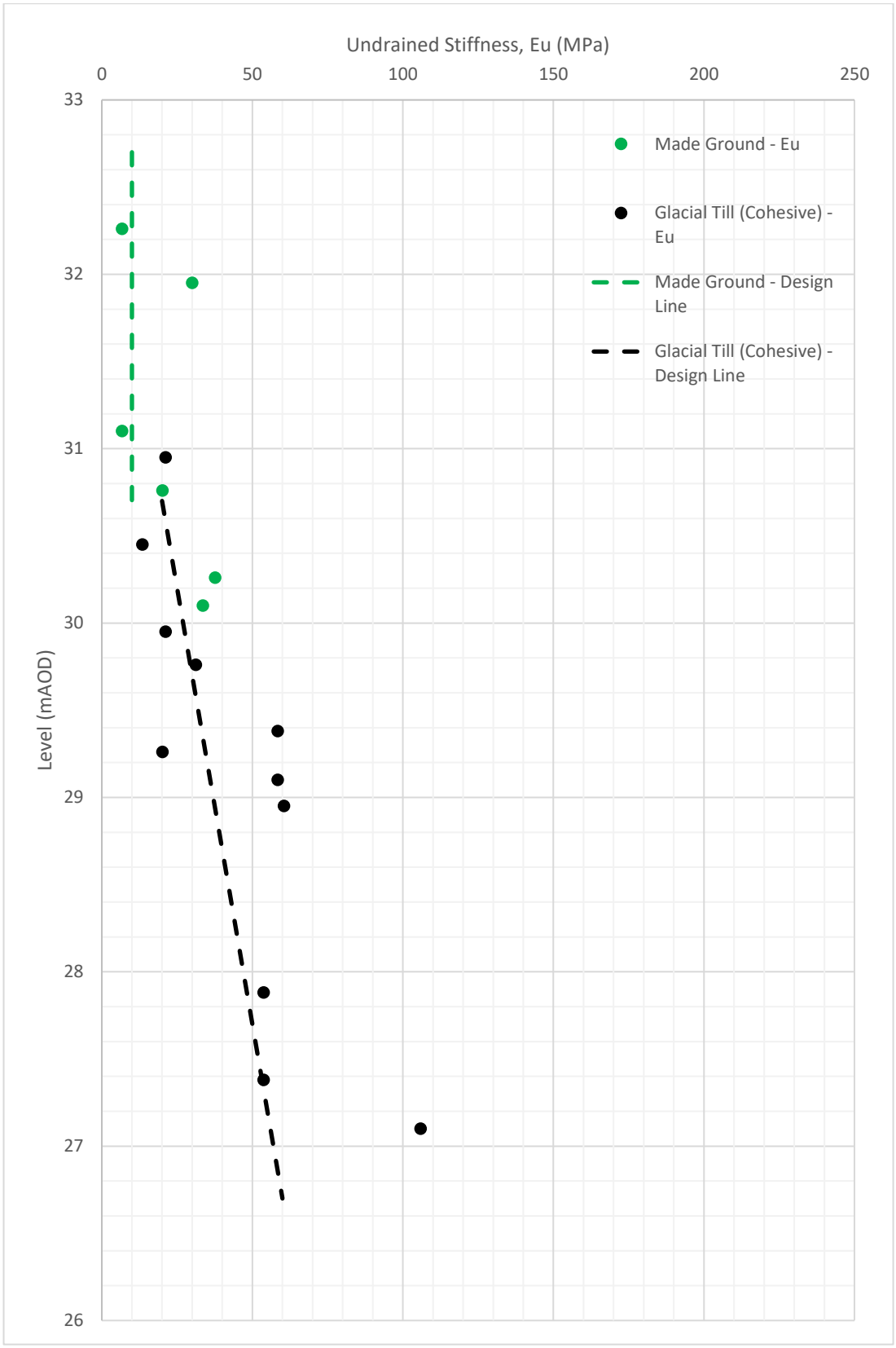


Figure 9: Soil Stiffness (Undrained) with Elevation

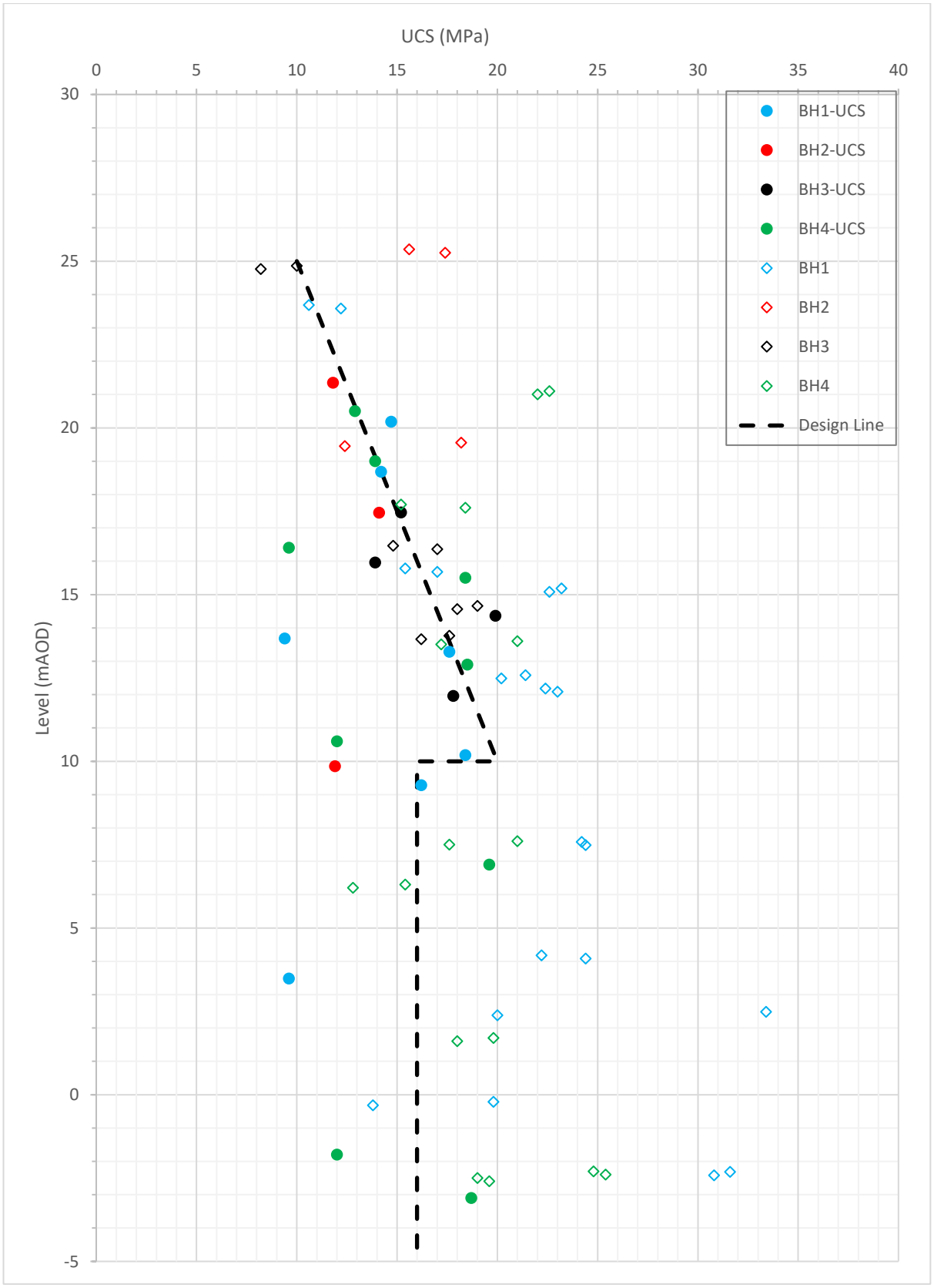


Figure 10: Sherwood Sandstone UCS with Elevation

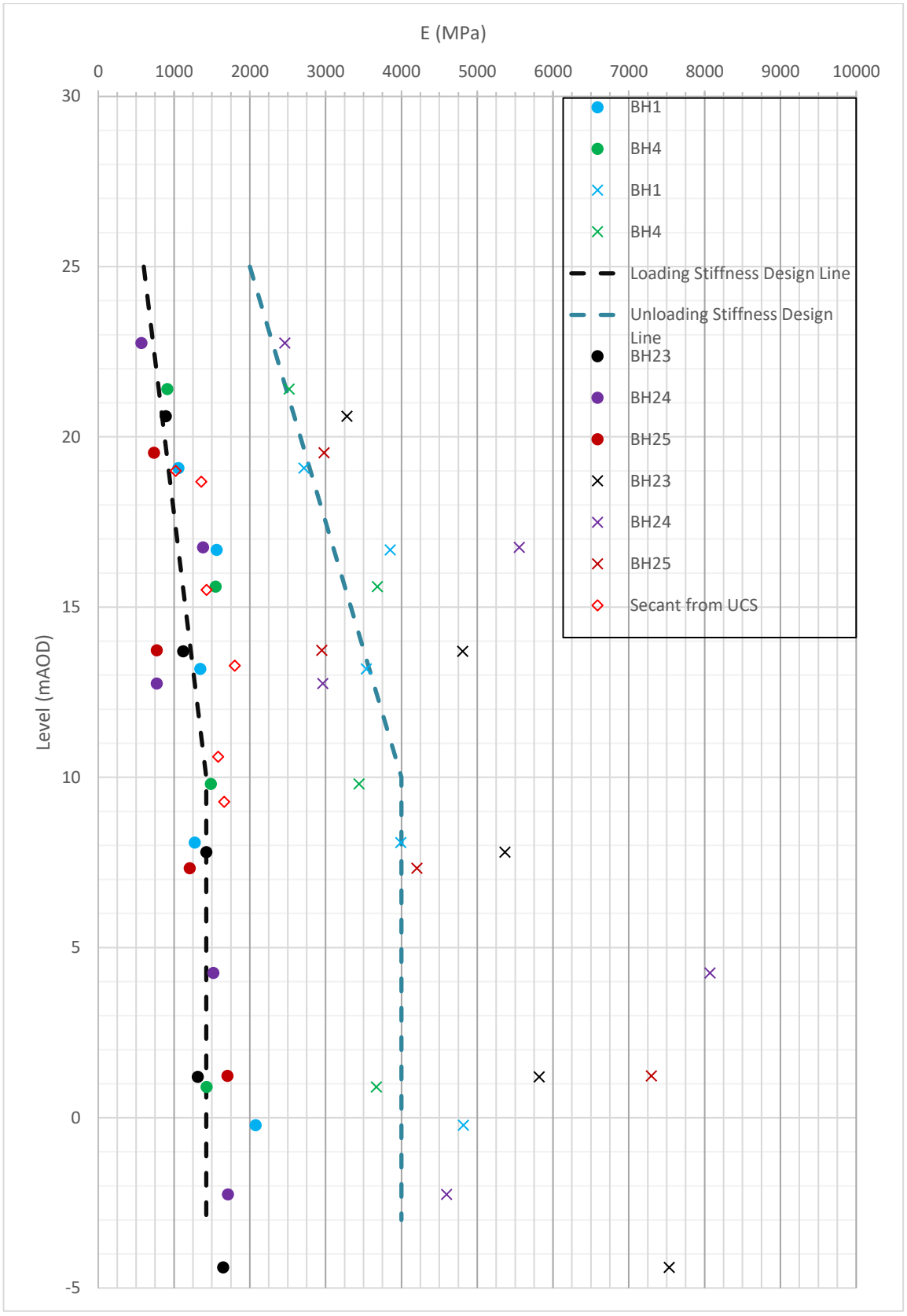


Figure 11: Sherwood Sandstone HPD Derived Stiffness with Elevation

4.2.1 Typical Properties – Made Ground

Based on the soil descriptions and geotechnical laboratory tests, made ground is considered as medium to high strength sandy gravelly clay.

The ground parameters have been derived as follows:

- Undrained shear strength s_u = 25kPa based on triaxial test measurements and SPT correlations.
- Based on an Ip = 21%, a critical state friction angle ϕ'_{cv} = 42°-12.5log(Ip%) = 25° is obtained.
- Young's modulus: λ = 400; OCR = 1; E_u = $400s_u$; E_u = 10MPa; E' = 8MPa.
- Bulk unit weight based on triaxial tests is 21kN/m^3.

4.2.2 Typical Properties – Glacial Till (Granular)

Based on the soil descriptions and geotechnical laboratory tests the Glacial Till (Granular) is considered as a loose to medium dense clayey silty sand and gravel.

The ground parameters have been derived as follows:

- Based on the relationship between SPT N and angle of shearing resistance after Peck *et al.,* the angle of shearing resistance considered appropriate for design is 30 degrees, based on a characteristic SPT N value of 10.
- A bulk unit weight of 18kN/m^3 is considered appropriate based on the description of the material and recommendations in Tomlinson (Ref: 17).
- A drained Young's modulus E' of 10MPa is considered appropriate based on a characteristic SPT N of 10 and the correlation by Stroud of E'/N_{60} = 1MPa and presented in CIRIA 143.

4.2.3 Typical Properties – Glacial Till (Cohesive)

Based on the soil descriptions and geotechnical laboratory tests, the Glacial Till (Cohesive) is considered as medium to high strength sandy silty clay.

The ground parameters have been derived as follows:

- Undrained shear strength s_u = 50kPa from 30.7mAOD, increasing linearly to 150kPa at 26.7mAOD, based on triaxial test measurements and SPT correlations.
- Based on an Ip = 18%, a critical state friction angle ϕ'_{cv} = 42°-12.5log(Ip%) = 26° is obtained. A single consolidated undrained triaxial test is available for BH4 at a depth of 3.8m which yields an effective stress friction angle ϕ' of 30 degrees. It is noted that index testing at this location indicates materials with a lower plasticity index than the average, which can explain the higher value. It is recommended that 26° is used as a characteristic value.
- Young's modulus: λ = 400; OCR = 1; E_u = $400s_u$; E_u = 20MPa from 30.7mAOD, increasing linearly to 60MPa at 26.7mAOD. E' = 16MPa from 30.7mAOD, increasing linearly to 48MPa at 26.7mAOD.
- Bulk unit weight based on oedometer and triaxial test results is 21kN/m^3.

4.2.4 Typical Properties – Sherwood Sandstone (Weathered)

Based on the soil descriptions and geotechnical laboratory tests the weathered Sherwood Sandstone is considered as a very dense silty Sand and Gravel.

- Based on the relationship between SPT N and angle of shearing resistance after Peck *et al*., the angle of shearing resistance considered appropriate for design is 42 degrees, based on a characteristic SPT N value of 149.
- Due to the description of the weathered sandstone as ‘very dense‘ the same bulk density will be used as the parent material, the Sherwood Sandstone. From available testing this is 22kN/m^3.
- A drained Young’s modulus E’ of 149MPa is considered appropriate based on a characteristic SPT N of 149 and the correlation by Stroud of E’/N_{60} = 1MPa and presented in CIRIA 143.

4.2.5 Typical Properties – Sherwood Sandstone (Intact)

Based on the rock descriptions and geotechnical laboratory tests the intact Sherwood Sandstone is considered a weak slightly weathered inferior cemented silty fine to medium grained Sandstone with faint thinly sub-horizontal bedding.

- Based on direct UCS tests and point load tests conversion using a correlation factor of 20 as outlined in Tomlinson (2001, Ref 17) a UCS of 10MPa at rockhead, increasing linearly with depth to 20MPa at 10mAOD, then constant 16MPa to depth, is considered representative. See Figure 10.
- A drained Poisson’s ratio of 0.2 is considered appropriate as recommended for rock in Tomlinson (Ref 17)
- A bulk unit weight of 22 kN/m^3 is considered appropriate based on UCS test data which is comparable with values recommended in Tomlinson (Ref 17) for weakly cemented Sandstones.
- An undrained shear strength of 10,750kPa is considered appropriate and has been derived from direct measurement from HPD testing.
- An angle of shearing resistance of 45° and effective cohesion of 370kPa are considered appropriate derived from RocData analysis using the following Hoek-Brown (Ref 19) parameters based on descriptions and test data:
    - UCS = 10MPa
    - GSI = 60
    - mi = 17
    - D = 0

  Note that the calculation assumes in situ stresses at formation level are equal to 1MPa which accounts for anticipated building loads and overburden.

4.3 Ground Model

The representative ground model and geotechnical parameters for design based on available information from the ground investigation are presented in Table 8 and 9 below.

Table 8: Design Ground Model

Material	Top Elevation (mAOD)	Base Elevation (mAOD)	Thickness (m)
Made Ground	32.7	30.7	2
Glacial Till (Granular)	30.7	29.7	1
Glacial Till (Cohesive)	29.7	26.7	3
Sherwood Sandstone (Weathered)	26.7	25.2	1.5
Sherwood Sandstone (Intact)	25.2	Not Proven	Not Proven

Typical characteristic material properties for design have been selected based on the results of in-situ and laboratory testing, the descriptions of the materials encountered and empirical correlations as well as experience of similar materials where test results are limited or not available. Properties for design are summarised below.

Table 9: Characteristic Material Parameters

Material	γb (kN/m^3)	φ' (°)	c' (kPa)	S_u (kPa)	E' (MPa)	E_u (MPa)	UCS (MPa)
Made Ground	21	25	-	25	8	10	-
Glacial Till (Granular)	18	30	-	-	10	-	-
Glacial Till (Cohesive)	21	26	-	50 + 25z	16 + 8z	20 + 10z	-
Sherwood Sandstone (Weathered)	22	42	-	-	149	-	-
Sherwood Sandstone (Intact)	22	45	370	10,750	600 + 55z (to 10mAOD) 1425 from 10mAOD	-	10 + 0.67z (to 10mAOD) 16 from 10mAOD
γb – bulk unit weight, φ' – effective angle of shearing resistance, c' – effective cohesion, s_u – undrained shear strength, E' – undrained Young's Modulus, E_u – undrained Young's Modulus, UCS – unconfined compressive strength, z – depth below top of stratum							

4.4 Groundwater

Groundwater levels recorded in locations BH1 – BH4 during drilling were between 23.75 and 21.60mAOD. Groundwater strike was at 15.26mAOD in BH3 before rising to a standing level of 22.86mAOD.

Groundwater monitoring was carried out between May 2021 and July 2021. During this time maximum and minimum recorded groundwater levels were 23.16mAOD and 22.92mAOD, respectively. Table 10 outlines the recorded groundwater levels for locations BH1 – BH4.

Table 10: Groundwater Monitoring Summary

Date	BH1 (mAOD)	BH2 (mAOD)	BH3 (mAOD)	BH4 (mAOD)
12/05/2021	22.98	22.95	23.15	23.16
19/05/2021	22.92	22.92	23.09	23.10
26/05/2021	22.94	22.92	23.09	23.11
02/06/2021	22.95	22.94	23.11	23.14
09/06/2021	23.00	22.98	23.12	23.14
16/06/2021	23.03	23.02	23.16	23.16
23/06/2021	23.02	22.99	23.13	23.14
30/06/2021	23.06	23.03	23.16	23.16

Based on groundwater monitoring data it is proposed that a design groundwater level of 23.5mAOD is adopted. It should be noted that groundwater monitoring has been undertaken during the summer months and groundwater levels may fluctuate throughout the year.

We note that the basement level noted in Section 1.3 for Plot F1, which has three levels of basement, is 23.59mAOD. Renaker has advised that actual groundwater levels encountered during excavation of the adjacent developments were 1m, or more, lower than indicated in relevant ground investigations. It would be prudent to allow for some sump dewatering, especially for Plot F1, and this consideration should be taken into account in the design and sequencing of the basement construction.

Pump tests were undertaken by GeoAssist in April 2016 for the Deansgate Square project located directly north of the Plot F boundary. Groundwater from this investigation was found to be within the Sandstone bedrock at levels around 24.0mAOD, similar to the proposed design groundwater level presented above. A summary of the hydraulic parameters for Sandstone as derived from the pump tests data using BS5931 1981 is outlined below.

Table 11: Pump Test Results (Reproduced from GeoAssist April 2016 Pump Test Report)

Parameter	Value
Permeability – k M1 to M3	2.2 x10^{-5} m/sec
Permeability – k M2 to M3	6.2 x10^{-6} m/sec

.

4.5 Visual / Olfactory Evidence of Ground Contamination

Asbestos was identified in the made ground at exploratory location BH4 at a depth between 0.2 and 1.4mbgl and was described as 'asbestos cement fragments.' Identification of this was confirmed during laboratory testing and is discussed further in Section 5.2

No hydrocarbon or fuel odours were noted on the logs. Photo-ionisation detector (PID) testing was not specified in the ground investigation specification.

4.6 Concrete in Aggressive Ground

Twelve soil samples and four groundwater samples were scheduled for testing to determine the aggressivity of the soils to buried concrete. The full BRE Special Digest 1 "Concrete in Aggressive Ground" (Ref 9) suite was used which consists of testing of pH, water soluble sulphate (as SO_4), water soluble nitrite, chloride, and magnesium.

In accordance with the guidance provided in BRE SD1 (Ref 9), where there are 10 or more soil test results available, the characteristic value has been taken as the mean of the worst case 20% of results. For sulphate tests this is the mean of the highest 20% of results. For pH, this is the mean of the lowest 20% of results.

Table 12 provides a summary of the pH results and 2:1 water soluble sulphate (SO_4) taken from the combined geotechnical and contamination soil tests undertaken as part of the April 2021 ground investigation by GeoAssist. Concrete classification based on guidance in BRE SD1 (Ref 9) is outlined in Table 13.

Table 12: Summary of Sulphate (2:1 water soluble, SO_4) and pH Testing

Determinand	Soil / Groundwater	Value		Characteristic Value *
		Min	Max	
pH	Soil (12 samples)	6.9	10.6	7.1**
	Groundwater (4 samples)	7.4	7.6	7.4**
Water Soluble Sulphate (SO_4) 2:1 water extract (mg/l)	Soil (12 samples)	22.4	297	234.3^{+}
	Groundwater (4 samples)	13.3	30.4	30.4^{++}

Notes:
* As defined in BRE Special Digest 1.
** Lowest measured if number of tested samples less than 9 or mean of the lowest 20% otherwise.
$^{+}$ Mean of the two highest if number of tested samples less than 9 or the mean of the highest 20% otherwise.
$^{++}$Highest sulphate concentration (mg/lSO4).

Table 13: BRE Concrete Classification

Characteristic Values	Design Sulphate Class	ACEC Class
soil pH = 7.1 sulphate in soil = 234.3 mg/l	DS-1	AC-1

Notes:
Assuming brownfield site and groundwater is 'mobile water'

5 SOIL GEO-ENVIRONMENTAL ASSESSMENT

Chemical laboratory testing was scheduled on 27 No. soil samples recovered from the made ground and natural soils as outlined in Section 3.2.2 above. A comparison of soil-chemistry concentrations with published CIEHL/LQM 'Suitable for Use Levels' (S4ULs, Ref 14) has been carried out to provide an indication of any potential elevated concentrations within the site.

Based on the development plans and the fact that most of the superficial deposits will be removed to accommodate construction of the basement levels, the end use has been assumed as public open spaces near residential housing.

Full soil chemical laboratory testing results are presented in the GeoAssist factual report in Appendix A.

5.1 Soil Organic Matter Content

A total of 7 No. samples from the made ground and Glacial Till were tested to determine their Soil Organic Matter (SOM) content.

The limit of detection for the test was 0.1%. From the three tests on samples from the made ground the measured SOM content was 1.3%, 1.4% and 3.1%.

From the four tests from samples within the natural soils the measured SOM contents were 1.5%, 1.5%, 1.8% and 7.1%.

The average SOM content of 2.5% has been used to allow the determination of the appropriate S4UL thresholds for organic contaminants. Lower SOM values are more conservative, and it has been determined that the value of 2.5% SOM be used as the most representative when selecting the S4UL thresholds for all the material obtained from the site based on the soil contamination test results. As metals are not sensitive to SOM a value of 6% SOM is adopted.

5.2 Asbestos

A total of 15 No. soil samples of the made ground and the potentially reworked Glacial Till were screened for the presence of asbestos. Asbestos was identified in 2 of the 15 samples screened; both samples were within the made ground. 'Chrysotile, Amosite – Loose Fibres' was identified in the asbestos screen in WS1 at 0.30mbgl depth. 'Chrysotile – Hard/Cement type material' was identified in BH4 at a depth of 0.5mbgl. Quantification testing on the samples where screening indicated the presence of asbestos is summarised below.

Table 14: Summary of Asbestos Quantification Testing

Location ID	Depth	Material	Asbestos Description	Quantification Testing
WS1	0.3mbgl	Made Ground	Chrysotile, Amosite – Loose Fibres	<0.001% (below reporting limit)
BH4	0.5mbgl	Made Ground	Hard/Cement type material	0.958%

5.3 Other Tests

The samples were also tested for a range of other parameters as listed in Section 3.2.2 above.

Measured concentrations of inorganic and metallic contaminants were below either their respective detection limits and / or S4UL for 'Public open spaces near residential'.

There were a number of exceedances of S4UL noted for three organic determinands. Details of these exceedances are outlined in Table 15 below.

Full results of the geo-environmental assessment using S4UL is provided in Appendix C.

Table 15: Soil Geo-environmental Assessment Exceedances

Determinand	S4UL (mg/kg)	Exceedance (mg/kg)
Benzo[b]fluoranthene	7.2	24 (WS4 at 0.3mbgl) 22 (WS4 at 0.6mbgl) 14 (WS4 at 1.4mbgl) 12 (WS5 at 0.3mbgl)
Benzo[a]pyrene	5.7	23 (WS4 at 0.3mbgl) 23 (WS4 at 0.6mbgl) 13 (WS4 at 1.4mbgl) 12 (WS5 at 0.3mbgl)
Dibenz[ah]anthracene	0.57	3.2 (WS4 at 0.3mbgl) 3.5 (WS4 at 0.6mbgl) 1.7 (WS4 at 1.4mbgl) 1.7 (WS5 at 0.3mbgl) 0.75 (WS5 at 0.8mbgl)

6 GROUNDWATER GEO-ENVIRONMENTAL ASSESSMENT

6.1 Groundwater samples

Groundwater samples were collected on the first round of groundwater monitoring on the 12 May 2021. A groundwater sample was obtained from each of the four boreholes (BH1-4) at a depth of 16.0mbgl and scheduled for geo-environmental testing. The results of the laboratory testing are presented in the GeoAssist factual report in Appendix A.

6.2 Groundwater assessment

The groundwater test results have been directly compared to the following standards (in order of selection hierarchy):

- 2015, Water Framework Directive (WFD) values from Table 1 in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
- 2016, UK Drinking Water Standards (DWS) from Schedules 1 and 2 of The Water Supply (Water Quality) Regulations 2016 (Statutory Instrument 2016 No. 614).
- 2017, World Health Organisation, Guideline Values for Chemicals that are of Health Significance in Drinking Water (4th Edition, incorporating the 1st Addendum).

It should be noted that there is not both an environmental quality standard (EQS) and drinking water standard (DWS) for every determinand tested for. For some determinands there are no EQS or DWS values.

Some determinand limits depend on the water hardness which was not tested for during the geo-environmental laboratory testing. However, a conservative assumption of Class 1 ($CaCO_3$ content > 0-40mg/L) has been made in the absence of test data.

The only determinand tested which showed exceedance of the EQS and/or the DWS values was copper. An exceedance of the EQS for copper (1µg/l) was measured in all four BH locations with measured concentrations ranging between 1.2 and 2.1µg/l. It is noted that the EQS for copper relates to *bioavailable* concentration rather than *total* concentration, which is what has been measured during the investigation. Not all of the copper concentration measured within the groundwater will be bioavailable and whilst the exceedances are not insignificant, they are not considered to be of concern. Therefore, no further action regarding groundwater remediation is considered necessary.

7 GROUND GAS ASSESSMENT

Ground gas monitoring was carried out at locations WS1-6 during six visits over a three-month period between 24th May 2021 and 25th August 2021. Full monitoring results are provided in the GeoAssist factual report in Appendix A and a summary is provided in Table 16 below.

Table 16: Summary of Ground Gas Monitoring

	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	LEL (%)	AP (mb)	Flow (l/h)
Maximum	0	6.1	21.3	0	0	0	1024	0
Minimum	0	0	6.5	0	0	0	997	0
Average	0	1.28	18.4	0	0	0	1009	0

7.1 Monitoring Results

Concentrations of methane (CH_4) were uniformly recorded as 0% during the three-month monitoring period.

Concentrations of carbon dioxide (CO_2) were measured in at least five out of six monitoring locations on every visit with the exception of the 28th July 2021 where CO_2 was measured in only two out of the six locations. The maximum concentration of 6.1% was measured in location WS1 and subsequently reduced to 0% on the following monitoring round.

Where elevated concentrations of carbon dioxide were measured the concentrations of oxygen (O_2) were observed to be correspondingly lower.

Concentrations of hydrogen sulphide (H_2S) and carbon monoxide (CO) were below the limit of detection in all the six standpipes throughout the monitoring period.

The flow rate was below the limit of detection in all locations throughout the monitoring period.

The lower explosive limit (LEL) was below the limit of detection in all locations throughout the monitoring period.

Atmospheric pressure (AP) ranged between 997mb and 1024mb during the monitoring period.

7.2 Soil Gas Assessment

Within the made ground the SOM content was found to range between 1.3% and 3.1% with an average SOM of 1.93%. Within the natural soils the SOM content was found to range between 1.5% and 7.1% with an average of 2.98%.

Under current CIEH guidance (Ref 10) the site is considered to have a VERY LOW generation potential; (e.g. made ground with low degradable organic content, up to 5% organic material such as pieces of wood, pieces of paper, rags, etc. with a high proportion of ash and no food or other easily degradable waste). The sensitivity of the proposed development to SOM is considered MODERATE; i.e. apartments. The risk of lateral migration is also considered to be NEGLIGIBLE as the underlying geology is clay and there are no credible nearby sources. As there is no credible source of soil gas below the site or a pathway for gas to migrate from external sources, further gas monitoring is considered not necessary.

The requirement for gas protection measures has been assessed following the British Standard guidance in BS5485:2016+A1:2019 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

As the flow rate was recorded as 0.0l/h for all gas monitoring readings, the provisional gas screening value (GSV) which is calculated as (GSV = flow rate x gas concentration) is zero. Based on the guidance in BS5485:2016+A1:2019 the Characteristic Situation (CS) value is therefore equal to 1 which indicates 'very low' hazard potential.

Assuming the development is a 'Type B' building as outlined in Table 3 of BS5485:2016+A1:2019 and considering the CS value of 1, then the gas protection score is 0 in accordance with Table 4 of BS5485:2016+A1:2019. This indicates that no gas protection measures are necessary.

8 WASTE DISPOSAL

8.1 Waste Classification

This GIR does not definitively classify the potential wastes generated from site for disposal. However, we note that the presence of asbestos – refer Section 5.2 – could affect the waste classification of any made ground removed.

It is noted that asbestos fibres were encountered at one location, WS1 at 0.3mbgl. Further quantification measured the amount of asbestos fibres to be below the reporting limit of <0.001%. This is well below the threshold at which waste containing 'free and dispersed asbestos fibres' is automatically classified as hazardous, i.e. ≥0.1%.

In one further location, BH4 at 0.5mbgl, an identifiable piece of asbestos containing material (ACM) was found. The ACM found at BH4 recorded 0.958% asbestos; this is above the hazardous waste limit. It has not been possible to identify this area of made ground as discretely separate from all other made ground on site and therefore, based on the site history, the presence of ACM cannot be discounted elsewhere within the made ground.

Guidance given by NHBC/CIEH/EA (Ref. 18) states that where waste contains identifiable pieces of asbestos containing material (ACM, i.e. any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye), these pieces must be assessed separately. ACM can be considered hazardous waste if the concentration of asbestos in the material is 0.1% or more. The waste is regarded as a mixed waste and classified accordingly: solely on the basis of the asbestos in soils test results, this would likely classify the made ground at this location as 17 06 05: Construction material containing asbestos, MH.

We recommend that in the first instance the earthworks sub-contractor discusses with their proposed landfill operator the appropriate classification (e.g. inert, non-hazardous or hazardous) of all excavated soils including waste made ground and natural soils (if it is proposed to dispose of these natural soils as waste rather than reuse as fill off site). A full copy of this GIR should be supplied to the landfill operator to assist in their assessments.

8.2 Waste Acceptance Criteria (WAC) Testing

Waste Acceptance Criteria (WAC) are only applicable following classification of the waste as hazardous or non-hazardous, and only where the waste is destined for disposal to landfill. Waste Acceptance Criteria (WAC) testing is therefore reliant upon the production of sufficient testing to fully characterise the soils.

WAC testing has not been undertaken as part of this ground investigation as per standard industry practice; to reiterate, this testing is only undertaken following classification of the waste as hazardous or non-hazardous, and only where the waste is destined for disposal to landfill. As recommended above, the earthworks sub-contractor should in the first instance discuss with their proposed landfill operator the appropriate classifications of all materials destined for disposal.

9 UPDATED CONCEPTUAL SITE MODEL

9.1 General

Following on from the Conceptual Site Model (CSM) presented in the Phase 1 Desk Study, this updated CSM is a representation of the conceptual understanding of all the geo-environmental components of the proposed development site. The updated CSM is a site-specific assessment which illustrates where, and by what mechanism, possible pollutant linkages or pathways may exist. This model is then used as the basis for a risk assessment, with the assignment of risk levels for each of the pollutant linkages identified. Any remaining areas of significant risk are then subject to further investigation.

9.2 Updated Source – Pathway – Receptor Pollutant Linkages

For the purpose of this CSM the end use of the proposed development will remain unchanged as a residential development including high rise buildings and associated areas of hardstanding with landscaping features.

9.2.1 Updated Potential Contamination Sources

The potential contamination sources remain unchanged following the ground investigation works. These are reproduced from the Desk Study below.

The site lies within the city centre of Manchester which has a well-documented history of industrial and commercial developments. The area to the north of the site identified as Knott Mill has been the site of various industries in the past including an 'Iron Works' and 'Automobile Engineering Works'. Other past industry identified in the vicinity of the site include a 'glass works', cotton mill and a gas works. There is one fuel station entry within 100m of the site which is associated with the now obsolete Castlefield Service Station located to 62m west of the site.

Currently active industries within 250m of the site are outlined in Table 17. A full list of contemporary businesses within 1km of the site is available in the Envirocheck report provided in Appendix D of the Phase 1 Desk Study report (Ref 8).

Table 17: Currently Active Industries within 250m of the Site

Name	Location	Classification	Estimated Distance from Site	Contaminant Hazards
The Flash Centre	38 City Road East	Photographic Equipment & Supplies	23m E	None
Pest Control Manchester	14 Commercial Street	Pest & Vermin Control	62m NE	Chemicals and lead
R O C Consulting	6 Commercial Street	Engineers - General	94m N	None
Gazprom Marketing & Energy	8 First Street	Gas Suppliers	195 E	None (Marketing premises)
G T Autos	88 Hewitt Street	MOT Testing Centre	206 N	Hydrocarbons and oils

On this basis and considering the information presented throughout this report, a range of potential contaminants could exist in the sub-surface materials across the site, particularly within any encountered made ground. These include:

- Chemical elements with the potential to pose significant risk to human health and/or the ecosystem. Examples of such chemical elements are arsenic, cadmium, chromium, lead, mercury, nickel, and selenium.
- Potentially phytotoxic elements such as copper and zinc.
- Other inorganic contaminants such as asbestos, high or low pH levels, etc.
- Organic contaminants such as phenolics, polyaromatic hydrocarbons (PAHs) and petroleum hydrocarbons.

9.2.2 Updated Potential Pathways

These are the mechanisms or routes by which substances or agents could come into contact with or otherwise affect a potential receptor. The identified pathways remain unchanged from those identified in the Phase 1 Desk Study and are reproduced below.

- Air and gas flow.
- Dermal contact, ingestion, and inhalation.
- Infiltration and runoff.
- Groundwater flow.
- Pathways via buried pipes such as redundant drainage.

Contaminants in the soil may also generate leachate, which could potentially reach the Principal Aquifer beneath the site. The superficial deposits have been identified as having fast pollutant speed.

9.2.3 Updated Potential Receptors

Potential receptors are everything that might become influenced by exposure to contaminants like persons (e.g. residents, intended users, construction workers), other organisms or complete ecosystems, environmental media, or artificial construction. The potential receptors considered are unchanged from those identified in the Phase 1 Desk Study and are reproduced below.

- Construction and maintenance workers exposed during ground works.
- Off-site personnel adjacent the site.
- Current and future end users exposed to soil in landscaped areas.
- Groundwater (underlying Principal Aquifer and associated abstractions) and surface waters.
- Adjacent site users during construction and maintenance works, possibly exposed to soil particles.
- Plants exposed to phytotoxic substances in soil or groundwater.

10 GEO-ENVIRONMENTAL RISK ASSESSMENT

10.1 General

The geo-environmental risk assessment for the proposed development area is outlined below in the context of the findings of the desk study, the recent ground investigation and the pollutant linkages identified in the CSM.

In brief, the geo-environmental risk assessment considers the various potential pollutant linkages identified in the CSM and determines a level of risk (based on the classification of the magnitude of the potential consequence of the risk occurring and the magnitude of the probability of the risk occurring). The risk assessment highlights areas which warrant either further investigation to prove and validate the level of risk, or remedial action. Where information is of insufficient detail or incomplete, risks may be identified as moderate / high and then reduced as necessary after further information is gathered. Table 18 below provides a description of the resultant risk levels.

Table 18: Risk Definitions

Risk Term	Description
VERY HIGH	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
HIGH	Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
MODERATE	It is possible that without appropriate remediation action harm could arise to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.
LOW	It is possible that harm could arise to a designated receptor from an identified hazard. It is likely that, at worst if any harm was realised any effects would be mild.
VERY LOW	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor

Table 19: Summary of Geo-environmental Risk Assessment (Risk Rating)

SOURCE	RECEPTOR	PATHWAY	RISK RATING
Asbestos containing materials present within the ground.	On-site construction workers	inhalation of fibres blown from any open ground where soils are exposed during construction	LOW TO MODERATE*
	End users and site visitors	inhalation of fibres blown from any open ground where soils are exposed post construction including maintenance work	VERY LOW
	Off-site personnel adjacent the site	inhalation of fibres blown from any open ground where soils are exposed during construction, maintenance works and building use	VERY LOW

SOURCE	RECEPTOR	PATHWAY	RISK RATING
Potential inorganic and/or organic contamination present within the made ground and natural soil at the site (excluding the imported fill materials)	On-site construction workers	direct contact, ingestion or inhalation of solids / liquids / gases / vapours or dust in any open ground where soils are exposed during construction	LOW
	End-users and site visitors	direct contact, ingestion or inhalation of dust blown from any open ground where soils are exposed in proposed landscaped areas	VERY LOW
	Off-site workers adjacent the site	ingestion or inhalation of dust blown from any open ground where soils are exposed during construction and maintenance works	LOW
	Foundation concrete	direct contact	LOW
Notes *Residual risk reduces to LOW following appropriate management controls as discussed in Section 10.2 below.			

10.2 Asbestos

Asbestos was identified in 2 of the 15 samples screened as discussed in Section 5.2; both samples were within the shallow made ground. 'Chrysotile, Amosite – Loose Fibres' was identified in the asbestos screen in WS1 at 0.30mbgl depth. 'Chrysotile – Hard/Cement type material' was identified in BH4 at a depth of 0.5mbgl. Quantification testing has been undertaken on these samples which indicated the 'Total Percentage of Asbestos in Soil' was below the recording limit (i.e. <0.001%) for the WS1 sample and 0.958% for the BH4 sample. This indicates that the presence of asbestos at locations across the site within the made ground cannot be discounted. Proposed guidance to deal with this contamination risk is outlined below.

According to current guidance (CIRIA C733) asbestos does not form vapours or occur as a gas. Asbestos does not pose a risk to plants or invertebrates (which cannot inhale asbestos fibres). Even though exposure of vertebrates, particularly burrowing animals (e.g. rabbits, foxes, badgers) may occur, it is unlikely to lead to mortality or to any impairment of ecological function. Asbestos does not pose a risk to buildings and services (except to the human users of such structures) and is unlikely to pose any risks to the water environment. The risks from ingestion are generally considered to be negligible, so asbestos risk is considered in terms of the inhalation of fibres only. The only possible pathway at the proposed development area site that would need to be addressed would be from asbestos-containing soils (ACSs) and involve outdoor inhalation of fibres.

The risk has been assessed using the CL:AIRE Joint Industry Working Group (JIWG) 'Decision Support Tool for Receptor Risk Ranking'. The outputs from this support tool propose a risk rating of 'LOW' for on-site construction workers and 'VERY LOW' for off-site personnel and development end users. The outputs from this are included in Appendix D.

Notwithstanding the low risk during construction, the possibility of further asbestos being encountered in the made ground across the wider Plot F site cannot be ruled out at this stage. Management of potential asbestos during construction is considered within the Remediation & Verification Strategy (Section 11). The contractor should undertake an assessment of risks and prepare a detailed method statement informed by the Remediation & Verification Strategy and relevant CL:AIRE guidance (Ref. 21). It is

anticipated that an ‘observation and discovery’ or watching brief approach would be appropriate to ensure that the resultant risk rating of ‘LOW’ to construction workers is achieved.

10.3 Other Contaminants

The expected risk to human health (both site workers and end users) is classified as ‘LOW or VERY LOW’. Based on the site history and the results of the contamination testing the extent and severity of any subsurface contamination is not considered to be significant. Most of the made ground and superficial deposits will be removed to facilitate the construction of basement areas, and it assumed that any soft landscaping areas of the proposed development will include sufficient thickness of imported clean topsoil which will mean the risk of end users being in contact with contaminated materials is LOW.

The general risk associated with the soil chemical test results described above has been assessed as LOW on the basis that the majority of measured concentrations were either below the limit of detection or below their respective S4UL.

10.4 Radon

Public Health England (PHE) recommends that radon levels should be reduced in homes where the annual average radon concentration is at or above 200 becquerels per cubic metre (Bq/m^3).

Review of the BGS Indicative Atlas of Radon coverage indicates the site is in the lowest band of radon potential with less than 1% of homes above the 200 Bq/m^3 action level set out by PHE. Therefore, the risk is assessed as ‘VERY LOW’ and no radon protection is anticipated to be required for the proposed development.

11 REMEDIATION & VERIFICATION STRATEGY

11.1 Proposed works with remediation implications

This remediation and verification strategy has been prepared with reference to EA Guidance: Land Contamination Risk Management, LCRM: Stage 3 remediation and verification (Ref. 26). The proposed development is for the demolition of the existing building on site and the construction of a high-quality residential scheme across two 51-storey towers (identified as Plot F1 and Plot F2 as indicated on Figure 1), together with external areas both in the public realm and communal spaces dedicated to residents and internal spaces for residential amenity use including: a gym, private car parking within two (F2) and three (F1) tiered basements and extensive cycle parking facilities.

Most of the footprint of Plot F1 and Plot F2 will be excavated and the made ground and superficial soils removed off site. The detailed phasing of ground works is anticipated to be based on 'bottom-up' construction methodology and include piling of the contiguous piled wall which is positioned virtually at the perimeter of the site (the site boundary) followed by excavation of made ground and superficial soils to form the basements and construction of the foundations for the towers – currently indicated to be raft foundations, subject to confirmation at detailed design stage. Proposed finished ground levels for Plot F1 and Plot F2 will be 32.47mAOD and 33.11mAOD, respectively. The proposed basement levels for Plot F1 and Plot F2 will be 23.57mAOD and 26.61mAOD, respectively.

As discussed in Section 5.2, asbestos was found at two locations in the near surface made ground (0.3mbgl and 0.5mbgl), and as discussed in Section 5.3 there were a number of exceedances of S4UL noted for three organic determinands as outlined in Table 15.

As per Section 10.2 a risk rating from asbestos of 'LOW' for on-site construction workers and 'VERY LOW' for off-site personnel and development end users was determined. As per Section 10.3 the expected risk to human health (both site workers and end users) from other contaminants is classified as 'LOW or VERY LOW'.

11.2 Remediation objectives

The remediation objectives for the site are to provide a remedial approach that will address the identified active pollutant linkages at the site and to enable residential end use for the site. Particular remediation criteria include:

- Permanently breaking the identified pollutant linkages such that exposure pathways are inactive;
- Ensure excavation works are completed in a satisfactory and compliant manner and, where necessary, to validate underlying soils as chemically suitable for use within the proposed development footprint; and
- Verification to ensure no unacceptable levels of contaminants are present.

11.3 Scope of Remediation

The Contractor is required to undertake a suitable and sufficient assessment of risks associated with the proposed remedial works and prepare appropriate method statements. The remediation requirements presented in this Section 11 are intended to guide the Contractor in developing an appropriate methodology to render the site suitable for the intended end use.

The scope of geo-environmental remedial actions required to be undertaken can be summarised as follows:

- Excavation for basement construction including removal of any contamination impacted soils.
- The risk of human exposure to groundwater impacted with organic contaminants during construction is to be managed by the adoption of good general working practices such as appropriate PPE and sensible precautions defined by appropriate Risk Assessment and Method of Statement (RA/MS) by the appointed Contractor. In terms of post-construction site use, made ground from the original site footprint will have been removed off site and because of the site-wide presence of structures including 2 and 3 storey deep basements and/or hardstanding there should be no exposed soils hence the potential pollutant pathway to end users is eliminated.
- A contingency plan for encountering ground locally impacted with contaminants such as asbestos-containing matter (ACM), organic contaminants or similar during the redevelopment ground works is advised. This will involve communications between the Contractor and Coffey, site visits at appropriate times (e.g. during site clearance, and if/when suspect ground conditions are encountered), and may necessitate further sampling and laboratory testing, with additional assessment and provision of recommendations.

The risk of exposure to asbestos is to be managed by the adoption of good general working practices (during all groundworks) such as personal protective equipment. See also Section 11.4.

11.4 Provision of an Asbestos Specialist

To recap, as per Section 10.2, Chrysotile, Amosite – Loose Fibres' was identified in the asbestos screen in WS1 at 0.30mbgl depth. 'Chrysotile – Hard/Cement type material' was identified in BH4 at a depth of 0.5mbgl. Quantification testing indicated the 'Total Percentage of Asbestos in Soil' was below the recording limit (i.e. <0.001%) for the WS1 sample and 0.958% for the BH4 sample. This indicates that the presence of asbestos at locations across the site within the made ground cannot be discounted.

The proposed strategy is that an asbestos specialist will be required at the outset to review and ensure appropriate risk assessments and method statements are in place, then available on a call-down basis if asbestos containing soil (ACS) or suspected ACS is encountered. Day to day responsibility for managing the works and the risk of encountering potential ACS will reside with the 'responsible site person', further details below.

Site clearance will include localised de-vegetation (as necessary), and removal of existing surface soils and hard standings for off-site disposal; this is anticipated to be undertaken prior to commencing the contiguous piling works at the site boundary and excavation works. As the presence of asbestos cannot be discounted, an asbestos specialist should be engaged by the Contractor for the project, to review the proposed methodology, particularly during the site clearance and ground works. This is required in order to ensure that all risks relating to asbestos at the site are mitigated and that the work is undertaken in accordance with current guidance and legislation. This review to include consideration of appropriate personal protective equipment (PPE) and, as appropriate, respiratory protective equipment (RPE) within an agreed safe system of work. It is anticipated that site operatives working within a work area where asbestos impacted soils are present (noting that only two such areas have been identified to date) will be supplied with PPE which includes Type 5 disposable overalls (BS EN ISO 13982-1) rather than cotton overalls (waterproof for outdoors work).

The contractor should undertake works in general accordance with CIRIA C765, *Asbestos in soil and made ground: good practice site guide* (2017, Ref. 25) and CL:AIRE 2012 industry guidance: Control of

Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials (Ref 27). CIRIA C765 requires the contractor to nominate a 'responsible site person', who can be a member of the contractor's own staff. CIRIA C765 defines the responsible site person as:

> "The person who has the initial responsibility to manage asbestos containing soil (ACS) encountered during ground works. Note that this person may change during the various stages of the project or work, e.g. initially supervisor, then site manager. The responsible site person must obtain advice from a competent person if decisions or actions are required that are beyond their skills, knowledge or experience."

The asbestos specialist will be the designated 'competent person' under CIRIA C765 (defined as "Someone with adequate knowledge, training and experience in understanding the risks associated with asbestos and are able to make informed and appropriate decisions about those risks and precautions needed"). In practice it is anticipated that the asbestos specialist will be required at the outset to review and ensure appropriate risk assessments and method statements are in place, then available on a call-down basis if ACS or suspected ACS is encountered. Day to day responsibility for managing the works and the risk of encountering potential ACS will reside with the responsible site person. The contractor must ensure that the responsible site person has adequate awareness training to allow this role to be properly discharged. Whenever ACS or suspected ACS is encountered the contractor should immediately inform the competent person (asbestos specialist) and follow their directions.

11.5 Other Potential Ground Contamination Sources

It is possible that localised ground that is impacted with previously unidentified contaminants may exist elsewhere at the site and may be encountered during the site redevelopment. Accordingly, the remediation works needs to include contingency measures for dealing with such.

On completion of the site clearance, to include breaking out of all residual hardstanding and removal of surface soils, the exposed soils are to be inspected and recorded by the Geo-environmental engineer.

If during this inspection, or at any other time during the ground works' activities, ground is exposed that is suspected to be impacted with contaminants (such as asbestos, hydrocarbons or similar) the suspect ground is to be sampled and tested, and the test results are to be subjected to further consideration and assessment.

If such ground contamination relates to asbestos-impacted soils, the work would need to be undertaken in accordance with the requirements of the asbestos specialist as per section 11.4.

It is therefore a requirement that the site is to be visited and inspected by a suitably experienced Geo-environmental engineer at key stages during the ground works' phases of the site redevelopment. Any unexpected contaminant exceedances will be notified to the regulatory authorities and any required amendments to the Remediation Strategy and Risk Assessments will be undertaken.

11.6 Re-use of Site-won Soil Materials

It is anticipated that site-won soils will not be retained for re-use on site.

11.7 Imported Soil Materials

Apart from limited volumes of topsoil being used within planters and the like, the proposed development is not anticipated to include areas of soft landscaping. Hence it is anticipated that there will not be a

requirement for import of soil materials. If there is a requirement to import soils to site, appropriate chain of custody records should be obtained and provided for inclusion in the Verification Report. Imported soils such as topsoil for planters and similar shall be appropriately certified to BS3882:2015 (Ref. 28).

11.8 Dewatering from Excavations

Where excavations are proposed below the groundwater table, the dewatering measures are to comply with the requirements of the Environment Agency Regulatory Position Statement on 'Temporary Dewatering from Excavations to Surface Water' (Ref. 23). These are summarised below. Dewatering proposed for a period greater than 3 months requires a permit.

If groundwater is found to be contaminated with hydrocarbons and/or metals an appropriate regime for abstracted groundwater of storage and treatment/storage or off-site disposal by tankering will be required.

Where it has been demonstrated that groundwater for discharge is not contaminated, permits are not required where the proposals:

- Have a short term, temporary discharge of uncontaminated water which is wholly or mainly rainwater, from an excavation to surface water (such as pumping water out of excavations on a building site, as is the case at this site);
- Comply with all the conditions in this regulatory position statement (RPS, Ref 23) as summarised below.

The discharged water must:

- Be clean water, for example clear rainwater or infiltrated groundwater which has collected in the bottom of temporary excavations;
- Not result in water containing fine or coarse suspended solids (silty water) entering surface water;
- Not last more than 3 consecutive months (the activity may stop and restart, but the clock does not restart) - if the activity is likely to go over 3 consecutive months then you need to apply for a permit;
- Be made to surface water, such as a river, stream or the sea;
- Have a method statement that minimises the risk of pollution.

Contractor's method statements are to demonstrate the requirements below:

- Plan how to minimise the level of contaminants such as silt entering the excavation;
- Plan how to dispose of water that enters the excavation;
- Plan not to use machinery in excavations while dewatering is taking place;
- Minimise water entering the excavation, for example from rainfall, runoff, groundwater ingress or high-water table; and
- Consider using sustainable urban drainage construction methods.

The discharge must not be located within, or less than 500 metres upstream of:

- Sites of Special Scientific Interest (SSSI);

- Special Areas of Conservation (SACs);
- Special Protection Areas (SPAs);
- Candidate SACs, possible SACs, potential SPAs, and sites of community importance;
- Internationally designated Ramsar sites (i.e. wetlands of international importance designated under the Ramsar Convention);
- Other nature conservation sites, such as ancient woodlands, local and national nature reserves;
- Local wildlife sites.

The contractor should review the Environment Agency Regulatory Position Statement on 'Temporary Dewatering from Excavations to Surface Water' (Ref. 23) in the context of the proposed works and the potential presence of contamination in groundwater and confirm whether or not a permit is required for the works proposed at this site.

11.9 Export of Soil Materials

It is anticipated that any waste soil materials proposed to be exported off site will be transported to a suitably licensed landfill by a duly licensed waste carrier, with all movements recorded using the relevant waste transfer notes.

11.10 Verification of Excavations and Site-won or Imported Soil Materials: Frequency of Verification Testing

The verification programme has been developed in general accordance with the Environment Agency's guidance on Verification of Remediation of Land Contamination (Ref. 24). The testing frequency proposed here is based on such guidance and Coffey's professional judgement and experience.

In relation to the area of the site covered by the new towers and their associated hardstanding including basement car parking no further verification testing of formation soils is required on the basis that the risk appraisal process (Section 10 of this GIR) has identified potential risks to human health and groundwater/surface water as LOW to VERY LOW with respect to both soil and groundwater. The excavation of existing made ground and superficial soils followed by the construction of basement carparking, hardstanding and new structures will effectively break the 'source-pathway-receptor' potential pollutant linkage in these areas.

As per Section 5.2, some evidence of asbestos containing material was noted within the made ground during the investigation. Where the asbestos specialist or Geoenvironmental engineer identify the potential for asbestos containing soils (ACS), additional samples are to be taken as directed. Analysis will be carried out by an appropriately certified laboratory.

It is anticipated that there will not be a requirement for reuse of site-won or imported soils.

Any site-won demolition or construction materials, to be crushed and used on site as an engineered fill or sub-base to proposed structures, will require testing at a minimum testing frequency of one sample per 500m^3 of material, to demonstrate it meets the specification required by the designer.

11.11 Verification Laboratory Testing and Assessment

Verification testing for any site-won demolition or construction materials to be used in the redevelopment should include the suite of chemical tests as per Section 3.2.2 of this GIR.

Initial asbestos screening shall be followed by quantification testing where asbestos fibres are detected.

Laboratories used for all testing shall be appropriately accredited and shall be UKAS and MCERTS certified.

A detailed geotechnical characterisation should be planned prior to detailed foundation design if site-won materials are to be used as engineered fill and sub-base for the proposed foundations.

11.12 Verification Reporting

Upon completion of the remediation works described in this document, a Verification Report is to be prepared to include details of the works undertaken, presenting factual data and records such as laboratory test results, site visit records, and photographic evidence. The Verification Report is to assess conformity and demonstrate compliance of the implemented remedial measures with the requirements set out herein. The Verification Report should then be submitted to the Planning Local Authority for their review and approval / comments.

The Verification Report will include the following:

- Remediation Strategy (including copies of confirmation from regulatory authorities agreeing criteria);
- Detailed surveys of all excavations and production of ‘as built’ drawings for the earthworks;
- Copy of Consignment Notes relating to the movement of wastes to a licensed waste management facility;
- Detailed drawings showing all sampling locations for both chemical and geotechnical testing;
- Chemical test results;
- Geotechnical test results;
- Details of Materials Management Plan (where applicable – refer Section 11.6); and,
- Monitoring results where undertaken (e.g. asbestos in air, etc.).

12 CONCLUSIONS AND RECOMMENDATIONS

The ground investigation has provided additional information on the geotechnical and geo-environmental conditions of the site.

12.1 Ground Model

The ground investigation has broadly confirmed the ground model proposed in the Phase 1 Desk Study. The updated ground model which accounts for the additional site-specific information from the 2021 GeoAssist ground investigation is outlined in Table 8.

Groundwater monitoring was relatively stable over the monitoring period between 12 May 2021 and 30 June 2021 as indicated in Table 10. The maximum groundwater level recorded over this period was 23.16mAOD in BH3 and BH4.

Based on groundwater monitoring data it is proposed that a design groundwater level of 23.5mAOD is adopted. It should be noted that groundwater monitoring has been undertaken during the summer months and groundwater levels may fluctuate throughout the year.

Typical characteristic material properties for design are presented in Table 9 and have been selected based on the results of in situ and laboratory testing, the descriptions of the materials encountered and empirical correlations as well as experience of similar materials where test results are limited or not available.

12.2 Geo-environmental Assessment

The results of the soil geo-environmental assessment reported that the majority of the concentrations of determinands tested were below the S4UL limits for 'Public open spaces near residential'. The exception was some exceedances of three organic determinands: Benzo[b]fluoranthene, Benzo[a]pyrene and Dibenz[ah]anthracene (refer Table 13). On the basis that most of the near surface soils will be removed during construction of the basement and assuming good earthworks practice informed by a detailed risk assessment and method statement (RA/MS), the resultant risk associated with these exceedances has been assessed as LOW.

The water geo-environmental assessment reported concentrations of copper which were slightly higher than the environmental quality standards (EQS) for inland waters but are lower than recommended limits for drinking water standards (DWS). The limit of detection for chromium (VI) was higher than the S4UL limit. No further actions are considered necessary regarding groundwater remediation.

The geo-environmental assessment for ground gasses has classified the site having a Characteristic Situation (CS) value of 1 which indicates 'VERY LOW' hazard potential. Based on the current guidance in BS5485:2016+A1:2019 it is considered that the new buildings would be classified as Type B structure which combined with the CS value of 1, indicates a gas protection score of 0. Therefore, no gas protection measures are necessary.

The risk to receptors (construction workers, off site personnel and end users) caused by contamination on site has been assessed as either 'VERY LOW' or 'LOW'.

Asbestos was identified in 2 of 15 samples screened as discussed in Section 5.2; both samples were within the shallow made ground. The risk associated with asbestos is considered in terms of inhalation of fibres only. Only one of the samples encountered asbestos as fibres, and the result of the quantification test on this sample indicated the percentage content of asbestos to be below the reporting limit (i.e.

<0.001%). The other sample was identified as Hard/Cement type material. The risk associated with asbestos has been assessed as 'LOW' for on-site workers and 'VERY LOW' for off-site workers and end-users provided that the management controls discussed in Section 10.2 are implemented during construction. A Remediation & Verification Strategy has been prepared (Section 11) which identifies the framework for management of potential asbestos and other contaminants in soils during groundworks.

This GIR does not definitively classify the potential wastes generated from site for disposal. Waste Acceptance Criteria (WAC) are only applicable following classification of the waste as hazardous or non-hazardous, and only where the waste is destined for disposal to landfill. Waste Acceptance Criteria (WAC) testing is therefore reliant upon the production of sufficient testing to fully characterise the soils.

Guidance given by NHBC/CIEH/EA (Ref. 18) states that where waste contains identifiable pieces of asbestos containing material (ACM, i.e. any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye), these pieces must be assessed separately. ACM can be considered hazardous waste if the concentration of asbestos in the material is 0.1% or more.

12.3 Recommendations

It is recommended that an additional round of groundwater monitoring is undertaken in the winter months to confirm any potential seasonal variation in groundwater levels below the site. The recorded groundwater levels can then be used to validate the proposed groundwater level for design.

The contractor should undertake an assessment of risks and prepare a detailed method statement informed by the Remediation & Verification Strategy (Section 11) and relevant CL:AIRE guidance (Refs. 21, 22 & 27)

We recommend in the first instance that the earthworks sub-contractor discusses with their proposed landfill operator the appropriate classification (e.g. inert, non-hazardous, or hazardous) of all excavated soils including waste made ground and natural soils (if it is proposed to dispose of these natural soils as waste rather than reuse as fill off site). A full copy of this GIR should be supplied to the landfill operator to assist in their assessments.

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Appendix A

2021 GeoAssist Factual Report

GeoAssist Limited
Civil, Environmental & Geotechnical

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Ground Investigation Factual Report

Plots F1 & F2 Great Jackson Street, Manchester

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January 2022 Site Ref: 6069/CGJ- FGI-v1.1 FINAL

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Ground Investigation Factual Report

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1. Introduction

This factual report is an account of a geotechnical and geoenvironmental ground Investigation carried out by GeoAssist Limited, at the site of a proposed residential development known as Plots F1 & F2 Great Jackson Street, Manchester.

The work undertaken in this ground investigation was as outlined in the Coffey Geotechnics Ltd Site Investigation Brief. This report describes the ground investigation undertaken and presents the data obtained.

The work was commissioned following acceptance of the tender submission and an instruction to proceed issued by Coffey Geotechnics Ltd in March 2021.

2. Object and scope of the investigation

The object of the ground investigation was to obtain information on ground and groundwater conditions to assist in the design of the proposed development within the limits imposed by exploratory hole numbers, locations, depths, methods adopted and the scope of approved in situ and laboratory testing. The investigation comprised geotechnical cable percussive boreholes to rockhead and extended to depth with rotary coring techniques in the bedrock. Environmental Dynamic sampled exploratory holes to rockhead with ground gas monitoring installations were undertaken across the site. In situ and laboratory testing and reporting was undertaken as part of this ground investigation.

The various aspects of the ground investigation were directed by GeoAssist Limited with specialists employed for various aspects of the ground investigation and as listed below.

Table 2.0. List of Specialists

Specialism	Specialist
High Pressure Dilatometer Testing	InSitu Site Investigation
Optical Televiewer	Robertson Geologging
Geotechnical Laboratory	I2 Geotechnical Laboratory Services
Environmental Laboratory	I2 Chemical Laboratory Services

3. Description of the Site

The location of the site is shown on the site plan in Appendix A1.

The approximate grid reference for the centre of the site is 383410, 397240 and the total area of the site is approximately 7,800 m^2. The area of the site is outlined with a red line on the site plan in Appendix A1.

The site is situated to the south and adjacent to the current Deansgate One Development and is bounded by Great Jackson Street to the south.

The site is currently a storage and supply area associated with the adjacent active construction site.

4. Geology

The 1 in 10,560 scale geological map of the area SJ 89 NW published in 1976 shows the site to be located over Fluvio Glacial Deposits over Boulder Clay (Glacial Till) including layers of sand and gravel in places and of the Recent and Pleistocene epoch. Notes on the geological map indicate the superficial deposits to be made ground and terrace deposits 2m to 5m thick, Boulder Clay 2m to 9m thick and overlying sandstone.

The underlying solid geology is shown as being Chester Pebble Beds (Sherwood) Sandstone of the Permian and Triassic period. Notes on the plan indicate that the Sandstone can contain gravelly bands and scattered pebbles in places. The sandstone is shown as dipping in a roughly south westerly direction at around 8 degrees.

The BGS on-line lexicon indicates that the lithological description of the Chester Pebble Beds sandstone 'is fine to course grained, commonly pebbly with conglomerates and sporadic siltstone, cross-stratified'.

No faults in the solid geology are shown as passing directly beneath the site. The North West to South East trending West Manchester Fault is shown passing approximately 700m to the east of the site boundary. The down throw is shown to the east.

5. Ground Investigation

5.1 Fieldwork

The procedures followed for the ground investigation were in general accordance with guidance presented in BS 5930:2015 Code of Practice for Site Investigations and BS 10175: 2013 Investigation of Potentially Contaminated Sites. The soils and rocks encountered have been described and classified essentially in accordance with BS 5930:2015, BS EN ISO 14688-1 and BS EN ISO 14688-2.

Appendix B1 outlines in more detail the 'Identification and description' combined with 'Principals of classification' as utilised for this particular ground investigation.

Four geotechnical exploratory holes referenced BH1 to BH4 were undertaken utilizing cable tool percussive and rotary coring techniques. Six environmental exploratory holes referenced WS1 to WS6 were undertaken utilising Windowless dynamic sampling techniques. The location of the exploratory holes is given on the site plan in Appendix A1.

5.2 Method of Exploration

Coffey Geotechnics Ltd provided an outline Site Investigation Brief including HPD testing and Televiewer surveys.

The geotechnical exploratory holes BH1 to BH4 were commenced with 200mm light cable tool percussive boring to bedrock followed by progressive rotary coring and open holing reaming techniques to depth in the sandstone bedrock.

High Pressure Dilatometer tests were undertaken at intervals within the sandstone in BH1 and BH4.

The socket for the pressuremeter testing was formed using a T6H core barrel with core line and water flush as dictated by the pressuremeter test specialists, In Situ Site Investigation.

The rock between pressuremeter test sockets was cored using 412F core barrel with core line and air/mist/foam flush.

In order to mitigate the possibility of the pressuremeter equipment being lost in the hole, the rock was progressively reamed out with PW casing to just above where the pressuremeter test socket was to be cored.

The drilling of the exploratory holes was undertaken by and supervised by GeoAssist Limited personnel.

The rock cores were securely boxed, labelled and returned to the main depot for photographing, logging and subsampling for rock Unconfined Compression and Point Load tests.

On reaching the end depth of the exploratory hole the rotary casing was extracted and 150mm diameter casing retained in the drift deposits to allow televiewer inspection to be undertaken subsequently in BH1 and BH4.

The environmental exploratory holes WS1 to WS6 were commenced with 120mm nominal diameter sampling and were terminated in the weathered sandstone bedrock.

The details of the strata in the exploratory holes were recorded by a ground engineering professional.

5.3 Surveying

The exploratory holes were surveyed at the time of the investigation. The easting, northing and Ordnance datum elevation for each hole is presented on the borehole logs.

5.4 In-Situ Testing – High Pressure Dilatometer Tests

High Pressure Dilatometer test were undertaken in pre-cored sockets at depths as indicated on the exploratory hole logs by In Situ Site Investigation with the method and pressures of the testing carried out according to the ground conditions encountered during the fieldwork.

The Pressuremeter test depths are summarised below.

Exploratory Hole	Pressuremeter test Depth (m below ground level)
BH1	13.30
BH1	15.70
BH1	19.20
BH1	24.30
BH1	32.60

Exploratory Hole	Pressuremeter test Depth (m below ground level)
BH4	10.70
BH4	16.50
BH4	22.30
BH4	31.20
BH4	

5.5 Televiewer Survey

An optical televiewer survey of the unlined exploratory holes BH1 and BH2 was undertaken by Robertson Geologging on 5th May 2021.

The optical survey was supplemented by an acoustic survey undertaken at the same time in case the clarity of the fluid in the unlined exploratory hole was impaired by suspended solids.

5.6 Fieldwork Records

Exploratory hole records are presented in Appendices C1 and C2.

Rock core photographs are presented in Appendix C3.

In Situ High Pressure Dilatometer Tests are summarised in Appendix C4.

The output from the Televiewer inspection is given in Appendix C5.

5.7 Exploratory Hole Completion

On completion WS1 to WS6 were converted to ground gas monitoring standpipes so that ground gas levels could be recorded for a period after completion of the fieldwork.

On completion BH1 to BH4 were converted to groundwater monitoring standpipes so that ground water levels could be recorded for a period after completion of the fieldwork. These standpipes were purge flushed and environmental groundwater samples recovered on 12th May 2021 to allow chemical testing to be undertaken.

5.8 Instrumentation and monitoring

The gas and groundwater monitoring standpipe installations are summarised below.

Exploratory Hole	Groundwater Standpipe Slotted pipe and filter Zone (m below ground level)
BH1	8.00 to 18.00
BH2	9.00 to 18.00
BH3	8.00 to 18.00
BH4	8.00 to 18.00

Exploratory Hole	Ground Gas Standpipe Slotted pipe and filter Zone (m below ground level)
WS1	1.00 to 5.00
WS2	1.00 to 5.50
WS3	1.00 to 4.00
WS4	1.00 to 5.50
WS5	1.00 to 4.00
WS6	1.00 to 4.60

The ground gas monitoring readings are given in Appendix C6.

The ground water monitoring readings and plots are given in Appendix C7.

6.0. Laboratory Testing

6.1 Geotechnical Testing

The following geotechnical tests were performed in i2 and GeoAssist laboratories on samples recovered from the exploratory holes and as specified by Coffey Geotechnics Ltd.

Table 6.0 Geotechnical Testing

Laboratory Test	Number of tests	Test Laboratory
Natural Moisture Content	21	I2 Geotechnical Laboratory
Classification test	18	I2 Geotechnical Laboratory
Particle Size Distribution test	14	I2 Geotechnical Laboratory
Organic Content	4	I2 Analytical Laboratory
BRE SD1 Full Suite	12	I2 Analytical Laboratory
Undrained Triaxial Compression test	7	GeoAssist Geotechnical Laboratory
Consolidation Test	4	GeoAssist Geotechnical Laboratory
Consolidated Undrained Triaxial Compression Test	1	GeoAssist Geotechnical Laboratory
Unconfined Compression Test on Rock Core	24	GeoAssist Geotechnical Laboratory
Point Load Index Test on Rock Core	23	GeoAssist Geotechnical Laboratory

The results of the geotechnical tests are given in the laboratory test results summary sheets, which form Appendices D1 and D2 to this report.

6.2 Contamination Testing

A series of 27 soil and 4 groundwater samples were collected during the fieldwork and subjected to elements of the suite of chemical testing as outlined in the contract tender specification. All tests were conducted by i2 Analytical Laboratories under UKAS Testing No 1549.

The results of all the chemical analysis tests are given in Appendix D3 and D4.





Matthew Benson MSc GMICE
Geotechnical/Environmental Engineer

Mark Richardson MSc CEng MICE
Technical Director

Field investigations have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions are, and can be, variable and have only been tested at isolated locations across the site. Therefore, the potential exists for ground conditions to be encountered which are different to those considered in this report.

This report has been prepared by GeoAssist Limited with all reasonable professional skill, care and diligence within the terms of the contract with Coffey Geotechnics Ltd. The report is confidential to Coffey Geotechnics Ltd, their/the named persons advisors and bankers, and GeoAssist Limited accepts no responsibility of whatever nature to third parties to whom this report may be divulged. GeoAssist Limited owns the copyright in this report. All rights are reserved, and unauthorised use is prohibited. Coffey Geotechnics Ltd may use the report for their/her/his own purposes.

This work has been undertaken in accordance with the quality management system of GeoAssist Limited.

Where relevant and practicable, the ground investigation and subsequent geotechnical assessments have been undertaken in accordance with the following standards and guidance:

BS EN 1997-1:2004+A1:2013. Eurocode 7: Geotechnical Design - Part 1: General Rules

NA+A1:2014 to BS EN 1997-1:2004+A1:2013. UK National Annex to Eurocode 7: Geotechnical design – Part 1: General rules

BS EN 1997-2:2007. Eurocode 7 - Geotechnical Design - Part 2: Ground investigation and testing

BS 5930:2015. Code of practice for ground investigations

BS 1377-1 to 9:1990. Methods of test for soils for civil engineering purposes - Parts 1 to 9 BS EN 1997-1:2007 - A1

ISRM Suggested Methods for Determining Unconfined Compressive Strength

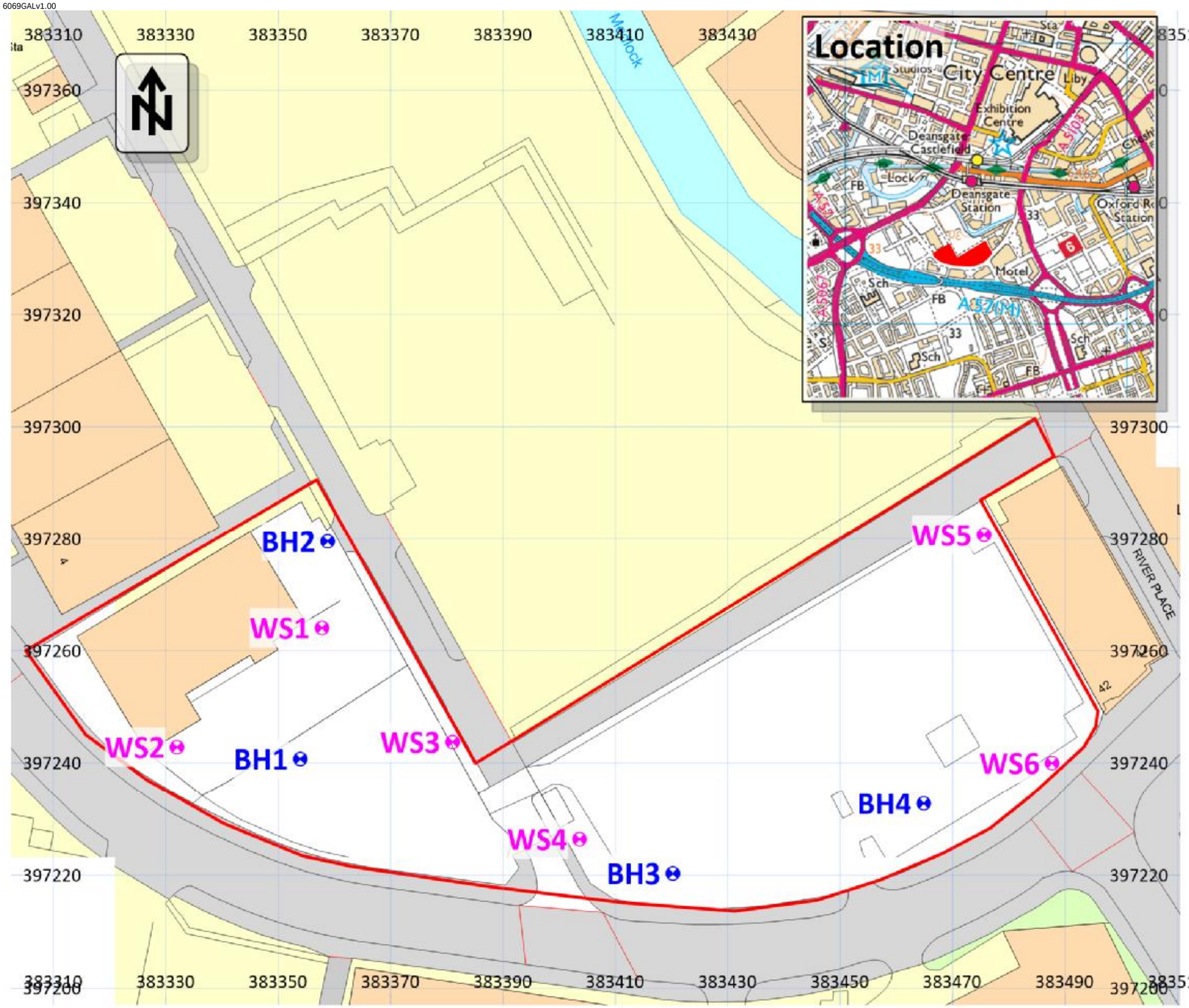
BS EN ISO 22475 Geotechnical Investigation and Testing, Part 1:2006.

Other technical sources have been identified in respect of specific aspects of the investigation, as referenced where relevant throughout the text.

Appendix A

A1 Site Location Plan and Site Plan with Exploratory Hole Locations

6069GALv1.00



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A1 Site Plan

Site Name	Plots F1 & F2 Great Jackson Street
Location	Manchester
GeoAssist Ref	6069CGJ
Client	Coffey Geotechnics Ltd
	Atlantic House Atlas Business Park Wythenshawe Manchester M22 5PR
Planning Consultant	Coffey Geotechnics Ltd
NGR (centre of site)	383410,397250
Production Date	August 2021
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

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Appendix B

B1 Terminology used in Soil Descriptions
B2 List of Abbreviations
B3 Standard Penetration Test
B4 Engineering Classification of Rock Cores

APPENDIX B1

Form No.: QF029AEN

Terminology used in Soil Descriptions

The procedure and principles given in BS EN ISO 14688-1:2002 Part 1: 'Identification and description' have been adopted in producing the soil descriptions contained within this report.
The general identification and description of soils is based on a flexible system for immediate (field) use by experienced persons, covering both material and mass characteristics by visual and manual techniques.
Details are given of the individual characteristics for identifying soils and the descriptive terms in regular use, including those related to the results of tests from the field.
This part of ISO 14688 is applicable to natural soils *in situ*, similar man-made materials *in situ* and soils redeposited by man.
Particular sections of BS EN ISO 14688-1:2002 Part 1 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Identification of soil

General

Soil characteristics that generally permit soil to be identified with adequate accuracy for general (or preliminary) characterization are outlined below. A more accurate identification and classification based on grading, plasticity or organic content can be achieved by laboratory tests. In addition to identifying soils, the condition in which a soil is encountered, any particular secondary constituents, other features of a soil, such as carbonate content, particle shape, surface roughness of particles, odour, any common names and the geological classification are indicated.
The identification and description of soils generally follows the flow chart in Figure B1.1 attached.

Particle size

Particle size is the fundamental basis for designating mineral soils using particle fractions to distinguish the soil mechanical behaviour.
Table B1 shows the terms to be used for each soil fraction and its sub-fractions, together with the corresponding chosen range of particle sizes.
Basic soils are soils with uniform grading (i.e. they consist of particles of only one size range as specified in Table B1.1

Table B1.1 Particle Size Fractions

Soil fractions	Sub-fractions	Symbols	Particle sizes mm
Very coarse soil	Large boulder	LBo	> 630
	Boulder	Bo	> 200 to 630
	Cobble	Co	> 63 to 200
Coarse soil	Gravel	Gr	> 2,0 to 63
	Coarse gravel	CGr	> 20 to 63
	Medium gravel	MGr	> 6,3 to 20
	Fine gravel	FGr	> 2,0 to 6,3
	Sand	Sa	> 0,063 to 2,0
	Coarse sand	CSa	> 0,63 to 2,0
	Medium sand	MSa	> 0,2 to 0,63
	Fine sand	FSa	> 0,063 to 0,2
Fine soil	Silt	Si	> 0,002 to 0,063
	Coarse silt	CSi	> 0,02 to 0,063
	Medium silt	MSi	> 0,006 3 to 0,02
	Fine silt	FSi	> 0,002 to 0,006 3
	Clay	Cl	⩽ 0,002

APPENDIX B1

Composite soils

General

Most soils are composite and consist of principal and secondary fractions. They are designated by a noun (main term) describing the principal fraction and by one or more adjectives (qualifying terms) describing the secondary fractions (e.g. sandy gravel saGr, gravelly clay grCl).

Principal fraction

The principal fraction in terms of mass determines the engineering properties of the soil and is given in capital letters for clarity.

In the case of very coarse soils, the principal fraction is the relevant very coarse soil fraction predominating in terms of mass. The very coarse fraction should be separated from the sample before identifying the fine and coarse fractions.

In the case of coarse soils, the principal fraction is the relevant coarse soil fraction predominating in terms of mass.

Composite coarse soils include a fines fraction (silt and/or clay) that does not determine the engineering properties of the soil.

In the case of fine soils, the principal fraction is the relevant fine soil type determining the engineering properties of the soil.

In the case of composite fine soils, the fines fraction determines the engineering properties of the soil. The fines fraction is regarded as determining the characteristics of a composite soil if this is of at least medium dry strength or exhibits a certain degree of plasticity.

In both cases, the soil is termed either “clay” or “silt”, depending on the plasticity of the fines fraction and not on the grading.

Secondary fractions

Secondary and further fractions do not determine but will affect the engineering properties of the soil. The secondary fractions as adjectives are placed with the term describing the principal fraction in the order of their relevance.

If coarse secondary fractions are present in a particularly small or particularly large proportion, the term “slightly” or “very” shall precede the qualifying term.

If it is a fine soil, the properties of which are determined by fines fractions, a soil can be identified as “silt” or “clay” by checking for the presence of fine secondary constituents on the basis of its plasticity properties.

If, in the case of coarse soils, two soil fractions are present in approximately equal proportions, an oblique shall be placed between the relevant terms, e.g. gravel/sand (Gr/Sa) or fine/medium sand (FSa/MSa).

Plasticity

Assessment of the plasticity and identification of a soil as either silt or clay permits the soil to be qualified as being of low plasticity or high plasticity.

An exact determination can only be made by establishing the liquid limit and the plastic limit in laboratory tests.

Organic content

Small quantities of dispersed organic matter in a soil can produce a distinctive odour and colour. The intensity of odour and colour indicates the proportion of organic matter and should be described.

Determination of consistency

The consistency of a cohesive soil shall be determined in a manual test, permitting the following identification and description:

a) a soil is to be identified as **very soft** if it exudes between the fingers when squeezed in the hand;

b) a soil is to be identified as **soft** if it can be moulded by light finger pressure;

c) a soil is to be identified as **firm** if it cannot be moulded by the fingers, but rolled in the hand to thick threads without breaking or crumbling;

d) a soil is to be identified as **stiff** if it crumbles and breaks when rolled to thick threads but is still sufficiently moist to be moulded to a lump again;

e) a soil is to be identified as **very stiff** if it has dried out and is mostly light coloured. It can no longer be moulded but crumbles under pressure. It can be indented by the thumbnail.

Preliminary descriptions are based on visual and manual identification only.

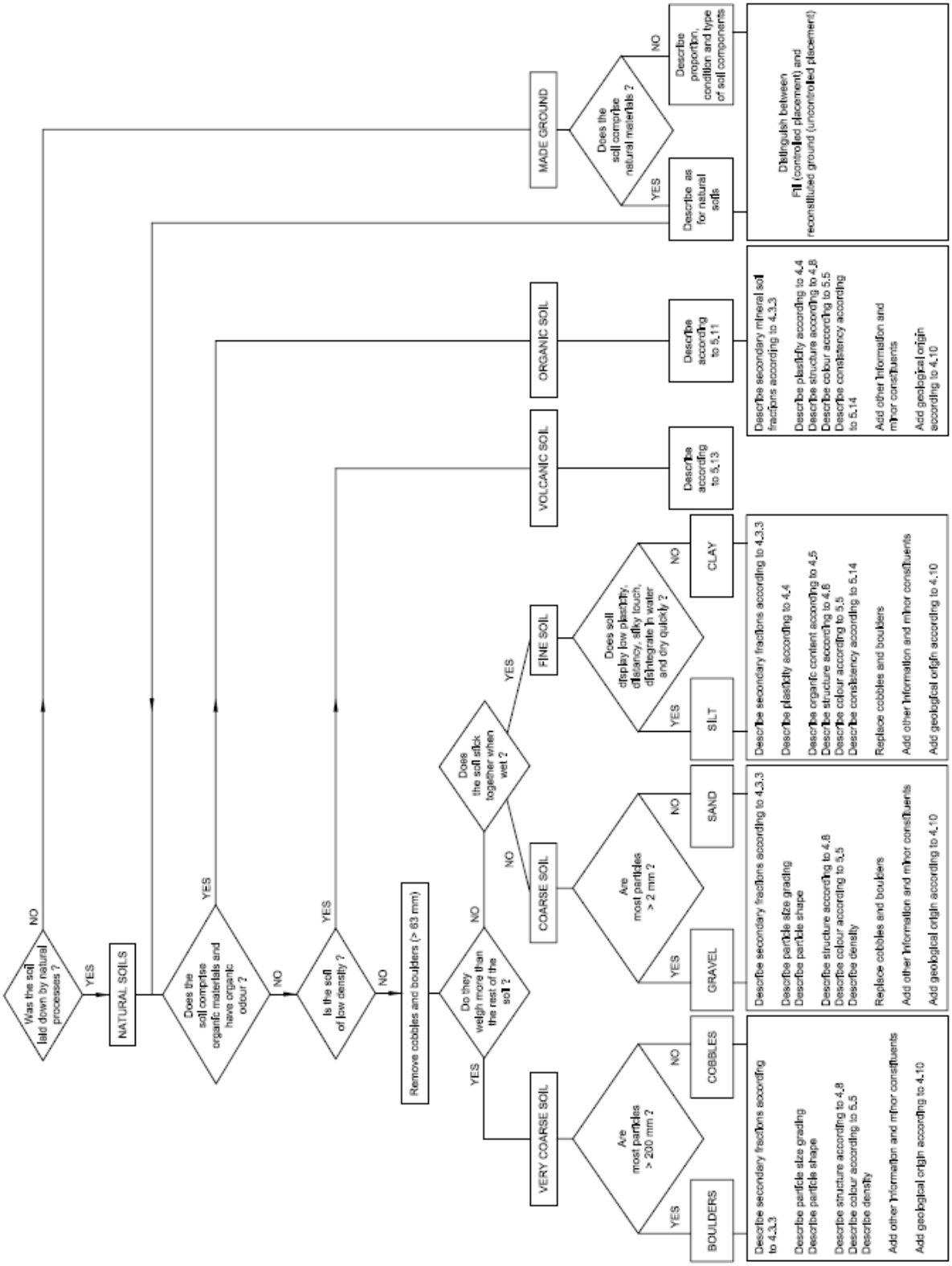


Figure B1.1 Flow chart for the identification and description of soils

APPENDIX B1

Form No.: QF029AEN

Terminology used in Soil Classification

The procedure and principles given in BS EN ISO 14688-2:2004 Part 2: 'Principles for a classification' have been adopted in producing the soil descriptions contained within this report where laboratory or in situ field tests have been carried out.
The classification principles established in this part of ISO 14688 permit soils to be grouped into classes of similar composition and geotechnical properties and, with respect to their suitability for geotechnical engineering purposes.
This part of ISO 14688 is applicable to natural soil and similar man-made material *in situ* and redeposited, but it is not a classification of soil by itself.
Particular sections of BS EN ISO 14688-1:2002 Part 2 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Principles of soil classifications

General

Soils shall be classified into soil groups on the basis of their nature, which is the composition only, irrespective of their water content or compactness, taking into account the particle size distribution (grading), plasticity, organic content, genesis as appropriate.
The most common approach to classification is to divide the soils on the basis of particle size grading and plasticity. The division is made on the relative size fractions present for the coarser soil fractions, determined on the whole sample, and on the plasticity of the finer fractions (Table B1.2).

Table B1.2 Principles of a classification of soils

Criterion	Soil group	Quantification	Denomination into groups of similiar properties			Further subdivision as appropriate by
Wet soil does not stick together	very coarse	most particles > 200 mm	Bo	xBo		Requires special consideration
				boCo	coBo	
		most particles > 63 mm	Co	saCo, grCo	sagrCo	
	coarse	most particles > 2 mm	Gr		cosaGr	Particle size (grading) Shape of grading curve Relative density Permeability
				coGr		
				saGr, grSa	sasiGr, grsiSa	
		most particles > 0,063 mm	Sa	siGr, clGr orSa	siSa, clSa, saclGr	(Mineralogy) (Particle shape)
Wet soils sticks together	fine	low plasticity dilatant	Si	saSi	sagrSi saclSi	Plasticity Water content Strength, sensitivity Compressibility, stiffness (Clay mineralogy)
				clSi, siCl		
		plastic non-dilatant	Cl		sagrCl	
				orSi, orCl		
Dark colour, low density	organic		Or	saOr, siOr	clOr	Requires special consideration
Not naturally	Made ground	deposited	Mg	xMg	Man-made material	Requires special consideration
					Relaid natural materials	As for natural soils
Key to symbols						Cases requiring special consideration should be classified according to national or project requirements
Soil	*Principal*	*Secondary or tertiary component*				
Boulders	Bo	bo				
Cobbles	Co	co				
Gravel	Gr	gr	Gr(gr) and Sa(sa) can be subdivided into fine F(f), medium M(m) or coarse C(c)			
Sand	Sa	sa				
Silt	Si	si				
Clay	Cl	cl				
Organic	Or	or				
Made ground	Mg	–				
		x	any combination of components			

Fractions

Soil is a mixture of materials of different particle size, which are grouped into fractions as specified in BS EN ISO 14688-1.
Classification of coarse and very coarse soils is to be based on the particle size distribution alone (see Table B1.3)

Table B1.3 Classification of very coarse soils

Fraction	Percent by mass	Term
Boulders	< 5	low boulder content
	5 to 20	medium boulder content
	> 20	high boulder content
Cobbles	< 10	low cobble content
	10 to 20	medium cobble content
	> 20	high cobble content

In the case of soils composed of both fine and coarse material, classification is to be based on both plasticity and particle size distribution.

Particle size distribution (grading)

The particle sizes and their distribution in a soil are determined by mechanical analysis carried out by the separation of the coarser fractions by sieving on a series of standard sieves and the determination of the finer fractions by sedimentation.
The results of the sieving and sedimentation process are plotted as a grading curve.

Plasticity

The fine fractions of soil, represented by clay and silt and containing clay minerals (see also BS EN ISO 14688-1), both alone or in mixtures with coarser material, are usually classified according to their plasticity characteristics. This is carried out on the basis of laboratory tests to determine the liquid limit w_L and plastic limit w_P.

Organic content

When soils with organic constituents are classified according to their organic content (Table B1.4), a distinction is to be made between organic soils and mineral soils with an organic content.

Table B1.4 Classification of soils with organic constituents

Soil	Organic content ($\leqslant$ 2 mm) % of dry mass
Low-organic	2 to 6
Medium-organic	6 to 20
High-organic	> 20

Classification of coarse and composite organic soils accumulated *in situ* is based on the type of organic matter and that of organic soils, on the genetic origin and the degree of decomposition of the organic constituents.

APPENDIX B1

Form No.: QF029AEN

Undrained shear strength of fine soils

The terms to be used for the designation of the undrained shear strength according to the results of laboratory and field tests are given in Table B1.5.

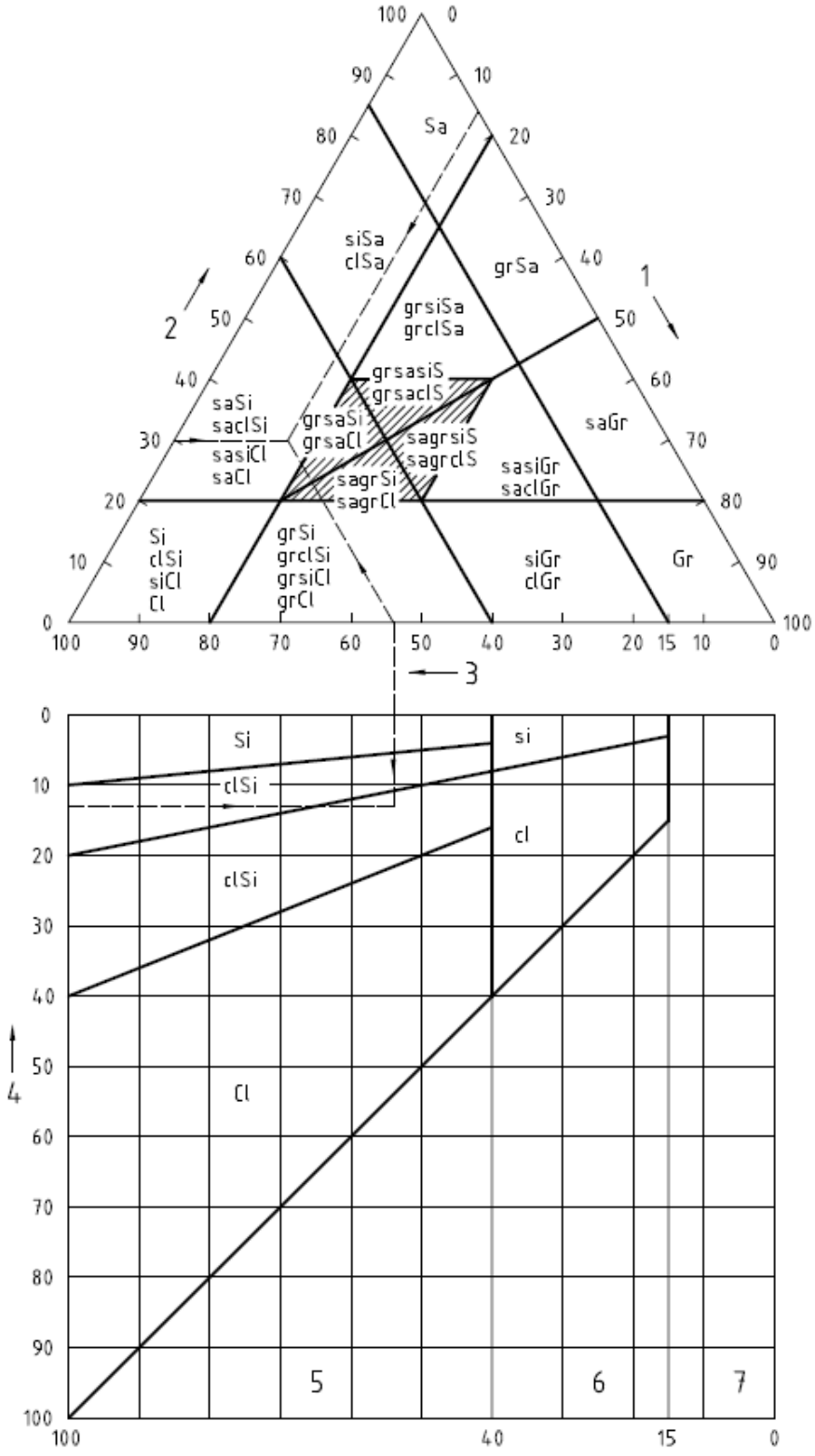
Table B1.5 Undrained shear strength of fine soils

Undrained shear strength of clays	Undrained shear strength c_u kPa
Extremely low	< 10
Very low	10 to 20
Low	20 to 40
Medium	40 to 75
High	75 to 150
Very high	150 to 300
Extremely high[a]	> 300

[a] Materials with shear strength greater than 300 kPa may behave as weak rocks and should be described as rocks according to ISO 14689-1.

Table B1.6 Guiding values for the division of mineral soils on a basis of the contents of various fractions

Fraction	Content of fraction in wt % of material ⩽ 63 mm	Content of fraction in wt % of material ⩽ 0,063 mm	Name of soil	
			Modifying term	Main term
Gravel	20 to 40 > 40		gravelly	gravel
Sand	20 to 40 > 40		sandy	sand
Silt + clay (fine soil)	5 to 15 15 to 40 > 40	< 20 ⩾ 20 < 20 ⩾ 20 < 10 10 to 20 20 to 40 > 40	slightly silty slightly clayey silty clayey clayey silty	 silt silt clay clay



Key

1 gravel content (2 mm to 63 mm)

2 sand content (0,063 mm to 2 mm)

3 fines content (< 0,063 mm)

4 clay content in % of mass of coarse and fine soil (grain size < 63 mm)

5 fine soils (silt and clay)

6 mixed-grained soils (silty or clayey gravel and sand)

7 coarse soils (gravel and sand)

S soil

See also Table A.1.

Figure B1.2 Classification of soils, based on grading alone

APPENDIX B1

Form No.: QF029AEN

References

BS EN ISO 14688-1: 2002
Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description

BS EN ISO 14688-2: 2004
Geotechnical investigation and testing — Identification and classification of soil — Part 2: Principles for a classification

APPENDIX B2

Form No.: QF033AEN

Abbreviations

Exploratory Hole log

Sample Type

AGS Code	Sample Type	AGS Code	Sample Type
B	Bulk Disturbed sample	**SPT**	Penetration Test – split spoon
CBR	CBR sample	**U**	Undisturbed sample – open drive
CPT	Penetration Test – cone	**UF**	Undisturbed sample failed recovery
D	Small disturbed sample	**W**	Water sample
PU	Piston sample	**C - ES**	Environmental sample

SPT and CPT – Standard Penetration Test

Blow Count (N) – If full penetration of 450mm then the total number of blows for the last 300mm is given.
If limited penetration following 150mm seating blows then the number of blows for the stated penetration is given.
If limited penetration then the total number of blows for the stated penetration is given.
The N values are actual blows recorded and uncorrected.

U - Undisturbed Sample

Blow Count – total number of blows for recovered length

Legend – As per British Standard – if blank then CAVITY/OPEN HOLE

Core Rec.:
T - Total Core Recovery as a percentage of the cored run
S – Solid Core Recovery as a percentage of the cored run
RQD – Rock Quality Designation as a percentage of the cored run
FI – Fracture index as number of fractures per metre
I_f – Fracture spacing as the average length of solid core pieces between natural fractures over core length of reasonable uniform characteristics

APPENDIX B2

Form No.: QF033AEN

Laboratory Test Summary Sheet

Tests on Soils

AGS Code	Test Name	AGS Code	Test Name
ASB	Asbestos	**IDEN**	In Situ Density
BDEN	Bulk Density	**IGNIS**	Loss on Ignition
CBR	California Bearing Ratio	**IVAN**	In Situ Vane
CD	Consolidated drained (single stage)	**LS**	Linear shrinkage
CDM	Consolidated drained (multi stage)	**MCVG**	Moisture Condition Value
CLSS	Atterberg Limits	**NMC**	Natural Moisture content
CMPG	Compaction	**OMS**	Organic Matter
CNMT	Contaminant and Chemical	**PD**	Particle density
CONG	Consolidation	**PHS**	pH
CU	Consolidated undrained with pwp measurement (single stage)	**PTST**	Laboratory permeability
CUM	Consolidated undrained with pwp measurement (multi stage)	**RELD**	Relative Density
DDEN	Dry Density	**SHBG**	Shear box
FRST	Frost Susceptibility	**SLIM**	Shrinkage Limit
GRAD HY	Particle Size (Hydrometer)	**SULWS** **SULTS**	Sulphate on 2:1 Water:Soil Extract Sulphate Total on Acid Extract
GRAD WS	Particle size (wet Sieve)	**TNPC**	Ten Per Cent Fines
HVP	Hand vane – peak	**UU**	Unconsolidated quick undrained (single stage)
ICBR	In situ CBR	**UUM**	Unconsolidated quick undrained (multi stage)

Tests on rocks and Aggregates

AGS Code	Test Name	AGS Code	Test Name
ACV	Aggregate crushing value	**SHOR**	Shore hardness
BRAZ	Tensile Strength by Brazilian method	**SOUN**	Aggregate Soundness Test
LOSA	Aggregate Los Angeles Abrasion	**UCS**	Uniaxial Compressive Strength
PLSI	Point Load Index – size corrected	**WTAB**	Aggregate Water Absorption

4. Reference AGS Format Edition 3

APPENDIX B3

Form No.: QFO31AEN

Standard Penetration Test

The full procedure for carrying out the Standard Penetration Test (SPT) is given in EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing - Field testing - Part 3: Standard penetration test.

The Energy ratio for the hammer used on this site is 65% as given in the test certificate attached.

The blow counts N noted on the borehole logs are the uncorrected field blows counts as recorded.

Essentially the test consists of driving a 50mm external diameter split barrel sampler into the soil using a 63.4kg hammer dropping 760mm. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows for the 300mm test drive penetration is recorded on the borehole log as the N-value.

The test is normally performed on sands, but may also be used in gravels, weak rocks and glacial tills in which case the driving shoe may be replaced by a cone. When attempting the standard penetration test in very dense materials or weathered bedrock it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner.

(a) Where the 150mm seating drive is complete and where the test drive is terminated at 50 blows the number of blows for the partial test drive (usually 50) and the penetration of the sampler within the test drive are recorded. An approximate N-value may be obtained by linear extrapolation of the number of blows recorded for the partial test drive.

(b) If the total penetration is equal to or less than the 150mm seating drive then the number of blows (usually 50) and the depth of penetration within the initial seating penetration are recorded on the borehole logs.

The N-value obtained from the Standard Penetration Test may be used to assess the terms for classification of relative density of sands and gravels only in accordance with Table 10 of BS 5930: 2015+A1:2020, Code of Practice for Site Investigations, as follows:

Term	Classification based on uncorrected SPT N-values for use of borehole logs Blows/300mm Penetration
Very loose	0-4
Loose	4-10
Medium dense	10 - 30
Dense	30 - 50
Very dense	over 50

The blow counts N noted on the borehole logs are the uncorrected field blows counts as recorded.

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

SPT Hammer Ref:	AR3561
Test Date:	19/03/2021
Report Date:	19/03/2021
File Name:	AR3561.spt
Test Operator:	JL

Instrumented Rod Data

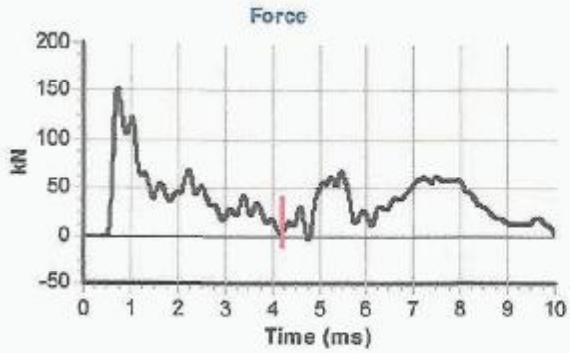
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.3
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	11609

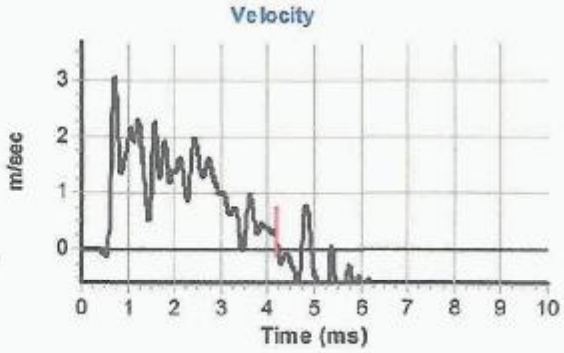
SPT Hammer Information

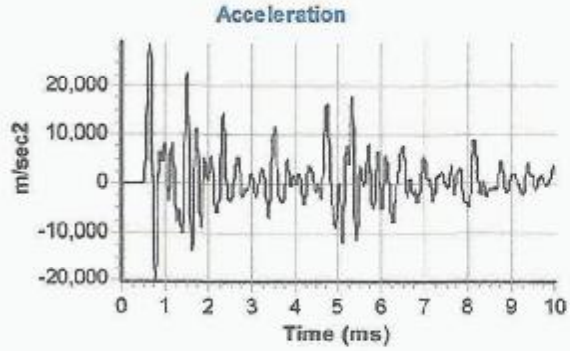
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location

GEO ASSIST LTD - 74732









Calculations

Area of Rod A (mm2):	944
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	309

Energy Ratio E_r (%): **65**

Signed: J.LOCK

Title: FITTER

The recommended calibration interval is 12 months

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SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

SPT Hammer Ref:	DART314
Test Date:	18/03/2021
Report Date:	18/03/2021
File Name:	DART314.spt
Test Operator:	JL

Instrumented Rod Data

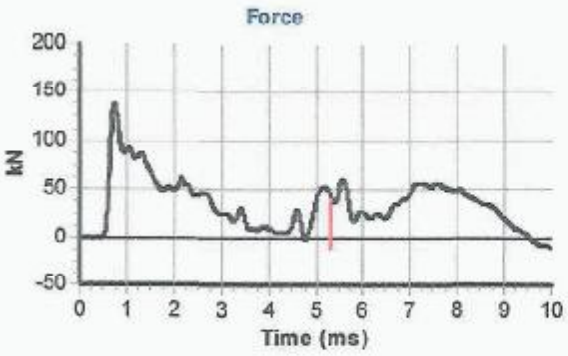
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.3
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	11609

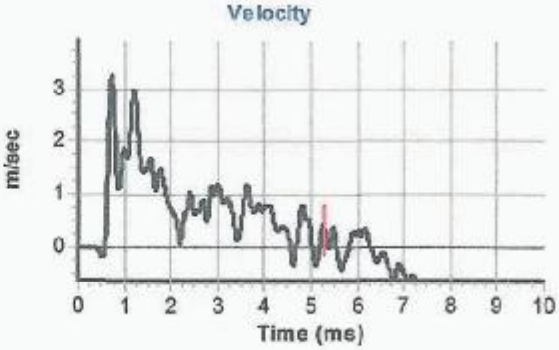
SPT Hammer Information

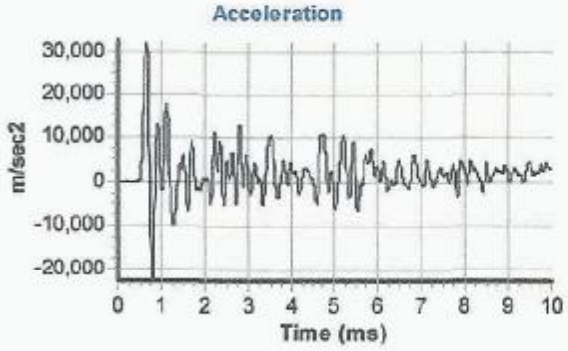
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location

GEO ASSIST LTD - 74732









Calculations

Area of Rod A (mm2):	944
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	307

Energy Ratio E_r (%): 65

Signed: J.LOCK

Title: FITTER

The recommended calibration interval is 12 months

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APPENDIX B4

Form No.: QF030AEN

Engineering Classification of Rock Cores

The procedure and principles given in BS EN ISO 14689-1:2003 Part 1: 'Identification and description' have been adopted in producing the rock core descriptions contained within this report. The code partially
supersedes BS 5930:1999 which is currently being revised in order to remove conflicting material. In the meantime, where conflict arises between the two documents the provisions of BS EN ISO 14689-1:2003 should take precedence.
The general identification and description of rocks is based on a flexible system for immediate (field) use by experienced persons, covering both material and mass characteristics by visual and manual techniques.
Details are given of the individual characteristics for identifying rocks and the descriptive terms in regular use, including those related to the results of tests from the field.
Particular sections of BS EN ISO 14688-1:2003 Part 1 are reproduced here in order to clarify the production of the rock core descriptions contained within this report.

Rock identification

The identification of rocks is based on the determination of the following:
a) genetic group: sedimentary, metamorphic, igneous
b) structure: bedded, foliated or massive
c) grain size : descriptive terms (for various sizes) are given in Table A.1 in correlation to rock types;
d) mineralogical composition: quartz, feldspars and related silicate minerals, dark coloured minerals (e.g. biotite, amphibole, pyroxene), clay minerals, carbonate minerals (e.g. calcite and dolomite), siliceous amorphous material (e.g. glass), carbonaceous material (e.g. coal and graphite), salts (e.g. halite [rock salt]), gypsum), swelling minerals (e.g. anhydrite and clay minerals), sulfide minerals (e.g. pyrite)
e) void content: primary voids (e.g. gas bubbles in volcanic rocks), secondary voids (e.g. solution voids).

Description of rock material

Colour

Rock material colour may be described using Colour Charts of an approved type. As an alternative, the following simple system should be used, which serves to limit the subjectivity of an estimation. One term is selected as required from each column (see Table 1) and combined as a colour assessment.
Examples of use are: yellow, light yellowish brown, dark reddish brown, dark brown, etc.

Table 1
Terms for lightness, chroma and hue which may be used in combination for colour description (examples)

Lightness Tertiary descriptor	Chroma Secondary descriptor	Hue Primary descriptor
Light Dark	Pinkish Reddish Yellowish Brownish Greenish Bluish Greyish	Pink Red Yellow Brown Green Blue White Grey Black

Grain size

Grain size refers to the average dimension of the predominant mineral or rock fragments comprising the rock material. It is usually sufficient to estimate the size by eye, which may be aided by a hand lens in the assessment of fine-grained or amorphous rocks, but separate descriptions of the grains and the matrix may be appropriate.

Matrix

The particle size and the mineralogical composition of the matrix shall be determined. Mineralogical composition shall be described using the terms siliceous, calcareous, carbonaceous, etc.) but may be amplified, as appropriate, with such standard geological terms as ferruginous, argillaceous (containing clay minerals), quartzose and others.

Weathering and alteration effects

The results of weathering/alteration of rock material are given in Table 2. Any or all of the descriptive terms can be used to describe weathering/alteration

Table 2 — Terms to describe weathering/alteration of rock materials

Term	Description
Fresh	No visible sign of weathering/alteration of the rock material
Discoloured	The colour of the original fresh rock material is changed and is evidence of weathering/alteration. The degree of change from the original colour should be indicated. If the colour change is confined to particular mineral constituents, this should be mentioned.
Disintegrated	The rock material is broken up by physical weathering, so that bonding between grains is lost and the rock is weathered/altered towards the condition of a soil in which the original material fabric is still intact. The rock material is friable but the mineral grains are not decomposed.
Decomposed	The rock material is weathered by the chemical alteration of the mineral grains to the condition of a soil in which the original material fabric is still intact; some or all of the mineral grains are decomposed.

Unconfined compressive strength

The unconfined compressive strength of rock material can be estimated according to Table 5.

Table 5 — Field identification of the unconfined compressive strength

Term	Field Identification	Unconfined compressive strength MPa
Extremely weak[a]	Indented by thumbnail	less than 1
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1 to 5
Weak	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5 to 25
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25 to 50
Strong	Specimen requires more than one blow of geological hammer to fracture it	50 to 100
Very strong	Specimen requires many blows of geological hammer to fracture it	100 to 250
Extremely strong	Specimen can only be chipped with geological hammer	greater than 250

[a] Some extremely weak rocks will behave as soils and should be described as soils according to ISO 14688-1.

NOTE Unconfined compressive strength cannot always be defined in the field, thus point load tests are often used as indices for strength of rock material.

Bedding Thickness

The terms to be used to describe bedding thickness are given in Table 7

Table 7 — Terms to describe bedding thickness

Term	Spacing mm
Very thick	greater than 2 000
Thick	2 000 to 600
Medium	600 to 200
Thin	200 to 60
Very thin	60 to 20
Thickly laminated	20 to 6
Thinly laminated	less than 6

Discontinuity spacing

The terms used to describe discontinuity spacing are given in Table 8.

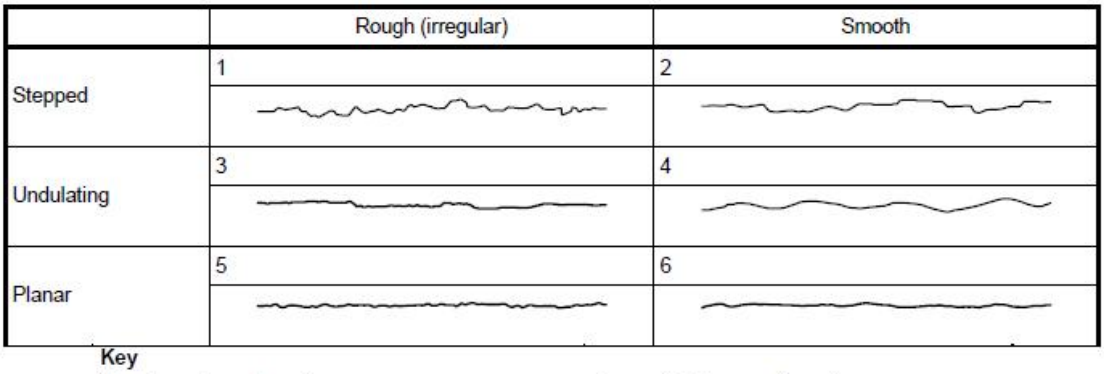
Table 8 — Terms to describe discontinuity spacing

Term	Spacing mm
Very wide	greater than 2 000
Wide	2 000 to 600
Medium	600 to 200
Close	200 to 60
Very close	60 to 20
Extremely close	less than 20

In drilled cores, it is usually difficult to measure the true discontinuity spacing and measurements are made along the core axis.

Roughness

The surface of discontinuities has to be described on the basis of three scales of observation:
a) small scale (several millimetres) — rough or smooth;
b) medium scale (several centimetres) — planar, stepped or undulating;
c) large scale (several metres) — wavy, curved or straight;
and using terms as indicated in Figure 2. A discontinuity surface could thus be described combining large or medium and small scale terms to give descriptions such as “stepped smooth” or “planar rough”.



Key
1 stepped rough surface
2 stepped smooth surface
3 undulating rough surface
4 undulating smooth surface
5 planar rough surface
6 planar smooth surface

Figure 2 — Terms for discontinuity roughness (not to scale)

APPENDIX B4

Form No.: QF030AEN

Fracture State

Fracture State is measured in accordance with the terms detailed in Figure 20 of BS 5930 (1999) and as further clarified using the definition of solid core, detailed by Norbury et al (1984) as follows:-

Core Run - Length of discrete drill run over which core is recovered.

Solid Core - Core with at least one full diameter (but not necessarily a full circumference) between two natural fractures. By this definition core that has a single set of inclined fractures would have a core recovery of 100%. Where there are two or more sets of non parallel fractures, only sections of the core in which the fractures actually intersect are excluded from the solid core.

Note:- All measurements are made along the axis of the core.

Based on these definitions, the following terms are defined.

Term	Abbreviation	Definition
Total Core Recovery	TCR (%)	The percentage ratio of core recovered (both solid and non-intact) to the total length of core run.
Solid Core Recovery	SCR (%)	The percentage ratio of solid core recovered to total length of core run.
Rock Quality Designation	RQD (%)	The total length of solid core pieces greater than 100mm between natural fractures expressed as a percentage of total length of core run.
Fracture Spacing	I_f (mm)	The average length of solid core pieces between natural fractures over core length of reasonable uniform characteristics, not core runs. The term non-intact (NI) is used when core is fragmented.

The above terms may be related to the details contained in the following figure for clarification

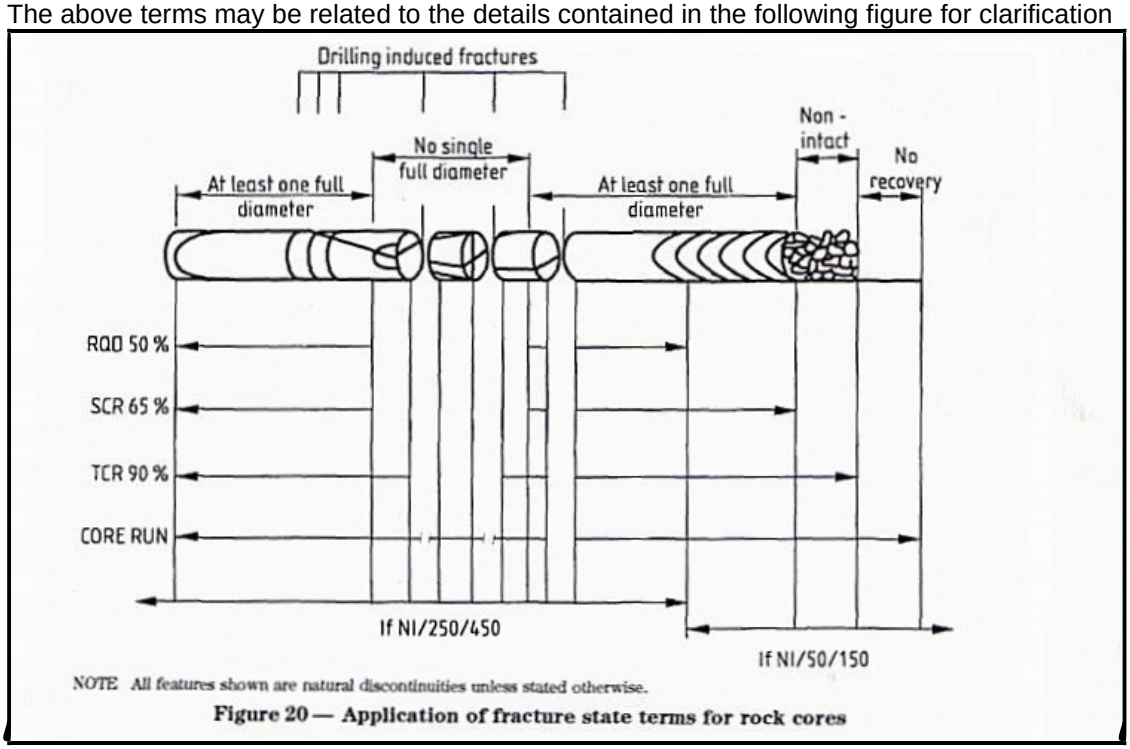


Figure 1 **- Schematic illustration of fracture logging terms.**

APPENDIX B4

Form No.: QF030AEN

References

BS EN ISO 14689 -1: 2003
Geotechnical investigation and testing — Identification and classification of rock — Part 1: Identification and description

BS 5930: 1999: 'Code of Practice for Site Investigations': British Standards Institution.

Norbury D.R., G.H. Child and T.W. Spink: 1984 'A critical review of Section 8 (BS 5930) - Soil and Rock Description'. Proc., 20th Regional Meeting, Engineering Group of the Geological Society - Site Investigation Practice - Assessing BS 5930. Univ., of Surrey.

Appendix C

C1	Exploratory Hole Logs BH1 to BH4
C2	Exploratory Hole Logs WS1 to WS6
C3	Rock Core Photographs BH1 to BH4
C4	In Situ High Pressure Dilatometer Test Summary Sheets – InSitu Site Investigation
C5	Televiewer In Hole Inspection Output – Robertson Geologging
C6	Ground Gas Monitoring Readings
C7	Groundwater Monitoring Readings

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH1
Sheet: 1

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)
Ground Level: 32.28 m.AOD
Co-ordinates: Easting: 383353.9(m) Northing: 397240.7(m)
Dates: 14/04/2021 to 10/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Depth (m) from	to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
Tarmac	0.10	32.18								14/04/2021: Inspection Pit excavated with hand tools to 1.00m depth.
Brown/grey sandy gravel subbase - MADE GROUND	0.40	31.88								
Brown clayey sand and gravel with brick fragments and cobbles - MADE GROUND	0.70	31.58		0.50	0.60	B1				
Loose brown clayey silty gravelly SAND				0.80	0.90	D1				
				1.00	1.45	P1		6		P1 at 1.00m - 1,1/1,2,2,1
	(1.00)									
				1.50	1.60	D2				
	1.70	30.58								
Medium dense brown/grey clayey silty gravelly SAND with dark grey fibrous matter	(0.50)			1.80	1.90	D3				
	2.20	30.08		2.00	2.45	P2		14		P2 at 2.00m - 1,2/3,3,4,4
Stiff to very stiff brown high strength slightly gravelly very sandy silty CLAY				2.50	2.60	D4				
	(1.40)									
				3.00	3.25	U1		(16)		
	3.60	28.68		3.50	3.60	D5				
Stiff grey/brown slightly gravelly silty CLAY	(0.40)									
	4.00	28.28		4.00	4.45	U2		(30)		
Very stiff brown high strength gravelly very sandy silty CLAY				4.50	4.95	P3		32		P3 at 4.50m - 4,4/6,8,8,10
				4.50	4.60	D6				
	(1.90)			5.00	5.45	P4		32		P4 at 5.00m - 8,6/7,8,8,9
				5.50	5.60	D7				14/04/2021: Hard Boring Sandstone 5.90m to 7.50m -1.0hr
	5.90	26.38								
Very dense orange/brown silty SAND with sandstone fragments and rounded gravel - Extremely weak to very weak weathered Sandstone				6.00	6.45	P5		89		P5 at 6.00m - 18,16/18,20,18,33
	(1.10)									
	7.00	25.28		7.00	7.12	P6				P6 at 7.00m - (81 for 115mm)
Weak orange/brown inferior cemented silty fine to medium grained SANDSTONE with random rounded gravel	(0.50)			7.00	7.10	D8				
	7.50	24.78		7.50	7.58	P7				P7 at 7.50m - (54 for 75mm)
Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/30/300				7.50	9.00	C1	93	40	27	14/04/2021: LCP hole completed at 7.50m. Standing Water Nil. 200mm dia Casing at 7.00m. 19/04/2021: Rotary Drilling commenced at 7.50m with air/mist flush. 19/04/2021: Water level Nil. 412F Rotary Coring from 7.50m to 12.00m with air/mist flush. PW Open hole casing from 7.50m to 12.00m with water/air/mist flush.
	(2.50)									
	10.00	22.28		9.00	10.50	C2	100	67	13	

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 26/04/2021
Checked: M Benson
Date: 27/04/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH1
Sheet: 2

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd

Project: Plots F1 & F2 Great Jackson Street
Location: Manchester

Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)

Ground Level: 32.28 m.AOD
Co-ordinates: Easting: 383353.9(m) Northing: 397240.7(m)
Dates: 14/04/2021 to 10/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION

Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
			10.50 12.00	C3	100	100	63	20/04/2021: Water level at 9.50m depth. T6H Rotary coring from 12.00m to 14.20m with water flush.
			12.00 14.20	C4	100	68	68	PW Open hole casing from 12.00m to 14.20m with water then air/mist flush.
			14.20 16.50	C5	91	78	48	21/04/2021: Water level at 8.40m depth. T6H Rotary coring from 14.20m to 16.50m with water flush.
			16.50 18.00	C6	93	89	53	412F Rotary Coring from 16.50m to 18.00m with air/mist flush. PW Open hole casing from 14.20m to 18.10m with water then air/mist flush.
			18.00 18.10	C7	0			22/04/2021: Water level at 9.80m depth. T6H Rotary coring from 18.10m to 20.40m with water flush.
			18.10 20.40	C8	98	87	74	
(10.00)								
20.00	12.28							

10 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/50/250

11

12

13

HPD Pressuremeter Test at 13.30m - aborted

14

15

HPD Pressuremeter Test at 15.70m

16

17

18

19

HPD Pressuremeter Test at 19.20m

20

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 26/04/2021
Checked: M Benson
Date: 27/04/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH1
Sheet: 3

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)
Ground Level: 32.28 m.AOD
Co-ordinates: Easting: 383353.9(m) Northing: 397240.7(m)
Dates: 14/04/2021 to 10/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
20 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/50/250									412F Rotary Coring from 20.40m to 23.50m with air/mist flush.
21				20.40 22.00	C9	94	84	28	PW Open hole casing from 18.10m to 23.30m with water then air/mist flush.
22									
23				22.00 23.50	C10	100	97	73	T6H Rotary coring from 23.50m to 25.60m with water flush.
24 HPD Pressuremeter Test at 24.30m				23.50 25.60	C11	100	86	55	PW Open hole casing from 20.40m to 25.60m with air/mist flush.
25	(10.00)								412F Rotary Coring from 25.60m to 30.10m with air/mist flush.
26				25.60 27.10	C12	100	87	40	
27									
28				27.10 28.60	C13	100	77	73	
29				28.60 30.10	C14	100	93	60	23/04/2021: Water level at 9.40m depth. PW Open hole casing from 25.60m to 30.50m with air/mist flush.
30	30.00	2.28							

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 26/04/2021
Checked: M Benson
Date: 27/04/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH1
Sheet: 4

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd

Project: Plots F1 & F2 Great Jackson Street
Location: Manchester

Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)

Ground Level: 32.28 m.AOD
Co-ordinates: Easting: 383353.9(m) Northing: 397240.7(m)
Dates: 14/04/2021 to 10/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
30 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/50/250				30.10 31.10	C15	50	25	25	T6H Rotary coring from 30.50m to 31.10m with water flush.
31									T6H Rotary coring from 31.10m to 33.50m with water flush.
32				31.10 33.50	C16	88	71	35	
HPD Pressuremeter Test at 32.60m	(5.00)								
33									412F Rotary Coring from 33.50m to 35.00m with air/mist flush.
34				33.50 35.00	C17	100	100	67	
35 Exploratory Hole complete at 35.00m	35.00	-2.72							23/04/2021:On completion of drilling at 35.00m depth, PW casing extracted, 150mm casing in drift retained in exploratory hole for televiewer inspection 10/05/2021: Water level at 9.40m depth. 50mm Groundwater monitoring standpipe installed to 18.00m depth with response zone from 8.00m to 18.00m
36									
37									
38									
39									
40									

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 26/04/2021
Checked: M Benson
Date: 27/04/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH2
Sheet: 1

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd

Project: Plots F1 & F2 Great Jackson Street
Location: Manchester

Equipment: Dando LCP Rig (150mm casing) + Rotary Rig with water and air/mist flush (412F core 72mm)

Ground Level: 32.95 m.AOD
Co-ordinates: Easting: 383420.2(m) Northing: 397220.3(m)
Dates: 04/05/2021 to 10/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from	to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
Tarmac	0.10	32.85								04/05/2021: Inspection Pit excavated with hand tools to 1.00m depth.
Brown/grey sandy gravel subbase - MADE GROUND	0.40	32.55								
Dark brown brick rubble - MADE GROUND	0.50	32.45		0.50	0.80	B1				
Brown clayey silty sand and gravel - MADE GROUND	0.80	32.15		0.80	0.90	D1				
Grey very sandy silty clay with brick and glass fragments and organic inlusions - MADE GROUND	(1.20)			1.00	1.35	U1		(10)		
				1.50	1.60	D2				
	2.00	30.95		2.00	2.45	U2		(18)		
Firm to stiff brown/grey medium strength slightly sandy silty CLAY, laminated with silt partings and inclusions	(1.80)			2.50	2.60	D3				
				2.50	2.95	P1		8		P1 at 2.50m - 1,2/2,1,2,3
				3.00	3.45	U3		(15)		
				3.50	3.60	D4				
	3.80	29.15								
Stiff to very stiff brown high strength slightly gravelly very sandy very silty CLAY	(0.90)			4.00	4.45	P2		36		P2 at 4.00m - 9,10/10,9,8,9
				4.50	4.60	D5				04/05/2021: Hard Boring Sandstone 4.70m to 5.90m -1.0hr
	4.70	28.25								
Very dense orange/brown silty SAND with sandstone fragments and rounded gravel - Extremely weak to very weak weathered Sandstone	(0.80)			5.00	5.12	P3				P3 at 5.00m - (91 for 115mm)
	5.50	27.45		5.50	5.60	D6				
Weak orange/brown inferior cemented slightly clayay silty fine to medium grained SANDSTONE with rounded gravel	(0.40)									
	5.90	27.05		5.90	5.95	P4				P4 at 5.90m - (50 for 50mm)
Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/70/200				5.90	7.40	C1	100	93	63	04/05/2021: LCP hole completed at 5.90m. Standing Water Nil. 150mm dia Casing at 5.50m. 07/05/2021: Rotary Drilling commenced at 5.90m with air/mist flush. 07/05/2021: Water level Nil. 412F Rotary Coring from 5.90m to 25.40m with air/mist flush.
	(4.10)			7.40	8.90	C2	97	85	50	
				8.90	10.40	C3	77	53	38	
	10.00	22.95								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 10/05/2021
Checked: M Benson
Date: 11/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH2
Sheet: 2

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (150mm casing) + Rotary Rig with water and air/mist flush (412F core 72mm)
Ground Level: 32.95 m.AOD
Co-ordinates: Easting: 383420.2(m) Northing: 397220.3(m)
Dates: 04/05/2021 to 10/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
10 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/70/200									
11				10.40 11.90	C4	93	80	53	
12				11.90 13.40	C5	100	87	47	
13									
14				13.40 14.90	C6	100	95	60	
15	(10.00)			14.90 16.40	C7	100	97	74	
16									
17				16.40 17.90	C8	87	80	17	
18									
19				17.90 19.40	C9	100	80	33	
20	20.00	12.95							

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 10/05/2021
Checked: M Benson
Date: 11/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH2
Sheet: 3

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (150mm casing) + Rotary Rig with water and air/mist flush (412F core 72mm)
Ground Level: 32.95 m.AOD
Co-ordinates: Easting: 383420.2(m) Northing: 397220.3(m)
Dates: 04/05/2021 to 10/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
20 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/60/250				19.40 20.90	C10	100	93	83	
21				20.90 22.40	C11	100	90	47	
22									
23	(5.40)			22.40 23.90	C12	100	93	63	
24				23.90 25.40	C13	100	93	67	07/05/2021 on completion of drilling at 25.40m depth, 150mm casing in drift retained in exploratory hole for installation of water monitoring standpipe
25	25.40	7.55							10/05/2021: Water level at 9.20m depth. 50mm Groundwater monitoring standpipe installed to 18.00m depth with response zone from 9.00m to 18.00m
Exploratory Hole complete at 25.40m									
26									
27									
28									
29									
30									

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 10/05/2021
Checked: M Benson
Date: 11/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH3

Sheet: 1

Consultant: Coffey Geotechnics Ltd

Client: Renaker Build Ltd

Project: Plots F1 & F2 Great Jackson Street

Location: Manchester

Equipment: Dando LCP Rig (150mm casing) + Rotary Rig with water and air/mist flush (412F core 72mm)

Ground Level: 33.26 m.AOD

Co-ordinates: Easting: 383464.9(m) Northing: 397232.7(m)

Dates: 16/04/2021 to 06/05/2021

Lead Driller: M Benson Assistant Driller: M Walton

STRATUM DESCRIPTION

Site Geotechnical Engineer/Geologist: M Benson

Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Depth (m) from	to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
0 Concrete 0.10	33.16								
Dark brown brick rubble - MADE GROUND 0.20	33.06								16/04/2021: Inspection Pit excavated with hand tools to 1.00m depth.
Dark brown/grey clayey gravelly silty SAND with brick fragments - MADE GROUND			0.50	0.60	B1				
(1.20)			0.80	0.90	D1				
1			1.00	1.45	P1		4		P1 at 1.00m - 1,0/1,1,1,1
1.40	31.86								
Dark brown/grey very sandy silty clay - MADE GROUND			1.50	1.60	D2				
(0.70)									
2 2.10	31.16		2.00	2.35	U1		(16)		
Dark brown clayey silty very gravelly SAND - MADE GROUND			2.50	2.95	P2				
			2.50	2.60	D3		12		P2 at 2.50m - 2,3/3,4,3,2
(1.10)									
3 3.20	30.06		3.00	3.45	U2		(18)		16/04/2021: LCP hole at 3.00m. Standing Water Nil. 150mm dia Casing at 3.00m. 30/04/2021: Standing Water Nil.
Firm to stiff brown/grey medium to high strength silty CLAY with silt partings			3.50	3.60	D4				
			3.50	3.95	U3		(24)		
(1.20)									
4			4.00	4.45	P3		12		P3 at 4.00m - 2,1/2,3,4,3
4.40	28.86								
Stiff to very stiff brown slightly gravelly very sandy silty CLAY with rare to medium cobble content			4.50	4.60	D5				
5									
(1.60)			5.20	5.55	U4		(55)		
			5.70	5.80	D6				30/04/2021: Hard Boring Sandstone 6.00m to 7.20m -1.0hr
6 6.00	27.26		6.00	6.45	P4		112		P4 at 6.00m - 8,7/10,19,37,46
Very dense orange/brown clayey silty SAND with sandstone fragments and rounded gravel - Extremely weak to very weak weathered Sandstone									
(1.00)			6.50	6.60	D7				
7.00	26.26								
7 Very weak to weak orange/brown inferior cemented silty fine to medium grained SANDSTONE with random rounded gravel 7.30	25.96		7.00	7.36	P5		P5		P5 at 7.00m - 13,20/116 for 210mm
Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough.									30/04/2021: LCP hole completed at 7.30m. Standing Water Nil. 150mm dia Casing at 7.20m.
8 If = NI/50/200			7.30	8.80	C1	93	80	47	05/05/2021: Rotary Drilling commenced at 7.30m with air/mist flush. 05/05/2021: Water level Nil. 412F Rotary Coring from 7.30m to 25.10m with air/mist flush.
(2.70)									
9			8.80	10.30	C2	100	77	43	
10 10.00	23.26								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 07/05/2021
Checked: M Benson
Date: 10/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH3
Sheet: 2

Project: Plots F1 & F2 Great Jackson Street
Location: Manchester

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd

Equipment: Dando LCP Rig (150mm casing) + Rotary Rig with water and air/mist flush (412F core 72mm)

Ground Level: 33.26 m.AOD
Co-ordinates: Easting: 383464.9(m) Northing: 397232.7(m)
Dates: 16/04/2021 to 06/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION

Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
10 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/60/300								
			10.30 13.30	C3	90	80	15	
			13.30 16.30	C4	93	83	40	
(10.00)								
			16.30 19.10	C5	100	84	62	Water struck at 18.00m. Standing water level at 10.40m following core run to 19.10m.
			19.10 20.60	C6	93	83	50	
20.00	13.26							

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 07/05/2021
Checked: M Benson
Date: 10/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH3
Sheet: 3

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (150mm casing) + Rotary Rig with water and air/mist flush (412F core 72mm)
Ground Level: 33.26 m.AOD
Co-ordinates: Easting: 383464.9(m) Northing: 397232.7(m)
Dates: 16/04/2021 to 06/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U): T %	S %	RQD %	Field Records
20 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/70/170									
21				20.60 22.10	C7	100	93	50	
22									
23	(5.10)			22.10 23.60	C8	100	93	47	
24				23.60 25.10	C9	100	92	37	05/05/2021: On completion of drilling at 25.10m depth, 150mm casing in drift retained in exploratory hole for installation of water monitoring standpipe 06/05/2021: Water level at 9.80m depth. 50mm Groundwater monitoring standpipe installed to 18.00m depth with response zone from 8.00m to 18.00m
25	25.10	8.16							
Exploratory Hole complete at 25.10m									
26									
27									
28									
29									
30									

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 07/05/2021
Checked: M Benson
Date: 10/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH4
Sheet: 1

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)
Ground Level: 32.1 m.AOD
Co-ordinates: Easting: 383358.8(m) Northing: 397279.6(m)
Dates: 15/04/2021 to 06/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from	to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
Concrete	0.15	31.95								15/04/2021: Inspection Pit excavated with hand tools to 1.00m depth.
Brown/grey sandy gravel subbase - MADE GROUND	0.20	31.90								
Brown clayey sand and gravel, brick rubble and fragments with glass and asbestos cement fragments - MADE GROUND	(1.20)			0.50	1.00	B1				
	1.40	30.70		1.00	1.45	P1		4		P1 at 1.00m - 2,2/1,1,1,1
Dark brown/grey clayey sandy gravel with brick fragments - MADE GROUND	(0.90)			1.50	1.60	D1				
	2.30	29.80		2.00	2.45	P2		20		P2 at 2.00m - 5,6/5,7,4,4
Medium dense brown/grey clayey silty SAND and GRAVEL	(0.70)			2.50	2.60	B2				
	3.00	29.10		3.00	3.45	U1		(22)		Change in U1
Stiff brown high strength gravelly sandy silty CLAY	(0.40)			3.00	3.10	D2				
	3.40	28.70								
Stiff grey/brown slightly gravelly very silty CLAY with silt partings	(0.60)			3.50	3.60	D3				
	4.00	28.10		3.80	4.25	U2		(25)		Change in U2
Very stiff brown high strength slightly gravelly very sandy silty CLAY with cobble at 5.80m depth	(1.90)			4.30	4.40	D4				
				5.00	5.45	P3		63		P3 at 5.00m - 5,5/8,15,15,25
				5.50	5.60	D5				
	5.90	26.20								Chiselling cobble at 5.80m
Very dense orange/brown silty SAND with sandstone fragments and rounded gravel - Very weak weathered Sandstone	(0.50)			6.00	6.40	P4				15/04/2021: Hard Boring Sandstone 5.90m to 7.00m -1.0hr
	6.40	25.70								P4 at 6.00m - 17,13/147 for 275mm
Weak orange/brown inferior cemented silty fine to medium grained SANDSTONE with random rounded gravel	(0.60)			6.50	6.60	D6				
	7.00	25.10		7.00	7.10	P5				P5 at 7.00m - (87 for 95mm)
Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/50/200				7.20	8.40	C1	100	67	10	15/04/2021: LCP hole completed at 7.00m. Standing Water Nil. 200mm dia Casing at 7.00m. 26/04/2021: Rotary Drilling commenced at 7.10m with air/mist flush. Water level Nil. 412F Rotary Coring from 7.20m to 9.90m with air/mist flush. PW Open hole casing from 7.00m to 9.90m with water/air/mist flush.
	(3.00)			8.40	9.90	C2	97	87	40	
	10.00	22.10								T6H Rotary coring from 9.90m

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 30/04/2021
Checked: M Benson
Date: 03/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH4
Sheet: 2

Project: Plots F1 & F2 Great Jackson Street
Location: Manchester

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd

Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)

Ground Level: 32.1 m.AOD
Co-ordinates: Easting: 383358.8(m) Northing: 397279.6(m)
Dates: 15/04/2021 to 06/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/80/250				9.90 12.10	C3	100	91	64	to 12.10m with water flush.
HPD Pressuremeter Test at 10.70m									
				12.10 13.60	C4	100	93	80	412F Rotary Coring from 12.10m 15.20m with air/mist flush. PW Open hole casing from 7.00m to 13.50m with water/air/mist flush.
				13.60 15.20	C5	100	94	75	27/04/2021: Water level at 10.50m depth PW Open hole casing from 13.50m to 15.10m with water then air/mist flush.
	(10.00)								T6H Rotary coring from 15.20m to 17.80m with water flush.
HPD Pressuremeter Test at 16.50m				15.20 17.80	C6	88	81	58	
									412F Rotary Coring from 17.80m to 20.50m with air/mist flush.
				17.80 20.50	C7	82	67	46	
	20.00	12.10							28/04/2021: Water level at 10.00m depth. PW Open hole

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 30/04/2021
Checked: M Benson
Date: 03/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH4
Sheet: 3

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)
Ground Level: 32.1 m.AOD
Co-ordinates: Easting: 383358.8(m) Northing: 397279.6(m)
Dates: 15/04/2021 to 06/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
20 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/80/250									casing from 15.10m to 20.50m with water/air/mist flush. T6H Rotary coring from 20.50m to 23.50m with water flush.
21									
22 HPD Pressuremeter Test at 22.30m				20.50 23.50	C8	100	97	73	
23									412F Rotary Coring from 23.50m 29.50m with air/mist flush.
24									
25	(10.00)			23.50 26.50	C9	90	80	60	
26									
27									
28				26.50 29.50	C10	100	92	50	PW Open hole casing from 20.50m to 29.50m with water/air/mist flush.
29									29/04/2021: Water level at 10.00m depth. T6H Rotary coring from 29.50m to 32.50m with water flush.
30	30.00	2.10							

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 30/04/2021
Checked: M Benson
Date: 03/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited

Exploratory Hole Record Sheet

Ref: BH4
Sheet: 4

Consultant: Coffey Geotechnics Ltd
Client: Renaker Build Ltd
Project: Plots F1 & F2 Great Jackson Street
Location: Manchester
Equipment: Dando LCP Rig (200mm casing) + Rotary Rig with water (T6H core 75mm) and air/mist flush (412F core 72mm and PW casing 140mm)
Ground Level: 32.1 m.AOD
Co-ordinates: Easting: 383358.8(m) Northing: 397279.6(m)
Dates: 15/04/2021 to 06/05/2021

Lead Driller: M Benson Assistant Driller: M Walton
Site Geotechnical Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records: Depth (m) from to	Ref.	Count N/(U) T %	S %	RQD %	Field Records
30 Continued Stratum. Weak orange/brown slightly weathered inferior cemented faint thinly subhorizontal bedded silty fine to medium grained SANDSTONE with random rounded gravel and rare small rounded marl clasts and lenses. Subhorizontal fractures close planar rough. If = NI/80/250									
31 HPD Pressuremeter Test at 31.20m				29.50 32.50	C11	100	95	52	412F Rotary Coring from 32.50m to 35.70m with air/mist flush.
32	(5.70)								
33				32.50 34.20	C12	88	50	31	
34									
35				34.20 35.70	C13	100	97	73	29/04/2021:On completion of drilling at 35.70m depth, PW casing extracted, 150mm casing in drift retained in exploratory hole for televiewer inspection 06/05/2021: Water level at 9.40m depth. 50mm Groundwater monitoring standpipe installed to 18.00m depth with response zone from 8.00m to 18.00m
	35.70	-3.60							
Exploratory Hole complete at 35.70m									
36									
37									
38									
39									
40									

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Richardson
Date: 30/04/2021
Checked: M Benson
Date: 03/05/2021
Site Ref: 6069/CGJ
Scale 1:50 nominal

GeoAssist Limited	Exploratory Hole Record Sheet	Ref: WS1
Consultant: Coffey Geotechnics Ltd	Project: Plots F1 & F2 Great Jackson Street Location: Manchester	Sheet: 1
Client: Renaker Build Ltd	Equipment: Archway Dart Rig with WLS sampling	Ground Level: 32.1 m.AOD Co-ordinates: Easting: 383357.8(m) Northing: 397264.1(m) Dates: 11/05/2021 to 11/05/2021

Drilling Foreman: M Walton
Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests: Depth (m) from	to	Sample Type/No	Blow Count N/(U)	Field Records
Tarmac	0.10	32.00						11/05/2021: Inspection Pit excavated with hand tools to 1.20m depth.
Grey/brown sandy gravel base - MADE GROUND	0.30	31.80		0.30	0.40	ES1		
Dark brown sandy gravel with brick and ceramic fragments - MADE GROUND	0.50	31.60						
Grey/brown sandy gravel base - MADE GROUND	0.60	31.50		0.60	0.70	ES2		
Grey with orange sandy silty clay - MADE GROUND	(0.50)							
Light grey silty CLAY with organic inclusions	1.10	31.00						
	(0.80)			1.30	1.40	ES3		
Dark brown clayey organic inclusion over grey clayey gravel band	1.90	30.20		1.90	2.00	ES4		Wet at 1.90m depth
Brown gravelly slightly sandy silty to very silty CLAY	2.00	30.10						
	(1.80)							
Brown gravelly silty fine to medium SAND	3.80	28.30						
Brown gravelly sandy silty CLAY	4.10	28.00						
	(1.40)							
Orange/brown silty SAND with sandstone fragments	5.50	26.60						On completion of exploratory hole at 5.60m. 50mm ground gas monitoring standpipe installed to 5.00m depth with response zone from 1.00 to 5.00m
	5.60	26.50						
Exploratory Hole complete at 5.60m								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 12/05/2021
Checked: M Richardson
Date: 12/05/2021
Site Ref: 6069/CGJ
Scale 1:25 nominal

GeoAssist Limited	Exploratory Hole Record Sheet	Ref: WS2
Consultant: Coffey Geotechnics Ltd	Project: Plots F1 & F2 Great Jackson Street Location: Manchester	Sheet: 1
Client: Renaker Build Ltd	Equipment: Archway Dart Rig with WLS sampling	Ground Level: 32.53 m.AOD Co-ordinates: Easting: 383332(m) Northing: 397242.8(m) Dates: 10/05/2021 to 10/05/2021

Drilling Foreman: M Walton
Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests: Depth (m) from	to	Sample Type/No	Blow Count N/(U)	Field Records
Tarmac	0.10	32.43						10/05/2021: Inspection Pit excavated with hand tools to 1.20m depth.
Grey/brown sandy gravel base - MADE GROUND	0.25	32.28						
Brown silty gravelly SAND with occasional cobbles	(1.85)			0.60	0.70	ES1		
				1.30	1.40	ES2		
				1.80	1.90	ES3		
	2.10	30.43						
Brown slightly gravelly slightly sandy very silty CLAY	(2.60)							
	4.70	27.83						
Brown gravelly sandy silty CLAY	(1.30)							On completion of exploratory hole at 6.00m. 50mm ground gas monitoring standpipe installed to 5.50m depth with response zone from 1.00 to 5.50m
	6.00	26.53						
Exploratory Hole complete at 6.00m								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 11/05/2021
Checked: M Richardson
Date: 11/05/2021
Site Ref: 6069/CGJ
Scale 1:25 nominal

GeoAssist Limited	Exploratory Hole Record Sheet	Ref: WS3
Consultant: Coffey Geotechnics Ltd	Project: Plots F1 & F2 Great Jackson Street Location: Manchester	Sheet: 1
Client: Renaker Build Ltd	Equipment: Archway Dart Rig with WLS sampling	Ground Level: 32.26 m.AOD Co-ordinates: Easting: 383381(m) Northing: 397243.7(m) Dates: 12/05/2021 to 12/05/2021

Drilling Foreman: M Walton
Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests: Depth (m) from	to	Sample Type/No	Blow Count N/(U)	Field Records
Grey/brown sandy gravel - MADE GROUND	(0.40) 0.40	31.86		0.40	0.50	ES1		12/05/2021: Inspection Pit excavated with hand tools to 1.20m depth.
Dark brown slightly gravelly sandy silty clay with brick fragments - MADE GROUND	0.70	31.56		0.80	0.90	ES2		
Orange/brown/grey sandy silty CLAY	(0.90) 1.60	30.66		1.30	1.40	ES3		
Brown/grey silty sandy GRAVEL	(0.50) 2.10	30.16		1.90	2.00	ES4		
Brown gravelly sandy silty CLAY with organic traces	2.30	29.96		2.20	2.30	ES5		
Brown/grey clayey silty sandy GRAVEL	2.50	29.76						
Brown/grey slightly gravelly silty CLAY	(1.60) 4.10	28.16						
Brown gravelly very sandy silty CLAY with orange/brown silty sand at base	(0.40) 4.50	27.76						On completion of exploratory hole at 4.50m. 50mm ground gas monitoring standpipe installed to 4.00m depth with response zone from 1.00 to 4.00m
Exploratory Hole complete at 4.50m								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 13/05/2021
Checked: M Richardson
Date: 13/05/2021
Site Ref: 6069/CGJ
Scale 1:25 nominal

GeoAssist Limited	Exploratory Hole Record Sheet	Ref: WS4
Consultant: Coffey Geotechnics Ltd	Project: Plots F1 & F2 Great Jackson Street Location: Manchester	Sheet: 1
Client: Renaker Build Ltd	Equipment: Archway Dart Rig with WLS sampling	Ground Level: 32.32 m.AOD Co-ordinates: Easting: 383403.6(m) Northing: 397226.4(m) Dates: 11/05/2021 to 11/05/2021

Drilling Foreman: M Walton
Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests: Depth (m) from	to	Sample Type/No	Blow Count N/(U)	Field Records
Dark brown sandy gravel with brick and slate fragments - MADE GROUND	(1.20)			0.30	0.40	ES1		11/05/2021: Inspection Pit excavated with hand tools to 1.20m depth.
				0.60	0.70	ES2		
	1.20	31.12						
Brown silty sandy GRAVEL with silty clay inclusions- Possible Made Ground	1.50	30.82		1.40	1.50	ES3		
Brown/grey gravelly sandy silty CLAY with occasional cobbles and sand inclusions	(2.80)			1.90	2.00	ES4		
				2.30	2.40	ES5		
	4.30	28.02						
Brown gravelly very sandy silty CLAY	(0.70)							
	5.00	27.32						
Brown silty SAND	5.20	27.12						
Brown gravelly very sandy silty CLAY with orange/brown silty sand with sandstone fragments at base	(0.80)							On completion of exploratory hole at 6.00m. 50mm ground gas monitoring standpipe installed to 5.50m depth with response zone from 1.00 to 5.50m
	6.00	26.32						
Exploratory Hole complete at 6.00m								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 12/05/2021
Checked: M Richardson
Date: 12/05/2021
Site Ref: 6069/CGJ
Scale 1:25 nominal

GeoAssist Limited	Exploratory Hole Record Sheet	Ref: WS5
Consultant: Coffey Geotechnics Ltd	Project: Plots F1 & F2 Great Jackson Street Location: Manchester	Sheet: 1
Client: Renaker Build Ltd	Equipment: Archway Dart Rig with WLS sampling	Ground Level: 33.34 m.AOD Co-ordinates: Easting: 383475.6(m) Northing: 397280.7(m) Dates: 11/05/2021 to 11/05/2021

Drilling Foreman: M Walton
Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests: Depth (m) from	to	Sample Type/No	Blow Count N/(U)	Field Records
Dark brown sandy gravel with brick rubble and fragments - MADE GROUND	(1.50)			0.30	0.40	ES1		11/05/2021: Inspection Pit excavated with hand tools to 1.20m depth.
				0.80	0.90	ES2		
	1.50	31.84		1.30	1.40	ES3		
Light grey/brown silty sand - MADE GROUND	1.70	31.64		1.60	1.70	ES4		
Brown silty fine to medium SAND	2.00	31.34						
Brown silty sandy GRAVEL with silty clay inclusions	(0.80)			2.20	2.30	ES5		
	2.80	30.54						
Brown gravelly sandy silty CLAY	(0.70)							
	3.50	29.84						
Brown silty SAND	3.70	29.64						
Brown gravelly very sandy silty CLAY	(0.70)							On completion of exploratory hole at 4.50m. 50mm ground gas monitoring standpipe installed to 4m depth with response zone from 1.00 to 4.00m
	4.40	28.94						
Orange/brown silty SAND with sandstone fragments	4.50	28.84						
Exploratory Hole complete at 4.50m								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 12/05/2021
Checked: M Richardson
Date: 12/05/2021
Site Ref: 6069/CGJ
Scale 1:25 nominal

GeoAssist Limited	Exploratory Hole Record Sheet	Ref: WS6
Consultant: Coffey Geotechnics Ltd	Project: Plots F1 & F2 Great Jackson Street Location: Manchester	Sheet: 1
Client: Renaker Build Ltd	Equipment: Archway Dart Rig with WLS sampling	Ground Level: 33.38 m.AOD Co-ordinates: Easting: 383487.7(m) Northing: 397239.9(m) Dates: 11/05/2021 to 11/05/2021

Drilling Foreman: M Walton
Engineer/Geologist: M Benson

STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests: Depth (m) from	to	Sample Type/No	Blow Count N/(U)	Field Records
Grey/brown sandy gravel - MADE GROUND	0.20	33.18						11/05/2021: Inspection Pit excavated with hand tools to 1.20m depth.
Dark brown/dark grey sandy gravel with brick, concrete, glass and metal fragments - MADE GROUND	(1.80)			0.30	0.40	ES1		
				0.60	0.70	ES2		
				1.30	1.40	ES3		
	2.00	31.38		1.90	2.00	ES4		
Brown silty sandy GRAVEL	(1.50)			2.30	2.40	ES5		
	3.50	29.88						
Brown gravelly sandy silty CLAY	(1.60)							On completion of exploratory hole at 5.20m. 50mm ground gas monitoring standpipe installed to 4.50m depth with response zone from 1.00 to 4.60m
	5.10	28.28						
Brown silty SAND with sandstone fragments	5.20	28.18						
Exploratory Hole complete at 5.20m								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 12/05/2021
Checked: M Richardson
Date: 12/05/2021
Site Ref: 6069/CGJ
Scale 1:25 nominal



BH1R – Box 1



BH1R – Box 2



BH1R – Box3



BH1R – Box4



BH1R – Box5



BH1R – Box6



BH2R – Box 1



BH2R – Box 2



BH2R – Box3



BH2R – Box4



BH3R – Box 1



BH3R – Box 2



BH3R – Box3



BH3R – Box4



BH4R – Box 1



BH4R – Box 2

Core Photographs
GeoAssist Limited
Report Number 6069/CGJ



BH4R – Box3



BH4R – Box4



BH4R – Box5



BH4R – Box6

Project: Great Jackson Street, Manchester HPD

Pressuremeter Testing Factual Report

Client: GeoAssist Ltd

Contract No.: P1210114

Issue	Date	Description	Prepared	Checked	Approved
01	26/05/2021	Draft	MT	JH	RC

Date: 26th May 2021
Our Ref: P1210114

Hastings Innovation Centre
Highfield Drive
St Leonards on Sea
East Sussex TN38 9UH

GeoAssist Ltd
Unit 4
Sheffield Street
Stockport
SK4 1RU

Attention: Matthew Benson

Pressuremeter testing at
Great Jackson Street, Manchester HPD

We have pleasure in providing a digital copy of our report for the above project.

We hope that you are satisfied with the performance of our staff, equipment and reporting on this project. If you should have any queries about any aspect of the works carried out, please do not hesitate to contact us. We look forward to being of service to you in the future.

Yours faithfully,
In Situ Site Investigation Limited



Darren Ward
Director

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ABBREVIATIONS

Pressuremeter types	
HPD	High pressure dilatometer
SBP	Self-boring pressuremeter
DPM	Driven pressuremeter

In situ horizontal stress (σho)	
p_o	Cavity reference pressure
$\sigma ho_{(M\&R)}$	In situ horizonal stress from Marsland & Randolph (1977) analysis (where $P_{yield} = P_L - S_u$)
$\sigma ho_{(LO)}$	In situ horizonal stress from lift-off analysis (SBP)
$\sigma ho_{(H\&W)}$	In situ horizonal stress from unloading curve (Houlsby & Withers, 1988; DPM)
$\sigma ho_{(CM)}$	In situ horizonal stress from curve modelling (Whittle, 1999; SBP)

Undrained shear strength (kPa)	
$s_{u\ (loading)}$	Shear strength from loading curve, via Gibson & Anderson (1961) analysis
$s_{u\ (M\&R)}$	Shear strength from Marsland & Randolph (1977) analysis (where $S_u = P_{yield} - P_L$)
$s_{u\ (unloading)}$	Shear strength from unloading curve, via Jefferies (1988) analysis (DPM & SBP)
$s_{u\ (H\&W)}$	Shear strength from unloading curve, via Houlsby & Withers (1988) analysis (DPM)
P_L	Limit pressure via Gibson & Anderson (1961) analysis
$P_{L\ (H\&W)}$	Limit pressure via Houlsby & Withers (1988) analysis (DPM)

Shear modulus parameters	
G_i	Initial shear modulus (MPa) derived from steep linear section of loading path, prior to yield
G_{ur}	Shear modulus (MPa) derived from unload-reload loop
ε_c	Cavity strain range over the unload-reload loop
β	Exponent of elasticity, after Bolton & Whittle (1999), where 1 is linear elastic
α	Shear stress constant (MPa), after Bolton & Whittle (1999)

Other	
P_{max}	Maximum test pressure reached prior to instrument unloading (MPa)
P_{yield}	Pressure at which material yield is assessed, defined as end of linear loading curve

1.0 INTRODUCTION

1.1 Site Details

At the request of GeoAssist Ltd, In Situ Site Investigation Limited (In Situ S.I.) carried out pressuremeter testing as part of the Great Jackson Street, Manchester project. The works form part of the ongoing residential redevelopment of the site, located close to Manchester City Centre, Lancashire.

The pressuremeter testing was attempted in two boreholes. The fieldwork was carried out on site between 19th and 29th April 2021.

This report presents the factual records of the pressuremeter testing, together with an interpretation of the test results to derive material parameters. Further specific details relating to the ground investigation, i.e., borehole locations and exploratory hole logs, are provided in the GeoAssist Ltd report.

2.0 FIELDWORK

2.1 General

Nine pressuremeter tests were carried out in boreholes constructed using a rotary drilling rig, operated by GeoAssist Ltd. The tests were carried out using a high-pressure dilatometer (HPD). The testing was carried out in general accordance with BS EN ISO 22476-5 (2012) and BS 5930 (2020). The test depths were scheduled by the Client. A summary table of the tests is presented below.

Table 2.1. *Summary of pressuremeter tests.*

Borehole Reference	Test Reference	Date	Test Depth	Probe	Operator	Remarks
BH1R	T01	20/04/2021	13.30m	HPD 04 Eleanor	A Lewins	Membrane calibration. No material yield. Membrane leak test aborted.
BH1R	T02	21/04/2021	15.70m	HPD 04 Eleanor	A Lewins	Sudden jump in expansion test aborted.
BH1R	T03	21/04/2021	19.20m	HPD 04 Eleanor	A Lewins	No material yield.
BH1R	T04	22/04/2021	24.30m	HPD 04 Eleanor	A Lewins	No material yield.
BH1R	T05	23/04/2021	32.60m	HPD 04 Eleanor	A Lewins	No material yield.
BH4R	T01	26/04/2021	10.70m	HPD 04 Eleanor	A Lewins	No material yield.
BH4R	T02	27/04/2021	16.50m	HPD 04 Eleanor	A Lewins	No material yield.
BH4R	T03	28/04/2021	22.30m	HPD 04 Eleanor	A Lewins	Partial material yield.
BH4R	T04	29/04/2021	31.20m	HPD 04 Eleanor	A Lewins	Partial material yield.

2.2 High Pressure Dilatometer (HPD)

The HPD is a cylindrical 95mm diameter probe which is inserted into a cored 99 to 101mm diameter test pocket, drilled using a T6-H or T6-101 core barrel. The HPD is therefore termed a pre-bored type instrument. The probe, approximately 1.5m in length, has a central section which is covered by a rubber membrane. Pressure applied to the inside of the instrument, via compressed air, forces the membrane to expand against the test pocket wall. The radial

displacement of the inside boundary of the membrane is measured at six points equally distributed around the centre of the expanding section, by free moving arms. This displacement, and the pressure necessary to cause the movement, is continuously monitored by transducers contained within the instrument. The HPD is linked to the ground surface via a combined pressure hose and electrical power/communication umbilical cable which connects the instrument to the pressure source and readout unit.

Analogue to digital conversion of the displacement and pressure transducers is carried out within the pressuremeter electronics package. The pressuremeter output comprises a multiplexed signal which connects through the pressuremeter interface unit to the USB port of a laptop computer. Software, supplied by PACE Geotechnics Ltd, is used to record the data, convert the received signals to engineering units (using the pressure and displacement transducer calibrations) and display these in real time on the laptop computer during testing to allow control of the test by the operator. Plotting these readings of displacement against pressure produces a loading curve for the material being tested. A number of mathematical analyses are applied to translate this loading curve into material strength and stiffness parameters.

The testing on this project was undertaken using a probe manufactured by In Situ S.I/PACE Geotechnics Ltd. Details of the instrument are provided below. Corrections measured for membrane stiffness (essentially resistance to inflation in air) were carried out during the testing program.

Table 2.2. *HPD instrument details.*

Instrument	Diameter (mm)	Pressure Capacity (MPa)	Displacement Measurement	ID & Serial No.
HPD	95	20	6 arms at 60° 3 opposite pairs	HPD 04 – Eleanor

2.3 HPD Testing Procedure

The boreholes were constructed using a rotary drilling rig by conventional rotary coring at nominal 146mm diameter, using water flush, to approximately 1.5m above the scheduled pressuremeter test depth. A 2 to 3m long section was then drilled using a T6-H size core barrel to provide a test pocket of nominal diameter 99.2mm. The HPD was inserted into the test pocket as soon as practicably possible using 2⅜ API drill rods, lowered in via the drilling rig winch.

The pressuremeter tests were carried out in a stress-controlled manner using a manually operated gas control box to pressurise the HPD at an appropriate rate for the ground conditions. During the tests a number of unload-reload loops were performed. Before carrying out the loops, a short holding period was maintained to allow reduction of creep on the ground. The loading was continued until either the ground had failed, maximum arm displacement had occurred, or if at lower pressure, expansion around the probe was uneven, such that in the opinion of the operator, continuation of the loading would result in risk of damage to the probe. Upon unloading and deflation of the membrane, the instrument was withdrawn from the tested section and recovered back to the ground surface. The boreholes were then advanced to the next specified test depth and the sequence repeated, until the testing program was completed.

3.0 TEST INTERPRETATION

3.1 Introduction

The pressure / cavity strain curve has been analysed to determine various material parameters, as appropriate, including:

Cavity reference pressure	p_o
Initial shear modulus	G_i
Yield	P_{yield}
Unload-reload shear modulus	G_{ur}
Undrained shear strength	s_u
Limit Pressure	P_L

The analysis methodologies used have followed the industry accepted practice for interpretation of pressuremeter tests (e.g., Clarke, 1996; Mair & Wood, 1987). The nature of the material tested can result in some limitations in the application and appropriateness of the interpretation methods. Any such limitations, if present, are discussed below and should be considered when selecting material parameters for engineering design purposes.

3.2 Description of Material Tested

An indication of the geology at the depth of each test completed is provided on the plots in Appendix A. The ground conditions encountered in the boreholes were thin layers of MADE GROUND over Glaciofluvial Sheet Deposits consisting of SAND and GRAVEL, overlying SANDSTONE bedrock of the Triassic age Chester Formation. For more detail refer to the GeoAssist Ltd report.

3.3 Cavity Reference Pressure

The act of drilling into undisturbed ground relieves the in situ horizontal stress, which is then effectively restored as the instrument membrane is initially pressurised. During this initial loading, a linear pressure / displacement response is anticipated as the pressure is increased and then exceeds the cavity reference pressure. With the HPD instrument, the direct correlation between the cavity reference pressure and in situ horizontal stress is problematic and should be treated with caution. This is due to the large potential for disturbance during test pocket formation and probable relaxation or stress relief of the ground following drilling of the open test pocket.

Marsland and Randolph (1977) proposed that in the vicinity of in situ horizontal stress, soil behaves elastically and therefore the initial loading curve is linear. This elastic behaviour will cease when the undrained shear strength of the soil in the cavity wall is reached, and hence the loading curve will then begin to curve away from linearity. The point at which the loading curve becomes non-linear (or the onset of yield, P_{yield}), represents the in situ horizontal stress plus the undrained shear strength at this point:

$$P_{yield} = \sigma_{ho} + s_u.$$

The tests performed at the site were in SANDSTONE rock. However, the analysis method used to determine the undrained shear strength assumes the material is a perfectly elastic prior to failure and perfectly plastic post failure. For a rock this analysis may not be valid as the material may behave as a brittle material and fail in tension, or in triaxial compression, depending on the strength of the material and in situ stress conditions.

3.4 Shear Modulus

A pressuremeter test, in an elastic, perfectly plastic material, imparts a pure shear failure, hence it is normal to report shear modulus in preference to an elastic modulus. Shear modulus is determined from the initial loading curve, and from unload reload loops, performed at intervals during the test progression. The relationship used to determine shear modulus (G) is below, where ε_c is the cavity strain range:

$$G = \frac{1}{2}\frac{dp}{d\varepsilon c}$$

Haberfield and Johnson (1993) have suggested that the unload-reload modulus is the most reliable parameter from a pressuremeter test in rock. It is noted that the nature and spacing of fissures in the rock mass will affect the result. Widely spaced fissures may result in the test giving the intact modulus of the rock, rather than a mass modulus, and / open fissures may be closed as the test progresses and give a modulus which is higher than the mass modulus.

Note is made that often in clays and sands some hysteresis is generally evident, and it is possible to determine a secant shear modulus from the reloading portion of an unload reload loop. A high degree of consistency is often possible when plotting secant shear modulus results from individual tests. This may be further extended to a series of tests in a geological formation by normalising via undrained shear strength, or in situ stress. The various plots for both initial loading shear modulus (G_i) and the shear modulus derived from unload reload loops (G_{ur}) are presented graphically in the test results.

Individual unload reload loops can also be analysed to determine small strain stiffness parameters. This is achieved by taking a secant modulus from the base of the loop, to the individual points on the reloading curve. Plotting the cavity strain range against modulus, gives an indication of how stiffness varies with strain. Further, a Bolton and Whittle (1999) analysis can be performed to investigate the non-linear elastic / plastic behaviour.

The secant modulus (G) can be converted to an undrained elastic (Youngs) modulus (E_u) by use of the following relationship:

$$E_u = 2.G(1 + \upsilon)$$ Where υ = Poisson's ratio (assumed 0.5)

Plots of calculated secant modulus values at varying shear strain % are provided within the analysis results. It is noted that any user of this analysis should satisfy themselves that it is appropriate to the material tested.

3.5 Strength

Undrained shear strength has been determined using Gibson and Anderson (1961) for the loading portion of the test curve. This is the generally accepted method for the determination of strength and are based on the assumption of an elastic - perfectly plastic material. The analysis of Gibson and Anderson (1961) also provides a Limit Pressure (P_L). This is a limiting pressure defined as the pressure at which the change in volume (ΔV) divided by the current volume (V) is equal to one. While this is not achieved in practice, it can be determined by extrapolation. Note is also made that the definition of P_L is different to that associated with a Ménard Limit Pressure, and the two should not be interchanged.

3.6 Summary of Results

Summary tables of the analysis results for each borehole location are presented in Appendix A, followed by the individual full graphical analyses for the tests completed.

4.0 REFERENCES

Bolton, M.D. & Whittle, R.W. (1999) A non-linear elastic/perfectly plastic analysis for plane strain undrained expansion tests. *Géotechnique*, Vol. 49, No. 1, pp. 133-141.

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Gibson, R.E. & Anderson, W.F. (1961) In situ measurement of soil properties with the pressuremeter. *Civil Engineering and Public Works Review*, Vol. 56, No. 658 May, pp. 615-618.

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Mair, R.J. & Wood, D.M. (1987) Pressuremeter testing: methods and interpretation. CIRIA Ground Engineering Report: In-situ Testing. London.

Marsland, A. & Randolph, M.F. (1977) Comparison of the results from pressuremeter tests and large in situ plate tests in London Clay. *Géotechnique*, Vol. 27, No. 2, pp. 217-243.

APPENDIX A

Test Data Analysis

Description	Figure No.
Pressuremeter Results Summary	All Boreholes
Pressuremeter Shear Modulus Plot & Undrained Shear Strength Plot	Figure 1
Pressuremeter In Situ Horizontal Stress, Yield & Limit Pressure Plot	Figure 2
Pressuremeter Test Analysis	
BH1R	T01 – T05
BH4R	T01 – T04

Pressuremeter Results Summary

IN SITU
SITE INVESTIGATION

Test ID	Depth (m)	Material description from borehole log	Max. test pressure (kPa)	po (kPa)	Undrained strength $S_{u\,(M\&R)}$ (kPa)	Undrained strength $S_{u\,(loading)}$ (kPa)	Undrained strength P_L (kPa)	G_i (MPa)	Loop No.	G_{ur} (MPa)	e_c (%)	Non linear stiffness α (MPa)	Non linear stiffness β	Secant shear modulus (MPa) Shear strain 1%	0.1%	0.01%	0.001%
BH1R																	
1	13.30	SANDSTONE.	7856	2200				406	1	1043	0.067	374.102	0.867	691	939	1276	1734
2	15.70	SANDSTONE.	14683	2506	11294	11294	58527	600	1	1455	0.044	596.111	0.886	1010	1315	1711	2227
									2	1493	0.067	564.667	0.873	1015	1361	1825	2447
									3	1498	0.088	615.301	0.880	1067	1405	1851	2438
3	19.20	SANDSTONE.	14582	2920				518	1	1236	0.057	385.606	0.856	748	1042	1452	2023
									2	1390	0.075	487.684	0.864	912	1247	1706	2333
									3	1455	0.089	533.197	0.866	987	1344	1828	2488
4	24.30	SANDSTONE.	16060	3673				490	1	1388	0.045	368.029	0.832	797	1174	1728	2543
									2	1606	0.061	551.041	0.865	1027	1402	1913	2611
									3	1613	0.079	613.099	0.869	1119	1511	2041	2757
5	32.60	SANDSTONE.	15465	3763				799	1	1872	0.044	691.302	0.877	1219	1620	2151	2857
									2	1844	0.060	714.397	0.879	1249	1652	2184	2889
									3	1842	0.072	739.939	0.880	1287	1697	2238	2951

Project	Great Jackson Street, Manchester	**Table No.**	**BH1R**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Results Summary

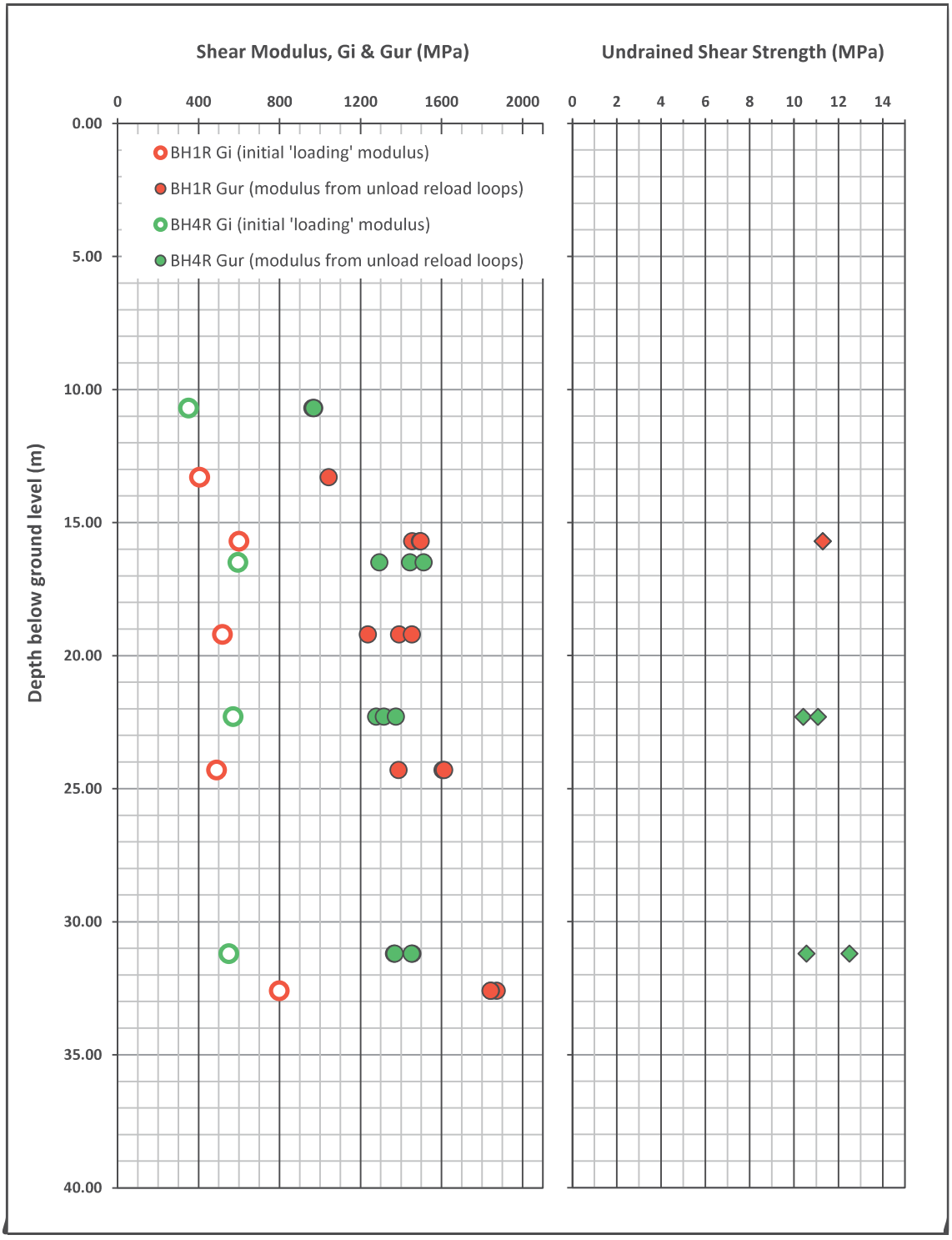
IN SITU
SITE INVESTIGATION

Test ID	Depth (m)	Material description from borehole log	Max. test pressure (kPa)	po (kPa)	Undrained strength $S_{u\,(M\&R)}$ (kPa)	Undrained strength $S_{u\,(loading)}$ (kPa)	Undrained strength P_L (kPa)	G_i (MPa)	Loop No.	G_{ur} (MPa)	e_c (%)	Non linear stiffness α (MPa)	Non linear stiffness β	Secant shear modulus (MPa) Shear strain 1%	0.1%	0.01%	0.001%
BH4R																	
1	10.70	SANDSTONE.	15998	1913				351	1	972	0.063	311.066	0.853	613	860	1207	1694
									2	963	0.098	323.225	0.854	634	889	1245	1745
									3	969	0.137	360.379	0.861	685	944	1302	1795
2	16.50	SANDSTONE.	14764	2600				595	1	1293	0.053	353.719	0.840	738	1067	1541	2226
									2	1445	0.060	435.701	0.852	863	1215	1711	2408
									3	1512	0.083	565.819	0.870	1031	1392	1878	2535
3	22.30	SANDSTONE.	15012	3234	10416	11071	57936	571	1	1278	0.048	399.307	0.856	774	1077	1499	2086
									2	1316	0.065	444.094	0.858	854	1184	1642	2277
									3	1375	0.088	535.508	0.873	963	1291	1731	2321
4	31.20	SANDSTONE.	14995	3537	10563	12500	63475	550	1	1366	0.047	570.009	0.881	984	1293	1699	2232
									2	1369	0.053	450.427	0.859	860	1189	1643	2271
									3	1456	0.066	657.664	0.897	1055	1336	1692	2142
									4	1452	0.093	628.810	0.888	1052	1361	1760	2276

Project	Great Jackson Street, Manchester	**Table No.**	**BH4R**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Shear Modulus & Undrained Shear Strength Plot

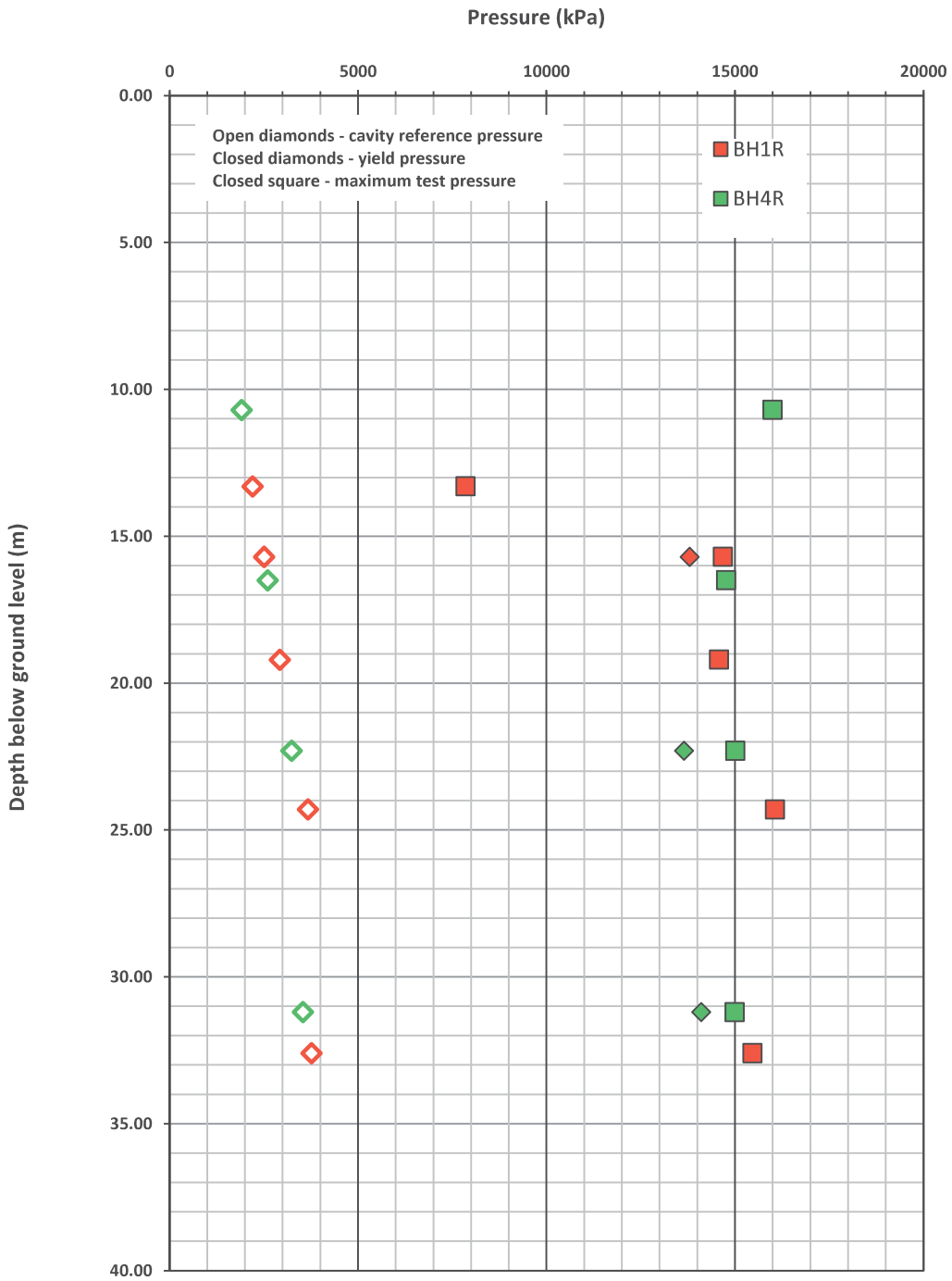
IN SITU SITE INVESTIGATION



Project	Great Jackson Street, Manchester	**Figure No.**	1
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Cavity Reference Pressure, Yield & Maximum Test Pressure Plot

IN SITU SITE INVESTIGATION

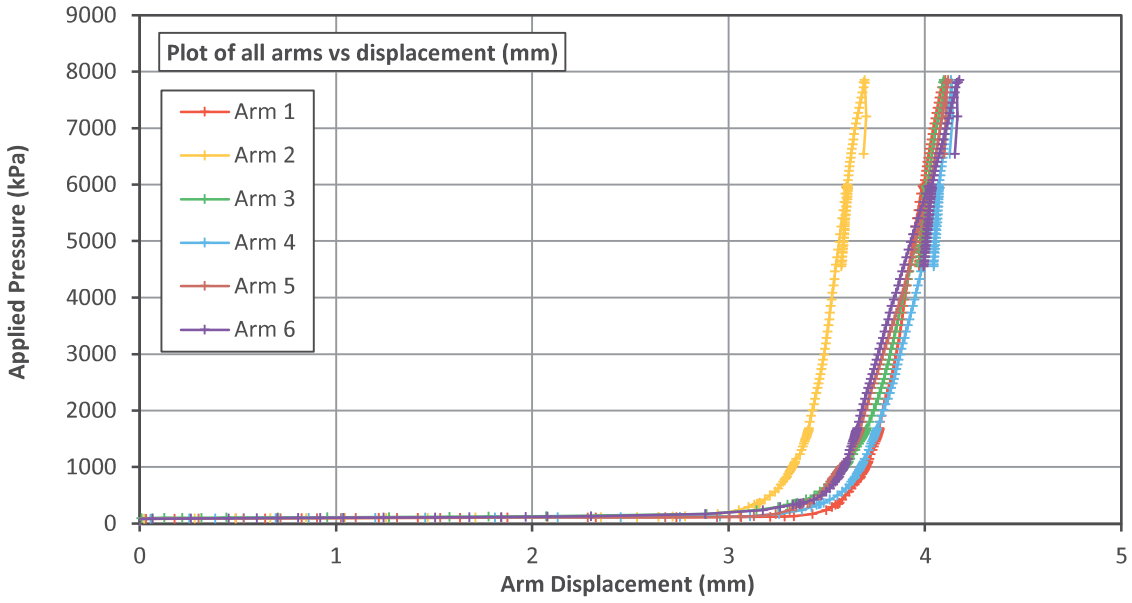


Project	Great Jackson Street, Manchester	**Figure No.**	**2**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	20/04/2021		**Test No.**	1
Borehole	BH1R		**Test Depth (m)**	13.30
Coordinates (m)	383353.9 (E)	397240.7 (N)	**Elevation (m)**	32.28



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	100 %	Test pocket depth range:	
Solid core recovery:	100 %	From: 12.00 m to: 10.00 m	
Rock quality designation:	68 %	Flush: Water	

Test comment:

The test pocket was tight with arms lifting off at 3.0 to 4.0mm. The po was estimated to be at 2500kPa, with the following loading section being long and linear. The test taken to a pressure of 7856kPa, when a small leak was noted from the membrane and the test was aborted. The displacement-pressure response shown by the arms was consistent. Analysis of a single unload reload loop provides a high modulus value of 1043MPa. No yield was observed during the test.

Test details: **Instrument:** Eleanor (HPD04)

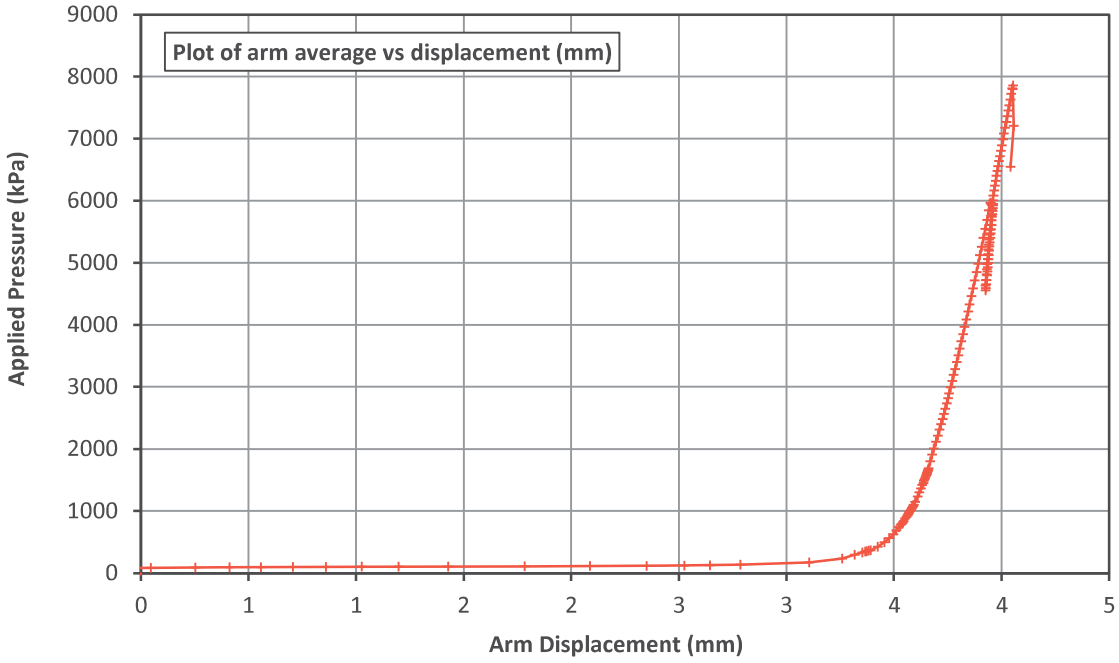
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	12.00 m	Arm 1:	-2381.4	122.9	TPC A:	292.3	102.9
Water level:	9.50 m	Arm 2:	-2057.1	124.9	TPC B:	-2132.4	110.7
		Arm 3:	-2291.3	129.5			
Test time:		Arm 4:	-2122.1	127.4			
Start (probe in):	09:30 hrs	Arm 5:	-2291.1	132.1			
Finish (probe out):	11:00 hrs	Arm 6:	-2147.4	124.1			

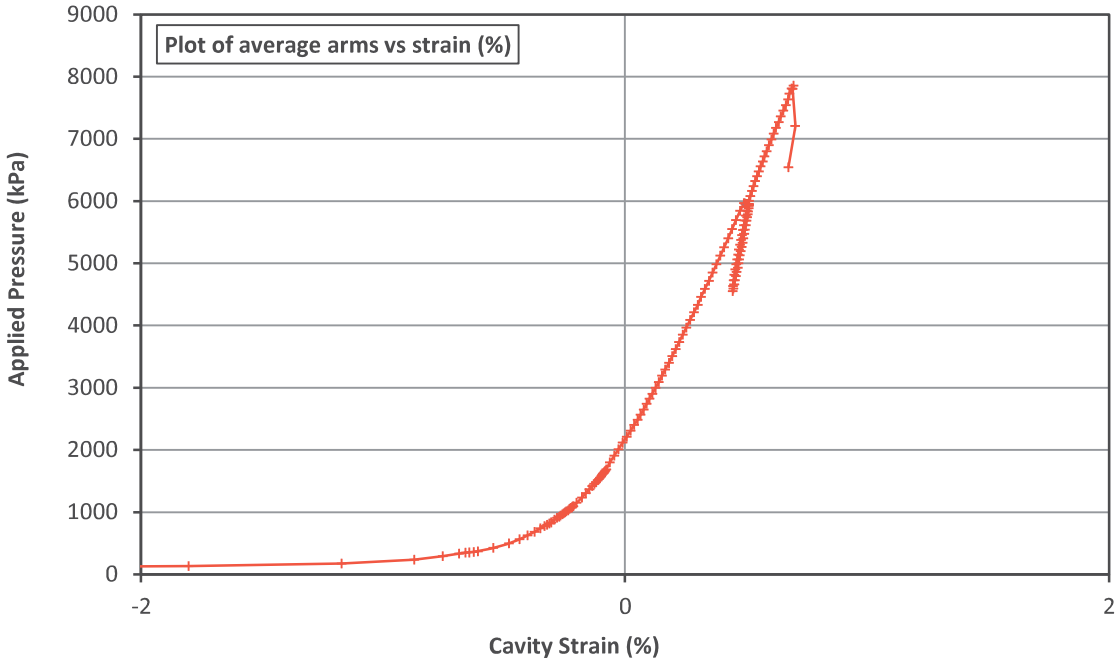
Project	Great Jackson Street	**Figure No.**	**BH1R T01 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	20/04/2021	**Test No.**	1
Borehole	BH1R	**Test Depth (m)**	13.30



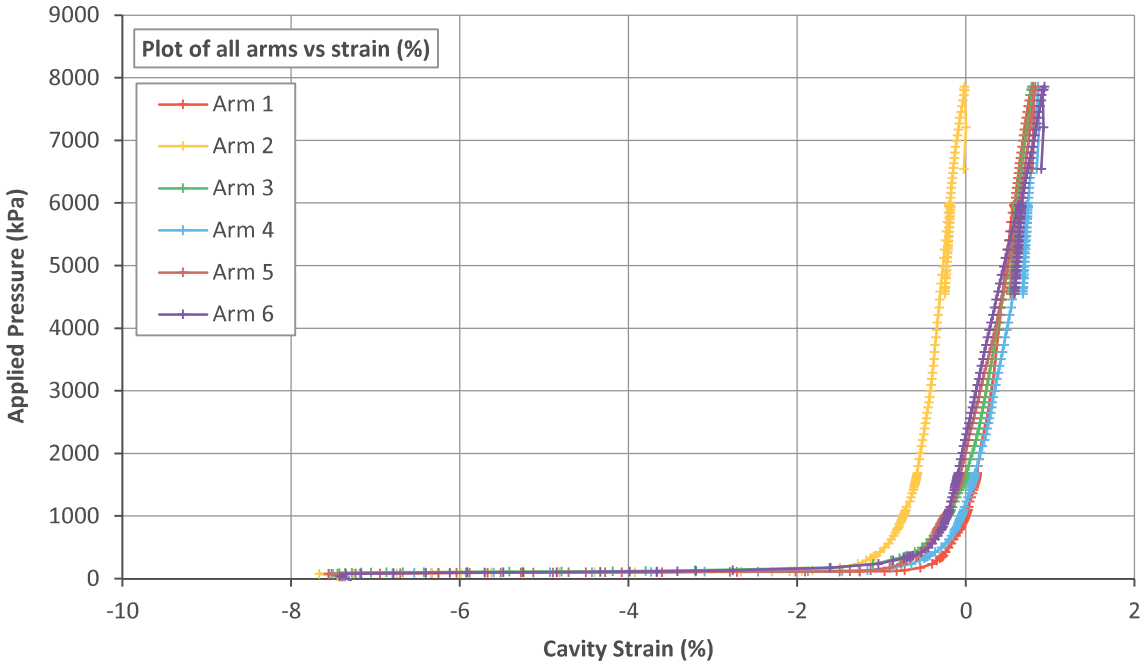


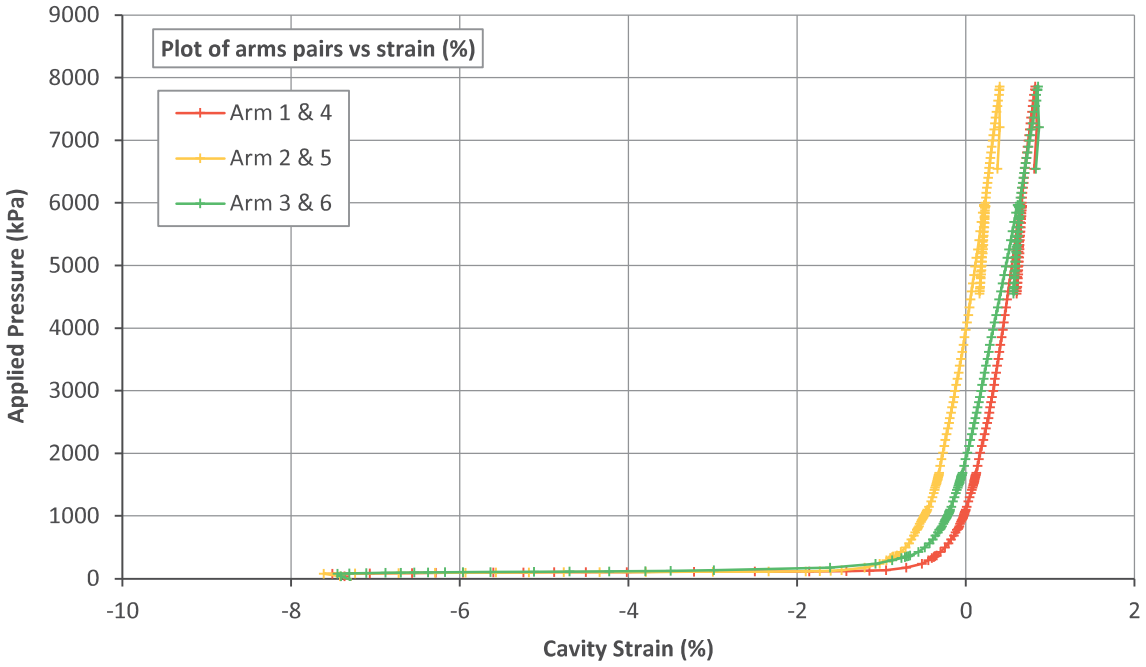
Project	Great Jackson Street	**Figure No.**	**BH1R T01 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	20/04/2021	**Test No.**	1
Borehole	BH1R	**Test Depth (m)**	13.30



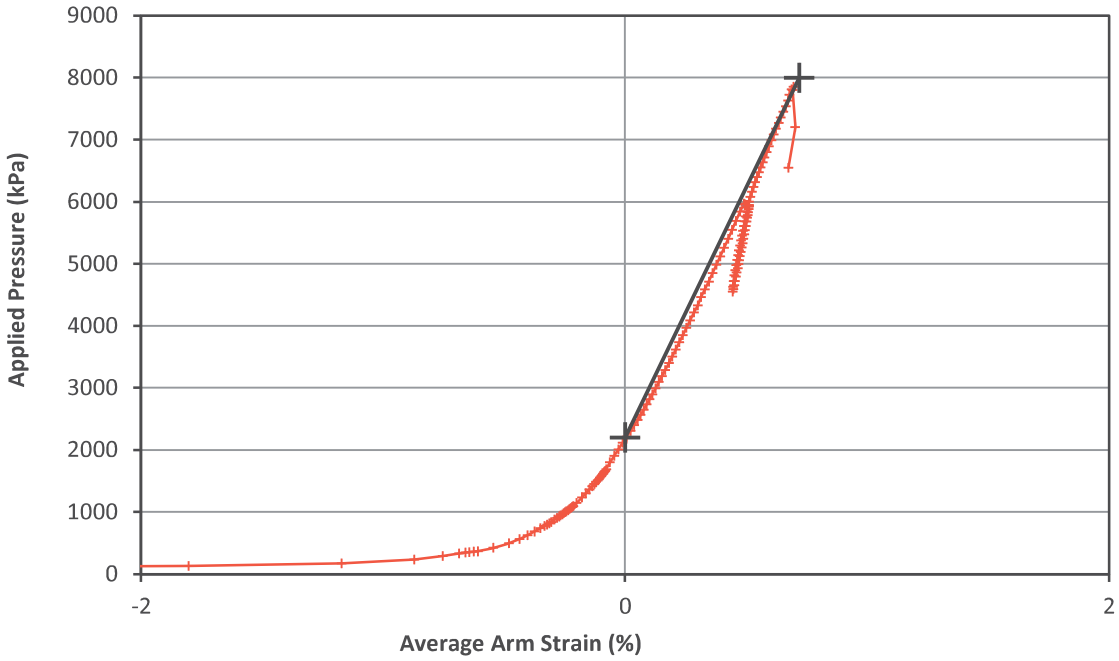


Project	Great Jackson Street	**Figure No.**	**BH1R T01 - 03**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	20/04/2021	**Test No.**	1
Borehole	BH1R	**Test Depth (m)**	13.30



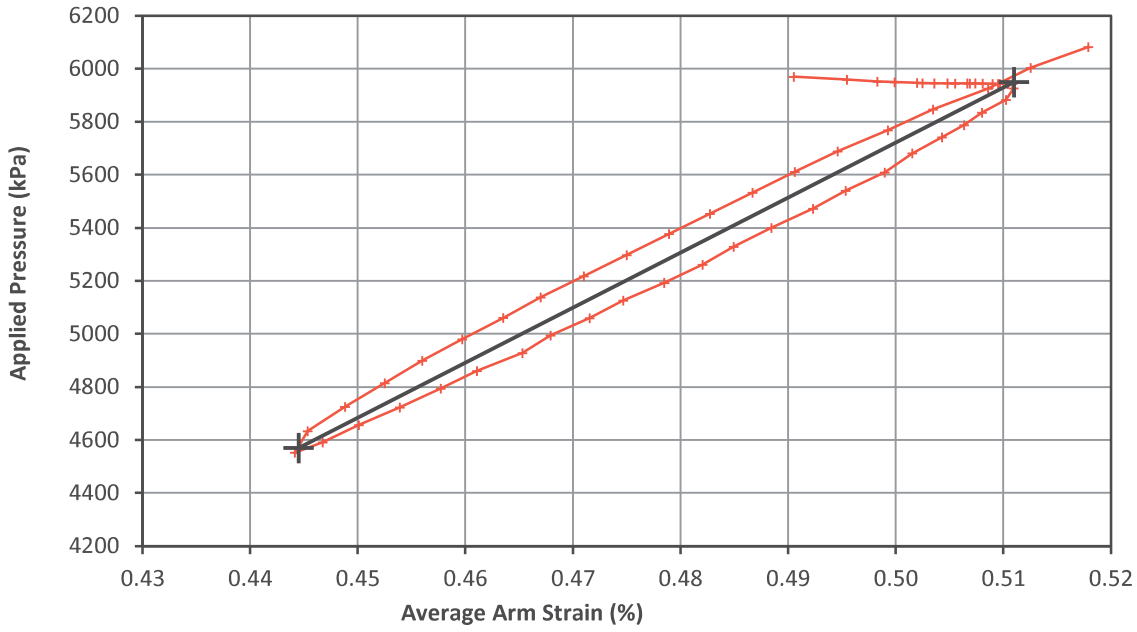
Initial Modulus	Shear Modulus	405.7 MPa

Project	Great Jackson Street	**Figure No.**	**BH1R T01 - 04**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	20/04/2021	**Test No.**	1
Borehole	BH1R	**Test Depth (m)**	13.30



Loop 1	Shear Modulus	1042.9	MPa
	Cavity Strain Range	0.067	%

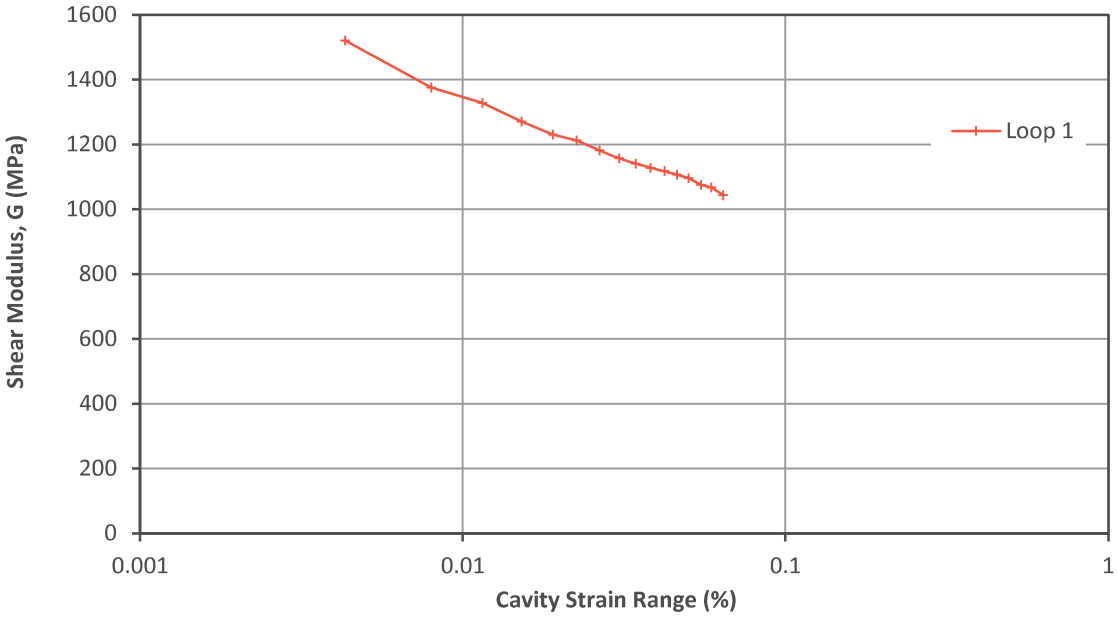
Project	Great Jackson Street	**Figure No.**	**BH1R T01 - 05**
Client	GeoAssist		
Project No.	P1210114		

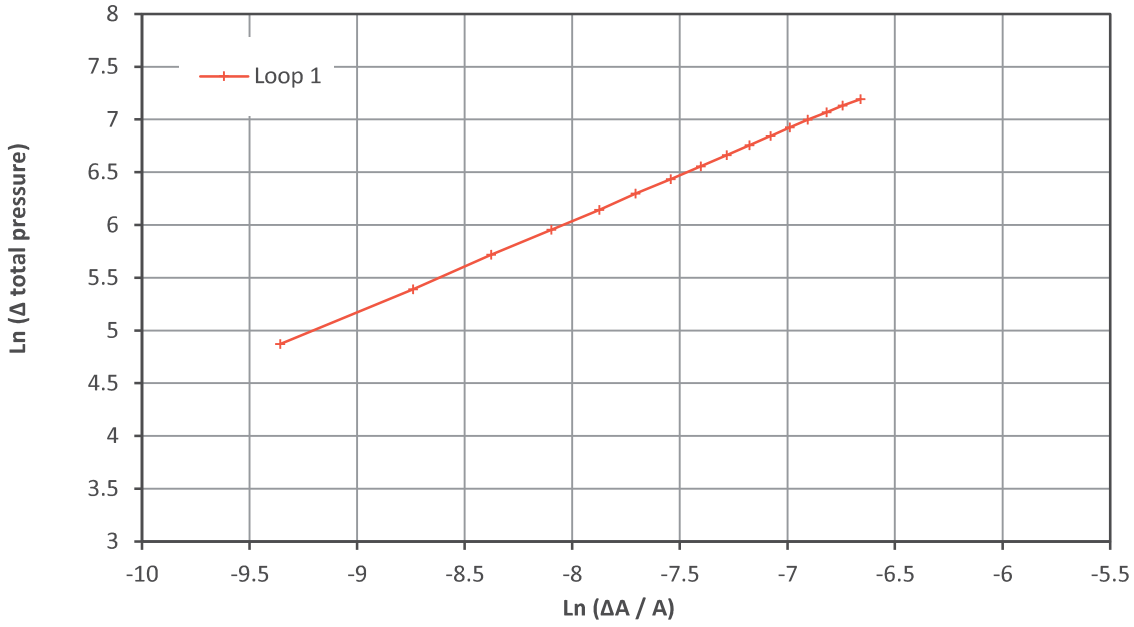
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	20/04/2021	Test No.	1
Borehole	BH1R	Test Depth (m)	13.30





Loop 1	
Gradient(β)	Intercept
0.867	431.591 (MPa)

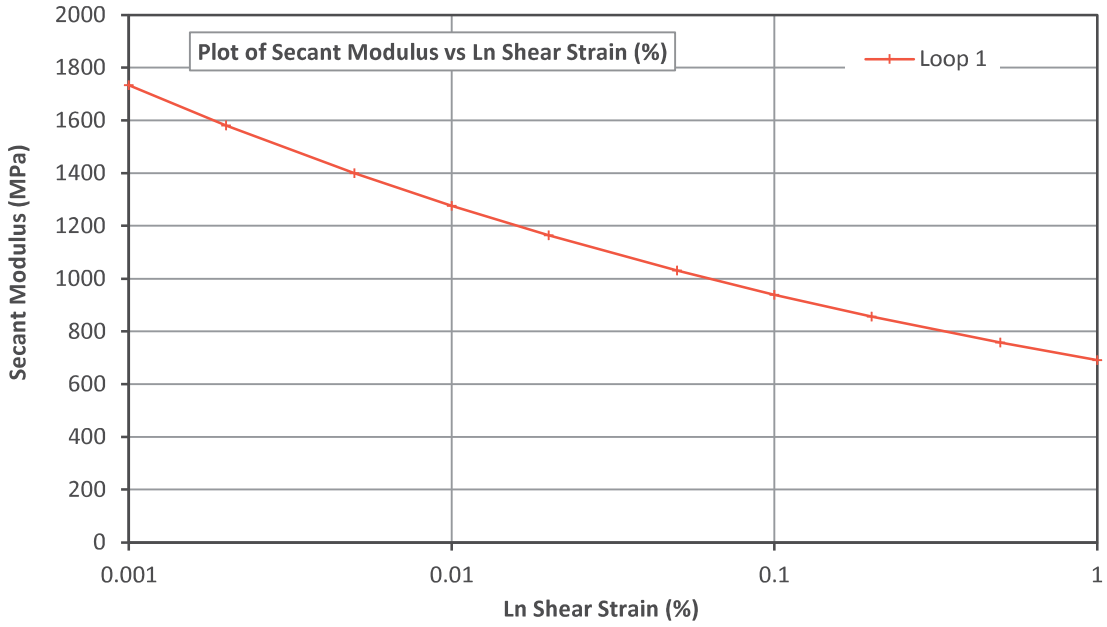
Project	Great Jackson Street	Figure No.	BH1R T01 - 06
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	20/04/2021	**Test No.**	1
Borehole	BH1R	**Test Depth (m)**	13.30



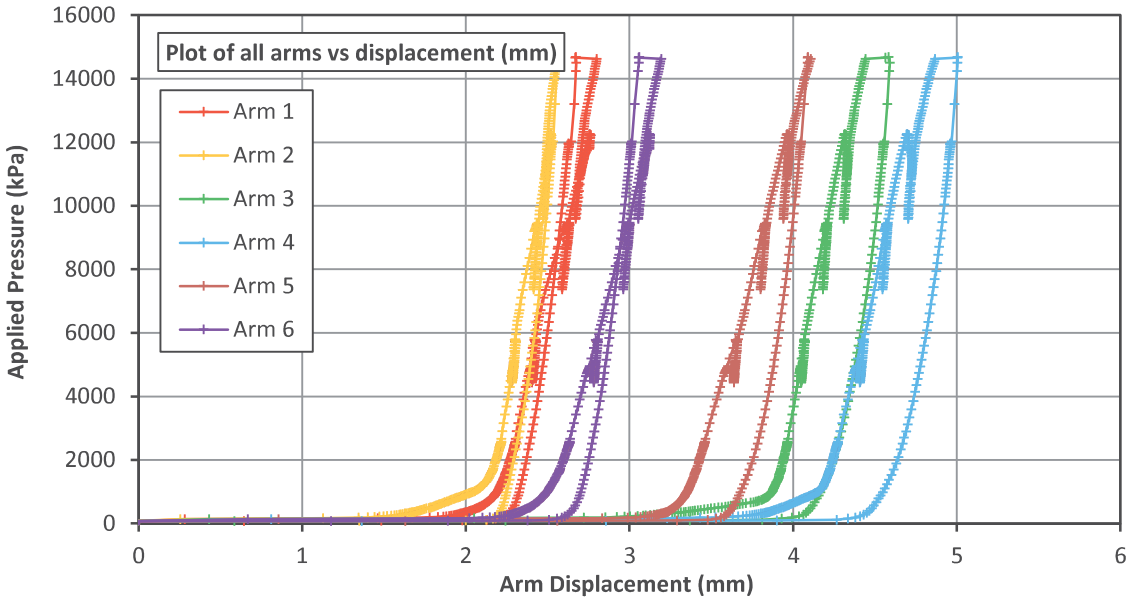
Shear Strain	Loop 1
0.001%	**1734**
0.002%	1581
0.005%	1399
0.010%	**1276**
0.020%	1163
0.050%	1030
0.100%	**939**
0.200%	856
0.500%	758
1.000%	**691**

Project	Great Jackson Street	**Figure No.**	**BH1R T01 - 07**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021		**Test No.**	2
Borehole	BH1R		**Test Depth (m)**	15.70
Coordinates (m)	383353.9 (E)	397240.7 (N)	**Elevation (m)**	32.28



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	91 %	Test pocket depth range:	
Solid core recovery:	78 %	From: 14.20 m to: 16.50 m	
Rock quality designation:	48 %	Flush: Water	

Test comment:

The test pocket was tight with arms lifting off at 2.0 to 4.0mm. The po was estimated to be at 2506kPa, with the following loading section being long and linear. The start of material yield was interpreted at 13800kPa, with the test taken to pressure of 14683kPa, where a jump in expansion and probe movement resulted in the test being aborted. The displacement-pressure response shown by the arms was consistent, albeit with some varying expansion. Analysis of three unload reload loops provides high modulus values of 1455 to 1498MPa. Derived undrained shear strength analysis provides a value of 11.3MPa.

Test details: **Instrument:** Eleanor (HPD04)

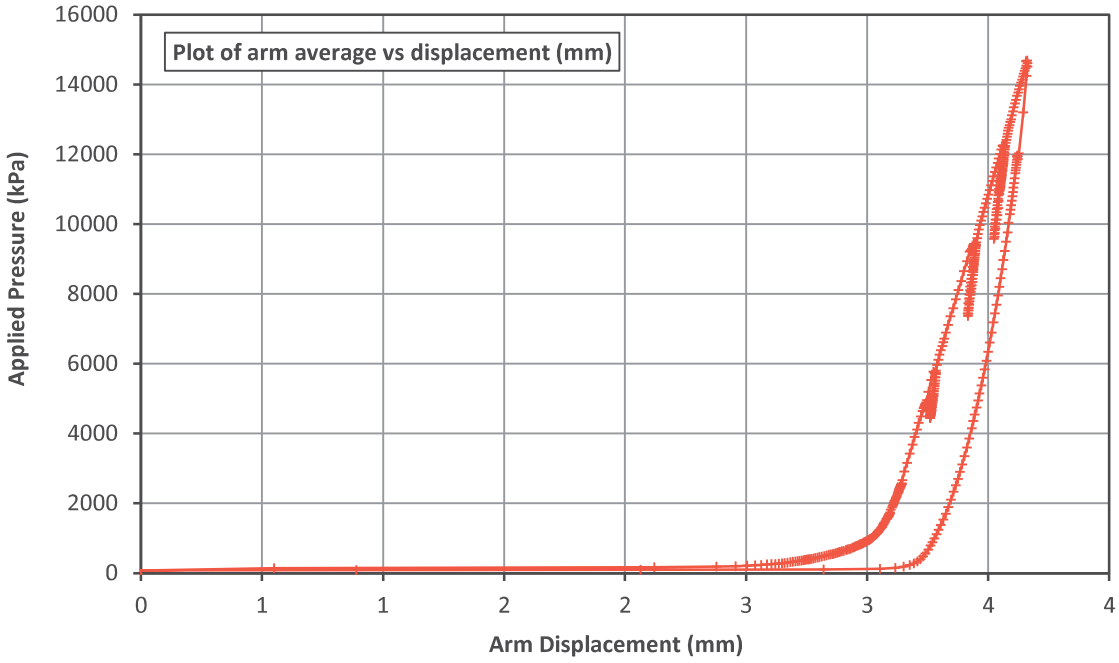
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	14.20 m	Arm 1:	-2377.5	122.9	TPC A:	292.9	102.9
Water level:	9.50 m	Arm 2:	-2046.7	124.9	TPC B:	-2132.8	110.7
		Arm 3:	-2292.5	129.5			
Test time:		Arm 4:	-2121.3	127.4			
Start (probe in):	09:20 hrs	Arm 5:	-2290.7	132.1			
Finish (probe out):	10:50 hrs	Arm 6:	-2137.7	124.1			

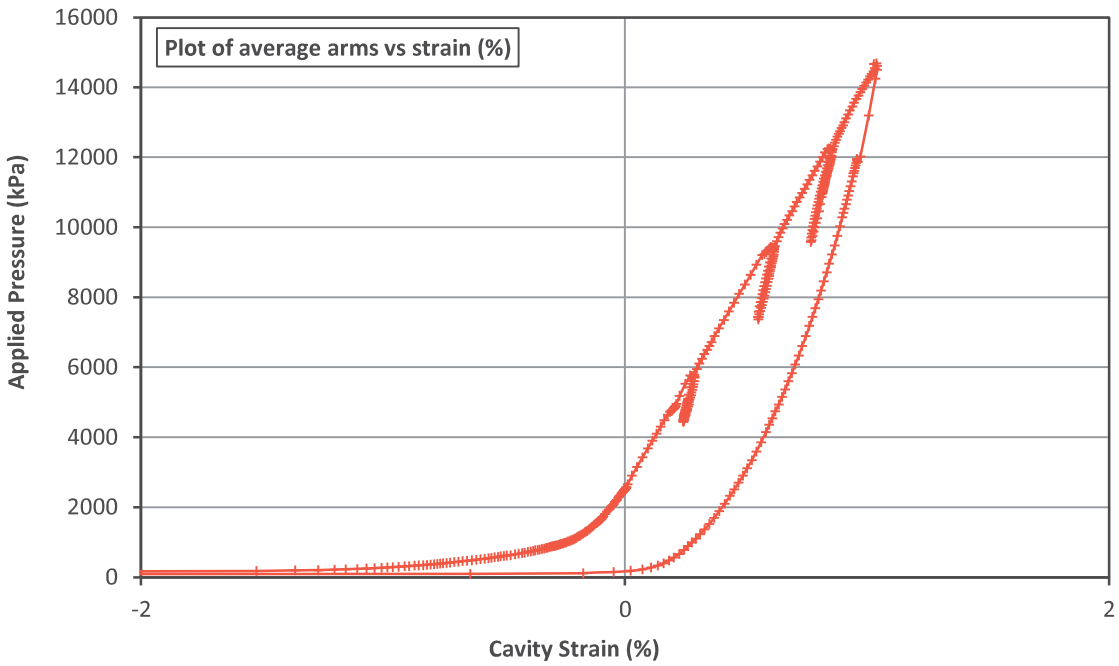
Project	Great Jackson Street	**Figure No.**	**BH1R T02 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	2
Borehole	BH1R	**Test Depth (m)**	15.70



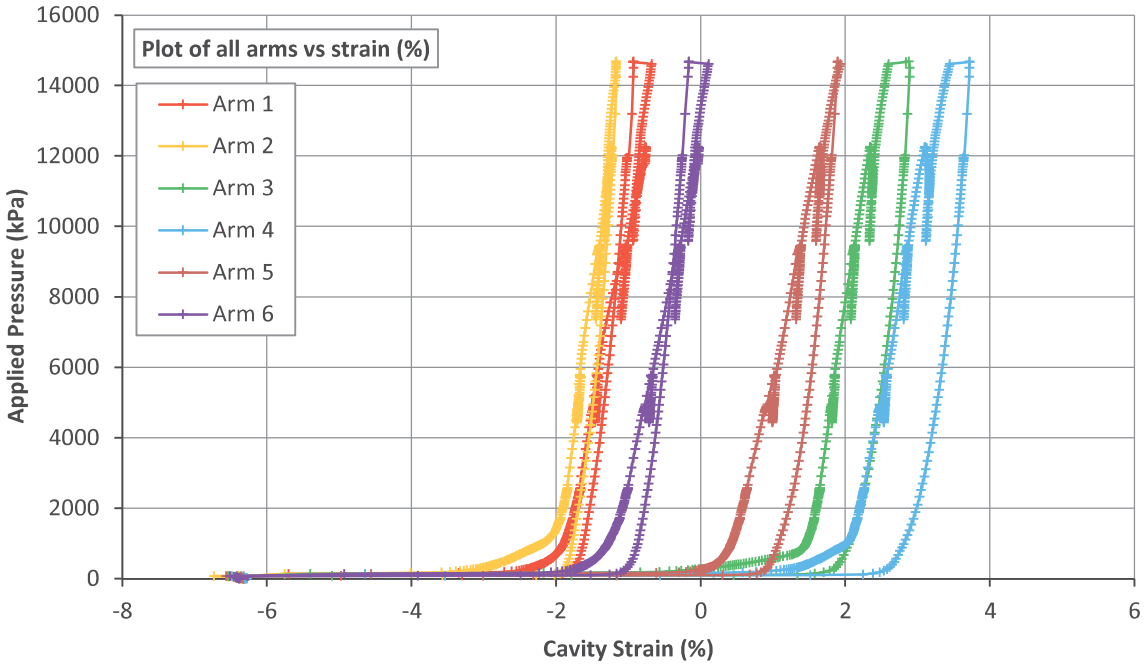


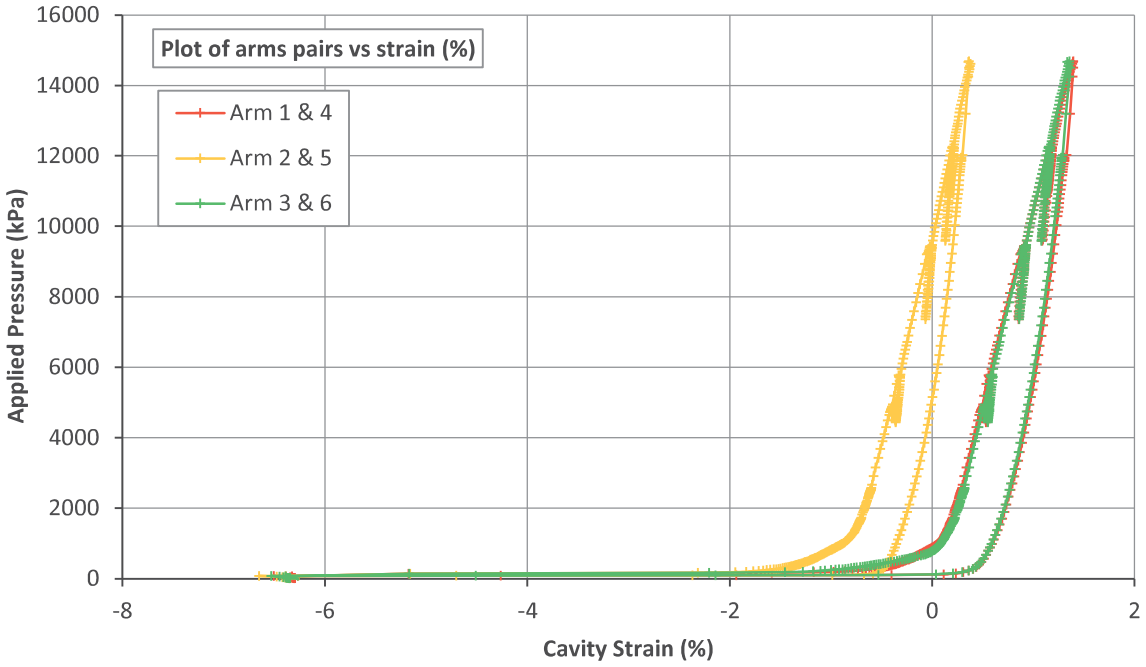
Project	Great Jackson Street	**Figure No.**	**BH1R T02 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	Test No.	2
Borehole	BH1R	Test Depth (m)	15.70



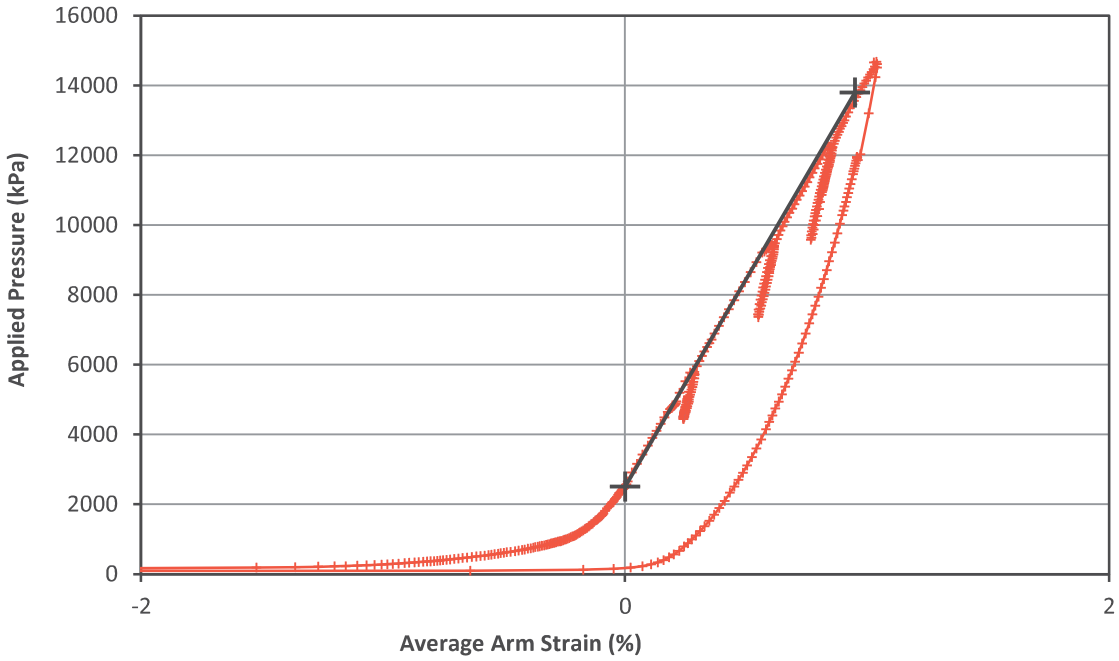


Project	Great Jackson Street	Figure No.	BH1R T02 - 03
Client	GeoAssist		
Project No.	P1210114		

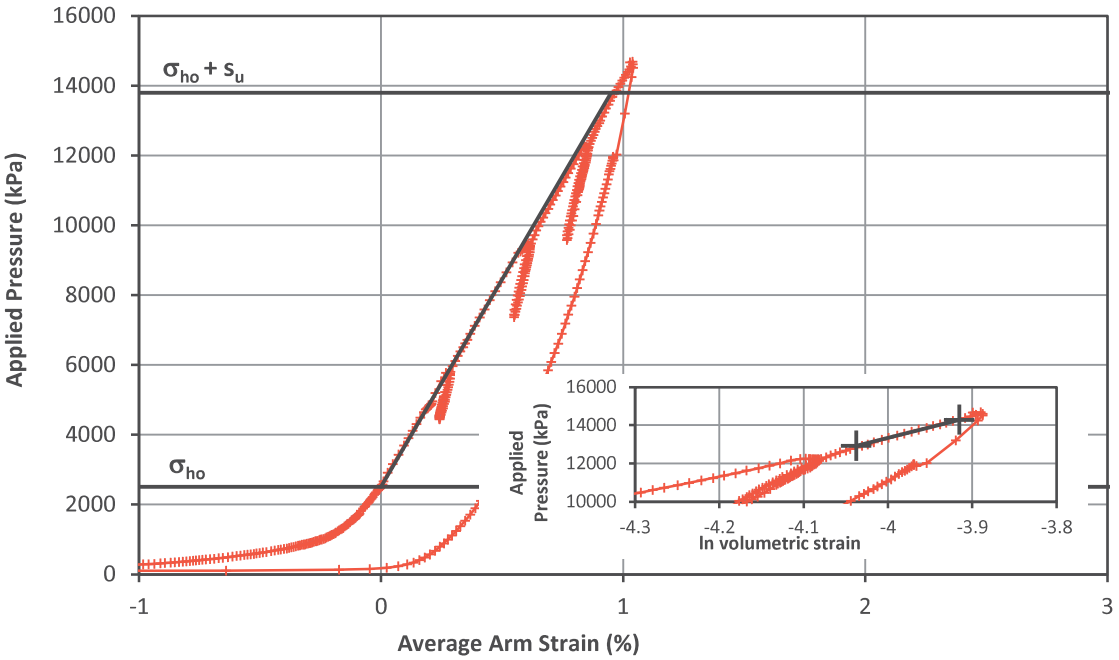
Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	2
Borehole	BH1R	**Test Depth (m)**	15.70



Initial Modulus	Shear Modulus	600.1 MPa



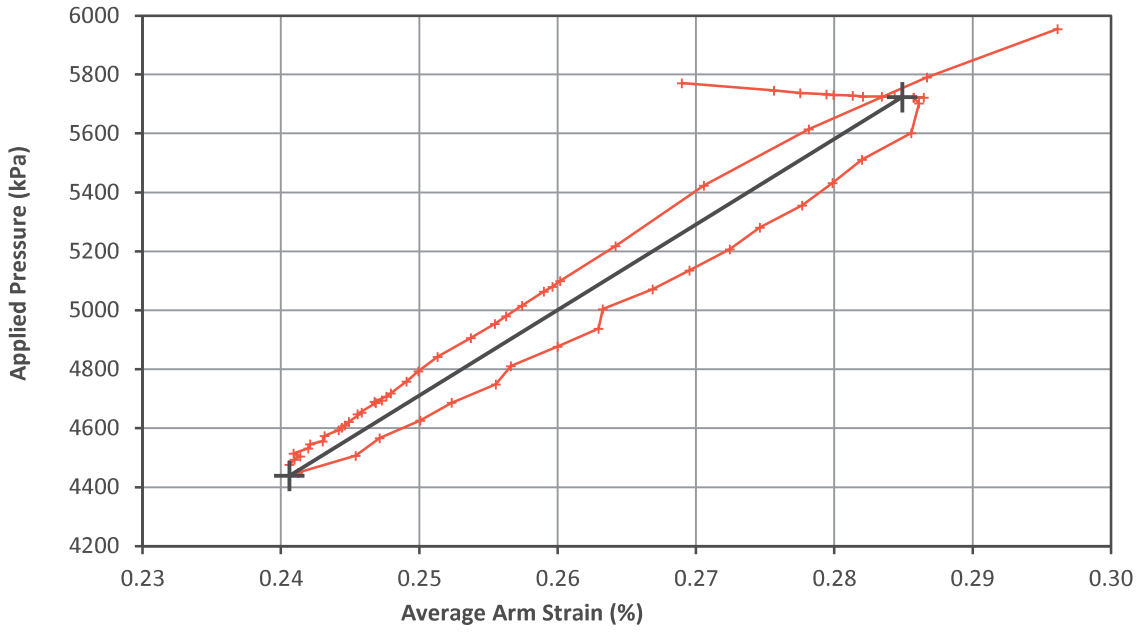
Marsland & Randolph	In situ horizontal stress	2506 kPa
	Undrained Strength	11294 kPa

Project	Great Jackson Street	**Figure No.**	**BH1R T02 - 04**
Client	GeoAssist		
Project No.	P1210114		

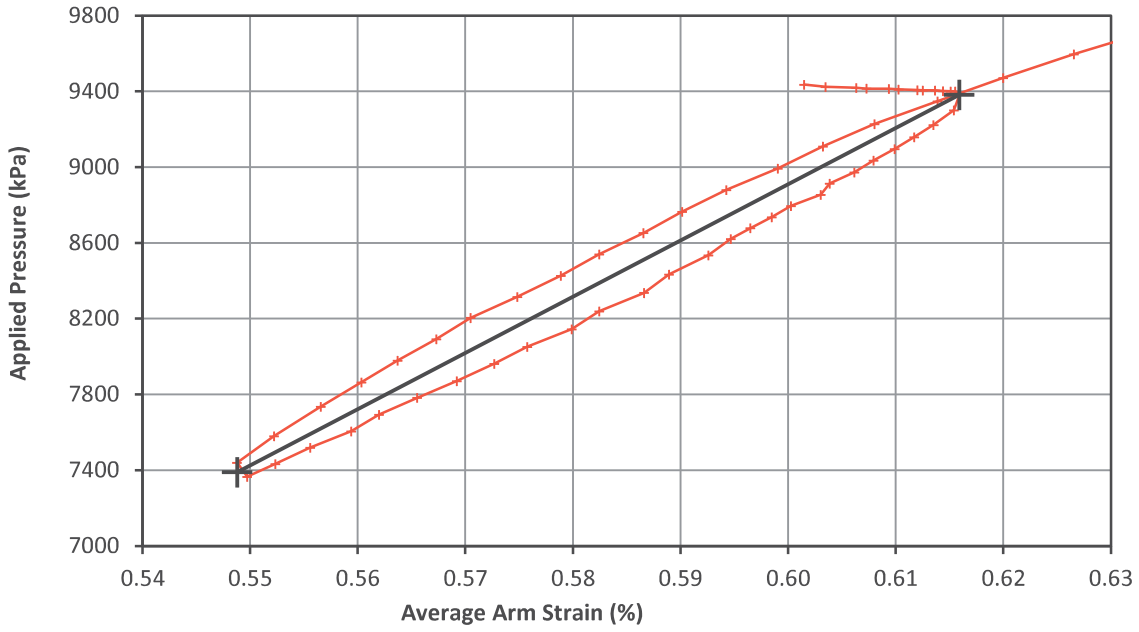
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	Test No.	2
Borehole	BH1R	Test Depth (m)	15.70



Loop 1	Shear Modulus	1455.4 MPa
	Cavity Strain Range	0.044 %



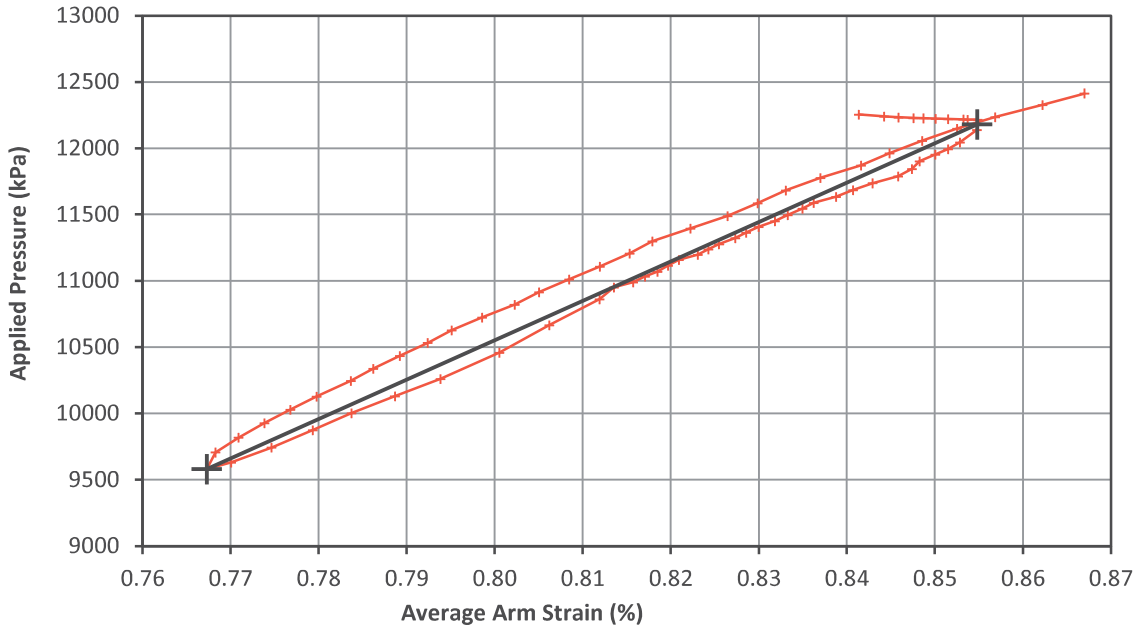
Loop 2	Shear Modulus	1493.5 MPa
	Cavity Strain Range	0.067 %

Project	Great Jackson Street	Figure No.	BH1R T02 - 05
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	2
Borehole	BH1R	**Test Depth (m)**	15.70



Loop 3	Shear Modulus	1497.7	MPa
	Cavity Strain Range	0.088	%

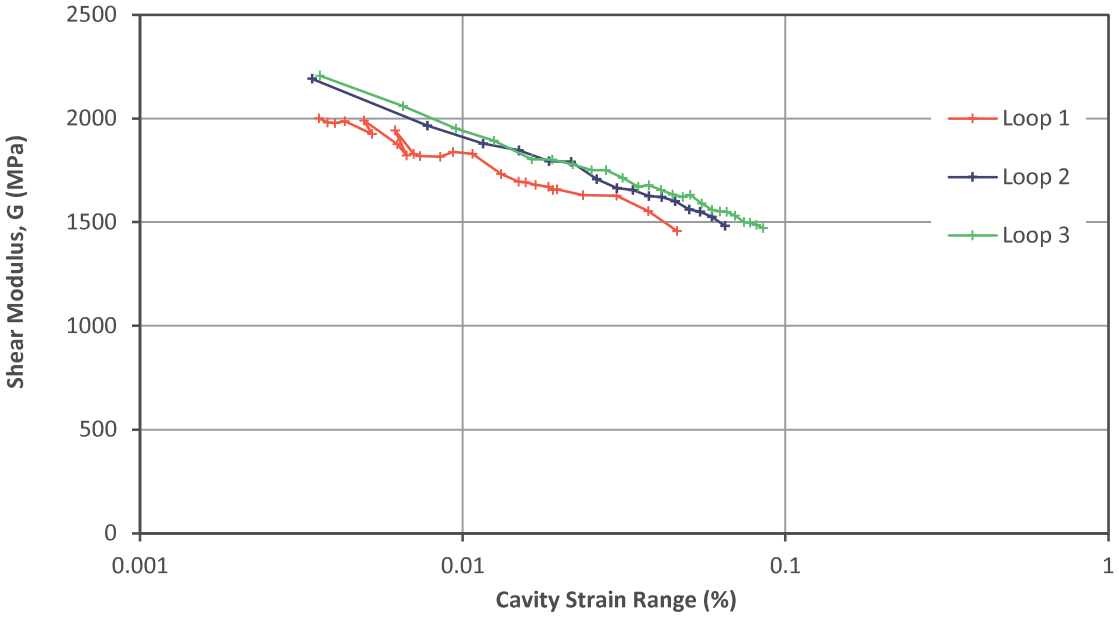
Project	Great Jackson Street	**Figure No.**	**BH1R T02 - 06**
Client	GeoAssist		
Project No.	P1210114		

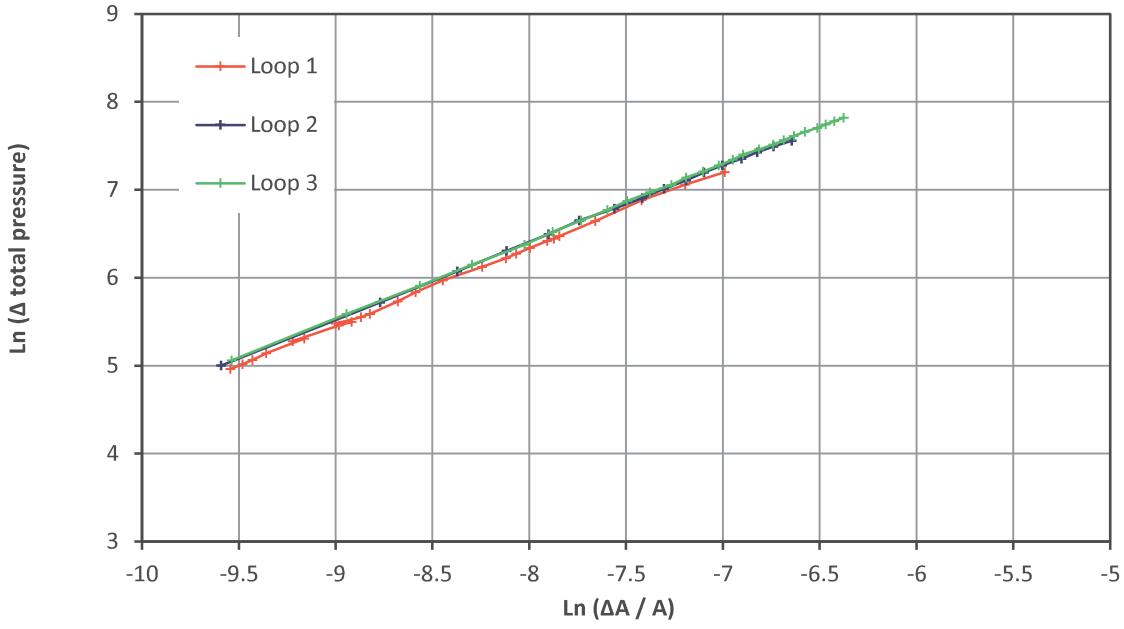
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	2
Borehole	BH1R	**Test Depth (m)**	15.70





Loop 1		Loop 2		Loop 3	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.886	673.182 (MPa)	0.873	647.090 (MPa)	0.880	698.872 (MPa)

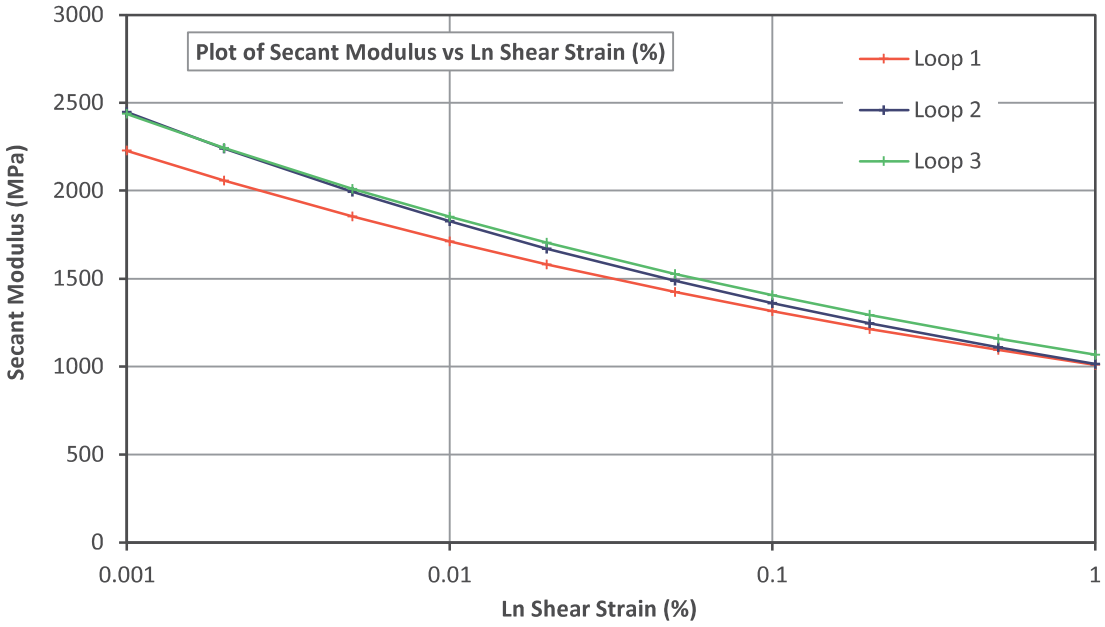
Project	Great Jackson Street	**Figure No.**	**BH1R T02 - 08**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	2
Borehole	BH1R	**Test Depth (m)**	15.70



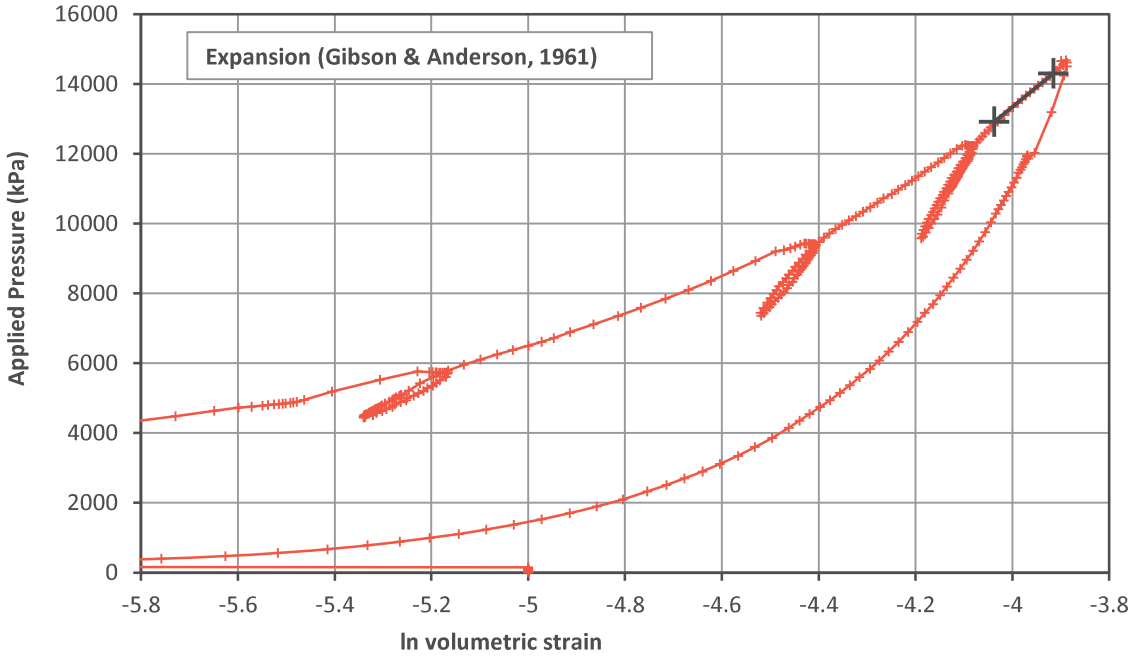
Shear Strain	Loop 1	Loop 2	Loop 3
0.001%	**2227**	**2447**	**2438**
0.002%	2057	2240	2244
0.005%	1852	1994	2011
0.010%	**1711**	**1825**	**1851**
0.020%	1581	1671	1704
0.050%	1423	1487	1527
0.100%	**1315**	**1361**	**1405**
0.200%	1214	1246	1294
0.500%	1093	1109	1159
1.000%	**1010**	**1015**	**1067**

Project	Great Jackson Street	**Figure No.**	**BH1R T02 - 09**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Undrained Strength

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	2
Borehole	BH1R	**Test Depth (m)**	15.70



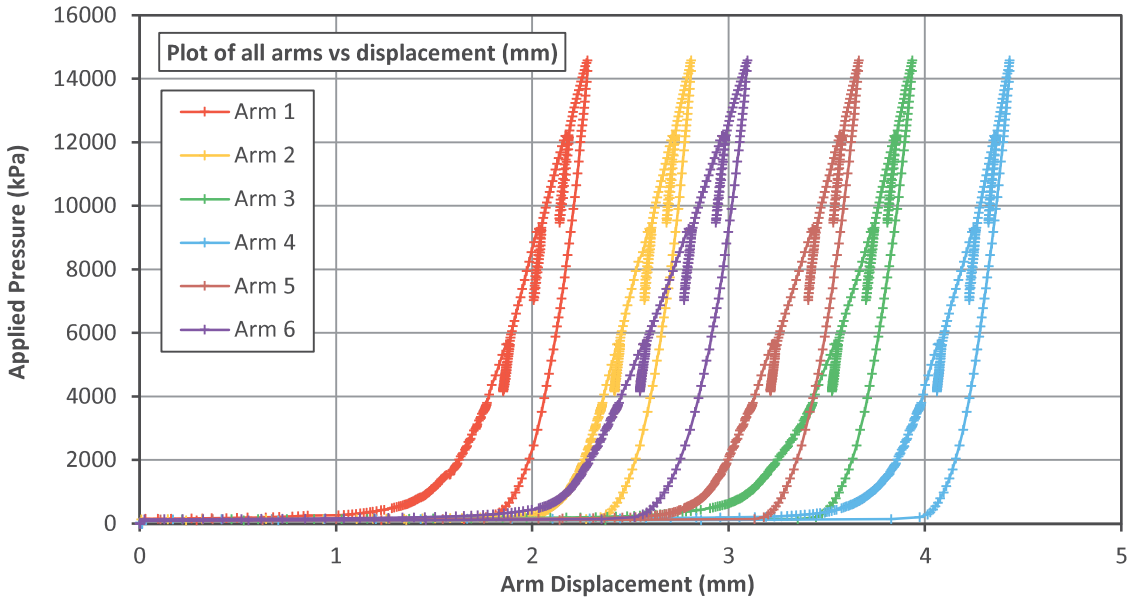
Strength (loading)	Undrained Shear	11294	kPa
	Limit Pressure	58527	kPa

Project	Great Jackson Street	**Figure No.**	**BH1R T02 - 10**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021		**Test No.**	3
Borehole	BH1R		**Test Depth (m)**	19.20
Coordinates (m)	383353.9 (E)	397240.7 (N)	**Elevation (m)**	32.28



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	98 %	Test pocket depth range:	
Solid core recovery:	87 %	From: 18.10 m to: 20.40 m	
Rock quality designation:	74 %	Flush: Water	

Test comment:

The test pocket was tight and even, with arms lifting off at 1.5 to 4.0mm. The po was estimated to be at 2920kPa, with the following loading section being long and linear. No material yield was seen and the test was taken to a high pressure of 14582kPa. The displacement-pressure response shown by the arms was reasonably consistent albeit with some variation in expansion. Analysis of three unload reload loops provides modulus values of 1237 to 1455MPa.

Test details: **Instrument:** Eleanor (HPD04)

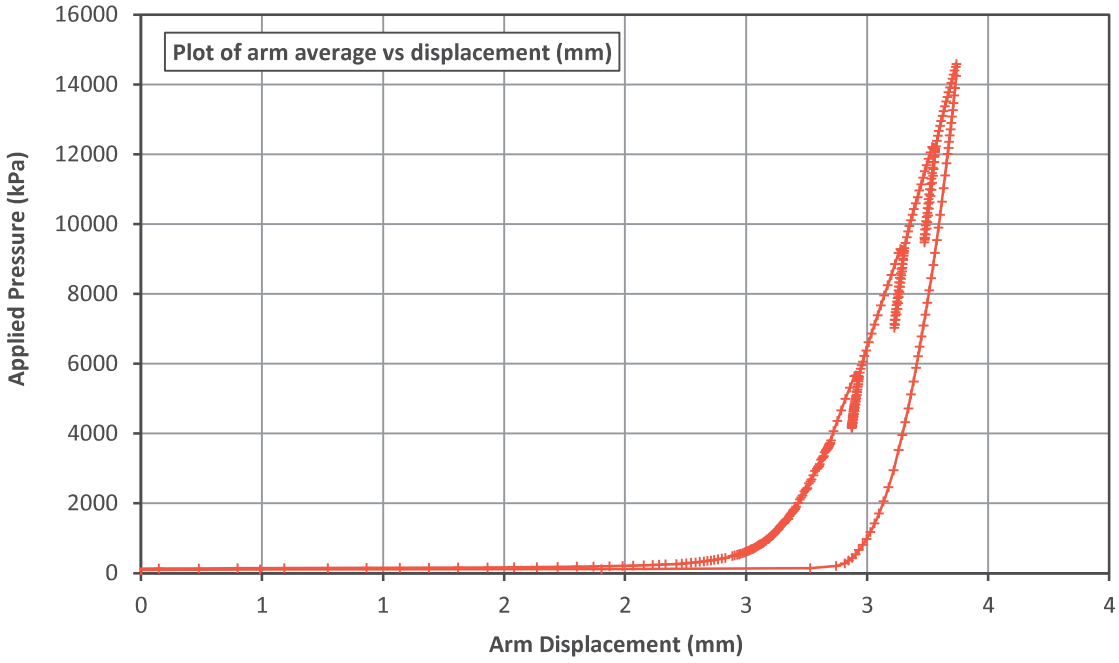
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	18.10 m	Arm 1:	-2377.2	122.9	TPC A:	294.1	102.9
Water level:	9.80 m	Arm 2:	-2048.0	124.9	TPC B:	-2132.9	110.7
		Arm 3:	-2290.9	129.5			
Test time:		Arm 4:	-2122.3	127.4			
Start (probe in):	14:25 hrs	Arm 5:	-2290.4	132.1			
Finish (probe out):	16:15 hrs	Arm 6:	-2141.9	124.1			

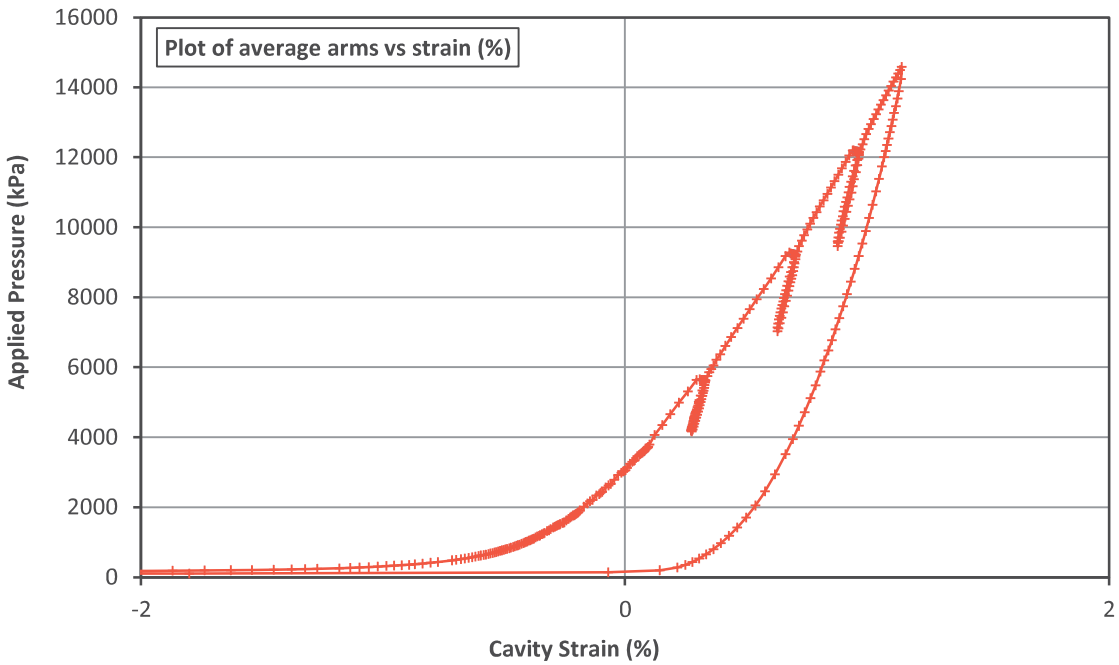
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T03 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	3
Borehole	BH1R	**Test Depth (m)**	19.20



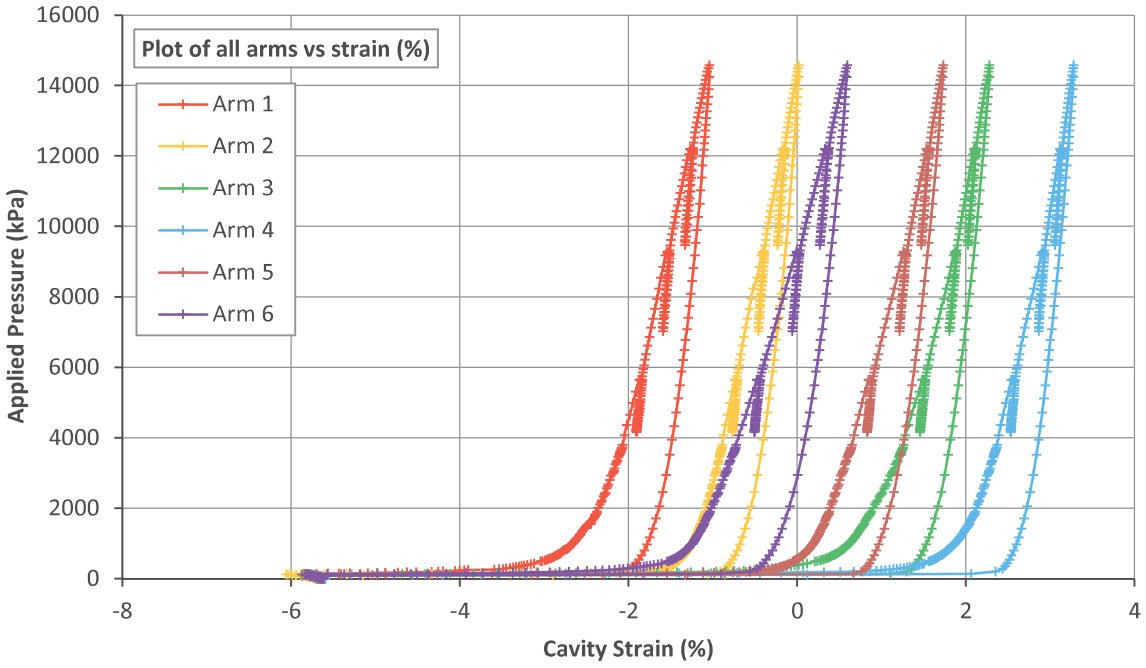


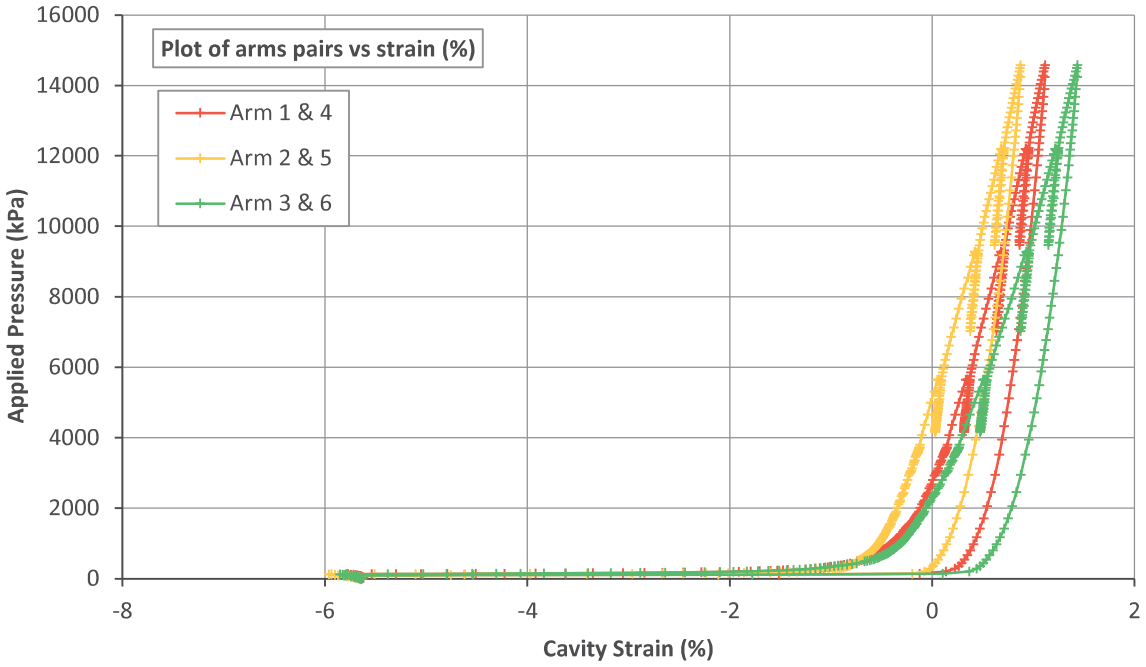
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T03 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	3
Borehole	BH1R	**Test Depth (m)**	19.20



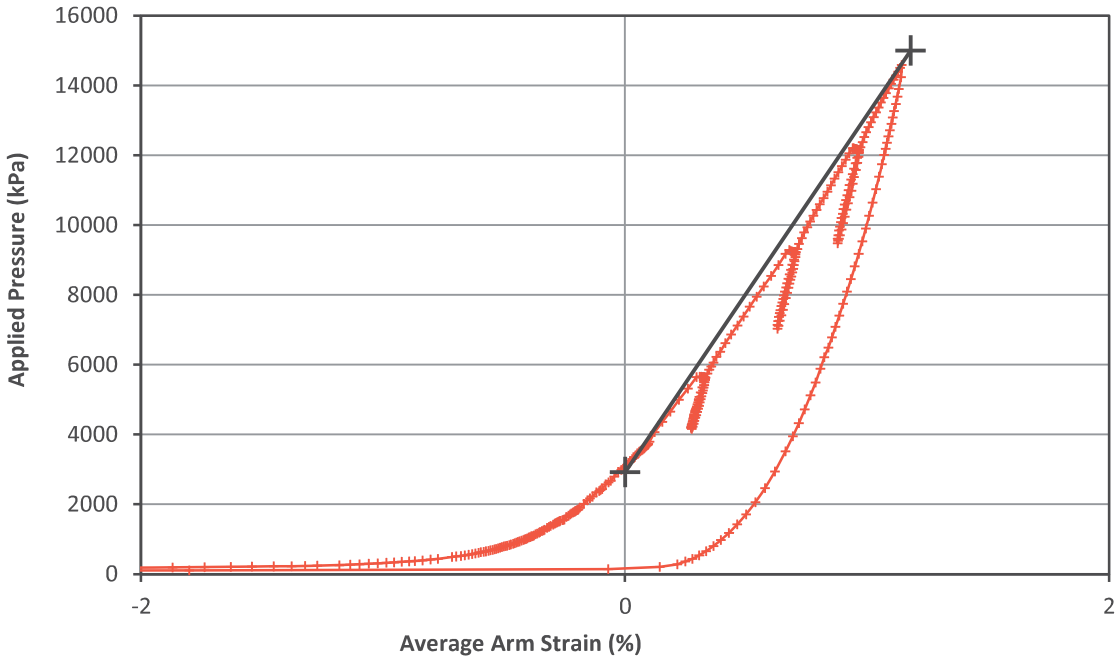


Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T03 - 03**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	3
Borehole	BH1R	**Test Depth (m)**	19.20



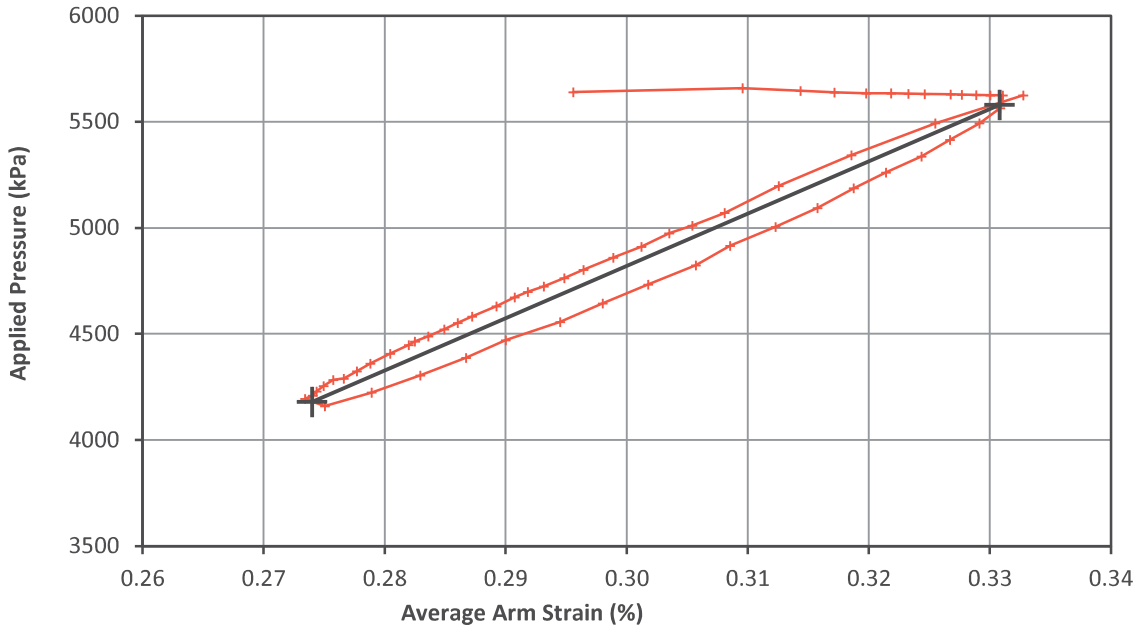
Initial Modulus	Shear Modulus	517.9 MPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T03 - 04**
Client	GeoAssist		
Project No.	P1210114		

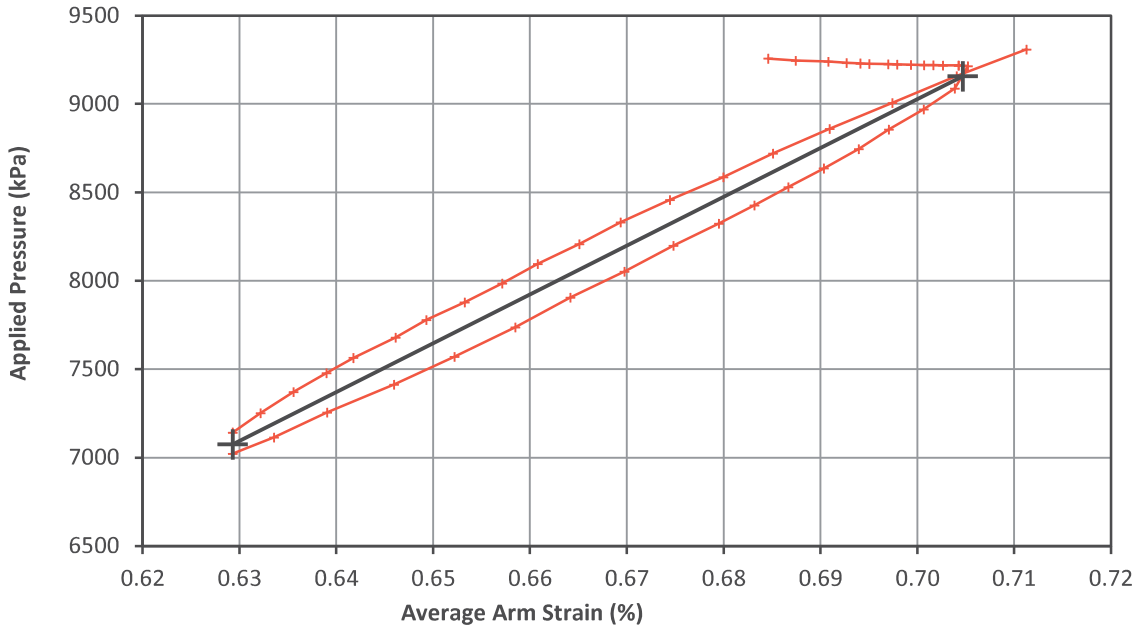
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	3
Borehole	BH1R	**Test Depth (m)**	19.20



Loop 1	Shear Modulus	1236.5 MPa
	Cavity Strain Range	0.057 %



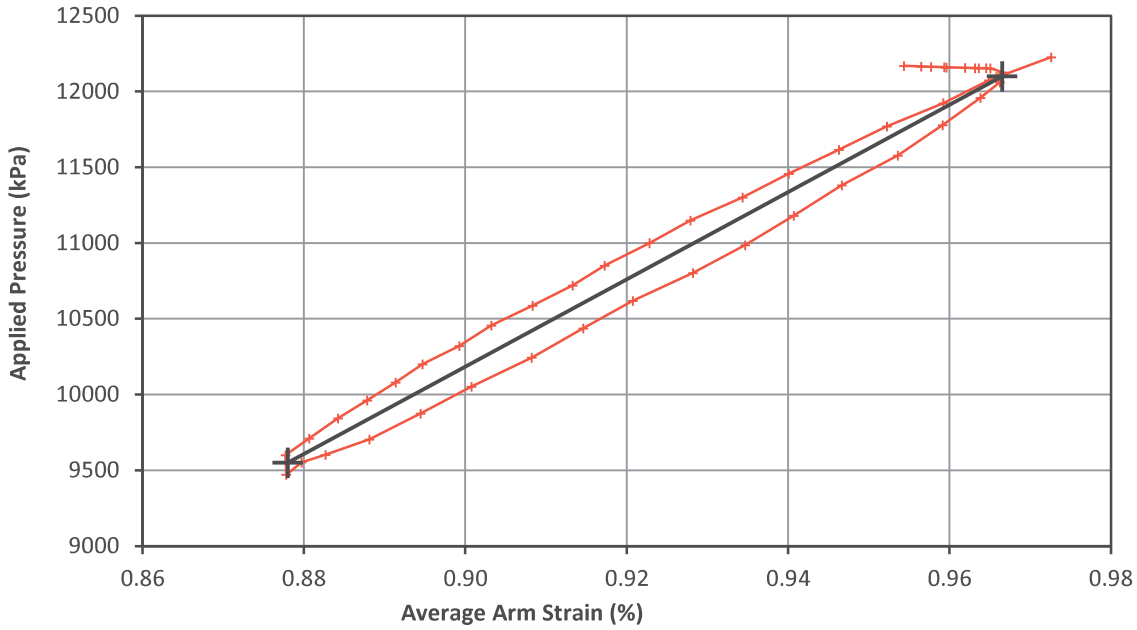
Loop 2	Shear Modulus	1390.4 MPa
	Cavity Strain Range	0.075 %

Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T03 - 05**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	**Test No.**	3
Borehole	BH1R	**Test Depth (m)**	19.20



Loop 3	Shear Modulus	1454.6	MPa
	Cavity Strain Range	0.089	%

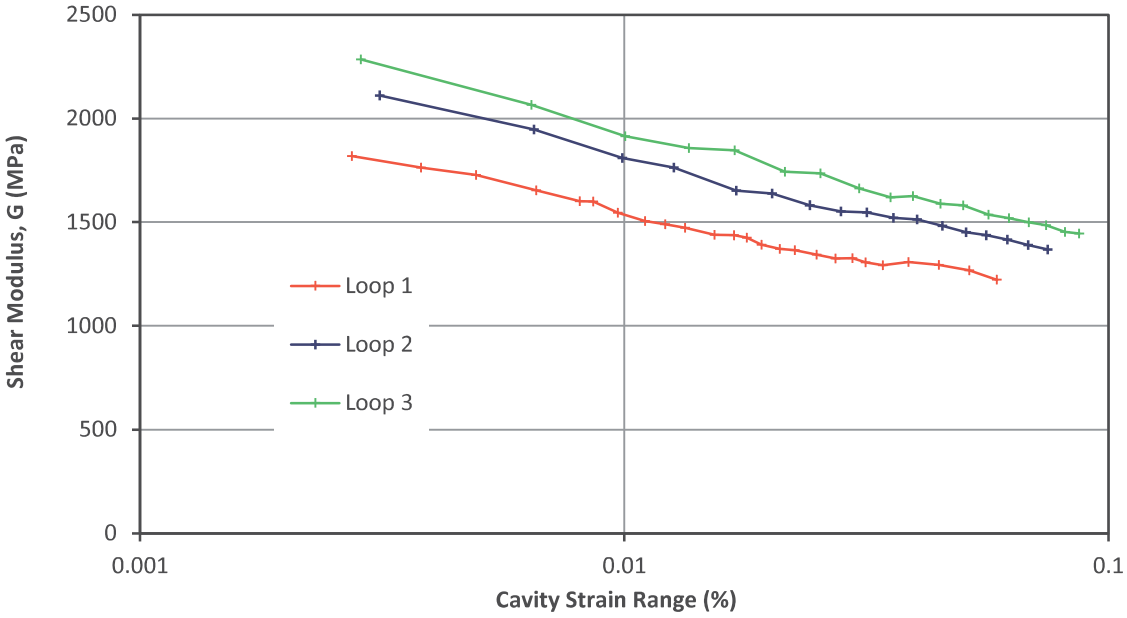
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T03 - 06**
Client	GeoAssist		
Project No.	P1210114		

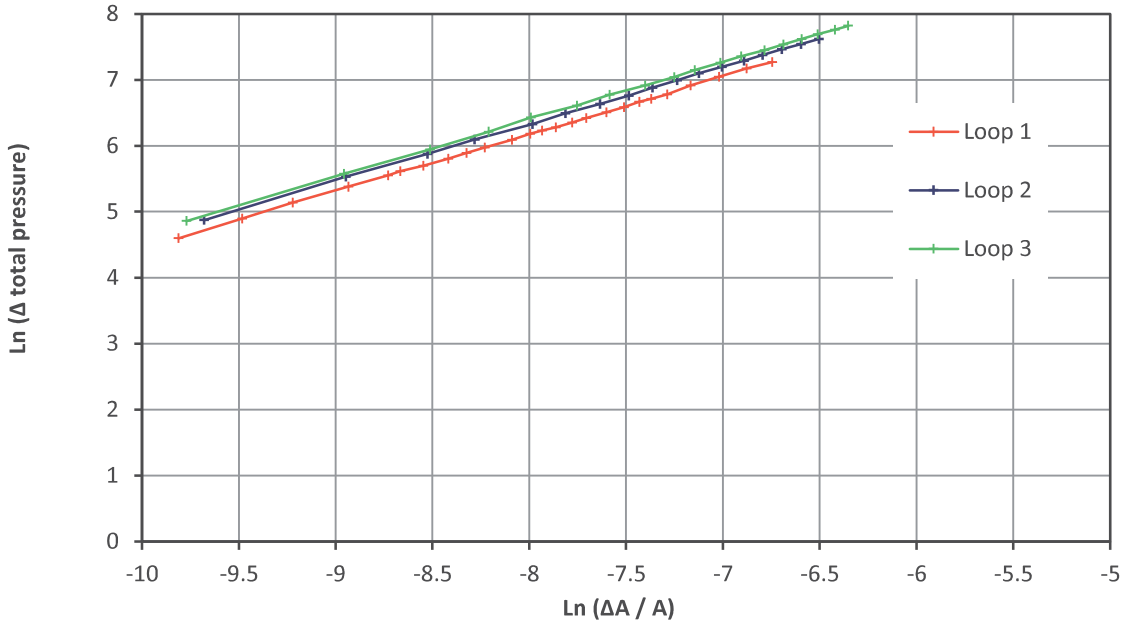
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	Test No.	3
Borehole	BH1R	Test Depth (m)	19.20





Loop 1		Loop 2		Loop 3	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.856	450.457 (MPa)	0.864	564.412 (MPa)	0.866	615.557 (MPa)

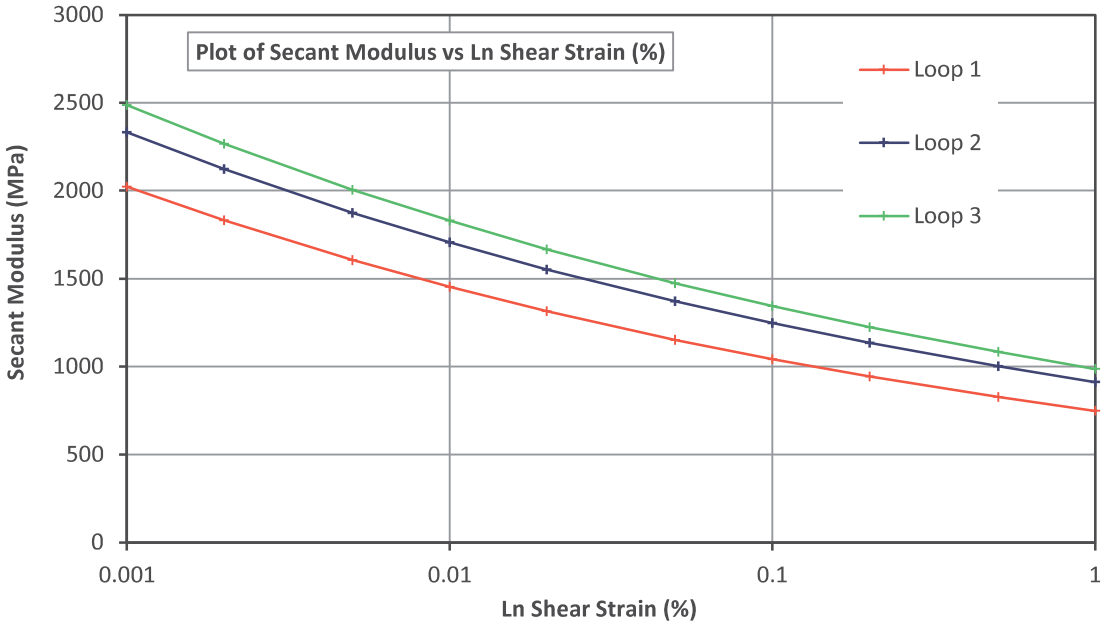
Project	Great Jackson Street, Manchester	Figure No.	BH1R T03 - 07
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	21/04/2021	Test No.	3
Borehole	BH1R	Test Depth (m)	19.20



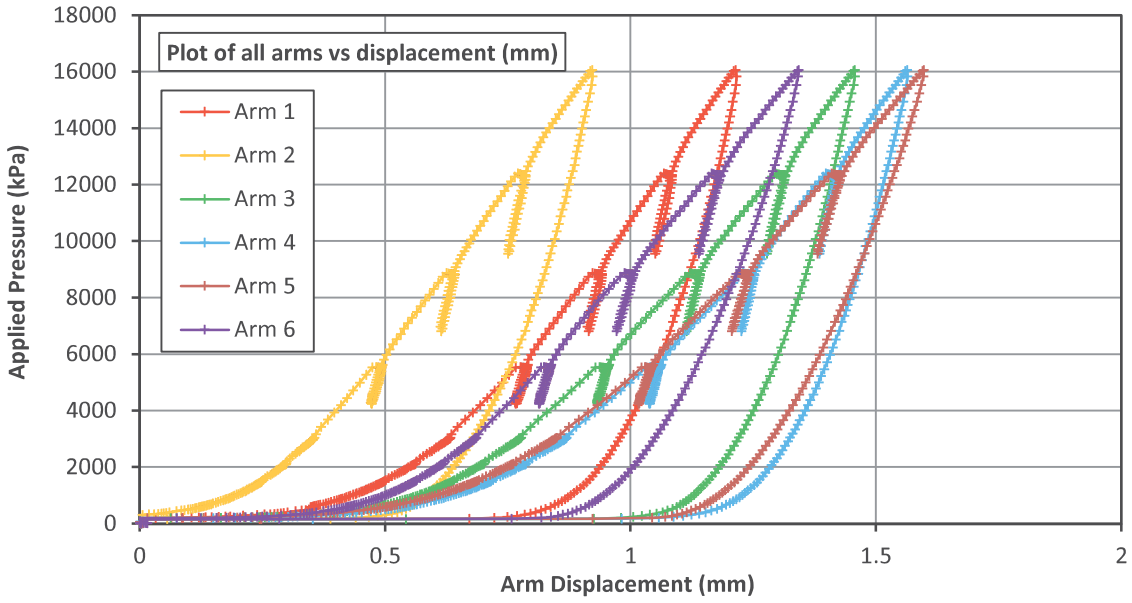
Shear Strain	Loop 1	Loop 2	Loop 3
0.001%	**2023**	**2333**	**2488**
0.002%	1831	2123	2268
0.005%	1605	1874	2006
0.010%	**1452**	**1706**	**1828**
0.020%	1314	1552	1666
0.050%	1152	1371	1474
0.100%	**1042**	**1247**	**1344**
0.200%	943	1135	1225
0.500%	827	1002	1083
1.000%	**748**	**912**	**987**

Project	Great Jackson Street, Manchester	Figure No.	BH1R T03 - 08
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	22/04/2021		**Test No.**	4
Borehole	BH1R		**Test Depth (m)**	24.30
Coordinates (m)	383353.9 (E)	397240.7 (N)	**Elevation (m)**	32.28



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	100 %	Test pocket depth range:	
Solid core recovery:	86 %	From: 23.50 m to: 25.60 m	
Rock quality designation:	55 %	Flush: Water	

Test comment:

The test pocket was tight and even, with arms lifting off at 0.3 to 1.0mm. The po was estimated to be at 3673kPa, with the following loading section being long and linear. No material yield was observed and the test was taken to a high pressure of 16060kPa. The displacement-pressure response shown by the arms was consistent over the small expansion range. Analysis of three unload reload loops provides modulus values of 1388 to 1613MPa.

Test details: **Instrument:** Eleanor (HPD04)

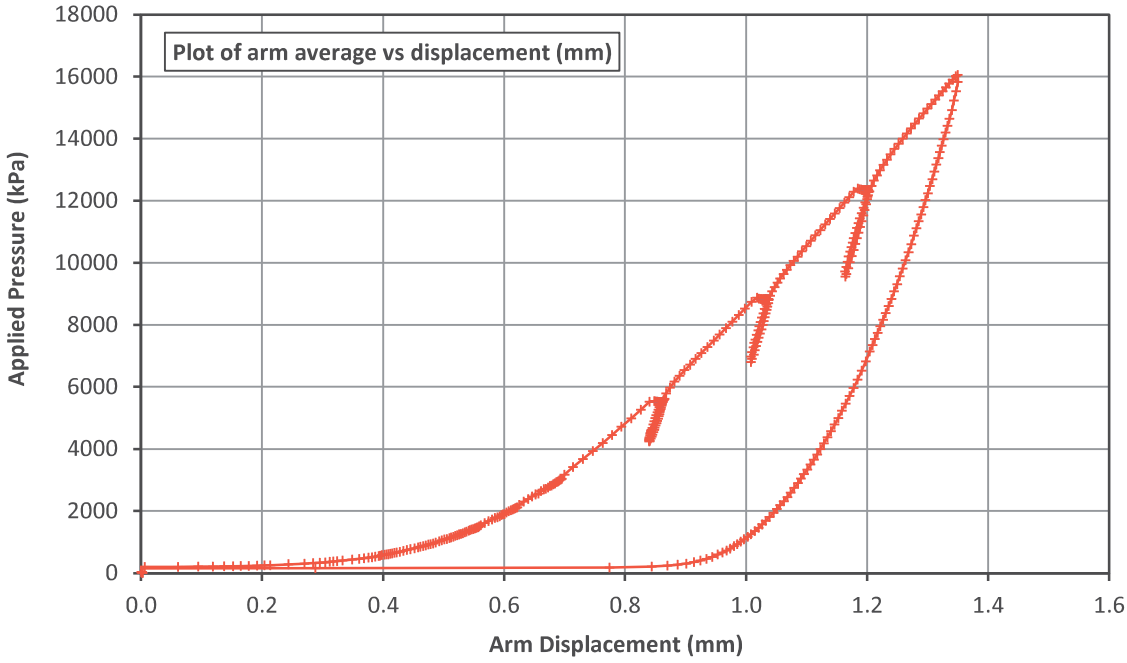
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	23.20 m	Arm 1:	-2378.4	122.9	TPC A:	291.9	102.9
Water level:	9.80 m	Arm 2:	-2041.7	124.9	TPC B:	-2134.5	110.7
		Arm 3:	-2290.3	129.5			
Test time:		Arm 4:	-2119.9	127.4			
Start (probe in):	12:05 hrs	Arm 5:	-2290.6	132.1			
Finish (probe out):	14:10 hrs	Arm 6:	-2139.9	124.1			

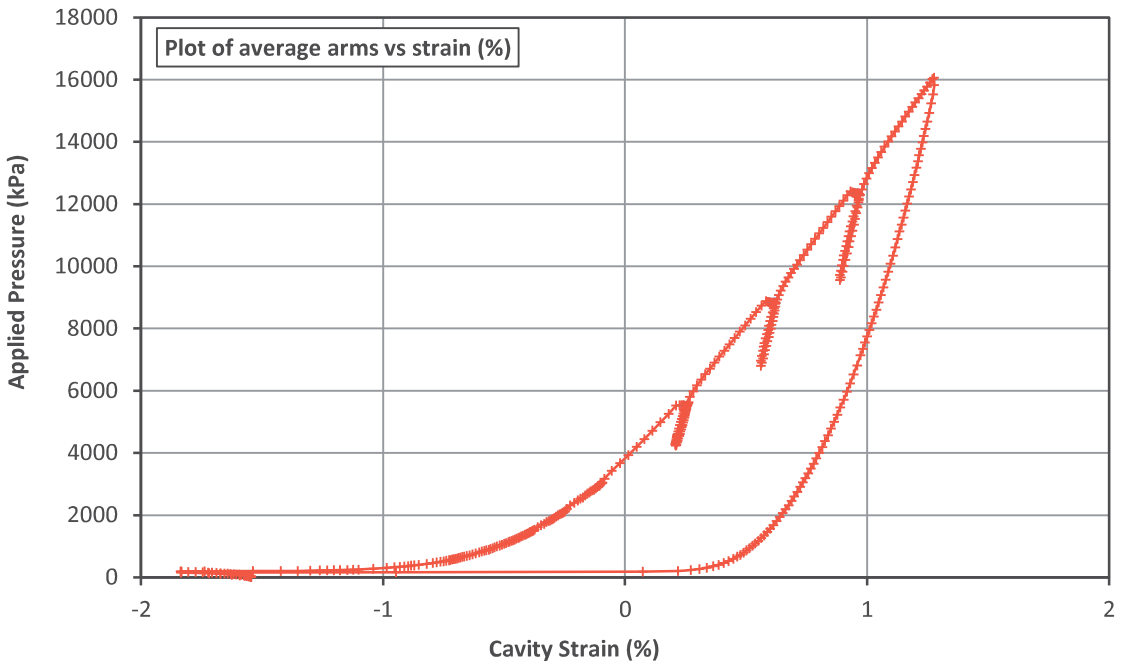
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T04 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	22/04/2021	**Test No.**	4
Borehole	BH1R	**Test Depth (m)**	24.30



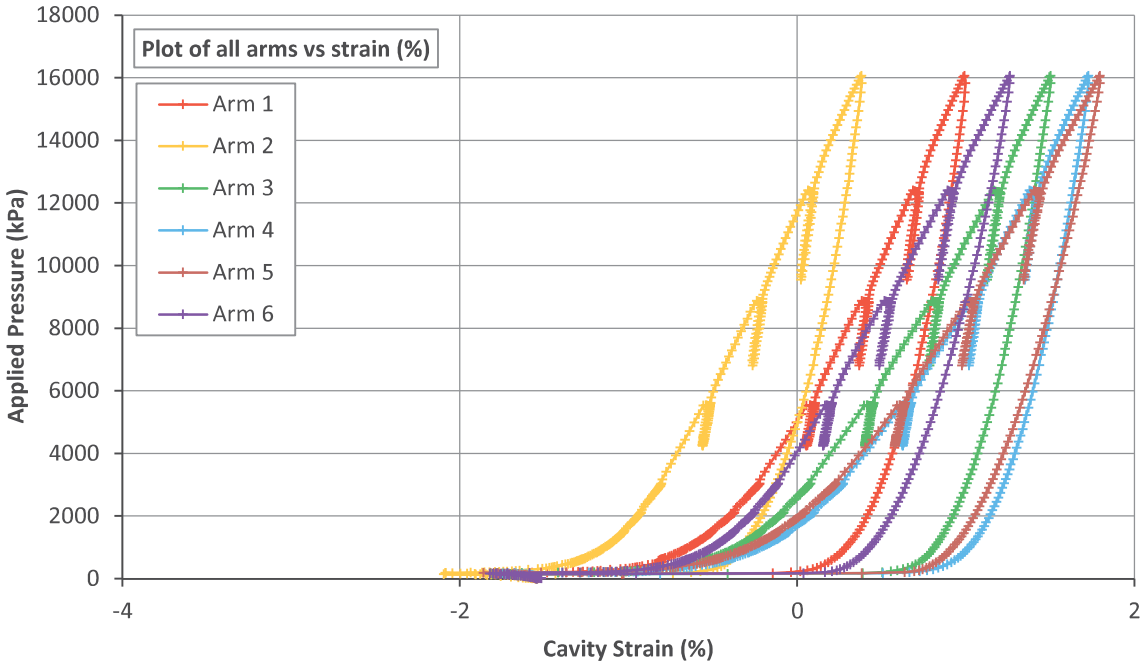


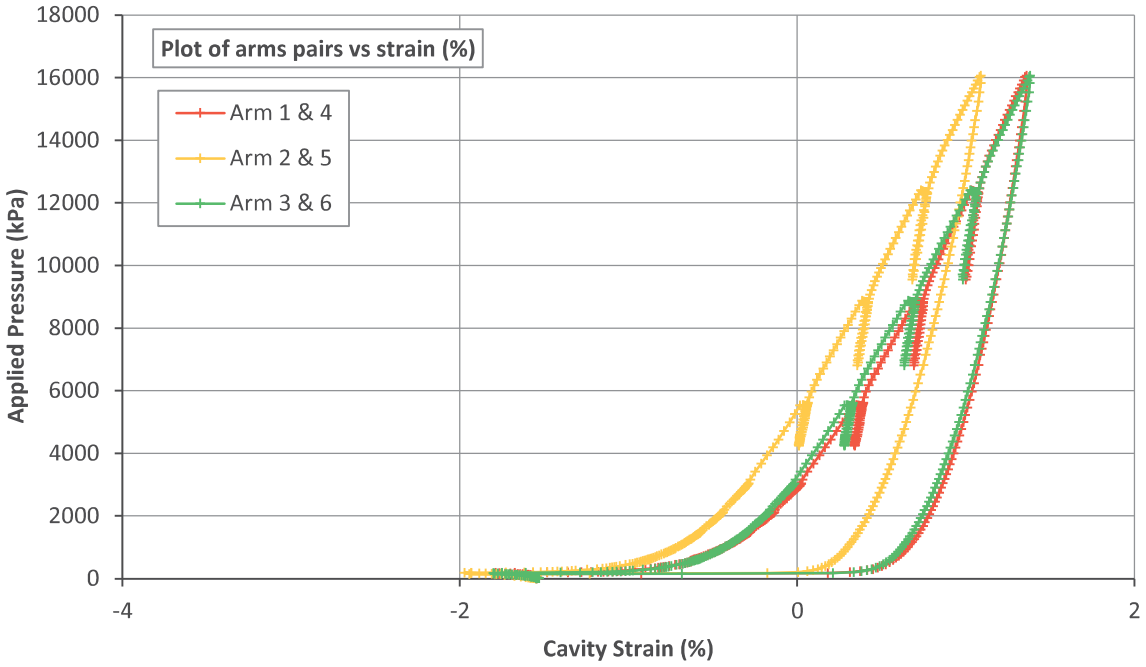
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T04 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	22/04/2021	**Test No.**	4
Borehole	BH1R	**Test Depth (m)**	24.30



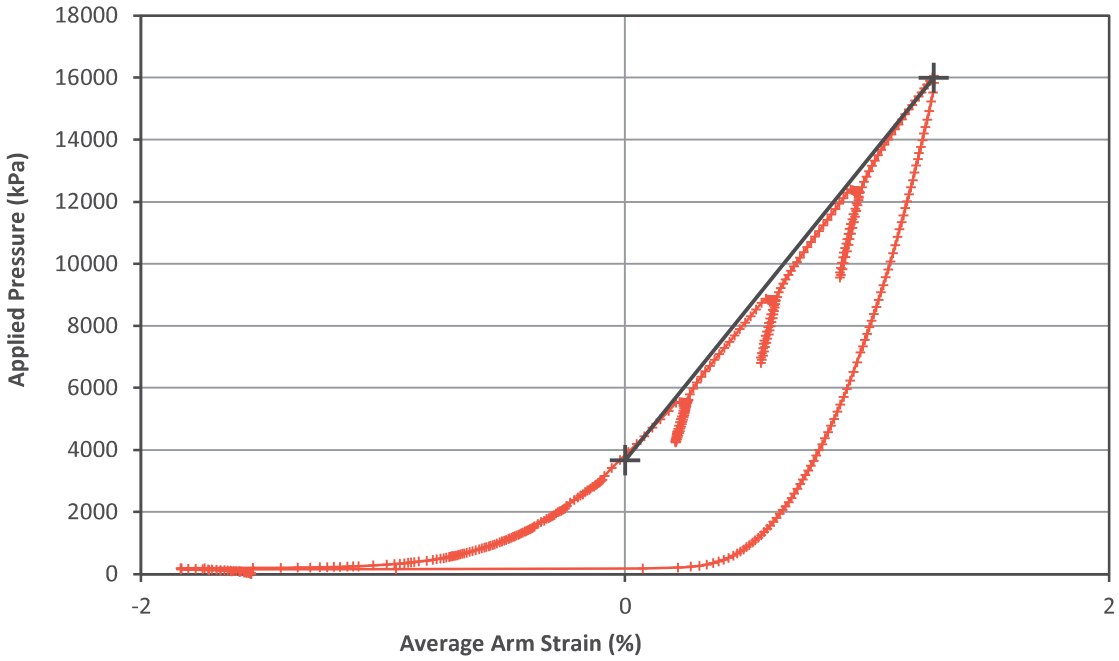


Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T04 - 03**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	22/04/2021	**Test No.**	4
Borehole	BH1R	**Test Depth (m)**	24.30



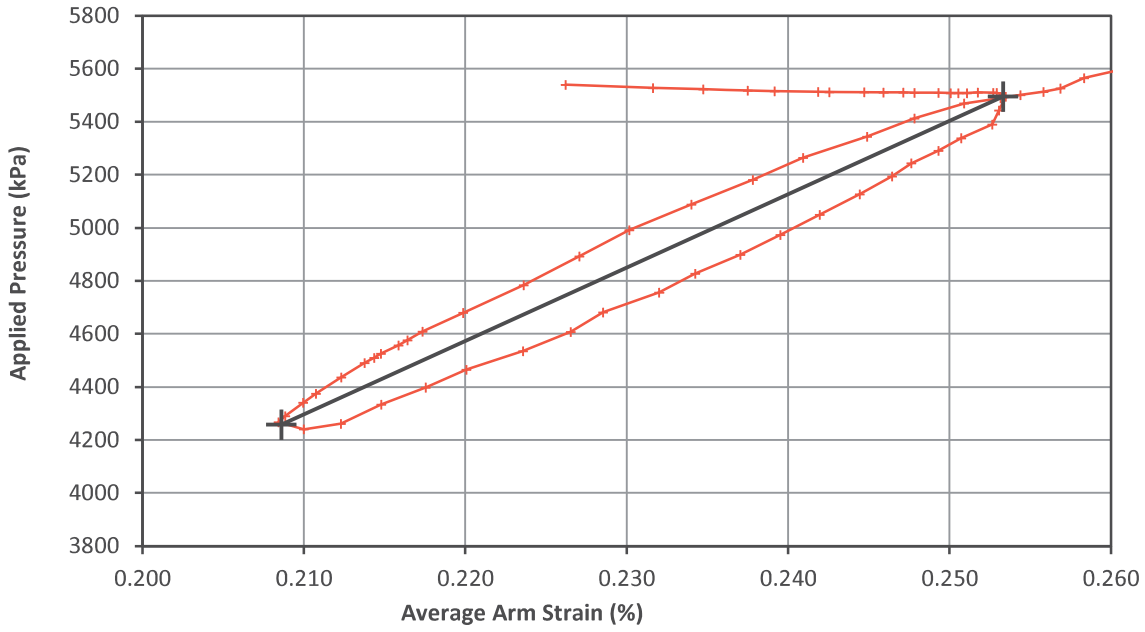
Initial Modulus	Shear Modulus	489.6 MPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T04 - 04**
Client	GeoAssist		
Project No.	P1210114		

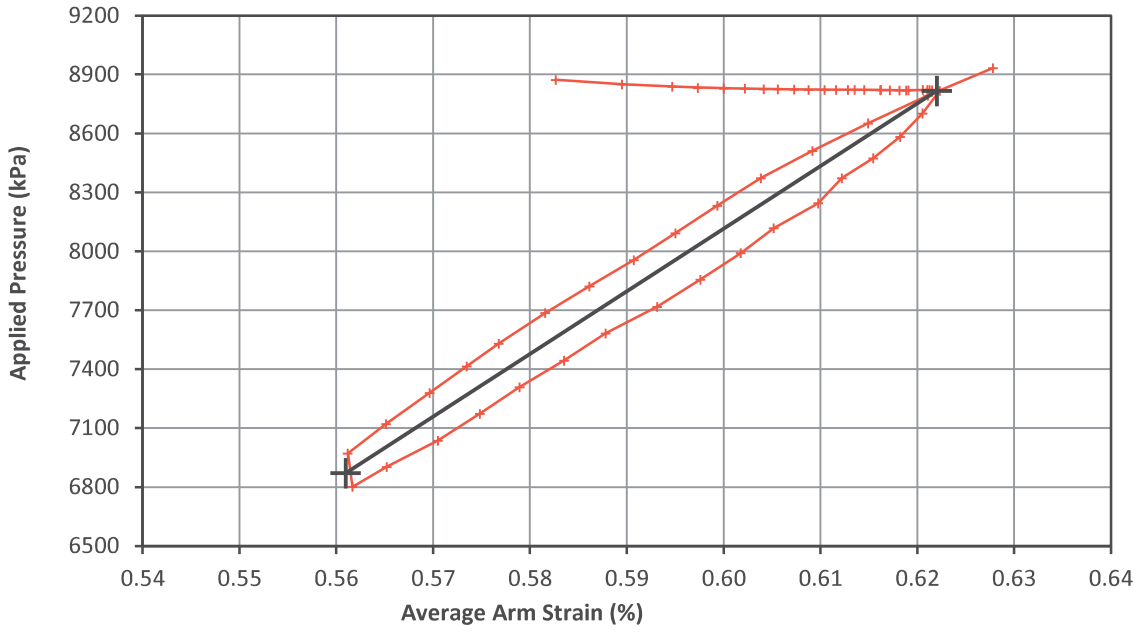
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	22/04/2021	Test No.	4
Borehole	BH1R	Test Depth (m)	24.30



Loop 1	Shear Modulus	1387.5 MPa
	Cavity Strain Range	0.045 %



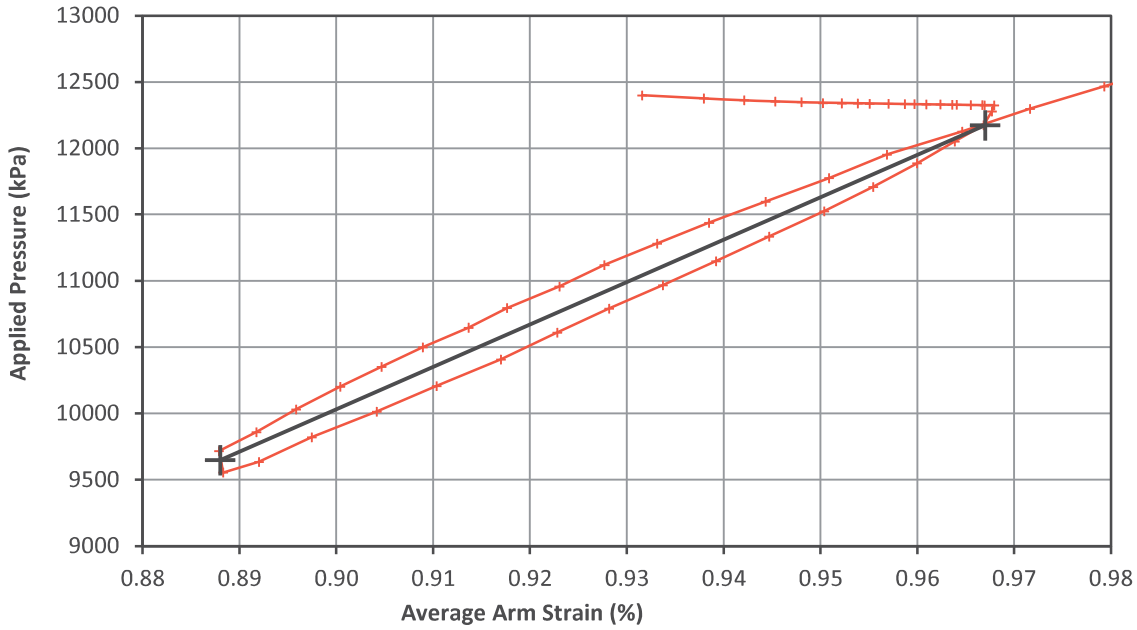
Loop 2	Shear Modulus	1605.6 MPa
	Cavity Strain Range	0.061 %

Project	Great Jackson Street, Manchester	Figure No.	BH1R T04 - 05
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	22/04/2021	**Test No.**	4
Borehole	BH1R	**Test Depth (m)**	24.30



Loop 3	Shear Modulus	1612.9	MPa
	Cavity Strain Range	0.079	%

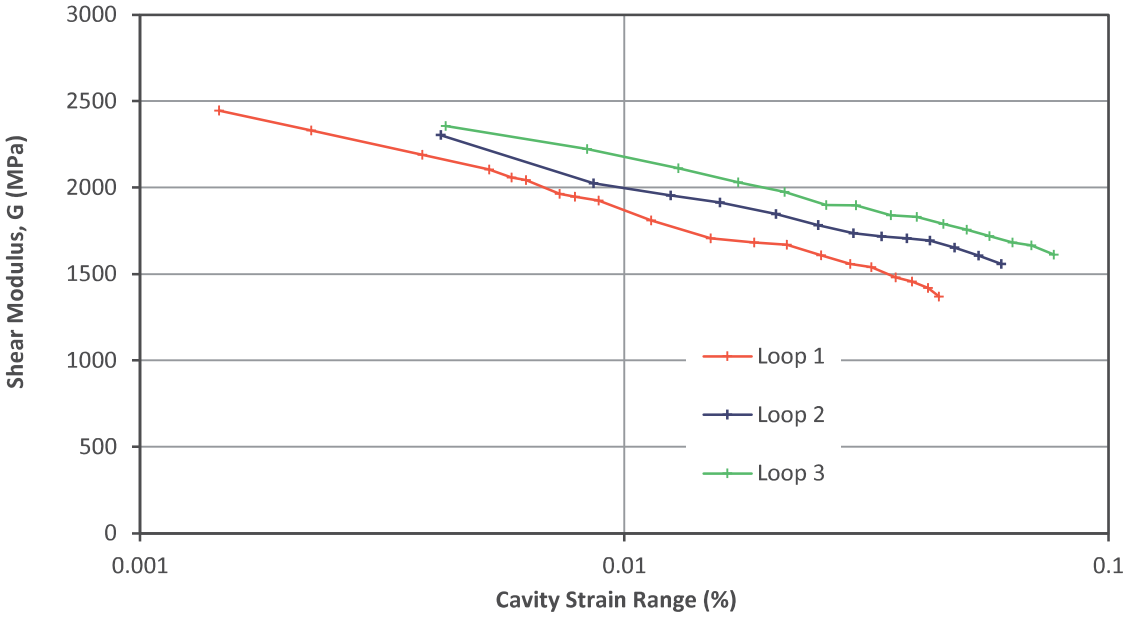
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T04 - 06**
Client	GeoAssist		
Project No.	P1210114		

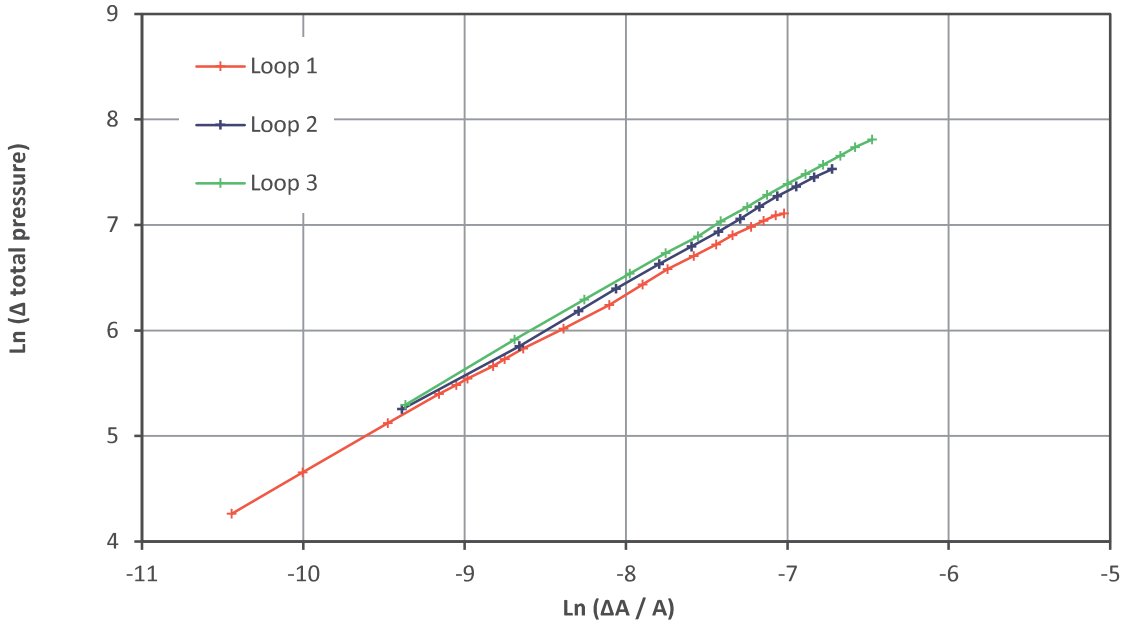
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	22/04/2021	Test No.	4
Borehole	BH1R	Test Depth (m)	24.30





Loop 1		Loop 2		Loop 3	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.832	442.285 (MPa)	0.865	637.146 (MPa)	0.869	705.170 (MPa)

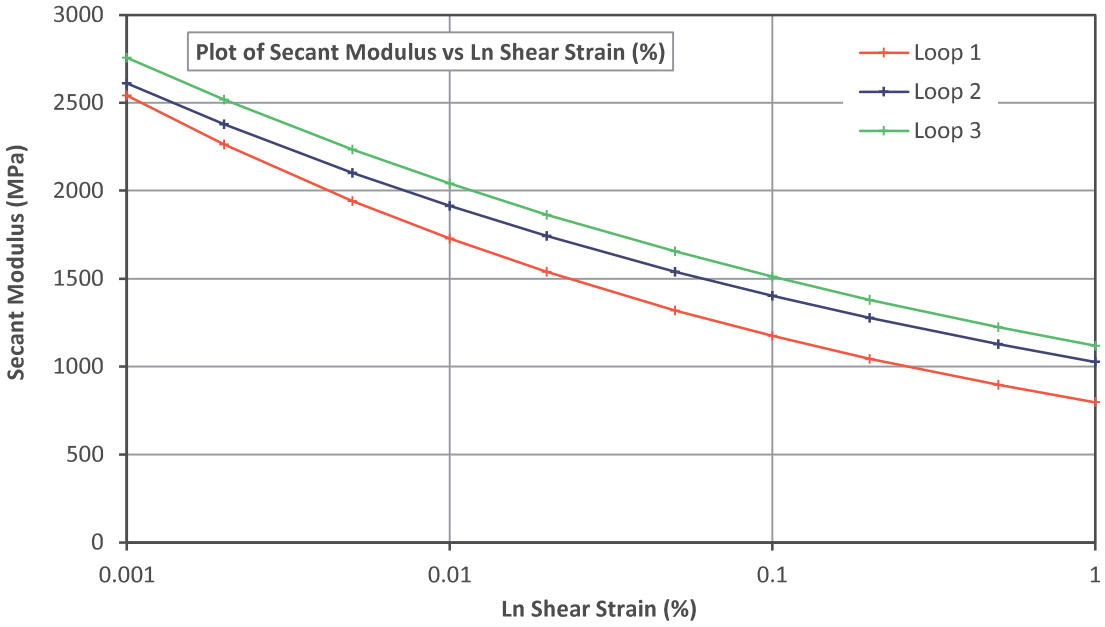
Project	Great Jackson Street, Manchester	Figure No.	BH1R T04 - 07
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	22/04/2021	Test No.	4
Borehole	BH1R	Test Depth (m)	24.30



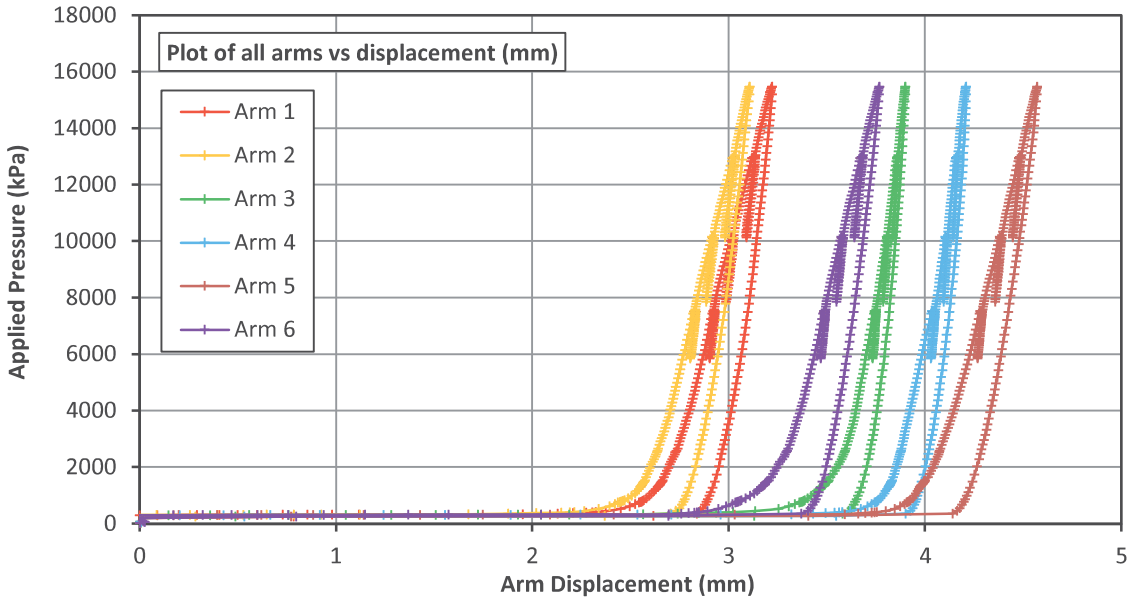
Shear Strain	Loop 1	Loop 2	Loop 3
0.001%	**2543**	**2611**	**2757**
0.002%	2264	2378	2518
0.005%	1941	2101	2234
0.010%	**1728**	**1913**	**2041**
0.020%	1538	1742	1864
0.050%	1319	1539	1654
0.100%	**1174**	**1402**	**1511**
0.200%	1045	1276	1380
0.500%	896	1128	1225
1.000%	**797**	**1027**	**1119**

Project	Great Jackson Street, Manchester	Figure No.	BH1R T04 - 08
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	23/04/2021		**Test No.**	5
Borehole	BH1R		**Test Depth (m)**	32.60
Coordinates (m)	383353.9 (E)	397240.7 (N)	**Elevation (m)**	32.28



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	88 %	Test pocket depth range:	
Solid core recovery:	71 %	From: 31.10 m to: 35.50 m	
Rock quality designation:	35 %	Flush: Water	

Test comment:

The test pocket was reasonable with arms lifting off at 2.5 to 4.0mm. The po was estimated to be at 3763kPa, with the following loading section being long and linear. No material yield was observed and the test was taken to a high pressure of 15465kPa. The displacement-pressure response shown by the arms was consistent, albeit at slightly varying expansion. Analysis of three unload reload loops provides modulus values of 1842 to 1872MPa.

Test details: **Instrument:** Eleanor (HPD04)

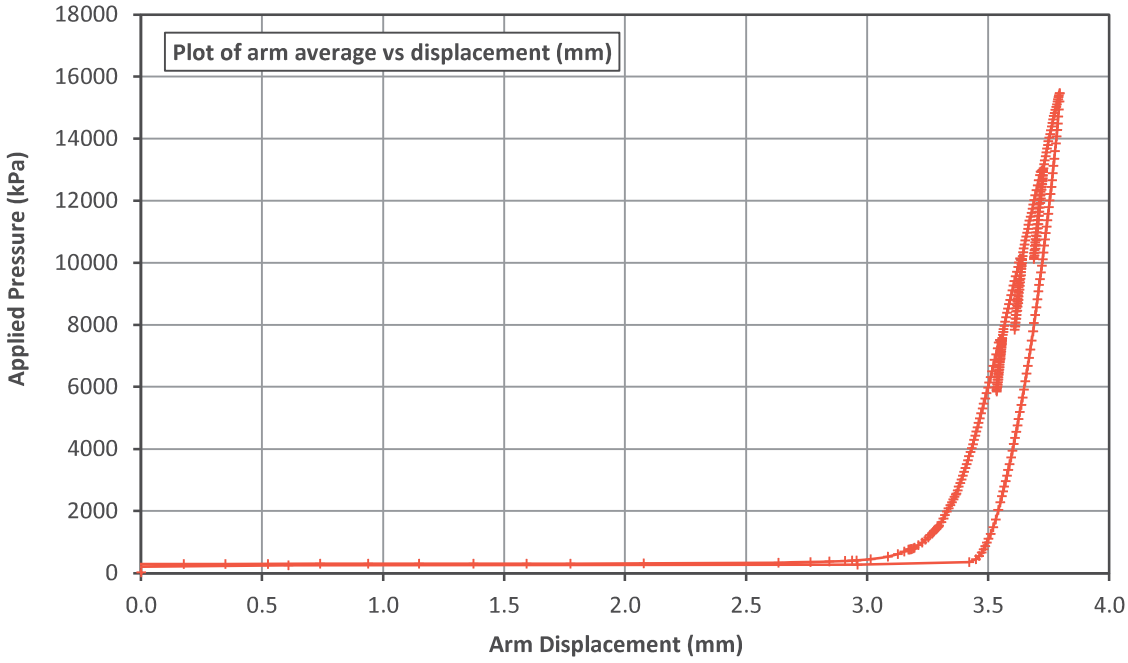
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	30.50 m	Arm 1:	-2373.0	122.9	TPC A:	292.7	102.9
Water level:	9.40 m	Arm 2:	-2033.1	124.9	TPC B:	-2136.4	110.7
		Arm 3:	-2289.1	129.5			
Test time:		Arm 4:	-2118.8	127.4			
Start (probe in):	12:00 hrs	Arm 5:	-2289.3	132.1			
Finish (probe out):	13:50 hrs	Arm 6:	-2138.3	124.1			

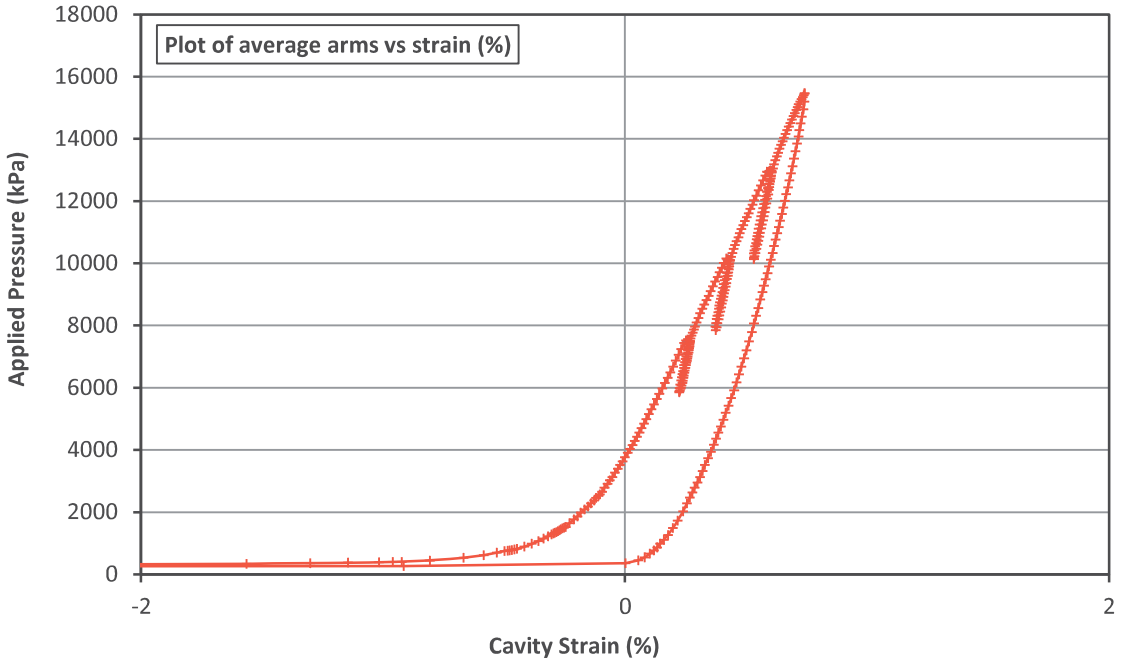
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T05 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	23/04/2021	**Test No.**	5
Borehole	BH1R	**Test Depth (m)**	32.60



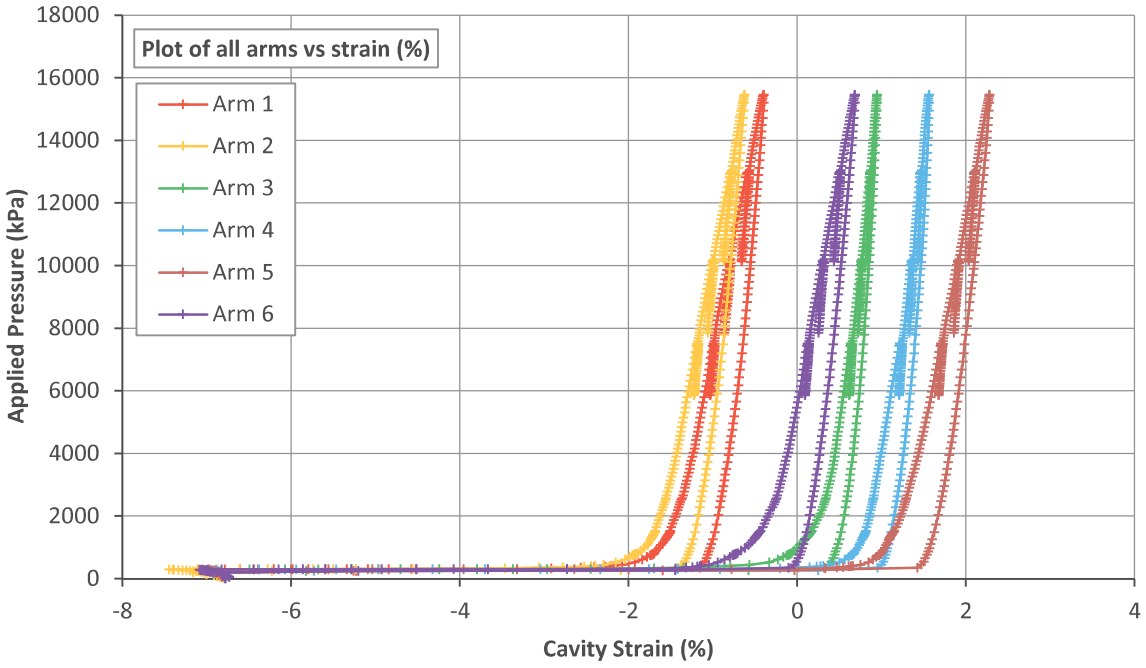


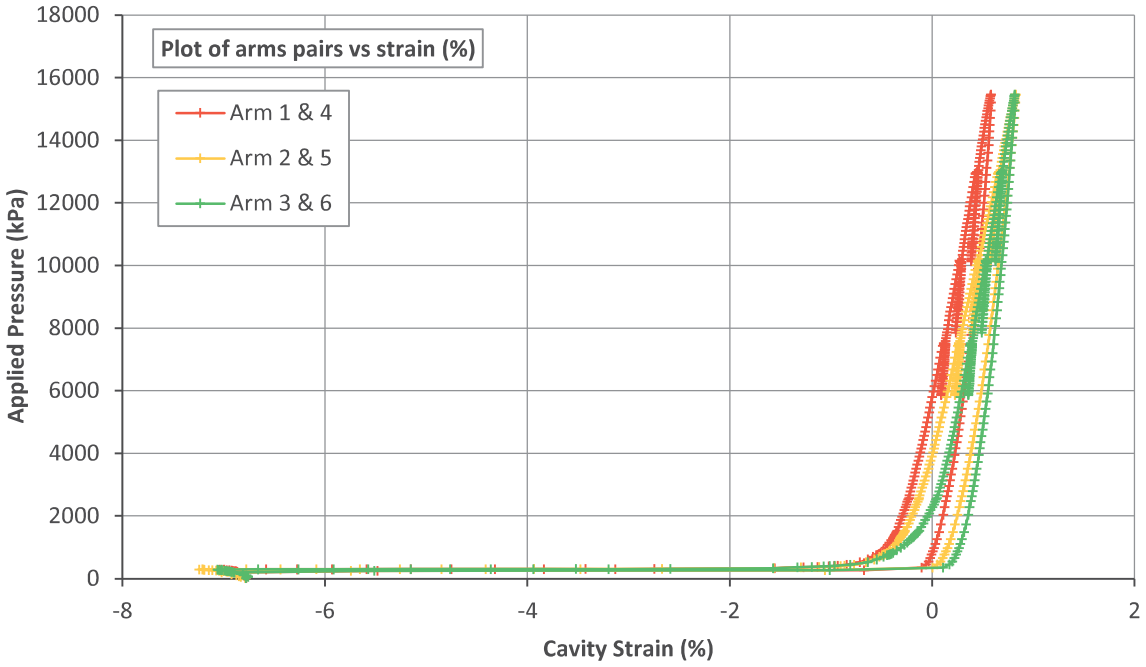
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T05 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	23/04/2021	**Test No.**	5
Borehole	BH1R	**Test Depth (m)**	32.60



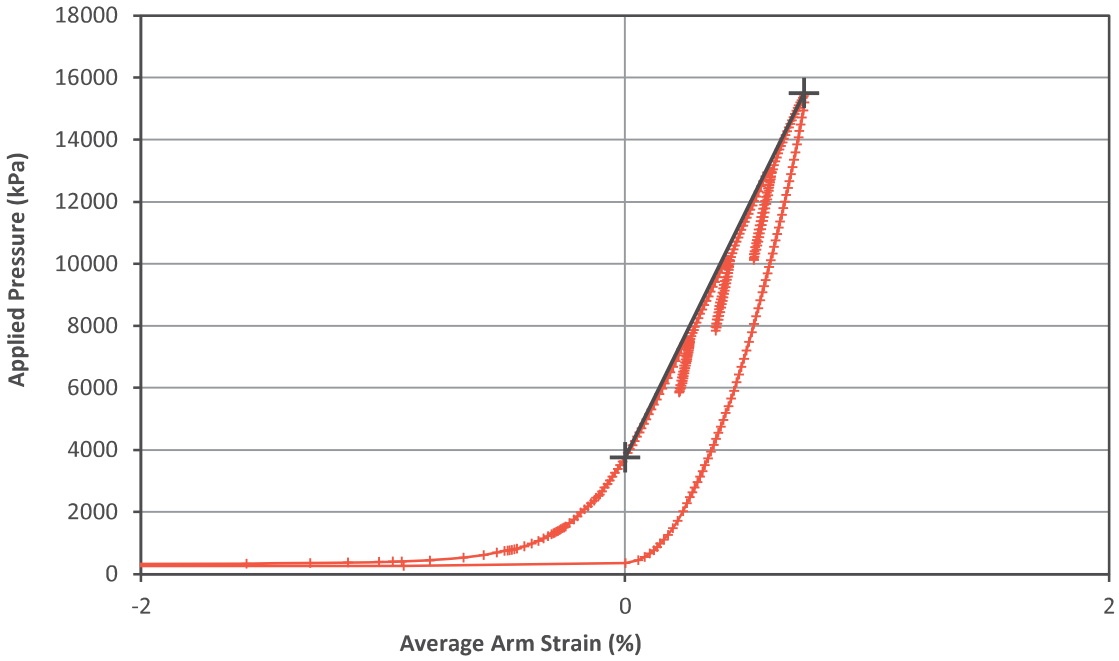


Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T05 - 03**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	23/04/2021	**Test No.**	5
Borehole	BH1R	**Test Depth (m)**	32.60



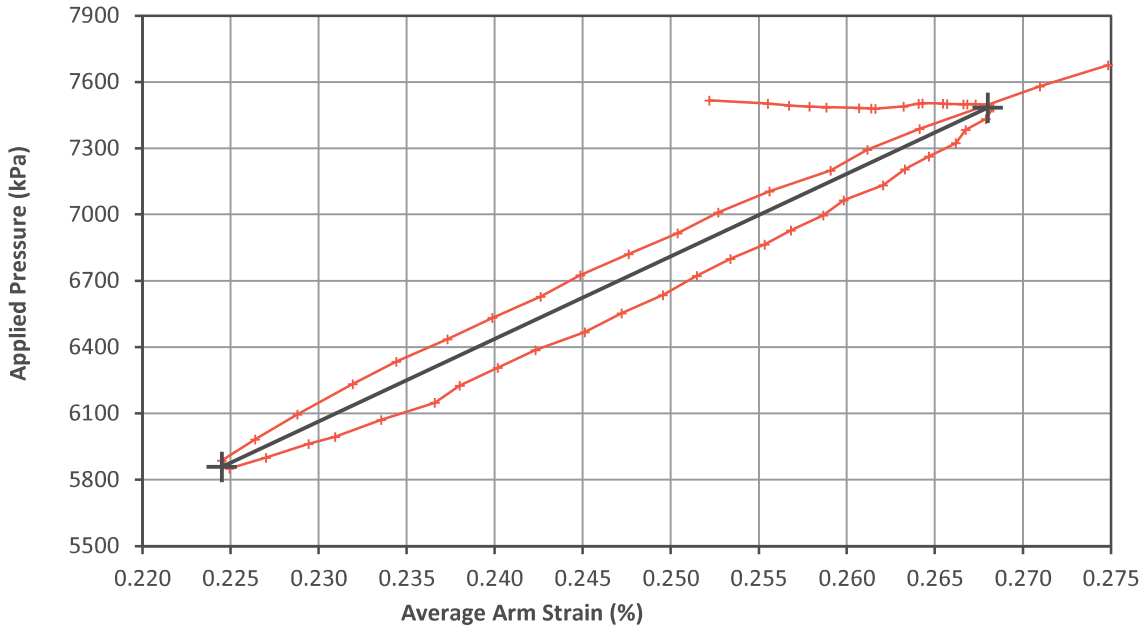
Initial Modulus	Shear Modulus	798.9 MPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T05 - 04**
Client	GeoAssist		
Project No.	P1210114		

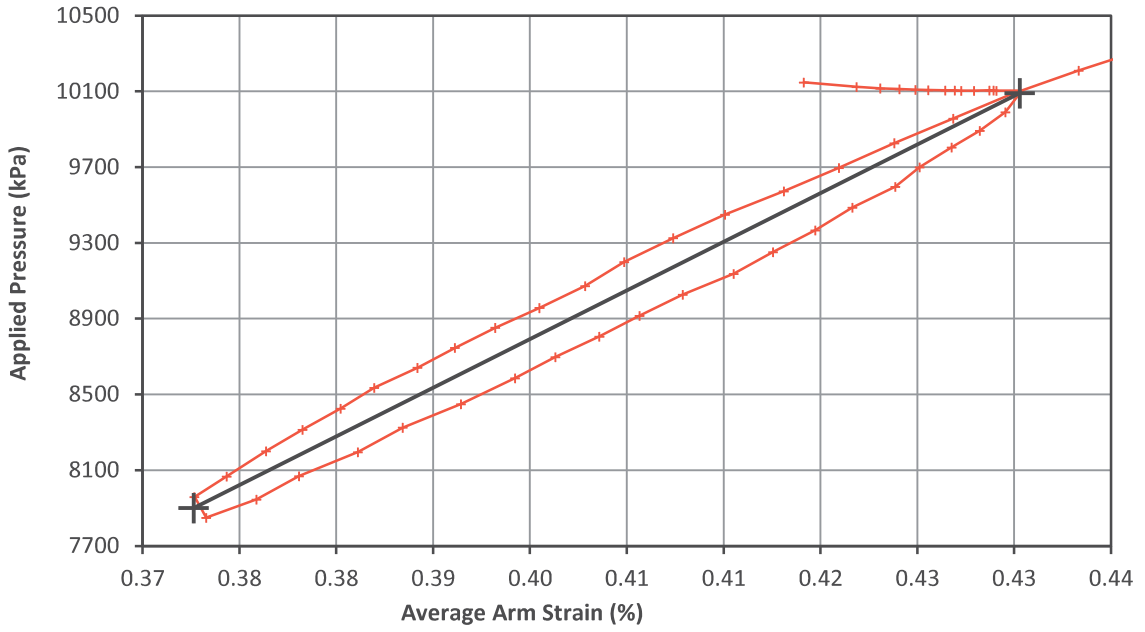
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	23/04/2021	Test No.	5
Borehole	BH1R	Test Depth (m)	32.60



Loop 1	Shear Modulus	1872.4 MPa
	Cavity Strain Range	0.044 %



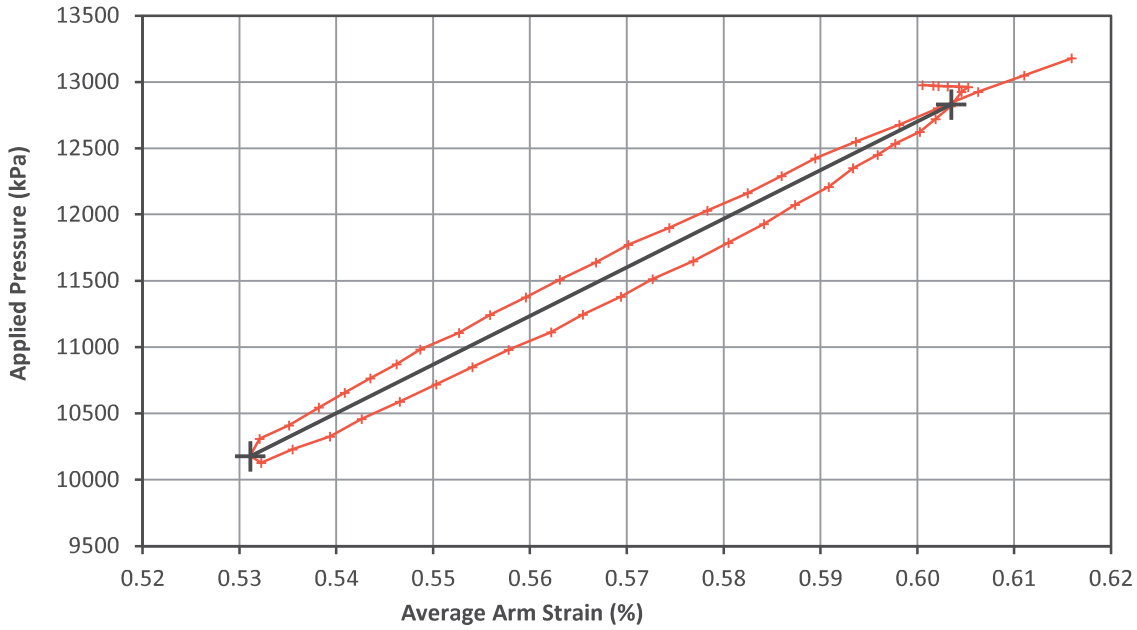
Loop 2	Shear Modulus	1843.7 MPa
	Cavity Strain Range	0.060 %

Project	Great Jackson Street, Manchester	Figure No.	BH1R T05 - 05
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	23/04/2021	**Test No.**	5
Borehole	BH1R	**Test Depth (m)**	32.60



Loop 3	Shear Modulus	1842.0	MPa
	Cavity Strain Range	0.072	%

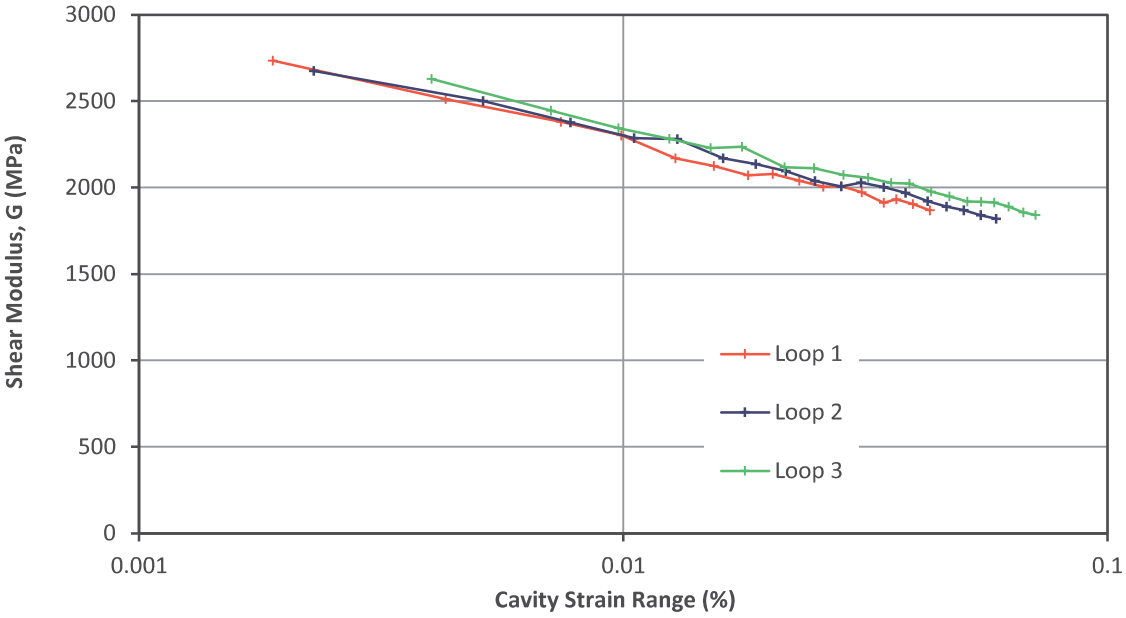
Project	Great Jackson Street, Manchester	**Figure No.**	**BH1R T05 - 06**
Client	GeoAssist		
Project No.	P1210114		

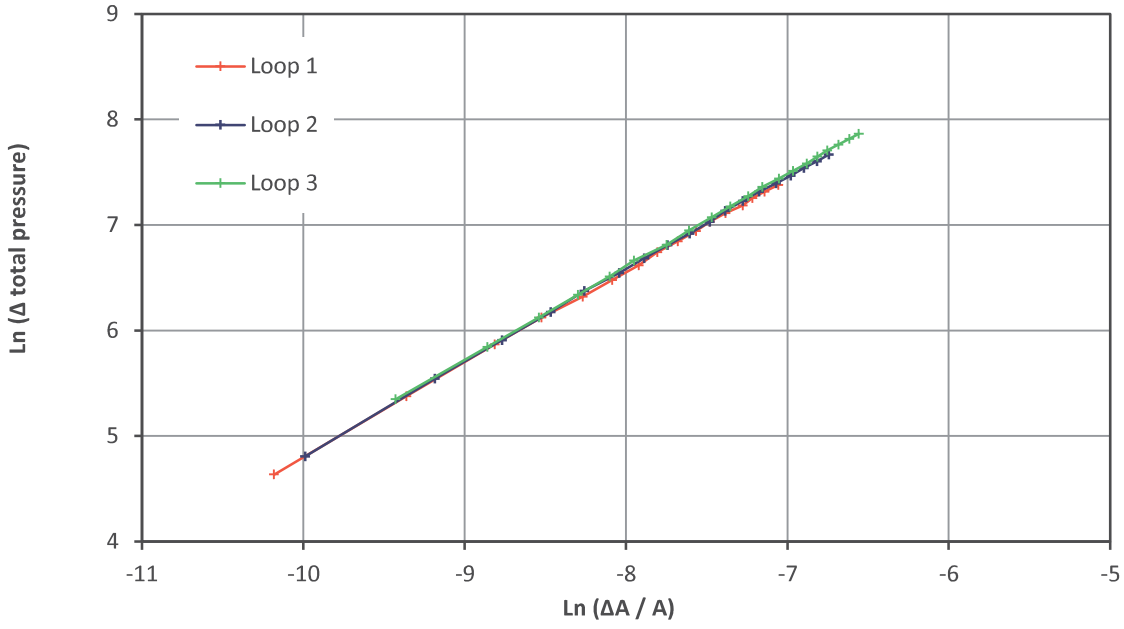
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	23/04/2021	Test No.	5
Borehole	BH1R	Test Depth (m)	32.60





Loop 1		Loop 2		Loop 3	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.877	788.479 (MPa)	0.879	813.061 (MPa)	0.880	840.975 (MPa)

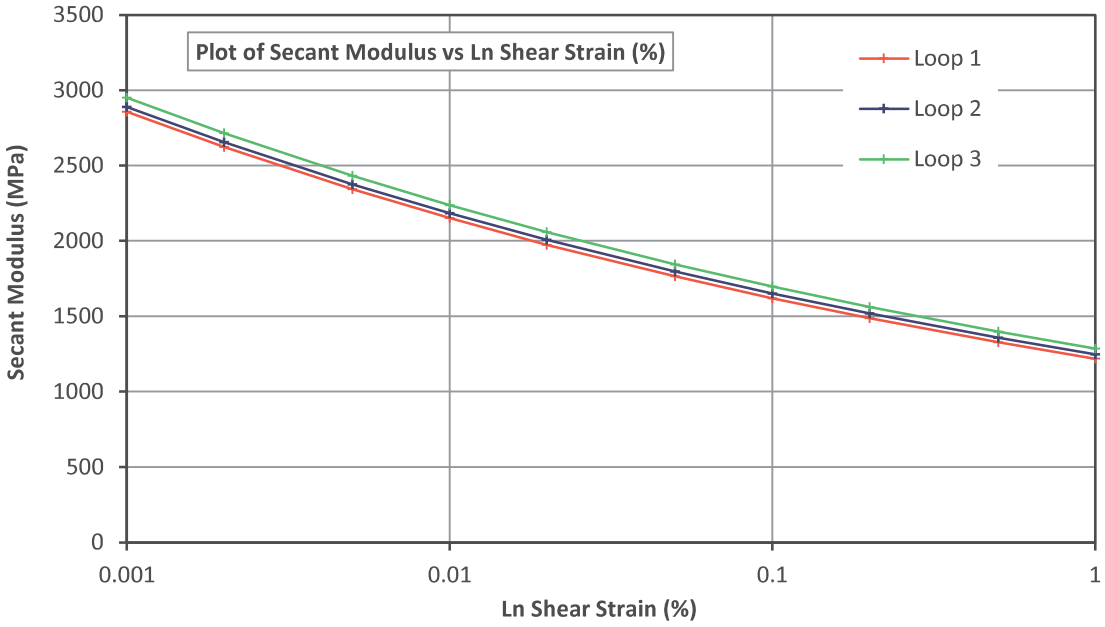
Project	Great Jackson Street, Manchester	Figure No.	BH1R T05 - 07
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	23/04/2021	Test No.	5
Borehole	BH1R	Test Depth (m)	32.60



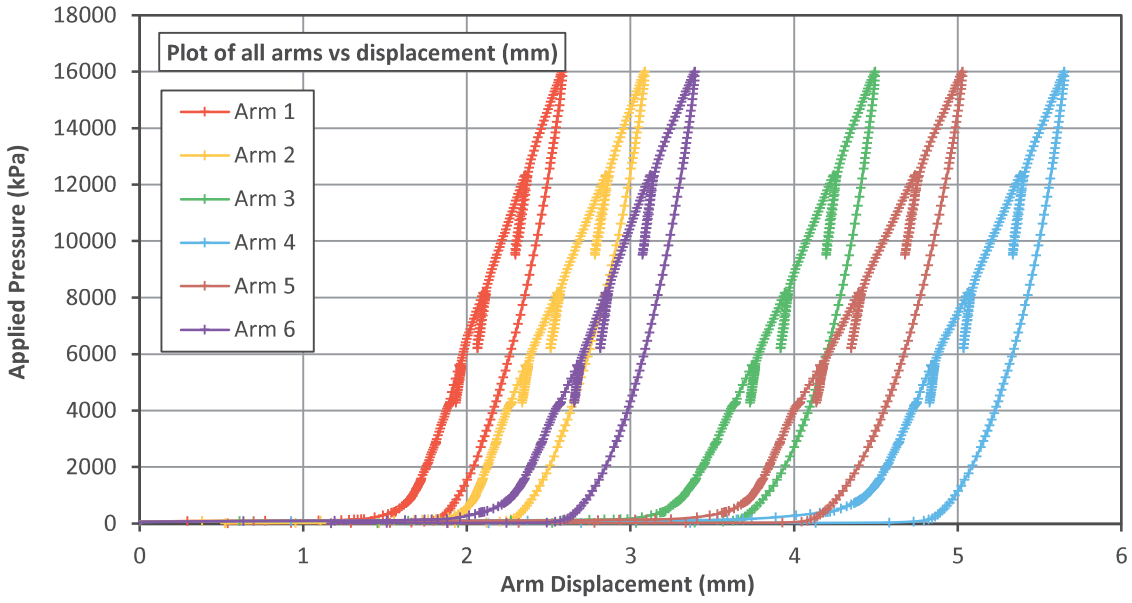
Shear Strain	Loop 1	Loop 2	Loop 3
0.001%	**2857**	**2889**	**2951**
0.002%	2623	2656	2715
0.005%	2343	2376	2432
0.010%	**2151**	**2184**	**2238**
0.020%	1975	2008	2059
0.050%	1764	1797	1844
0.100%	**1620**	**1652**	**1697**
0.200%	1487	1519	1561
0.500%	1328	1359	1398
1.000%	**1219**	**1249**	**1287**

Project	Great Jackson Street, Manchester	Figure No.	BH1R T05 - 08
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	26/04/2021		**Test No.**	1
Borehole	BH4R		**Test Depth (m)**	10.70
Coordinates (m)	383464.9 (E)	397232.7 (N)	**Elevation (m)**	33.26



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	100 %	Test pocket depth range:	
Solid core recovery:	91 %	From: 9.90 m to: 12.10 m	
Rock quality designation:	64 %	Flush: Water	

Test comment:

The test pocket was reasonable with arms lifting off at 1.5 to 4.5mm. The po was estimated to be at 1913kPa, with the following loading section being long and linear. No material yield was seen and the test was taken to a high pressure of 15998kPa. The displacement-pressure response shown by the arms was reasonably consistent albeit with some slight variation in expansion. Analysis of three unload reload loops provides modulus values of 963 to 972MPa.

Test details: **Instrument:** Eleanor (HPD04)

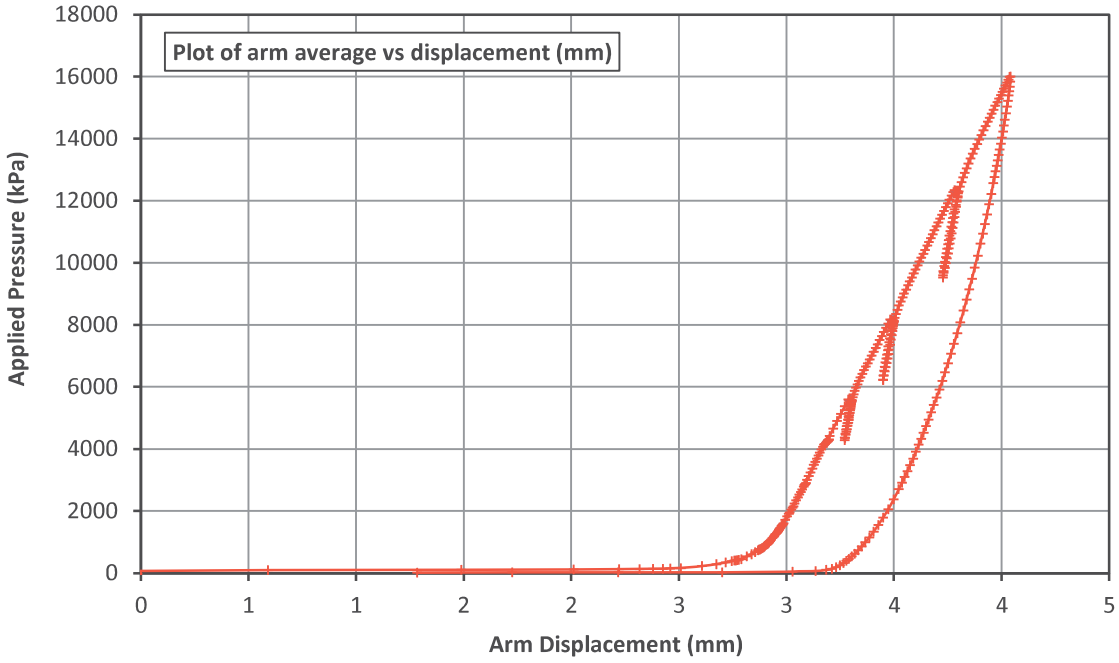
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	9.90 m	Arm 1:	-2381.3	122.9	TPC A:	292.6	102.9
Water level:	9.00 m	Arm 2:	-2055.5	124.9	TPC B:	-2133.8	110.7
		Arm 3:	-2295.5	129.5			
Test time:		Arm 4:	-2122.7	127.4			
Start (probe in):	11:50 hrs	Arm 5:	-2298.4	132.1			
Finish (probe out):	13:30 hrs	Arm 6:	-2147.9	124.1			

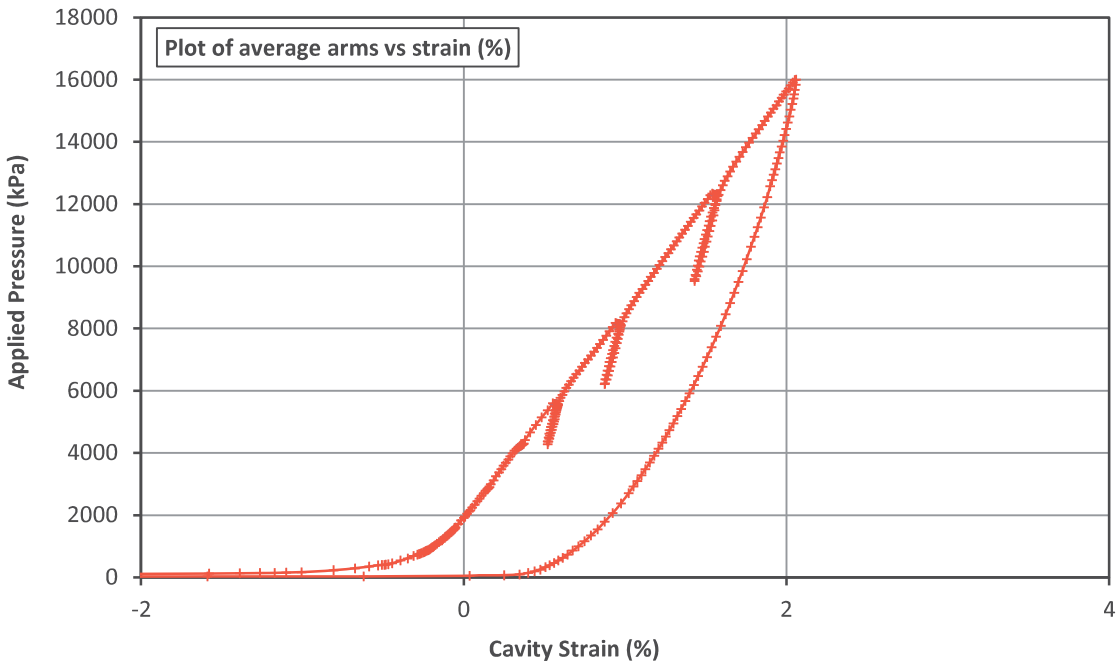
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	26/04/2021	**Test No.**	1
Borehole	BH4R	**Test Depth (m)**	10.70



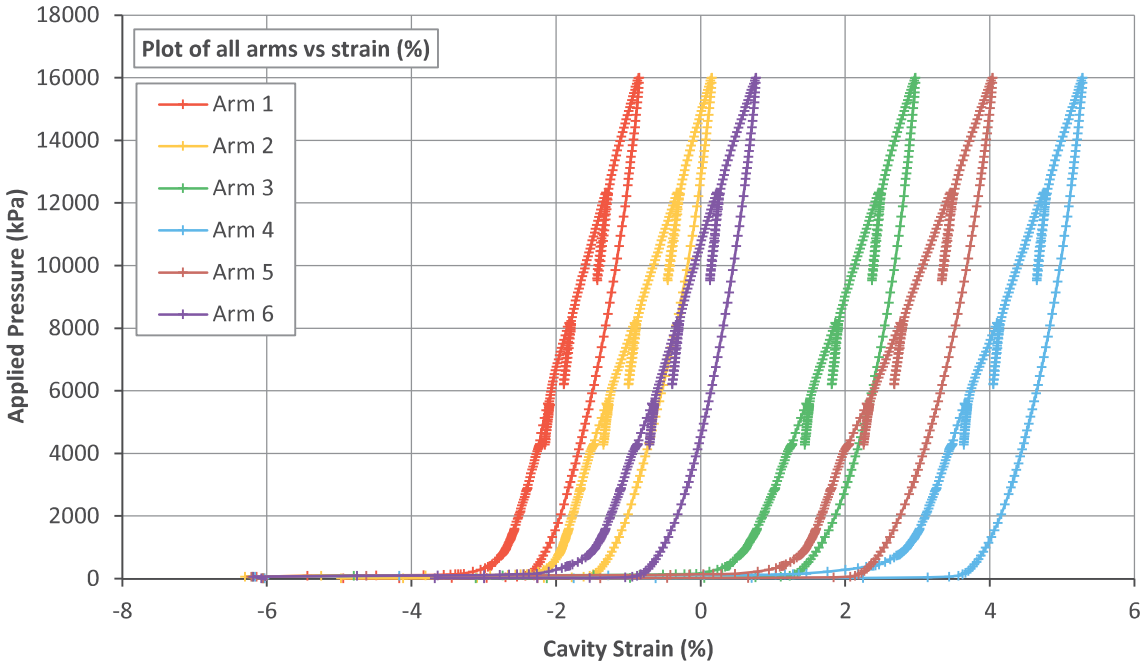


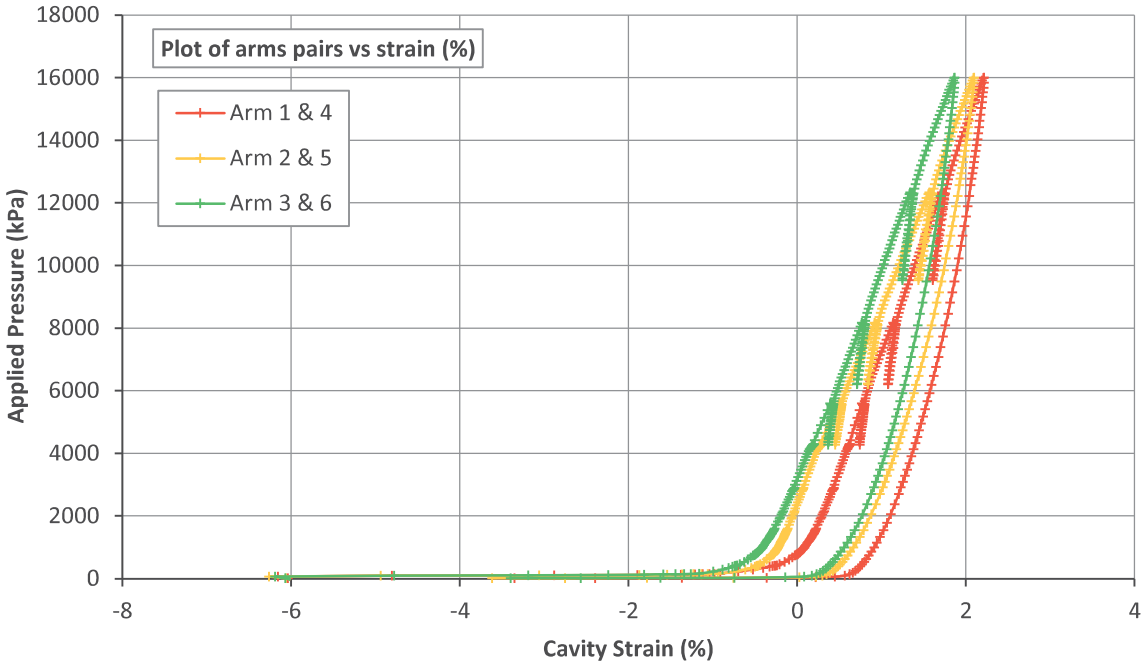
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	26/04/2021	**Test No.**	1
Borehole	BH4R	**Test Depth (m)**	10.70



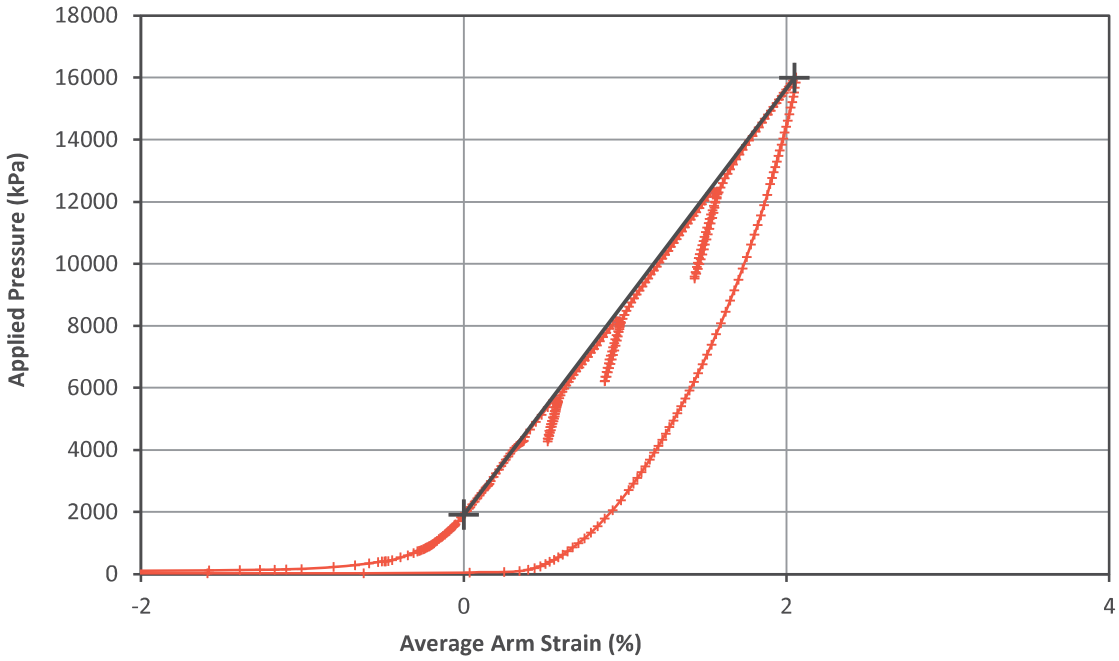


Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 03**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	26/04/2021	**Test No.**	1
Borehole	BH4R	**Test Depth (m)**	10.70



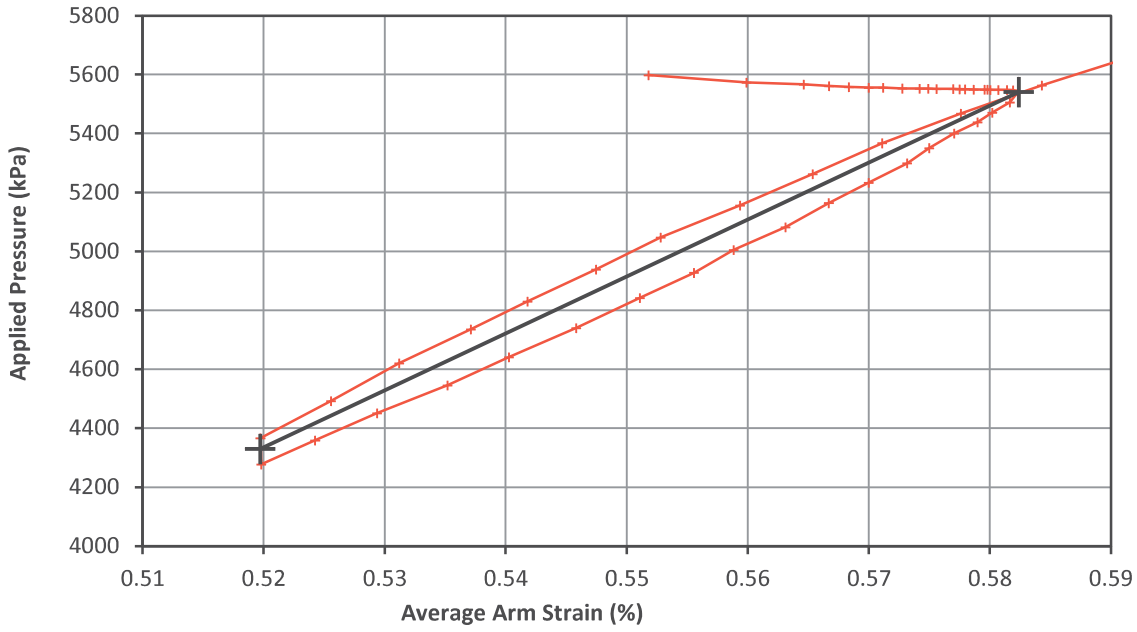
Initial Modulus	Shear Modulus	350.6 MPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 04**
Client	GeoAssist		
Project No.	P1210114		

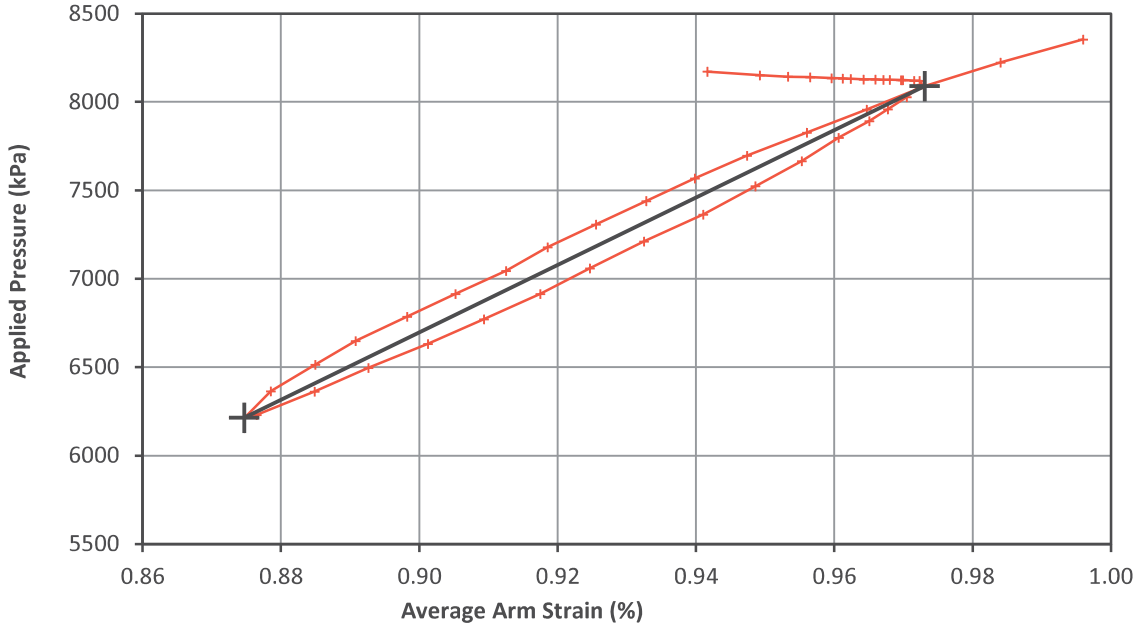
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	26/04/2021	**Test No.**	1
Borehole	BH4R	**Test Depth (m)**	10.70



Loop 1	Shear Modulus	971.9 MPa
	Cavity Strain Range	0.063 %



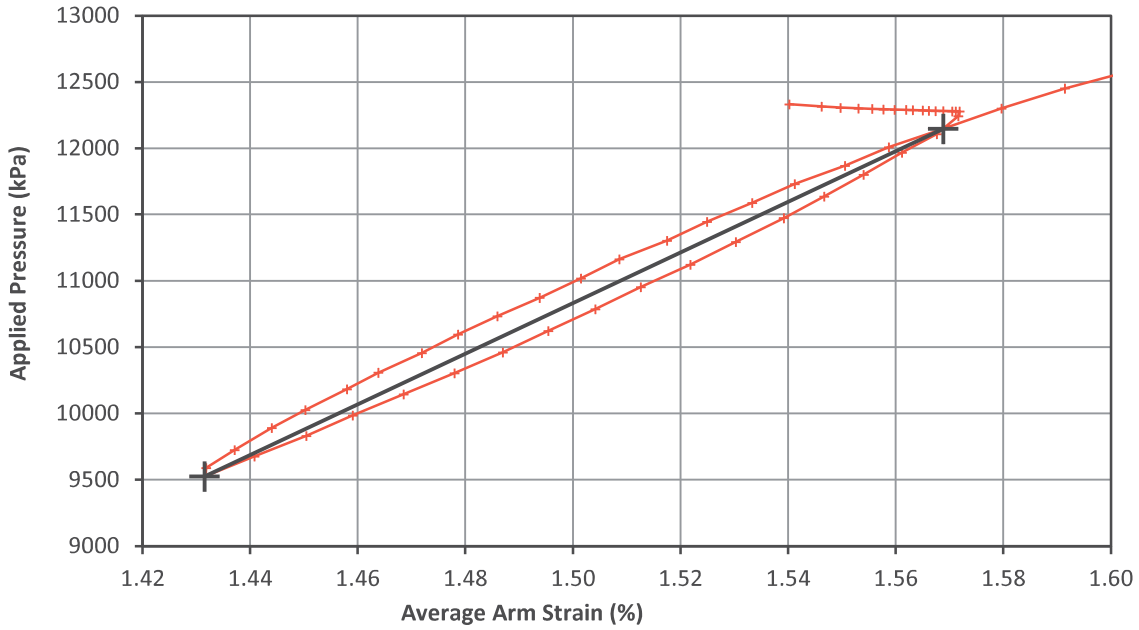
Loop 2	Shear Modulus	962.7 MPa
	Cavity Strain Range	0.098 %

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 05**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	26/04/2021	**Test No.**	1
Borehole	BH4R	**Test Depth (m)**	10.70



Loop 3	Shear Modulus	969.1	MPa
	Cavity Strain Range	0.137	%

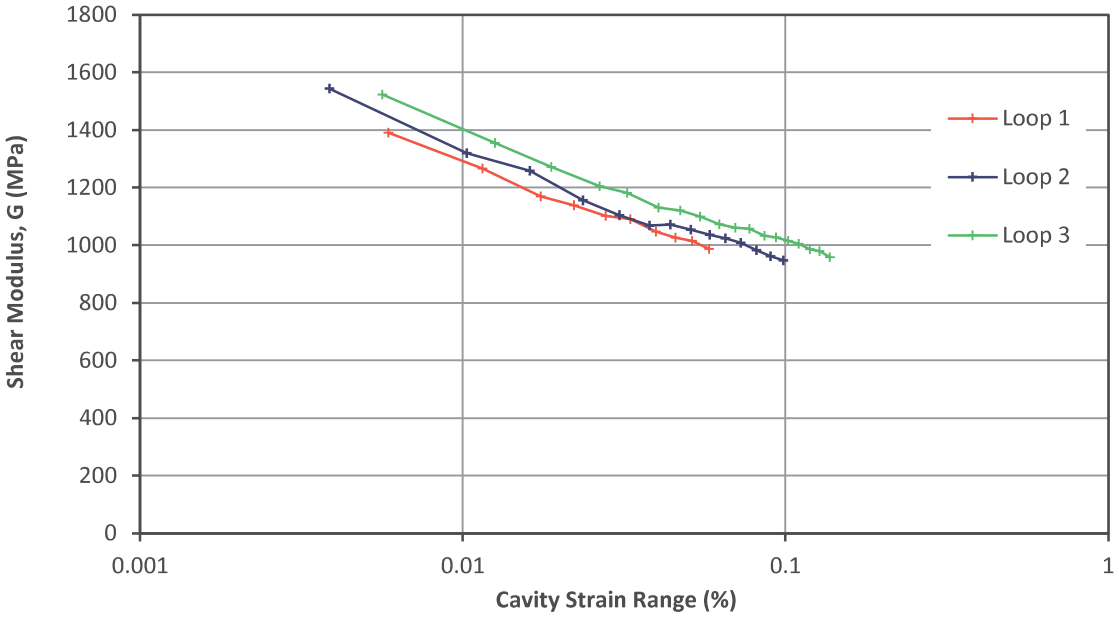
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 06**
Client	GeoAssist		
Project No.	P1210114		

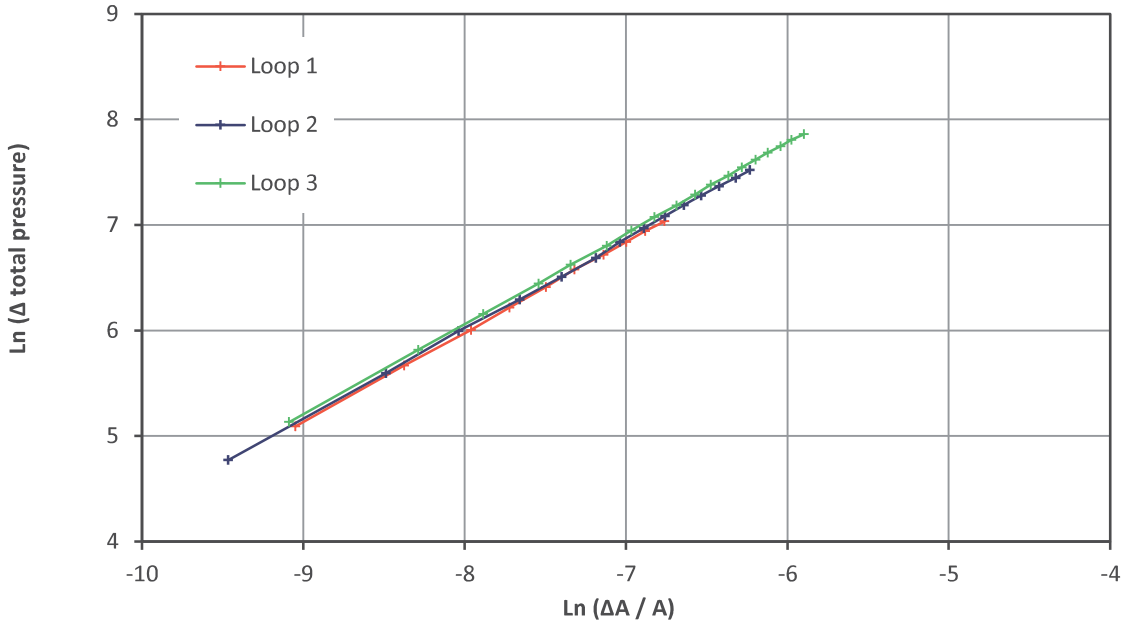
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	26/04/2021	**Test No.**	1
Borehole	BH4R	**Test Depth (m)**	10.70





Loop 1		Loop 2		Loop 3	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.853	364.758 (MPa)	0.854	378.685 (MPa)	0.861	418.792 (MPa)

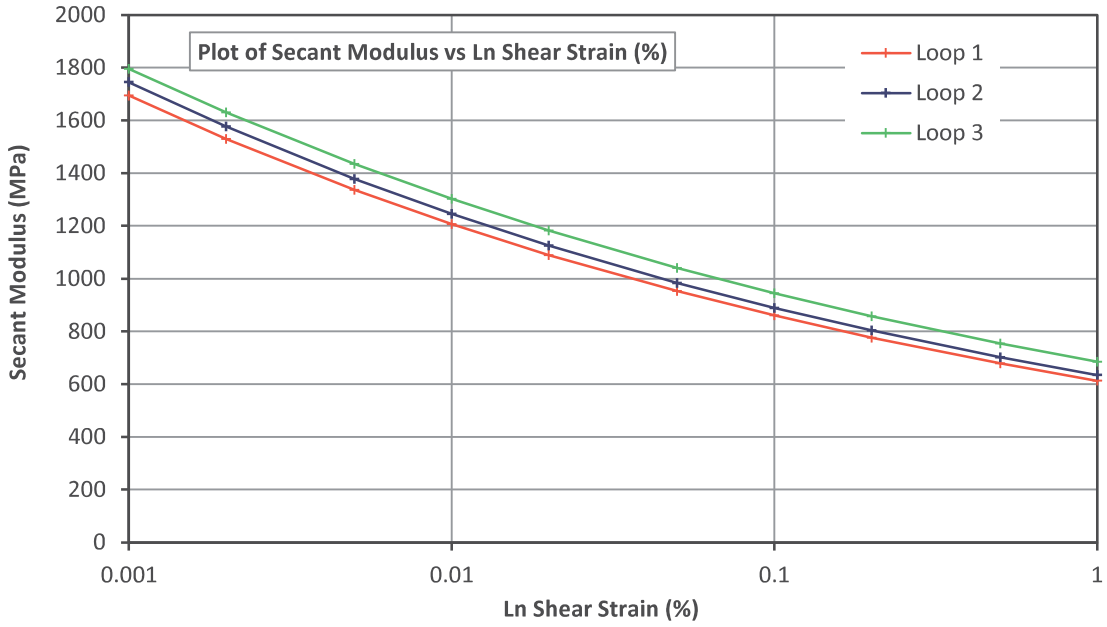
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 07**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	26/04/2021	**Test No.**	1
Borehole	BH4R	**Test Depth (m)**	10.70



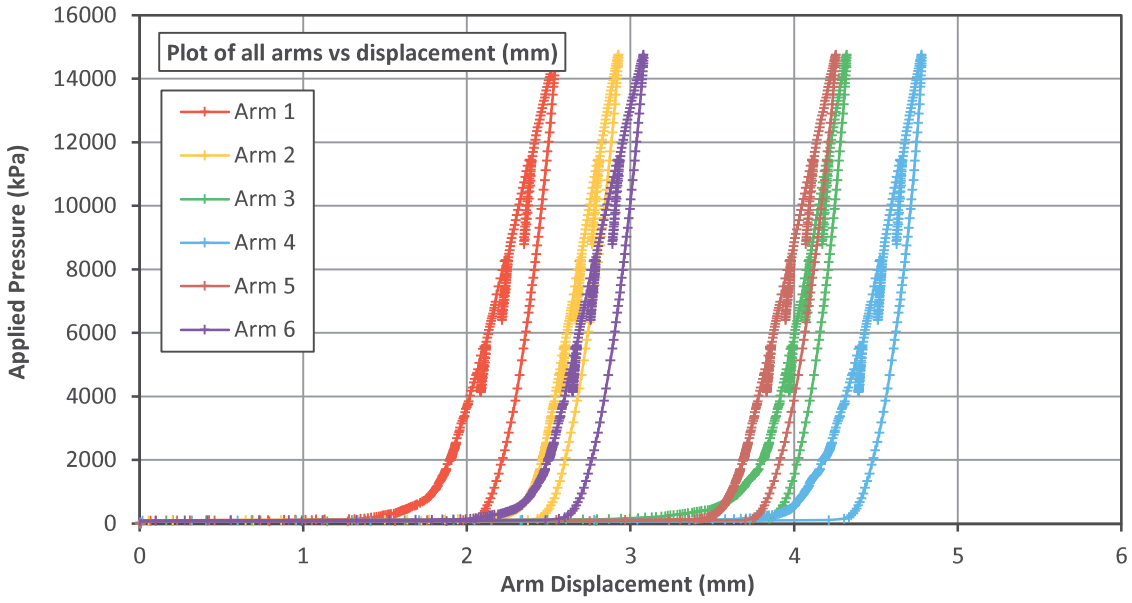
Shear Strain	Loop 1	Loop 2	Loop 3
0.001%	**1694**	**1745**	**1795**
0.002%	1529	1576	1630
0.005%	1336	1379	1434
0.010%	**1207**	**1245**	**1302**
0.020%	1090	1125	1182
0.050%	952	984	1040
0.100%	**860**	**889**	**944**
0.200%	776	803	857
0.500%	679	702	755
1.000%	**613**	**634**	**685**

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T01 - 08**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	27/04/2021		**Test No.**	2
Borehole	BH4R		**Test Depth (m)**	16.50
Coordinates (m)	383464.9 (E)	397232.7 (N)	**Elevation (m)**	33.26



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	88 %	Test pocket depth range:	
Solid core recovery:	81 %	From: 15.20 m to: 17.80 m	
Rock quality designation:	58 %	Flush: Water	

Test comment:

The test pocket was reasonable with arms lifting off at 1.5 to 4.5mm. The po was estimated to be at 2600kPa, with the following loading section being long and linear. No material yield was seen and the test was taken to a high pressure of 14764kPa. The displacement-pressure response shown by the arms was reasonably consistent albeit with some slight variation in expansion. Analysis of three unload reload loops provides increasing modulus values of 1293 to 1512MPa.

Test details: **Instrument:** Eleanor (HPD04)

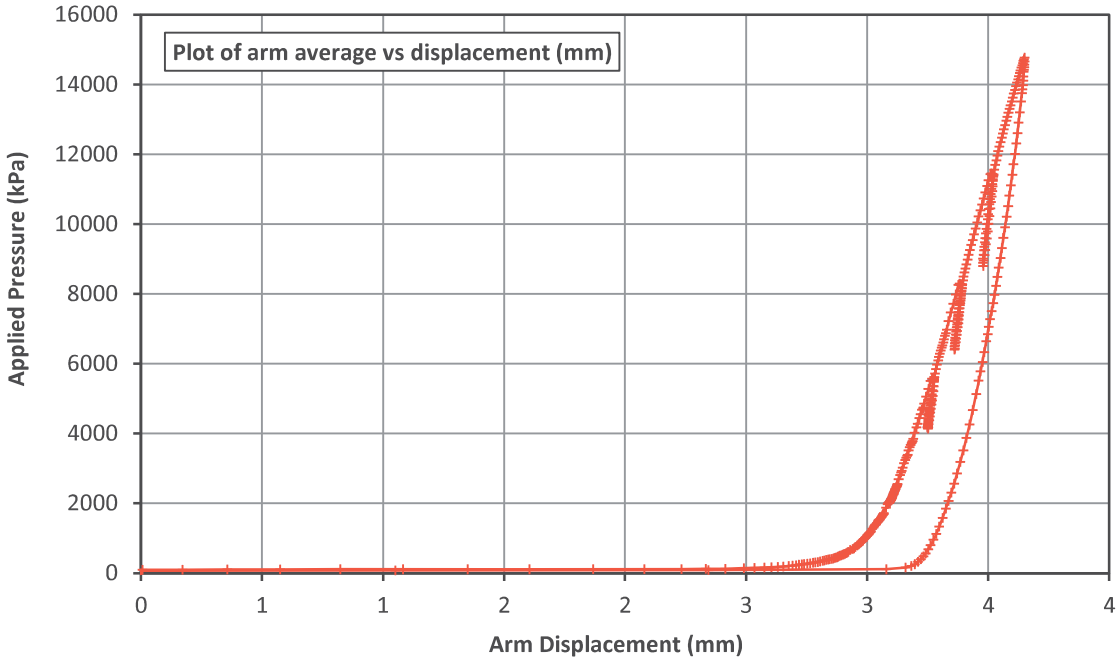
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	15.20 m	Arm 1:	-2379.6	122.9	TPC A:	294.0	102.9
Water level:	9.00 m	Arm 2:	-2056.0	124.9	TPC B:	-2134.4	110.7
		Arm 3:	-2295.3	129.5			
Test time:		Arm 4:	-2123.7	127.4			
Start (probe in):	11:30 hrs	Arm 5:	-2296.9	132.1			
Finish (probe out):	13:30 hrs	Arm 6:	-2149.0	124.1			

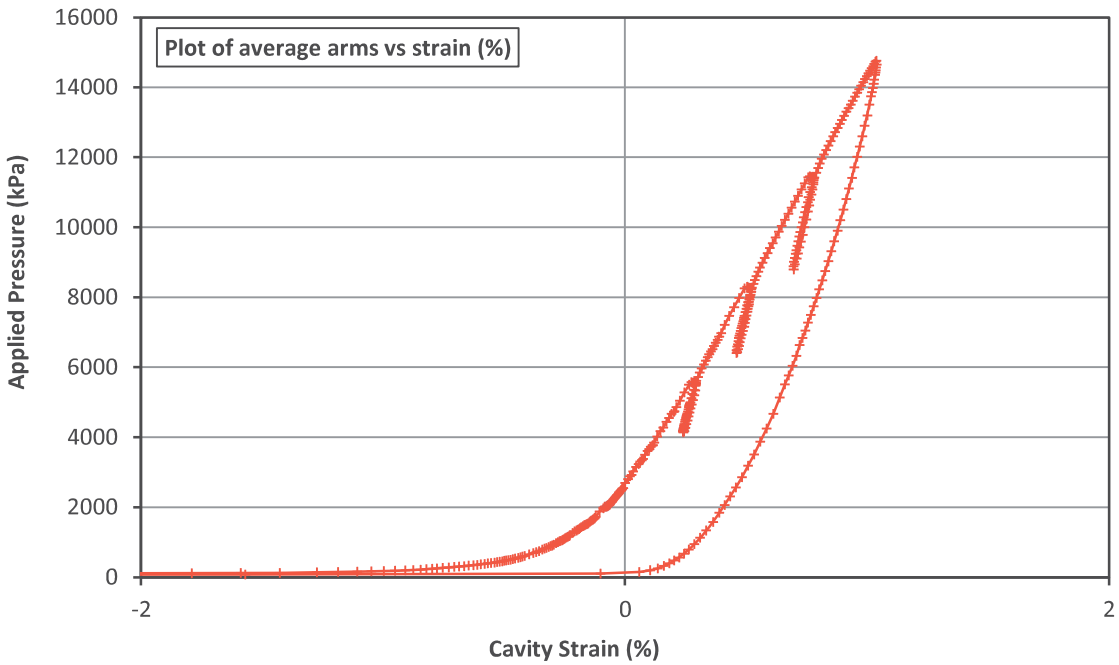
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	27/04/2021	**Test No.**	2
Borehole	BH4R	**Test Depth (m)**	16.50



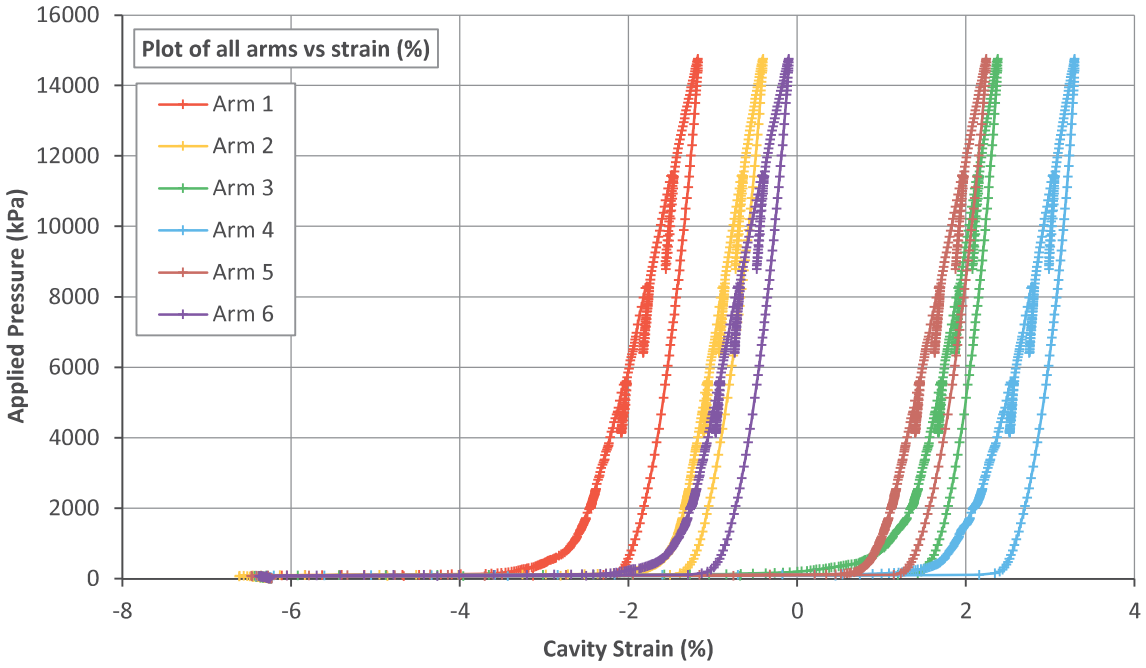


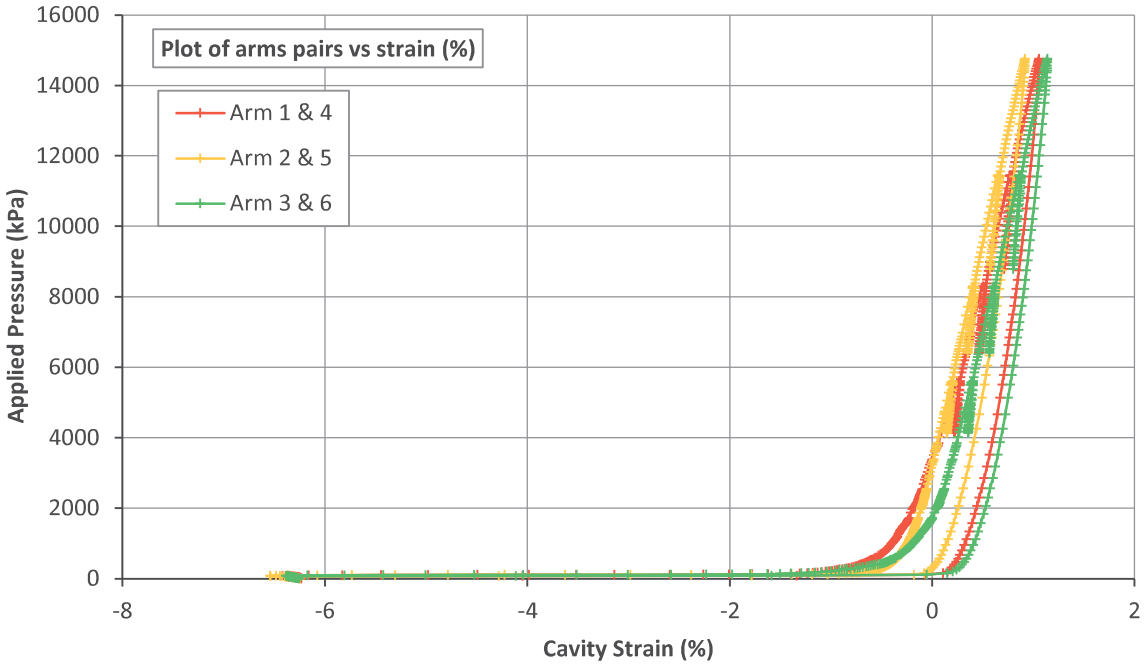
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	27/04/2021	**Test No.**	2
Borehole	BH4R	**Test Depth (m)**	16.50



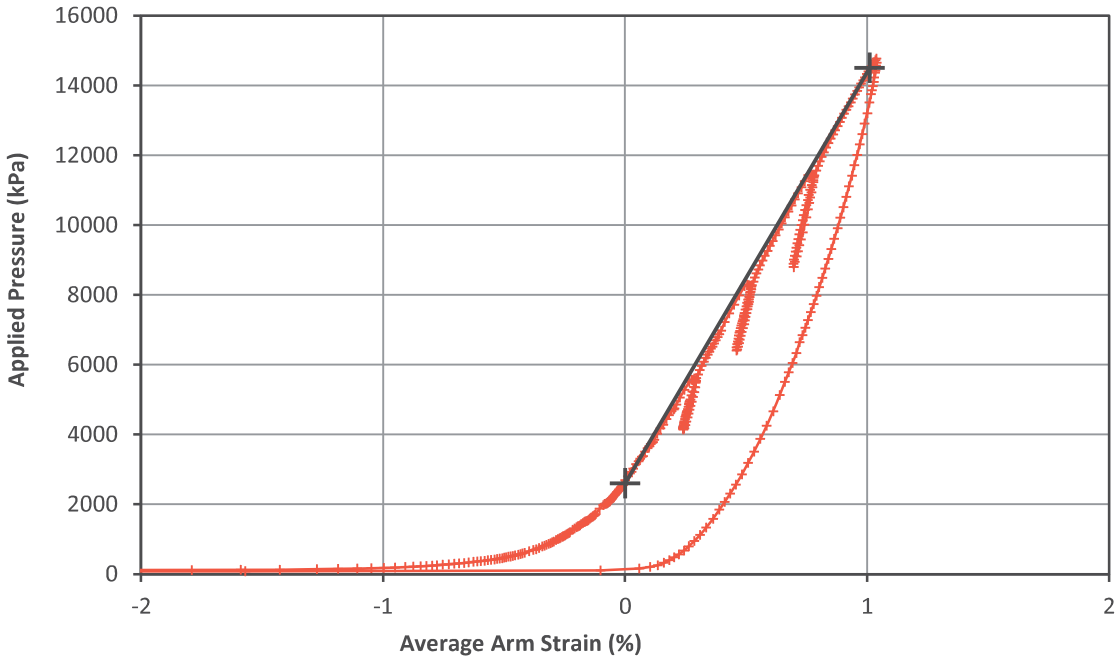


Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 03**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	27/04/2021	**Test No.**	2
Borehole	BH4R	**Test Depth (m)**	16.50



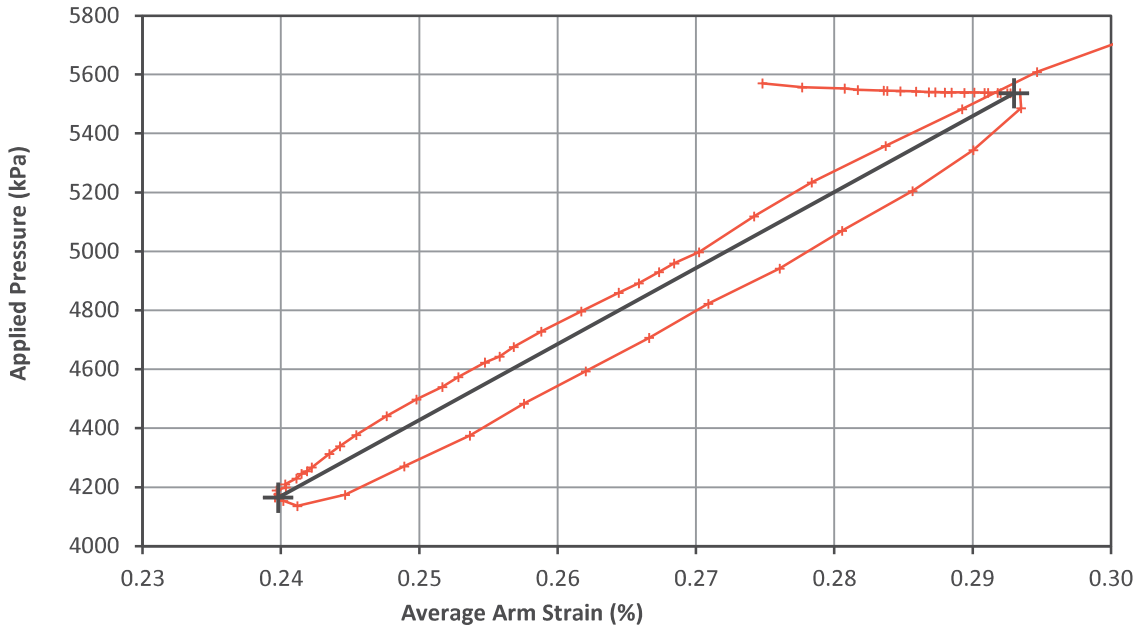
Initial Modulus	Shear Modulus	595.1 MPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 04**
Client	GeoAssist		
Project No.	P1210114		

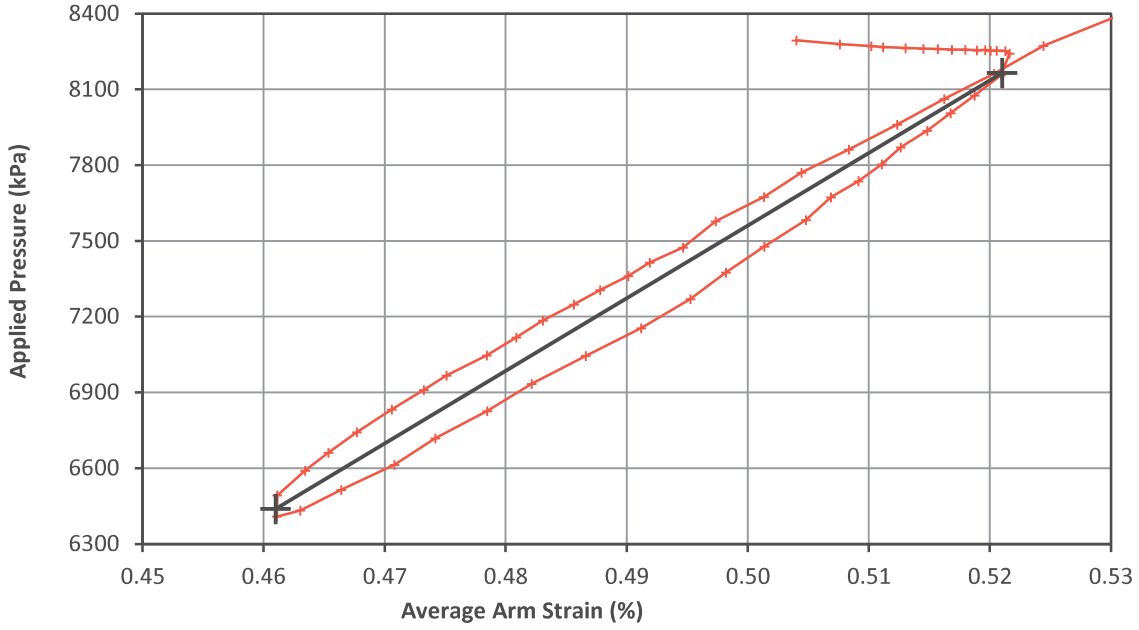
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	27/04/2021	**Test No.**	2
Borehole	BH4R	**Test Depth (m)**	16.50



Loop 1	Shear Modulus	1293.4 MPa
	Cavity Strain Range	0.053 %



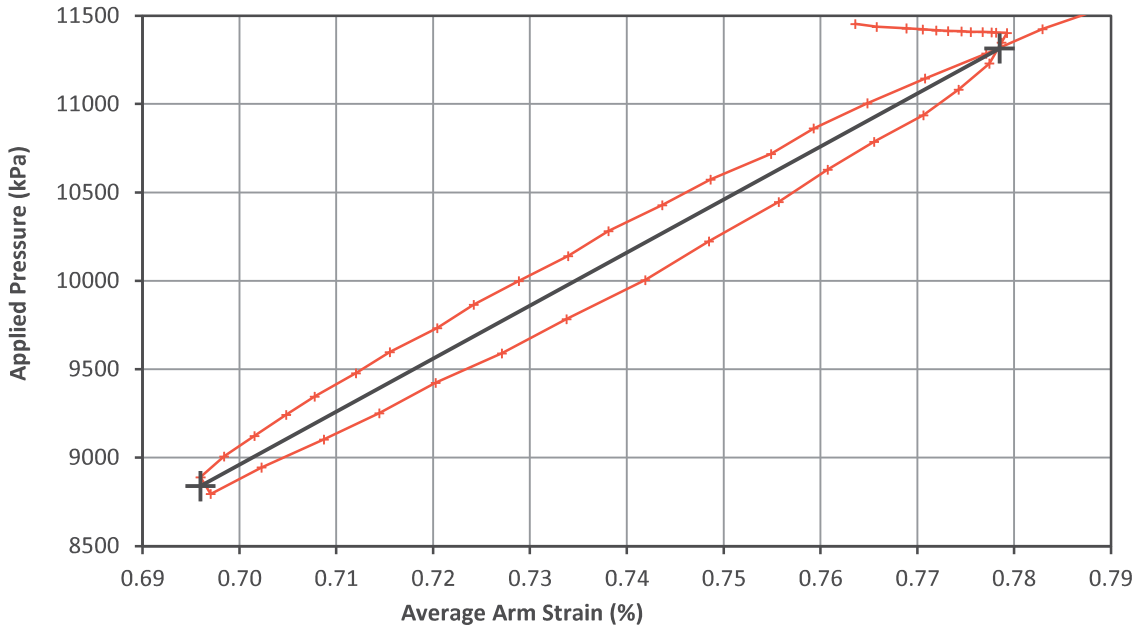
Loop 2	Shear Modulus	1445.0 MPa
	Cavity Strain Range	0.060 %

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 05**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	27/04/2021	**Test No.**	2
Borehole	BH4R	**Test Depth (m)**	16.50



Loop 3	Shear Modulus	1511.7	MPa
	Cavity Strain Range	0.083	%

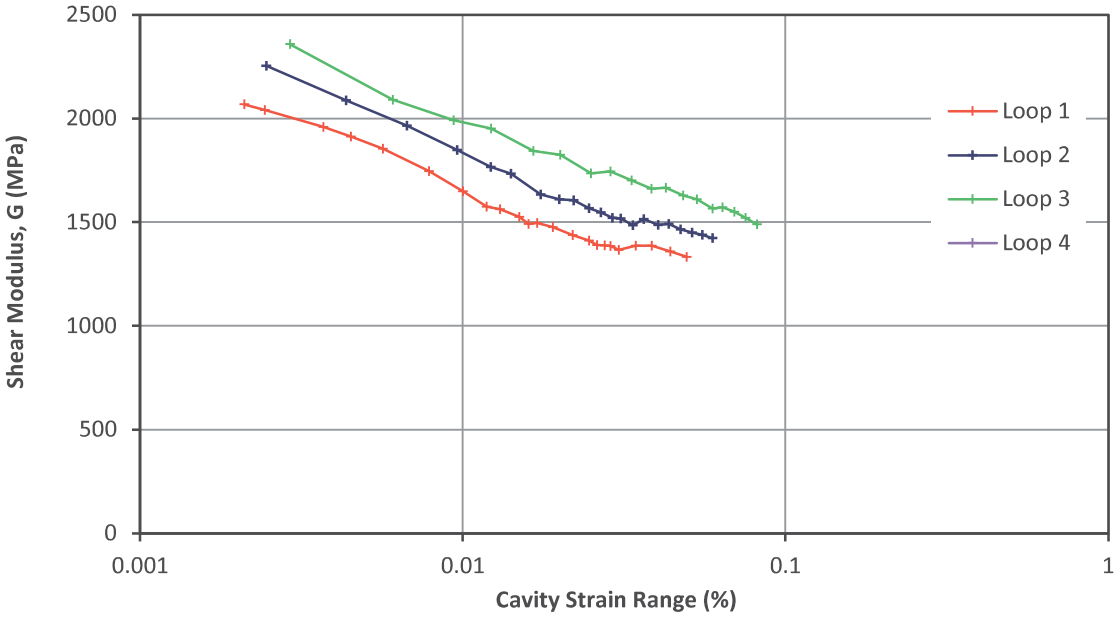
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 06**
Client	GeoAssist		
Project No.	P1210114		

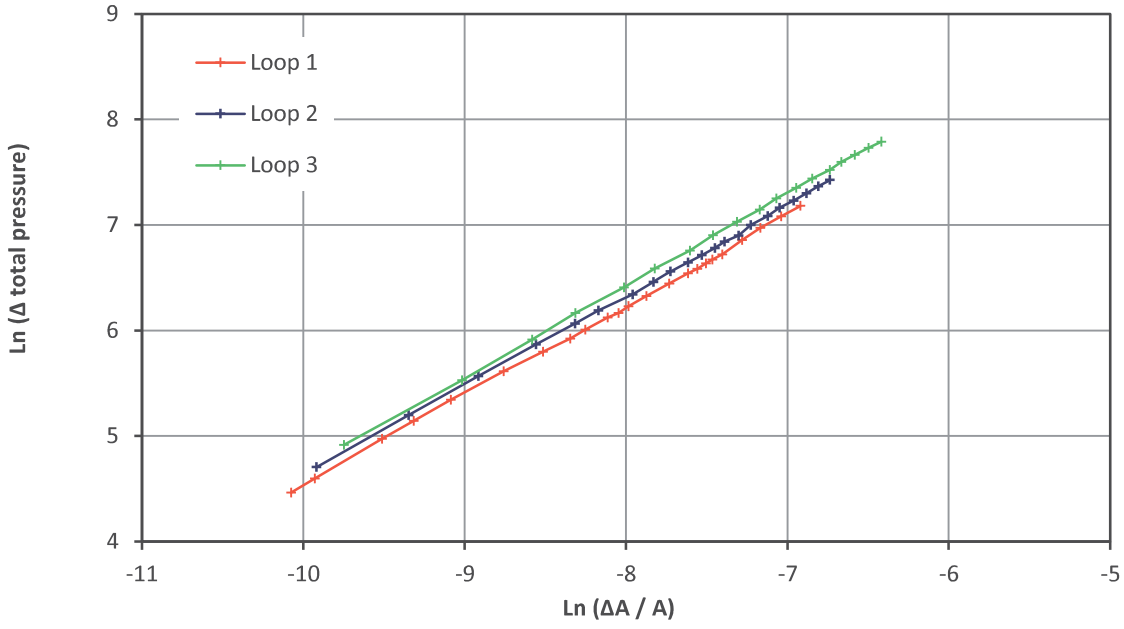
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	27/04/2021	**Test No.**	2
Borehole	BH4R	**Test Depth (m)**	16.50





Loop 1		Loop 2		Loop 3	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.840	420.978 (MPa)	0.852	511.680 (MPa)	0.870	650.572 (MPa)

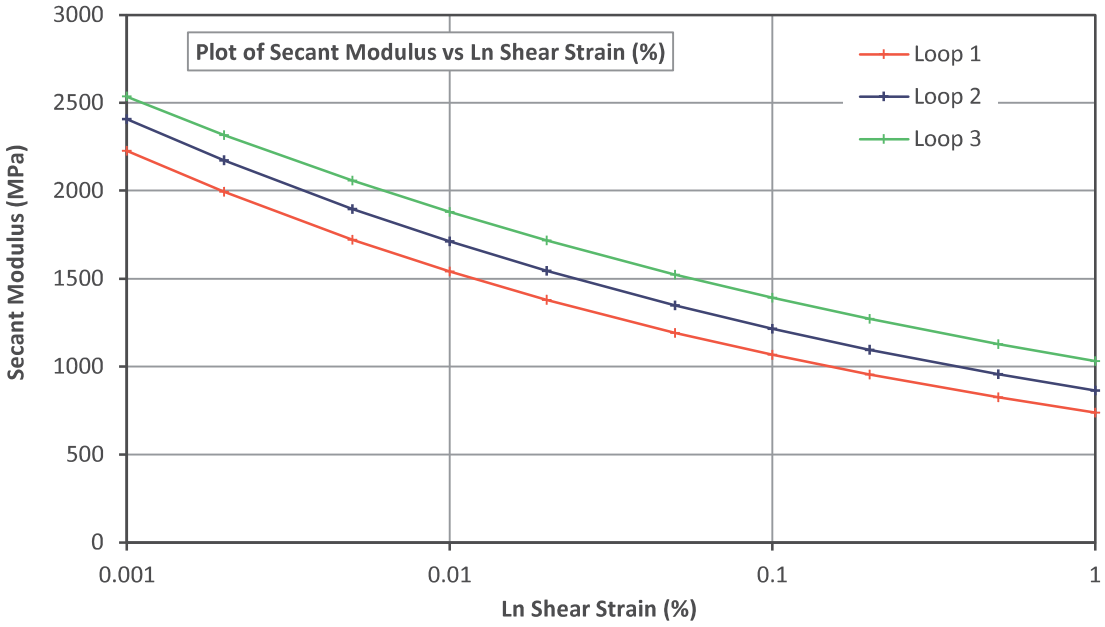
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 07**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	27/04/2021	**Test No.**	2
Borehole	BH4R	**Test Depth (m)**	16.50



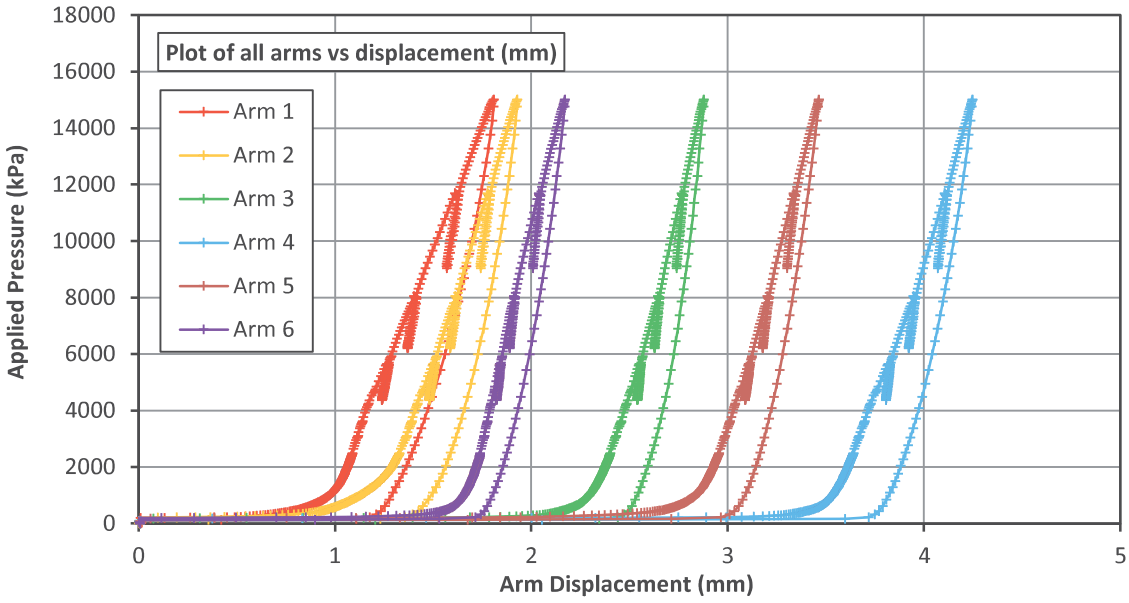
Shear Strain	Loop 1	Loop 2	Loop 3
0.001%	**2226**	**2408**	**2535**
0.002%	1993	2172	2316
0.005%	1721	1896	2056
0.010%	**1541**	**1711**	**1878**
0.020%	1379	1543	1716
0.050%	1191	1347	1523
0.100%	**1067**	**1215**	**1392**
0.200%	955	1096	1271
0.500%	825	957	1128
1.000%	**738**	**863**	**1031**

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T02 - 08**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	28/04/2021		**Test No.**	3
Borehole	BH4R		**Test Depth (m)**	22.30
Coordinates (m)	383464.9 (E)	397232.7 (N)	**Elevation (m)**	33.26



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	100 %	Test pocket depth range:	
Solid core recovery:	97 %	From: 20.50 m to: 23.50 m	
Rock quality designation:	73 %	Flush: Water	

Test comment:

The test pocket was good with arms lifting off at 1.5 to 3.0mm. The po was estimated to be at 3234kPa, with the following loading section being long and linear. The start of material yield is indicated at 13650kPa and the test was taken to a high pressure of 15012kPa. The displacement-pressure response shown by the arms was reasonably consistent albeit at some variation in expansion. Analysis of three unload reload loops provides increasing modulus values of 1279 to 1375MPa. Derived undrained shear strength analysis provides values of 10.4 to 11.1MPa, although these should be treated as minumum values due to incomplete failure.

Test details: **Instrument:** Eleanor (HPD04)

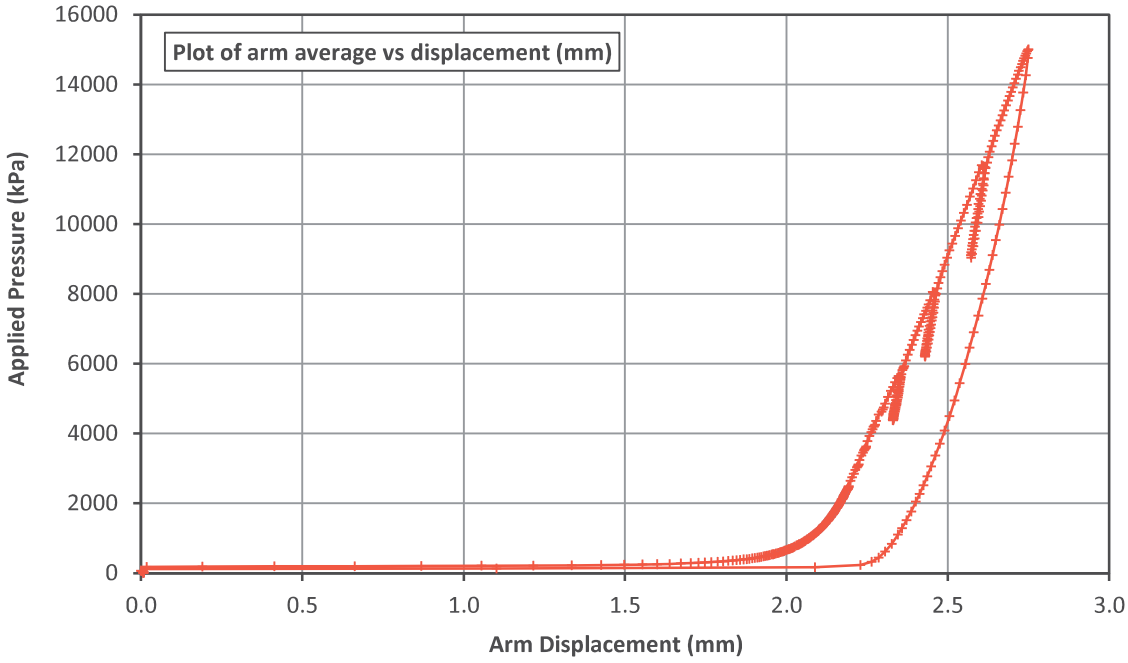
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	20.50 m	Arm 1:	-2376.0	122.9	TPC A:	292.5	102.9
Water level:	10.10 m	Arm 2:	-2043.4	124.9	TPC B:	-2135.9	110.7
		Arm 3:	-2290.4	129.5			
Test time:		Arm 4:	-2119.3	127.4			
Start (probe in):	11:05 hrs	Arm 5:	-2289.7	132.1			
Finish (probe out):	12:50 hrs	Arm 6:	-2141.7	124.1			

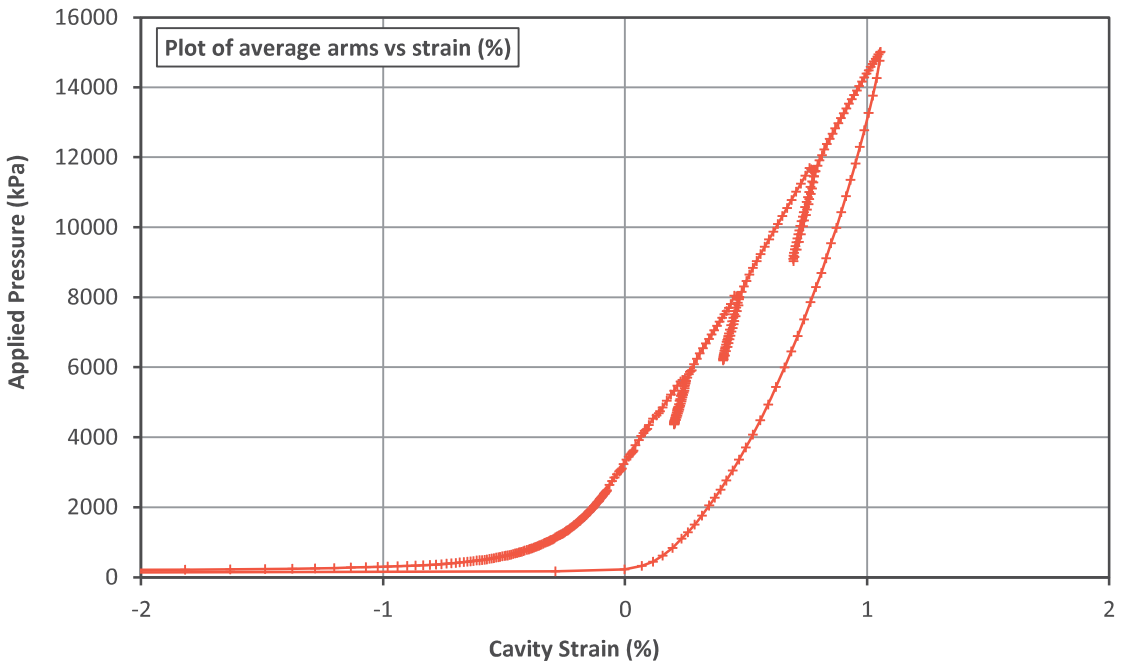
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	**Test No.**	3
Borehole	BH4R	**Test Depth (m)**	22.30



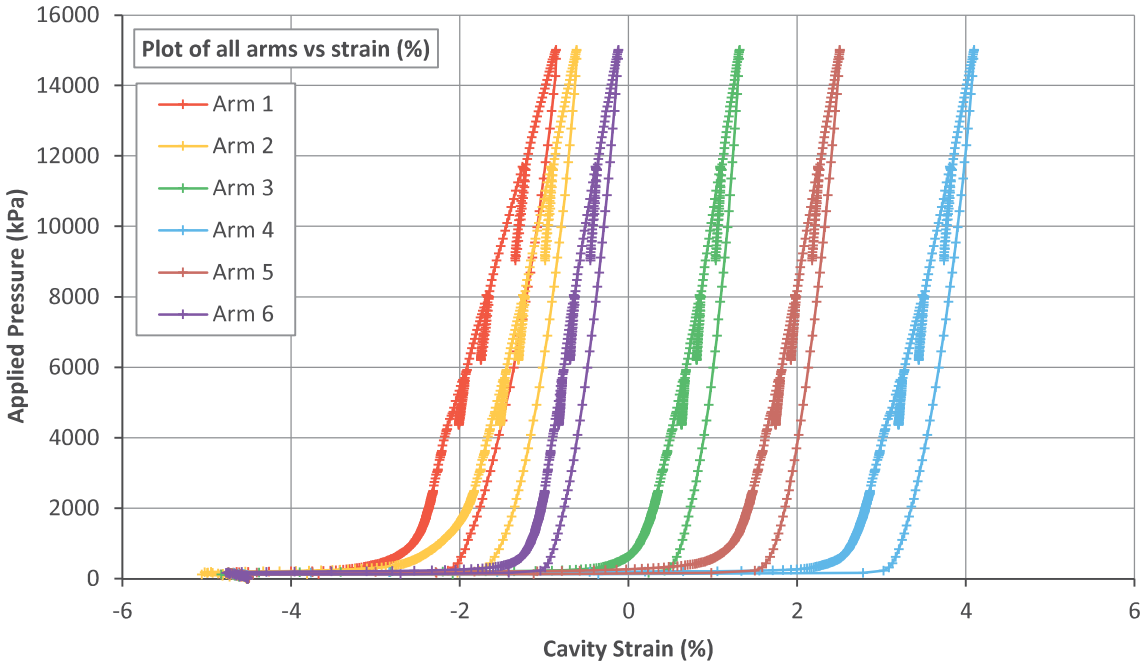


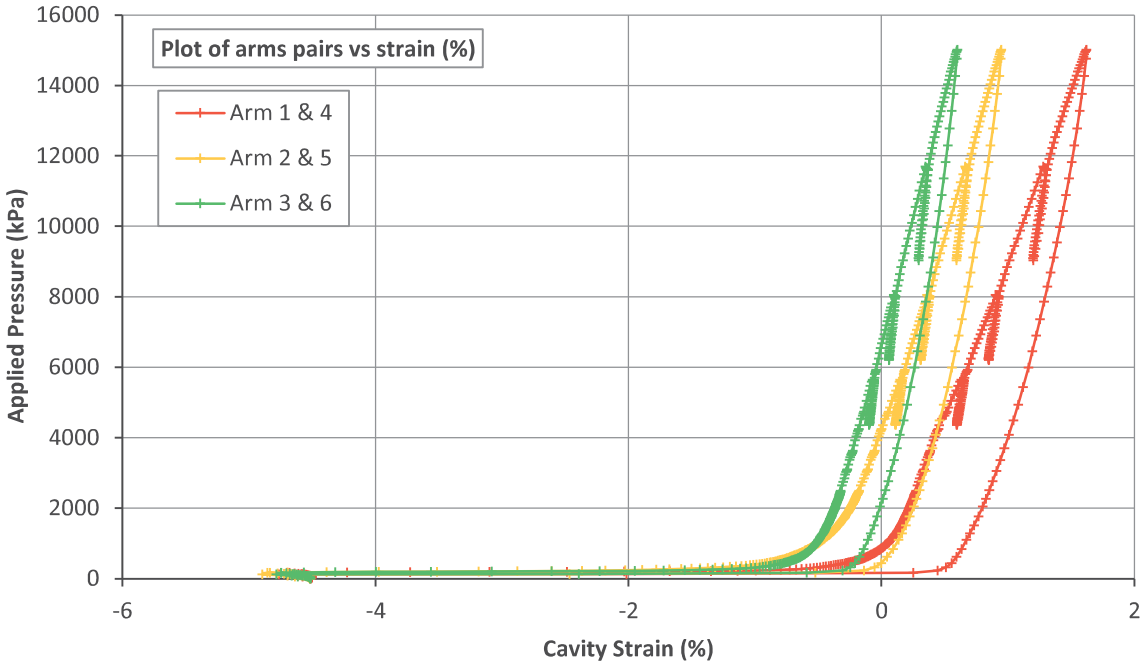
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	**Test No.**	3
Borehole	BH4R	**Test Depth (m)**	22.30



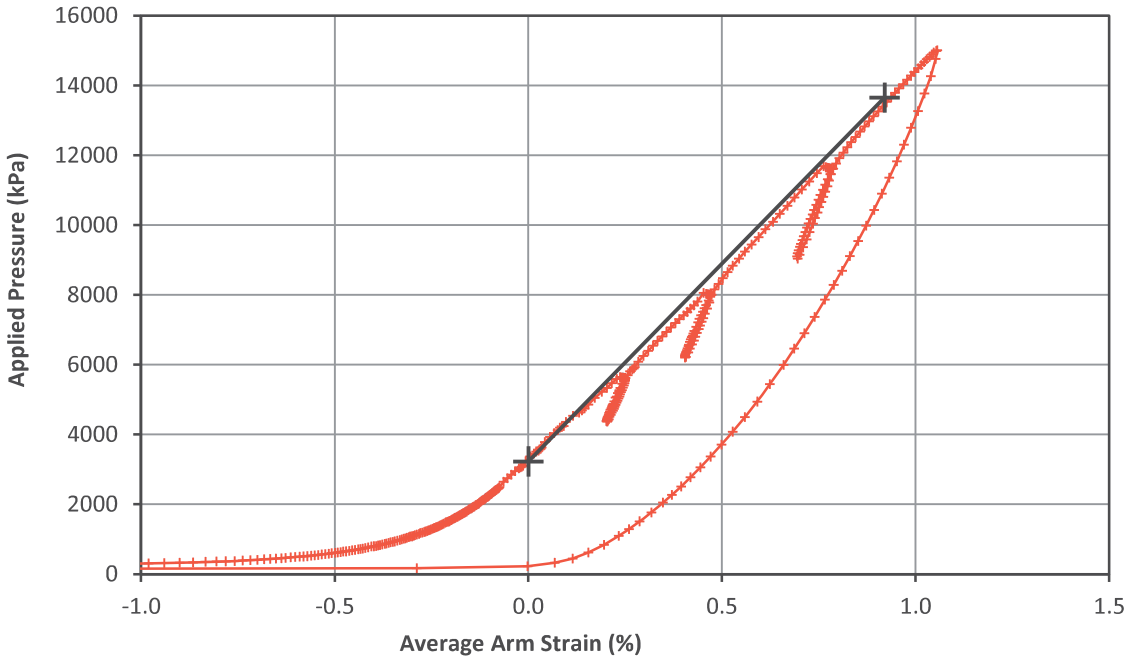


Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 03**
Client	GeoAssist		
Project No.	P1210114		

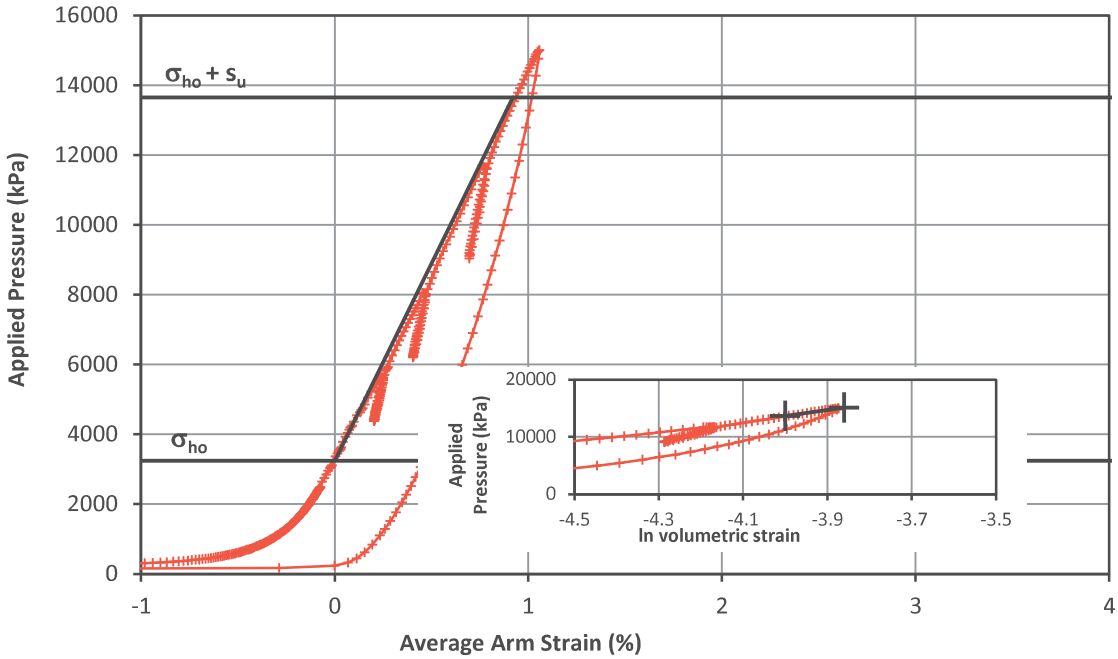
Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	Test No.	3
Borehole	BH4R	Test Depth (m)	22.30



Initial Modulus	Shear Modulus	571.3 MPa



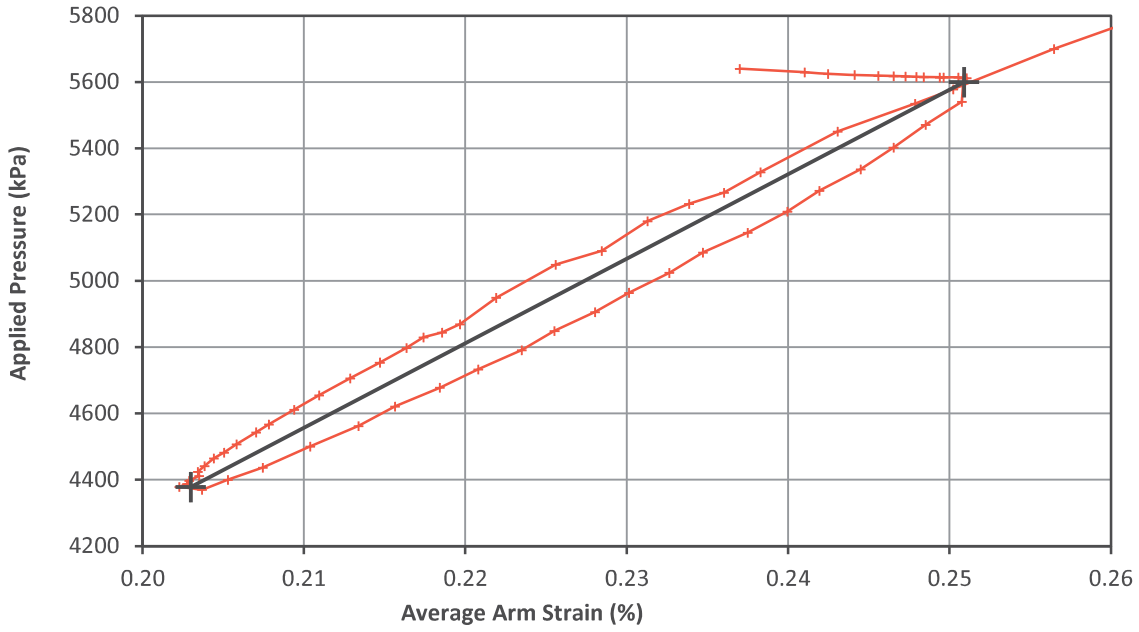
Marsland & Randolph	In situ horizontal stress	3234 kPa
	Undrained Strength	10416 kPa

Project	Great Jackson Street, Manchester	Figure No.	BH4R T03 - 04
Client	GeoAssist		
Project No.	P1210114		

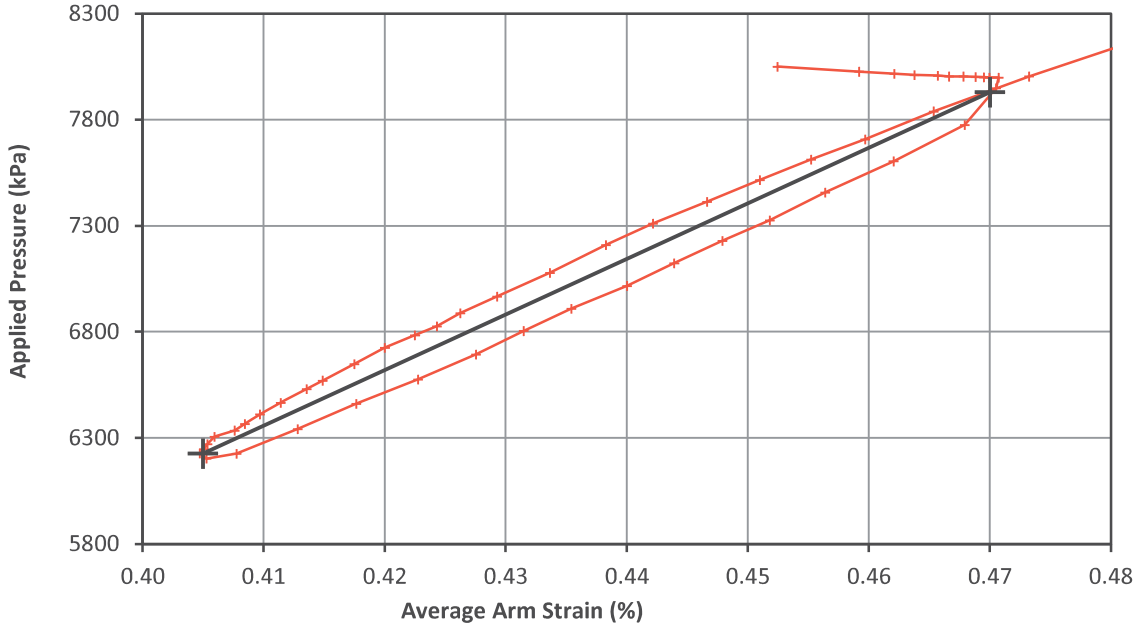
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	**Test No.**	3
Borehole	BH4R	**Test Depth (m)**	22.30



Loop 1	Shear Modulus	1277.8 MPa
	Cavity Strain Range	0.048 %



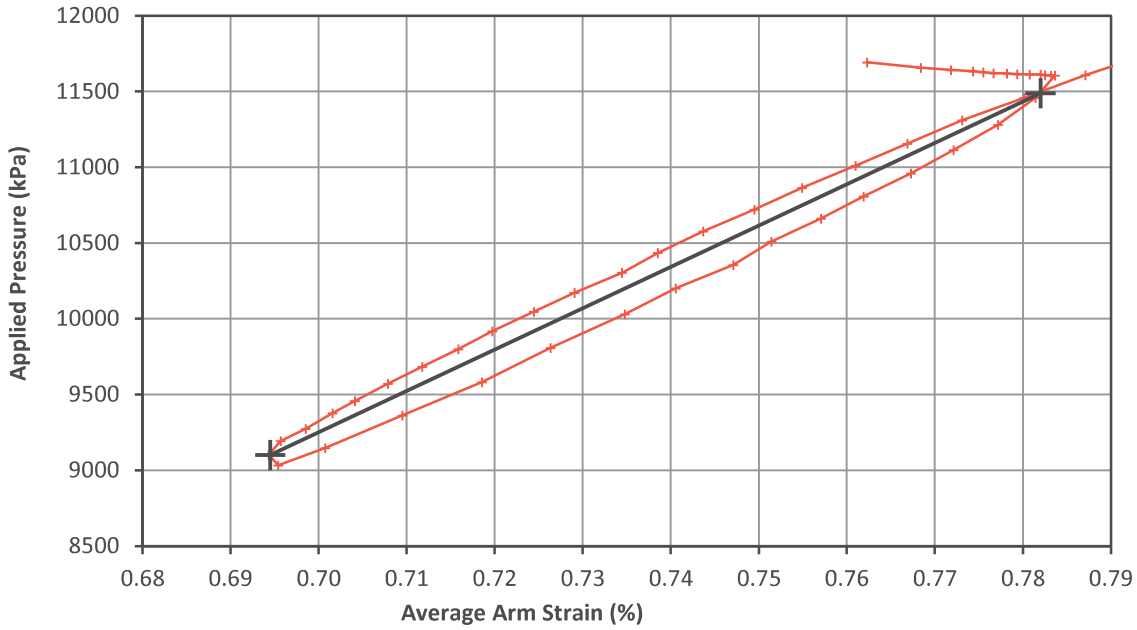
Loop 2	Shear Modulus	1315.9 MPa
	Cavity Strain Range	0.065 %

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 05**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	**Test No.**	3
Borehole	BH4R	**Test Depth (m)**	22.30



Loop 3	Shear Modulus	1375.2	MPa
	Cavity Strain Range	0.088	%

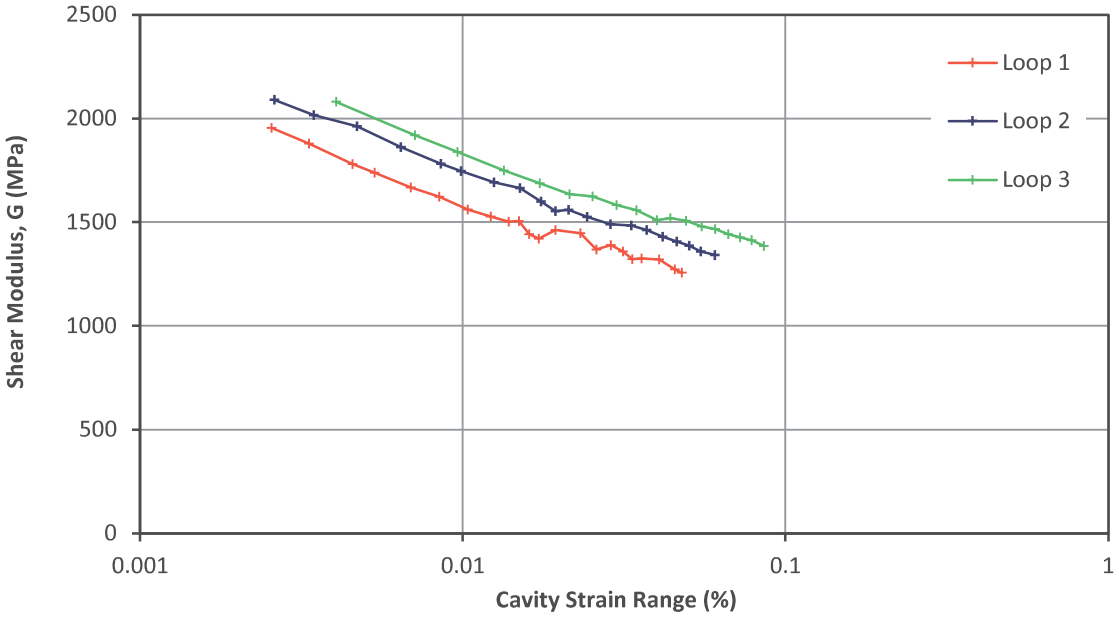
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 06**
Client	GeoAssist		
Project No.	P1210114		

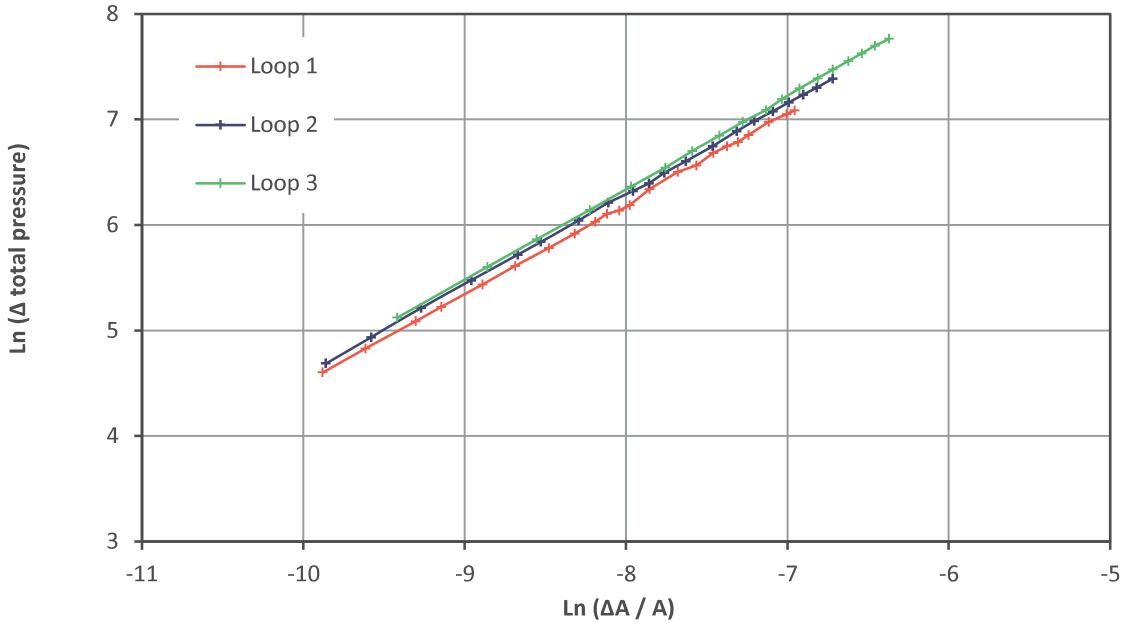
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	**Test No.**	3
Borehole	BH4R	**Test Depth (m)**	22.30





Loop 1		Loop 2		Loop 3	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.856	466.257 (MPa)	0.858	517.584 (MPa)	0.873	613.685 (MPa)

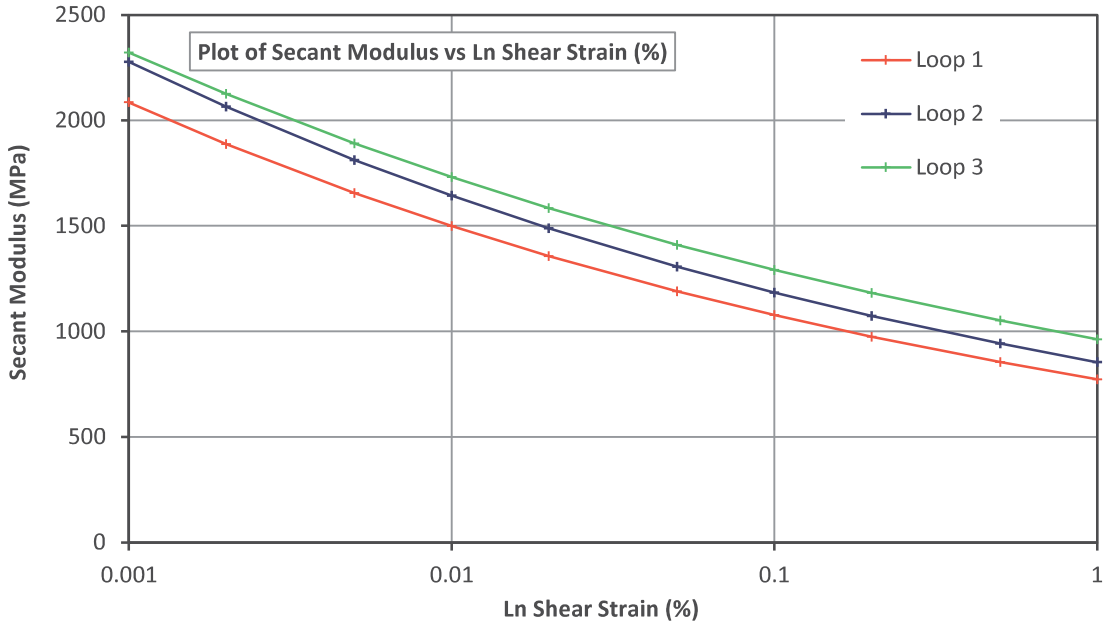
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 07**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	**Test No.**	3
Borehole	BH4R	**Test Depth (m)**	22.30



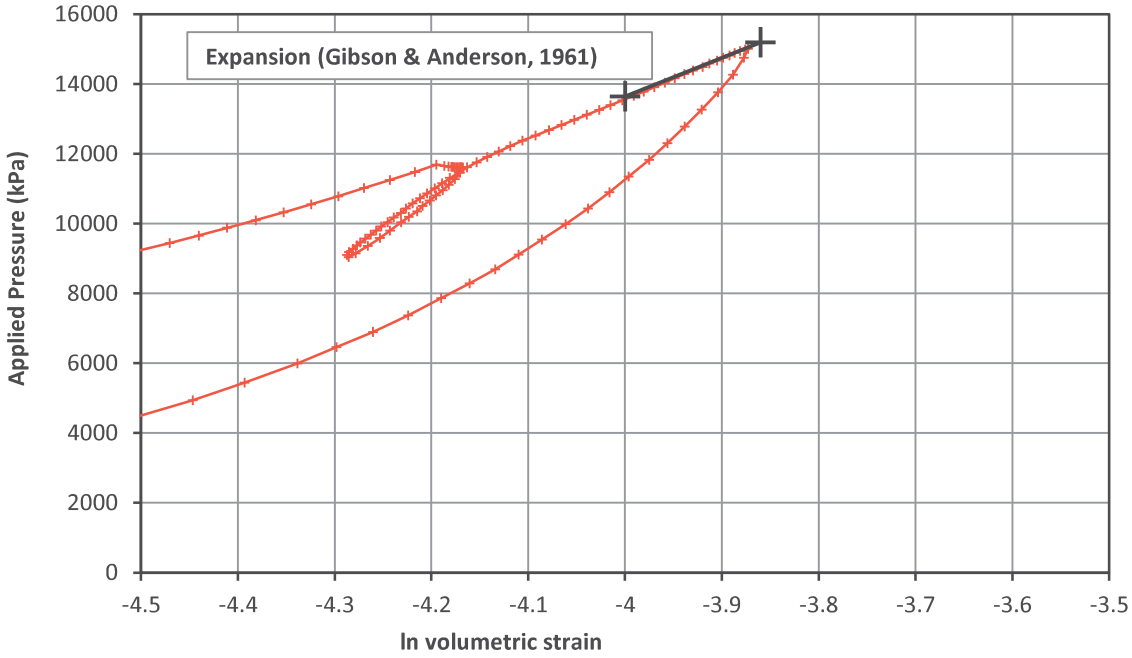
Shear Strain	Loop 1	Loop 2	Loop 3
0.001%	**2086**	**2277**	**2321**
0.002%	1888	2064	2125
0.005%	1655	1812	1891
0.010%	**1499**	**1642**	**1731**
0.020%	1357	1488	1585
0.050%	1189	1307	1410
0.100%	**1077**	**1184**	**1291**
0.200%	975	1073	1182
0.500%	854	942	1052
1.000%	**774**	**854**	**963**

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 08**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Undrained Strength

IN SITU SITE INVESTIGATION

Test Date	28/04/2021	**Test No.**	3
Borehole	BH4R	**Test Depth (m)**	22.30



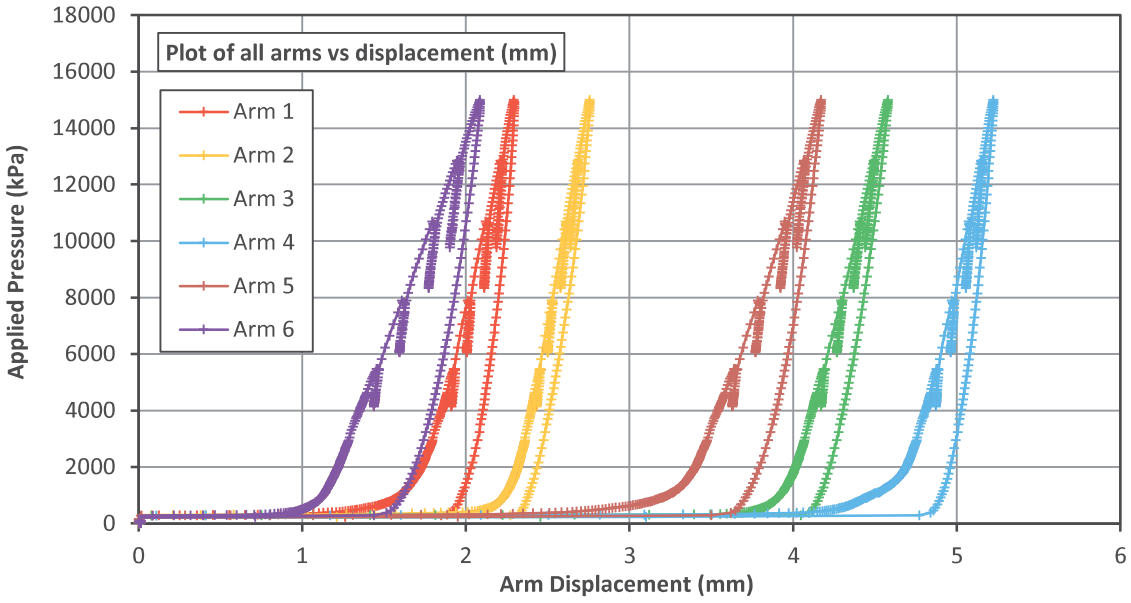
Strength (loading)	Undrained Shear	11071	kPa
	Limit Pressure	57936	kPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T03 - 09**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test Overview
High Pressure Dilatometer (HPD)

IN SITU SITE INVESTIGATION

Test Date	29/04/2021		**Test No.**	4
Borehole	BH4R		**Test Depth (m)**	31.20
Coordinates (m)	383464.9 (E)	397232.7 (N)	**Elevation (m)**	33.26



Material description from borehole log:

SANDSTONE.

Test pocket conditions:

Total core recovery:	100 %	Test pocket depth range:	
Solid core recovery:	95 %	From: 29.50 m	to: 32.50 m
Rock quality designation:	52 %	Flush:	Water

Test comment:

The test pocket was reasonable with arms lifting off at 1.0 to 4.5mm. The po was estimated to be at 3537kPa, with the following loading section being long and linear. The start of material yield is indicated at 14100kPa and the test was taken to a high pressure of 14995kPa. The displacement-pressure response shown by the arms was reasonably consistent albeit at some variation in expansion. Analysis of four unload reload loops provides increasing modulus values of 1366 to 1457MPa. Derived undrained shear strength analysis provides values of 10.6 to 12.5MPa, although these should be treated as minumum values due to incomplete failure.

Test details: **Instrument:** Eleanor (HPD04)

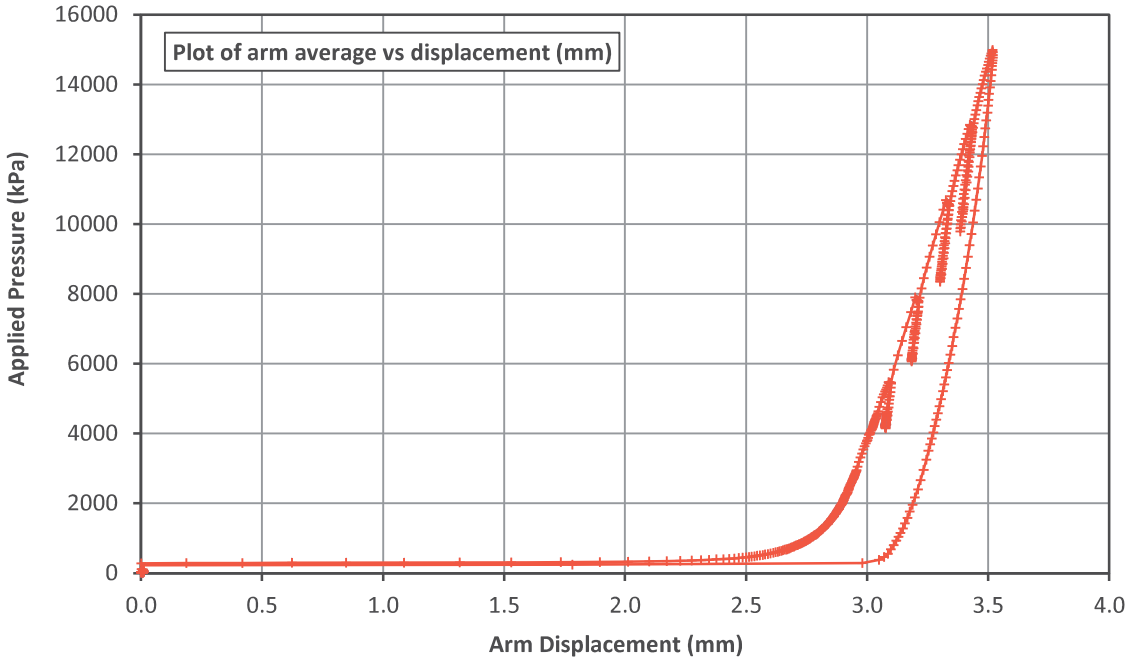
			mV	mV/mm		mV	mV/MPa
Drilling method:	Rotary coring						
Casing depth:	29.50 m	Arm 1:	-2371.9	122.9	TPC A:	291.9	102.9
Water level:	10.10 m	Arm 2:	-2034.1	124.9	TPC B:	-2136.8	110.7
		Arm 3:	-2287.6	129.5			
Test time:		Arm 4:	-2117.1	127.4			
Start (probe in):	10:30 hrs	Arm 5:	-2287.2	132.1			
Finish (probe out):	13:30 hrs	Arm 6:	-2138.4	124.1			

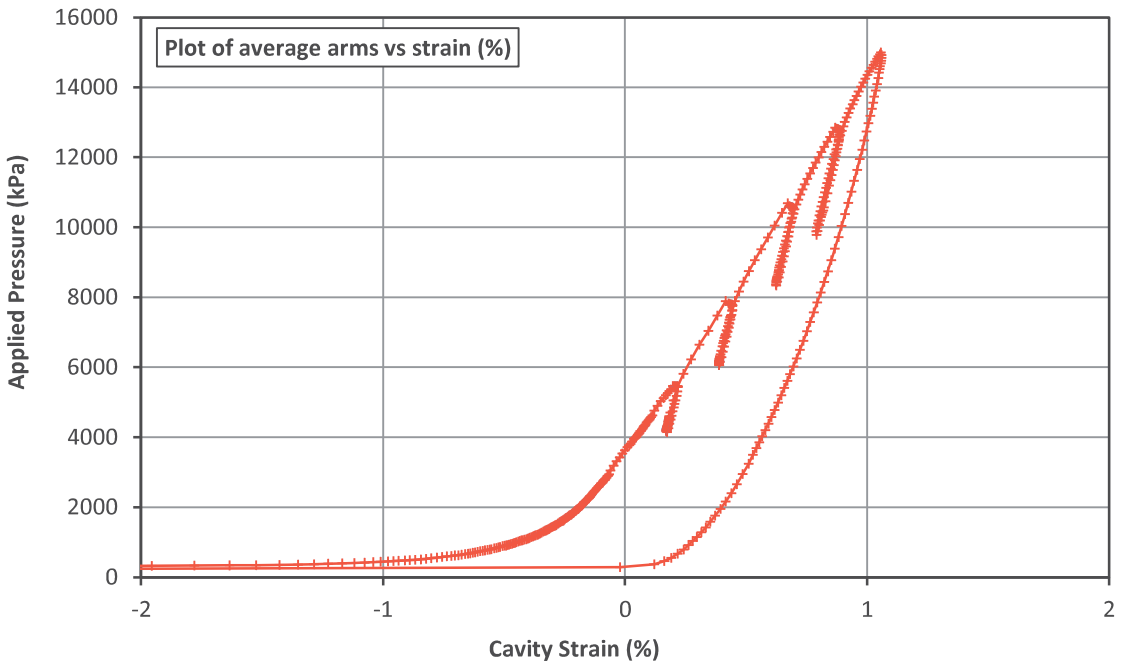
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T04 - 01**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Average Arm Plots

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	**Test No.**	4
Borehole	BH4R	**Test Depth (m)**	31.20



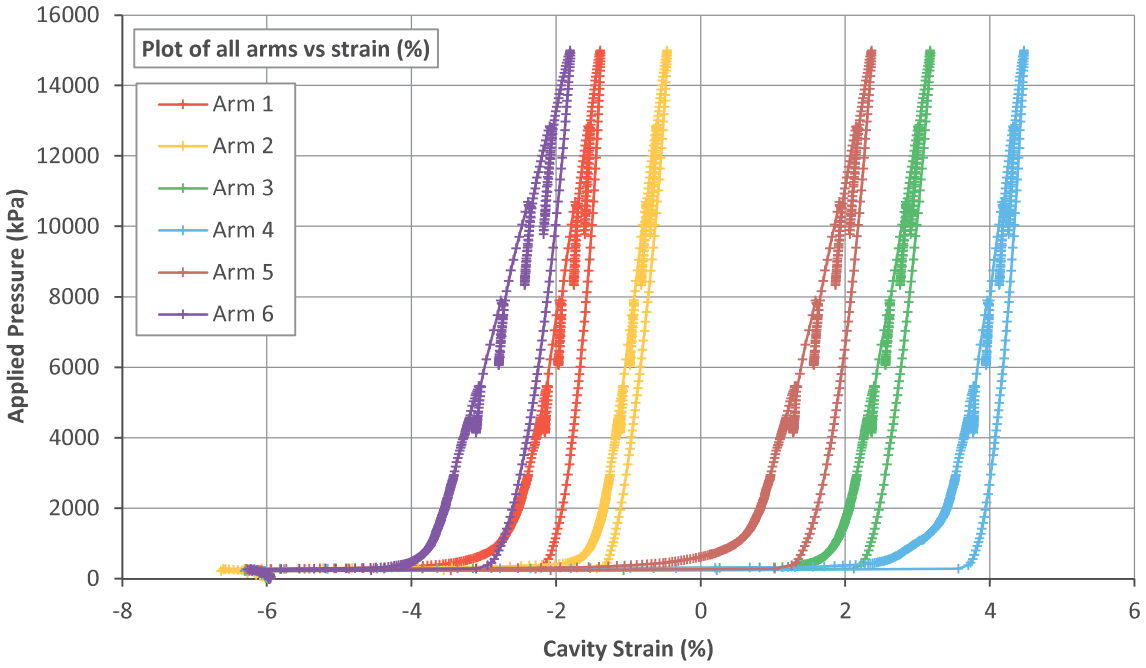


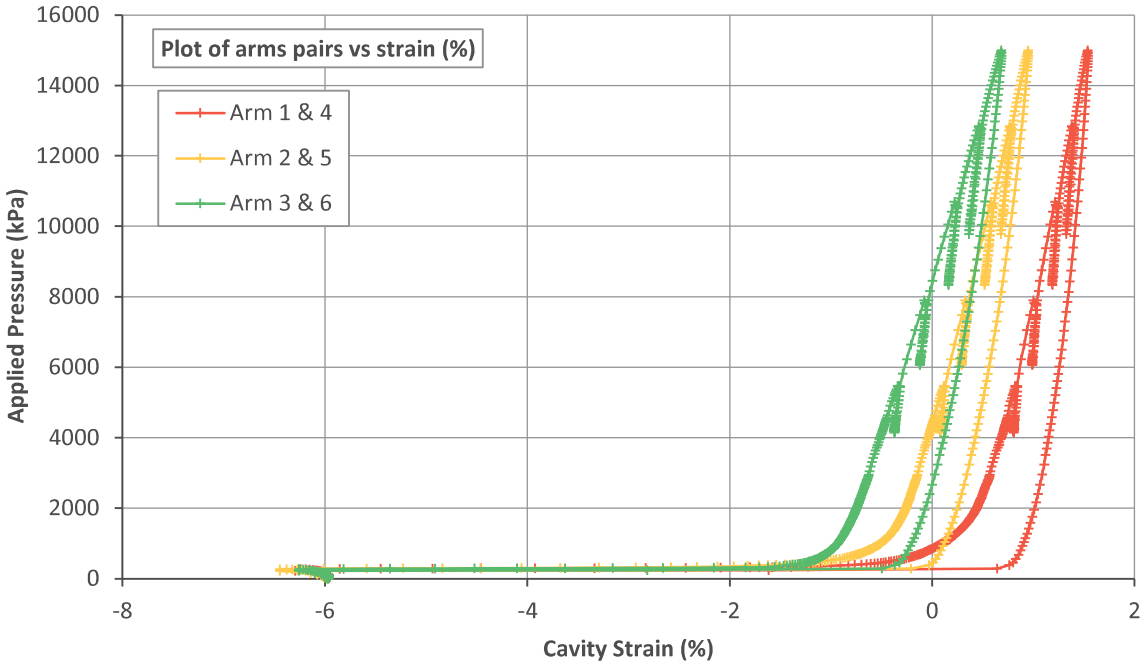
Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T04 - 02**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Test - Arm Displacement vs Strain (%)

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	**Test No.**	4
Borehole	BH4R	**Test Depth (m)**	31.20



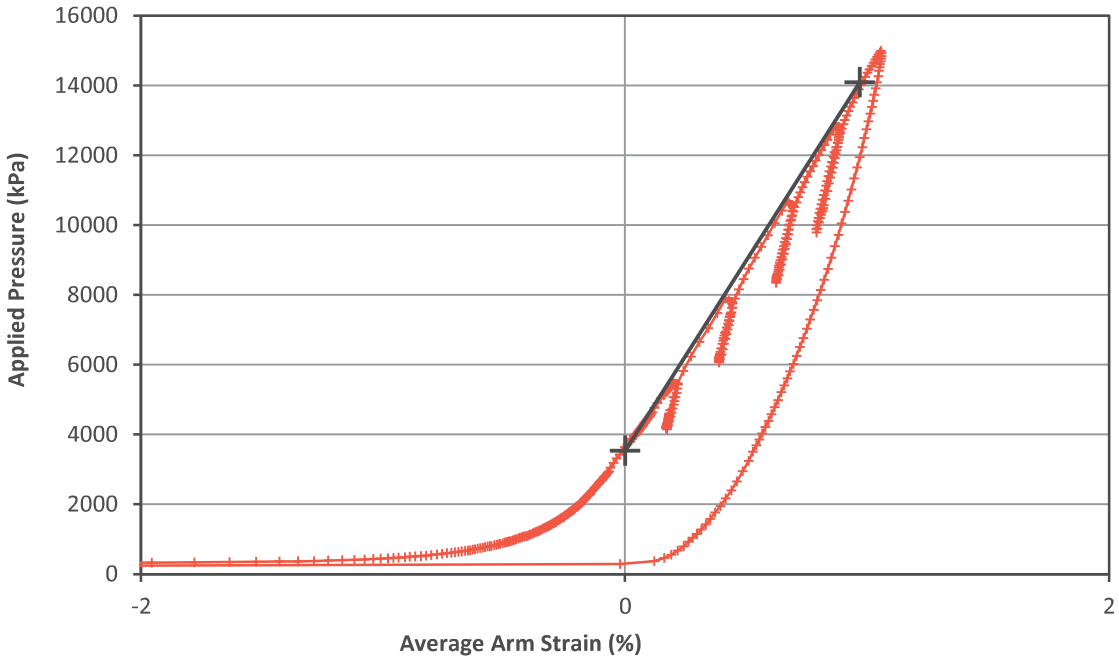


Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T04 - 03**
Client	GeoAssist		
Project No.	P1210114		

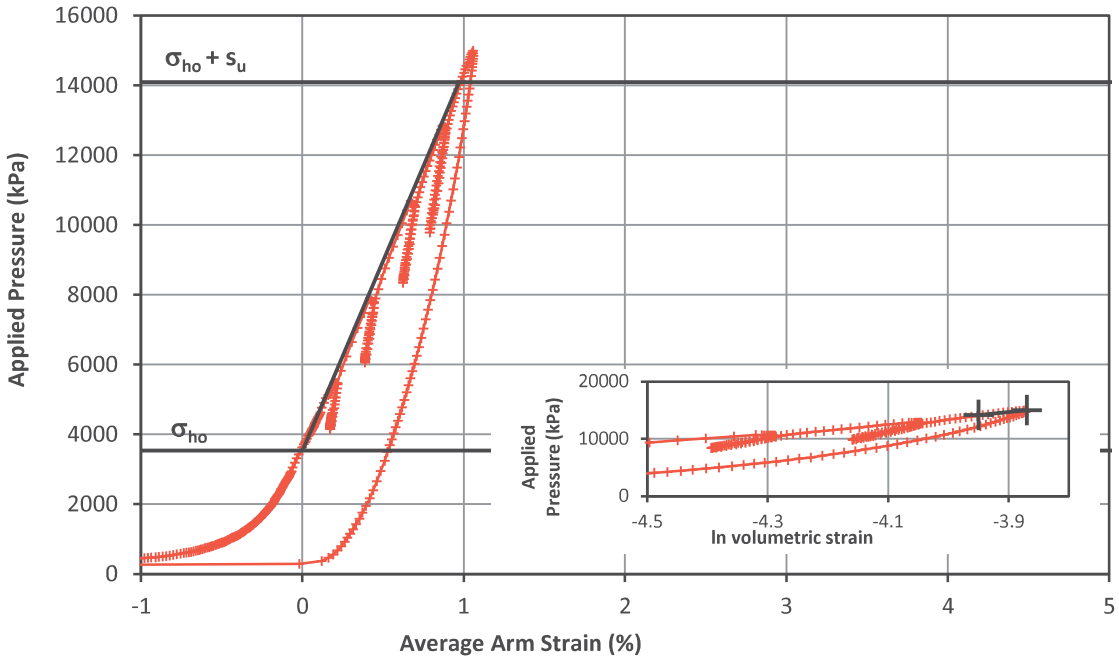
Pressuremeter Analysis - Initial Modulus & In Situ Horizontal Stress

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	**Test No.**	4
Borehole	BH4R	**Test Depth (m)**	31.20



Initial Modulus	Shear Modulus	549.8 MPa



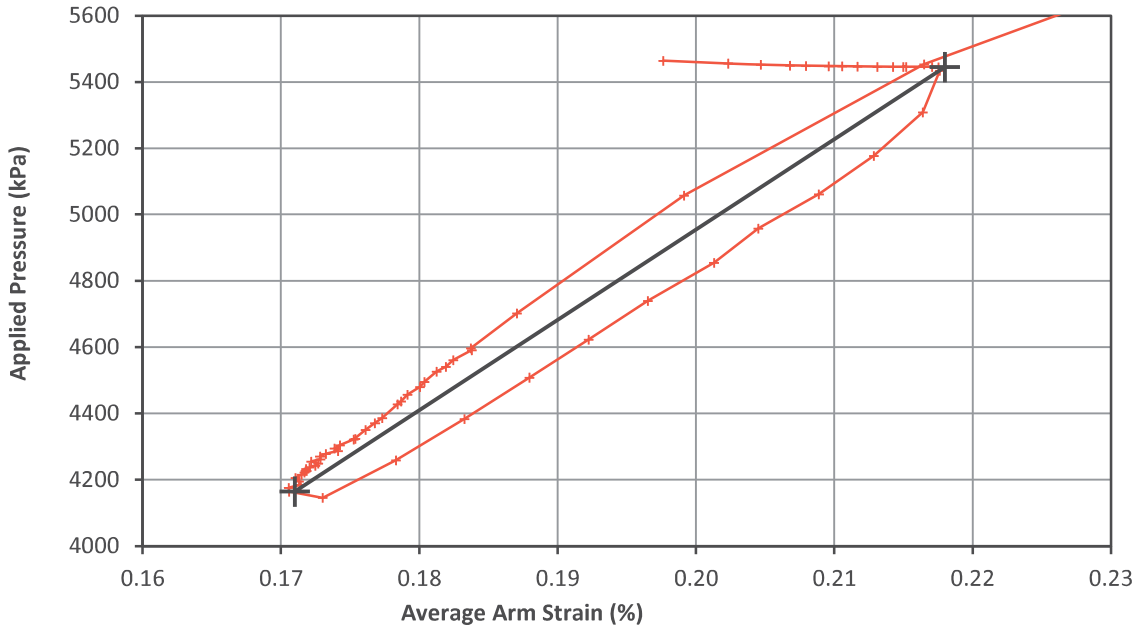
Marsland & Randolph	In situ horizontal stress	3537 kPa
	Undrained Strength	10563 kPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T04 - 04**
Client	GeoAssist		
Project No.	P1210114		

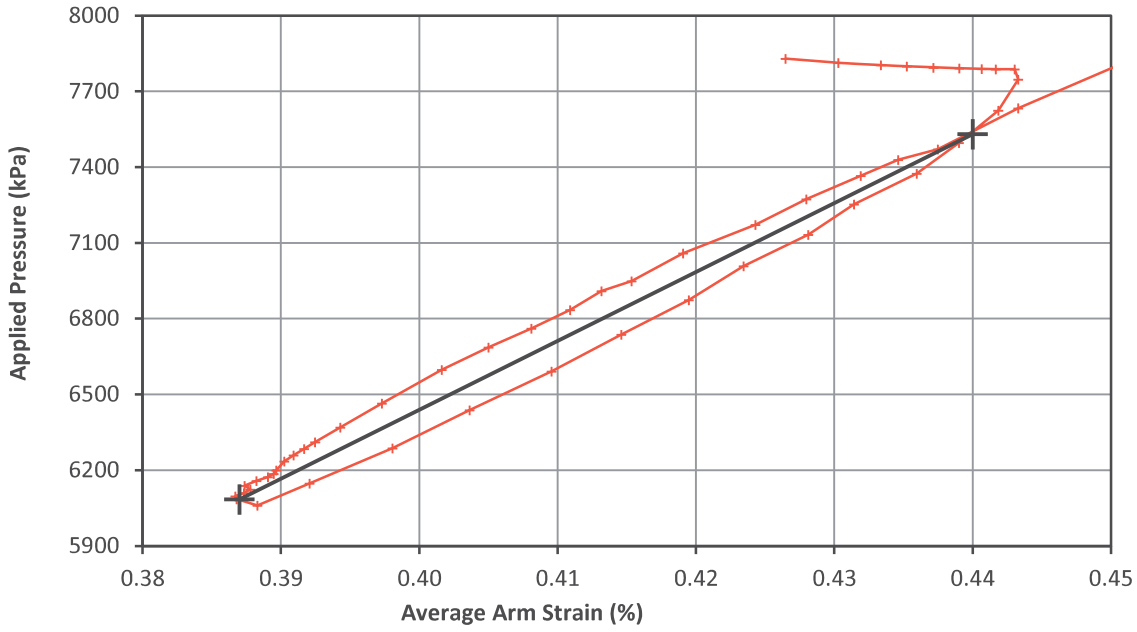
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	**Test No.**	4
Borehole	BH4R	**Test Depth (m)**	31.20



Loop 1	Shear Modulus	1365.7 MPa
	Cavity Strain Range	0.047 %



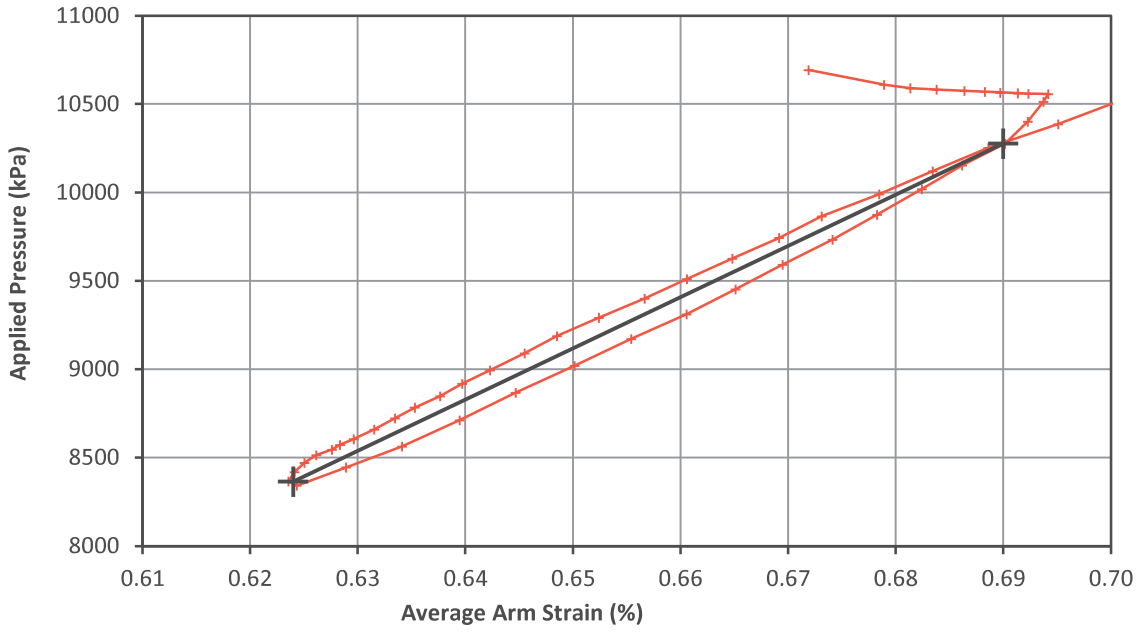
Loop 2	Shear Modulus	1369.2 MPa
	Cavity Strain Range	0.053 %

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T04 - 05**
Client	GeoAssist		
Project No.	P1210114		

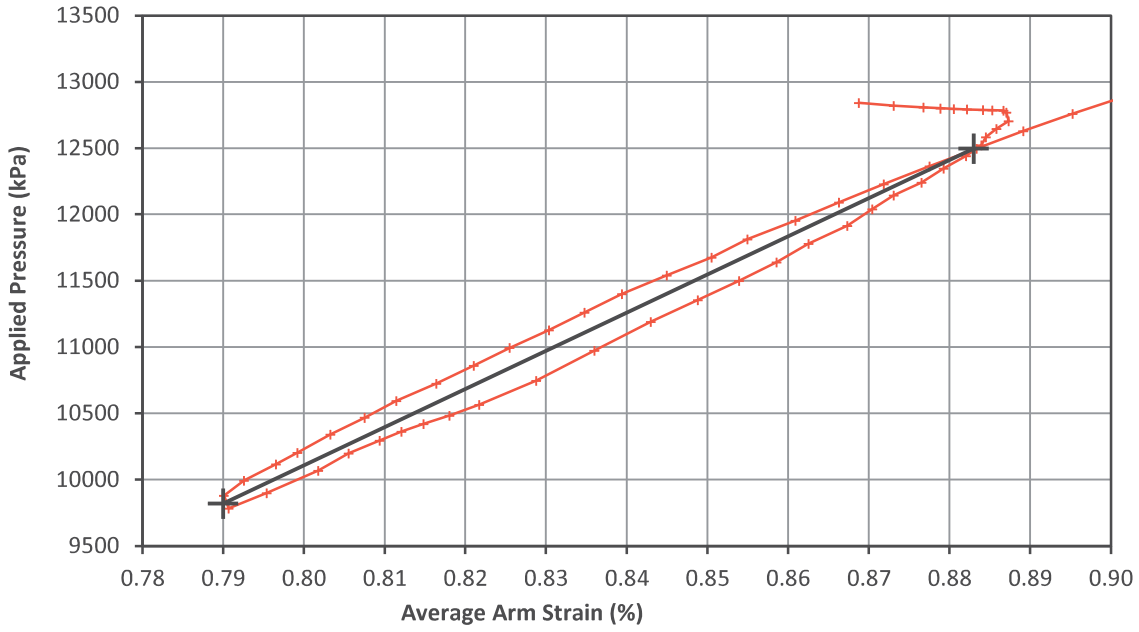
Pressuremeter Analysis - Unload Reload Loop

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	Test No.	4
Borehole	BH4R	Test Depth (m)	31.20



Loop 3	Shear Modulus	1456.5 MPa
	Cavity Strain Range	0.066 %



Loop 4	Shear Modulus	1451.7 MPa
	Cavity Strain Range	0.093 %

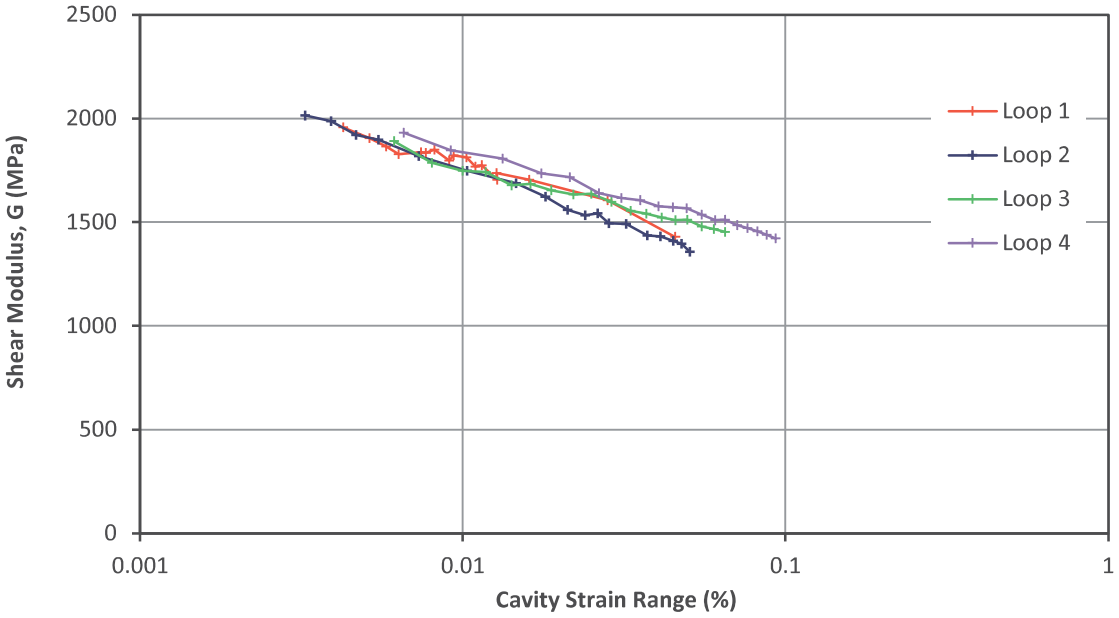
Project	Great Jackson Street, Manchester	Figure No.	BH4R T04 - 06
Client	GeoAssist		
Project No.	P1210114		

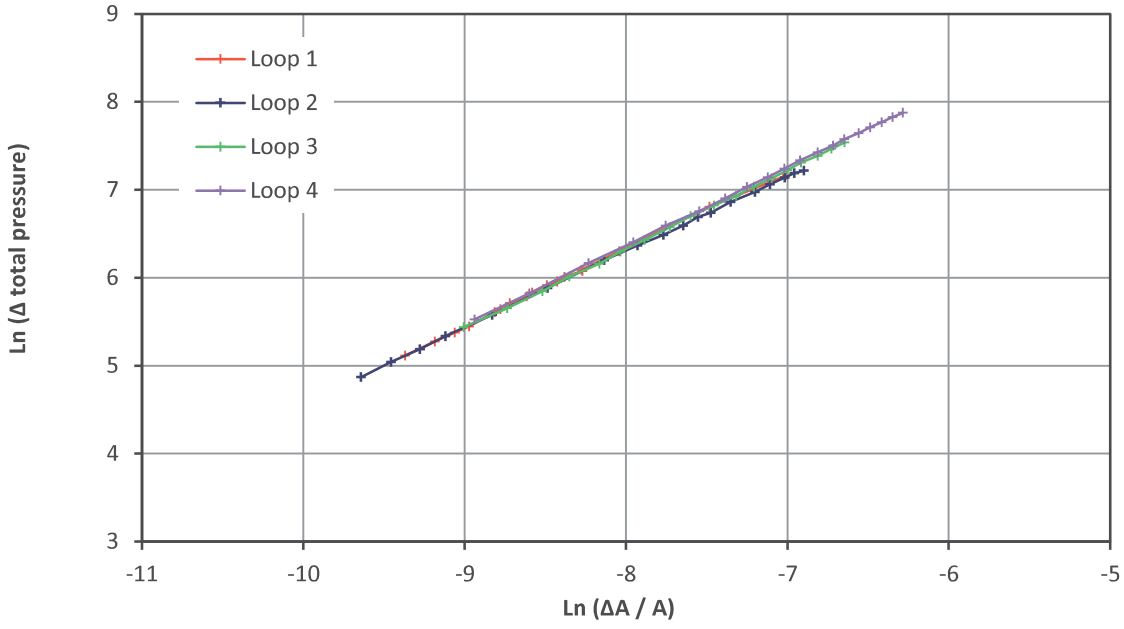
Pressuremeter Analysis

Small Strain Stiffness and Bolton & Whittle (1999)

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	Test No.	4
Borehole	BH4R	Test Depth (m)	31.20





Loop 1		Loop 2		Loop 3		Loop 4	
Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept	Gradient(β)	Intercept
0.881	646.683 (MPa)	0.859	524.069 (MPa)	0.897	732.838 (MPa)	0.888	707.906 (MPa)

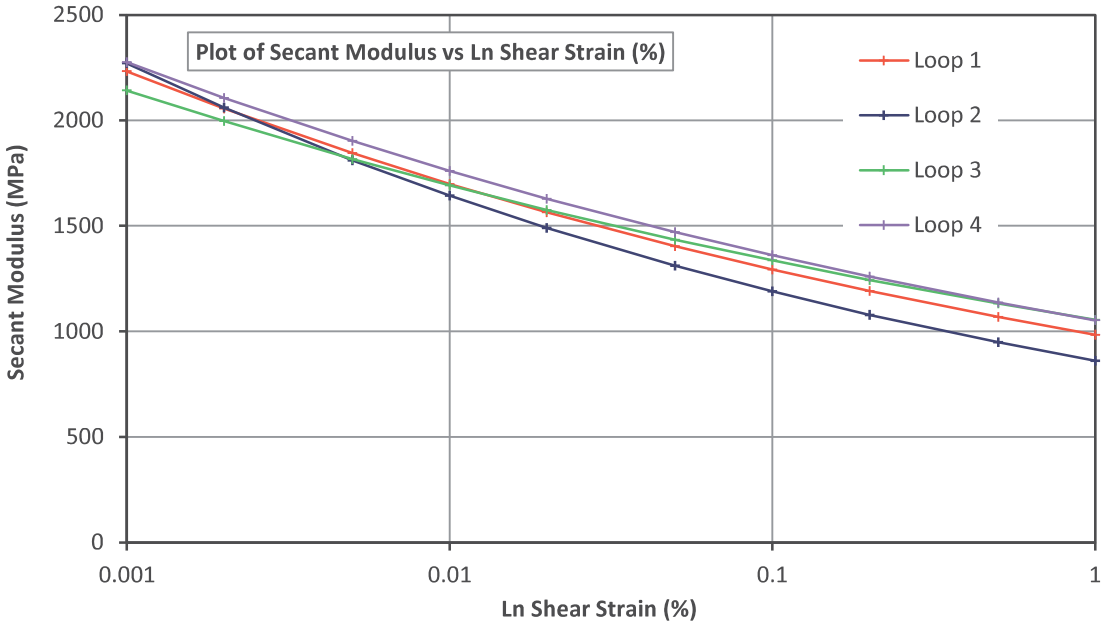
Project	Great Jackson Street, Manchester	Figure No.	BH4R T04 - 07
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis

Secant Modulus - Shear Strain (%)

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	**Test No.**	4
Borehole	BH4R	**Test Depth (m)**	31.20



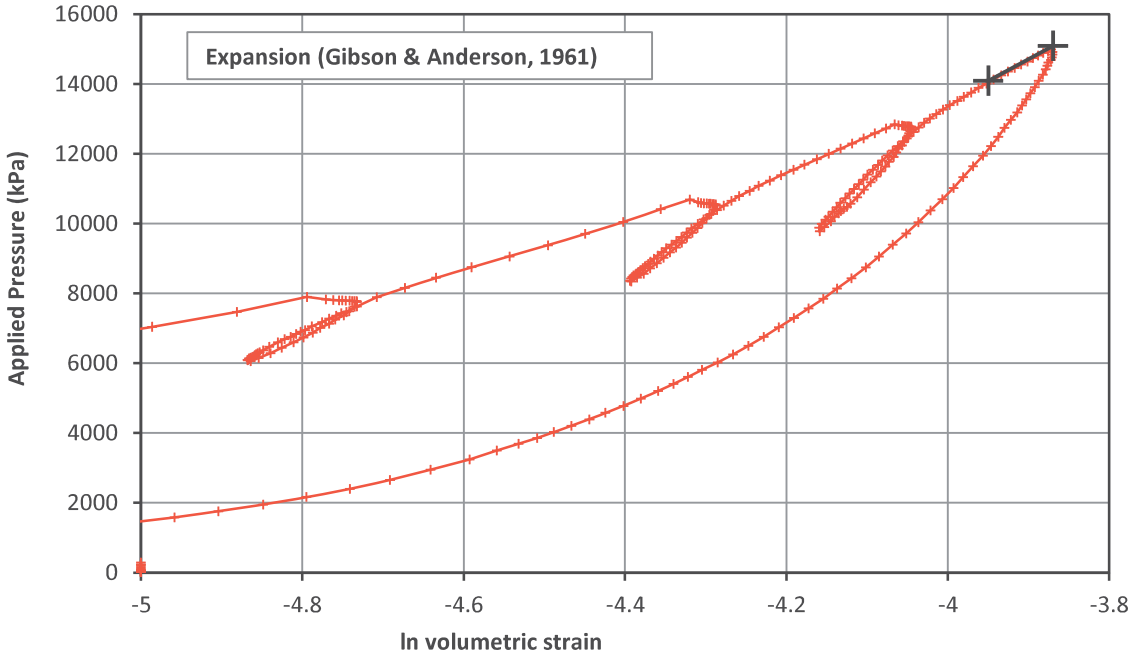
Shear Strain	Loop 1	Loop 2	Loop 3	Loop 4
0.001%	**2232**	**2271**	**2142**	**2276**
0.002%	2056	2060	1995	2106
0.005%	1844	1811	1816	1901
0.010%	**1699**	**1643**	**1692**	**1760**
0.020%	1565	1491	1576	1629
0.050%	1404	1311	1434	1470
0.100%	**1293**	**1189**	**1336**	**1361**
0.200%	1191	1079	1244	1259
0.500%	1068	948	1133	1137
1.000%	**984**	**860**	**1055**	**1052**

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T04 - 08**
Client	GeoAssist		
Project No.	P1210114		

Pressuremeter Analysis - Undrained Strength

IN SITU SITE INVESTIGATION

Test Date	29/04/2021	**Test No.**	4
Borehole	BH4R	**Test Depth (m)**	31.20



Strength (loading)	Undrained Shear	12500	kPa
	Limit Pressure	63475	kPa

Project	Great Jackson Street, Manchester	**Figure No.**	**BH4R T04 - 09**
Client	GeoAssist		
Project No.	P1210114		

APPENDIX B

Calibrations

Description
HPD 04 – Eleanor

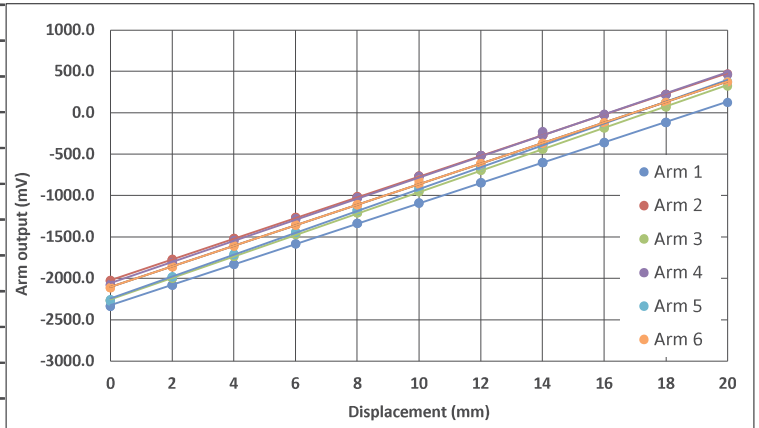
HPD-95 ISSI

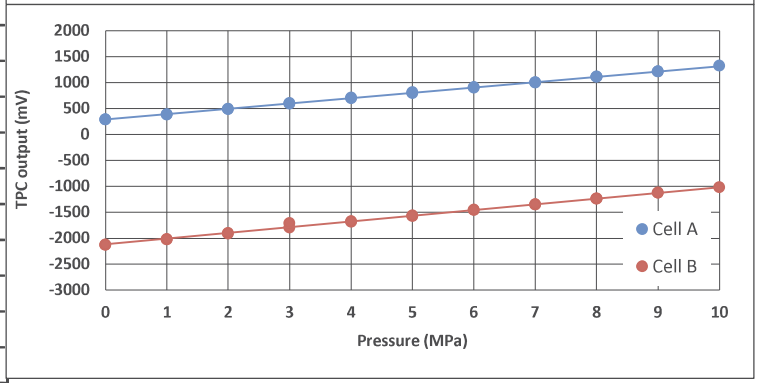
HPD04 - Eleanor

IN SITU
SITE INVESTIGATION

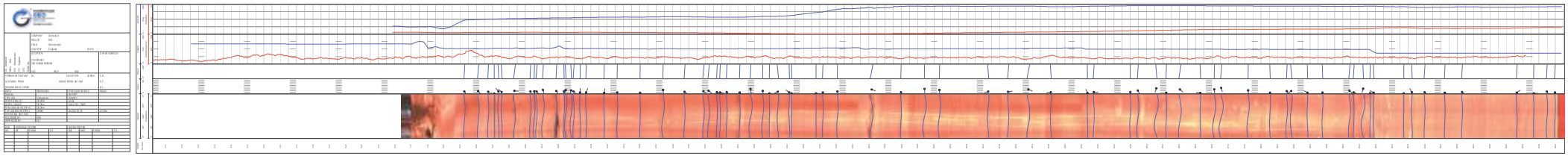
Arms	05/01/2021					
Displacement	Arm 1	Arm 2	Arm 3	Arm 4	Arm 5	Arm 6
mm	mV	mV	mV	mV	mV	mV
0	-2333.7	-2025.8	-2263.9	-2074.9	-2272.0	-2112.3
2	-2080.0	-1772.3	-1996.0	-1808.9	-1982.3	-1860.2
4	-1828.4	-1516.2	-1730.6	-1544.2	-1707.6	-1608.3
6	-1580.8	-1264.4	-1468.3	-1283.1	-1440.2	-1353.4
8	-1334.5	-1012.9	-1207.0	-1025.1	-1173.4	-1109.8
10	-1090.1	-764.0	-948.6	-770.2	-911.1	-863.3
12	-845.7	-517.3	-691.4	-516.2	-650.2	-616.4
14	-602.2	-270.0	-436.5	-226.8	-388.0	-369.2
16	-359.0	-22.0	-180.9	-21.8	-130.5	-122.1
18	-115.9	224.9	73.2	218.6	124.6	123.2
20	123.6	471.6	324.6	462.4	374.9	371.2
18	-117.2	224.3	71.8	215.7	122.9	124.4
16	-359.8	-23.1	-182.8	-24.3	-131.1	-121.4
14	-602.9	-271.9	-438.0	-268.0	-389.5	-367.9
12	-846.1	-519.1	-693.5	-517.8	-651.0	-613.5
10	-1090.7	-766.0	-950.5	-770.5	-913.1	-816.4
8	-1335.5	-1015.2	-1209.3	-1025.5	-1177.5	-1108.4
6	-1582.2	-1265.9	-1470.4	-1284.5	-1445.4	-1356.3
4	-1830.1	-1517.3	-1732.2	-1546.0	-1713.6	-1607.6
2	-2081.4	-1773.7	-1996.9	-1812.2	-1982.9	-1860.8
0	-2335.6	-2029.8	-2264.1	-2077.5	-2256.6	-2114.0
Slope (mV/mm)	122.9	124.9	129.5	127.4	132.1	124.1
Zero (mV)	-2320.8	-2016.0	-2247.9	-2048.6	-2239.4	-2100.3

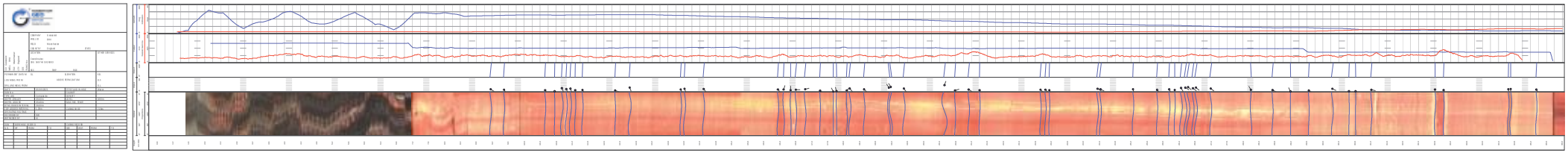
Pressure Cells	05/01/2021			
Pressure	Cell A		Cell B	
MPa	V	mV	V	mV
0	0.28680	286.80	-2.13130	-2131.30
1	0.38170	381.70	-2.02690	-2026.90
2	0.48700	487.00	-1.91240	-1912.40
3	0.59470	594.70	-1.79570	-1795.70
4	0.69650	696.50	-1.68570	-1685.70
5	0.79720	797.20	-1.57620	-1576.20
6	0.90180	901.80	-1.46320	-1463.20
7	0.99580	995.80	-1.35570	-1355.70
8	1.11100	1111.00	-1.24260	-1242.60
9	1.20970	1209.70	-1.12670	-1126.70
10	1.32210	1322.10	-1.01750	-1017.50
9	1.21310	1213.10	-1.12740	-1127.40
8	1.11260	1112.60	-1.23620	-1236.20
7	1.00560	1005.60	-1.35050	-1350.50
6	0.91020	910.20	-1.45420	-1454.20
5	0.81050	810.50	-1.56330	-1563.30
4	0.70700	707.00	-1.67560	-1675.60
3	0.60080	600.80	-1.70910	-1709.10
2	0.49520	495.20	-1.90440	-1904.40
1	0.39070	390.70	-2.01780	-2017.80
0	0.29140	291.40	-2.12820	-2128.20
Slope (mV/MPa)		102.94462		110.68170
Zero (mV)		287.0		-2122.3





Calibrated by:	Dave Lewins
Calibrated at:	Rotherham
Checked by:	John Holt
Date:	05/01/2021





Site Reference:	6069 CGJ
Project Site:	Plots F1 & F2 Great Jackson Street
Project Location:	Manchester
Client:	Coffey Geotechnics Ltd

Ground Gas Readings

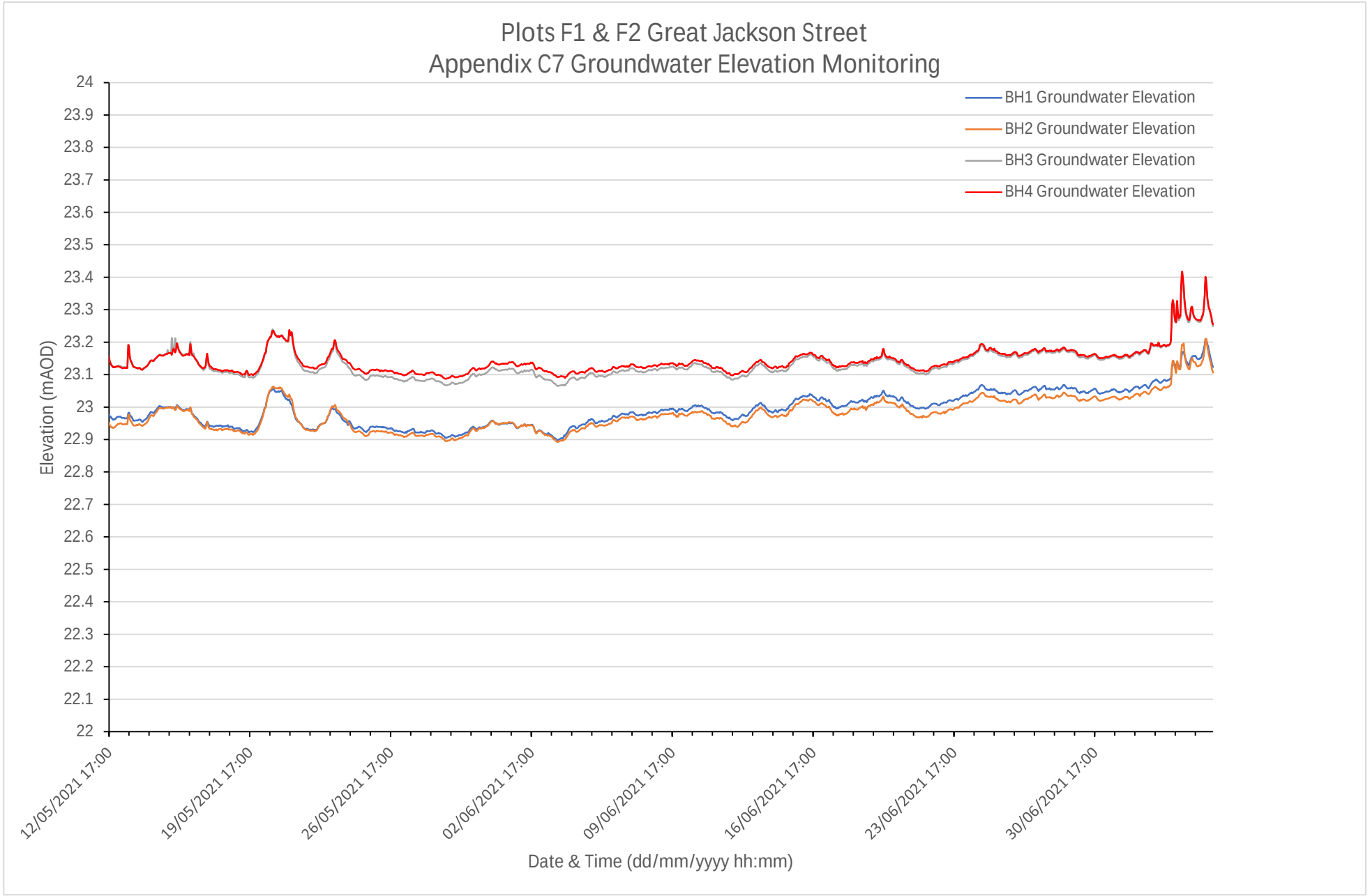
Date - Time	BH	CH4 (%)	CO2 (%)	O2 (%)	H2S (ppm)	CO (ppm)	LEL (%)	aP (mb)	Flw (l/h)	H2O (m)	State
24/05/2021	WS1	0.0	0.8	18.0	0.0	0.0	0.0	997	0.0		
24/05/2021	WS2	0.0	0.1	20.3	0.0	0.0	0.0	998	0.0		
24/05/2021	WS3	0.0	1.3	18.0	0.0	0.0	0.0	998	0.0		
24/05/2021	WS4	0.0	0.3	20.3	0.0	0.0	0.0	998	0.0		
24/05/2021	WS5	0.0	0.7	20.1	0.0	0.0	0.0	997	0.0		
24/05/2021	WS6	0.0	0.3	20.3	0.0	0.0	0.0	998	0.0		
07/07/2021	WS1	0.0	1.2	15.9	0.0	0.0	0.0	1006	0.0		
07/07/2021	WS2	0.0	0.1	20.5	0.0	0.0	0.0	1006	0.0		
07/07/2021	WS3	0.0	3.2	15.5	0.0	0.0	0.0	1006	0.0		
07/07/2021	WS4	0.0	0.6	19.9	0.0	0.0	0.0	1005	0.0		
07/07/2021	WS5	0.0	0.5	19.0	0.0	0.0	0.0	1005	0.0		
07/07/2021	WS6	0.0	0.0	20.7	0.0	0.0	0.0	1006	0.0		
16/07/2021	WS1	0.0	2.7	14.5	0.0	0.0	0.0	1024	0.0		
16/07/2021	WS2	0.0	0.3	20.5	0.0	0.0	0.0	1024	0.0		
16/07/2021	WS3	0.0	3.4	15.6	0.0	0.0	0.0	1024	0.0		
16/07/2021	WS4	0.0	0.0	21.3	0.0	0.0	0.0	1023	0.0		
16/07/2021	WS5	0.0	1.3	18.6	0.0	0.0	0.0	1024	0.0		
16/07/2021	WS6	0.0	0.1	20.9	0.0	0.0	0.0	1024	0.0		
26/07/2021	WS1	0.0	6.1	6.5	0.0	0.0	0.0	1007	0.0		
26/07/2021	WS2	0.0	0.3	20.4	0.0	0.0	0.0	1007	0.0		
26/07/2021	WS3	0.0	3.7	14.8	0.0	0.0	0.0	1007	0.0		
26/07/2021	WS4	0.0	0.0	20.6	0.0	0.0	0.0	1006	0.0		
26/07/2021	WS5	0.0	1.8	17.3	0.0	0.0	0.0	1006	0.0		
26/07/2021	WS6	0.0	0.3	20.5	0.0	0.0	0.0	1006	0.0		
28/07/2021	WS1	0.0	0.0	20.7	0.0	0.0	0.0	1000	0.0		
28/07/2021	WS2	0.0	0.0	20.7	0.0	0.0	0.0	1000	0.0		
28/07/2021	WS3	0.0	3.7	14.9	0.0	0.0	0.0	999	0.0		
28/07/2021	WS4	0.0	0.0	20.6	0.0	0.0	0.0	999	0.0		
28/07/2021	WS5	0.0	1.7	16.9	0.0	0.0	0.0	998	0.0		
28/07/2021	WS6	0.0	0.0	20.6	0.0	0.0	0.0	998	0.0		
25/08/2021	WS1	0.0	3.8	13.8	0.0	0.0	0.0	1023	0.0		
25/08/2021	WS2	0.0	2.2	18.1	0.0	0.0	0.0	1023	0.0		
25/08/2021	WS3	0.0	3.7	16.0	0.0	0.0	0.0	1023	0.0		
25/08/2021	WS4	0.0	0.0	20.2	0.0	0.0	0.0	1024	0.0		
25/08/2021	WS5	0.0	1.5	18.3	0.0	0.0	0.0	1024	0.0		
25/08/2021	WS6	0.0	0.3	20.3	0.0	0.0	0.0	1024	0.0		

Plots F1 F2 Great Jackson Street

Appendix C7

Weekly Groundwater Elevation Monitoring

Date (dd/mm/yyyy)	Time (hh:mm:ss)	BH1 Groundwater (mAOD)	Temp	BH2 Groundwater (mAOD)	Temp	BH3 Groundwater (mAOD)	Temp	BH4 Groundwater (mAOD)	Temp
12/05/2021	17:00:00	22.98	-	22.95	-	23.15	-	23.16	-
19/05/2021	17:00:00	22.92	-	22.92	-	23.09	-	23.10	-
26/05/2021	17:00:00	22.94	-	22.92	-	23.09	-	23.11	-
02/06/2021	17:00:00	22.95	-	22.94	-	23.11	-	23.14	-
09/06/2021	17:00:00	23.00	-	22.98	-	23.12	-	23.14	-
16/06/2021	17:00:00	23.03	-	23.02	-	23.16	-	23.16	-
23/06/2021	17:00:00	23.02	-	22.99	-	23.13	-	23.14	-
30/06/2021	17:00:00	23.06	-	23.03	-	23.16	-	23.16	-


Plots F1 & F2 Great Jackson Street
Appendix C7 Groundwater Elevation Monitoring
BH1 Groundwater Elevation
BH2 Groundwater Elevation
BH3 Groundwater Elevation
BH4 Groundwater Elevation
Elevation (mAOD)
24
23.9
23.8
23.7
23.6
23.5
23.4
23.3
23.2
23.1
23
22.9
22.8
22.7
22.6
22.5
22.4
22.3
22.2
22.1
22
12/05/2021 17:00
19/05/2021 17:00
26/05/2021 17:00
02/06/2021 17:00
09/06/2021 17:00
16/06/2021 17:00
23/06/2021 17:00
30/06/2021 17:00
Date & Time (dd/mm/yyyy hh:mm)

GeoAssist Limited **SOIL LABORATORY SUMMARY SHEET**	Project: **Plots F1 & F2 Great Jackson Street**	Site Ref: **6069/CGJ**
	Location: **Manchester**	Project Code :
	Client: **Coffey Geotechnics Ltd**	
	Consultant : **Coffey Geotechnics Ltd**	**Hole Ref BH1**

			Classification					Triaxial Compression					Chemical		
Sample Ref.	**Depth m**	**Sample Description**	**LL %**	**PL %**	**PI %**	**% passing 425**	**Moist Cont. %**	**Bulk Density Mg/m³**	**Sample Dia mm**	**Confining Pressure kN/m²**	**Deviator /Shear Stress kN/m²**	**Shear Cohesion kN/m² /Friction angle degrees**	**So4 Total %** / **So4 2:1 extract Soil:Water mg/l**	**pH**	**Test Code**
BH1 B1	0.50	Brown clayey sand and gravel with brick fragments and cobbles - MADE GROUND					-						0.033 / 39.4	7.1	GRAD WS Organic = 1.4% See BRE
BH1 D1	0.80	Brown clayey silty gravelly SAND					-								GRAD WS
BH1 D3	1.80	Brown/grey clayey silty gravelly SAND with dark grey fibrous matter					-						0.062 / 270	7.4	GRAD WS Organic = 1.5% See BRE
BH1 D4	2.50	Brown slightly gravelly very sandy silty CLAY	36	17	19	91	16						0.043 / 108	8.3	NMC+CLSS GRAD WS+HYD See BRE
BH1 U1	3.00	Brown slightly gravelly very sandy silty CLAY	37	19	18	100	19 15	1.98	102	50 100 200	291 291 291	146			NMC CLSS UUM
BH1 D5	3.50	Brown slightly gravelly very sandy silty CLAY	35	16	19	100	15								NMC+CLSS
BH1 U2	4.00	Brown slightly gravelly very sandy silty CLAY	28	13	15	76	13	Sample unsuitable for Triaxial – high gravel content in middle of sample							NMC+CLSS CONG CUP
BH1 D6	4.50	Brown gravelly very sandy silty CLAY	24	12	12	93	8.7								NMC+CLSS
BH1 D7	5.50	Brown gravelly very sandy silty CLAY	29	13	16	85	9.5								NMC+CLSS GRAD WS+HYD
BH1 D8	7.00	Orange/brown silty SAND with sandstone fragments and rounded gravel					-						0.014 / 22.4	8.3	GRAD WS SEE BRE

GeoAssist Limited **SOIL LABORATORY SUMMARY SHEET**	Project: **Plots F1 & F2 Great Jackson Street**	Site Ref: **6069/CGJ**
	Location: **Manchester**	Project Code :
	Client: **Coffey Geotechnics Ltd**	
	Consultant : **Coffey Geotechnics Ltd**	**Hole Ref BH2**

			Classification					Triaxial Compression					Chemical		
Sample Ref.	**Depth m**	**Sample Description**	**LL %**	**PL %**	**PI %**	**% passing 425**	**Moist Cont. %**	**Bulk Density Mg/m³**	**Sample Dia mm**	**Confining Pressure kN/m²**	**Deviator /Shear Stress kN/m²**	**Shear Cohesion kN/m² /Friction angle degrees**	**So4 Total %** / **So4 2:1 extract Soil:Water mg/l**	**pH**	**Test Code**
BH2 B1	0.50	Dark brown brick rubble - MADE GROUND					-								Asbestos
BH2 D1	0.80	Brown clayey silty sand and gravel - MADE GROUND					-						0.054 / 96.8	6.9	Organic = 3.1% See BRE
BH2 U1	1.00	Grey very sandy silty clay with brick and glass fragments and organic inclusions - MADE GROUND					39	2.06	100	50 100 200	132 154 161	75			NMC UUM
BH2 U2	2.00	Brown/grey slightly sandy silty CLAY, laminated with silt partings and inclusions					24	2.04	102	50 100 200	103 105 107	53			UUM
BH2 D3	2.50	Brown/grey slightly sandy silty CLAY, laminated with silt partings and inclusions	44	19	25	100	21						0.026 / 58.0	8.0	NMC+CLSS GRAD WS SEE BRE
BH2 U3	3.00	Brown/grey slightly sandy silty CLAY, laminated with silt partings and inclusions					25	2.13	102	50	106	53			NMC CONG UU
BH2 D4	3.50	Brown/grey slightly sandy silty CLAY, laminated with silt partings and inclusions	44	21	23	88	25								NMC+CLSS GRAD WS
BH2 D5	4.50	Brown slightly gravelly very sandy very silty CLAY	24	12	12	94	8.9								NMC+CLSS GRAD WS+HYD
BH2 D6	5.50	Orange/brown silty SAND with sandstone fragments and rounded gravel					-								GRAD WS

GeoAssist Limited **SOIL LABORATORY SUMMARY SHEET**	Project: **Plots F1 & F2 Great Jackson Street**	Site Ref: **6069/CGJ**
	Location: **Manchester**	Project Code :
	Client: **Coffey Geotechnics Ltd**	
	Consultant : **Coffey Geotechnics Ltd**	**Hole Ref BH3**

			Classification					Triaxial Compression					Chemical		
Sample Ref.	**Depth m**	**Sample Description**	**LL %**	**PL %**	**PI %**	**% passing 425**	**Moist Cont. %**	**Bulk Density Mg/m³**	**Sample Dia mm**	**Confining Pressure kN/m²**	**Deviator /Shear Stress kN/m²**	**Shear Cohesion kN/m² /Friction angle degrees**	**So4 Total % / So4 2:1 extract Soil:Water mg/l**	**pH**	**Test Code**
BH3 B1	0.50	Dark brown/grey clayey gravelly silty SAND with brick fragments - MADE GROUND					-								Asbestos
BH3 D2	1.50	Dark brown/grey very sandy silty clay - MADE GROUND					-						0.040 / 48.5	8.1	Organic =1.3% See BRE
BH3 U1	2.00	Dark brown/grey very sandy silty clay - MADE GROUND changing at 2.10m to Dark brown clayey silty very gravelly SAND - MADE GROUND	43	22	21	100	27 13.5 7.4	Unsuitable for Triaxial test changing to gravelly Sand at 2.10m							NMC+CLSS UUM
BH3 D3	2.50	Dark brown clayey silty very gravelly SAND - MADE GROUND					-						0.060 / 124	9.1	GRAD WS See BRE
BH3 U2	3.00	Dark brown clayey silty very gravelly SAND - MADE GROUND changing at 3.20m to brown/grey silty CLAY with silt partings					18	2.19	102	50 100 200	188 188 188	94			UUM
BH3 D4	3.50	Brown/grey silty CLAY with silt partings	47	21	26	100	25								NMC+CLSS
BH3 U3	3.50	Brown/grey silty CLAY with silt partings					26	2.12	102	50 100 200	155 155 155	78			CONG UUM
BH3 D5	4.50	Brown slightly gravelly very sandy silty CLAY	30	12	18	85	14								NMC+CLSS GRAD WS+HYD
BH3 U3	5.20	Brown slightly gravelly very sandy silty CLAY with cobble					9.6								NMC
BH3 D6	5.70	Brown slightly gravelly very sandy silty CLAY	28	12	16	97	9.7								NMC+CLSS GRAD WS

GeoAssist Limited **SOIL LABORATORY SUMMARY SHEET**	Project: **Plots F1 & F2 Great Jackson Street**	Site Ref: **6069/CGJ**
	Location: **Manchester**	Project Code :
	Client: **Coffey Geotechnics Ltd**	
	Consultant : **Coffey Geotechnics Ltd**	**Hole Ref BH3**

			Classification					Triaxial Compression					Chemical		
Sample Ref.	**Depth m**	**Sample Description**	**LL %**	**PL %**	**PI %**	**% passing 425**	**Moist Cont. %**	**Bulk Density Mg/m^3**	**Sample Dia mm**	**Confining Pressure kN/m^2**	**Deviator /Shear Stress kN/m^2**	**Shear Cohesion kN/m^2 /Friction angle degrees**	**So4 Total %** / **So4 2:1 extract Soil:Water mg/l**	**pH**	**Test Code**
BH3 D7	6.50	Orange/brown clayey silty SAND with sandstone fragments and rounded gravel					-								GRAD WS

GeoAssist Limited **SOIL LABORATORY SUMMARY SHEET**	Project: **Plots F1 & F2 Great Jackson Street**	Site Ref: **6069/CGJ**
	Location: **Manchester**	Project Code :
	Client: **Coffey Geotechnics Ltd**	
	Consultant : **Coffey Geotechnics Ltd**	**Hole Ref BH4**

			Classification					Triaxial Compression					Chemical		
Sample Ref.	**Depth m**	**Sample Description**	**LL %**	**PL %**	**PI %**	**% passing 425**	**Moist Cont. %**	**Bulk Density Mg/m^3**	**Sample Size mm**	**Effective Confining Pressure kN/m^2**	**Deviator /Shear Stress kN/m^2**	**Shear Cohesion kN/m^2 /Friction angle degrees**	**So4 Total %** / **So4 2:1 extract Soil:Water mg/l**	**pH**	**Test Code**
BH4 B1	0.50	Brown clayey sand and gravel, brick rubble and fragments with glass and asbestos cement fragments - MADE GROUND					-						0.193 / 136	10.6	See BRE
BH4 D1	1.50	Dark brown/grey clayey sandy gravel with brick fragments - MADE GROUND					-						0.136 / 87.0	10.1	See BRE
BH4 B2	2.50	Brown/grey clayey silty SAND and GRAVEL					-						0.073 / 131	8.8	GRAD WS See BRE
BH4 U1	3.00	Brown gravelly sandy silty CLAY	37	18	19	83	16 15	2.21	102	50 100 200	275 294 304	146			NMC+clss CONG UUM
BH4 D3	3.50	Grey/brown slightly gravelly very silty CLAY with silt partings	52	21	31	100	24						0.074 / 297	8.3	NMC+CLSS See BRE
BH4 U2	3.80	Grey/brown slightly gravelly very silty CLAY with silt partings	28	13	15	84	12 14	2.25	103	100 200 300	123 240 427	$0/30^0$			NMC+CLSS CUP
BH4 D4	4.30	Brown slightly gravelly very sandy silty CLAY	27	12	15	93	11								NMC+CLSS GRAD WS +HYD
BH4 D5	5.50	Brown slightly gravelly very sandy silty CLAY	26	11	15	89	8.6								NMC+CLSS GRAD WS+HYD
BH4 D6	6.50	Orange/brown silty SAND with sandstone fragments and rounded gravel					-								GRAD WS

SUMMARY REPORT

Summary of Classification Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with:

Moisture Content by BS 1377-2: 1990: Clause 3.2; Water Content by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3 (4 Point Test), Clause 4.4 (1 Point Test) and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: GeoAssist Ltd

Client Address: Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU

Contact: Matthew Benson

Site Address: Great Jackson Street, Manchester

Client Reference: 6069-CGJ
Job Number: 21-86752
Date Sampled: Not Given
Date Received: 13/07/2021
Date Tested: 22/07 - 04/08/2021
Sampled By: Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	Moisture Content [W]	Water Content [W]	Atterberg				Density			Total Porosity#		
		Reference	Depth Top	Depth Base	Type					% Passing 425um	WL	Wp	Ip	bulk	dry	PD			
			m	m				%	%	%	%	%	%	Mg/m3	Mg/m3	Mg/m3	%		
1937326	BH1	D4	2.50	Not Given	D	Brown slightly gravelly sandy very clayey SILT	Atterberg 1 Point	16		91	36	17	19						
1937327	BH1	U1-D	3.00	Not Given	D	Brown sandy CLAY	Atterberg 1 Point	19		100	37	19	18						
1937328	BH1	D5	3.50	Not Given	D	Brown sandy CLAY	Atterberg 1 Point	15		100	35	16	19						
1937329	BH1	U2-D	4.00	Not Given	D	Brown slightly gravelly very sandy CLAY	Atterberg 1 Point	13		76	28	13	15						
1937330	BH1	D6	4.50	Not Given	D	Brown slightly gravelly clayey SAND	Atterberg 1 Point	8.7		93	24	12	12						
1937331	BH1	D7	5.50	Not Given	D	Brown gravelly very clayey SAND	Atterberg 1 Point	9.5		85	29	13	16						
1937333	BH2	D3	2.50	Not Given	D	Brownish grey slightly sandy CLAY	Atterberg 1 Point	21		100	44	19	25						
1937334	BH2	D4	3.50	Not Given	D	Brown slightly sandy gravelly CLAY	Atterberg 1 Point	25		88	44	21	23						
1937335	BH2	D5	4.50	Not Given	D	Brown silty clayey slightly gravelly SAND	Atterberg 1 Point	8.9		94	24	12	12						
1937337	BH3	U1-D	2.00	Not Given	D	Grey sandy CLAY	Atterberg 1 Point	27		100	43	22	21						

Note: # Non accredited; NP - Non plastic

Comments:

Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

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Date Reported: 16/08/2021

GF 234.12

UKAS TESTING
4041

SUMMARY REPORT

Summary of Classification Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Environmental Science

Tested in Accordance with:

Moisture Content by BS 1377-2: 1990: Clause 3.2; Water Content by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3 (4 Point Test), Clause 4.4 (1 Point Test) and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: GeoAssist Ltd

Client Address: Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU

Contact: Matthew Benson

Site Address: Great Jackson Street, Manchester

Client Reference: 6069-CGJ
Job Number: 21-86752
Date Sampled: Not Given
Date Received: 13/07/2021
Date Tested: 22/07 - 04/08/2021
Sampled By: Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	Moisture Content [W]	Water Content [W]	Atterberg				Density			Total Porosity#		
		Reference	Depth Top	Depth Base	Type					% Passing 425um	WL	Wp	Ip	bulk	dry	PD			
			m	m				%	%	%	%	%	%	Mg/m3	Mg/m3	Mg/m3	%		
1937339	BH3	D4	3.50	Not Given	D	Reddish brown slightly sandy CLAY	Atterberg 1 Point	25		100	47	21	26						
1937340	BH3	D5	4.50	Not Given	D	Brown gravelly very sandy very clayey SILT	Atterberg 1 Point	14		85	30	12	18						
1937341	BH3	D6	5.70	Not Given	D	Brown slightly gravelly clayey very silty SAND	Atterberg 1 Point	9.7		97	28	12	16						
1937344	BH4	U1-D	3.00	Not Given	D	Brown slightly gravelly sandy CLAY	Atterberg 1 Point	16		83	37	18	19						
1937345	BH4	D3	3.50	Not Given	D	Brown slightly sandy CLAY	Atterberg 1 Point	24		100	52	21	31						
1937346	BH4	U2-D	3.80	Not Given	D	Brown slightly gravelly very sandy CLAY	Atterberg 1 Point	12		84	28	13	15						
1937347	BH4	D4	4.30	Not Given	D	Brown slightly gravelly very sandy very clayey SILT	Atterberg 1 Point	11		93	27	12	15						
1937348	BH4	D5	5.50	Not Given	D	Brown silty clayey slightly gravelly SAND	Atterberg 1 Point	8.6		89	26	11	15						

Note: # Non accredited; NP - Non plastic

Comments:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 234.12

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

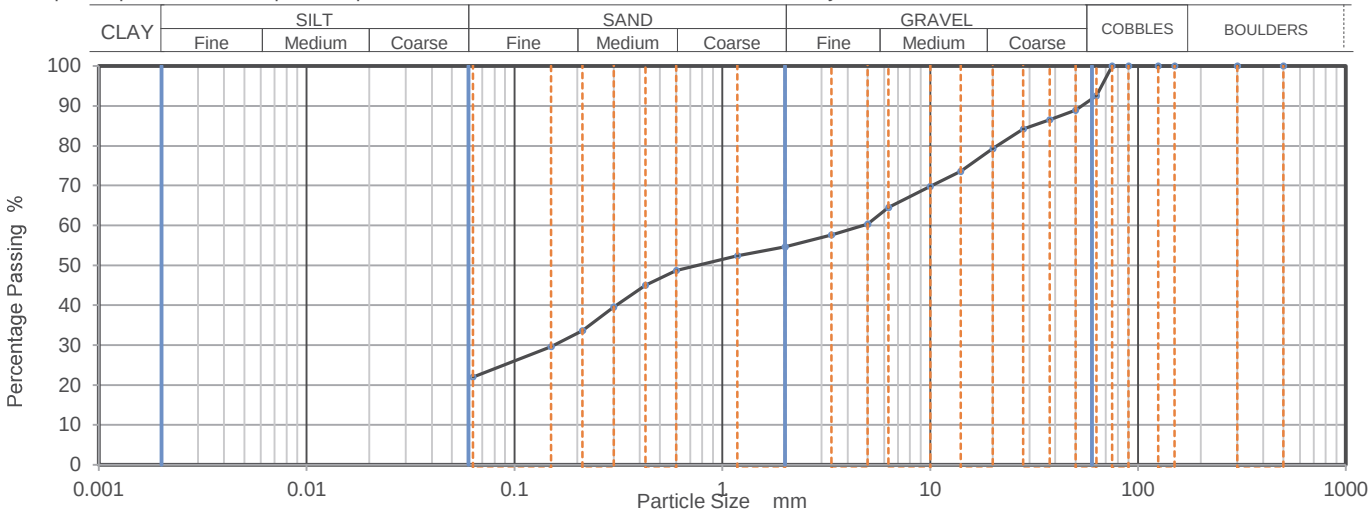
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	17/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937323	Depth Top [m]:	0.50
Hole No.:	BH1	Depth Base [m]:	Not Given
Sample Reference:	B1	Sample Type:	B
Sample Description:	Brown very clayey very sandy GRAVEL with cobbles		
Sample Preparation:	Sample was quartered, oven dried at 106.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	93		
50	89		
37.5	87		
28	84		
20	79		
14	74		
10	70		
6.3	65		
5	60		
3.35	58		
2	55		
1.18	52		
0.6	49		
0.425	45		
0.3	40		
0.212	34		
0.15	30		
0.063	23		

Sample Proportions	% dry mass
Very coarse	7
Gravel	38
Sand	32
Fines <0.063mm	23

Grading Analysis		
D100	mm	75
D60	mm	4.76
D30	mm	0.155
D10	mm	
Uniformity Coefficient		> 76
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

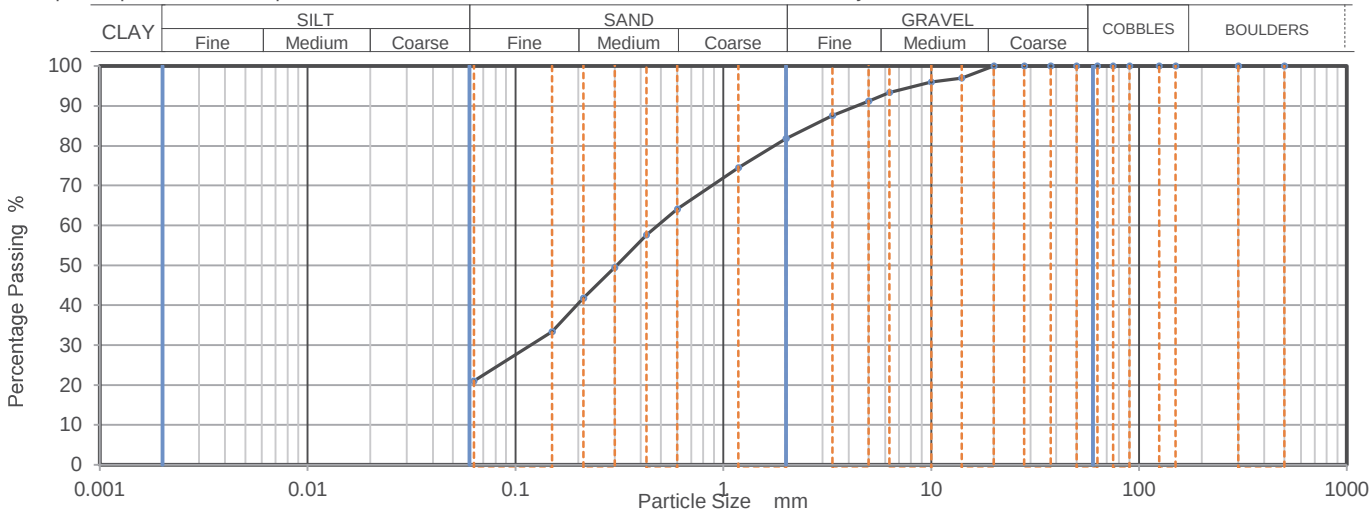
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937324	Depth Top [m]:	0.80
Hole No.:	BH1	Depth Base [m]:	Not Given
Sample Reference:	D1	Sample Type:	D
Sample Description:	Brown gravelly clayey SAND		
Sample Preparation:	Sample was whole tested, oven dried at 106.1 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	97		
10	96		
6.3	93		
5	91		
3.35	88		
2	82		
1.18	75		
0.6	64		
0.425	58		
0.3	50		
0.212	42		
0.15	33		
0.063	22		

Sample Proportions	% dry mass
Very coarse	0
Gravel	18
Sand	60
Fines <0.063mm	22

Grading Analysis		
D100	mm	20
D60	mm	0.482
D30	mm	0.116
D10	mm	
Uniformity Coefficient		> 7.7
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

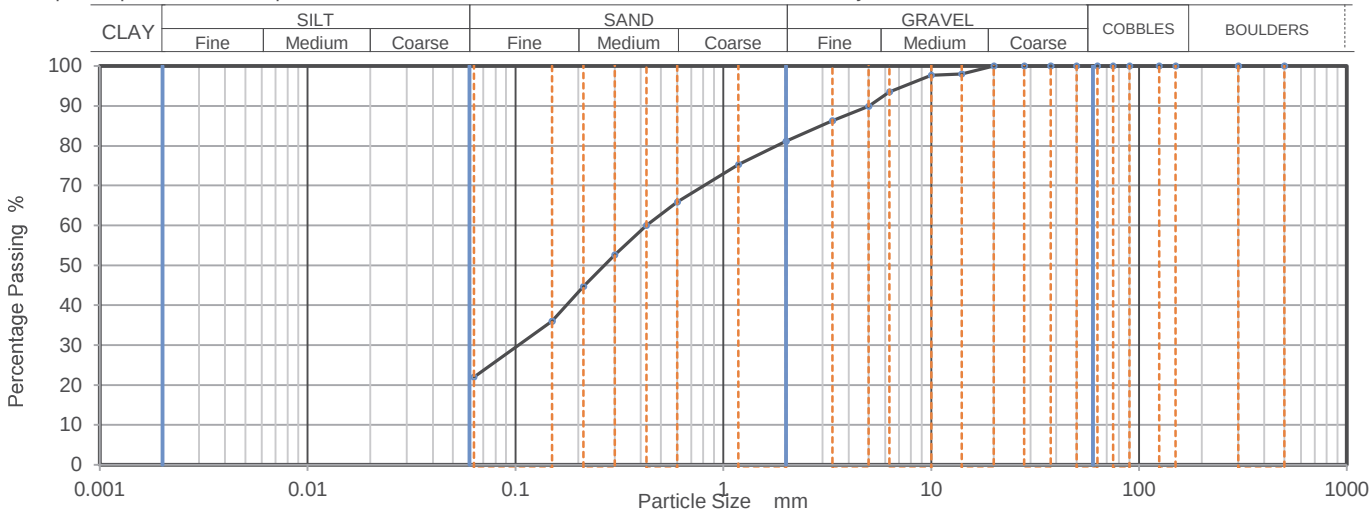
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937325	Depth Top [m]:	1.80
Hole No.:	BH1	Depth Base [m]:	Not Given
Sample Reference:	D3	Sample Type:	D
Sample Description:	Brown gravelly clayey SAND		
Sample Preparation:	Sample was whole tested, oven dried at 107.5 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	98		
10	98		
6.3	94		
5	90		
3.35	86		
2	81		
1.18	75		
0.6	66		
0.425	60		
0.3	53		
0.212	45		
0.15	36		
0.063	23		

Sample Proportions	% dry mass
Very coarse	0
Gravel	19
Sand	59
Fines <0.063mm	22

Grading Analysis		
D100	mm	20
D60	mm	0.425
D30	mm	0.102
D10	mm	
Uniformity Coefficient		> 6.7
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

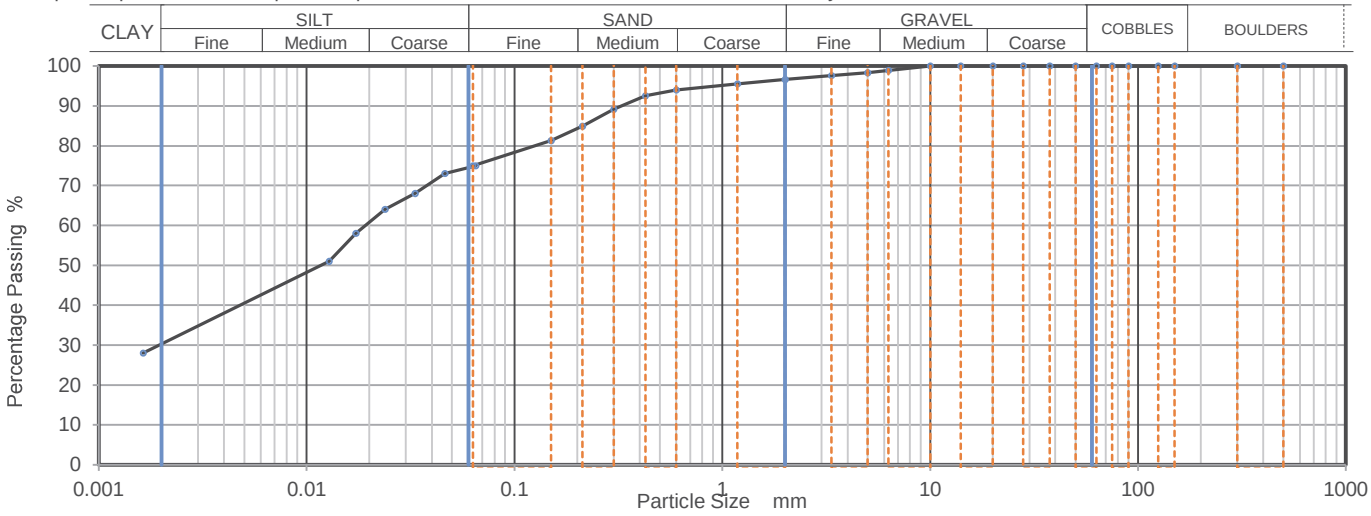
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937326	Depth Top [m]:	2.50
Hole No.:	BH1	Depth Base [m]:	Not Given
Sample Reference:	D4	Sample Type:	D
Sample Description:	Brown slightly gravelly sandy very clayey SILT		
Sample Preparation:	Sample was quartered, oven dried at 107.5 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0649	75
300	100	0.0462	73
150	100	0.0332	68
125	100	0.0238	64
90	100	0.0172	58
75	100	0.0128	51
63	100	0.0016	28
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	99		
5	98		
3.35	98	Particle density	(assumed)
2	97	2.65	Mg/m3
1.18	96		
0.6	94		
0.425	93		
0.3	89		
0.212	85		
0.15	81		
0.063	75		

Sample Proportions	% dry mass
Very coarse	0
Gravel	3
Sand	22
Silt	45
Clay	30

Grading Analysis		
D100	mm	10
D60	mm	0.0194
D30	mm	0.00198
D10	mm	
Uniformity Coefficient		> 12
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

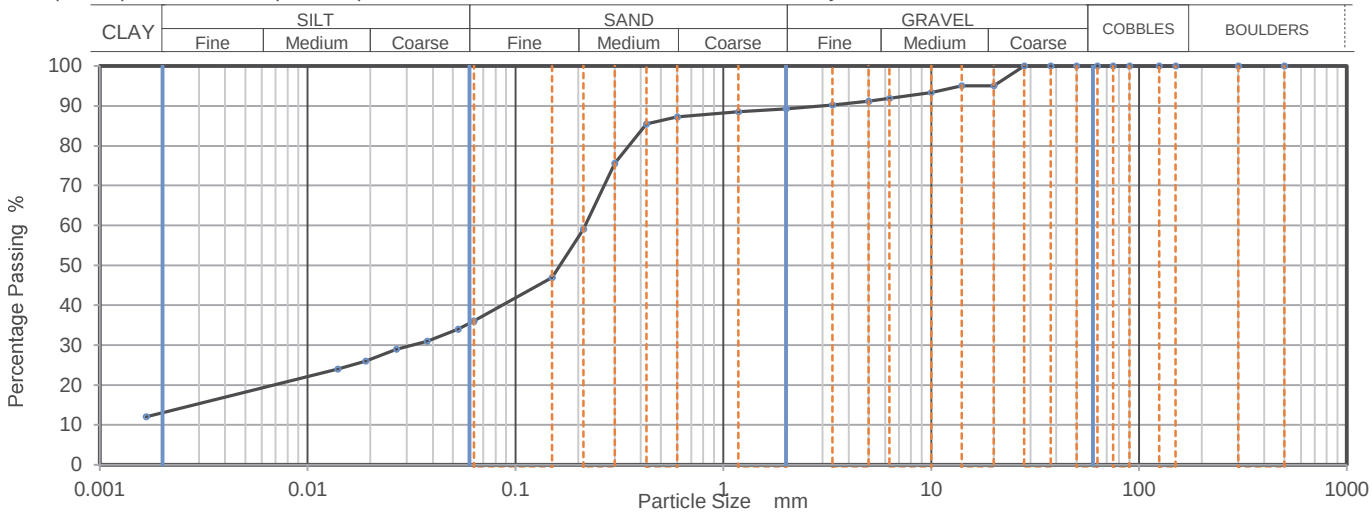
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937331	Depth Top [m]:	5.50
Hole No.:	BH1	Depth Base [m]:	Not Given
Sample Reference:	D7	Sample Type:	D
Sample Description:	Brown gravelly very clayey SAND		
Sample Preparation:	Sample was quartered, oven dried at 110.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	36
300	100	0.0528	34
150	100	0.0376	31
125	100	0.0267	29
90	100	0.0190	26
75	100	0.0140	24
63	100	0.0017	12
50	100		
37.5	100		
28	100		
20	95		
14	95		
10	93		
6.3	92		
5	91		
3.35	90	Particle density	(assumed)
2	89	2.65	Mg/m3
1.18	89		
0.6	87		
0.425	85		
0.3	76		
0.212	59		
0.15	47		
0.063	36		

Sample Proportions	% dry mass
Very coarse	0
Gravel	11
Sand	53
Silt	23
Clay	13

Grading Analysis		
D100	mm	28
D60	mm	0.216
D30	mm	0.0313
D10	mm	
Uniformity Coefficient		> 130
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

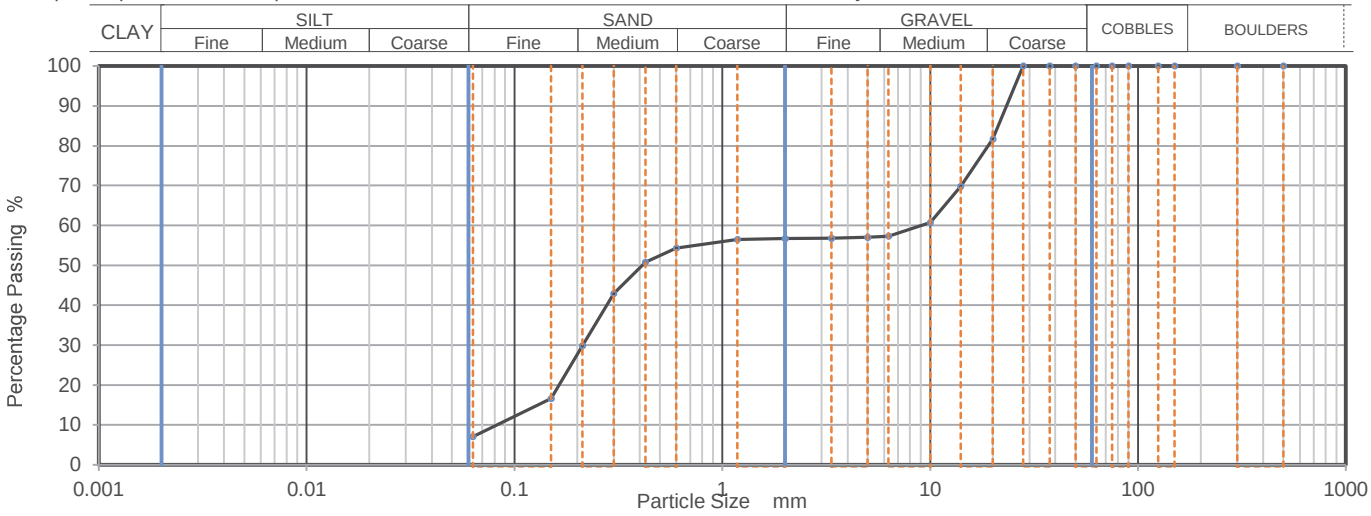
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937332	Depth Top [m]:	7.00
Hole No.:	BH1	Depth Base [m]:	Not Given
Sample Reference:	D8	Sample Type:	D
Sample Description:	Reddish brown slightly clayey very gravelly SAND		
Sample Preparation:	Sample was whole tested, oven dried at 107.5 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	82		
14	70		
10	61		
6.3	57		
5	57		
3.35	57		
2	57		
1.18	57		
0.6	54		
0.425	51		
0.3	43		
0.212	30		
0.15	17		
0.063	8		

Sample Proportions	% dry mass
Very coarse	0
Gravel	43
Sand	49
Fines <0.063mm	8

Grading Analysis		
D100	mm	28
D60	mm	9.08
D30	mm	0.213
D10	mm	0.0779
Uniformity Coefficient		120
Curvature Coefficient		0.064

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

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PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

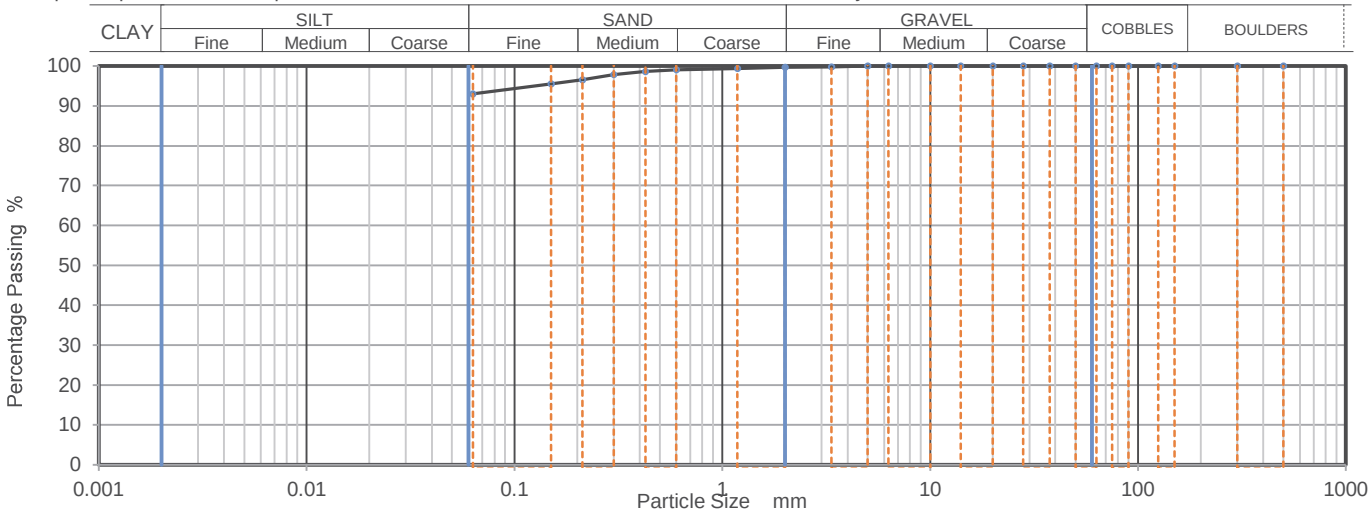
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937333	Depth Top [m]:	2.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	D3	Sample Type:	D
Sample Description:	Brownish grey slightly sandy CLAY		
Sample Preparation:	Sample was whole tested, oven dried at 106.1 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	99		
0.425	99		
0.3	98		
0.212	97		
0.15	96		
0.063	93		

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	6
Fines <0.063mm	93

Grading Analysis		
D100	mm	5
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		N/A
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

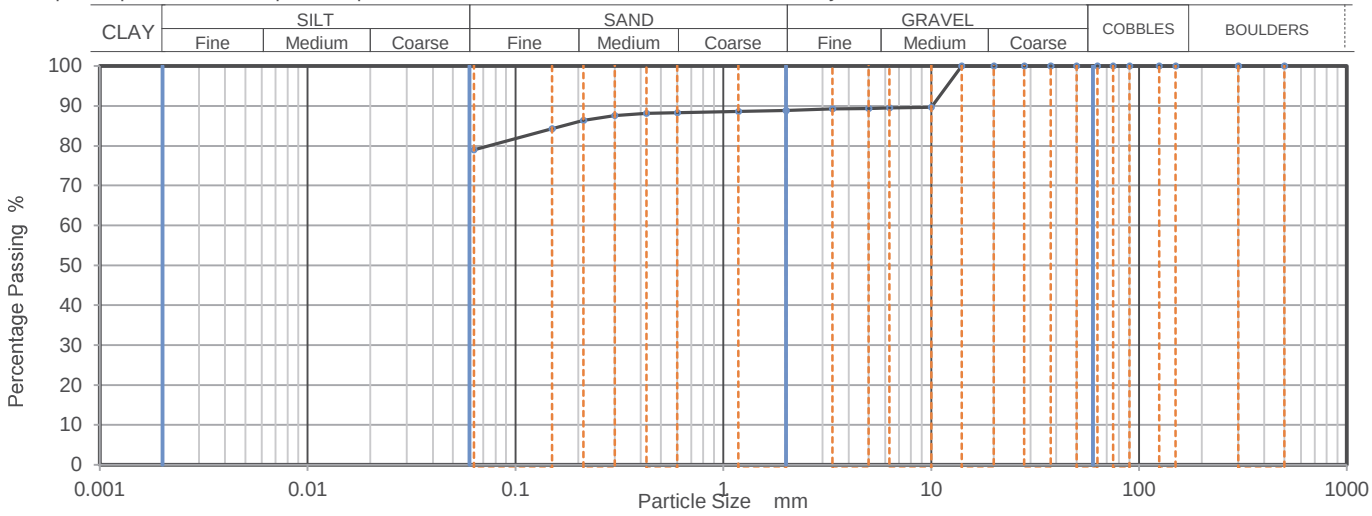
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937334	Depth Top [m]:	3.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	D4	Sample Type:	D
Sample Description:	Brown slightly sandy gravelly CLAY		
Sample Preparation:	Sample was quartered, oven dried at 110.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	90		
6.3	90		
5	89		
3.35	89		
2	89		
1.18	89		
0.6	88		
0.425	88		
0.3	88		
0.212	86		
0.15	84		
0.063	80		

Sample Proportions	% dry mass
Very coarse	0
Gravel	11
Sand	9
Fines <0.063mm	80

Grading Analysis		
D100	mm	14
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		N/A
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

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PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

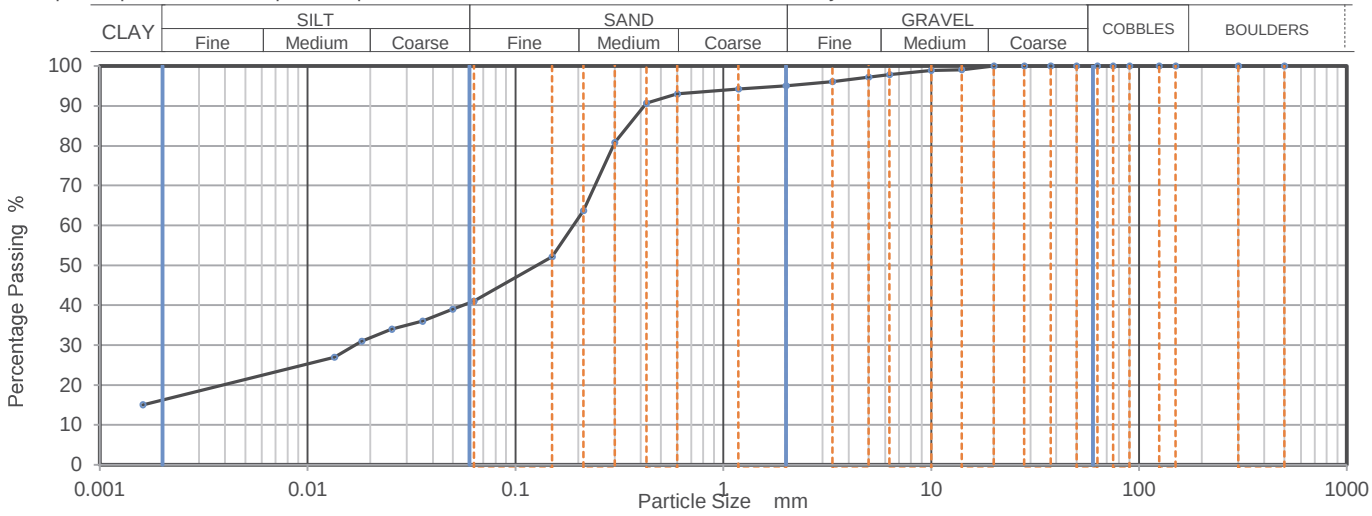
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937335	Depth Top [m]:	4.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	D5	Sample Type:	D
Sample Description:	Brown silty clayey slightly gravelly SAND		
Sample Preparation:	Sample was quartered, oven dried at 110.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	41
300	100	0.0498	39
150	100	0.0356	36
125	100	0.0254	34
90	100	0.0182	31
75	100	0.0134	27
63	100	0.0016	15
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	99		
6.3	98		
5	97		
3.35	96	Particle density	(assumed)
2	95	2.65	Mg/m3
1.18	94		
0.6	93		
0.425	91		
0.3	81		
0.212	64		
0.15	52		
0.063	41		

Sample Proportions	% dry mass
Very coarse	0
Gravel	5
Sand	54
Silt	24
Clay	17

Grading Analysis		
D100	mm	20
D60	mm	0.19
D30	mm	0.017
D10	mm	
Uniformity Coefficient		> 120
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

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Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

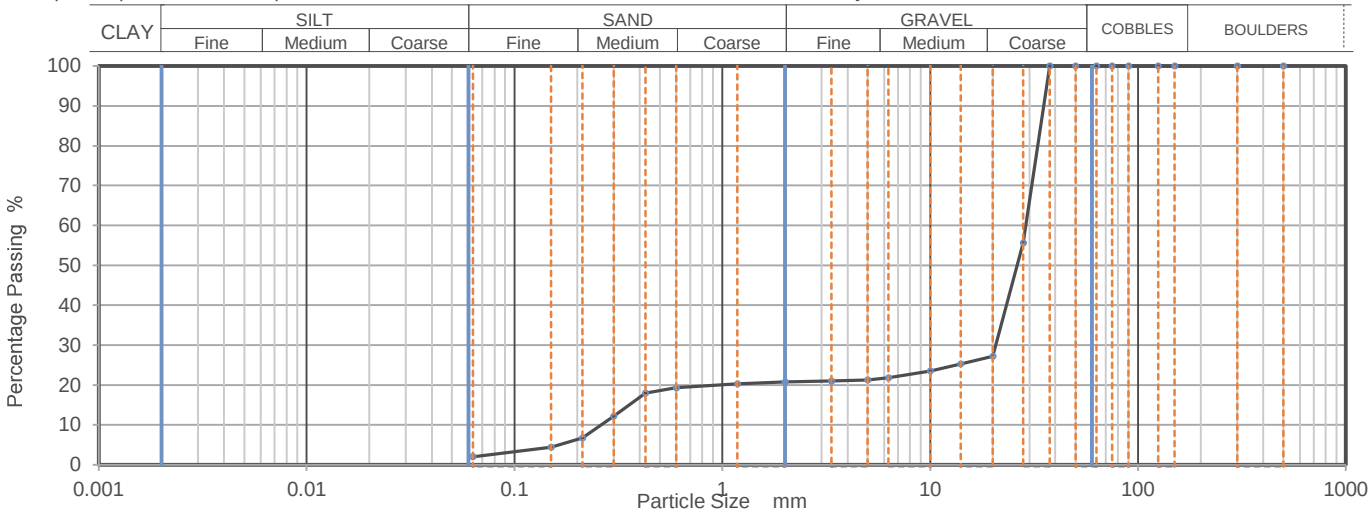
UKAS TESTING 4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937336	Depth Top [m]:	5.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	D6	Sample Type:	D
Sample Description:	Reddish brown slightly clayey sandy GRAVEL		
Sample Preparation:	Sample was whole tested, oven dried at 107.5 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	56		
20	27		
14	25		
10	24		
6.3	22		
5	21		
3.35	21		
2	21		
1.18	20		
0.6	19		
0.425	18		
0.3	12		
0.212	7		
0.15	4		
0.063	3		

Sample Proportions	% dry mass
Very coarse	0
Gravel	79
Sand	18
Fines <0.063mm	3

Grading Analysis		
D100	mm	37.5
D60	mm	28.8
D30	mm	20.7
D10	mm	0.261
Uniformity Coefficient		110
Curvature Coefficient		57

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

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Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

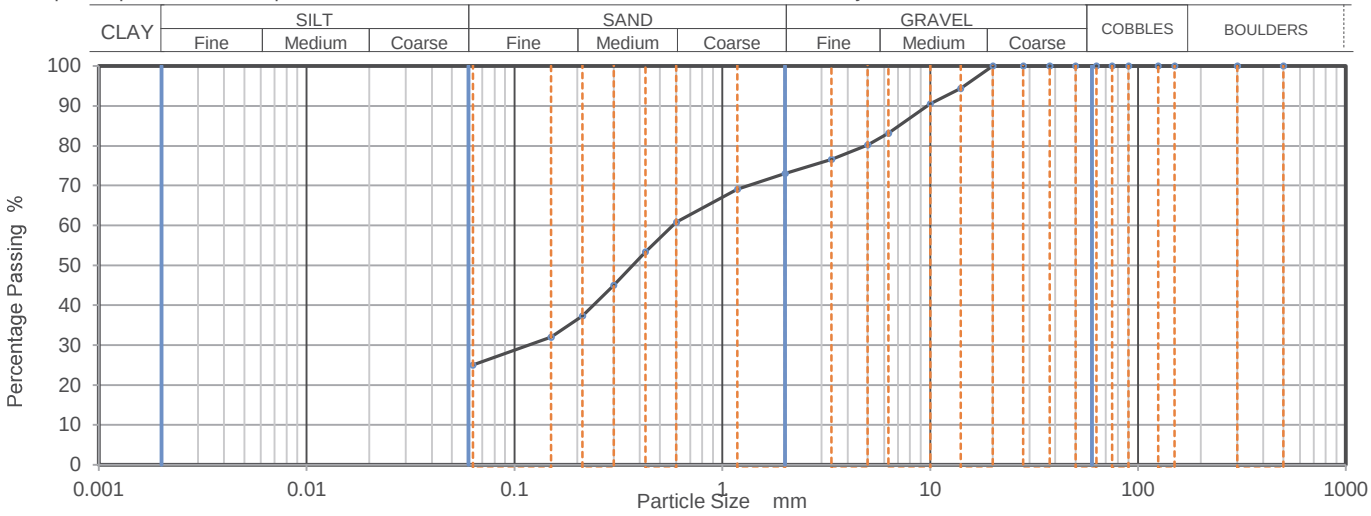
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937338	Depth Top [m]:	2.50
Hole No.:	BH3	Depth Base [m]:	Not Given
Sample Reference:	D3	Sample Type:	D
Sample Description:	Dark brown very gravelly very clayey SAND		
Sample Preparation:	Sample was whole tested, oven dried at 107.5 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	94		
10	91		
6.3	83		
5	80		
3.35	77		
2	73		
1.18	69		
0.6	61		
0.425	53		
0.3	45		
0.212	37		
0.15	32		
0.063	25		

Sample Proportions	% dry mass
Very coarse	0
Gravel	27
Sand	48
Fines <0.063mm	25

Grading Analysis		
D100	mm	20
D60	mm	0.579
D30	mm	0.116
D10	mm	
Uniformity Coefficient		> 9.2
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

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Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

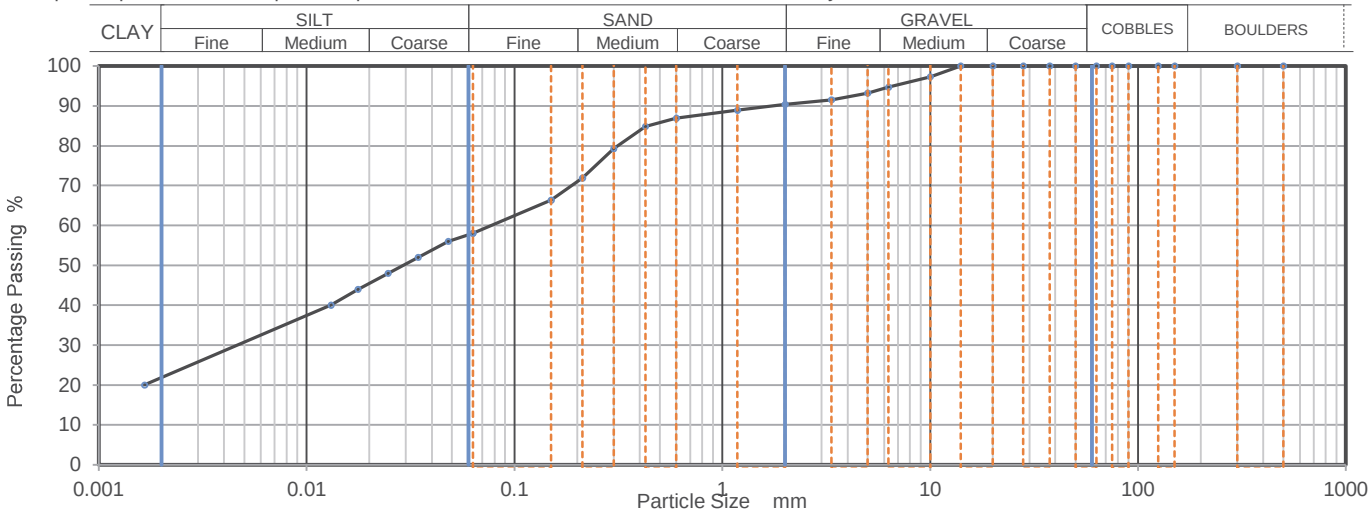
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937340	Depth Top [m]:	4.50
Hole No.:	BH3	Depth Base [m]:	Not Given
Sample Reference:	D5	Sample Type:	D
Sample Description:	Brown gravelly very sandy very clayey SILT		
Sample Preparation:	Sample was quartered, oven dried at 106.1 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	58
300	100	0.0479	56
150	100	0.0344	52
125	100	0.0246	48
90	100	0.0176	44
75	100	0.0131	40
63	100	0.0017	20
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	97		
6.3	95		
5	93		
3.35	92	Particle density	(assumed)
2	90	2.65	Mg/m3
1.18	89		
0.6	87		
0.425	85		
0.3	79		
0.212	72		
0.15	66		
0.063	58		

Sample Proportions	% dry mass
Very coarse	0
Gravel	10
Sand	32
Silt	36
Clay	22

Grading Analysis		
D100	mm	14
D60	mm	0.0779
D30	mm	0.00465
D10	mm	
Uniformity Coefficient		> 47
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

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Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
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Northampton NN4 7EB

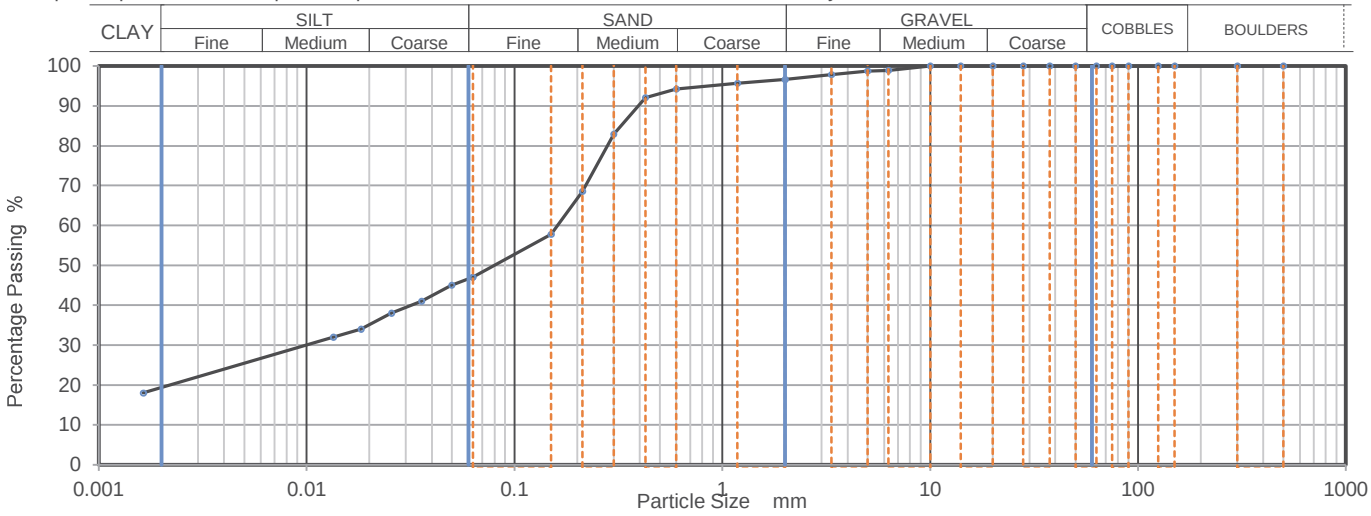
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937341	Depth Top [m]:	5.70
Hole No.:	BH3	Depth Base [m]:	Not Given
Sample Reference:	D6	Sample Type:	D
Sample Description:	Brown slightly gravelly clayey very silty SAND		
Sample Preparation:	Sample was quartered, oven dried at 107.5 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	47
300	100	0.0498	45
150	100	0.0356	41
125	100	0.0255	38
90	100	0.0183	34
75	100	0.0134	32
63	100	0.0016	18
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	99		
5	99		
3.35	98		
2	97		
1.18	96		
0.6	94		
0.425	92		
0.3	83		
0.212	69		
0.15	58		
0.063	47		

Sample Proportions	% dry mass
Very coarse	0
Gravel	3
Sand	49
Silt	29
Clay	19

Grading Analysis		
D100	mm	10
D60	mm	0.161
D30	mm	0.0105
D10	mm	
Uniformity Coefficient		> 98
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

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PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

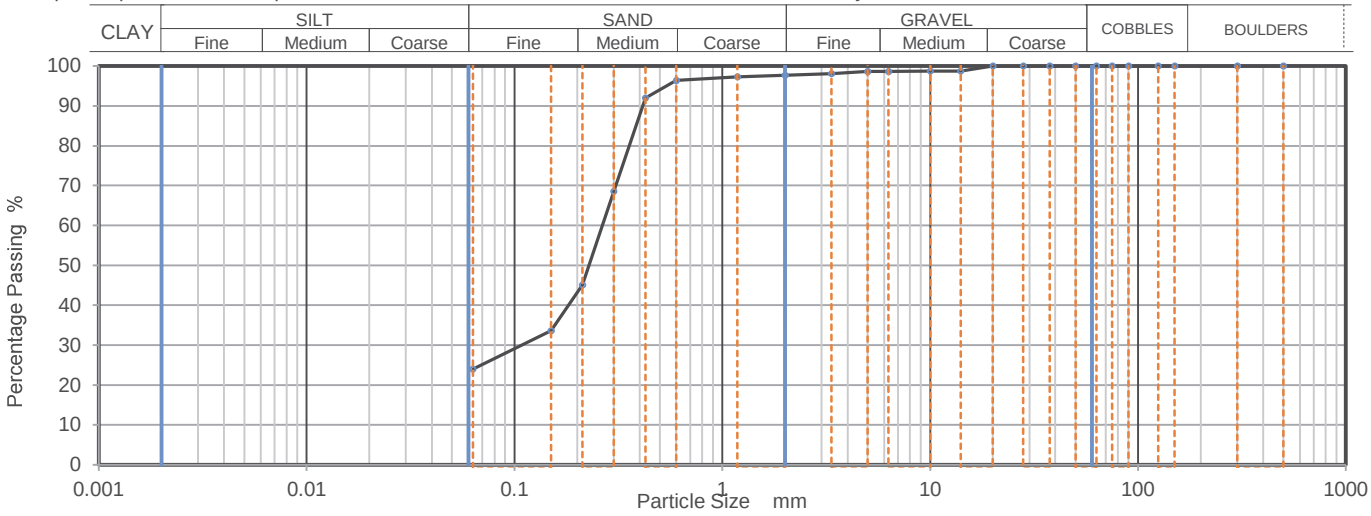
UKAS TESTING 4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937342	Depth Top [m]:	6.50
Hole No.:	BH3	Depth Base [m]:	Not Given
Sample Reference:	D7	Sample Type:	D
Sample Description:	Reddish brown slightly gravelly clayey SAND		
Sample Preparation:	Sample was whole tested, oven dried at 108.7 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	99		
6.3	99		
5	99		
3.35	98		
2	98		
1.18	97		
0.6	96		
0.425	92		
0.3	69		
0.212	45		
0.15	34		
0.063	25		

Sample Proportions	% dry mass
Very coarse	0
Gravel	2
Sand	73
Fines <0.063mm	25

Grading Analysis		
D100	mm	20
D60	mm	0.264
D30	mm	0.106
D10	mm	
Uniformity Coefficient		> 4.2
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

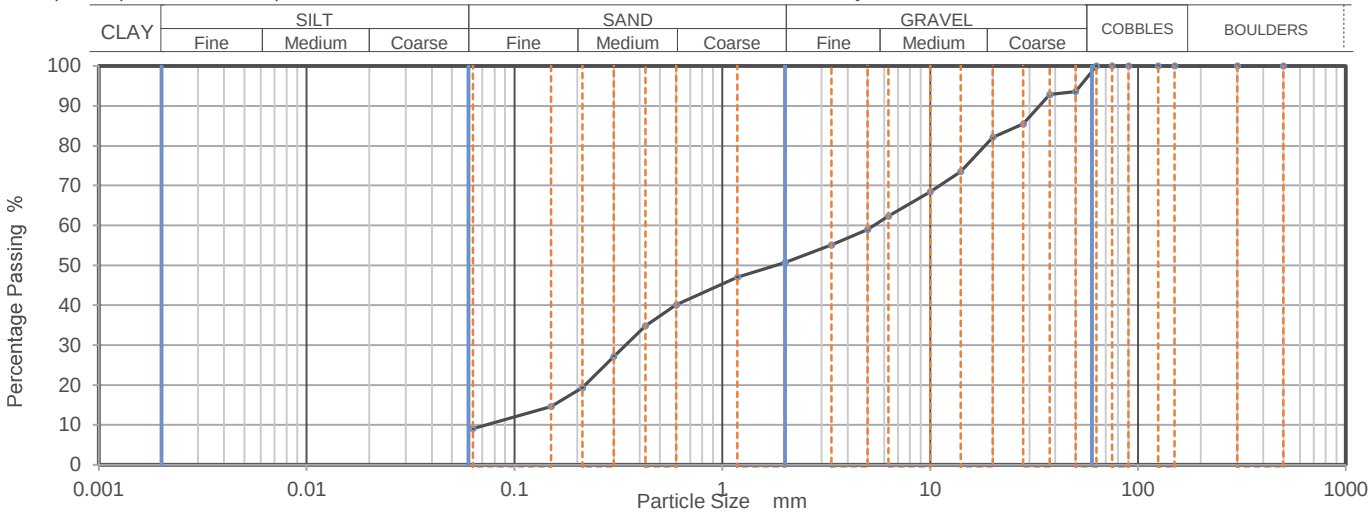
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	17/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937343	Depth Top [m]:	2.50
Hole No.:	BH4	Depth Base [m]:	Not Given
Sample Reference:	B2	Sample Type:	B
Sample Description:	Brown sandy GRAVEL		
Sample Preparation:	Sample was whole tested, oven dried at 106.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	94		
37.5	93		
28	85		
20	82		
14	74		
10	69		
6.3	62		
5	59		
3.35	55		
2	51		
1.18	47		
0.6	40		
0.425	35		
0.3	27		
0.212	19		
0.15	15		
0.063	10		

Sample Proportions	% dry mass
Very coarse	0
Gravel	49
Sand	41
Fines <0.063mm	10

Grading Analysis		
D100	mm	63
D60	mm	5.36
D30	mm	0.342
D10	mm	0.0684
Uniformity Coefficient		78
Curvature Coefficient		0.32

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

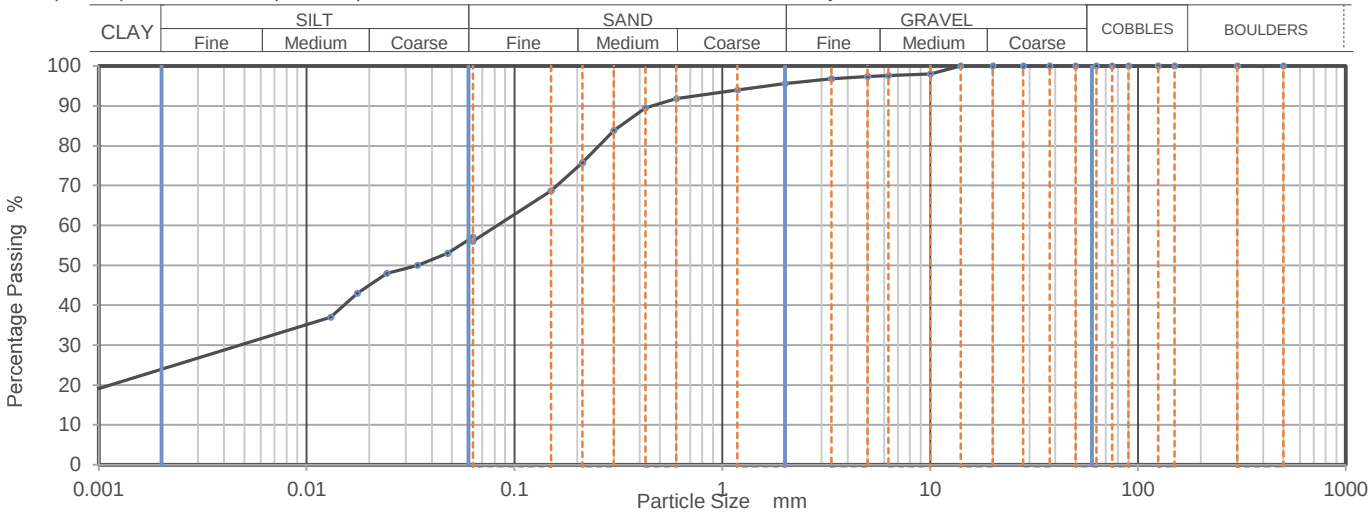
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937347	Depth Top [m]:	4.30
Hole No.:	BH4	Depth Base [m]:	Not Given
Sample Reference:	D4	Sample Type:	D
Sample Description:	Brown slightly gravelly very sandy very clayey SILT		
Sample Preparation:	Sample was quartered, oven dried at 107.5 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	57
300	100	0.0475	53
150	100	0.0341	50
125	100	0.0243	48
90	100	0.0175	43
75	100	0.0130	37
63	100	0.0009	18
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	98		
6.3	98		
5	97		
3.35	97	Particle density	(assumed)
2	96	2.65	Mg/m3
1.18	94		
0.6	92		
0.425	90		
0.3	84		
0.212	76		
0.15	69		
0.063	57		

Sample Proportions	% dry mass
Very coarse	0
Gravel	4
Sand	39
Silt	33
Clay	24

Grading Analysis		
D100	mm	14
D60	mm	0.0797
D30	mm	0.00472
D10	mm	
Uniformity Coefficient		> 93
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

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Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

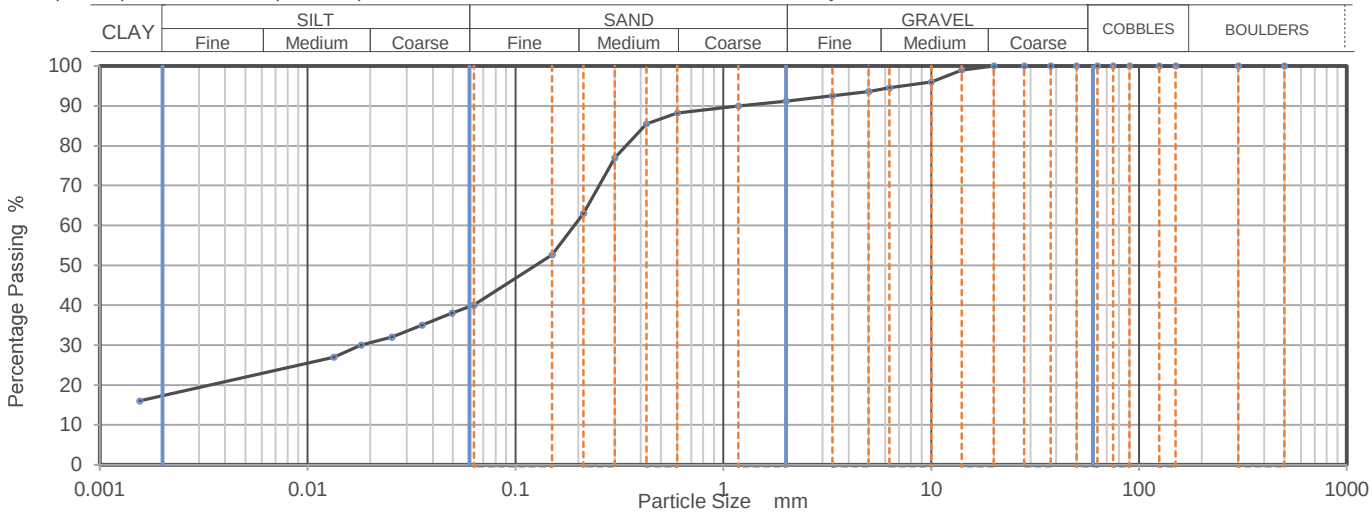
4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937348	Depth Top [m]:	5.50
Hole No.:	BH4	Depth Base [m]:	Not Given
Sample Reference:	D5	Sample Type:	D
Sample Description:	Brown silty clayey slightly gravelly SAND		
Sample Preparation:	Sample was quartered, oven dried at 110.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	40
300	100	0.0495	38
150	100	0.0354	35
125	100	0.0254	32
90	100	0.0180	30
75	100	0.0133	27
63	100	0.0016	16
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	96		
6.3	95		
5	94		
3.35	93	Particle density	(assumed)
2	91	2.65	Mg/m3
1.18	90		
0.6	88		
0.425	86		
0.3	77		
0.212	63		
0.15	53		
0.063	40		

Sample Proportions	% dry mass
Very coarse	0
Gravel	9
Sand	51
Silt	23
Clay	17

Grading Analysis		
D100	mm	20
D60	mm	0.192
D30	mm	0.0176
D10	mm	
Uniformity Coefficient		> 120
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

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Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

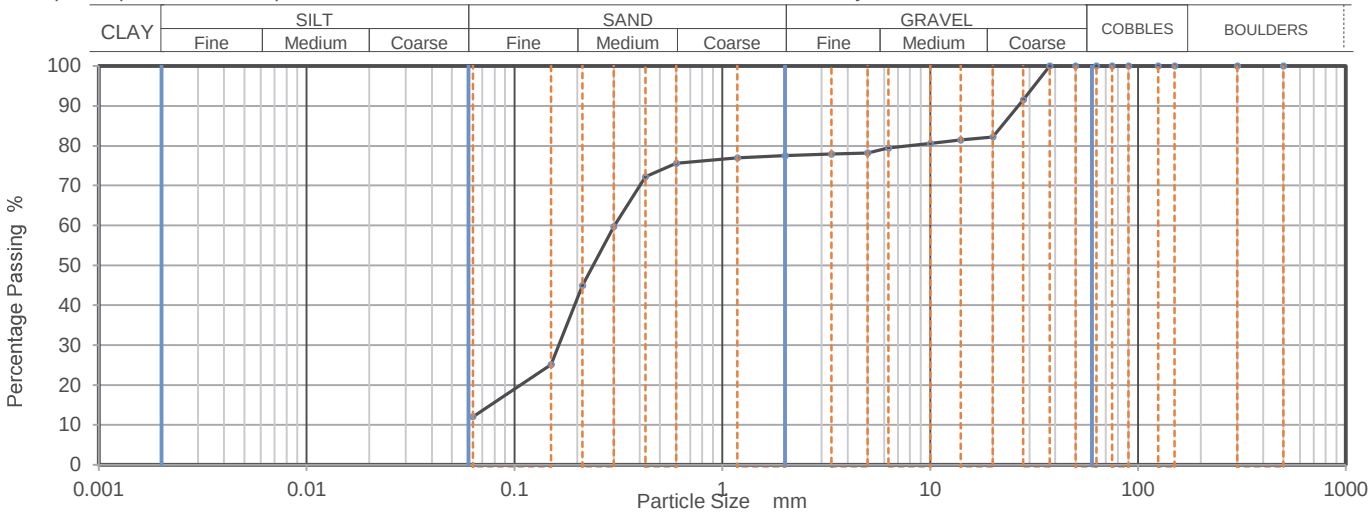
UKAS TESTING 4041

Client:	GeoAssist Ltd	Client Reference:	6069-CGJ
Client Address:	Unit 4, Sheffield Street, Heaton Norris, Stockport, Cheshire, SK4 1RU	Job Number:	21-86752
		Date Sampled:	Not Given
		Date Received:	13/07/2021
Contact:	Matthew Benson	Date Tested:	22/07/2021
Site Address:	Great Jackson Street, Manchester	Sampled By:	Client - MR

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1937349	Depth Top [m]:	6.50
Hole No.:	BH4	Depth Base [m]:	Not Given
Sample Reference:	D6	Sample Type:	D
Sample Description:	Reddish brown gravelly clayey SAND		
Sample Preparation:	Sample was whole tested, oven dried at 110.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	92		
20	82		
14	81		
10	81		
6.3	79		
5	78		
3.35	78		
2	78		
1.18	77		
0.6	76		
0.425	72		
0.3	60		
0.212	45		
0.15	25		
0.063	13		

Sample Proportions	% dry mass
Very coarse	0
Gravel	23
Sand	65
Fines <0.063mm	13

Grading Analysis		
D100	mm	37.5
D60	mm	0.303
D30	mm	0.163
D10	mm	
Uniformity Coefficient		> 4.8
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

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PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 16/08/2021

GF 100.20

GEO ASSIST LIMITED
ROCK LABORATORY
U.C.S. TEST
SUMMARY SHEET

Project: **Plots F1 & F2 Great Jackson Street**
Location: **Manchester**
Client: **Coffey Geotechnics Ltd**
Contractor: **Coffey Geotechnics Ltd**

Site Ref: **CGJ**
Project No : **6069**

Borehole Ref	Sample Depth	Sample Ref.	Description	L Length (mm)	D Diameter (mm)	Load (kN)	Bulk Density (Mg/m3)	U.C.S (Mpa)	Moisture Content (%)	L/D Corrected U.C.S. (Mpa)	Secant E (Gpa) 0 to 50%
BH1	12.20	UCS1	Orange/brown silty SANDSTONE	189.0	75.8	66.3	2.18	**14.7**	12.1	**15.1**	
BH1	13.70	UCS2	Orange/brown silty SANDSTONE	185.0	75.3	63.2	2.20	**14.2**	13.3	**14.5**	**1.36**
BH1	18.70	UCS3	Orange/brown silty SANDSTONE	187.0	75.5	42.2	2.20	**9.4**	12.6	**9.7**	
BH1	19.10	UCS4	Orange/brown silty SANDSTONE	189.0	75.7	79.2	2.20	**17.6**	12.7	**18.0**	**1.80**
BH1	22.20	UCS5	Orange/brown silty SANDSTONE	190.0	72.6	76.2	2.14	**18.4**	11.7	**18.9**	
BH1	23.10	UCS6	Orange/brown silty SANDSTONE	190.0	72.6	67.1	2.18	**16.2**	11.8	**16.7**	**1.66**
BH1	28.90	UCS7	Orange/brown silty SANDSTONE	185.0	72.7	39.8	2.17	**9.6**	13.2	**9.8**	

GEO ASSIST LIMITED			Project:	**Plots F1 & F2 Great Jackson Street**					Site Ref:		**CGJ**	
ROCK LABORATORY			Location:	**Manchester**					Project No :		**6069**	
U.C.S. TEST			Client:	**Coffey Geotechnics Ltd**								
SUMMARY SHEET			Contractor:	**Coffey Geotechnics Ltd**								
Borehole Ref	**Sample Depth**	**Sample Ref.**	**Description**		**L Length (mm)**	**D Diameter (mm)**	**Load (kN)**	**Bulk Density (Mg/m3)**	**U.C.S (Mpa)**	**Moisture Content (%)**	**L/D Corrected U.C.S. (Mpa)**	**Secant E (Gpa) 0 to 50%**
BH2	11.60	UCS1	Orange/brown silty SANDSTONE		180.0	72.6	49.0	2.16	**11.8**	12.9	**12.1**	
BH2	15.50	UCS2	Orange/brown silty SANDSTONE		176.0	72.5	58.2	2.25	**14.1**	12.1	**14.4**	
BH2	23.10	UCS3	Orange/brown silty SANDSTONE		178.0	72.4	49.0	2.16	**11.9**	12.2	**12.2**	

GEO ASSIST LIMITED			Project:	**Plots F1 & F2 Great Jackson Street**					Site Ref:		**CGJ**	
ROCK LABORATORY			Location:	**Manchester**					Project No :		**6069**	
U.C.S. TEST			Client:	**Coffey Geotechnics Ltd**								
SUMMARY SHEET			Contractor:	**Coffey Geotechnics Ltd**								
					L	**D**					**L/D**	**Secant**
Borehole	**Sample**	**Sample**	**Description**		**Length**	**Diameter**	**Load**	**Bulk Density**	**U.C.S**	**Moisture**	**Corrected U.C.S.**	**E**
Ref	**Depth**	**Ref.**			**(mm)**	**(mm)**	**(kN)**	**(Mg/m3)**	**(Mpa)**	**Content**	**(Mpa)**	**(Gpa)**
										(%)		**0 to 50%**
BH3	15.80	UCS1	Orange/brown silty SANDSTONE		180.0	72.3	62.4	2.23	**15.2**	6.5	**15.6**	
BH3	17.30	UCS2	Orange/brown silty SANDSTONE		179.0	72.6	57.6	2.18	**13.9**	11.2	**14.2**	
BH3	18.90	UCS3	Orange/brown silty SANDSTONE		180.0	72.4	82.0	2.24	**19.9**	11.6	**20.4**	
BH3	21.30	UCS4	Orange/brown silty SANDSTONE		178.0	72.5	73.6	2.24	**17.8**	12.0	**18.2**	

GEO ASSIST LIMITED		Project:	**Plots F1 & F2 Great Jackson Street**					Site Ref:		**CGJ**	
ROCK LABORATORY		Location:	**Manchester**					Project No :		**6069**	
U.C.S. TEST		Client:	**Coffey Geotechnics Ltd**								
SUMMARY SHEET		Contractor:	**Coffey Geotechnics Ltd**								

Borehole Ref	**Sample Depth**	**Sample Ref.**	**Description**	**L Length (mm)**	**D Diameter (mm)**	**Load (kN)**	**Bulk Density (Mg/m3)**	**U.C.S (Mpa)**	**Moisture Content (%)**	**L/D Corrected U.C.S. (Mpa)**	**Secant E (Gpa) 0 to 50%**
BH4	11.60	UCS1	Orange/brown silty SANDSTONE	179.0	74.7	56.3	2.20	**12.9**	14.2	**13.1**	
BH4	13.10	UCS2	Orange/brown silty SANDSTONE	180.0	72.6	57.6	2.19	**13.9**	11.5	**14.3**	**1.02**
BH4	15.70	UCS3	Orange/brown silty SANDSTONE	177.0	75.0	42.2	2.21	**9.6**	14.9	**9.7**	
BH4	16.60	UCS4	Orange/brown silty SANDSTONE	179.0	75.2	81.5	2.25	**18.4**	12.4	**18.7**	**1.43**
BH4	19.20	UCS5	Orange/brown silty SANDSTONE	186.0	72.3	76.0	2.24	**18.5**	12.7	**19.0**	
BH4	21.50	UCS6	Orange/brown silty SANDSTONE	190.0	75.8	54.1	2.17	**12.0**	14.2	**12.3**	**1.58**
BH4	25.20	UCS7	Orange/brown silty SANDSTONE	191.0	72.4	80.8	2.28	**19.6**	13.2	**20.2**	
BH4	33.90	UCS8	Orange/brown silty SANDSTONE	169.0	72.5	49.7	2.20	**12.0**	12.5	**12.2**	
BH4	35.20	UCS9	Orange/brown silty SANDSTONE	190.0	72.7	77.6	2.15	**18.7**	13.3	**19.2**	

GeoAssist Limited
ROCK LABORATORY
POINT LOAD TEST
SUMMARY SHEET

Project: **Plots F1 & F2 Great Jackson Street**
Location: **Manchester**
Client: **Coffey Geotechnics Ltd**
Consultant: **Coffey Geotechnics Ltd**

Site Ref: **CGJ**
Project No : **6069**

Borehole Ref	Sample Depth (m)	Description	Shape A/D/I	Width (mm)	Platon Seperation (mm)	Load (kN)	Equivalent Diameter (mm)	Is (MPa)	Size Correction	Is_{50} (MPa)
BH1	8.70	Orange/brown silty SANDSTONE	A	72.3	54.0	1.67	70.51	0.45	1.17	0.53
BH1	8.80	Orange/brown silty SANDSTONE	A	72.3	52.0	1.91	69.19	0.53	1.16	0.61
BH1	16.60	Orange/brown silty SANDSTONE	A	72.3	54.0	2.48	70.51	0.66	1.17	0.77
BH1	16.70	Orange/brown silty SANDSTONE	A	72.3	51.0	2.60	68.52	0.74	1.15	0.85
BH1	17.20	Orange/brown silty SANDSTONE	A	71.7	51.0	3.54	68.23	1.01	1.15	1.16
BH1	17.30	Orange/brown silty SANDSTONE	A	72.3	52.0	3.51	69.19	0.98	1.16	1.13
BH1	19.80	Orange/brown silty SANDSTONE	A	75.8	57.0	3.74	74.17	0.90	1.19	1.07
BH1	19.90	Orange/brown silty SANDSTONE	A	75.8	48.0	3.05	68.06	0.88	1.15	1.01
BH1	20.20	Orange/brown silty SANDSTONE	A	75.7	54.0	3.71	72.14	0.95	1.18	1.12
BH1	20.30	Orange/brown silty SANDSTONE	A	76.0	49.0	3.58	68.86	1.00	1.15	1.15
BH1	24.80	Orange/brown silty SANDSTONE	A	75.3	55.0	4.06	72.62	1.02	1.18	1.21
BH1	24.90	Orange/brown silty SANDSTONE	A	75.2	50.0	3.79	69.19	1.05	1.16	1.22
BH1	28.20	Orange/brown silty SANDSTONE	A	73.2	51.0	3.44	68.94	0.96	1.16	1.11
BH1	28.30	Orange/brown silty SANDSTONE	A	73.0	50.0	3.72	68.17	1.06	1.15	1.22
BH1	29.90	Orange/brown silty SANDSTONE	A	72.6	55	5.42	71.30	1.42	1.17	1.67
BH1	30.00	Orange/brown silty SANDSTONE	A	72.8	53	3.19	70.09	0.86	1.16	1.00
BH1	32.60	Orange/brown silty SANDSTONE	A	73.9	52	3.14	69.95	0.85	1.16	0.99
BH1	32.70	Orange/brown silty SANDSTONE	A	73.6	54	2.26	71.14	0.59	1.17	0.69
BH1	34.70	Orange/brown silty SANDSTONE	A	71.0	51	4.77	67.90	1.38	1.15	1.58
BH1	34.80	Orange/brown silty SANDSTONE	A	71.6	49	4.52	66.84	1.35	1.14	1.54

A Axial Load applied parallel to core axis

D Diametral Load applied across core axis

GeoAssist Limited
ROCK LABORATORY
POINT LOAD TEST
SUMMARY SHEET

Project: **Plots F1 & F2 Great Jackson Street**
Location: **Manchester**
Client: **Coffey Geotechnics Ltd**
Consultant: **Coffey Geotechnics Ltd**

Site Ref: **CGJ**
Project No : **6069**

Borehole Ref	Sample Depth (m)	Description	Shape A/D/I	Width (mm)	Platon Seperation (mm)	Load (kN)	Equivalent Diameter (mm)	Is (MPa)	Size Correction	Is_{50} (MPa)
BH2	7.60	Orange/brown silty SANDSTONE	A	72.6	52.0	2.42	69.33	0.67	1.16	0.78
BH2	7.70	Orange/brown silty SANDSTONE	A	72.6	50.0	2.64	67.98	0.76	1.15	0.87
BH2	13.40	Orange/brown silty SANDSTONE	A	72.5	51.0	2.81	68.61	0.79	1.15	0.91
BH2	13.50	Orange/brown silty SANDSTONE	A	72.5	50.0	1.87	67.94	0.54	1.15	0.62

A Axial Load applied parallel to core axis

D Diametral Load applied across core axis

GeoAssist Limited
ROCK LABORATORY
POINT LOAD TEST
SUMMARY SHEET

Project: **Plots F1 & F2 Great Jackson Street**
Location: **Manchester**
Client: **Coffey Geotechnics Ltd**
Consultant: **Coffey Geotechnics Ltd**

Site Ref: **CGJ**
Project No : **6069**

Borehole Ref	Sample Depth (m)	Description	Shape A/D/I	Width (mm)	Platon Seperation (mm)	Load (kN)	Equivalent Diameter (mm)	Is (MPa)	Size Correction	Is_{50} (MPa)
BH3	8.40	Orange/brown silty SANDSTONE	A	72.3	55.0	1.62	71.16	0.43	1.17	0.50
BH3	8.50	Orange/brown silty SANDSTONE	A	72.3	49.0	1.21	67.16	0.36	1.14	0.41
BH3	16.80	Orange/brown silty SANDSTONE	A	72.2	52.0	2.30	69.14	0.64	1.16	0.74
BH3	16.90	Orange/brown silty SANDSTONE	A	72.3	51.0	2.62	68.52	0.74	1.15	0.85
BH3	18.60	Orange/brown silty SANDSTONE	A	72.4	51.0	2.90	68.57	0.82	1.15	0.95
BH3	18.70	Orange/brown silty SANDSTONE	A	72.4	50.0	2.71	67.89	0.78	1.15	0.90
BH3	19.50	Orange/brown silty SANDSTONE	A	72.3	51.0	2.67	68.52	0.76	1.15	0.88
BH3	19.60	Orange/brown silty SANDSTONE	A	72.4	51.0	2.49	68.57	0.70	1.15	0.81

A Axial Load applied parallel to core axis

D Diametral Load applied across core axis

GeoAssist Limited
ROCK LABORATORY
POINT LOAD TEST
SUMMARY SHEET

Project: **Plots F1 & F2 Great Jackson Street**
Location: **Manchester**
Client: **Coffey Geotechnics Ltd**
Consultant: **Coffey Geotechnics Ltd**

Site Ref: **CGJ**
Project No : **6069**

Borehole Ref	Sample Depth (m)	Description	Shape A/D/I	Width (mm)	Platon Seperation (mm)	Load (kN)	Equivalent Diameter (mm)	Is (MPa)	Size Correction	Is_{50} (MPa)
BH4	11.00	Orange/brown silty SANDSTONE	A	74.3	45.0	3.21	65.25	1.00	1.13	1.13
BH4	11.10	Orange/brown silty SANDSTONE	A	74.4	44.0	3.08	64.56	0.98	1.12	1.10
BH4	14.40	Orange/brown silty SANDSTONE	A	72.3	50.0	2.28	67.84	0.66	1.15	0.76
BH4	14.50	Orange/brown silty SANDSTONE	A	72.5	50.0	2.78	67.94	0.80	1.15	0.92
BH4	18.50	Orange/brown silty SANDSTONE	A	72.5	53.0	3.30	69.95	0.90	1.16	1.05
BH4	18.60	Orange/brown silty SANDSTONE	A	72.5	53.0	2.71	69.95	0.74	1.16	0.86
BH4	24.50	Orange/brown silty SANDSTONE	A	72.4	53.0	3.30	69.90	0.90	1.16	1.05
BH4	24.60	Orange/brown silty SANDSTONE	A	72.4	55.0	2.85	71.20	0.75	1.17	0.88
BH4	25.80	Orange/brown silty SANDSTONE	A	72.7	53.0	2.42	70.04	0.66	1.16	0.77
BH4	25.90	Orange/brown silty SANDSTONE	A	72.7	52.0	1.98	69.38	0.55	1.16	0.64
BH4	30.40	Orange/brown silty SANDSTONE	A	75.5	54.0	3.26	72.05	0.84	1.18	0.99
BH4	30.50	Orange/brown silty SANDSTONE	A	75.5	52.0	2.90	70.70	0.77	1.17	0.90
BH4	34.40	Orange/brown silty SANDSTONE	A	72.4	57.0	4.13	72.49	1.05	1.18	1.24
BH4	34.50	Orange/brown silty SANDSTONE	A	72.4	53.0	3.99	69.90	1.09	1.16	1.27
BH4	34.60	Orange/brown silty SANDSTONE	A	72.1	53	2.99	69.75	0.82	1.16	0.95
BH4	34.70	Orange/brown silty SANDSTONE	A	72.0	42	2.58	62.05	0.89	1.10	0.98

A Axial Load applied parallel to core axis

D Diametral Load applied across core axis

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Analytical Report Number : 21-79676

Replaces Analytical Report Number: 21-79676, issue no. 1
Additional analysis undertaken.

Project / Site name:	Great Jackson Street, Manchester	**Samples received on:**	07/06/2021
Your job number:	6069-CGJ	**Samples instructed on/ Analysis started on:**	07/06/2021
Your order number:	2210604	**Analysis completed by:**	27/09/2021
Report Issue Number:	2	**Report issued on:**	28/09/2021
Samples Analysed:	14 soil samples		

Signed: A. Czerwińska

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
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.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.

Analytical Report Number: 21-79676
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210604

Lab Sample Number				1895299	1895300	1895301	1895302	1895303
Sample Reference				BH1-B1	BH1-D3	BH1-D4	BH1-D8	BH2-B1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	1.80	2.50	7.00	0.50
Date Sampled				04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021
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	< 0.1	< 0.1	< 0.1	-
Moisture Content	%	0.01	NONE	11	13	12	11	-
Total mass of sample received	kg	0.001	NONE	1.2	0.40	0.40	0.40	-
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	-	-	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.1	7.4	8.3	8.3	-
Total Sulphate as SO4	%	0.005	MCERTS	0.033	0.062	0.043	0.014	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.039	0.27	0.11	0.022	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	39.4	270	108	22.4	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	2.3	2.7	3.6	4.7	-
Total Sulphur	%	0.005	MCERTS	0.017	0.060	0.082	0.005	-
Ammoniacal Nitrogen as NH4	mg/kg	0.5	MCERTS	< 0.5	< 0.5	12	< 0.5	-
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	< 0.05	1.19	< 0.05	-
Organic Matter (automated)	%	0.1	MCERTS	1.4	1.5	-	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	2.1	< 2.0	< 2.0	< 2.0	-
Heavy Metals / Metalloids								
Magnesium (water soluble)	mg/kg	5	NONE	8.7	16	19	8.8	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	4.3	7.7	9.5	4.4	-

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-79676
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210604

Lab Sample Number				1895304	1895305	1895306	1895307	1895308
Sample Reference				BH2-D1	BH2-D3	BH3-B1	BH3-D2	BH3-D3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.80	2.50	0.50	1.50	2.50
Date Sampled				04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021
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	< 0.1	-	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	22	16	-	14	12
Total mass of sample received	kg	0.001	NONE	0.40	0.40	-	0.50	0.50
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	-	-	Not-detected	-	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.9	8.0	-	8.1	9.1
Total Sulphate as SO4	%	0.005	MCERTS	0.054	0.026	-	0.040	0.060
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.097	0.058	-	0.049	0.12
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	96.8	58.0	-	48.5	124
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	23	9.5	-	2.8	11
Total Sulphur	%	0.005	MCERTS	0.037	0.047	-	0.025	0.040
Ammoniacal Nitrogen as NH4	mg/kg	0.5	MCERTS	46	< 0.5	-	< 0.5	< 0.5
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	4.57	< 0.05	-	< 0.05	< 0.05
Organic Matter (automated)	%	0.1	MCERTS	3.1	-	-	1.3	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	-	< 2.0	< 2.0
Heavy Metals / Metalloids								
Magnesium (water soluble)	mg/kg	5	NONE	11	24	-	7.2	< 5.0
Magnesium (leachate equivalent)	mg/l	2.5	NONE	5.3	12	-	3.6	< 2.5

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-79676
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210604

Lab Sample Number				1895309	1895310	1895311	1895312
Sample Reference				BH4-B1	BH4-D1	BH4-B2	BH4-D3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	1.50	2.50	3.50
Date Sampled				04/06/2021	04/06/2021	04/06/2021	04/06/2021
Time Taken				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	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	11	7.6	9.6	17
Total mass of sample received	kg	0.001	NONE	0.50	1.0	0.60	0.40
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	-	-	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	0.958	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	0.958	-	-	-
General Inorganics							
pH - Automated	pH Units	N/A	MCERTS	10.6	10.1	8.8	8.3
Total Sulphate as SO4	%	0.005	MCERTS	0.193	0.136	0.073	0.074
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.14	0.087	0.13	0.30
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	136	87.0	131	297
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	51	24	8.6	3.3
Total Sulphur	%	0.005	MCERTS	0.092	0.061	0.042	0.101
Ammoniacal Nitrogen as NH4	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5	< 0.5
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Organic Matter (automated)	%	0.1	MCERTS	-	-	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	3.3	2.5	< 2.0	< 2.0
Heavy Metals / Metalloids							
Magnesium (water soluble)	mg/kg	5	NONE	< 5.0	< 5.0	12	52
Magnesium (leachate equivalent)	mg/l	2.5	NONE	< 2.5	< 2.5	5.9	26

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-79676
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210604

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1895309	BH4-B1	0.50	52	Hard/Cement Type Material	Chrysotile	0.958	0.958

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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Analytical Report Number : 21-76875

Replaces Analytical Report Number: 21 76875, issue no. 1
Additional analysis undertaken.

Project / Site name:	Great Jackson Street, Manchester	**Samples received on:**	13/05/2021
Your job number:	6069 CGJ	**Samples instructed on/ Analysis started on:**	24/05/2021
Your order number:	7210514	**Analysis completed by:**	07/10/2021
Report Issue Number:	2	**Report issued on:**	07/10/2021
Samples Analysed:	12 soil samples		

Signed: A. Czerwińska

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
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

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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.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 21-76875
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210514

Lab Sample Number				1880948	1880949	1880950	1880951	1880952
Sample Reference				WS1-ES1	WS1-ES2	WS1-ES3	WS1-ES4	WS2-ES1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.60	1.30	1.90	0.60
Date Sampled				11/05/2021	11/05/2021	11/05/2021	11/05/2021	10/05/2021
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	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	16	27	23	28	7.6
Total mass of sample received	kg	0.001	NONE	0.40	0.40	0.40	0.40	0.50
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile & Amosite	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	-	-	-	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	< 0.001	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	< 0.001	-	-	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.1	8.2	7.1	7.5	7.4
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	5.3	< 5.0
Total Sulphate as SO4	%	0.005	MCERTS	0.075	0.081	0.104	0.068	0.009
Sulphide	mg/kg	1	MCERTS	25	5.7	14	32	< 1.0
Total Sulphur	%	0.005	MCERTS	0.048	0.041	0.071	0.162	0.007
Organic Matter (automated)	%	0.1	MCERTS	-	-	1.5	7.1	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80

Analytical Report Number: 21-76875
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210514

Lab Sample Number				1880948	1880949	1880950	1880951	1880952
Sample Reference				WS1-ES1	WS1-ES2	WS1-ES3	WS1-ES4	WS2-ES1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.60	1.30	1.90	0.60
Date Sampled				11/05/2021	11/05/2021	11/05/2021	11/05/2021	10/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	24	14	6.7	4.9	4.9
Barium (aqua regia extractable)	mg/kg	1	MCERTS	280	180	140	160	22
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.5	1.2	0.88	1.8	0.44
Boron (water soluble)	mg/kg	0.2	MCERTS	0.7	1.3	1.3	3.3	< 0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.6	< 0.2	< 0.2	0.4	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	22	23	18	28	8.0
Copper (aqua regia extractable)	mg/kg	1	MCERTS	83	62	11	30	8.5
Lead (aqua regia extractable)	mg/kg	1	MCERTS	180	80	17	17	6.5
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.7	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	30	20	11	22	8.1
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	40	34	28	21	11
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	140	86	45	43	25

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-76875
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210514

Lab Sample Number				1880953	1880954	1880955	1880956	1880957
Sample Reference				WS2-ES2	WS2-ES3	WS6-ES1	WS6-ES2	WS6-ES3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.30	1.80	0.30	0.60	1.30
Date Sampled				10/05/2021	10/05/2021	11/05/2021	11/05/2021	11/05/2021
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	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	8.3	12	17	16	15
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.40	0.40	0.40
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	-	-	Not-detected	Not-detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.9	8.1	8.1	8.3	8.0
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Sulphate as SO4	%	0.005	MCERTS	0.016	0.012	0.096	0.121	0.142
Sulphide	mg/kg	1	MCERTS	< 1.0	1.1	18	19	16
Total Sulphur	%	0.005	MCERTS	0.009	0.008	0.071	0.099	0.091
Organic Matter (automated)	%	0.1	MCERTS	-	-	-	-	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.8	0.57	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.29	0.23	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.6	0.65	0.28
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.0	0.57	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	17	5.5	2.1
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	4.0	1.4	0.57
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	16	5.4	3.6
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	16	5.1	3.6
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	8.8	3.1	2.5
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	7.8	2.8	2.0
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	7.1	2.5	2.1
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	3.5	1.4	1.0
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	7.3	2.6	2.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	3.4	1.3	1.1
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.1	0.49	0.27
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	4.1	1.7	1.4
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	103	35.3	22.6

Analytical Report Number: 21-76875
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210514

Lab Sample Number				1880953	1880954	1880955	1880956	1880957
Sample Reference				WS2-ES2	WS2-ES3	WS6-ES1	WS6-ES2	WS6-ES3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.30	1.80	0.30	0.60	1.30
Date Sampled				10/05/2021	10/05/2021	11/05/2021	11/05/2021	11/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	6.6	5.2	39	42	33
Barium (aqua regia extractable)	mg/kg	1	MCERTS	41	45	570	570	420
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.50	0.38	1.8	1.8	1.4
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.7	0.4	0.6
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.3	0.2	3.1	4.6	38
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	11	7.9	27	27	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	12	14	230	380	250
Lead (aqua regia extractable)	mg/kg	1	MCERTS	13	20	790	1100	1000
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	1.1	1.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	12	9.3	35	35	25
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	14	9.9	46	44	33
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	33	31	300	360	300

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-76875
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210514

Lab Sample Number				1880958	1880959
Sample Reference				WS6-ES4	WS6-ES5
Sample Number				None Supplied	None Supplied
Depth (m)				1.90	2.30
Date Sampled				11/05/2021	11/05/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	10	6.6
Total mass of sample received	kg	0.001	NONE	0.50	0.50

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-
Asbestos in Soil	Type	N/A	ISO 17025	-	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.4	7.7
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0
Total Sulphate as SO4	%	0.005	MCERTS	0.048	0.009
Sulphide	mg/kg	1	MCERTS	1.2	< 1.0
Total Sulphur	%	0.005	MCERTS	0.028	0.008
Organic Matter (automated)	%	0.1	MCERTS	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80

Analytical Report Number: 21-76875
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210514

Lab Sample Number				1880958	1880959
Sample Reference				WS6-ES4	WS6-ES5
Sample Number				None Supplied	None Supplied
Depth (m)				1.90	2.30
Date Sampled				11/05/2021	11/05/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	5.0
Barium (aqua regia extractable)	mg/kg	1	MCERTS	140	28
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.72	0.50
Boron (water soluble)	mg/kg	0.2	MCERTS	0.7	< 0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	15	9.6
Copper (aqua regia extractable)	mg/kg	1	MCERTS	42	9.5
Lead (aqua regia extractable)	mg/kg	1	MCERTS	170	7.6
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	5.8	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	16	12
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	20	14
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	130	37

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-76875
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210514

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1880948	WS1-ES1	0.30	94	Loose Fibres	Chrysotile & Amosite	< 0.001	< 0.001

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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Analytical Report Number : 21-76899

Project / Site name:	Great Jackson Street, Manchester	**Samples received on:**	17/05/2021
Your job number:	6069-CGJ	**Samples instructed on/ Analysis started on:**	24/05/2021
Your order number:	2210516	**Analysis completed by:**	02/06/2021
Report Issue Number:	1	**Report issued on:**	02/06/2021
Samples Analysed:	15 soil samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
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.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 21-76899
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210516

Lab Sample Number				1881028	1881029	1881030	1881031	1881032
Sample Reference				WS3	WS3	WS3	WS3	WS3
Sample Number				1	2	3	4	5
Depth (m)				0.40	0.80	1.30	1.90	2.20
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021
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	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	14	22	13	8.9	19
Total mass of sample received	kg	0.001	NONE	0.40	0.40	0.50	0.50	0.40
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	-	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.8	7.1	7.7	7.7	8.3
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Sulphate as SO4	%	0.005	MCERTS	0.027	0.041	0.017	0.013	0.057
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphur	%	0.005	MCERTS	0.036	0.023	0.010	0.013	0.030
Organic Matter	%	0.1	MCERTS	-	-	-	-	1.8
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.77
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.20
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.92
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.84
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.46
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.45
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.53
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.15
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.39
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.27
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.31
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	< 0.80	5.29

Analytical Report Number: 21-76899
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210516

Lab Sample Number				1881028	1881029	1881030	1881031	1881032
Sample Reference				WS3	WS3	WS3	WS3	WS3
Sample Number				1	2	3	4	5
Depth (m)				0.40	0.80	1.30	1.90	2.20
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.7	6.8	2.1	3.3	5.9
Barium (aqua regia extractable)	mg/kg	1	MCERTS	64	110	60	41	91
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.90	0.72	0.24	0.55	1.1
Boron (water soluble)	mg/kg	0.2	MCERTS	0.8	0.5	< 0.2	< 0.2	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	0.3
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	3.5	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	19	21	12	13	24
Copper (aqua regia extractable)	mg/kg	1	MCERTS	60	14	4.3	11	26
Lead (aqua regia extractable)	mg/kg	1	MCERTS	28	18	11	21	34
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	22	12	8.4	12	33
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	24	28	13	19	29
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	91	39	20	33	74

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-76899
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210516

Lab Sample Number				1881033	1881034	1881035	1881036	1881037
Sample Reference				WS4	WS4	WS4	WS4	WS4
Sample Number				1	2	3	4	5
Depth (m)				0.30	0.60	1.40	1.90	2.30
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021
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	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	16	17	20	22	12
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.40	0.40	0.50
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	-	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.5	8.4	8.5	9.5	7.9
Total Cyanide	mg/kg	1	MCERTS	1.6	1.0	2.5	1.6	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Sulphate as SO4	%	0.005	MCERTS	0.144	0.201	0.264	0.248	0.040
Sulphide	mg/kg	1	MCERTS	32	23	20	18	< 1.0
Total Sulphur	%	0.005	MCERTS	0.092	0.103	0.116	0.106	0.037
Organic Matter	%	0.1	MCERTS	-	-	-	-	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	4.7	9.2	0.89	0.20	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	7.5	10	3.1	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	4.8	6.7	2.2	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	39	52	21	1.3	0.32
Anthracene	mg/kg	0.05	MCERTS	9.0	14	5.3	0.22	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	49	50	26	2.0	0.28
Pyrene	mg/kg	0.05	MCERTS	42	45	25	2.0	0.34
Benzo(a)anthracene	mg/kg	0.05	MCERTS	22	27	13	1.3	< 0.05
Chrysene	mg/kg	0.05	MCERTS	20	24	11	1.1	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	24	22	14	1.6	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	11	12	5.1	0.54	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	23	23	13	1.4	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	11	11	6.5	0.85	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	3.2	3.5	1.7	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	14	14	8.4	1.1	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	282	322	156	13.7	0.94

Analytical Report Number: 21-76899
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210516

Lab Sample Number				1881033	1881034	1881035	1881036	1881037
Sample Reference				WS4	WS4	WS4	WS4	WS4
Sample Number				1	2	3	4	5
Depth (m)				0.30	0.60	1.40	1.90	2.30
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	22	26	25	29	8.0
Barium (aqua regia extractable)	mg/kg	1	MCERTS	360	490	820	470	95
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.1	1.0	0.77	0.66	0.94
Boron (water soluble)	mg/kg	0.2	MCERTS	0.4	0.6	0.5	0.3	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	1.0	0.3
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	19	19	21	19	28
Copper (aqua regia extractable)	mg/kg	1	MCERTS	110	190	63	64	49
Lead (aqua regia extractable)	mg/kg	1	MCERTS	430	510	2200	1200	55
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.9	0.9	1.8	1.3	1.1
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	18	19	14	13	31
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	1.9	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	25	26	19	20	27
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	200	330	230	720	78

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-76899
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210516

Lab Sample Number				1881038	1881039	1881040	1881041	1881042
Sample Reference				WS5	WS5	WS5	WS5	WS5
Sample Number				1	2	3	4	5
Depth (m)				0.30	0.80	1.30	1.60	2.20
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021
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	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	10	8.9	15	15	13
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.50	0.50	0.50
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2	8.3	7.9	7.7	7.8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	2.4	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Sulphate as SO4	%	0.005	MCERTS	0.113	0.068	0.198	0.026	0.034
Sulphide	mg/kg	1	MCERTS	3.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphur	%	0.005	MCERTS	0.063	0.027	0.071	0.008	0.012
Organic Matter	%	0.1	MCERTS	-	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	4.1	1.3	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.68	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	5.1	1.6	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	4.4	1.4	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	26	11	0.35	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	5.9	2.5	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	26	13	0.47	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	24	12	0.52	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	13	6.1	0.33	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	11	5.2	0.24	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	12	6.1	0.36	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	5.1	2.4	0.12	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	12	5.4	0.27	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	5.7	2.8	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	1.7	0.75	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	6.9	3.4	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	163	74.4	2.66	< 0.80	< 0.80

Analytical Report Number: 21-76899
Project / Site name: Great Jackson Street, Manchester
Your Order No: 2210516

Lab Sample Number				1881038	1881039	1881040	1881041	1881042
Sample Reference				WS5	WS5	WS5	WS5	WS5
Sample Number				1	2	3	4	5
Depth (m)				0.30	0.80	1.30	1.60	2.20
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13	8.1	16	2.4	8.6
Barium (aqua regia extractable)	mg/kg	1	MCERTS	190	180	400	58	43
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.95	0.75	0.67	0.29	1.1
Boron (water soluble)	mg/kg	0.2	MCERTS	1.0	0.2	0.6	0.3	< 0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	12	16	13	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	65	33	35	18	24
Lead (aqua regia extractable)	mg/kg	1	MCERTS	350	280	950	9.3	13
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.6	1.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	12	14	7.2	19
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	26	16	19	16	40
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	64	85	23	48

U/S = Unsuitable Sample I/S = Insufficient Sample

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Analytical Report Number : 21-76761

Project / Site name:	Great Jackson Street, Manchester	**Samples received on:**	13/05/2021
Your job number:	6069-CGJ	**Samples instructed on/ Analysis started on:**	24/05/2021
Your order number:	2210515	**Analysis completed by:**	01/06/2021
Report Issue Number:	1	**Report issued on:**	01/06/2021
Samples Analysed:	4 water samples		

Signed: 

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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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.

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Analytical Report Number: 21-76761
Project / Site name: Great Jackson Street, Manchester

Your Order No: 2210515

Lab Sample Number				1880477	1880478	1880479	1880480
Sample Reference				BH1-W1	BH2-W1	BH3-W1	BH4-W1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				16.00	16.00	16.00	16.00
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				
General Inorganics							
pH	pH Units	N/A	ISO 17025	7.6	7.5	7.4	7.4
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Thiocyanate as SCN	µg/l	200	ISO 17025	220	< 200	240	< 200
Sulphate as SO4	mg/l	0.045	ISO 17025	17.9	21.3	13.3	30.4
Total Sulphur	µg/l	15	NONE	6000	7100	4400	10000
Sulphide	µg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
Total Phenols							
Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs							
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH							
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16

Analytical Report Number: 21-76761
Project / Site name: Great Jackson Street, Manchester

Your Order No: 2210515

Lab Sample Number				1880477	1880478	1880479	1880480
Sample Reference				BH1-W1	BH2-W1	BH3-W1	BH4-W1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				16.00	16.00	16.00	16.00
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				
Heavy Metals / Metalloids							
Boron (dissolved)	µg/l	10	ISO 17025	33	55	28	69
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0
Arsenic (dissolved)	µg/l	0.15	ISO 17025	< 0.15	< 0.15	< 0.15	< 0.15
Barium (dissolved)	µg/l	0.06	ISO 17025	59	47	63	96
Beryllium (dissolved)	µg/l	0.1	ISO 17025	< 0.1	< 0.1	< 0.1	< 0.1
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	< 0.02	< 0.02	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	1.6	2.0	2.1	2.3
Copper (dissolved)	µg/l	0.5	ISO 17025	1.2	2.1	2.0	1.5
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.6	2.0	2.8	1.9
Selenium (dissolved)	µg/l	0.6	ISO 17025	< 0.6	< 0.6	< 0.6	< 0.6
Vanadium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2
Zinc (dissolved)	µg/l	0.5	ISO 17025	3.4	3.1	4.4	3.2

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-76761
Project / Site name: Great Jackson Street, Manchester

Your Order No: 2210515

Lab Sample Number				1880477	1880478	1880479	1880480
Sample Reference				BH1-W1	BH2-W1	BH3-W1	BH4-W1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				16.00	16.00	16.00	16.00
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				
General Inorganics							
pH	pH Units	N/A	ISO 17025	7.6	7.5	7.4	7.4
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Thiocyanate as SCN	µg/l	200	ISO 17025	220	< 200	240	< 200
Sulphate as SO4	mg/l	0.045	ISO 17025	17.9	21.3	13.3	30.4
Total Sulphur	µg/l	15	NONE	6000	7100	4400	10000
Sulphide	µg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
Total Phenols							
Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs							
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH							
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16

Analytical Report Number: 21-76761
Project / Site name: Great Jackson Street, Manchester

Your Order No: 2210515

Lab Sample Number				1880477	1880478	1880479	1880480
Sample Reference				BH1-W1	BH2-W1	BH3-W1	BH4-W1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				16.00	16.00	16.00	16.00
Date Sampled				12/05/2021	12/05/2021	12/05/2021	12/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				
Heavy Metals / Metalloids							
Boron (dissolved)	µg/l	10	ISO 17025	33	55	28	69
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0
Arsenic (dissolved)	µg/l	0.15	ISO 17025	< 0.15	< 0.15	< 0.15	< 0.15
Barium (dissolved)	µg/l	0.06	ISO 17025	59	47	63	96
Beryllium (dissolved)	µg/l	0.1	ISO 17025	< 0.1	< 0.1	< 0.1	< 0.1
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	< 0.02	< 0.02	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	1.6	2.0	2.1	2.3
Copper (dissolved)	µg/l	0.5	ISO 17025	1.2	2.1	2.0	1.5
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.6	2.0	2.8	1.9
Selenium (dissolved)	µg/l	0.6	ISO 17025	< 0.6	< 0.6	< 0.6	< 0.6
Vanadium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2
Zinc (dissolved)	µg/l	0.5	ISO 17025	3.4	3.1	4.4	3.2

U/S = Unsuitable Sample I/S = Insufficient Sample

Appendix B

Geological Information

Geology 1:10,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	MGR	Made Ground (Undivided)	Artificial Deposit	Holocene - Holocene
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene
	WMGR	Infilled Ground	Artificial Deposit	Holocene - Holocene

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Sand with Clay And Gravel	Flandrian - Pleistocene
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Pleistocene
	GFSDD	GLACIOFLUVIAL SHEET DEPOSITS, DEVENSIAN	Sand and Gravel	Devensian - Ipswichian
	TILLD	Till, Devensian	Diamicton	Devensian - Ipswichian
	GFDUD	Glaciofluvial Deposits, Devensian	Sand and Gravel	Devensian - Ipswichian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	CPB	Chester Pebble Beds Formation	Sandstone	Early Triassic - Early Triassic
	WLSF	Wilmslow Sandstone Formation	Sandstone	Early Triassic - Early Triassic
	MM	Manchester Marls Formation	Mudstone	Late Permian - Late Permian
	Fault			

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Geology 1:10,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:10,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around a site. This mapping may be more up to date than previously published paper maps.

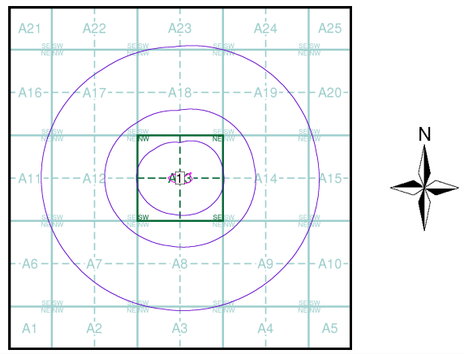
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page.

Please Note: Not all of the layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:10,000 Maps Coverage

Map ID: 1
Map Name: SJ89NW
Map Date: 1973
Bedrock Geology: Available
Superficial Geology: Available
Artificial Geology: Available
Faults: Available
Landslip: Not Available
Rock Segments: Not Available

Geology 1:10,000 Maps - Slice A



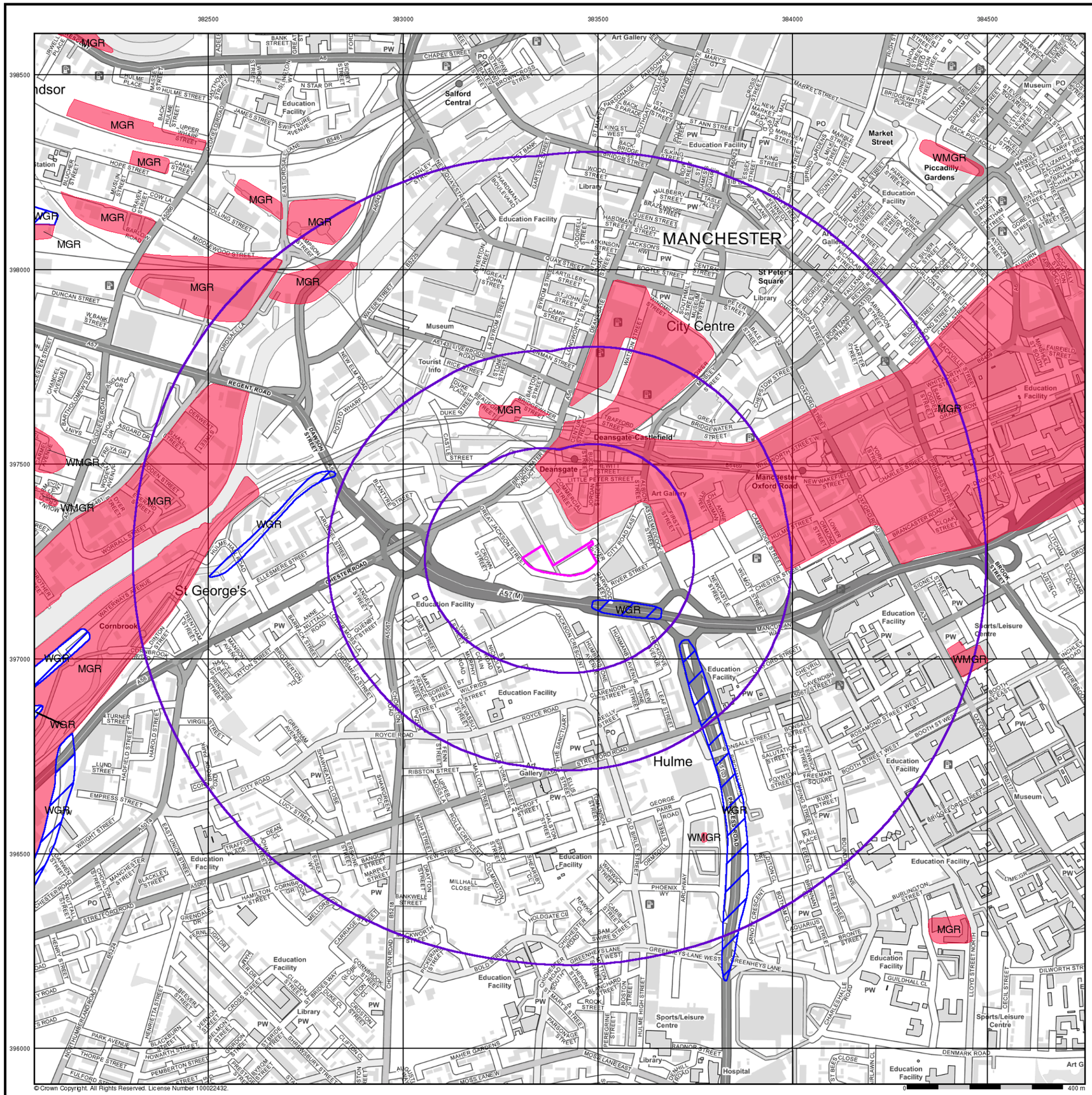
Order Details

Order Number: 276405343_1_1
Customer Ref: 03558AA
National Grid Reference: 383410, 397260
Slice: A
Site Area (Ha): 0.86
Search Buffer (m): 1000

Site Details

Site at 383410, 397220

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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coffey

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Artificial Ground and Landslip

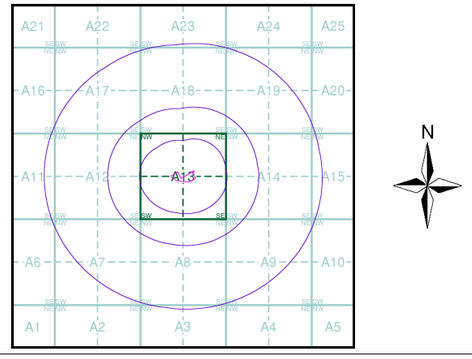
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A



Order Details

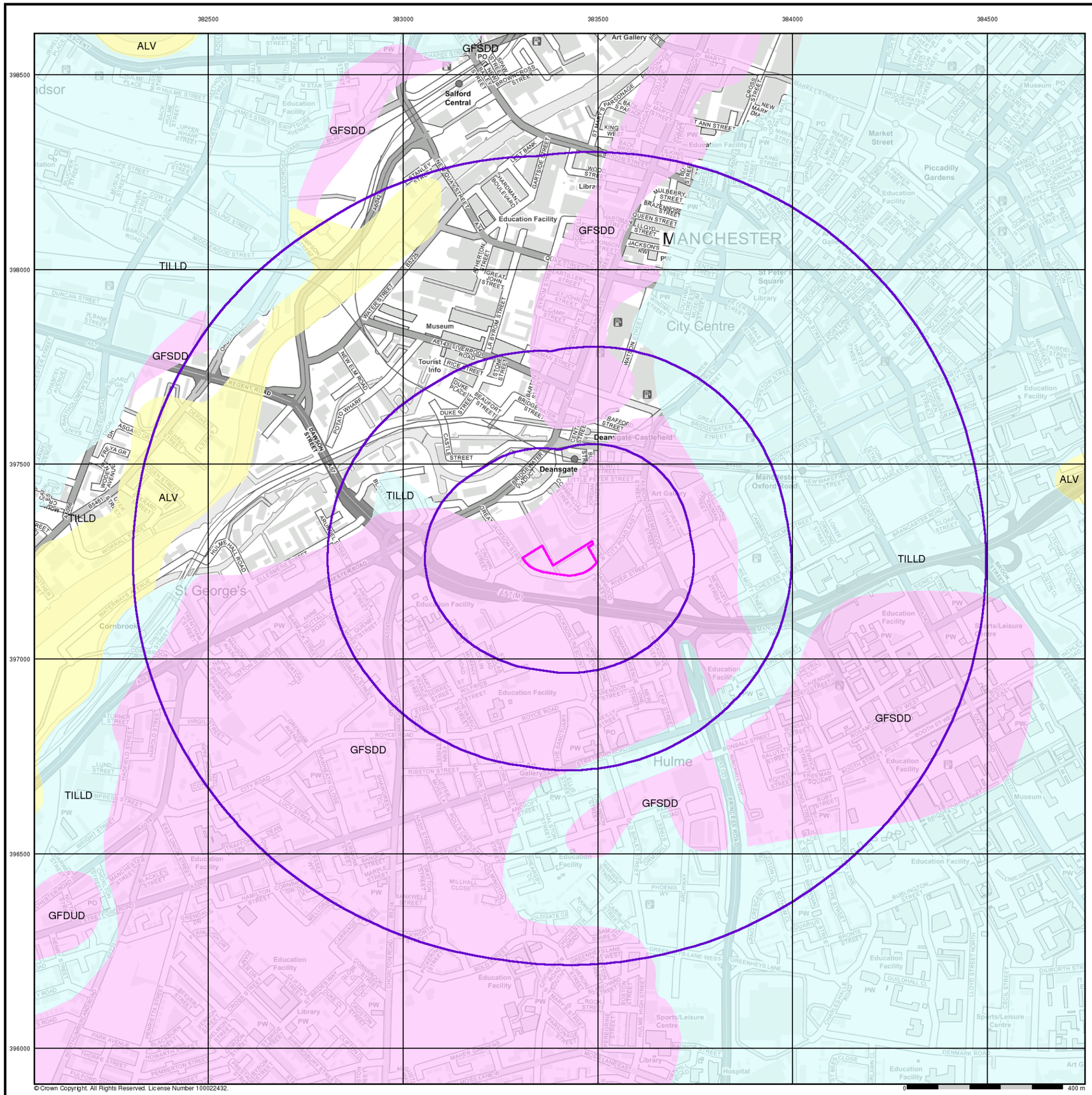
Order Number:	276405343_1_1
Customer Ref:	03558AA
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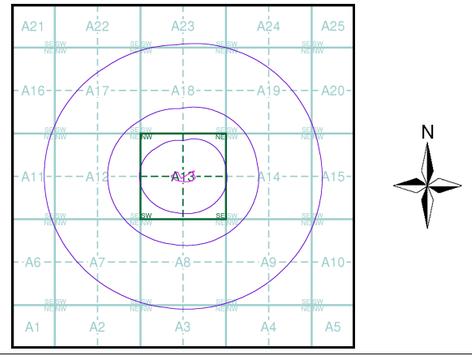
Superficial Geology

BGS 1:10,000 Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



Order Details

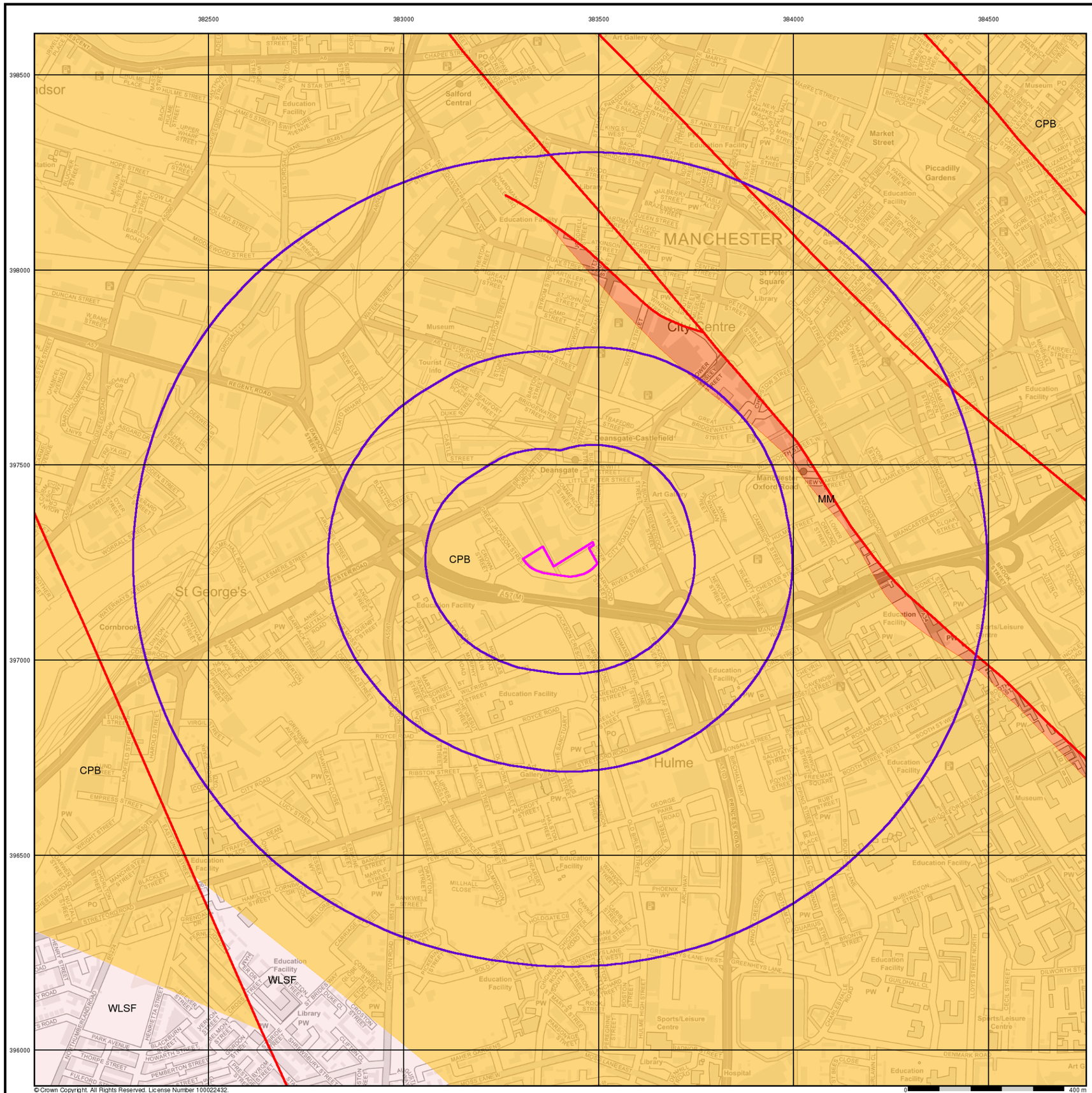
Order Number:	276405343_1_1
Customer Ref:	03558AA
National Grid Reference:	383410, 397260
Slice:	A
Site Area (Ha):	0.86
Search Buffer (m):	1000

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Bedrock and Faults

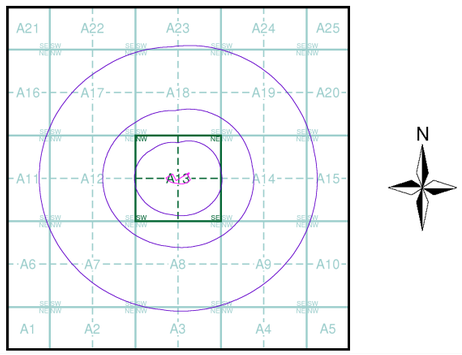
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults and thin beds mapped as lines such as coal seams and mineral veins. These are not restricted by age and could relate to features of any of the 1:10,000 geology datasets.

Bedrock and Faults Map - Slice A



Order Details

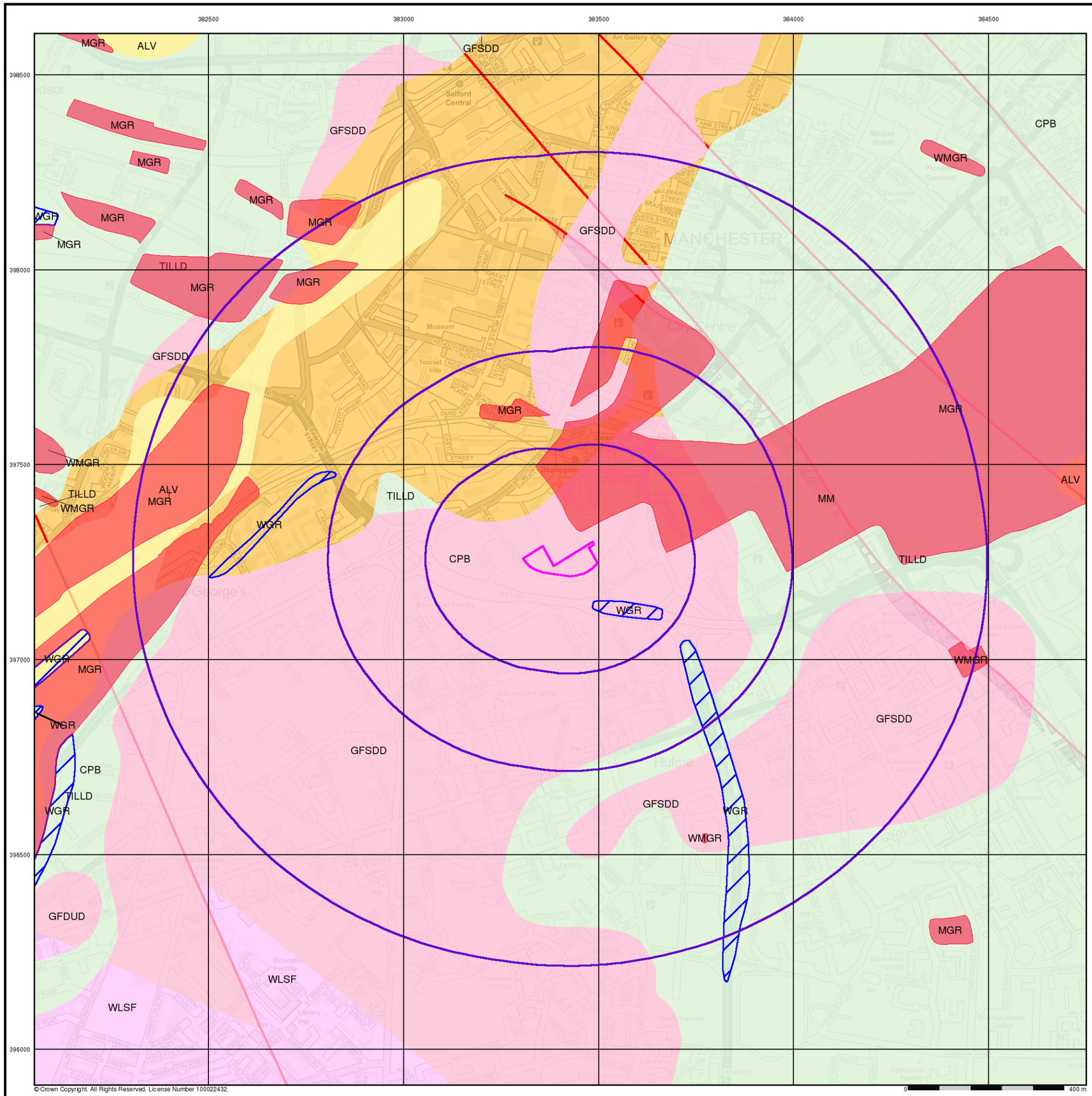
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Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

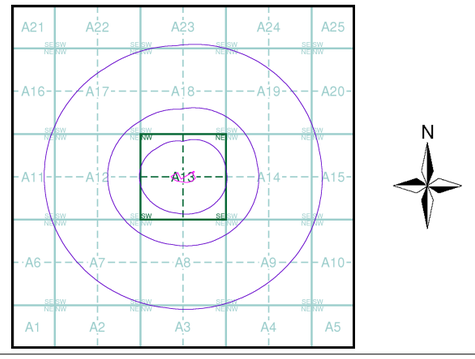
Additional Information

More information on 1:10,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

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NG12 5GG
Telephone: 0115 936 3143
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website: www.bgs.ac.uk

Combined Geology Map - Slice A



Order Details

Order Number:	276405343_1_1
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Slice:	A
Site Area (Ha):	0.86
Search Buffer (m):	1000

Site Details

Site at 383410, 397220

Appendix C

S4UL Geo-Environmental Assessment

GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA) - SOILS

Document Ref: 161.14_GAC_SGV & WATER_GQRA_v2.xlsx
Site: Great Jackson Street
Project No.: 03558AA
Client: Renaker Build Ltd
Assessment Scenario: Public Open Space
SOM content (%) 2.5

INORGANICS & METALS

(always assume SOM = 6%)

Soil Concentration (mg/kg)

Determinand	Assessment Value* (AV) (mg/kg)	Samples Exceeding AV	Results where LOD > AV	Units	Limit of Detection	1880948	1880949	1880950	1880951	1880952	1880953	1880954	1880955	1880956	1880957	1880958	1880959
Sample Reference						WS1-ES1	WS1-ES2	WS1-ES3	WS1-ES4	WS2-ES1	WS2-ES2	WS2-ES3	WS6-ES1	WS6-ES2	WS6-ES3	WS6-ES4	WS6-ES5
Sample Number						None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)						0.30	0.60	1.30	1.90	0.60	1.30	1.80	0.30	0.60	1.30	1.90	2.30
Date Sampled						11/05/2021	11/05/2021	11/05/2021	11/05/2021	10/05/2021	10/05/2021	10/05/2021	11/05/2021	11/05/2021	11/05/2021	11/05/2021	11/05/2021
Date Received																	
Date Tested																	
Asbestos Screen	Not Detected	0	0	%	0.01	Detected	-	-	-	Not detected	-	-	Not detected	Not detected	Not detected	-	-
Comments	-	-	0	%	N/A	Chrysotile, Amosite - Loose Fibres	-	-	-	-	-	-	-	-	-	-	-
Asbestos Quantification - Gravimetric	-	-	0	%	0.001	< 0.001	-	-	-	-	-	-	-	-	-	-	-
pH	-	-	0	mg/kg	N/A	8.1	8.2	7.1	7.5	7.4	7.9	8.1	8.1	8.3	8	7.4	7.7
Total Cyanide	-	-	0	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	-	-	0	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate	-	-	0	mg/kg	5	< 5.0	< 5.0	< 5.0	5.3	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphate	-	-	0	mg/kg	5	750	810	1040	680	90	160	120	960	1210	1420	480	90
Sulphide	-	-	0	mg/kg	1	25	5.7	14	32	< 1.0	< 1.0	1.1	18	19	16	1.2	< 1.0
Sulphur	-	-	0	mg/kg	0.05	480	410	710	1620	70	90	80	710	990	910	280	80
Soil Organic Matter (SOM)	-	-	0	%	0.1	-	-	1.5	7.1	-	-	-	-	-	-	-	-
Arsenic	79	0	0	mg/kg	1	24	14	6.7	4.9	4.9	6.6	5.2	39	42	33	14	5
Barium	-	-	0	mg/kg	1	280	180	140	160	22	41	45	570	570	420	140	28
Beryllium	2	0	0	mg/kg	0.06	1.5	1.2	0.88	1.8	0.44	0.5	0.38	1.8	1.8	1.4	0.72	0.5
Boron	21,000	0	0	mg/kg	0.2	0.7	1.3	1.3	3.3	< 0.2	< 0.2	< 0.2	0.7	0.4	0.6	0.7	< 0.2
Cadmium	120	0	0	mg/kg	0.2	1.6	< 0.2	< 0.2	0.4	< 0.2	0.3	0.2	3.1	4.6	38	< 0.2	< 0.2
Chromium (VI)	8	0	0	mg/kg	1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (III)	1,500	0	0	mg/kg	1	22	23	18	28	8	11	7.9	27	27	20	15	9.6
Copper	12,000	0	0	mg/kg	1	83	62	11	30	8.5	12	14	230	380	250	42	9.5
Lead	-	-	0	mg/kg	1	180	80	17	17	6.5	13	20	790	1100	1000	170	7.6
Mercury - Elemental	16	0	0	mg/kg	0.3	0.7	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	1.1	1.3	5.8	< 0.3
Nickel	230	0	0	mg/kg	1	30	20	11	22	8.1	12	9.3	35	35	25	16	12
Selenium	1,100	0	0	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium	2,000	0	0	mg/kg	1	40	34	28	21	11	14	9.9	46	44	33	20	14
Zinc	81,000	0	0	mg/kg	1	140	86	45	43	25	33	31	300	360	300	130	37

Determinand	1881028	1881029	1881030	1881031	1881032	1881033	1881034	1881035	1881036	1881037	1881038	1881039	1881040	1881041	1881042
Sample Reference	WS3	WS3	WS3	WS3	WS3	WS4	WS4	WS4	WS4	WS4	WS5	WS5	WS5	WS5	WS5
Sample Number	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Depth (m)	0.40	0.80	1.30	1.90	2.20	0.30	0.60	1.40	1.90	2.30	0.30	0.80	1.30	1.60	2.20
Date Sampled	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021	12/05/2021
Date Received															
Date Tested															
Asbestos Screen	Not detected	-	-	-	-	Not detected	Not detected	-	-	-	Not detected	Not detected	Not detected	-	-
Comments	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos Quantification - Gravimetric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	7.8	7.1	7.7	7.7	8.3	8.5	8.4	8.5	9.5	7.9	8.2	8.3	7.9	7.7	7.8
Total Cyanide	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.6	1	2.5	1.6	< 1.0	< 1.0	< 1.0	2.4	< 1.0	< 1.0
Free Cyanide	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphate	270	410	170	130	570	1440	2010	2640	2480	400	1130	680	1980	260	340
Sulphide	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	32	23	20	18	< 1.0	3	< 1.0	< 1.0	< 1.0	< 1.0
Sulphur	360	230	100	130	300	920	1030	1160	1060	370	630	270	710	80	120
Soil Organic Matter (SOM)	-	-	-	-	1.8	-	-	-	-	-	-	-	-	-	-
Arsenic	7.7	6.8	2.1	3.3	5.9	22	26	25	29	8	13	8.1	16	2.4	8.6
Barium	64	110	60	41	91	360	490	820	470	95	190	180	400	58	43
Beryllium	0.9	0.72	0.24	0.55	1.1	1.1	1	0.77	0.66	0.94	0.95	0.75	0.67	0.29	1.1
Boron	0.8	0.5	< 0.2	< 0.2	0.3	0.4	0.6	0.5	0.3	0.5	1	0.2	0.6	0.3	< 0.2
Cadmium	< 0.2	< 0.2	< 0.2	< 0.2	0.3	< 0.2	< 0.2	< 0.2	1	0.3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (VI)	< 1.2	< 1.2	< 1.2	3.5	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (III)	19	21	12	13	24	19	19	21	19	28	20	12	16	13	20
Copper	60	14	4.3	11	26	110	190	63	64	49	65	33	35	18	24
Lead	28	18	11	21	34	430	510	2200	1200	55	350	280	950	9.3	13
Mercury - Elemental	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	0.9	0.9	1.8	1.3	1.1	1.6	1.3	< 0.3	< 0.3	< 0.3
Nickel	22	12	8.4	12	33	18	19	14	13	31	20	12	14	7.2	19
Selenium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.9	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium	24	28	13	19	29	25	26	19	20	27	26	16	19	16	40
Zinc	91	39	20	33	74	200	330	230	720	78	110	64	85	23	48

Determinand	1895299	1895300	1895301	1895302	1895303	1895304	1895305	1895306	1895307	1895308	1895309	1895310	1895311	1895312
Sample Reference	BH1-B1	BH1-D3	BH1-D4	BH1-D8	BH2-B1	BH2-D1	BH2-D3	BH3-B1	BH3-D2	BH3-D3	BH4-B1	BH4-D1	BH4-B2	BH4-D3
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	1.80	2.50	7.00	0.50	0.80	2.50	0.50	1.50	2.50	0.50	1.50	2.50	3.50
Date Sampled	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021	04/06/2021
Date Received														
Date Tested														
Asbestos Screen	Not detected	-	-	-	Not detected	-	-	Not detected	-	-	Detected	-	-	-
Comments	-	-	-	-	-	-	-	-	-	-	Chrysotile	-	-	-
Asbestos Quantification - Gravimetric	-	-	-	-	-	-	-	-	-	-	0.958	-	-	-
pH	7.1	7.4	8.3	8.3	-	6.9	8	-	8.1	9.1	10.6	10.1	8.8	8.3
Total Cyanide	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Free Cyanide	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	330	620	430	140		540	260		400	600	1930	1360	730	740
Sulphide	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphur	170	600	820	50	-	370	470	-	250	400	920	610	420	1010
Soil Organic Matter (SOM)	1.4	1.5	-	-	-	3.1	-	-	1.3	-	-	-	-	-
Arsenic														
Barium														
Beryllium														
Boron														
Cadmium														
Chromium (VI)														
Chromium (III)														
Copper														
Lead														
Mercury - Elemental														
Nickel														
Selenium														
Vanadium														
Zinc														

ORGANICS

Soil Concentration (mg/kg)

Determinand	Assessment Value* (AV) (mg/kg)	Samples Exceeding AV	Results where LOD > AV	Units	Limit of Detection	1880948	1880949	1880950	1880951	1880952	1880953	1880954	1880955	1880956	1880957	1880958	1880959
Sample Reference						WS1-ES1	WS1-ES2	WS1-ES3	WS1-ES4	WS2-ES1	WS2-ES2	WS2-ES3	WS6-ES1	WS6-ES2	WS6-ES3	WS6-ES4	WS6-ES5
Sample Number						None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)						0.30	0.60	1.30	1.90	0.60	1.30	1.80	0.30	0.60	1.30	1.90	2.30
Date Sampled																	
Naphthalene	4900	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	1.8	0.57	< 0.05	< 0.05	< 0.05
Acenaphthylene	15000	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.29	0.23	< 0.05	< 0.05	< 0.05
Acenaphthene	15000	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	2.6	0.65	0.28	< 0.05	< 0.05
Fluorene	9900	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	2	0.57	< 0.05	< 0.05	< 0.05
Phenanthrene	3100	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	17	5.5	2.1	< 0.05	< 0.05
Anthracene	74000	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4	1.4	0.57	< 0.05	< 0.05
Fluoranthene	3100	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	16	5.4	3.6	< 0.05	< 0.05
Pyrene	7400	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	16	5.1	3.6	< 0.05	< 0.05
Benzo[a]anthracene	29	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	8.8	3.1	2.5	< 0.05	< 0.05
Chrysene	57	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	7.8	2.8	2	< 0.05	< 0.05
Benzo[b]fluoranthene	7.2	4	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	7.1	2.5	2.1	< 0.05	< 0.05
Benzo[k]fluoranthene	190	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	3.5	1.4	1	< 0.05	< 0.05
Benzo[a]pyrene	5.7	5	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	7.3	2.6	2.1	< 0.05	< 0.05
Indeno[1,2,3-cd]pyrene	82	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	3.4	1.3	1.1	< 0.05	< 0.05
Dibenz[ah]anthracene	0.57	6	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	1.1	0.49	0.27	< 0.05	< 0.05
Benzo[ghi]perylene	640	0	0	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4.1	1.7	1.4	< 0.05	< 0.05
Total Phenols	No Criteria	0	0	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
PAH, Total Detected USEPA 16	No Criteria	0	0	mg/kg	0.8	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	103	35.3	22.6	< 0.80	< 0.80

Determinand	1881028	1881029	1881030	1881031	1881032	1881033	1881034	1881035	1881036	1881037	1881038	1881039	1881040	1881041	1881042
Sample Reference	WS3	WS3	WS3	WS3	WS3	WS4	WS4	WS4	WS4	WS4	WS5	WS5	WS5	WS5	WS5
Sample Number	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Depth (m)	0.40	0.80	1.30	1.90	2.20	0.30	0.60	1.40	1.90	2.30	0.30	0.80	1.30	1.60	2.20
Date Sampled															
Naphthalene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4.7	9.2	0.89	0.2	< 0.05	4.1	1.3	< 0.05	< 0.05	< 0.05
Acenaphthylene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.68	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	7.5	10	3.1	< 0.05	< 0.05	5.1	1.6	< 0.05	< 0.05	< 0.05
Fluorene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4.8	6.7	2.2	< 0.05	< 0.05	4.4	1.4	< 0.05	< 0.05	< 0.05
Phenanthrene	< 0.05	< 0.05	< 0.05	< 0.05	0.77	39	52	21	1.3	0.32	26	11	0.35	< 0.05	< 0.05
Anthracene	< 0.05	< 0.05	< 0.05	< 0.05	0.2	9	14	5.3	0.22	< 0.05	5.9	2.5	< 0.05	< 0.05	< 0.05
Fluoranthene	< 0.05	< 0.05	< 0.05	< 0.05	0.92	49	50	26	2	0.28	26	13	0.47	< 0.05	< 0.05
Pyrene	< 0.05	< 0.05	< 0.05	< 0.05	0.84	42	45	25	2	0.34	24	12	0.52	< 0.05	< 0.05
Benzo[a]anthracene	< 0.05	< 0.05	< 0.05	< 0.05	0.46	22	27	13	1.3	< 0.05	13	6.1	0.33	< 0.05	< 0.05
Chrysene	< 0.05	< 0.05	< 0.05	< 0.05	0.45	20	24	11	1.1	< 0.05	11	5.2	0.24	< 0.05	< 0.05
Benzo[b]fluoranthene	< 0.05	< 0.05	< 0.05	< 0.05	0.53	24	22	14	1.6	< 0.05	12	6.1	0.36	< 0.05	< 0.05
Benzo[k]fluoranthene	< 0.05	< 0.05	< 0.05	< 0.05	0.15	11	12	5.1	0.54	< 0.05	5.1	2.4	0.12	< 0.05	< 0.05
Benzo[a]pyrene	< 0.05	< 0.05	< 0.05	< 0.05	0.39	23	23	13	1.4	< 0.05	12	5.4	0.27	< 0.05	< 0.05
Indeno[1,2,3-cd]pyrene	< 0.05	< 0.05	< 0.05	< 0.05	0.27	11	11	6.5	0.85	< 0.05	5.7	2.8	< 0.05	< 0.05	< 0.05
Dibenz[ah]anthracene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	3.2	3.5	1.7	< 0.05	< 0.05	1.7	0.75	< 0.05	< 0.05	< 0.05
Benzo[ghi]perylene	< 0.05	< 0.05	< 0.05	< 0.05	0.31	14	14	8.4	1.1	< 0.05	6.9	3.4	< 0.05	< 0.05	< 0.05
Total Phenols	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
PAH, Total Detected USEPA 16	< 0.80	< 0.80	< 0.80	< 0.80	5.29	282	322	156	13.7	0.94	163	74.4	2.66	< 0.80	< 0.80

Determinand	1895299	1895300	1895301	1895302	1895303	1895304	1895305	1895306	1895307	1895308	1895309	1895310	1895311	1895312
Sample Reference	BH1-B1	BH1-D3	BH1-D4	BH1-D8	BH2-B1	BH2-D1	BH2-D3	BH3-B1	BH3-D2	BH3-D3	BH4-B1	BH4-D1	BH4-B2	BH4-D3
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	1.80	2.50	7.00	0.50	0.80	2.50	0.50	1.50	2.50	0.50	1.50	2.50	3.50
Date Sampled														
Naphthalene														
Acenaphthylene														
Acenaphthene														
Fluorene														
Phenanthrene														
Anthracene														
Fluoranthene														
Pyrene														
Benzo[a]anthracene														
Chrysene														
Benzo[b]fluoranthene														
Benzo[k]fluoranthene														
Benzo[a]pyrene														
Indeno[1,2,3-cd]pyrene														
Dibenz[ah]anthracene														
Benzo[ghi]perylene														
Total Phenols														
PAH, Total Detected USEPA 16														

GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA) - GROUNDWATER

Document Ref:	161.14_GAC_SGV & WATER_GQRA_v2.xlsx
Site:	Great Jackson Street
Project No.:	03558AA
Client:	Renaker Build Ltd
Specific Values Standard:	Inland surface waters EQS (1)

coffey
A TETRA TECH COMPANY

INORGANICS & METALS

Determinand	Surface Water	Drinking Water		Assessment Value* (AV)	Samples Exceeding AV	Results where LOD > AV	Units	Limit of Detection	Concentration			
		WHO	UK / EU									
Lab Sample Number									1880477	1880478	1880479	1880480
Sample Reference									BH1-W1	BH2-W1	BH3-W1	BH4-W1
Sample Number									None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)									16.00	16.00	16.00	16.00
Date Sampled									12/05/2021	12/05/2021	12/05/2021	12/05/2021
pH	- -	- -	- -	-	-	-	0		7.6	7.5	7.4	7.4
cyanide	1 -	70 17	50 -	1	0	**4**	µg/l	10	< 10	< 10	< 10	< 10
cyanide	1 -	70 17	50 -	1	0	**4**	µg/l	10	< 10	< 10	< 10	< 10
<BLANK>	- -	- -	- -	-	-	-	-	200	220.0	< 200	240.0	< 200
sulphate	- -	N/A 15	250 -	250	0	0	mg/l	0.045	17.9	21.3	13.3	30.4
<BLANK>	- -	- -	- -	-	-	-	-	15	6000.0	7100.0	4400.0	10000.0
sulphide	- -	- -	- -	-	-	-	µg/l	5	< 5.0	< 5.0	< 5.0	< 5.0
phenols (total monohydric)	- -	- -	- -	-	-	-	0	1	< 0.16	< 0.16	< 0.16	< 0.16
boron	- -	2400 -	1000 -	1000	0	0	µg/l	10	33	55	28	69
chromium(vi)	0.6 -	- -	- -	0.6	0	**4**	µg/l	5	< 5.0	< 5.0	< 5.0	< 5.0
arsenic	25 -	10 -	10 -	25	0	0	µg/l	0.15	< 0.15	< 0.15	< 0.15	< 0.15
barium	- -	0.7 -	- -	0.7	0	0	mg/l	0.06	0.06	0.05	0.06	0.10
beryllium	- -	N/A 13	- -	-	-	-	µg/l	0.1	< 0.1	< 0.1	< 0.1	< 0.1
cadmium and its compounds	≤0.08 5	3 -	5 -	≤0.08	0	0	µg/l	0.02	< 0.02	< 0.02	< 0.02	< 0.02
chromium	- -	50 -	50 -	50	0	0	µg/l	0.2	1.6	2	2.1	2.3
Copper	1 6	2000 -	2000 -	1	**4**	0	µg/l	0.5	1.2	2.1	2	1.5
lead and its compounds	1.2 -	10 -	10 -	1.2	0	0	µg/l	0.2	< 0.2	< 0.2	< 0.2	< 0.2
mercury	0.07 4	6 -	1 -	0.07	0	0	µg/l	0.05	< 0.05	< 0.05	< 0.05	< 0.05
nickel and its compounds	4 -	70 -	20 -	4	0	0	µg/l	0.5	1.6	2	2.8	1.9
selenium	- -	40 -	10 -	10	0	0	µg/l	0.6	< 0.6	< 0.6	< 0.6	< 0.6
vanadium	- -	- -	- -	-	-	-	µg/l	0.2	< 0.2	< 0.2	< 0.2	< 0.2
zinc	8.2 8	N/A 15	- -	8.2	0	0	µg/l	0.5	3.4	3.1	4.4	3.2

Appendix D

Outputs from JIWG Risk Decision Support

JIWG

Joint Industry Working Group

Asbestos in Soil and Construction & Demolition Materials

Decision Support Tool for Receptor Risk Ranking

Stage 1

Hazard Identification		Score
Select ACM type (run model for each type to generate 'Worst Case' output)	Loose fibrous asbestos debris	3
Extent of degradation of ACMs	Disaggregated (dominated by loose fibrous material; extreme degradation in ACM and/or free asbestos fibres/fibre bundles)	4
Friability and degree of bonding by matrix (ACM matrix, not ground materials)	Friable ACM or ACM with fibres not linked in any matrix (free dispersed fibres/fibre bundles)	4
Distribution of Visible Asbestos Across Affected Area	Occasional/random occurrences of visible contamination by ACMs	1
Asbestos fibre type	Mainly amosite (and possible trace tremolite/anthophyllite) with/without chrysotile (no crocidolite)	3
Sub-total		15
Hazard ranking		Medium

No warranty, expressed or implied, or reliance, is provided in relation to the use of this tool.
It is contingent on users to satisfy themselves that the output from the tool is relevant and appropriate to the assessment being made.

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Version 2, February 2017

Stage 2

Emission Factors		Score
Amount of asbestos fibre in selected ACM/fibre type as % of host material	Low quantities - >0.01 to <0.05 %wt/wt	2
Respirable fibre index for ACM - RIVM report 711701034 (2003)	Negligible	0
Activity type and effect on deterioration of ACMs	High disturbance, significant deterioration expected	4
Best description of primary host material matrix	Coarse to Fine Sand	2
Sub-total		8
Exposure ranking		Low

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Stage 3

Pathway and Receptor Sensitivity		Score	
Receptor category	Construction	No score required	
Age of Receptor	Young adult (>16 and <24)	2	
Duration of exposure/site occupancy	> 1hr <10 hr daily exposure (e.g. part-time to full time occupational exposure or extended daily recreational exposure)	3	
Receptor ranking		5	Medium
Combined hazard, exposure and receptor ranking			Medium
Pathway: Distance of Receptor from Source	In or within 10m of area of disturbance	4	
Pathway: Depth to impacted material	Material buried at shallow depth, potential to be disturbed by excavation	C	
Pathway ranking		4C	Low
Overall ranking			Low

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Project Reference	Plot F, Great Jackson Street, Manchester

Site Name	Plot F, Great Jackson Street
Client	Renaker Build Ltd

Run by	Craig Temporal
Date	15-Nov-21
Reviewed by	Ed Barrett

Characterisation of scenario being evaluated	Inhalation by construction workers of fibres blown from any open ground where soils are exposed during construction

Interpretation of scenario ranking by DST	LOW

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Version 2, February 2017

JIWG

Joint Industry Working Group

Asbestos in Soil and Construction & Demolition Materials

Decision Support Tool for Receptor Risk Ranking

Stage 1

Hazard Identification		Score
Select ACM type (run model for each type to generate 'Worst Case' output)	Loose fibrous asbestos debris	3
Extent of degradation of ACMs	Disaggregated (dominated by loose fibrous material; extreme degradation in ACM and/or free asbestos fibres/fibre bundles)	4
Friability and degree of bonding by matrix (ACM matrix, not ground materials)	Friable ACM or ACM with fibres not linked in any matrix (free dispersed fibres/fibre bundles)	4
Distribution of Visible Asbestos Across Affected Area	Occasional/random occurrences of visible contamination by ACMs	1
Asbestos fibre type	Mainly amosite (and possible trace tremolite/anthophyllite) with/without chrysotile (no crocidolite)	3
Sub-total		15
Hazard ranking		Medium

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It is contingent on users to satisfy themselves that the output from the tool is relevant and appropriate to the assessment being made.

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Stage 2

Emission Factors		Score
Amount of asbestos fibre in selected ACM/fibre type as % of host material	Low quantities - >0.01 to <0.05 %wt/wt	2
Respirable fibre index for ACM - RIVM report 711701034 (2003)	Negligible	0
Activity type and effect on deterioration of ACMs	No disturbance activity	0
Best description of primary host material matrix	Coarse to Fine Sand	2
Sub-total		4
Exposure ranking		Very Low

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Stage 3

Pathway and Receptor Sensitivity		Score	
Receptor category	Public open space or building	No score required	
Age of Receptor	Infant (under 5)	4	
Duration of exposure/site occupancy	<1 hour in any week (e.g. short duration work or equivalent infrequent exposure event when exposure aggregated over 1 yr)	0	
Receptor ranking		4	Low
Combined hazard, exposure and receptor ranking			Low
Pathway: Distance of Receptor from Source	In or within 10m of area of disturbance	4	
Pathway: Depth to impacted material	Material buried at shallow depth, potential to be disturbed by excavation	C	
Pathway ranking		4C	Low
Overall ranking			Very Low

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Project Reference	Plot F, Great Jackson Street, Manchester

Site Name	Plot F, Great Jackson street
Client	Renaker Build Ltd

Run by	Craig Temporal
Date	15-Nov-21
Reviewed by	Ed Barrett

Characterisation of scenario being evaluated	Inhalation by end user of fibres blown from any open ground where soils are exposed post construction including maintenance work.

Interpretation of scenario ranking by DST	VERY LOW

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JIWG

Joint Industry Working Group

Asbestos in Soil and Construction & Demolition Materials

Decision Support Tool for Receptor Risk Ranking

Stage 1

Hazard Identification		Score
Select ACM type (run model for each type to generate 'Worst Case' output)	Loose fibrous asbestos debris	3
Extent of degradation of ACMs	Disaggregated (dominated by loose fibrous material; extreme degradation in ACM and/or free asbestos fibres/fibre bundles)	4
Friability and degree of bonding by matrix (ACM matrix, not ground materials)	Friable ACM or ACM with fibres not linked in any matrix (free dispersed fibres/fibre bundles)	4
Distribution of Visible Asbestos Across Affected Area	Occasional/random occurrences of visible contamination by ACMs	1
Asbestos fibre type	Mainly amosite (and possible trace tremolite/anthophyllite) with/without chrysotile (no crocidolite)	3
Sub-total		15
Hazard ranking		Medium

No warranty, expressed or implied, or reliance, is provided in relation to the use of this tool.
It is contingent on users to satisfy themselves that the output from the tool is relevant and appropriate to the assessment being made.

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Stage 2

Emission Factors		Score
Amount of asbestos fibre in selected ACM/fibre type as % of host material	Low quantities - >0.01 to <0.05 %wt/wt	2
Respirable fibre index for ACM - RIVM report 711701034 (2003)	Negligible	0
Activity type and effect on deterioration of ACMs	High disturbance, significant deterioration expected	4
Best description of primary host material matrix	Coarse to Fine Sand	2
Sub-total		8
Exposure ranking		Low

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Stage 3

Pathway and Receptor Sensitivity		Score	
Receptor category	Public open space or building	No score required	
Age of Receptor	Infant (under 5)	4	
Duration of exposure/site occupancy	<1 hour in any week (e.g. short duration work or equivalent infrequent exposure event when exposure aggregated over 1 yr)	0	
Receptor ranking		4	Low
Combined hazard, exposure and receptor ranking			Low
Pathway: Distance of Receptor from Source	>10m of edge of area of disturbance	3	
Pathway: Depth to impacted material	Material buried at shallow depth, potential to be disturbed by excavation	C	
Pathway ranking		3C	Low
Overall ranking			Very Low

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Project Reference	Plot F, Great Jackson Street, Manchester

Site Name	Plot F, Great Jackson Street
Client	Renaker Build Ltd

Run by	Craig Temporal
Date	15-Nov-21
Reviewed by	Ed Barrett

Characterisation of scenario being evaluated	Inhalation by offsite personnel of fibres blown from any open ground where soils are exposed during construction, maintenance works and building use

Interpretation of scenario ranking by DST	VERY LOW

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